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January 26, 1994

Honorable Brian Choy, Director
Office of Environmental Quality Control
Central Pacific Plaza
220 South King Street, 4th Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Acceptance Notice for the East Mamala Bay
Wastewater Facilities Plan
Final Environmental Impact Statement (Final EIS)

We are notifying you of our acceptance of the Final EIS for the East Mamala Bay Wastewater Facilities Plan, as satisfactory fulfillment of the requirements of Chapter 343, Hawaii Revised Statutes.

Pursuant to Section 11-200-23 (c), Chapter 200, Title 11 ("Environmental Impact Statement Rules") of the Administrative Rules, this Acceptance Notice should be published in the February 28, 1994 OEQC Bulletin.

We have attached our Acceptance Report of the Final EIS for the East Mamala Bay Wastewater Facilities Plan. Should you have any questions, please contact Eugene Takahashi of our staff at 527-6022.

Sincerely,

ROBIN FOSTER
Chief Planning Officer

RF:lh

Attachment

cc: Department of Wastewater Management
Belt Collins Hawaii

1993 - Oahu - FEIS -
East Mamala Bay I

FILE COPY

EAST MAMALA BAY
WASTEWATER FACILITIES PLAN

FINAL ENVIRONMENTAL IMPACT STATEMENT

December 1993

EAST MAMALA BAY WASTEWATER FACILITIES PLAN

FINAL ENVIRONMENTAL IMPACT STATEMENT

This document is prepared pursuant to Chapter 343, Hawaii Revised Statutes.

Submitted by:

Department of Wastewater Management
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Responsible Official:

[signature]

Kenneth M. Rappolt, Director

December 1993

Prepared by:

Belt Collins Hawaii
680 Ala Moana Boulevard
Honolulu, Hawaii 96813
Phone: (808) 521-5361

Preface

PREFACE

This Final Environmental Impact Statement is prepared in compliance with Chapter 343, Hawaii Revised Statutes. The City and County of Honolulu Department of Wastewater Management, formerly the Division of Wastewater Management under the Department of Public Works, is the lead agency for this project. The accepting agency is the Planning Department, City and County of Honolulu.

OVERVIEW

The East Mamala Bay wastewater subdistrict extends from the Salt Lake/Aliamanu Crater/Red Hill area to Niu Valley. The proposed action is implementation of the East Mamala Bay Facilities Plan, prepared to ensure compliance with Sections 301 and 302 of the Clean Water Act. The Facilities Plan specifies the improvements required of the subdistrict's municipal wastewater collection and treatment system to meet projected demand for the planning period, 1995 to the year 2015. Proposed improvements to the system must also comply with applicable requirements of the State of Hawaii Department of Health regulations.

The wastewater system includes four major elements: the wastewater collection system (wastewater collection lines, pump stations, and force mains), the Sand Island Wastewater Treatment Plant (wastewater and solids treatment), the deep ocean outfall and diffuser, which extends approximately 12,500 feet seaward from Sand Island, and the solids disposal system.

The planning process involves two interrelated components: preparation of the Facilities Plan and preparation of an Environmental Impact Statement (EIS) for the proposed action described in the plan. The East Mamala Bay Facilities Plan is being developed in three stages, the first of which began in March, 1992. Each development phase ends with a draft document for comment and a public meeting; the three phases are preliminary, interim, and final. At the time of this Final EIS, the Facilities Plan reflects comments made on the Prefinal Facilities Plan and Draft Final EIS. The purpose of the Facilities Plan is to project future wastewater flow generation over the study period, evaluate system adequacy to meet project demands, determine the upgrades required, evaluate all feasible alternatives for necessary expansion or improvement of the collection, treatment, and disposal systems, and to identify a preferred alternative to meet future needs.

Based on the alternatives developed in the Facilities Plan, the EIS process commenced in January, 1993. The primary purposes of the EIS are to describe the existing environment and the proposed improvement of the East Mamala Bay wastewater system, to evaluate the environmental, social, and economic impacts of the proposed action as developed in the Facilities Plan, and to inform government decision makers and the general public of these impacts, available alternatives, and possible mitigation measures. This document identifies programmatic impacts of system-wide improvements in the preferred alternative and specific impacts at:

1. Sand Island WWTP
2. Ala Moana WWPS
3. Moana Park WWPS
4. Fort DeRussy WWPS

5. Public Baths WWPS
6. Kahala WWPS
7. Niu Valley WWPS
8. Paiko Drive WWPS
9. Awa Street WWPS
10. Kamehameha Highway WWPS
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12. Aliamanu II WWPS
13. Sand Island Parkway WWPS
14. Kuliouou WWPS
15. Hart Street WWPS (existing site)
16. Beachwalk WWPS (existing site)

For compliance with HRS 343, additional environmental impact assessment will be needed for all projects not listed above, at the time of the Preliminary Engineering Report (PER). However, other types of studies related to the PER and possible mitigation actions (for example, traffic studies and archaeological data recovery) may be needed for any project.

More detailed analysis will be needed in the future for some individual construction projects included in the preferred alternative, particularly those projected for construction later in the planning period, to account for changing circumstances between now and the time of construction. Additional information not presently available may contribute to changes in planned projects. For example, results of the five-year infiltration and inflow study, now under way, will shed more light on this significant factor of the collection and treatment system. The preferred alternative is subject to change based on preliminary engineering design and review.

Background

The Federal Water Pollution Control Act of 1972 established water quality goals and procedures, authorized funding for construction of publicly-owned treatment works (POTW), and established controls to reduce point-source discharges into waters of the U.S. This law, as amended in 1977 and 1982, is now referred to as the Clean Water Act. States with approved control programs (of which Hawaii is one) are required to manage water quality to meet established standards, plan ahead to meet future demand, and take enforcement actions, as necessary under the law, to ensure compliance.

As a result of the Federal Water Pollution Control Act of 1972, POTWs were required to meet effluent standards based on secondary treatment technology. In 1977, further amendments allowed for a waiver of this requirement subject to certain environmental and management conditions.

The Sand Island WWTP was originally designed as an advanced primary treatment facility utilizing a floatation clarification process. As of December 1993, the dissolved air floatation system was being operated on a trial basis (see Chapter Four for a detailed description of the WWTP). The plant operates under the authority of a National Pollutant Discharge Elimination System (NPDES) permit issued by the State Department of Health.

An NPDES 301(h) waiver permit waiving secondary treatment requirements for the Sand Island facility was requested by the City and County of Honolulu in 1979 and again in 1983, and granted by the Environmental Protection Agency and Department of Health in January 1990. This waiver was subsequently stayed when the Sierra Club and Hawaii's Thousand Friends filed an evidentiary hearing request challenging several permit conditions. In March 1990, the Sierra Club and Hawaii's Thousand Friends also filed a lawsuit against the City, alleging that the City was discharging without an NPDES permit and that the Sand Island plant should have had secondary treatment as of July 1, 1988. In September 1991, the City, without admitting guilt, reached a settlement agreement with the Sierra Club and Hawaii's Thousand Friends. A provision of the settlement consent decree provided for the Sierra Club and Hawaii's Thousand Friends to drop their evidentiary hearing request so that the Environmental Protection Agency could put the secondary waiver permit into effect. As a result of the settlement, the waiver permit became effective on January 15, 1992, with a permit expiration date of February 19, 1995.

An additional provision of the settlement required the City to complete a Facilities Plan and Environmental Impact Statement (EIS) for the East Mamala Bay Wastewater Subdistrict covering the planning period of 1995 to 2015 by the end of calendar year 1993. Preparation of the Facilities Plan began in March, 1992, and based on the Facilities Plan, preparation of this EIS began in January, 1993. This Environmental Impact Statement is intended to fulfill the intent of the consent decree, including completion by December 31, 1993. Therefore, the Facilities Plan and the EIS are being prepared concurrently, and alternatives and impacts are refined in iterations between the two documents, rather than sequentially.

Organization of the EIS

This Final Environmental Impact Statement includes an Executive Summary (Chapter One) and ten additional chapters. The Executive Summary presents the major findings of the document in summary form.

Chapter Two presents an overview of the relevant government regulations and policies. The intent of Chapter Two is to ensure that adequate information is available for the reader to fully understand the regulatory framework within which the operation and maintenance of the wastewater system is carried out.

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Chapter Five presents a discussion of the projected conditions in the year 2015 and briefly discusses the models used to determine these projections. The information contained in this chapter is derived from the Facilities Plan.

Chapter Six presents a summary of the alternatives considered during the Facilities Planning process. It also discusses the methodology by which the preferred alternative was selected.

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Chapter Nine presents a brief discussion of contextual issues surrounding the proposed action including inter-relationships, resource commitments, and government land-use regulations. This chapter also identifies the issues that cannot be resolved at the time this document was prepared. Because the improvements proposed for the wastewater system span a period of twenty years and land area exceeding 70 square miles, there are a number of issues that will only be resolved during site-specific planning and design.

Chapter Ten presents a summary of the comments received after the publication of the EIS Preparation Notice for the project on January 8, 1993 and publication of the Draft EIS on August 23, 1993. It also lists the agencies consulted during the preparation of the document and the preparers of the document.

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CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

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GLOSSARY

area source — any stationary source of HAPs that is not a major source.

bacteria — Microscopic unicellular organisms, typically spherical, rodlike, or spiral and threadlike in shape, often clumped into colonies. Some bacteria cause disease, others perform an essential role in nature in the recycling of materials; for example, by decomposing organic matter into a form available for reuse by plants.

benthic organisms — (Invertebrates) The group of animals living in or on the bottom of an aquatic environment. They include a number of types of organisms, such as bacteria, fungi, insect larvae and nymphs, snails, clams, and crayfish.

biochemical oxygen demand (BOD) — A measure of respiratory use of dissolved oxygen, in milligrams per liter, necessary for the decomposition of organic matter by microorganisms, such as bacteria. BOD_5 is the five-day measure of BOD.

bypass — the intentional diversion of waste streams from any portion of a treatment facility whose operation is necessary to maintain compliance with the terms and conditions of a permit.

chlorophyll — Refers to the green pigments of plants. Chlorophyll a and b are the two most common pigments in plants.

cubic foot per second — (FT^3/s, ft^3/s) is the rate of discharge representing a volume of one cubic foot passing a given point during one second and is equivalent to 7.48 gallons per second or 448.8 gallons per minute or 0.02832 cubic meters per second.

discharge — The volume of liquid (or more broadly, volume of fluid plus suspended sediment), that passes a given point within a given period of time.

drainage area — A stream at a specific location is that area, measured in a horizontal plane, enclosed by a topographic divide from which direct surface runoff from precipitation normally drains by gravity into the river above the specified point. Figures of drainage area given herein include all closed basins, or noncontributing areas, within the area unless otherwise noted.

drainage basin — A part of the surface of the earth that is occupied by a drainage system, which consists of a surface stream or a body of impounded surface water together with all tributary surface streams and bodies of impounded water.

dry weather infiltration (DWI) — Infiltration that occurs when the groundwater table has not risen as a result of rain. What is referred to as DWI may include minimal quantities of non-rainy weather inflow as well.

embayment — Land-confined and physically protected marine waters with restricted openings to open coastal waters.

exfiltration — Leakage out of sewage piping into the ground.

gaging station — A particular site on a stream, canal, lake or reservoir where systematic observations of hydrologic data are obtained.

infiltration — The entrance of underground water into the wastewater collection system, usually through defects or cracks in the sewer lines and manholes.

inflow — The entrance of aboveground waters to the sewer collection system though openings in sewer manhole tops and storm drain connections.

inject — to dispose or emplace fluids, either under pressure or by gravity flow, into a subsurface formation or formations.

injection well — a well into which subsurface disposal of fluid or fluids occurs or is intended to occur by means of injection. See well.

interference — defined in 40 CFR Part 403.3(i) as *A discharge which, alone or in conjunction with a discharge or discharges from other sources, both: 1) inhibits or disrupts the POTW, its treatment processes or operations, or its sludge processes, use or disposal; and 2) therefore, is a cause of a violation of any requirement of the POTW's NPDES permit or of the prevention of sewage sludge use or disposal in compliance with the following statutory provisions and regulations or permits issued thereunder (or more stringent state or local regulations): Section 405 of the Clean Water Act, the Solid Waste Disposal Act (SWDA), the Clean Air Act, and the Marine Protection, Research and Sanctuaries Act.*

leak — same as a spill; however, when used in a regulatory context, "spill" rather than "leak" is used. Historically, not all spills were reportable; the non-reportable spills were referred to as leaks.

life cycle costs (LCC) — continuing costs. LCCs relate to the life expectancy of the facility, the cyclical O&M and remodeling and replacement costs, and the present and future costs associated with the projected project over the life of the facility. Projected inflation, interest rates, depreciation, and other factors affecting the future cost of money are factored into future costs.

major modification — a physical change in or change in the method of operation of a major stationary source that would result in significant net emissions increase of any pollutant subject to regulation under the Clean Air Act.

major source — For HAPs, a major source means any stationary source that has the potential to emit 10 TPY or more of any HAP or 25 TPY or more of any combination of HAPs.

major stationary source — one of a list of specific facility types which emit 100 tons per year or more of any air pollutant. A major stationary source is also any other source with the potential to emit 250 tons per year or more of any air pollutant subject to regulation under the Clean Air Act. See **stationary source.**

National Ambient Air Quality Standards (NAAQS) — National primary ambient air quality standards define levels of air quality which the Administrator judges are necessary, with an adequate margin of safety, to protect the public health. National secondary ambient air quality standards define levels of air quality which the Administrator judges necessary to protect the public welfare from any known or anticipated adverse effects of a pollutant.

Nonpoint source pollution — pollution caused by diffuse sources that are difficult to trace and are not regulated as point sources. Nonpoint source pollution includes human-induced alteration of the chemical, physical, biological and radiological integrity of water. Nonpoint source pollutants are transported primarily by water. Rain, which detaches and entrains pollutants, becomes surface runoff and carries pollutants from the land into surface water. Water soluble pollutants or those entrained in the infiltrating rain water may leach through soils and rock to pollute groundwater. (Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems, DOH, 1990.)

National Pollutant Discharge Elimination System (NPDES) — Regulatory program under the federal Clean Water Act, which requires permits for the discharge of pollutants from any point source into waters of the United States.

open coastal waters — Marine waters bounded by the one hundred fathom (600 foot) depth contour and the shoreline, excluding embayments.

pass through — defined in 40 CFR Part 403.3(n) as *A discharge which exits the POTW into waters of the United States in quantities or concentrations which, alone or in conjunction with a discharge or discharges from other sources, is a cause of violation of any requirement of the POTW's NPDES permit.*

pesticides — Chemical compounds used to control the growth of undesirable plants and animals. Major categories of pesticides include insecticides, miticides, fungicides, herbicides, and rodenticides.

point sources — Point sources of pollution are readily identifiable, controllable discharges. Point sources may be municipal, agricultural, or domestic in nature. Examples of point sources in Hawaii, which have received a great deal of attention, include sewage outfalls and sugar mill discharges. (Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems, DOH, 1990.)

polychlorinated biphenyls (PCBs) — Industrial chemicals that are mixtures of chlorinated biphenyl compounds having various percentages of chlorine. They are similar in structure to organochlorine insecticides. This group of toxic, persistent chemicals were used in transformers and capacitors for insulating purposes and in gas pipeline systems as a lubricant. Further sale of new use was banned by law in 1979.

primary treatment — Treatment by screening, sedimentation, and skimming adequate to remove at least 30 percent of the biochemical oxygen demanding material and of the suspended solids in the treatment works influent.

redundancy — the provision of one or a combination of operational devices, structures, infrastructure, or pieces of equipment to provide additional reliability for the purpose of controlling spills and overflows.

reliability — the state or condition where a device, structure, infrastructure, or piece of equipment can be dependable.

secondary treatment — Treatment by a biological process to convert organic matter into biological growth (that is removed as biosolids from the process) to obtain an effluent with less than 30 milligrams per liter of biochemical oxygen demand and 30 milligrams per liter of suspended solids.

sediment — Solid material that originates mostly from disintegrated rocks and is transported by, suspended in, or deposited from water; it includes chemical and biochemical precipitates and decomposed organic material, such as humus. The quantity, characteristics, and cause of the occurrence of sediment in streams are influenced by environmental factors. Some major factors are degree, of slope, length of slope, soil characteristics, land usage, and quantity and intensity of precipitation.

septic tank — A settling tank in which settled sludge is in immediate contact with the wastewater flowing through the tank and the organic solids are decomposed by anaerobic bacterial action.

septic wastewater — Wastewater undergoing putrefaction under anaerobic conditions.

sewage — The spent water of a community. Term now being replaced in technical usage by preferable term "wastewater." See **wastewater.**

sewer — A pipe or conduit that carries wastewater or drainage water.

sewerage — System of piping, with appurtenances, for collecting and conveying wastewater from source to discharge. Term declining in use. See **sewer system, wastewater facilities.**

sewer district — (1) An organization created and operating under statutory authorization for the purpose of financing, constructing, and operating a wastewater system. (2) The land or area within the boundaries of a sewer district as delimited in the organizing statute. It may embrace parts of one or more political subdivisions.

sewer manhole — A shaft or chamber providing access from the surface of the ground to a sewer.

sewer outfall — The outlet or structure through which wastewater is finally discharged.

sewer system — Collectively, all of the property involved in the operation of a sewer utility. It includes land, wastewater lines and appurtenances, pumping stations, treatment works, and general property. Occasionally referred to as a "sewerage system." See **sewer utility.**

sewer utility — Enterprise established chiefly to render sewer service.

spill — a discharge of a waste stream, to the ground surface or a body of water that is not made via the permitted discharge point. (In the case of the East Mamala Bay wastewater system, the permitted discharge point is the outfall from the Sand Island WWTP.)

State waters — defined in Hawaii Revised Statues, section 342D-1, as "all waters, fresh, brackish, or salt around and within the State, including, but not limited to, coastal waters, streams, rivers, drainage ditches, ponds, reservoirs, canals, ground waters, and lakes; provided that drainage ditches, ponds, and reservoirs required as part of a water pollution control system are excluded."

stationary source — any building, structure, facility, or installation which emits or may emit any air pollutant subject to regulation under the Clean Air Act, HAR 11-59, or HAR 11-60. See **major stationary source.**

streamflow — The discharge that occurs in a natural channel. Although the term "discharge" can be applied to the flow of a canal, the work "streamflow" uniquely describes the discharge in a surface stream course. The term "streamflow" is more general than "runoff" as streamflow may be applied to discharge whether or not it is affected by diversion or regulation.

tertiary treatment — Any level of wastewater treatment that produces an effluent beyond or superior to secondary treatment.

turbidity — A measure of the light scattering properties of suspended materials in a water sample. In this report, it is expressed Nephelometric turbidity units (NTU).

vector attraction— the characteristic of sewage sludge that attracts rodents, flies, mosquitos, or other organisms capable of transporting infectious agents.

waste treatment — Any process to which wastewater or industrial waste is subjected to make it suitable for subsequent use.

wastewater — The spent water of a community. From the standpoint of source, it may be a combination of the liquid and water-carried wastes from residences, commercial buildings, industrial plants, and institutions, together with any groundwater, surface water, and storm water they may be present. In recent years, the word "wastewater" has taken precedence over the word "sewage."

wastewater composition — (1) The relative quantities of the various solid, liquid, and gaseous constituents of wastewater. (2) The chemical and physical characteristics of the solid and liquid constituents of wastewater, and their relationships apart from the degree of concentration.

wastewater disposal — The act of disposing of wastewater by any method. Not synonymous with wastewater treatment. Common methods of disposal are: dispersion, dilution, broad irrigation, privy, cesspool.

wastewater facilities — The structures, equipment, and processes required to collect, carry away, and treat domestic and industrial wastes, and dispose of the effluent and solids.

well — A bored, drilled or driven shaft, or a dug hole, whose depth is greater than its widest surface dimension. See **injection well.**

wet weather infiltration/inflow — Infiltration that occurs when, as a result of rain, the groundwater table has risen or the soil has become saturated, plus inflow (mostly from rain-induced above-ground sources).

zone of mixing (ZOM) — Limited areas around outfalls and other facilities to allow for the initial dilution of waste discharges. It is recognized that zones of mixing for the assimilation of domestic, agricultural, and industrial discharges which have received the best degree of treatment or control are necessary.

zone of initial dilution (ZID) — The region of initial mixing surrounding or adjacent to the end of the outfall pipe or diffuser ports, provided that the ZID may not be larger than allowed by mixing zone restrictions in applicable water quality standards.

ABBREVIATIONS AND ACRONYMS

ALISH	Agricultural Lands of Importance to the State of Hawaii
AMH	Aliamanu Military Housing
ASCE	American Society of Civil Engineers
ATC	Authority to Construct
BACT	best available control technology
BAT	best available technology
BIP	balanced indigenous population
BOD_5	biochemical oxygen demand
BWS	Board of Water Supply
C&C	City and County of Honolulu
CERCLA	Comprehensive Environmental Response Compensation and Liability Act
CFR	Code of Federal Regulations
cfs	cubic feet per second
CFU	coliform forming unit
CI	cast iron
Cl	chlorination
Cl/deCl	chlorination/dechlorination
CMU	concrete masonry unit
CPA	capita per acre
cu. yd.	cubic yards
CWA	Clean Water Act
CWDA	Critical Wastewater Disposal Area
CWRM	Commission on Water Resource Management
CZM	Coastal Zone Management
DAF	dissolved air flotation
DBEDT	Department of Business, Economic Development and Tourism
DEIS	Draft Environmental Impact Statement
DLNR	Department and Land and Natural Resources
DLU	Department of Land Utilization
DO	dissolved oxygen
DOH	Department of Health
DP	Development Plan
DPW	Department of Public Works
DTS	Department of Transportaion Services
DWI	Dry Weather Infiltration
DWWM	Department of Wastewater Management, formerly the Division of Wastewater Management
EA	environmental assessment
EDR	Electrodialysis Reversal
EIS	environmental impact statement
EISPN	environmental impact statement preparation notice
ELS	effluent limitation segment
EPA	Environmental Protection Agency
FAA	Federal Aviation Administration
FIRM	Flood Insurance Rate Maps
FR	Federal Register
GACT	generally available control technology
GP	General Plan
gpad	gallons per acre per day
gpcd	gallons per capita per day
HAP	hazardous air pollutant
HAR	Hawaii Administrative Rules
HECO	Hawaiian Electric Company
HN	Honolulu
HP	horsepower
ISAP	Islandwide Sewer Adequacy Project
IWS	individual wastewater systems
kVA	kilovolt
kW	kilowatt
LPG	Liquid Propane Gas
LUO	Land Use Ordinance
MACT	maximum achievable control technology
MCC	Motor Control Center
MCL	maximum contaminant level
MFF	maximum flow factor
mg	million gallons
mgd	million gallons per day
MLCD	Marine Life Conservation District
MLSS	mixed liquor suspended solids

MSL	mean sea level
MWWTP	municipal wastewater treatment plant
NAAQS	National Ambient Air Quality Standards
NESHAP	National Emission Standards for Hazardous Air Pollutants
NPDES	National Pollutant Discharge Elimination System
NSPS	new source performance standards
NTE	not to exceed
OFR	overflow rate
PCB	polychlorinated biphenyl
PD	Planning Department, formerly the Department of General Planning
PDR	Preliminary Design Report
PFRP	Process to Further Reduce Pathogens
PSRP	Process to Significantly Reduce Pathogens
PL	public law
POTW(s)	publicly owned treatment works
PSD	prevention of significant deterioration
psi	pounds per square inch
PSIG	pounds per square inch gage
PTO	Permit to Operate
PUC	Primary Urban Center
RBC	rotating biological contactor
RC	reinforced concrete
RCP	reinforced concrete pipe
RCRA	Resource Conservation and Recovery Act
RO	reverse osmosis
SBR	sequencing batch reactor
SCADA	Supervisory Control and Data Acquisition
SCLDF	Sierra Club Legal Defense Fund
SDWA	Safe Drinking Water Act
SFM	Sewer Force Main
SIC	Standard Industrial Classification
SIP	State Implementation Plans
SITC	Sand Island Treatment Center
SIWWTP	Sand Island Wastewater Treatment Plant
SPS	sewage pump station
SRCHG	surcharge
SS	suspended solids
SWD	side water depth
SVI	sludge volume index
TAMC	Tripler Army Medical Center
TAZ	Traffic Analysis Zone
TC	terra cotta
TDH	total dynamic head
TMDL	Total Maximum Daily Load
TMK	Tax Map Key
TPY	tons per year
TRC	total residual chlorine
TSS	total suspended solids
UIC	underground injection control
UIW	underground injection well
USDW	underground sources of drinking water
USFWS	United States Fish and Wildlife Service
USGS	United States Geological Survey
UV	ultraviolet
VA	Veteran's Administration
VC	vitrified clay
VFD	variable frequency drivers
VSS	volatile suspended solids
WAO	wet air oxidation
WAS	waste activated sludge
WLA	Wasteload Allocation
WQLF	Water Quality Laboratory Facility
WQLS	water quality-limited segment
WQM	Water Quality Management
WQS	water quality standard
WSST	wet sludge storage tank
WWCS	wastewater collection system
WWI/I	wet weather infiltration and inflow
WWPS	wastewater pump station
WWTP	wastewater treatment plant
ZID	zone of initial dilution
ZOM	zone of mixing

1
Executive Summary

ONE
EXECUTIVE SUMMARY

PURPOSE

This Environmental Impact Statement (EIS) is being prepared in compliance with Hawaii Revised Statutes (HRS) Chapter 343 for actions proposed by the Department of Wastewater Management (DWWM), City and County of Honolulu. The Planning Department, City and County of Honolulu is the accepting authority. The proposed action is adoption and implementation of a Facilities Plan prepared in accordance with 40 CFR 35.917. The purpose of the Facilities Plan is to propose actions "...necessary to comply with sections 301 and 302 of the (Clean Water) Act", and which are "...the most economical means of meeting established effluent and water quality goals while recognizing environmental and social considerations." [40 CFR 35.917 (b)].

STUDY AREA

The twenty-year study period for which the Facilities Plan is being prepared begins in 1995 and ends in 2015. The Facilities Plan, entitled East Mamala Bay Wastewater Facilities Plan, covers the geographic area of East Honolulu and the Primary Urban Center, extending from Kuliouou in the east to Red Hill in the west, and *mauka* from the shoreline to the Koolau crest. With the exception of Kuliouou, the wastewater currently collected from this region is treated at Sand Island Wastewater Treatment Plant (Sand Island WWTP or SIWWTP) and discharged through a deep ocean outfall. Currently, Kuliouou wastewater is collected and transmitted for treatment under contract to the private treatment works at Hawaii Kai, where effluent is discharged into the ocean near Sandy Beach.

ALTERNATIVES

Alternatives considered to meet Facilities Plan objectives for the study period included: (1) no action; (2) optimize operation of the existing system; (3) necessary changes to "meet water quality standards"; (4) necessary changes to have "secondary treatment"; and (5) necessary changes to "reduce or eliminate ocean discharges." Criteria were developed to evaluate alternatives. There were two categories of criteria. Measures of effectiveness criteria included regulatory compliance, public and occupational safety, environmental impacts to air, water, and land, socio-economic effects, and cultural resources effects. Implementation feasibility criteria included matters of technical feasibility, reliability, cost, and conformity with social values.

Application of the evaluation criteria to the Facilities Plan alternatives led to the selection of "meet water quality standards" as the preferred alternative. This alternative includes a set of actions for each of seven components to the wastewater collection, treatment and disposal system. The components are: (1) collection in already sewered areas; (2) treatment in already sewered areas; (3) collection and treatment in areas not presently sewered; (4) treatment level; (5) effluent disposal; (6) solids treatment and disposal; and (7) redirection of Kuliouou flows to Sand Island WWTP.

PREFERRED ALTERNATIVE

The preferred alternative includes the following actions related to each of these components:

(1 and 2) Collection in Sewered Areas.

a. Expand the capacity of the gravity sewer system throughout the region to meet 2015 flows and improving system reliability. Corrective action may include either replacement of existing lines, or installing additional parallel lines. These improvements comprise over 300 individual segments of the collection system for an estimated $270.4 million total capital cost and $284.6 million life cycle cost.

b. Upgrade wastewater pump stations (WWPS) and sewer force mains (SFM) for capacity and/or reliability. For reliability and/or capacity, install new WWPS for Hart Street and Beachwalk, and new force mains. The capital costs for these improvements is estimated to total approximately $120.5 million, and the life cycle costs $125.3 million.

(3) Extend conventional gravity sewer service to presently unsewered areas of Puowaina/Punchbowl, Aukai Avenue, Nuuanu Pali Drive, Diamond Head, and Upper Makiki. Extend low pressure and/or small diameter sewer service to Crater Road, Kinohou Place, Mapunapuna, Black Point, Palolo Valley, and Upper Tantalus/Round Top Drive. The estimated capital cost is approximately $13.0 million and the life cycle costs $16.8 million.

(4) Treatment system improvements involving SIWWTP provide additional capacity to meet projected 2015 flows and improve plant performance. Primary treatment has been found sufficient to meet water quality standards, given the continuation of the 301(h) waiver of secondary treatment provided for in the Clean Water Act. The waiver must be renewed every five years in an administrative process. There are no known environmental reasons for the waiver not to be continued in the future.

The preferred alternative for treatment level to meet water quality standards is to expand primary treatment. The capacity required to meet future flows is based on population projections. This expansion will be accomplished in a manner that allows the flexibility to convert the plant to secondary treatment in the future, should the waiver be discontinued.

Specific actions at the plant include a new headworks for influent receiving, three new primary clarifiers, conversion to anaerobic digestion with three new anaerobic digesters, chemical (coagulant) treatment system, and two additional gravity thickeners. The approximate capital cost of these improvements is $119.7 million, and the approximate life cycle costs are $316.3 million. Sufficient space is preserved in the proposed concept site plan to add roughing filter activated sludge basins with associated equipment for secondary treatment, should the need arise. The additional capital cost for this conversion to secondary is estimated to be $310.8 million above that of the preferred alternative, with an additional life cycle cost of approximately $625.2 million.

(5) Effluent disposal would continue to be accomplished through the existing deep ocean outfall, which has the design capacity for the projected additional flows.

(6) Treatment and disposal of solids includes a primary system incorporating conversion and reuse of treated sludge, with backup disposal alternative capabilities incorporating the existing incinerator (brought into air quality compliance) and land filling. There are several solids treatment systems suitable to this end, for which sufficient land exists at the SIWWTP site to deal with primary treatment level sludge volumes. Capital cost of solids treatment and disposal facilities is estimated to range from approximately $11.8 million to $77.0 million, with a life cycle cost ranging from $70.0 million to $133.0 million, depending on the specific option chosen.

(7) The preferred alternative option for Kuliouou is to redirect wastewater flows from the Hawaii Kai treatment plant to SIWWTP. The existing Kuliouou WWPS will require upgrading, and an SFM will be constructed to Aina Haina. Capital costs are an estimated $5.7 million with life cycle costs of approximately $5.8 million.

SIGNIFICANT IMPACTS

Implementation of the preferred alternative will have external effects, some of which will directly cause or contribute to environmental impacts. The significance of the impacts is determined by the degree of detriment (or improvement) to the affected resource or environmental characteristic, as stipulated in the "significance criteria" in HAR 11-200-12.

The potential impacts discussed in this document are in three categories. Short-term impacts are transient, primarily construction related. Long term impacts are persistent, and include those that result from continuing operations. Cumulative impacts are those resulting from additive or interactive impacts from more than one system component, or from other activities occurring in the area of effect.

(1) *Significant Collection System* **Impacts and Mitigation.**

(Collection system includes improvements to the gravity sewer systems, WWPSs, SFMs, and extension of sewer service to unsewered areas).

Short-Term

Construction effects include excavation of roadways, noise in neighborhoods, construction equipment in neighborhoods, and traffic constriction. These will be mitigated by working on limited segments at one time, managing working hours, and providing traffic control. Working in parklands will have similar impacts, with the additional impact of deprivation of recreational use, and similar mitigation. Excavation will have potential impact on archaeological and cultural resources including burials, which will be mitigated by monitoring in sensitive areas during construction and following State Historic Preservation Office procedures if artifacts are encountered. Impacts to water quality from stormwater run-off and dewatering will be mitigated in accordance with Department of Health rules. Extension of sewage service will require payment of connection fees for affected households.

Long-Term

There are no long term detrimental effects from collection system improvements. Cost impacts are discussed under cumulative programmatic effects. Rights of way across private property will require condemnation, which limits structural uses of the immediately affected land. This is mitigated by fair compensation and minimizing use of private land in system planning.

Cumulative

The cumulative impact is positive, in the reduced potential for releases of untreated sewage from the collection system because of improved capacity and reliability. However, some portions of the collection system are located in flood and tsunami zones, potentially subjecting pump stations to outages and damage. In these locations, pump stations are required to be flood-proofed.

(2) **Significant Treatment Plant Impacts and Mitigation.**

Short-Term

Effects are primarily construction-related, none of which will have significant environmental impacts in the vicinity of the SIWWTP location.

Long-Term

Air quality impacts from the plant are presently not significant; planned improvements will result in a slight increase in air emissions with no significant impact. The anaerobic digesters attain elevations above ground level approaching 100 feet; this poses a change in some public views of the area, but remains within the visual context of Sand Island. Appropriate painting will diminish the impact. The digesters will remain below the threshold clearance elevation for Honolulu International Airport, but will be obstruction-lighted if required by the FAA.

Cumulative

Improvements to the SIWWTP result in reduced potential for untreated or partially treated wastewater releases from the SIWWTP.

(3) **Significant Effluent Discharge Impacts and Mitigation**

Short-Term

No changes are proposed.

Long-Term

Model predictions indicate that as flows increase in the future, the existing standard for the geometric mean concentrations of nutrients will be met at the Zone of Mixing (ZOM) monitoring stations. However, the possibility exists that water quality standards and/or accepted monitoring procedures may change in the future. The effluent and ZOM currently meet the eligibility criteria for expansion of the ZOM, if necessitated by future regulatory changes.

Cumulative

There are no cumulative impacts.

(4) **Significant Solids Treatment/Disposal Impacts and Mitigation**

Short-Term

These are the same as for Treatment Plant impacts.

Long-Term

Air quality impacts from incineration would occur (within ambient air quality standards) if the incinerator were to be required for continued, rather than backup, use. Odors are a potential impact for sludge treatment, but are diminished in the selected technology. These effects will not cause an exceedance of ambient air quality standards.

Cumulative

The impact of the preferred alternative is positive in reducing solid waste to be disposed of and converting it to a useful product.

(5) Significant Kuliouou Diversion Impacts

Short-Term

These are the same as for other collection system improvement construction impacts, localized to the Kuliouou WWPS, and Kuliouou SFM. The SFM extension impacts will be mitigated by constructing in combination with the Niu Valley SFM extension required in the same right of way over a portion of its length, limited and carefully planned work schedules, and traffic control.

Long-Term

There are no significant impacts.

Cumulative

There are no significant cumulative impacts.

SIGNIFICANT CUMULATIVE AND UNAVOIDABLE IMPACTS

Cumulative impacts are positive in their net effect, although they cannot be quantified. Positive impacts of the preferred alternative include reduced solid waste, reduced potential for release of untreated or partially treated sewage, and reduced potential for public health and environmental harm. In addition, the preferred alternative prevents the unintended distortion of City and County development planning by installing sufficient infrastructure to meet population and land use growth allocations without over-building infrastructure capacity. This avoids infrastructure constraint to development in the PUC that would result in additional growth pressures in areas where growth is not intended.

The cumulative and largely unavoidable cost of these benefits is the direct economic impact to government and to the ultimate source of revenues, Oahu's households. The costs used in assessing the economic impact of the preferred alternative are approximately $559.8 million in capital costs and $922.1 million in life cycle costs. If secondary treatment is required, an additional $661.2 million in estimated life cycle costs would be experienced. Annual average debt service experienced by DWWM from the preferred alternative will rise from its FY 1991-92 level of $1.6 million for all Oahu by an estimated 171 percent over the study period. DWWM expenditures will rise from an existing annual level of about $70.7 million by about 55 percent.

To meet these revenue needs, the average sewage cost allocated to each Oahu household will increase an average of 27.5 percent, increasing from $23.57 to an average of $30.04 per month over the study period. In addition, increased pass-through expenses by businesses of higher sewage fees will marginally increase household cost of living by an average of $3.68 per month.

COMPATIBILITY WITH LAND USE PLANS AND POLICIES

The preferred alternative of the Facilities Plan is consistent with county, state and federal land use plans and policies. The Development Plan, reflecting General Plan policies, is captured in the Planning Department's socioeconomic forecast which has been used to project wastewater flow. Additional lands required for wastewater pump station improvements are designated as public facilities on the Development Plan Land Use maps.

The Waikiki Master Plan, published by the City's Planning Department (formerly the Department of General Planning), is also incorporated into the socioeconomic forecast provided by that department. Therefore, wastewater flow associated with the Waikiki Master Plan's proposed projects are accounted for in the Facilities Plan to the extent that they are accounted for in the socioeconomic forecast. For the proposed New Beachwalk WWPS, around 30,000 square feet of public land, specifically within the Ala Wai Park - Ewa parklands, would need to be set aside for the pump station facilities.

Zoning changes are not required for the proposed actions.

Required permits and approvals that may be required, depending on the specific details of the wastewater improvement projects resulting from the Facilities Plan, are shown in Table 2-17.

UNRESOLVED ISSUES

Because of the length of the planning period, and the scope of the preferred alternative, most of the individual projects are addressed at a programmatic level. With the exception of improvements at Sand Island WWTP and certain WWPSs, site-specific environmental studies, complying with HRS Chapter 343, will be required, in addition to detailed engineering design and review. Several other matters remain to be resolved, primarily relating to future conditions and their effects on the preferred alternative. These include continuation of the 301(h) secondary treatment waiver authorized under 40 CFR 125, findings of the Mamala Bay Study Commission, the method and location of sludge treatment and disposal, the final location of the SITC (if secondary treatment is necessary in the future), future changes to water quality standards, and actual population growth. The specific sources of funding for the preferred alternative have yet to be determined.

2
Relationship to Government Regulations

TWO

RELATIONSHIP TO GOVERNMENT REGULATIONS AND REQUIREMENTS

2.1 INTRODUCTION

The development, operation, and maintenance of a municipal wastewater treatment system traditionally has been part of local government's responsibility to preserve the health, safety, and welfare of the general public. However, since the early 1970s, attention to the cumulative environmental impacts upon groundwater, air quality, and ocean resources have resulted in the creation of several layers of government regulations. On Oahu, operation of the municipal wastewater system is subject to public health regulations of the City and County of Honolulu, the State of Hawaii, and the Federal Government. In addition, the products of the wastewater treatment process (the so-called "releases" to water, land, and air, such as effluent, sludge, and odors) are also regulated. The actual location of wastewater collection, treatment, and disposal facilities is typically controlled by a separate set of land-use regulations administered by both the State and the City and County of Honolulu.

The development, operation, maintenance, and funding of these facilities must comply with the goals, objectives, and policies of the federal Coastal Zone Management Program, the Hawaii State Plan, the Oahu General Plan, the relevant Oahu Development Plans, the specific county ordinances regulating activities within the Special Management Area, and the policies of several government agencies charged with implementing the various aspects of public health policy.

The way to begin evaluating the environmental impacts of proposed improvements to a municipal wastewater system is to acquire a basic knowledge and understanding of the policies and laws that regulate it. This chapter attempts to provide such an understanding. In doing so, it goes beyond the Chapter 343 requirement to demonstrate the relationship of the proposed action to land-use plans, policies, and controls for the affected areas. However, in the interest of full public disclosure, it is better to provide too much information than not enough.

The following is a discussion of the federal, State, and local regulations which govern the various "releases" of the wastewater system, as well as a review of federal, State, and local land-use plans, policies, and controls which establish the context within which the system operates.

The federal, State, and local regulations that apply to the East Mamala Bay wastewater collection, treatment, and disposal system are summarized in Tables 2-1, 2-2, and 2-3, respectively. These tables *do not* address applicable land-use regulations. Land-use plans, policies, and controls are discussed in Sections 2.7 through 2.10 of this chapter.

2.2 OVERVIEW OF ENVIRONMENTAL REGULATIONS

Environmental regulations deal primarily with the control of impacts to the environment resulting from human activity, including the release of pollutants to the environment with potential harmful results. For the purposes of this chapter, these actions are referred to as "releases." The affected environment includes water (surface water and groundwater), air, and soil/land. Releases can be in liquid, solid, or gaseous states, or combinations thereof. In addition, discharges can be hazardous or nonhazardous, with prescribed requirements for each. Environmental regulations set standards for the environment to be preserved and control discharges in terms of their physical and chemical characteristics and/or their quantities. The environmental regulations that are pertinent to this project are discussed below and categorized into releases to surface water, groundwater, air, and soil/land.

Table 2-1
Federal Regulations

COMPONENT	FEDERAL (40 CFR) Regulated Activity						
	RELEASES TO WATER (EXCEPT GW)	RELEASES TO GROUND-WATER	RELEASES TO AIR	RELEASES TO LAND (SOLID WASTE)	FISCAL	DESIGN	OPERATIONS
Wastewater Sources							
Sewered							
Industrial Pretreatment (Categorical)							4032
Unsewered							
Wastewater Collection							
Cross Connection and Backflow Control							
Flows							
Sewage Pump Stations							
Wastewater Treatment Plant							
Influent							
Pretreatment Program							122.44 (j)
Treatment							
Secondary Treatment	133,125.56						133
Sludge							
Handling							
Use or Disposal							122.44(a)(2)
Incineration			60.150-156,503				
Land Application				501(a)(2)(ix),503			
Surface Disposal				503			
Effluent							
Disposal to Water (except GW)	122						
Effluent Limitations	122.44						
Toxic Pollutant	129						
Water Quality Planning and Management	130				30-35,39	35	
Water Quality Standards	131						
Water Pollution Control	125						
Disposal to Groundwater/Land/Soil							
UIC		144-148					
Groundwater		141-143					
Irrigation							
Storm Water Runoff, Dewatering, Hydro Testing	122,123,124						
Operating Personnel Certification							

Table 2-2
State Regulations

	STATE (HAR DOH Title 11)						
	Regulated Activity						
COMPONENT	RELEASES TO WATER (EXCEPT GW)	RELEASES TO GROUND-WATER	RELEASES TO AIR	RELEASES TO LAND (SOLID WASTE)	FISCAL	DESIGN	OPERATIONS
Wastewater Sources							
Sewered							
Industrial Pretreatment (Categorical)							
Unsewered							62-31 to 35
Wastewater Collection							
Cross Connection and Backflow Control							
Flows							21
Sewage Pump Stations						62-08	
Wastewater Treatment Plant			59,60				
Influent							
Pretreatment Program							
Treatment							62-07
Secondary Treatment							
Sludge							
Handling							
Use or Disposal							
Incineration							
Land Application				Clean Sludge			
Surface Disposal							
Effluent						62-26	
Disposal to Water (except GW)	62-26						
Effluent Limitations							
Toxic Pollutant							
Water Quality Planning and Management							
Water Quality Standards	54						
Water Pollution Control	55						
Disposal to Groundwater/Land/Soil							
UIC	23						
Groundwater	20						
Irrigation		62-25					
Storm Water Runoff, Dewatering, Hydro Testing	55						
Operating Personnel Certification							61

Table 2-3
Local Regulations

	LOCAL						
	Regulated Activity						
COMPONENT	RELEASES TO WATER (EXCEPT GW)	RELEASES TO GROUND-WATER	RELEASES TO AIR	RELEASES TO LAND (SOLID WASTE)	FISCAL	DESIGN	OPERA-TIONS
Wastewater Sources							
Sewered							
Industrial Pretreatment (Categorical)					6,8,10,ch11,appA		1,8,11
Unsewered							5,11
Wastewater Collection					7.3,ch14,appB		1,7,11
Cross Connection and Backflow Control							
Flows							
Sewage Pump Stations							
Wastewater Treatment Plant							
Influent							
Pretreatment Program							
Treatment							
Secondary Treatment							
Sludge							
Handling							
Use or Disposal							
Incineration							
Land Application							
Surface Disposal							
Effluent							
Disposal to Water (except GW)							
Effluent Limitations							
Toxic Pollutant							
Water Quality Planning and Management							
Water Quality Standards							
Water Pollution Control							
Disposal to Groundwater/Land/Soil							
UIC							
Groundwater							
Irrigation							
Storm Water Runoff, Dewatering, Hydro Testing							
Operating Personnel Certification							

2.3 RELEASES TO SURFACE WATER

The Federal Water Pollution Control Act (enacted by PL 92-500), as amended (commonly referred to as the Clean Water Act) requires the development of comprehensive programs for water pollution control. It also allows more stringent State requirements. Therefore, each State can enact its own statutes and regulations. These regulations must be at least as stringent and encompassing as the federal requirements. In Hawaii, almost all such programs are under the jurisdiction of the State Department of Health (DOH).

The programs relevant to the East Mamala Bay EIS in terms of discharges to surface water are the Water Quality Planning and Management Program, the National Pollutant Discharge Elimination System (NPDES) Program, and the permitting of discharges into navigable waters. Noncompliance with these programs can result in fines or civil penalties. In addition, federal funding for projects may be available only if specific requirements are met. These programs as they relate to discharges to surface water are discussed in Sections 2.3.1, 2.3.2, and 2.3.3.

In addition to the Clean Water Act, the Rivers and Harbors Act, Section 10, requires that the emplacement of any obstruction to the navigable capacity of the waters of the U.S. be authorized by the Secretary of the Army. This permitting program is discussed in Section 2.3.3.

2.3.1 WATER QUALITY PLANNING AND MANAGEMENT PROGRAM

Title 40, Part 130 of the Code of Federal Regulations describes the Water Quality Management (WQM) process which provides the authority for a consistent national approach for maintaining, improving, and protecting water quality while allowing states to implement the most effective individual programs. The components of the dynamic and ongoing WQM process are:

- Development of water quality management plans;
- Development of water quality standards;
- Assessment of the quality of a state's waters through monitoring;
- Development of the state's WQM plans to identify priority water quality problems and provide management to control specific sources of pollution;
- Issuing permits, building publicly-owned treatment works, instituting best management practices for nonpoint sources of pollution, and other means for implementing control measures.

These activities in the State of Hawaii, as they relate to this project, are described below.

Water Quality Management Plans

Section 101(a)(5) of the Clean Water Act (CWA) states that:

> It is the national policy that area-wide waste treatment management planning processes be developed and implemented to assure adequate control of sources of pollutants in each state.

Section 208 of the CWA contains the specific requirements for the development and contents of the initial WQM plans (thus the term "208 plans"). They are used to direct implementation of recommended solutions to correct priority point and nonpoint water quality problems. Recommended solutions are developed based on evaluation of alternatives and with consideration of control measures and financial considerations.

The DOH has been designated as the agency responsible for water quality planning in the State. The DOH has developed the 208 plans in cooperation with other State and city agencies to achieve State and national goals and objectives. There are five planning documents, one for the State as a whole, and one for each of the four counties in the State. Each county plan discusses numerous topics, including a statement of goals, classification of water bodies and the beneficial uses and water quality criteria for each, an assessment of water quality problems and their causes, and pollution control policies and programs.

The current 208 plan for Oahu is the *Water Quality Management Plan for the City and County of Honolulu* (September 1990). It is hereinafter referred to as the *208 Plan*. The *208 Plan* is the primary guidance document for wastewater management planning in the East Mamala Bay area.

Water Quality Standards

The water quality standards (WQS) define the water quality goals for a water body or a portion thereof. This is achieved by designating the use or uses of the water to be protected and by setting criteria designed to protect these uses. A particular WQS is adopted for the following reasons:

- To protect the public health and welfare;
- To improve the existing water quality;
- To provide a sufficient level of water quality to permit the protection and propagation of fish, shellfish and other wildlife;
- To provide sufficient water quality for recreation in and on the water; and/or
- To take into consideration the water body's use and value for public water supply, agricultural, industrial, and other purposes, including navigation.

These standards serve the dual purpose of establishing the water quality goals for specific water bodies and forming the regulatory basis for establishing water quality-based treatment controls and strategies beyond the technology-based level of treatment. Technology-based and water quality-based controls are discussed in Section 2.3.2, National Pollutant Discharge Elimination System (NPDES).

The DOH has developed the water quality standards for the State of Hawaii. These are set forth in Hawaii Administrative Rules, Title 11, Chapter 54 (HAR 11-54). They apply to all State waters, including wetlands, excluding the following: groundwater, ditches, flumes, ponds and reservoirs required for water pollution control or used solely for irrigation, so long as they do not discharge into any other State waters. The current version of these rules is dated October 29, 1992.

In HAR 11-54, State waters are defined and classified, based on physical characteristics, ecological systems, and other natural criteria (Table 2-4) as well as beneficial use (Table 2-5). The classes of water bodies that exist in the study area are streams, estuaries, open coastal waters, and recreational areas; the specific criteria for these classifications are shown in Tables 2-6 and 2-7, 2-8, 2-9, and 2-10 and 2-11, respectively. The purpose of this classification system is to establish "beneficial uses" of groups of water bodies.

The basic water quality requirement is that all waters shall be reasonably free of controllable pollutants. These requirements include standards for chemical and bacterial concentrations of the water body. These requirements were developed to prevent pollutant concentrations sufficient to be toxic or harmful to human, animal, plant, or aquatic life.

In addition to the basic water quality standards applicable to all water bodies, regulations prohibit or limit concentrations of certain physical characteristics of discharges to State waters, based on the uses of the receiving body (Table 2-12). Moreover, specific criteria have been developed for each type of water body.

As defined in HAR 11-54, water quality certification is a statement which asserts that a proposed discharge activity will not violate applicable water quality standards. A water quality certification is required by Section 401 of the CWA of any applicant for a federal license or permit to conduct any activity, including, but not limited to, the construction or operation of facilities which may result in any discharge into navigable waters of the U.S. These federal permits include NPDES permits (see Section 2.3.2) and Army Corps of Engineers Permits (see Section 2.3.3).

Table 2-4
Summary Classification of State Waters Based on Ecological Systems

INLAND WATERS	
Water Types	**Ecological Sub-types**
Fresh waters	(1) Streams (perennial or intermittent) (2) Springs, seeps, natural lakes, and reservoirs (3) Elevated wetlands (4) Low wetlands
Brackish waters or saline waters	(1) Coastal wetlands (2) Estuaries (3) Anchialine pools (4) Saline waters
MARINE WATERS	
Water Types	**Bottom Sub-types**
Embayments or open coastal waters	(1) Sand Beaches (2) Lava rock shorelines and solution benches (3) Marine pools and protected coves (4) Artificial basins (5) Reef flats (6) Soft bottoms
Oceanic waters	

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-5
Beneficial Uses of State Inland and Marine Waters by Water Classification

INLAND WATERS	
Water Classification	**Beneficial Uses To Be Protected:**
Class 1	Natural state or condition, wilderness character.
Class 1.a	Scientific and educational purposes, breeding stock, compatible recreation, aesthetic enjoyment.
Class 1.b	Domestic water supplies, food processing, propagation of aquatic life, compatible recreation, aesthetic enjoyment.
Class 2	Recreational purposes, propagation of fish and other aquatic life, agricultural water supply, industrial water supply, shipping, navigation, propagation of shellfish.
MARINE WATERS	
Water Classification	**Beneficial Uses To Be Protected:**
Class AA	Natural pristine state, wilderness character, oceanographic research, propagation of shellfish and other marine life, conservation of coral reefs and wilderness areas, compatible recreation, aesthetic enjoyment.
Class A	Recreational purposes, aesthetic enjoyment, propagation of fish, shellfish and wildlife.
MARINE BOTTOM ECOSYSTEM	
Bottom Classification	**Beneficial Uses To Be Protected:**
Class I	Natural pristine state, non-consumptive scientific research, non-consumptive education, aesthetic enjoyment, passive activities, preservation.
Class II	Propagation of fish, shellfish and wildlife, recreational purposes.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-6
Specific Criteria for Streams:
Water Column Criteria

PARAMETER	GEOMETRIC MEAN NOT TO EXCEED THE GIVEN VALUE	NOT TO EXCEED THE GIVEN VALUE MORE THAN 10% OF THE TIME	NOT TO EXCEED THE GIVEN VALUE MORE THAN 2% OF THE TIME
Total Nitrogen (µg N/L)	250.0* 180.0**	520.0* 380.0**	800.0* 600.0**
Nitrate + Nitrate Nitrogen (µg –N/L)	70.0* 30.0**	180.0* 90.0**	300.0* 170.0**
Total Phosphorus (µg P/L)	50.0* 30.0**	100.0* 60.0**	150.0* 80.0**
Total Suspended Solids (mg/L)	20.0* 10.0**	50.0* 30.0**	80.0* 55.0**
Turbidity (N.T.U.)	5.0* 2.0**	15.0* 5.5**	25.0* 10.0**

*	Wet Season – November 1 through April 30.
**	Dry season – May 1 through October 31.
L	liter.
N.T.U.	Nephelometric Turbidity Units. A comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the intensity of scattered light, the higher the turbidity.
µg	microgram or 0.000001 grams.
pH Units	Shall not deviate more than 0.5 units from ambient conditions and shall not be lower than 5.5 nor higher than 8.0.
Dissolved Oxygen	Not less than 80 percent saturation, determined as a function of ambient water temperature.
Geometric Mean	is calculated as the nth root of the product of n data values.
Temperature	Shall not vary more than one degree Celsius from ambient conditions.
Specific Conductance	Not more than 300 micro-ohms/centimeter.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-7
Specific Criteria for Streams—Bottom Criteria

(A)	Episodic deposits of flood-borne soil sediment shall not occur in quantities exceeding an equivalent thickness of five millimeters (0.20 inch) over hard bottoms twenty-four hours after a heavy rainstorm.
(B)	Episodic deposits of flood-borne soil sediment shall not occur in quantities exceeding an equivalent thickness of ten millimeters (0.40 inch) over soft bottoms twenty-four hours after a heavy rainstorm.
(C)	In soft bottom material in pool sections of streams, oxidation-reduction potential (E_H) in the top ten centimeters (four inches) shall not be less than +100 millivolts.
(D)	In soft bottom material in pool sections of streams, no more than fifty percent of the grain size distribution of sediment shall be smaller than 0.125 millimeter (0.005 inch) in diameter.
(E)	The director shall prescribe the appropriate parameters, measures, and criteria for monitoring stream bottom biological communities including their habitat, which may be affected by proposed actions. Permanent benchmark stations may be required where necessary for monitoring purposes. The water quality criteria for this subsection shall be deemed to be met if time series surveys of benchmark stations indicate no relative changes in the relevant biological communities, as noted by biological community indicators or by indicator organisms which may be applicable to the specific site.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-8
Specific Criteria for Estuaries (Except Pearl Harbor)

PARAMETER	GEOMETRIC MEAN NOT TO EXCEED THE GIVEN VALUE	NOT TO EXCEED THE GIVEN VALUE MORE THAN 10% OF THE TIME	NOT TO EXCEED THE GIVEN VALUE MORE THAN 2% OF THE TIME
Total Nitrogen (µg N/L)	200.00	350.0	500.0
Ammonia Nitrogen (µg NH_4-N/L)	6.00	10.0	20.00
Nitrate + Nitrite Nitrogen (µg - N/L)	8.00	25.00	35.00
Total Phosphorus (µg P/L)	25.00	50.00	75.00
Chlorophyll a (µg/L)	2.00	5.00	10.00
Turbidity (N.T.U.)	1.50	3.00	5.00

L Liter
N.T.U. Nephelometric Turbidity Units. A comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the intensity of scattered light, the higher the turbidity.
µg Microgram or 0.000001 grams.
pH Units Shall not deviate more than 0.5 units from ambient conditions and shall not be lower than 7.0 nor higher than 8.6.
Dissolved Oxygen Not less than 75 percent saturation, determined as a function of ambient water temperature and salinity.
Geometric mean is calculated as the nth root of the product of n data values.
Temperature Shall not vary more than one degree Celsius from ambient conditions.
Salinity Shall not vary more than ten percent from ambient conditions.
Oxidation Reduction potential (EH)—Shall not be less than −100 millivolts in the uppermost ten centimeters (four inches) of sediment.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-9
Specific Criteria for Class A Open Coastal Waters

PARAMETER	GEOMETRIC MEAN NOT TO EXCEED THE GIVEN VALUE	NOT TO EXCEED THE GIVEN VALUE MORE THAN 10% OF THE TIME	NOT TO EXCEED THE GIVEN VALUE MORE THAN 2% OF THE TIME
Total Nitrogen (µg N/L)	150.00* 110.00**	250.00* 180.00**	350.00* 250.00**
Ammonia Nitrogen (µg N/L)	3.50* 2.00**	8.50* 5.00**	15.00* 9.00**
Nitrate + Nitrite Nitrogen (µg N/L)	5.00* 3.50**	14.00* 10.00**	25.00* 20.00**
Total Phosphorus (µg P/L)	20.00* 16.00**	40.00* 30.00**	60.00* 45.00**
Light Extinction Coefficient (k units)	0.20* 0.10**	0.50* 0.30**	0.85* 0.55**
Chlorophyll a (µg/L)	0.30* 0.15**	0.90* 0.50**	1.75* 1.00**
Turbidity (N.T.U.)	0.50* 0.20**	1.25* 0.50**	2.00* 1.00**

k units — The ratio of light measured at the water's surface to light measured at a particular depth.
L — Liter
N.T.U. — Nephelometric Turbidity Units. A comparison of the intensity of light scattered by the sample under defined conditions with the intensity of light scattered by a standard reference suspension under the same conditions. The higher the intensity of scattered light, the higher the turbidity.
µg — 0.000001 gram.
pH — Shall not deviate more than 0.5 units from a value of 8.1, except at coastal locations where and when freshwater from stream, stormdrain or groundwater discharge may depress the pH to a minimum level of 7.0.
Dissolved Oxygen — Not less than 75 percent saturation, determined as a function of ambient water temperature and salinity.
Geometric mean — Calculated as the nth root of the product of n data values.
Temperature — Shall not vary more than one degree Celsius from ambient conditions.
Salinity — Shall not vary more than ten percent from natural or seasonal changes considering hydrologic input and oceanographic factors.
* — "Wet" criteria apply when the open coastal waters receive more than three million gallons per day of fresh water discharge per shoreline mile.
** — "Dry" criteria apply when the open coastal waters receive less than three million gallons per day of fresh water discharge per shoreline mile.
Light Extinction Coefficient — Is only required for dischargers who have obtained a waiver pursuant to Section 301(h) of the Federal Water Pollution Control Act of 1972 (33 U.S.C. 1251), as amended, and are required by EPA to monitor it.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-10
Specific Criteria for Inland Recreational Waters

(1) Fecal coliform content shall not exceed a geometric mean of two hundred per one hundred milliliters in ten or more samples collected during any thirty day period and not more than ten percent of the samples shall exceed four hundred per one hundred milliliters in the same period.

(2) Raw or inadequately treated sewage, sewage for which the degree of treatment is unknown, or other pollutants of public health significance, as determined by the director of health, shall not be present in natural public swimming, bathing or wading areas.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-11
Specific Criteria for Marine Recreational Waters

(1) Within 300 meters (one thousand feet) of the shoreline, including natural public bathing or wading areas, enterococci content shall not exceed a geometric mean of seven per one hundred milliliters in not less than five samples which shall be equally spaced at six-day intervals or unequally spaced at five-, six-, seven- or eight-day intervals, provided that the total period covered is between 25 and 30 days. Consecutive sample shall not be collected on the same day of the week. Marine recreational waters along sections of coastline where enterococci content does not exceed the standard, as shown by the geometric mean test described above, shall not be lowered in quality.

(2) Marine recreational waters adjacent to sections of coastline receiving stream discharges or stormdrain discharges or in areas of restricted water exchange caused by shore protection structures such as offshore breakwaters and groins, where the standard has been shown by monitoring data to be chronically exceeded, as determined by the geometric mean test, may be posted with signs warning the public that a risk to human health from exposure to dense populations or water-borne microorganisms may exist at those locations. Chronic exceedance of the standards at a location is defined as the condition where more than 50 percent of the geometric means calculated for the preceding 12-month period exceeded the standards, or, for infrequently sampled stations, the median for the data set from the preceding 12-month period exceeded the standard.

(3) At locations where sampling is less frequent than five samples per 25–30 days, if one sample exceeds the standard by a factor of ten or more, sampling should be repeated on the schedule described in paragraph (1) above and geometric means calculated until it is possible to determine the cause of the high bacterial counts. The nature of the cause will determine if warning signs may be posted.

(4) Raw or inadequately treated sewage, sewage for which the degree of treatment is unknown, or other pollutants of public health significance, as determined by the director of health, shall not be present in natural public swimming, bathing or wading areas.

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

Table 2-12
Water Discharge Limitations Based on Beneficial Uses

INLAND WATERS	
Use Classification	**Waste Discharge**
Class 1	Prohibited
Class 2	Controlled (1) No "noncompliance" discharges in any inland waters. (2) No new sewage discharges within estuaries. (3) No new industrial discharges within estuaries (except Pearl Harbor)
MARINE WATERS	
Use Classification	**Waste Discharge**
Class AA	No zones of mixing
Class A	Controlled (1) No "noncompliance" discharges in any marine waters (2) No new sewage discharges within embayment (3) No new industrial discharges within embayment (except Honolulu Harbor, Barbers Point Harbor, Keehi Lagoon Marina Area, Ala Wai Boat Harbor, and Kahului Harbor)
MARINE BOTTOM ECOSYSTEMS	
Use Classification	**Wastewater Effluent Outfall Structures**
Class I	Prohibited
Class II	Controlled

Source: Compiled from Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (October 29, 1992).

The DOH general policy of water quality antidegradation is:

> Waters whose quality are higher than established water quality standards shall not be lowered in quality unless it has been affirmatively demonstrated to the director that the change is justifiable as a result of important economic or social development and will not interfere with or become injurious to any assigned uses made of, or presently in, those waters.

HAR Chapter 11-54 defines "zones of mixing" (ZOMs) as "limited areas around outfalls and other facilities to allow for the initial dilution of waste discharges." It is recognized that zones of mixing for domestic, agricultural, and industrial discharges which have received the best degree of treatment or control are necessary. The standards contain rules for establishment, renewal, and termination of zones of mixing. They also state:

> It is the objective of these limited zones to provide for a current realistic means of control over the placement and manner of discharges or emissions so as to achieve the highest attainable level of water quality or otherwise to achieve the minimum environmental impact considering initial dilution, dispersion, and reactions from substances which may be considered to be pollutants.

In addition to the ZOM defined by the State water quality standards, federal regulations define a Zone of Initial Dilution (ZID) as the region of initial mixing surrounding or adjacent to the end of the outfall pipe or diffuser ports, provided that the ZID cannot be larger than allowed by mixing zone restrictions in applicable water quality standards.

It is recognized that waters which receive a discharge from a treated wastewater outfall, may not meet applicable water quality standards for initial dilution and mixing in close proximity to the outfall. Thus, within a zone of mixing established for a particular outfall, compliance with state water quality standards is not required. However, outside of this area, water quality standards may not be exceeded. Note that a ZID and ZOM have been established for the existing Sand Island WWTP outfall. The performance of this outfall with respect to applicable water quality standards is discussed in Chapter Four.

The specific criteria for "wet" "Class A" "open coastal waters" (shown in Table 2-9) apply at the ZID or ZOM boundary and beyond for the Sand Island outfall. The criteria for light extinction coefficient and turbidity (plus dissolved oxygen of not less than 75% saturation) apply beyond the ZID boundary; the criteria for all other "wet" parameters apply beyond the ZOM boundary. "Wet" open coastal waters are defined as receiving more than three million gallons per day of freshwater discharge per shoreline mile. Monitoring data collected from different depths at specified locations over time are compiled, and the following are calculated for each parameter shown in Table 2-9: the geometric mean, the 90th, and 98th percentile of the log normal distribution of the data set. These statistics are measures of the central tendency and the amount of variability for the data set.

In the case of the East Mamala Bay monitoring program, there are four ZOM boundary stations. Samples are collected four times a year from three depths (the surface, 30 meters below the surface and 60 meters below the surface at each of these stations). Only the surface and 30-meter samples are used to determine compliance with the standards shown in Table 2-9, resulting in 32 samples annually. The geometric mean is calculated as the 32nd root of the product of the 32 samples. The "ten percent not to exceed" and the "two percent not to exceed" requirement are based on the probability distribution of the sampling data. However, because the regulations do not specify the protocol to be used in calculating the probability distribution, determination of compliance is uncertain.

Water Quality Monitoring

Section 106(e)(1) of the CWA requires the establishment and operation of a monitoring program to determine the quality of surface waters, and to the extent practicable, ground waters. The data are compiled, analyzed and reported to the public, as required under Section 305(b) of this act. Section 305 of the CWA also required that an initial baseline inventory and assessment of the water quality in each State be performed during 1973. States currently perform biennial updates, which include: (1) a description of the water quality of all State waters; (2) an analysis of the extent to which State waters provide for the protection and propagation of a balanced population of aquatic biota and allow recreational activities in and on the water; (3) an assessment of the impacts and costs of achieving these objectives; and (4) a description of the nature and extent of nonpoint sources of pollutants and recommendations for programs to control these sources. States which do not meet this requirement are not eligible for federal grants for pollution control programs available under Section 106 of the act.

The DOH administers the water quality monitoring program for the State of Hawaii. Sampling takes place routinely at fixed monitoring stations. Additional stations are established in response to water quality complaints or other special needs for water quality data. Types of samples gathered in the ongoing monitoring program include ambient water column, bottom sediment, effluent from point source discharges, and biota tissue. The chemical, physical, and/or microbiological data are used for such purposes as determining abatement and control priorities; developing and reviewing water quality standards, and reviewing site-specific monitoring efforts.

In addition, the City performs water quality monitoring to determine compliance with NPDES permits (see Section 2.3.2). The NPDES permit monitoring program for Sand Island WWTP includes monitoring of the plant's influent, effluent, outfall, diffuser, and the receiving waters, sediment, and biota associated with the outfall.

Priority Water Quality Problems—Water Quality-Limited Segments

The State is required to identify, based on monitoring results, navigable waters which, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain State water quality standards. These water bodies are known as water quality-limited segments (WQLSs). The State is required by Section 303(d) of the Clean Water Act to identify and establish a priority ranking for WQLSs, and to develop Total Maximum Daily Loads/Wasteload Allocations (TMDLs/WLAs) for these waters.

On Oahu, there are eight WQLSs. Four WQLSs exist in the East Mamala Bay study area; Ala Wai Canal, Kewalo Basin, Honolulu Harbor, and Keehi Lagoon. The 208 Plan includes the following information for each of these segments: description, frequently violated parameters, source of pollutants, general control strategy, point sources, nonpoint sources, and TMDLs/WLAs. The locations of the four segments are shown in Figure 2-1.

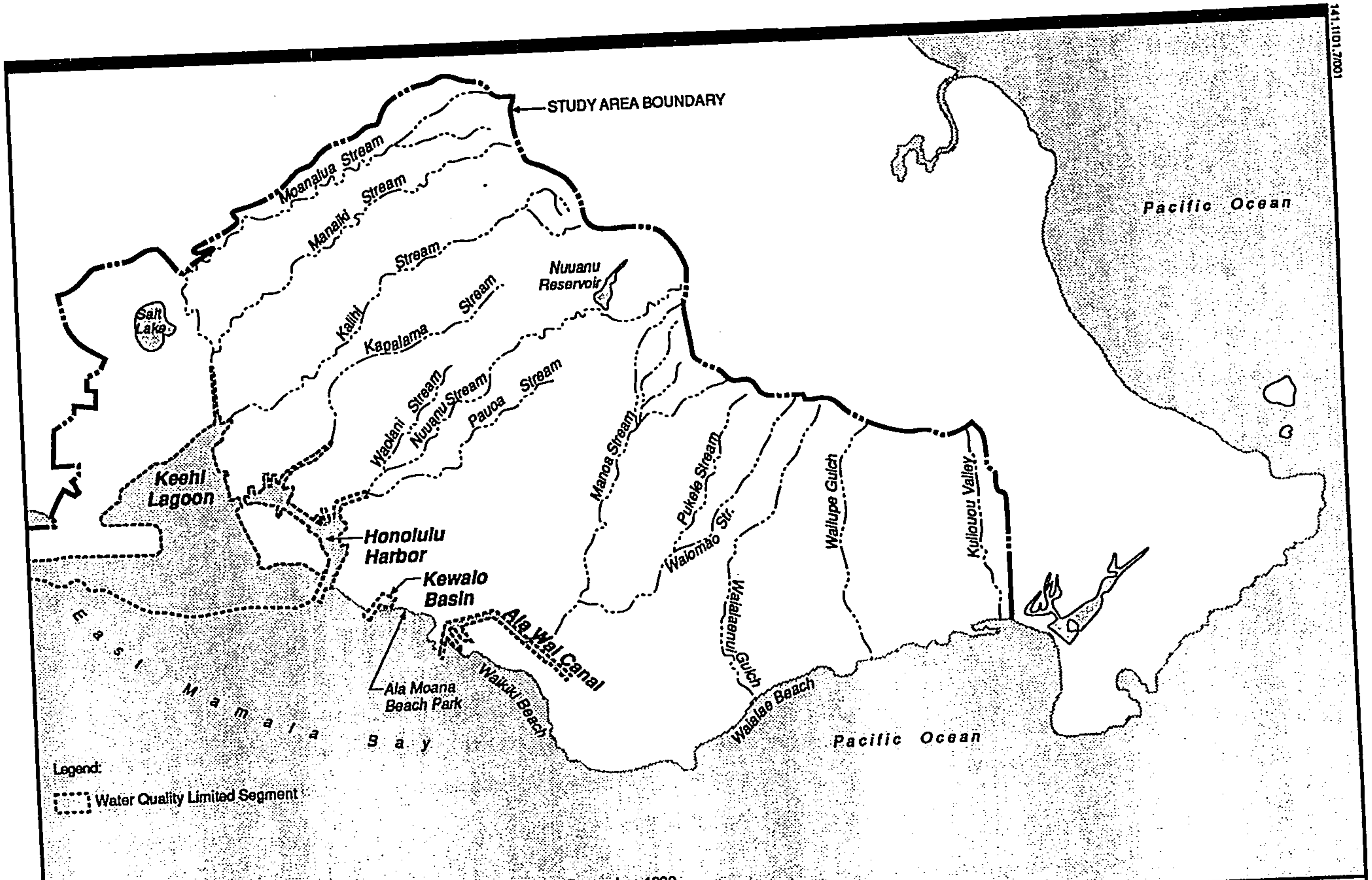
2.3.2 NATIONAL POLLUTANT DISCHARGE ELIMINATION SYSTEM (NPDES)

Point-source discharges of pollutants into surface waters are controlled under the NPDES permitting program, pursuant to Section 402 of the CWA. The NPDES Program requires a permit for any discharge of pollutants from a point source into waters of the United States. Efforts to improve water quality under the NPDES program have focused, traditionally and primarily, on reducing pollutant discharges of industrial process wastewater and domestic wastewater. However, the 1987 amendments to the CWA (Water Quality Act of 1987) required the EPA to promulgate regulations governing storm water permit application requirements. The EPA regulations are applicable to stormwater discharges, including discharges from industry and construction activities. In addition, Hawaii NPDES regulations address non-storm water discharges. The NPDES permit for the Sand Island WWTP effluent outfall contains specific water quality standards that must be maintained in the receiving waters of Mamala Bay. Standards include limits on nutrient levels, heavy metals, and toxic constituents, including a list of "Priority Pollutants." Compliance with these standards is discussed in detail in Section 4.9.

NPDES Permitting

In the State of Hawaii, the NPDES program is administered jointly by the EPA and DOH. The program is set forth in HAR 11-55, Water Pollution Control. The requirements for this program are at least as stringent as those required under federal regulations. The NPDES permits issued by the DOH impose specific limitations on effluent characteristics to ensure that State water quality standards will be met in the receiving waters. Technology-based treatment requirements under Section 301(b) of the CWA represent the *minimum* level of control that must be imposed in an NPDES permit (40 CFR 125.3). If technology-based effluent limitations are insufficient to ensure that State water quality standards will be met in the receiving water, the NPDES permit must contain additional or more stringent water quality-based limitations.

For publicly-owned treatment works (POTWs), technology-based effluent limitations are based upon secondary treatment. 40 CFR 133.102 describes the minimum level of effluent quality attainable by secondary treatment in terms of the parameters of biochemical oxygen demand (BOD_5), suspended solids (SS), and pH, as shown in Table 2-13.



Source: *Water Quality Management Plan for the City and County of Honolulu*, September, 1990.

EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

Figure 2-1
Water Quality Limited Segments in the Study Area

Table 2-13
Minimum Level of Effluent[1] Quality Attainable by Secondary Treatment

MEASUREMENT	BOD_5[2]	SS[3]	pH
30-day average[4]	less than 30 mg/L	less than 30 mg/L	N/A
7-day average[5]	less than 45 mg/L	less than 45 mg/L	N/A
30-day average percent removal[6]	not less than 85 percent	not less than 85 percent	N/A
Each reading	N/A	N/A	6.0 to 9.0

Notes:

1. Effluent is that which exits the last treatment unit before reaching receiving waters.
2. The five-day measure of the pollutant parameter biochemical oxygen demand.
3. The pollutant parameter total suspended solids.
4. The arithmetic mean of pollutant parameter values of samples collected in a period of 30 consecutive days.
5. The arithmetic mean of pollutant parameter values for samples collected in a period of seven consecutive days.
6. A percentage expression of the removal efficiency across a treatment plant for a given pollutant parameter, as determined from the 30-day average values of the raw wastewater influent pollutant concentrations to the facility and the 30-day average values of the effluent pollutant concentrations for a given time period.

Source: *Compiled from* 40 CFR 133.102.

However, Section 301(h) of the CWA allows for requests for modifications of the secondary treatment requirements. 40 CFR 125 Subpart G, Criteria for Modifying the Secondary Treatment Requirements Under Section 301(h) of the Clean Water Act, establishes the criteria to be applied by EPA in acting on these requests. It also establishes special permit conditions which must be included in any permit incorporating a Section 301(h) modification of the secondary treatment requirements.

Section 301(h) of the Clean Water Act provides that:

> The Administrator, with the concurrence of the State, may issue a permit under Section 402 which modifies the requirements of Section (b)(1)(B) of this section with respect to the discharge of any pollutant from a publicly owned treatment works into marine waters, if the applicant demonstrates to the satisfaction of the Administrator that:
>
> (1) There is an applicable water quality standard specific to the pollutant for which the modification is requested, which has been identified under Section 304(a)(6) of this Act;
>
> (2) The discharge of pollutants in accordance with such modified requirements will not interfere, alone or in combination with pollutants from other sources, with the attainment or maintenance of the water quality which assures protection of public water supplies and the protection and propagation of a balanced, indigenous population of shellfish, fish, and wildlife, and allows recreational activities, in and on the water;
>
> (3) The applicant has established a system for monitoring the impact of such discharge on a representative sample of aquatic biota, to the extent practicable, and the scope of such monitoring is limited to include only those scientific investigations which are necessary to study the effects of the proposed discharge;
>
> (4) Such modified requirements will not result in any additional requirements on any other point or nonpoint source;

(5) All applicable pretreatment requirements for sources introducing waste into such treatment works will be enforced;

(6) In the case of any treatment works serving a population of 50,000 or more, with respect to any toxic pollutant introduced into such works by an industrial discharger for which pollutant there is no applicable pretreatment requirement in effect, sources introducing waste into such works are in compliance with all applicable pretreatment requirements, the applicant will enforce such requirements, and the applicant has in effect a pretreatment program which, in combination with the treatment of discharges from such works, removes the same amount of such pollutant as would be removed if such works were to apply secondary treatment to discharges and if such works had no pretreatment program with respect to such pollutant;

(7) To the extent practicable, the applicant has established a schedule of activities designed to eliminate the entrance of toxic pollutants from nonindustrial sources into such treatment works;

(8) There will be no new or substantially increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit.

(9) The applicant at the time such modification becomes effective will be discharging effluent which has received at least primary or equivalent treatment and which meets the criteria established under Section 304(a)(1) of this Act after initial mixing in the waters surrounding or adjacent to the point at which such effluent is discharged.

Section 301(h) does not state that the modified requirement is a temporary or interim measure. It contemplates conditions in which receiving waters are able to assimilate greater organic loadings. However, the Clean Water Act is scheduled for reauthorization, and requirements may be changed by the U.S. Congress.

Zones of mixing (ZOMs) are established to allow "limited areas around outfalls and other facilities to allow for the initial dilution of waste discharges." HAR 11-54-09 identifies the process and the criteria for establishing ZOMs. ZOMs are to be established or renewed only if the criteria are met. These include:

- The function or operation producing the discharge requiring the ZOM is in the public interest.
- The discharge does not substantially endanger human health or safety.
- The discharge does not violate basic water quality standards, will not "unreasonably interfere with any actual or probable use" of the receiving water, and has received the degree of treatment or control that is required by applicable statutes and regulations or otherwise specified by the DOH.
- Compliance with WQS in the ZOM would produce serious hardships without equal or greater benefits to the public.

The Sand Island WWTP outfall complies with all these criteria.

ZOM applications are evaluated in light of impacts on receiving waters based on type of waters, uses to be protected, character of the effluent, and public comment. ZOMs are permitted for specific periods and must be renewed periodically. ZOMs are granted subject to development and implementation of sampling and monitoring programs.

If water quality standards cannot be met outside the ZOM with secondary treatment, a higher level of treatment or an expanded ZOM may be required. If water quality standards are met outside the ZOM using primary treatment and the nine previously cited conditions are met, then criteria for granting "301(h) waiver permit" are met. This waiver permit allows the use of primary treatment.

The Sand Island Wastewater Treatment Plant (Sand Island WWTP) currently discharges under NPDES permit HI0020117, which is a 301(h) waiver permit. The permit establishes a monitoring program which: (1) ensures compliance with effluent standards; (2) ensures compliance with water quality standards; and (3) monitors the impact of the discharge on aquatic biota.

In summary, there are two basic requirements for water pollution control under the CWA. First and foremost, discharges are required to meet water quality standards outside the ZOM. These are described as water-quality-based controls. Second, discharges are required to be controlled using certain technologies. These are known as technology-based control requirements. For POTWs, technology-based control requirements are based upon secondary treatment, but may be waived under Section 301(h).

Industrial Pretreatment Requirements

"Indirect" discharges contribute industrial wastewater to POTWs. There is no nationwide system for permitting of indirect dischargers, although some local wastewater authorities, including the City and County of Honolulu, have established permitting programs for industrial users.

There are three types of requirements that apply to non-domestic discharges to POTWs: General Pretreatment Standards specified in 40 CFR 403, Categorical Pretreatment Standards for various industry categories, and additional State and/or local requirements. Unlike the NPDES program, the first two requirements apply to indirect dischargers even if no permit is required by State or local regulations, or if an issued permit contains less stringent limitations.

General Pretreatment Standards: The General Pretreatment Standards are designed to prohibit the introduction of specific types of pollutants into POTWs and prevent interference and pass through that could jeopardize operations of the POTW.

Categorical Pretreatment Standards: Categorical Pretreatment Standards have been developed by the EPA under Sections 307(b) and (c) of the CWA. Categorical Standards are specific to select industrial categories, and include concentration limits and equivalent mass limits wherever possible.

Regulations in 40 CFR 403.12 state that industrial users subject to categorical pretreatment standards and who are currently discharging to a POTWs must submit a "baseline report" within 180 days after the standards become effective, indicating the nature and concentration of pollutants in their discharge. Compliance reports are required on a periodic basis thereafter, a minimum of two reports each year. These reports must also include estimated average and maximum daily flows during the reporting period.

State and Local Requirements: POTWs are required to implement their own pretreatment programs and regulations if any of the following exist:

1. If the POTW has a total design flow of more than five million gallons per day and it receives pollutants from industrial users that have the potential to interfere with, or pass through, or are otherwise subject to pretreatment standards.
2. If the EPA or the State finds that circumstances warrant a pretreatment program for small POTWs (because of the nature and volume of industrial effluent, contamination of sludge, etc.).
3. If the POTW wishes to obtain approval to grant removal credits.

The program for the City is described in Revised Ordinances, Chapter 14, Articles 1 and 5. Section 14-5.1(a) of the Revised Ordinances states, "No person shall discharge or cause to be discharged any industrial wastewaters into the public sewers without first obtaining an Industrial Wastewater Discharge Certificate from the Department." The certificate may specify pretreatment requirements, flow restrictions, point of discharge, monitoring requirements, and other conditions. Dilution is prohibited as a substitute for treatment.

Industrial pretreatment requirements can be thought of as "source control" upstream of a POTW. By identifying and regulating what enters a POTW, the POTW is better able to anticipate and adequately address the chemicals in its influent. The current Sand Island WWTP NPDES 301(h) waiver permit contains specific pretreatment requirements. These are discussed in Chapter Four of this EIS.

Spill and Bypass Reporting Requirements

Certain diversions or spills of sewage from the wastewater system are considered non-compliance events and must be recorded and reported, and appropriate measures must be taken to protect human health. The reporting requirements are included as provisions in NPDES permits. In the Sand Island WWTP NPDES permit, the various types of diversions of sewage are defined as follows:

> "Bypass" means the intentional or unintentional diversion of waste streams from any portion of a treatment facility whose operation is necessary to maintain compliance with the terms and conditions of this permit.
>
> "Overflow" means the intentional or unintentional diversion of flow from the collection and transport systems, including the pumping facilities.
>
> "Upset" means any exceptional incident in which there is unintentional and temporary noncompliance with effluent limitations in the permit because of factors beyond the reasonable control of the discharger. It does not include noncompliance caused by operational error, improperly designed facilities, inadequate facilities, lack of preventive maintenance, or problems the discharger should have foreseen.

The NPDES permit for Sand Island WWTP specifies the actions to be taken in the event of a diversion:

> For an unanticipated "overflow" or "bypass," the discharger shall notify the HI DOH and EPA Region IX of each such "overflow" or "bypass," in accordance with procedures outlined in paragraph E.4. of General Reporting Requirements. The written confirmation shall include information relative to the location; estimated volume; pH, BOD, and TSS values; date and time; duration; cause; and remedial measures taken to effect cleanup and/or to prevent recurrence. Immediate measures shall be initiated to clean up wastes due to any such "overflow" or "bypass" and to abate the effects thereof or, in the case of threatened pollution or nuisance, to take other necessary remedial action.

The Sand Island WWTP NPDES permit requires reporting of any noncompliance that may endanger public health or the environment. The discharger must notify DOH and EPA Region IX immediately by telephone or in person, and in no case later than 24 hours, from the time the noncompliance is discovered. Unless waived by EPA Region IX, a written report is also required within 5 days of the non-compliance date. The report must contain a description of the noncompliance and its cause; the duration of the noncompliance, and steps taken and/or planned to reduce, eliminate, and prevent recurrence of the noncompliance.

In addition, the City has adopted the DOH's Protocol for Sewage Spills (August 1993). The protocol includes procedures for notification, bacterial sampling, posting of warning signs and reporting for spills to surface waters and spills contained within a wastewater system facility. Based on the DOH protocol, the City has in place a "Standard Operating Procedure for Reporting Bypass of Sewage or Discharge of Partially-Treated Sewage."

Regulations Governing NPDES Permitting of Storm Water Runoff, Dewatering, and Hydrotesting

The EPA recently has promulgated regulations governing storm water permit application requirements (November 1990). These regulations address pollutants in discharges that had been largely uncontrolled. For example, studies have shown that many storm sewers receive illicit discharges of improperly disposed wastes, particularly used oil.

Discharges associated with storm water systems and industrial activity are now subject to regulations and permitting. Storm water systems are defined as storm water collection/conveyance systems not connected to wastewater systems or POTWs. Industrial activity includes specific industries, as described by Standard Industrial Classification (SIC) code.

Treatment Works treating domestic sewage with design flows of 1.0 mgd or more, such as Sand Island WWTP, are considered industrial activities and thus subject to NPDES storm water permitting requirements. These requirements include development of a stormwater pollution control plan to minimize pollutants in stormwater runoff, and identification of non-storm water sources connected to the storm drain system.

Within the study area, other facilities subject to storm water permitting requirements include lumber and wood products manufacturing facilities, paper and associated products manufacturing facilities, recycling facilities, and transportation facilities with vehicle maintenance shops. Construction activity disturbing five acres or more is also subject to storm water permitting requirements. In addition, the City has filed a storm water permit application for its storm water system.

The Clean Water Branch of the DOH is responsible for the issuance of NPDES permits for discharges of storm water to state waters. It has promulgated rules to implement the storm water program in Hawaii (HAR 11-55, effective October 29, 1992). The major program element is adoption of the NPDES General Permit Program. There are two different general permits for storm water discharges, one for industrial facilities and one for construction activities of five acres or more. There are also four general permits for non-storm water discharges, one each for treated groundwater from leaking underground storage tank site, once-through cooling water (less than one mgd), hydrotesting water, and construction dewatering.

Construction activity also requires plan review and approval by DPW, including erosion control computations and best management practices. If any construction activity involves the discharge of groundwater dewatering or pipeline hydrotesting water into the City-owned storm drain system, a permit must be obtained from the DPW. A permit will be granted if it can be shown that the discharge will not create a drainage or pollution problem or cause a violation of any provisions of the City's NPDES permit for its municipal separate storm sewer system.

For construction of wastewater system improvements, NPDES general permit coverage is needed if the disturbed area is five acres or more and storm water is discharged to state waters. DPW plan approval is also needed. In addition, if construction activity involves dewatering or hydrotesting that result in discharges to state waters, NPDES general permit coverage is required. If the dewatering or hydrotesting results in discharges to the City's storm drain system, a permit from the DPW is required.

2.3.3 ARMY CORPS OF ENGINEERS PERMITS

The Army Corps of Engineers is the administrating agency for the permitting programs under Section 404 of the CWA and under Section 10 of the Rivers and Harbors Act. The permits are known as "Section 404" and "Section 10" permits, respectively.

A Section 404 permit is required for the discharge of dredged or fill material into navigable waters. The permit requirements are contained in 33 CFR 323, permits for discharges of dredged or fill material into waters of the U.S. Section 404 of the CWA allows for denying or restricting of any defined area as a disposal site, if it is determined that the discharge will have an unacceptable adverse effect on municipal water supplies, shellfish beds and fishery areas (including spawning and breeding areas), wildlife, or recreational areas.

A Section 10 permit is required for structures or work in or affecting navigable waters of the U.S. (see 33 CFR 322). "Work" includes any dredging or disposal of dredged material, excavation, filling, or other modification of a navigable waters of the U.S.

If proposed wastewater system improvements will result in construction work being done in waters such as Mamala Bay and Honolulu Harbor, a Section 404 and/or Section 10 permit will be required. Applications for these permits will need to include water quality certification under section 401 of the CWA (see Section 2.3.1), unless the requirement is waived.

2.4 RELEASES TO GROUNDWATER

The federal Safe Drinking Water Act (SDWA) regulates the quality of groundwater as a drinking source and controls discharges to groundwater. In Hawaii, underground injection of fluids, including treated wastewater, is regulated by the Underground Injection Control (UIC) program established by the DOH. In addition, the location of individual wastewater systems (IWS) is regulated by the DOH.

2.4.1 SAFE DRINKING WATER ACT (SDWA) STANDARDS

Under the authority of the SDWA, the EPA is mandated to establish National Primary Drinking Water Regulations. Included in these regulations are the standards which set the maximum contaminant levels (MCLs) allowable in drinking water. Both primary and secondary standards exist. Primary standards are established because of the adverse health effects associated with certain contaminants; secondary standards address the aesthetic qualities of drinking water (e.g., taste and odor). The primary standards are federally enforceable.

The Department of Health has developed HAR 11-20, Rules Relating to Potable Water Systems (effective March 7, 1992), which applies to each public water system with collection and treatment facilities. These rules specify maximum contaminant levels, monitoring, sampling, record maintenance, and public notification. A maximum contaminant level is the maximum permissible level of a contaminant in water which is delivered to the free flowing outlet of the ultimate user of a public water system, with the exception of turbidity, where the maximum permissible level is set at the point of entry to the distribution system. Any contaminants that may be added to the water by the user, are excluded from this definition.

2.4.2 UNDERGROUND INJECTION CONTROL PROGRAM

In addition to requiring the establishment of drinking water standards, the SDWA mandated the EPA to develop minimum requirements for State underground injection programs. The purpose of the UIC program is to prevent underground injection of fluids (via injection wells) which endanger drinking water sources. Underground injection endangers drinking water sources "if such injection may result in the presence in underground water which supplies or can reasonably be expected to supply any public water system of any contaminant, and if the presence of such contaminant may result in such system's not complying with any national primary drinking water regulation or may otherwise adversely affect the health of persons" (SDWA Sec. 1421(b)(1),(d)(2)).

The State of Hawaii UIC regulations administered by the DOH specify conditions governing the location, construction and operation of injection wells to prevent the contamination of underground sources of drinking water (USDW) by injected fluids. The State's UIC program does not apply to residential individual wastewater systems serving single family households or to non-residential systems which receive only sanitary wastes in quantities less than one thousand gallons per day.

The UIC line for the island of Oahu has been established by the DOH as part of its UIC program. Lands which are *makai* of the UIC Line (see Figure 2-2) overlie aquifers that are generally considered "exempted." Exempted aquifers are exempted from being used as an USDW, on the basis of the following criteria: (1) the aquifer does not currently serve as a source of drinking water; and (2) the aquifer cannot now and will not in the future serve as a source of drinking water. Non-exempted aquifers (i.e. USDWs) generally are located *mauka* of the UIC line.

As of July 6, 1984, injection wells injecting domestic wastewater are not permitted *mauka* of the UIC line (into a USDW), but may be permitted *makai* of the UIC line. In addition, all injection wells must be located at least one-quarter mile from a drinking water source.

A UIC permit must be obtained from DOH prior to the construction, modification, and operation of wells injecting into *any* aquifer. Injection wells found to be in violation of primary drinking water standards will be cited by the DOH. Remedial action must then be taken to bring the well into compliance. Failure to do so could result in closure of the well.

2.4.3 INDIVIDUAL WASTEWATER SYSTEMS LIMITATIONS

According to HAR 11-62, Wastewater Systems, a "Critical Wastewater Disposal Area (CWDA)" is an area where proposed cesspools are severely restricted or prohibited. The entire island of Oahu has been designated as a CWDA and no new cesspools can be built. Regulations found in Hawaii Administrative Rules, Title 11, Chapter 62, Section 32 (HAR 11-62-32) state that no cesspool, seepage pit, or soil absorption system shall be located closer than 1,000 feet to any potable drinking water well. Further, landowners using existing cesspools may be required to upgrade them to meet current IWS standards when adding to or remodeling their properties.

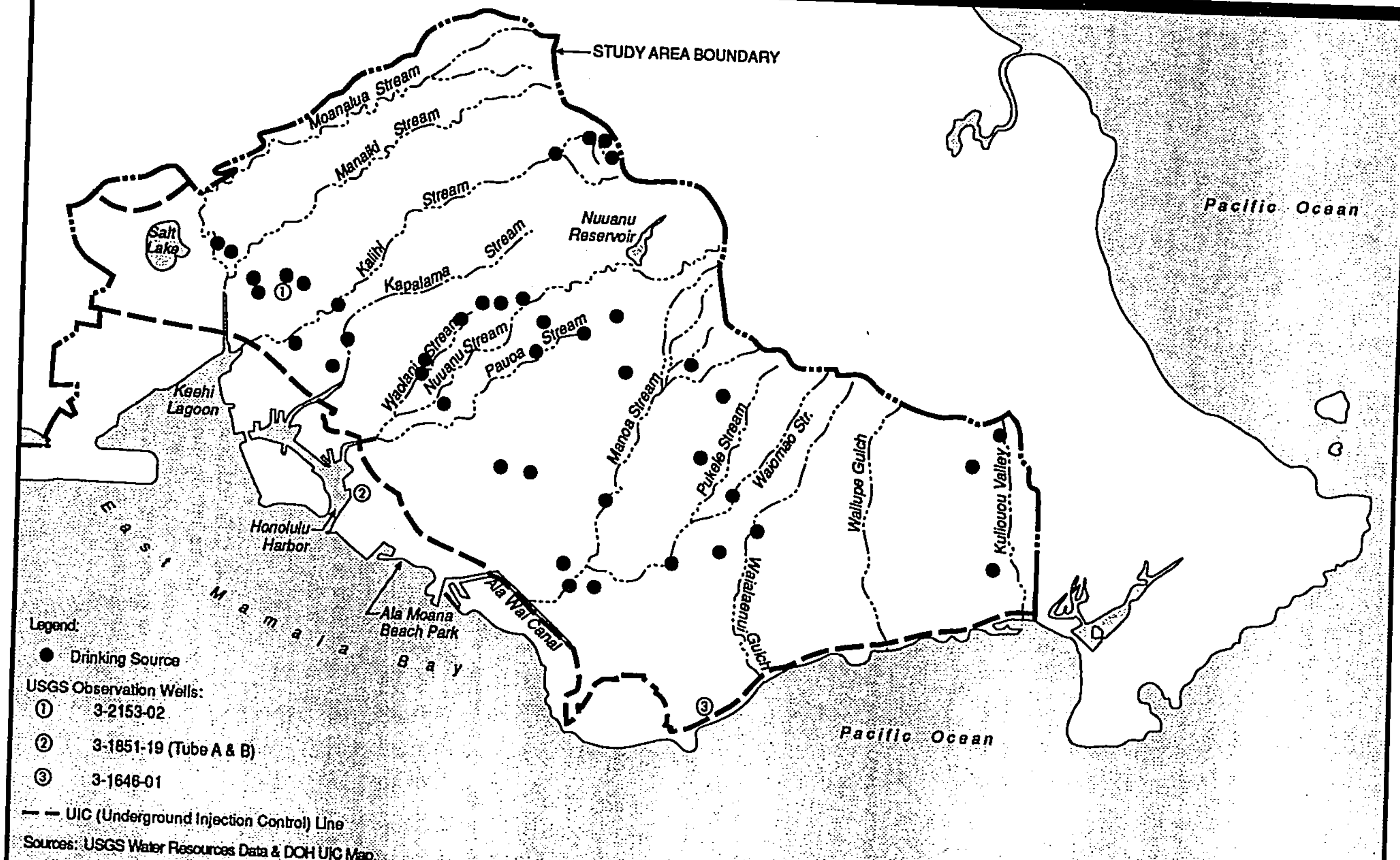
2.5 RELEASES TO LAND/SOIL

Releases to land/soil are of primary concern in the disposal of wastewater sludge and other solids. The CWA (Section 405) requires the development of guidelines for sludge disposal and utilization. Also required are: (1) the identification of toxic pollutants that may be present in the sludge in concentrations that may adversely affect public health or the environment, (2) the development of regulations specifying acceptable management practices for disposal or use of sewage sludge containing such toxic pollutants, and (3) development of numerical limitations for each pollutant based on the potential use of sludge. The sludge regulations developed by the EPA are discussed in Section 2.5.1.

Releases to land/soil are also a concern with regard to the disposal of treated wastewater effluent which may be reclaimed and used in a beneficial manner. The draft guidelines developed by the DOH for reclaimed wastewater are summarized in Section 2.5.2. Solid waste management priorities and goals for the State of Hawaii are discussed in Section 2.5.3.

2.5.1 SEWAGE SLUDGE

Pursuant to Section 405 of the CWA, 40 CFR 503 contains standards for the disposal of sewage sludge. The regulation includes standards for the use or disposal of non-hazardous sewage sludge. General requirements, pollutant concentration limits (see Table 2-14), management practices, and operational standards applicable to each use or disposal method are specified. The operational standards include requirements for pathogen reduction and vector management, monitoring frequency, record keeping, and reporting.



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

Figure 2-2
Groundwater Map

As mandated by Section 405(f) of the CWA, any NPDES permit issued to a POTW shall include requirements for the use and disposal of sludge that implement the regulations in 40 CFR 503. In addition to establishing the state sludge management program requirements and procedures, 40 CFR 503 revised the NPDES permit requirements and procedures to incorporate sludge permitting and state program requirements.

Wastewater sludge disposal is addressed by HAR 11-62-07 (August 30, 1991) which states:

Wastewater sludge shall only be disposed of in the following manner:

(1) By a private, county, or State solid waste disposal facility which has a permit pursuant to chapter 11-58, to accept wastewater sludge;

(2) By reclamation or reuse for agricultural purposes as set forth by EPA regulations;

(3) By incineration which meets all applicable requirements of chapter 11-60; or

(4) By a private, county, or State wastewater system which has been given specific written authorization to accept and dispose of sludge.

Table 2-14
Pollutant Limits for the Use and Disposal of Sewage Sludge
(dry weight basis)

	LAND APPLICATION				SURFACE DISPOSAL						
					POLLUTANT CONCENTRATION (MG/KG) - ACTIVE SEWAGE SLUDGE UNIT WITHOUT A LINER AND LEACHATE COLLECTION SYSTEM DISTANCE FROM UNIT BOUNDARY TO PROPERTY LINE (METERS):						
POLLUTANT	MAX. CON. (MG/KG)	CUMUL. POLL. LOAD. RATE (KG/HA)	POLL. CONC. (MG/KG)	ANNUAL POLL. LOAD. RATE (KG/HA/365 DAY PERIOD)	LESS THAN 25	LESS THAN 50	LESS THAN 75	LESS THAN 100	LESS THAN 125	LESS THAN 150	150 OR GREATER
Arsenic	75	41	41	2.0	30	34	39	46	53	62	73
Cadmium	85	39	39	1.9	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Chromium	3000	3000	1200	150	200	220	260	300	360	450	600
Copper	4300	1500	1500	75	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Lead	840	300	300	15	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Mercury	57	17	17	0.85	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Molybdenum	75	18	18	0.90	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Nickel	420	420	420	21	210	240	270	320	390	420	420
Selenium	100	100	36	5.0	N/A	N/A	N/A	N/A	N/A	N/A	N/A
Zinc	7500	2800	2800	140	N/A	N/A	N/A	N/A	N/A	N/A	N/A

Notes:

1. MG = milligram; KG = kilogram; HA = hectare; N/A = Not Applicable
2. Sewage sludge applied to land shall not exceed the maximum concentration of any pollutant.
3. Sewage sludge applied to agricultural land, forest, a public contact site, or a reclamation site shall not exceed the cumulative pollutant loading rate for each pollutant or the pollutant concentration for each pollutant.
4. Sewage sludge applied to a lawn or home garden shall not exceed the pollutant concentration for each pollutant.
5. Sewage sludge bagged for application to land shall not exceed the annual pollutant loading rate.
6. For a surface disposal site, site-specific pollutant limits may be requested.
7. Pathogen and vector attraction reduction requirements and pollutant limits for incineration are not shown in this table.

Source: Compiled from 40 CFR 503, as published in the Federal Register on February 19, 1993.

40 CFR 258 (Solid Waste Disposal Facility Criteria) applies to all municipal solid waste landfills (MSWLFs) in which sewage sludge is disposed with household wastes. Although the EPA decided that development of numeric limitations for the pollutants in sewage sludge disposed with municipal solid waste was not technically feasible, it determined that the requirements in 40 CFR 258 for MSWLFs were adequate to protect public health and the environment. The bases for this determination of adequacy are that the design and engineering standards will prevent the migration of pollutants from waste leachate and corrective measures are prescribed. On the local level, under DPW rules, sewage sludge disposed with municipal solid waste is required to consist of not less than 40 percent solids.

2.5.2 RECLAIMED WATER

The Wastewater Branch of the DOH has developed draft guidelines for the treatment and use of water reclaimed from municipal wastewater. This section summarizes the final version of these guidelines dated November 22, 1993. Reclaimed water is defined as treated domestic wastewater which is suitable for a direct beneficial use or a controlled use that would not otherwise occur.

Reclaimed water is classified in one of three categories depending on the level of treatment received. The three categories, in order of decreasing level of treatment, are:

- R-1 Water (Significant reduction in viral and bacterial pathogens), is defined as reclaimed water that is at all times oxidized, then filtered, and then exposed, after the filtration process to a disinfection process which meets DOH criteria.
- R-2 Water (Disinfected secondary–4 reclaimed water), is defined as reclaimed water that is at all times oxidized and then exposed to a disinfection process which meets DOH criteria.
- R-3 Water (Undisinfected secondary reclaimed water), is defined as oxidized wastewater.

The DOH guidelines contain design requirements for reclamation facilities, information required in construction plans, the approval process, and compliance reporting. These requirements must be considered when developing and evaluating options for reclamation and reuse of treated liquid effluent from Sand Island WWTP. Table 2-15 lists the permissible uses of the three categories of reclaimed wastewater.

2.5.3 INTEGRATED SOLID WASTE MANAGEMENT

The Hawaii Integrated Solid Waste Management Act (Hawaii Revised Statutes, Chapter 342G) identifies the following solid waste management practices and processing methods in order of priority: (1) source reduction; (2) recycling and bioconversion, including composting; and (3) landfilling and incineration. It is the goal of the State to reduce the solid waste stream prior to disposal by 25 percent by January 1, 1995 and by 50 percent by January 1, 2000 through source reduction, recycling, and bioconversion.

Each county was required to adopt and submit an integrated solid waste management plan to the DOH by January 1, 1993. Each county plan includes:

- A program element, containing the following components
  - Waste stream assessment
  - Source reduction
  - Recycling and bioconversion
  - Energy-balance
  - Special waste
  - Household hazardous waste
  - Public education and information
  - Landfill and incineration
  - Marketing and procurement of materials

- Program implementation
- Program funding

• A facility capacity and siting element, containing the following components
  - Existing capacity and future needs
  - Facility implementation
  - Enterprise zone

Table 2-15
(2 Pages)
Summary of Suitable Uses of 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 limited 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	**R1**	**R2**	**R3**
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

Table 2-15
(2 Pages)
Summary of Suitable Uses of Reclaimed Water

SUITABLE USES OF RECLAIMED WATER	R1	R2	R3
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 surfaces	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 shortages	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

Source: *Guidelines for the Treatment and Use of Reclaimed Water*, Hawaii State Department of Health, Wastewater Branch, November 22, 1993.

2.6 RELEASES TO AIR

The federal Clean Air Act established the basic framework for federal and state regulation of air pollution. The cornerstone of the act was the establishment of air quality standards and performance standards to protect public health and welfare. The task of achieving these various air quality standards is borne by the various states through the adoption of State Implementation Plans (SIPs). The Clean Air Act Amendments of 1990 mandate numerous requirements and deadlines for further development of clean air regulations.

The air permitting program in Hawaii is administered by the DOH. The SIP for Hawaii air quality standards and permitting requirements are contained in Hawaii Administrative Rules, Title 11, Chapters 59 and 60.1. The current versions of these rules became effective November 26, 1993, and contain new requirements as mandated by the Clean Air Act Amendments of 1990.

In addition to the Clean Air Act, Section 405(d) of the Clean Water Act requires promulgation of standards for incineration of sewage sludge. These standards for air emissions from sewage sludge incinerators are included in 40 CFR 503, Standards for the Use or Disposal of Sewage Sludge. The DOH is the administering agency for these rules in the State of Hawaii.

Existing air permitting requirements prior to November 26, 1993 are summarized in Section 2.6.1. New air permitting requirements as stipulated in the Clean Air Act Amendments of 1990 are discussed in Section 2.6.2. Clean Water Act requirements as they relate to the incineration of sewage sludge are outlined in Section 2.6.3. The direct applicability of these requirements to Sand Island WWTP is discussed in Section 2.6.4.

2.6.1 EXISTING REQUIREMENTS PURSUANT TO THE CLEAN AIR ACT

HAR 11-59 (Ambient Air Quality Standards) and HAR 11-60.1 (Air Pollution Control) together constitute the clean air regulations for the State of Hawaii. The two subsections summarized the requirements that have been in effect since June 29, 1992.

Standards and Control Technology

The regulatory structure reflects both a goals-oriented and a technology-based approach to addressing air pollution problems.

Three types of standards have been developed for the control of air emissions:

- Ambient air quality standards;
- New source performance standards (NSPS); and
- National Emission Standards for Hazardous Air Pollutants (NESHAPs).

Ambient air quality standards limit the time-averaged concentration of specified "criteria pollutants." Primary standards are intended to protect public health with an adequate margin of safety. Secondary standards are intended to prevent adverse impacts to comfort, visibility, vegetation and animals.

National Ambient Air Quality Standards (NAAQS) are shown in columns one and two of Table 2-16 (40 CFR 50). State ambient air quality standards are shown in column three of Table 2-16 (HAR 11-59). The State standards are at least as stringent as the federal standards. NSPS are technology-based emission requirements. NESHAPs are emission requirements for eight designated hazardous air pollutants (HAPs). These are pollutants which present a threat of adverse human health or environmental effects. Such a threat may be present through inhalation or other routes of exposure. The Clean Air Act Amendments of 1990 increased the number of HAPs to 189 (see Section 2.6.2 for further discussion). NSPS and NESHAPs requirements must be met regardless of specific ambient air quality standards.

NSPS and NESHAPs for sewage treatment plant incinerators are summarized in columns four and five of Table 2-16, respectively. The NSPS apply to each incinerator that combusts wastes containing more than ten percent sewage sludge (dry basis) produced by municipal sewage treatment plants, or each incinerator that charges more than 1,000 kg (2,205 pounds) per day municipal sewage sludge (dry basis). The NSPS consist of standards for particulate matter and opacity in emissions to the atmosphere.

Table 2-16
(2 Pages)
Air Quality Standards

(All values are micrograms per cubic meter unless otherwise noted. Values in brackets [ ] are in ppm.)

COLUMN NUMBER	1	2	3	4	5	6	7	8	9	10	11	12
	AMBIENT AIR QUALITY STANDARDS							AMBIENT AIR INCREMENT				
	FEDERAL											
REGULATED POLLUTANT	PRIMARY	SECONDARY	STATE OF HAWAII	NSPS	NESHAPS	SIG. EMISSION RATE (TONS PER YEAR)	MAX. ALLOW. IN-CREASE	CLASS I	CLASS II	CLASS III	DE MINIMIS CRITERIA	SLUDGE CONTENT LIMIT?
Arsenic												Yes
Asbestos						0.007						
Beryllium					10 grams[a,u]	0.0004					0.001[b]	
Cadmium												Yes
Carbon monoxide	10 [9][f,h] 40 [35][e,h]		avg 10[m,t] avg 5[n,t]			100					575[i]	
Chromium												Yes
Fluorides						3					0.25[b]	
Gases				20% opacity								
Hydrocarbons, total												Yes
Hydrogen sulfide			avg 35 [25 ppb][m,t]			10					0.2[e]	
Lead	1.5[k]	1.5[k]	avg 1.5[c]			0.6					0.1[v]	
Mercury					3200 grams[d]	0.1					0.25[b]	
Nickel												Yes
Nitrogen dioxide	100 [0.053][f]	100[0.053][b]	avg 70[f]			40 NO_x	25[c]	25[c]	25[c]	50[c]	14[a]	
Ozone	235 [0.12][c,j]	235 [0.12][c,j]	avg 100[m,t]			40 VOCs					none[x]	
Particulate matter				0.65 g/kg dry sludge 1.30 lb/ton dry sludge		25	19[a,w] 37[c,w]	5[c,w] 10[c,w]	19[a,w] 75[c,w]	37[a,w] 75[c,w]	10[h,w]	
PM-10	150[h,j] 50[f]	150[h,j] 50[f]	arith 50[f] avg 150[a]								10[h]	
Reduced sulfur						10					10[a]	
Reduced sulfur, total						10					10[a]	

Table 2-16

(2 Pages)

Air Quality Standards

(All values are micrograms per cubic meter unless otherwise noted. Values in brackets [ ] are in ppm.)

COLUMN NUMBER	1	2	3	4	5	6	7	8	9	10	11	12
	AMBIENT AIR QUALITY STANDARDS							AMBIENT AIR INCREMENT				
	FEDERAL											
REGULATED POLLUTANT	PRIMARY	SECONDARY	STATE OF HAWAII	NSPS	NESHAPS	SIG. EMISSION RATE[i] (TONS PER YEAR)	MAX. ALLOW. INCREASE	CLASS I	CLASS II	CLASS III	DE MINIMIS CRITERIA	SLUDGE CONTENT LIMIT?
Sulfur dioxide (Sulfur oxides)	80 [0.03][c] 365 [0.14][b,h]	1300 [0.5][i,h]	avg 80[f] avg 365[q,t] avg 1300[n,t]			40	20[c] 91[q] 325[n]	2[c] 5[q] 25[n]	20[c] 91[q] 512[n]	40[c] 182[q] 700[n]	13[b]	
Sulfuric acid mist						7						
Vinyl chloride						1					15[b]	

Notes:

[a] Annual geometric mean
[b] 24-hour average
[c] Annual arithmetic mean
[d] 3-hour average
[e] 1-hour average
[f] 8-hour average
[g] Annual average

[h] Not to be exceeded more than once per year
[i] Maximum 3-hour concentration
[j] Number of days per year with exceedance less than or equal to one
[k] Arithmetic mean over a calendar quarter
[m] Over any 1-hour period
[n] Over any 3-hour period
[p] Over any 8-hour period

[q] Over any 24-hour period
[r] Over any 12-month period
[s] Over any calendar quarter
[t] Not to be exceeded more than once in any 12-month period
[u] Or ambient concentration limit in the vicinity of the stationary source of 0.01 micrograms per cubic meter averaged over a 30-day period, subject to Administrator approval
[v] 3-month average
[w] Total suspended particulates
[x] Any net increase of 100 tons per year or more of volatile organic compounds (VOCs) requires ambient impact analysis

avg = average
arith = arithmetic mean

Sources:

1. Federal ambient air quality standards - 40 CFR 50 (7/1/91)
2. Hawaii state ambient air quality standards - HAR 11-59 (11/26/93)
3. New Source Performance Standard (NSPS) - 40 CFR 60 Subpart O (7/1/91)
4. National Emission Standards for Hazardous Air Pollutants (NESHAP) - 40 CFR 61 (7/1/91)
5. Significant Emissions Rate - HAR 11-60.1, (11/26/93) (Note: Significant emission rates are also those for a pollutant subject to regulation under the Clean Air Act not listed in the table, and any emissions rate associated with a major stationary source within ten kilometers of a Class I area with an impact greater than or equal to one microgram per cubic meter (24-hour average).
6. Maximum Allowable Increase - HAR 11-60.1 (11/26/93)
7. Ambient Air Increments - HAR 11-60.1 (11/26/93)
8. De Minimis Criteria - HAR 11-60.1 (11/26/93)
9. Sludge Content Limit - 40 CFR 503 (from 58 FR 9387, 2/19/93)

The NESHAP for mercury applies to wastewater treatment plant sludge incinerators. The NESHAP for beryllium applies to incinerators which process beryllium ore, beryllium, beryllium oxide, beryllium alloys, or beryllium-containing waste.

Emissions of pollutants subject to NAAQS or State ambient air quality standards are also subject to control requirements. For emissions of these pollutants in "significant amounts", best available control technology must be installed. "Significant" emission rates are shown in column six of Table 2-16.

Permitting

Air emissions are controlled and enforced via permitting by the DOH. Any stationary emissions source must obtain an Authority to Construct (ATC) prior to construction, modification, or relocation. Subsequently, a Permit to Operate (PTO) is required for ongoing operations. Applications for ATCs and PTOs must contain specific information that demonstrates compliance with air quality standards and emission limitations, and that control equipment requirements can be achieved.

Major stationary sources or majority modifications face additional requirements for obtaining an ATC and PTO. A Prevention of Significant Deterioration (PSD) review is required for all major stationary sources except those exempted. A major stationary source or major modification may be exempted from any pre-construction monitoring because they emit a pollutant at a rate lower than a specified threshold. These thresholds or "de minimis" rates are shown in column 11 of Table 2-16.

The PSD program limits the amount of additional pollution that is allowed in areas where NAAQS are met. Areas where NAAQS are met are called "attainment" areas for that pollutant. The State of Hawaii is an attainment area for all pollutants with an NAAQS. Allowable increases in pollutant concentrations are limited according to impact area. Impact areas are designated as class I, II, or II, with class I areas being the most restrictive. In Hawaii, class I area are Volcanoes National Park and Haleakala National Park. All other areas are designated class II. Ambient air quality increments are shown in columns eight, nine, and ten of Table 2-16.

2.6.2 NEW REQUIREMENTS PURSUANT TO THE CLEAN AIR ACT

The 1990 Amendments to the Clean Air Act added several provisions that has resulted in additional requirements. HAR Chapter 11-60.1 became effective November 26, 1993. The major addition is the identification of 189 hazardous air pollutants to be regulated under NESHAPs. These chemicals will be regulated in terms of emission limitations, control technology, and prevention of accidental releases. Also, permit applicants will be required to submit a compliance plan with the permit application. These additional requirements are discussed in the subsections that follow.

National Emissions Standards for Hazardous Air Pollutants

The Clean Air Act Amendments of 1990 established a list of 189 HAPs. The EPA has identified 174 types of industrial sources of these HAPs and grouped the sources into 17 categories. EPA must regulate major stationary sources according to a 10-year schedule. Regulation includes the establishment of emission standards for routine releases and provisions for the prevention of accidental releases.

Emission standards will initially be based on maximum achievable control technology (MACT) for major sources and generally available control technology (GACT) for other sources. MACT is the average emission limitation achieved by the best performing 12 percent of the existing sources (by the best five if less than 30 sources exist). The EPA is required to promulgate standards applicable to POTWs no later than November 1995. Establishment of control standards for sewage sludge incineration is scheduled for November 1997.

By November 15, 1996, EPA must determine the risk to public health remaining after application of MACT. More stringent standards may be promulgated if required in order to provide an ample margin of safety to protect public health.

Compliance dates of up to three years may be established for existing sources. Moreover, a facility may be issued a permit that grants an extension allowing an existing source up to one additional year to comply with standards if the time is needed for the installation of controls. In addition, an existing source can be issued a permit to meet alternative emissions limitations if early reduction is demonstrated. Early reduction is a reduction of 90 percent or more in emissions of HAPs (95 percent in the case of HAPs which are particulates).

The Clean Air Act Amendments of 1990 also include requirements to develop regulations and programs to prevent accidental releases and to minimize the consequences of accidental releases of acutely toxic air pollutants. The EPA is required to promulgate an initial list of 100 substances and their threshold quantities which may reasonably be anticipated to cause death, injury, or serious adverse effects to public or the environment. The EPA is also required to promulgate regulations and guidance to provide for the prevention and detection of accidental releases and for response to such releases. Release prevention, detection, and correction requirements may include monitoring, record-keeping, reporting, training, vapor recovery, secondary containment, and other design, equipment, work practice, and operational requirements. Risk management plans including hazard assessment, safety precautions, and response programs will need to be prepared and implemented by owners and operators of stationary sources at which a regulated substance is present in more than a threshold quantity.

Compliance Plan

The Clean Air Act Amendments of 1990 stipulate that the permitting requirements must include submittal of a Compliance Plan. The Compliance Plan must describe how the source will comply with all applicable requirements under the Clean Air Act. It must include a schedule of compliance and a schedule for submitting progress reports at least every six months. In addition, the permittee will be required to certify (at least annually) that the facility is in compliance with any applicable requirements of the permit, and to promptly report any deviations from the permit requirements to the permitting authority.

2.6.3 CLEAN WATER ACT – DISPOSAL OF SEWAGE SLUDGE BY INCINERATION

Pursuant to the Clean Water Act, the EPA has developed regulations on Standards for the Use or Disposal of Sewage Sludge (40 CFR 503). Subpart E of these rules apply to incineration of sewage sludge. The federal rule is discussed below. Rules for the State of Hawaii are being developed by the DOH.

The federal rule limits the concentrations of certain chemicals in sludge fed to the incinerator. These chemicals are lead, arsenic, cadmium, chromium, and nickel as indicated in column 12 of Table 2-16. In addition, the federal rule limits the total hydrocarbons in the exit gas from the incinerator. The methods for calculating the allowable limits are specified as functions of the sewage sludge feed rate and various air quality parameters, including NAAQS, dispersion factors, incinerator control efficiencies, and risk specific concentrations.

2.6.4 SUMMARY OF APPLICABILITY TO SAND ISLAND WWTP

Under existing clean air rules, any stationary source such as the existing sludge incinerator must obtain an ATC prior to modification or relocation. Subsequently, a PTO is required for ongoing operations.

Permitting requirements include compliance with the NSPS for sewage treatment plants, the NESHAPs for mercury, and a PSD review with possible exemptions depending on the anticipated emission rates.

New regulation under the Clean Air Act covers additional HAP chemicals potentially present in sewage sludge and require more stringent control technology. A Compliance Plan will be required to be submitted as part of the permit application.

In addition to Clean Air Act requirements, chemical concentrations in sewage sludge to be incinerated are limited under the Clean Water Act as prescribed in 40 CFR 503.

2.7 OVERVIEW OF LAND-USE PLANS, POLICIES, AND CONTROLS

The following sections review the various levels of land-use regulations which affect the project including federal, state, and local government. The relationship of the proposed project to the policy, plan, and control levels of the regulations may be characterized as supportive and implementation oriented. The development, operation, and maintenance of the East Mamala Bay wastewater collection, treatment, and disposal system fulfills the intent of the State and the City and County of Honolulu to ensure the health and welfare of the general public.

2.8 FEDERAL LAND-USE PLANS AND CONTROLS

Direct federal involvement in local land-use plans and controls is limited to three areas: environmental controls, ownership, and data collection. Federal environmental controls have been discussed above in Sections 2.2 through 2.6. Federal land ownership pertains to the occupation of land by the United States government. Data collection involves the activities of the United States Census Bureau and the use of its data by State and County agencies.

2.8.1 LAND OWNERSHIP

Within the study area, the United States government owns several properties including the Aliamanu Military Reservation near Salt Lake, Tripler Army Hospital above Moanalua Valley, Fort Shafter just west of the Likelike Highway, the Federal Building at the corner of South Street and Ala Moana Boulevard, the Coast Guard Reservation on Sand Island, the Coast Guard Marine Safety office at Pier 4 of Honolulu Harbor, Fort DeRussy in Waikiki, Fort Ruger on the inland slope of Diamond Head, and the Federal Aviation Facility in Diamond Head Crater.

Land uses and densities for individual government properties are not subject to City and County land-use controls, although the U.S. government can choose voluntary compliance. All the government properties identified above are linked directly to the City's sewage collection system, with the exception of Fort Shafter, which has its own wastewater pump station, and is linked to the Sand Island WWTP by a separate force main.

2.8.2 DATA COLLECTION

The United States Census Bureau utilizes Census Enumeration Districts as a way of mapping population areas for statistical analysis. Census Tracts are subdivisions of Enumeration Districts. Each Census Tract is composed of a number of Census Blocks which vary in actual size from one to several city blocks. Every ten years, the Census Bureau conducts a nationwide survey to determine population growth and distribution, as well as to identify socioeconomic trends. The reporting of the Bureau's findings in the form of regular census reports provides volumes of useful information for planning purposes. Although the City and County of Honolulu does not utilize the Census Bureau's geographic areas as the basis for establishing land-use policy or controls, census data generated by the Federal Government is useful in identifying population trends and changes.

2.9 STATE LAND-USE POLICIES, PLANS, AND CONTROLS

The participation of the State in the land-use planning process occurs at three distinct levels. The entire land-use designation system is derived from the State's land-use law (Chapter 205, Hawaii Revised Statutes) and Section 15-15, Hawaii Administrative Rules. In addition, the administration of State agencies, the allocation of State resources, and the implementation of State policies is coordinated through the Hawaii State Plan Chapter 226, HRS and Functional Plans. Finally, many environmental protection programs mandated by the Federal Government are implemented at the State level.

2.9.1 STATE LAND-USE LAW

The State Land-Use Law, enacted in 1961, resulted in the classification of all lands statewide into four categories; Urban, Conservation, Agriculture, and Rural. Only two of the four classifications are found in the study area: Urban and Conservation. Conservation lands include all forest reserves, all unimproved ridges, Diamond Head Crater, Punchbowl Crater, and Salt Lake Crater. In addition, all property extending seaward of the upper reach of the wave wash or vegetation line, including submerged lands, to the limit of the State's police powers and management authority is classified as Conservation. The remaining portion of the study area is classified as Urban.

2.9.2 HAWAII STATE PLAN

The purpose of the Hawaii State Plan is to provide "a guide for the future long-range development of the State; identify the goals, objectives, policies, and priorities for the State; provide a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources; improve coordination of State and county plans, policies, programs, projects, and regulatory activities; and to establish a system for plan formulation and program coordination to provide for an integration of all major State and county activities."

Following is a presentation of the sections of the State Plan and Priority Guidelines that are directly applicable to facilities planning for the East Mamala Bay project. It should be noted that the numbering of the following sections, subsections, subparagraphs, goals, and objectives corresponds to the formatting of the State Plan and is preserved to facilitate efficient evaluation for policy-oriented reviewers of this EIS.

Part I. Goals, Objectives, and Policies

SEC. 226-4 State goals: In order to guarantee, for present and future generations, those elements of choice and mobility that insure that individuals and groups may approach their desired levels of self reliance and self determination, it shall be the goals of the State to achieve:

(1) A strong, viable economy, characterized by stability, diversity, and growth, that enables the fulfillment of the needs and expectations of Hawaii's present and future generations.

(2) A desired physical environment, characterized by beauty, cleanliness, quiet, stable natural systems, and uniqueness, that enhances the mental and physical well-being of the people.

(3) Physical, social, economic well-being, for individuals and families in Hawaii, that nourishes a sense of community responsibility, of caring, and of participation in community life.

SEC. 226-6 Objectives and policies for the economy—in general.

(a) Planning for the State's economy in general shall be directed toward achievement of the following objectives:

(1) Increased and diversified employment opportunities to achieve full employment, increased income and job choice, and improved living standards for Hawaii's people.

(b) To achieve the general economic objectives, it shall be the policy of this State to:

(14) Promote and protect intangible resources in Hawaii, such as scenic beauty and the aloha spirit, which are vital to a healthy economy.

SEC. 226-11 Objectives and policies for the physical environment—land-based, shoreline, and marine resources.

(a) Planning for the State's physical environment with regard to land-based, shoreline, and marine resources shall be directed towards achievement of the following objectives:

(1) Prudent use of Hawaii's land-based, shoreline, and marine resources.

(2) Effective protection of Hawaii's unique and fragile environmental resources.

(b) To achieve the land-based, shoreline, and marine resources objectives, it shall be the policy of this State to:

(1) Exercise an overall conservation ethic in the use of Hawaii's natural resources.

(2) Ensure compatibility between land-based and water-based activities and natural resources and ecological systems.

(3) Take into account the physical attributes of areas when planning and designing activities and facilities.

(4) Manage natural resources and environs to encourage their beneficial and multiple use without generating costly or irreparable environmental damage.

(6) Encourage the protection of rare or endangered plant and animal species and habitats native to Hawaii.

(8) Pursue compatible relationships among activities, facilities, and natural resources.

SEC. 226-13 Objectives and policies for the physical environment—land, air, and water quality.

(a) Planning for the State's physical environment with regard to land, air, and water quality shall be directed towards achievement of the following objectives:

(1) Maintenance and pursuit of improved quality in Hawaii's land, air, and water resources.

(2) Greater public awareness and appreciation of Hawaii's environmental resources.

(b) To achieve the land, air, and water quality objectives, it shall be the policy of this State to:

(2) Promote the proper management of Hawaii's land and water resources.

(3) Promote effective measures to achieve desired quality in Hawaii's surface, ground, and coastal waters.

(4) Encourage actions to maintain or improve aural and air quality levels, to enhance the health and well-being of Hawaii's people.

(6) Encourage design and construction practices that enhance the physical qualities of Hawaii's communities.

SEC. 226-14 Objective and policies for facility systems—in general.

(a) Planning for the State's facility systems in general shall be directed towards achievement of the objective of water, transportation, waste disposal, and energy and telecommunication systems that support statewide social, economic, and physical objectives.

(1) Accommodate the needs of Hawaii's people through coordination of facility systems and capital improvement priorities in consonance with State and county plans.

(2) Encourage flexibility in the design and development of facility systems to promote prudent use of resources and accommodate changing public demands and priorities.

(3) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.

(4) Pursue alternative methods of financing programs and projects and cost-saving techniques in the planning, construction, and maintenance of facility systems.

SEC. 226-15 Objectives and policies for facility systems—solid and liquid wastes.

(a) Planning for the State's facility systems with regard to solid and liquid wastes shall be directed towards the achievement of the following objectives:

(1) Maintenance of basic public health and sanitation standards relating to treatment and disposal of solid and liquid wastes.

(2) Provision of adequate sewerage facilities for physical and economic activities that alleviate problems in housing, employment, mobility and other areas.

(b) To achieve solid and liquid waste objectives, it shall be the policy of this State to:

(1) Encourage the adequate development of sewerage facilities that complement planned growth.

(2) Promote re-use and recycling to reduce solid and liquid wastes and employ a conservation ethic.

(3) Promote research to develop more efficient and economical treatment and disposal of solid and liquid wastes.

SEC.226-18 Objectives and policies for facility systems—energy & telecommunications.

(a) Planning for the State's facility systems with regard to energy/telecommunication shall be directed towards the achievement of the following objectives:

(1) Dependable, efficient, and economical statewide energy and telecommunication systems capable of supporting the needs of the people.

(2) Increased energy self-sufficiency.

(b) To achieve the energy/telecommunication objectives, it shall be the policy of this State to ensure the provision of adequate, reasonably priced, and dependable power and telecommunication services to accommodate demand.

(c) To further achieve the energy objectives, it shall be the policy of this State to:

(3) Promote prudent use of power and fuel supplies through conservation measures including education and energy efficient practices and technologies.

SEC. 226-20 Objectives and policies for socio-cultural advancement—health.

(a) Planning for the State's socio-cultural advancement with regard to health shall be directed towards achievement of the following objectives:

(1) Fulfillment of basic individual health needs of the general public.

(2) Maintenance of sanitary and environmentally healthful conditions in Hawaii's communities.

(b) To achieve the health objectives, it shall be the policy of this State:

(5) Provide programs, services, and activities that ensure environmentally healthful and sanitary conditions.

Part III. Priority Guidelines

SEC. 226-101 Purpose. The purpose of this part is to establish overall priority guidelines to address areas of statewide concern.

SEC. 226-102 Overall direction. The State shall strive to improve the quality of life for Hawaii's present and future population through the pursuit of desirable courses of action in five major areas of statewide concern which merit priority attention: economic development, population growth and land resource management, affordable housing, crime and criminal justice, and quality education.

SEC. 226-103 Economic priority guidelines.

(a) Priority guidelines to stimulate economic growth and encourage business expansion and development to provide needed jobs for Hawaii's people and achieve a stable and diversified economy:

(b) Priority guidelines to promote the economic health and quality of the visitor industry:

(1) Promote visitor satisfaction by fostering an environment which enhances the Aloha Spirit and minimizes inconveniences to Hawaii's residents and visitors.

(3) Support appropriate capital improvements to enhance the quality of existing resort destination areas and provide incentives to encourage investment in upgrading, repair, and maintenance of visitor facilities.

SEC. 226-104 Population growth and land resources priority guidelines.

(a) Priority guidelines to effect desired statewide growth and distribution:

(1) Encourage planning and resource management to insure that population growth rates throughout the State are consistent with available and planned resource capacities and reflect the needs and desires of Hawaii's people.

(3) Ensure that adequate support services and facilities are provided to accommodate the desired distribution of future growth throughout the State.

(b) Priority guidelines for regional growth distribution and land resource utilization:

(1) Encourage urban growth primarily to existing urban areas where adequate public facilities are already available or can be provided with reasonable public expenditures and away from areas where other important benefits are present, such as protection of important agricultural land or preservation of lifestyles.

(8) Support the redevelopment of Kakaako into a viable residential, industrial, and commercial community.

(10) Identify critical environmental areas in Hawaii to include but not be limited to the following: watershed and recharge areas; wildlife habitats (on land and in the ocean); areas with endangered species of plants and wildlife; natural streams and water bodies; scenic and recreational shoreline resources; open space and natural areas; historic and cultural sites; areas particularly sensitive to reduction in water and air quality; and scenic resources.

(12) Utilize Hawaii's limited land resources wisely, providing adequate land to accommodate projected population and economic growth needs while ensuring the protection of the environment and the availability of the shoreline, conservation lands, and other limited resources for future generations.

(13) Protect and enhance Hawaii's shoreline, open spaces, and scenic resources.

2.9.3 STATE FUNCTIONAL PLANS

As set forth in Section 2 of the Hawaii State Plan, functional plans shall include "the policies, programs and projects designed to implement the objectives of a specific field of activity when such activity or program is proposed, administered, or funded by any agency of the State." The twelve functional plans were examined to determine the relationship of the proposed project to each of their administrative areas of responsibility. Following is a summary of those plans that are relevant to the proposed project, and the particular sections within the functional plans that are relevant to the project.

State Agricultural Functional Plan (1991)

Because the proposed project does not utilize or impact any agricultural land of importance within the study area, the objectives, policies and implementing actions of the Agricultural Functional Plan are not relevant to the proposed project.

State Conservation Functional Plan (1991)

The relationship of the East Mamala Bay project to this functional plan is limited to its impacts upon the area seaward of the high water mark along the shoreline and to submerged lands. Thus, there are several objectives and policies in the State Conservation Functional Plan which pertain to the proposed project. These are identified below.

Objective IIB: Protection of fragile or rare natural resources.

Objective IIC: Enhancement of natural resources.

Policy IIC(2): Expand and enhance outdoor recreation opportunities and other resource uses.

State Educational Functional Plan (1989)

The State Education Functional Plan reflects the Department of Education's strategies to address the goals, policies and priority guidelines of the Hawaii State Plan and the goals of the State Board of Education. The specific objectives and policies of the functional plan are not directly applicable to the East Mamala Bay project.

State Higher Educational Functional Plan (1989)

There are no objectives, policies or implementing actions in this functional plan that are directly applicable to the proposed project.

State Employment Functional Plan (1989)

The State Employment Function Plan contains objectives, policies and implementing actions directed in four major areas: (1) Improve the Qualifications of Entry-Level Workers and Their Transition to Employment; (2) Develop and Deliver Education, Training and Related Services to Ensure and Maintain a Quality and Competitive Workforce, and Improve Labor Exchange; (3) Improve the Quality of Life for Workers and Families; and (4) Improve Planning of Economic Development, Employment and Training Activities. The East Mamala Bay project will provide new employment opportunities in the construction trades to the existing and future residents of Oahu which will, in turn, have a direct impact upon improving the quality of life for workers and families. The timely implementation of the Preferred Alternative will also result in a positive contribution to economic development in the study area by ensuring the availability and adequacy of the wastewater infrastructure.

State Energy Functional Plan (1991)

The State Energy Functional Plan's objective to promote energy efficiency through land use and support facility systems planning relates directly to the overall master planning of the East Mamala Bay project as well as its implementation. The use of diesel motors as back-ups for electrical supply during emergencies does not directly support the goal to reduce Hawaii's dependence upon fossil fuels. However, the lack of a suitable non-fossil-fuel alternative and the need to ensure the availability of emergency back-up energy, requires the use of the diesel motors.

State Health Functional Plan (1989)

The State Health Functional Plan includes objectives and policies that relate directly to the proposed improvements.

Objective: To prevent degradation and enhance the quality of Hawaii's air, land and water.

Policy: (A1) Prevent and control the pollution of air, water and land through long-range planning, environmental impact assessments, interagency coordination, programs, regulations, and financial assistance to local governments.

Objective: Minimize the threat to public health from unsanitary conditions by ensuring that facilities are built and maintained so that products and services are provided in a healthful manner.

State Historic Preservation Functional Plan (1991)

Objectives, policies and implementing actions in the Historic Preservation Functional Plan are intended for implementation by the Department of Land and Natural Resources and affiliated State agencies.

Individual sites within the project area have been evaluated for their potential archaeological and cultural resource value. In view of the project's location within historic portions of Honolulu, the East Mamala Bay project is particularly sensitive to full compliance with all regulations and policies pertaining to Historic Preservation.

State Housing Functional Plan (1989)

Because the project contains no proposed housing development, the objectives and policies of the State Housing Functional Plan are not directly applicable to the proposed development.

State Human Services Functional Plan (1989)

Objectives and polices of the Human Services Functional Plan are directed specifically to administration and implementation by State agencies including the Department of Human Services, the Department of Health, the Department of Education, the Department of Labor and Industrial Relations, and the State Office of Children and Youth and Executive Office on Aging. The functional plan does not relate directly to the East Mamala Bay project.

State Recreation Functional Plan (1991)

A number of objectives and policies of the Recreation Functional Plan are applicable to the proposed project. These are presented below.

Objective IV-A:	Promote a conservation ethic in the use of Hawaii's recreational resources.
Objective IV-B:	Prevent degradation of the marine environment.
Policy B-1:	Enhance water quality to provide high-quality ocean recreation opportunities.
Policy B-2:	Protect, preserve, restore, and enhance recreational fishery resources.
Policy B-3:	Protect surfing sites.

State Tourism Functional Plan (1991)

The following objectives of the Tourism Functional Plan directly relate to the proposed development.

Objective: Development, implementation and maintenance of policies and actions which support the steady and balanced growth of the visitor industry.

Objective: Development and maintenance of well-designed visitor facilities and related developments which are sensitive to the environment, sensitive to neighboring communities and activities, and adequately serviced by infrastructure and support services.

State Transportation Functional Plan (1991)

The objectives and policies of the Transportation Functional Plan relate primarily to the administration and implementation of transportation policy by the State Department of Transportation. For this reason, the functional plan does not directly relate to the proposed project. Nonetheless, specific mitigation measures have been proposed to improve traffic circulation in areas impacted by short-term construction projects related to the East Mamala Bay project.

State Water Resources Development Functional Plan (1989)

Objectives and policies of the Water Resources Development Functional Plan are directed primarily to State and County agencies responsible for the management of water resources and are not directly applicable to the proposed project. Although the East Mamala Bay project has the potential of impacting potable water resources, it does not involve the development of potable water sources.

2.9.4 COASTAL ZONE MANAGEMENT (CZM)

The federal CZM program is administered in Hawaii by the Office of State Planning. However, the CZM guidelines and objectives are not directly applicable unless a project involves federal lands and/or federal agencies. Because the proposed project does not involve the Federal Government, it does not require a coastal zone management federal consistency review. While nationally inventoried wetlands are contained within the project area, specifically at Salt Lake crater, they are privately owned and are to be preserved in their current state.

2.9.5 STATE WATER CODE

The State Water Code (Hawaii Revised Statutes, Chapter 174C) applies to all waters of the State, except coastal waters. The code recognizes that the waters of the state are held for the benefit of the citizens of the State, and declares that the people of the State are beneficiaries and have a right to have the waters protected for their use. The code is administered by the Commission on Water Resource Management (CWRM). The administrative rules of the State Water Code are in HAR Title 13, Subtitle 7, Chapters 13-167 through 13-171.

The provisions of the code that are applicable to the proposed activities for improvements to the East Mamala Bay wastewater system relate to the alteration of stream channels.

HAR 13-169-50 states that stream channels shall be protected from alteration whenever practicable to provide for fishery, wildlife, recreational, aesthetic, scenic, and other beneficial instream uses. No stream channel shall be altered until an application for a permit to undertake the work has been filed and a permit is issued by the commission. (Routine streambed and drainageway maintenance activities and maintenance of existing facilities are exempt from obtaining a permit.)

2.10 CITY AND COUNTY OF HONOLULU LAND-USE PLANS, POLICIES AND CONTROLS

The City and County of Honolulu has jurisdiction over properties in two general areas. The first is the realm of land-use policy; the City's long-term goals and objectives that are established by a General Plan, and implemented via a series of Development Plans and zoning regulations, and various special district controls. The second realm pertains to the actual identification of properties for taxation and analytical purposes. Following is a discussion of the major jurisdictional controls which impact the study area.

2.10.1 GENERAL PLAN

The General Plan establishes the City and County of Honolulu's long-term objectives and policies represents its commitment to a desirable and attainable future of the Island of Oahu. Objectives and policies that are relevant to the study are identified below.

Objectives and Policies for Population

Objective B: To plan for future population growth.

Policy 1: Allocate efficiently the money and resources of the City and County in order to meet the needs of Oahu's anticipated future population.

Policy 2: Provide adequate support facilities to accommodate future growth in the number of visitors to Oahu.

Objective C: To establish a pattern of population distribution that will allow the people of Oahu to live and work in harmony.

Policy 1: Facilitate the full development of the primary urban center.

Objectives and Policies for the Natural Environment

Objective A: To protect and preserve the natural environment.

Policy 3: Retain the Island's streams as scenic, aquatic, and recreational resources.

Policy 7: Protect the natural environment from damaging levels of air, water, and noise pollution.

Objective B: To preserve and enhance the natural monuments and scenic views of Oahu for the benefit of both residents and visitors.

Policy 1: Protect the Island's well-known resources: its mountains and craters; forests and watershed areas; marshes, rivers, and streams; shoreline, fishponds, and bays; and reefs and offshore islands.

Policy 3: Locate roads, highways, and other public facilities and utilities in areas where they will least obstruct important views of the mountains and sea.

Objectives and Policies for Transportation and Utilities

Objective B: To meet the needs of the people of Oahu for an adequate supply of water and for environmentally sound systems of waste removal.

Policy 5: Provide safe, efficient, and environmentally sensitive waste collection and waste disposal services.

Policy 7: Require the safe disposal of hazardous waste.

In addition to these policies, the General Plan also establishes a long-term goal for population allocation among the various areas of Oahu. Population allocations are assigned in terms of percentages. A range of population growth is established for each Development Plan area. The General Plan identifies the Primary Urban Center (PUC) as the major growth area for Oahu, and the Ewa area as a Secondary Urban Center.

2.10.2 DEVELOPMENT PLANS

The Island of Oahu is divided into eight Development Plan (DP) areas. The project area consists of portions of two DP areas—the Primary Urban Center and East Honolulu. The Development Plans are intended to provide a system of land-use controls designed to implement the objectives and policies of the General Plan and to guide more specific zoning and density regulations. Each DP consists of two principal sections: the Common Provisions which are common to all eight of Oahu's DPs, and the Special Provisions which vary with each DP area.

Pursuant to Chapter 226, Hawaii Revised Statutes, each County within the State of Hawaii is mandated to implement the Hawaii State Plan through the adoption and implementation of a County General Plan. In the instance of the City and County of Honolulu, the DPs have been established as a policy "bridge" between the county's General Plan and its zoning powers. The DPs are relatively detailed guidelines for the physical development of the island of Oahu. They serve as intermediate means of implementing the objectives and policies of the General Plan.

Section 32-1.8(2)(A) of the Development Plans' Common Provisions defines wastewater collection and disposal systems as consisting of "treatment facilities, ocean outfalls, force mains, interceptors, trunk sewers, and pump stations..." "Adequate screening and/or a buffer zone of compatible uses shall be provided around wastewater treatment facilities," is also specified.

Each DP also includes two official maps — a Land Use map and a Public Facilities map. The Land Use map presents land-use classifications for both existing built-up areas, as well as projected development areas, and public and quasi-public facilities. The inclusion of projected development areas on the Land Use map provides the mechanism by which the DP is able to allocate land uses and population densities recommended in the General Plan. The Public Facilities Map presents existing public and quasi-public facilities, as well as planned facilities, depicted by development phase. A portion of the DP Land Use Map for the PUC is presented as *Figure 2-3*.

The approximate location of all major planned public facilities is shown on the development plan public facilities map. Major facilities generally include those which: (1) significantly increase system capacity; (2) expand service areas; (3) change the function of an existing facility; (4) involve replacement of or renovations to existing facilities which would permit significant new development or redevelopment; (5) have a significant impact on surrounding land uses; or (6) cost over $1,000,000.00 for capital improvements. The elements of the wastewater system which are shown on the public facilities map are treatment facilities, ocean outfalls, force mains, interceptors, trunk sewers, and pump stations. Collection sewers which provide service to individual properties are not shown on the public facilities map.

The DP land use and public facilities maps for the Primary Urban Center and East Honolulu DP areas will need to be amended to include the new wastewater system elements proposed in this Facilities Plan. The specific locations are discussed in Chapter 8.

2.10.3 WAIKIKI MASTER PLAN

The Waikiki Master Plan was published in May 1992 and is intended to guide the physical development of Waikiki during the next 20 years. Its purpose is to enhance the district's unique qualities, address its problems, and assure its viability as a world-class visitor destination and residential community. The Waikiki Master Plan is the culmination of a two-year consensus-building effort led by the City's Planning Department (formerly the Department of General Planning). It embraces previous efforts, further investigating those along with new concepts and proposals. The following summarizes the recommendations and proposals in the *Waikiki Master Plan* (Department of General Planning, City and County of Honolulu, May 15, 1992). The Waikiki Master Plan study area is bounded by Kapahulu Avenue, Ala Wai Golf Course, Ala Wai Park, and Ala Wai Boulevard to the west of Ala Wai Park.

DOCUMENT CAPTURED AS RECEIVED

Legend:

- Residential
- Low Density Apartment
- Medium Density Apartment
- High Density Apartment
- Public and Quasi-Public
- Parks and Recreation
- Preservation
- State Land Use Boundary
- Military
- Commercial
- Industrial
- Resort
- Agricultural

AMENDMENTS

NO.	DATE	ORD NO.	CHANGE FROM	CHANGE TO	DISTRICT
10	11/17/83	83-65	Preservation	Residential	Manoa
13	12/07/84	Initiative (84-111)	H.D. Apt./ M.D. Apt.	Low Den. Apt.	Moiliili
14	05/29/85 Not Shown on Map	85-46	Numerous	Changes	PUC
18	03/27/85	85-13	Med. Den. Apt.	Commercial	Makiki
22	05/22/86	86-53	Numerous	Changes	PUC
25	12/30/86	86-147	Road	Residential	Manoa
29	03/12/87	87-22	Residential	Med. Den. Apt.	Punchbowl
31	12/17/87	87-119	Commercial	Pub. Facility	Punchbowl
37	03/09/90	90-87	Roadway	Commercial	McCully
41	07/29/91	90-05	Med. Den. Apt.	Commercial	McCully
43	03/14/91 Not Shown on Map	91-14	Various	M/U Designations	PUC
45	01/06/92	90-5	Low Den. Apt.	Park	Nuuanu
49	05/15/92	92-43	Roadway	High Den. Apt.	Punahou

2000 1000 0 2000

Scale in Feet

North

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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Figure 2-3
Development Plan
Land Use Map

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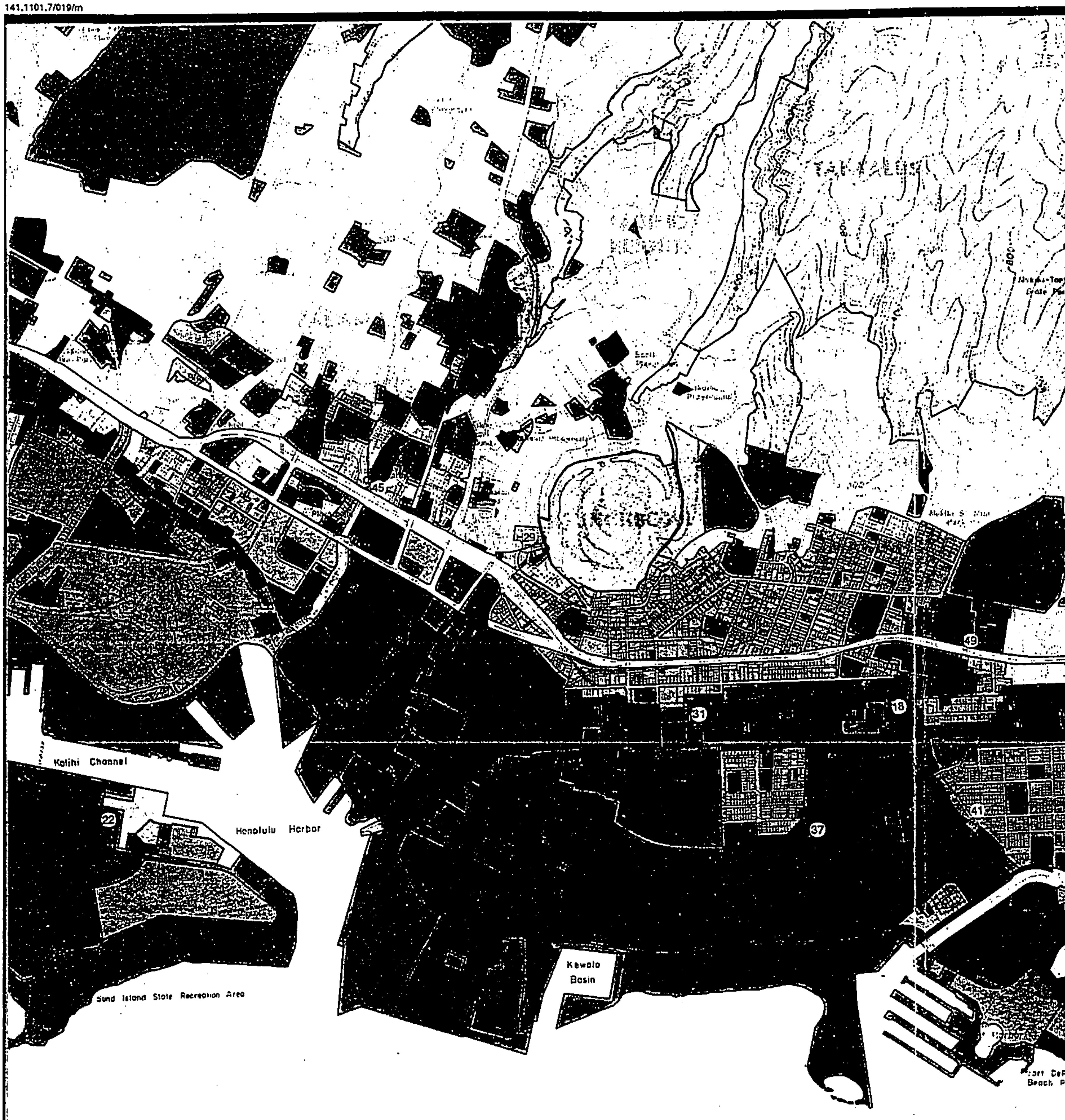

Sources: City and County of Honolulu Development Plans

Land Use Plans

Overall, the land use concept is to retain prevailing land use pattern with resort/mixed use, residential apartment use, and public spaces reserved for open space and recreational uses. The master plan recommends a few targeted changes to the land use plan in order to stimulate redevelopment and the provision of new plazas and open spaces.

Elements

The Waikiki Master Plan's proposed elements include:

- Major Open Spaces: Fort DeRussy Park, Ala Wai Park (Ewa and Diamond Head, combining the existing Ala Wai Park and Ala Wai Golf Course)
- Public Plazas and Parks: King Kalakaua Plaza (blocks bounded by Kuhio, Kalakaua, and Lewers), International Marketplace Plaza, Piinaio Park (at the entrance to Waikiki at the Ala Moana Bridge)
- Linear Open Space Networks (Waikiki Promenade): Waikiki Beachwalk, Ala Wai Yacht Harbor, Ala Moana Gateway, Ala Wai Canal - Ewa Section, Ala Wai Canal - Mauka Section, Kapahulu Avenue, Alanui Hele (connecting neighborhood parks)
- Neighborhood and District Parks: Residential Neighborhood Parks, Resort Mixed Use District Parks
- History Trail
- Streets as Open Space, Street Tree Planting, Sidewalks, Bus or People-Mover Stops
- Major Projects: Gateway, King Kalakaua, International Marketplace, Beachwalk/Lewers, Jefferson School
- Resort Mixed Use "Core" Districts
- Other Resort Mixed Use Precinct Districts
- Residential Neighborhoods

Summary

The area addressed in the Waikiki Master Plan is within the East Mamala Bay wastewater system service area. The planning and design efforts associated with the Waikiki Master Plan will need to be coordinated with the context of the Facilities Plan.

2.10.4 SPECIAL MANAGEMENT AREA

The State of Hawaii has identified the coastal regions of all the islands as Special Management Areas (SMA). The City and County of Honolulu is authorized to administer the permit process to regulate development within the SMA on Oahu. Following are the specific objectives and policies of Chapter 205A, Hawaii Revised Statutes that are relevant to the East Mamala Bay project.

Recreational Resources Objective:
Provide coastal recreational opportunities accessible to the public.

Scenic and Open Space Resources Objective:
Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

CORRECTION

THE PRECEDING DOCUMENT(S) HAS
BEEN REPHOTOGRAPHED TO ASSURE
LEGIBILITY
SEE FRAME(S)
IMMEDIATELY FOLLOWING

DOCUMENT CAPTURED AS RECEIVED

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Sources: City and County of Honolulu Development Plans

Land Use Plans

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Recreational Resources Objective:
Provide coastal recreational opportunities accessible to the public.

Scenic and Open Space Resources Objective:
Protect, preserve, and where desirable, restore or improve the quality of coastal scenic and open space resources.

Coastal Ecosystems Objective:
Protect valuable coastal ecosystems from disruption and minimize adverse impacts on coastal ecosystems.

Economic Uses Objective:
Provide public or private facilities and improvements important to the State's economy in suitable locations.

Managing Development Objective:
Improve the development review process, communication and public participation in the management of coastal resources and hazards.

As shown in Figures 2-4 and 2-5, the Sand Island WWTP, a number of East Mamala Bay wastewater pump stations, and a considerable amount of the collection system is located within the SMA, *makai* of the SMA line. Improvements to any of these various components will require an SMA permit from the Department of Land Utilization before construction can begin.

2.10.5 ZONING

Zoning of all land area on the island of Oahu is established by the 1990 Land Use Ordinance (LUO), as amended, and the various zoning maps adopted pursuant to it. The LUO establishes the following zoning districts: Agriculture, Country, Residential, Apartment, Apartment Mixed Use, Resort, Business, Business Mixed Use, Industrial, and Industrial/Commercial Mixed Use. There are no specific zoning districts for public facilities such as wastewater treatment plants or pump stations. Rather, the underlying zoning of the specific lot prevails. Furthermore, subsurface structures such as sewer lines and force mains are not subject to zoning restrictions. The LUO presents permitted uses and structures, development standards, and height controls for each zoning district.

The LUO also establishes six Special Design Districts that are situated within the East Mamala Bay study area. These include: the Hawaii Capitol District, the Diamond Head Special District, the Punchbowl Special District, the Chinatown Special District, the Thomas Square/Academy of Arts Special District, and the Waikiki Special District. The rules pertaining to each individual special district supersede the general zoning classifications applied elsewhere in the City and County, unless otherwise specified in the LUO.

Zoning classifications are parcel-specific, meaning that each parcel of property in the City and County of Honolulu has its own zoning classification. The City has attempted to eliminate situations where parcels are split-zoned, meaning they contain more than one zoning designations. Since zoning classifications are supposed to conform to and implement DP designations, DP designations have had to become parcel-specific so that a single parcel is not designated more than one DP classification. In instances where parcels were found to be zoned a greater density than their corresponding DP designation at the time the area's DP was originally adopted, those parcels were usually down-zoned to match the DP. In instances where properties are zoned at substantially less density than their DP designation, corrections are usually made only at such time that new development may be proposed on the parcel.

The parcel on which Sand Island WWTP is currently located (TMK 1-5-41:05) is zoned I-3, Waterfront Industrial District. Permitted uses and structures in the I-3 Waterfront Industrial District include public uses and structures. The development standards for the I-3 Waterfront Industrial District include minimum lot size and setbacks. Because the lot does not adjoin residential, apartment, apartment mixed use, or resort districts, yards are not required. The maximum Floor Area Ratio is 2.5. The maximum height for the I-3 district is 60 feet.

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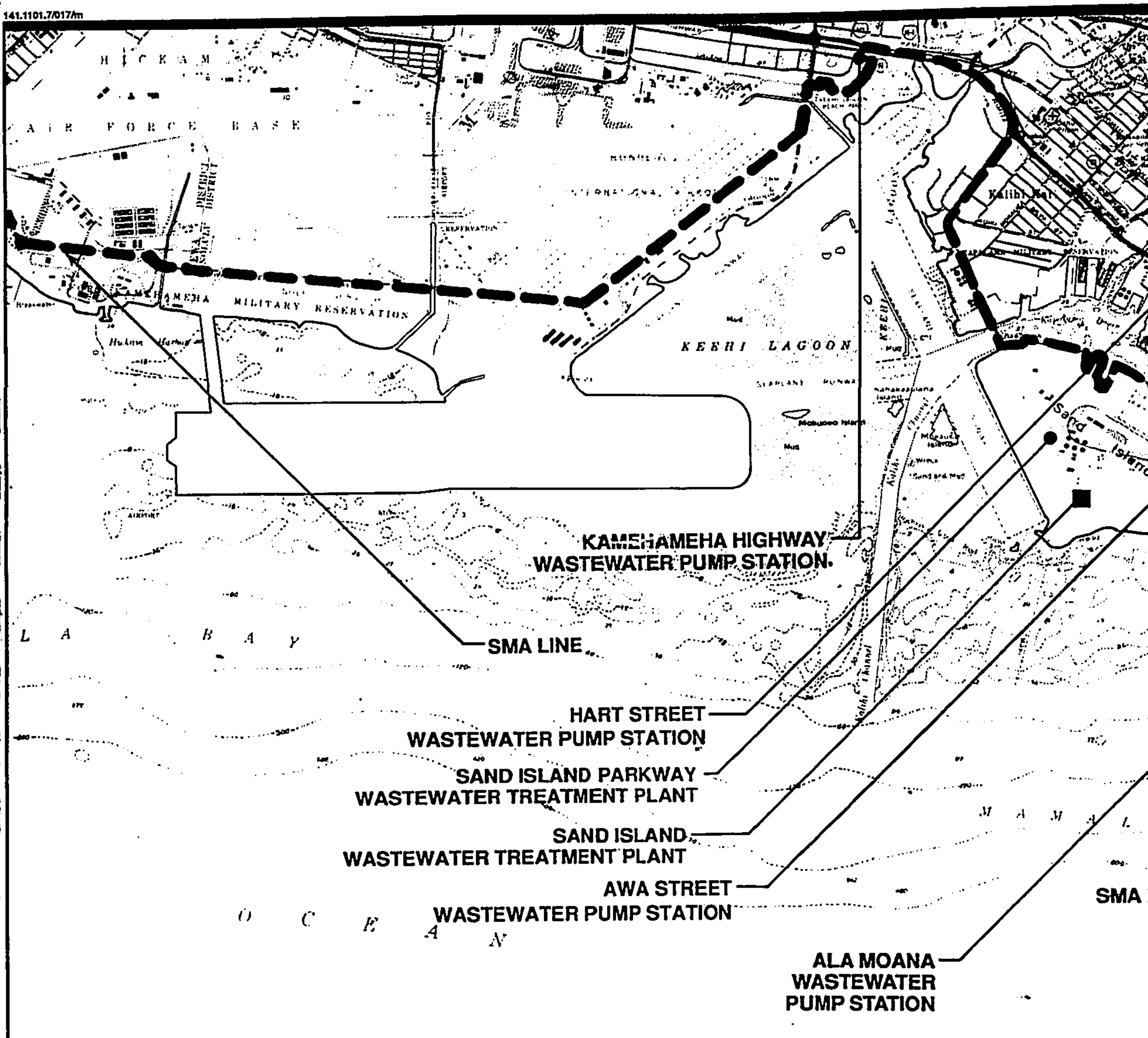

Note: The SMA area is located makai of the SMA line.

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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3000 1500 0 3000
Scale in Feet

North

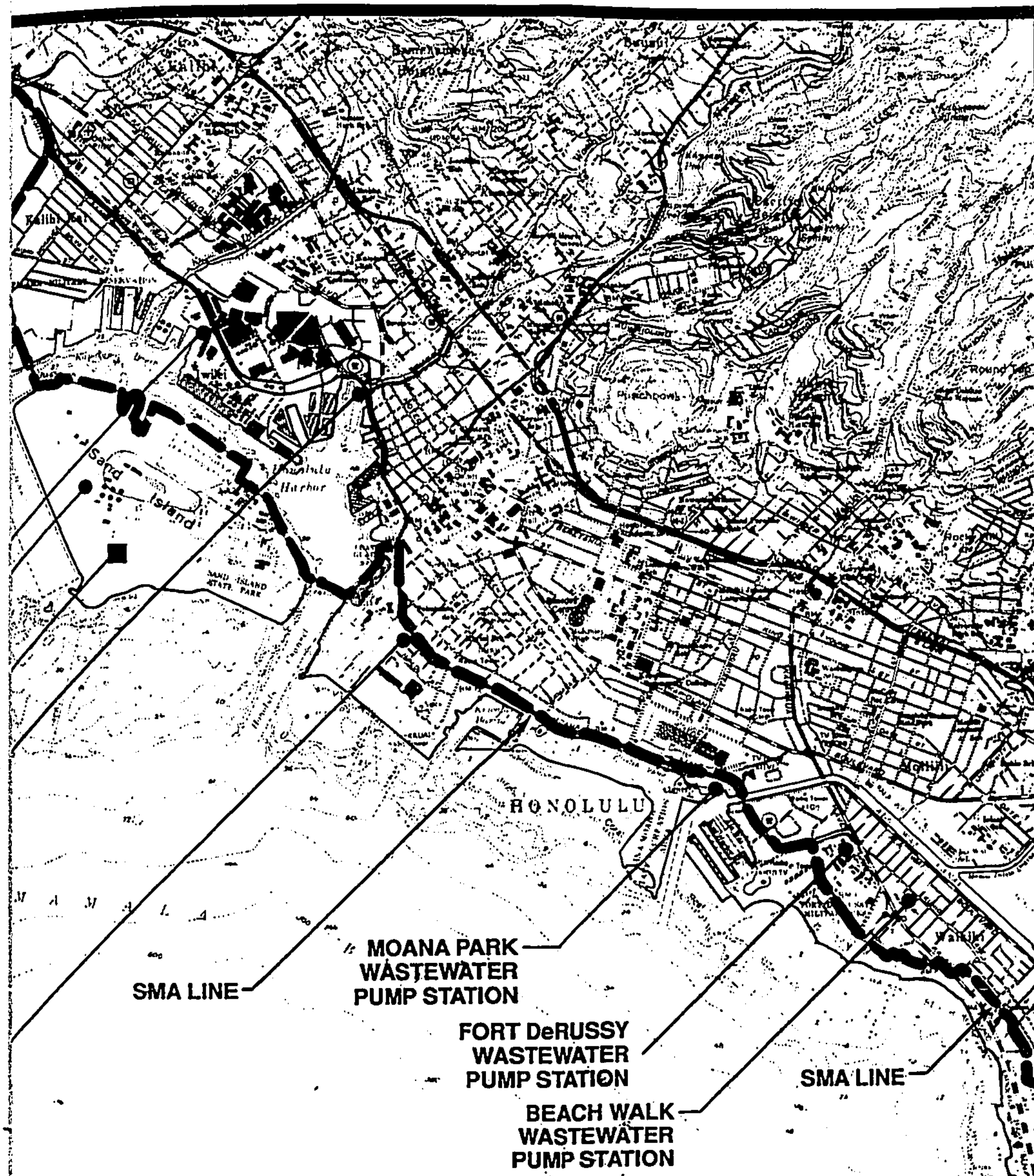
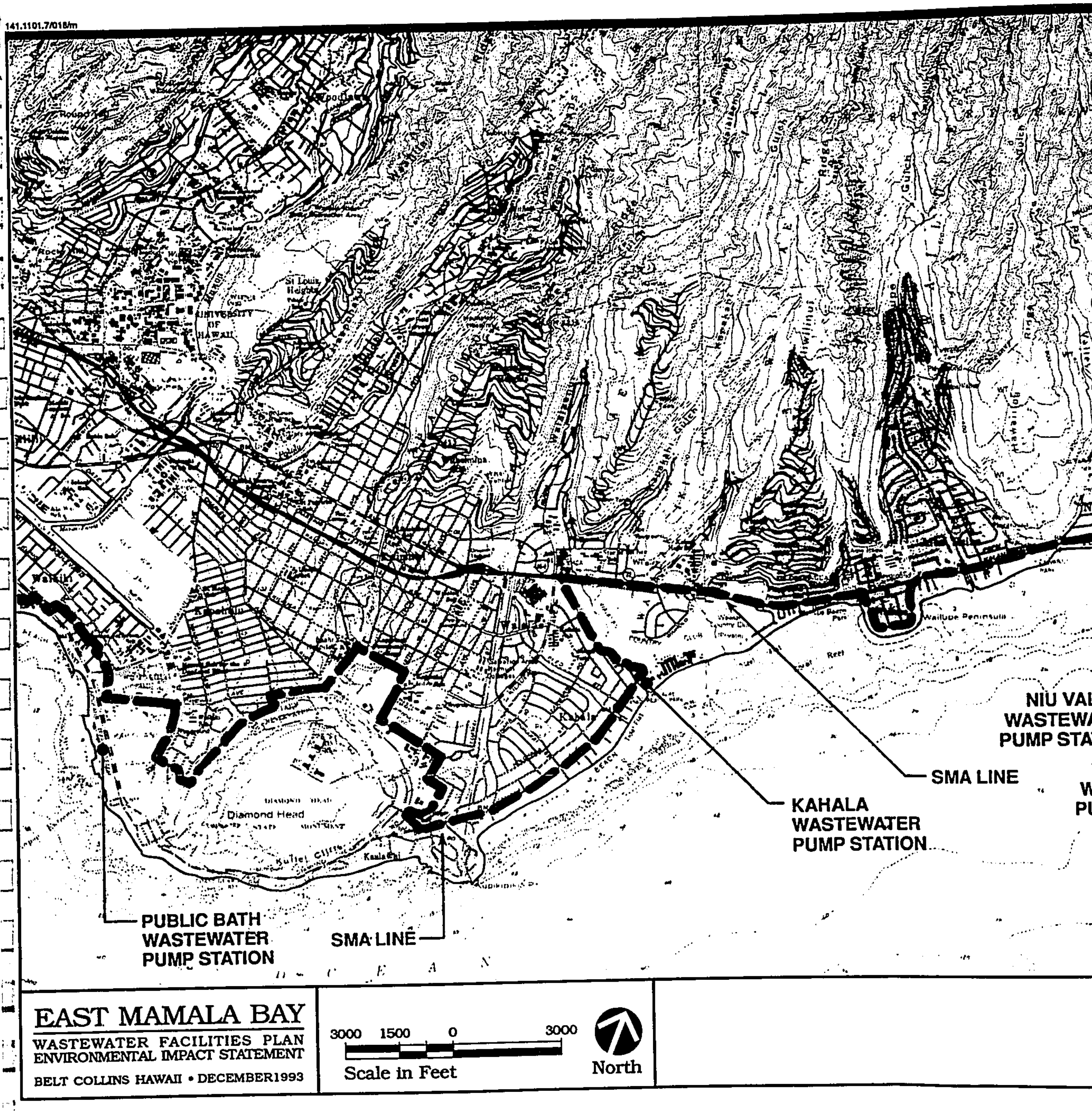


Figure 2-4

Location of Special Management Area (SMA)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University of Hawaii
St Louis Heights
Waikiki
Kahala
Diamond Head
Kuilei Cliffs
Wailupe Peninsula
NIU VAL
WASTEWA
PUMP STA
SMA LINE
KAHALA
WASTEWATER
PUMP STATION
PUBLIC BATH
WASTEWATER
PUMP STATION
SMA LINE
EAST MAMALA BAY
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Scale in Feet
North

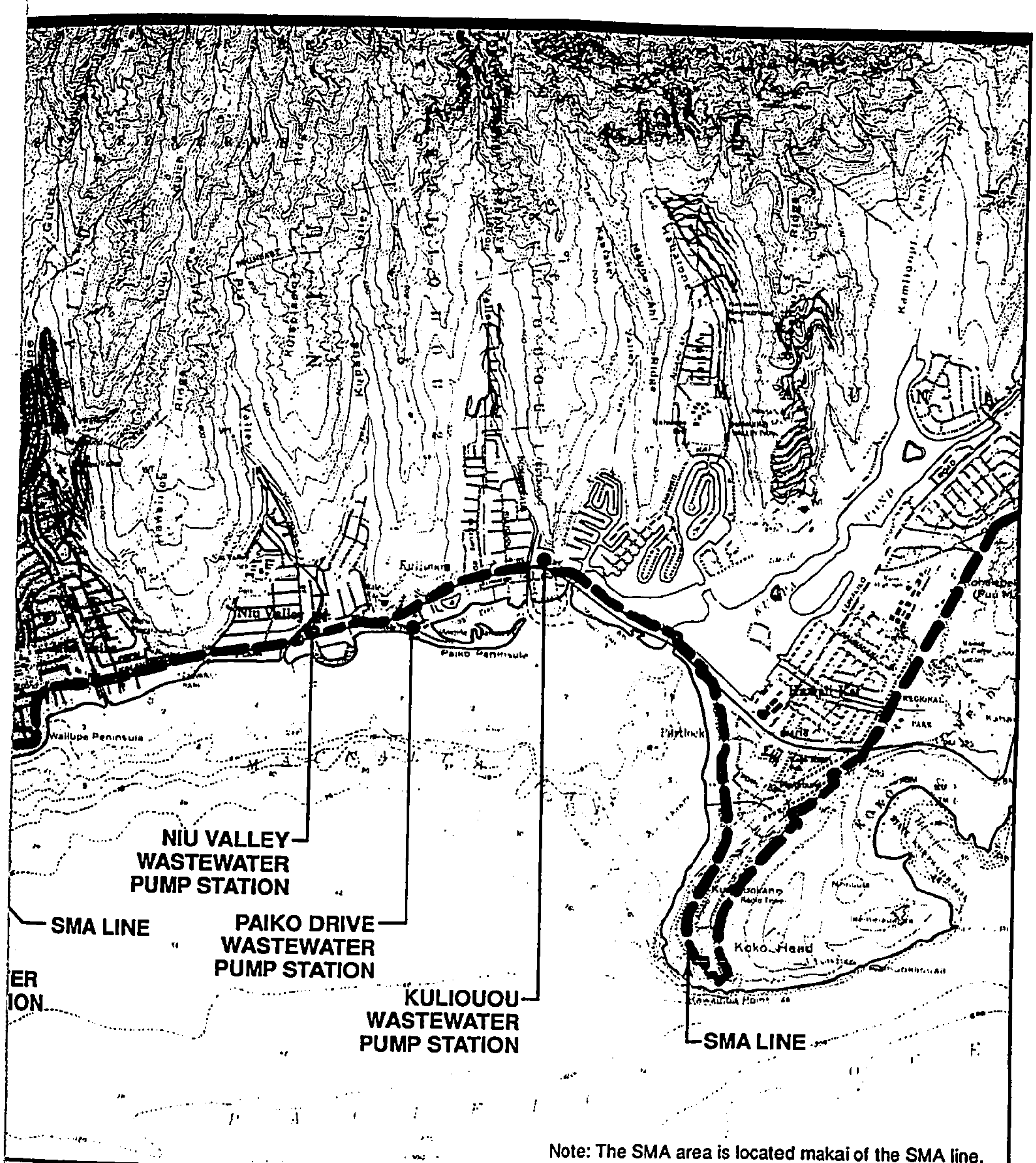

Figure 2-5
Location of Special Management Area (SMA)

2.10.6 TAX KEY MAPS

The Real Property Division of the City's Finance Department is responsible for maintaining files for all properties within the jurisdiction of the City and County of Honolulu. For tax assessment purposes, individual properties are identified under a five-number code system; island, zone, section, plat, and parcel. However, for reporting purposes, the island reference number is usually dropped, leaving a four-number identification code, i.e., 3-4-5:06, which means zone 3, section 4, plat 5, parcel 6.

2.10.7 TRAFFIC ANALYSIS ZONES (TAZS)

For purposes of transportation and population planning, a mapping designation called a Traffic Analysis Zone (TAZ), is used by the City and the State to describe the spatial distribution of traffic-generating activities in a geographic area. There are presently 284 TAZs islandwide, and 169 contained entirely within the study area. An additional five TAZs are partially contained in the study area (see Figure 2-6).

Because TAZs usually contain one or more Census Blocks and correspond closely with existing patterns of density, the City's Planning Department (PD) (formerly the Department of General Planning (DGP) utilizes the TAZ as a basic geographic mapping element in its projections of future population growth and distribution. For this reason, population projections allocated by TAZ were utilized to model future flows in the East Mamala Bay Facilities Plan.

2.10.8 FLOOD HAZARD DISTRICTS

Pursuant to the U.S. National Flood Insurance Act of 1968 (PL 90-448 and PL 91-152) and the U.S. Flood Disaster Protection Act of 1973 (PL 93-234), both as amended, the City and County of Honolulu enacted Section 7.10 of the LUO, Flood Hazard Districts. The purpose of these districts are to protect life and property and to reduce public costs of flood control and rescue relief efforts.

In general, developments within the flood hazard districts (floodway, flood fringe, coastal high hazard, and general flood plain) must have adequately anchored structures, and use construction design, materials, equipment, methods, and practices to minimize damage. Effects on utility infrastructure should also be minimized.

Damage of concern is that which is caused by the "regulatory flood," which is defined as the flood having a one percent chance of being equalled or exceeded in any given year. Regulatory floods are indicated on the Federal Insurance Rate Maps (see Figures 3-15 through 3-18) in terms of water surface elevation, or flood elevation. The means by which flood damage is reduced is called "flood proofing," or any combination of structural and/or non-structural additions, changes, or adjustments to structures and/or properties.

2.11 RELATIONSHIP OF LAND USE CONTROLS TO FACILITIES PLANNING

Land-use plans, policies, and controls discussed above are designed to promote organized development within a community. As a result, these controls influence the geographical distribution of residents, jobs, public facilities, and visitor units over Oahu. The geographical distribution of the various projections must be considered in the Facilities Plan so that wastewater collection systems will accommodate the projected wastewater load.

The projections used to determine future population, employment, and housing units were developed by the City's Planning Department (formerly the Department of General Planning). This socioeconomic forecast is discussed in Section 5.3. They use a land-use model based on supply, demand and allocation.

The supply side of the model uses the DP, and potential, proposed and committed projects as input in order to develop an estimate for future housing supply. The demand side of the model uses a population distribution policy based on the General Plan, to forecast housing demand. The model proceeds to perform allocations after examining existing conditions, by allocating housing, population, and employment over the island. In summary, this model uses land-use controls to develop a forecast and most likely distribution scenario. As discussed in Chapter Five, the Facilities Plan also uses the development plan land use designations in modeling future flows.

The determination of likely future demand is based in part upon the forecast of future development locations.

2.12 STATE ENVIRONMENTAL IMPACT STATEMENT (EIS) REQUIREMENTS

In the East Mamala Bay facilities planning process, there is no specific federal action involved or direct expenditure of federal funds. Therefore, this Environmental Impact Statement (EIS) is being prepared under HRS 343. Federal officials will be consulted and provided copies of the submittal for comment.

On the State level, Chapter 343 of the HRS establishes the Hawaii system of environmental review. The system ensures that environmental concerns are given appropriate consideration in decision making along with economic and technical considerations. The procedures, specifications, and contents of the EIS, and criteria and definitions of statewide application are contained in Hawaii Administrative Rules (HAR), Department of Health (DOH), Title 11, Chapter 200 (abbreviated HAR 11-200). These are similar to the requirements established on the federal level.

Section 343-5(a) of Chapter 343, HRS (revised) states that except as otherwise provided, an environmental assessment shall be required for actions which utilize government funds, for actions that propose any use within any land classified as conservation district by the State land-use commission under Chapter 205, as well as for projects located within sites included on the National Register of Historic Places. Accordingly, this EIS for the proposed project has been prepared and is submitted pursuant to the provisions of Chapter 343.

As discussed previously, the accepting agency for this document is the Planning Department of the City and County of Honolulu for the Mayor. Upon acceptance of this EIS and approval of the requested Federal, State and County permits, the proposed project would conform with relevant State and county land use regulations.

2.13 SUMMARY OF APPROVALS NEEDED

The preceding sections in this chapter discussed the federal, State, and local regulation which govern the various "releases" of the wastewater system. They also reviewed federal, State, and local land-use plans, policies, and controls which establish the context within which the system operates. A summary of the possible permits and approvals needed for construction and operation of improvements to the wastewater system, as proposed in the Facilities Plan, is provided in Table 2-17. During the development of each specific improvement project, the applicable permits will need to be determined and applied for, and relevant approvals sought.

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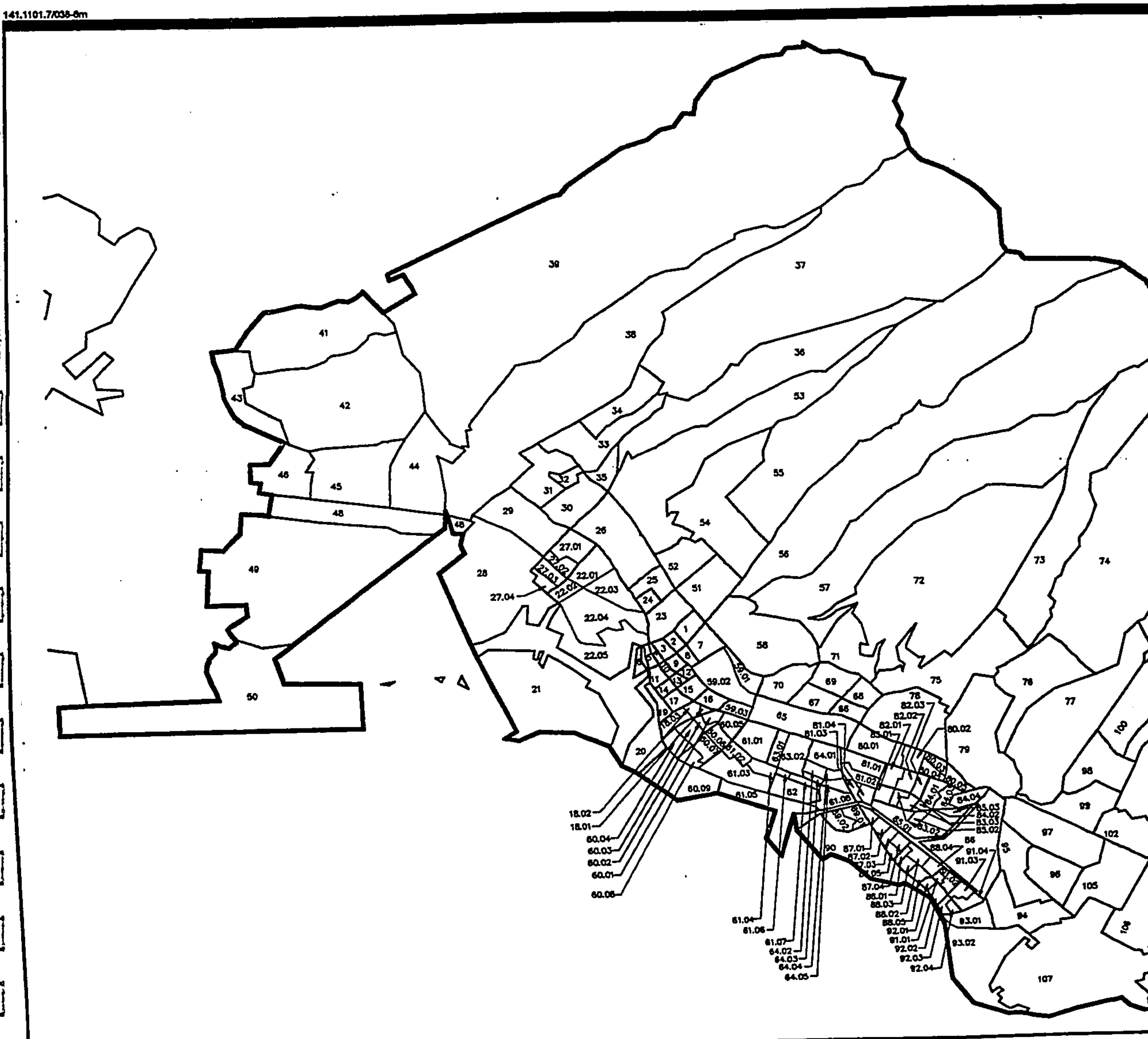

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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Not to Scale

North

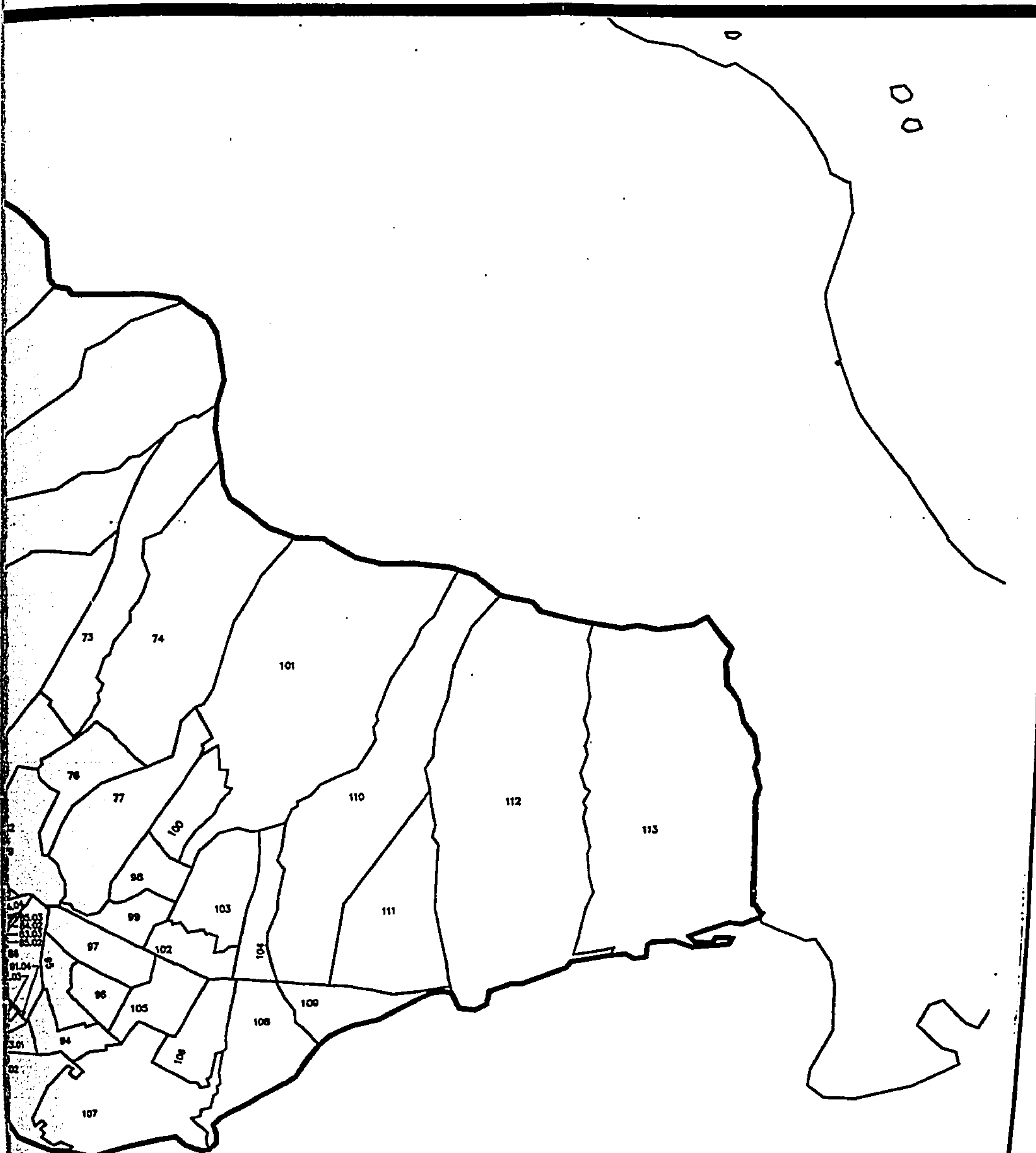


Figure 2-6
Traffic Analysis Zones (TAZs) in the Study Area

Table 2-17
Permits and Approvals

APPROVAL AGENCY	PERMIT/APPROVAL NEEDED
CITY & COUNTY OF HONOLULU	
Dept. of Land Utilization	Special Management Area Use Permit National Flood Insurance Program Conformance Shoreline Setback Variance
Dept. of Public Works	Grading Permit Drainage Approval Plan
Board of Water Supply	Water Connection Approval Fire Hydrant Installation Plan Approval
Building Department	Building Permit
Planning Department	Development Plan Public Facilities Map Amendment
Dept. of Transportation Services	Construction Approval in Rights-of-Way
STATE OF HAWAII	
Dept. of Health	Conditional Use Permit of Construction Activities National Pollutant Discharge Elimination System Permit, including sewage sludge provisions Section 401 Water Quality Certification Air Quality Permit Underground Injection Control Permit Approval for Treatment and Use of Reclaimed Water Solid Waste Management Permit
Dept. of Land & Natural Resources/	Historic Sites Review Burial Council Conservation District Use Permit State Land Lease Approval Well Drilling Permit Stream Channel Alteration Permit
Dept. of Transportation	Permit to Perform Work Within State Highways Permit to Perform Work in Shore Waters
Office of State Planning	Coastal Zone Management Consistency Determination
FEDERAL GOVERNMENT	
Army Corps of Engineers	Section 10 Permit Section 404 Permit
PRIVATE UTILITIES	
Hawaiian Electric Company	Electrical Connection Approval
Hawaiian Telephone Company	Telephone Connection Approval

3
Current Conditions in the Project Area

THREE

CURRENT CONDITIONS IN THE PROJECT AREA

3.1 DESCRIPTION OF THE PROJECT AREA

The Island of Oahu is divided into seven municipal wastewater districts: Waianae, Waialua-Haleiwa, North Oahu, Kaneohe-Kailua, Hawaii Kai, Mamala Bay, and Central Oahu (*208 Plan*). The Mamala Bay Sewerage District is located on the southern coast of Oahu and has the highest concentration of population in the State. The Mamala Bay district is served by two separate municipal wastewater collection, treatment, and disposal systems and one independent military system. The two municipal systems are the Sand Island system, also known as the Honolulu (East Mamala Bay) system, and the Honouliuli (West Mamala Bay) system. The military system is the Fort Kamehameha Sewage Treatment Plant system.

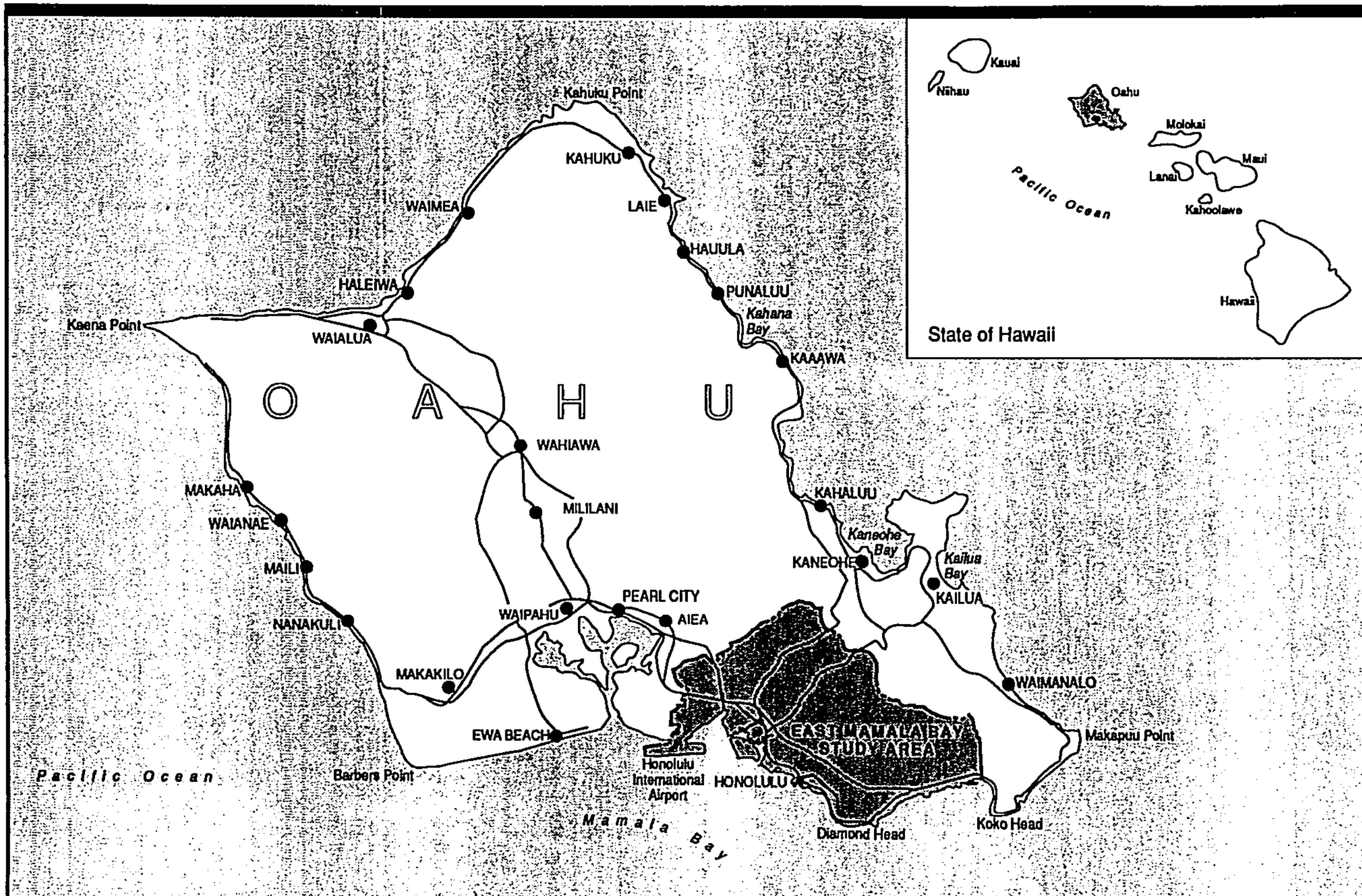
This Environmental Impact Statement (EIS) addresses the East Mamala Bay system, which extends from Moanalua/Aliamanu on the west to Niu Valley/Paiko Peninsula on the east. In the north-south direction, it extends from the forest reserve boundaries to the coastal waters (see Figure 3-1). In addition, this study addresses the Kuliouou tributary area, located to the east of Niu Valley (see Figure 3-2). Wastewater from this area is routed to the Kuliouou Wastewater Pump Station, which currently discharges into the Hawaii Kai sewer system and not the East Mamala Bay system. The Hawaii Kai system is privately owned and operated, and treats municipal wastewater on a contract basis. The feasibility of routing flow from the Kuliouou Wastewater Pump Station to the East Mamala Bay wastewater system is addressed in this report. The East Mamala Bay subdistrict together with the Kuliouou tributary area is hereinafter referred to as the "study area."

The East Mamala Bay wastewater system serves the developed portion of the East Mamala Bay subdistrict, referred to as the "service area." The system consists of a network of collection pipes: individual wastewater treatment units (cesspools and septic tanks), wastewater pump stations (WWPSs), a regional wastewater treatment plant on Sand Island, and a deep ocean outfall, extending 9,000 feet offshore with 3,350-foot-long diffuser section at a depth of 225 to 243 feet.

Areas that are connected to the existing wastewater collection system are hereinafter referred to as "sewered areas." Areas that are not connected to the network are hereinafter referred to as "unsewered areas." Wastewater generated in unsewered areas is routed to cesspools or septic tanks. Occasionally, cesspools and septic tanks require pumping.

There are three major and one minor subsystems within the study area. The major subsystems correspond to the collection areas served by the three major WWPSs: the South Honolulu subsystem served by the Ala Moana WWPS, the North Honolulu subsystem served by the Hart Street WWPS, and the U.S. Army Fort Shafter subsystem served by the Fort Shafter WWPS. A fourth, relatively small subsystem is located on Sand Island and is served by the Sand Island Parkway WWPS located on the Sand Island WWTP site. These four subsystems are hereinafter referred to as the Ala Moana WWPS area, the Hart Street WWPS area, the Fort Shafter area, and the Sand Island area, respectively. The boundaries of and neighborhoods within each of these areas are listed in Table 3-1.

The City and County of Honolulu (referred to as "the City" or "C&C") owns and operates the Sand Island WWTP, which treats domestic and industrial wastewater. This facility is designed to treat an average flow of 82 million gallons per day (mgd) of wastewater. The present average daily flow to the plant is approximately 73 mgd, or about 89 percent of its capacity.



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
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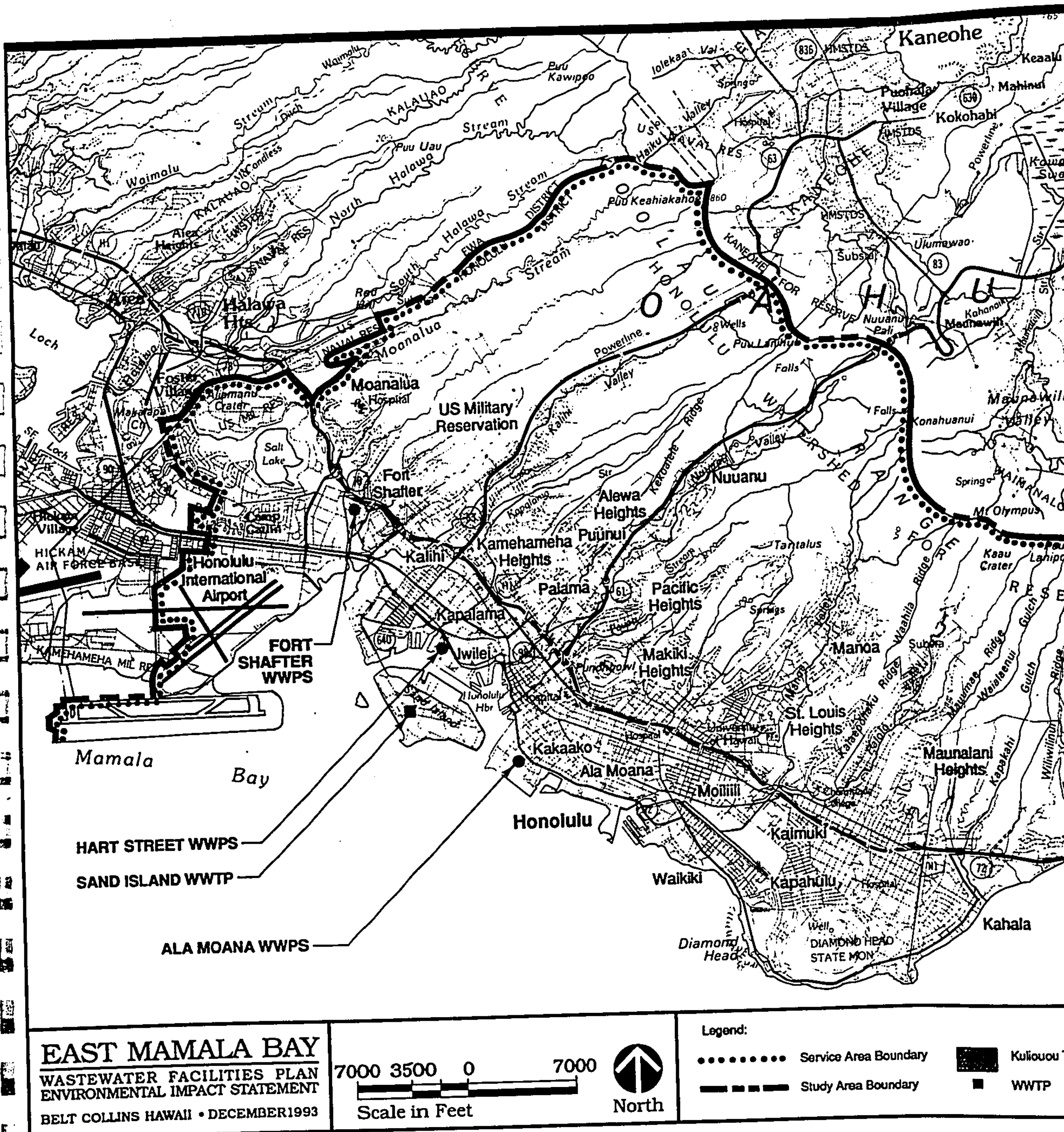
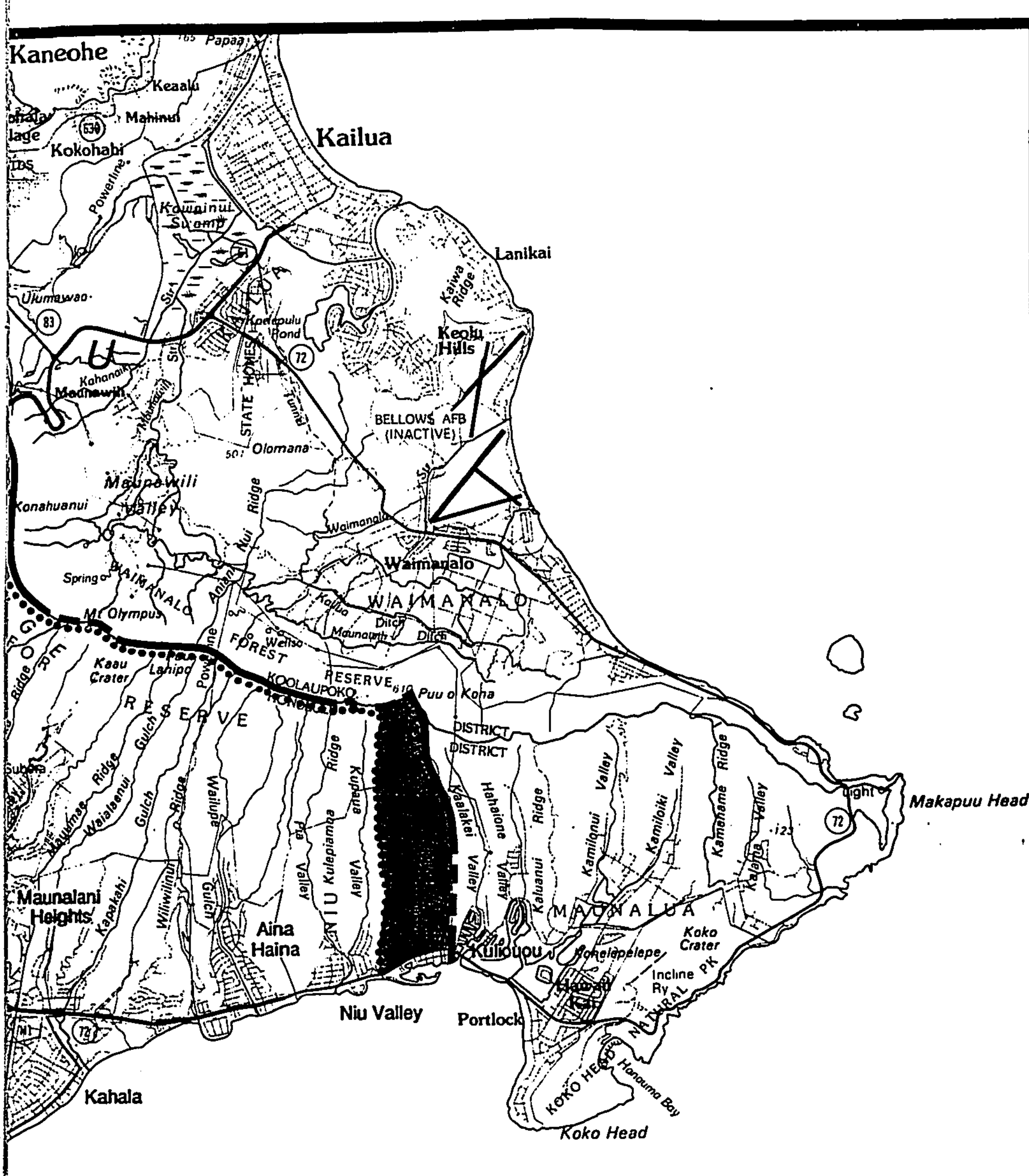
6 3 0 6
Scale in Miles
North

Figure 3-1
Subdistrict Location Map



Kaneohe
Honolulu
Kaimuki
Kapahulu
Waikiki
Kahala
Diamond Head
DIAMOND HEAD STATE MON
Mamala
Bay
Loch
Moanalua
US Military Reservation
Fort Shafter
Honolulu International Airport
HICKAM AIR FORCE BASE
Kalihi
Kapalama
Iwilei
Kakaako
Ala Moana
Moiliili
Manoa
Nuuanu
Alewa Heights
Puunui
Kamehameha Heights
Palama
Pacific Heights
Makiki Heights
St. Louis Heights
Maunalani Heights
Halawa Hts
Aiea
Salt Lake
Camp Catlin
Tantalus
Mt Olympus
Konahuanui
FORT SHAFTER WWPS
HART STREET WWPS
SAND ISLAND WWTP
ALA MOANA WWPS
EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993
7000 3500 0 7000
Scale in Feet
North
Legend:
Service Area Boundary
Study Area Boundary
WWTP



Kuliouou Tributary Area
Major WWPS
WWTP

Figure 3-2
Service and Study Area Location Map

Table 3-1
Summary of the East Mamala Bay Subdistrict

SUBSYSTEM	WWPS	BOUNDARIES	AREAS SERVED
South Honolulu	Ala Moana	Niu Valley–Paiko Peninsula to River Street–Pacific Heights/ Dowsett	• Niu Valley • Kalani • Waialae Iki • Wailupe • Aina Haina • Aina Koa • Waialae-Kahala • Kaimuki • Diamond Head/Kapahulu • Palolo • Saint Louis Heights • Manoa • McCully/Moiliili • Waikiki • Makiki/Tantalus • Ala Moana/Kakaako • University • Downtown • Alewa Heights • Puunui • Pacific Heights • Portions of Nuuanu • Portions of Punchbowl
North Honolulu	Hart Street	Aala–Puunui/ Nuuanu to Moanalua/ Aliamanu	• Kalihi Valley • Liliha/Kapalama • Portions of Nuuanu • Kalihi/Palama • Portions of Aliamanu/Salt Lake • Iwilei • Portions of Moanalua • Honolulu International Airport • Halsey Terrace Naval Housing • Radford Terrace Naval Housing • Camp Catlin Naval Housing • Red Hill Coast Guard Housing
Fort Shafter	Fort Shafter	see next column	• Fort Shafter • Tripler Army Medical Center • Aliamanu Military Housing • Moanalua Gardens
Sand Island	Sand Island Parkway	Sand Island	• Sand Island State Park • Piers 51 and 52 • Warehousing and Contractors' Baseyards • Coast Guard Reservation

The Sand Island WWTP was constructed in three increments (deep ocean outfall in 1975, phase 1 in 1976, phase 2 in 1979) by three contractors (Morrison-Knudsen, Hood-Boecon, Hawaiian Dredging). The entire treatment facility covers 50 acres of land.

Sand Island WWTP is the only wastewater treatment facility in the study area. Its treatment process consists of preliminary treatment, primary treatment, sludge thickening, and thermal conditioning. Treated wastewater effluent can be chlorinated prior to discharge into the Pacific Ocean through the deep ocean outfall. A complete description of the East Mamala Bay wastewater system is presented in Chapter Four.

3.2 GENERAL SOCIOECONOMIC CONDITIONS

Hawaii's economic base has undergone a number of fundamental changes over the past two centuries. In the distant past, sandalwood and whaling played important roles in the economic development and population growth of the Islands. In more recent times, sugar, pineapple, defense spending, and tourism have played dominant roles in the economy of the Islands.

Rapid economic growth began a decade before Statehood when the Territory of Hawaii began a sustained recovery from a deep and protracted depression caused primarily by a sharp reduction in defense expenditures following the end of World War II. Following Statehood, sustained and then accelerated growth continued through 1975. Defense activities and spending continued to grow modestly but provided a major source of stability to the Island's economy. During this same period, tourism became increasingly important, while the sugar and pineapple industries experienced steady declines. The post Statehood boom was attributable not only to the 1960s era of unprecedented and uninterrupted prosperity for the United States, but also to the beginning of commercial jet airline service to the State. Adding to the rapid economic growth of the State was the accompanying investment boom. The economic effects of the visitor and investment surges were widespread. The high demand for labor and land sent wages up and caused a rapid increase in building costs.

The long period of prosperity that characterized the United States in the 1960s began to falter in 1971. The country experienced four recessions between the years of 1971 to 1984. Inflation rose from an average of 2.7 percent per year through the 1960s to 8.9 percent between 1975 and 1980. As interest rates increased through the 1970s, real incomes of Americans slowed considerably. These factors combined to result in a reduction in tourism in general, and fewer mainland visitors to Hawaii. The energy crisis in the later 1970s had a significant effect on Hawaii's growth both directly and indirectly. The fuel shortages and significant increases in fuel prices changed the fundamental economics of many industries, especially the airline industry. Due to the related rise in airfares during the 1975-1980 period, Hawaii experienced its first actual decline in year to year visitor arrivals since 1949.

Hawaii's sugar and pineapple industries, which had been declining steadily for many years, were particularly hard hit during the 1970s. Foreign competition, with cheaper labor costs were cutting deeply into the State's canned pineapple markets. The U.S. Sugar Act, which had protected the domestic sugar industry for many years, expired in 1974. U.S. sugar growers were now competing in a "world" sugar market and prices were, for the most part, lower than production costs. Although the Agricultural Act of 1979 provided some protection and stability for the Hawaii sugar industry, the sugar and pineapple industries, which had accounted for an estimated 17 percent of Hawaii's personal income in 1965, accounted for only five percent by 1982 (Schmitt, 1977; State of Hawaii, 1984).

By 1970, Hawaii's construction industry was overdeveloped both in size and scope. Facilities were being constructed to meet future needs. As a result, during the building boom of 1974, 7.5 percent of the total State work force was engaged in the construction industry. When the energy crisis materialized, construction sagged over the next three years while significant inventories of housing units, hotel rooms, and office space were consumed. This resulted in a 29 percent decline in the number of jobs in the construction industry from its peak in 1974.

Thus the late 1970s and 1980s were times of readjustment for the economy and the people of Hawaii. During the mid to late 1980s, Hawaii experienced a steady growth in tourism and population. There was also considerable Japanese investment in businesses and in commercial and residential properties. Although the rate of this investment has decreased dramatically over the recent years, the demand on infrastructure has been considerable.

The State of Hawaii has not escaped the recent recession experienced by the mainland. In early/mid 1993, with signs that a sustained but sluggish economic recovery is unfolding on the mainland, Hawaii's economy appears somewhat listless. The outlook for the State's economy is cautiously optimistic but many economic projections have been revised to reflect a more conservative and cautious outlook.

3.2.1 POPULATION OF THE PLANNING AREA

Sizing of the wastewater collection and treatment system is determined by a number of community variables such as the amount and type of industrial discharge, per capita wastewater flow calculations, and population projections. "Resident population" is based on a person's place of usual residence. It includes armed forces stationed or homeported in Hawaii and residents temporarily absent and excludes visitors present. "De facto Population" includes all persons physically present in the area. This count includes visitors present but excludes residents temporarily absent, calculated as 12-month moving averages.

Data Sources

The primary source for existing population data is the State of Hawaii Data Book 1991, a statistical abstract of the official summary of statistics on the social, economic, and political organization of the State of Hawaii. Many federal, State, county and private organizations contributed to the data summarized in the abstract. The Data Book is produced on an annual basis and emphasizes statewide data but also provides source references for additional statistical detail that allow a more focused review of data.

This source was selected because its principal sources for population data are: the decennial population censuses conducted by the U.S. Bureau of Census; the estimates developed annually by the Hawaii State Department of Health and Department of Business, Economic Development and Tourism in cooperation with the Bureau of Census; the Hawaii Health Surveillance Program conducted regularly since 1969 by DOH; the ongoing series on visitors present and residents absent provided by the Hawaii Visitors Bureau; and the U.S. Immigration and Naturalization Service tabulations on immigration.

In addition, the population figures prepared by the Planning Department, Department of the City and County of Honolulu allocate population into discrete geographical areas.

The City Planning Department aggregates its population, job, hotel room, and visitor unit projections into relatively small geographical areas called Traffic Analysis Zones (sometimes referred to as Traffic Assignment Zones). By using this aggregation, they project the most likely distribution scenario across Oahu.

In general, TAZ boundaries resemble Census Block boundaries for less densely population areas of Oahu. In densely populated areas, several TAZs may be included in one Census Block. There are presently 284 TAZs islandwide with 171 whole and five partial TAZs located within the study area (see Figure 2-6.)

In order to remain consistent with projections used for other City and County projects, TAZs were used as a geographical unit in forecasts prepared for this plan.

Population

According to the Planning Department's records, the study area on Oahu included approximately 339,640 residents in 1990. This is approximately 41 percent of the resident population of Oahu and is located primarily in the Primary Urban Center development plan area with a portion in East Honolulu.

The de facto population differs from the resident population in that it accounts for residents temporarily absent and visitors present. The information for 1990 provided by the City's Planning Department included number of residents by TAZ, but did not include counts by TAZ for the number of residents temporarily absent and visitors present. Therefore, the 1990 de facto population for the City and County of Honolulu has been allocated to the study area using the methodology and data sources shown in Table 3-2. The number of residents temporarily absent from the study area and service area is assumed to be equal to the number of Oahu residents temporarily absent multiplied by the percentage of Oahu residents in the study and service areas. Also, the average number of visitors present in the study and service areas is estimated to equal the average visitor census for Oahu multiplied by the percentage of Oahu hotel rooms/resort units in the service and study areas. The de facto populations for the study area and service area are approximated at 420,226 and 417,407, respectively.

3.2.2 ECONOMIC CONDITIONS

To assess the current economic situation, the conditions of the leading industries are summarized below. Those industries are tourism, sugar and pineapple, and federal defense spending.

Tourism

During the past three years, the tourism industry in Hawaii has been especially hard hit due to the Persian Gulf War and the related disinclination of Westbound visitors to travel. These negative impacts were exacerbated by the recession on the mainland, and compounded by the airfare wars which were concentrated on intra-continental flights and resulted in a net decrease of scheduled flights to Hawaii. The number of westbound visitors has fallen below the 1990 levels and although eastbound counts have increased above the dramatic Gulf War lows, they remain only modestly ahead of 1990 levels.

Sugar and Pineapple

In the last several years, low prices and rising production costs, increased urbanization pressures, and subsequent conversion of sugar production lands have led to predictions of the demise of Hawaii's sugar industry. Today, sugar still remains as the State's largest agricultural industry. However, the over leveraged condition of a major sugar producer on the Big Island, has recently led to a bankruptcy filing. The State's sugar industry estimated at $342.1 (millions) in 1989, has experienced an 11.7 percent decline during the 1989-1991 period. (Business Trends, Bank of Hawaii, May June 1992.)

The pineapple industry has followed a similar path. The State's second largest agricultural crop, whose value was estimated at $241.9 (millions) in 1989, has experienced a cumulative decline of 10.7 percent over the 1989-1990 period. Additionally, the number of acres under cultivation has decreased steadily from 62,400 acres in 1969, to 32,700 acres in 1989. Outside factors such as foreign competition, increased pressure to convert lands for urban development or alternative uses, and a tight labor market have contributed to this decline and are expected to continue to impact the future of Hawaii's agricultural industries.

Table 3-2
Allocation of 1990 De Facto Population to Study and Service Areas

DESCRIPTION	CITY AND COUNTY OF HONOLULU	STUDY AREA	SERVICE AREA (STUDY AREA WITHOUT KULIOUOU)	SOURCE
De facto population of Oahu	908,019	N/A	N/A	1991 Data Book p. 18
Resident population of Oahu	836,231	N/A	N/A	1991 Data Book p.18 Planning Department Population Projections 1990
Resident Population in the study and service areas	N/A	342,511	339,640	PD Population Projections 1990 Aggregation of TAZs in study and service areas (1)
Average Visitor Census for Oahu	87,400	N/A	N/A	1991 Data Book p.183 Average Visitor Census 1990 for Oahu
Average Number of Residents Temporarily absent from Oahu	15,612	N/A	N/A	Derived from: Residents + Avg. Visitors – De Facto
Percentage of residents in study and service areas	N/A	41.0%	40.6%	PD Population Projections 1990 Residents in study and service areas divided by Total Oahu Residents
Residents temporarily absent in study and service areas	N/A	6,395	6,341	Oahu Residents Temporarily absent multiplied by percent of residents in study and service areas
Percentage of Hotel Rooms/Resort Units in study and service areas	N/A	96.2%	96.2%	PD Population Projections 1990
Visitors present in study and service areas on average	N/A	84,108	84,108	Average Visitor Census 1990 multiplied by 96.2% (2)
De Facto Population in study and service areas	**N/A**	**420,225**	**417,407**	**(Residents – Residents Temporarily Absent + Visitors)**

Note:

(1) The City Planning Department aggregates its population, job, hotel room, and visitor unit projections into relatively small geographical areas called Traffic Analysis Zones (sometimes used interchangeably with Traffic Assignment Zones). By using this aggregation, they project the most likely distribution scenario across Oahu.

(2) The 96.2 percent is based on the approximate ratio of visitor accommodations in the study area versus the entire island.

Source: The State of Hawaii Data Book 1991. Department of Business Economic Development and Tourism.

Federal Government Spending (Defense)

Defense spending in the State of Hawaii has remained fairly constant in recent years. Total defense investment in Hawaii was $5,461.0 (millions) in 1990. Aside from Naval Air Station (NAS) Barbers Point being recently added to the base closure list by the Base Realignment and Closure Commission (BRCC), it is not entirely clear how defense spending on Oahu will change in the future.

3.3 GENERAL PHYSICAL CONDITIONS

The following is a discussion of the environmental conditions which provide the physical setting for the proposed project.

3.3.1 TOPOGRAPHY

The island of Oahu consists of two roughly parallel mountain ranges extending generally from northwest to southeast and joined by a central plateau. The Waianae Range on the west and the Koolau Range on the east are both eroded remnants of shield volcanoes. The central plateau was formed when lavas from the younger Koolau Volcano banked against the already-eroded eastern slope of the Waianae Range (See Figure 3-3).

The Koolau Range represents the remnant of a shield volcano formed over two and a half million years ago, and since eroded by the effects of wind, rain, sea level changes, and massive slumping, the latter occurring principally on the windward side of the range between Waimanalo and Waikane. Along the southeastern end of the Koolau Range, volcanic activity resumed between approximately 30,000 and 1,100,000 years ago with at least 30 separate eruptions forming cinder, spatter, and ash cones, and pouring lava over the eroded topography and out onto the fringing reef. This period of eruptions is known as the Honolulu Volcanic Series and established the study area's current topographic character, including Punchbowl and Diamond Head craters.

The study area encompasses about 79 square miles (50,560 acres) along the southern end and lower western (leeward) side of the Koolau Range. The area consists of a series of ridges and valleys extending in a southerly and southwesterly direction from the crest of the Koolau Range and includes the narrow coastal plain sloping seaward from the Koolau Range to the shoreline. On the eastern end of the study area, the coastal plain consists of little more than a coral shelf a few hundred feet wide, while on the western end, the coastal plain broadens to a width of nearly two miles.

The Pacific Ocean shoreline forms the southern boundary of the study area and the crest of the Koolau Range forms its northern, or inland, boundary. The western boundary follows the course of Moanalua Stream and includes Aliamanu Crater and Honolulu International Airport Reef Runway to the south. The eastern boundary extends to the summit of the eastern ridge overlooking Kuliouou Valley. The study area also includes Sand Island, in the southwestern corner of the study area.

From shoreline to the crest of the Koolau Range, the study area's width ranges from 2.8 miles to 8.3 miles. Its length is approximately 15 miles, measured from its extreme ends (the Airport's Reef Runway on the west and Kuliouou Valley on the east).

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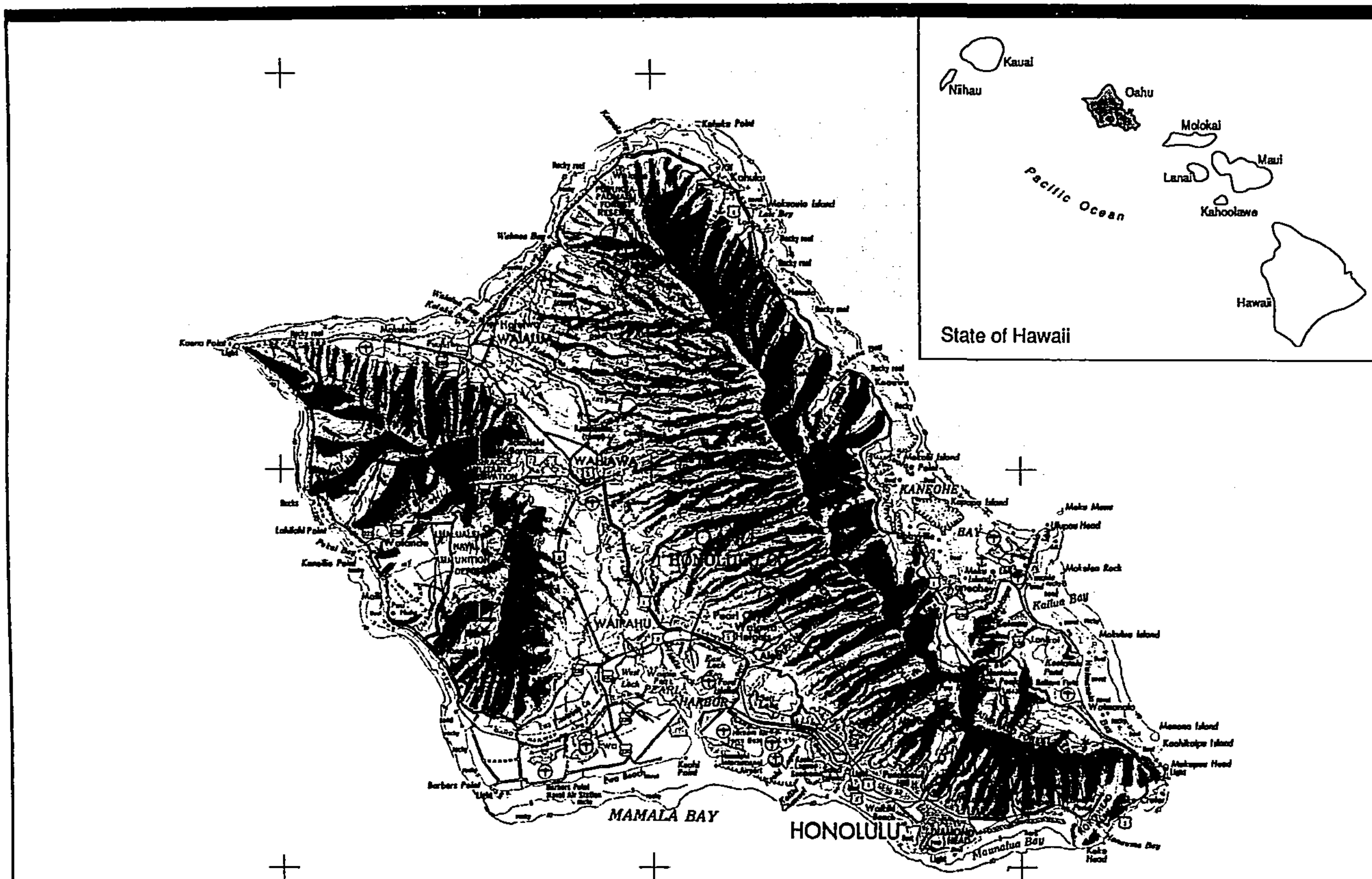

Source: U.S. Geological Survey, Washington D.C., 1961

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6 3 0 6
Scale in Miles
North

Figure 3-3
Shaded Relief Map Showing
General Topography of Oahu

Elevations range from sea level to approximately 3,100 feet above mean sea level (msl). In general, the topography of the study area consists of gentle slopes extending from the shoreline to the back of the valleys and the base of the mountain ridges, and steep to precipitous slopes extending from the valley's floors to the crest of the Koolau Range. The general character of the topography is interrupted, however, by two prominent volcanic craters, Leahi and Puowaina, or more commonly, Diamond Head and Punchbowl.

3.3.2 SOILS AND GEOLOGY

Specific soil conditions in an area can directly impact the cost of development, as well as the long-term costs of operation and maintenance. As shown in the General Soil Map (Figure 3-4; Soil Conservation Service, 1971), there are four principal soil associations in the study area.

Lualualei-Fill Land-Ewa Association, which occurs mainly on the coastal plain, is characterized by deep, nearly level to moderately sloping, well-drained soils that have a fine textured or moderately fine textured subsoil, and areas of fill land.

Rock Land-Stony Steep Land Association, which is described as steep to precipitous, well-drained to excessively drained, rocky and stony land, mainly occurs inland of the coastal areas.

Rough Mountainous Land-Kapaa Association dominates the upper elevations of the west side of the study area, where gulches and narrow ridges are found. It is very steep land broken by numerous drainage ways and deep, well-drained soils that have a fine textured or moderately fine textured subsoil. This association also occurs along the Moanalua Stream, the west boundary of the study area.

Lolekaa-Waikane Association has deep, nearly level to very steep, well-drained soils with a dominantly fine-textured subsoil. This association is limited to an area approximately one square mile around the Nuuanu Reservoir.

The following description of soil and subsoil characteristics in the study area is derived from a geotechnical and geological reconnaissance of the study area conducted by GEOLABS - HAWAII in 1992 for the East Mamala Bay Facilities Plan. The soil and bedrock within the study area can be grouped into the following major stratigraphic units (see Figure 3-5).

Koolau Basalt (Tkb). This is the oldest geologic unit within the project area. It generally consists of interbedded pahoehoe and a'a flows of basaltic lavas and may have a mantle of cobbles and boulders, or residual soil overlying the top of the rock. Various types of volcanic rock subcomponents, such as clinker layers and lava tubes, may also be present. Koolau Basalt rocks comprise the aquifer of the Honolulu Artesian Basin, the principal developed groundwater supplying fresh water for the study area. Soils associated with this unit are generally the Rock Land–Stony Steep Land and Rough Mountainous Land–Kapaa Associations.

Older Alluvium (Qa). This unit generally overlies the Koolau Basalt and consists of terrigenous sediments which have been transported by stream action from the upper reaches of the streams. The material consists mainly of very stiff to hard brown clay silts and silty clays. Gravel lenses representing buried stream channels may exist in this layer. Portions of the older alluvium unit may contain some weathered basalt boulders and cobbles. These coarse grained layers may also contain artesian water of the groundwater basal fresh water system. Soils of this unit are generally the Rock Land–Stony Steep Land Association.

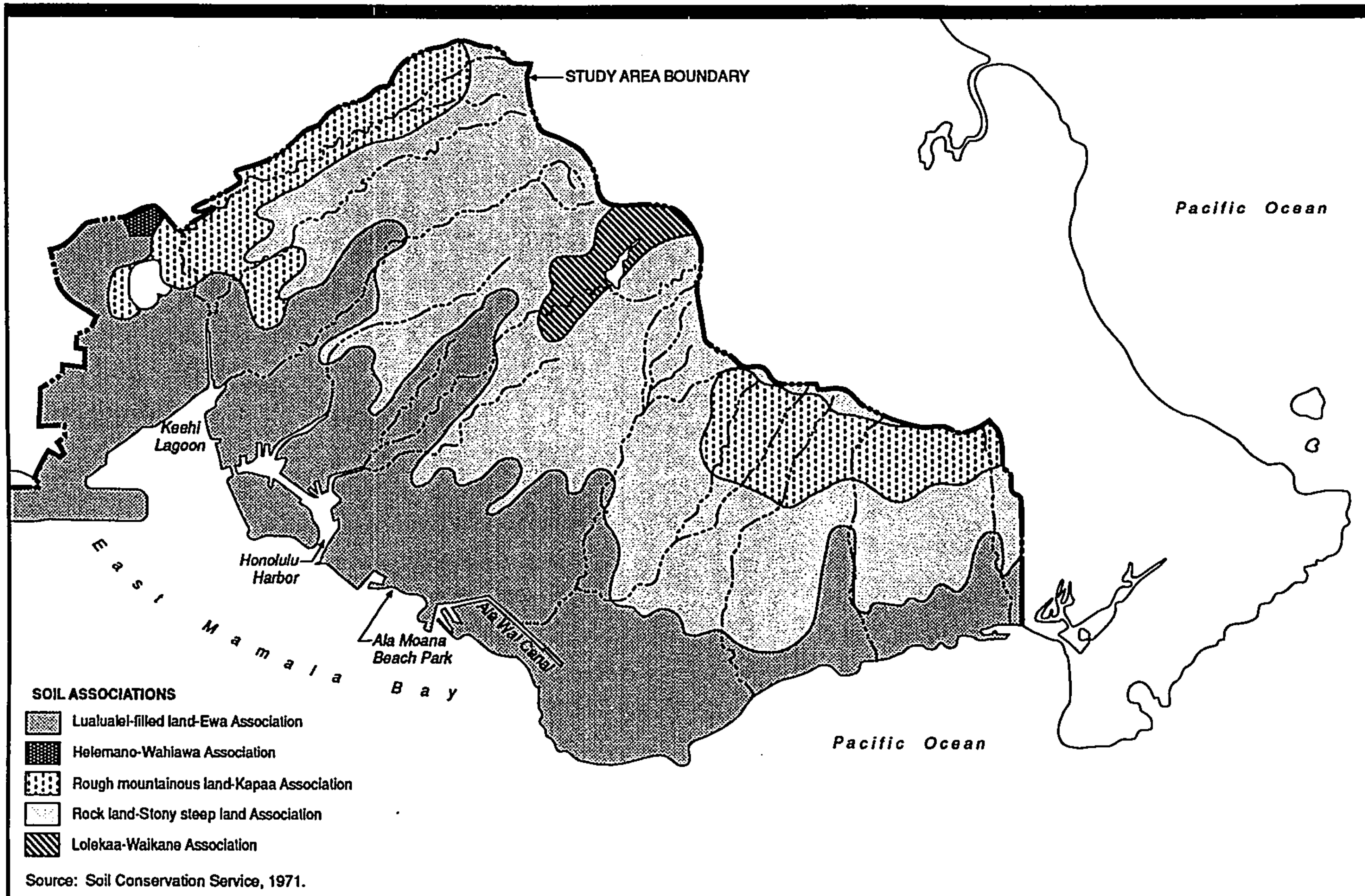

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Figure 3-4
General Soil Map

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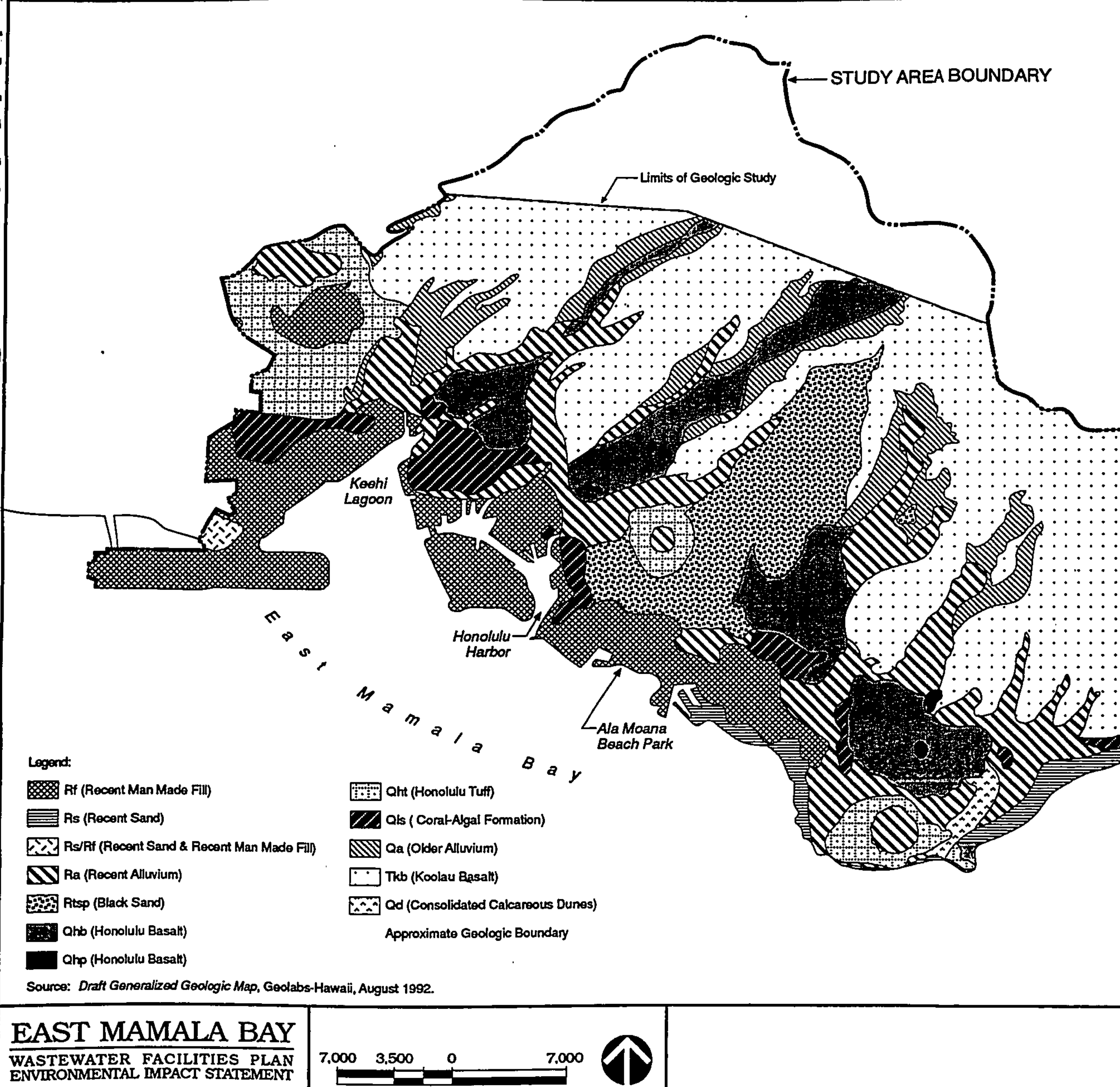

Source: *Draft Generalized Geologic Map*, Geolabs-Hawaii, August 1992.

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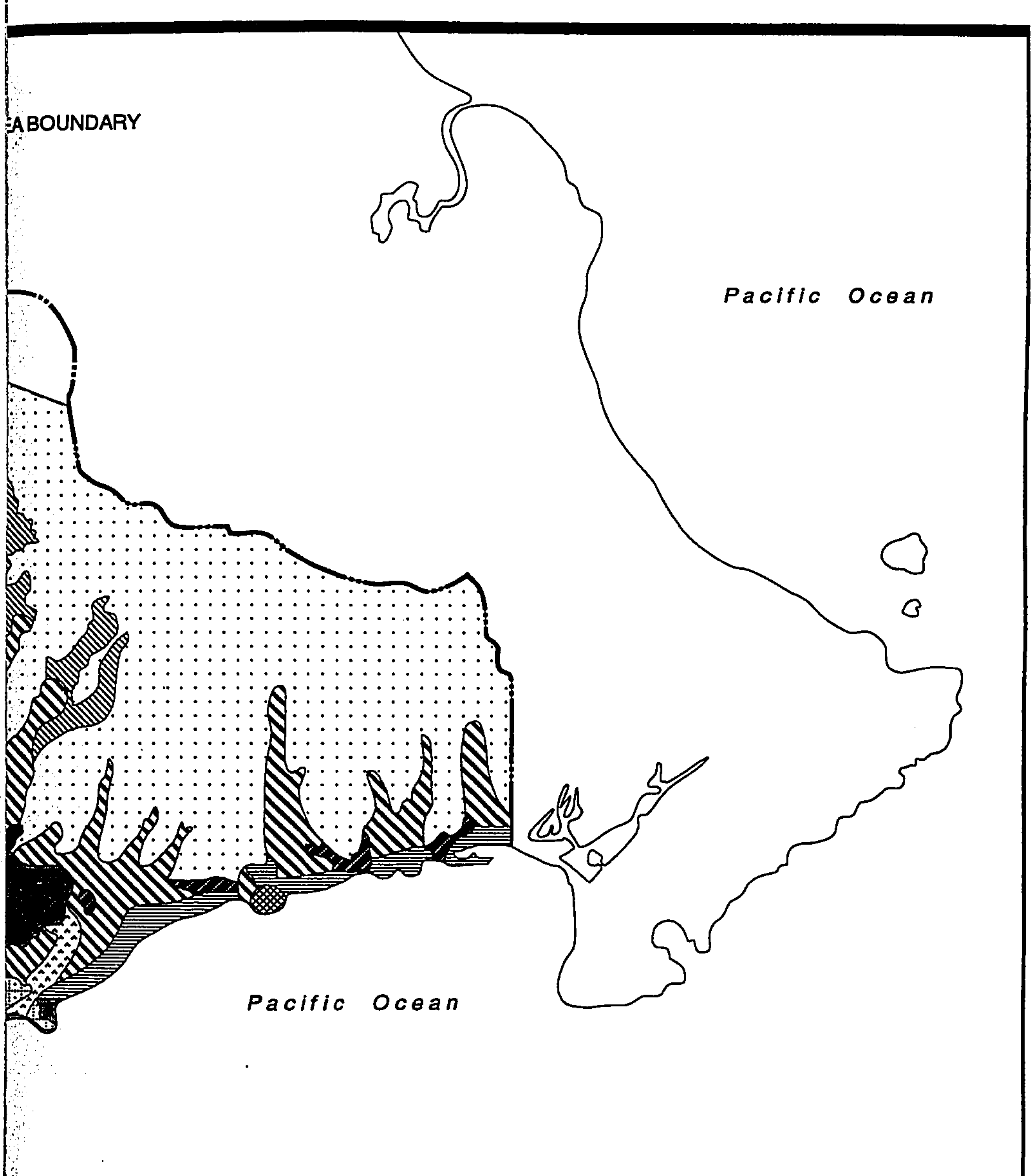

Figure 3-5
Generalized Geologic Map

Coral-Algal Deposits (Qls). This unit consists of fossil remnants of coral-algal reefs and their related detrital debris deposits. In Hawaii, the detrital deposits tend to constitute the dominant portion of any coral rock assemblage. They are weakly to strongly cemented coral including gravel, sand, and silt-sized fragments. Soils associated with this unit are generally the Lualualei-Fill Land-Ewa Association.

Honolulu Basalt (Qhb and Qhp). The Honolulu Basalt generally consists of interbedded pahoehoe and a'a flows and may have alluvial clays with cobbles and boulders overlying the top of the rock. Clinker layers and lava tubes may also exist. Honolulu Basalt frequently contains either perched or confined groundwater. Soils of this unit are generally the Lualualei-Fill Land-Ewa Association.

Honolulu Tuffs (Qht). Tuff from vents of the Honolulu Volcanic Series consist of volcanic ash which consolidated and hardened to form a medium-hard rock that resembles siltstone or sandstone, locally called "mudrock." The tuff is frequently found overlying coralline deposits or alluvium units. Soils of this unit are generally the Lualualei-Fill Land-Ewa Association.

Black Sand (Rtsp). These soils were developed from volcanic cinder sands laid down by eruptions of the Tantalus-Roundtop vents of the Honolulu Volcanic Series. They generally form a relatively thin (less than 10 feet) mantle over coral, tuff, or basalt and consist of a surface layer, a few feet thick, of silt/silty sand underlain by relatively unweathered cinder sand. The sand is usually of medium-dense to dense consistency and is often weakly to moderately cemented. Black sand is generally found in the Lualualei-Fill and Rock Land-Stony Steep Land Association.

Recent Alluvium (Ra). The recent alluvium consists mainly of very soft to medium stiff, brown to dark-gray clayey silt, and organic silt with varying amounts of sand and infrequent pockets of gravel and cobbles. These soils generally result from sedimentation in very low-energy environments such as estuaries or embayments. Often, the soils assigned to this unit accumulated very rapidly under water and have never been exposed. Soils of this unit are generally the Lualualei-Fill Land-Ewa and Rock Land-Stony Steep Land Associations.

Recent Sand (Qd). This unit represents recent deposits of beach and nearshore marine sands. These sands are generally composed of medium grained fragments derived from the coral-algal reefs which have been reduced in size and rounded by water action. The sands are generally medium-dense to dense. There are some areas where the sands have lithified to poorly consolidated sandstone (Qd). Soils of this unit are generally the Lualualei-Fill Land-Ewa Association.

Recent Man-Made Fill (Rf). This unit represents low areas which were filled during urbanization. The majority of these low areas are underlain at relatively shallow depths by Recent Alluvium (RA) and were originally marshy areas. A small part of the filled land is underlain by coral. Along most of Nimitz Highway, in the Downtown area and in parts of Waikiki, it appears that the man-made fills are underlain at relatively shallow depths by coral-algal limestone. The fill materials range from clays to gravels and mixtures of soils. The consistencies range from soft or loose to hard or very dense. The quality and composition of the fill is variable. These fills were frequently placed without control. Soils in this unit are generally found in the Lualualei-Fill Land-Ewa Association.

3.3.3 CLIMATE

Winds. Prevailing winds in the study area are northeasterly tradewinds, which blow approximately perpendicular to the northwest-southeast oriented Koolau ridge. In general, the trades are stronger in the afternoon than at night and more persistent in summer than in winter, with frequencies of approximately

85 and 35 percent respectively. A wind rose, based on National Weather Service data (1982), is shown in Figure 3-6. Seasonal and diurnal wind direction and percent frequency are also presented.

Temperature. Based on 1951-1980 records, the average annual temperature measured at Honolulu is 77° Fahrenheit (F). Seasonal variation in temperature is slight. During the coldest month of January, the average monthly temperature is approximately 72.6° F; during the warmest month of August, the average is 81° F. Temperature is related, however, to elevation. For example, based on 1990 Annual Summary, an inland station situated at the Manoa Lyon Arboretum (elevation 500 feet) has an average annual temperature of 72.8° F, four degrees lower than the coastal station. The coldest month for this station is in February, when the average temperature is approximately 68.8° F; the warmest month is August, when the average temperature is 76.6° F.

The day's highest temperature generally occurs about 2PM, when the air temperature is augmented by heat radiating from the ground. The lowest daily temperature occurs near sunrise when air and ground have been cooling longest. The warmest days occur during "Kona Weather" when the trade winds are replaced by southerly or westerly (i.e. "Kona") winds, or the winds diminish completely and the air stagnates over the islands. Extreme temperatures in the study area range from near 50° F to 92° F.

Rainfall. Rainfall patterns in the study area are directly related to wind patterns and the topography of the Koolau Range. The median annual rainfall variations on Oahu (see Figure 3-7) illustrate the effect of topography on rainfall in the study area. The principal rain-producing mechanism is orographic lifting of trade winds along the Koolau slopes; updrafts created by the Koolau barrier propel moisture laden trade winds into cooler atmosphere resulting in condensation over the summit areas of the mountain range. Thus, in the study area, rainfall levels decrease proportionately with distance from the crest of the Koolau's. As shown in Figure 3-8, near the Koolau summit (at Station 782), the median annual rainfall can be as high as 156 inches while on the coastal plain (at Station 704), it can be as low as 24 inches. Seasonal variations in rainfall correspond to a "wet" season from February to May and a "dry" season from July to October.

Humidity/Pan Evaporation. Average daily maximum humidity in the study area is approximately 80 percent; the average minimum humidity is about 55 percent. Most of the daily fluctuation results from changes in ambient air temperature rather than changes in the vapor pressure. Therefore, the minimum relative humidity tends to occur during daylight hours, with the maximum occurring at night.

Pan evaporation data is indicative of the potential water loss through evaporation and transpiration. There are three stations that measure pan evaporation in the vicinity of the study area. Mean annual evaporation rates at these stations range from 36 to 75 inches. Like rainfall patterns,seasonal and geographical variations in pan evaporation are also significant. Maximum evaporation occurs during the summer months while minimum evaporation occurs during the months of December and January. And consistent with rainfall patterns, the pan evaporation is lower in the mountainous regions of the study area where rainfall is the highest. On the coastal plain, pan evaporation reaches the highest of the entire island, due to heat absorption associated with urban development. In urban Honolulu, water loss is typically 7.8 to 8.0 inches per month in the summer and is about 4.1 to 4.8 inches per month in December and January.

3.3.4 HYDROLOGY

Groundwater and surface waters in the study area are important resources. Groundwater provides primary drinking water sources for human consumption; surface waters provide major recreational areas for activities such as fishing, swimming, snorkeling, and surfing. Thus, it is very important to preserve these

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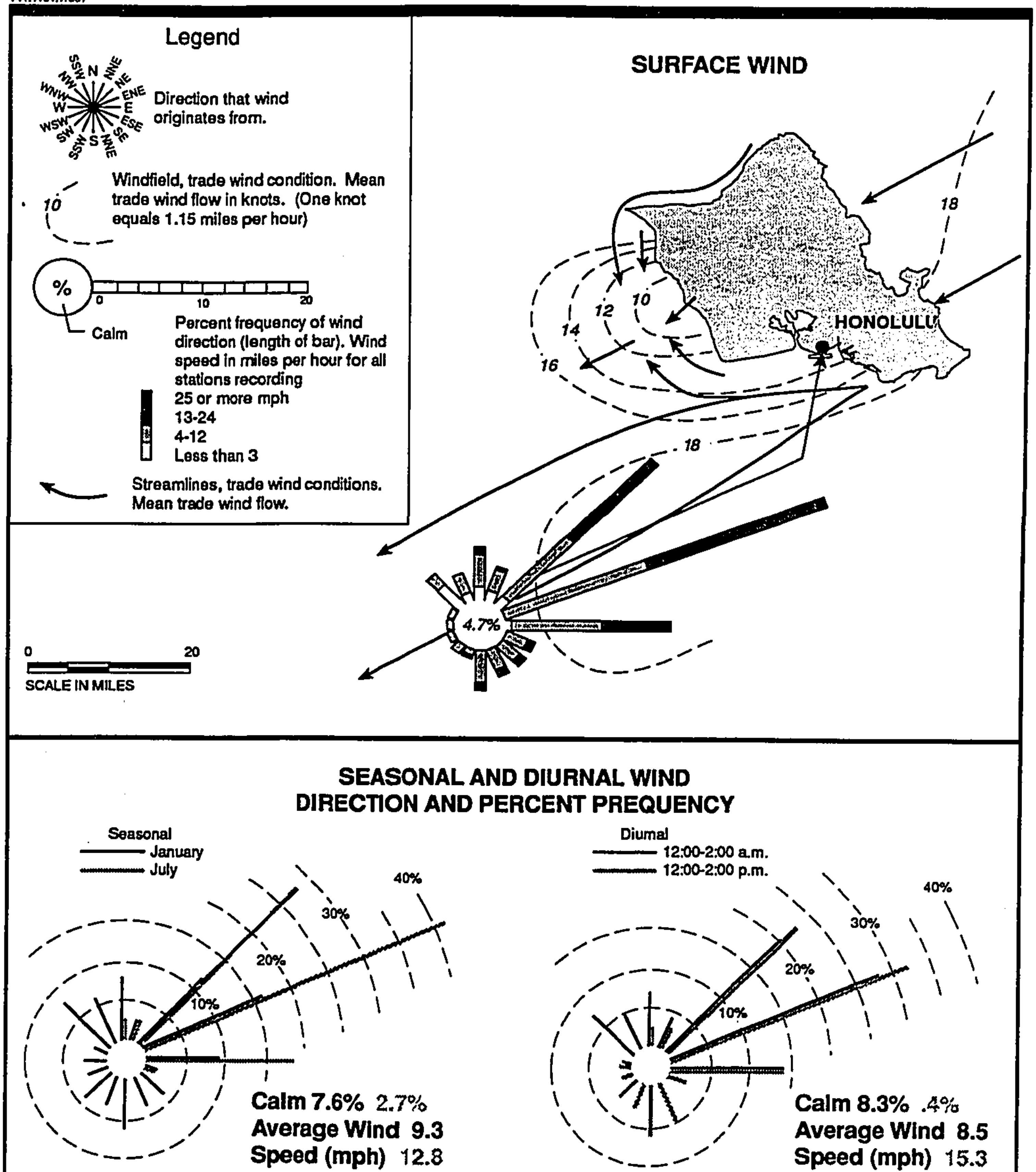

Source: National Weather Service, Pacific Region 1982 (From *Atlas of Hawaii*)

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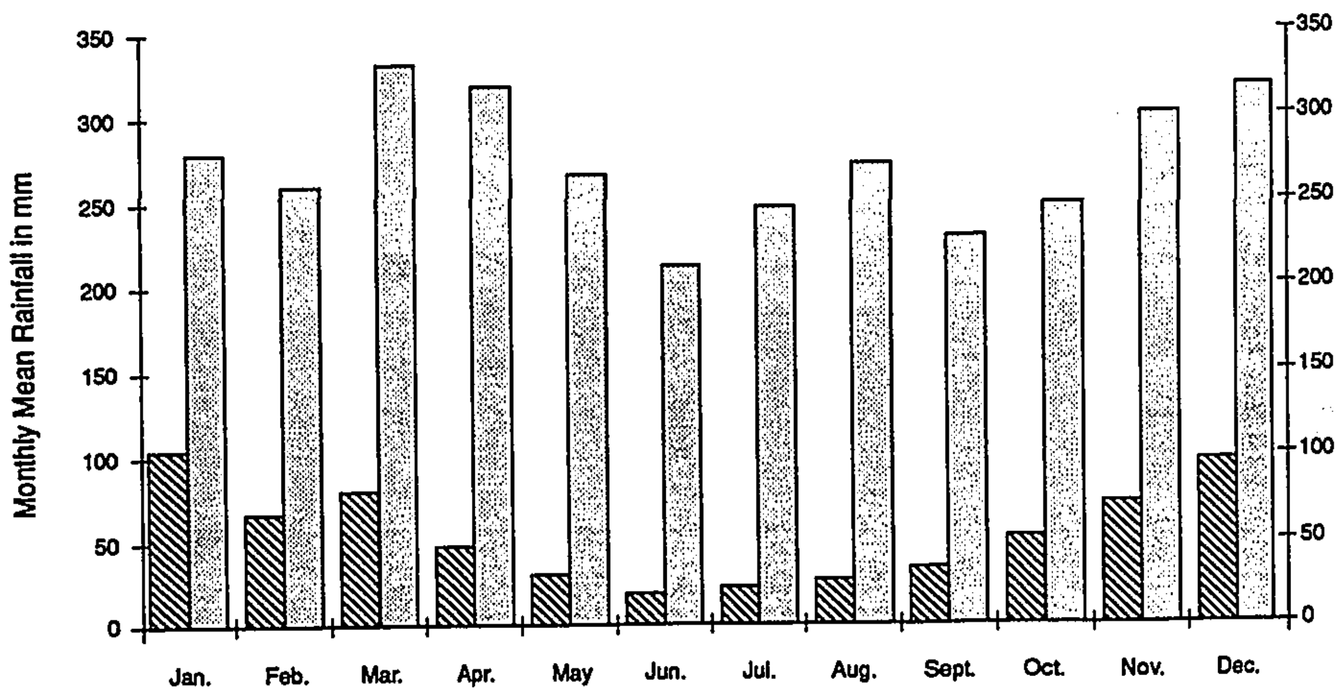
Figure 3-6
Wind Rose for the Study Area



Legend:

Station #704 (Over 10 years)

Station #782 (1916 to 1983)

Source: *Rainfall Atlas of Hawaii*, (1986), DLNR, Report R76.

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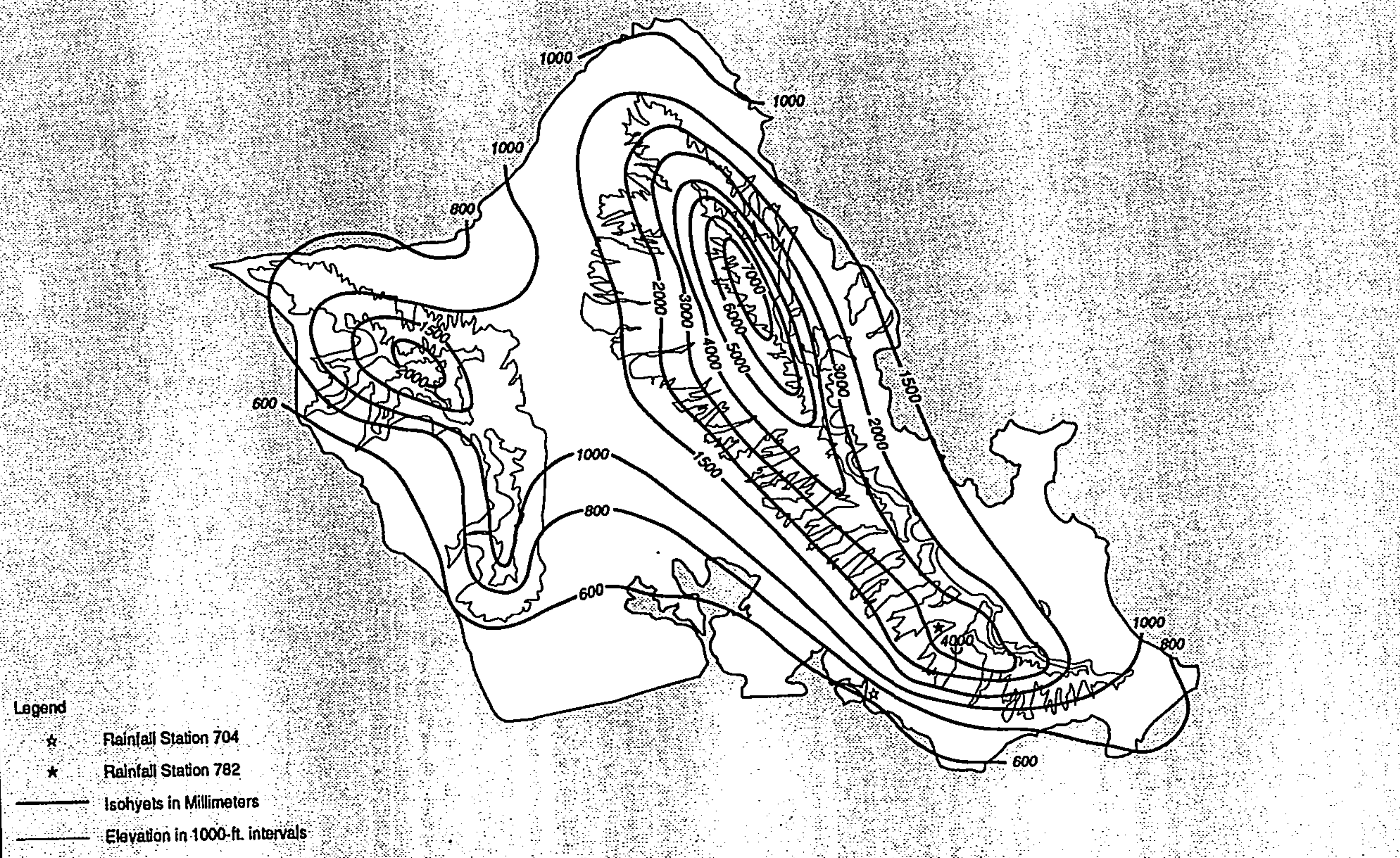
Figure 3-7
Geographical Rainfall Variations at Two Rainfall Stations in the Study Area



Source: *Rainfall Atlas of Hawaii*, Hawaii State DLNR, 1986

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Figure 3-8
Median Annual Rainfall

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waters and prevent wastewater contamination. These waters are also waste transport mechanisms and are potential health hazards once contaminated. In order to protect the water resources, the unique hydrological characteristics of these waters are considered.

Groundwater

The hydrology of the study area is characterized by a complex groundwater system referred to as the Honolulu Sector Aquifer. The aquifer has two principal components: high-level dike and perched groundwater, and basal groundwater.

As shown in Figure 3-9, high level dike and perched groundwater refers to fresh water that is impounded above sea level and separated from sea water by relatively impermeable dikes (Stearns and Vaksvik, 1935). Commonly saturated to hundreds of feet above sea level, these dikes form compartments of fresh water which feed springs and streams in the mountainous regions.

The freshwater table under much of the island consists of a basal groundwater "lens" floating on sea water, commonly called a Ghyben-Herzberg lens (or basal lens). Islandwide, the upper elevations of the lens averages between a few feet above sea level to a few tens of feet. According to the Ghyben-Herzberg principal, the ratio of densities between fresh and salt water causes the salt water to be displaced downward about 40 feet below sea level for every foot that the fresh basal water table is above sea level. A permeable "caprock," composed of marine reef deposits and containing brackish water, underlies most of the coastal plain. The caprock is separated from deeper permeable marine strata (containing salt water) by a relatively impermeable clay layer. A similar clay layer separates the marine deposits from the basalt (see Figure 3-9).

The abundance of groundwater yield is estimated by sustainable yield, which refers to the forced withdrawal rates of groundwater that could be sustained indefinitely without affecting either the quality of the pumped water or the volume rate of pumping (George A. L. Yuen & Associates, Inc., 1990). These estimates usually are not adjusted for the effects on water balances due to return irrigation, nor do they take into consideration reductions in stream flow where groundwater accounts for the base flow of streams.

The estimated sustainable yields for groundwater in the study area are derived from water balances in conjunction with pumping data from the long history of operation for five systems in the Honolulu Aquifer Sector. These systems and their sustainable yields are the Palolo System with 5 mgd; the Nuuanu System with 15 mgd; the Kalihi System with 9 mgd; the Moanalua System with 18 mgd; and the Waialae System with 3 mgd. The first four systems are among the best in the State. However, the study area still requires importation of water from the Central Oahu area to meet drinking water needs.

As shown in Figure 2-2, there are approximately 40 drinking water sources in the East Mamala Bay study area (DOH, 1987). These sources include public and private sources, and at least 20 of them are public drinking water stations (BWS, 1991).

Surface Water

Surface water bodies are distributed throughout the study area, including inland and marine waters. Inland waters are found in mountainous regions (Nuuanu Reservoir), along the drainage basins (Kalihi Stream, Manoa Stream) or at the "mouth" of the stream where stream water meets the ocean. Along the southern coast, approximately 20 miles of shoreline provides access to a variety of commercial and recreational waters.

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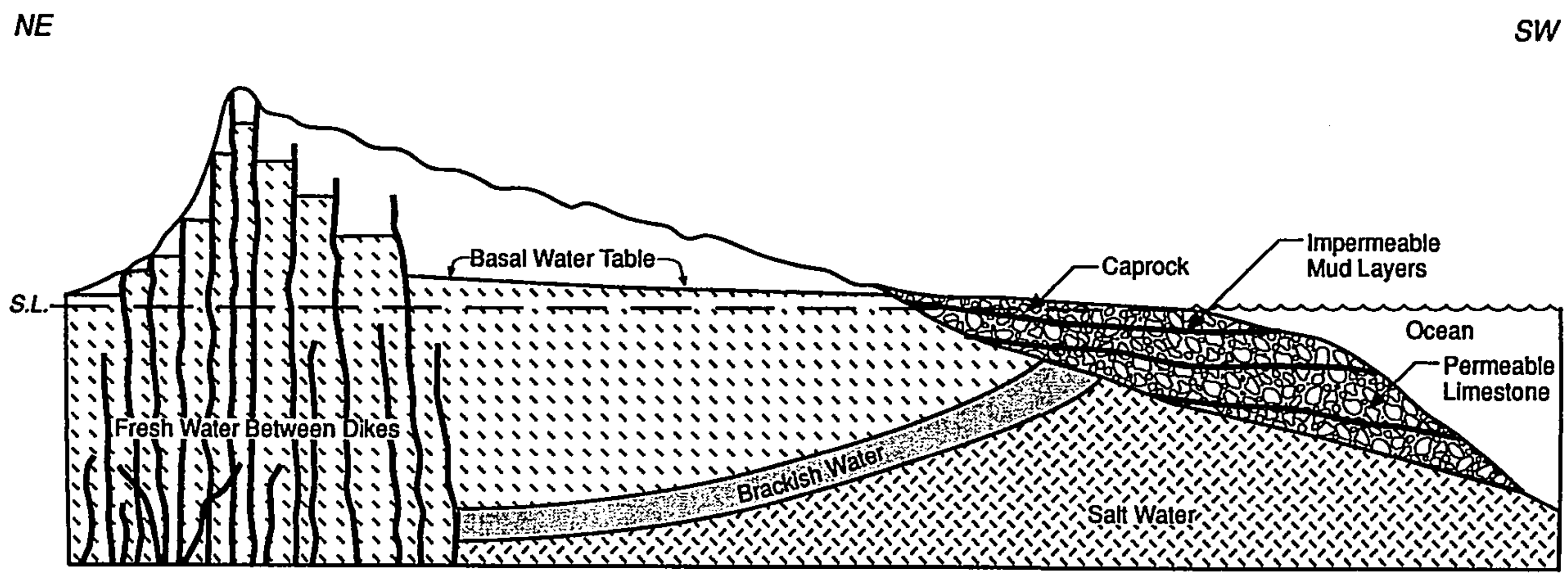

Source: *Volcanoes in the Sea; the Geology of Hawaii*, Gordon Andrew MacDonald, 1970.

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Figure 3-9
Diagrammatic Cross-Section Showing General Groundwater Conditions

Inland Waters

Inland waters are defined by the State of Hawaii as either fresh waters, brackish waters, or saline waters (HAR 11-54-02). As shown in Table 3-3, inland fresh waters include perennial and intermittent streams; springs, seeps, natural lakes, and reservoirs; elevated wetlands; and low wetlands. Inland brackish waters include coastal wetlands, estuaries, anchialine pools, and saline waters.

Table 3-3
Summary Classification of State Inland Waters Based on Ecological Systems

WATER TYPES	ECOLOGICAL SUBTYPES
Fresh waters	(1) Streams (perennial or intermittent) (2) Springs, seeps, natural lakes, and reservoirs (3) Elevated wetlands (4) Low wetlands
Brackish waters or saline waters	(1) Coastal wetlands (2) Estuaries (3) Anchialine pools (4) Saline waters

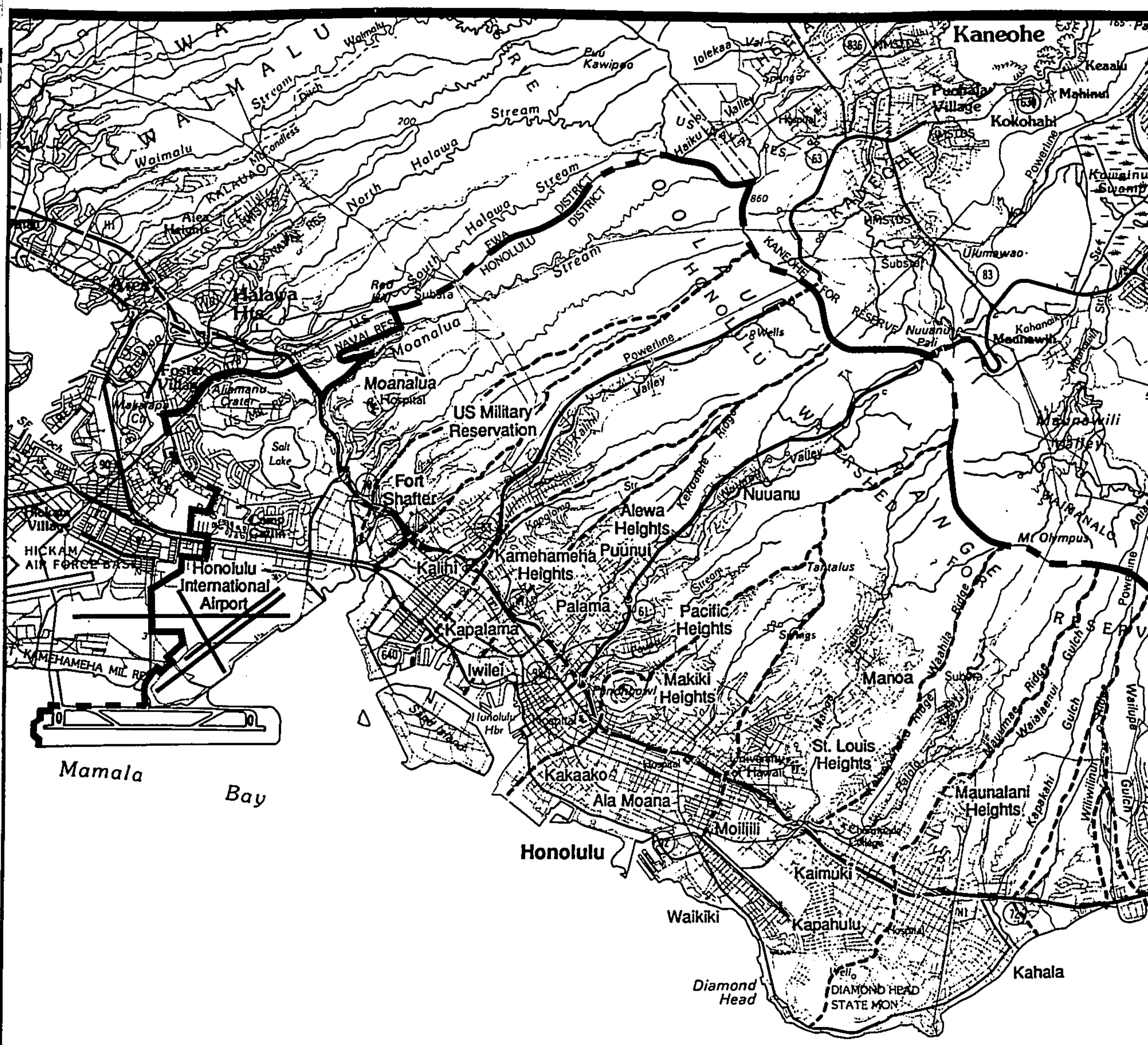
Source: Compiled from Title 11, Chapter 54, Hawaii Administrative Rules (1992). The format of this table is patterned after Table 6-2 in the 208 Plan.

Within the study area, there are no natural fresh water lakes or anchialine ponds. Wetlands are discussed in Section 3.8.1. Thus, inland waters described in this section are limited to streams, reservoirs, estuaries, and a saline lake.

Following is an overview of the hydrology of each of these inland water types.

Streams. The primary source of inland water in the study area is stream flow. A series of roughly parallel drainage basins are created corresponding to the area's numerous valleys and gulches. These drainage basins extend from the mountains to the ocean shoreline over short distances in a relatively small area, feeding the stream flow. Generally, one principal stream has several minor tributaries, forming a watershed. Figure 3-10 depicts the 14 drainage basins and watersheds in the study area. During the process of urbanization, the original course ways of most major streams have been channelized through the lower or seaward portions of the valleys and across the coastal plain.

As shown in Figure 3-11, nine streams in the study area have gaging stations which have recorded stream flow information for up to 74 years (until 1990). These nine streams are Moanalua Stream, Kalihi Stream, Waihi Stream, Waolani Stream, Nuuanu Stream, Pauoa Stream, Manoa Stream, Kuliouou Valley Stream, and Wailupe Gulch (see Table 3-4). Drainage areas associated with each station ranges from 1.06 to 9.35 square miles. Average stream flow measured at each station ranges from 3.63 cubic feet per second (cfs) to 10.6 cfs. Peak flow ranges from 792 cfs to 12,400 cfs.



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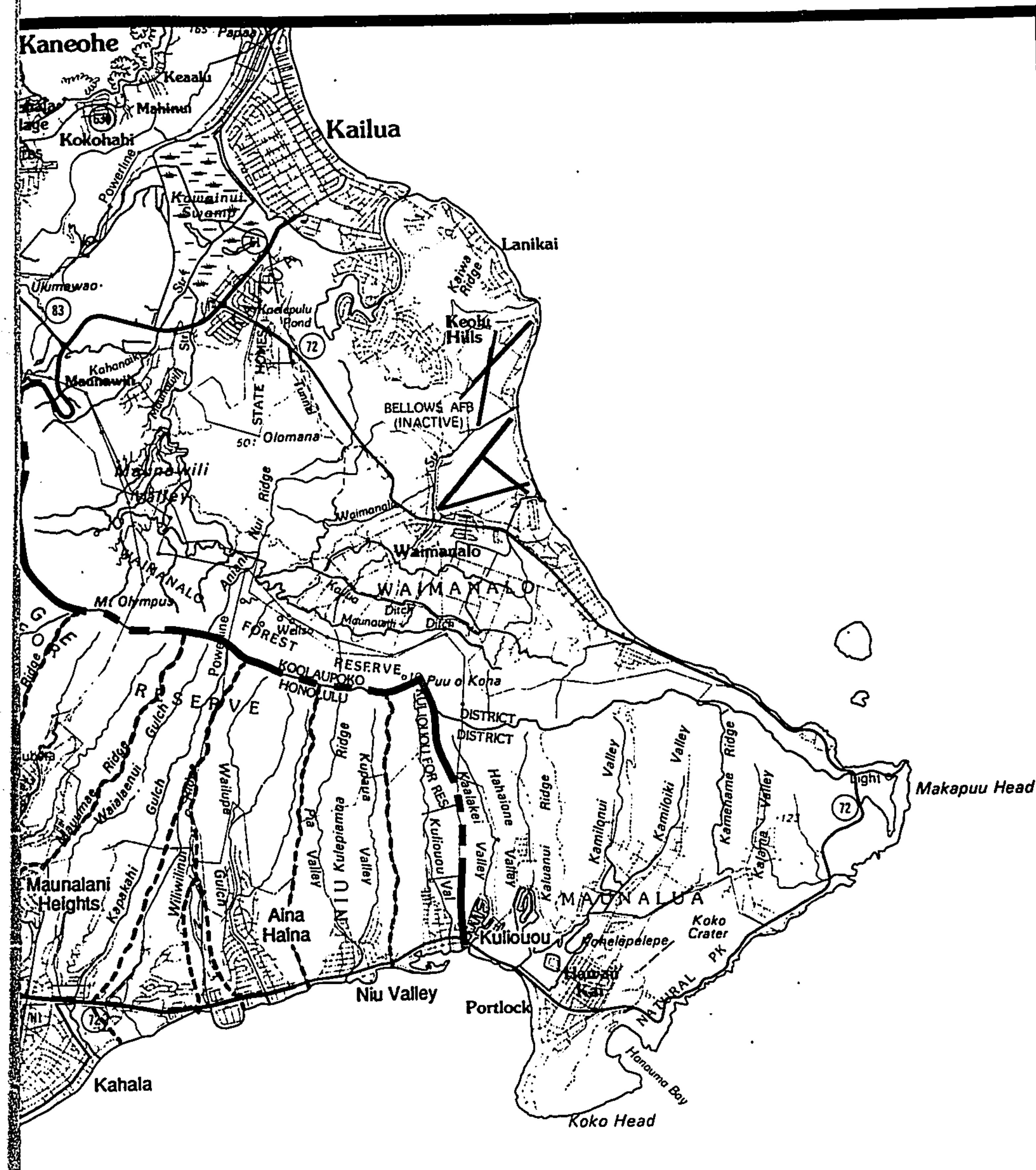
Scale in Feet

North

Legend

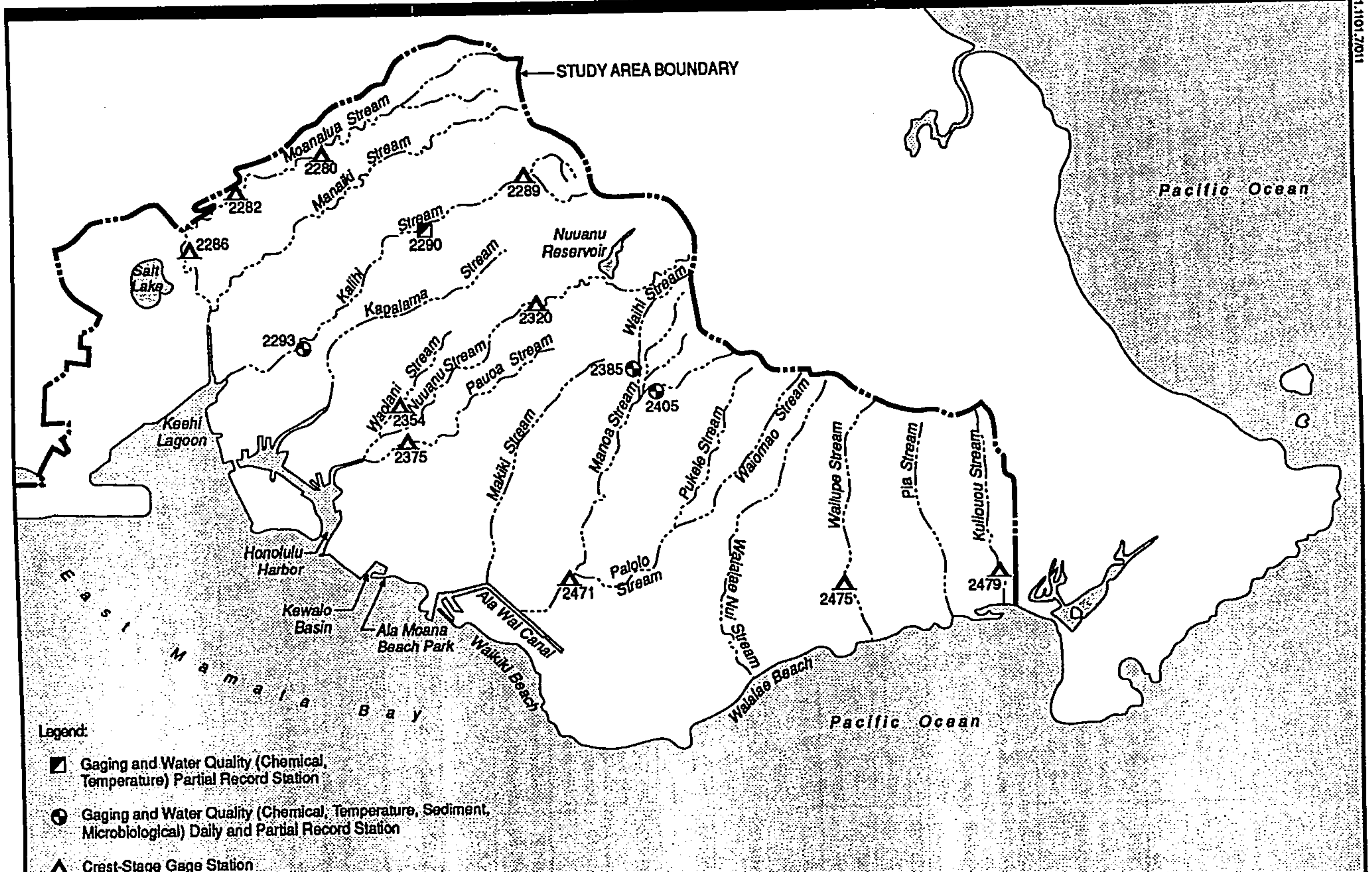
Drainage Basin Boundary

Study Area Boundary



ndary

Figure 3-10
Drainage Basins



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
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Figure 3-11
Stream Gaging & Water Quality Monitoring Stations

Table 3-4
Stream Flow Information

STATION NUMBER	PERIOD OF RECORD	NAME AND LOCATION OF STATION	AL-TITUDE (FT.)	DRAIN-AGE AREA (MI^2)	DISCHARGE INFORMATION					
					AVERAGE		PEAK		MINIMUM	
					(CFS)	YEARS	(CFS)	DATE	(CFS)	DATE
Moanalua 2288	1971-90	Moanalua Stream near Tripler Hospital	-	4.44	-	-	950	10/3/89*	-	-
2282	1969-1990	Moanalua Stream near Aiea	-	3.34	-	-	908	10/3/89*	-	-
2280	1927-90	Moanalua Stream near Honolulu	337	2.73	-	-	792	10/3/89*	-	-
Kalihi 2293	1962-90	Kalihi Stream at Kalihi	70	5.18	10.6	28	7110	4/19/74	0.16	6/24/66
2290	1913-90	Kalihi Stream near Honolulu	484.4	2.61	6.62	75	12400	11/18/30	0.09	10/22/33, 7/29/66
2289	1967-80	Kalihi Stream near Kaneohe	-	4.44	-	-	-	-	-	-
Waihi 2385	1913-21 1925-82	Waihi Stream at Honolulu	289.84	1.14	3.63	64	3250	1/16/21	0.07	1/7,8/77
Pauoa 2375	1958-90	Pauoa Stream near Honolulu	-	1.43	-	-	285	10/3/89*	-	-
Waolani 2354	1958-90	Waolani Stream at Honolulu	-	1.28	-	-	-	-	-	-
Nuuanu 2320	1913-90	Below Res. 2 Waste-way near Honolulu	631.7	3.35	7	74	6990	1/16/21	0.09	9/10, 11/25
Manoa 2471	1968-82	Manoa-Palolo Drive Canal at Moiliili	6.6	9.35	-	-	2090	10/3/89*	-	-
2405	1913-21 1925-90	Waiakeakua Stream at Honolulu	294.5	1.06	5.09	-	3090	1/16/21	0.6	6/7, 8/1928
Wailupe 2475	1958-90	Wailupe Gulch at Aina Haina	-	2.35	-	-	-	-	-	-
Kuliouou 2479	1958-59 1970-90	Kuliouou Valley at Kuliouou	-	1.18	-	-	-	-	-	-

Notes:
- \- no data; ft. denotes feet above the mean sea level; mi^2 denotes square miles; cfs denotes cubic feet per second.
- * peak for 1990 water year.

Source: USGS Water Resources Data - Hawaii and other Pacific Areas. (1982 & 1990).

Within the study area, there are ten perennial streams with modifications. The length of each stream, length of modifications and number of diversions are presented in Table 3-5. These streams carry common features of all "high island" streams in the Pacific. They are relatively short in length, rocky and precipitous in the highlands, and flat near the coastal area.

Reservoirs. The Nuuanu Reservoir is the only fresh water reservoir in the study area. It is situated in the forest reserve above Nuuanu Valley where high rainfall occurs throughout the year. This reservoir was built in 1910 for flood control purposes and was modified in 1932. Its current volume is about 625 million gallons. The reservoir is open to the public for fresh water fishing activities.

Estuaries. Estuaries are defined as "deep characteristically brackish coastal waters in well-defined basins with a continuous or seasonal surface connection to the ocean that allows entry of marine fauna" (HAR 11-54). Estuaries are distinguished as being either bay estuaries or stream estuaries. Bay estuary systems in the study area include Keehi Lagoon, Honolulu Harbor, and the Ala Wai Harbor. Generally, all bay estuaries in the study area are connected to embayments (see next section). Stream estuaries are formed at streams' entrances to the ocean. Major stream estuaries in the study area include Moanalua Stream, Kalihi Stream, Kapalama Canal, Nuuanu Stream, and the Ala Wai Canal. Table 3-6 summarizes the character of these major estuaries.

Saline Lakes. The only saline lake in the study area is Salt Lake, situated on the coastal plain fronting Moanalua Valley. Salt Lake is fed by an artesian well, as well as by periodic storm drainage. However, with no natural drainage-way to allow circulation, evaporation typically offsets infiltration and results in the maintenance of a relatively high level of salinity in the lake. Historically, stagnation of the lake over the decades resulted in a steadily increasing anaerobic condition. By the mid-1960s, the lake was rapidly evolving to an odorous marsh. However, the subsequent development of the lake area as a golf course, which included infilling major portions of the lake, reversed the natural process and converted the lake into the pattern of channels and wetlands arrayed among golf course fairways that exist today.

Table 3-5
Perennial Streams in the Study Area

NAME OF STREAM	STREAM FLOW STATUS	TOTAL CHANNEL LENGTH (MILE)	LENGTH OF MODIFICATIONS	NUMBER OF DIVERSIONS
Moanalua Stream	Interrupted	27.3	9.4	—
Kalihi Stream	Continuous	11.2	3.0	1
Kapalama Stream	Interrupted	5.6	5.6	—
Nuuanu Stream	Continuous	18.6	11.1	3
Makiki Stream	Interrupted	6.2	2.0	—
Manoa Stream	Continuous	21.1	5.2	2
Waialae Nui Stream	Interrupted	8.7	4.7	—
Wailupe Stream	Interrupted	8.1	2.0	—
Pia Stream	Interrupted	6.8	1.4	—
Kuliouou Stream	Interrupted	2.5	1.0	—

Notes:
Interrupted: Intermittent flow in a portion of channel, discharges into the sea during the wet season
Continuous: Naturally flowing to the sea year-round.
Diversion: Water diverted (Number of diversions in stream system).

Source: Modified from Maciolek and Timbol 1976.

Table 3-6
Major Estuaries in the Study Area

ESTUARY SYSTEM	BAY ESTUARY	STREAM ESTUARY	INDUSTRIAL DEV.	URBAN DEV.	ESTUARY DEV.
Keehi		Moanalua Stream	M	S	—
		Kalihi Stream	M	S,C	—
	Keehi Lagoon		M	—	H,Sb,R
Honolulu		Kapalama Canal	P,M	S,C	H,Or
		Nuuanu Stream	—	S,C	—
	Honolulu Harbor		M,Rf,E	S	—
Ala Wai	Ala Wai Harbor	Ala Wai Canal	—	S,C	—

Symbols: M—miscellaneous; P—pineapple; Rf—petroleum refinery; E—thermal power plant S—sanitary-sewered urban areas; C—urban areas served by cesspools; H—commercial harbor; Sb—small-boat harbor; R—swimming, boating, and other recreational uses; Or—sewer outfall

Source: *Estuary Pollution in the State of Hawaii*, Water Resources Research Center, 1970.

Marine Waters

As specified in HAR 11-54, marine waters are either embayments, open coastal, or oceanic waters.

Embayments. Embayments are defined as land-confined and physically protected marine waters with restricted openings to open coastal waters. Embayments are further defined by the ratio of total bay volume to the cross-sectional entrance area of seven hundred to one or greater. There are five embayments along the shorelines of the study area. These are Keehi Lagoon, Honolulu Harbor, Kewalo Basin, Ala Wai Boat Harbor, and waters bounded by Paiko Peninsula at the end of the east boundary of the study area.

Open Coastal Waters and Oceanic Waters. Open Coastal Waters are marine waters bounded by the one hundred fathom (600 foot) depth contour and the shoreline, excluding embayments. All other waters outside the one hundred fathom contour are Oceanic Waters.

These waters include recreational areas such as Sand Island, Fort DeRussy, Waikiki, Kuilei Cliffs, Waialae, Aina Haina, Ala Moana, Kewalo, Waikiki, and Diamond Head beaches.

3.3.5 GROUNDWATER QUALITY

Groundwater serves as the major source of drinking water on Oahu. In this section, potable and non-potable groundwater in the study area are evaluated using data gathered from BWS, DOH, and USGS.

Drinking water sources are monitored to ensure their compliance with the drinking water standards (HAR 11-20). Other groundwater resources are monitored to serve various purposes which include the establishment of baseline data, research, and some site-specific investigations. These efforts will ultimately contribute to the evaluation of the integrity of the groundwater resources.

Potable Water

In order to ensure the quality of drinking water, the BWS continuously monitors chemical and microbiological data in pot water sources. These data are summarized in the BWS's annual reports where they are to determine regulatory compliance compared with Federal (EPA, SDWA) and State drinking water standards (HAR 11-20). Data on pH, alkalinity, hardness (mineral content), and chloride content are included in these reports. Bacteriological certification results are also reported. Among the wells in the Honolulu District, two (Waimalu Well 1 and Kaonohi Well 1) were still secured for high chloride content during 1991 fiscal year.

In 1991, the EPA established a stricter Coliform Rule under the SDWA. This new regulation bases compliance on the presence or absence of total coliform organisms rather than on a concentration limit, and requires testing for fecal coliforms as well. In an effort to comply with this new rule, a total of 1,584 samples were obtained for coliform testing of the water system during half a year period (BWS, 1991). From July 1, 1990 to June 30, 1991, the number of total coliform-positive samples did not exceed 5.0 percent of all samples for systems examining 40 or more samples per month. Overall, the quality of the drinking water is high in the East Mamala Bay area. However, the potential impact of salt water intrusion, existing cesspools, and underground injection wells on drinking water sources should be recognized.

Nonpotable Water Quality

Potential sources of nonpotable water contamination are mainly related to cesspools and underground waste disposals.

To protect the integrity of the groundwater resources, the Environmental Management Division of DOH recently combined the drinking water and nonpotable groundwater monitoring activities into a single monitoring program for evaluating chemical contaminants. In its *Groundwater Contamination Report* (DOH, 1992), DOH presented monitoring results for one well (or well field) in Manoa Valley from the study area. Perchlorolethylene (PCE) was the only contaminant of concern detected at the elevated level of 0.03 parts per billion (ppb), which, however, is well below the applicable drinking water standard of 5.0 ppb.

Groundwater quality data were also obtained from the USGS. Based on *Water Resources Data for Water Year 1990*, there are water quality records for only four groundwater wells. Specific conductance, temperature and dissolved chloride contents were reported for each sampling event and these are presented in Table 3-7.

High levels of specific conductance and chloride were recorded in one well (3-1851-19). This provided an indication that salt water intrusion to the groundwater resources is occurring in parts of the study area. High pumpage of inland potable water may aggravate the salt water intrusion process, and in the long-term, may affect chloride levels of pot water sources.

3.3.6 QUALITY OF INLAND AND COASTAL WATERS

Water quality data are collected mainly in water bodies in commercial or recreational areas, where public health or aquatic life is of great concern. This section provides an evaluation of water quality based on data obtained from sources as identified in each subsection.

Table 3-7
Water Quality on USGS Groundwater Wells in the Study Area

WELL NO.	LOCAL IDENTIFIER	DATE	S.C. US/CM	TEMP. DEG C	CHLORIDE MG/L AS CL	DATE	S.C. US/CM	TEMP. DEG C	CHLORIDE MG/L AS CL
3-1646-01	W1-B Waial	3-Nov-88	710	21	-	1-Nov-89	740	21	-
		30-Mar-89	710	21	-	5-Apr-90	700	21.5	-
		23-May-89	850	21.5	-	18-Jun-90	735	21.5	-
		11-Jul-89	810	21.5	-	15-Aug-90	830	21	-
						25-Sep-90	840	21	-
3-1851-19	W102 TubeA	2-Dec-88	32000	23.5	12000	1-Nov-89	34,000	23.5	12,000
		16-Feb-89	31000	23.5	12000	13-Dec-89	34,000	23.5	12,000
		4-Apr-89	32000	23	12000	7-Feb-90	34,000	23.5	12,000
		23-May-89	34000	23.5	12000	5-Apr-90	34,000	23.5	12,000
		11-Jul-89	34000	23.5	12000	18-Jun-90	32,000	23.5	11,000
						15-Aug-90	32,200	-	11,000
						25-Sep-90	30,000	24	12,000
3-1851-19	W102 TubeB	2-Dec-88	8000	23	-	1-Nov-89	8,600	23.5	-
		16-Feb-89	8000	23	-	13-Dec-89	8,700	23.5	-
		4-Apr-89	8100	23.5	-	7-Feb-90	9,000	23.5	-
		23-May-89	8500	23	-	5-Apr-90	9,200	23.5	-
		11-Jul-89	8200	23.5	-	18-Jun-90	9,400	23.5	-
						15-Aug-90	9,550	23.5	-
						25-Sep-90	9,600	24	-
3-2153-02	W153 Moana	11-Oct-88	440	21.5	86	13-Dec-89	455	21.5	76
		2-Dec-88	440	21.5	86	21-Feb-90	450	21.5	64
		14-Feb-89	450	22	85	5-Apr-90	460	21.5	86
		13-Apr-89	460	21.5	86	18-Jun-90	450	21.5	86
		19-May-89	460	21.5	88	14-Aug-90	458	21.5	84
		11-Jul-89	460	22	86	25-Sep-90	440	22	84
		27-Sep-89	460	22	88				

Note: SC refers to specific conductance; Temp. refers to temperature.

Source: USGS Water Resources Data Hawaii and other Pacific Areas (1989 and 1990)

As shown in Figure 3-12, inland waters in the study area classified as beneficial use Class 1 waters consist of inland waters on the upper Nuuanu Watershed which lies on the Koolau Range Crest. Class 2 waters is the beneficial use classification of all other inland waters in this area.

Most of the coastal waters in the study area are classified as beneficial use Class 1 waters. Class 2 waters are only encountered at Sand Island State Park and Paiko Peninsula Reserve.

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Most of the coastal waters in the study area are classified as beneficial use Class 1 waters. Class 2 waters are only encountered at Sand Island State Park and Paiko Peninsula Reserve.

Stream Water Quality

Streams in the study area frequently experience high levels of turbidity, nutrients, and fecal coliform. Although most of the streams are not regularly monitored, sporadic water quality data can be found in newspaper and technical reports, usually as a result of special studies or issues. Poor water quality has been reported in Kapalama Canal (WRRC, 1972). Based on DOH heavy metal analysis reports (1990 and 1991), elevated levels of dissolved metals in Manoa Stream and Makiki Stream were detected, but well below the numeric standards (see Table 3-8). In general, the nature and extent of pollution in these streams is not well understood.

Table 3-8
Concentrations (in ppb) of Dissolved Heavy Metals in Waters in the Study Area

STATION NAME – LOCATION	SILVER	ARSENIC	CADMIUM	CHROMIUM	COPPER	MERCURY	NICKEL	LEAD	SELENIUM	TITANIUM	ZINC
Keehi Lagoon [1]	40.005	1.08	0.0403	0.20	1.23	0.00044	1.41	0.15	<1.67	<1.57	4.28
Ala Wai Canal [1]	<0.001	1.19	0.0395	0.32	2.07	0.00039	2.64	<0.07	<1.27	<1.5	8.51
Mamala Bay (oceanic)	<0.002	1.42	<0.022	0.16	1.39	0.00041	1.01	0.12	<1.59	<1.50	1.35
Mamala Bay (open coastal)	0.004	1.68	<0.002	0.13	0.41	0.00048	0.74	0.12	<1.59	<1.50	3.51
Kapalama Canal (mouth)	0.002	1.54	0.032	0.27	1.27	0.00084	1.92	0.17	<1.59	<1.50	14.84
Kalihi Stream (mouth)	<0.001	0.66	0.014	0.31	1.09	0.00100	1.20	<0.04	<1.59	<1.65	2.34
Moanalua Stream (mouth)	<0.002	0.72	0.003	0.18	0.76	0.00370	1.80	<0.07	<1.59	<1.50	4.88
Manoa Stream (above Palolo)	<0.002	0.40	<0.002	0.18	0.78	0.00085	2.06	<0.07	<1.59	<1.50	5.67
Makiki Stream (Pualoki Pl.)	<0.002	0.44	<0.002	0.9	1.53	0.00255	1.87	0.10	<1.59	<1.50	4.86
Manoa Stream (Date St.)	<0.002	0.3	<0.002	0.16	1.03	0.00051	2.07	<0.07	<1.59	<1.50	1.89
Honolulu Harbor S (Diamond Head End)	0.003	1.51	0.165	0.39	2.03	0.00075	1.60	0.29	<1.59	<1.50	17.00
Honolulu Harbor M (Diamond Head End)	<0.002	1.28	<0.002	0.13	0.58	0.00048	0.62	0.07	<1.59	<1.50	2.43
Honolulu Harbor B (Diamond Head End)	<0.002	1.42	0.051	0.18	0.72	0.00043	1.38	0.19	<1.59	<1.50	5.13
Honolulu Harbor S (Mid Channel)	<0.002	0.87	0.047	0.23	1.09	0.00036	1.43	0.14	<1.59	<1.50	5.67
Honolulu Harbor M (Mid Channel)	<0.002	1.44	0.008	0.18	1.11	0.00104	2.16	0.12	<1.59	<1.50	2.70
Honolulu Harbor B (Mid Channel)	<0.002	1.39	<0.002	0.25	0.65	0.00050	2.43	<0.07	<1.59	<1.50	3.51
Honolulu Harbor S (Ewa End)	0.004	1.37	<0.002	0.18	1.28	0.00041	1.31	0.07	<1.59	<1.50	5.13
Honolulu Harbor M (Ewa End)	0.0035	1.34	<0.002	0.33	1.115	0.00035	1.745	0.1	<1.59	<1.50	4.86
Honolulu Harbor B (Ewa End)	0.003	1.62	<0.002	0.13	1.15	0.00040	1.67	0.14	<1.59	<1.50	3.78
Maximum	0.005	1.68	0.051	0.9	2.07	0.00255	2.64	0.29	N/A	N/A	17.00
Minimum	<0.001	0.3	<0.002	0.13	0.41	0.00036	0.62	<0.04	N/A	N/A	1.35
Numeric Standards [2]	NS	36	9.300	50	2.90	0.02500	8.30	5.60	71	NS	86

Notes:

[1] Stations were sampled twice during the years of 1990 and 1991; all other stations were sampled only once during the two-year period.

[2] The numeric standards presented are the most stringent. "NS" indicates that no standards have been set.

Source: Department of Health, Clean Water Branch, April-May 1991.

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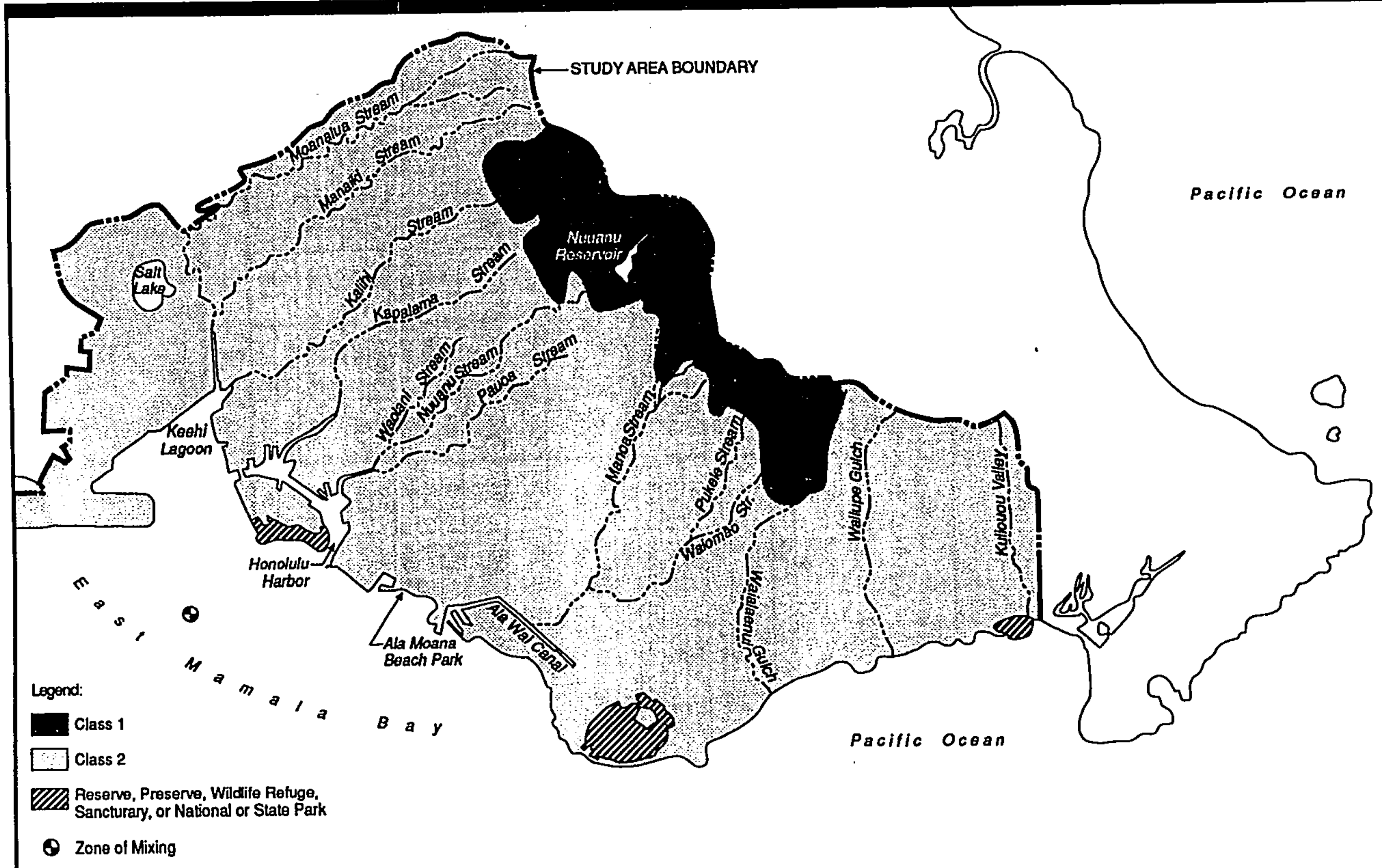


Source: Water Quality Standards Map, October 1987

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

10,000 5,000 0 10,000
Scale in Feet

North

Figure 3-12
Surface Water Quality Map

Among all the streams in the study area, Kalihi Stream has the most water quality information. Since 1970, Station 2293 (Kalihi Stream at Kalihi) has been listed in the National Stream Quality Accounting Network monitored by USGS. Samples from these stations were analyzed for conventional water quality parameters including pH, temperature, total nitrogen, total phosphorus, and fecal coliform, on a bimonthly or quarterly basis. Trace metals such as iron, lead, lithium, and manganese, and some organic chemicals (PCB, chlordane) were also measured quarterly. Finally, particle-size distribution of suspended sediment was also analyzed quarterly.

Monitoring results are shown in Table 3-9. Nitrate-nitrite, total phosphorus, and total suspended solids (TSS) measurements well exceed the geometric mean standards for the wet and dry seasons (see Table 2-6) during the 1986 and 1991 water years (October to September). The geometric mean levels for three criteria in wet seasons are consistently higher than those in dry seasons. When compared with inland recreational water standards for fecal coliform density (see Table 2-10), the levels far exceed the geometric mean limit. The fecal coliform levels also exhibit a wet-dry season periodicity.

Table 3-9
Water Quality in Kalihi Stream

DATE	PH	DO %	TEMP. DEG C	S.C. µS/CM	TN µG N/L	NO3-NO2 µG N/L	TP µG/L	TSS MG/L	TUR-BIDITY NTU	FC CFU/ 100 ML
14-Oct-86	7.5	96	25	206	-	-	-	119	5.2	13000
9-Feb-87	8.2	98	21	241	-	220	50	138	2.1	11000
20-Apr-87	7.8	89	22	169	-	170	40	102	4.7	6400
25-Aug-87	7.4	97	25	260	-	150	60	144	2.9	9600
20-Oct-87	7.7	91	25	237	-	180	50	142	1.8	11000
23-Feb-88	7.2	104	22	190	-	180	60	107	6.9	11000
20-Apr-88	8.1	106	22	245	-	100	80	138	0.5	5400
30-Aug-88	8.1	101	25	240	-	190	100	134	4.6	9100
31-Oct-88	7.9	93	24	195	-	160	50	108	3.3	4400
27-Feb-89	7.9	96	21	275	-	190	40	144	1.5	8100
1-May-89	8.4	101	21	195	-	130	30	105	1.9	3000
21-Aug-89	7.9	99	24	122	-	100	100	74	26	11000
24-Oct-89	8.2	92	24	226	-	-	70	134	2.9	6600
27-Feb-90	8.1	99	20	221	-	-	40	136	2.8	5200
1-May-90	8.3	110	24	240	-	-	70	144	1.6	3900
28-Aug-90	6.8	-	24	205	30	100	50	119	0.7	960
10-Oct-90	8.1	106	25	210	-	100	40	136	2.2	5300
12-Feb-91	7.6	99	22	265	-	100	1000	154	2	6600
22-Apr-91	8.5	109	25	385	-	190	50	133	1	23000
12-Aug-91	7.3	100	24	218	-	110	60	123	1.5	13000
Wet Season GeoMean	NA	NA	NA	NA	-	149	73	130	2	8480
Dry Season GeoMean	NA	NA	NA	NA	-	132	58	122	3	6177

Notes:

DO refers to dissolved oxygen; S.C. refers to specific conductance; Temp. refers to temperature; TN refers to total nitrogen; TP refers to Total Phosphorus; TSS refers to total suspended solids; cfu refers to coliform forming unit. Underlined numbers exceed water quality standards.

Source: USGS Water Resources Data Hawaii and Other Pacific Areas (1986 to 1991)

Water Quality Limited Segments (Estuaries and Embayments)

As discussed in Section 2.3.1, Water Quality Limited Segments (WQLSs) are water bodies which, without additional action to control nonpoint sources of pollution, cannot reasonably be expected to attain or maintain State water quality standards. Four water quality limited segments are located in the study area: Ala Wai Canal, Kewalo Basin, Honolulu Harbor, and Keehi Lagoon. These segments are within or drained into embayments and estuaries (see Figure 2-1).

Estuaries are inland waters while embayments are marine waters. Estuaries in the study area are generally poor in water quality, and frequently exceed water quality standards for nitrogen, phosphorus, and turbidity, especially after rains. These waters are not always safe for swimming since these waters frequently exceed recreational water quality standards.

Based on DOH heavy metal analysis reports (1990 and 1991), dissolved metals in stream estuaries such as Ala Wai Canal, Kapalama Canal, Kalihi Stream, and Moanalua Stream were detected, but at levels well below numeric standards for chronic effects in seawater (refer to Table 3-8). Similar results are also found in bay estuaries such as Keehi Lagoon and Honolulu Harbor.

The four Water Quality Limited Segments are discussed as follows based on "Hawaii's Assessment of Nonpoint Source Pollution Water Quality Problems" (DOH, 1990). The possible sources of pollution are mainly nonpoint sources, as discussed below.

Ala Wai Canal

The Ala Wai Canal is a two-mile long man-made canal located in the middle of the study area, extending southeast by northwest to physically separate Waikiki from the rest of urban Honolulu. The canal originates at the Ala Wai Boat Harbor and runs to Kapahulu Avenue where it "dead-ends" near the Honolulu Zoo. The canal is comprised of two sections joined by a 45 degree elbow. The first section is roughly 818 yards long by 82 yards wide. Depth ranges between 39.3 inches and 9.8 feet, and averages 6.5 feet; where the canal is dredged, it is a uniform 9.8 feet (Fox and Freeman, 1992). The canal covers an area of approximately 12 acres.

The canal was built in 1927 as a marsh reclamation project to control mosquitoes. In addition to draining the marsh, however, the canal was also designed to drain runoff from forest reserves and urban areas. The canal also receives stream flows from Manoa and Palolo Stream and their tributaries.

The Ala Wai Canal and Harbor regularly exceed general water quality standards for nitrogen, phosphorus, turbidity, and bacteria. Based on January 1990 to July 1992 enterococci monitoring data, recreational water quality standards were violated 100 percent of the time during both wet and dry seasons. Again, the wet and dry season periodicity is observed when geometric means are compared, with 277 colony forming units (cfu) per 100 milliliters (ml) during the wet season and 111 cfu/100 ml during the dry season. Cursory observation of the channel indicates that basic water quality standards (e.g., nutrient levels, sediment levels, and litter and garbage disposal) are also commonly violated. Toxins (including chlordane, dieldrin and heptachlor epoxide) and heavy metals (including lead and copper) have been identified in sediments in the canal and in fish tissue samples taken from the canal.

In the report, *Toward a Management Plan for the Ala Wai Watershed*, prepared for Edward K. Noda & Associates (September 1992), Fox and Freeman concluded that the Ala Wai Canal and its watershed face numerous water quality problems, based on a review of literature and a reconnaissance survey of the canal and its watershed. They pointed out that the major problems include high sediment loads; high levels of fecal coliform bacteria; high levels of lead and copper; high levels of the pesticides dieldrin, chlordane, and heptachlor epoxide; and litter and garbage dumping throughout the watershed.

In spite of the water quality and general condition of the canal, the Ala Wai continues to support recreational uses. In the past, fishing, crabbing, and canoeing were important recreational activities along the Ala Wai Canal. However, high levels of pesticides and bacteria are found in tissue of fish taken from the Ala Wai.

Construction activity in Waikiki and urbanization of the McCully, Manoa Valley, and Palolo Valley districts contribute sediment input and stormwater runoff into the Ala Wai Canal. Although major construction activities upstream have ceased, nonpoint sources and urban runoff continue to drain into the canal. The canal extends to the ocean at Ala Wai Harbor and eastern end of Ala Moana Beach Park (Magic Island), where recreational activities can be affected.

Based on recent research conducted by OI Consultants, the nutrient load to the Ala Wai Canal is attributed to groundwater seeping into the canal itself and/or into the Manoa-Palolo Drainage Canal, and also to natural sources high in the watershed.

Kewalo Basin

Kewalo Basin is located on Oahu's southern coast, approximately one mile west of Ala Wai Harbor. The WQLS extends from the Honolulu Channel to the east end of Kewalo Basin, and is bounded by the 30-foot depth contour. It covers approximately 10 acres of ground.

Kewalo Basin is the principal commercial fishing port in Hawaii. The basin also provides a port for various leisure vessels which serve the tourist industry, supports dry dock and mooring facilities, the University of Hawaii's Kewalo Marine Lab and the U.S. Fish and Wildlife Service's facilities.

Two major storm drains discharge into Kewalo Basin. One of these storm drains collects runoff from extensive areas of commercial areas to the north. The other storm drain serves the Ward Avenue-Kakaako District, a district consisting of mostly light industrial and commercial businesses. All areas are surrounded and affected by heavy vehicular traffic.

Kewalo Basin's design hinders circulation of water in the basin. As a result, the urban pollutants that collect in the basin remain concentrated for extended periods. Kewalo Basin is an example of how nonpoint source discharges can influence the water quality of dredged basins. Discharge from Kewalo Basin occurs adjacent to Ala Moana Beach Park.

Although the State conducted only limited monitoring of Kewalo Basin, it has received complaints of various spills of oil and paint into the basin from storm drains. Based on a special study and observations of the basin, DOH has determined that storm water runoff into the basin causes exceedance of water quality standards for nitrogen, phosphorus, and turbidity and, thus, Kewalo Basin has been included in the State's list of WQLSs.

Honolulu Harbor

Honolulu Harbor is located between Honolulu and Sand Island. Historically, the Harbor fronted Nuuanu Stream, and the freshwater flow of Nuuanu Stream formed a natural channel in the reef leading out into Mamala Bay. The channel was expanded and deepened through dredging. Later, Kapalama Basin was added to the harbor. Now Honolulu Harbor is bounded by the bridge which leads to Sand Island, and the Honolulu Channel. The harbor receives flows from Kapalama Stream, Nuuanu Stream, and their tributaries. The segment lies within this boundary and extends to the 30-foot-depth contour to cover an area of 1,775 acres.

Studies of the Harbor indicate that coliform bacteria, nitrogen, phosphorus, turbidity, and bacteria levels in the water regularly exceed State water quality standards. Honolulu Harbor is one of two commercial deep-draft harbors on Oahu. Due to its location in the Pacific, Honolulu has become an important port of call. Besides the normal port services and businesses, Honolulu Harbor is a Foreign Trade Zone, Headquarters for the 14th Coast Guard District, and home of the University of Hawaii's Marine Center. Many types of goods ranging from pineapple, cattle, and automobiles to petroleum products enter and exit the State through this harbor. Generally, these harbor activities are unaffected by the quality of harbor water. Moreover, harbor activities contribute to the degraded condition of the harbor waters.

Honolulu Harbor receives runoff from the highly industrial areas adjacent to it. The harbor lacks effective tidal and stream flow circulation and flushing. Although harbor modifications have been conducted and have improved the harbor's circulation, harbor water residence time remains long enough to show the effects of water pollution from drainage canals and streams in the surrounding areas. Harbor waters potentially affect Sand Island Beach Park and Keehi Lagoon.

Keehi Lagoon

Keehi Lagoon is located on the southern coast next to Honolulu Harbor. The WQLS extends from the airport reef runway to the bridge which leads to Sand Island and is bounded by the 30-foot-depth contour. The lagoon receives stream flows from Moanalua, Kalihi, and Kapalama Streams and their tributaries. It covers an area of 3,550 acres.

Although its circulation is good, Keehi Lagoon regularly experiences violations of water quality standards for phosphorus, turbidity, and bacteria. This may be caused by Oahu's southern coastal waters, which move from Honolulu Harbor into Keehi Lagoon, which have the potential to transport the polluted waters of Honolulu Harbor into Keehi Lagoon and recirculate suspended matter within the lagoon.

Light industries, businesses, parks, and harbor facilities line the lagoon's shoreline. On the northeast shore of the lagoon is a small boat harbor, a marina and dry dock, and a number of light industrial baseyards. The northwest shore is primarily an open, filled area. A park is located on the extreme northern portion of this shore. Keehi Lagoon is value for its fishery and wildlife resources and is presently used for bait fishing, crabbing, and to some extent, recreational fishing. The lagoon is extensively used for boating. The two public boat ramps of the Keehi Small Boat Harbor are heavily used during weekends and holidays.

Keehi Lagoon's shoreline is nearly all man-made. Two perennial streams enter into Keehi Lagoon at its northern end—Moanalua Stream and Kalihi Stream. Nonpoint source runoff from these streams contributes considerably to the pollution of Keehi Lagoon. Both streams receive runoff from the Mapunapuna industrial area, the Army's Fort Shafter, Tripler Army Medical Center, residential Kalihi Valley, major highways, and the airport industrial area.

Summary

Within approximately 20 miles of study area shoreline, there are seven miles of WQLSs, which cover 5,347 acres. Watersheds associated with WQLSs cover approximately 62 percent of the study area, indicating that 62 percent of the study area may potentially contribute to the deterioration of water quality in these segments. Table 3-10 summarizes the acreage of the segments, major land use, pollutants, and major potential sources of pollution.

3.3.7 QUALITY OF MARINE RECREATIONAL WATERS

The quality of marine recreational waters in the study area is evaluated based on data from 15 shoreline stations from the DOH "Storet" database. Locations of the stations, which are distributed along Ala Moana Beach, Waikiki Beach and Waialae Beach, are shown on Figure 3-13. Table 3-11 summarizes the percent of samples that exceeded bacterial standards for recreational waters during wet and dry seasons. This analysis differs from that used to determine compliance, which is based on the geometric mean of a minimum of five consecutive sampling events, equally spaced over a 5-year period.

Table 3-10
Acreage, Major Land Use, Pollutants, and Sources of Pollution at Water Quality Limited Segments

SEGMENT		ALA WAI CANAL	KEWALO BASIN	HONOLULU HARBOR	KEEHI LAGOON
AREA (ACRES)	Segment	12	10	1,775	3,550
	Watershed	10,400	4,000	7,000	10,200
LAND USE (% APPROX.)	Forest	50	40	45	50
	Urban	50	60	55	50
MAJOR USES AND VALUES	Recreation	x			x
	Economic	x	x	x	x
POLLUTANTS	Litter Solids	x	x	x	x
	Turbidity/ TSS	x	x	x	x
	Nutrients	x	x	x	x
	Heavy Metals	x	x	x	
	Pesticides	x	x	x	
	Pathogens	x		x	
MAJOR SOURCES OF POLLUTION	Major Streams	Manoa, Palolo & Makiki		Nuuanu & Kapalama	Moanalua, Manaiki & Kalihi
	Urban Runoff	x	x	x	x
	Storm Drains	x	x	x	
	Point Sources	x		x	x

Source: Compiled from 208 Plan for City and County of Honolulu (1990) and A Report of the Hawaii Environmental Risk Ranking Study to DOH (1992)

The exceedance percentage is significantly higher in the wet versus the dry season. This matches the pattern found in stream fecal coliform concentrations, and supports the identification of streams (as collectors of land-based urban runoff) as a significant contributor to violations of recreational water standards.

Overall, during wet seasons, the recreational use of Waikiki Beach (especially in Kahanamoku Lagoon, Fort DeRussy Beach, Kuhio Beach, and Waialae-Kahala Beach) is more frequently threatened by bacterial levels than at other stations along the shoreline.

Waialae Beach Park is located west of Kahala Hilton on the Kahala shore. Kapakahi Stream discharges stream flow into coastal water through Muliwai Canal. The intermittent stream passes through Waialae Golf Course and a residential area, and carries urban and golf-course runoff such as waste, silt, and sedimentary material into the ocean.

In November 1988, this beach was listed as one of the four sites affected by nonpoint sources on Oahu by DPW.

Table 3-11
Analysis of Shoreline Recreational Water Quality Information by Wet and Dry Season

STATION NAME AND NUMBER		NO. OF SAMPLES		NO. OF EXCEEDANCES		EXCEEDANCE %	
		WET	DRY	WET	DRY	WET	DRY
Ala Moana Park, Ewa	152	54	52	2	0	4	0
Ala Moana Park, Center	153	22	16	4	0	18	0
Ala Moana Park, Diamond Head End	154	69	90	21	8	30	9
Kahanamoku Beach, Waikiki	155	68	66	41	2	60*	3
Kahanamoku Lagoon, Diamond Head End	157	68	69	47	11	69*	16
Fort DeRussy Beach, Waikiki	158	12	18	6	3	50	17
Gray's Beach, Waikiki	159	68	71	34	3	50	4
Tavern's Beach	160	10	9	3	0	30	0
Kuhio Beach, Waikiki	161	67	69	56	46	84*	67*
Public Baths Beach, Waikiki	162	19	25	1	0	5	0
Elk's Club Beach, Waikiki	163	37	40	4	0	11	0
Sand Island Point No.3	164	48	50	13	1	27	2
Sand Island Point No.2	165	66	67	3	10	5	15
Sand Island Point No.1	166	52	49	5	1	10	2
Waialae-Kahala Beach	214	46	39	35	8	76*	21

Notes: * denotes the worst cases.

Exceedances refer to measurements exceeding the current recreational water quality standard. Wet season is assumed to extend from November to April; Dry season is assumed to extend from May to October. Stations are shown by number in Figure 3-13.

$$\text{Exceedance \% in Wet Season} = \frac{\text{No. of Exceedances in Wet Season}}{\text{No. of Samples Analyzed in Wet Season}}$$

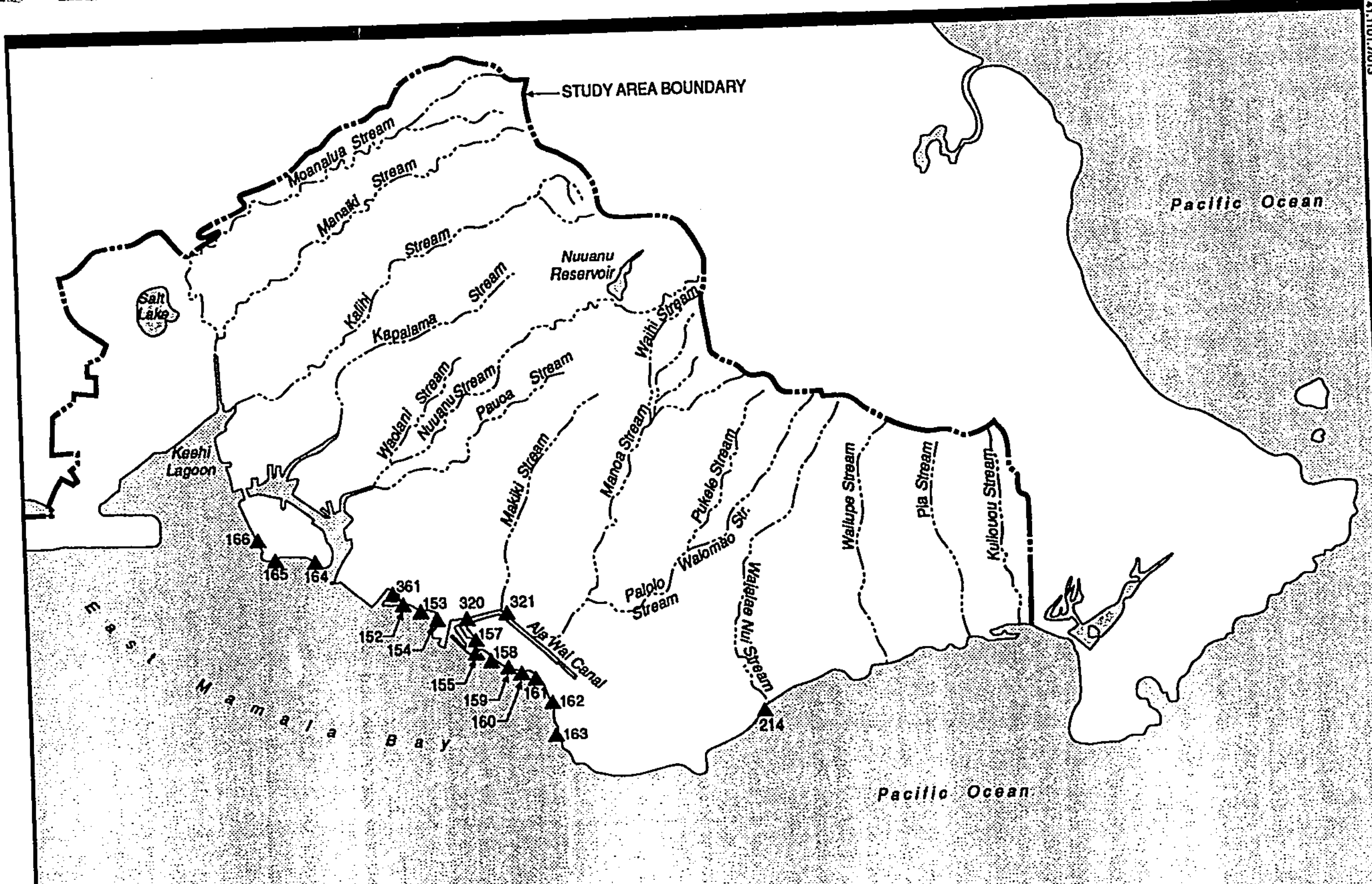
$$\text{Exceedance \% in Dry Season} = \frac{\text{No. of Exceedances in Dry Season}}{\text{No. of Samples Analyzed in Dry Season}}$$

Source: Compiled from DOH Storet Database, Jan. 1990 to July 1992 Records.

Nonpoint Sources

In the study area, nonpoint source pollution is mainly caused by rainfall moving over and through the ground, carrying contaminants. Rainwater, running off roofs, lawns, streets, industrial sites, and pervious and impervious areas, comprises surface runoff. The average runoff is 30 percent of the rainfall (208 Plan, 1990). As urban runoff travels overland, it can pick up sediment and debris; rubber, oil, grease, and other automobile-related residuals; lawn and garden fertilizers and pesticides; and lead, zinc, asbestos, PCBs, and a host of other pollutants (Novotny and Chesters, 1981).

141.1101.7/013



Source: *305(b) Water Quality Report for the State of Hawaii*, DOH, 1992.

EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

Figure 3-13
Coastal Water
Bacterial Monitoring Stations

Nonpoint sources are intermittent and originate over a broad area. Runoff contamination can be severe when flooding occurs, especially along the drainage basins in the study area. These include the Nuuanu, Manoa, and Moanalua drainage basins. Flooding may result in soil erosion especially in mountainous regions where steep slopes exist. Flooding may also result in overflow of stream waters, storm drains, and sanitary sewers through inflow and infiltration.

Surface water quality has been significantly affected by the rapid urbanization of the area. Most streams in the study area are polluted, presumably by a combination of surface runoff, storm drains, sewage, and other human-related activities. Streams collect wastes from their drainage basins, and deliver them into the estuaries and finally into the ocean where most recreational activities occur.

The uncontrollable, unidentifiable attributes of nonpoint sources make the assessment of the impacts of these pollutants difficult. The State of Hawaii only recently began to assess the impacts of these pollutants. It is known that these pollutants can adversely affect the quality of recreational water resources and affect fisheries and other aquatic life.

Areas of high concern include popular recreational (shoreline) areas such as Ala Moana, Kuhio, Waikiki, and Waialae beaches. These beaches, especially Kuhio Beach, have frequently experienced chronic exceedance of State water quality criteria during both wet and dry seasons.

Incidences of lowered water quality have occurred in the study area episodically. Possible sources are urban runoff and offshore nonpoint-source runoff during heavy rainfall, sewage plant bypasses, and sewage collection system releases. Predominant sources of certain contaminants can be inferred from evaluation of patterns in occurrence.

Water quality data for the study areas falls into one of three general patterns. Similar to a pattern identified in the 1991 DOH *Water Quality Report*, there is a pronounced wet season–dry season periodicity. Bacterial counts during the wet season, estimated to run from November through April, frequently exceed counts during the dry season, estimated to run from May through October. This pattern is evident in fecal coliform levels at Kalihi Stream Station and also in enterococci levels measured at shoreline stations.

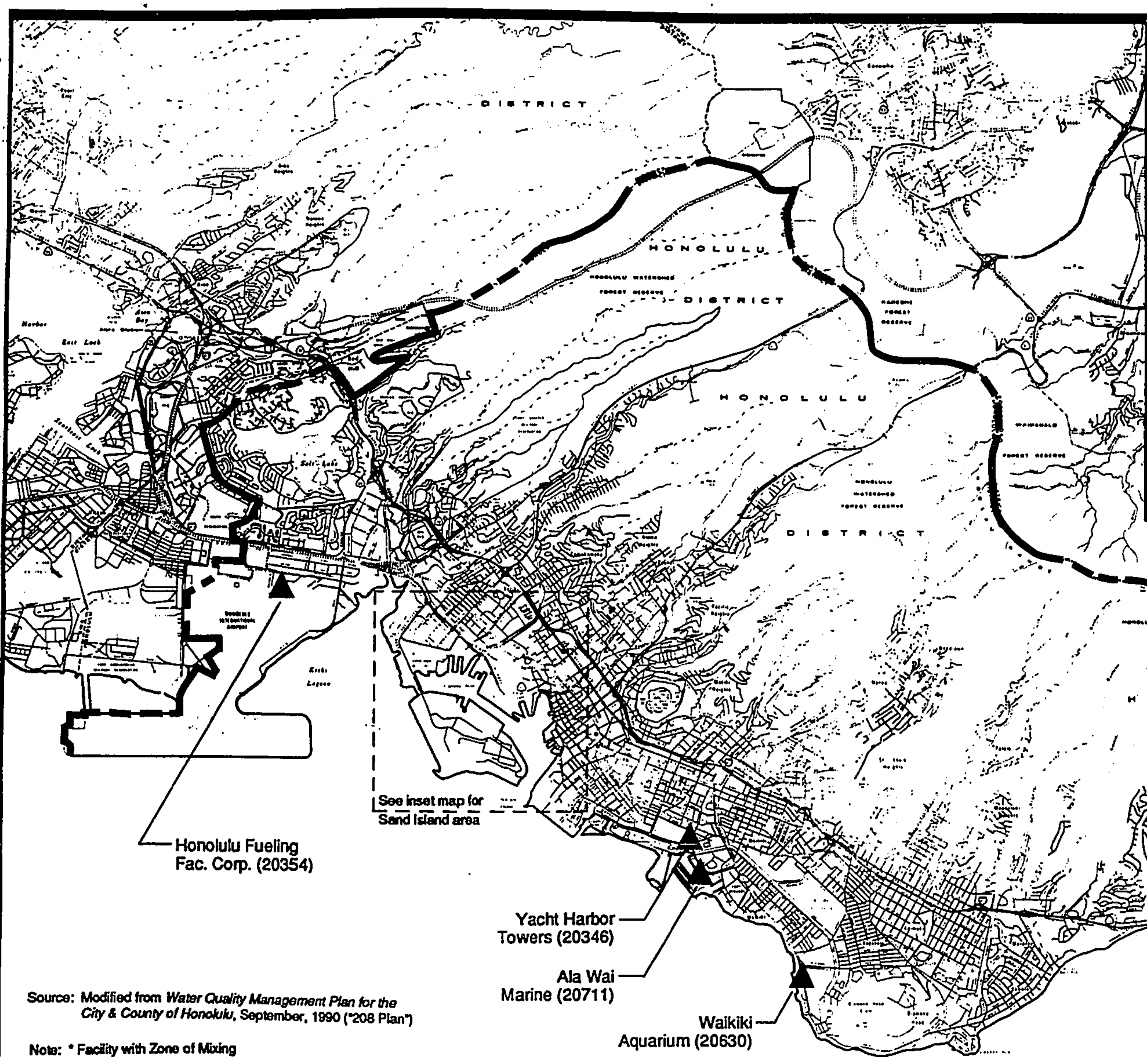
Point Sources

Discharges of pollutants from point sources are regulated through the NPDES Program as described in Section 2.3.2. During 1990 and 1991, there were 13 industrial dischargers and one municipal discharger (Sand Island WWTP) in the study area (see Figure 3-14). These dischargers are listed in Table 3-12. Six violations were recorded for four industrial dischargers in the study area. Such violations were attributed to oil and grease, pH, TSS, and BOD_5. Waikiki Aquarium has the highest number of violations among these dischargers. The other violations are from minor dischargers.

Sand Island WWTP is the only municipal discharger in the study area. Based on DOH records, no violations were recorded during 1990 and 1991.

3.3.8 SUMMARY OF WATER QUALITY PROBLEMS

The majority of drinking water for the study area is from groundwater resources. The geologic structure of Oahu provides for the formation of a parabasil fresh water lens that goes replenished by the high infiltration of rainwater through the porous volcanic soils. The groundwater resources in the study area are of good quality. Microbial contamination and salt water intrusion from over-withdrawal are sources of potential pollution to groundwaters in the study area. Leaching cesspools and exfiltration occurring in sewage collection systems distributed on the upper land, and high pumpage of potable water are potential problems. Data on drinking water wells, however, do not indicate a problem with microbial contamination.



Source: Modified from *Water Quality Management Plan for the City & County of Honolulu*, September, 1990 ("208 Plan")

Note: * Facility with Zone of Mixing

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7000 3500 0 7000
Scale in Feet

North

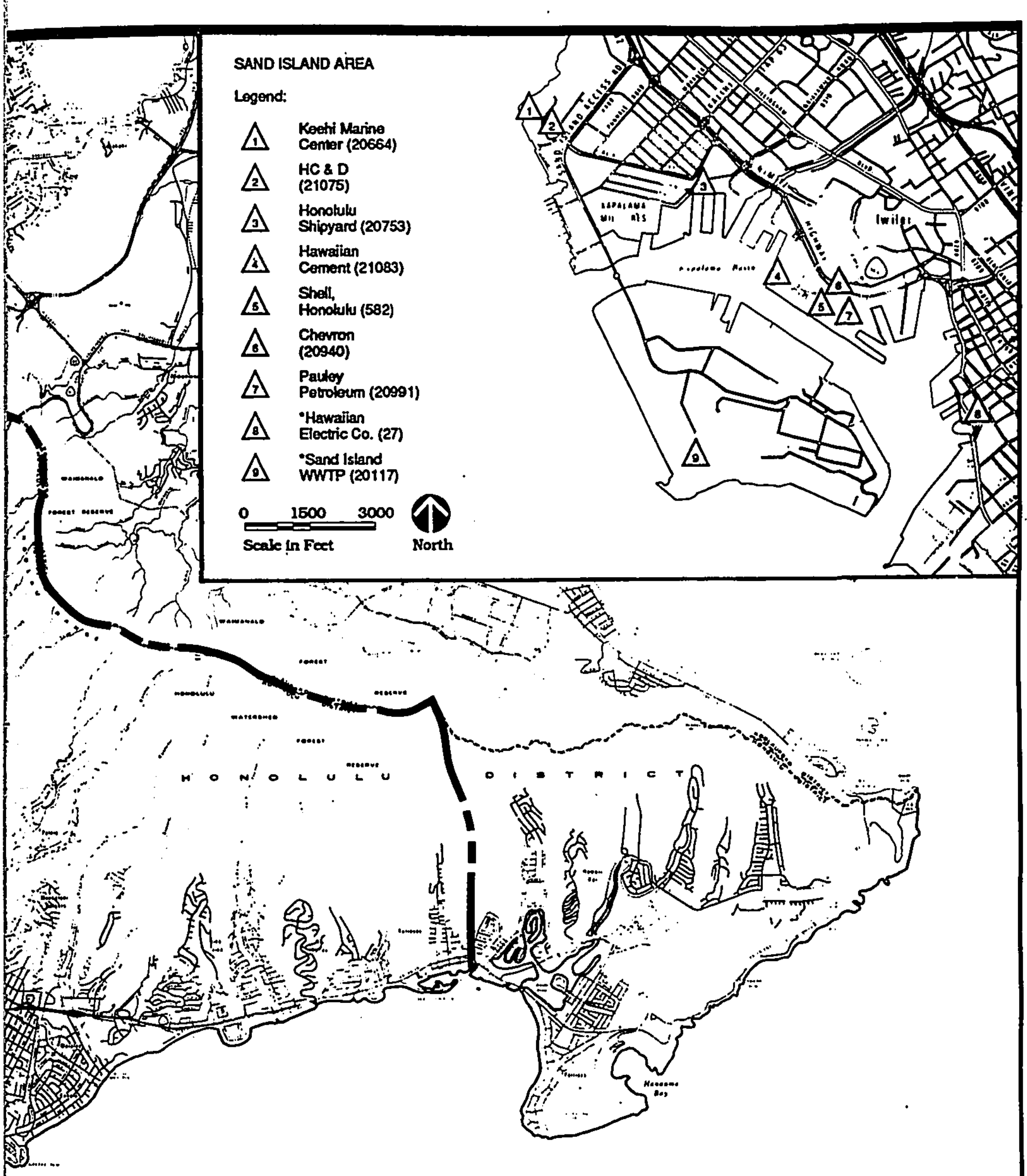

Figure 3-14
NPDES Point Sources in the Study Area

Table 3-12
NPDES Permittees in the Study Area

FACILITY NAME	NPDES NO.	CLASS	MAJOR/ MINOR	NO. OF VIOLATIONS 1990 TO 1991	CONSTITUENT*
Super Hawaii Ala Wai Marine LTD.	HI 0020711	Industrial	Major	None	---
Ameron HC&D, LTD.	HI 0021075	Industrial	Minor	None	---
Chevron USA Inc., Kapalama Terminal	HI 0020940	Industrial	Minor	1	Oil & Grease
Hawaii Cement, Distribution Center Pier 34	HI 0021083	Industrial	Minor	1	pH
Hawaiian Electric Co., Honolulu Gen. Station	HI 0000027	Industrial	Major	None	---
City & County of Honolulu, Sand Island WWTP	HI 0020117	Municipal	Major	None	---
Honolulu Fueling Facilities Corp.	HI 0020354	Industrial	Minor	None	---
Honolulu Shipyard	HI 0020753	Industrial	Minor	None	---
Keehi Marine Inc.	HI 0020664	Industrial	Minor	None	---
Pauley Petroleum, Inc.	HI 0020991	Industrial	Major	None	---
Shell Oil Company, Marketing Dist. Plt. Honolulu Plant	HI 0000582	Industrial	Minor	1	TSS
University of Hawaii, Waikiki Aquarium	HI 0020630	Industrial	Minor	3	BOD
Yacht Harbor Towers	HI 0020346	Industrial	Minor	None	---

Notes:
* TSS: Total Suspended Solids
* BOD: Biochemical Oxygen Demand

Source: Compiled from Department of Health Unpublished Document, Clean Water Branch, Jan. 1992.

There is a pattern that is characteristic of stations located at beaches where rates of water exchange with open coastal waters are reduced by coastal structures such as offshore breakwater (Kuhio Beach station, Waikiki), and dikes (Kahanamoku Lagoon Station, Waikiki). Water quality at these stations with a high residence time is also impacted by land-based nonpoint sources. The marine recreational water quality standard was exceeded chronically at these stations.

Finally, studies have shown that water quality at many stream mouths, where stream flow meets ocean currents such as at Keehi Lagoon, Honolulu Harbor, Ala Wai Harbor, and Waialae-Kahala Beach Park also experience frequent violations of water quality standards, especially after heavy rainfall.

Water quality is deemed to be deteriorated when the physical environment at particular locations can no longer assimilate the wastes to the degree required for the predominant beneficial uses of the environment. The patterns described above support a land-based source for deteriorated water quality at these locations. This conclusion is supported by gradients in water quality monitoring data discussed in **Bacterial Indicators** of Chapter Four.

3.3.9 AIR QUALITY

The project area is composed of a full range of land uses and densities, ranging from unpopulated mountain-side watershed to densely populated hotel districts in Waikiki and heavy industrial activities associated with Honolulu Harbor. As a result, existing air quality conditions vary within the study area.

Despite its urban character, the study area is generally free from serious air pollution conditions. This is largely due to the effects of the northeastern trade winds that regularly cleanse the island atmosphere of emissions and particulates, and the lack of major industrial uses typical of similar sized cities. However, during Kona wind conditions, when the wind shifts to a southerly or southwestern direction, or diminishes altogether, a buildup of particulates does occur.

Based on data from the State DOH's network of air quality monitoring stations throughout Oahu and including the study area, both State and national ambient air quality standards are generally being met on a regional basis. On a sub-regional basis, the more stringent State regulations pertaining to ambient ozone and carbon monoxide concentrations are occasionally exceeded.

The DOH has four monitoring stations in the Honolulu area that corresponds to the study area: Liliha, the DOH building on Punchbowl Street, Sand Island, and Waikiki at Beachwalk and Kalakaua. However, the DOH only measures ozone at the Sand Island station. The other three stations are utilized to measure traffic-related air quality impacts. None of the stations measure hydrogen sulfide. Consequently, any air quality monitoring required to determine existing impacts of the wastewater collection and treatment system, as well potential improvements to it, must be undertaken by the City.

3.3.10 VISUAL ATTRIBUTES

The existing wastewater pump stations and the Sand Island wastewater treatment plant are the only components of the East Mamala Bay wastewater system that are generally visible. Collection lines and force mains, as well as the effluent outfall are all sub-surface infrastructure.

In general, the fifteen pump stations are unobtrusive single-story structures that are usually screened from view by landscaping around the perimeter of their respective properties.

Views of the existing wastewater treatment facility on Sand Island are generally limited to Keehi Lagoon and areas of Honolulu with elevations exceeding 100 feet above sea level. These higher areas include Punchbowl, Pacific Heights, Alewa Heights, Upper Kalihi, and Tantalus/Roundtop. However, even at higher elevations, views of the Sand Island and the treatment plant are sometimes obscured by buildings in the downtown area or the Matson loading cranes situated on the northern shore of Sand Island.

Although the plant's clarifier tanks are visible from the Lagoon Drive portion of the airport, its most distinguishing feature is the incinerator building which reaches a height of 80 feet, 20 feet above the Sand Island height limit.

3.3.11 SONIC ENVIRONMENTAL (NOISE LEVELS)

Ambient noise conditions in the study area are typical of urban environments in cities of similar size. The principal source of noise are related to commuter traffic along the major transportation corridors, including the H-1/Lunalilo Freeway, Nimitz Highway, Kalanianaole Highway, and the trans-Koolau Pali and Likelike Highways. Other sources include commercial development-related construction activity, emergency vehicles, street repair, and air traffic from Honolulu International Airport. The latter source directly impacts Sand Island WWTP, which is located within the airport's flight corridor.

3.4 NATURAL HAZARDS

In addition to storms and strong winds, the natural hazards which could have the greatest potential impact are tsunamis and earthquakes.

3.4.1 EARTHQUAKE HAZARDS

The State of Hawaii experiences thousands of earthquakes every year. Earthquakes endanger people and property by shaking structures and generating ground fractures, settling and landslides. Sudden subsidence along the shoreline associated with an earthquake can also generate a tsunami. The two most severe earthquakes in Hawaii during historical times occurred in 1868 and 1975. The first was centered at Kau and the second at Puna. The magnitudes of both quakes exceeded seven on the open-ended Richter scale and resulted in major damage in the Kau and Kilauea districts of the Big Island, respectively. Both events generated a localized tsunami. Although there is no record of the 1868 earthquake's impacts on Oahu and the study area, the 1975 earthquake was felt, but resulted in no measurable damage, loss of property, or loss of life on Oahu. The tsunami generated by the 1975 earthquake impacted a small coastal region on the east side of Hawaii and did not affect Oahu.

The Hawaiian Islands are divided into four distinct seismic zones (Zones 0 - 3). Kauai and the Northwestern Islands are in Zone 0. Oahu, Molokai, and Lanai are in Zone 1. Maui and Kahoolawe are in Zone 2, and the island of Hawaii is in Zone 3. These zones are based upon the modified Mercalli scale of earthquake effect intensity. Zone 1 corresponds to intensity VI defined as:

Intensity VI – Felt by all; glassware broken; books off shelves.

It should be noted that the Mercalli scale does not correlate with the more well-known Richter scale. While the former measures the actual shaking of the ground at a given location from the perspective of human experience, the Richter scale measures the amplitude of the earthquake at its source. Thus, a major earthquake on the Richter scale (perhaps 7.5 or above) will have different intensities on the Mercalli scale, corresponding to distance from the epicenter and geology of each specific area impacted.

3.4.2 STORM HAZARDS

Historically, storm hazards in the study area are limited to high winds and inland flooding due to intensive rainfall resulting in surging stream flows. Lightning strikes are relatively rare. In the early decades of the 20th century, heavy rainfall resulted in several serious floods associated with Palolo Stream (which in those days was considered to be a river). Urbanization of the main valleys behind Honolulu has resulted in the channelization of stream courses which has all but eliminated residential flooding problems.

During the past 20 years, Oahu has been subjected to a number of severe storms and high winds which have caused extensive damage. Storms and high winds can potentially impact wastewater collection and treatment facilities by causing electricity loss at the pumping stations and treatments facilities, creating infiltration and bypass problems in pipes and other collection infrastructure, and causing general water damage to buildings and electrical equipment.

Inland flooding in the central area of urban Honolulu is generally associated with a lack of adequate drainage in low-lying areas following intense rainfall. The eastern portion of Waikiki and the *mauka* portion of Kakaako have been particularly susceptible to flooding. However, actual damage due to flooding is minimal and usually amounts to nothing more than a short-term nuisance for traffic and pedestrians.

Federal Insurance Rate Maps (FIRMs) are intended to provide information about areas that are prone to flooding. According to FIRM maps for the study area, there are seven general regions were flooding may occur as a result of storm surge or heavy rain:

- Maunawili and Manaiki streams and the lowlands at the point where they converge near Keehi Lagoon
- The southeastern end of Sand Island
- The coastal area extending east from Ward Avenue to a point just west of Kapahulu Avenue, including most properties *makai* of Kapiolani Boulevard, as well a portions of Makiki and lower Kapahulu
- Manoa Stream
- The lower portions of Waialae Nui Stream and Kapakahi Drainage Stream, as well as coastal areas of Kahala
- The floor of Aina Haina valley
- Most of the coastline between Kahala and Kuliouou

In most of these areas, flood elevations have been determined. Potential flood waters could rise to height of between four and ten feet west of Diamond Head, and from one to six feet east of Diamond Head.

Of the WWPSs in the study area, seven are in or close to the following FEMA flood zones (see Figures 3-15 through 3-18):

- The Kamehameha Highway WWPS is close to Zone AO, special flood hazard areas inundated by 100-year flood up to three feet.
- Fort DeRussy and Beachwalk WWPSs are in a flood zone designated Zone AO, special flood hazard areas inundated by 100-year flood up to two feet.
- The Moana Park WWPS is in a 100-year flood Zone A, no base flood elevation.
- The Public Baths WWPS is located near the edge of a flood zone designated Zone A, special flood hazard areas inundated by 100-year flood, no base flood elevation.
- The Kahala WWPS is located in a flood zone designated Zone AE, special flood hazard areas inundated by 100-year flood, six feet base flood elevation.
- The Paiko Drive WWPS is located in a flood zone designated Zone AE, special flood hazard areas inundated by 100-year flood where the base flood elevation is determined to be six feet.

3.4.3 TSUNAMI HAZARDS

The coastline from Sand Island to Niu Valley is identified as a tsunami inundation area. Generally, the tsunami inundation area is situated *makai* of the major coastal highway system (Nimitz Highway-Ala Moana Boulevard-Kalanianaole Highway). In the vicinity of Sand Island, the inundation area includes the southeastern shore of the island. Sand Island WWTP is not situated within the inundation zone. In the vicinity of Waikiki, the inundation area includes all of Kapiolani Park, the area *makai* of Kalakaua Avenue, and the area *makai* of Kalia Road west of Lewers Street. Around Diamond Head, the zone includes the area *makai* of Diamond Head Road and Kahala Avenue.

Tsunamis and flooding can potentially impact wastewater collection and treatment facilities by causing electricity loss at the pumping stations and treatment facilities, creating infiltration and bypass problems in pipes and other collection infrastructure, and causing general water damage to buildings and electrical equipment.

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- The Paiko Drive WWPS is located in a flood zone designated Zone AE, special flood hazard areas inundated by 100-year flood where the base flood elevation is determined to be six feet.

3.4.3 TSUNAMI HAZARDS

The coastline from Sand Island to Niu Valley is identified as a tsunami inundation area. Generally, the tsunami inundation area is situated *makai* of the major coastal highway system (Nimitz Highway-Ala Moana Boulevard-Kalanianaole Highway). In the vicinity of Sand Island, the inundation area includes the southeastern shore of the island. Sand Island WWTP is not situated within the inundation zone. In the vicinity of Waikiki, the inundation area includes all of Kapiolani Park, the area *makai* of Kalakaua Avenue, and the area *makai* of Kalia Road west of Lewers Street. Around Diamond Head, the zone includes the area *makai* of Diamond Head Road and Kahala Avenue.

Tsunamis and flooding can potentially impact wastewater collection and treatment facilities by causing electricity loss at the pumping stations and treatment facilities, creating infiltration and bypass problems in pipes and other collection infrastructure, and causing general water damage to buildings and electrical equipment.

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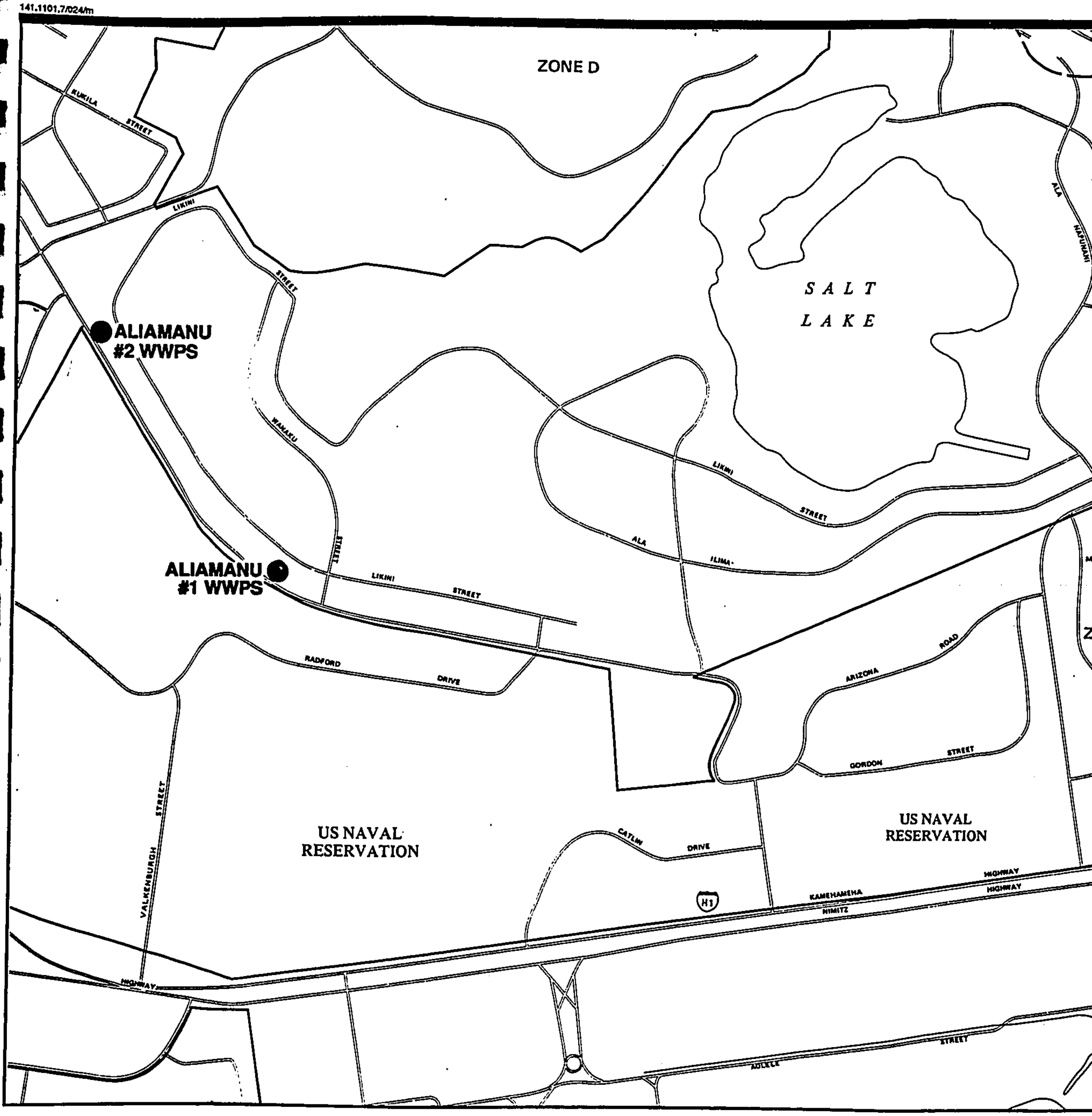
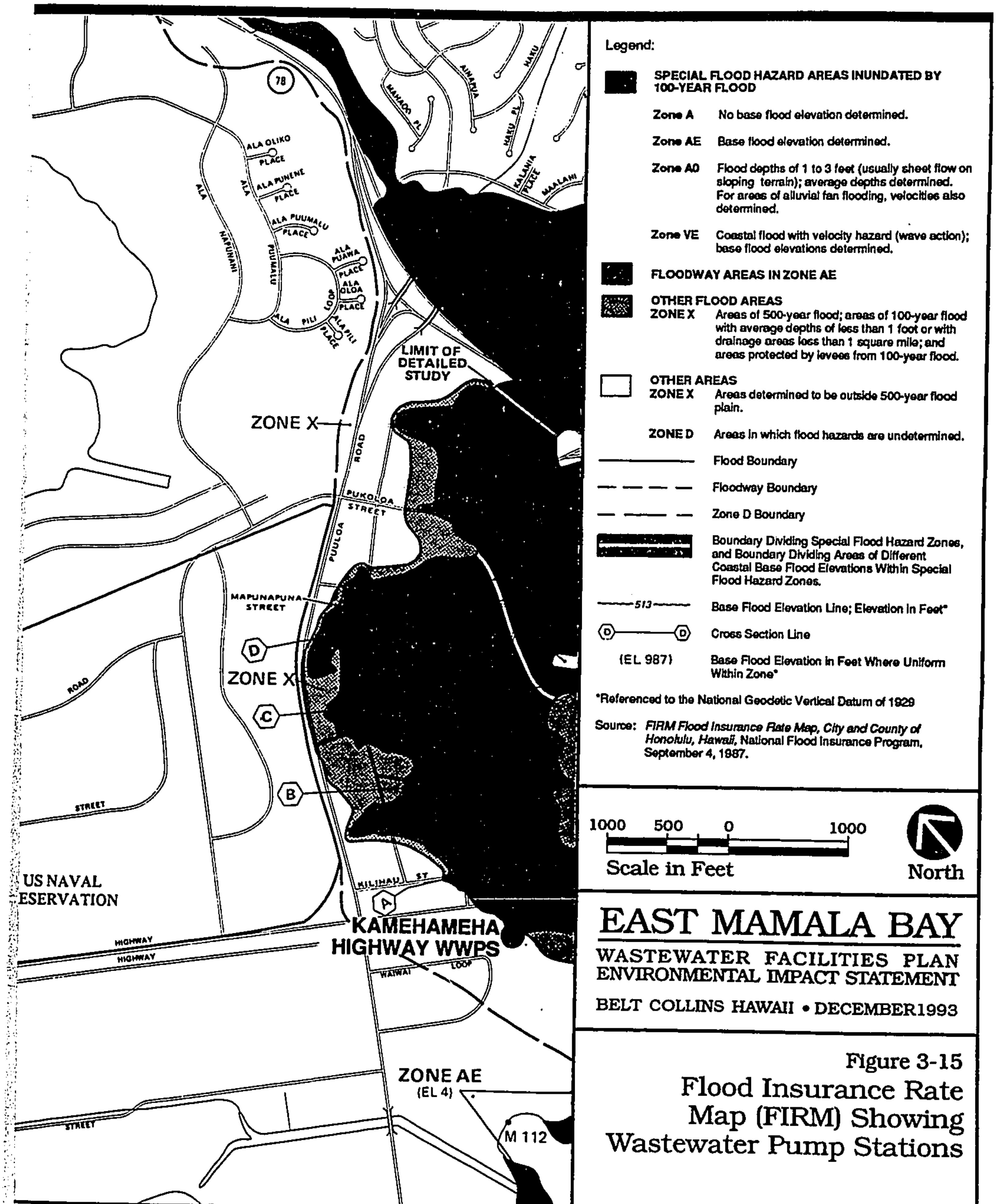


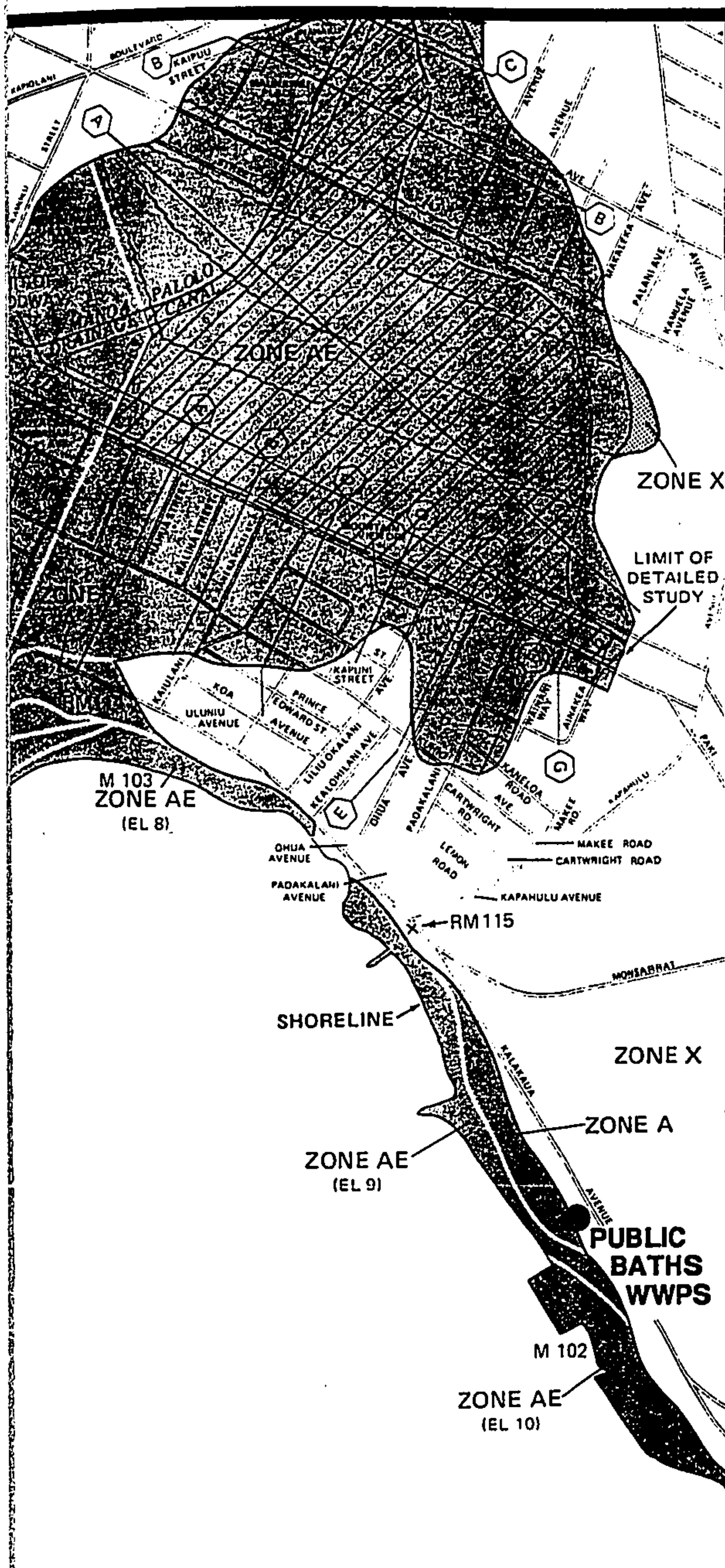


EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER1993

Figure 3-15
Flood Insurance Rate Map (FIRM) Showing Wastewater Pump Stations



Legend:

[shaded symbol]	**SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD**
Zone A	No base flood elevation determined.
Zone AE	Base flood elevation determined.
Zone AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
Zone VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.
[shaded symbol]	**FLOODWAY AREAS IN ZONE AE**
[shaded symbol]	**OTHER FLOOD AREAS**
ZONE X	Areas of 500-year flood; 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 flood.
[open symbol]	**OTHER AREAS**
ZONE X	Areas determined to be outside 500-year flood plain.
ZONE D	Areas in which flood hazards are undetermined.
———	Flood Boundary
— — — —	Floodway Boundary
— —— —	Zone D Boundary
[heavy line]	Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.
~~513~~~	Base Flood Elevation Line; Elevation in Feet*
(D)———(D)	Cross Section Line
(EL 987)	Base Flood Elevation in Feet Where Uniform Within Zone*

*Referenced to the National Geodetic Vertical Datum of 1929

Source: *FIRM Flood Insurance Rate Map, City and County of Honolulu, Hawaii*, National Flood Insurance Program, September 4, 1987.

1000 500 0 1000

Scale in Feet

North

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER1993

Figure 3-16
Flood Insurance Rate Map (FIRM) Showing Wastewater Pump Stations

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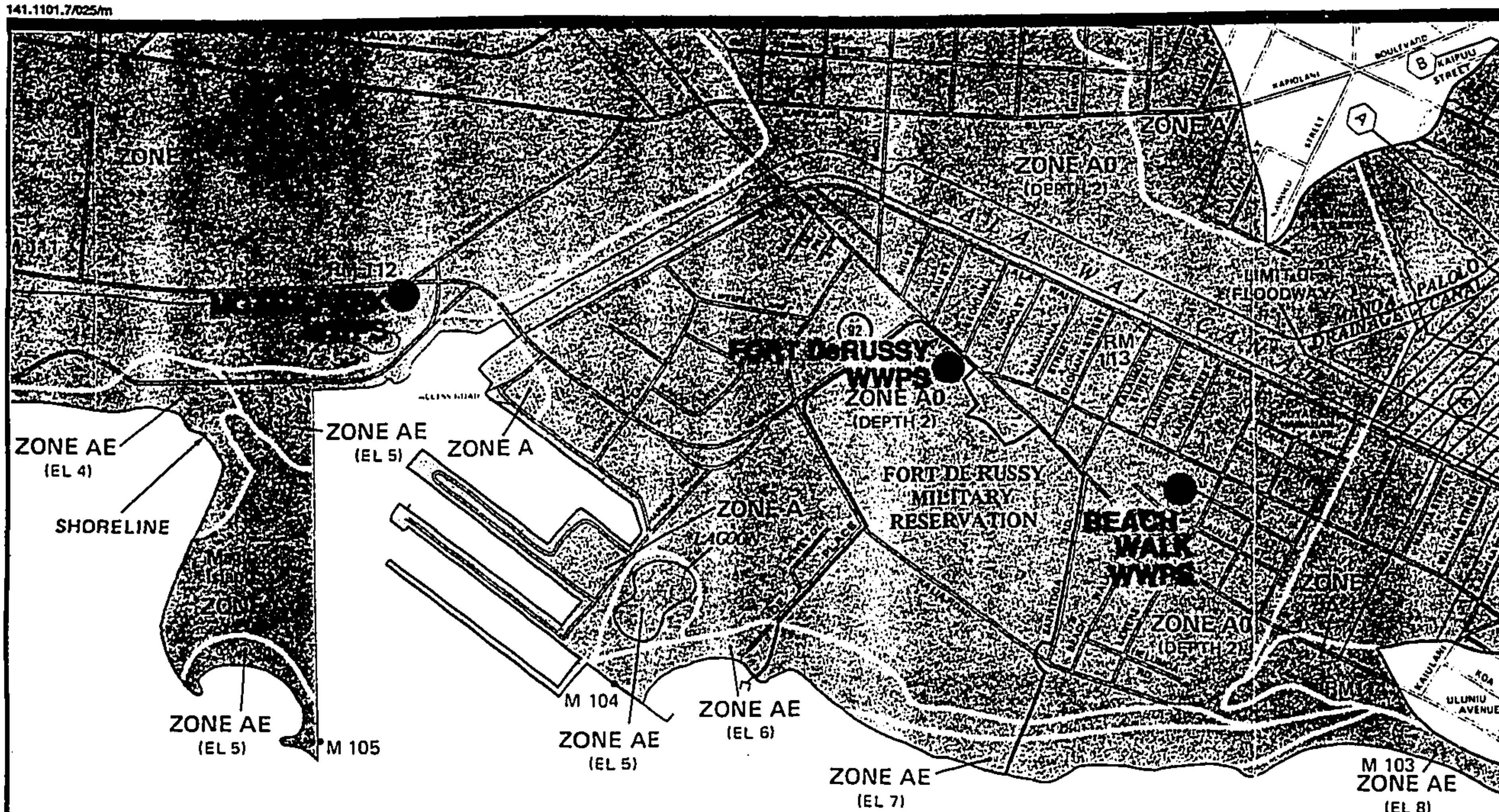

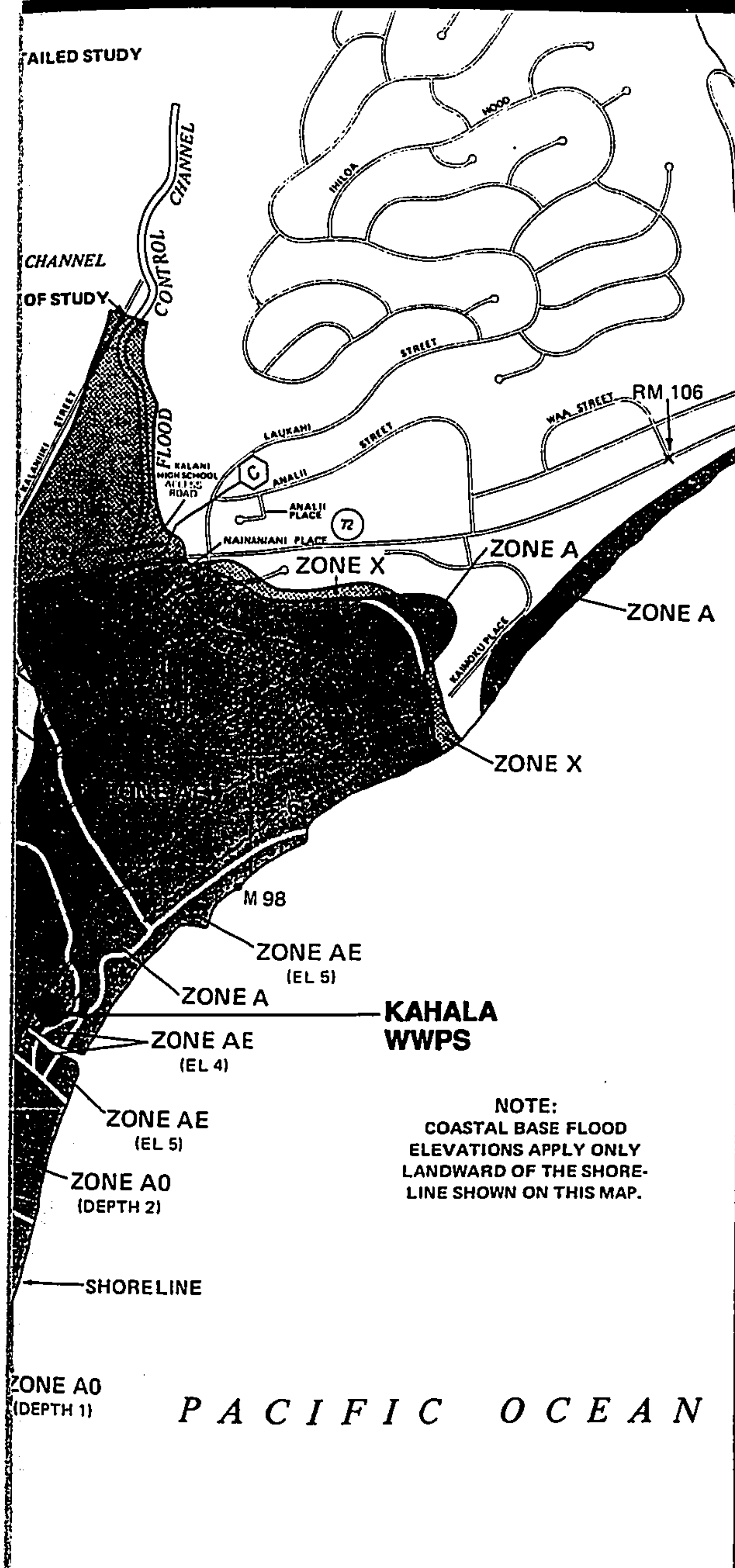

Legend:

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

- **Zone A** No base flood elevation determined.
- **Zone AE** Base flood elevation determined.
- **Zone A0** Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
- **Zone VE** Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS
ZONE X Areas of 500-year flood; 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 flood.

OTHER AREAS
ZONE X Areas determined to be outside 500-year flood plain.

ZONE D Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 Base Flood Elevation Line; Elevation in Feet*

Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

*Referenced to the National Geodetic Vertical Datum of 1929

Source: *FIRM Flood Insurance Rate Map, City and County of Honolulu, Hawaii*, National Flood Insurance Program, September 4, 1987.

1000 500 0 1000
Scale in Feet

North

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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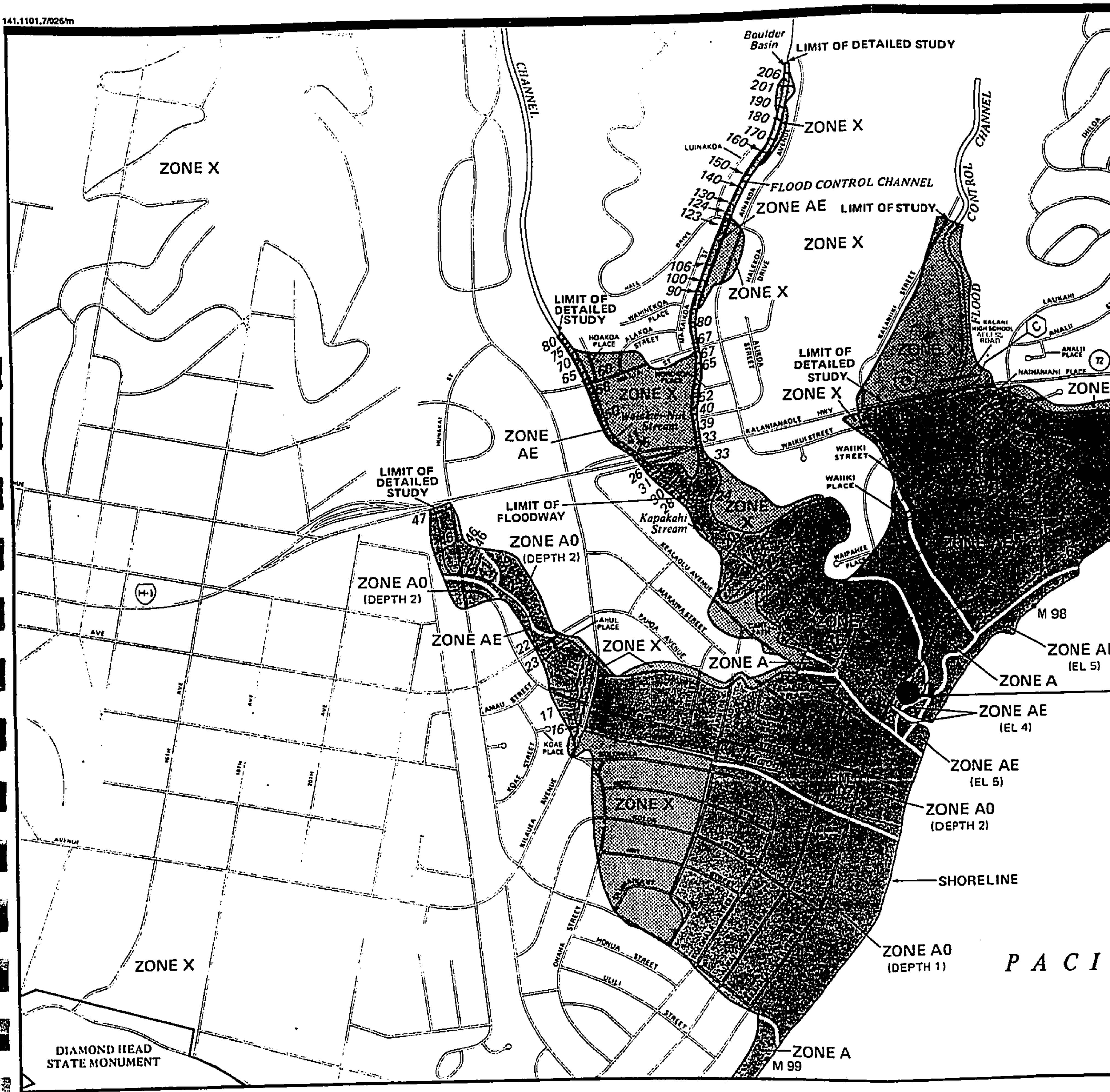
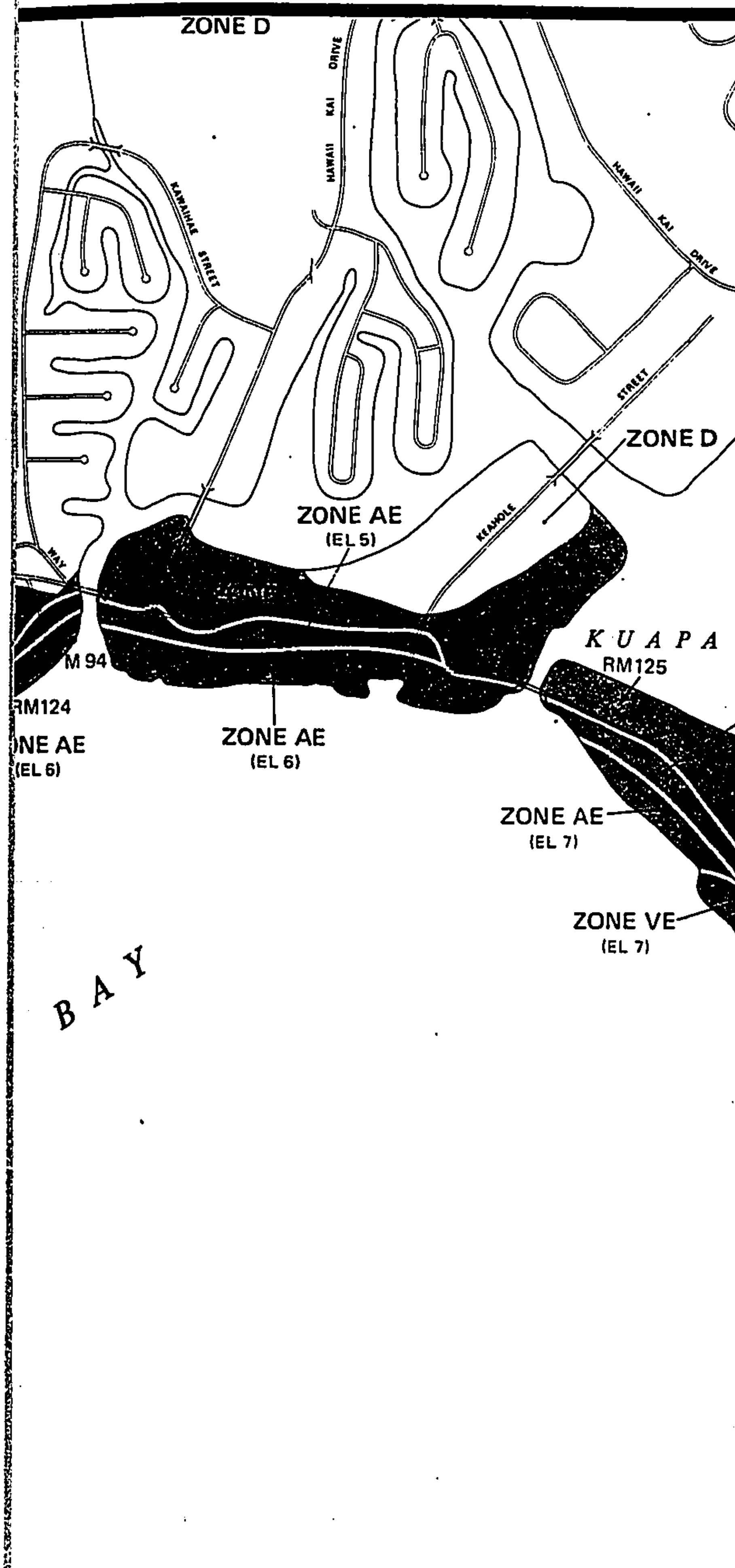
Figure 3-17
Flood Insurance Rate Map (FIRM) Showing Wastewater Pump Station

141.1101,7/026/m





Legend:

SPECIAL FLOOD HAZARD AREAS INUNDATED BY 100-YEAR FLOOD

Zone A	No base flood elevation determined.
Zone AE	Base flood elevation determined.
Zone AO	Flood depths of 1 to 3 feet (usually sheet flow on sloping terrain); average depths determined. For areas of alluvial fan flooding, velocities also determined.
Zone VE	Coastal flood with velocity hazard (wave action); base flood elevations determined.

FLOODWAY AREAS IN ZONE AE

OTHER FLOOD AREAS

ZONE X	Areas of 500-year flood; 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 flood.

OTHER AREAS

ZONE X	Areas determined to be outside 500-year flood plain.
ZONE D	Areas in which flood hazards are undetermined.

Flood Boundary

Floodway Boundary

Zone D Boundary

Boundary Dividing Special Flood Hazard Zones, and Boundary Dividing Areas of Different Coastal Base Flood Elevations Within Special Flood Hazard Zones.

513 — Base Flood Elevation Line; Elevation in Feet*

(D)—(D) Cross Section Line

(EL 987) Base Flood Elevation in Feet Where Uniform Within Zone*

*Referenced to the National Geodetic Vertical Datum of 1929

Source: *FIRM Flood Insurance Rate Map, City and County of Honolulu, Hawaii*, National Flood Insurance Program, September 4, 1987.

1000 500 0 1000

Scale in Feet

North

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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Figure 3-18
Flood Insurance Rate Map (FIRM) Showing Wastewater Pump Stations

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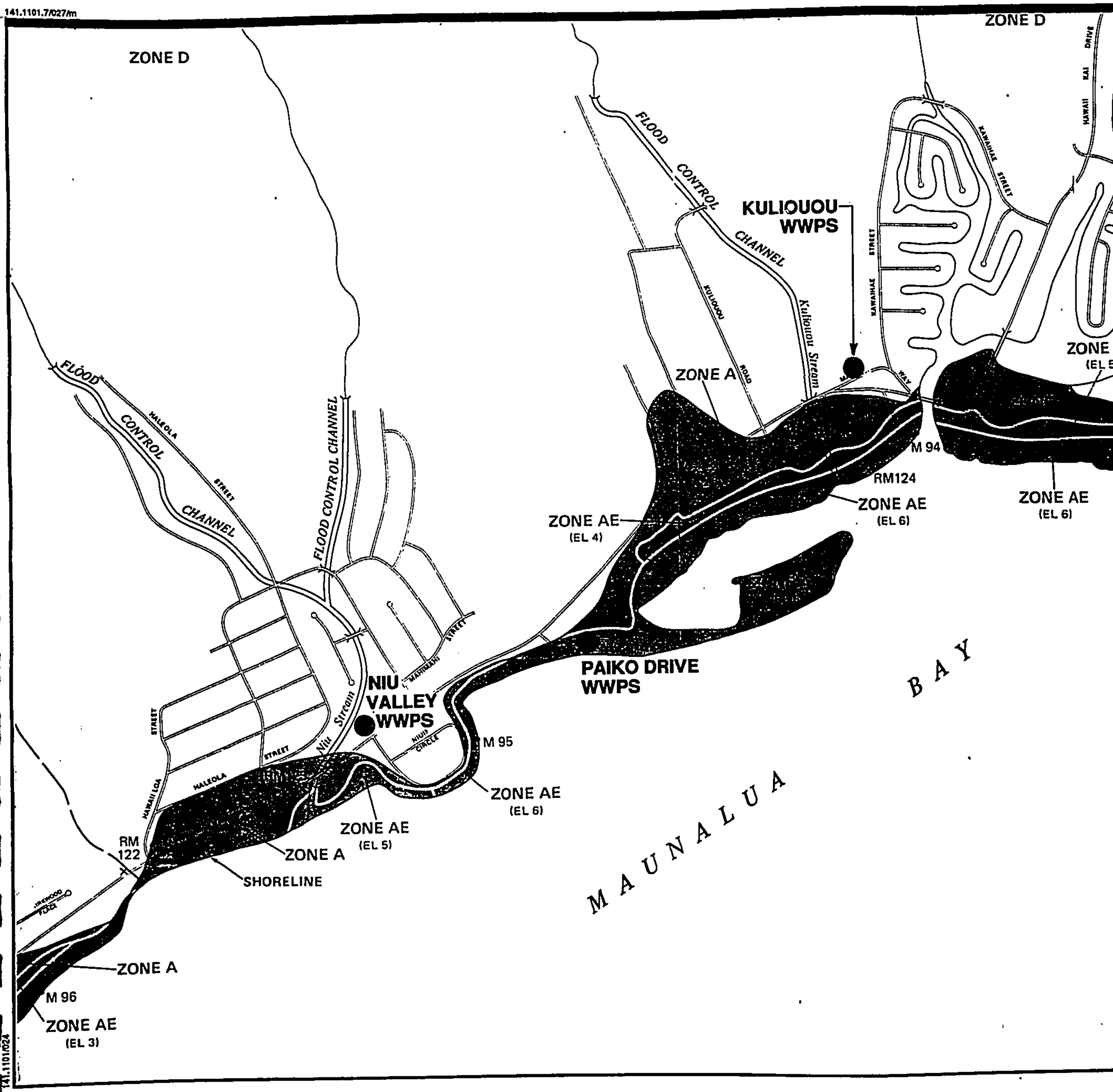

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The determination of inundation zone boundaries is based upon calculations of flood elevations and historical experience of previous tsunamis (GTE Civil Defense Tsunami Evacuation Maps). The last significant tsunami to affect the study area was in 1960. The height of maximum run-up in the study area was from eight to nine feet.

A related aspect of inland flooding pertains to the condition of the Nuuanu Dam No. 4, which was built in the upper Nuuanu Stream in 1910. In the mid-1970s it was identified by the U.S. Army Corps of Engineers as being considered potentially hazardous. It is the only publicly-owned dam in the study area.

3.5 BIOLOGICAL CONDITIONS

3.5.1 VEGETATION

From a botanical point of view, the study area may be generally characterized as a relatively dense urban area bordered by forest reserves. The historical development of the city of Honolulu within the study area has resulted in the systematic alteration of its botanical character. Today, the study area's vegetation, including the forest reserves, may be characterized as consisting primarily of exotic and introduced species.

3.5.2 AVIFAUNA AND FAUNA

As the state's largest urban region, the study area provides a 70-square-mile habitat for a multitude of native and introduced bird species. These include resident endemic and indigenous land birds, resident waterbirds, migratory indigenous birds, and exotic species. Feral mammals in the study area include the introduced Small Indian Mongoose, cats, dogs, rats and mice. The endemic and endangered Hawaiian Hoary Bat *(Lasiurus cinereus semotus)* has been noted in the study area but its distribution is believed to be relatively limited.

3.5.3 AQUATIC FAUNA

The variety of aquatic fauna in East Mamala Bay is considerably limited when compared to coastal areas in more rural portions of Oahu. The cumulative impact of nearly 200 years of urban development upon the bay's reef system, as well as the pressures placed upon the food chain by extensive fishing and food gathering, have left the marina biota relatively depleted when compound to other areas around Oahu.

3.6 HISTORIC AND ARCHAEOLOGICAL CONDITIONS

The study area contains a wide variety of historic and archaeological resources corresponding to its various phases of use and development. Beginning with prehistorical occupation by native Hawaiians, regions of the study area have been previously identified as having a rich cultural heritage related to their agricultural usage. The emergence of the town of Honolulu in the early 1800's and its steady growth from its original location along the waterfront of Honolulu harbor to its present size provides an equally rich historic resource.

It should be emphasized that, contrary to popular belief, archaeological resources and human burials often exist in subsurface contexts under a variety of urban settings where previous construction activities have taken place. Media coverage of recent archaeological investigations at three sites in downtown Honolulu (located at Bethel Street, the Kekaulike Site, and Marin Tower) may be helping to change this misconception; however the extent of the archaeological resources in urban settings is still not fully appreciated. During the development of the Marin Tower Project, a wealth of historical artifacts and the burial remains of 17 individuals were recovered from an area previously covered by a multi-storied building and parking lot. Similarly, recent experience on the Kalanianaole Highway Project on Oahu has demonstrated that right-of-way corridors and the area directly under existing roads cannot be considered devoid of archaeological resources simply because asphalt has been laid on the surface or utilities have been laid underground at those locations. Refer to Section 8.6 for site-specific information on the potential for historic resources to exist.

3.7 OVERVIEW OF INFRASTRUCTURE

Infrastructure plays a supporting role in the collection and treatment of wastewater. Roadways and drainage have an indirect relationship to wastewater; they provide support for the transportation and relief of rainwater such that transit of wastewater material is not impeded. Water supply has some bearing too, in the sense that it is a source of wastewater. Finally, the electrical system provides power for wastewater collection and treatment units. Information about this existing infrastructure is described below. For the purpose of consistency, a brief overview of the study area's wastewater system is included in this section.

3.7.1 EXISTING WATER SUPPLY SYSTEM

The existing BWS infrastructure services low- and high-elevation zones with two major systems. The low-level system handles users up to the 100-foot elevation; the high-level system handles users above this elevation. The low-level system is interconnected along the entire length of Oahu, but the supply area for urban Honolulu currently extends from Waipahu to Hawaii Kai. Water for the windward side of Oahu currently remains on that side of the island. In the study area, the low-level system (called the 180 system) is fed by the Waipahu, Punanani, Kalauao, Moanalua, Jonathan Spring, Kalihi, Beretania, Manoa (I and II), Wilder, Kaimuki, and Aina Koa Wells, as well as the Kalihi and Halawa Shafts. The high-level system (also called the 405 system) in study area is actually divided into a number of subsystems serving each major ridge/valley. However, there is one major high-level system that stretches from Moanalua to Aina Koa. Figures 3-19 and 3-20 depict the major elements of the water system in the study area.

3.7.2 EXISTING DRAINAGE SYSTEM

The primary drainage features of the study area are the major streams that channel water from the valleys to the ocean. Other major man-made drainage features also exist, such as the Kapalama and Ala Wai Canals. Otherwise, there are a number of smaller drain lines and culverts that service the study area. These are shown in Figures 3-21 and 3-22. These urban drainage features are major sources delivering nonpoint-source pollution from urban runoff into East Mamala Bay.

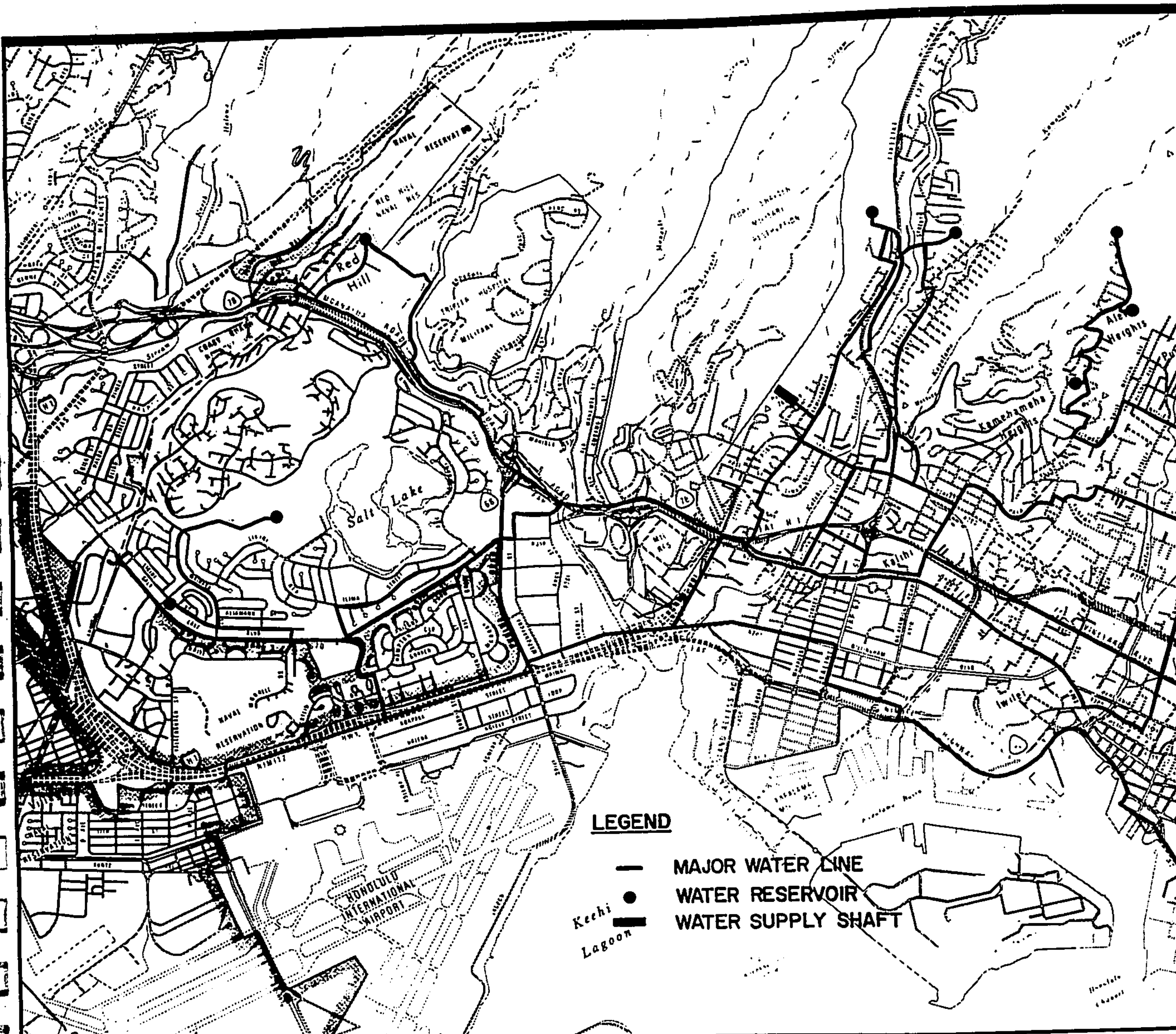
3.7.3 EXISTING WASTEWATER SYSTEM

Most of the study area is served by a gravity system that transports raw sewage to the Sand Island WWTP for treatment and disposal. The collection system includes WWPSs which facilitate the flow of sewage through a network of pipelines and tunnels.

Some areas of the study area are not connected to the collection system. These areas are served by private collection and/or treatment systems. The entire system is discussed in greater detail in Chapter Four.

3.7.4 EXISTING ELECTRICAL SYSTEM

The existing electrical service system for the study area consists of a continuous grid that is fed by the major Hawaiian Electric Company (HECO) power plants (Kahe, Waiau, and Honolulu). Only the Honolulu plant lies within the study area. Power is also supplied to the grid by co-generators such as Kalailea, AES



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

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Scale in Feet

North

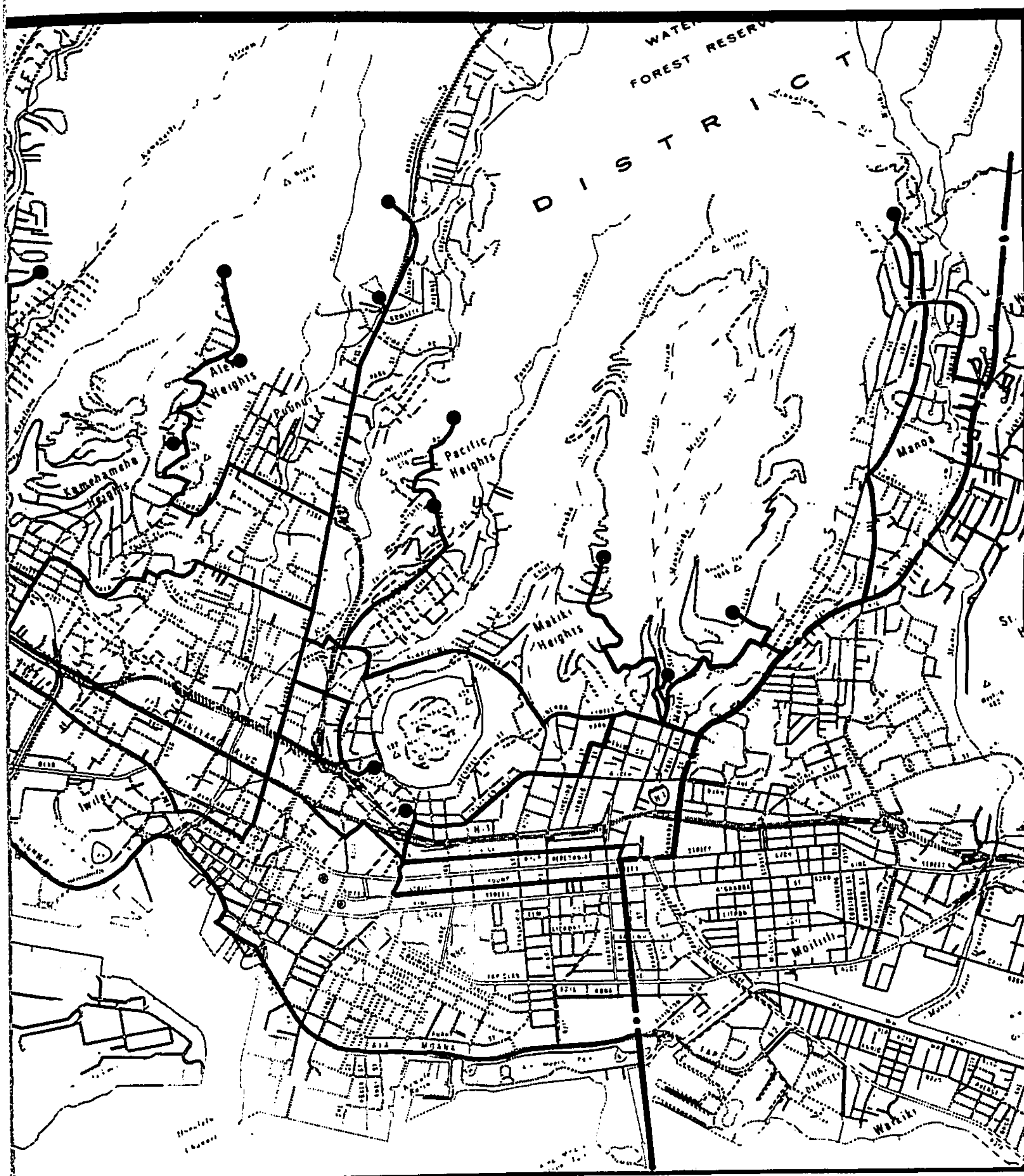
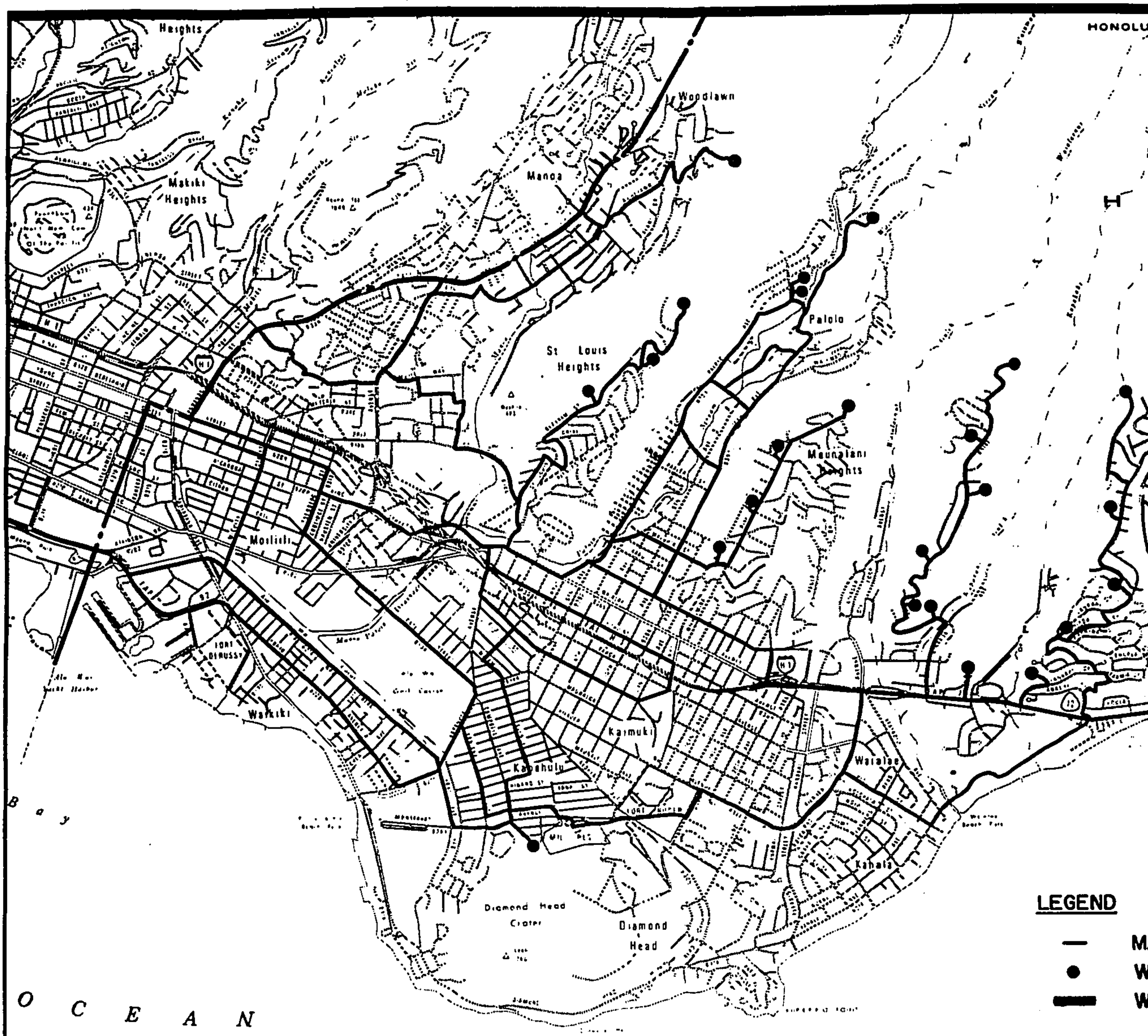


Figure 3-19
Major Components of the Existing
Water Supply System in the Study Area



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
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Scale in Feet

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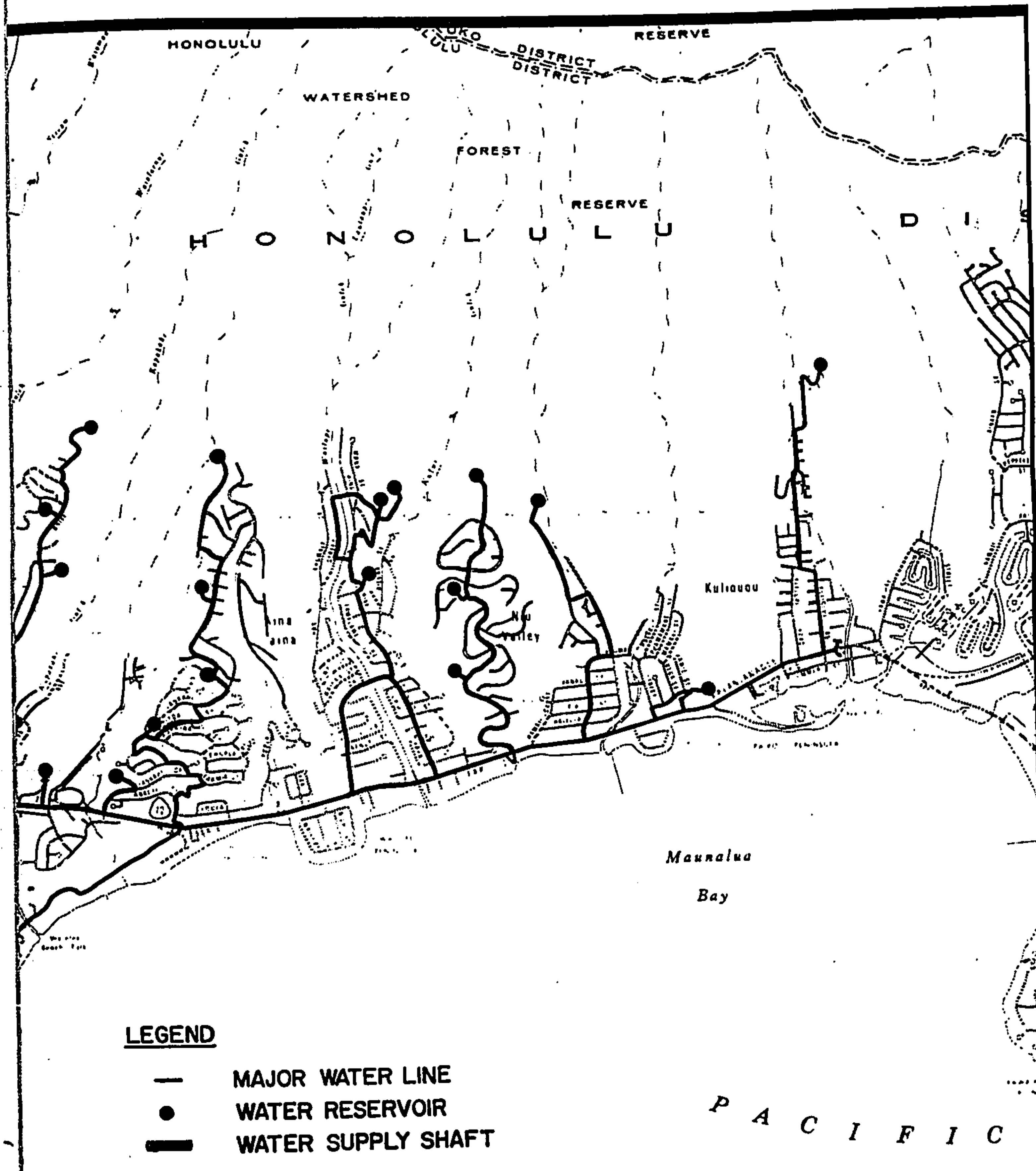
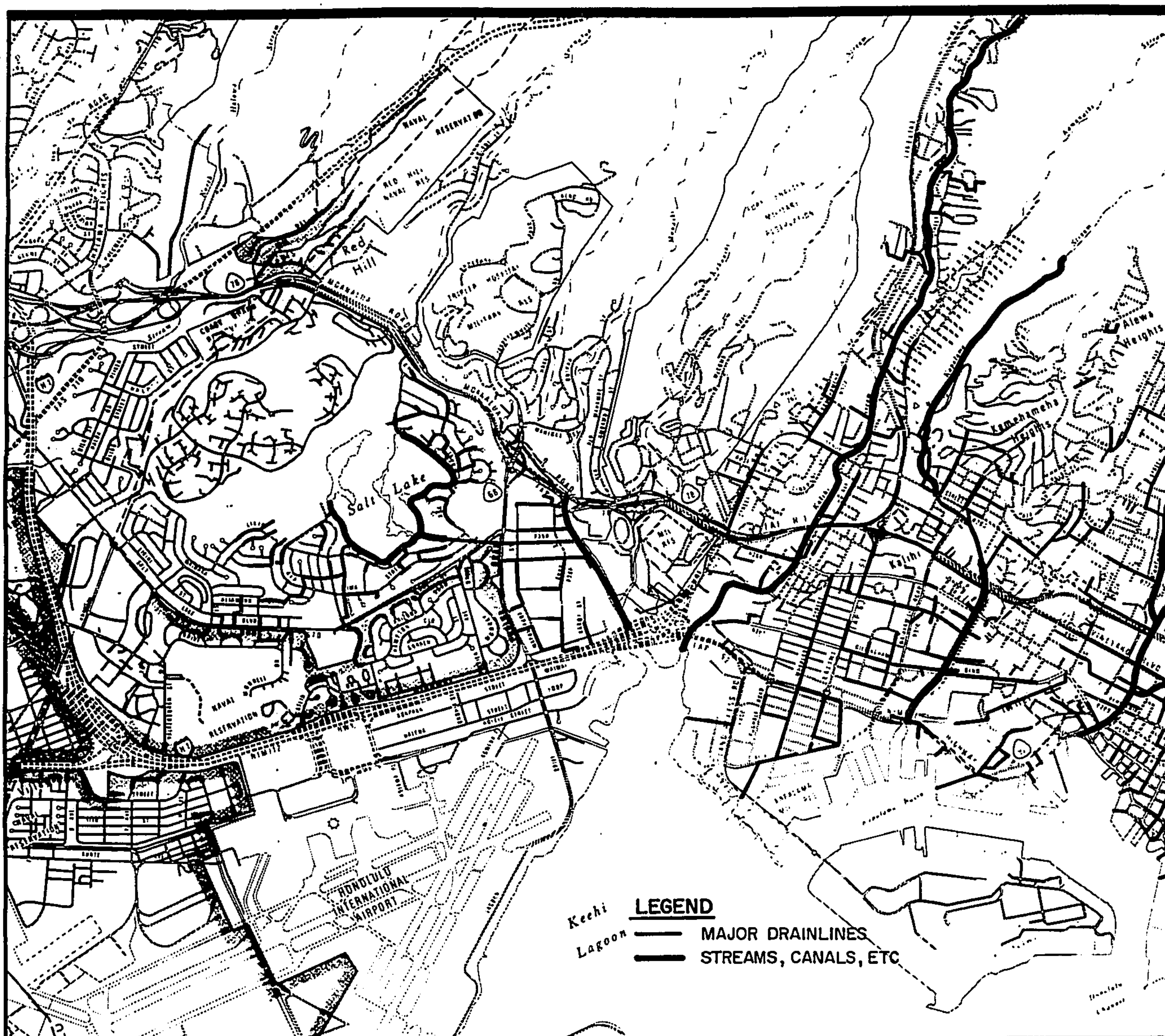


Figure 3-20
Major Components of the Existing Water Supply System in the Study Area



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

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Scale in Feet

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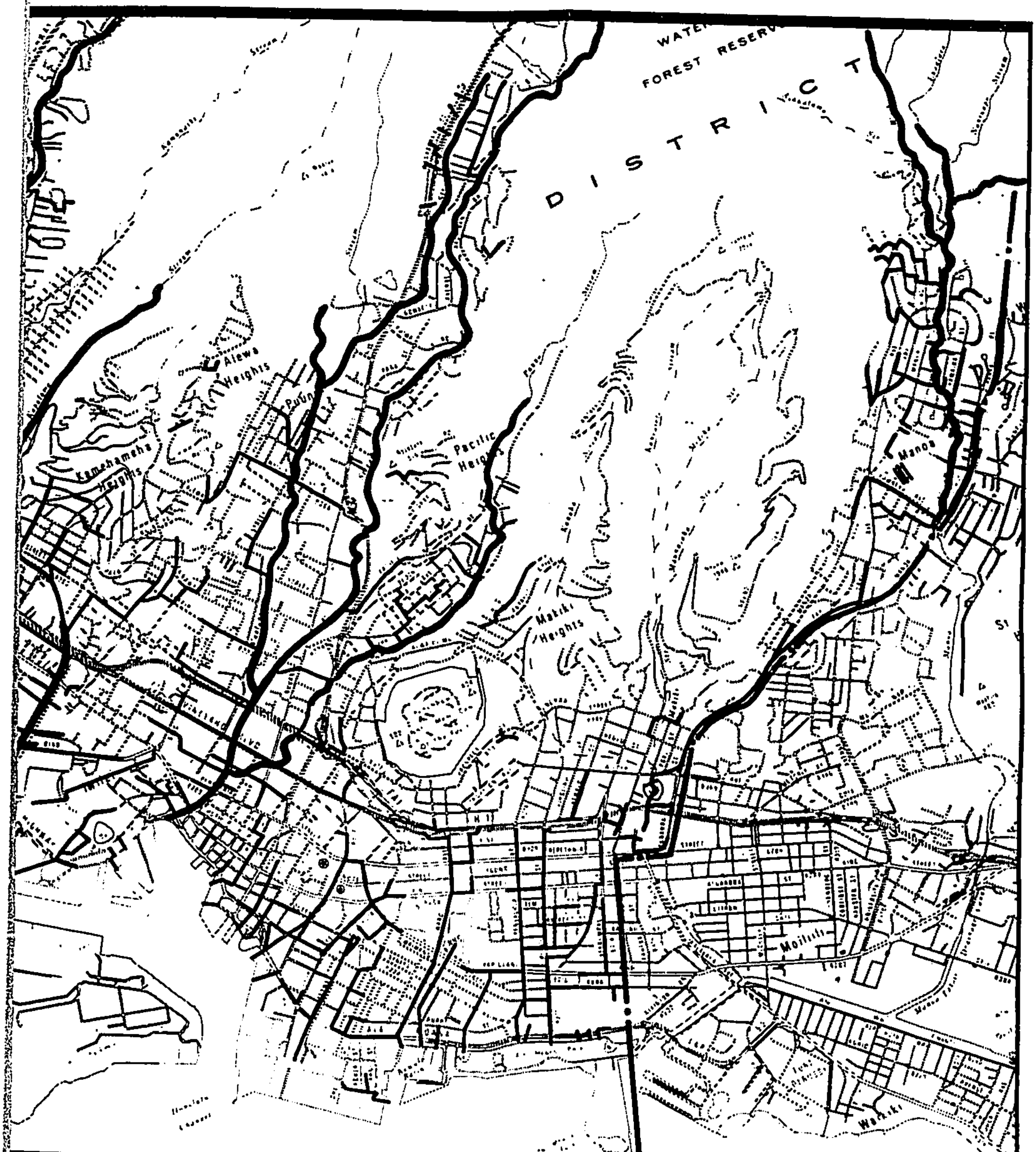
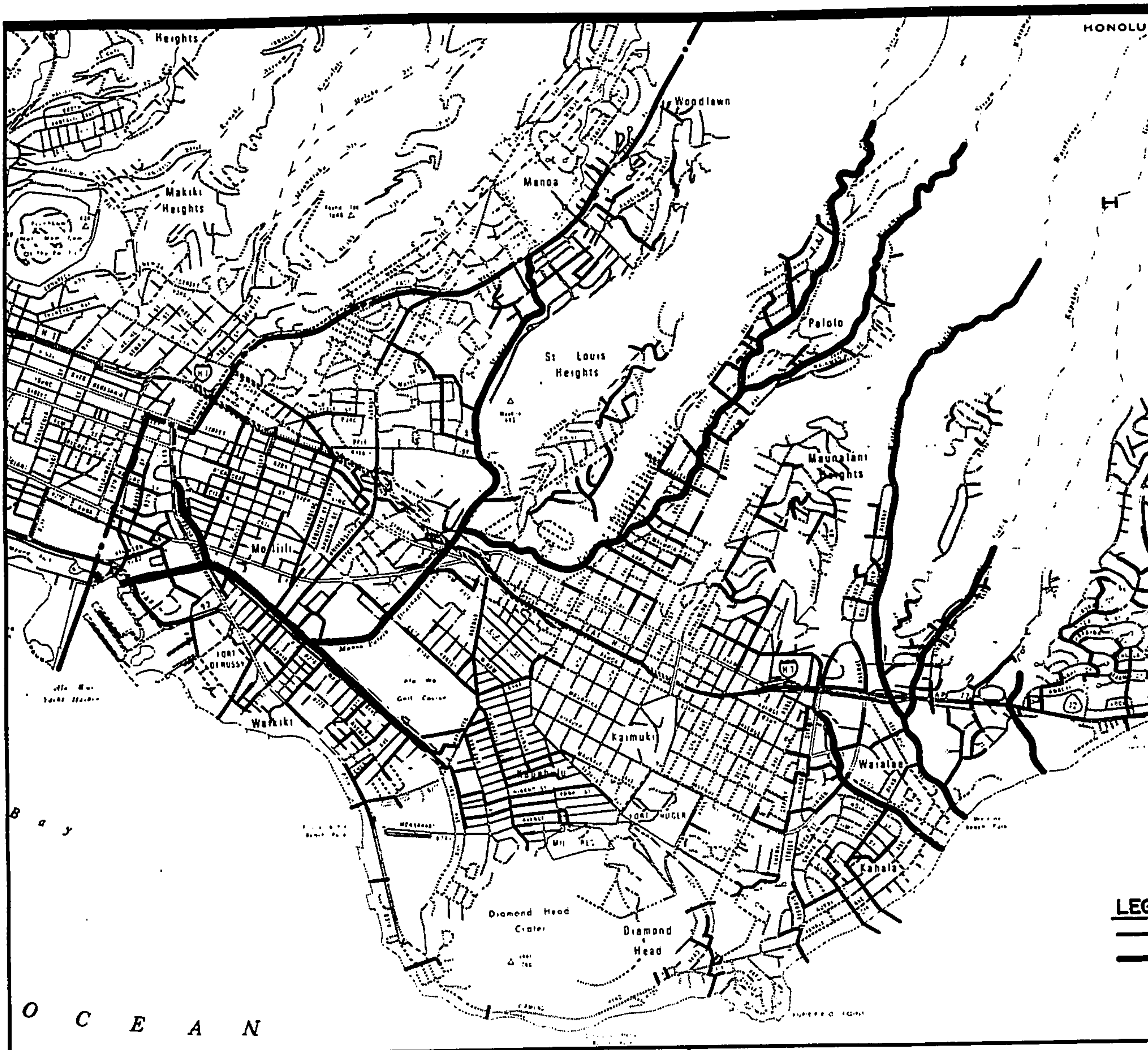


Figure 3-21
Major Components of the Existing Drainage System in the Study Area



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
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Scale in Feet

North

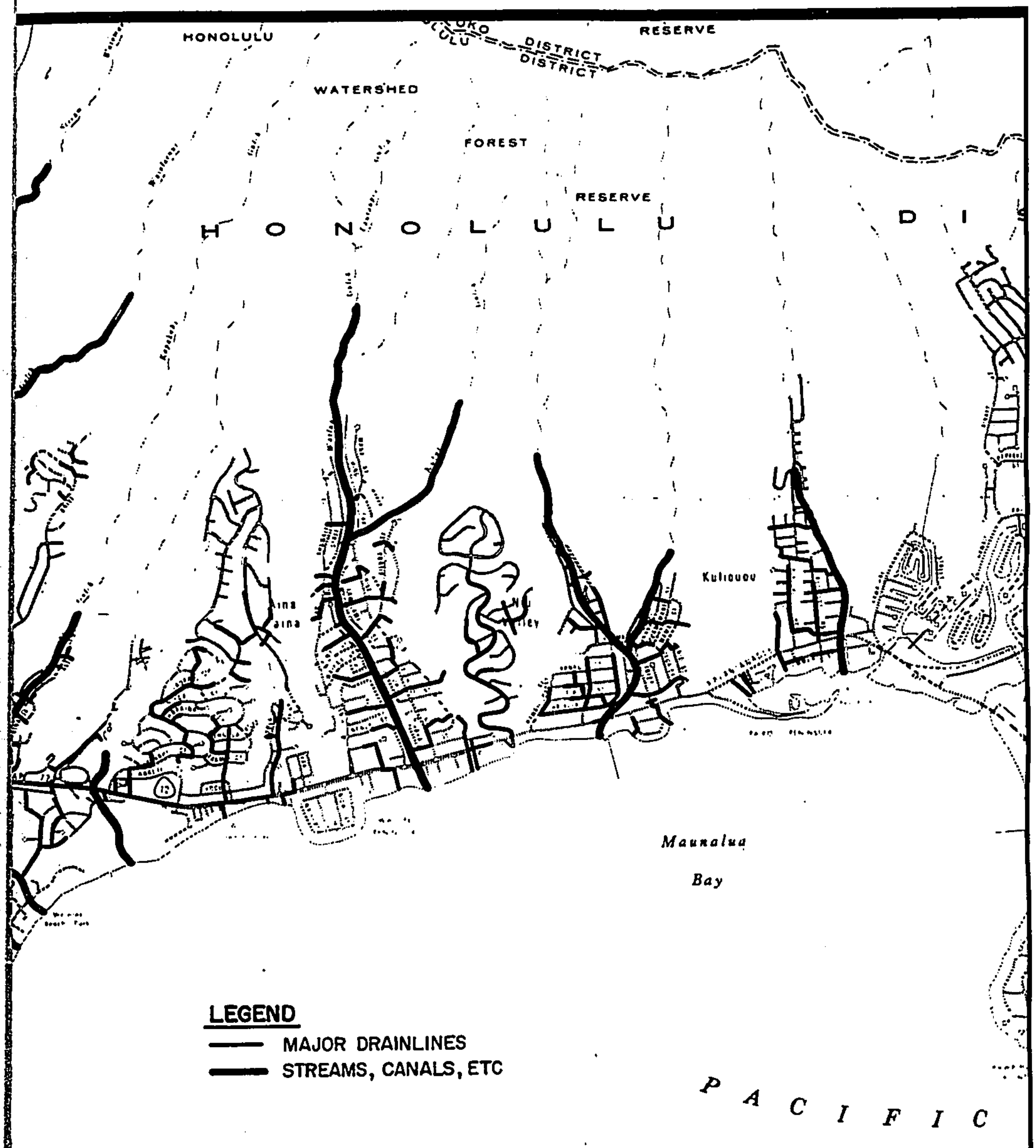


Figure 3-22
Major Components of the Existing Drainage System in the Study Area

and H-Power. Major substations in the study area include Keehi, Lagoon, Mapunapuna, Kapalama, Sand Island, Hila (Moanalua), Waiakamilo, Kapalama, Hala (Kalihi), Nuuanu, School St., Iwilei, Fort St., Emma (Downtown), Archer (Downtown), Piikoi, Pauoa, Woodlawn, Kakaako, Kewalo, Makaloa, Makiki, Moiliili, Manoa, Pukele, Kapiolani, Ena, Waikiki, Kuhio, Kapahulu, Kahala, Aina Koa, Wailupe, and Wiliwili substations. Major transmission lines include 138 and 46 Kilovolt (KV) overhead and underground lines. Primary distribution lines consist of 12.47, 11.5 and 4.16 KV overhead and underground lines. Figures 3-23 and 3-24 indicate the location of major substations and major transmission lines.

3.7.5 Existing Roadway System

Major roadways in the study area include freeways (H-1 and Moanalua), highways (Likelike, Pali, Kamehameha, Nimitz, and Kalanianaole), boulevards (Vineyard, Dillingham, Salt Lake, Ala Moana and Ala Wai), and other major roads, streets and avenues (Puuloa and Waiakamilo Roads; Middle, King, Beretania, Bishop, Punchbowl, South, Piikoi, and Keeaumoku Streets; and Ward, Pensacola, Kalakaua, University, Kuhio, and Waialae Avenues). These roadways are highlighted on Figures 3-25 and 3-26. Access to Sand Island WWTP is via Sand Island Access Road.

3.7.6 Solid Waste Collection Disposal System

The Division of Refuse Collection & Disposal of the Department of Public Works collects, transports, and disposes of refuse from residential areas on Oahu. Oahu is divided into seven collection districts: two windward districts, four leeward districts, and the Honolulu District. Most of the Honolulu District, bounded by Halawa Stream to the west and Kalama Valley to the east, is within the study area. The City also operates the H-Power facility at Campbell Industrial Park. Most commercial and industrial facilities are served by private collection companies.

In 1991, approximately 1.5 million tons of refuse were collected by private and municipal haulers on Oahu. An estimated 755,400 tons of refuse were generated in the study area. About 40 percent of the total was incinerated at the H-Power facility. Utilizing the solid waste as fuel, H-Power sells the electrical energy it produces to Hawaiian Electric Company. A small percentage of waste is incinerated at the Waipahu Incinerator. The ash produced by the incineration process and solid waste that is not incinerated is disposed of at one of the two landfills operated by the City: The Kapaa Landfill in Windward Oahu, or the Waimanalo Gulch Landfill, located mauka of the West Beach Resort in Ewa.

3.8 PHYSICAL AREAS OF PLANNING IMPORTANCE

3.8.1 Wetlands

The only major wetland existing in the study area is situated at Salt Lake and consists of marsh areas bordering the fairways of the Honolulu Country Club golf course. Tidal wetlands and reef flats also exist at certain locations along the shoreline throughout the study area.

3.8.2 Coastal Zone

The State of Hawaii's Coastal Zone Management (CZM) office interprets the federal Coastal Zone Management Act to pertain to the entire island of Oahu except for forest reserves. The CZM Act also pertains to, "all marine waters extending from the upper reaches of the wash of the wave onshore seaward to the limit of the State's police power and management authority, including the U.S. territorial sea"

(Section 205A-1, HRS, as amended by Act 126, 1990). Thus, for purposes of the federal regulation, the entire study area is situated within the coastal zone.

3.8.3 RECREATION AREAS

A majority of the recreational activities on Oahu take place in or near the ocean. The user populations in almost all ocean activities on Oahu have increased substantially in the last ten years. The increases have been due to a number of factors, including general population growth, an increase in popularity of ocean activities among Hawaii's youth, new and improved ocean activities equipment, and a greater emphasis on ocean recreation by the visitor industry.

An offshore recreation activities study was conducted by John Clark in June, 1993 to provide background information for the East Mamala Bay Facilities Plan and EIS. The report examines the ocean recreation industry within the area of activity between Hawaii Kai and the Reef Runway and reports on the economic value of activities there. The information was gathered from a larger study commissioned by the Hawaii State Department of Business and Economic Development. A copy of the Clark report is included as Appendix E.

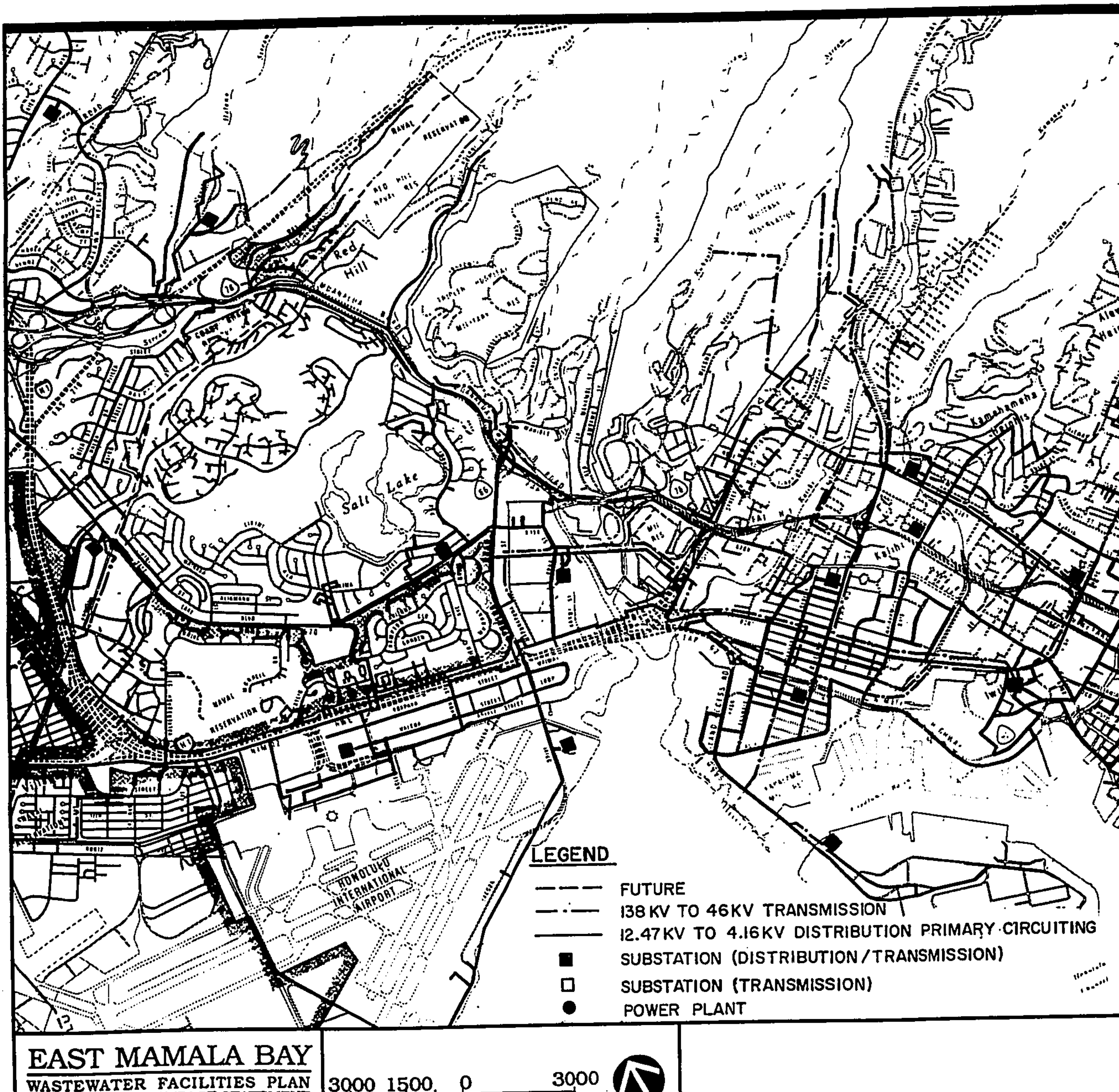
The shoreline from the Reef Runway to Hawaii Kai includes almost the entire seaward extremity of the city of Honolulu. It includes Honolulu Harbor, the largest deep draft harbor in the state; Keehi Lagoon; the Ala Wai Canal; Waikiki Beach, the major visitor destination in Hawaii; and the residential communities of Diamond Head, Kahala, Waialae, Aina Haina, Niu Valley, Kuliouou, and Hawaii Kai.

The shoreline from the Reef Runway to Diamond Head consists primarily of man-made features, the result of extensive dredging of reef areas, the construction of artificial structures, and the filling of former mudflats, fishponds, and shallow reefs. The shoreline from Diamond Head to Koko Head is known as Maunalua Bay and has also been altered considerably by artificial structures, primarily seawalls bordering residential properties.

Ocean activity user groups include commercial groups such as commercial fishermen and non-commercial groups such as subsistence fishermen and recreational surfers. Whether commercial or non-commercial, the ocean activity user groups are limited to those groups who practice in-water activities. Peripheral shoreline user groups such as sunbathers were not included in the study, and user groups in motorized vessels such as tour groups on dinner cruises were not included.

The ocean recreation industry involves statewide expenditures of more than $500 million dollars annually. It is a vital part of Hawaii's main industry of tourism. The result of the expansion of the ocean recreation industry on Oahu has been competition for finite resources by different user groups, including consumptive and non-consumptive users and commercial and non-commercial users. This expansion and competition has caused heavy demands on these finite resources and has taken the form of resource depletion. Heavy and conflicting demands have led to government regulation, and in 1988 the State Department of Transportation included all potentially conflicting forms of ocean recreation and ocean use into the "Statewide Ocean Recreation and Management Plan." This plan is a good example of the restrictive trends that are occurring in Hawaii.

As the state becomes increasingly dependent on tourism as its major industry, and the ocean recreation industry grows in size, pressures on the marine environment will continue to escalate, and it will become increasingly vulnerable to changes in water quality. The increased pressure and the need to preserve ocean water quality will mean more regulation for both residents and visitors alike.



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

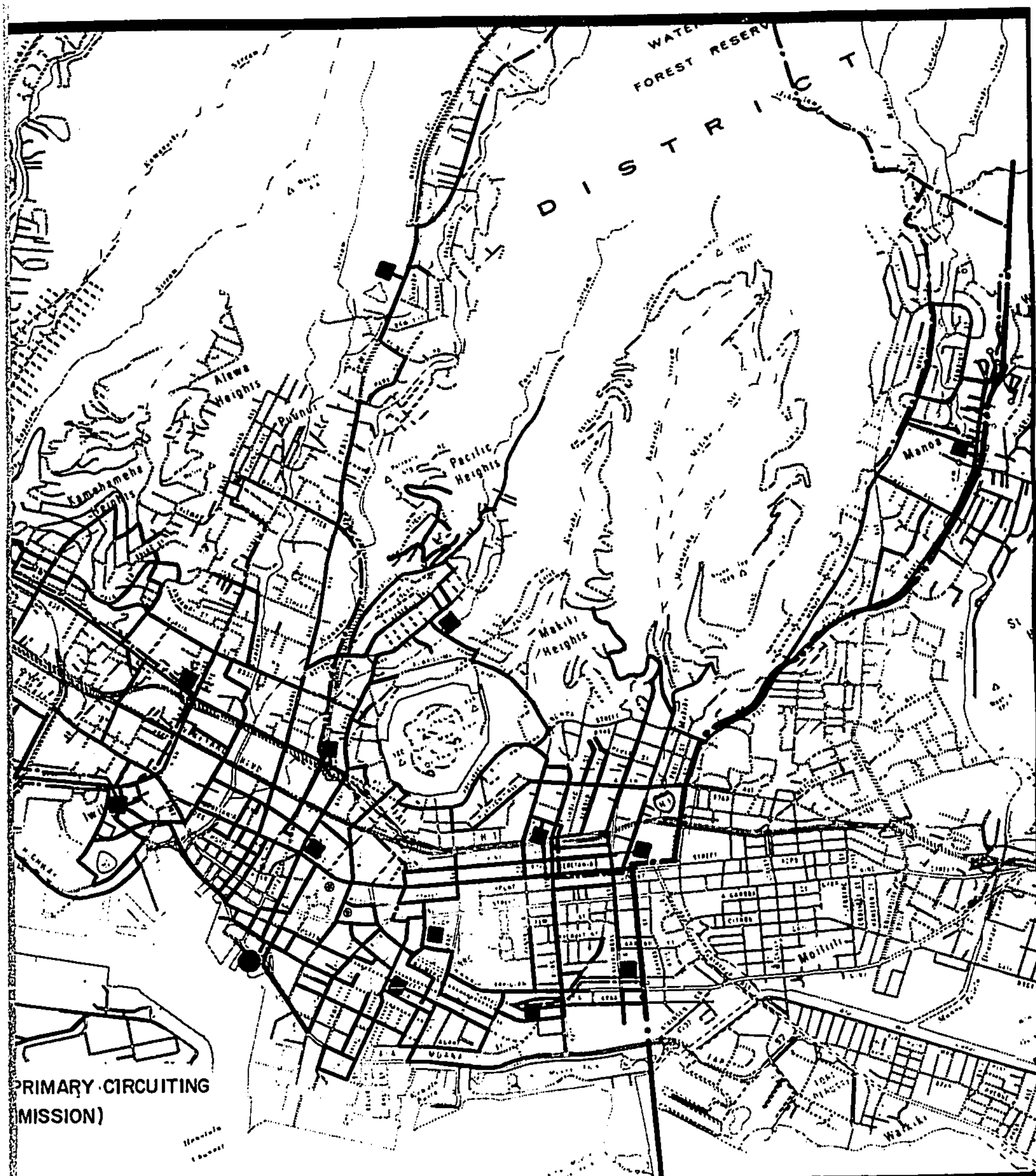
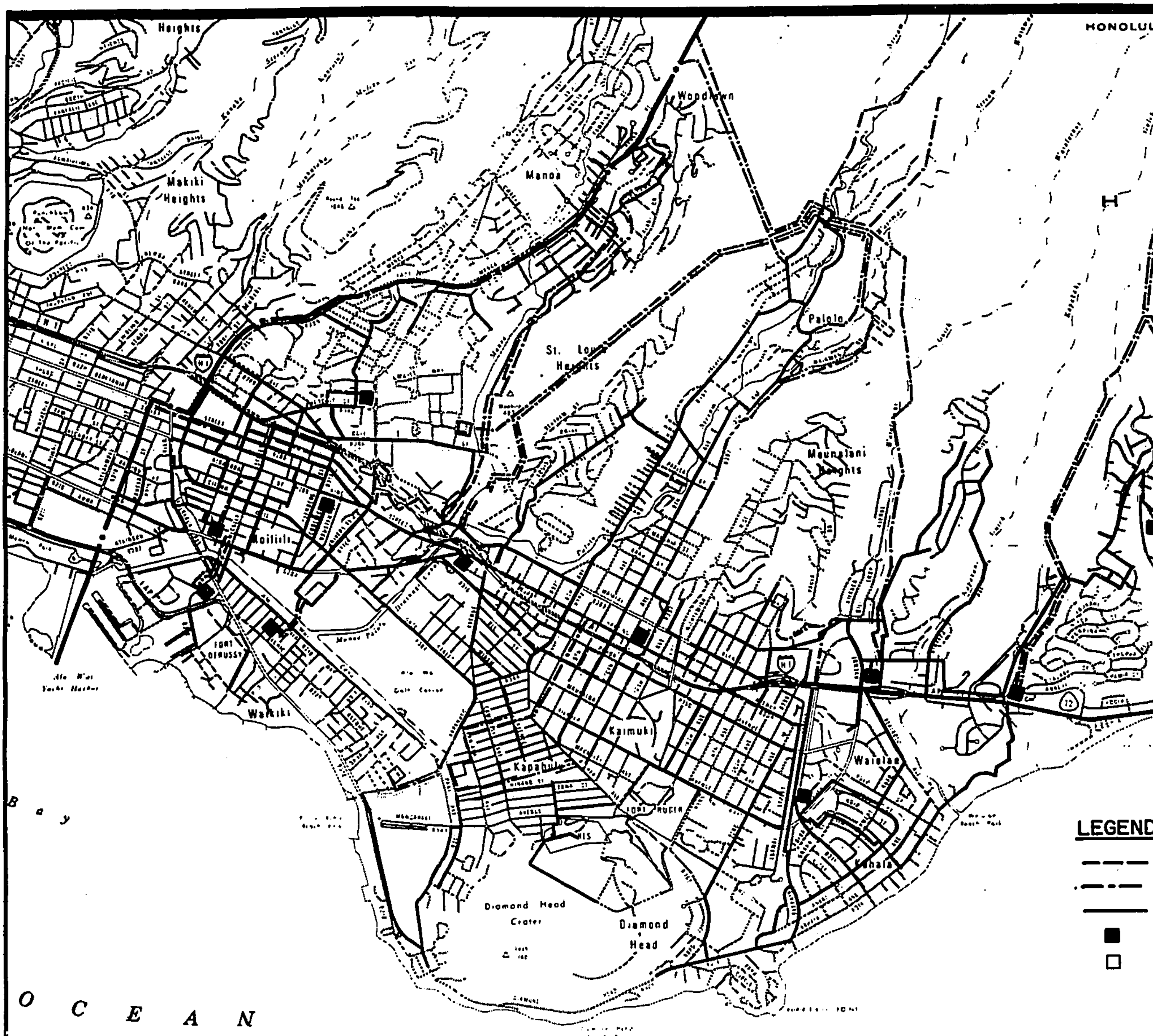


Figure 3-23
Major Components of the Existing
Electrical Transmission System in the Study Area



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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Scale in Feet

North

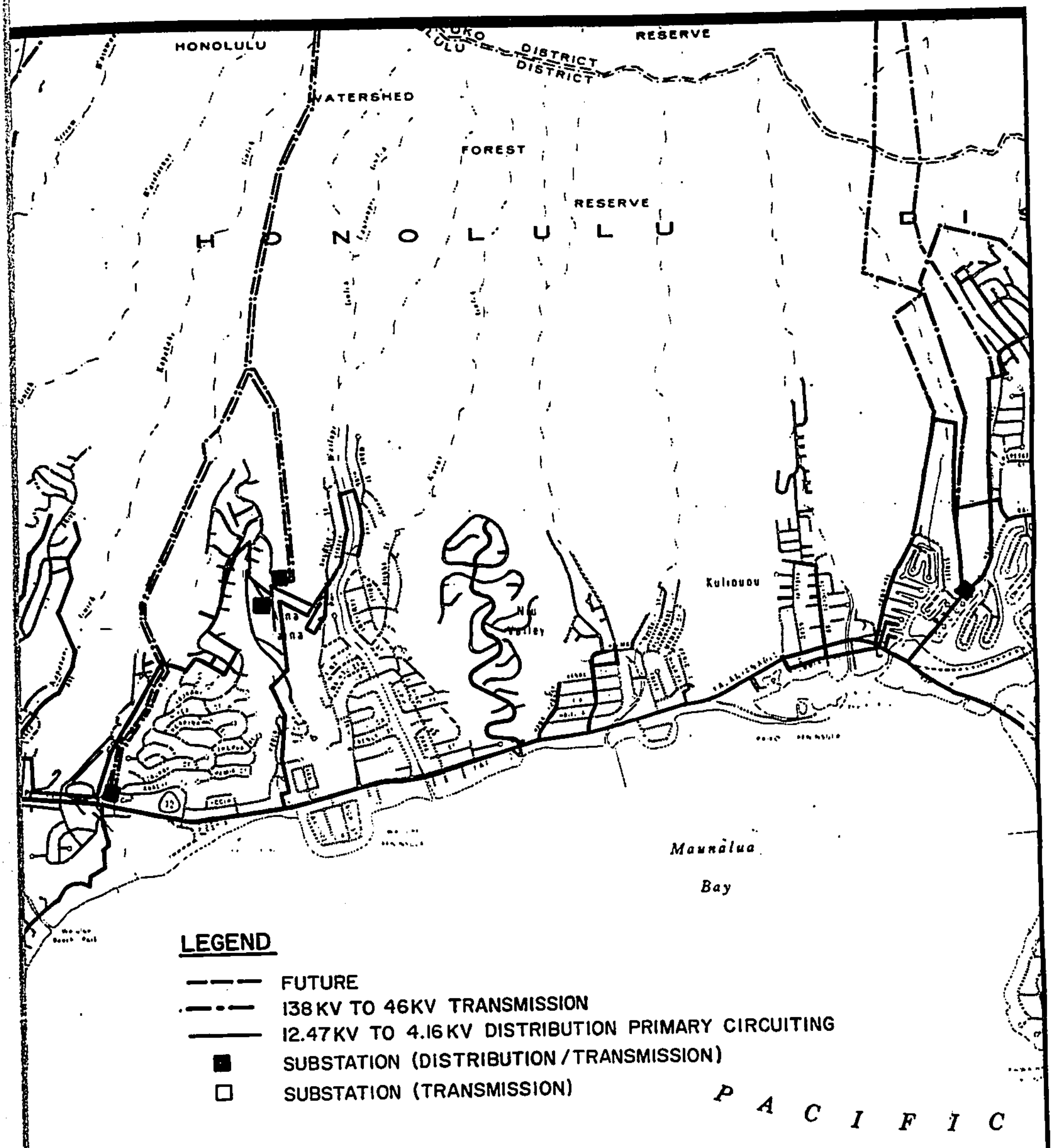
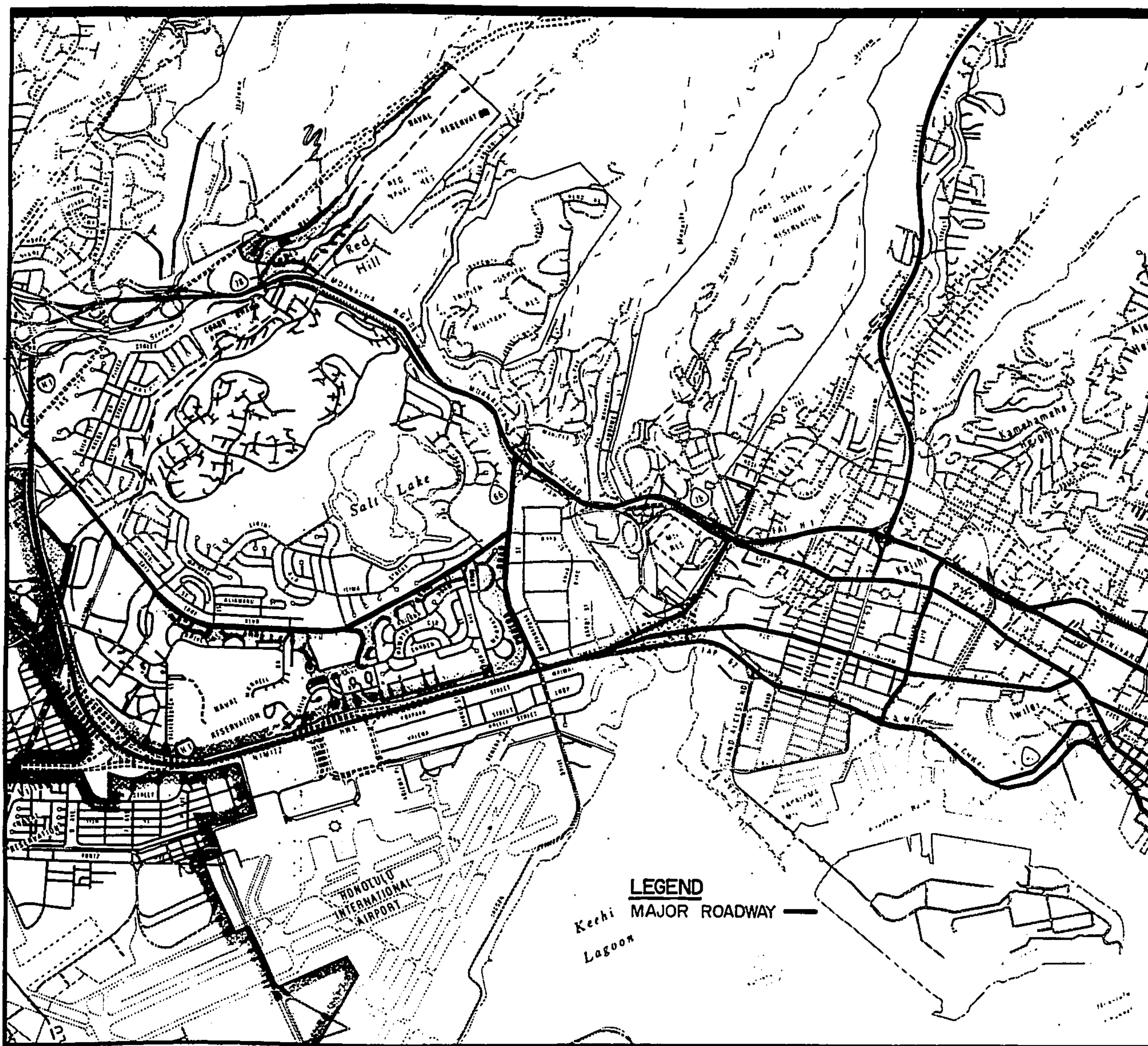


Figure 3-24
Major Components of the Existing Electrical Transmission System in the Study Area



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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Scale in Feet

North

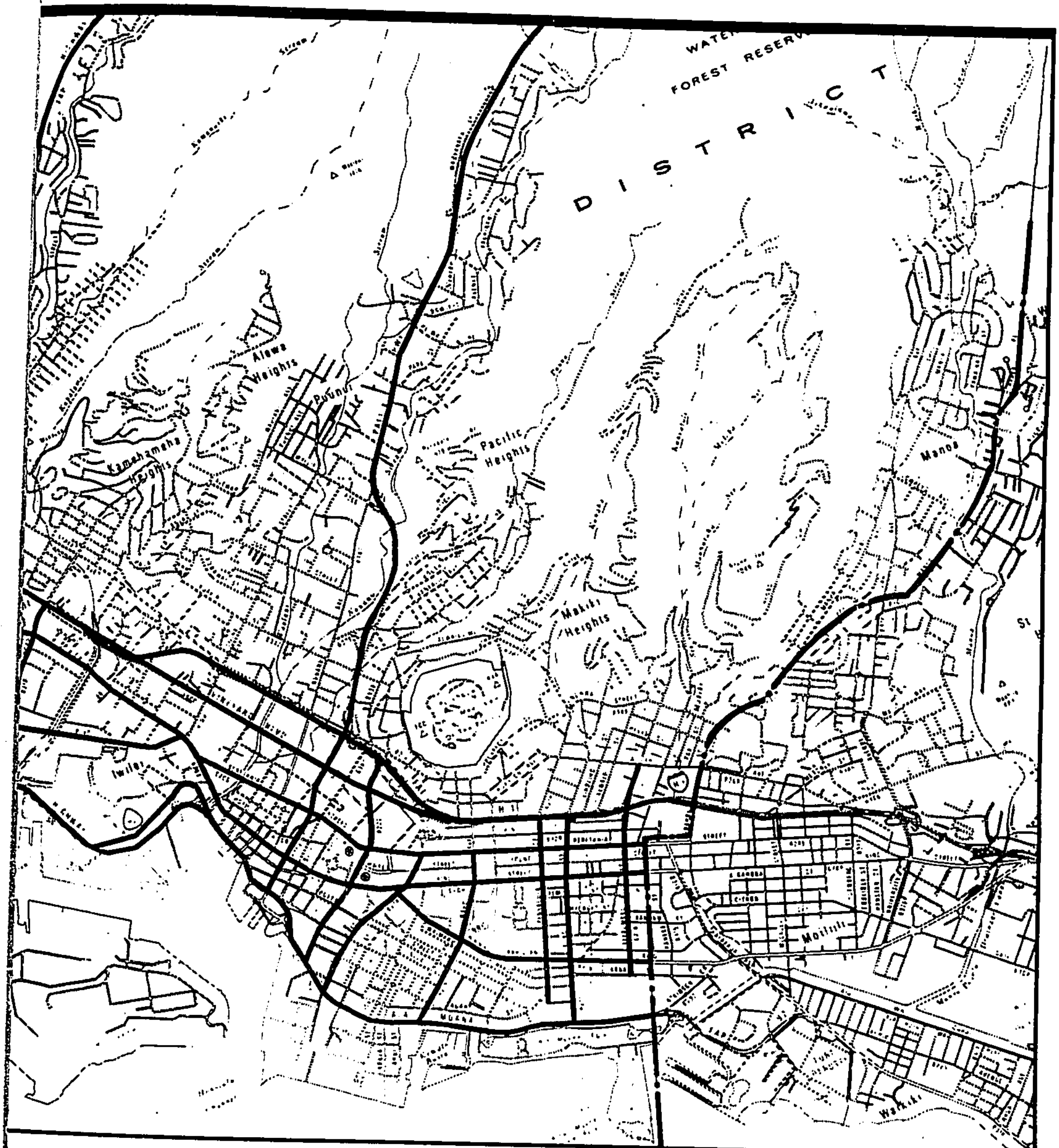
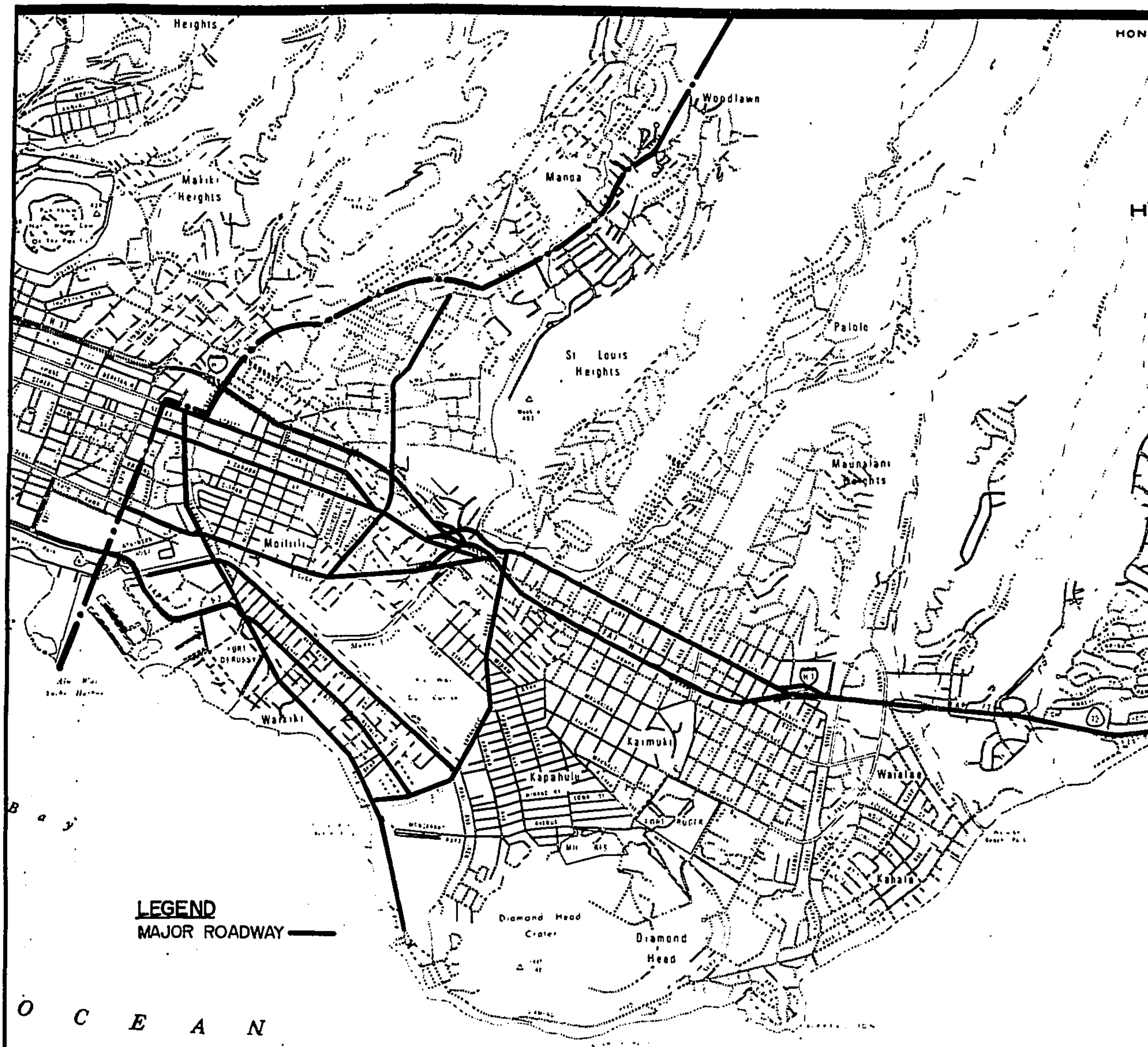


Figure 3-25
Existing Major Roadways in the Study Area



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
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Scale in Feet
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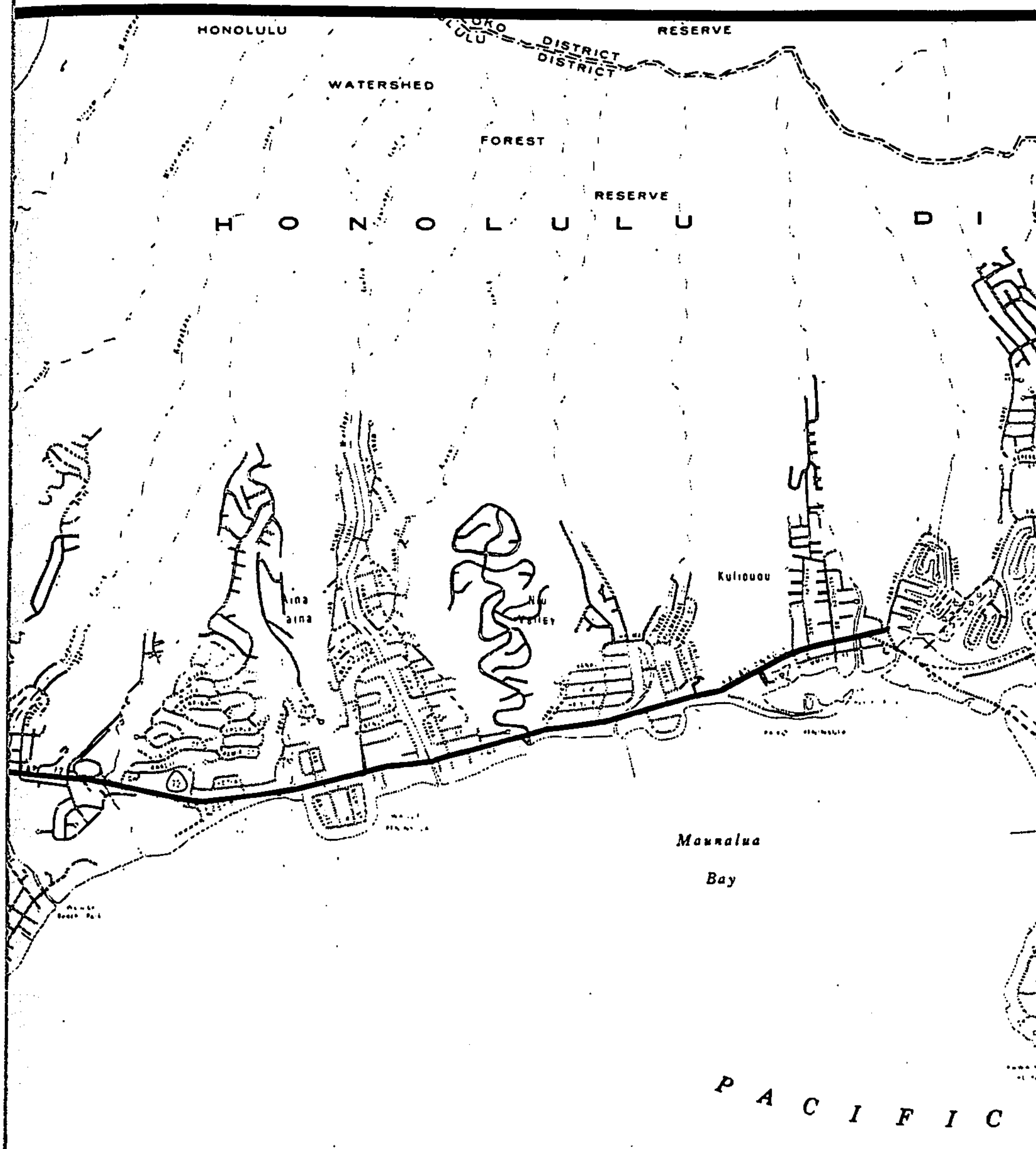

Figure 3-26
Existing Major Roadways in the Study Area

3.8.4 AGRICULTURAL LANDS OF IMPORTANCE TO THE STATE OF HAWAII (ALISH)

Lands identified as being of agricultural importance to the State of Hawaii are divided into three classifications: Prime, Unique, and Other Important (see Figure 3-27). These classifications are defined as follows:

Prime — Land which has the soil quality, growing season, and moisture supply needed to produce sustained high yields of crops economically when treated and managed according to modern farming methods.

Unique — Land that has the special combination of soil quality, location, growing season, and moisture supply, and is used to produce sustained high quality and/or high yields of a specific crop when treated and managed according to modern farming methods.

Other Important — Land other than Prime or Unique Agricultural Land that is also of Statewide or local importance for agricultural use.

Despite the fact that the vast majority of the study area is classified as urban land and is intensely developed, there are small pockets of agricultural land situated within the study area. In all instances, however, these so called pockets are located outside of the urban area.

Prime agricultural lands can be found in three areas: immediately *mauka* of the Tripler Army Hospital, including a portion of the ridge *diamond head* of the hospital; at the upper reaches of Palolo Valley; and at the back of Wiliwilinui Valley immediately east of Waialae Iki. Areas containing other important agricultural lands include: lands *mauka* of Fort Shafter and Agricultural Lands of Importance to the State of Hawaii (ALISH) contained within the Shafter Military Reservation; a small parcel above the *mauka* terminus of Keeaumoku Street in the Makiki Heights area; a relatively large area on Waahila ridge situated on the *diamond head* side of the University of Hawaii's Manoa campus; at the back of Wiliwilinui Valley *mauka* of the Prime lands discussed above, a large area on Hawaii Loa Ridge, and a small area at the back of Kupaua Valley between Niu Valley and Kuliouou Valley.

3.8.5 WATERSHEDS

During the first several decades of the 20th century, the upper slopes of the Koolau mountain range above urban Honolulu were systematically planted with a wide variety of introduced species in an effort to control erosion and establish a watershed that could aid in the replenishment of the Honolulu Aquifer. In addition, lands were acquired for preservation as a Forest Reserve which was intended to provide Honolulu with a watershed. From 1906 to 1936, the dedicated Forest Reserve quadrupled in size from about 36,500 acres to about 120,500 acres.

Today, the Forest Reserve consists of State-owned land that is controlled by the Department of Land and Natural Resources. Designated as Conservation land, development within this watershed area is relatively restricted. Although a few small pockets of residential land uses have been permitted over the years on privately-owned portions of conservation land outside of the forest reserve/watershed, for the most part, the Honolulu watershed has been successfully protected from development.

3.8.6 MARINE LIFE CONSERVATION DISTRICTS

Since 1988, the Waikiki Marine Life Conservation District (MLCD) has been established at the Diamond Head end of Waikiki Beach. Although MLCDs are not yet being designated as Class AA by HAR 11-54, MLCDs are marine parks designed to conserve and replenish marine resources. Only limited consumptive

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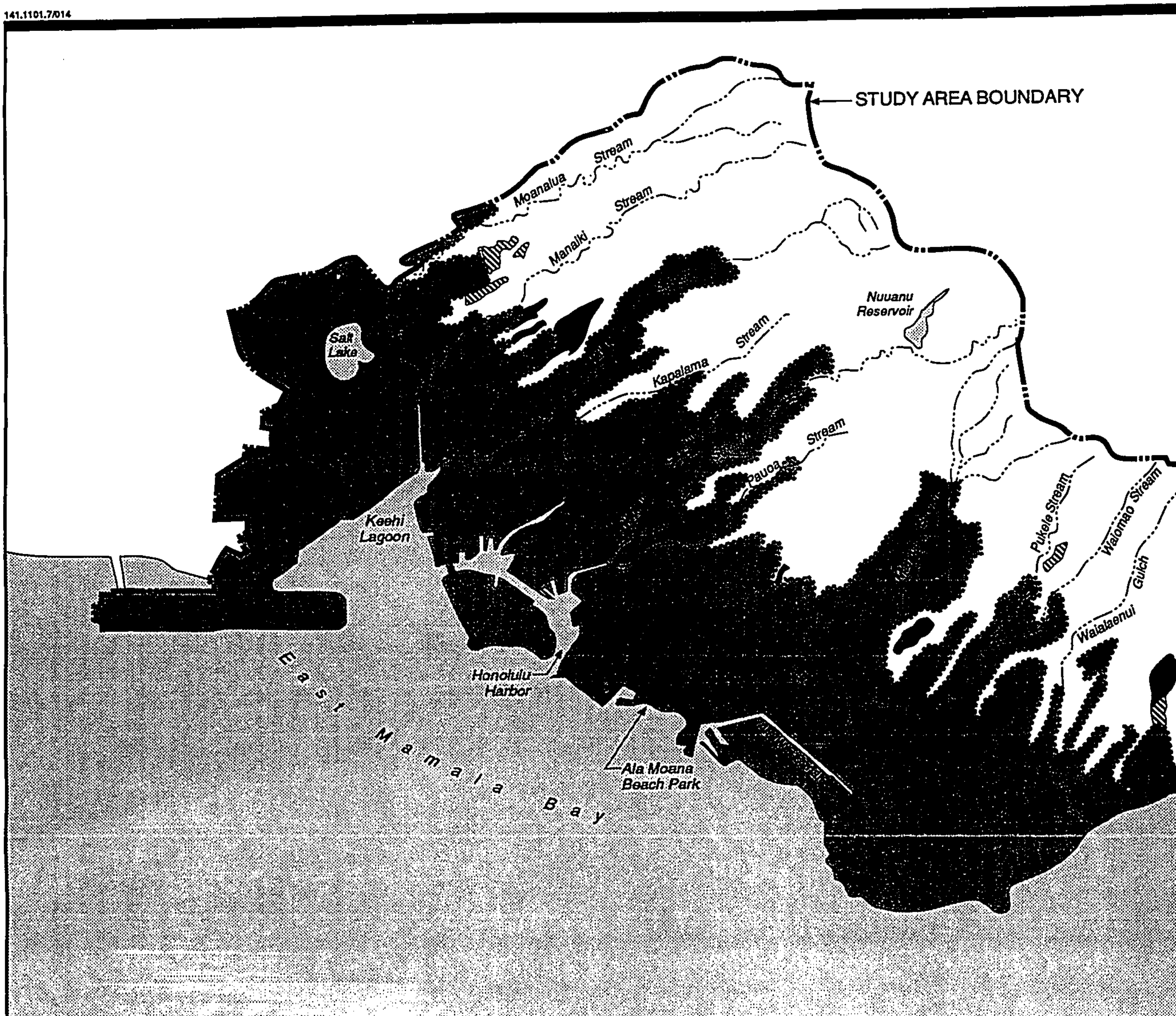

Source: *Agricultural Lands of Importance to the State of Hawaii*, State of Hawaii Department of Agriculture, January, 1977.

EAST MAMALA BAY
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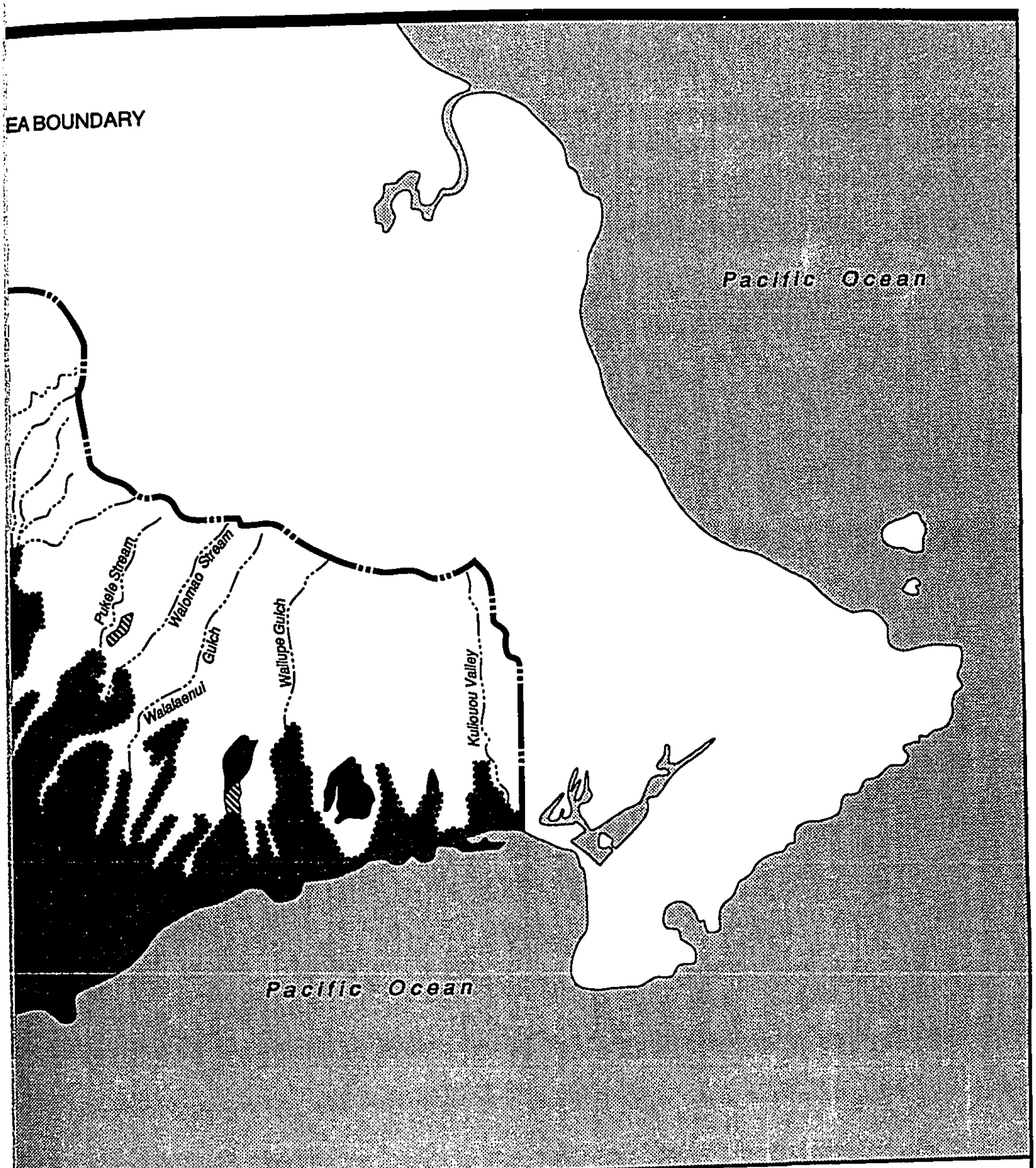
7,000 3,500 0 7,000
Scale in Feet

North

Legend
Prime Agricultural Land
Other Important Agricutural Land
Forest Reserve Line
Existing Urban Deve



Forest Reserve Line

Existing Urban Development

Figure 3-27

ALISH (Agricultural Lands of Importance) Map

Nearly 2,400 individuals are employed by the Honolulu Police Department, of which over 1,900 are sworn officers. This accounts for an estimated 2.2 officers per 1,000 persons living on Oahu. Because officers are frequently reassigned to different beats and different districts, it is not possible to accurately estimate the number working in the study area at any particular time. However, based on the population of study area, it is likely that the number is in the vicinity of 900 to 1,000.

The Honolulu Fire Department is responsible for the prevention and extinguishment of fires, and the protection of life and property within the City & County of Honolulu. The department enforces fire regulations, provides public fire education, maintains a modern communication system, conducts mountain and ocean search and rescue, and trains a highly responsive team of fire fighters.

The department is organized into six bureaus and 41 fire stations. Of the 41 stations, 18 fall within the study area. As of 1991, the department employed 1,008 uniformed fire fighters and 34 civilians. Approximately 450 of the fire fighters are stationed within the East Mamala Bay study area.

3.9.2 HEALTH CARE FACILITIES

The island of Oahu is serviced by a network of hospitals and clinics. According to the 1992 State of Hawaii Data Book, there are 39 hospitals on Oahu, providing over 5,000 beds. Major medical facilities located within the study area include Kaiser Permanente (Honolulu Clinic and Moanalua Medical Center), Kapiolani Medical Center, Kuakini Medical Center, Queen's Medical Center (Kuakini Clinic), Shriners Hospital, Straub Clinic & Hospital, and Tripler Army Medical Center.

3.9.3 SCHOOLS AND EDUCATIONAL FACILITIES

Oahu is divided into four school districts: Windward, Leeward, Central, and Honolulu. With the exception of its far eastern portion, the Honolulu District falls entirely within the study area. The Salt Lake area of the Central District is also part of the study area.

There are over 340 elementary, intermediate, and high schools on the island, of which approximately 90 are private schools. Nearly 160 public schools and over half of the private schools are within the study area.

There are four community colleges, four independent colleges and universities, and variety of occupational training schools on Oahu. Five colleges and universities are located in the study area: Chaminade University, Hawaii Pacific University, Honolulu Community College, Kapiolani Community College, and the University of Hawaii at Manoa. The University of Hawaii is the primary State institution of higher education. Approximately 90 percent of the students attending degree-granting institutions in the State are enrolled at the University of Hawaii.

4
Description of Wastewater System

FOUR

DESCRIPTION OF WASTEWATER SYSTEM

This chapter describes the components of the existing wastewater system, including the collection lines, WWPSs, Sand Island Wastewater Treatment Plant (Sand Island WWTP), effluent disposal, sludge treatment and disposal, and individual wastewater systems. It also discusses complaints and reported spillages associated with the Sand Island wastewater system and the existing water quality monitoring program required by the existing NPDES permit for Sand Island WWTP. Commercial and industrial establishments may or may not be connected to the Sand Island wastewater system and are also discussed in this chapter.

Numerous reports, plans and studies were used to develop this description of the existing wastewater system. One of the most applicable is the Islandwide Sewer Adequacy Project (ISAP). This study, authorized by the DWWM in 1986, was designed to address the adequacy of the wastewater system. Among the products of the ISAP were a series of maps of the existing system and a computerized database containing detailed information on system components (e.g. collection line diameters, inverts, and manhole locations). In addition to the maps and database, wastewater flow was measured at selected locations within the system.

Three of the resulting ISAP reports were used as references for the Facilities Plan and EIS:

- Islandwide Sewer Adequacy Study Project, Hart Street Area, September 1990.
- Islandwide Sewer Adequacy Project; Kahala Area Sanitary Sewer System, April 1989.
- Islandwide Sewer Adequacy Report; Ala Moana Basin; Volume I, June 1991.

Other studies were also investigated for information about the existing wastewater system:

Sand Island WWTP:

- Environmental Impact Statement for Sand Island STP and Outfall Sewer, June 1972.
- Final Report on the Infiltration & Inflow Analysis for the East Mamala Bay System, February 1974.
- Preliminary Design Report for the Sand Island Sewage Treatment Plant, October 1971.
- Preliminary Design Report for the Sand Island Ocean Outfall System, September 1971.
- Water Quality Program for Oahu with Special Emphasis on Waste Disposal, September 1971.
- Final Environmental Statement/D-EPA-240002-HI/Mamala Bay Wastewater Treatment and Disposal System, Oahu, Hawaii, December 1973.

Ala Moana WWPS:

- Final Report/Master Plan Report for Ala Moana Sewage Pump Station Modification No. 2, June 1974.
- Final Environmental Impact Statement for New Ala Moana Sewage Force Main, November 1974.

Hart Street WWPS:

- Final Report for the Hart Street Sewage Pump Station Modification, November 1974.
- Negative Environmental Declaration Statement for Hart Street Sewage Pump Station Modification.

Kahala WWPS:

- Engineering Report Covering the Design Modifications to the Kahala Sewage Pump Station and New Kahala Force Main, June 1981.

- Notice of Negative Declaration for the Kahala Sewage Pump Station Modification and New Force Main, July 1981.

Sewer Tunnels:

- Final Environmental Impact Statement for Sewer Tunnel Relief, September 1985.
- Preliminary Engineering Report for East End Relief Sewer, September 1986.
- Final Environmental Assessment for East End Relief Sewer, April 1987.
- Preliminary Engineering Report, Sewer Tunnel Relief, Increment 5, September 1987.
- Environmental Impact Assessment, Sewer Tunnel Relief, Increment 5, December 1988.
- Preliminary Engineering Report; Nimitz Highway Relief Sewer, August 1989.
- Preliminary Engineering Report and Cost Estimates for Wailupe Reconstructed Trunk Sewer, July 1990.

The discussion also relied on design and construction plans, interviews with DWWM personnel, and visits to the WWPSs and WWTP.

The wastewater collection system is composed of three major and one minor subsystems: Ala Moana, Hart Street, Fort Shafter, and the Sand Island Parkway systems. This chapter describes each of these subsystems separately. It then describes the treatment and disposal systems associated with the Sand Island WWTP and includes a discussion of individual (domestic) systems, commercial, and industrial treatment systems and the existing water quality monitoring program. Figures 4-1 and 4-2 show the locations of the major components of the collection system.

The wastewater collection system consists of a network of pipes that collects wastewater from residences and businesses in the service area and carries it to the Sand Island WWTP. The sewer system consists of approximately 2,980,000 linear feet, or 564 miles, of sewer lines, which range in size from 6 inches to 78 inches in diameter (plus tunnels, some of which are box-shaped). Table 4-1 presents an inventory of the sewer lines within the study area, by size. The sewer lines within the study area are made primarily of four types of material: reinforced concrete (RC), cast iron (CI), vitrified clay (VC), and terra cotta (TC). A breakdown of each type of sewer line within the study area is presented in Table 4-2.

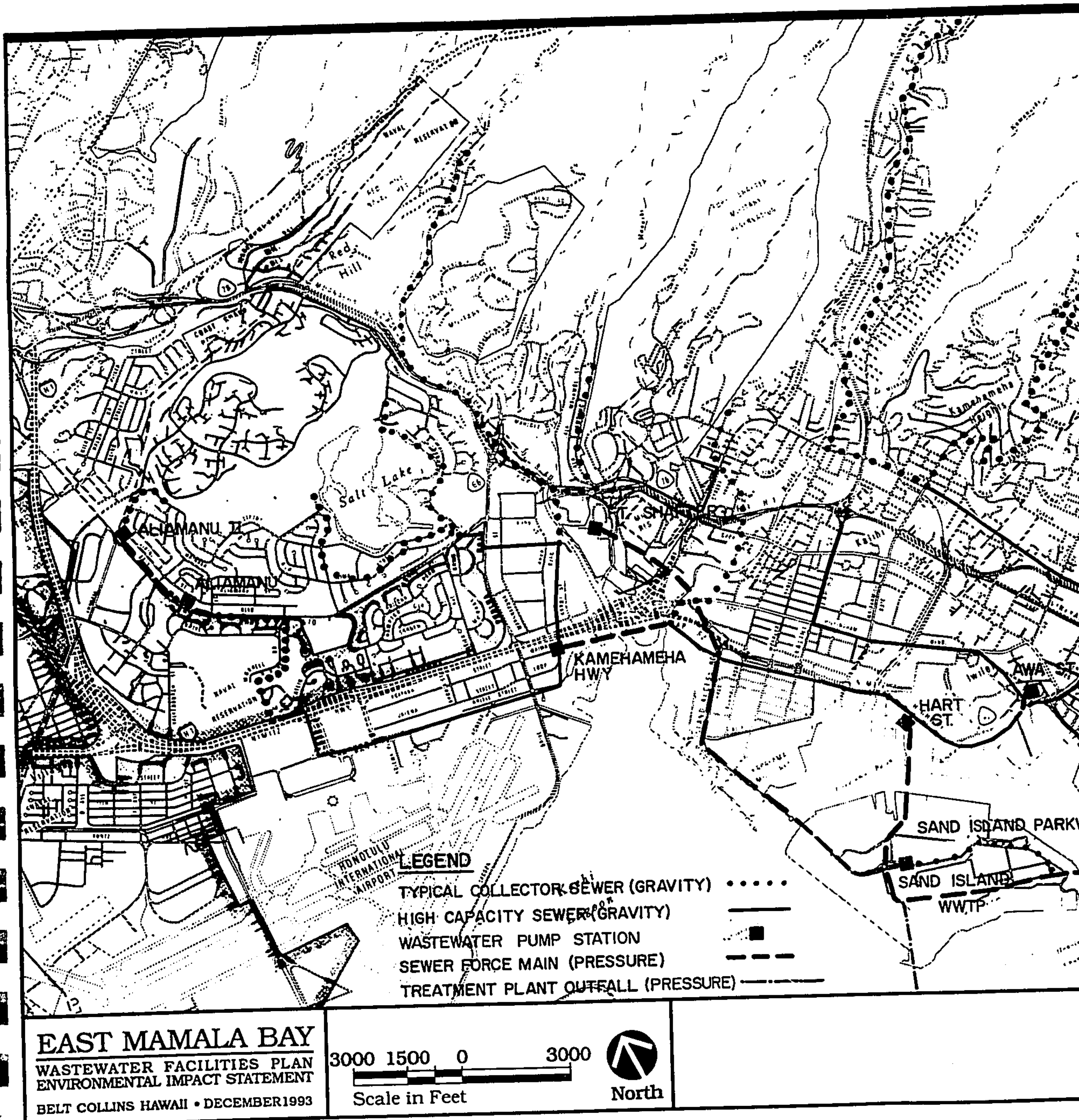
4.1 ALA MOANA COLLECTION SYSTEM FACILITIES

4.1.1 ALA MOANA WWPS AND SERVICE AREA

The Ala Moana WWPS is located on Keawe Street near Honolulu Harbor. It was developed in four stages over a period of about 80 years. The first pump station was built in 1901; a second facility was built in 1940. Although the buildings remain, these two pump stations are no longer in service. A third, "Station I", was built in 1955, and a fourth, "Station II", was constructed in 1983. Today Station II operates as the main facility in daily operation and Station I serves as a backup. Figure 4-3 presents the site plan of the Ala Moana WWPS.

The combined Ala Moana WWPS facility is the largest pump station in the East Mamala Bay study area, receiving sewage from all other pump stations in the Ala Moana sub-district (see Figure 4-4). The average daily sewage flow rate recorded from May 1990 to May 1992 through the Ala Moana WWPS is 56.7 mgd.

The pumps at Ala Moana Station I operate at variable speed using a "Flomatcher" system by which the liquid level in the pump station wet well controls the speed of the pump motors. The pumps at Station II are controlled by variable-voltage-type variable-speed drives. This type of drive has been a problem historically and, consequently, is no longer commonly used. According to DWWM maintenance personnel, all of the variable-voltage drives, including those at Ala Moana WWPS, will be considered for replacement.



Red Hill
Salt Lake
ALIAMANU II
ALIAMANU
FT. SHAFTER
KAMEHAMEHA HWY
AWA ST.
HART ST.
SAND ISLAND PARKW
SAND ISLAND WWTP
HONOLULU INTERNATIONAL AIRPORT
LEGEND
TYPICAL COLLECTOR SEWER (GRAVITY)
HIGH CAPACITY SEWER (GRAVITY)
WASTEWATER PUMP STATION
SEWER FORCE MAIN (PRESSURE)
TREATMENT PLANT OUTFALL (PRESSURE)
EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
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Scale in Feet
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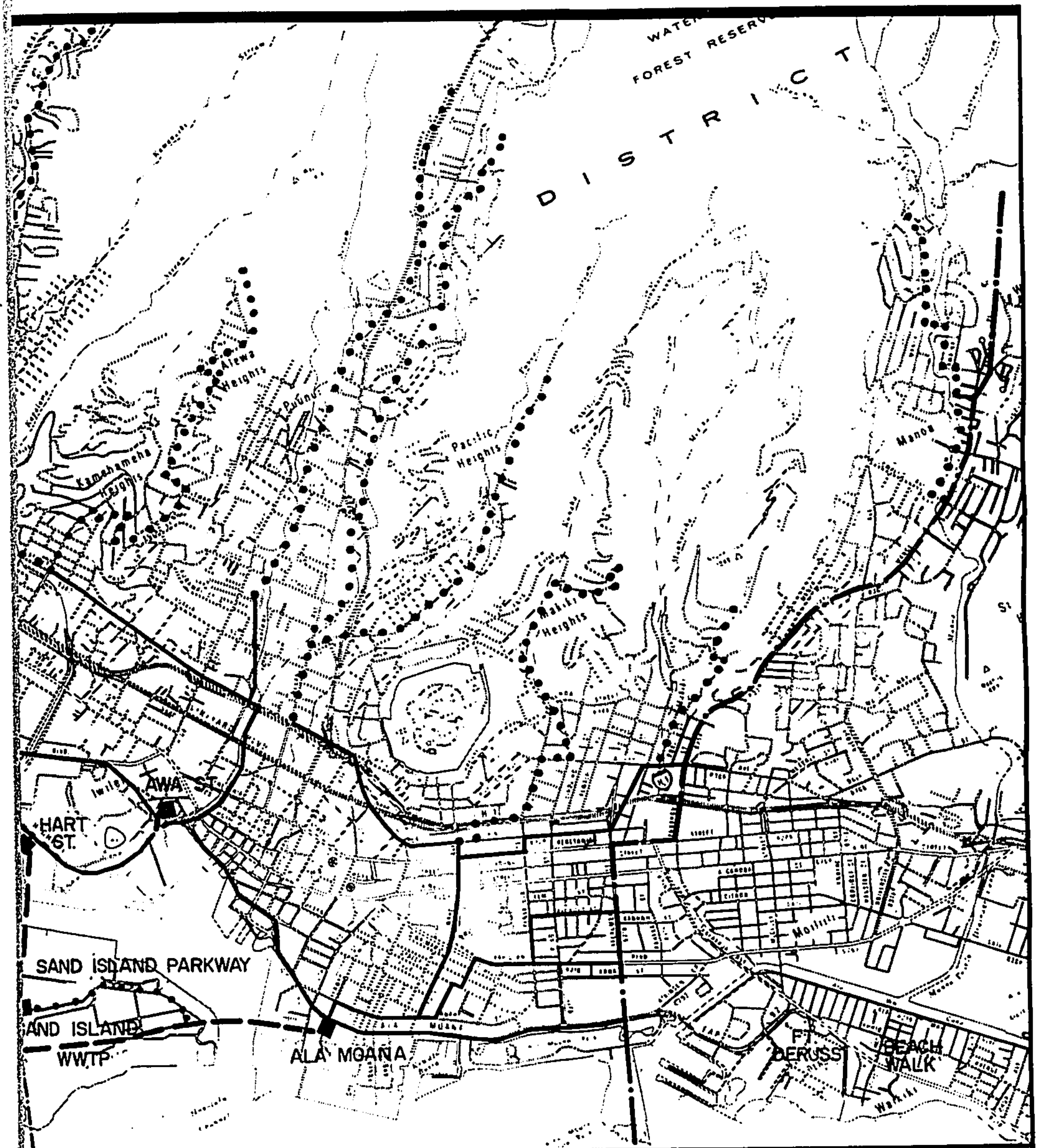
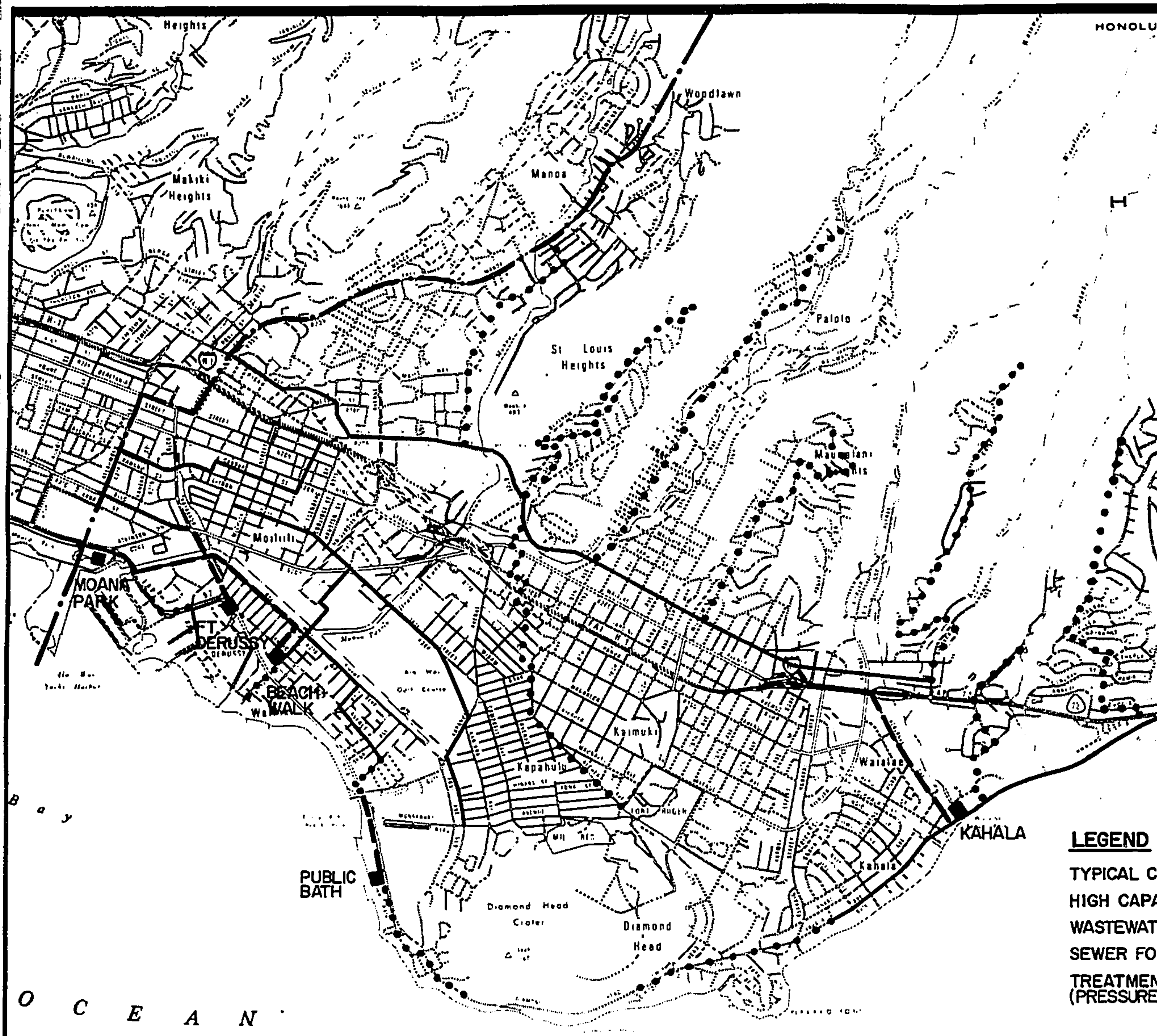


Figure 4-1
Major Components of the Existing Wastewater System in the Study Area



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

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Scale in Feet

North

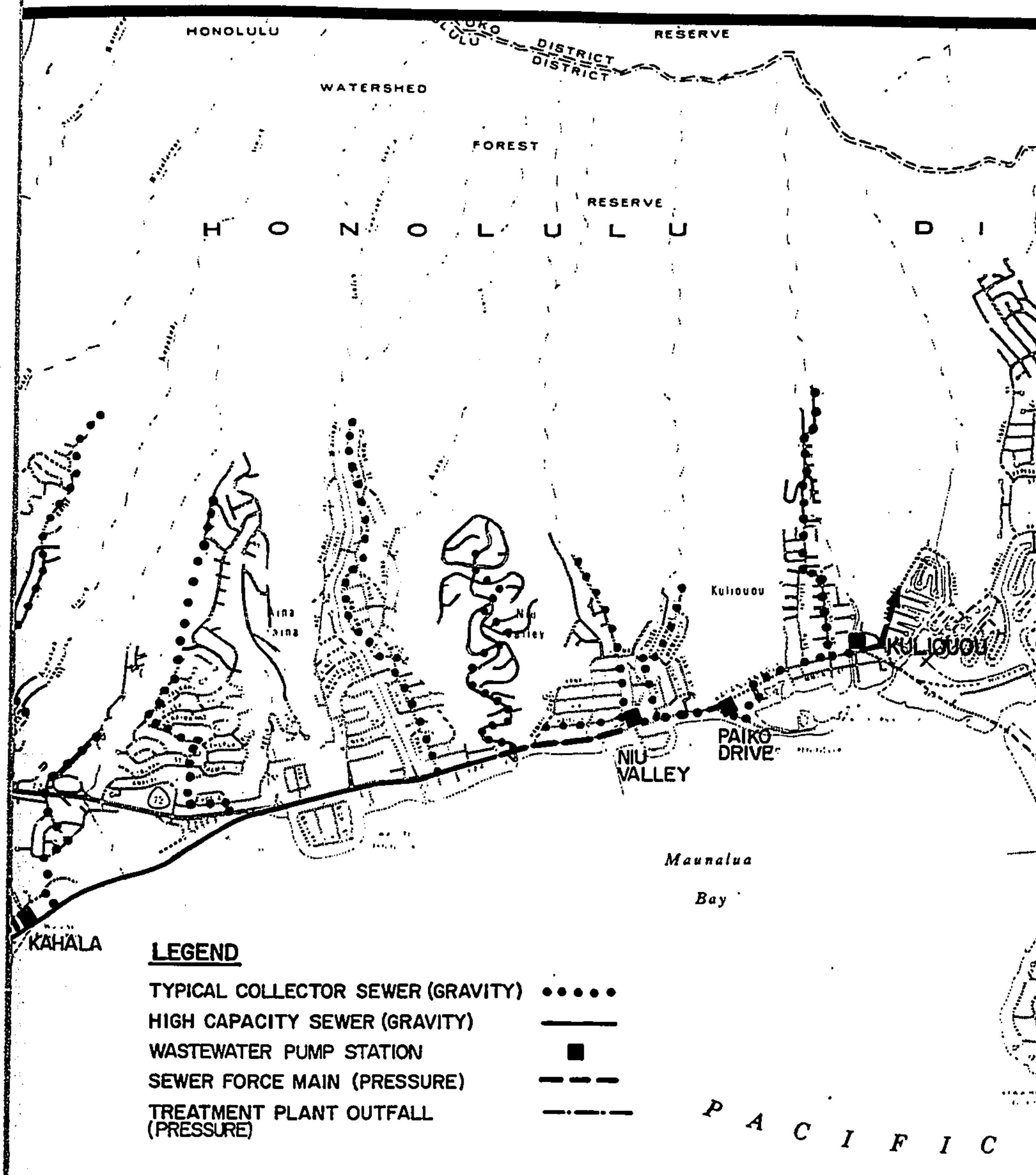

Figure 4-2
Major Components of the Existing Wastewater System in the Study Area

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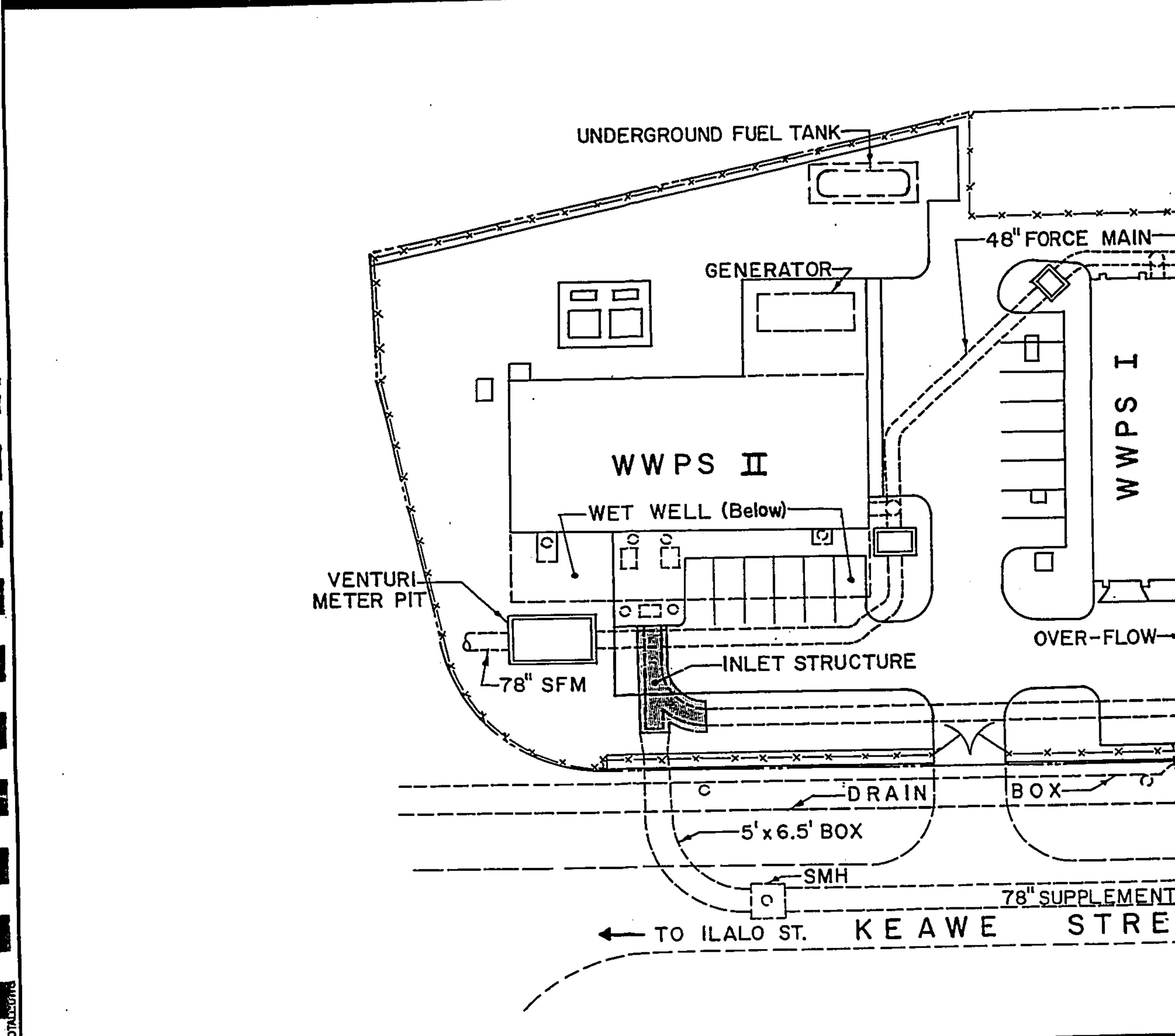

EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
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Not to Scale

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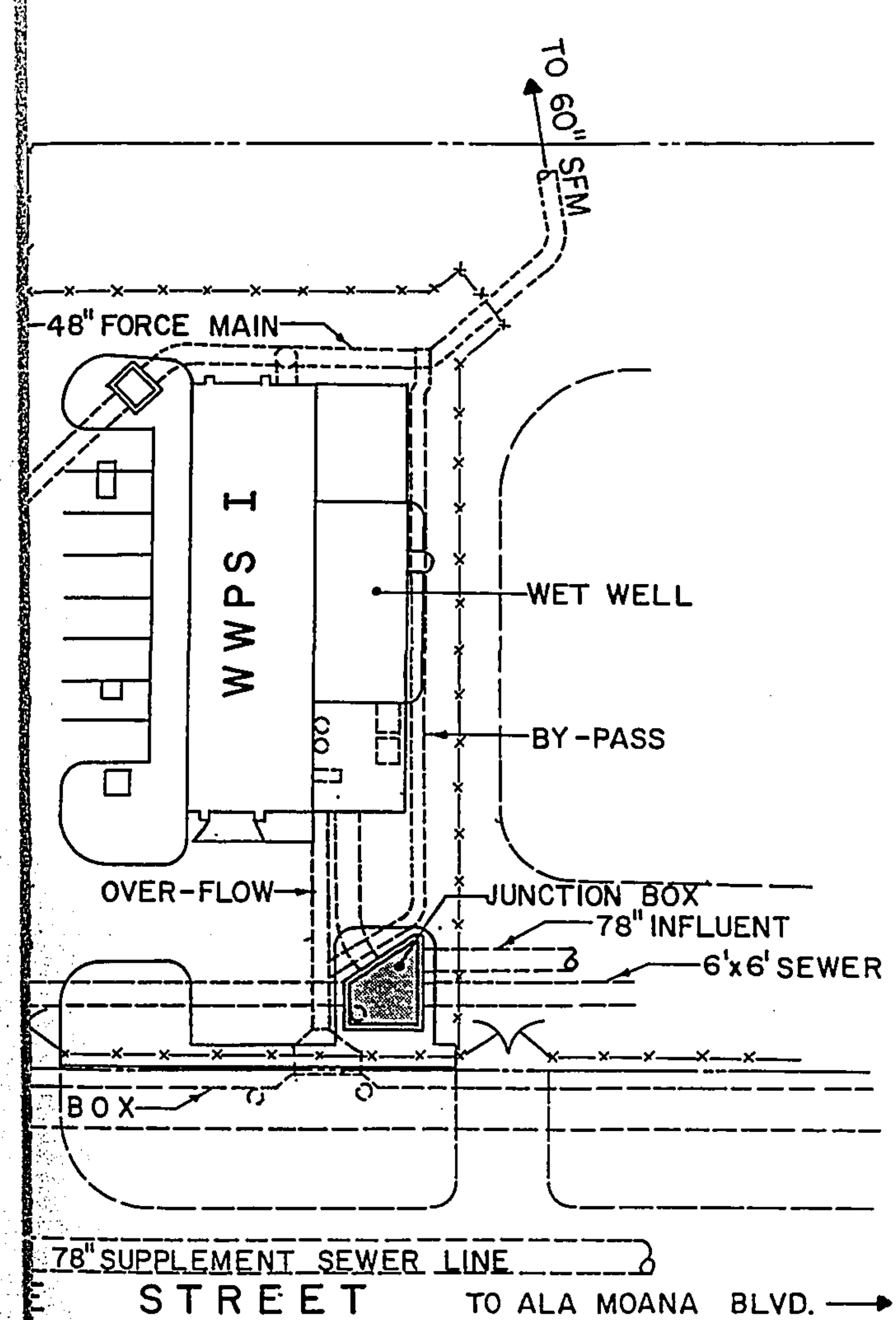

Figure 4-3
Ala Moana WWPS I & II SIte Plan

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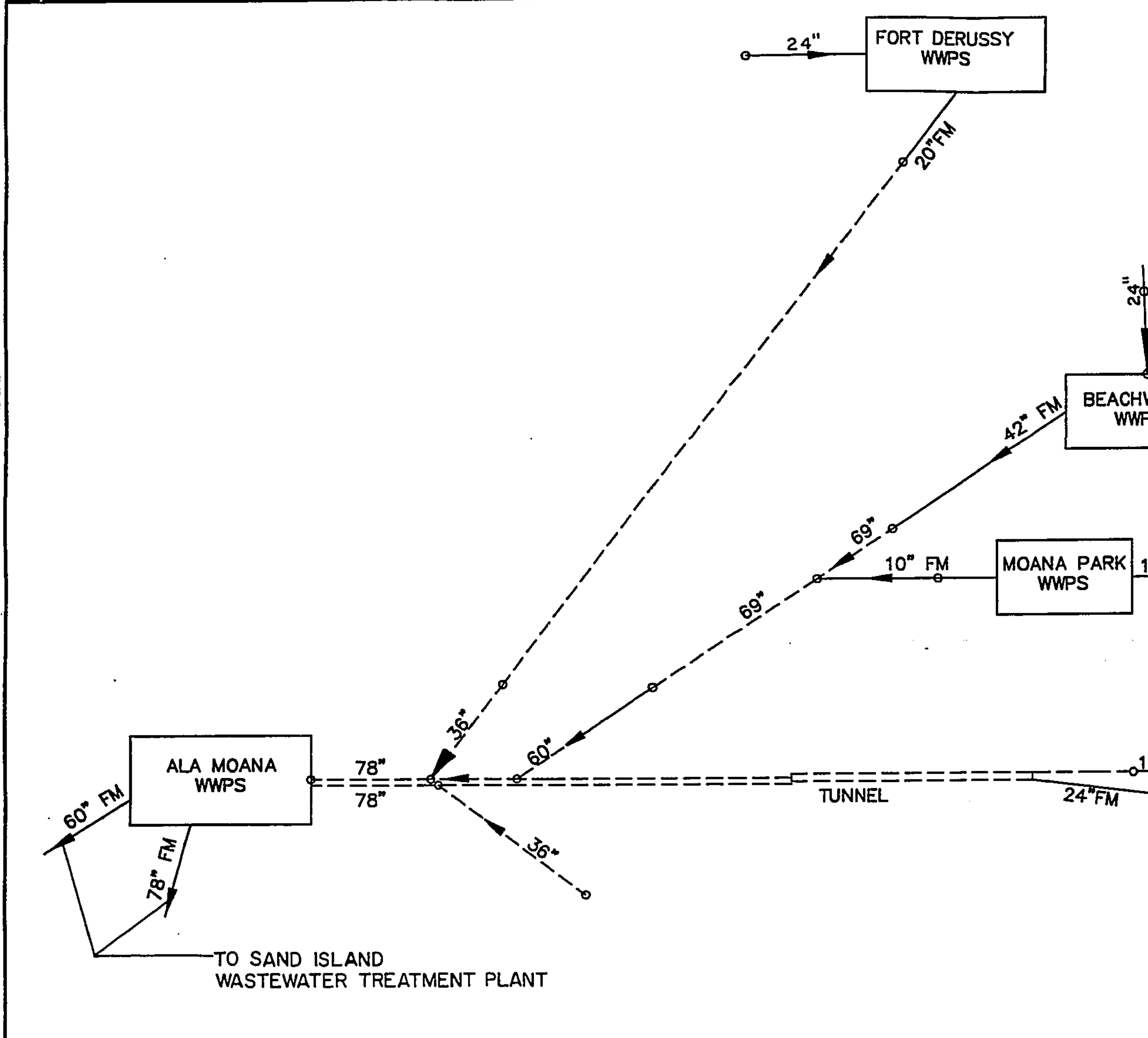

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
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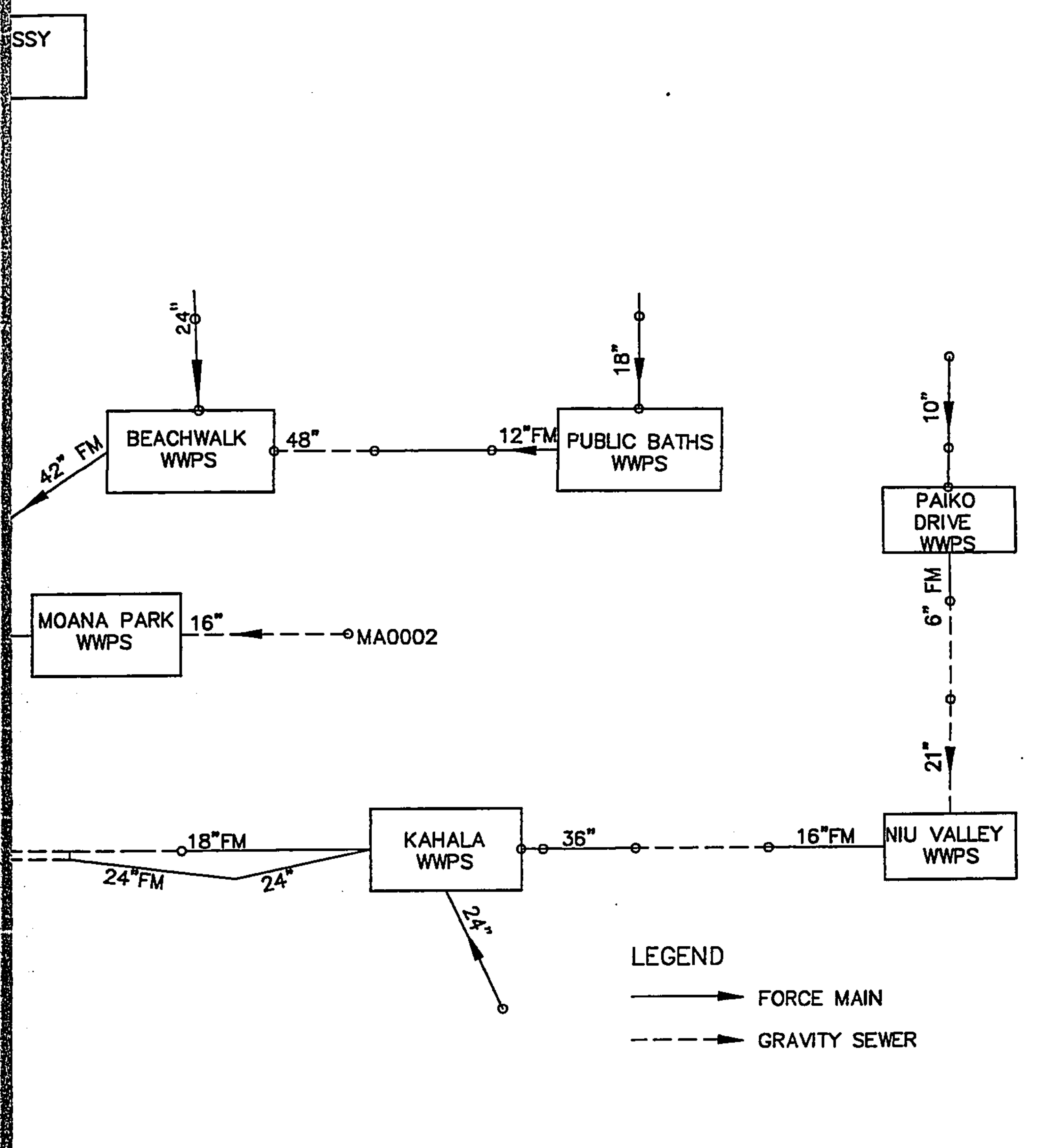


Figure 4-4
Flow Schematic Diagram - Ala Moana Subsystem

Table 4-1
Sand Island WWTP Service Area: Linear Footage of Sewer System, by Size

SIZE	FOOTAGE	MILES	% OF TOTAL	INCH-MILES*	% OF TOTAL
6"	682,321	129.23	22.6	775.4	12.6
8"	1,642,869	311.15	54.4	2,489.2	40.5
10"	188,669	35.73	6.2	357.3	5.8
11"	90	0.02	0.0	0.2	0.0
12"	118,419	22.43	3.9	269.1	4.4
14"	5,769	1.09	0.2	15.3	2.5
15"	61,864	11.72	2.1	175.7	2.9
16"	13,608	2.58	0.5	41.2	0.7
18"	70,084	13.27	2.3	238.9	3.9
20"	1,335	0.25	0.0	5.1	0.1
21"	17,029	3.23	0.6	67.7	1.1
24"	42,875	8.12	1.4	194.9	3.2
27"	4,601	0.87	0.2	23.5	0.4
28"	2,649	0.50	0.1	14.0	0.2
30"	21,538	4.08	0.7	122.4	2.0
32"	1,768	0.33	0.1	10.7	0.2
34"	998	0.19	0.0	6.4	0.1
36"	42,733	8.09	1.4	291.4	4.7
42"	6,149	1.16	0.2	48.9	0.8
48"	14,948	2.83	0.5	135.9	2.2
54"	11,771	2.23	0.4	120.4	2.0
60"	22,444	4.25	0.7	255.0	4.2
69"	8,070	1.53	0.3	105.5	1.7
78"	3,172	0.60	0.1	46.9	0.8
TUNNELS	34,412	6.52	1.1	325.3	5.3
OTHER	1,427	0.26	0.1	12.5	0.2
TOTAL	3,021,606	572.27	100.0	6,148.8	100.0

Notes: * Inch-Miles = sewer line diameter x length
Source: City records.

Table 4-2
Sand Island WWTP Service Area: Linear Footage of Sewer System, by Material

MATERIAL	FOOTAGE	MILES	% OF TOTAL	INCH-MILES*	% OF TOTAL
Reinforced Concrete	217,725	41.23	7.2	1,550.3	25.2
Cast Iron	158,212	29.96	5.3	284.0	4.6
Vitrified Clay	1,895,145	358.93	62.7	3,173.9	51.6
Terra Cotta	750,093	142.06	24.8	1,139.6	18.5
Ductile Iron	50	0.01	0.0	0.0	0.0
Polyvinyl chloride	379	0.07	0.01	0.6	0.01
TOTAL	3,021,606	572.27	100.0	6,148.8	100.0

Notes: * Inch-Miles = sewer line diameter x length
Source: City records.

Two separate force mains link the Ala Moana WWPS to Sand Island WWTP: a 78-inch force main from Station II and an older 60-inch force main from Station I. Wastewater from both Station I and Station II can be discharged into either force main. Presently, the older 60-inch force main is usually used only as a backup. Influent to Station I and Station II is controlled through a junction box. In an emergency, influent can be discharged to storm drains. Effluent from the WWPS or force mains can also be discharged into storm drains under emergency conditions. However, the release into the storm drain is dependent on seawater inflow during high tides and may negate successful wastewater discharge. The use of chlorination at the Ala Moana facility is limited to emergency situations when sewage needs to be released into storm drains.

Station I was designed to house five pumps. Three pumps are currently available for use. As a result, this station is capable of handling normal daily flow but not wet-weather flow. Although the wet well of this facility is not divided, the availability of Station II allows this facility to be taken off-line for inspection or maintenance. Station II is currently equipped with four pumps. A fifth pump may be added in the future. Three of the four existing pumps are capable of handling normal daily sewage flow. The wet well of this station is divided into two sections to allow inspections and maintenance without removing the facility from service.

Station I is constructed of reinforced concrete, concrete masonry, and structural steel. The below grade portion of the structure is mainly conventional reinforced concrete. The roof is constructed of reinforced-concrete slab supported by structural steel beams. The walls above the ground are constructed of concrete-masonry units. There are no obvious signs of structural distress. There are some minor cracks in the above-grade portion of the structure that are only of cosmetic concern. The below-grade concrete walls show no signs of water leakage. Station II is very similar to the older structure. The roof is constructed of pre-cast, pre-stressed triple T-beams and poured-in-place concrete. The above-grade walls are conventional reinforced concrete. There are several cracks in the above-grade walls that appear to be caused by concrete shrinkage. There are no signs of water leakage through these cracks.

There are two HECO transformers (A and B) located at the Ala Moana WWPS. Transformer A is connected to the Kakaako Substation, and Transformer B is connected to the substation at the Honolulu Power Plant. Connection of transformers to separate substations enhances system reliability. If one HECO substations fails, Ala Moana WWPS will still receive power from the other. If one HECO feeder line fails, the associated transformer automatically switches to the second feeder.

Station II has an emergency generator designed to run two pumps. The generator is controlled by automatic transfer equipment. DWWM maintenance personnel indicated that this equipment suffers from a relatively high failure rate. A 10,000-gallon-capacity underground diesel tank located on the site provides fuel for the emergency generator.

4.1.2 MOANA PARK WWPS AND SERVICE AREA

The Moana Park WWPS was built in 1945. It serves the Ala Moana Shopping Center and the Ala Moana Park area. The average daily flow rate recorded from May 1990 to May 1992 is 0.39 mgd. There are two pumps in the station. One pump is in normal daily operation while the other pump serves as a standby. The Moana Park WWPS is an aged pump station with limited space for new equipment. The pumps are old and need to be replaced. In addition, large amounts of grease have accumulated in the wet well.

Upgrades to Moana Park WWPS are currently being installed. Based on the engineering design, two larger pumps will replace the existing pumps and the wet well will be divided into two separate chambers. Division of the wet well will allow for future inspections and maintenance without removing the facility from service. A new emergency generator building will also be constructed.

The existing structure is constructed entirely of reinforced concrete. Although there are several cracks in the pump-room walls, there are no signs of water leakage. According to the facility manager, the station has not had any leakage problems. Aside from the cracks, the structural condition of the facility appears to be good.

The entire Moana Park WWPS electrical system is also being replaced. The following description is based on the proposed station modifications. The Moana Park WWPS will be powered by two existing HECO transformers located on the site. Two primary circuits will be extended to each transformer. Normally, the transformers will be connected to the preferred Makaloa Street Circuit. If the preferred circuit should fail, however, HECO will be able to manually switch to the alternate feeder. Planned modifications also include a new emergency generator with the capacity to run the two proposed pumps. An automatic transfer switch will facilitate operation during a power failure.

4.1.3 FORT DERUSSY WWPS AND SERVICE AREA

The Fort DeRussy WWPS conveys wastewater from military facilities and hotels in Waikiki to the Ala Moana WWPS. The average daily flow rate recorded from May 1990 to May 1992 is 2.1 mgd.

Fort DeRussy WWPS houses three pumps: two variable-speed and one constant-speed. The wet well is divided into two sections to facilitate inspections and maintenance. The two variable-speed pumps are run alternating in daily operation. The variable-speed pump speeds are controlled by "Flomatcher" controllers. The constant-speed pump is designed to run at full capacity of 3.64 mgd; current station capacity does not warrant its continual operation.

The roof is constructed of concrete. The walls above-grade are concrete masonry unit. The pump-room walls and foundation are reinforced concrete. There are visible signs of separation between the concrete masonry unit infill walls and the concrete columns. There is a horizontal crack going all around the pump-room wall, about seven feet above the floor. There are also several vertical cracks in the walls of the pump room. However, there are no signs that these cracks are leaking, nor do any of these cracks seem to be structurally significant.

There are two HECO transformers located on the site. Two primary circuits are extended to each transformer. The transformers are connected to individual circuits so that one circuit acts as a backup in the event that one of the transformers fails. An automatic transfer switch provides the least amount of disruption in the event of a failure of either of the two circuits. The electrical equipment at this WWPS is approximately 25 years old. This WWPS does not have an emergency generator; however, there is a connection for a portable emergency generator.

4.1.4 BEACHWALK WWPS AND SERVICE AREA

The Beachwalk WWPS serves Waikiki and surrounding areas, with 70 percent of its flow originating in Waikiki. The average daily flow rate recorded from May 1990 to May 1992 is 12.2 mgd.

The Beachwalk WWPS is equipped with four pumps. Pumps 1 and 3 are variable-speed controlled by a "Flomatcher" system which is approaching the end of its useful life. Pumps 2 and 4 are equipped with constant-speed motors. Only the two variable-speed pumps are required for normal daily operation. The wet well has a divider designed to allow for inspections and maintenance without removing the facility from service. However, the divider has separated from the wet well wall, and isolation is not possible.

The main facility that houses the WWPS was constructed of pre-cast concrete in 1966. There is a crack in the *ewa* end wall that runs from the top of the door to the roof. Another crack exists on the *ewa* end of the *mauka* side wall approximately one foot above the floor level. The wet well slab cover has separated from the building wall. The generator building was constructed of pre-cast concrete in 1986. There are no signs of structural problems in the generator building.

HECO transformers are located in a vault that is part of the WWPS building. Two primary feeders are extended to the HECO substation; however, both feeders are from the same circuit.

A separate structure adjacent to the WWPS building houses the emergency generator, switchgear, and fuel tank. The emergency generator is automatically activated by power circuit breakers in the event of a HECO power failure. It is capable of running three of the four existing pumps at the station. A 5,000-gallon-capacity diesel fuel tank is located on the site.

4.1.5 PUBLIC BATHS WWPS AND SERVICE AREA

The Public Baths WWPS services the Honolulu Zoo area and the *ewa* slopes of Diamond Head. Effluent from the pump station is pumped to the vicinity of the Outrigger Hotel through a force main and then flows to Beachwalk WWPS by gravity. The average daily flow rate recorded from May 1990 to May 1992 is 0.43 mgd.

Three constant-speed pumps exist at this pump station. Normally, one pump is lead, one is lag, and the third is standby. The lead pump operates only 9 to 10 hours a day to handle the current flow. The pumps and motors in this station are only two and half years old. The wet well is divided to permit inspections and maintenance without removing the facility from service. There is no room for expansion in the existing pump station.

Problems identified at the Public Baths WWPS include inadequate discharge pipe capacity and saltwater infiltration into the collection system. Because of the inadequate design of the discharge pipes, solids in the wastewater tend to settle in the discharge pipes of the pumps not in use. As a result, all pumps have to be run for several minutes each day to flush out the sediment. The volume and occurrence of saltwater infiltration depends largely on tidal conditions, but no quantitative estimates of infiltration volumes were available.

There are two similar structures at Public Baths WWPS, one housing the WWPS and one housing the generator. Each building has concrete walls and a poured-in-place concrete roof covered with clay tile. There are no signs of structural problems.

The Public Baths WWPS is serviced directly by HECO. The emergency generator at this WWPS is automatically started during HECO power failures by an automatic transfer switch. The generator is capable of running all three pumps simultaneously. There is a 1,000-gallon underground fuel diesel tank located on the site.

4.1.6 KAHALA WWPS AND SERVICE AREA

The Kahala WWPS services the area from the lower slopes of Diamond Head to Niu Valley. Two force mains (24-inch and 18-inch) convey the discharge from this pump station to the Kaimuki Tunnel and then to Ala Moana WWPS. The station is one of the few WWPSs equipped with influent bypasses. In the case of an emergency, influent can be diverted from the station, via a bypass weir, to Kapakahi stream. There is also a discharge bypass. The two-year average daily flow rate from May 1990 to May 1992 is 4.0 mgd.

This WWPS is equipped with four pumps, two constant-speed and two variable-speed. Only one pump (usually variable-speed) is needed in daily operation. The upgraded "Flomatcher" system regulates the speed of the variable-speed pumps. Portable pumps are capable of pumping sewage out of the station in case of a power failure. The wet well is divided to allow for inspections and maintenance without removing the facility from service. Hydrogen sulfide odor from the wastewater, as well as saltwater infiltration into the collection system are primary concerns at the Kahala WWPS. Noise levels at the plant are excessive.

The entire structure is constructed of cast-in-place reinforced concrete. There are some cracks in the concrete beams that support relatively light loads. Despite these minor cracks, there were no signs of structural problems.

The Kahala WWPS is fed directly by two HECO transformers located on the site. Two primary circuits are extended to each transformer. If one HECO feeder should fail, the associated transformer automatically switches to the second feeder. The station has an emergency generator capable of operating two pumps at a time. Automatic switching to the emergency generator is controlled by power circuit breakers. A 1,000-gallon-capacity underground diesel fuel tank is located on the site.

4.1.7 NIU VALLEY WWPS AND SERVICE AREA

The Niu Valley WWPS conveys wastewater from Niu Valley to the Kahala WWPS. The sewage from Paiko Drive WWPS (Section 4.1.8) also passes through Niu Valley WWPS. Although there were large daily flow rate changes recorded in 1991, the daily flow rates in 1992 steadily decreased to approximately 0.3 mgd. The two-year (May 1990 to May 1992) average daily flow rate is 0.57 mgd. This WWPS houses two pumps and a divided wet well. One pump works approximately six hours per day under normal conditions. The second is a standby. There is no room for future pumps in the pump station.

The Niu Valley WWPS was constructed in 1959 and is supported on timber piles. The roof is constructed of reinforced concrete and is supported on concrete walls. Non-load bearing concrete masonry units are used on two sides. The remaining portion of the structure is reinforced concrete. There are no signs of structural problems.

The Niu Valley WWPS is serviced directly by HECO. A separate building houses an emergency generator. The generator is automatically started during a HECO power failure. It is capable of powering both existing pumps simultaneously. The equipment appears to be well-maintained and in good condition, despite its advanced age. An underground 1,000-gallon-capacity diesel fuel tank is located on the site.

4.1.8 PAIKO DRIVE WWPS AND SERVICE AREA

Wastewater from Paiko Drive WWPS is pumped through a very short force main and then flows to the Niu Valley WWPS by gravity. There are two pumps in this WWPS. The first pump runs for four hours a day to handle the daily flow and the second pump is standby. There is no room for additional pumps in the existing pump station. The wet well is not divided. Portable pumps are employed in emergency situations to bypass the influent from the wet well to the discharge force main. This pump station does not have a flow meter, so average flows are unknown.

The Paiko Drive WWPS was constructed in 1970. The structure has a concrete roof, load-bearing concrete masonry unit walls, and a concrete substructure. The generator building is separate, and constructed similarly. Both buildings are in good structural condition. Pump running times indicate that the daily average flow is 0.086 mgd.

The Paiko Drive WWPS is serviced directly by HECO. An automatic transfer switches to an emergency generator in the event of a power failure. The generator is adequate to run both existing pumps simultaneously, if the motors are started separately. A 550-gallon-capacity aboveground liquid propane gas fuel tank is located on site.

4.1.9 KULIOUOU WWPS AND SERVICE AREA

The Kuliouou WWPS serves Kuliouou Valley as well as development along the *makai* side of Kalanianaole Highway at the front of the valley. The Kuliouou WWPS currently discharges wastewater to the Hawaii Kai WWTP through a contractual agreement between the City DPW and the Hawaii Kai WWTP owner. The Kuliouou WWPS houses two constant-speed pumps. One pump is run two or more hours a day during normal operations. The second pump is a standby. The wet well is divided to allow inspections and maintenance without removing the facility from operation.

By Letter of Agreement between the City and the Hawaii Kai WWTP owner, only one pump is allowed to operate at any one time because the Hawaii Kai system cannot accommodate the flow with two pumps operating simultaneously. Also, average daily flow is restricted to 0.566 mgd. The average daily flow rate of Kuliouou WWPS was 0.32 mgd from May 1990 to May 1992. The station is designed to allow portable pumps to bypass influent from the wet well directly to the force main in the event of an emergency. There is also a force main bypass which can discharge effluent into a nearby storm-drain gutter in emergencies. Discharge to the Hawaii Kai system is shut off for short periods of time when the Hawaii Kai system is overloaded. If the influent at Kuliouou exceeds the wet well capacity during a temporary shutdown, wastewater is discharged into the roadside storm drain.

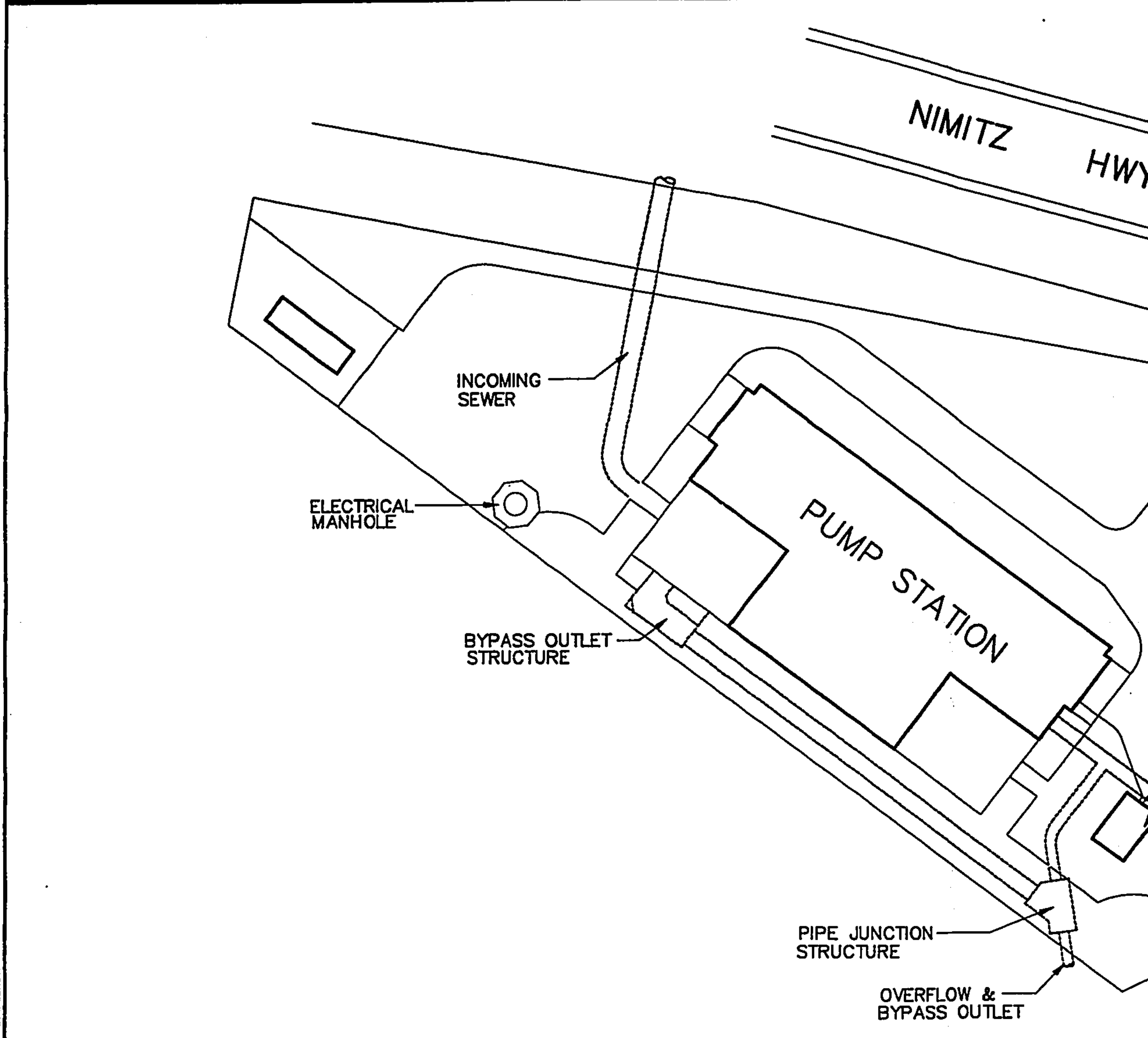
The structure is constructed of reinforced concrete. There are some hairline cracks in the roof and walls, probably due to shrinkage. Overall, the structure is in very good condition. Kuliouou WWPS is serviced directly by HECO. There is an emergency generator capable of powering one pump, controlled by an automatic transfer switch. The equipment appears to be well-maintained, but is probably reaching the end of its useful life. A 550 gallon-capacity aboveground liquid propane gas fuel tank is located on the site.

4.2 HART STREET COLLECTION SYSTEM FACILITIES

4.2.1 HART STREET WWPS AND SERVICE AREA

The Hart Street WWPS was built in 1954 utilizing the same design as the Ala Moana WWPS Station I. A site plan of the facility is shown in Figure 4-5. The Hart Street WWPS pumps wastewater to Sand Island WWTP through a force main which crosses under Honolulu Harbor. Hart Street WWPS serves the central Honolulu area from Salt Lake to Downtown (see Figure 4-6). The 1990 to 1992 average daily flow rate was 19.6 mgd. The WWPS has both an influent bypass and a discharge bypass which can divert wastewater directly to the harbor in case of an emergency. The 30-inch discharge force main bypass is manually operated, but is expected to be automated in the near future. It is currently reported as inoperable. Influent bypass is controlled by a sluice gate in the wet well. The wet well at this WWPS is not divided. Signage located within the building identifies the presence of asbestos in the insulation of this WWPS.

141.1101.7/029/3-m



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

Not to Scale

North

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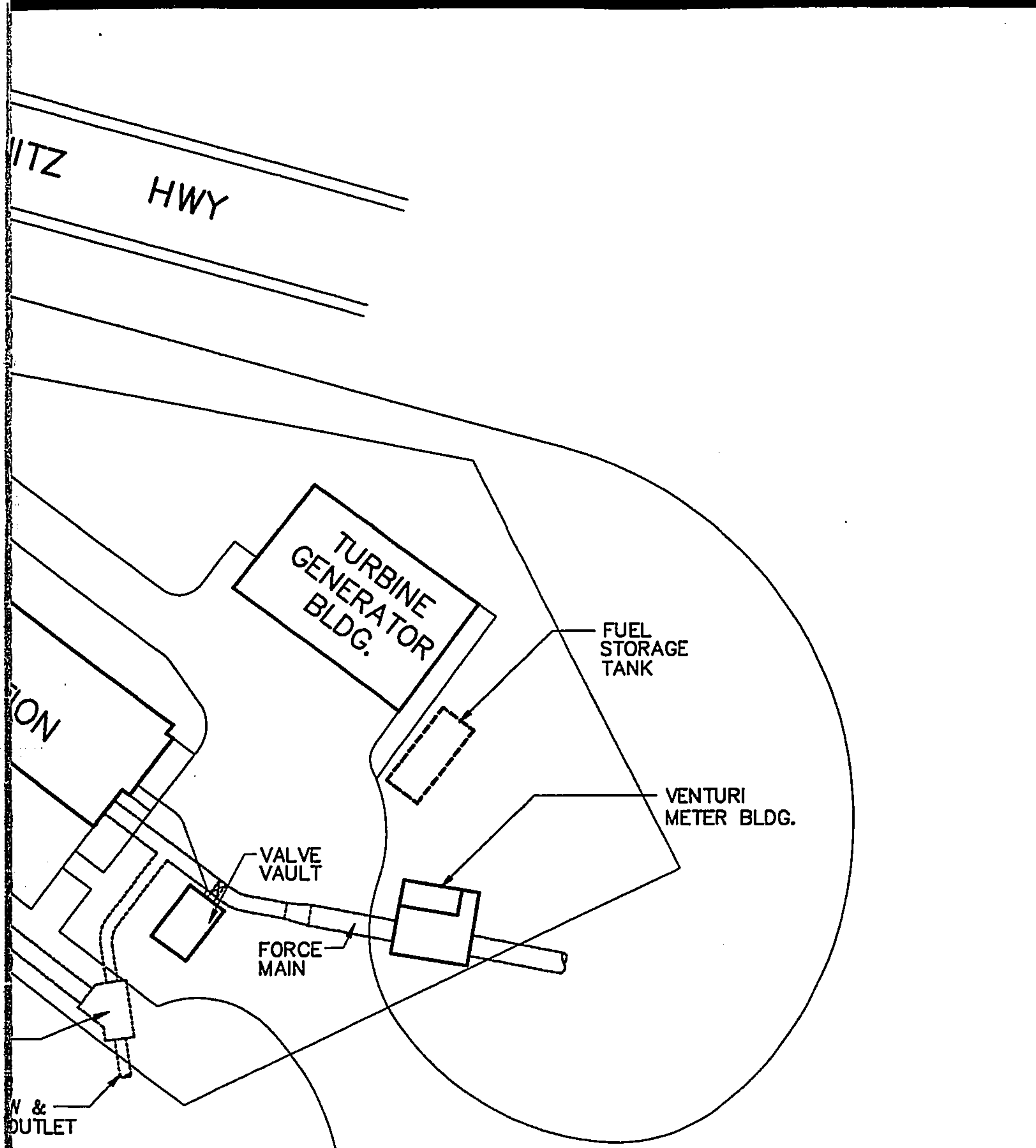
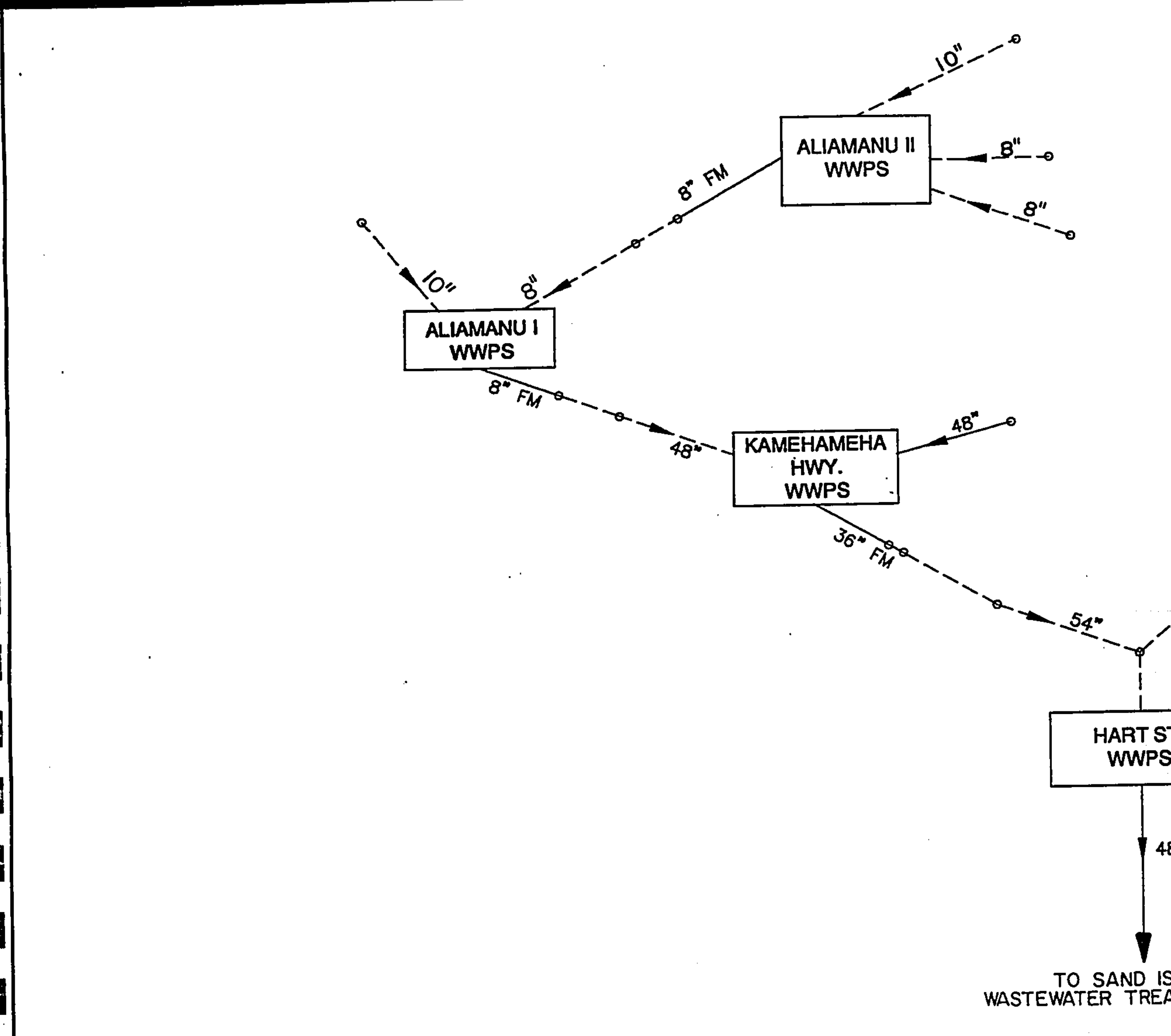


Figure 4-5
Hart Street WWPS Site Plan

141.1101.7/029/4-m



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

Not to Scale

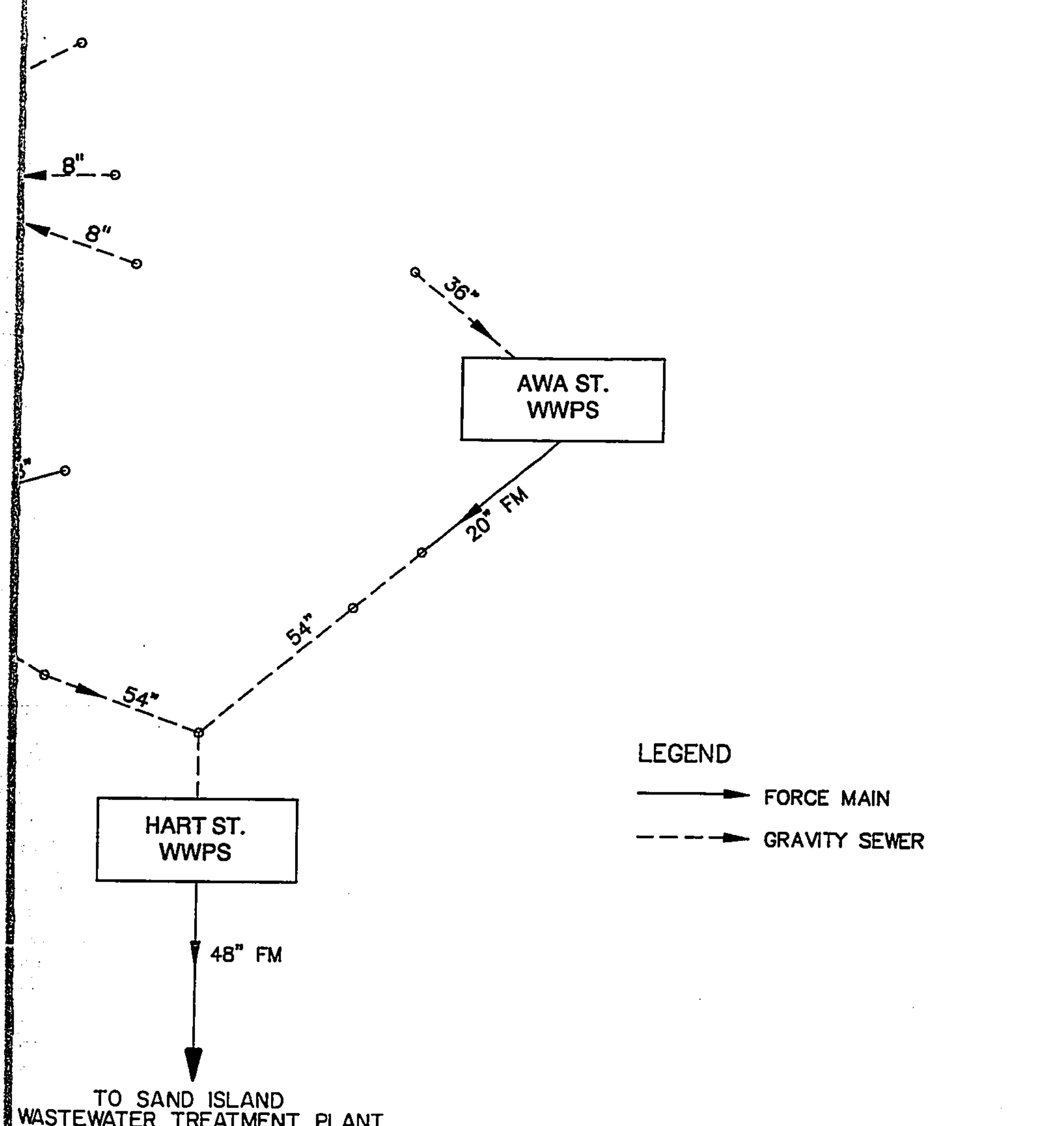


Figure 4-6
Flow Schematic Diagram -
Hart Street Subsystem

Hart Street pump station houses five pumps with variable-speed motors which were installed in 1988. One pump is required to handle normal operation. Two or three pumps are required to pump storm flows (normal wastewater flow augmented by high volumes of rainwater infiltration and inflow). The City is in the process of installing one constant-speed motor to pump the normal flow of the station.

Numerous cracks are visible in the building's exterior walls. However, the cracking may be in the veneer finish since there are no signs of cracks in the interior walls. The cracks do not appear to indicate structural damage.

A HECO transformer is located on the Hart Street WWPS site. One primary circuit is extended to the transformer. The Hart Street WWPS is unusual because it is the only facility in the study area serviced with medium-voltage power. Consequently, the equipment used elsewhere in the system is incompatible with the Hart Street power supply.

The Hart Street facility has two emergency generators. Each generator is capable of running two pumps at once. The emergency generators were reported to suffer from a relatively high failure rate. According to DWWM maintenance personnel, the automatic transfer switches have been a problem. As a result, the City plans to replace the existing equipment with updated models. An underground diesel fuel tank with a 5,000-gallon capacity is located on the site.

4.2.2 AWA STREET WWPS AND SERVICE AREA

The Awa Street WWPS is located adjacent to Nimitz Highway and Nuuanu Stream. Its service area includes portions of Nuuanu, Palama, Alewa Heights, Kalihi, and Kapalama. The wastewater from this WWPS is routed to the Hart Street WWPS. The two-year (May 1990 – May 1992) average daily flow rate is 4.0 mgd. Since the beginning of 1992, the average daily flow rate has decreased to approximately 3.5 mgd. There are two influent bypasses in the Awa Street WWPS. Influent to the station can be diverted to a gravity line directed to the Hart Street WWPS or can be diverted into Nuuanu Stream under extreme conditions. However, a gravity line manhole at the north end of Kuwili Street will overflow because its cover is below the station's gravity overflow weir.

There are four constant-speed pumps in Awa Street WWPS, two with a capacity of 4.0 mgd and two with a capacity of 2.0 mgd. Only one of the 4.0 mgd pumps is needed for normal daily operation. Two float level controllers automatically regulate the operation sequence of the pumps. Replacement units (identical to the two 4.0 mgd capacity pumps) for the smaller pumps are on-site.

The structure appears to have been built around the same period as the Ala Moana WWPS Station I. It consists of a concrete roof supported by concrete masonry unit walls. The substructure is reinforced concrete. Despite some minor cracks in the architectural masonry at the doorways, the facility appears to be in good structural condition.

Presently, the Awa Street WWPS does not have an emergency generator, but does have a manual transfer switch and generator connection so that a portable generator can be used at the site. According to DWWM maintenance personnel, an emergency generator is being installed. A 1,000-gallon-capacity underground diesel fuel tank is also being installed.

4.2.3 KAMEHAMEHA HIGHWAY WWPS AND SERVICE AREA

The Kamehameha Highway WWPS serves the Honolulu Airport area and also collects wastewater from both Aliamanu WWPSs I and II (see Section 4.2.4). Wastewater from the Kamehameha Highway WWPS is pumped to the Hart Street WWPS through a 36-inch force main. The May 1990 to May 1992 average daily flow rate is 5.78 mgd. Influent, controlled by wet well wastewater elevations, can bypass the pump station and enter the force main by gravity. However, a gravity influent line will overflow from a manhole on Kilihau Street before the force main flows by gravity. There is also a force main bypass which can discharge wastewater to Moanalua Stream in the case of an emergency.

Three constant-speed pumps housed in the Kamehameha Highway WWPS have been in use since the 1960s. Two smaller pumps are operated in turn during normal operations. The larger pump is used as a backup. A spare slot is available at the station for the installation of a fourth pump. Although the age of the equipment exceeds its assumed 20-year life-span, it appears to be well-maintained and no problems were noted. A second SFM has been in planning since 1989. The present 36-inch diameter SFM has sustained several breaks and needs to be supplemented.

The Kamehameha Highway WWPS superstructure consists of steel rigid frames. The walls consist of concrete-masonry units. The substructure is reinforced concrete. The facility appears to be in excellent structural condition.

One HECO transformer is located on-site. A single feeder is extended from the transformer to the WWPS. An emergency generator was installed in 1984. It is automatically started during a HECO power failure and switched by power circuit breakers. The emergency generator is sized to run all of the existing pumps. A 2,000-gallon-capacity underground diesel fuel tank is located on the site.

4.2.4 ALIAMANU WWPS I AND II AND SERVICE AREA

Aliamanu WWPSs I and II serve the civilian and military housing of the Salt Lake area. The discharge from Aliamanu WWPS II flows to Aliamanu WWPS I, and then to the Kamehameha Highway WWPS. The average daily flow rate from May 1990 to May 1992 is 0.27 mgd for WWPS I and 0.23 mgd for WWPS II. The design of the two WWPSs are the identical, with the exception of pump capacities. Only one of the two pumps at either station is in operation during normal conditions. However, during intense storms, two pumps are necessary. Both Aliamanu WWPS I and II have wet well overflows which discharge to storm drains during emergencies.

Due to the low elevations of the two sites, flooding problems exist at both facilities. Flooding not only causes significant increases in wastewater volumes, but also threatens the safe operation of motors and generators. To prevent storm water from entering the pump-rooms, wooden dams were installed inside each doorway and around the emergency generators. The existing pumps are also scheduled to be replaced with submersible-type pumps. Both pump-rooms are fully utilized; if expansion is required, new facilities must be constructed.

Aliamanu WWPS I and II are serviced directly by HECO. In 1988, both structures were enlarged to house emergency generators, fuel tanks, and automatic transfer switches. During a HECO power failure, the generators are automatically started by the automatic transfer switches. Each emergency generator adequately runs both of the existing pumps simultaneously. 550-gallon-capacity underground diesel fuel tanks are located on each site.

4.3 FORT SHAFTER COLLECTION SYSTEM FACILITIES

Fort Shafter WWPS collects wastewater from Fort Shafter, Tripler Army Medical Center, and Aliamanu Military Housing. This WWPS is under the Army's jurisdiction and is not operated by the City. As a result, its capacity and operational reliability were not evaluated as part of this EIS, but existing conditions are discussed for completeness. The current maximum average daily flow of 1.7 mgd is directed to the Sand Island WWTP via a 24-inch cast-iron force main. The Army contracts with the City for treatment of 2.3 mgd of wastewater.

There are four variable-speed pumps housed at this WWPS. One large capacity (75 hp) pump can adequately pump the existing normal flows. However, two pumps are required to pump extreme peak flows. The third large pump acts as a backup pump, while the smaller (30 hp) pump acts as an emergency pump. The WWPS relies on an on-site emergency generator during power failures. The Fort Shafter WWPS has a divided wet well.

Proposed additional housing units at Tripler Army Medical Center will increase the flow to Fort Shafter WWPS, but not enough to require capacity upgrades at the WWPS. The Army has no plans to modify Fort Shafter WWPS or the force main which connects the WWPS to Sand Island WWTP (U.S. Corps of Engineers, February 1992, *Study of Fort Shafter Pump Station and Force Main in support of the Sand Island Wastewater Treatment Plant Modification*).

4.4 SAND ISLAND PARKWAY COLLECTION SYSTEM FACILITIES

4.4.1 Sand Island Parkway WWPS

The Sand Island Parkway WWPS currently services the industrial, military, and recreational facilities on Sand Island. The wastewater from this WWPS is discharged to the Hart Street junction box located at the Sand Island WWTP. The average daily flow rate is 0.1 mgd (May 1990 to May 1992), with higher flow rates during weekends due to the increased wastewater generated by park users at the Sand Island State recreation area. There are three constant-speed 1.15 mgd pumps located on-site. Only one pump is needed to accommodate normal daily flow. The equipment is relatively new and well-maintained. The undivided wet well is flushed manually with clean water once a week to prevent build-up of trash which accumulates during periods of low flows.

The Sand Island Parkway WWPS superstructure consists of a concrete frame with concrete-masonry unit infill. The roof is reinforced concrete. There are several vertical cracks in the concrete-masonry wall on the upper level, *ewa* end of the building and there are vertical cracks in the lower-level walls spaced at approximately 10-foot intervals. Horizontal cracks also exist.

HECO provides electrical power to this WWPS. The WWPS includes an emergency generator sized to run two of the three existing pumps. It is activated during a power failure by an automatic transfer switch. There is an underground diesel fuel tank with a 1,000-gallon capacity located on the site.

4.4.2 Sand Island Industrial WWPS

The Sand Island Industrial WWPS is currently being designed by a consultant to the State. This WWPS is being installed to allow sewering of the industrial lands near the east end of Sand Island. The facility is being designed to handle a 2.3 mgd peak flow. The flows from this pump station will be routed to the Sand Island Parkway WWPS.

4.5 WASTEWATER COLLECTION SYSTEM PROBLEMS

The following is a review of significant problems associated with the collection system.

4.5.1 AGE AND CONDITION OF SEWER LINES

The sewers within the study area are up to 100 years old (See Table 4-3). Consequently, some have deteriorated and/or are not large enough to accommodate present peak flows.

Table 4-3
Sand Island WWTP Service Area,Linear Footage of Sewer System, by Age

YEAR OF INSTALLATION	FOOTAGE	MILES	% OF TOTAL	INCH MILES	% OF TOTAL
1890 - 1910	198,969	37.68	6.7	348.7	5.8
1911 - 1930	369,931	70.06	12.4	834.6	13.8
1931 - 1950	536,588	101.63	18.0	1028.3	17.0
1951 - 1970	1,532,921	290.33	51.4	2972.7	49.0
1970 - 1992	341,933	64.76	11.5	880.5	14.5
TOTAL	2,980,342	564.46	100.0	6064.8	100.0

Source: City records.

4.5.2 INFILTRATION AND INFLOW

Infiltration is defined as the entrance of water into the wastewater collection system below the ground surface, usually through defects or cracks in sewer lines and manholes. Inflow is the entrance of water above the ground surface, primarily through openings in manhole tops and storm-drain connections. Dry weather infiltration (DWI) is infiltration that occurs when the groundwater table has not risen because of rain. DWI contains a minimal volume of inflow. Wet weather infiltration/inflow (WWI/I) is infiltration that occurs when the groundwater table has risen as a result of rain plus inflow (mostly from rain-induced above-ground sources). High DWI contributes to increased flows requiring capacity upgrades sooner than otherwise would be needed. Where groundwater is high in salts, DWI can also create problems in wastewater and sludge treatment and disposal. WWI/I contributes to increased flow rates and sewer-line surcharging and the potential for surface-wastewater releases during periods of high precipitation. Furthermore, locations of infiltration and inflow are expected to be locations of wastewater seepage out of lines (exfiltration) when lines are above the groundwater table during dry weather.

A DWI value of 35 gallons per capita per day (gpcd) is identified in the DWWM Design Standards. According to the EPA, if DWI levels exceed 40 gpcd, studies should be undertaken to determine the extent of infiltration/inflow and the cost-effectiveness of rehabilitating the sewer lines versus treating the infiltration/inflow (EPA, October 1991). Estimates of infiltration determined as part of the Islandwide Sewer Adequacy Project (ISAP) indicate that these standards are exceeded under certain circumstances in areas throughout the collection system (See Figures 4-7 and 4-8). For example, in the Kahala collection area, DWI values range between 8 and 270 gpcd. In the rest of the Ala Moana collection area, DWI ranges from 3 to 172 gpcd; in the Hart Street collection area, DWI ranges between 1 and 224 gpcd.

On November 22, 1991, the EPA issued a "Findings of Violation and Order for Compliance" to the City DPW which cited the excessive number of overflows and spills of untreated wastewater from the East Mamala Bay wastewater collection system. It required the City to undertake a sewer rehabilitation and infiltration/inflow study and to reduce infiltration and inflow. This study, called the Sewer Rehabilitation and Infiltration & Inflow Minimization Plan, is being undertaken to determine more definitively the areas where DWI exceed the guidelines and require cost-effectiveness evaluation.

The EPA has established a guideline of 155 gpcd for wet weather infiltration & inflow. The WWI/I in the Ala Moana collection area approaches 916 gpcd in some portions of the system; the WWI/I in the Hart Street collection area approaches 335 gpcd in some portions. The areas exceeding the EPA guideline for WW I/I are depicted in Figures 4-9 and 4-10.

The same EPA publication mentioned above establishes a guideline of 155 gpcd for WW I/I. Based on the results of the ISAP, although the Kahala collection area did not obtain a significant wet weather storm to draw any measurable conclusion, the WW I/I in the remaining Ala Moana collection area approached 916 gpcd in portions of the area; the WW I/I in the Hart Street collection area approached 335 gpcd in portions of the area. The areas exceeding the guideline are depicted in Figure 4-9 and 4-10. It should be noted, however, that the rainfall data obtained from the ISAP is probably not statistically significant and more reliable results would be obtained from the DWWM's Sewer Rehabilitation and Infiltration & Inflow Minimization Plan.

4.5.3 SPILLS AND COMPLAINTS

Sewer complaint data were obtained for calendar years 1990 and 1991 from the DWWM Wastewater Collection and Maintenance Branch. A summary of these complaints, divided between lateral-related and main-related are provided in Table 4-4. The greatest problems appear to be related to clogged laterals and mains. The clogging is attributed primarily to excessive grease and/or root growth. In mains, clogs may result in overflows through manhole covers.

Figures 4-11 and 4-12 show the location of overflows from manhole covers and leaks from mains, respectively. Spill and bypass data, generated as part of a reporting requirement for the EPA, is summarized in Table 4-5. The application of more stringent reporting requirements during this period appears to be a factor in the increase of the number of incidents and the estimated volume between 1990 and 1991. Figure 4-13 depicts the location of spill sites summarized in Table 4-5. Keehi Lagoon received the greatest volume: 1.5 million gallons of sewage during the years of 1989 to 1991. Palolo Stream, Kewalo Basin, and Manoa Stream received raw sewage volumes totaling over 100,000 gallons during this three-year period.

These data indicate that spills occur throughout the entire study area, and are not concentrated at lower elevations in larger sewer mains. This scatter suggests that the spills are not related to inadequate sewer-line capacity. If inadequate capacity was the primary cause, more spills would be expected in the portions of the collection system carrying the largest volumes of wastewater and fewer spills would occur in the low flow volume portions of the system.

Table 4-4
Sewer Complaint Data — 1990 and 1991

LATERALS	Number	Percent
Complaints that resulted in backup:		
Clogged Lateral	1119	66.2%
Broken Lateral	4	0.2%
Subtotal	1123	66.4%
Complaints that did not cause a backup or were not the City's responsibility:		
Owner's Problem	564	33.4%
Miscellaneous	3	0.2%
Subtotal	567	33.6%
Total Lateral Complaints	1690	
MAINS		
Complaints that resulted in visible sewage spillage:		
Manhole Overflow	403	35.4%
Leakage from Mains	207	18.2%
Subtotal	610	53.6%
Complaints that did not cause visible sewage spillage:		
Foul Odor	183	16.1%
Rats	105	9.2%
Roaches	18	1.6%
Broken Manhole	118	10.4%
Broken Line	52	4.6%
Ground Sag (of line)	34	3.0%
Miscellaneous	19	1.7%
Subtotal	529	46.4%
Total Main Complaints	1139	

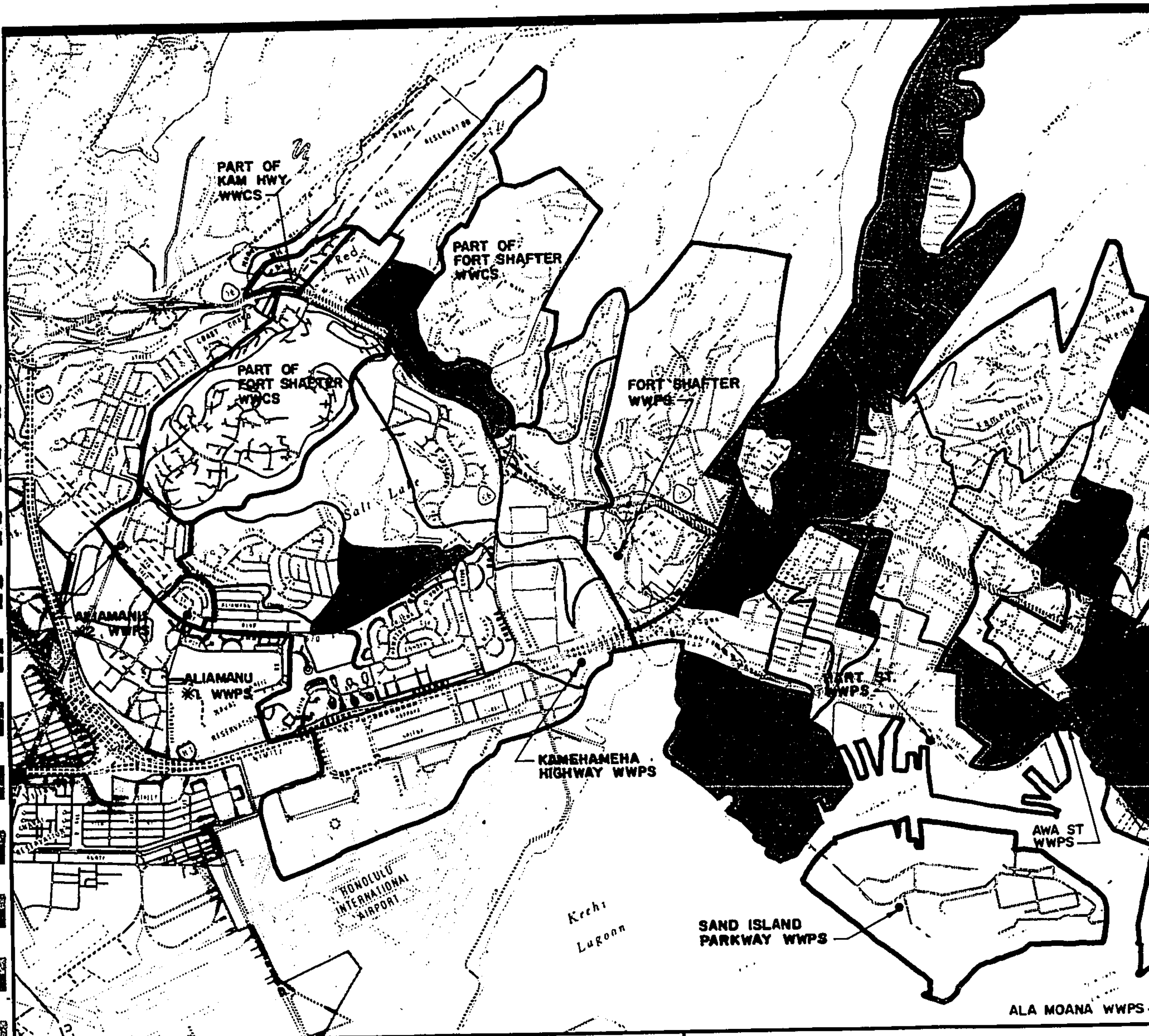
Source: DWWM records

Table 4-5
Spills and Bypasses 1989-1991

TYPE OF SPILL OR BYPASS	1989 (#)	1989 EST. VOL. (MG)	1990 (#)	1990 EST. VOL. (MG)	1991 (#)	1991 EST. VOL. (MG)	TOTAL (#)	TOTAL EST. VOL. (MG)
Collection System	5	0.2173	11	0.0168	59	0.5545	75	0.7886
Pump Station	1	0.0010	1	0.0300	4	1.7830	6	1.814
Treatment Plant (Sand Island WWTP)	0	0	2	0.1960	4	0.0864	6	0.2824
Total	6	0.2183	14	0.2428	67	2.4239	87	2.885

Note: MG is estimated volume in millions of gallons.

Source: DWWM Records



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

SOURCE:
ISAP, 1989-1991

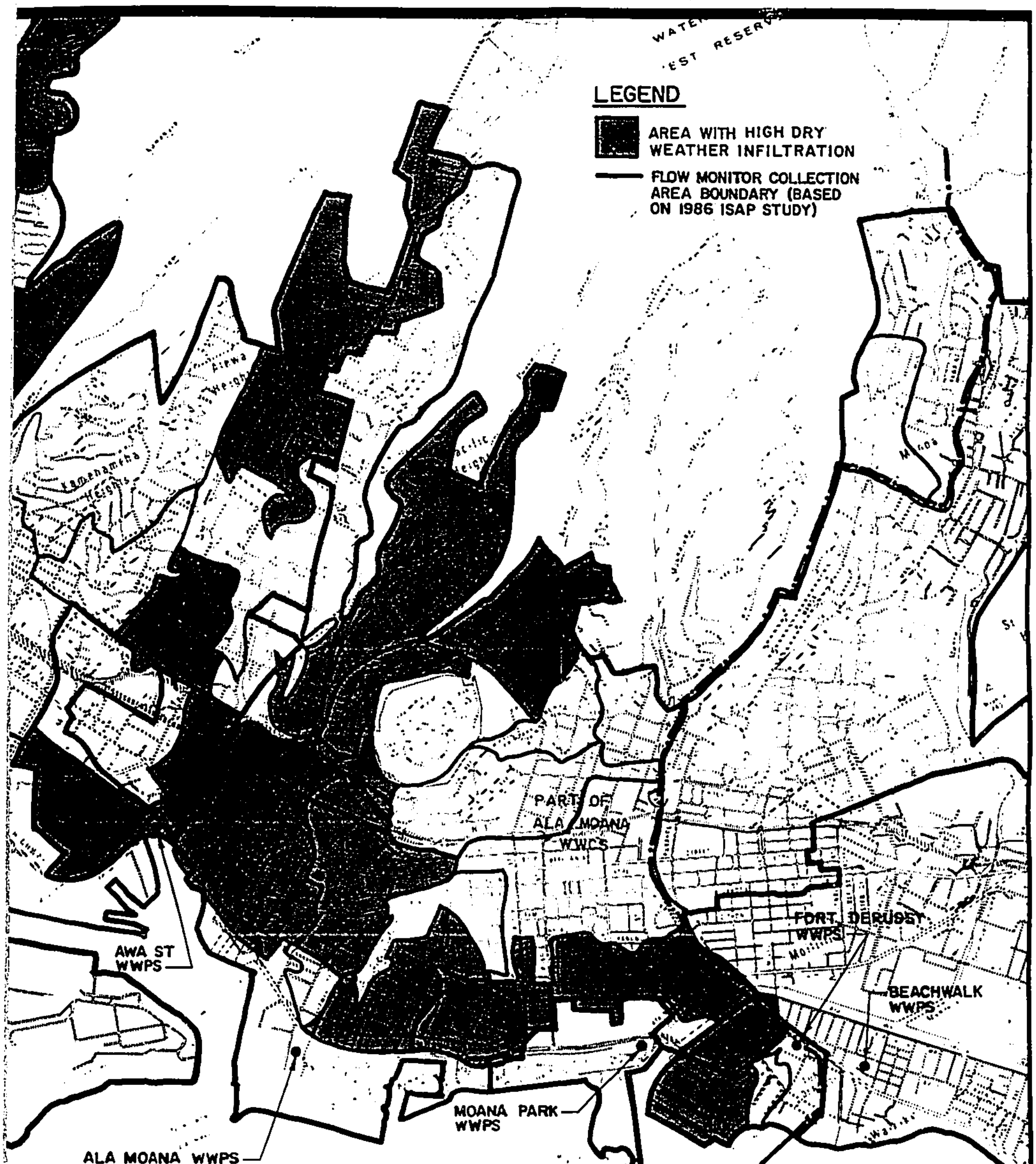
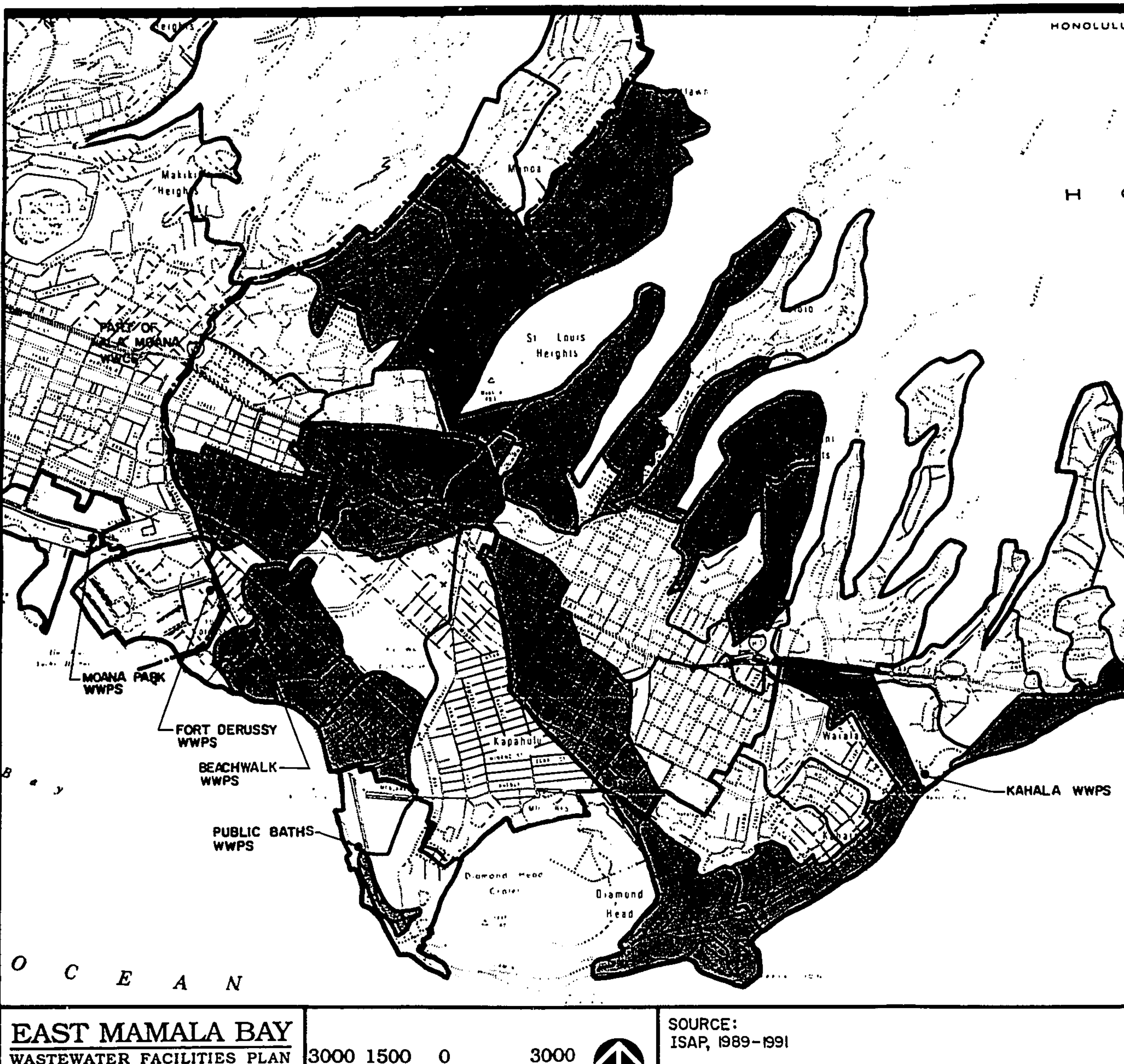


Figure 4-7
Tributary Areas with High Dry Weather Infiltration



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

3000 1500 0 3000

Scale in Feet

North

SOURCE:
ISAP, 1989-1991

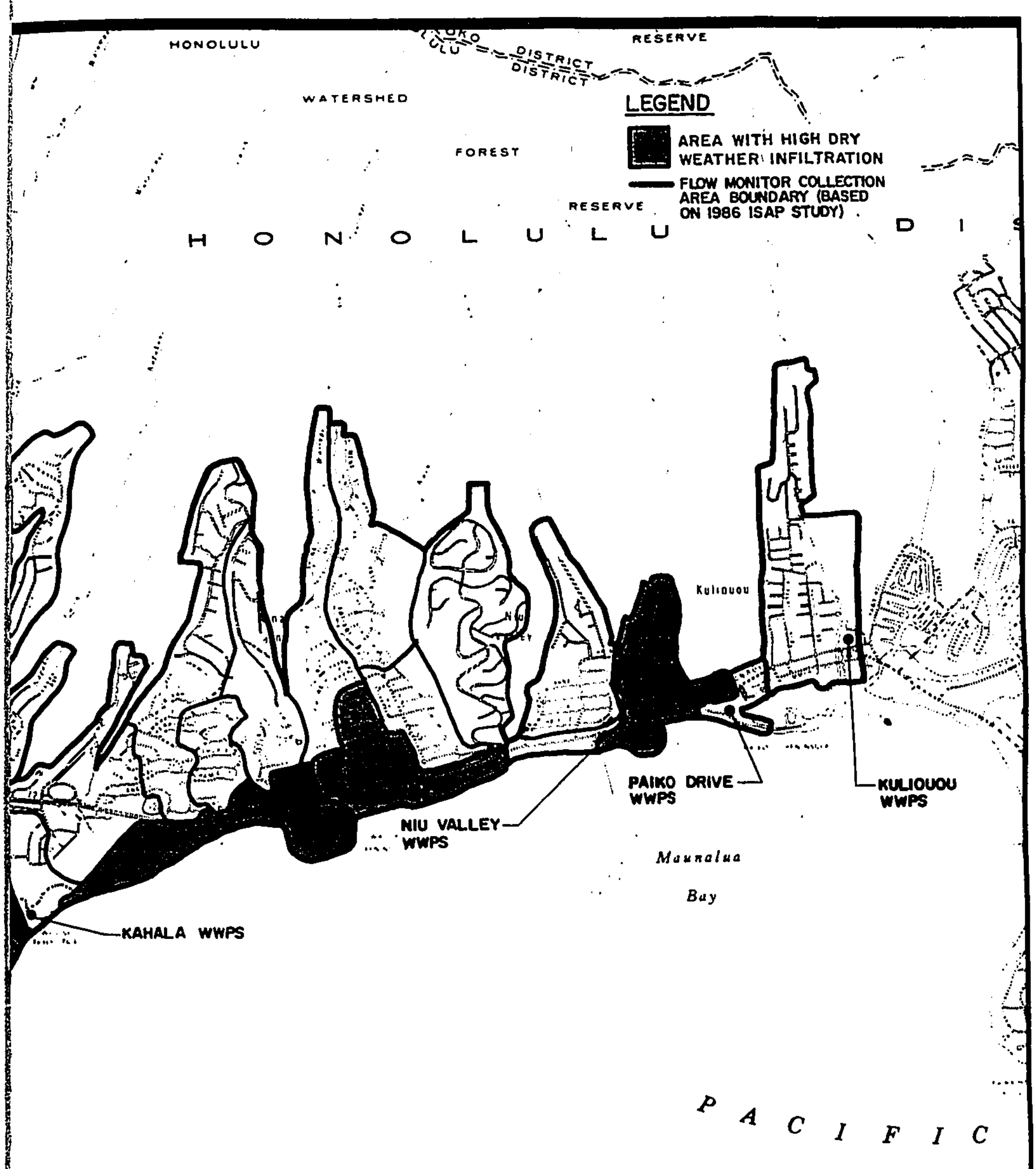
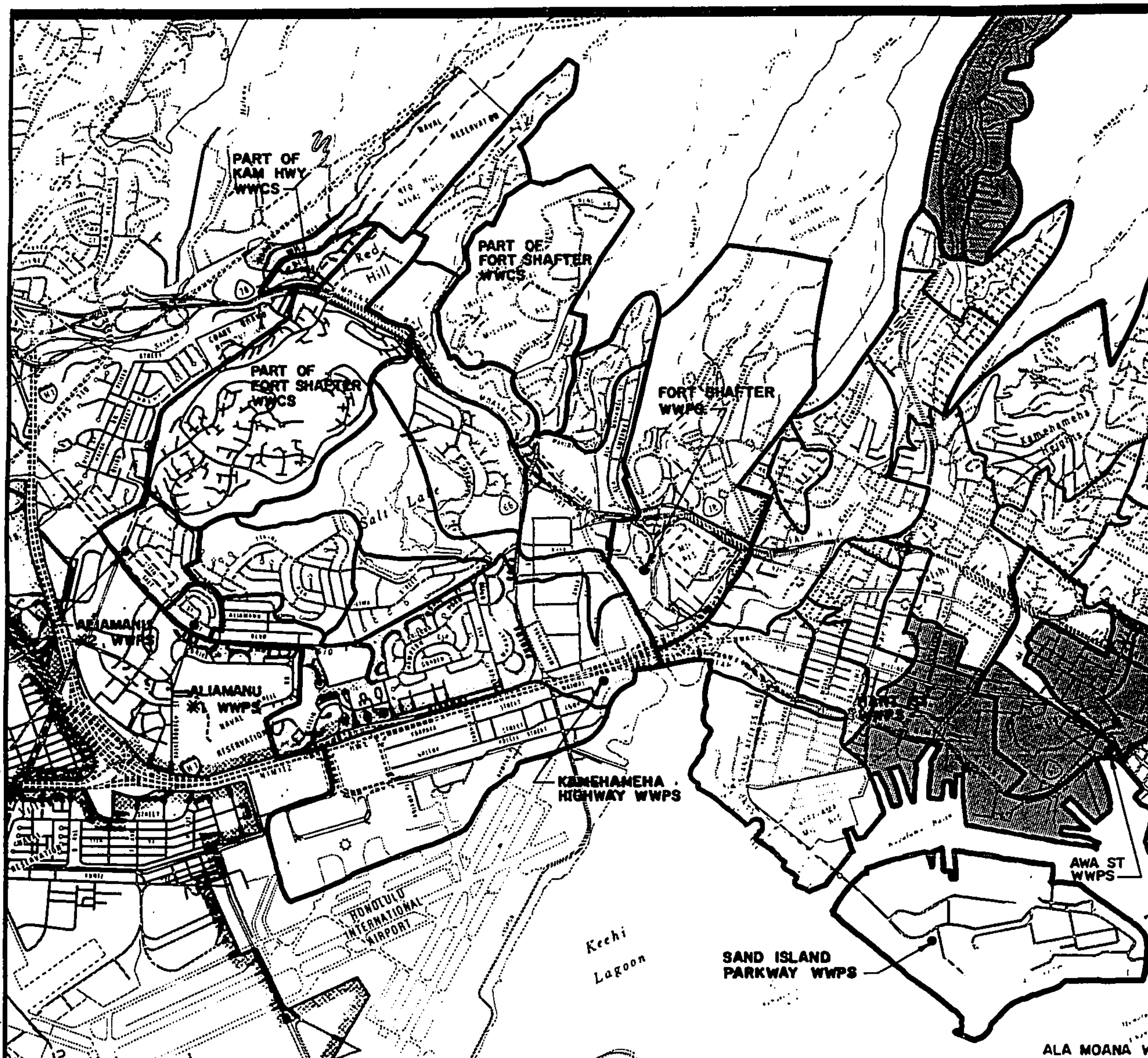


Figure 4-8
Tributary Areas with High Dry Weather Infiltration



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

3000 1500 0 3000

Scale in Feet

North

SOURCE:
ISAP, 1989-1991

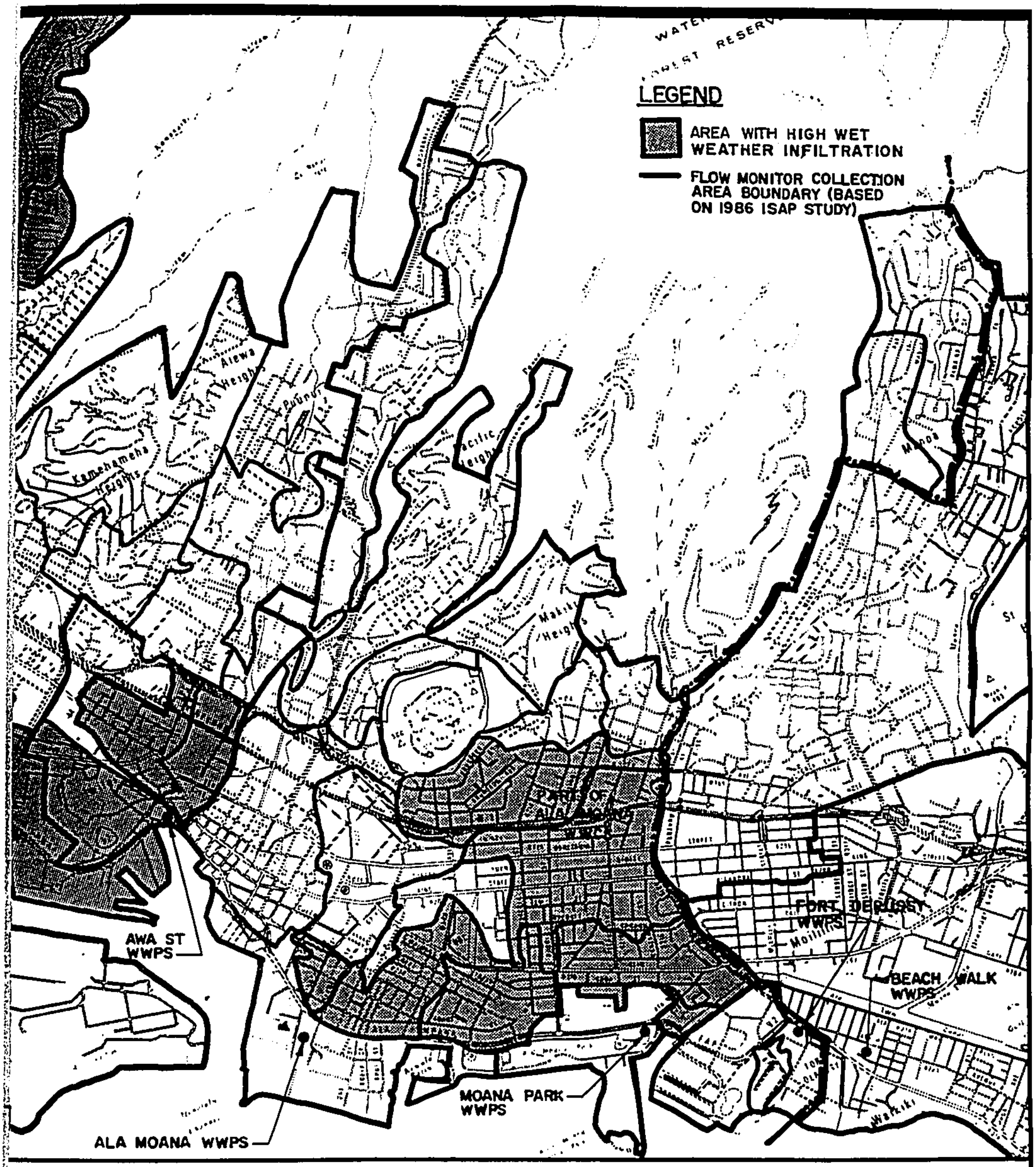
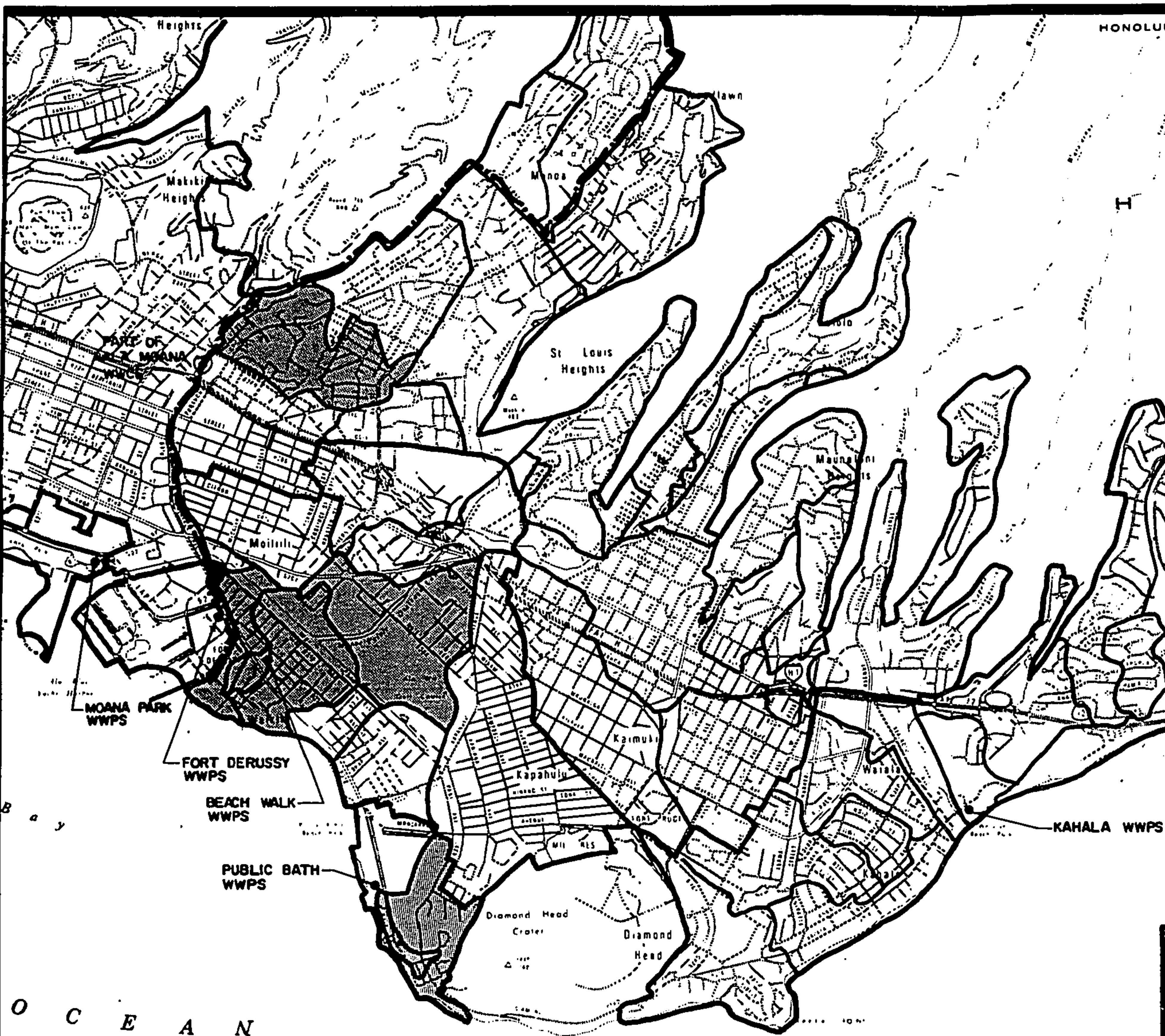


Figure 4-9
Tributary Areas with High Wet Weather Infiltration/Inflow



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

3000 1500 0 3000

Scale in Feet

North

SOURCE:
ISAP, 1989-1991

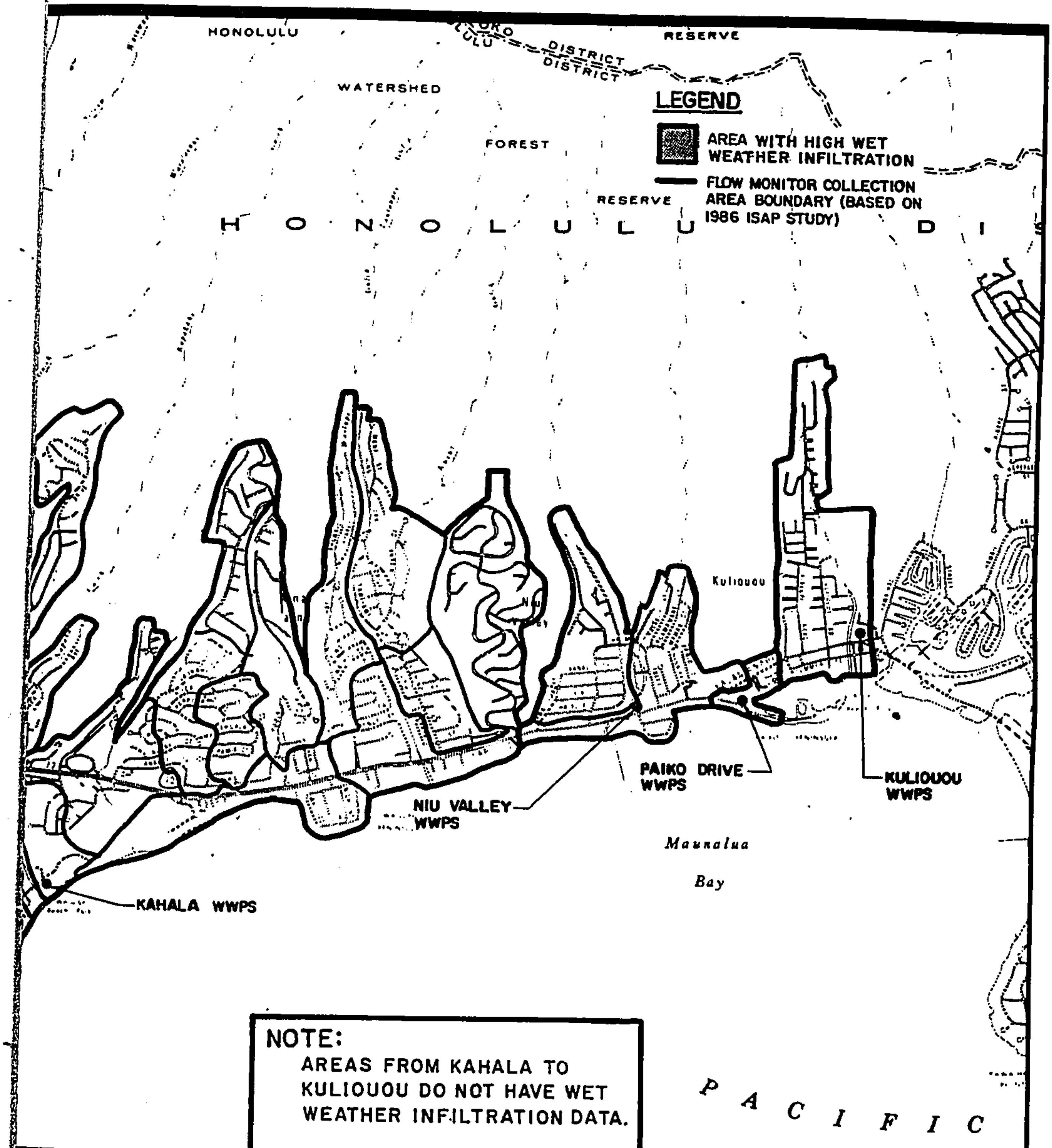
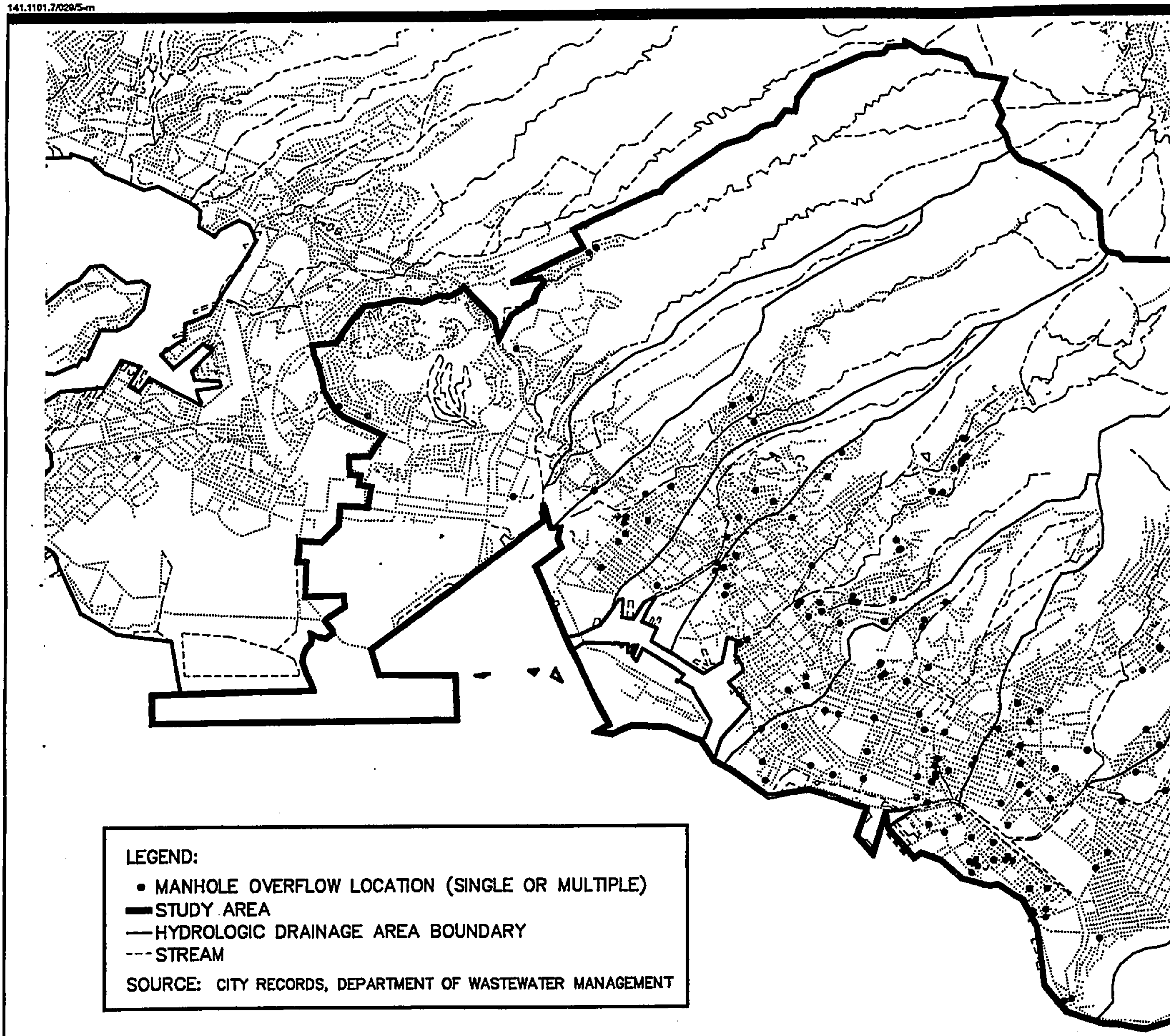


Figure 4-10
Tributary Areas with High Wet Weather Infiltration/Inflow

141.1101.7/029/5-m



LEGEND:
- • MANHOLE OVERFLOW LOCATION (SINGLE OR MULTIPLE)
- ▬ STUDY AREA
- — HYDROLOGIC DRAINAGE AREA BOUNDARY
- --- STREAM

SOURCE: CITY RECORDS, DEPARTMENT OF WASTEWATER MANAGEMENT

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER1993

6000 3000 0 6000

Scale in Feet

North

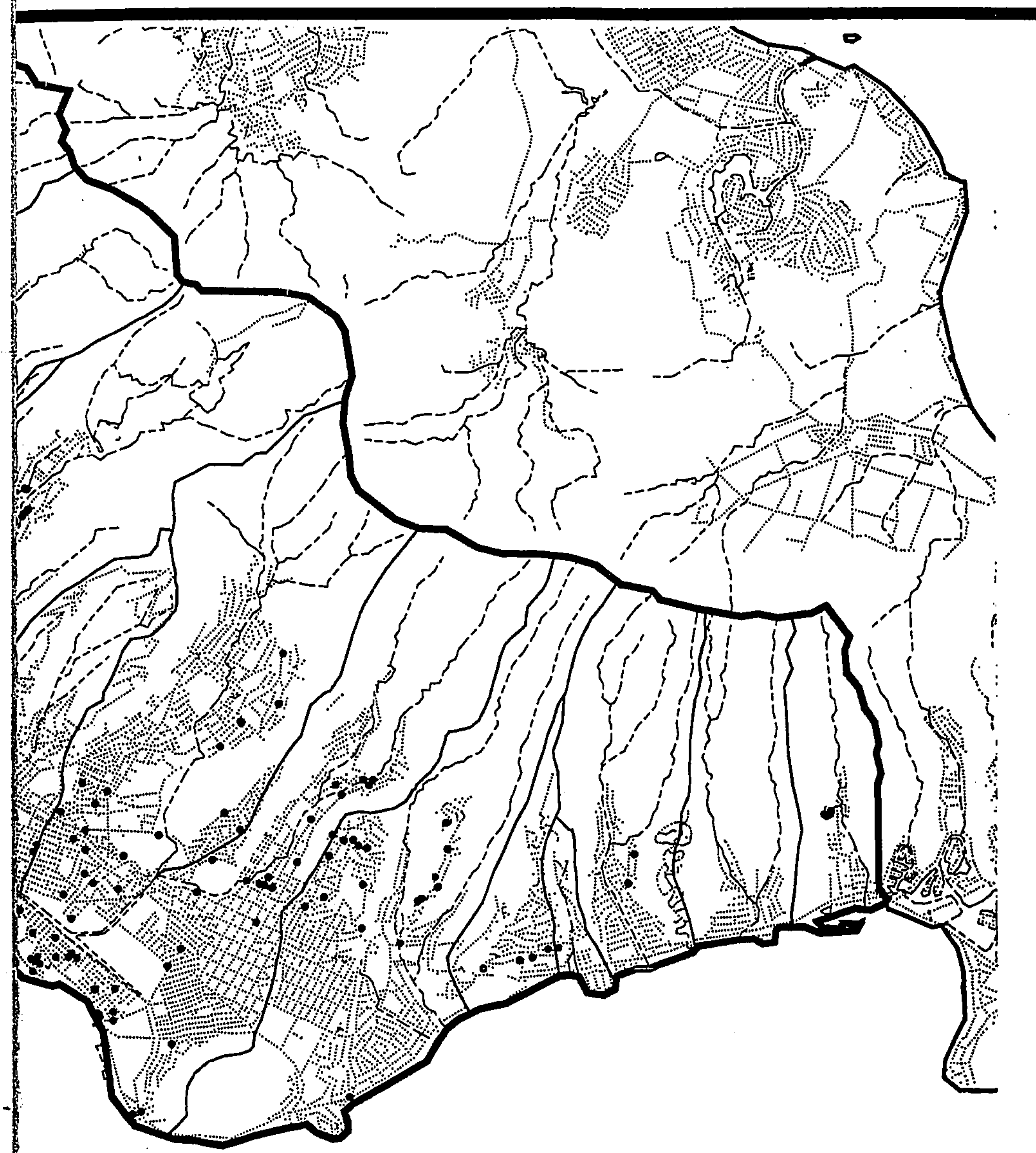
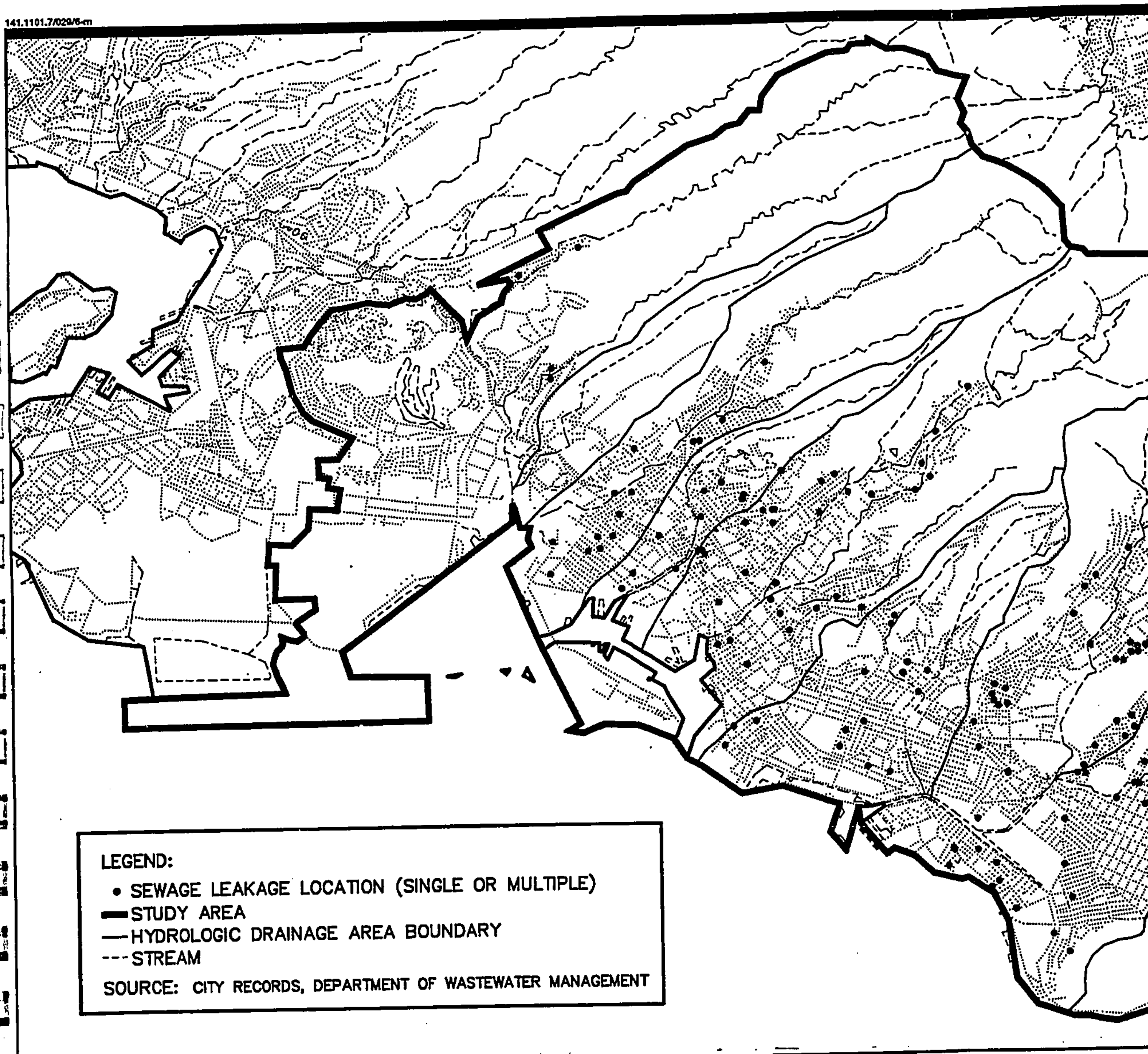


Figure 4-11
Manhole Overflow Locations



EAST MAMALA BAY
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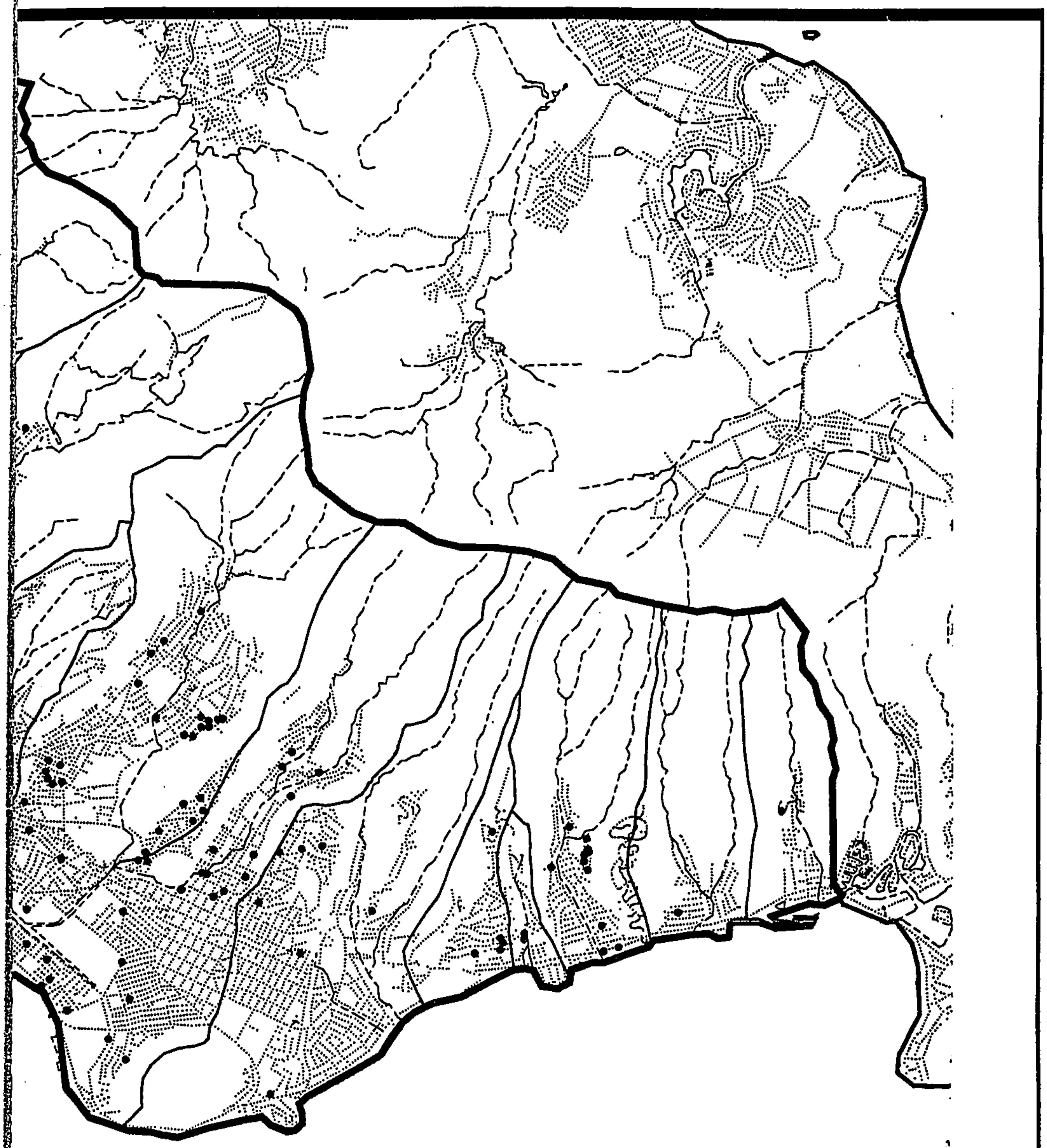
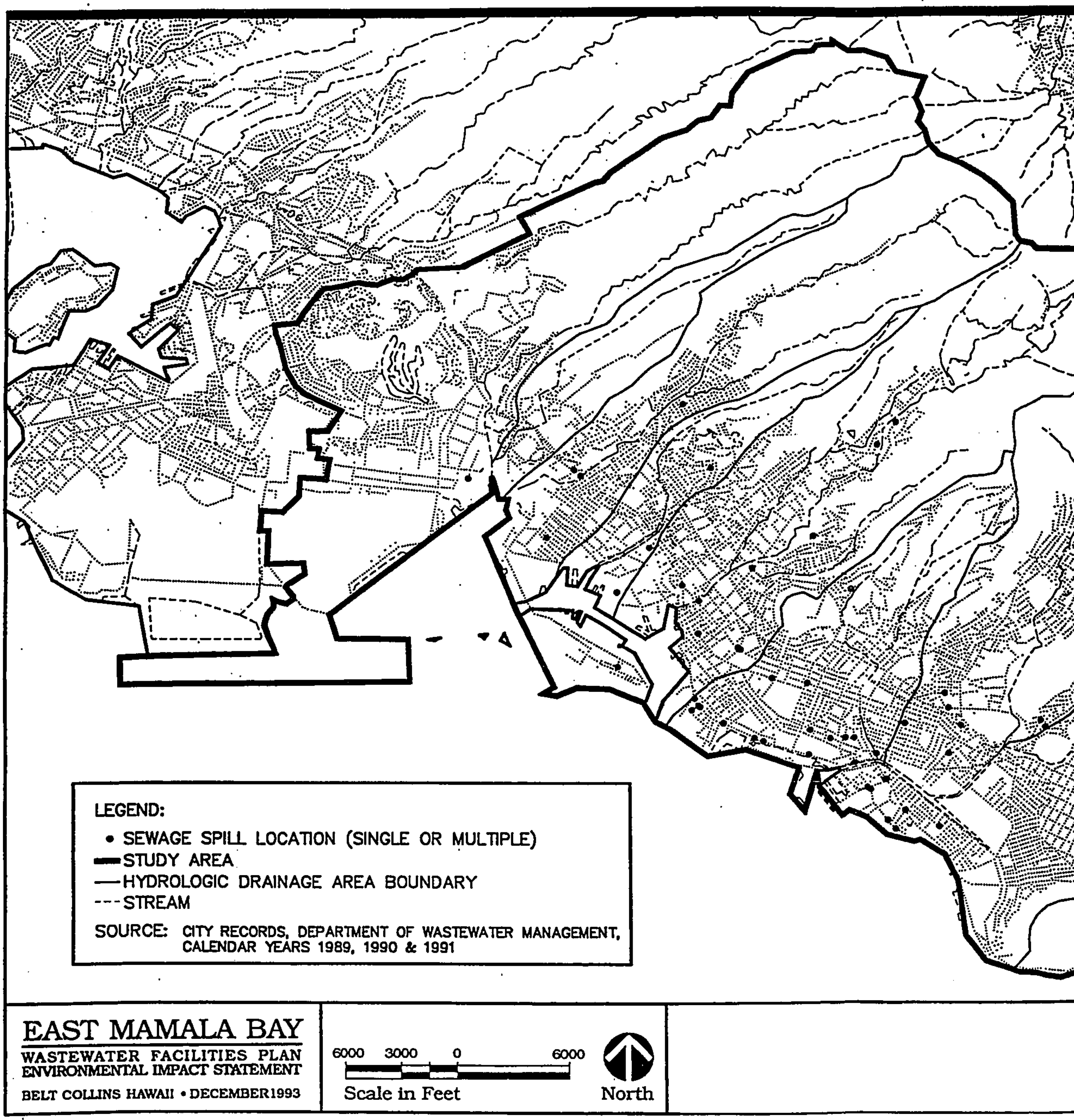


Figure 4-12
Wastewater Leakage Locations


LEGEND:
• SEWAGE SPILL LOCATION (SINGLE OR MULTIPLE)
STUDY AREA
HYDROLOGIC DRAINAGE AREA BOUNDARY
STREAM
SOURCE: CITY RECORDS, DEPARTMENT OF WASTEWATER MANAGEMENT, CALENDAR YEARS 1989, 1990 & 1991
EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993
6000 3000 0 6000
Scale in Feet
North

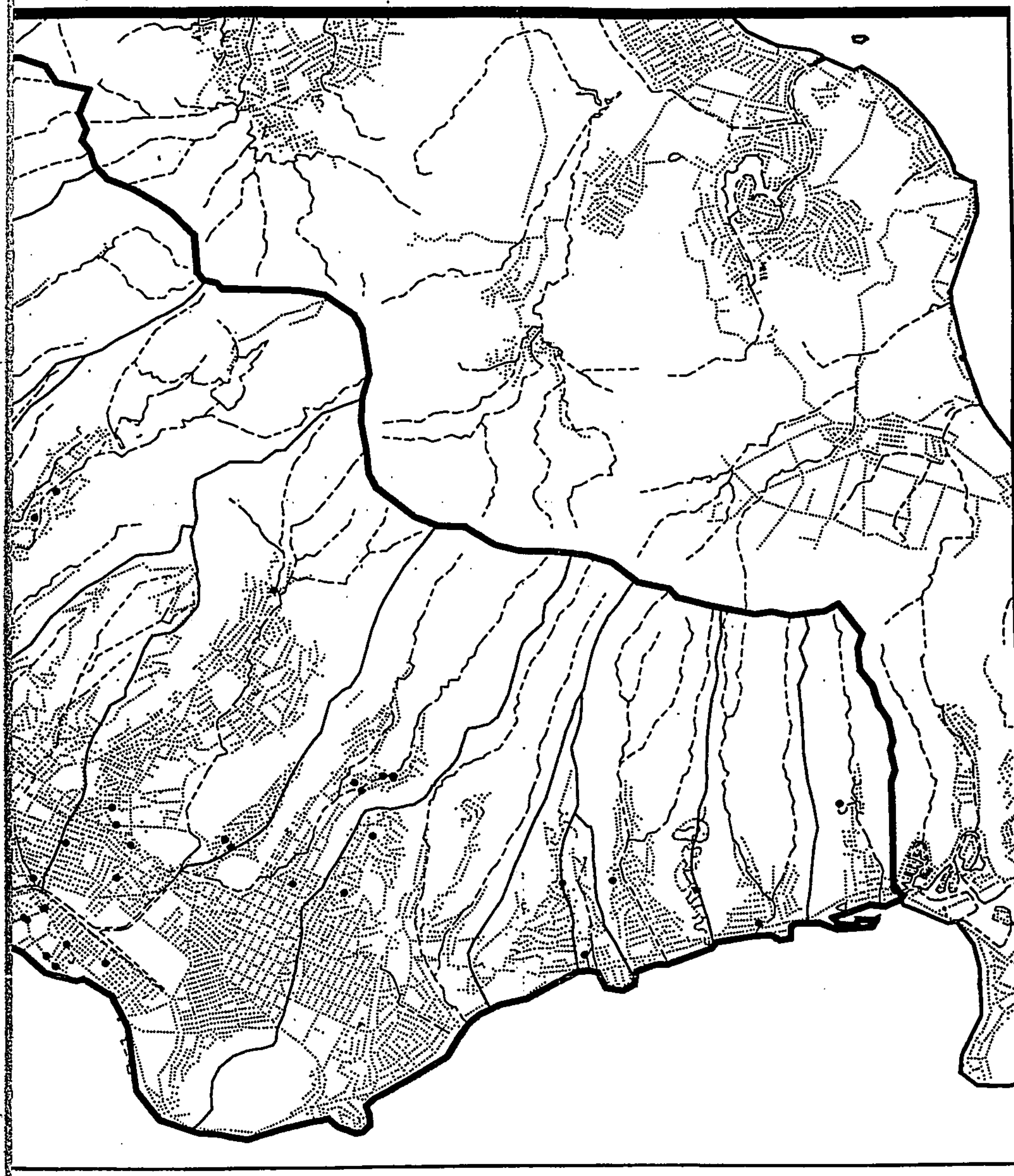


Figure 4-13
Existing Wastewater System in the Study Area - Spill Locations

As a result of the "Findings of Violations and Order for Compliance" issued to the City DPW by the EPA, the City is also required to comply with the following requirements:

- Immediate reduction of collection system spills from 1986-91 levels;
- Development of a collection system spill reduction action plan including:
  - Preventive maintenance plan
  - Collection system and pump station personnel training
  - Information management
  - Equipment and spare-parts inventory
  - Pump station operating instructions;
- Long-term sewer rehabilitation and I&I plan to ensure the elimination of collection system spills;
- Quarterly progress reports; and
- A complete summary of collection system spills and overflows, capital costs and resources.

4.5.4 ODOR CONTROL

There are many sources of odors in wastewater systems, including at the point of discharge to the collection system, throughout the collection system, and at the point of treatment and disposal. Hydrogen sulfide gas is the primary odor source and is a result of septic conditions in the wastewater. Hydrogen sulfide odors are generated under conditions of low dissolved oxygen, long detention times, and high temperatures. Gravity sewer lines harbor odors in sludge deposits and "slime layers." Slime layers, composed of bacteria and inert solids, form below the water level in sewer lines. An anoxic zone develops within this slime layer when it grows thick enough to prevent penetration of dissolved oxygen. Hydrogen sulfide gas is produced in this anoxic zone.

WWPS wet wells are ideal locations for the release of odors. Force mains with long hydraulic residence times also allow wastewater to become anoxic and release odors at air valves and outlets. Manholes with high drops and rough channels may also be associated with odor release. The Ala Moana, Kahala, and Beachwalk WWPSs have been the reported causes of odor complaints in the past. The odors were assumed to be caused by hydrogen sulfide gas, probably due to septic sewage conditions in the wet wells. As a result of the complaints, activated carbon filters were installed in the ventilation systems. The activated carbon is capable of absorbing organic and some inorganic substances, and removing odor-causing compounds. There have also been some odor complaints associated with the Moana Park WWPS, which is located near a highly-traveled pedestrian area. Odor emissions at this WWPS could be due to septic conditions at a manhole near the pedestrian walkway, at the wet well or at the Beachwalk WWPS SFM which discharges to a sewer near the Moana Park WWPS. There are also refuse dumpsters located in the vicinity which may contribute to the odor. No additional odor control measures have been implemented at this WWPS.

4.5.5 PUMP STATION CONDITIONS

Site visits were made to each pump station. Based on these visits, the following observations regarding problems were made:

- Hydrogen sulfide odor was not a noticeable problem during the site visits. However, some complaints have occurred and the City is currently conducting a study on the hydrogen sulfide concentration in several of the pump stations.
- Aliamanu pump stations I and II have experienced flooding that threatens the integrity and safety of the pump stations' structures, as well as motors and generators.
- At a few of the WWPSs, the main door after the safety gate was left unlocked. Although personnel were working at the WWPSs, this practice could allow access by the public. In

addition, control panel doors were left open to prevent overheating. With electrical equipment exposed, tampering and public safety are concerns.

- Signage identifies the presence of asbestos at the Hart Street WWPS. (Asbestos ceiling panels and floor tiles in the MCC area have been identified. Planning for removal has been initiated by DWWM.)

4.6 SAND ISLAND WASTEWATER TREATMENT PLANT

4.6.1 INTRODUCTION

The existing WWTP facility was designed as an advanced primary treatment plant but currently is operated as a primary treatment plant. As discussed in Chapter Two, the treatment of wastewater at the Sand Island WWTP must comply with Federal and State regulations to meet water quality standards established as a result of the Clean Water Act.

Biochemical oxygen demand (BOD) is a measurement of biochemical oxidation or the amount of dissolved oxygen consumed during the metabolic actions of microorganisms (primarily bacteria) with organic material. Usually, waters with high amounts of organic pollution exhibit high BOD values. The standard method of reporting BOD is as an average over a 5-day period which represents the amount of oxygen consumed by the microorganisms in a sample during five days. This standard reference is known as BOD_5.

There are two types of solids of concern—dissolved (including colloidal solids like clay, and very small suspended particles) and suspended (including settleable). Any particles that pass through a membrane filter with 1.2 μm ($1.2 * 10^{-6}m$) openings are considered to be dissolved solids. Suspended solids are filterable residues, or solids that are retained by the filter.

Since dissolved solids are more difficult and expensive to remove than suspended solids, primary wastewater treatment processes such as that at the Sand Island WWTP focus on the removal of non-solubles. BOD_5 in treated wastewater is related to the ratio of solubles to non-solubles and the characteristics of the non-solubles (i.e., settleable or non-settleable). Settleable non-solubles will sink; non-settleable non-solubles remain suspended.

4.6.2 DESCRIPTION OF TREATMENT PROCESS

Figure 4-14 presents a layout of the existing Sand Island WWTP and Figure 4-15 presents a schematic of the wastewater treatment process. The following describes the treatment process that the wastewater undergoes, in approximately the order it occurs.

Influent Junction Boxes

Wastewater enters Sand Island WWTP through two influent junction boxes. One junction box receives flow via SFMs from Hart St., Ft. Shafter, and Sand Island Parkway WWPSs. The other receives flow via a SFM from Ala Moana WWPS. The junction boxes are covered concrete boxes built at-grade to a height of about twelve feet. Wastewater is pumped into the junction boxes from the respective force mains to a sufficient height that it flows through most of the treatment plant by gravity flow. The wastewater flows from the two junction boxes to the "headworks" of the plant, the first stage of the treatment process.

Headworks

In the headworks, the wastewater flow is divided into four open concrete channels, each about six feet wide with an average wastewater depth of five and a half feet. There is a bar screen in each channel. The bar screens are actually racks, each consisting of about 50 rectangular bars spaced one inch apart. The wastewater flows through the bar screens. The bar screens are intended to remove large debris, such as

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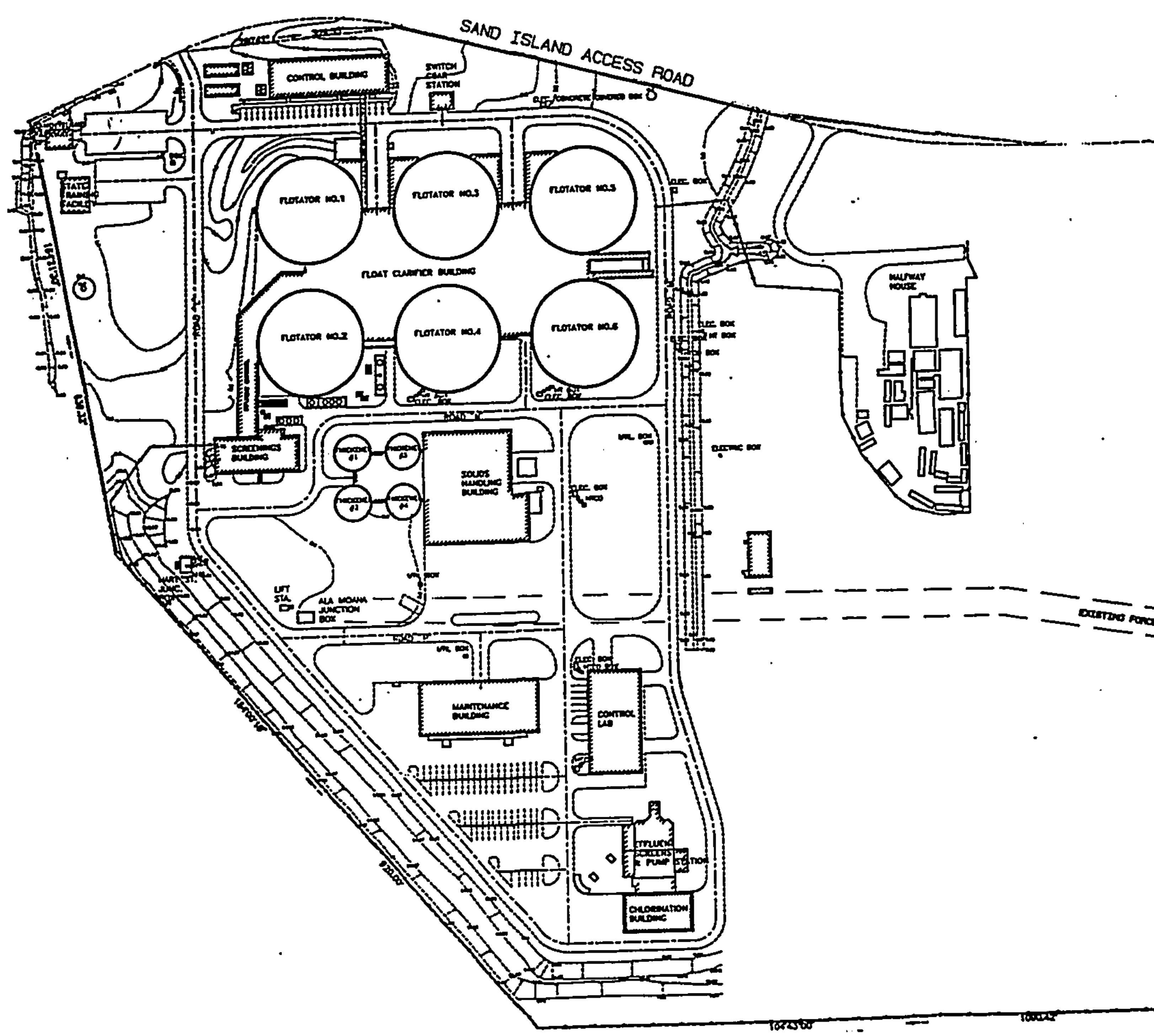

EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

200 100 0 200
Scale in Feet

North

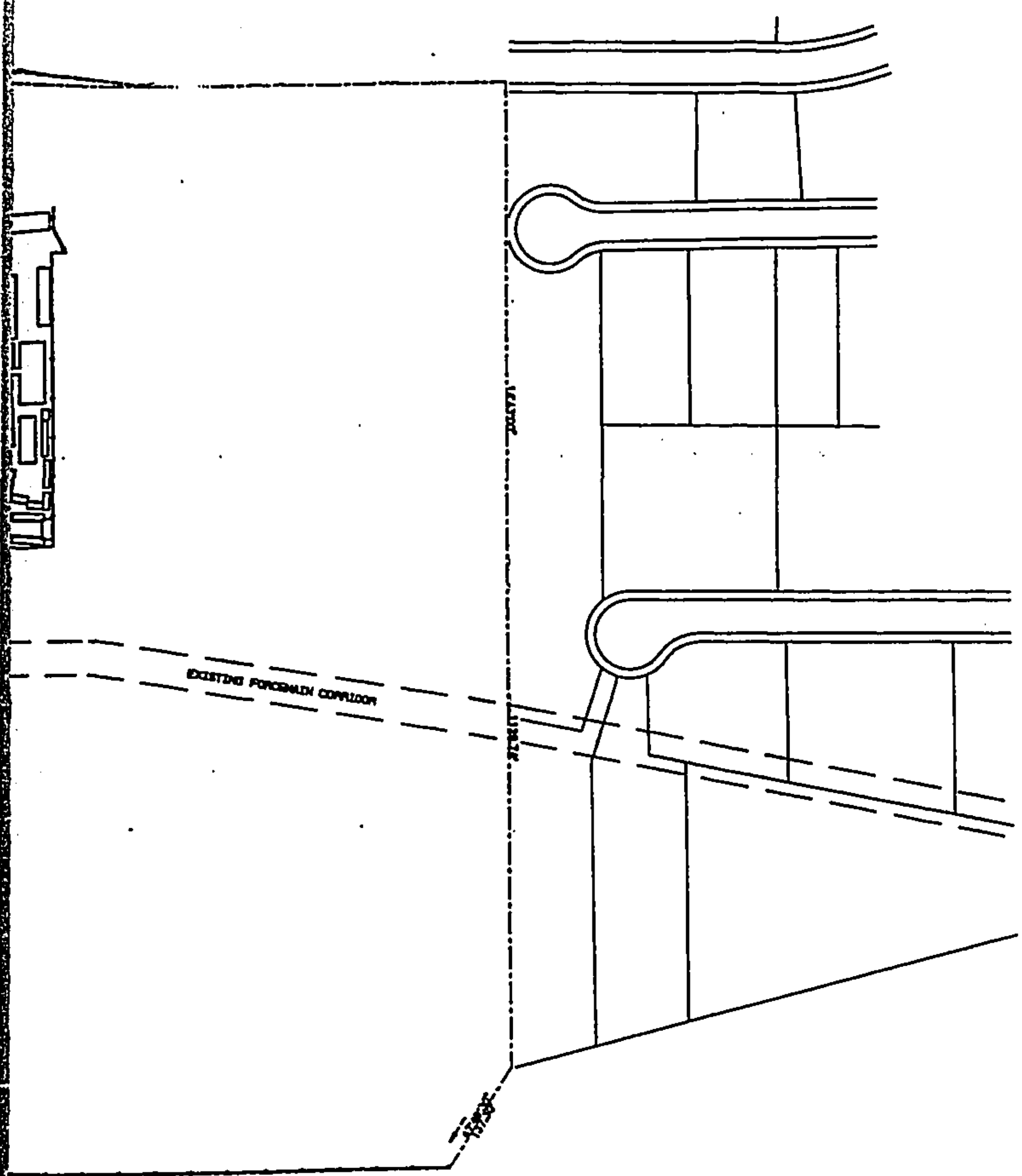

Figure 4-14
Sand Island WWTP Site Plan - Existing

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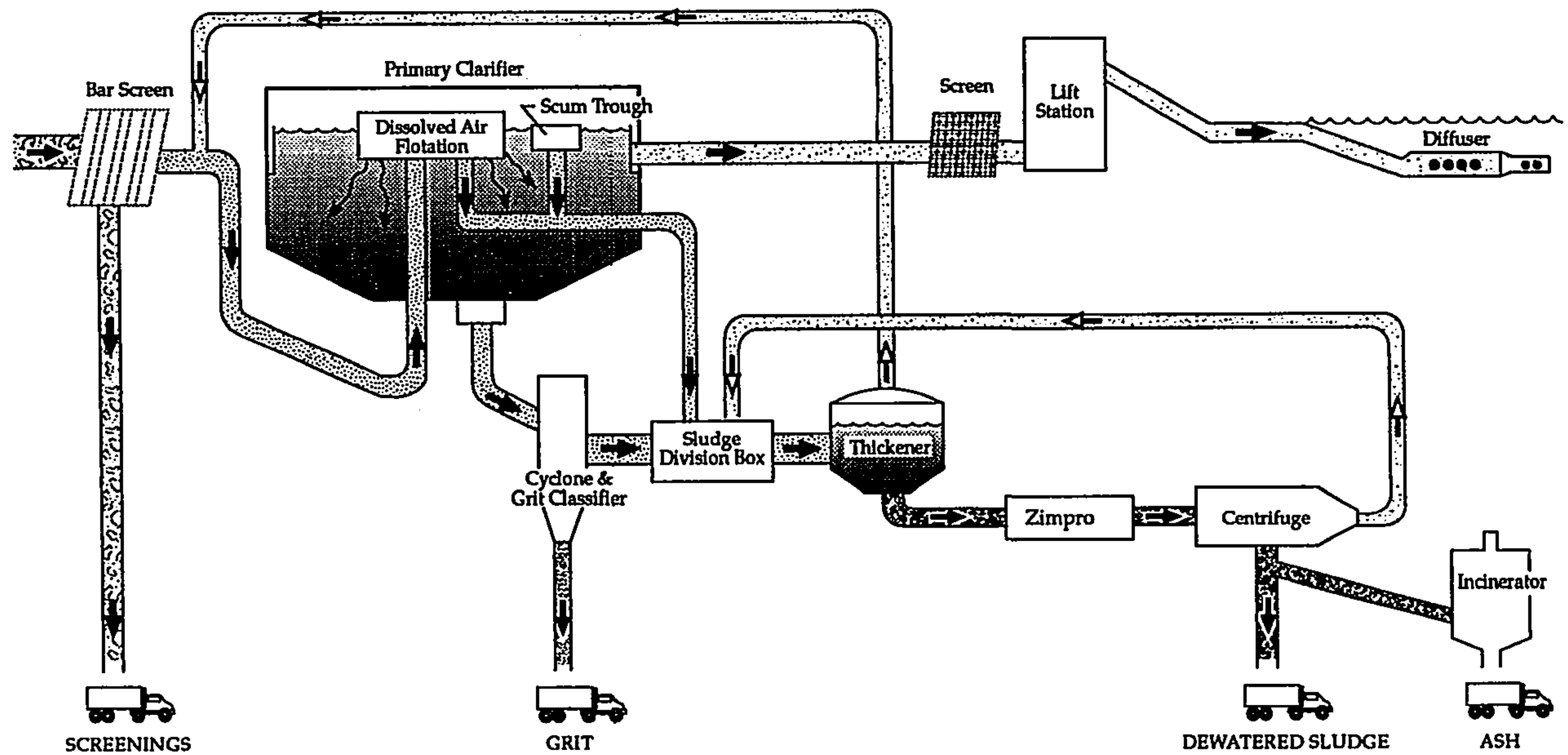

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ENVIRONMENTAL IMPACT STATEMENT
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Figure 4-15
Existing Treatment Process

litter, plant material, glass, etc. The average volume of the debris removed is by the bar screens about 36 cubic feet per day. Debris that is trapped by the bar screens ("screenings"), is removed by a device called a chain-in flight which consists of a vertical chain conveyor with scrapers attached to it. The debris is scraped off the bars, lifted by the slowly rotating conveyor and deposited into a second conveyor which carries it to a hopper where it is held until a truck transports it to a landfill. Alternatively, the screenings can be transported by a vacuum conveyor to the on-site incinerators for burning. The incinerators are not in use presently; thus, all debris caught in the bar screen is disposed in a landfill.

The bar screens are designed to regulate the size of debris that can enter the treatment plant, by the spacing between the bars. The number and spacing of the bars can affect the velocity of the wastewater flow passing through the screen. This is particularly important because if the velocity is too high, debris can be forced through the spaces between the bars and may clog or damage mechanisms in the plant. If the velocity is too low, the debris is not held against the scrapers as they move up the face of the bar screens and turbulence jars the debris from the scrapers and reduces the efficiency of the operation. The existing bar screens permit passage of large debris into the treating plant.

Clarifiers

From the bar screens, flows are directed to a covered concrete channel that is divided vertically. This divided channel is operated at maximum flow with a minimum of air and is sealed for odor control. Siphon pipes are located at the end of each side of the channel leading into clarifier tanks. There are three clarifier tanks on each side of the divided channel. During peak flows, both sides of the channel are utilized. During low flow periods, one side of the channel can be closed, and only three clarifiers are used.

The purpose of the clarifiers is to remove suspended solids from the wastewater. This is accomplished through a combination of floatation and settling. Wastewater in the clarifier tanks is treated by facilitating suspended solids to either float to the surface or sink to the bottom. The key to efficient removal is ensuring that the wastewater in the clarifier tank is as undisturbed as possible. To achieve this, introduction of the wastewater must create minimum disturbance and the open-air surface of the clarifiers must be shielded from the wind.

Each clarifier tank is 150 feet in diameter with a cone-shaped bottom that slopes down to the center where the siphon pipe enters. The sides of each clarifier are about 14 feet in height. The wastewater in each tank typically reaches a height of about 12 feet. Each tank has a design capacity of approximately 28.8 mgd. The tops of the clarifiers are open; however, the liquid surfaces are protected by pre-cast concrete rings rising another 8 feet above the tops of the clarifiers. The purpose of the protective rings is to ensure that the surface of the influent in the tank is not disturbed by wind action. They also aid in odor control.

The wastewater flows into the clarifiers through siphon pipes that extend up through the bottom of the tanks through baffles. The baffle, designed to minimize agitation in the tank, diffuses the influent equally in all directions. An additional baffle surrounds the siphon pipe to further reduce the disturbance caused by the wastewater entering the clarifier.

Suspended solids that float are skimmed from the surface by a slowly rotating skimmer arm extending out from the center of the tank. Through the configuration of baffles on the arm, floatables are moved to the outer edge of the tank where they are deposited into a trough and pumped to the Solids Handling facility (see Section 4.6.4). Typically, less than two percent of the total suspended solids in the tanks at any given time are removed by the skimmer. Suspended solids that settle are removed by a scraper arm that slowly rotates around the bottom of the clarifiers in the same manner as the skimmer. The scraper directs the settled solids to the lowest point in the center of the tank where they are deposited into a sump drain and pumped to the solids handling facility. Clarified effluent from the clarifier tank passes over a weir which is located around the inside perimeter of the tank at the water surface level (see Figure 4-15).

The velocity of the wastewater moving through the clarifiers determines the retention time of the wastewater in the tanks, and thus the time available for solids to settle. Therefore, effluent flow rate and the number of clarifier tanks available determines the volume of solids that are removed. The lower the volume and greater the number of tanks in use, the longer the wastewater can be retained, and the larger the volume of suspended solids that settle. However, because the NPDES permit dictates specific discharge limitations for BOD_5 and TSS (see Section 4.9), excessive retention times are neither cost-efficient nor necessary.

Dissolved Air Floatation (DAF)

Another method used to facilitate removal of suspended solids, particularly non-settleable solids, is a process called "Dissolved Air Floatation" (DAF). In the DAF system, a portion of the effluent from the clarifiers is supersaturated with air and transferred to the sludge division box where it is pumped to the thickener (see Section 4.6.4 - Sludge Treatment). The bubbles of air released when the effluent attains atmospheric pressure facilitates the floatation of some non-settleable material.

The Sand Island WWTP is equipped with a DAF system; however, it was taken out of service several years ago because the City felt that the improvement in effluent quality could not justify its operating cost. As of December 1993, the DAF system was re-implemented on a trial basis to better quantify its impact on the removal of TSS and BOD_5.

Effluent Pump Station

The effluent which passes over the weirs of each clarifier enters a clarifier effluent channel that transports it by gravity flow to a main channel, which, in turn, directs it to an effluent pump station. Two flow meters are located in the channel leading to the pump station. The purpose of the effluent pump station is to force the effluent at a constant pressure into the outfall and through the diffuser (see Section 4.6.3 - Effluent Disposal). Before reaching the pump station, the effluent passes through three self-cleaning screens with 1/4-inch openings which are designed to ensure that no floatables enter the outfall. Normally, the effluent flows by gravity to the ocean outfall; however, during flows greater than 90 mgd, pumps are utilized to assist in the transport of effluent to the outfall. Because the flow rate through the treatment plant varies hour to hour, additional energy is needed at times to force the effluent through the diffuser.

Chlorination

After the effluent passes through the effluent pump station, but before it enters the outfall, chlorine can be injected to disinfect it and to destroy certain pathogens. The WWTP has one chlorinator unit for internal wastewater reuse processing (described below) and six chlorinator units for effluent disinfection. Currently, the Sand Island WWTP does not utilize effluent chlorination because of the potential negative health and safety effects associated with chlorine. Because of these issues, a separate chlorination study will be conducted; this study has been postponed.

Internal Wastewater Reuse

A small portion of effluent is diverted from the effluent pump station to a storage tank where it is chlorinated and utilized as wash water in the plant. None of this water is used outside of the treatment plant or allowed to seep into the ground. Wash water is collected within the system and cycled back to the primary clarifiers.

4.6.3 EFFLUENT DISPOSAL

Effluent from the Sand Island WWTP is disposed through a deep ocean outfall extending off Sand Island, depicted in Figure 4-16. What is generally referred to as the outfall is actually composed of two parts, the outfall and the diffuser. The outfall is a reinforced concrete pipe 84 inches in diameter which extends 9,200 feet out to sea along the ocean floor. Approximately 2,000 feet of the outfall is protected by armour rock (see Figure 4-17). The armour rock cover is used over the transition area between the buried section of pipe and the section that is located on the ocean bottom.

The diffuser, at the end of the outfall, is the unit which disperses the effluent into the receiving waters. The diffuser is an approximately 3,350-foot-long reinforced-concrete pipe perforated by openings, or ports. It is located at depths ranging from 225 to 243 feet below mean sea level. While the depth of the outfall gradually increases with distance from shore, the diffuser is located at a relatively constant depth, because the diffuser is oriented parallel with the depth contours.

The operation of the outfall system is based upon the principle of dispersing the effluent into the receiving water. As the effluent moves through the diffuser it begins to disperse through the ports. To compensate for the loss of pressure in the effluent stream caused by the reduction in its volume along the diffuser, the diffuser diameter is decreased. The diameter of the diffuser reduces in stages: 84 inches, 66 inches, and 48 inches, respectively. The ports increase in diameter along the diffuser as the pressure of the effluent moving through the pipe decreases. The inverse relationship between the pressure of effluent and the size of the ports ensures that the same volume of effluent is released at all ports.

The dilution of the effluent in the receiving waters is of principal concern in the design of the outfall and the diffuser. Dilution depends upon the volume and composition of the effluent, the temperature and salinity of the receiving waters, and prevailing currents. The need to substantially reduce the possibility that the diffused effluent will rise to the surface is of almost equal importance. Surfacing effluent might be subjected to winds or currents that could direct it into coastal recreational waters and consequently, human contact. The likelihood of the effluent surfacing is related primarily to the temperature and salinity stratification of the receiving waters. On the other hand, sunlight and saline conditions tend to exterminate pathogens in the rising effluent.

Computer modeling conducted by Edward K. Noda & Associates (1992), indicated that the Sand Island WWTP diffuser plume (upon leaving the diffuser, the discharged effluent is referred to as a plume) remained submerged approximately 85 percent of the time and surfaced approximately 15 percent of the time. "Surfacing" is defined as reaching the upper 30 meters of the water column. When the plume is submerged, its average initial dilution is 662 (661 parts seawater to 1 part effluent). As the plume rises to the surface, effluent dilution increases. Surfacing effluent is calculated to have an average initial dilution of 1465 (1464 parts seawater to 1 part effluent).

The area immediately around the diffuser is identified as the "Zone of Initial Dilution" (ZID). For the existing outfall, the ZID is defined as a rectangular prism whose surface projection parallels the alignment of the diffuser with a width twice the diffuser depth and the length extending a distance beyond the end of the diffuser equal to the depth of the diffuser. For the Sand Island diffuser, the ZID is 469 feet wide and 3,860 feet long (see Figure 4-16). The NPDES permit for the operation of the treatment plant and its outfall defines the size and location of the ZID, and establishes limits for certain water quality parameters beyond the ZID.

Hawaii water quality standards also allow establishment of a "Zone of Mixing" (ZOM) beyond the ZID. Waters outside the ZOM are required to achieve minimum water quality standards specified in the NPDES permit. The State DOH approved a ZOM for the Sand Island WWTP diffuser which is 1,400 feet wide by 4,800 feet (parallel to the diffuser). Chapter Two of this document contains a detailed discussion of the applicable water quality standards.

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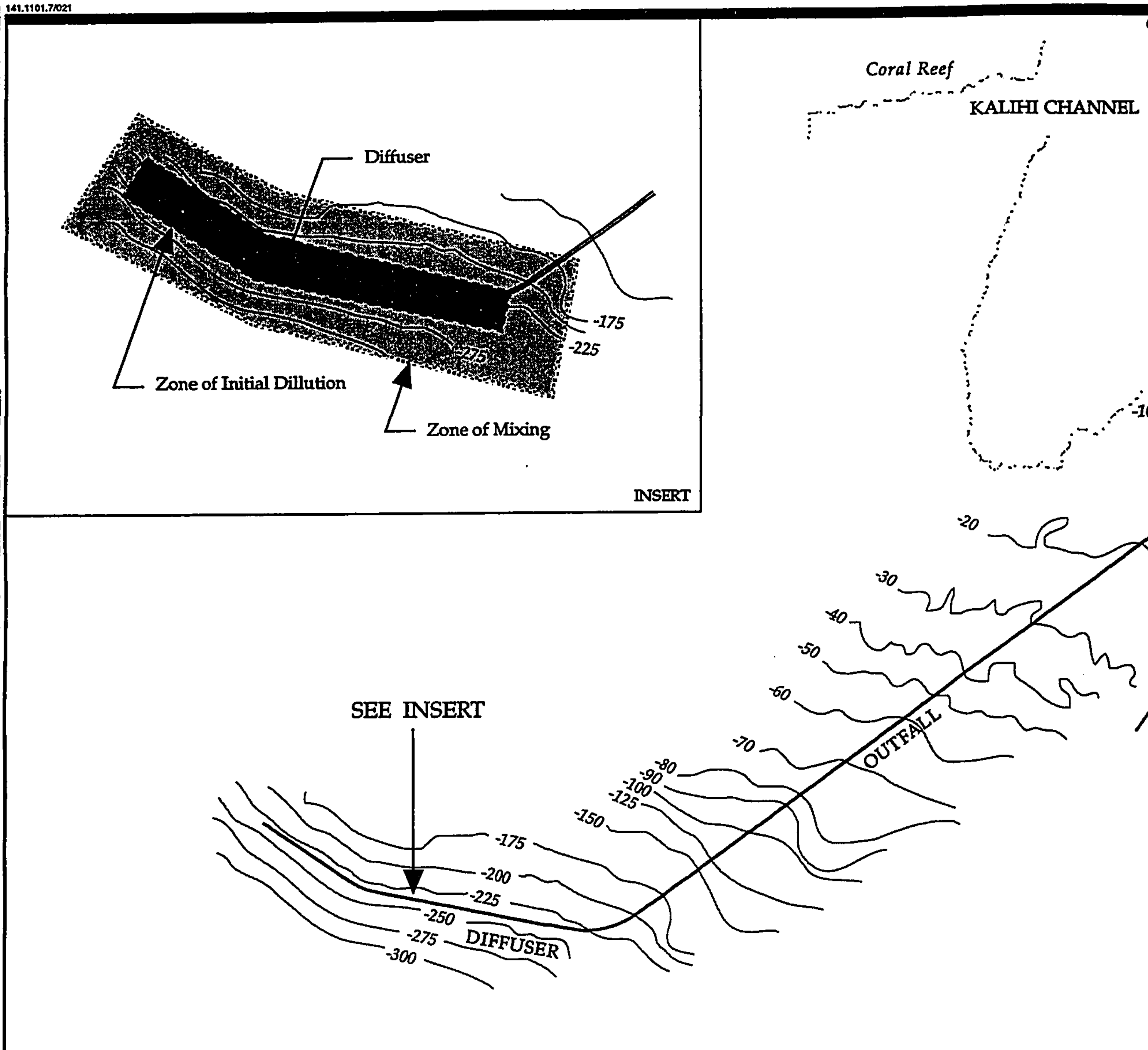

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Scale in Feet

North

LEGEND
-30 Elevation in Feet Relative to Mean Sea Level

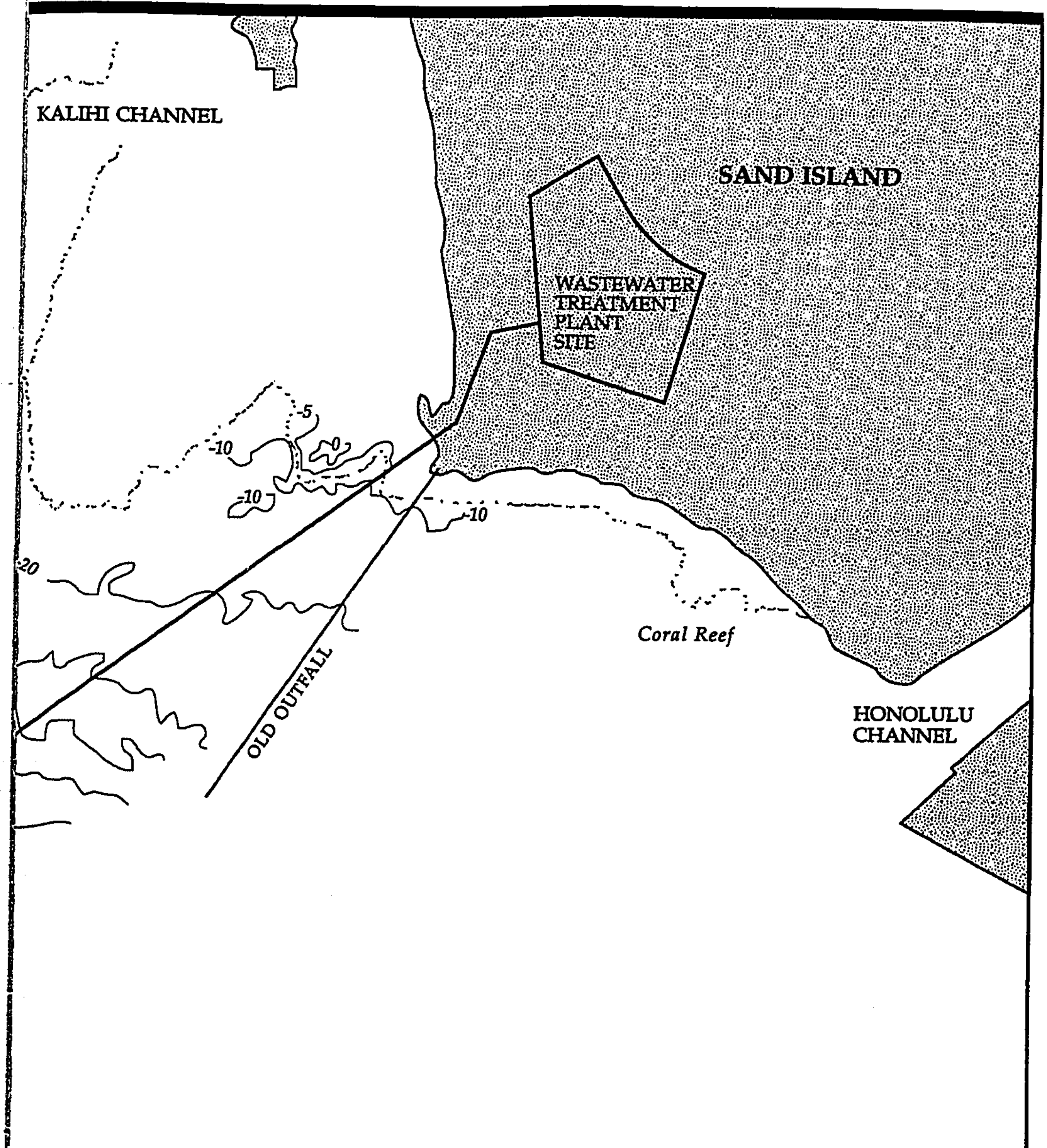

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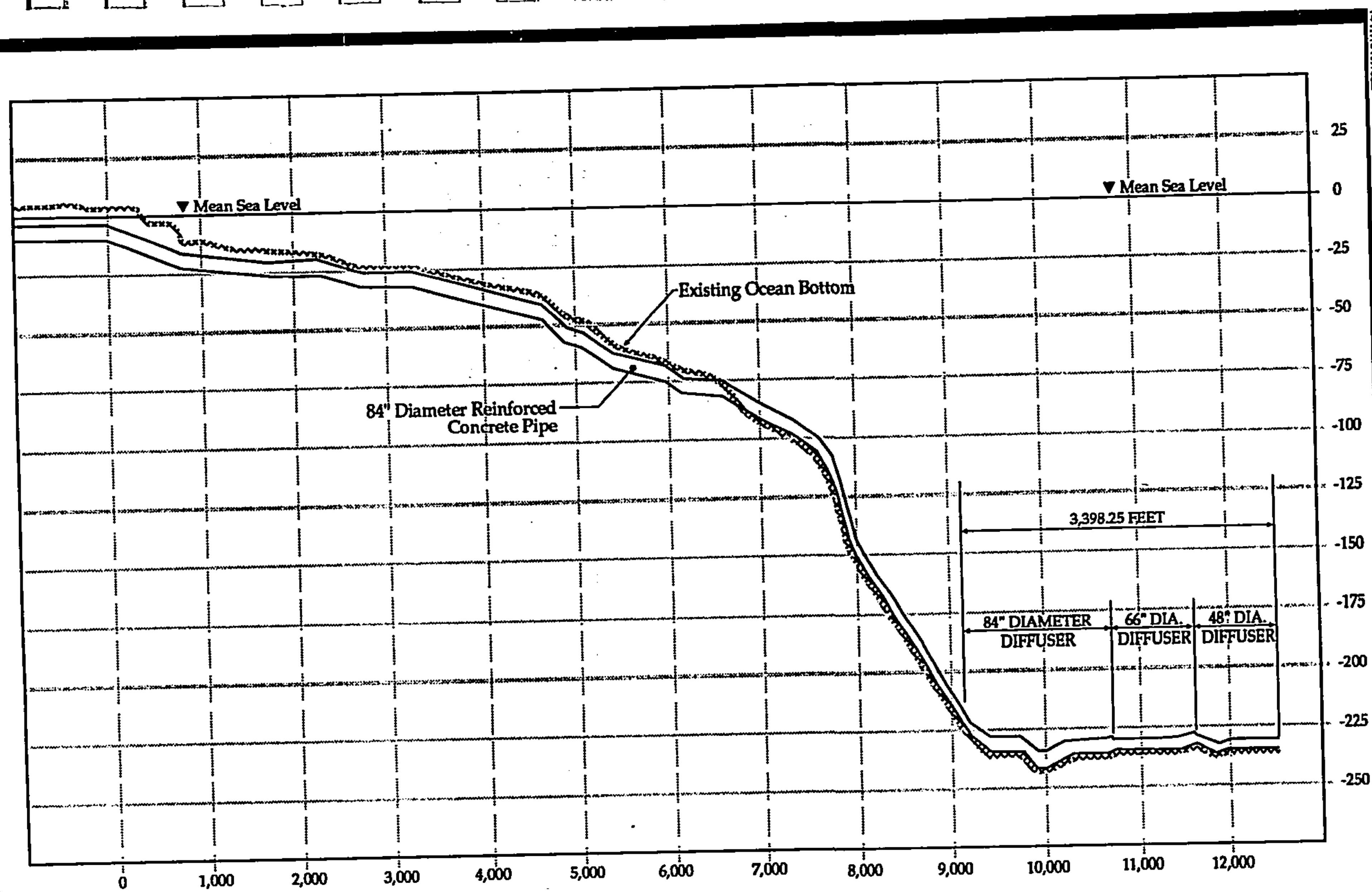
Figure 4-16
Ocean Outfall and Zone of Mixing



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0 375 750 1500 3000
Horizontal Scale in Feet
0 15 30 60 120
Vertical Scale in Feet
Note: Vertical scale is exagerated for display purposes

Figure 4-17
General Outfall Profile

The efficiency and regulatory compliance of the treatment plant's operations are determined through the monitoring of the ZID, the ZOM, the receiving waters, and marine sediments and biota. Section 4.9 contains a detailed discussion of Sand Island WWTP's compliance with the NPDES permit.

The old 78-inch diameter outfall (Figure 4-16) was examined in 1973 during the design of the present 84-inch diameter outfall. The old outfall was found to be satisfactory for disposal of effluent in emergency situations.

4.6.4 SOLIDS TREATMENT

Cyclones/Grit Classifiers

The floatable and settled solids (collectively referred to as sludge) collected from the clarifiers consist of organic material and inorganic grit (sand, soil, etc.). The sludge is piped from the clarifiers into cyclone/grit classifiers, devices that utilize centripetal force to separate the heavier particles (primarily inorganic grit) from the remainder of the sludge. The Sand Island WWTP operates four 18-inch diameter cyclones, each capable of handling 500 gallons per minute. Two effluent streams leave the cyclones. The organics, still suspended in effluent, are transported from the cyclone to a thickener by gravity flow. The grit, which is at a higher concentration than the organic emulsion, is deposited into two grit classifiers. Each classifier is a large tank with mechanical rakes that push the grit up an inclined plane. The grit settles out and is removed by the rakes, which also agitate the mixture to release any attached organic material. The remaining effluent in the grit classifier spills over a weir and is pumped to the gravity thickeners. The grit leaving the classifiers is dewatered, then deposited into a hopper (holding bin) and eventually transferred to trucks for disposal at a landfill. The average volume of grit generated at the Sand Island WWTP is nine tons/day.

Gravity Thickeners

The effluent from the cyclones and the grit classifiers is pumped to a sludge division box. From the sludge division box, the sludge can be directed to one of four gravity thickeners. These are devices almost identical to the primary clarifiers but on a smaller scale (50 feet in diameter with side walls about 10 feet high) and without the rotating skimmer at the surface. The effluent that spills over the thickener's weir is pumped back to the influent channel of the primary clarifiers. The solids which settle to the bottom of the thickener are deposited into a sump by a rotating scraper arm and are pumped to a thermal stabilization unit for further treatment.

Zimpro Units

The two thermal stabilization units utilized at Sand Island WWTP were manufactured by a firm named Zimpro, and typically are referred to as the Zimpros or Zimpro units. Each unit operates at a capacity of about 5,000 gallons per hour. The sludge pumped from the thickener is heated in the Zimpros to 380° Fahrenheit and pressurized to 330 psi. Due to the high moisture content of the sludge, the water vaporizes and the organics in the sludge literally explode. This process stabilizes and pasteurizes the sludge, by killing the pathogens. It also promotes efficient dewatering by destroying the cellular walls of organic solids and releasing the water they contain.

Centrifuges

The stabilized solids are dewatered in one of three 24-inch-diameter centrifuges, each capable of operating at 100 gallons per minute. The resulting liquid, called centrate, is returned to the sludge division box. The dewatered solids are transported to a landfill by truck.

Multi-hearth Incinerator

The Sand Island WWTP incinerator facility has two units sized to incinerate 4.5 wet tons of dewatered sludge per hour. The units are capable of completely burning the sludge. Ash from the incinerators is trucked to a landfill for disposal. However, the units have not been operated steadily since 1985. These units are being retrofitted with air emission control equipment needed to attain compliance with air quality standards, so that they may be permitted to operate. One of the units has successfully completed the testing and is permitted. The other unit is being upgraded to bring it within standards (see discussion in Section 4.6.7).

Evaluation of the Sludge Treatment Process

Based upon visits to the facility, interviews with plant operators, and City records of sludge analysis studies, the following general conclusions regarding sludge treatment were made:

1) Higher than typical levels of salts were found in the dewatered sludge, probably as a result of infiltration of saltwater into the collection system.

2) The caloric heating value of the sludge was found to be much lower than is typical for primary-treated sludge, and thus may require more energy to burn than was estimated previously. This could present a problem if the sludge was to be burned at the City's H-POWER facility.

Table 4-6 presents a summary of the sludge characteristics at Sand Island WWTP as of 1989. Table 4-7 summarizes the results of analyses done in June 1990.

4.6.5 SOLIDS DISPOSAL

Treated sludge, screenings, grit, and incinerator ash are transported by truck for disposal at a City-operated landfill. The Sand Island WWTP presently generates approximately 11 truckloads per day with a total weight of approximately 53 tons. Presently, the Kapaa landfill is the receiving landfill. The City projects the remaining capacity of the Kapaa landfill to be approximately 36,500 tons, which is equivalent to one year at the present refuse disposal rate.

4.6.6 ODOR CONTROL

The influent channel and screening building are sources of hydrogen sulfide (H_2S) which has been controlled successfully with a liquid-oxidation catalytic-control system and carbon adsorption tanks. Odors are also generated during sludge heat treatment. Odor control units have been ordered for installation in the Solids Handling Building that will augment the practice of oxidizing gaseous emissions in the incineration units (once the incinerator is returned to operation).

Additional odor control does not appear to be necessary at Sand Island WWTP. There have not been any recent odor complaints by the public, except for rare complaints by the neighboring Matson Co. and Sand Island Treatment Center. Their complaints typically occur during Kona-wind conditions.

Table 4-6
Year 1989 Sludge Characteristics Summary

POLLUTANT	CONCENTRATION, MG/KG		
	12/19/89 SAMPLE	2/9/90 SAMPLE	AVERAGE[3]
Aldrin	0.0005[1]	0.013[1]	0.0005
Arsenic	1.74	1.93	1.84
Benzene	—	1.20	1.20
Benzo(a)pyrene	1.55[1]	0.13[1]	0.13
Beryllium	0.330[1]	0.112	0.112
Bis(2-ethylhexyl)pthalate	15.0	15.0	15.0
Cadmium	2.2	2.77	2.5
Chlordane	0.001[1]	0.024[2]	0.024
alpha	0.0005[1]	0.0120[2]	0.0120
gamma	0.0005[1]	0.0120[2]	0.0120
Chromium	29.7	27.1	28.4
Copper	252	182	217
DDD	0.0011[1]	0.0120[2]	0.0120
DDE	0.0005[1]	0.0053[2]	0.0053
DDT	0.0016[1]	0.0370[2]	0.0370
Dieldrin	-	0.011[2]	0.011
Dimethyl nitrosamine	-	0.17[1]	0.17
Heptachlor	-	0.012	0.012
Hexachlorobenzene	10.3[1]	0.22[2]	0.22
Hexachlorobutadiene	17.1[1]	0.15[1]	0.15
Lead	64.4	62.4	63.4
Lindane	0.0005[1]	0.011[2]	0.011
Mercury	2.0	3.15	2.6
Nickel	18.7	16.0	17.4
Polychlorinated biphenyls	0.027[1]	0.460[2]	0.460
Selenium	3.3[1]	1.84	2.6
Toxaphene	0.133[1]	0.73[2]	0.73
Trichloroethylene	-	0.008[1]	0.008
Zinc	701	402	561

Notes:

1. Pollutant concentration was below detection limit. The value shown is the detection limit of the analytical test.
2. The value shown is an estimated value. Pollutant concentration was below reporting limit.
3. For pollutants that were below the detection limit for both the 12/19/89 and the 2/9/90 analysis, the average is defined by the lower detection limit. For pollutants detected by the 2/9/90 which were either not analyzed or not detected by the 12/19/90 analysis, the average is defined by the 2/9/90 analysis.

Source: Barrett Consulting Group. *Preliminary Draft Wastewater Sludge Management Plan*. Nov. 1990

Table 4-7
June 1990 Sludge Analysis

CONSTITUENT	UNITS[2]	6/20/90 SAMPLE	6/20/90 DUPLICATE SAMPLE[3]	6/27/90 SAMPLE
pH	-	5.15[1]	5.05[1]	5.22[1]
Total Solids	mg/kg (wet)	615,000	606,000	370,000
Volatile Solids	mg/kg (wet)	549,000	542,000	
Total Dissolved Solids	mg/kg	21,700	23,000	
Total Nitrogen	mg/kg	81,300	59,400	
Ammonia Nitrogen	mg/kg	506[1]	498[1]	
Nitrate & Nitrite Nitrogen	mg/kg	1.20[1]	1.36[1]	
Total Organic Phosphorous	mg/kg	176[1]	174[1]	
Orthophosphate	mg/kg	150[1]	146[1]	
Total Organic Carbon	mg/kg	115,000	203,000	
Chloride	mg/kg	3,140[1]	2,930[1]	3,160[1]
Sodium	mg/kg	998	997	3,910
Calcium	mg/kg	4,550	4,950	
Magnesium	mg/kg	699	726	
Boron	mg/kg	1.23[1]	1.21[1]	
Bulk Density	g/ml	0.250	0.236	
Caloric Heating Value	cal/g	3,180	3,320	

Notes:
1. Aqueous extract analyzed.
2. Expressed as dry weight unless otherwise noted.
3. Duplicate samples were analyzed as part of the quality assurance/quality control program.

Source: Barrett Consulting Group. *Preliminary Draft Wastewater Sludge Management Plan*. Nov. 1990.

4.6.7 AIR QUALITY

When in operation, the two sludge incinerators are potential sources of regulated gases such as SO_2 and NO_2, as well as particulate matter and heavy metals, notably mercury and lead. After a shutdown in 1985 for modification, the incinerators were unable to meet emission standards. Stack testing has indicated that emissions from one unit complied with the New Source Performance Standards (NSPS), but emissions from the other one did not. Efforts to bring the latter into compliance continue. Despite some potential difficulties, the incinerator emissions appear capable of complying with State and Federal air quality standards.

4.6.8 ENERGY DEMAND OF WASTEWATER TREATMENT

In 1992, the East Mamala Bay wastewater system consumed approximately 48,874 kilowatt hours of electricity per day. Over 48 percent of this amount was utilized to operate the Sand Island WWTP and the rest was consumed by the system's wastewater pump stations. Energy consumption fluctuates with peak usage periods.

4.6.9 EVALUATION OF THE WASTEWATER TREATMENT SYSTEM

Based upon visits to the facility and interviews with plant operators, the following general conclusions were made:

(1) Overall, most of the equipment appeared to be clean and well-maintained.

(2) Hydrogen sulfide odors were not a noticeable problem.

(3) Due to the high approach velocity of the influent flow to the bar screens, large solids that should be removed pass through the screens and into the treatment plant.

(4) The centrifuges which receive sludge from the Zimpro units are relatively inaccessible and, therefore, are difficult to reach for maintenance. In addition, the area is poorly lit. The catchment and drainage system is not adequate to drain wash water. As a result, it is hard to hose down the units without causing a ponding problem.

(5) DWWM personnel have indicated that various types of equipment experience problems resulting from grit in the influent that enters the treatment plant. A major problem is that grit tends to settle out in the channels leading to the clarifiers. This decreases the capacity of the channels and has led to plugged clarifier feed pipes. As a result, the channels must be cleaned manually to prevent build-up. Sludge treatment processes are also adversely affected by grit.

(6) The Zimpro treatment units have poor accessibility for maintenance.

(7) Although the volume of effluent entering the outfall is measured, there is no device at the facility for measuring the volume of influent entering the junction boxes or the headworks. The influent flow can only be estimated by summing the measurements of four WWPS flow meters; these are located at Hart Street, Ala Moana, Fort Shafter, and Sand Island Parkway WWPSs.

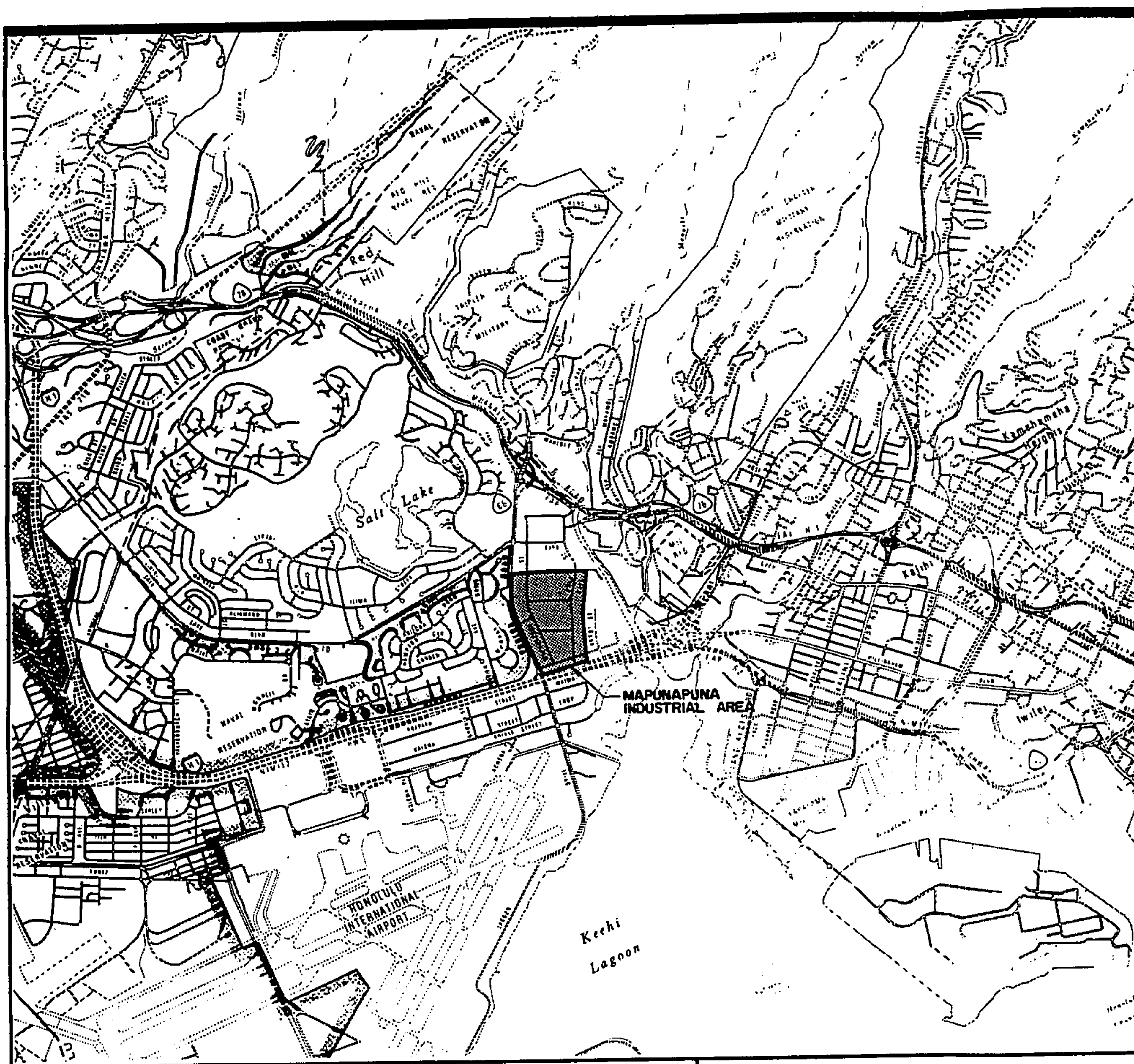
(8) A wastewater reuse system is used to wash plant equipment. The water is screened, chlorinated, primary-treated effluent. The high organic content of this effluent, however, increases the possibility of exposure of plant workers to pathogens. In addition, anticipated changes in DOH guidelines would require this water to be treated to tertiary levels for use in the plant.

(9) A study is planned to evaluate the effect of chlorine on the ocean environment and the potential for human health risk. The NPDES permit required operation with and without chlorination for one year each. Currently, the City is running the plant with the chlorination turned off.

4.7 INDIVIDUAL WASTEWATER SYSTEMS

Most of the residential and commercial areas in the study area are serviced by the City wastewater collection system which conveys wastewater to Sand Island WWTP. However, there are several locations throughout the study area where the collection system does not reach all of the parcels that have been or could be developed. Figures 4-18 and 4-19 show the general locations of these unsewered areas. Table 4-8 lists the locations of the unsewered areas, and the unsewered parcels within each area. In addition to the areas shown on Figures 4-18 and 4-19, an industrial area immediately east of the Sand Island WWTP site is in the process of being collected to the system. A new Sand Island Industrial WWPS is currently being designed to accommodate a 2.3 mgd peak flow. This WWPS will discharge to the existing Sand Island Parkway WWPS. This unsewered area is not included in Table 4-8 or Figure 4-18.

Inhabitants of the unsewered areas rely on individual wastewater systems to treat and/or dispose of household wastewater. Some individual wastewater systems are employed in the sewered areas as well. Effluent from most individual wastewater systems is typically discharged to the subsurface on-site. Individual wastewater systems in the study area include cesspools, septic tanks, and aerobic units. The State DOH has jurisdiction over individual wastewater systems at this time.



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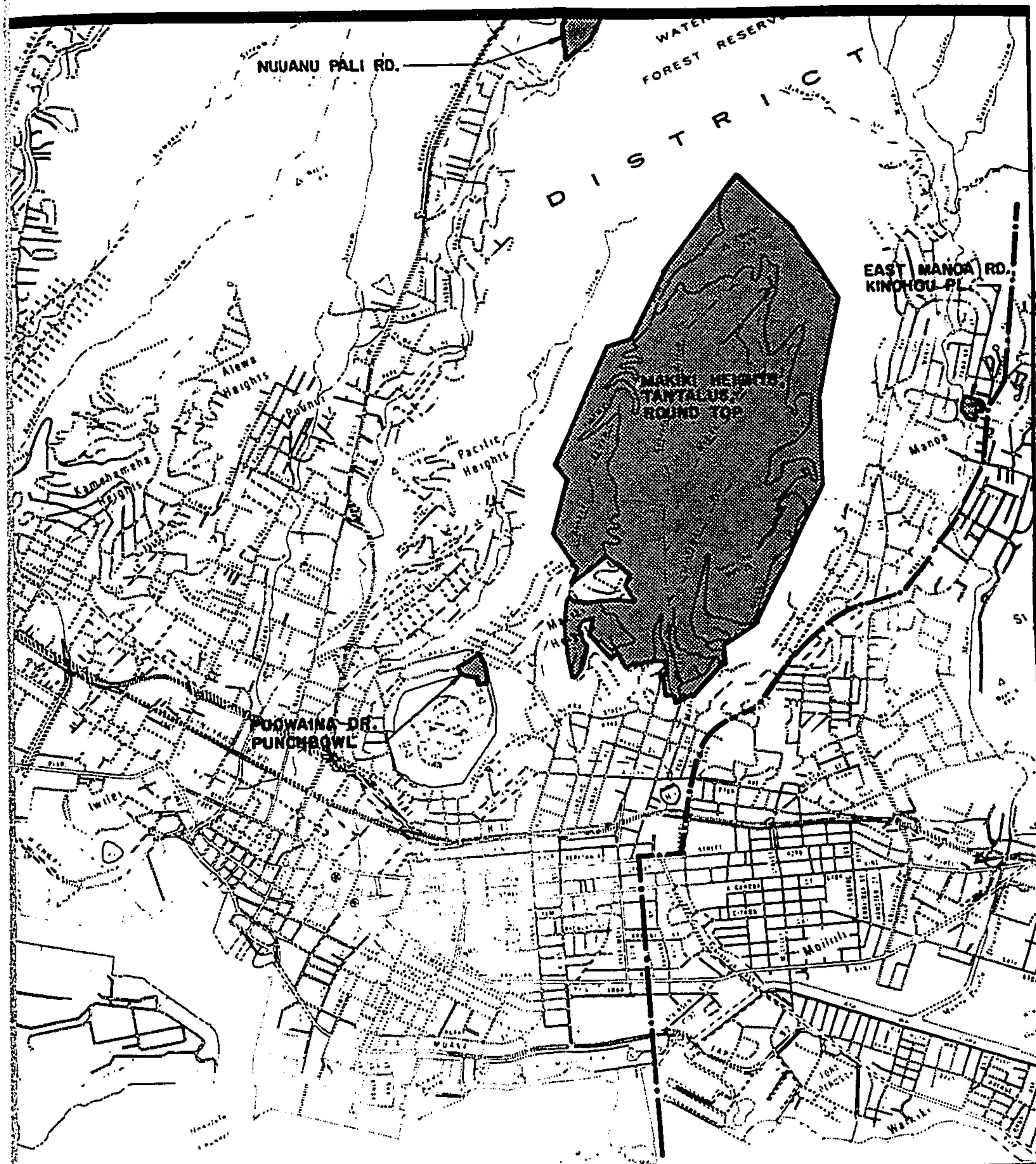
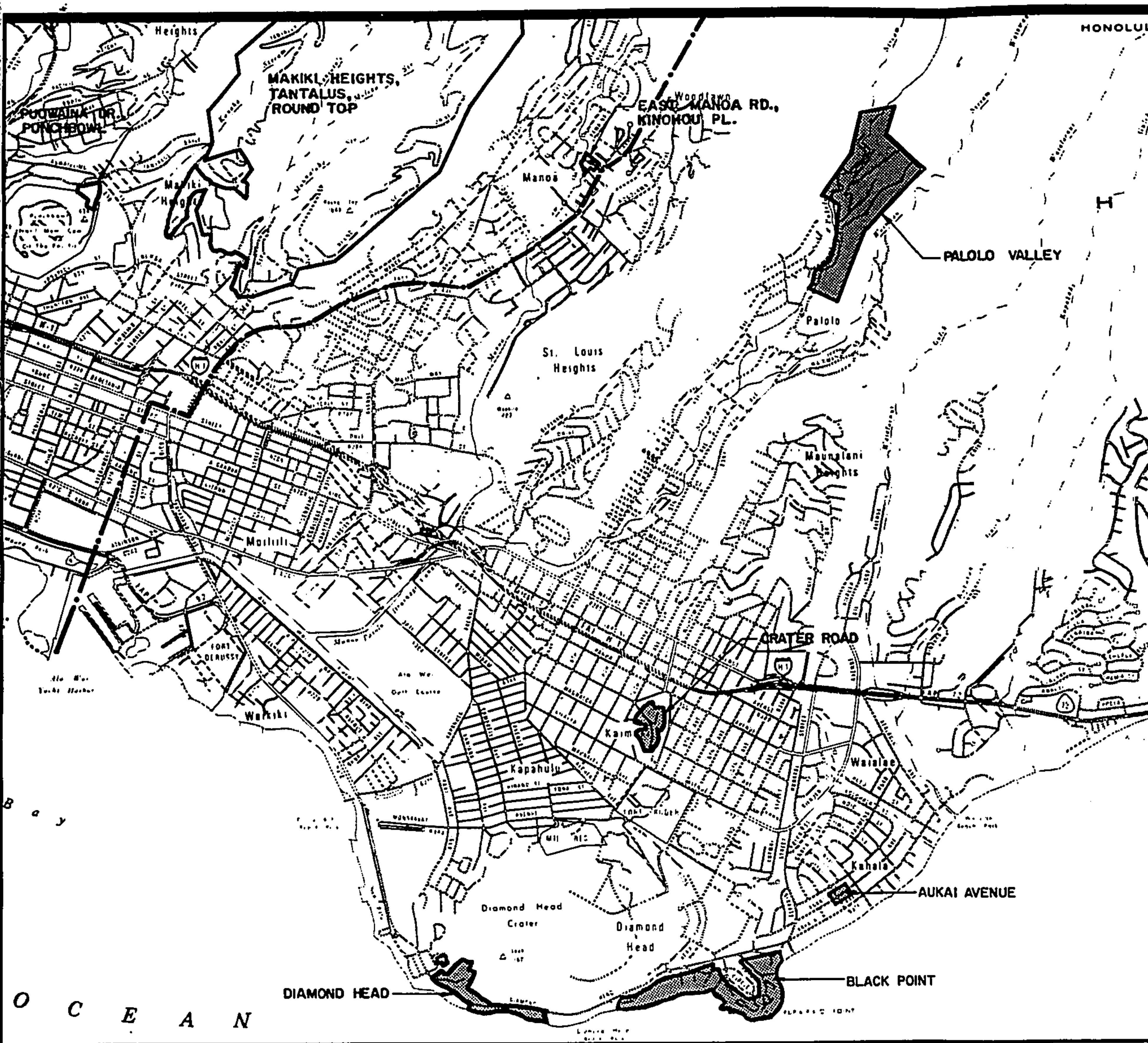


Figure 4-18
Unsewered Areas in the Study Area



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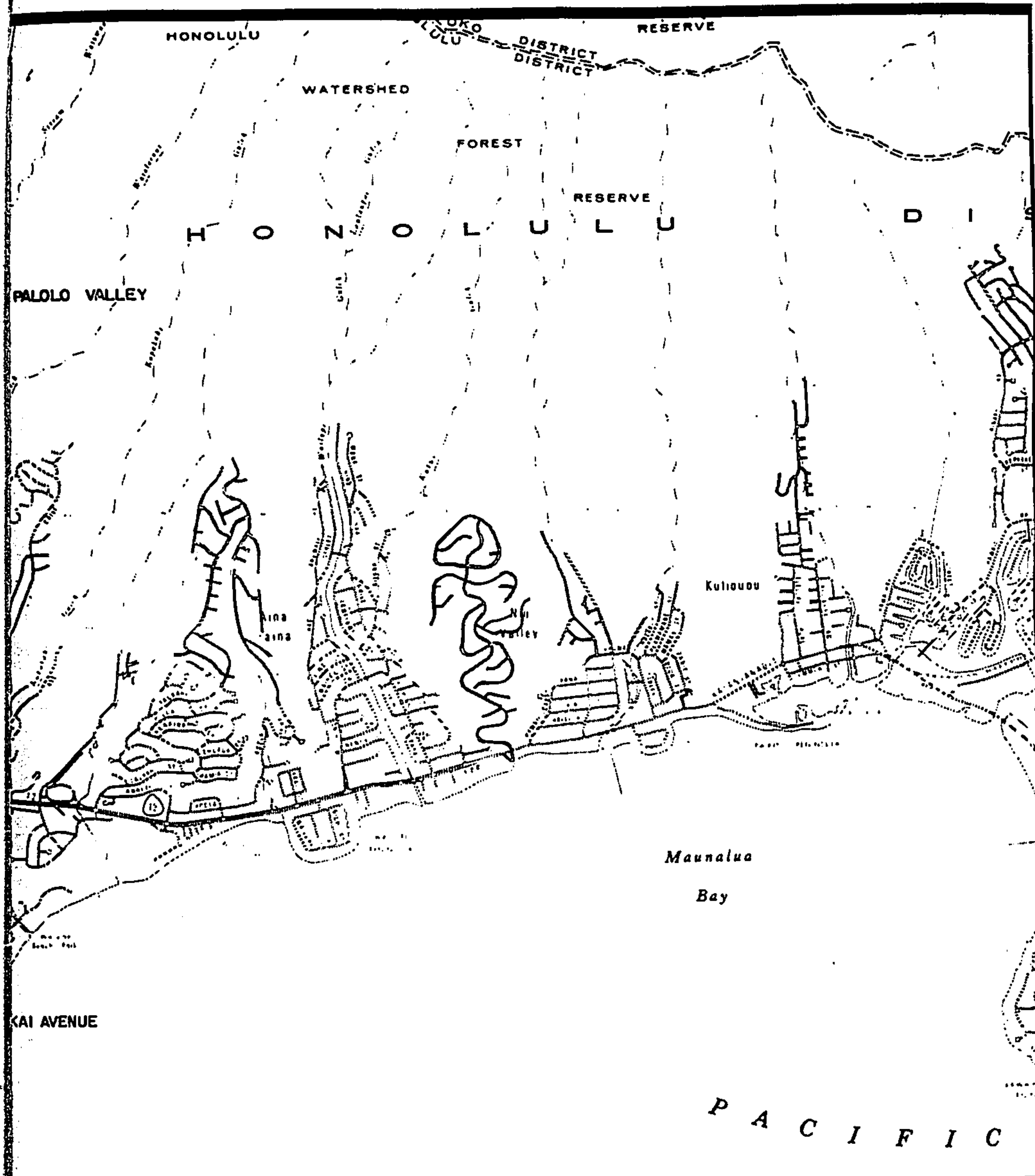


Figure 4-19
Unsewered Areas in the Study Area

4.7.1 CESSPOOLS

Cesspools are the dominant means of wastewater disposal in the unsewered areas. Based on *The 208 Plan* (September 1990), there were approximately 1,940 active cesspools located in the study area. An inventory of DOH cesspool records revealed more than 3,600 cesspools have been constructed in the study area, but most of these were abandoned when wastewater collection systems were installed. In the unsewered areas, it is estimated that there are about 1,595 active cesspools (based on 1,639 parcels in the unsewered areas that have housing units upon them, minus 21 known septic tanks and 23 aerobic units). There may be active cesspools in the areas served by gravity sewers, but this number is difficult to estimate.

The 208 Plan identified 460 cesspools in the study area that have required pumping, approximately one-quarter of the total active cesspools within the study area. A cesspool that requires pumping could become a public health hazard if the contents overflow, because overflow may release disease-causing organisms. The list of water-carried diseases includes nematode worms, anthrax, brucellosis, dysentery, shigellosis, leptospirosis, bacillary dysentery, tapeworms, cholera, poliomyelitis, and hepatitis. Groundwater resources could also become contaminated from wastewater seepage from cesspools. The possibility of polluting coastal waters also exists, where cesspools are close to the shoreline or to streams or drainage channels. The only unsewered area that is close to the ocean is along the coastal rim of Diamond Head, where it is estimated there are about 237 active cesspools.

An inventory of City records for calendar years 1990 and 1991 revealed that 40 cesspools were pumped. Note that cesspools could also be pumped by private pumping services, but the City offers a subsidized pumping rate for residential cesspool users.

Table 4-8
(2 Pages)
TMKs of Unsewered Areas

UNSEWERED AREA	TAX MAP KEYS OF UNSEWERED PARCELS
Mapunapuna Industrial Area	1-1-05:1, 4-11, 16, 19-25, 28-31, 34-42, 44-46, 48-52, 54, 55, 58-65, 68-70, 72-84, 86-102, 104, 106, 109-111, 113, 114 1-1-10:25
Nuuanu Pali Drive	2-2-55:1, 2, 4-8
Puowaina Drive, Punchbowl	2-2-05:6, 8-17, 22, 23, 25-32 2-2-13:2, 5, 9, 16, 95 2-2-14:16-18, 26-29
Makiki Heights, Subarea 1	2-5-19:10, 12
Makiki Heights, Subarea 2	2-4-34:1, 2, 6, 12, 13, 15, 17, 20, 21 2-4-35:7, 17, 18 2-4-36:1-8, 17-25, 28-31 2-4-37:2-5, 9, 10, 38, 50
Makiki Heights, Subarea 3	2-4-26:3, 4, 18, 19, 20, 75-76 2-4-35:2-6, 8, 11, 12, 14-16, 19-23 2-4-38:1, 43 2-5-08:1-6, 8 2-5-09:1-4, 6-8, 11-18, 21, 22 2-5-20:1, 2, 4, 5, 7
Makiki Heights, Subarea 4	2-5-01:10, 14-22, 27-30, 41-43, 68, 69 2-5-03:33, 36-39, 41-47, 49-54, 56-58, 60-68, 70, 73-77 2-5-06:1, 2, 5-7, 9, 12-22 2-5-07:1-12, 14-23, 25-33, 38-41, 43-45, 47-49 2-5-20:3, 6(50%), 8 2-5-24:2-24

Table 4-8
(2 Pages)
TMKs of Unsewered Areas

UNSEWERED AREA	TAX MAP KEYS OF UNSEWERED PARCELS
Makiki Heights, Subarea 5	2-5-05:2, 3, 5, 8, 9, 11-40, 52 2-5-06:3, 4, 8, 10, 11 2-5-20:6(50%) 2-5-24:25-32
Upper Tantalus & Round Top	2-5-11:3-13 2-5-12:1-12, 14, 15 2-5-13:1-5 2-5-14:1-5, 8-22, 24-27 2-5-15:2-5, 7-16, 18-22 2-5-16:1-25, 28-31 2-5-17:1-14, 16-22 2-5-18:1, 2, 13-17, 19-28
East Manoa Road, Kinohou Place	2-9-37:9, 55-60, 74, 77-80
Diamond Head, Subarea 1	3-1-34:46, 47
Diamond Head, Subarea 2	3-1-35:11-18, 20-22, 25, 26, 29
Diamond Head, Subarea 3	3-1-36:1, 2, 5, 7, 12, 13, 15, 16 3-1-37:1, 2, 4-5, 9-12 3-1-42:3
Black Point	3-1-38:1-4, 6, 8-14, 17, 18, 20, 22-24, 27, 30-36 3-1-39:1, 3, 5-28, 34-39, 42-44, 63 3-1-40:2-18, 20-22, 25, 26, 28-31, 43, 44, 46-54, 61, 65, 73-75 3-1-41:1-5, 7, 8, 10, 11, 13, 14, 16, 19, 21-25, 27, 31-37, 39-43, 45-47 3-5-01:1-7, 9-18, 20-28, 30-33 3-5-02:4-17, 19, 22-33, 43-47, 49, 50
Aukai Avenue	3-5-04:19-23, 34 3-5-33:16-21 3-5-41:7
Crater Road	3-2-33:6(50%), 11-13, 15-27, 30, 32, 33, 43, 44 3-2-34:3, 5-8, 10-14, 21(20%), 46, 50-55 3-2-35:2-6, 12, 14, 17-19, 23, 24, 29-37, 39, 40, 43, 44, 46-52 3-2-36:11-14, 16, 25-28
Upper Palolo Valley	3-4-19:51, 52 3-4-21:1, 2, 5, 6, 8, 10, 12-26, 31-35 3-4-27:37,46

Source: ISAP sewer inventory data and TMK maps

Based on analysis of the City's records, the number of defective cesspools is relatively small. The ratio of the number of cesspools that have been pumped at least once in 1990 and 1991 to the total number of cesspools in the unsewered areas, is 2.5 percent. This percentage is much lower than the percentage of pumped cesspools reported in *The 208 Plan* which reported cesspool failure based on all years of historical record.

Frequency of pumping can be used to define cesspool failure. Table 4-9, taken from *The 208 Plan*, suggests a method to rank cesspool failure. The number of cesspools for each category within the study area based on City pumping records for calendar years 1990 and 1991 (averaging the pumping frequency for the two years) is presented in Table 4-10.

Table 4-9
Cesspool Failure Ranking

CESSPOOL FAILURE STATUS	NUMBER OF ANNUAL PUMPINGS
Non-Defective	0-3
Slightly Defective	4-8
Moderately Defective	9-12
Highly Defective	More than 12

Source: The 208 Plan

Table 4-10
Cesspool Failure Categories

CESSPOOL FAILURE STATUS	NUMBER OF CESSPOOLS
Non-Defective	24
Slightly Defective	6
Moderately Defective	4
Highly Defective	6
Total Defective	16
Total Pumped at Least Once in the Period of Calendar Years 1990 and 1991	40

Source: Derived from DWWM pumping records and Table 4-9 criteria.

The DOH has banned the construction of new cesspools on Oahu (see Section 2.4.3). It is the Department's intention that all cesspools on Oahu eventually be eliminated as new construction occurs.

4.7.2 SEPTIC TANKS

In comparison to cesspools, a septic-tank system is a more advanced wastewater treatment process which combines treatment with disposal. A septic-tank system consists of a wastewater holding tank and an underground distribution system. Wastewater is digested under anaerobic conditions in the tank before it is discharged into the distribution system. Underground disposal drain fields and seepage pits are the most commonly used type of distribution systems. Settled sludge and scum in the tanks must be periodically pumped out to maintain treatment efficiency.

Household septic tanks were not commonly used on Oahu until recently. In an effort to protect ground water supplies, DOH restricted all cesspools from being placed above (*mauka* of) the DOH Underground Injection Control (UIC) line (refer to Figure 2-2). This restriction has been in effect since January 1, 1990.

Septic tanks, however, were not restricted. In addition, as of January 1, 1991, DOH has prohibited the construction of new cesspools on Oahu. Septic tanks or aerobic units are to be used instead of cesspools. Since the restrictions on cesspools went into effect, the number of household septic tanks has increased and more are planned for in the study area. As shown in Figure 4-20, most of the existing septic tanks are located around Tantalus Drive and Round Top Drive.

4.7.3 AEROBIC UNITS

Aerobic units are similar to septic-tank systems in features and processes; however, they operate under different digestion conditions. Septic tanks process the wastewater under anaerobic conditions, while aerobic units digest wastewater aerobically. Air is introduced into the holding tank through an air blower or a mechanical mixer. When the systems are well-equipped and maintained, aerobic units dispose of cleaner effluent than do septic tanks. They are also more reliable than septic tanks in meeting higher standards of treatment. However, no information on the current operation conditions of the aerobic units are available in the study area at this time. Since aerobic units require a constant supply of air, they incur higher capital, operating, and maintenance costs.

A total of 23 known aerobic units have been constructed in the study area; most are located in the Tantalus Drive and Round Top area. Figure 4-21 shows the location of known aerobic units in the study area.

4.7.4 OTHERS

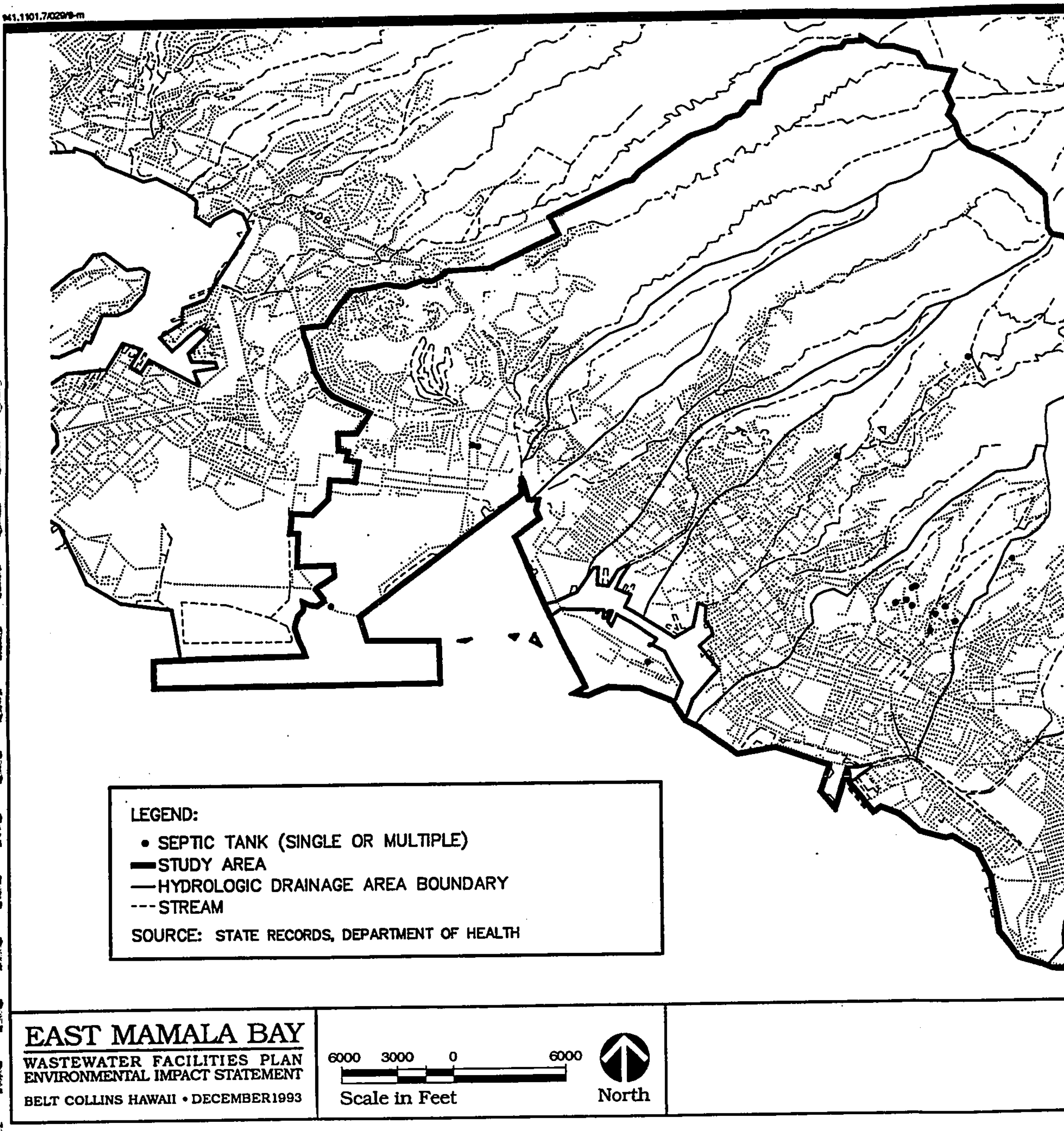
In addition to the use of cesspools, septic tanks, and aerobic units, there may be other types of residential wastewater treatment or disposal systems in use within the study area. These could include waterless or low-water use systems and wastewater holding tanks with septage pumping trucks. No quantitative information on these units is available.

4.8 PRIVATE, COMMERCIAL, AND INDUSTRIAL TREATMENT SYSTEMS

There are two types of commercial and industrial treatment and disposal systems existing in the study area: private pre-treatment systems and underground injection wells. Industrial and commercial establishments with private pre-treatment systems are required to pre-treat wastewater in compliance with its industrial wastewater discharge permit, before it is discharged into the City collection system. Underground injection well systems discharge treated effluent directly into the subsurface.

4.8.1 PRIVATE PRE-TREATMENT SYSTEMS

There are over 3,000 private wastewater pre-treatment systems in the study area. All are small scale, such as grease traps and neutralization tanks. The industries which employ pre-treatment include the food-service industry, automobile services, hair salons, and medical practices. The types and numbers of commonly used private pre-treatment processes are listed in Table 4-11.



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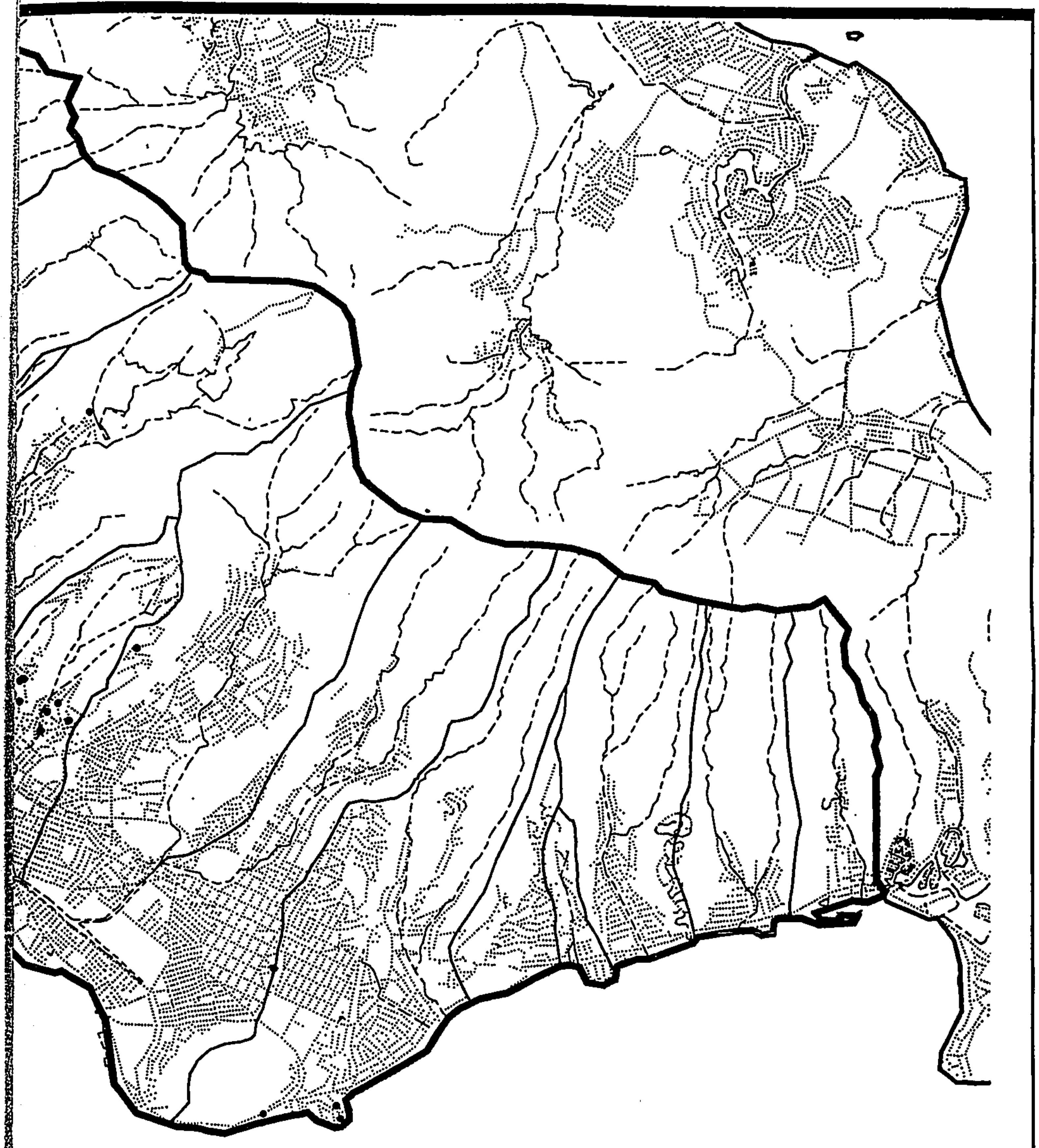

Figure 4-20
Existing Wastewater Systems in the Study Area - Septic Tanks

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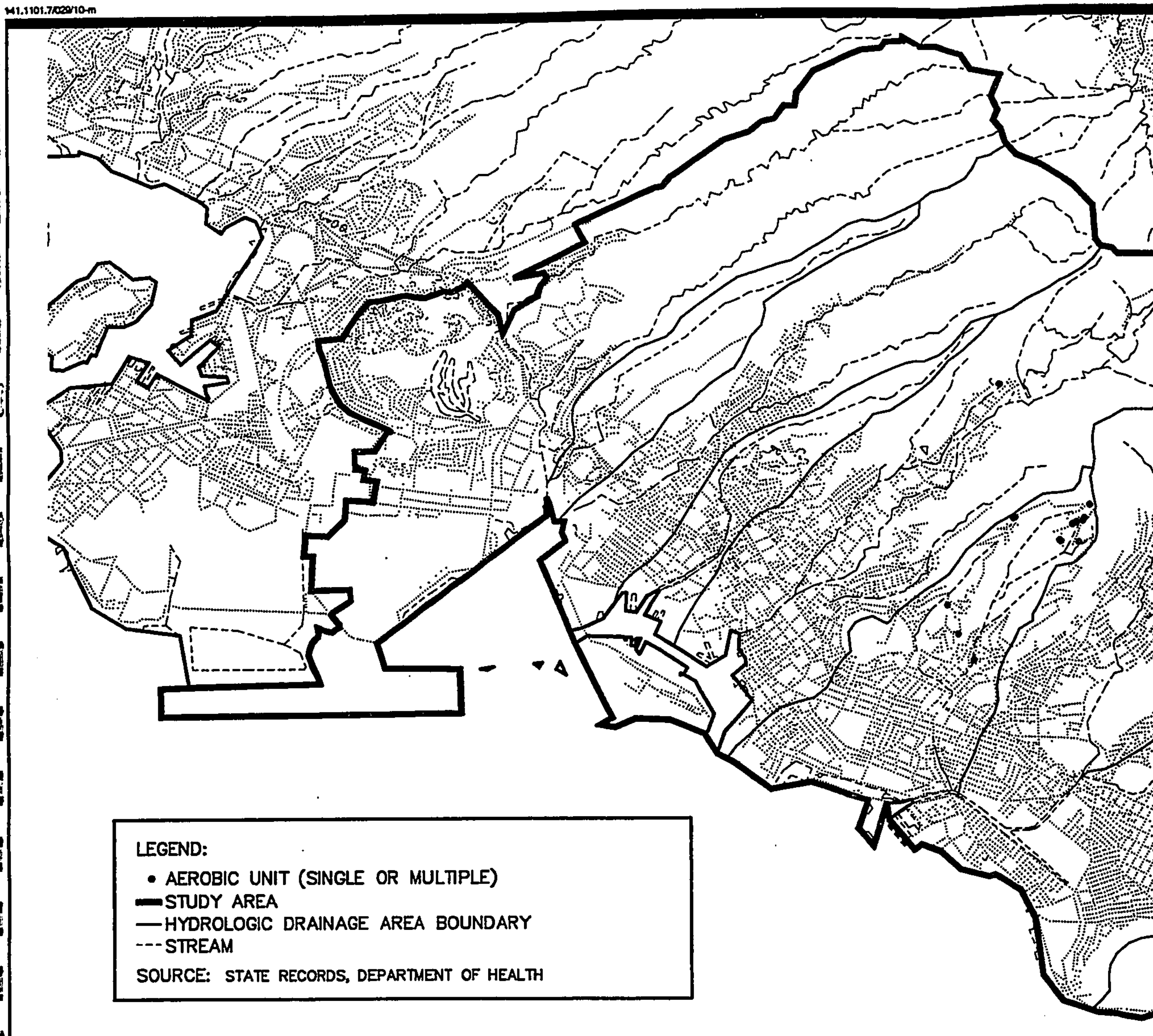

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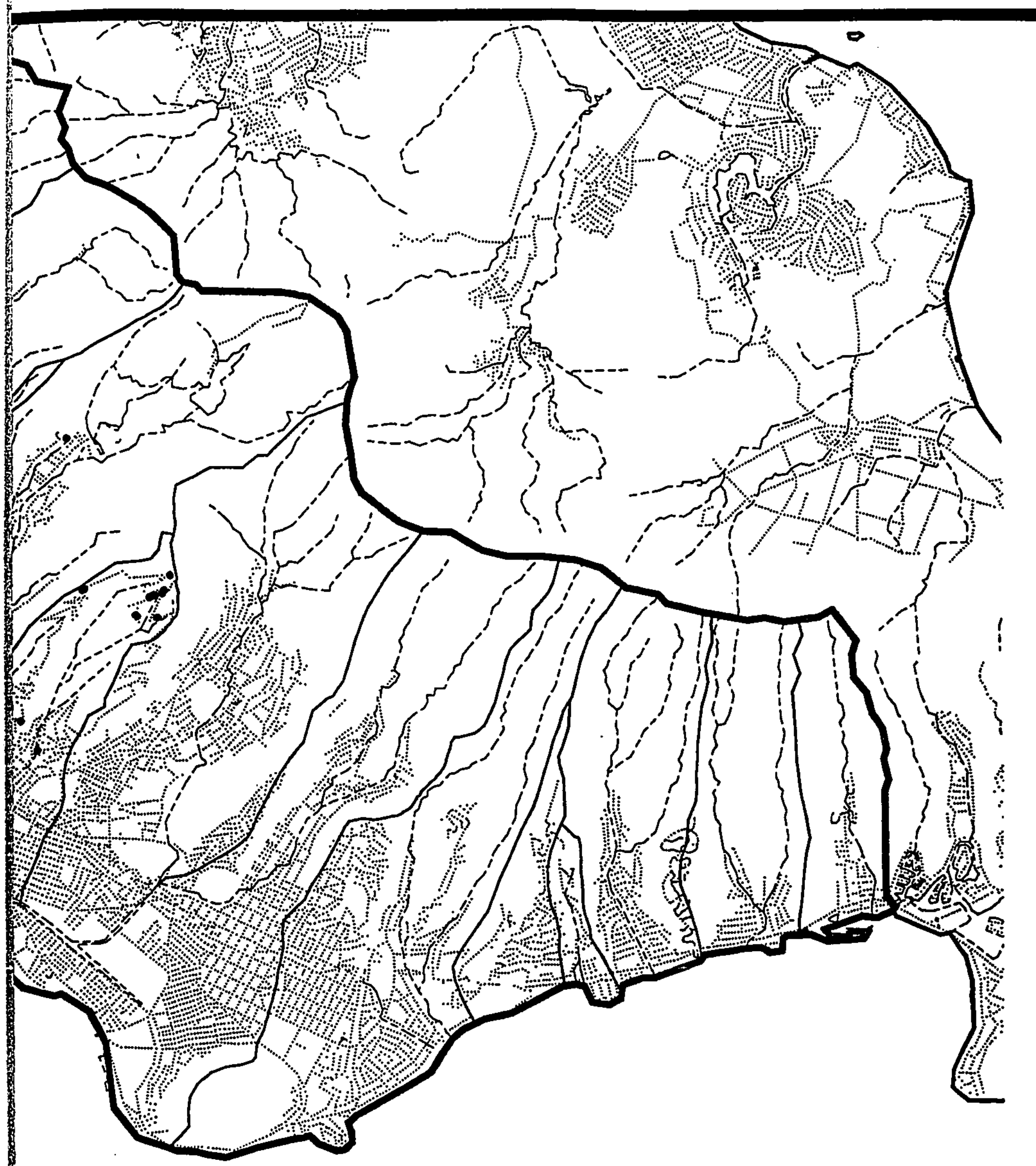

Figure 4-21
Existing Wastewater Systems in the Study Area - Aerobic Units

Table 4-11
Private Pre-Treatment Systems in East Mamala Bay Area

TYPE OF TREATMENT	NO. OF UNITS	INDUSTRIAL CLASSIFICATION
Grease Trap	2017	Eating places, food industries, schools, bakeries
Neutralization Tank	339	Universities, schools, medical services, photographic services
Oil Trap	171	Automobile services, transportation stations
Neutralization Tank & Silver Recovery	120	Schools, photofinishing labs, dentist's offices
Hair Trap	105	Barber & beauty shops
Screen	101	Food industries, eating places, barber shops, laundry services
Solids Interceptor	58	Schools, hospitals
Neutralization Tank & Plaster Trap	56	Dentists' offices

Source: DWWM Records

4.8.2 UNDERGROUND INJECTION WELLS

The permitting program for underground injection wells is administered by the State DOH; the wells are used to discharge rainfall runoff and approved liquid waste into the subsurface. A total of fourteen commercial and industrial underground injection wells are currently in operation at nine locations in East Mamala Bay area (Table 4-12). Some of the injected influent is untreated or primary-treated non-sewage wastewater. There are three commercial underground injection well facilities which are currently in construction. Two of the three facilities are for groundwater remediation. The location of the existing and planned commercial and industrial underground injection wells is shown on Figure 4-22.

4.9 OUTPUTS AFFECTING THE ENVIRONMENT

Wastewater collection, treatment, and disposal processes generate solid, liquid, and gaseous wastes which may affect land, water, and air quality. This section provides a discussion of the nature and extent of these outputs.

4.9.1 SAND ISLAND WASTEWATER TREATMENT OUTFALL

Sand Island WWTP operates under the authority of a NPDES permit (No. HI0020117) issued by the DOH. This permit was administratively extended in 1988. An NPDES 301(h) waiver, waiving secondary treatment requirements, was issued by the EPA and DOH in January 1990. (For a discussion of waiver

Table 4-12
Underground Injection Wells in the Study Area

NO.	ADDRESS & TMK	OWNER	FLOW RATE	SIZE DIA.X DEPTH	INJECTION INFLUENT
1	432 Pacific St. 1-5-12-6-1A1	GASCO	8,000 GPD	16"x 75'	
			15,000 GPD	12"x 65'	
2	1111 Victoria St 2-2-2-20	Linekona School	1,240* GPM	4'x 12" (drywell)	Untreated Rainfall Runoff
3	540 N. Nimitz Hwy 1-5-39-12	Surf Union Service	3,000 GPD	2 wells 8'x 100+'	Untreated Carwash Effluent
4	1279 Ala Aolani St. 1-1-15-12	Tropical Rent-a-Car	650 GPD	36"x 24"	Carwash Effluent and Rainfall Runoff
5	4 Sand Isl. Access Rd. 1-2-25-20	Honolulu Fueling Facilities	1,400 GPY	10"x 70.25'	Oil/Water Separator Effluent
6	3201 Aolele St. 1-1-3-11	H.F.F.C. Satellite Plant	700,000 GPY	2 wells 12"x 70.5'	Oil/Water Separator Effluent
7	2771 Waiwai Lp. 1-1-16-26	Young Laundry & Dry Cleaning	200,000 GPD	14"x 145'	Primary Treated Laundry Wastewater
8	448 Kalewa St. 1-1-70-30	Budget Carwash	500** GPD	4"x 75'	Untreated Carwash Effluent
9	333 Kalihi St. 1-2-4-5	McKinley Carwash	3,352 3,990** GPD	3 wells 2: 6" Dia. 1: 36" Dia.	Primary Treated Carwash Effluent
10***	1777 Kapiolani Blvd. 2-3-35		216,000 GPD	7 wells 8"x 100'	Treated Groundwater (Petroleum-related Compounds removal)
11***	248 Sand Island Access Rd 1-2-21-13	Hawaiian Bitumuls & Paving Com.	40 GPM	4 wells 4" Dia.	Groundwater Reinjection (Remediation)
12***	2261 Nuuanu Avenue 2-2-21-12		0.03 cfs	16' Depth (Drywell)	Rainfall Runoff

Notes: GPD: gallons per day; GPM: gallons per minute; GPY: gallons per year; cfs: cubic feet per second
* indicates peak flow rates.
** indicates maximum flow rates.
*** indicates injection well under construction.

Source: DOH Permit Files

permits, see Section 2.3.2. The Sand Island WWTP permit is technically a NPDES 301(h) waiver permit; for the purposes of this report, it is referred to as a NPDES permit.) This waiver was subsequently stayed when the Sierra Club Legal Defense Fund (SCLDF) filed an evidentiary hearing request challenging several permit conditions. In March 1990, the SCLDF also filed a lawsuit against the City, alleging that the City was discharging without an NPDES permit and that the plant should have had secondary treatment as of 1 July 1988. In September 1991, the City, without admitting guilt, reached a tentative settlement agreement with the Sierra Club and Hawaii's Thousand Friends. A provision of the settlement consent decree provides for the SCLDF to drop their evidentiary hearing request so that the EPA can put the secondary waiver permit into effect. As a result of the settlement, the waiver permit became effective on 15 January 1992 with the permit expiration date still set at 19 February 1995.

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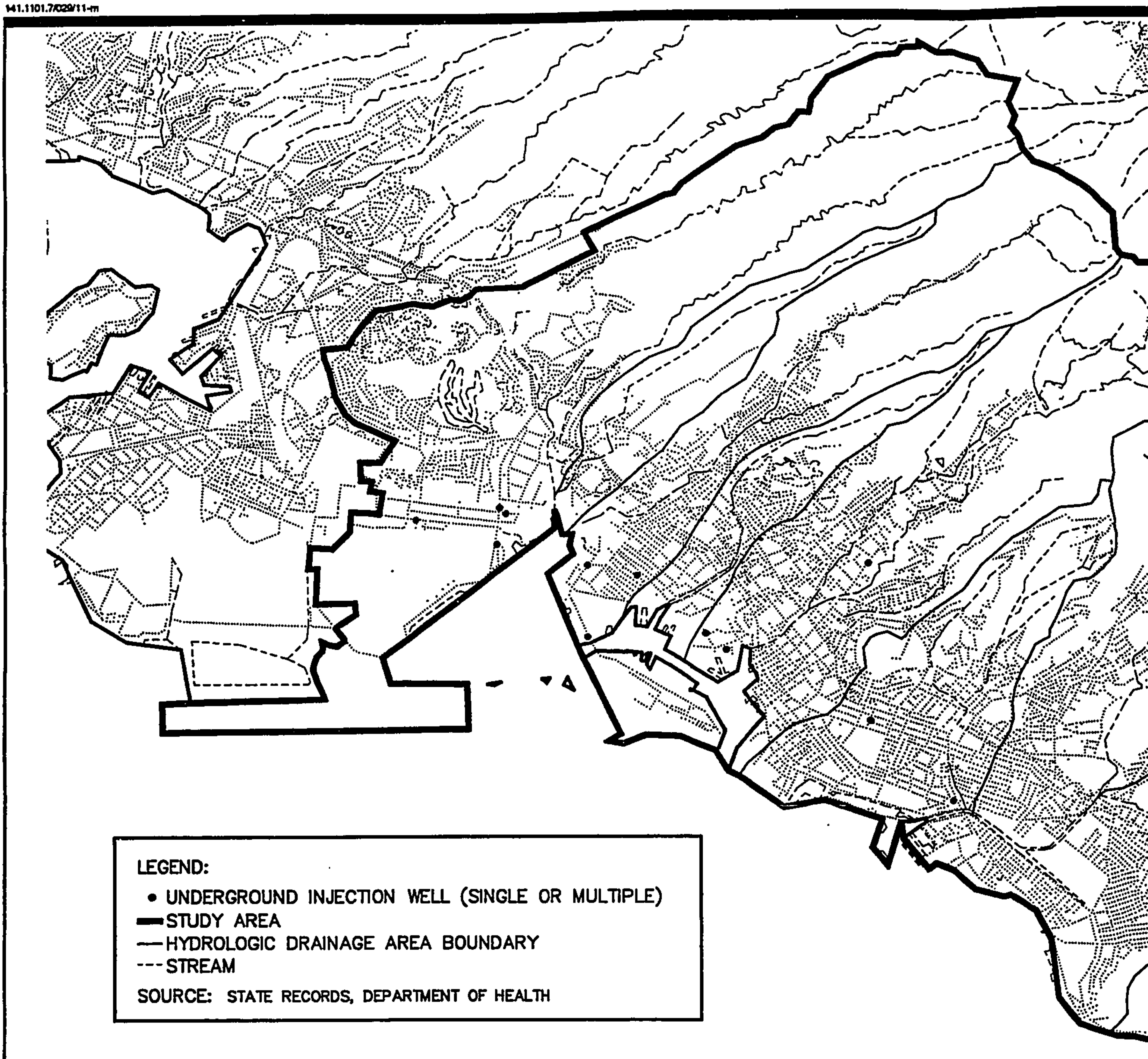

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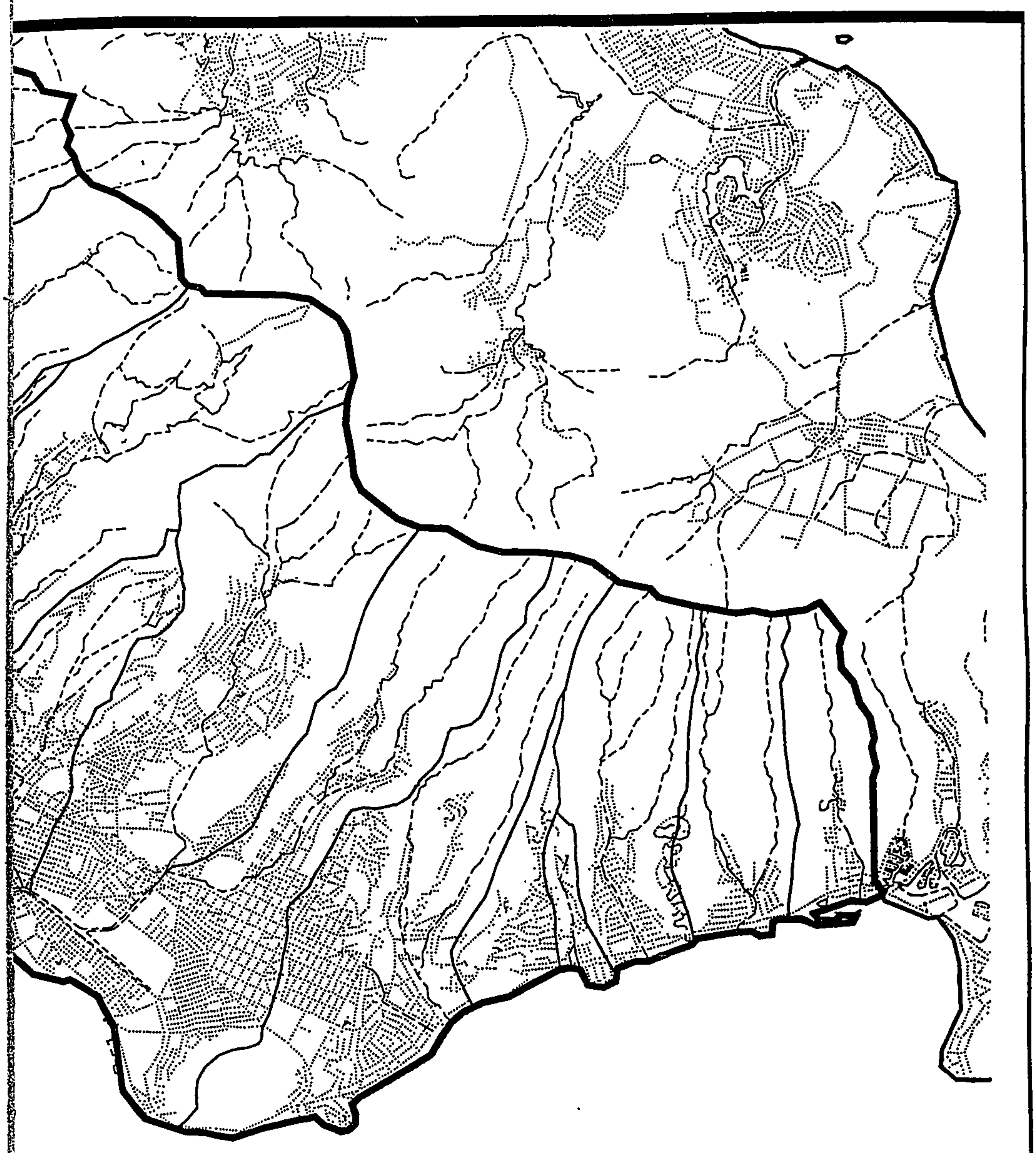


Figure 4-22
Existing Wastewater Systems in the Study Area - Underground Injection Wells

NPDES Permit Requirements

The NPDES permit for Sand Island WWTP sets limits on effluent characteristics and enforces receiving water quality standards. The permit specifies monitoring and reporting requirements.

Effluent limitations set limits on BOD_5, suspended solids (SS), flow volume, pH, and whole-effluent-toxicity in the effluent discharged from Sand Island WWTP. The permit also specifies a total residual chlorine range for the period when effluent chlorination is in operation. These limits are itemized in Table 4-13.

Receiving water limitations prohibit the discharge from violating State of Hawaii water quality objectives. Receiving water quality standards are divided into General Criteria, designed to prevent degradation of the use and aesthetic quality of the receiving water, and Specific Criteria, which define quantitative concentration standards for certain pollutants. Water quality objectives identified in the NPDES permit for the Sand Island WWTP receiving waters are the Specific Criteria for "Class A" "Wet" "Open Coastal Waters" (see Table 2-9) and certain criteria for Recreational Waters (Table 4-14).

Compliance with these standards is evaluated by comparison of monitoring results with the standards specified in the permit. Monitoring also generates data intended to determine the effectiveness of the treatment process and to identify operational problems. The permit requires the City to perform five basic types of monitoring: influent into the WWTP, effluent leaving the plant, receiving waters, sediments and marine biota, and condition of the outfall.

Influent and effluent monitoring requirements specified in the permit include flow volume, BOD_5, suspended solids, oil and grease, pH, priority pollutants, and pesticides. Effluent monitoring also includes bacterial analyses, whole-effluent-toxicity, and total residual chlorine (when effluent chlorination is in effect).

Table 4-13
NPDES Effluent Discharge Limitations for Sand Island WWTP

EFFLUENT CHARACTERISTIC	DISCHARGE LIMITATIONS			
	KG/DAY (LBS/DAY)		mg/l	
	MONTHLY AVERAGE	WEEKLY AVERAGE	MONTHLY AVERAGE	WEEKLY AVERAGE
5-Day Biochemical Oxygen Demand (BOD_5)	85,068 (187,554)	127,602 (281,331)	290	435
Suspended Solids	26,400 (58206)	39,600 (87,309)	90	135
Flow	Maximum three-hour flow of 4.47 M^3/sec (102 MGD)			
pH	Not less than 6.0 standard units nor greater than 9.0 standard units			
	MONTHLY AVERAGE	DAILY MAXIMUM/MINIMUM		
"Whole-effluent-toxicity" ["toxicity unit chronic" (TU_c)]	78.7 TU_c	78.7 TU_c (max.)		
Total Residual Chlorine*		0.6 mg/l (max.) 0.1 mg/l (min.)		

* This limit in effect only when effluent chlorination is occurring.

Source: NPDES permit for Sand Island WWTP.

Receiving water quality monitoring includes monitoring at offshore stations (including plume stations), nearshore, and shoreline stations. Offshore monitoring is similar to that required in the effluent monitoring program, with the exclusion of priority pollutants and whole-effluent-toxicity, and inclusion of nutrient analyses (total nitrogen, ammonia nitrogen, nitrate + nitrite nitrogen, total phosphorus, and chlorophyll a), dissolved oxygen, light extinction coefficient, and turbidity. Nearshore and shoreline monitoring requirements are limited primarily to bacterial analyses (although other parameters, such as temperature, salinity, oil and grease, turbidity measures, pH, and dissolved oxygen are also required at nearshore stations).

Sediment and biota monitoring includes sediment physical and chemical analyses, oil and grease, benthic infaunal surveys, fish analyses and coral reef surveys. Sediment and infauna sampling stations correspond to offshore monitoring stations (although not all offshore water quality stations have an associated bottom sampling station). All monitoring stations are shown in Figure 4-23.

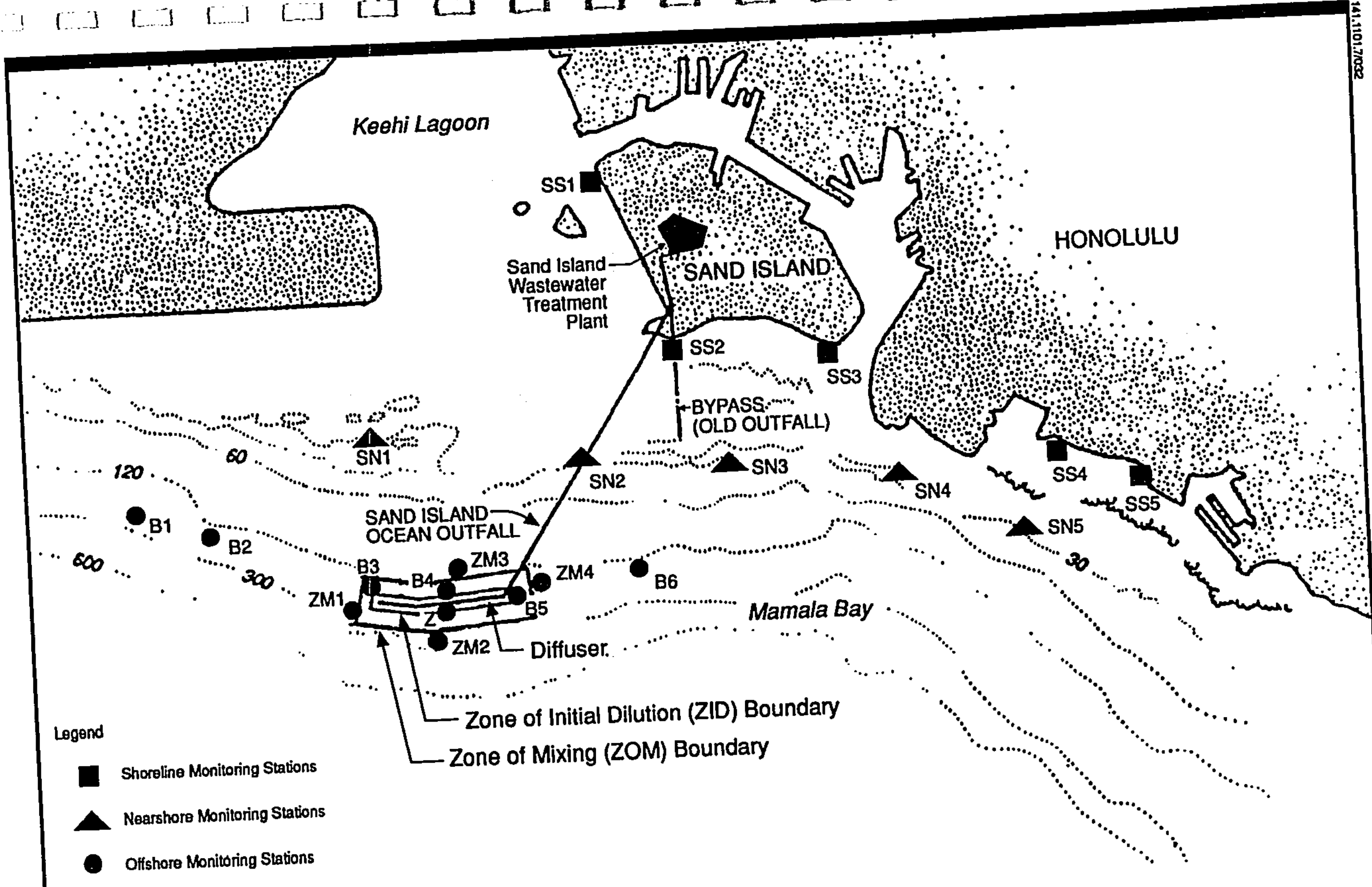
Annual inspections are also required to evaluate the condition of the outfall pipe, diffuser, and surrounding area.

Table 4-14
Sand Island NPDES Permit Criteria for Marine Waters Within 1,000 feet of the Shoreline

(1) Enterococci content shall not exceed a geometric mean of thirty-five per one hundred millimeters in not less than five samples equally spaced over a thirty-day period.	Note: The numeric criteria differs from that in Table 2-11, Specific Criteria for Marine Recreational Waters, item (1). Current state recreational water quality standards of seven per one hundred millimeters were promulgated after the Sand Island WWTP's NPDES permit went into effect. However, the Consent Decree requires compliance with the current standard.
(2) Raw or inadequately treated sewage or other pollutants of public health significance, as determined by the director of health, shall not be present in natural public bathing or wading areas.	Note: This is analogous to Specific Criteria for Inland Recreational Waters, item (2); Table 2-10.

Source: NPDES permit for Sand Island WWTP

Pretreatment Requirements specified in the NPDES 301(h) waiver permit require the City to implement and enforce an approved POTW Pretreatment Program, and to submit an annual report describing the pretreatment activities over the previous 12 months. This annual report must include an updated list of Sand Island WWTP's industrial users, and a characterization of each user's compliance status. The report is also required to address "upset, interference, or pass through" incidents known or suspected to result from industrial users of the SIWWCS. The City is required to enforce compliance of industrial users, through inspections, sampling, restriction or disconnection of users' flow, and court actions. In addition, the EPA issued an Administrative Order to the City (September 17, 1991) requiring compliance with additional pretreatment requirements. The City is currently complying with the requirements of the Administrative Order.



Source: Modified from NPDES Permit for Sand Island WWTP (1990)

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Figure 4-23
Locations of Shoreline, Nearshore, and Offshore Monitoring Stations

Monitoring Results

NPDES monitoring data were examined to determine Sand Island WWTP's compliance with the NPDES permit limitations (Table 4-15). The data includes routine DWWM monitoring results and specialized studies. The former were analyzed by OI Consultants (1992). This report is included in Appendix C. The analyses presented here are not intended to be exhaustive nor all-inclusive, but rather are intended primarily to determine whether improvements to the wastewater collection and/or treatment facilities would be necessary if compliance was not demonstrated. Because of differences in monitoring requirements for years prior to 1990, earlier data were not included in the evaluation.

Table 4-15
NPDES Permit Monitoring Program Parameters Examined

TREATMENT STREAM	PARAMETERS	FREQUENCY OF DATA COLLECTION
Effluent Monitoring	Flow	continuous
	FC and Enterococci	daily
	BOD_5	5 day/week
	Suspended solids	5 day/week
	pH	5 day/week
	Oil and grease	twice weekly
	Temperature	weekly
	Priority pollutants	semiannually
	Whole-effluent-toxicity	monthly
Receiving Water Monitoring	Shoreline Stations: FC & Enterococci	5 days/month
	Nearshore Stations: FC & Enterococci	5 days/month
	Offshore Stations: FC and Enterococci Nutrients	5 days/month quarterly
Sediment and Biological Monitoring	Sediment analyses	annually
	Benthic fauna	annually
	Fish analysis	annually
	Coral reef survey	annually
Outfall and Diffuser Monitoring	Visual inspection	annually

The NPDES permit for SIWWTP requires that an annual assessment report be submitted to the DOH and EPA. This comprehensive report is required to address all monitoring activities during the previous year and must discuss findings with regard to compliance with criteria for waiving the requirement for secondary treatment. The annual assessment report for 1991 was prepared by Oceanit Laboratories (1993), independent of the evaluation that is summarized below. The conclusions in the assessment report are consistent with those discussed here. In addition, the assessment report indicates that the Sand Island outfall complies with State WQS, temperature, salinity, dissolved oxygen, pH, light extinction coefficient, turbidity, and other criteria specified in the NPDES permit. The overall conclusion of the report was that the outfall discharge meets both Federal and State water quality standards. The outfall was found to have no significant adverse impacts on public health or marine biota.

EFFLUENT MONITORING AND OUTFALL INSPECTION

Average daily flow has remained constant or decreased slightly during the evaluation period (January 1990 to July 1992). Occasional spikes in flow were observed, but they were of short duration. On only two occasions did the daily flows exceed the permit limit. There is no pronounced seasonality in the effluent flow. The data show no evidence of systematic increased flow during the wet season.

Concentrations of BOD_5 and suspended solids in the effluent also decreased with time. Because flow also decreased, this means the total mass of BOD and suspended solids decreased, and were not just diluted by higher flow volumes. Neither BOD_5 nor suspended solids exceeded the permit level at any time during the study period.

Visual observation of the outfall, diffuser, and immediate vicinity was conducted in 1990 and 1992. The diffuser pipe ports were found to be operational and free from constrictive debris, and the concrete pipe, ballast rock, and armour stone were reported to be in good condition (OI Consultants, 1992; Appendix C).

RECEIVING WATER MONITORING – NUTRIENTS

The geometric means of the nutrient data are below the regulatory (State WQS) limits. However, compliance with allowable variation above the geometric mean is not so clear. As discussed in Chapter Two, the state water quality regulations do not specify the statistical methodology for determining if a dataset complies with the ten percent and two percent not to exceed (NTE) standards. One viable methodology is calculation of the cumulative probability distribution function. When this method is applied to the Sand Island WWTP ZOM boundary ammonia nitrogen dataset for 1990 through 1993, the geomean and ten and two percent NTE standards are met.

Several factors bear on the relevancy of the ammonia nitrogen dataset to the adequacy of the Sand Island WWTP wastewater treatment and performance of the outfall. Given that the water quality standards present no specific guidance for computation of variation in the data, several methods are available. Also of importance is the fact that the NPDES permit does not specify which monitoring stations should be used to demonstrate compliance. The data evaluated here were compiled from only ZOM boundary samples, and thus represent the worst-case scenario.

The evaluation does not attempt to separate naturally occurring ammonia nitrogen from that associated with the discharge. Background levels of ammonia in East Mamala Bay are estimated to be 1.31 μg/l (geometric mean), 2.16 μg/l (90 percent) and 2.9 (98 percent), based on data from control stations.

Evaluation of conditions in and around the ZOM indicate that marine communities have experienced no adverse impacts resulting from the discharge (see below). Application of standard types of secondary treatment at Sand Island WWTP would only convert ammonia nitrogen into another nutrient form, resulting in little net improvement in total nutrient concentrations.

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Receiving Water Monitoring – Bacteria

In general, water-borne diseases are caused by pathogenic organisms. A major potential source of these organisms is human sewage. Monitoring of the pathogenic content of sewage can provide an indication of the potential that a community may be exposed to illnesses. Water quality monitoring for the presence of pathogenic organisms is important to ensure protection of public health. Appendix C contains a detailed discussion of bacterial monitoring.

Sewage-borne pathogens entering the ocean become a potential problem only if they survive and are present in populated areas, recreational areas, or seafood-producing waters. Loh, Lau and Fujioka (1980) reported that human enteric viruses were not detected in sea water samples taken from outside the ZOM. They were recovered only when the sample volumes taken from within the ZOM were doubled. The failure to isolate human enteric viruses outside the ZOM strongly suggests that the outfall design essentially fulfills the basic requirements for the 301(h) waiver from the EPA for secondary treatment.

State recreational water quality standards for bacteria are frequently exceeded in shoreline portions of East Mamala Bay. OI Consultants Inc. (1992) evaluated recent shoreline and nearshore bacterial monitoring data to investigate the source. Elevated bacterial levels were correlated to seasons of greater precipitation and days of higher recreational use. The report concluded that the elevated bacteria levels resulted primarily from terrestrial sources and recreational use of the nearshore area.

Fujioka and Shizumu (1983, 1985, and 1988) have reported that freshwater streams in Hawaii contain naturally high levels of fecal coliform and fecal streptococci (including enterococci). Hardina and Fujioka (1991) reported that soil is commonly the source of *E. coli* and enterococci in Hawaii's streams. Soil samples obtained near a stream bank, 11 yards (10 m) from a stream bank, as well as from a grassy area on the university campus were determined to be sources of both *E. coli* and enterococci. Bacteria were detected in samples from the surface as well as from samples at depths down to 14 inches. Therefore, high concentrations of fecal coliform and fecal streptococci do not necessarily indicate fecal pollution or the presence of pathogenic organisms. Moreover, runoff during period of rainfall is expected to transport these bacteria to coastal and nearshore waters.

A bacterial gradient analysis was also conducted to investigate the origin of the bacterial contamination observed in the nearshore. Data obtained from December 1988 to December 1992 at nearshore and shoreline stations (City and County of Honolulu, Planning and Public Services Branch) were used.

Nearshore surface stations were examined in pairs (SN1 vs. SN2, SN2 vs. SN3, SN3 vs. SN4, SN4 vs. SN5). The differences between the two were categorized as: (1) indicating a westward gradient of bacterial contamination; (2) indicating an eastward gradient; or (3) indicating no gradient parallel to shore. Table 4-16 presents the number of events in each category for each of the four pairs.

The incidence of no shore-parallel gradient events in the fecal coliform data was higher than the number of westward or eastward gradients for all four pairs. For enterococci, this is true for three pairs. Overall, there is no statistically significant gradient detected in the direction parallel to the shoreline along nearshore stations. This trend indicates that multiple shoreline sources, rather than a single off-shore source, are the principal contributors of the measured bacterial indicators. The data further indicate that the shore-parallel gradients change direction in the vicinity of Station SN3 near the entrance to Honolulu Harbor.

Table 4-16
Number of Shore-Parallel Gradients Across Station Pairs

DIRECTION OF GRADIENT	SN1-SN2		SN2-SN3		SN3-SN4		SN4-SN5	
	FC	ENT	FC	ENT	FC	ENT	FC	ENT
Westward	61	64	75	66	58	39	66	39
Eastward	50	58	49	56	66	67	35	93
No gradient	108	96	121	112	99	116	117	61
Total	219	218	245	234	223	222	218	193

Note: FC represents fecal coliform, Ent. represents enterococci. See Figure 4-23 for locations of sample stations.

Source: Compiled from City monitoring records

The bacterial concentrations at nearshore and shoreline stations were compared. The differences were categorized as (1) indicating an offshore gradient of bacterial contamination, (2) indicating a shoreward gradient, or (3) indicating no gradient perpendicular to the shore. Table 4-17 presents the number of events in each category for each of the four pairs.

Table 4-17
Number of Shore-Perpendicular Gradients Across Station Pairs

DIRECTION OF GRADIENT	SN3-SS3		SN4-SS3		SN5-SS4		SN5-SS5	
	FC	ENT.	FC	ENT	FC	ENT	FC	ENT
Offshore	135	42	160	111	103	75	157	109
Shoreward	36	97	82	119	46	100	26	79
None	29	36	13	25	81	62	40	47
Total	200	175	255	255	230	237	223	235

Note: FC represents fecal coliform, Ent. represents enterococci. See Figure 4-23 for locations of sample stations.

Source: Compiled from City monitoring records

Fecal coliform data indicate an offshore gradient at all four pairs of stations, while enterococci data are less consistent. This may due to the relatively fast die-off rate for fecal coliform in sea water (T90 for fecal coliform is two to three times shorter than T90 for enterococci). The probability that the observed fecal coliform gradients are a result of chance alone, rather than representative of an actual trend, is only 5 percent (assuming a binomial probability distribution). Samples with concentrations higher than 7 CFU/100 ml (i.e., the current State recreational WQS) are shown in Table 4-18.

Table 4-18
Number of Shore-Perpendicular Gradients Across Station Pairs with Enterococci Levels Exceeding 7 CFU/100 ml

DIRECTION OF GRADIENT	SN3-SS3	SN4-SS4
Offshore	59	38
Shoreward	28	10
None	2	0

Source: Compiled from City monitoring records

Analysis of the results indicates that the predominant bacterial gradient is offshore and that the source of enterococci in samples exceeding State recreational WQS appears to be land- or nearshore-based. There is only a 1.5 percent probability that these gradients could have been generated by chance alone if there were no trend in the sampled environment.

EFFLUENT MONITORING — TOXICITY

Sand Island WWTP effluent was analyzed for short-term chronic toxicity, (i.e., whole-effluent-toxicity) using the water flea, *C. dubia* and a sea urchin, *C. atratus*. Table 4-19 shows the number of results obtained, the range of Toxic Unit Chronic (TU_c), and the percentage of violations for each type of organism from February 1990 to December 1992.

Table 4-19
Whole-Effluent-Toxicity Study Results

ORGANISM	NO. OF RESULTS	RANGE OF TU_c	% OF VIOLATIONS
C. dubia	34	4 to 64.1	0
C. atratus	18	26 to >16,000	94

Source: Compiled from Sand Island WWTP Whole-effluent-toxicity results (1990 to 1992).

The results indicate that whole-effluent-toxicity measurements are significantly different when different organisms are used. The permit condition for whole-effluent-toxicity (78.7 TU_c) for Sand Island effluent is met when *C. cubia* is used, whereas the permit condition is not met when *C. atratus* is used. Tests with two other types of sea urchins were undertaken, but were unsuccessful. EPA has acknowledged the problem with the sea urchin protocol and is in the process of refining it.

EFFLUENT MONITORING — PRIORITY POLLUTANTS

Priority pollutants measured in the Sand Island outfall effluent include 13 metal elements, 28 purgeable compounds, 47 base/neutral compounds, 11 acids, cyanide, asbestos, and 31 pesticides. The data indicate that the concentrations of most of the elements or compounds were below the method detection limits (MDLs) for those constituents. Only copper, zinc, benzene, ethylbenzene, methylene chloride, and toluene were detected. The concentrations are presented in Table 4-20.

Levels of copper, zinc, and tetrachloroethane were well below the sea water chronic effect standards after application of an average outfall initial dilution of 118 (Fujioka, Fujioka, and Oshiro, 1992). Levels of benzene, ethylbenzene, and toluene were well below the seawater acute effect standards without application of a dilution factor. Thus, no significant levels of priority pollutants were detected in Sand Island WWTP effluent during the two sampling events examined. It should be noted that many current State WQS concentrations are set below MDL values. The EPA has recognized the problems with this situation and is working with the City to rectify the problem.

SEDIMENT AND BIOLOGICAL MONITORING

Sediment and biological monitoring data discussed below include pollutant concentrations in sediments, benthic fauna surveys, fish analyses, and coral reef analyses.

Table 4-20
Concentrations (in μg/L) of Priority Pollutants in Sand Island Effluent

POLLUTANTS	COPPER		ZINC		BENZENE		ETHYL-BENZENE		METHYLENE CHLORIDE		TETRA-CHLORO-ETHANE		TOLUENE	
	Meas	Adj	Meas	Adj	Meas	Adj	Meas	Adj	Meas	Adj	Meas	Adj	Meas	Adj
1991	10	0.085	60	0.509	28	0.237	4	0.034	20	0.169	6	0.051	18	
1992	<20	0.170	40	0.339	9	0.076	<4	<0.034	7	0.059	<4	<0.034	4	
Standard		2.9		86		1,700		140		--		145		2100

Notes: Meas = measured, Adj = adjusted. Adjusted concentrations are measured concentrations divided by a dilution factor of 118.

Sources:
1. Measured data from City & County of Honolulu, Planning and Public Services Branch (Priority Pollutant Analysis Aug. 1991 and Feb. 1992.
2. Standards from HAR 11-54, Numeric standards for toxic pollutants applicable to all waters. The value shown is the lower of the saltwater acute and saltwater chronic toxicity standards for each pollutant.

Marine communities offshore of Honolulu have been subject to considerable disturbance over the last 100 years. Raw sewage was dumped in shallow water until 1978; point- and nonpoint-source pollution from both urban sources and industry continue. All of these disturbances potentially impact marine communities. The marine communities show a considerable range in development that is probably related to past (historical) impacts.

The results of a coral reef study were reported in "Community Structure of Fish and Macrobenthos at Selected Sites Fronting Sand Island, Oahu, in Relation to the Sand Island Deep Ocean Outfall" (1992, Water Resources Research Center, Special Report 04.30:92). The following discussion is a summary of the findings of that study.

Measurements included the percent coral cover, number of coral species, number of invertebrate species, total number of invertebrates counted, number of fish species, total number of fishes counted, and the biomass of fish present at each station. Two transects were investigated at each of three sites. Transects 1 and 2 were located east of the outfall in about 16 m of water offshore of the Kakaako Waterfront Park area, and were utilized as controls. Transects 3 and 4 were located about 120 m east of Kalihi entrance channel in approximately 15 m of water, and were about 900 m west of the former wastewater bypass outfall in an area heavily impacted by the previous (1955 to 1977) shallow water discharge. Transects 5 and 6 were located in an area of complex limestone substratum, in water ranging from 7.5 to 12 m deep, fronting Honolulu International Airport's Reef Runway. All transects were permanently established using metal stakes and copper wire. Transects were 20 m in length and were orientated perpendicular to shore. The monitoring data from 1990 and 1991 are presented in Table 4-21.

Analysis of these measurements indicate that there are no statistically significant differences between the stations and no quantitatively discernable impact to the shallow water benthic or fish communities that can be attributed to the outfall.

Bailey-Brock, et al. studied benthic fauna in the vicinity of the Sand Island WWTP outfall ("Benthic faunal sampling adjacent to Sand Island Ocean Outfall, Oahu, Hawaii"; 1990 and 1991). Benthic infauna were sampled at seven stations along the diffuser isobath in 1990 and 1991. Stations were located within the ZID, on the boundary of the ZID, and at distances between 1.2 to 2 km from the ZID boundary. Total nonmollusk species abundance was significantly lower only at Station B3 during the 1991 survey. Results show no consistent trends in either mollusk abundances or number of species. ZID stations as a whole were not different from non-ZID stations. The data led the authors to conclude that the response patterns of benthic infauna near the Sand Island ocean outfall shown little indication of a strong influence being exerted by the diffuser effluent.

Table 4-21
Summary of Biological Parameters Measured at Transect Locations, 1990 and 1991

	1990 TRANSECT NUMBER						1991 TRANSECT NUMBER					
	1	2	3	4	5	6	1	2	3	4	5	6
% Coral Cover	18	30	4	3	2	10	18	29	4	3	2	7
No. Coral Species	4	5	4	3	5	5	5	4	3	3	5	4
No. Invertebrate Species	4	5	6	6	2	2	4	4	4	6	2	2
No. Invertebrate Individuals	12	15	25	25	3	5	13	18	17	44	10	10
No. Fish Species	38	37	24	16	29	31	31	26	22	12	28	29
No. Fish Individuals	455	481	310	126	197	267	260	240	138	68	176	202
Biomass (g/m²)	763	824	91	30	129	293	148	221	72	20	101	183

Note: Each transect sampled 80 m² of substratum for fishes and invertebrates other than corals. Coral data (given in percent cover) from 5 m² samples on each transect.

Source: Brock, R. (1992). Community Structure of Fish and Macrobenthos at Selected Sites Fronting Sand Island, Oahu, in relation to the Sand Island Deep Ocean Outfall.

Values of percent volatile solids, total nitrogen and oxidation-reduction potential showed no indication of organic buildup in sediments at any station (Brock, 1990 and 1991). Cyanide concentrations were below detection limits in all sediment samples obtained in 1990.

Brock (1992) conducted analyses of the fish community along the outfall, using remote video camera, in 1990 and 1991. Five visual "transects" were carried out; approximately 41 percent of the total diffuser length (1,036 m) was observed using the camera system. In total, at least 27 species of fishes were seen (1,785 individuals) having an estimated standing crop ranging from 8 to 106 g/m². The 1990 video census covered only the terminal 183 m of the diffuser, whereas in 1991, the transects were spread out along the entire diffuser length; therefore, the two years are not directly comparable. Nevertheless, the data suggest that the abundance and diversity of fishes increased in the vicinity of the diffuser between the two surveys. It is suspected, however, that better control of the video camera in the 1991 survey may have resulted in a better survey, and thus higher counts. Further sampling should resolve this question.

In October 1990 and September 1991, four types of fish were sampled for tissue analysis of heavy metals. Table 4-22 presents the resulting data.

In October 1990, fish tissues from taape, akule, kahala were analyzed for 37 volatile organics. Only methylene chloride was detected at levels greater than 0.88, 0.63 and 0.55 μg/kg, respectively, but values were less than 38, 24, and 33 μg/kg, respectively. It should be noted that neither DOH nor EPA impose tissue toxic concentration limits.

Tissue from these fish were also analyzed for 73 semi-volatile organics. No semi-volatile organics were detected in akule tissue. Only benzoic acid was detected at a level less than 1,500 μg/kg but greater than 59 μg/kg in Taape tissue. Benzoic acid and bis(2-ethylhexyl)phthalate were detected at levels of less than 530 μg/kg but greater than 59 μg/kg, and less than 130 μg/kg but greater than 42 μg/kg, respectively.

ANALYSIS OF CUMULATIVE IMPACTS ON MAMALA BAY FROM POINT SOURCES

The Sand Island WWTP deep ocean outfall is one of three outfalls located in Mamala Bay. The second outfall is associated with the City's Honouliuli WWTP in Ewa, and the third outfall is associated with the Navy's Fort Kamehameha WWTP. It is recognized that the discharges from the outfalls could interact or combine to produce cumulative impacts on the Mamala Bay environment. Because the Fort Kamehameha WWTP's outfall discharge at the mouth of Pearl Harbor is only about 7,000 meters or so from the Sand Island WWTP outfall, the potential interaction of these two discharges is the primary concern. Because of data limitations, assumptions were made when necessary.

Table 4-22
Metal Concentrations (μg/kg-wet) Measured in Fish Tissue

	1990			1991			1992		
	TAAPE	AKULE	KAHALA	TAAPE	TRIGGER	OPELU	TAAPE	TRIGGER	OPELU
Arsenic	4270	3090	3610	3140	7380	1640	5600	7240	3550
Copper	192	565	219	193	428	489	292	179	491
Mercury	39.2	51.7	42.2	140	47.8	22.0	—	—	—
Nickel	32	—	—	—	—	—	—	—	—
Selenium	317	367	351	—	—	—	—	—	—
Zinc	2680	3760	3200	2750	4650	4040	6250	3210	4080

Note:
— denotes the value is below detection limit. QA/QC information is not presented in this table.

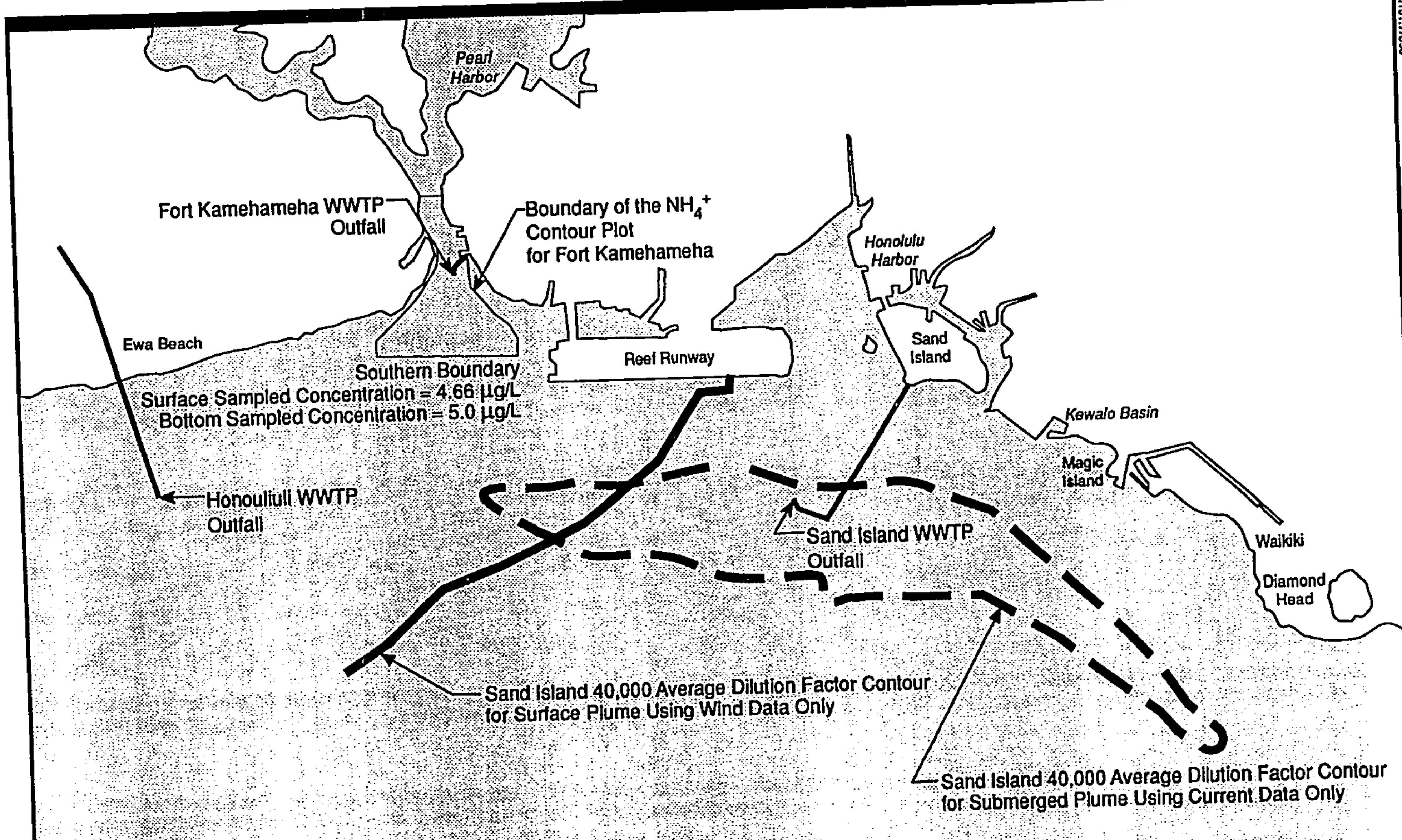
Source: Compiled from Report on Sand Island Outfall Fish Tissue Analysis, 1990, 1991, and 1992. Department of Wastewater Management, City and County of Honolulu.

The available sources of information were:

1. *Expansion of the Wastewater Treatment Plant at Fort Kamehameha, Environmental Assessment* (Department of the Navy, Public Works Center, Pearl Harbor, 1992), Appendix 1, Water Quality Study, Figure 9;
2. *Preliminary Report: Near-Field and Far-Field Plume Analysis, Sand Island Outfall System* (Edward K Noda & Associates, 1992), Figures 23, 27 and 31;
3. Ammonia nitrogen concentration measurements from Sand Island WWTP effluent samples collected by OI Consultants (1993), which ranged from 13.47 mg/L to 22.73 mg/L; and
4. Plume travel time estimated by the PLUMES Model (discussed in Appendix C), 182 meters/hr for the first 1000 meters.

The parameter evaluated in the cumulative impacts analysis was ammonia nitrogen, because ammonia nitrogen is the only criteria pollutant approaching receiving water standards. The Fort Kamehameha WWTP environmental assessment contains (EA) contour plots of ammonia nitrogen concentrations in surface and deep waters in the vicinity of the Fort Kamehameha WWTP ZOM developed from measurements taken on February 17, 1992 and May 8, 1992. The Noda (1992) report contains a plot of average representative plume dilution for the Sand Island WWTP outfall. This plot is based on ocean current data obtained at the diffuser site over the period from March 27 to April 28, 1990. The pollutant concentration at any point can be calculated by applying the appropriate dilution factor obtained from the Noda (1992) report to the effluent concentrations reported by OI Consultants (1993). It is assumed that the ocean current data used to calculate dilution and the effluent concentration data represent typical scenarios. The results of the data available from the Fort Kamehameha EA and the Noda (1992) report are shown in Figure 4-24.

Ammonia nitrogen concentrations in surface waters at the southern boundary of the contour plot for Fort Kamehameha (i.e., that closest to the Sand Island WWTP outfall) ranged from 0.3 micromoles (μM) to 0.4 μM in February, 1992, and 0.2 μM in May, 1992. The geometric mean (geomean) of the estimated concentrations for all surface water samples collected along the southern boundary was 0.27 μM (4.66 μg/L).



Sources:
1. *Preliminary Report: Near-Field and Far-Field Plume Analysis, Sand Island Outfall System*, Noda 1992.
2. *Expansion of the Wastewater Treatment Plant at Fort Kamehameha, Environmental Assessment*, U.S. Navy, 1992
3. *Draft Supplemental Environmental Impact Statement for the Proposed Honouliuli WWTP, Unit 2, City and County of Honolulu*, 1988

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Figure 4-24
Cumulative Impact Analysis

The concentration of ammonia nitrogen in bottom water samples ranged from 0.25 to 0.35 μM in both February 1992 and May 1992; the geomean was 0.29 μM (5.00 μg/L).

For the Sand Island WWTP outfall, the average dilution factor for both surface and subsurface water samples was determined to be 40,000 for a point approximately 5000 meters south of the southern boundary of the Fort Kamehameha contour plot (approximately 6500 meters from the Sand Island outfall). This value was derived from Figures 23 and 31 of the Noda (1992) report. Using the high end of the range of ammonia nitrogen concentrations in the effluent obtained by OI Consultants (1993) (22.73 mg/L), the resulting concentration of ammonia nitrogen at this point is 0.57 μg/L.

Although the Fort Kamehameha and Sand Island data sets do not have any points in common, the potential for cumulative impact can be evaluated by comparing the data and resulting gradients. The time required for the Sand Island plume to travel from the outfall to the point 5000 meters south of the southern boundary of the Fort Kamehameha contour plot is estimated to be 37 hours. This can be calculated by assuming the plume velocity from the PLUMES model (182 meters/hr; see Appendix C) applies over the distance of concern (6,500 meters).

The modeled dilution of the Sand Island plume does not account for the decay rate associated with biological uptake of ammonia nitrogen or conversion of ammonia to other nitrogen compounds (or vice versa) in the ocean environment. It also does not account for other ammonia sources, such as decaying organic material. Biological uptake will further reduce ammonia nitrogen (and other nutrient) concentrations from those which occur as a result of dilution alone. Biological uptake is dependent upon factors such as ocean water pH, sunlight, and temperature. Although no appropriate decay rates were available for use in this evaluation, uptake at some rate is likely to occur during the travel time from the outfall to the potential interaction zone.

The data examined indicate that ammonia nitrogen concentrations in the Sand Island effluent discharged through the outfall are diluted to background levels by the time the plume reaches the potential zone of interaction with the Fort Kamehameha outfall. Thus it appears that the impacts due to interactions of the Sand Island WWTP outfall and the Fort Kamehameha WWTP outfall are not significant, and the impacts from each outfall can be considered separately in evaluations of their impact on Mamala Bay.

Conclusions

The primary conclusion of the studies described above is that no significant environmental impacts have resulted from discharge of effluent from the Sand Island outfall, and therefore, that the current WWTP and outfall design are sufficient to meet existing water quality standards and other permit requirements. Specific conclusions are summarized in Table 4-23.

4.9.2 COLLECTION SYSTEM

Releases from the wastewater collection system during the years 1989, 1990, and 1991 are summarized in Table 4-24. Unlike effluent discharge from the outfall, these releases—since they may occur at numerous locations—are more difficult to identify, quantify, and control. This study investigated collection lines of four major types and five age groups, spill records, and compliance records to evaluate the potential for surface water pollution from collection system sources.

Characteristics such as pipeline age, pipelines constructed of terra cotta, areas where lines are surcharged (see Chapter 5 for a discussion of surcharge), locations of reported spills, and receiving waters with significant bacterial contamination were mapped over the study area to identify areas in which the collection system is a potential contributor to surface water pollution. Where several of these characteristics coincide in areas where bacterial pollution is present, the system is considered a potential source of contaminants.

Table 4-23
Summary Conclusions For Water Quality at the Sand Island Outfall

TREATMENT STREAM	CONCLUSIONS
Effluent Monitoring	1. The daily flow has remained constant or decreased slightly. The levels for BOD_5 and suspended solids decreased over the data period and no exceedances occurred. 2. Whole-effluent-toxicity results are ambiguous because of protocol problems. EPA recognizes the problems and is in the process of the refining its bioassay protocol. 3. No significant levels of priority pollutants were detected in the effluent samples.
Receiving Water Monitoring	1. At ZOM stations, water quality standards were met using statistically sufficient data. 2. Offshore water quality monitoring stations did not exhibit chronic exceedances of enterococci. 3. Shoreline stations often exceed water quality standards for bacterial indicators. 4. Correlation of fecal colliform and enterococci levels between shoreline and offshore stations indicated a land-based origin rather than the ocean outfall as the source of shoreline violations of water quality criteria.
Sediment and Biological Monitoring	1. No significant organic buildup in sediments was reported as a result of outfall. 2. There was little indication of a strong influence from sewage outfall on benthic infauna, coral reef community, or fish community.
Outfall and Diffuser Monitoring	1. The diffuser ports were found to be operational and free from any constructive debris. 2. The outfall pipe, ballast rock and armour stone were all reported to be in good condition.

Table 4-24
Releases from the Sand Island Wastewater Collection System
(in million gallons)

YEAR	TOTAL	WET SEASON	DRY SEASON	WET/DRY RATIO
1989	0.2183	0.2172	0.001	217.3
1990	0.2428	0.2382	0.0046	51.8
1991	2.4235	2.2694	0.1542	14.7
3-year Total	2.8846	2.7258	0.1598	17.1

Note: Wet season extends from Nov. through April; dry season extends from May through Oct.

Source: City & County of Honolulu, DWWM (1992).

Most terra cotta pipes are 80 to over 100 years old. DWWM indicates that terra cotta pipes have low strength and durability, and are susceptible to cracking, breaking, and leaking. Spill records confirmed that approximately 65 percent of the spill events (40 out of 61) occurred in areas with terra-cotta pipes.

Sewage spill records from 1989 to 1991 are summarized in Table 4-24. Since reporting requirements changed during this time period, the data are not directly comparable; however, it is assumed that the relative proportions of spills occurring in different seasons remained the same, regardless of the change in reporting requirements. A wet-dry seasonal pattern is found in the sewage spill record. The volume of sewage released is much higher during wet seasons than in dry seasons, presumably as a result of infiltration and inflow.

Sewage problem complaint records were also examined (DWWM, 1992). Manhole overflow incidences exhibited a wet-dry season ration of 1.1 (210 complaints in the wet seasons of 1990 and 1991 divided by 193 complaints in the dry seasons during 1990 and 1991). Again, the greater-than-one ratio could indicate the effects of infiltration and inflow.

Nondetected leakage of collection lines (exfiltration) may also occur in the collection system, and could ultimately contribute to nonpoint source pollution, particularly where lines are above the water table.

4.9.3 RELEASES TO GROUNDWATER

Cesspools

As indicated in the 208 Plan, there are 1,940 cesspools distributed in the Honolulu, upper Nuuanu Valley, Makiki Heights, Diamond Head, Kaimuki, and Kahala areas. Estimated wasteloads from household cesspools in the study area are presented in Table 4-25. The potential for groundwater contamination by these sources is of concern but does not yet appear to be a direct threat to drinking water sources.

Table 4-25
Estimated Wasteloads from Household Cesspools in the Study Area

AREA	NO. OF PEOPLE	WASTELOADS (LBS. PER DAY)			
		BOD	SS	TOTAL N	TOTAL P
Honolulu	3,104	590	497	98	25
Nuuanu Valley	178	34	28	6	1
Makiki-Puowaina	969	184	155	30	8
Diamond Head	581	110	93	18	5
Kahala	147	28	24	5	1
Kaimuki	372	71	60	23	3
Other	857	163	137	27	7

Total N refers to total nitrogen; Total P refers to total phosphorous; BOD refers to biological oxygen demand; SS refers to suspended solids

Source: City and County of Honolulu 208 Plan (1990)

Underground Waste Disposal

Waste can also be disposed via underground injection wells (UIWs). As shown in Table 4-12, there are 14 known UIWs within the study area, located mainly near the west boundary of the study area. There are two UIWs located inland of the UIC line. The DOH has allowed these wells to remain as long as no increases in discharge rates are requested. All other wells are installed *makai* of the UIC line, away from known drinking water supplies. Nevertheless, it is possible that the discharge from these sources may contaminate future water supplies or unidentified private wells. Table 4-26 provides information on four facilities that have been inspected and/or cited for permit violations.

Depending on the well, the injected fluid may contain rainfall runoff, carwash effluent, oil/water separator effluent, and laundry wastewater. Dispersion occurs when these wastes reach groundwater. Groundwater flow mobilizes contaminants within the substrata and/or transports them to coastal water. Solvents, oil and grease, solids, heavy metals, nutrients, and bacteria are contaminants in injection fluids. The migration of these contaminants may have toxic effects or may affect the aquatic ecosystem. However, such effects have not been documented in the study area. Chapter Two discusses regulations under which these wells are managed to control pollutants.

Table 4-26
Facilities Inspected and/or Cited for Underground Injection Well Violations

FACILITY NAME AND ID	INJECTION FLUID TYPE	AVERAGE FLOW	INSPECTION OR VIOLATION
Gasco, Inc. (UO1322)	Boiler blowdown	15,000 gpd	Illegal discharge, and failure to transfer permit to new owner (1988).
Tropical Rent-A-Car Systems, Inc.	Treated waste-water from carwash	1,000 gpd (Max.)	Installed on 23 Dec. 1985, renewed on 27 Feb. 1992. 21 volatile organic compounds were tested on 10 Apr. 1992.
Budget Carwash (UO1341)	Wastewater from carwash facility	500 gpd (Max.)	On 18 July 1988, EPA noticed excessive amounts of surface runoff water drained into the storm drain. Buildup clogged the wells.
Young Laundry and Dry Cleaning (UO1339)	Primary treated laundry wastewater	200,000 gpd	Cited for poor hazardous waste housekeeping on 12 Aug. 1991. Wastewater samples indicated high tetrachloroethylene levels. Listed on CERCLIS Database by EPA Region IX on 21 Sept. 1992.

Source: Safe Drinking Water Branch, DOH Permit Records

4.9.4 RELEASES TO LAND

Sewage sludge from Sand Island WWTP is currently disposed of at the Kapaa Sanitary Landfill in Kailua. This landfill, as well as the Waimanalo Gulch Sanitary Landfill in Leeward Oahu, are estimated to be at capacity before 2015.

4.9.5 RELEASES TO AIR

The wastewater collection and treatment system has two forms of impacts upon air quality. The first impact is associated with emission of hydrogen sulfide gas from various elements of the system. Hydrogen sulfide is sometimes detected at the initial point of wastewater discharge from homes and businesses into collection lines, at manhole covers, in the vicinity of wet wells at pump stations, and at junctions of force mains. Hydrogen sulfide is also emitted during the treatment process at the Sand Island WWTP. The second form of air quality impact is associated with operation of the two incinerators when they are used for sludge disposal. The incinerators, when operating, are the WWTP's major source of emissions.

The incinerator furnaces have been out of service since 1986. In 1989 they were tested and failed to meet the particulate emission air quality standards. Subsequently, repairs were made on the scrubber systems and retested. One incinerator unit has passed emission tests and is permitted. The City is undertaking measures intended to bring the second unit into compliance.

5
Future Situation

FIVE
FUTURE SITUATION

5.1 INTRODUCTION

Chapters Three and Four assessed current conditions in the study area as they relate to the generation, treatment, and quality of wastewater. They discussed the characteristics of the natural and socioeconomic environment, and wastewater system infrastructure that would cause changes or be impacted by change.

This chapter discusses future conditions forecasted to the year 2015. The forecast of future conditions considers the major elements expected to influence or be influenced by the need for wastewater collection and treatment over the 20-year planning horizon.

Future conditions are divided into three categories: government policies and regulation, population, and the physical environment. Because the future is unknown, assumptions must be made about some parameters in order to predict future conditions. The assumptions are presented in Section 5.2. Subsequent sections build upon these judgements to predict the future population, the wastewater generated, and the infrastructure needed to meet these demands as efficiently as possible without adversely affecting public health or the environment.

5.2 ASSUMPTIONS

This section presents the assumptions used in predicting the scenario to be accommodated in the year 2015. These assumptions represent the best professional judgement of the study team. Where there is no convincing evidence on which to base a change in existing conditions or constraints, the existing condition is projected into the future.

5.2.1 GOVERNMENT POLICY AND REGULATIONS

The laws and rules enacted to govern society are dynamic and responsive to numerous inputs. The regulations and policies that would have the most impact on wastewater generation, collection, treatment, and disposal are related to land use and the environment. However, future changes to these regulations cannot be projected. These rules, as presently written, must be complied with in the future, and are discussed below.

Land Use Policies

There are various federal, State, and county land use planning controls and systems which are relevant to the current study. The Development Plans established by the City for each Development Plan area on Oahu are intended to provide a system of land use controls designed to implement the objectives and policies of the General Plan, and to guide more specific zoning regulation. However, the Development Plans are not cast in stone and incremental changes to them occur. For the purposes of the Facilities Plan, the socioeconomic forecast provided by the City's Planning Department is used as the primary basis for projecting future wastewater flow. Development Plan land use, generally thought of as having a 20-year horizon due to their linkage to the General Plan, is also considered in certain cases where the use of the socioeconomic forecast is not feasible.

Releases to Surface Water

The objective of the federal Clean Water Act is to restore and maintain the chemical, physical, and biological integrity of the Nation's waters. This act is scheduled for reauthorization in the current session of Congress. It is assumed that the reauthorized legislation would not contain additional requirements that would impact the East Mamala Bay wastewater system. In addition, it is assumed that Section 301(h) of the act, which authorizes waivers of the requirement for effluent limitations based upon secondary treatment, would remain intact. Thus, Sand Island WWTP would be able to continue to operate under an NPDES 301(h) waiver permit as it is currently. It is recognized, however, that (1) certain conditions must be met to be granted a waiver permit, (2) future legislation may change the requirements, and (3) NPDES permits must be renewed. Therefore, the uncertainty inherent in future regulatory changes are explicitly incorporated in the evaluation and recommendation of alternatives.

The second assumption related to releases to surface water is that there would be no discharges into Mamala Bay in the future from point sources other than those that currently exist. In addition, it is assumed that expansion of the existing zone of mixing can be pursued if necessary to accommodate population growth.

Releases to Air

Under the Clean Air Act, a PSD program limits the amount of additional pollution that is allowable in areas where NAAQS are met. The maximum allowable increase over baseline concentrations (ambient air quality increments) is assumed to be available in the future for additional Sand Island WWTP incinerator emissions.

Releases to Land

The Hawaii Integrated Solid Waste Management Act identifies the following solid waste management practices and processing methods in order of priority: (1) source reduction; (2) recycling and bioconversion, including composting; and (3) landfilling and incineration. In addition, it is the goal of the State to reduce the solid waste stream prior to disposal. Therefore, the Facilities Plan reflects a preference toward recycling and bioconversion over landfilling and incineration.

5.2.2 POPULATION

Population growth as projected by State and City agencies is used in predicting future wastewater flows. The volume of wastewater generated by the future population is assumed to not be limited by availability of natural or socioeconomic resources such as the availability of housing and infrastructure (water, drainage, electrical, and transportation systems). The evaluation or prioritization of the relative impacts of these various influences upon population growth is outside the scope of the wastewater facilities planning process. The sources of the population projections used in the Facilities Plan and this EIS are discussed in Section 5.4.

5.2.3 FLOWS TO THE WASTEWATER COLLECTION AND TREATMENT SYSTEM

Assumptions must be made regarding the volume and characteristics of wastewater generated in the future. Reductions in flow rates due to minimization of infiltration and inflow and to implementation of water conservation programs are discussed below. Also discussed is the predicted chemical composition of the wastewater generated.

Reduction of Infiltration and Inflow

An NPDES permit is required for any discharge of pollutants from a point source into waters of the United States. The EPA issued a Findings of Violation and Order for Compliance to the DPW for unauthorized discharges associated with excessive overflows and spills, on November 22, 1991. This order required that specific measures be taken by the City. The goals of these measures are to reduce collection system spills over the short- and long-term. For the purposes of the Facilities Plan, and thus this EIS, it is assumed that the City would maintain compliance with the requirements of this order.

The DWWM is undertaking a study of infiltration and inflow (I/I) in the collection system as part of the Sewer Rehabilitation and Infiltration/Inflow Minimization Plan. The resulting reduction in I/I was estimated in the following way: it is assumed that 50 percent of the I/I enters the system within City rights-of-way and that the City is 50 percent effective in reducing this I/I. Also, it is assumed that it is more cost-effective to transport and treat rather than reduce I/I, such that 60 percent of the peak flow will be transported. This assumption is based on a number of I/I studies performed in the 1970s for sewer systems on the island of Oahu, which showed that in all cases it was more cost-effective to transport and treat than to reduce I/I. Therefore, a 10 percent reduction in the I/I rates will be used in projecting future flows.

Reduction in Flows Due to Water Conservation

The intent of water conservation programs is to reduce the volume of water used. Because the water used in sinks, showers, and toilets drains to the sewer system, water conservation should decrease the volume of wastewater generated. This would decrease the capacity needed for the wastewater collection and treatment systems.

A case study in Elmhurst, Illinois, involving installation of household water saving devices, resulted in a wastewater flow reduction of 10 percent (*Proceedings - National Conference of Water Conservation and Municipal Wastewater Flow Reduction*, EPA, August 1979). For Honolulu, City Ordinance number 92-01, amended by Ordinance number 92-109, enacted on October 5, 1992, requires all nonresidential properties to be equipped with low-flow devices. These include low-flow showerheads, kitchen and lavatory faucets, ultra-low flush toilets, and low-flush urinals. In addition, the ordinance requires the Board of Water Supply to prepare, within one year, a water conservation plan for residences, recommending how to retrofit residences with water-saving fixtures and devices.

Based on the above, a future five percent reduction in the wastewater generation rate of 80 gallons per capita per day was assumed. Therefore, a residential flow rate of 76 gallons per capita per day was used in projecting future flows. It is important to note that any flow reduction would not affect the solids loading of the system; it would only reduce the dilution factor.

Characteristics of Wastewater Generated

The chemical composition of the wastewater generated for treatment and disposal at Sand Island WWTP is of concern, in terms of influent, effluent, and sludge characteristics. It is assumed that the chemical concentrations in these streams would be the same in the future as they are now, although the flow rates would increase. Also, it is assumed that industrial wastewater generators would implement pretreatment programs as required by law and not input high concentrations of pollutants to the municipal system.

5.2.4 OTHER INFRASTRUCTURE

Future improvements to the other infrastructure systems enhance the wastewater facilities' ability to collect and treat wastewater. Especially important are improvements to the electrical system which provides power for wastewater collection and treatment units. It is assumed in this EIS that the necessary non-wastewater infrastructure discussed below will be provided to support the wastewater system.

Water Supply System

Water supply is assumed to meet projected land use and population growth, as modified by conservation, such that project wastewater flows are realized.

Drainage System

Drainage system additions would be installed in future subdivisions, most of which would be located in the eastern portion of the study area. There would be future additional development of the waterfront from Iwilei to Ala Moana Park and portions of Kakaako; this development may also require drainage system improvements.

Electrical System

Information about future major transmission line additions for the study area is not available. However, the Hawaiian Electric Company (HECO) plans to issue a report to the Public Utilities Commission (PUC) detailing future service plans. Future transmission lines would be documented in this report, as well as other major improvements. Increases in plant capacity and level of treatment will increase future electrical demand. However, this increase is not expected to significantly affect HECO's future service plans.

Roadway System

No major roadway additions are planned for the study area. The widening of Kalanianaole Highway is currently under construction. Minor roadway realignments in the Kakaako and other areas are also expected.

5.2.5 ENVIRONMENTAL CONDITIONS

As discussed earlier in this document, the existing wastewater collection system is susceptible to environment influences, especially the infiltration and inflow of water into the collection lines.

Over the past several years, increasing attention has been focused upon theories concerning the potential impacts that global industrialization may be having upon the environment. While there is considerable disagreement about the extent of these impacts and the climatic changes that may manifest, there is general agreement that the Earth's climate is, in fact, changing, and sea level rise is among the most frequently mentioned potential consequences of this change.

While the significance of global warming (from the greenhouse effect) may seem somewhat removed from this EIS, examination of the existing system yields a cause for concern. The flood insurance rate maps presented in Chapter Three show the location of WWPSs that are in or near flood hazard areas. A relatively modest increase in sea level of a few inches could result in the submersion of these facilities from storm surge and wave set-up during major storm events. In addition, a change in the sea level would also impact the island's water table. In low-lying areas, existing sewer lines would be increasingly susceptible to infiltration of sea water. However, since the actual amount, and rate, of sea-level rise cannot be predicted accurately in the study period, sea-level rise is considered only as it is accounted for by the FIRMs.

As discussed above, it is theorized that the greenhouse effect could elevate global temperatures. If water temperatures in the Pacific Ocean were to increase, it has been hypothesized that Hawaii might experience an increase in hurricane incidence. Hurricanes form in warmer waters to the south and east of Hawaii and historically have lost their energy as they move in a northerly direction into colder waters near Hawaii. In recent years, however, the Hawaiian Islands have experienced two severe hurricanes. If water temperatures were increasing, it has been suggested that the incidence of hurricanes passing through Hawaii would also increase. There is no evidence available on which to base a prediction that the threat of tropical cyclones is increasing within the planning horizon. Therefore, risk of coastal and inland flooding is assumed to be the same in the future as represented in existing FIRM maps.

5.3 GROWTH PROJECTIONS

5.3.1 USE OF GROWTH PROJECTIONS

It is generally recognized that anticipated growth dictates infrastructure needs (Director, Planning Department, letter of October 12, 1993). Projections for future growth can be expressed in terms of categories of land use or in terms of population. The existing land use is compared with projected future land use to determine an increase or decrease in land use densities. Similarly, existing population is compared with future projected population to determine an increase or decrease in the number of people in a given area.

Land Use Projections

Traditionally, the expression of growth is found in the form of a land use plan. In the case of Honolulu, the long-range land use plan is generally taken to be the City's Development Plans (DPs). The DPs do not have an explicit planning horizon, but because of their linkage to the General Plan (see Chapter 2), they are generally thought of as having a 20-year horizon (Director, Planning Department, letter of October 12, 1993). However, this does not mean that everything in the plans will materialize exactly as designated over the next 20 years. In some locations, actual future land use will be less dense than indicated in the DP. In contrast, DP land use in other areas may be up-designated when infrastructure restrictions such as inadequate sewer capacity are removed.

Land use limitations other than DP designation also impact land use. For example, varying height restrictions can cause lands with the same DP designation to have widely different densities. In addition, some designations do not specifically reflect their intended use. One example of this is the Honolulu waterfront area. Most of it is designated "Public Facilities," but its future use will most likely include industrial, commercial, apartment, and hotel.

It should be noted that the City's Planning Department is currently engaged in a multi-year program to review the existing DPs pursuant to the City Charter amendment of 1992. A key objective is to replace the current parcel-specific map with a more conceptual plan of how and where growth should occur.

Population Projections

The City's Planning Department uses a socioeconomic forecast that is designed to provide the amount and location (by TAZ) of population, housing, and employment for specific future years. The forecast for the

East Mamala Bay study area is based on the State's projection for the island as a whole as provided by DBEDT, as required by the General Plan of the City and County of Honolulu. The set of state projections that is currently in use is known as the M-K series, or M-K projections. The City's forecast distributes or allocates the state's M-K series projections to individual areas on the island.

This allocation of population is based on the City's development policies as expressed in the DPs and market factors found to have contributed to the extent and pattern of growth in the past. The market factors considered include historical growth, development capacity, employment opportunity and commuting time. These supply and demand factors are considered explicitly in the City Planning Department's distribution process. The forecast also explicitly takes into account known development projects. Much of the growth forecast for the Primary Urban Center Development Plan area is due to these projects.

Use of Projections in Infrastructure Planning

The City's Planning Department recommends that infrastructure planning be based on its socioeconomic forecast, and that DP designations not be used directly to provide the basis for infrastructure planning (Director, Planning Department, letter of October 12, 1993). It states that:

> "By accounting explicitly for the timing of development, by capturing the nature and intent of land use policies and by incorporating market factors which are known to have impacted developments on the island, we believe the forecast will provide the line agencies charged with infrastructure planning with a realistic view of the future. The forecast is considered the most likely depiction of the future. To the extent that uncertainties are involved and errors are unavoidable, we recommend that line agencies apply a safety factor to the forecast before generating its infrastructure implications. The nature and magnitude of such factors are best provided by the agencies themselves based on experience, judgement and professional practice."

Thus, to be consistent with City policies and use of the socioeconomic forecast, projections of future wastewater flow in the facilities plan considers the City Planning Department's projections as the primary input. Development Plan land use is also considered, for two reasons: (1) when addressing smaller areas requiring small collection lines, where the information provided by TAZ is not detailed enough; and (2) where future projected flow rate is less than the current actual (metered) flow rate. The specifics on the application of the socioeconomic forecast and development plan land use in developing wastewater flow projections are discussed in section 5.5.

In addition to the City Planning Department's recommendation, facilities planning requirements under 40 CFR 35, State and Local Assistance, Subpart C, Grants for Construction of Wastewater Treatment Works, state that:

> "Facility planning must be based on load allocations, delineation of facility planning areas and population projection totals and disaggregations in approved water quality management plans."

The population projection totals in the water quality management plan for the City and County of Honolulu (*The 208 Plan*) are derived from the M-K projections, which is the basis used by the City Planning Department's socioeconomic forecast.

In terms of the City Planning Department's recommendation that line agencies such as the DWWM determine and apply safety factors to the forecast, this will be done at the preliminary design phase. In determining design capacity safety factors for a given improvement project, the DWWM will take into account: (1) the DP-designated land use; (2) the estimated existing demand on the infrastructure; (3) the age, condition and design service life of the existing infrastructure; (4) service life of the replacement or new infrastructure; and (5) the anticipated growth and known development projects that are expected to occur during the life of the facility.

The decision to replace or upgrade wastewater infrastructure can be viewed as a two-stage process. The first stage, whether and when to replace or upgrade, is determined by the physical condition and performance adequacy of the system. In projecting need to replace in the future, given that the physical condition is adequate, capacity is the primary consideration. Since land use designation does not have a temporal element, population-based flow projections are best used to evaluate the timing of replacement projects in the future.

The second stage of the process is designing the infrastructure to be built. This process normally begins several years prior to construction. At this time, capacity is a central concern. The issue of required capacity is addressed using all available growth information, which will generally be more accurate than that which was available to planners in the past. At this stage, land uses allowed within the next 20 years may be more useful than population growth projections as an index of required capacity for infrastructure facilities, especially for those with service life expectancies of 30 years or more.

5.3.2 DEVELOPMENT PROJECTS

Planned development projects are taken into account in modeling of future wastewater flow. Modeling based on both land use-based and population-based projections are discussed in section 5.5. In the land use-based model, when information on development projects is known, computations of wastewater flow are based on this information rather than the Development Plan designation, which may not reflect or provide enough detail on current plans for near-term development. In the socioeconomic forecast provided by the City Planning Department, information on development projects is taken into consideration when distributing population and employment. Specific major development projects that have been taken into account in modeling of wastewater flow are listed in Table 5-1. A complete listing of development projects by TMK is provided in the Facilities Plan.

5.4 POPULATION PROJECTIONS IN THE AREA

Population projections were developed for the study area for the year 2015, the final year in the 20-year horizon of the facilities plan. The City Planning Department provided its socioeconomic forecast for the year 2010, the furthest extent of the M-K projections and thus the PD's forecast. Projections for 2015 were made by extrapolating from the PD's forecast.

5.4.1 PLANNING DEPARTMENT'S SOCIOECONOMIC FORECAST

As discussed in section 5.3.1, the City's Planning Department uses a socioeconomic forecast that is designed to provide the amount and location (by TAZ) of population, housing, and employment for specific future years. The forecast for the East Mamala Bay study area is based on the State's M-K projections for the City and County of Honolulu as a whole, which is distributed among its eight Development Plan areas down to the TAZ level by the City's Planning Department. The distribution is based on the City's development policies as reflected in the DPs, market (supply and demand) factors, and known development projects.

Table 5-1
Major Development Projects[1]

Block of Kalaimoku and Launiu Streets
Mauka of Royal Kuhio Theatres
Tusitala Superblock
Behind Outrigger on Hobron Lane
Near the Wave Waikiki
Waikiki Landmark
Corner of Kalakaua and Keoni Ana
Block of the Kuhio Theaters
Corner of Kalaimoku and Lewers
Honolulu Convention Center (Aloha Motors Site)
Kalia Tower (Hilton Hawaiian Village Expansion)
Hale Koa Expansion
Waikiki Gateway (Jack Meyers)
Mauka of the Hyatt Regency Waikiki
Mauka of Saint Augustine Church
Keeaumoku Street Superblock
Pawaa
Marin Tower
Kekaulike
Aloha Tower
Kakaako Community Development
Harbor Court
Chinatown Gateway
Highness Tower
Alakea Plaza
First Hawaiian Tower (Pan Pacific Plaza)
Kalihi Shopping Center
Park Place
Corner of King and Houghtailing Streets
Hawthorne Airport Hotel
Shimizu Airport Hotel
Airport Industrial Part Association Hotel
Pier 60 Marina[2]
Kapalama Industrial Park Area (KIPA)[2]
Kapalama Military Reservation
Waterfront Redevelopment, Iwilei Area[2]
Military[2]

Notes:

1. All major projects in this table were accounted for in the land use-based wastewater flow model.
2. This project was not specifically identified in the City Planning Department's socioeconomic forecast.

Sources:
Socioeconomic Forecast, Planning Department, City and County of Honolulu
Department of Business, Economic Development & Tourism, State of Hawaii

5.4.2 M-K SERIES PROJECTIONS

The M-K series was prepared in 1988 using 1985 as the base year. The projection was in 5-year increments, so the first projection year was 1990. The M-K series projected a population of 861,600 for Oahu in 1990. The 1990 Census reported a total resident population of 836,231 for Oahu. Subsequently, however, the Census Bureau conducted a Post-Enumerative Survey to evaluate the quality of the count ad concluded that Oahu had an undercount of about 25,000 people and that the true population for Oahu in 1990 should be 861,000. This corrected 1990 Census count is almost identical to the M-K projection (letter from R. Foster, October 12, 1993).

5.4.3 DE FACTO POPULATION FOR 2015

Table 5-2 presents the M-K series resident and de facto populations for the City and County of Honolulu and the study area through the year 2010. As noted above, the M-K projections are used by the City Planning Department as the basis for its socioeconomic forecast, which projects population, housing, and employment. Table 5-2 also provides the algorithm used to extrapolated these projections for the period from 2010 (the end-point for the City Planning Department's forecast) to 2015. Since the M-K projections and, therefore, the City Planning Department's projections only project through the year 2010, figures for 2015 were developed by using the average 5-year growth rate (approximately 3.52 percent) experienced during the preceding 10-year period (2000 to 2010). (The projections for 2015 in the facilities plan will need to be updated when the DBEDT and City Planning Department issue the 2015 City and County of Honolulu population projections and 2015 socioeconomic forecast, respectively.) Using the methodology shown in Table 5-2, the resident population of Oahu is expected to reach 1,034,630, with the study area resident population (412,319) comprising 39.9 percent. The wastewater flow projections for the study area (see section 5.5) account for de facto population by using the City's forecast for population, housing, and employment. The breakdown of the study's 2015 resident population and percent change from 2010 and 2015 (by TAZ) is provided in Appendix I.

5.4.4 SUMMARY

Tables 5-3 and 5-4 show the population projections for the study and service areas. The interim 5-year increases in resident and de facto population were computed using the M-K series' projected percentage increases for the City and County of Honolulu for the same time period.

5.5 FORECASTS OF WASTEWATER FLOW

Forecasting wastewater flow to the end of the study period (2015) is crucial to determining the size of future wastewater collection and treatment units needed to accommodate population growth to the year 2015. This section provides a summary of the procedure and data used to develop the forecasts, as detailed in the facilities plan. In general, the flow in the wastewater system is modeled by applying flow generation rates to the future 2015 scenario. Flow generation rates are also applied to the existing 1990 scenario, in order to determine the applicability of the various wastewater flow models to reflect the future flow scenario. The future scenario was depicted in terms of land use and in terms of population and jobs. The land use-based and population-based models are discussed in section 5.5.1. The flow generation rates used in each model are discussed in section 5.5.2. The wastewater infrastructure capacities required to meet flow projections to 2015 are provided in section 5.5.3.

Table 5-2
Allocation of 2015 De Facto Population to Study and Service Areas

DESCRIPTION	CITY & COUNTY OF HONOLULU	STUDY AREA	SERVICE AREA (STUDY AREA WITHOUT KULIOUOU)	DATA SOURCE
De Facto population for City and County of Honolulu	1,138,279	N/A	N/A	Average 5-year increase in de facto population based on last 10 years (2000 - 2010). Increase of 3.9809% for a 5-year period; Apply it to M-K de facto 2010 population (M-K page 10); M-K November 1988 Page 10; M-K de facto for 2010 1094.7 (in thousands)
Resident Population for City and County of Honolulu	1,034,630	N/A	N/A	Extrapolated according to text. Use Average 5-year increase in resident population based on last 10 years (2000 - 2010). Increase of 3.515% for a 5-year period; Apply it to M-K resident 2010 population; M-K November 1988 Page 10; M-K residents for 2010 = 999.5 (1,000).
Resident Population in study and service areas	N/A	412,319	409,049	Applied the average increase in each TAZ in study and *service areas. Percent used: 3.515%.*
Average Visitor Census for Oahu	122,739	N/A	N/A	Applied average 5-year increase in visitor census projections from M-K based on last 10-year period (2000-2010). Increase of 8.23536% for a 5-year period; Applied to 113.4 (1,000) visitors; M-K Page 18 year 2010.
Average Number of Residents Temporarily Absent from Oahu	19,090	N/A	N/A	Deri2ved from: Residents + Avg Visitors - De Facto Population
Percent of Residents in study and service areas	N/A	39.9%	39.5%	Residents in study and service areas 2015/Oahu residents in 2015
Residents temporarily absent from the service and study areas	N/A	7,608	7,547	Oahu residents temporarily absent multiplied by percent of residents in study and service areas
Percentage of hotel rooms and resort units in study and service areas	N/A	82.93%	82.93%	46,278 Hotel and resort units in study area for 2010 55,802 Hotel and resort units for 2010
Visitors Present in study and service areas on average	N/A	101,786	101,786	Average Oahu census multiplied by percent of hotel rooms and resort units
De Facto Population	N/A	506,497	503,288	Residents - residents temporarily absent + Visitors

Table 5-3
Service Area Population Projections 1990-2015 (Kuliouou excluded)

	1990	1995	2000	2005	2010	2015
Resident Population	339,640	358,999	367,974	379,013	395,171	409,049
De Facto Population	417,407	441,850	455,105	471,489	492,235	503,288

Table 5-4
Study Area Population Projections 1990-2015 (Kuliouou included)

	1990	1995	2000	2005	2010	2015
Resident Population	342,511	362,034	371,085	382,218	398,330	412,319
De Facto Population	420,225	445,018	458,369	474,870	495,764	506,497

5.5.1 FLOW MODELING

The first step in the modeling procedure consisted of compiling detailed information on the existing elements of the wastewater collection system. This information was input to the map and computer-based inventory from the ISAP study. As discussed in Chapter 4, the data came from previous studies, drawing files, flow records, and complaint files.

Land-use-based and population-based flow scenarios were modeled for both the existing and future conditions, as shown in Table 5-5.

Table 5-5
Flow modeling scenarios

SCENARIO	LAND USE BASIS	POPULATION BASIS
Existing	Existing Land Use codes	1990 Population Counts from PD
Future	Development Plan codes	2010 Population Projections from PD, extrapolated to 2015

The existing land use codes by TMK were obtained from DLU. The 1990 population counts from the PD were allocated by TAZ and matched the counts from the Hawaii State Data Book and the 1990 Census. The Development Plan codes (see discussion on Development Plans in section 2.10.2) by TMK were obtained from DLU. The 2010 Population Projections from the PD and the extrapolation to 2015 are discussed in section 5.4.

For each land use or population count, flow generation rates were applied to determine the cumulative flow in sewer lines, sewer force mains, WWPSs, and the WWTP. The flow generation rates used are discussed in section 5.5.2.

The models of the existing scenario were used to check the modeling results against known conditions. The known conditions consist of actual measured flows at pump stations over the period May 1990 to May

1992. Based on an evaluation of the modeling results and their applicability, the flow projections that the preferred alternative will be designed to accommodate is determined.

The results of the modeling identified sewer lines whose capacity is less than the projected design peak wastewater flows. Stated another way, the design peak wastewater flows generated will be greater than the wastewater flow that a sewer line could handle when the wastewater level reaches the top of the pipe (i.e., the pipe is "flowing full"). The corresponding flow rate is calculated using Manning's equation and is a function of the pipe's roughness, slope, and size. When the projected flow rate in a pipe equals or exceeds the "flowing full" rate, the pipe is identified as being surcharged. For the purposes of the Facilities Plan, "100 percent surcharged" means that the modeled flow rate equals the "flowing full" rate; "150 percent surcharged" means that the modeled flow rate is 1.5 times the "flowing full" rate. The results of the modeling also showed the flow rates at each WWPS and at the Sand Island WWTP.

5.5.2 FLOW GENERATION RATES

For both the existing and future scenario, flow rates through the wastewater system infrastructure were modeled based both on land use and on population. The rates at which flow is generated by each type of land use and by each person is discussed in this section. In general, these flow generation rates are multiplied by the number of acres of land use or by the number of people in each category (e.g., resident, visitor, etc.) in a given area; the resulting flow rates are input to the flow model at the appropriate modeled locations within the wastewater system.

Flow generation rates — land use

Five flow rates are calculated in determining the required capacities of the components of the wastewater 2system based on land use:

- Average – the rates at which flows are generated by persons or land uses
- Maximum – average flow multiplied by a maximum flow factor
- Design Average – average flow plus dry weather infiltration
- Design Maximum – maximum flow plus dry weather infiltration
- Design Peak – design maximum flow plus wet weather infiltration and inflow.

These are based on Design Standards of the Department of Wastewater Management, Volume 1, July 1993 (hereinafter referred to as "DWWM Design Standards"). The average flow rates, maximum flow factor, dry weather infiltration, and wet weather infiltration/inflow are discussed below.

AVERAGE FLOW

The average flow is the sum of average residential and non-residential flows shown in Table 5-6.

Table 5-6
Basis for Land Use Flow Generation Rates

LAND USE TYPE	LAND USE	BASIS FOR AVERAGE DAILY FLOW[1]
Residential	House	4 persons per house
	Apartment Unit	2.8 persons per apartment unit
Non-residential	Central Business	300 capita per acre (cpa)
	Community Business	140 cpa
	Neighborhood Business	40 cpa
	Resort	400 cpa
	Apartment (high density)	390 cpa
	Apartment (medium density)	250 cpa
	Apartment (low density)	85 cpa
	General Industry	100 cpa
	Waterfront Industry	40 cpa
	School	25 cpa[2]
	Parks	6.25 cpa[3]
	Institution (hospital, etc.)	200 gallons per capita per day (gpcd)

Notes:

1 Numbers shown in this column are from DWWM Design Standards except where noted. The per capita flow rate applied to all land uses (except institution) is the DWWM standard of 80 gpcd for the existing scenario. The per capita flow rate applied to all land uses (except institution) is 76 gpcd for the future scenario, which is based on the City DWWM Design Standard of 80 gpcd reduced by 5 percent for water conservation (as discussed in section 5.2.3).

2 Based on an estimate of 2000 gallons of wastewater generated per acre of school land.

3 Based on an estimate of restroom usage during heavy-use conditions.

MAXIMUM FLOW FACTOR

For this study, the Babbit Formula was used to determine the maximum flow factor (MFF), as recommended by DWWM Design Standards. Symbolically, the formula is:

$$MFF = \frac{5}{P^{0.2}}; \text{ and } MFF \leq 5.0$$

where P = population in thousands.

Note that as the population increases, the MFF decreases. The theory behind Babbit's Formula is that an increase in population tends to smooth out the flow peaks, because there is a tendency for more coordinated or even generation of sewage with a greater population base. Based on Babbit's Formula, the maximum MFF is 5.

DRY WEATHER INFILTRATION AND WET WEATHER INFILTRATION/INFLOW

As discussed in section 4.5.2, infiltration is defined as the entrance of water into the wastewater collection system below the ground surface. Inflow is the entrance of waters at the surface through openings in the system such as sewer manhole tops. Dry weather infiltration (DWI) is infiltration that occurs when the groundwater table has not risen because of rain. Wet weather infiltration/inflow (WWI/I) is infiltration that occurs when the groundwater table has risen as a result of rain, plus inflow during rain.

Calculations of existing flows use DWI and WWI/I rates measured in the ISAP study. These rates were reduced by 10 percent for calculating future flows, as discussed in section 5.2.3.

The ISAP-estimated rates were presented in Chapter 4. As mentioned earlier, these rates were the latest attempt in determining the extent of infiltration and inflow for the Island of Oahu, and to this date the best estimates of infiltration and inflow in the sewer system. The Sewer Rehabilitation and Infiltration/Inflow Minimization Plan currently being conducted by the City DWWM will eventually serve as a basis for the presentation of new and more accurate infiltration rates.

Flow generation rates – Population

As discussed in section 5.4, output of the City's land use simulation model for 1990 and 2010 for the study area was obtained from the PD. (The 2010 figures were extrapolated to 2015, the end of the study period.) The output provided the following information by TAZ:

- Resident population
- Number of hotel rooms
- Dwelling units for residents, by household size (1-person, 2-person, 3-person, 4-person, and 5+person)
- Jobs (employment) by the following sectors:
  - military
  - government
  - hotel
  - agriculture
  - transportation, communication and utilities
  - industrial
  - finance, insurance and real estate
  - service
  - retail
  - construction

The resident population, number of hotel rooms, and number of jobs were input to the wastewater flow models. The flow generation rate for each resident, hotel room (assuming 100 percent occupancy), and job was determined so that the modeled 1990 population average design flow rate (including ISAP-measured dry weather infiltration) approximately equaled the actual average daily flow rates measured at Ala Moana and Hart Street WWPSs over the period May 1990 to May 1992. In order to calibrate the existing population model, the flow rate per resident was varied, with the resulting flow generation rates shown below.

	GALLONS PER RESIDENT PER DAY (Same Number of Gallons per Hotel Occupant per Day)	GALLONS PER JOB PER DAY
Ala Moana	80	82
Hart Street	80	153

These flow generation rates were reduced by 5 percent in the year 2015 population model. ISAP infiltration/inflow rates, reduced by 10 percent, were also used. The resulting rates are:

	GALLONS PER RESIDENT PER DAY (Same Number of Gallons per Hotel Occupant per Day)	GALLONS PER JOB PER DAY
Ala Moana	76	78
Hart Street	76	145

5.5.3 FLOW PROJECTIONS

Four flow models are presented in the Facilities Plan. Two are land use based: the existing land use model, and the future development plan model. The other two are population based: the existing (year 1990) population model, and the future (year 2015) population model.

The results from the two future flow models were combined to develop the flow projections for 2015 that become system improvements design parameters. The results were combined as follows:

- The WWTP, large WWPSs and large sewer lines with modeled future population (2015) design average flow rates greater than one mgd are modeled on future population (2015);
- Small WWPSs and small sewer lines with modeled future population (2015) design average flow rates less than or equal to one mgd (with two WWPS exceptions, where measured average daily flow is already greater than 2015 population average design flow) are modeled on future land use.

Population and land use flows projections are combined in this way for several reasons. There is some overlapping in the generation of these two projections, because the allocation for population to TAZs within the planning district is made using Development Plan land use designation as an input. However, as the DP's additional density capacity exceeds projected population growth in the district over the study period, it is clear that all land will not reach its Development Plan planned capacity by 2015.

The dividing line between large (greater than one mgd) and small (less than or equal to one mgd) sewerage components was derived from several characteristics of the system and the flow modeling methodology. First, based on examination of Table 5-7, it is evident that there is a clear dividing line between small and large pump stations. The largest pump station of the "small" category is the Niu Valley WWPS with an average daily flow of 0.57 mgd. The next larger pump station is the Ft. DeRussy WWPS with an average daily flow of 2.10 mgd, clearly putting it in the "large" category.

Second, since the allocation of population and employment levels to units smaller than a TAZ is essentially an educated guess, it is not prudent to design to a flow unit smaller than the largest TAZ. One mgd is roughly equivalent to a population of 12,500 people, which is safely greater than all except two of the TAZs in the study area. For larger system elements, larger land areas consisting of multiple TAZs are serviced; hence design to population projection flows is warranted at this level to prevent costly development of unneeded capacity, while ensuring adequate capacity. For the East Mamala Bay study area, one mgd was determined to be the appropriate "cutoff" between land use and population-based flows. The exact "cutoff" value should be determined for other study areas on a case-specific basis.

The population models were used for the analysis of large elements of the system such as the treatment plant, large pump stations and large sewer lines. The reason for using the population models for the larger elements is that the population model tends to predict more realistically a future wastewater generation than a land use model. A land use model may predict the more ultimate development of a particular area, but the population model predicts the "anticipated" development of an area within the planning period. Since the population models smallest level of accuracy is the TAZ to assign population and employment densities, it would not be logical to use a population model on the parcel level. Thus where parcel level accuracy was required, land use models were used. The one mgd dividing line ensures that there is enough

Table 5-7
Comparison of Measured and Modeled Flow Rates (in mgd)

WASTEWATER PUMP STATION	MEASURED AVERAGE DAILY PUMPING RATE	MODELED EXISTING LAND USE DESIGN AVERAGE FLOW RATE	MODELED EXISTING POPULATION DESIGN AVERAGE FLOW RATE	MODELED FUTURE LAND USE (DP) DESIGN AVERAGE FLOW RATE	MODELED FUTURE POPULATION (2015) DESIGN AVERAGE FLOW RATE	EXISTING PEAK PUMPING CAPACITY (WITH LARGEST PUMP AS A STANDBY UNIT) (mgd)	MODELED FUTURE LAND USE (DP) DESIGN PEAK FLOW RATE	MODELED FUTURE POPULATION (2015) DESIGN PEAK FLOW RATE	EXISTING PEAK CAPACITY ADEQUACY (A=ADEQUATE, I=INADEQUATE)
Ala Moana	56.7	58.04	56.64	78.67	65.71	101.5	165.78	142.85	I
Moana Park	0.39	0.41	0.54	0.61	0.65	2.1	2.02	2.14	A
Fort DeRussy	2.10	2.40	2.65	2.74	3.82	9.8	6.55	8.68	A
Public Baths	0.43	0.54	0.26	0.62	0.26	2.8	3.61	2.73	I
Beachwalk	12.2	18.68	22.23	22.07	23.95	30.9	44.30	46.68	I
Kahala	4.0	6.78	4.46	8.50	4.31	18.4	17.67	11.73	A
Niu Valley	0.57	0.76	0.52	0.75	0.51	3.9	2.24	1.76	A
Paiko Drive	no record	0.04	0.04	0.04	0.04	0.6	0.22	0.20	A
Kuliouou	0.32	0.38	0.25	0.38	0.27	2.4	1.66	1.38	A
Hart Street	19.6	23.96	19.64	33.63	22.27	87.1	81.32	62.71	A
Awa Street	3.96	4.79	4.09	5.86	4.77	10.0	14.22	12.78	I
Kamehameha Hwy	5.78	7.95	5.21	11.19	5.72	21.6	26.20	18.05	I
Aliamanu I	0.27	0.22	0.30	0.22	0.27	1.2	1.16	1.32	I
Aliamanu II	0.23	0.18	0.24	0.17	0.22	1.2	0.95	1.11	A
Sand Island Pkwy	0.12	1.45	0.48	1.94	0.42	3.2	5.62	2.73	I

Notes:

1. All existing flows do not include Kuliouou in the East Mamala Bay system. All future flows include Kuliouou in the East Mamala Bay system.
2. Dry weather infiltration (DWI) and wet weather infiltration/inflow (WWI/I) are included in the flow rates as shown below. Measured flow rates include DWI and WWI/I components. Modeled DWI and WWI/I used in the modeled rates are 90 percent of the ISAP-estimated DWI and WWI/I rates.
   - Measured average daily pumping rate – includes DWI
   - Modeled existing land use design average – includes ISAP-estimated DWI
   - Modeled existing population design average – includes ISAP-estimated DWI
   - Modeled future land use (DP) design average – includes 90 percent of ISAP-estimated DWI
   - Modeled future population (2015) design average – includes 90 percent of ISAP-estimated DWI
   - Modeled future land use (DP) design peak – includes 90 percent of ISAP-estimated DWI and 90 percent of ISAP-estimated WWI/I
   - Modeled future population (2015) design peak – includes 90 percent of ISAP-estimated DWI and 90 percent of ISAP-estimated WWI/I
3. ▒ highlights design peak flow rate used to estimate costs.
4. Sand Island Parkway has a much higher existing land use and existing population modeled flow rate versus the measured flow rate, because its collection system was recently enlarged and this enlargement is not reflected in the measured flow.

statistically accurate information for the flow model to use: below one mgd, land use information, which is parcel based, gives accurate low-level detail; above one mgd, TAZ population data offers a broader forecasting viewpoint.

Using the above approach, the sewer lines that have been identified as being presently surcharged are shown on Figures 5-1 and 5-2. Sewer lines that are modeled as being surcharged by the year 2015 are shown on Figures 5-3 and 5-4.

WWPSs where the existing peak pumping capacity will not be able to meet the projected 2015 flows are identified in the last column of Table 5-7. It should be noted that the actual capacity required should be determined at the time of preliminary engineering design; for the purposes of the facilities plan, the shaded modeled future peak design flow in Table 5-7 (either population or land-use based) is used for estimating costs.

The Sand Island WWTP will need to be expanded to accommodate an average daily wastewater flow of 90 mgd and a peak flow of 214 mgd, as shown in Table 5-8, based on population modeled flow projections.

If all WWPSs and sewer lines were modeled strictly on future land use from the Development Plan and only the WWTP were modeled on future population (2015), then the projected peak flows to be accommodated would be higher in the larger elements of the collection system. WWPSs whose existing peak pumping capacity would not be able to meet the projected 2015 flows are the same as those identified in the last column of Table 5-7; the required capacities would be those shown under the column labeled "Modeled Future Land Use (DP) Design Peak Flow Rate." The SIWWTP would not be affected and would be based on the modeled future (2015) population flows.

Generally, as shown in Table 5-7, the land use model results in higher flow values than the population model. This is because the land use model conservatively assigns an above average flow value to the various land uses (similar to applying a "safety factor"), as demonstrated by the measured flow being higher than the modeled existing land use design average flow rate for many WWPSs. In contrast, the population model is calibrated to the measured flow, and thus the future population model represents the effects of population growth with no safety factor. Therefore, the actual year 2015 flow will probably fall between the modeled land use and population flows.

It should also be noted that the wastewater projections presented in this section conform to the water demand projections of the Board of Water Supply (BWS). The BWS bases its projections on the City Planning Department's population projections and linearly projects water demand according to the population projections by keeping the demand per person constant. Refer to Table 5-9. The water demands are normally higher than wastewater flow by 10 to 30 percent, since not all water used ends up in the sewerage system. Also, note that the resident and de facto population in Table 5-9 is slightly higher than the values for the study area because the Table 5-9 values include the Hawaii Kai area (which also uses water that does not become sewage for the study area).

5.6 FUTURE ENVIRONMENT WITHOUT THE PROJECT

Sand Island WWTP is presently operating at approximately 89 percent capacity. Portions of the wastewater collection system, including both sewer lines and pump stations, are presently operating at or near 100 percent capacity.

By the year 2015, the resident population of the study area is projected to increase by approximately 69,800 people, or approximately 20 percent of the existing population. If no improvements are made to existing collection and treatment system, demand upon the system will clearly exceed capacity. This section briefly examines the consequences of increased demand.

Table 5-8
Sand Island WWTP Future (2015) Flow Rates

WASTEWATER PUMP STATION	MEASURED AVERAGE DAILY PUMPING RATE (mgd)	FUTURE MODEL DESIGN AVERAGE FLOW (mgd)*	FUTURE MODEL DESIGN PEAK FLOW (mgd)
Hart Street	19.6	22.3	62.7
Ala Moana (with Kuliouou)	56.7	65.7	142.9
Sand Island Parkway	0.1	0.4	2.7
Fort Shafter	1.2	1.4	6.0
TOTAL	77.6	89.8 Rounded to 90 mgd	214.3 Rounded to 214 mgd

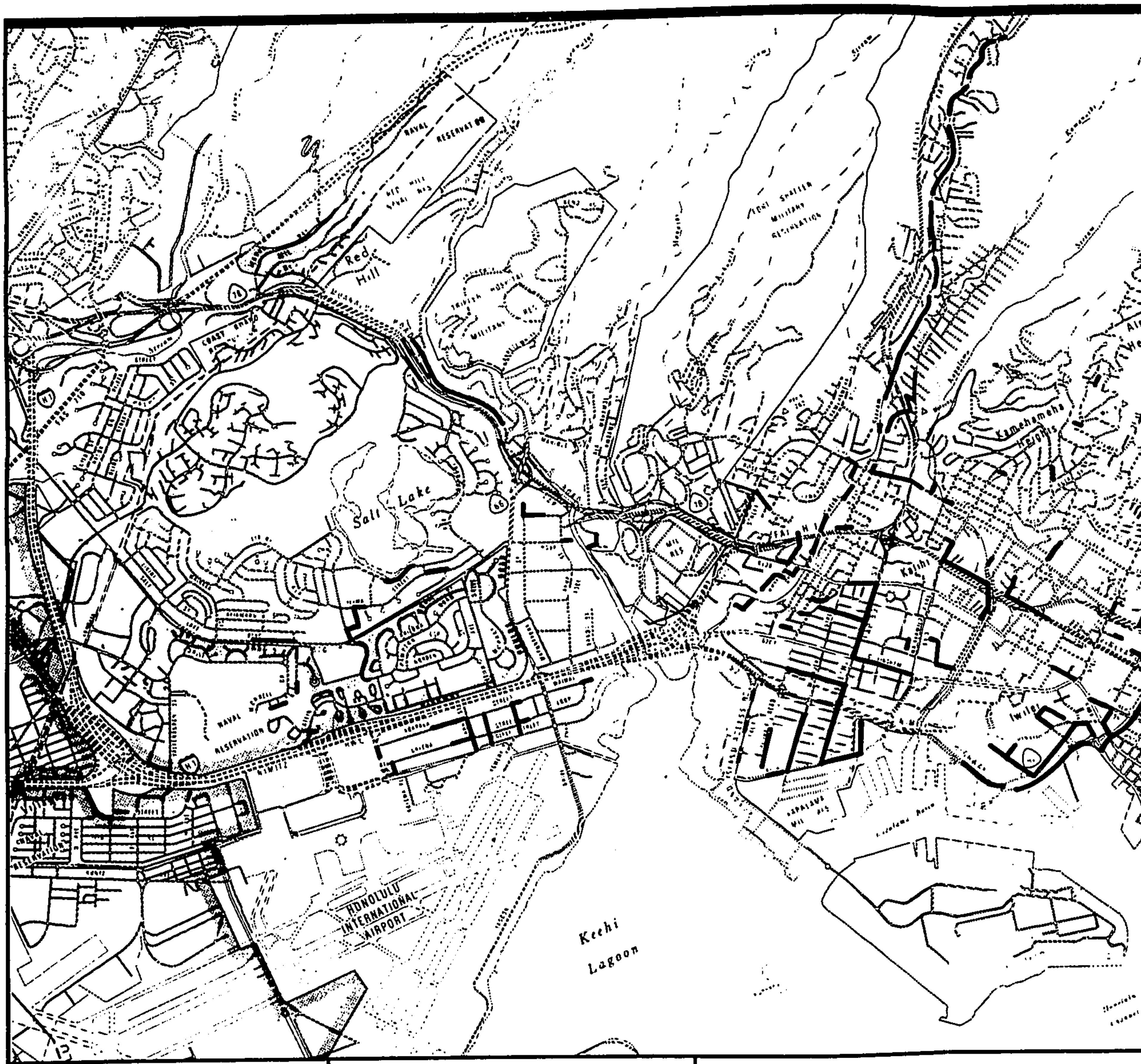
* The projected average flow of 90 mgd exceeds the current Sand Island WWTP design capacity which is 82 mgd.

Table 5-9
BWS Projected Water Demands

YEAR	RESIDENT POPULATION	DE FACTO POPULATION	WATER DEMAND (MGD)
1990	377,059	452,826	86.75
1995	402,171	478,580	91.83
2000	403,498	475,760	91.27
2005	406,888	484,371	92.97
2010	413,968	497,969	95.66

5.6.1 PUBLIC HEALTH AND SAFETY IMPACTS

When demand exceeds existing capacity, public health and safety could be impacted in two ways. First, raw sewage could be redirected from the treatment plant or pump stations directly into the ocean or streams. This could result in potential short-term contamination of ocean recreational areas in the vicinity of a spill. Weather conditions at the time of a spill could exacerbate the situation. If a spill were to occur during Kona weather conditions, southerly winds may interrupt normal circulation and increase the time required for the raw sewage to dissipate. Second, increased demand upon collection lines may result in sewage backups in homes and businesses. In either case, the release of raw sewage into the environment may endanger public health by increasing the likelihood of the public coming into contact with bacteria, viruses, and toxins associated with wastewater.



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

3000 1500 0 3000

Scale in Feet

North

LEGEND:

SURCHARGED SEWER

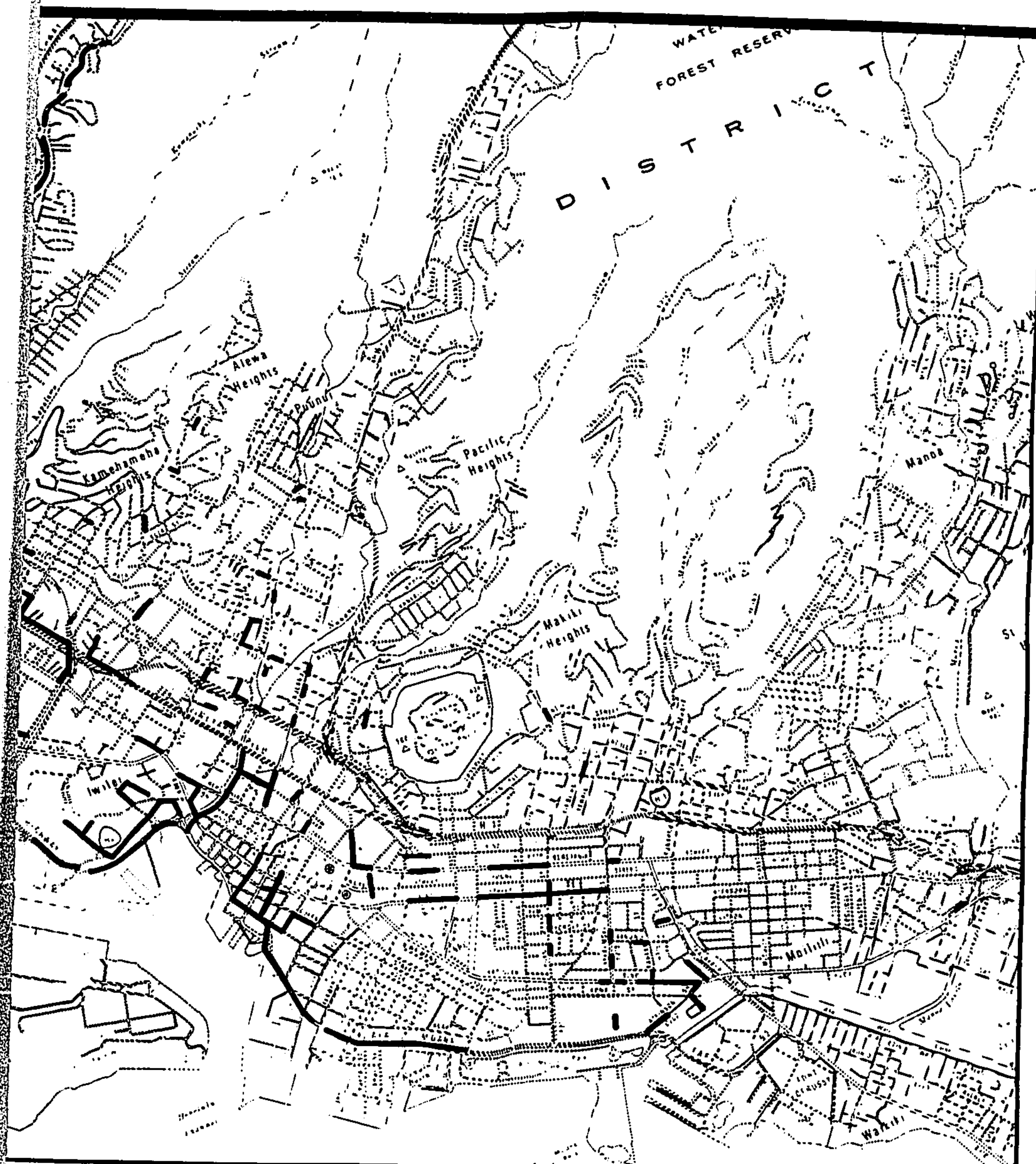


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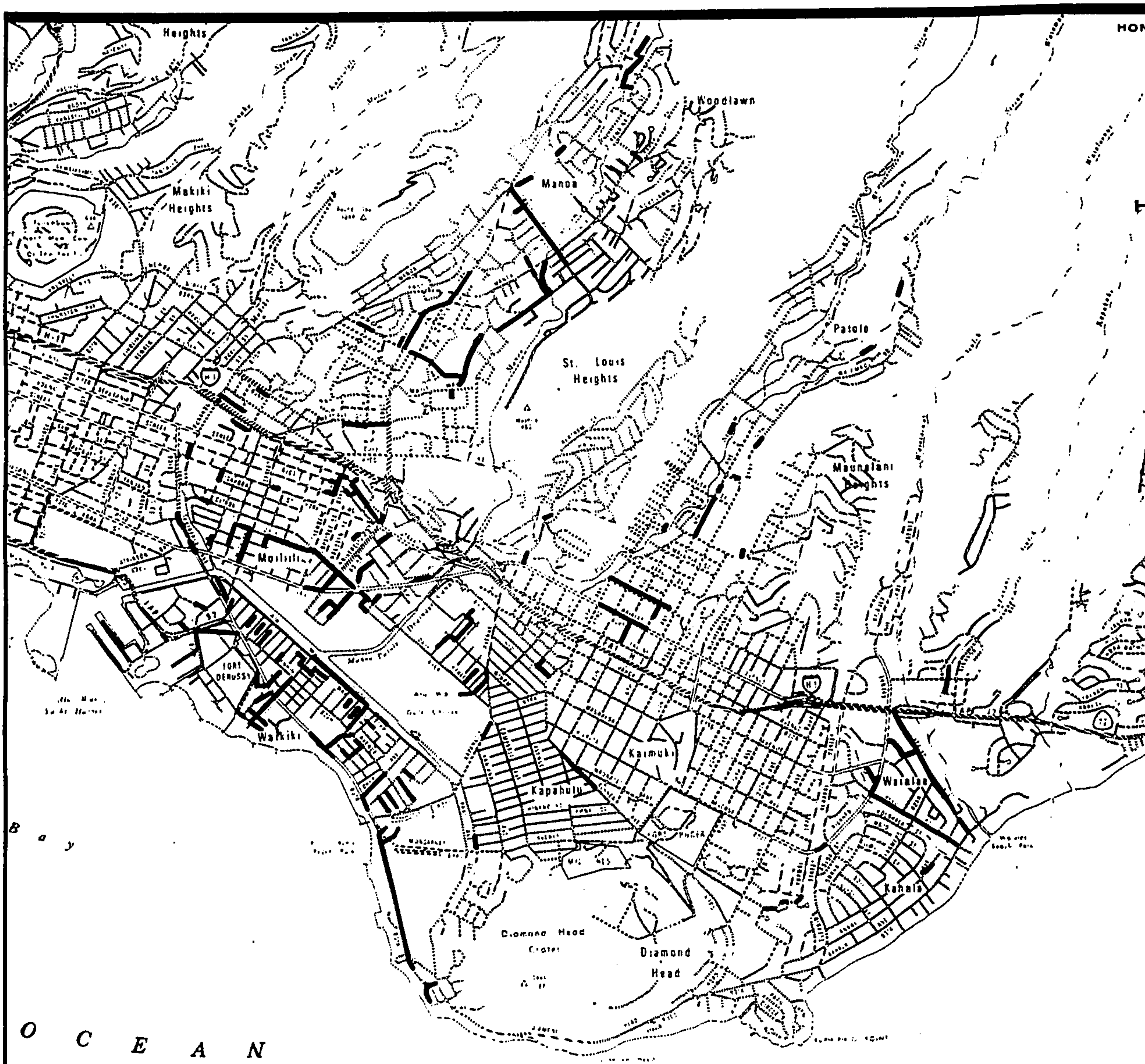
Figure 5-1
Locations of Surcharged Sewers–
Existing Population and Land Use Combined Model



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

3000 1500 0 3000

Scale in Feet

North

LEGEND:

SURCHARGED SEWER

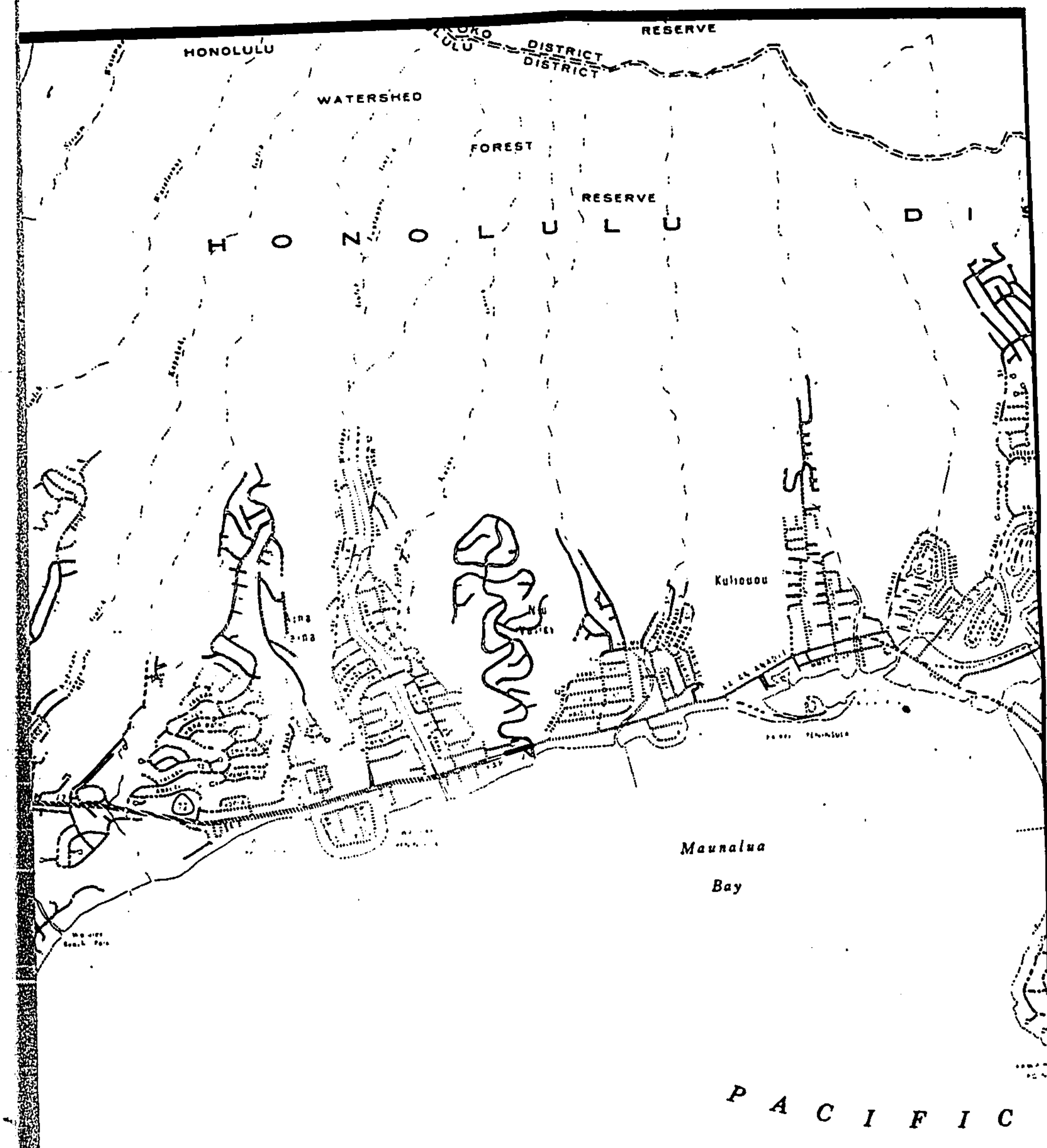


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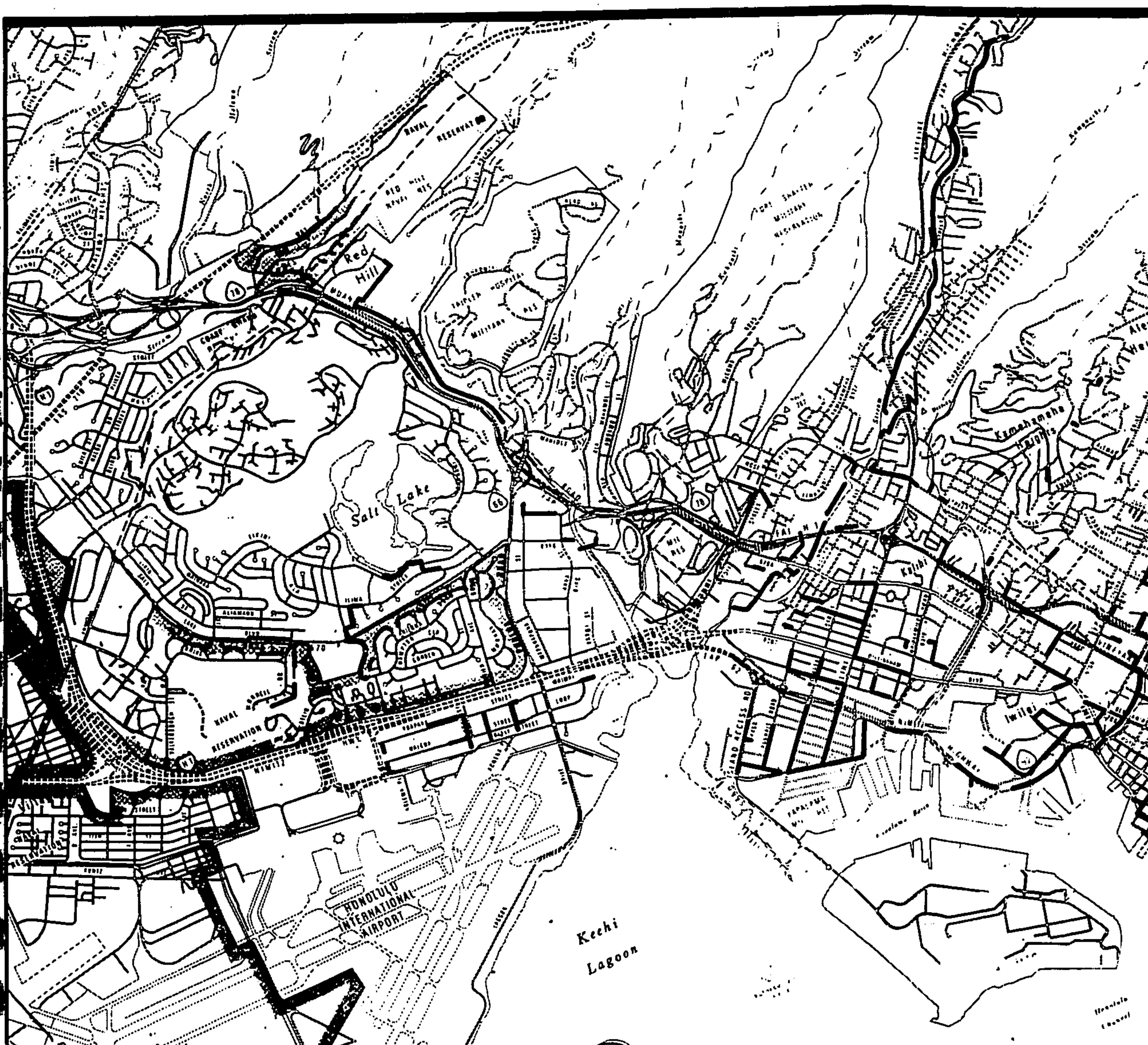
Figure 5-2
Locations of Surcharged Sewers–
Existing Population and Land Use Combined Model



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

3000 1500 0 3000
Scale in Feet
North

LEGEND:

— SURCHARGED SEWER

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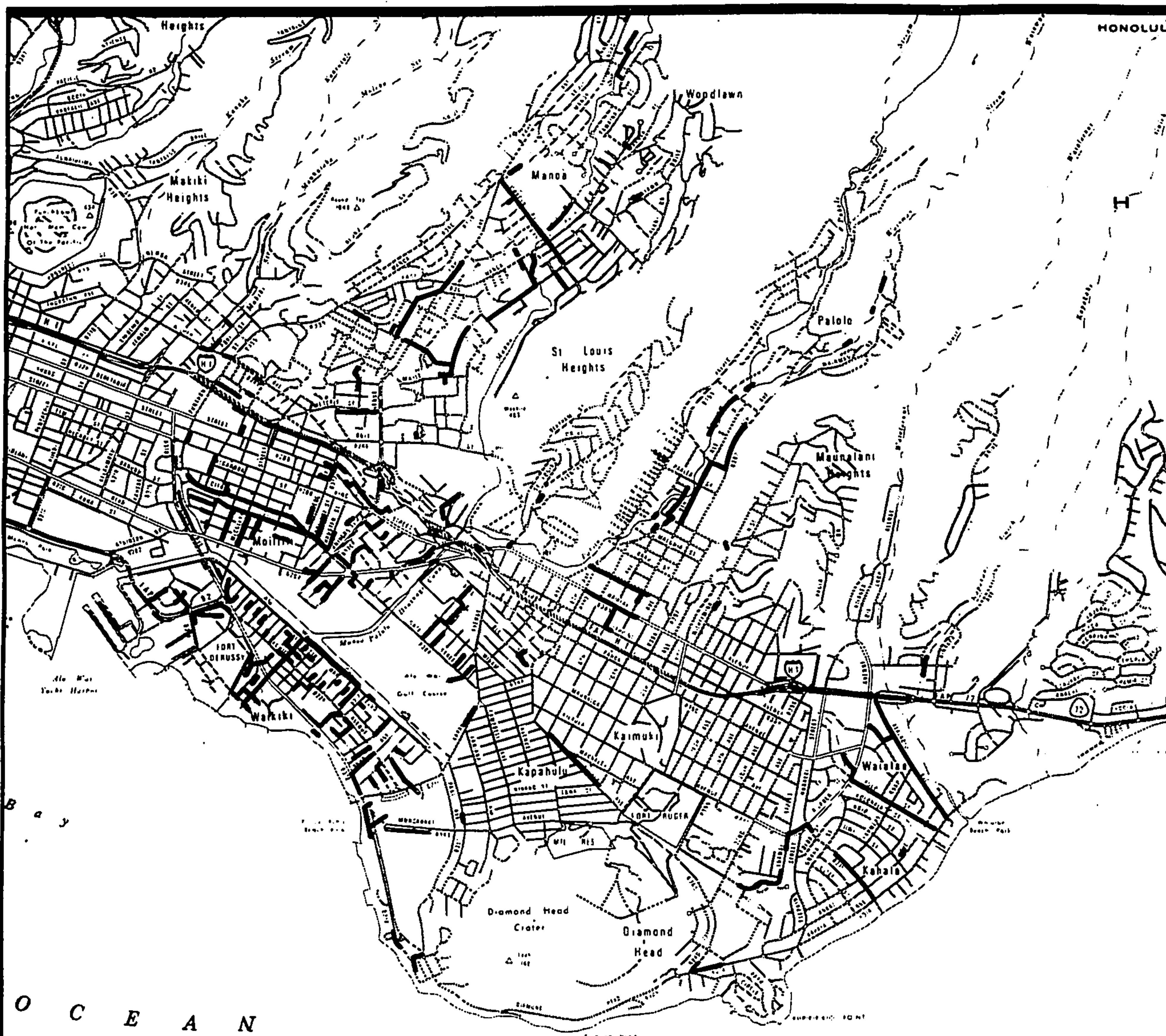
Figure 5-3
Locations of Surcharged Sewers–
Future 2015 Population and Land Use Combined Model



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

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Scale in Feet

North

LEGEND:

SURCHARGED SEWER

Fut

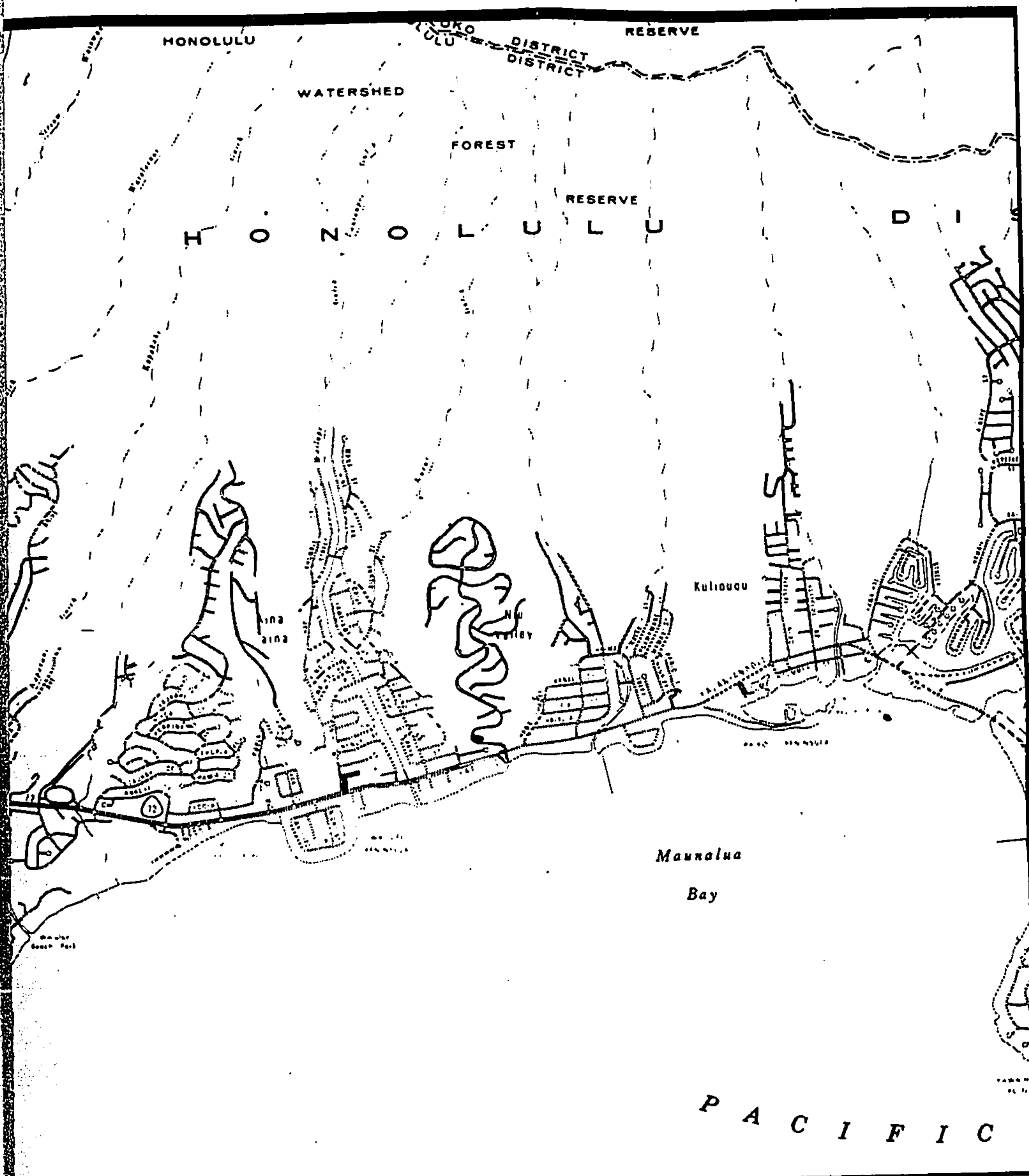

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Figure 5-4
Locations of Surcharged Sewers–
Future 2015 Population and Land Use Combined Model

5.6.2 ENVIRONMENTAL IMPACTS

The release of raw sewage could have significant environmental impacts. In addition to the potential reduction in marine water quality, aquatic biota, including fish, could be affected. Existing and potential ocean-related food sources could become contaminated. Sewage spills could also impact terrestrial flora and fauna. Finally, exfiltration of sewage from deteriorating sewer lines could reach the aquifer and contaminate groundwater resources.

5.6.3 SOCIAL IMPACTS

If the capacity of the collection and treatment system is not increased to meet projected demand, a decrease in the quality of life is expected. In addition to the environmental and public health issues discussed above, a deteriorating wastewater system could disrupt ocean recreation and ocean-recreation-dependent businesses. Constraints imposed on the supply of housing in the study area by a decrease in the availability of sewer hook-ups is discussed in Section 5.6.5.

5.6.4 FINANCIAL COSTS

The East Mamala Bay wastewater system is subject, under the Clean Water Act, to the terms of the Water Quality Planning and Management Program, described in Section 2.3. Sand Island WWTP currently operates under the authority of a NDPES permit. As discussed in Section 2.3.2, this permit regulates the quality of the effluent and its impact on receiving waters. Violations of permit conditions or noncompliance with the terms stipulated under the Water Quality Planning and Management Program, could result in fines, civil penalties, and/or court costs.

Spills, resulting from inadequate sewer lines, or backups at pump stations or businesses and residences could constitute violations of the CWA, and also result in legal fees and fines. Costs would also accrue from cleanups and repairs.

Adverse impacts to recreational activities and a potential change in the perception of Waikiki in particular, and Hawaii in general, as a desirable vacation destination would have serious consequences for the visitor industry. Decreases in tourism would result in reductions in tax revenues to the City and the State, and could result in depressed economic conditions.

5.6.5 GROWTH MANAGEMENT

A deteriorating wastewater collection and treatment system would ultimately constrain housing and economic growth in the study area. Inadequate capacity would prevent new structures from being built, underdeveloped lots from being improved, and existing buildings from being renovated if densities are increased. These impacts would, in turn, reduce employment and housing opportunities in the PUC and East Honolulu. The long-term outcome could be a significant reduction in the City's capability to manage growth as planned.

6
Conceptual Development Alternatives

6.1 INTRODUCTION

The prime purpose of the Facilities Plan process is to develop and evaluate a wide range of options addressing seven different components of the wastewater treatment system in order to define the alternative most likely to fulfill the goals and objectives of the city. The feasibility of each of the components must be evaluated on the basis of numerous criteria, including construction and operating costs. Therefore, each of the options considered had to be very detailed. Such a detailed description of the alternatives is beyond the scope of this EIS. Instead, this chapter presents brief descriptions of the five alternatives considered. Chapters Seven and Eight describe the options that comprise the preferred alternative and their potential impacts, respectively.

For the purposes of this analysis, the wastewater collection-treatment-disposal system has been broken down into seven components:

Component 1 Collection - Areas already sewered
Component 2 Treatment - Areas already sewered
Component 3 Collection & Treatment - Unsewered areas
Component 4 Treatment Level
Component 5 Effluent Disposal
Component 6 Solids Treatment and Disposal
Component 7 Kuliouou WWPS

Specific technical options were identified for each component (Table 6-1). The options are numbered as listed in the table to provide the reader a point of reference.

In the Facilities Plan, each option within each component was described in detail and analyzed on the basis of the appropriate criteria. The total number was then reduced to a smaller group of feasible options. Various factors were considered to determine and rate the feasibility of each option, including constructability, workability, compatibility, and cost.

Five possible alternatives were identified. Each alternative consists of a preferred option for each of the seven components that best meets the intent of the alternative. An alternative was designed for each of four objectives: optimize operation of existing facilities, meet water quality standards, secondary treatment, and eliminate/reduce ocean discharges. The "no action" alternative—wherein no improvements, upgrades, or additions are made to the system—was also considered.

The five objectives (including "no action") are described below.

- *No Action.* Evaluating "No Action" as an alternative is a facilities plan and EIS requirement. The "No Action" alternative comprises the existing wastewater system without upgrades or improvements. It would impose costs on the community by maintaining the status quo, despite projected increases in flows.

- *Optimum Operation of Existing Facilities.* This objective comprises actions necessary for the maintenance of the existing system at its optimum operating capability. It includes repairs and modifications to the existing collection and treatment systems, so that the entire system operates at its designed performance level. It does not allow for capital expenditures, but includes consideration of costs for complete preventive and corrective maintenance of the system.

Table 6-1
System Components and Options

COMPONENTS						
1 COLLECTION– SEWERED AREAS	2 TREATMENT– SEWERED AREAS	3 COLLECTION & TREATMENT– UNSEWERED AREAS	4 TREATMENT LEVEL	5 EFFLUENT DISPOSAL	6 SOLIDS TREATMENT AND DISPOSAL	7 KULIOUOU WWPS
OPTIONS						
Option 1a – No action	Option 2a – Centralized	Option 3a – Extend Centralized	Option 4a – Existing Primary	Option 5a – Outfall	Option 6a – Landfill	Option 7a– No Action
Option 1b – Optimize Operation of Existing Facilities	Option 2b – Neighborhood Facilities	Option 3b – Neighborhood Facilities	Option 4b – Improve Maintenance	Option 5b – Reuse	Option 6b – Thermal Drying	Option 7b – Redirect Collection
Option 1c – Upgrade System for Capacity	Option 2c – Individual Wastewater Systems	Option 3c – Individual Wastewater Systems	Option 4c – Expanded Primary	Option 5c – Underground Injection	Option 6c – Alkaline Stabilization	
Option 1d – Upgrade System for Capacity and Reliability and Minimize Spills			Option 4d – Secondary	Option 5d – Evaporation	Option 6d – Composting	
Option 1e – Upgrade System for Capacity and Reliability and Minimize Subsurface Transfers			Option 4e – Tertiary	Option 5e – Wetlands	Option 6e – Incineration	
					Option 6f – Power Generation	

- ***Meet Water Quality Standards.*** This objective includes upgrades and additions necessary to ensure that the wastewater system consistently meets the future water quality standards. Effluent from Sand Island WWTP must be in compliance with its NPDES permit and with applicable water quality standards. In addition, recreational water quality standards must be maintained in recreational areas adjacent to components of the wastewater system.

- ***Secondary Treatment.*** The "Secondary" objective considers the options required to upgrade the Sand Island WWTP from the existing primary to secondary. Although Sand Island WWTP currently operates under a NPDES 301(h) permit which waives secondary treatment, the secondary treatment option was evaluated because the waiver is discretionary and must be renewed every five years, and because future changes in the law may change the provisions of CWA Section 301(h) which authorizes waivers of secondary treatment.

- ***Eliminate or Reduce Ocean Discharges.*** This objective seeks to eliminate or minimize ocean discharges from the wastewater system. It would require terminating usage of the existing outfall and the minimization of spillage from the collection system. This objective includes establishment of tertiary treatment and discharge of effluent to land.

6.2 PROCEDURE FOR DEVELOPING ALTERNATIVES

An alternative was developed for each of the objectives listed above. Thus, each alternative received its title from its respective objective. Options from each wastewater system component were chosen for each alternative by determining which option(s) would provide a means of meeting the objective. Options were eliminated from consideration for a particular alternative if they were not compatible with the objective or were not compatible with other options. For example, the alternative "Secondary Treatment," by definition, must have a treatment level of "secondary", and the remaining treatment levels (existing primary, improve maintenance, expanded primary and tertiary) are not compatible with this alternative. Table 6-2 presents compatible options for each of the five alternatives. When necessary, (i.e., where more than one compatible option exists), the option determined to best meet the objective was chosen. Section 6.3 discusses the five alternatives in terms of the chosen options.

6.3 DISCUSSION OF ALTERNATIVES

6.3.1 "NO ACTION" ALTERNATIVE

The "no action" alternative involves keeping the existing system as is except for upkeep and normal maintenance. There are various costs and trade-offs involved in not upgrading the system. This alternative looks at the existing wastewater disposal systems in both the unsewered and sewered areas, and the impacts to the community of maintaining the status quo.

The systems in the unsewered areas are primarily cesspools, septic tanks, and aerobic units. The sewered areas include the complete existing collection, treatment, and disposal system.

Under the "no action" alternative, the collection system would continue to produce spills and bypasses that would subject the City to violations under the Clean Water Act. Also, the treatment level at the Sand Island WWTP would decline, as the future average daily wastewater flow entering the plant exceeds its design capacity. Although this alternative should be discarded for these reasons, it was retained for comparison with the other alternatives.

Collection – Sewered Areas: Option 1a – "No Action"

Under the implementation of the "no action" alternative, the collection system would remain in its current state (Option 1a – "no action"). The result of not upgrading the collection system to keep pace with the predicted increases in wastewater flows would be surcharging of sewers throughout the collection system. The surcharge conditions would likely result in spills, overflows, and backups throughout the collection system. Infiltration/inflow would not be reduced by this alternative, and would actually increase over the term of the study period as the sewer lines of the collection system continue to deteriorate. A number of WWPSs would not be able to handle future wastewater flows. As a result of "no action," the chances of spillage and bypasses at the WWPSs, particularly those with limited capacity, increases significantly and the level of treatment would suffer. Because spills and bypasses are prohibited by law, the legal requirements to prevent spills and bypasses do not allow the implementation of the "no action" option.

Table 6-2
Configured Alternatives with Compatible Options

COMPONENTS OBJECTIVES	1 COLLECTION-- SEWERED AREAS	2 TREAT-MENT-- SEWERED AREAS	3 COLLECTION & TREATMENT -- UNSEWERED AREAS	4 TREATMENT LEVEL	5 EFFLUENT DISPOSAL	6 SOLIDS TREATMENT & DISPOSAL	7 KULIOUOU WWPS
No Action	1a – No Action	2a – Centralized	3c – Individual Wastewater Systems (IWS)	4a – Existing Primary	5a – Outfall	6a – Landfilling	7a – No Action
Optimize Operation of Existing Facilities	1b – Optimize Operation of Existing Facilities	2a – Centralized	3c – IWS	4b – Improve Maintenance	5a – Outfall	6e + 6a – Incineration & Landfilling	7a – No Action
Meet Water Quality Standards	1a – No Action 1b – Optimize Operation of Existing Facilities 1c – Upgrading System for Capacity 1d – Upgrading System for Capacity + Reliability (C+R) 1e – Upgrading System for Capacity + Reliability + Minimizing Sub-surface Transfers (C+R+M)	2a – Centralized	3a – Extend Centralized 3b – Extend Centralized + IWS 3c – IWS	4c – Expanded Primary	5a - Outfall 5d – Evaporation 5e – Wetlands	6a – Landfilling 6b – Thermal-Drying 6c – Alkaline Stabilization 6d – Composting 6e – Incineration 6f – Power Generation	7a – No Action 7b – Redirect Collection
Secondary	1a – No Action 1b – Optimize Operation of Existing Facilities 1c – Upgrading System for Capacity 1d – Upgrading System for Capacity + Reliability (C+R) 1e – Upgrading System for Capacity + Reliability + Minimizing Sub-surface Transfers (C+R+M)	2a – Centralized	3a – Extend Centralized 3b – Extend Centralized + IWS 3c – IWS	4d – Secondary	5a – Outfall 5d – Evaporation 5e – Wetlands	6a – Landfilling 6b – Thermal-Drying 6c – Alkaline Stabilization 6e – Incineration 6f – Power Generation	7a – No Action 7b – Redirect Collection
Eliminate/ Reduce Ocean Discharges	1e – Upgrading System for Capacity + Reliability + Minimizing Sub-surface Transfers (C+R+M)	2a – Centralized	3a – Extend Centralized 3b – Extend Centralized + IWS 3c – IWS	4e – Tertiary	5b – Reuse 5c – Underground Injection 5d – Evaporation	6a – Landfilling 6b – Thermal-Drying 6c – Alkaline Stabilization 6e – Incineration 6f – Power Generation	7a – No Action 7b – Redirect Collection

In addition, the operation and maintenance costs associated with the system would continue to increase with this alternative. Funds would be spent on cleaning up spills and on fines the City would incur for spills that violate the Clean Water Act.

Treatment – Sewered Areas: Option 2a – Centralized

The "no action" alternative entails the continued use of centralized treatment at the existing Sand Island WWTP to treat domestic wastewater effluent (Option 2a).

Centralized treatment consists of the collection and conveyance of waste from an area to a single treatment works. Currently, the only centralized treatment facility in the study area is Sand Island WWTP. This option therefore considers the retention of this facility as the only means of wastewater treatment in the sewered areas.

Collection and Treatment – Unsewered Areas: Option 3c – Individual Wastewater Systems

The "no action" alternative consists of not sewering the areas and the continued use of individual wastewater systems (IWS) (Option 3c). Over 1,600 IWS exist in the unsewered portions of the study area. These IWSs are on-site wastewater treatment and disposal systems. The majority of the systems are cesspools. Cesspools have the potential to: (1) inconvenience the user, (2) pose a public health hazard, (3) contaminate drinking water sources, and (4) pollute coastal and surface waters if not properly designed, installed, or maintained. Septic systems can result in similar problems, but in general, they provide a much higher level of safety than cesspools. The DOH's current policy is to require replacement of cesspools with "treatment" individual wastewater systems, such as septic tanks or aerobic units, when the existing cesspool fails or when a building permit application is submitted.

Comparisons of the life cycle costs of IWS versus other collection and treatment options indicates that IWSs would never be the least expensive choice. Further costs and environmental concerns result from the fact that the City offers a subsidized pumping service through which a homeowner can get unlimited pumping service for a fixed cost. Consequently, a homeowner with a failed cesspool has much less incentive to replace it. Therefore, the "no action" alternative is more costly, from an environmental standpoint as well as a fiscal one.

Treatment Level: Option 4a – Existing Primary

The "no action" alternative retains existing primary treatment at Sand Island WWTP (Option 4a). Neither operational and/or maintenance modifications nor facilities expansion would occur.

At a fraction of the cost, primary treatment in combination with the outfall (through dilution of pollutants as the primary treated wastewater mixes with seawater as it travels to the outfall zone of mixing) may achieve a level superior to that of biological (secondary) treatment plant effluent. Under this approach, the wastewater pollutants are sufficiently diluted that the ocean can assimilate them. This approach is sound if there is no public health threat and no exceedance of the water quality standards. Furthermore, this treatment method is highly respected in the wastewater engineering community as a means of optimizing limited economic resources to the long term benefit of society.

At present, the plant is in compliance with the existing NPDES discharge requirements and was determined to be generally well maintained. However, some existing problems were noted. For example, grit causes operational problems, including plugging of the influent channels and the clarifier influent siphon pipe inlets. Plugging of the influent channels has resulted in two spills in recent years. Unless the grit removal system is upgraded, additional spills can be anticipated.

Plugging of the clarifier inlets occurs for several reasons, such as when the grit has not been removed upstream and not all six primary clarifiers are on line simultaneously. Only three to four of the units are in constant use, the remaining units are designed as backups for peak periods. If all six units were in constant use, the detention times would be too long, the wastewater could become septic, and odor problems would occur. However, grit can settle and plug the clarifier inlets when they are not being used.

As discussed in Chapter Four, dissolved air flotation (DAF) was part of the original clarifier design, but was removed because of maintenance difficulties and adequate performance without the units. As of December 1993, the DAF units are being used on a trial basis as part of the settlement agreement between the City and the Sierra Club and Hawaii's Thousand Friends.

The primary problem associated with this alternative is that the projected future flows, based on the population model, are 90 mgd (design average) and 214 mgd (peak). These exceed the design flow rates for the existing facilities (design average flow is 82 mgd; peak is 173 mgd). While the existing plant functions sufficiently under the existing permit limitations, the probability of meeting the possible requirement of 30 percent removal of BOD_5 is very low without improvements and upgrades. Also, the grit plugging problems would remain, and under future peak flow conditions, the design standard applicable to primary clarifiers would not be met.

Effluent Disposal: Option 5a – Outfall

The "no action" alternative consists of the continued disposal of treated wastewater effluent through the existing ocean outfall with the existing ZOM (Option 5a).

The effectiveness of this option was modeled and evaluated. An analysis of water quality monitoring data, effluent data, and shoreline sampling station data, shows that the Sand Island WWTP is generally in compliance with the required water quality parameters. Based on monitoring results and modeled future conditions, primary treatment is sufficient to meet current regulatory standards. However, predicted future increases and flows and potential changes in the water quality standards increase the possibility of violations.

Solids Treatment and Disposal: Option 6a – Landfilling

This alternative would involve Option 6a, the continuation of sludge disposal at a sanitary landfill after stabilization by wet air oxidation and dewatering. Disposal occurs at a "co-disposal" landfill that accepts both solid waste and treated wastewater sludge.

Environmental concerns with this option include the transport of the sludge to the landfill, odor control both enroute and at the landfill, vector control at the landfill, and the impacts on the landfill's remaining capacity. Currently, Sand Island WWTP sludge is being co-disposed at the Kapaa Landfill. However, this landfill is beginning to reach its maximum capacity, and the City is looking for a new disposal site.

Kuliouou WWPS: Option 7a – "No Action"

Under the "no action" alternative, Kuliouou WWPS would continue to pump sewage to the Hawaii Kai WWTP (Option 7a). This option would not impact the Sand Island wastewater collection system, but the possibility of wastewater spills due to overloading of the Hawaii Kai collection system would continue.

Conclusion - "No Action" Alternative

Under the "no action" alternative, the collection and treatment system would not be improved or upgraded. No capital costs would be incurred, but spills and bypasses that would continue to occur that would subject the City to violations under the Clean Water Act. Projected future flows would exceed the design level of Sand Island WWTP and the treatment level would decline. The cost of the spills and associated fines can not be determined, but would most probably be of the order of millions of dollars. In addition to these costs, legal fees would also accumulate due to probable enforcement actions from the EPA.

6.3.2 Optimize Operation of Existing Facilities Alternative

This alternative includes repairs, increased maintenance, and limited expansion of existing collection and treatment systems to ensure that the system operates at its optimum. However, no new major capital investments are proposed.

Collection – Sewered Areas: Option 1b – Optimize Operation of Existing Facilities

Option 1b includes projects designed to optimize operation of all existing facilities. Included in this option is the implementation of water conservation measures intended to reduce the volume of wastewater generated in the study area and infiltration and inflow reduction measures designed to result in reduced flows in portions of the collection system. Specific measures include regular inspection and repair of sewer lines for clogging and root growth, leakage, and breakage. More intensive testing of electrical and mechanical systems as well as more frequent equipment maintenance, at the WWPS are also proposed. The Supervisory Control and Data Acquisition (SCADA) system should be expanded. Sewer rehabilitation would also optimize the existing system by decreasing infiltration, inflow, and exfiltration. Specific projects, however, cannot be identified until completion of the Sewer Rehabilitation and Infiltration & Inflow Minimization Plan.

Treatment – Sewered Areas: Option 2a – Centralized

This alternative entails the continued use of centralized treatment (the existing Sand Island WWTP facilities, Option 2a) to treat domestic wastewater.

Collection and Treatment – Unsewered Areas: Option 3c – Individual Wastewater Systems

This alternative would retain individual wastewater systems in the unsewered areas (Option 3c). However, operation of the existing systems would be improved. For example, failed cesspools would be replaced with new septic tank systems. A monitoring program could be developed to ensure detection of failed cesspools and replacement, and proper solids removal from septic tanks. The problems identified in Section 6.3.1 would still exist, however.

Treatment Level: Option 4b –Improve Maintenance

Option 4b (Improve Maintenance) would maintain the existing facilities at Sand Island WWTP, but would seek to improve primary treatment through minor modifications to existing units. No units would be added.

Pretreatment: Although the treatment plant is operating well at this time, treatment could be improved through implementation of wastewater pretreatment before it is processed at Sand Island WWTP. Wastewater could be more efficiently treated by removing particular types of pollutants upstream of Sand Island WWTP. Other options are to charge a higher usage fee based on the generators' contribution of a particular pollutant, or to award negotiable pollution permits to industrial users. The latter system would reward producers that reduce pollutant concentrations in their wastewater by allowing them to sell or lease their excess permitted waste level.

Grease is a wastewater component that causes problems in the collection system, pump stations and in the treatment plant itself. More than half of the sewer collection system complaints were related to grease blockage. One of the primary contributors of grease is restaurants; stricter enforcement of grease collection at the source would result in decreased maintenance costs at the WWTP and cleaner wastewater. Alternatively, a higher fee, based on the pounds of grease discharged by restaurants could be charged.

Another alternative is regulation of commercial and household hazardous wastes. Future DOH regulations may include stricter standards for effluent discharge and/or sludge reuse. Components in household products such as heavy metals could be far more effectively eliminated upstream of the treatment plant by a collection system for household hazardous waste. However, these improvements are difficult to implement.

Screening: The spacing between the bars of the influent bar screens is too wide for effective removal of coarse materials. Improved maintenance is unlikely to improve the removal rate. The screens should be replaced with finer mechanically cleaned bar racks for improved coarse solids removal.

Clarifiers: Clarifiers are the heart of the existing wastewater treatment operation. It is in these tanks that most of the purification (BOD_5 and TSS removal) occurs. To date, removal of TSS has been excellent; for years 1988 to 1990 removal has exceeded 60 percent which is twice the possible NPDES renewal standard. Of particular significance to this option is whether or not improvements to the clarifiers can attain the 30 percent monthly minimum average removal for BOD_5 that may be required by the NPDES renewal permit. Approximately 60% of the BOD_5 is particulate rather than soluble material (R.M. Towill, 1991). Assuming that a substantial portion of the particulate BOD_5 is colloidal and cannot be settled efficiently, clarifier upgrades alone are expected to result in only marginal improvements in BOD_5 removal rates. However, the particle distribution should be investigated to confirm that this assumption is true.

Clarifier improvements worth investigating to optimize removal efficiencies include deepening and/or replacement of the existing collection blades with spiral blades, an increase in rotation speed, addition of deflection baffles under the weirs, and weir adjustments (presentation 1993 HWPCA annual meeting). These upgrades could dramatically improve solids removal and reduce the number of clarifiers needed under the higher peak flow conditions. This option proposes that the City study clarifier modifications and implement those that would improve performance.

In addition to meeting future possible increases in BOD_5 removal standards, another concern is whether the existing clarifiers can adequately accommodate the anticipated increase in peak flow over the study period from 173 mgd to 214 mgd. Design consultants for the City DWWM suggest conducting a series of flow loading tests on the clarifiers to see if the removal is adequate for the anticipated design and peak flows. If the tests are successful, then the overflow regulatory standards which are the responsibility of City could be waived. Upstream polymer addition could enable sufficient removal that a design flow of up to 90 mgd could be accommodated with the existing number of clarifiers. Both the flow loading tests and analysis of upstream polymer addition are included in this option.

Summary – Option 4b – Improve Maintenance: The Improve Maintenance option includes components that would result in the optimization of the existing units. It is unlikely, however, that it would result in consistent future compliance with the possible NPDES 30 percent BOD_5 average monthly minimum removal rate. It also does not adequately address grit removal difficulties; this would probably only be solved through addition of new facilities.

Clarifier improvements potentially provide treatment efficiency gains for relatively little additional cost. It is an area that bears careful examination by the City before proceeding with large amounts of capital for additional clarifiers to meet peak flow demand. It appears that increasing the number of clarifiers can be delayed with little ill effect. When further advances in clarifier technology are available, a superior clarifier (if needed) can be constructed for about the same costs as one similar to the existing units, since clarifier technology is improving rapidly (Albertson, presentation, 1993 HWPCA conference). Unless the current City standards are changed to allow higher peak overflow rates, however, two additional clarifiers would be required to accommodate increased flows, but are not considered in the "improved maintenance option." In addition, with or without the DAF portion of the existing facilities, the existing facilities are not sufficient to meet the projected future flows. Treatment efficiencies would decline as flow rate increased.

Effluent Disposal: Option 5a – Outfall

This alternative includes Option 5a, the continued use of the existing ocean outfall, which has been discussed in Section 6.3.1.

Solids Treatment and Disposal: Options 6e & 6a – Incinerator & Landfilling

This alternative would include landfilling (Option 6a) and incineration (Option 6e). Option 6a was discussed in the previous Section; Option 6e is described below.

Option 6e – Incineration

Incineration involves high temperature oxidation through the use of furnaces or deep-well wet air oxidation. Sand Island WWTP has two existing multi-hearth furnaces. These furnaces are not large enough to handle the projected sludge volumes from primary treatment; the excess would have to be landfilled (see Section 6.3.1).

In conventional incineration, sludge must be sufficiently dewatered prior to incineration, regardless of the treatment level. When biosolids with a moisture content of 75 percent (25 percent solids) or less is delivered to the incinerators, the heat required to evaporate the water nearly balances the available heat from combustion of the dry solids and the process requires no additional energy input. Current dewatering facilities at Sand Island WWTP, however, produce sludge with a moisture content higher than that required for efficient operation of the incinerators.

The incineration process must be shown to comply with air quality standards before implementation and throughout operation. Emissions must conform to federal and State Air emission standards. Currently, only one of the incinerator furnaces has passed emission tests and is permitted. The City is working to bring the second furnace into compliance. Increases in sludge production, as a result of increased flow rates, and the corresponding increase in incinerator use may result in exceedances of certain air quality standards. Exceedances of the PSD Class II increments require the initiation of best available technology (BAT) to lower emissions to within acceptable levels. To reach these levels may require the use of improved venturi scrubbers and subcoolers or the addition of electrostatic precipitators.

A large portion of the heat emitted by the burning of biosolids is lost with the stack gases while a small portion is lost with the ash. The portion lost in the stack gases can be recovered by preheating incoming furnace air. The reuse of stack gases can save considerably on auxiliary fuel costs.

Environmental concerns regard the air emissions caused by incineration. Mitigation would include taller stacks and the appropriate scrubbing technology to meet Clean Air Act Standards. Odors could be kept to a minimum by exposing the stack gases to deodorizing temperatures of 1,350° to 1,400° F after the gasses pass the biosolids in the incinerator.

Kuliouou WWPS: Option 7a – "No Action"

The Kuliouou WWPS would continue to pump sewage to the Hawaii Kai WWTP collection system (Option 7a – "no action"). However, the potential for spills resulting from overloading of the Hawaii Kai collection system would continue.

Conclusion – Optimize Operation of Existing Facilities Alternative

Under this option, there would be continued spills and overflows (though at a lesser degree than the "no-action" alternative) because future wastewater flow capacity requirements would not be met. Also, the treatment level at the Sand Island WWTP would decline and the average daily wastewater flow entering the plant would exceed its design capacity. This option would subject the City to fines and penalties similar to the no-action option and thus, is legally prohibited by the requirements of the CWA.

6.3.3 MEET WATER QUALITY STANDARDS ALTERNATIVE

This alternative includes the options needed to meet applicable Federal and State water quality standards. Federal requirements are addressed through the NPDES permitting process. The NPDES permit for Sand Island WWTP requires effluent to be in compliance with all established physical, chemical, and biological standards. In addition, State of Hawaii Water Quality Standards for open coastal waters must be met outside of the ZOM boundary.

Collection – Sewered Areas: Option 1d – Upgrade for Capacity & Reliability & Minimize Spills

This option would include the improvements in Option 1c, upgrade system for capacity, as well as additional improvements and upgrades designed to increase reliability and minimize spills. All analyses are based on the assumption that Kuliouou flows would be diverted to Sand Island WWCS.

Capacity improvements include construction of parallel, replacement, or diversion sewer lines. These improvements should be undertaken in areas where the existing gravity sewer lines are, or will be, subject to wastewater flows that are greater than 100% surcharged (see Chapter Five for discussion and location map of surcharged areas). All the WWPS will also require modifications for capacity upgrades and/or reliability improvements to meet future flow projections. Improvements for increased capacity include increased pump capacity and new, larger emergency generators. Installation of new force mains are also recommended to accommodate future flows. Recommended changes intended to improve reliability include installation of new sewer force mains, new WWPS and WWPS improvements. In addition, the diversion of flow from a 30-inch cast iron sewer line (and converted force main) running along Nuuanu Stream and River Street is proposed. By transferring its flow from the Hart Street collection system to the Ala Moana collection system, this potentially unreliable line would be eliminated.

Treatment – Sewered Areas: Option 2a – Centralized

The only feasible option for this alternative is centralized treatment (Option 2a), collecting all wastewater and treating it at Sand Island WWTP.

Collection and Treatment – Unsewered Areas: Option 3a – Extend Centralized

Option 3a (extending the centralized system to unsewered areas) is the proposed option for this alternative. Analyses indicated that it would be feasible, and less expensive, to sewer all of the unsewered areas with some type of collection system. The unsewered areas and recommended type of extension scheme (conventional gravity sewerage, small diameter gravity sewerage, low pressure sewerage, or vacuum sewerage) are summarized in Table 6-3.

Treatment Level: Option 4c – Expanded Primary

Out of the five possible options for treatment level, only expanded primary (Option 4c) and secondary (Option 4d) can be considered for meeting water quality standards. As explained earlier, the "no action" and improve maintenance options would not achieve the objective of this alternative. Tertiary treatment (Option 4e) exceeds the requirements for meeting water quality standards, and thus is also not considered.

Analyses of the existing water quality monitoring data and modeling of future conditions indicate that primary treated effluent would be sufficient to meet the current WQS at the existing ZOM at the future effluent flow rate. Based on this modeling, primary treatment with improvements for increased capacity and improved reliability would be the preferred level of treatment. The secondary treatment option was rejected for this alternative because of life cycle costs and solids disposal impacts. The capital and operating costs of secondary treatment are significantly greater than those associated with expanded primary (see Table 6-5 at the end of this chapter).

The selection of primary treatment is based on the assumption that the 301(h) waiver can and would be renewed. Based on the studies performed as a part of this Facilities Plan/EIS process, the renewal of the waiver should be granted under the current requirements. However, unforeseen changes in the Federal Clean Water Act could change conditions under which the waiver can be granted, or discontinue the waiver altogether. If this were to occur, and secondary treatment had to be implemented, the entire 50 acre parcel at Sand Island WWTP would be required for expansion of the facilities. Therefore, this alternative includes the condition that all currently vacant area on the parcel be retained (or used for temporary activities), to provide for the possibility that secondary treatment may be mandated at a future date. The proposed expanded facilities are sited such that expanding to secondary treatment, should that be required, could be facilitated.

Table 6-3
Proposed Extension Schemes for Unsewered Areas

UNSEWERED AREA		EXTENSION TYPE
Mapunapuna Industrial Area		Low pressure / small diameter gravity
Nuuanu Pali Drive		Small diameter gravity
Puowaina Drive, Punchbowl		Small diameter gravity
Makiki Heights	Subarea 1	Conventional gravity
	Subarea 2	Small diameter gravity
	Subarea 3	Conventional gravity
	Subarea 4	Conventional gravity
	Subarea 5	Conventional gravity
Upper Tantalus, Round Top		Low pressure / small diameter gravity
Diamond Head	Subarea 1	Conventional gravity
	Subarea 2	Conventional gravity
	Subarea 3	Low pressure
East Manoa Road, Kinohou Place		Low pressure
Upper Palolo Valley		Small diameter gravity
Aukai Avenue		Conventional gravity
Black Point		Low pressure
Crater Road		Low pressure

Option 4c - Expanded Primary would incorporate many of the recommendations from the improve maintenance option as well as new treatment units necessary for capacity expansion and improved reliability and efficiency. Major upgrades and improvements are also proposed in this option, including new influent bar screens, grit removal chambers with an odor control system, additional primary clarifiers, standby chemical additional facility, an effluent flushing water system upgrades to the effluent pump station, the addition of anaerobic sludge digestion, and additional final sludge processing.

Many of the components of the expanded primary option are already being studied and/or being implemented through the City's Capital Improvement Program (Table 6-4). These include additional and improved influent screening, additional clarifiers, new grit removal chambers, standby chemical treatment facility, and a new odor collection system.

Effluent Disposal: Option 5a – Outfall

The outfall (Option 5a), evaporation (Option 5d) and wetlands (Option 5e) options were considered for this alternative. The evaporation and wetlands options would redirect effluent from the existing ocean outfall to large shallow ponds. The goal of the evaporation system is complete evaporation of the effluent stream without a liquid discharge to the environment. The ponds for the wetlands option would be designed such that the effluent would flow through hydrophilic plants, such as bulrushes, where microbial growth on the stems and roots would further treat the effluent to tertiary standards. Intermixed with the plants would be open areas to allow surface feeding fish to control vectors such as mosquitos. The portion of the water entering the wetland treatment facility that does not evaporate would then be discharged or reused. Because these two options would require a considerable amount of very flat land, they are undesirable from a land cost standpoint.

The outfall method of effluent disposal was chosen as the preferred option for this alternative. Water quality monitoring data and modeled future conditions indicate that the outfall is generally in compliance with Water Quality Standards and should remain so in the future. Therefore, the large land area requirements and high costs of the evaporation and wetlands disposal methods are not justified.

Table 6-4
(2 Pages)
Capital Improvement Program Projects for WWTP Improvements

PROJECT NAME	PROJECT DESCRIPTION/JUSTIFICATION
Wastewater Facilities Grounds Modification	Scope: Project consists of modifying the grounds of city-operated wastewater facilities. Focus would be on the Sand Island WWTP to install a sprinkler system and to increase tree planting. Justification: Modifying the grounds will make the treatment plant and pump stations low maintenance facilities. The modifications will also reduce labor, conserve water, reduce the use of fertilizers and pesticides, and prevent noise pollution.
Wastewater Facilities, Upgrading Underground Storage Tanks	Scope: Project involves replacing or modifying existing underground fuel storage tanks and piping at various wastewater facilities in accordance with EPA regulations. It would also include the installation of leak detection devices and/or spill/overfill prevention devices. Funding of this project has been approved through 1997. Justification: The project will minimize the possible occurrence of leaks of petroleum products from wastewater facilities into the environment.
Sand Island WWTP, Unit I, Phase 2A	Scope: Project involves the construction of chemical treatment facilities and additional pretreatment facilities at the Sand Island WWTP. Justification: The project would satisfy the requirement for 30% removal of BOD_5 material for secondary waiver discharges specified in the Water Quality Act of 1987, assist in removing BOD_5 during periods of poor performance, and improve the efficiency of the plant.
Sand Island WWTP, Unit I, Phase 2B	Scope: Project involves designing and constructing a 0.5 mgd activated sludge treatment facility, consisting of two 0.25 mgd systems operated in parallel and appurtenant equipment. Justification: The facility would provide clarified secondary effluent for in-plant use as process water and to use the proposed facility as a "hands-on" training facility for both new and experienced operators.

Table 6-4
(2 Pages)
Capital Improvement Program Projects for WWTP Improvements

PROJECT NAME	PROJECT DESCRIPTION/JUSTIFICATION
Sand Island WWTP Disinfection Facility	Scope: Project consists of providing a permanent disinfection facility at the Sand Island WWTP. Justification: Based on State Department of Health requirements and the results of a chlorination study, the project would provide the Sand Island WWTP with a disinfection facility needed to comply with the requirements of the NPDES permit.
Sand Island WWTP Expansion, Primary Treatment, 94 mgd	Scope: Project involves installing additional primary treatment units, including pretreatment facilities. Justification: The project is required to increase the capacity of the existing treatment plant, from 82 to 94 mgd in order to accommodate increasing anticipated future flows.
Centralized Parts Warehouse at Sand Island WWTP	Scope: Project consists of an 8000 ft² parts warehouse to be constructed at the Sand Island WWTP. Justification: Project would enable the City to have a centralized parts storage and distribution warehouse for its various wastewater treatment plants and pump stations. The warehouse would allow for an adequate inventory of important parts and assemblies, and therefore reduce equipment breakdown repair time. Prompt repair and/or replacement of inoperable equipment would preserve proper wastewater collection (including pumpage), treatment and disposal, and thus protect human health and welfare. The project would also prevent the City from being fined up to $25,000 per day for bypasses.
Sand Island WWTP Septage Handling Facility	Scope: Project consists of constructing facilities to handle septic tank and cesspool wastes within the existing Sand Island WWTP site. Justification: Project is required to provide an area for private pumpers to discharge cesspool wastes.

Solids Treatment and Disposal: Options 6a through 6f

All solids disposal options (Option 6a – landfilling, Option 6b – thermal drying, Option 6c – alkaline stabilization, Option 6d – composting, Option 6e – incineration and Option 6f – power generation) are viable for this alternative, since there is not a very strong relationship between the solids disposal option and meeting water quality standards. Based on the available analyses, this alternative includes thermal drying, alkaline stabilization or power generation, with landfilling and incineration retained as back-up systems. The preferred solids disposal options would include privatizing ultimate treatment and disposal thereby moving the operational and marketing risk from the City to those vendors who have experience in producing and marketing a biosolids product. Technologies would include in-vessel composting, post-dewatering alkaline stabilization, power generation, and a privatized thermal drying pelletizer plant.

The backup options, 6a (landfilling) and 6e (incineration) have been discussed in previous sections; the other four options are summarized below.

Option 6b - Thermal Drying: Thermal drying dries and pelletizes the sludge into a marketable product that is easy to store and transport. Furthermore, the system qualifies as a Process to Further Reduce Pathogens (PFRF) by the EPA and the resulting product meets 40 CFR 503 criteria for distribution and marketing.

Option 6c - Alkaline Stabilization: Alkaline stabilization involves adding an alkaline chemical to the sludge to stabilize it, to destroy pathogens, and to reduce odors. The process includes raising the pH and temperature of the sludge for a certain period, then drying the resulting material. The process generates a useable product and also qualifies as a PFRP.

Option 6d – Composting: Composting is a process in which solids are degraded, through biological processes, a stable end product. The end product, compost, if of good quality, is sanitary, nuisance-free and humus-like (M&E, 1991). Although approximately 20 to 30 percent of the volatile solids are converted to carbon dioxide and water, volume is not reduced, since bulking agents such as woodchips or bagasse are required as additives to decrease weight and ensure porosity for aerobic decomposition.

Composting may be done outdoors or in an enclosed container (i.e., in-vessel composting). The advantage of outdoor composting is minimal capital costs; however, it requires more land and is more labor intensive. In-vessel composting is an energy and capital intensive process. In-vessel composting would be preferred for Sand Island WWTP because it requires less land and is enclosed, making odors easier to control. The disadvantage to in-vessel composting is the high initial capitalization cost. An in-vessel composting unit would fit on the Sand Island WWTP site under this alternative, provided that the treatment level is expanded to primary. If the WWTP must be upgraded to secondary, however, the composting unit would have to be dismantled and removed. Therefore, although composting is a viable, and in some cases attractive, option, it is not recommended as part of this alternative because of space conflicts.

Option 6f - Power Generation: Power generation requires a product which is suitable as fuel. One process capable of producing such a fuel is the Carver-Greenfield method, which uses evaporation to remove the water from the sludge. Oil is mixed with the sludge prior to evaporation then is separated out of the dried mixture and recycled through the process. After combustion, the end product is also suitable as fertilizer with additional energy input.

Kuliouou WWPS: Option 7b – Redirect Collection

Option 7b is recommended as part of this alternative. This option provides for the redirection of the Kuliouou WWPS wastewater flow to the Sand Island WWCS by using the existing Kuliouou WWPS to pump the wastewater to the Ala Moana WWCS. The additional volume contributed by the Kuliouou WWPS would be less than one percent of the total predicted flow into Sand Island WWTP. A new force main to connect the WWPS would be required.

Conclusion – Meet Water Quality Standards Alternative

Under this alternative, the collection and treatment system would be modified to meet water quality standards and reduce the spills and bypasses that would subject the City to violations under the Clean Water Act. Also, the Sand Island WWTP would be expanded and upgraded to sufficiently treat all of the future wastewater flow entering the plant. Various options are viable for solids treatment and disposal. This alternative includes privatization of one or more of these options, with landfilling and incineration as backups. Kuliouou WWPS should be re-directed to the Sand Island collection system.

6.3.4 SECONDARY TREATMENT

The CWA requires that treated effluent discharged by a POTW such as Sand Island WWTP receives the equivalent of secondary treatment. However, this requirement can be waived if conditions in Section 301(h) of the CWA are met (these include compliance with effluent and receiving water standards). The Sand Island WWTP currently operates under an NPDES permit which waives secondary treatment (i.e., a 301(h) waiver permit). The existing primary system meets effluent and water quality standards, and is projected to continue to do so at year 2015 flows with the upgrades for capacity and reliability discussed in Section 6.3.3. However, uncertainty exists regarding future continuation of the 301(h) waiver. Thus, this alternative considers secondary treatment.

Collection – Sewered Areas: Option 1d – Upgrading System for Capacity and Reliability

This alternative includes Option 1d, Upgrade System for Capacity and Reliability and minimize spills. Option 1d was discussed in Section 6.3.3.

Treatment – Sewered Areas: Option 2a – Centralized

The option of centralized treatment (Option 2a) is the only reasonable option for this alternative.

Collection and Treatment – Unsewered Areas: Option 3a – Extending Centralized System

The unsewered area collection and treatment Option 3a (extend centralized system) is included in this alternative. Refer to Section 6.3.3 for a summary of this option.

Treatment Level: Option 4d – Secondary Treatment

By definition, this alternative is based on secondary treatment (Option 4d) at Sand Island WWTP. Commonly, secondary treatment includes a microbiological process in which soluble and colloidal organic matter is metabolized by microbes as a food and energy source. This occurs in a chamber or holding tank where the wastewater is brought into contact with the microbiological community and purified of pollutants. The organic matter in the wastewater largely is converted into water, carbon dioxide, and biosolids. Secondary treatment typically results in maximum monthly averages of 30 mg/l BOD_5 and 30 mg/l TSS. Secondary treatment biosolids have several potential uses.

Biological treatment is usually preceded by primary or gravitational treatment; in some situations, biological treatment is the first treatment and primary clarification is eliminated. The advantages of the latter include the money and land saved by eliminating primary clarifiers and having a single sludge stream.

Elimination of primary treatment was examined for Sand Island WWTP. But is not feasible for two reasons: 1) the existing layout does not result in large space savings by elimination of existing primary clarifiers; 2) the greasy wastewater influent may not permit primary clarification elimination without creating operational problems in downstream units. Thus, this option includes primary clarification prior to biological treatment. Because further treatment would occur, the clarifiers do not have to be designed to the conservative overflow standards required for primary treatment.

Biological wastewater processes can be of two types, aerobic and anaerobic. The latter, though potentially promising and less expensive, is virtually untested on the proposed scale (only one full scale application is known). For this reason, anaerobic treatment is not considered further.

Aerobic biological treatment processes are divided into three categories:

- Attached growth systems
- Suspended growth systems
- Combined systems, which incorporate both suspended and attached growth systems

Attached Growth Systems: Attached growth or fixed film systems are biological treatment processes in which the major portion of the system's microbes are attached to inert surfaces or media. Such growth is common in the natural environment and can be used as an advantage in wastewater treatment. The chief advantage of fixed films are that they are resistant to hydraulic and organic shock; unlike suspended growth systems (discussed in the next subsection), the fixed films microbes remain in the holding tank (reactor) during hydraulic surges. Because the fixed films are generally older communities than suspended growth systems, they tend to have been exposed to a wider range of operating, environmental and feeding conditions; thus they have a greater tolerance for extremes in conditions which might inhibit or kill a suspended growth system. Fixed film systems generally have lower maintenance requirements. Once established, the systems generally run smoothly.

In addition, fixed film systems generally can be loaded at a higher rate than suspended systems on a unit volume basis. Thus, a smaller reactor can be built and achieve the same quality treatment. In summary, a fixed film system generally has a longer solids retention time (SRT) and a shorter hydraulic retention time (HRT); both of these are significant operational benefits.

Fixed film systems have disadvantages also. They offer less flexibility than suspended growth systems. Plugging of the substrate on which the films reside can occur. Less experience with these systems exists. There can be problems in establishing a working population in a reactor, though this is rare in an aerobic system where bacterial populations grow rather quickly. Finally, aside from varying the feeding rate and recycle rate, the operator has relatively little control over the biological processes. In contrast, suspended systems SRT is directly controllable by the operator. In addition, fixed film systems do not allow easy manipulation of the sludge return and removal rates or partitioning of an individual tank.

Operators have had good experience with fixed film technology on Oahu. In contrast, numerous problems have been reported for more conventional suspended growth systems. The most common fixed film systems used here are trickling filters. This technology has had a reputation in other parts of the country for plugging, odors and pest generation. These operational problems have largely been solved, and the systems are becoming increasingly reliable, low maintenance units.

Trickling Filters: Trickling filters are fixed film systems in which a biofilm coated substrate is contained in enclosed or open cylinders. Primary treated effluent flows intermittently or percolates over the biofilm. Water is collected at the bottom of the unit and is recycled to the top and/or sent to the final clarifier for separation of liquids and solids. The biota on the media remove the organics in the wastewater by adsorption and assimilation of soluble and suspended constituents. The quantity of biomass produced is controlled by the available food and the way in which liquid is applied to the substrate.

A trickling filter secondary treatment system could work at Sand Island WWTP, but there are a number of anticipated problems that eliminate it as a stand alone option. The piping would be extremely convoluted; there is a lack of flexibility particularly if denitrification becomes a requirement (trickling filters have not yet been shown to denitrify reliably). Additionally, trickling filter systems as stand alone systems are not as consistently capable of meeting secondary standards. Therefore, the trickling filter plant is not recommended for Sand Island WWTP.

Biological Aerated Filters: Biological aerated filters are submerged fixed film systems in which microorganisms grow on media completely immersed in wastewater. One type is similar to a tower filled with submerged plastic media. Mixing is accomplished by pumping the liquid and air from the bottom up through the media. These systems have advantages and have been proven with other types of wastewaters. The second type resembles a sand filtration unit. Solids build up is controlled by periodic backwashing. The wash water is directed to the primary clarifiers. Because no known experience with dilute wastewaters such as Sand Island WWTP's influent exists, these technologies are not recommended for Sand Island WWTP.

Rotating Biological Contactors: Rotating biological contactors (RBC) is a process that partially combines attached growth and suspended growth, but the bulk of the microbiological population is on a plastic disk which is suspended above the tank, partially submerged in the wastewater and attached to a rotating shaft through the center. Wastewater is fed into the tank with the RBCs which also contains suspended sludge that has sloughed off the disk. Aeration occurs as the unsubmerged portion of the disk is exposed to air and may be supplemented by diffused air released under the disk.

The limitation to tank depth is due to structural constraints which limit the diameter of the disk, based on the loads exerted by the biomass. Thus the tanks are necessarily shallower than suspended growth aeration tanks. Furthermore, due to the low ratio of media per square foot of land area, and RBC unit would not fit on-site at Sand Island WWTP with the solids handling processes. This coupled with operational difficulties eliminates this technology from further consideration.

Suspended Growth Systems: Suspended growth systems are characterized by flocculated agglomerations of microbes that are suspended in the wastewater in a holding chamber or tank. The suspension of the microbes is maintained by mechanical mixers or aeration. The operator has the ability to control the process and the sludge characteristics by manipulating operational parameters such as aeration and sludge age. This provides increased operationally flexibility over fixed film systems. A disadvantage is that these processes generally require more land. They are also subject to hydraulic and organic shock-loading, potentially resulting in washout (whereby the microbial population is washed away and must be regenerated) or death of the microbial population. Sludge production may be higher due to the faster growth rates of younger microbial populations. Several types of suspended growth systems exist. They are discussed in the following subsections.

Conventional Activated Sludge: Conventional activated sludge is one of the oldest suspended growth wastewater treatment methods. It is also the most common process for municipal wastewater treatment. Generally, an activated sludge system consists of a single chamber or aeration tank in which wastewater is fed continuously and is completely mixed with the 'activated sludge', a flocculated microbial population; liquid is continuously removed from the tank and flows into a settling chamber or clarifier. In the clarifier, the sludge settles and the clear liquid is sufficiently clean to meet discharge standards. Much of the sludge is usually returned to the aeration tank to maintain the high concentrations of microbial material required to rapidly consume the organic matter in the incoming wastewater. Since a large portion of the energy derived from the respiration of this organic matter is utilized to generate new cell mass, an excess of biosolids is generated by this process. This excess is withdrawn from the system for treatment and disposal.

The process is characterized by severe operational problems which result in a sharp decrease in treatment efficiency. The process is particularly prone to problems on Oahu because of warm temperatures and high grease loadings which increase the tendency towards bulking. Thus, conventional activated sludge is eliminated.

Pure Oxygen Activated Sludge: Pure oxygen activated sludge is similar to conventional activated sludge but aeration is done with pure oxygen rather than air. The advantage to this process is that large volumes of sewage can be treated in a relatively small area. This is because theoretically higher concentrations of sludge can be retained in the aeration tank. However, bulking in the final clarifiers and the associated decrease in treatment efficiency, can prevent the attainment of these high concentrations of solids.

This system would fit on the site and may be feasible technologically, but is expensive to build and operate and has daunting operational problems. Staff must be trained to maintain and operate highly technical equipment, the facilities typically require skilled instrumentation technicians. Enclosed reactors are also plagued by maintenance problems and there is explosion potential. Ultimately, for Sand Island WWTP the operational limitations of this process outweigh the space savings.

Sequencing Batch Reactor: The advantages of sequencing batch reactors (SBRs) are their technological and operational simplicity and relatively low operational and capital costs. Furthermore, bulking problems are minimized. Because of the effluent peak flow discharge from a SBR is higher than the existing ocean outfall capacity, effluent equalization basins would be required. The combination of batch reactor and effluent equalization basins would use all available site land and none would be available for sludge treatment. Thus, space requirements eliminate SBR as a viable option at Sand Island WWTP.

Selector Activated Sludge: Selector activated sludge (SAS) is a modification of conventional activated sludge. That has been shown to be successful in controlling 'bulking' and dramatically improving previous sludge problems. This system would require only slightly more land than conventional activated sludge and is considered a viable version of secondary treatment for Sand Island's WWTP.

Combined Systems: Combined systems join fixed film systems with suspended growth systems. Such an approach attempts to maximize the advantages of both technologies (fixed film's robustness to organic and hydraulic shock, ease of operation and lower sludge production; suspended growth's flexibility and operator control over sludge characteristics) while minimizing the disadvantages of both (fixed film's lack of flexibility and operator control, suspended growth's lack of reliability under fluctuating conditions). This particular version of the secondary treatment option for Sand Island WWTP is especially attractive because these systems require relatively small areas.

Roughing Filter/Activated Sludge: In a roughing filter/activated sludge (RF/AS) system, the primary effluent is first treated by a fixed film system (a trickling filter process). The effluent from the trickling filter then becomes the influent to the suspended growth system which is a form of activated sludge. For Sand Island WWTP, this system would combine a selector activated sludge treatment unit with the RF.

This system provides reliable functioning with high loading capabilities. Should regulatory requirements be made more stringent in the future, the process has sufficient flexibility to respond. Furthermore, the process lends itself to stacking; the filters can be suspended over the activated sludge chambers to save space. The advantages of this system are decreased operational costs, flexibility and superior sludge settling characteristics. The disadvantages are higher capital costs, additional pumping costs and the complication of operating two biological unit operations.

Conclusion – Option 4d – Secondary: The secondary treatment processes that are best suited for Sand Island WWTP and which are included in this alternative are selector activated sludge (SAS) and roughing filter/activated sludge (RF/AS). Both offer performance stability as well as process flexibility to avoid operating problems such as "bulking." These systems are also fairly compact and fit well on the limited available space at Sand Island WWTP.

Effluent Disposal: Option 5a – Outfall

As with the Meet Water Quality Standards alternative , use of the existing outfall (Option 5a), evaporation (Option 5d) and wetlands (Option 5e) options are considered feasible for this alternative. Effluent reuse (Option 5b) and underground injection (Option 5c) options would require tertiary treatment and are thus incompatible with this alternative. Option 5a, Outfall was chosen for reasons that were discussed in Section 6.3.3.

Solids Treatment and Disposal - Options: 6a, 6b, 6c, 6d, and 6f

All solids disposal options except composting (Option 6a – landfilling, Option 6b – thermal drying, Option 6c – alkaline stabilization, Option 6e – incineration, and Option 6f – power generation) are viable on-site options for this alternative, since there is not a very strong relationship between the solids disposal option and the secondary treatment level. Due to large space requirements, composting is incompatible with secondary treatment. Characteristics of the viable solids treatment options are discussed in Section 6.3.3.

Kuliouou WWPS: Option 7b – Redirect Collection

Either Kuliouou option (Option 7a – no action, or Option 7b – redirect collection to the Sand Island WWTP system) would be feasible under this alternative. Option 7b, Redirection of the Kuliouou WWPS effluent to Sand Island WWTP, via a force main to the Kalanianaole Highway trunk sewer, is part of this alternative.

Conclusion – Secondary Treatment Alternative

Under this alternative, the collection and treatment system would be upgraded for capacity and increased reliability and possible spills and bypasses would be reduced. Also, Sand Island WWTP would be expanded and upgraded to provide secondary treatment of the wastewater.

6.3.5 ELIMINATE/REDUCE OCEAN DISCHARGE ALTERNATIVE

The objective of this alternative is to eliminate and/or reduce ocean discharges of wastewater.

Collection – Sewered Areas: Option 1e – Upgrade System

The only feasible option for this alternative would be to increase collection system capacity, increase reliability and minimize subsurface transfers (Option 1e). All these steps would be needed to minimize surface and underground discharges. Option 1e includes the improvements of Options 1c and 1d and additional upgrades intended to reduce the occurrences of wastewater releases into the soil by exfiltration. The latter improvements should also reduce the volume of infiltration and inflow into the collection system. However, identification of the specific improvements to minimize subsurface infiltration and exfiltration cannot be done until completion of the Sewer Rehabilitation and Infiltration & Inflow Minimization Plan.

Treatment – Sewered Areas: Option 2a – Centralized

Similar to the other alternatives, the sewered area treatment option of centralized treatment is the only reasonable option.

Collection and Treatment – Unsewered Areas: Option 3a – Extending Centralized System

Option 3a (extending the centralized system) is the only viable option for this alternative. It was discussed in detail in Section 6.3.3.

Treatment Level: Option 4e – Tertiary Treatment

Effluent reuse (Option 5b), underground injection (Option 5c) and evaporation (Option 5d) are the only options that can reduce or eliminate ocean discharges. Therefore, only these options can be considered for this alternative. Options 5b and 5c would require tertiary treatment (Option 4e); Option 5d would require secondary treatment; however, the land area required for complete evaporation of the effluent is prohibitively high (see next section). Thus, the only treatment level that is viable for this alternative is tertiary treatment.

Tertiary treatment produces effluent of a higher quality than secondary effluent and usually involves greater solids and/or nutrient removal. The tertiary treatment process investigated for the purposes of this planning process features two stage carbon oxidation and nitrification, a separate denitrification unit, and final clarification followed by filtration. This treatment facility would have dual sludge units with two sets of clarifiers and effluent filtration. The facility would require most of the adjacent land east of the present Sand Island WWTP site. The tertiary treatment option would be appropriate only to ensure compliance with extreme and unforeseeable regulatory standards, such as a case in which treated wastewater would be used for drinking water. Furthermore, in warm tropical climates, nutrient removal can be accomplished far more effectively through selector activated sludge technology than through typical tertiary treatment systems.

Due to the relatively high volumes of water used at various stages of the wastewater treatment process (e.g., flushing and cleaning of basins, air pollution control, wet scrubbing systems, and cooling systems), effluent recycling is typically employed. DOH guidelines will require that this water comply with "R-1" standards, which require tertiary treatment. Therefore, a portion of the effluent from Sand Island WWTP will need to be treated to tertiary levels, regardless of the treatment level chosen for the entire WWTP.

Effluent Disposal: Option 5e – Underground Injection

Since the objective of this alternative is to eliminate/reduce ocean discharges, the outfall and wetland options are eliminated. Thus, effluent reuse (Option 5b), underground injection (Option 5c) and evaporation (Option 5d) are left for consideration. These are discussed below.

Effluent Reuse: Assuming that tertiary treatment is implemented, the additional costs associated with effluent reuse are relatively low. A comparison of the unit costs for wastewater reuse, seawater desalination, and use of BWS water for irrigation indicates that wastewater reuse would be cheapest (based on costs in addition to tertiary treatment only). The feasibility of this option, however, depends on the existence of sufficient land suitable for irrigation near the Sand Island WWTP. Currently, only two areas, Ala Moana, and Salt Lake, fit these characteristics. This would mean that only part of the treated effluent could be disposed by reuse.

Underground Injection: Underground injection is the process of injecting or pumping wastewater effluent underground. The Waipio Peninsula area was chosen as the potential location of the underground injection well effluent disposal site. This area is beneath the UIC line and is approximately 1.5 miles from the nearest drinking water source. The design influent rate for the underground injection well (UIW) system is 201 MGD, the future peak flow rate of Sand Island WWTP. Two parallel 72-inch pipe lines and a pump station would be needed to transfer the effluent from Sand Island WWTP along Kamehameha Highway and Farrington Highway to Waipio Peninsula. Since the existing ocean outfall could be used as a backup for UIW system, no backup UIWs would be needed. It is true that ultimately, some form of diluted, purified injected effluent may reach coastal waters and in this regard, reduction, not elimination of ocean discharge, would be achieved.

Evaporation: A zero-discharge disposal method is to evaporate the effluent in a shallow basin. According to the Department of Land and Natural Resources, the approximate pan evaporation rate near Sand Island is 0.26 inches per day. In order to evaporate off 111 MGD, an area of about 17,000 acres would be required. This land is not available on-site and is estimated to cost nearly $100 million to obtain the cost associated with this process are prohibitively expensive.

Underground injection was chosen as the preferred option for this alternative.

Solids Treatment and Disposal: Options 6a, 6b, 6c, 6e, and 6f

With the exception of Option 6d – composting, all solids disposal options (Option 6a – landfilling, Option 6b – thermal drying, Option 6c – alkaline stabilization, Option 6e – incineration and Option 6f – power generation) are viable for this alternative, since there is not a very strong relationship between the solids disposal option and tertiary treatment level. Refer to Section 6.3.3 for a description of these options.

Kuliouou WWPS: Option 7b – Redirect Collection

Either Kuliouou option (Option 7a – no action, or Option 7b – redirect collection to the Sand Island WWTP system) would be feasible under this alternative. Option 7b is the preferred option. Refer to Section 6.3.3 for a description of this option.

Conclusion – Eliminate/Reduce Ocean Discharge Alternative

Under this alternative, the collection and treatment system would be modified to eliminate and/or reduce discharges to inland and ocean waters. Also, the Sand Island WWTP would be expanded and upgraded to sufficiently treat wastewater to a tertiary level, so that it can be reinjected into the ground. The outfall would be abandoned or used for back-up only. The cost of this alternative is far in excess of that needed to ensure compliance with water quality regulations.

6.4 EVALUATION OF ALTERNATIVES

Five alternatives addressing the objectives presented in Section 6.1 were developed and described in the previous sections. The alternatives are:

- No Action.
- Optimize Operation of Existing Facilities.
- Meet Water Quality Standards.
- Secondary Treatment.
- Eliminate or Reduce Ocean Discharges.

As discussed earlier, this EIS is based upon the East Mamala Bay Wastewater Facilities Plan. The facilities plan is a planning document intended to assure that the wastewater system is developed on the basis of technical feasibility, water quality objectives, environmental compatibility, cost-effectiveness, and other applicable considerations. The alternatives were evaluated in a systematic manner using criteria which reflect these considerations.

Selection of the preferred alternative took into account the complexity of issues surrounding the construction, operation, and maintenance of a wastewater treatment system. In addition to meeting regulatory requirements, potential alternatives were also evaluated from the perspective of the various groups who would be impacted by the changes. Thus, considerations included potential environmental and social impacts, as well as technical feasibility, system reliability, cost, and safety, both to the general public and to operation and maintenance employees.

The following general procedure was used in the evaluation:

1. Criteria were developed to estimate the effectiveness of the component options and the five alternatives.
2. Weights were assigned to the criteria to quantify their relative importance.
3. Conceptual alternatives were developed from the component options, based on how well they met the specific criteria, and presented in the Preliminary Facilities Plan (September 1992).
4. Semi-quantitative scores were calculated for each conceptual alternative from the weighted criteria and scores for each option.
5. Refinements to the conceptual alternatives were made using additional and more detailed engineering and cost data.

Based on this evaluations procedure, the order of preference for the alternatives is:

1. Meet Water Quality Standards
2. Secondary Treatment
3. Optimize Operation of Existing Facilities
4. No Action
5. Eliminate/Minimize Ocean Discharges

The preferred alternative was selected for the following reasons.

1. It includes improvements necessary to meet regulatory standards set to protect public health and the environment. To arbitrarily exceed these requirements would require expenditures of public funds that might better be spent addressing other problems and issues: To fail to meet the requirements would expose the City to penalties resulting from Clean Water Act violations and would endanger human health and environmental safety.

2. It allows for the expansion of collection system components to meet the increase in wastewater flows that are anticipated from population increases, changes in land use, and density of development. It further includes collection system improvements that are needed to prevent violations of water quality standards, and proposes specific actions based on the degree of certainty with which the problem can be identified.

The alternative considered second best, Secondary Treatment, is less desirable than the preferred alternative because it arbitrarily imposes a level of treatment without regard either to its cost or its efficacy in addressing water quality concerns. Should secondary treatment not be required to meet water quality standards, the additional capital and operating costs would be wasted in light of what is known about environmental impacts of the outfall.

The third alternative in order of preference (Optimize Existing System) is also less desirable than the first, in that it does not include actions needed to accommodate projected flow increases in the future. It also doesn't address the adequacy or inadequacy of the present level of treatment or collection system to meet water quality standards. The fourth ("No Action") and fifth (Eliminate/Reduce Ocean Discharges) alternatives are more extreme versions of the second and third alternatives, for which the previous comments apply.

Costs of the preferred options of the five alternatives are presented in Table 6-5. The financial costs associated with the "No Action" and "Optimize Operation of Existing Facilities" alternatives will result primarily from fines and other costs associated with regulatory non-compliance. These are not included in Table 6-5 because they cannot be quantified.

Table 6-5
Cost Comparisons
Costs (Million Dollars)

ALTERNATIVE	COLLECTION AND TREATMENT-SEWERED AREAS		COLLECTION AND TREATMENT-UNSEWERED AREAS		TREATMENT LEVEL		EFFLUENT DISPOSAL		SOLIDS TREATMENT AND DISPOSAL		KULIOUOU WWPS	
	CAP.	LIFE	CAP.	LIFE	CAP.	LIFE	CAP.	LIFE	CAP.	LIFE	CAP.	LIFE
No Action	—	(a)	—	(a)	—	(a)	—	(a)	0(b)	63.8(b)	—	4.3
Optimize Operation of existing Facilities	—	(a)	—	(a)	0	73.3	—	(a)	0(b) 17(c)	63.8(b) 108(c)	—	4.3
Meet Water Quality Standards	120.5(d) 270.4(e) 390.9(f)	125.3(d) 284.6(e) 409.9(f)	13.0	16.8	119.7	316.3	1.3	12.3	0(b) 17(c) 12(g) 11.8(h) 54(i) 77(j)	63.8(b) 108(c) 95(g) 70(h) 117(i) 133(j)	5.7	5.8
Secondary Treatment	120.5(d) 270.4(e) 390.9(6)	125.3(d) 284.6(e) 409.9(6)	13.0	16.8	430.5	941.5	1.3	12.3	0(b) 33(c) 22(g) 16.7(h)	182.7(b) 144(c) 250(g) 175(h)	5.7	5.8
Eliminate or Reduce Ocean Discharges	(k)	(k)	13.0	16.8	441.5	1,094.5	310.0	462.5	(l)	(l)	5.7	5.8

Notes:

(a) Costs are not possible to determine at this time.

(b) Landfilling option. (Backup for all alternatives except "No Action" and "Optimize Existing Facilities) option.

(c) Incineration (Backup for all alternative except "No Action and "Optimize Existing Facilities)

(d) Total WWPS (cost of force mains included in these costs).

(e) Gravity sewer modification costs.

(f) Total cost collection system.

(g) Thermal drying option.

(h) Alkaline stabilization option.

(i) Power generation option.

(j) Composting option (assumes that composting would be on-site at Sand Island WWTP and no additional land would be required.)

(k) Deferred until completion of the Sewer Rehabilitation and Infiltration & Inflow Minimization Plans.

(l) Solids treatment and disposal options are the same as those for the secondary treatment alternative; costs would be slightly higher.

Source: Compiled from East Mamala Bay Wastewater Facilities Plan.

7
Description of the Preferred Alternative

SEVEN

DESCRIPTION OF PREFERRED ALTERNATIVE

7.1 COMPONENTS OF THE PREFERRED ALTERNATIVE

Chapter Six identified five alternatives consisting of a preferred option in each of the seven components of the wastewater system. The preferred alternative was described for comparison in Section 6.3.3, entitled "Meet Water Quality Standards Alternative." This chapter describes the preferred alternative in greater detail and in view of future wastewater flows as discussed in Chapter Five. Programmatic environmental impacts and some site-specific impacts are summarized in Chapter Eight.

The component options that comprise the preferred alternative, Meet Water Quality Standards, are listed in Table 7-1.

Table 7-1
"Meet Water Quality Standards" Components

COMPONENT NUMBER AND NAME	PREFERRED OPTION
1 Collection - Sewered Areas	1d - Upgrade for Capacity and Reliability
2 Treatment - Sewered Areas	2a - Centralized
3 Collection and Treatment - Unsewered Areas	3a - Extend Centralized
4 Treatment Level	4c - Expanded Primary
5 Effluent Disposal	5a - Outfall
6 Solids Treatment and Disposal	6b,6c,6f with 6a & 6e as Backup
7 Kuliouou WWPS	7b - Redirect to Sand Island WWTP

Estimated costs for the various options include capital (land and construction), operation and maintenance, and impact mitigation costs that can be quantified. Included in operation and maintenance costs are personnel costs, energy costs, and replacement and repair costs. The primary method for evaluating cost is the present worth method, which capitalizes annual costs to create a lump sum "present worth value." The method also considers the useful life of the option and any salvage value. To capitalize annual costs, an opportunity cost interest rate is assumed. Preliminary evaluations prior to specific site selections are based on unit costs for land and technology. The cost of borrowing (interest) on public debt incurred for capital expense is not included under lifecycle capital costs, but is considered under economic impact evaluation. Costs are in 1993 dollars; costs do not include design and administrative costs.

7.2 COLLECTION IN SEWERED AREAS

The preferred alternative involves expanding the existing collection system to adequately accommodate the projected wastewater flows and remedy capacity inadequacies, as well as modifying the system to increase its reliability and efficiency. Specific measures to optimize operation of the existing system will also be implemented.

7.2.1 OPTIMUM OPERATION OF EXISTING SYSTEM

Operation of the existing sewer lines and pump stations would be improved through more intensive and improved maintenance. Specific activities are described below.

Sewer Maintenance and Rehabilitation: Sewer lines should be inspected for clogging and root growth, line leakage, and breakage on a regular basis. The implementation of sewer rehabilitation measures is expected to result in decreases in infiltration, inflow and exfiltration. Reductions in infiltration and inflow would reduce the volume of wastewater entering into the collection and treatment facilities and could also reduce spills and back-ups in the collection system. The sewer Rehabilitation and Infiltration & Inflow Minimization Plan would decrease exfiltration from sewer rehabilitation and would reduce the likelihood of groundwater contamination by reducing the amount of wastewater that leaks out of the collection system into the soil. Sewer rehabilitation is expected to reduce the volume of infiltration and inflow by approximately 10 percent (see Chapter Five for a discussion of the basis of this value). Identification of specific rehabilitation projects will be deferred until completion of the Sewer Rehabilitation and Infiltration & Inflow Minimization Plan.

Wastewater Pump Station Modifications: More intensive testing of mechanical and electrical systems at wastewater pump stations, particularly the emergency generators, would help ensure uninterrupted operation. More frequent maintenance at the pump stations would also be implemented. Furthermore, the expansion of the existing Supervisory Control & Data Acquisition (SCADA) system to include pump station alert sensors for bypasses and spillage should minimize extended periods of sewage spillage.

Water Conservation Measures: Water conservation measures are expected to result in a slight decrease (five percent) in the average daily wastewater flow within the system.

7.2.2 UPGRADES FOR CAPACITY, RELIABILITY AND EFFICIENCY

The expansions for capacity take into account anticipated reductions in flow resulting from water conservation measures and implementation of sewer rehabilitation projects. Proposed improvements for increased reliability and efficiency would reduced potential causes of surface discharges such as backups, spills, and overflows, and could reduce the maintenance requirements of the system.

Gravity Sewer Lines

Gravity sewer lines proposed for capacity improvements via construction of parallel sewers, replacement sewers, or diversion sewers are listed in Table A-1 and shown in Figures A-1 through A-64 in Appendix A. These lines are, or will be, subject to flows that are greater than 100 percent surcharged (see Chapter Five for a discussion on surcharge). Priority lines (lines that require attention and relief before all others) are those serving areas presently limited for sewage connection because they are, or will be, subject to modeled flows that are either: (1) greater than 150 percent surcharged, (2) greater than 100 percent surcharged and have a problem indication (backups or clogging problems), (3) located in areas that are important commercial districts (such as Downtown Honolulu and Waikiki), or (4) are currently rated critical (surcharged) by the DWWM. Priority for implementation is shown in Appendix A, Table A-1; "1" indicates highest priority, and "4" indicates lowest priority. The maps shown in the Appendix figures are intended for conceptual purposes; relief sewers will be located alongside the existing sewers, but because of the scale of the maps, they may be shown outside of the actual route. Engineering studies will be performed to determine more definitive routes and sizes.

Use of the 30-inch cast iron sewer along Nuuanu Stream and River Street from School Street to Nimitz Highway will be discontinued to improve reliability of the system (see Figure A-100 in Appendix A). A study will be conducted to evaluate its rehabilitation for use as a standby for the School Street sewer.

As discussed in Chapter Five, the City is undertaking a Sewer Rehabilitation and Infiltration & Inflow Minimization Plan study to identify specific lines that might require improvements to reduce the volume of infiltration and inflow. The structural conditions of the sewer lines and corrosion control on large lines, particularly the sewer tunnels, are also being investigated in that study. Additional collection system improvements may be identified as a result of the study, and prioritization of sewer line projects should be re-examined at that time.

Wastewater Pump Stations

The WWPSs in the study area have been evaluated to determine the modifications needed to upgrade the pumping capacity to meet the future flow projections (capacity), to increase operational reliability, and to decrease the possibility of spills or bypasses. The analyses included diversion of the Kuliouou WWPS flow from the Hawaii Kai wastewater collection system to the Sand Island system. The Kuliouou WWPS is only a small percentage of the total Sand Island System, however, so this assumption does not result in excessive over-sizing of the affected wastewater facilities if this part of the preferred alternative is delayed.

Future flows used in the analysis of each WWPS were derived from either a population flow model or a Development Plan land use flow model (see Chapter Five). Since Development Plan land use models generally result in conservative flow projections compared to population flow models, the following approach was used in determining future flows. For WWPSs with future (2015) design average flow rates greater than one mgd based on the population flow model, the future population flow model was used. Flows based on the population flow model were applied to Ala Moana, Fort DeRussy, Beachwalk, Hart Street, and Awa Street WWPSs. For WWPS with future design average flow rates less than one mgd, based on the population flow model, future flows from the Development Plan land use model were used. There are two WWPS exceptions. The Development Plan land use model was also used to estimate future flow conditions at Kahala and Kamehameha Highway WWPSs. These two WWPSs have current measured average daily flow rates that are greater than the projected 2015 population average design flow.

Table 7-2 presents a summary of the proposed modifications for capacity upgrades and reliability improvements to accommodate the modeled future flow rates at the WWPSs.

Specific details of the proposed improvements, including the numbers and sizes of proposed units (i.e., pump hp and pipe sizes) were required to develop costs. These details should be considered preliminary, and re-evaluated when the actual improvements are implemented. At that time, the re-evaluation should consider the actual population, growth rates, I&I, measured flows, and the current development plans for the area.

Table 7-2
(4 Pages)
WWPS Modifications — Preferred Alternative

WWPS	CRITERIA	SPECIFIC MODIFICATIONS
Ala Moana	Capacity	**Ala Moana II** • Upgrade to five variable-speed pumps; two pumps operate at design flow, four pumps operate at peak flow • Upgrade electrical equipment and expand MCC building

	Reliability	**Ala Moana II**
		• Although modifications for this WWPS have been planned and detailed in the *Emergency Generator Study for Ala Moana WWPS, Final Submittal* [Cedric D.O. Chong & Assoc., Inc., September, 1993], a separate generator facility with two conventional diesel-powered generators is suggested as follows:
		  • Expand generator facility to handle increase in pump capacity
		  • Based on the recommendations in the *Emergency Generator Study for Ala Moana WWPS, Prefinal Submittal* [Cedric D.O. Chong & Assoc., Inc., September, 1993]:
		    • Increase the size of the proposed new generator building to accommodate the new generators; dimensions need to be increased to a minimum of 50'x50.'
		    • Acquire State land for the new generator building
		    • Install two emergency generators
		    • Install a 21,000-gal. fuel tank
		• Enclose and air condition the MCC area
		• Enlarge connections to the existing (60") SFM
		• Install standby motor starters
		• General Reliability Improvements

	Reliability	**Ala Moana I** • Due to corrosion and age, the building and structure are in need of rehabilitation. A future study should be conducted to determine the scope of this work and the feasibility of upgrading this station to sound condition. If feasible, this station could be upgraded to provide increased redundancy at this WWPS.
Moana Park	Capacity	• No pump modification required
	Reliability	• Install a larger fuel tank • General Reliability Improvements
Fort DeRussy	Capacity	• No pump modifications required
	Reliability	• Construct a new structure to house a new emergency generator • Install an emergency generator and fuel tank • Replace electrical equipment dating 25 years old • General Reliability Improvements

Table 7-2
(4 Pages)
WWPS Modifications — Preferred Alternative

WWPS	CRITERIA	SPECIFIC MODIFICATIONS
Public Baths	Capacity	• Upgrade three pumps • Install new electrical equipment to control new pumps • Install 14" SFM to the intersection of Kuhio and Ohua Ave.
	Reliability	• Modifications to rectify seawater infiltration will be addressed in the *Sewer Rehabilitation and Infiltration & Inflow Minimization Plan* • Install a 240-foot section of 10" sewer along Ohua Avenue at the intersection of Kuhio Ave. and Ohua Ave. to relieve the existing line • Increase generator size • Expand existing generator building • General Reliability Improvements
Beachwalk	Capacity	• Construct new WWPS — see "Reliability" below.
	Reliability	• Construct a new WWPS. Two options should be considered: 1) Locate the new WWPS next to the existing WWPS. Existing WWPS may act as a standby. Add new SFM. ; 2) Locate the new WWPS in the park *mauka* of the Ala Wai Canal with new SFM. This WWPS would handle the flow in the Ala Wai siphon. Both sites are situated in the FEMA 100-year flood zone. Measures to protect the new WWPS against flooding should be incorporated into design. • Study the feasibility of repairing the existing WWPS.
Kahala	Capacity	• No pump modifications required
	Reliability	• Modifications to rectify seawater infiltration will be addressed in the *Sewer Rehabilitation and Infiltration & Inflow Minimization Plan* • Install a 3,500-gal. fuel tank • Relocate the Flomatcher's heat exchangers and the generator's exhaust and radiator cooling system to discharge on the south side of the building • Replace electrical equipment • General Reliability Improvements
Niu Valley	Capacity	• Install two pumps
	Reliability	• Install new 16" SFM to 30" trunk sewer in Kalanianaole Hwy. • Replace electrical equipment dating 32 years old • General Reliability Improvements
Paiko Drive	Capacity	• No pump modifications required
	Reliability	• Replace electrical equipment dating 22 years old • Modify wet well to incorporate a divider wall • Replace existing fuel tank and generator with a diesel fuel tank and diesel generator • Install flow tube • General Reliability Improvements

Table 7-2
(4 Pages)
WWPS Modifications — Preferred Alternative

WWPS	CRITERIA	SPECIFIC MODIFICATIONS
Kuliouou	Capacity	• Upgrade two pumps • Upgrade electrical equipment • Install new SFM to 30" trunk sewer on Kalanianaole Hwy. to redirect flows to SI WWCS
	Reliability	• Replace existing fuel tank and generator with a diesel fuel tank and 125 kW diesel-powered generator • General Reliability Improvements
Hart St.	Capacity	• Construct new WWPS — see "Reliability" below
	Reliability	• Construct a new WWPS with generator facility in the vicinity of the intersection of Waiakamilo Road and Nimitz Hwy. This requires acquisition of land and construction of a new sewer line to the new WWPS from the existing WWPS. A new 42-inch SFM connected to the existing WWPS will connect the new WWPS to the existing junction box at Sand Island WWTP and the existing SFM will be extended to the new WWPS. • Add sewers to connect to the new WWPS • A study to determine the feasibility of rebuilding the existing WWPS to serve as a backup facility should be conducted
Awa St.	Capacity	• Upgrade four pumps • Replace electrical equipment
	Reliability	• Replace pump discharge lines and valves • Install new pump risers • Install new 24" SFM across Nuuanu Stream and connect to Ala Moana WWCS • General Reliability Improvements
Kamehameha Highway	Capacity	• Add one pump to serve as a standby unit
	Reliability	• Upgrade pump motors • Replace electrical equipment dating approx. 34 years old • Install 2,500-gal. fuel tank
Aliamanu I	Capacity	• No pump modifications required
	Reliability	• Implement a drainage study to determine if the existing drainage system is capable of handling a 100-year flood; if not, construct a combination earth-berm and concrete-dike around the perimeter of the building to alleviate flooding during heavy rain storms. Install a small submersible stormwater pump system to pump water out of this protected area. • Incorporate a divider wall in the wet well • Replace pumps with dry pit mounted submersible units • General Reliability Improvements

Table 7-2
(4 Pages)
WWPS Modifications — Preferred Alternative

WWPS	CRITERIA	SPECIFIC MODIFICATIONS
Aliamanu II	Capacity	• No pump modifications required
	Reliability	• Replace pumps with dry pit-mounted submersible units • Determine the feasibility of adding a drainage system to prevent flooding of the site. If not feasible, construct a combination earth-berm and concrete-dike around the perimeter of the building to alleviate flooding during heavy rain storms. Install a small submersible storm-water pump station to pump water out of this protected area. • Incorporate a divider wall in the wet well • General Reliability Improvements
Sand Island Parkway	Capacity	• Upgrade three pumps • Install a new 14" SFM • Upgrades are required to handle flows from new subdivision on Sand Island. (New Sand Island Industrial WWPS to be constructed within new subdivision on Sand Island will discharge to Sand Island Parkway WWPS).
	Reliability	• Install a new emergency generator to accommodate pump upgrade • Install an approximately 2,500-gal. fuel tank • General Reliability Improvements

General Reliability Improvements

In addition to specific improvements at individual WWPSs, the following upgrades are proposed for investigation and possible implementation at each WWPS to increase reliability and efficiency. These modifications are included in the cost estimates presented in Table 7-3.

1. Many of the WWPSs have a single wet well level control and no backup controls. Float levels are susceptible to scum and grease, and a failure could result in undetected spills. A backup level control is proposed at each pump station as part of alternatives for future action to improve collection reliability.

2. It is suggested that an evaluation of the potential advantages of changing from pump packing glands to mechanical glands be done. Installation of mechanical glands would be expensive; however, in the long run, this should reduce the maintenance involved compared with the packing glands. Mechanical glands are more durable and have a longer life.

3. Many of the WWPSs are equipped with passive bypass systems or manually operated bypass systems. It is suggested that these systems be connected to the Supervisory Control and Data Acquisition (SCADA) system during planned system upgrades in order to keep a log of when the bypass is open during upgrades to the system.

Table 7-3
Cost of Proposed WWPS Upgrades for Capacity and Reliability*

WWPS	COST ($)	
	CAPITAL	LIFE CYCLE
Ala Moana II	8,800,000	9,224,000
Kamehameha Highway	1,150,000	1,405,000
Awa Street	760,000	964,000
Sand Island Parkway	1,590,000	1,841,000
Aliamanu #1	380,000	605,000
Aliamanu #2	380,000	545,000
Moana Park	185,000	290,000
Public Baths	4,325,000	5,008,000
Beachwalk: New WWPS	29,923,000	30,408,000
Hart Street: New WWPS	69,900,000	70,450,000
Fort DeRussy	455,000	852,000
Kahala	1,235,000	1,912,000
Niu Valley	1,109,000	1,350,000
Kuliouou	5,662,000	5,845,000
Paiko Drive	340,000	466,000
TOTAL COST	120,532,000	125,320,000

Notes:
* Costs include installation of sewer force mains, which are shown in Table 7-6.
Total WWPS costs do not include Kuliouou (see Section 7.8).

4. Those WWPSs with the wound rotor "Flomatcher" variable-speed system that are suggested for upgrade to larger motors, and the WWPSs that are suggested for upgrade to variable-speed operation from constant speed should be equipped with systems that allow the use of backup reduced-voltage starters.

5. Many of the WWPSs with the "Flomatcher" variable-speed system are still utilizing SFM coupled heat exchangers for electrolyte cooling. Those WWPSs that are not suggested for upgrade to header-mounted exchangers should be tested for electrolyte cooling capacity. Systems found with cooling deficiencies could be upgraded to forced air-cooled radiator-type cooling systems.

6. Electronic variable-speed drivers for motor horsepowers 75 hp and larger should be located in air-conditioned rooms or cabinets to prevent shutdowns from corrosive air and excessive heat buildup which shortens equipment life. Electronic variable-speed drivers for motor horsepowers

less than 75 hp may be installed in non-air-conditioned rooms provided sufficient forced-air ventilation is provided. A study of hydrogen sulfide levels should be conducted to determine the need for a scrubbing system.

7. Generators and automatic transfer switches capable of operating the pumps required to handle design peak flow plus 10 percent over peak flow could be installed at all WWPSs.

8. The SCADA system is currently connected for monitoring and some supervisory control. A study of the system should be performed to determine if upgrading to allow more supervisory control of the WWPS would result in a more reliable system.

9. The SCADA system has had failure due to excessive heat buildup in the SCADA cabinets located in the WWPSs. These cabinets could be air-conditioned or relocated to a climate-controlled room.

10. Wet well inspections, inspections for asbestos, and underground storage tank compliance analysis (with DOH regulations) should be conducted during the preliminary engineering design phase.

11. Engineering design should consider the special requirements of WWPS in designated flood- and tsunami-susceptible locations. Of the WWPSs in the study area, seven WWPSs are situated in or close to a 100-year flood zone (Kamehameha Highway, Fort DeRussy, Beachwalk (including the proposed new WWPS site), Moana Park, Public Baths, Kahala, Paiko Drive). Five WWPSs are located in or close to a tsunami run-up zone (Kamehameha Highway, Moana Park, Public Baths, Kahala, Paiko Drive). It is recommended that these WWPSs be studied and "flood-proofed" as required by the development standards of the LUO, Flood Hazard Regulations. In addition, any new facilities at these sites should be designed and constructed to incorporate flood-proofing measures. Preliminary Engineering Reports should consider measures to protect vital components such as electronics by locating them above design flood levels, by use of waterproof components or by providing for rapid, modular replacement of components likely to be rendered inoperable by inundation.

Many of the proposed WWPS upgrades and improvements involve alterations or modifications that would have the potential to impact the surrounding environment (these include excavations, construction of new structures, and changes in emissions). These projects are summarized in Table 7-4. Preliminary site plans of the affected WWPSs addressed by this EIS are shown in Appendix Figures A-65 through A-72; a site plan of the proposed Hart Street site is included.

Flow Model Predictions

As discussed in Chapter Five, two models were used to predict future flow rates. The preferred alternative includes components that were designed based on flows derived from both future Development Plan land use and future population. The preferred alternative includes components designed based on modeled flows intended to maximize the existing (finite) resources and facilitate proper development. Both flow models were examined at each WWPS, however. Changes in the preferred alternative that would occur if the alternative model were used are shown in Table 7-5.

Table 7-4
WWPS Modifications with Potential to Impact the Environment

WWPS	UPGRADE
Ala Moana	**Ala Moana II** • Construction of new generator building • Installation of two generators • Installation of 21,000-gal. fuel tank • Installation of HVAC equipment
Moana Park	• Installation of larger fuel tank
Fort DeRussy	• Construction of a generator building • Installation of generator and fuel tank
Beachwalk	• Construction of a new WWPS (1) next to the existing WWPS or (2) in the park *mauka* of the Ala Wai Canal • Installation of a new SFM
Public Baths	• Replacement of a 240-foot section of sewer line along Ohua Avenue • Installation of a 14" SFM to the intersection of Kuhio and Ohua Ave. • Expansion of the existing generator building • Increase generator size
Kahala	• Installation of 3,500-gal. fuel tank
Niu Valley	• Construction of new SFM to 30" trunk sewer in Kalanianaole Hwy.
Paiko Drive	• Modifications to wet well to incorporate a divider wall • Replacement of existing fuel tank with a larger fuel tank • Replacement of existing generator • Install a flow tube
Kuliouou	• Replacement of existing fuel tank with a larger tank • Replacement of existing generator • Installation of new SFM to 30" trunk sewer on Kalanianaole Hwy.
Hart St.	• Installation of a new SFM • Construction of a new WWPS in the vicinity of Waiakamilo Rd. and Nimitz Hwy., including a standby generator facility • Installation of a gravity sewer from the existing WWPS to the new WWPS • Extension of both SFMs from the existing WWPS site to the new WWPS site • Installation of a gravity sewer from Nimitz Hwy. to the new WWPS site.
Awa St.	• Installation of new SFM crossing Nuuanu Stream to Ala Moana WWPS
Kamehameha Hwy.	• Installation of larger fuel tank
Aliamanu I	• Modifications to the wet well
Aliamanu II	• Modifications to the wet well
Sand Island Parkway	• Installation of a new SFM • Installation of a larger generator and fuel tank

Table 7-5
Changes to WWPS and Force Main Improvements Resulting from Alternative Flow Prediction Model

WASTEWATER PUMP STATION	FLOW MODEL		CHANGES TO IMPROVEMENT PROJECTS
	PREFERRED	ALTERNATIVE	
Ala Moana II	Population	Land Use	Upgrade to seven 600-hp pumping units and associated electrical equipment; Increase number of generators required to four 1,500 KW each; Increase fuel storage to minimum 28,000 gallons
Moana Park	Land Use	Population	No changes
Fort DeRussy	Population	Land Use	No changes
Beachwalk — New WWPS	Population	Land Use	No changes
Public Baths	Land Use	Population	Upgrade to three 35-hp pumping units. Increase generator size to 125 KW.
Kahala	Population	Land Use	Increase size of required fuel tank. Additional 450 KW generator required (existing at 450 KW).
Niu Valley	Land Use	Population	No changes
Paiko Drive	Land Use	Population	No changes
Kuliouou	Land Use	Population	Delete requirement for pump upgrades
Hart Street — New WWPS	Population	Land Use	No changes
Awa Street	Population	Land Use	No changes
Kamehameha Highway	Land Use	Population	Delete requirement for additional 150-hp pump and associated piping and electrical equipment. Decrease size of required fuel tank.
Aliamanu I	Land Use	Population	Upgrade to two 20-hp pumping units
Aliamanu II	Land Use	Population	No changes
Sand Island Parkway	Land Use	Population	Decrease size of required pumping units.

Sewer Force Mains

Table 7-6 lists the WWPSs that require construction of force mains to meet capacity requirements or to improve reliability. This table also includes estimates of costs. New force mains would become the primary force main. The existing force mains would remain and would be put into operation if the primary (i.e., new) force main became damaged or blocked, thus minimizing potential backups and spills. The existing force mains could also be used during periods when maintenance or cleaning operations are performed on the primary force main. A study is recommended to determine the need for rehabilitation of the existing force mains.

Table 7-6
Cost of Proposed New Force Mains

CRITERIA	WWPS	SFM REQUIREMENT	COST ($)	
			CAPITAL COST	LIFE CYCLE COST
To Meet Capacity	Sand Island Parkway	14" SFM (existing is 12")	760,000	1,240,000
	Public Baths	14" SFM (existing is 12")	3,550,000	4,240,000
	Kuliouou	Redirect flow to Sand Island WWCS	5,117,000	5,317,000
To Improve Reliability	Hart St.	42" SFM	44,200,000	44,690,000
	Beachwalk	42" SFM	12,103,000	12,793,000
	Awa St.	20" SFM to Ala Moana WWCS (also allows redirection of flow to Ala Moana WWPS)	160,000	480,000
	Niu Valley	SFM to 30" trunk sewer	659,000	1,139,000
TOTAL COST*			61,432,000	64,582,000

* Total costs do not include Kuliouou (see Section 7.8)

Cost and Prioritizations

Table 7-3 presents a summary of the costs for upgrading the WWPSs. These values include costs for upgrading and constructing the new force mains described below. Table 7-7 categorizes projects by order of priority to be used as a guideline for implementation. "1" signifies a recommendation for the highest priority be given to a project; "2" signifies medium-high priority, and "3" signifies a project of medium-low priority and "4" signifies the lowest priority, relative to the other projects. Categories for prioritization are based on five-year increments, urgency in relation to the other WWPS projects, and need for a specific project. Because all WWPS projects are proposed for the first 15 years of the study period, none are considered lowest priority.

Table 7-7
Prioritization of WWPS Projects*

PROJECT	PRIORITY FOR IMPLEMENTATION
Ala Moana II WWPS Upgrades (Capacity) ***	1
Ala Moana II WWPs Generator Upgrade	
Moana Park WWPS Modifications **	
Fort DeRussy Generator Facility	
Public Baths SFM and WWPS Upgrade	
Beachwalk (New) WWPS	
Kahala WWPS	
Kuliouou WWPS Upgrades and new SFM	
Niu Valley new SFM and Parallel Portion of Kuliouou SFM	
Hart St. (New) WWPS ***	
Hart St. new SFM	
Awa St. Generator Upgrade	
Aliamanu I Drainage Study and Repair	
Aliamanu I WWPS Upgrades (Capacity)	
Aliamanu II WWPS Drainage Study and Flood	
Sand Island Parkway SFM and Station Upgrades ***	
Beachwalk Existing WWPS Rehabilitation Study	
Hart St. Existing WWPS Rehabilitation Study	
Ala Moana I WWPS Rehabilitation Study	2
Beachwalk new SFM	
Awa St. WWPs Upgrades (Capacity)	
Awa St. new SFM	
Kamehameha WWPS Upgrades (Capacity)	
Aliamanu II WWPS Upgrades	3
Niu Valley WWPs Upgrades (Capacity)	
Paiko Drive Upgrades	

Notes:
- * Each project should be allotted 2 - 4 years for plan/design and an additional 1 - 2 years for construction.
- ** Soon to be under construction
- *** Includes work required to accommodate additional head imposed on system by new headworks at Sand Island WWTP.

7.3 TREATMENT FOR SEWERED AREAS

Wastewater collected from areas that are currently sewered will continue to be treated at the Sand Island WWTP.

7.4 COLLECTION AND TREATMENT FOR UNSEWERED AREAS

7.4.1 PREFERRED ALTERNATIVE

The unsewered areas and the individual wastewater systems currently in use are described in detail in Chapter Four. The preferred alternative includes extending centralized collection over time to all unsewered areas (see Figures 4-18 and 4-19), and treating the flow at Sand Island WWTP. The proposed method of sewerage for each affected area and the total capital and life-cycle cost estimates are presented in Table 7-8. A portion of the costs are allocated across the entire sewer service rate base, rather than borne exclusively by the affected households. Relative priorities to be used as a guideline for sewering the unsewered areas ("1" signifying the highest level of priority) have been assigned and are also presented in Table 7-8. In comparison with all of the recommended projects, including WWPS projects and Sand Island WWTP modifications, of the preferred alternative, collection and treatment for the unsewered areas were not assigned first priority. Second priority was assigned to areas in which conventional gravity sewerage was the least expensive of all methods (including retaining IWSs). Third priority was assigned to the areas which are essentially urban in character and in which conventional gravity sewerage, although not the least expensive, was less expensive than retaining IWSs. Fourth priority was assigned to those areas which are more rural in character. These prioritizations are subject to change based upon specific project requirements and future changes in policy. This option is also subject to prioritization with other projects, as well as practical constraints in implementation as discussed below.

Table 7-8
Cost Summary of Extending the Centralized Collection System and Project Prioritization

	CAPITAL COST ($)	LIFE CYCLE COST ($)	PRIORITY FOR IMPLEMENTATION
Aukai Avenue: Conventional Gravity Sewerage	46,300	46,300	2
Diamond Head, Subareas 1 & 2: Conventional Gravity Sewerage	93,700	93,700	
Makiki Heights, Subarea 1: Conventional Gravity Sewerage	88,600	88,600	
Makiki Heights, Subarea 3: Conventional Gravity Sewerage with Individual Pumps	847,800	1,026,500	
Makiki Heights, Subarea 4: Conventional Gravity Sewerage with Individual Pumps	1,110,100	1,296,200	
Makiki Heights, Subarea 5: Conventional Gravity Sewerage with Individual Pumps	692,400	863,700	
Pilot study of alternative sewerage systems			3
Diamond Head, Subarea 3: Low Pressure Sewerage	261,100	387,500	
Puowaina/Punchbowl: Small Diameter Gravity Sewerage	201,100	238,900	
Makiki Heights, Subarea 2: Small Diameter Gravity Sewerage w/Individual Pumps	332,000	433,900	
E. Manoa Road Kinohou Place: Low Pressure Sewerage	193,900	290,700	
Black Point: Low Pressure Sewerage	2,937,700	3,754,800	
Mapunapuna: Low Pressure/Small Diameter Gravity Sewerage	1,144,200	1,543,900	
Crater Road: Low Pressure Sewerage	1,056,400	1,659,400	
Nuuanu Pali Drive: Small Diameter Gravity Sewerage	107,400	115,400	4
Upper Palolo Valley: Small Diameter Gravity Sewerage	567,300	601,600	
Upper Tantalus, Round Top: Low Pressure/Small Diameter Gravity Sewerage	3,593,200	4,523,000	
TOTAL COSTS	13,273,200	16,964,100	

It should be noted that two methods of alternative sewerage which are proposed at various locations, small diameter gravity sewerage and low-pressure sewerage, are not covered by the City's standards for wastewater collection. Before the DWWM can implement these technologies, the standards would need to be revised. In order to develop standards for these alternative methods, and to further assess their advantages and disadvantages, pilot projects should be carried out for each of the two methods. The pilot project for each method should consist of design and construction of the alternative type of sewerage in one of the appropriate unsewered areas. The project should be monitored throughout design and construction, and for several subsequent years of operation. Data concerning design, construction, operation, maintenance and costs should be collected for evaluation and for development of standards if these methods are to be incorporated into the DWWM design standards.

7.4.2 ALTERNATIVE COLLECTION AND TREATMENT FOR UNSEWERED AREAS

If the pilot study of small diameter and low pressure sewers proves that these systems are not viable, then the only methods available would be conventional sewerage and retention of IWSs (i.e., the areas would remain unsewered). In this case, some of the areas would retain IWSs because of the excessive costs associated with conventional sewerage. This alternative scenario, along with cost estimates, is presented in Table 7-9. The areas recommended for sewerage under this scenario are identified in Figures A-98 and A-99 in Appendix A.

Table 7-9
Cost Estimates for Alternative Collection and Treatment in Unsewered Areas

		CAPITAL COST ($)	LIFE CYCLE COST ($)
Puowaina/Punchbowl	- Conventional Gravity Sewerage	497,600	497,600
Crater Road	- Individual Wastewater System (IWS)	2,002,700	2,825,300
Aukai Avenue	- Conventional Gravity Sewerage	46,300	46,300
Nuuanu Pali Drive	- Conventional Gravity Sewerage	162,700	162,700
East Manoa Road, Kinohou Place	- IWS	296,600	418,500
Diamond Head, Subarea 1	- Conventional Gravity Sewerage	16,400	16,400
Diamond Head, Subarea 2	- Conventional Gravity Sewerage	77,300	77,300
Diamond Head, Subarea 3	- Conventional Gravity Sewerage with Individual Pumps	300,000	426,400
Mapunapuna	- IWS	2,200,500	3,104,300
Black Point	- IWS	4,994,500	7,036,300
Upper Palolo Valley	- IWS	1,046,400	1,024,800
Makiki Heights, Subarea 1	- Conventional Gravity Sewerage	88,600	88,600
Makiki Heights, Subarea 2	- Conventional Gravity Sewerage with Individual Pumps	538,000	590,000
Makiki Heights, Subarea 3	- Conventional Gravity Sewerage with Individual Pumps	847,800	1,026,500
Makiki Heights, Subarea 4	- Conventional Gravity Sewerage with Individual Pumps	1,110,100	1,296,200
Makiki Heights, Subarea 5	- Conventional Gravity Sewerage with Individual Pumps	692,400	863,700
Upper Tantalus, Round Top	- IWS	3,461,500	4,883,200
TOTAL COSTS		18,379,400	24,384,100

7.5 TREATMENT LEVEL

The treatment level proposed to meet water quality standards is expanded primary. This option involves primary treatment with improvements designed to handle future projected average and peak flows of 90 mgd and 214 mgd, respectively (flows were derived from a population-based flow model; see Chapter Five). These improvements involve the entire treatment stream, including the planned addition of pretreatment facilities; upgrades to the existing primary clarifiers; upgrades to the effluent pump station; addition of tertiary treatment to the effluent flushing water system; and addition of anaerobic sludge digestion and additional final sludge processing. If studies substantiate a need for effluent disinfection in the future, chlorination-dechlorination would be implemented. The proposed improvements are described in detail below. A preliminary site plan of the proposed expanded primary treatment facility is presented in Figure 7-1.

7.5.1 HEADWORKS

In order to consistently meet the possible EPA effluent requirements for 30 percent BOD removal, a new pretreatment headworks will be incorporated into the WWTP system (R.M. Towill Corp., *30 Percent BOD Removal Facilities, Preliminary Engineering Report,* Jan. 1992). These additions will also increase reliability and improve operations. The new headworks facility will consist of an influent receiving area, sampling stations, bar screens, grit removal, an odor control system, a standby chemical treatment unit, reroute piping, and bypasses.

Coarse Material and Grit Removal: The removal rate of large material will be improved by the installation of finer bar screens. Currently, there are an insufficient number of screens and the spacings are too wide. The high velocity of the wastewater hitting the bars causes some of the coarse material to bypass the screens and enter the clarifiers which results in decreased efficiency. Additional bar screens will be installed for the removal of the larger solids.

New grit removal (aeration) chambers are also proposed. The aeration will cause larger and heavier particles to settle and will force odors out of the wastewater into the air over the grit chambers; these will be treated by an odor removal system.

Chemical Treatment: A chemical treatment process will be used to supplement the preaeration from the grit chambers during periods when the preaeration system does not remove the possible 30 percent BOD that may be required. Chemical treatment adds compounds to the influent to enhance coagulation and settlement of particulate, colloidal, and dissolved solids.

7.5.2 CLARIFIERS

To meet capacity requirements for projected 2015 flows of 90 mgd (average) and 214 mgd (peak), two additional primary clarifiers are needed to comply with DWWM clarifier standard peak overflow limitation. A third additional unit is also required to act as a standby unit.

7.5.3 EFFLUENT FLUSHING WATER

The existing effluent flushing water (EFW) facilities should be upgraded to comply with the DOH Reclaimed Municipal Wastewater Guidelines. Section 6.3.5 describes the suggested method of producing water of the necessary quality.

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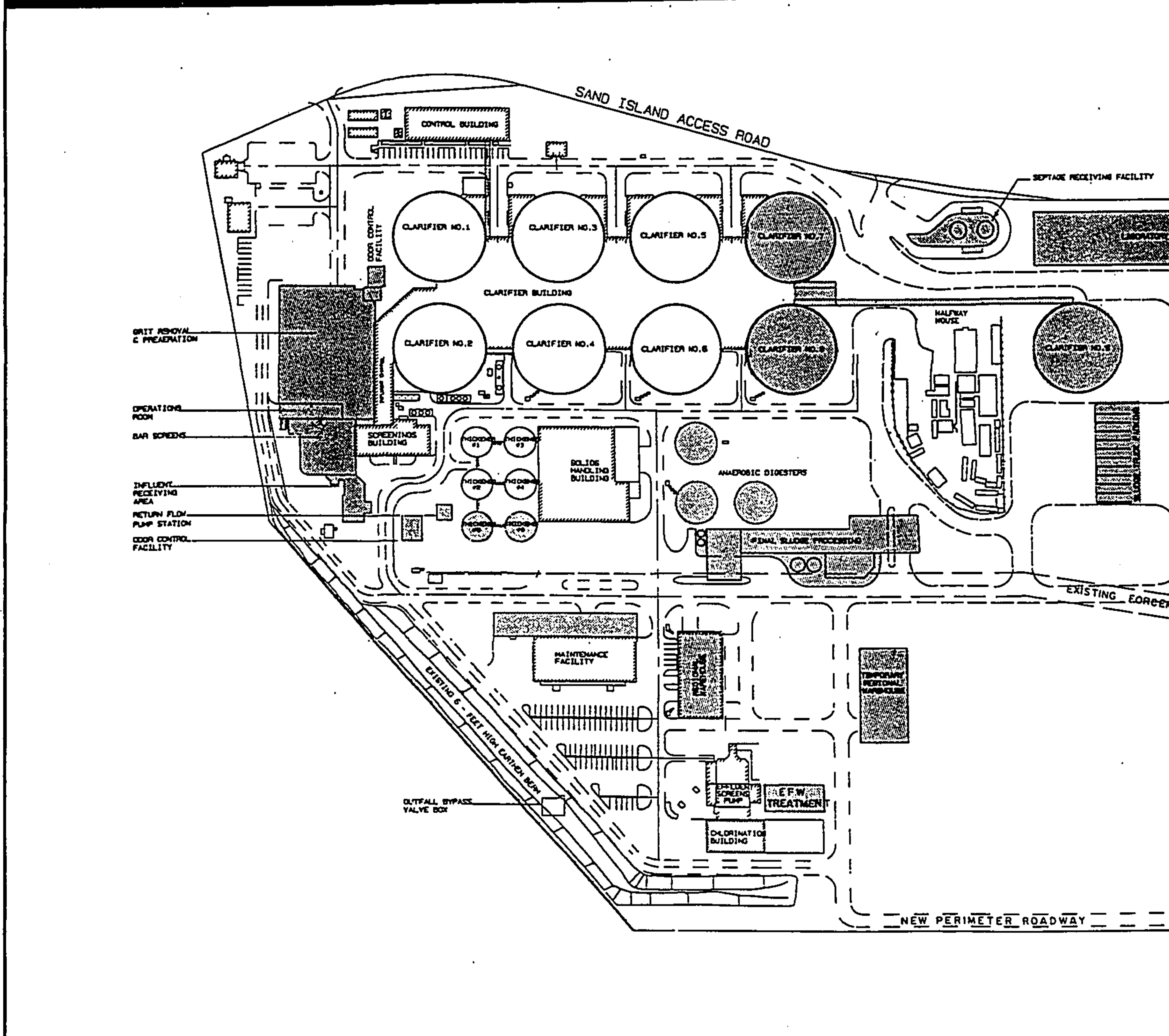


EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

200 100 0 200
Scale in Feet

North

LEGEND:
PROPOSED IMPROVEMENTS

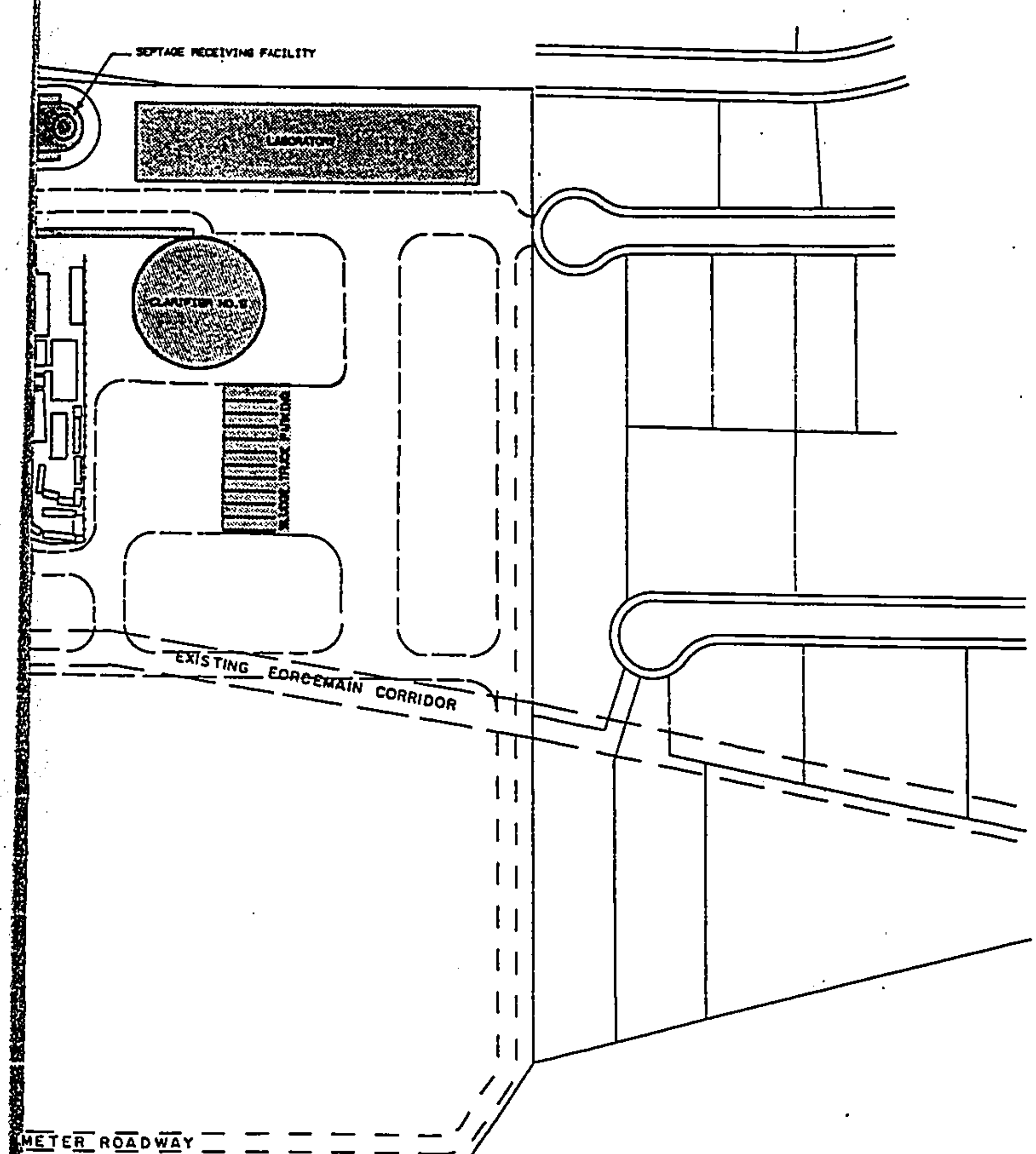


Figure 7-1
Sand Island WWTP Site Plan–Expanded Primary

7.5.4 ODOR CONTROL

The most offensive odors in the WWTP are usually associated with processes that handle raw incoming wastewater such as influent screening, grit removal, and primary clarification. Expansion of the WWTP also requires expansion of the odor control system.

The air from the grit chambers should be "scrubbed" with an odor control system. This system should use the same technology as the existing system. The existing odor removal system coupled with the new aerated grit collection system is expected to be very effective in reducing overall plant odors.

7.5.5 SOLIDS HANDLING

Two additional gravity thickeners, new dewatering facilities, three anaerobic digesters, and a final sludge processing system should be constructed. A sludge truck parking (staging) area should also be constructed next to the final sludge processing building. Solids processing and disposal options are discussed in Section 7.7.

7.5.6 EFFLUENT PUMP STATION

The Sand Island WWTP Effluent Pump Station currently has three dual-input pumps with two spare slots for future pumping units. *One additional dual-input pump should be installed in the available spare slot.*

7.5.7 SAND ISLAND TREATMENT CENTER

The treatment plant site is bound on all sides by State property. The property to the east is leased as an industrial subdivision, the property to the south is Sand Island Park, and the property to the north is Sand Island Access Road and Matson Company. The property to the west is slated to be the new site of the City's corporation yard. Recent attempts to acquire additional adjacent property from the State have failed and the Sand Island WWTP site is unlikely to expand (pers. comm. with City DWWM staff). Thus, flexibility to expand and modify operations is limited by existing site boundaries and the configuration of existing facilities on the site. The Sand Island Treatment enter (SITC), located in the middle of the Sand Island WWTP site, occupies approximately 1.5 acres. Currently, the SITC does not adversely impact plant operations. However, should secondary treatment be required in the future, the SITC would need to be relocated off-site.

7.5.8 WATER QUALITY LAB FACILITY AND MAINTENANCE FACILITIES

The proposed Water Quality Lab Facility will be located in the northeast corner of the SIWWTP site.

The existing maintenance shop for the Sand Island WWTP is located on the ground floor of the existing laboratory building. With the growth of the WWTP, a larger shop area will be required. Therefore, when the laboratory and the associated oceanographic team is relocated, this building should be converted into the Sand Island WWTP maintenance facility.

The existing Central (Regional) Maintenance Facility (CMF) at Sand Island WWTP should be enlarged to provide permanent paint and carpentry shops. Sufficient land is available to the north and west of the CMF for this expansion. The material presently stored on the north side of the CMF could be relocated to the Regional Warehouse (RWH).

The RWH is proposed to support the operation and maintenance activities for the East Mamala Bay System. Since this facility must be located in the open space area reserved for possible future expansion of the Sand Island WWTP to secondary treatment, the structure should be designed so that it can be removed, if required.

7.5.9 COST AND PRIORITIZATIONS

The preferred alternative includes both the implementation of improved maintenance and operational procedures and the addition of new treatment units. This option has the flexibility to improve, change, or add an operation as the situation evolves. The estimated costs of Expanded Primary Treatment are shown in Table 7-13 at the end of this chapter. Project prioritizations ("1" signifies the highest level of priority) are included in Table 7-10.

Table 7-10
Prioritization of Sand Island WWTP Modification Projects

PROJECT	PRIORITY FOR IMPLEMENTATION
Chemical Treatment	1
New Headworks	
Clarifier Study	
Primary Clarifiers - Nos. 7 and 8	
Effluent Flushing Water Treatment System	
Effluent Pump Station Upgrades	
New Regional Warehouse	
Primary Clarifier - No. 9	2
Additional Standby Generator	
New Sludge Stabilization (Digesters) and Dewatering	
New Islandwide Laboratory	
Expansion of Regional Maintenance Facility	
Conversion of the Existing Laboratory Building to a Sand Island Maintenance Facility	
Final Sludge Processing	
Gravity Thickeners - Nos. 5 and 6	3

Clarifier additions will include installation of two units initially. Installation of the third should be delayed until completion of a study of peak capacity conditions at Sand Island WWTP after other improvements are in place. An additional emergency generator is also proposed.

7.6 EFFLUENT DISPOSAL

Continued use of the existing outfall is the preferred option for meeting water quality standards. The old outfall should be maintained to provide an alternative disposal method in case of failure or maintenance activities on the present outfall. Based on modeling results for primary treatment with the existing outfall and ZOM, modeled State WQS will be met (see Chapter 8 and Appendix C). Water quality monitoring data show that the existing treatment plant and outfall have no significant impact on marine water quality or the marine biological communities near the outfall.

The capital costs for the continued use of the outfall are those associated with upgrading the effluent pump station to reliably handle the future peak effluent flow. The operating and maintenance cost associated with the outfall include the power required by the effluent pumps and the maintenance of the pumps, including their ancillary equipment, and the outfall. The capital cost for effluent disposal is $1.3 million and the life cycle cost is $12.3 million.

7.7 SOLIDS TREATMENT AND DISPOSAL

Solids processing encompasses the treatment steps in the conditioning of the biosolids to produce a disposable end product. Flexibility should be designed into the operation to allow removal of biosolids at any point in the treatment scheme should beneficial reuse markets call for that particular form of biosolids. Regardless of the final treatment option, many of the initial processing phases are the same.

Once the sludge is thickened in the gravity thickeners it can either be sent directly to be dewatered or it can be stabilized. Sludge sent to the stabilization facility would be dewatered after stabilization. Once dewatered, the sludge could be conveyed to the existing incinerators, to trucks, or to an on-site processing system to be converted to a reusable resource. If an off-site processing facility is chosen by the City to allow islandwide processing of solids, then a truck loading area would be needed. This system would also permit landfilling of the sludge when needed.

7.7.1 THICKENING

The proposed thickening process continues the process begun in the existing gravity thickeners. The existing thickeners are marginally sufficient for the future flows, but will not permit removal of the units for maintenance and cleaning. Therefore, the addition of two more thickening units is proposed immediately south of the existing units. If secondary treatment is ever required, the secondary biosolids should be thickened in centrifugal thickeners. This will require the construction of a new facility to house the units and their ancillary equipment.

7.7.2 STABILIZATION

Anaerobic digestion is proposed for sludge stabilization. This process will be implemented in stages, based on the level of treatment. As long as Sand Island WWTP operates at a primary level of treatment, three digestion units will be sufficient. If the facility is ever required to expand to secondary treatment, then three additional units and an aerobic thermophilic pretreatment system (TPS) will be required to treat the secondary solids prior to digestion.

Not all of the available final treatment processes benefit from anaerobic sludge digestion. These processes, such as composting and power generation, utilize the organic matter in the sludge as an energy source. To accommodate processes in which raw solids are preferred, the solids stream is designed to allow diversion of thickened raw solids prior to digestion. The anaerobic digesters provide a means of minimizing the quantity of biosolids and stabilizing them for landfill disposal and/or land application. Other processes, such as thermal drying and alkaline stabilization, can use the methane gas produced by the digestion process as fuel. Therefore the digesters provide a great deal of flexibility.

7.7.3 DEWATERING

Dewatering is required before the sludge can be processed further. The preferred dewatering method uses solid bowl centrifuges. In addition to high solids capture and concentration, solid bowl centrifuges eliminate health concerns associated with aerosols which can be emitted from open devices. The space required for the centrifuges is also relatively small. Locating the new units on the second floor of the Solids Handling Building will provide the greatest operational flexibility. This area is presently occupied by the thermal stabilization pumps, but will become available once the anaerobic digesters are constructed and the thermal units are taken off line. The proposed system will allow the dewatered solids to be pumped to the existing incinerators, to the truck loading area, or to on-site final treatment.

A minimum of three centrifuges will be required to dewater the quantity of biosolids that will be generated by primary treatment processes. This will provide for one standby unit to allow for maintenance. The addition of secondary treatment would require that a minimum of two or more machines be brought on-line for a total of five. This would require an expansion of the Solids Handling Building into the area currently occupied by the Zimpro units.

Chemical addition (organic and/or inorganic) may be required for improved performance of both thickening and dewatering units. Laboratory and pilot plant studies should be performed to determine their necessity and to provide guidelines for chemical selection.

7.7.4 FINAL TREATMENT AND DISPOSAL

The preferred options include thermal drying, alkaline stabilization and power generation. Composting is technically viable and feasible if the WWTP retains expanded primary treatment. However, if secondary treatment is required at some point, the composting unit would have to be removed or relocated off-site, but is not included as a preferred option for Sand Island WWTP because the large amount of land needed would require the City acquire land off-site. The treatment and disposal option ultimately selected will depend on the market demand, regulatory, environmental, and social constraints at the time. Incineration and landfilling capabilities should be maintained as backups, should the reuse of all the biosolids not be practical.

The City will investigate the possibility of privatization of the final solids treatment by vendors who have a proven technology and have successfully distributed their product. If a fully privatized operation is not feasible, then other avenues to bring in proven technology and marketing of end products should be investigated. Options like turn-key construction with City operation of the processing facility and private marketing may prove beneficial. The primary objective of the operation, however, is to produce a consistent product that has a market demand. The three most viable reuse options are discussed below.

Thermal Drying

Thermal drying turns biosolids into a dry (about 95 percent solids) pelletized product that is easy to store, transport, and market as a soil conditioner. The temperature of the airstream used to dry the solids and the extended contact time, qualifies the system as a PFRP (Process to Further Reduce Pathogens) by the EPA. The biosolids meet 40 CFR 503 criteria for distribution and marketing; however, the Sand Island biosolids would be limited by copper concentrations in the sludge to an application rate of three to five tons per year per acre.

Alkaline Stabilization

The addition of an alkaline chemical (e.g., lime or fly ash) to stabilize sludge destroys harmful pathogens and minimizes odors. The process involves raising and holding the pH of the sludge to a value greater or equal to 12 for 72 hours and the temperature to 52°C or above for 12 hours. This process is also an EPA PFRP-approved process. The end product is dried to greater than 50 percent solids and is suitable for landfill cover, land reclamation, highway and median construction, landscaping, and soil conditioning. Stabilized biosolids are a good source of nitrogen and lime, as well as beneficial organic matter.

Odor is virtually eliminated through processes which use fly ash as a main ingredient in the alkaline admixture. However, high levels of fugitive dust and ammonia gas would be generated. The stabilization facility would include collection and treatment of emissions before releasing them into the atmosphere. The use of this process would require chemical handling capabilities for the transport and storage of the additives.

Power Generation

Power can be generated if the solids processing produces an end product which is suitable for fuel in an electricity generating plant. One method of producing a fuel end product is through a drying system known as the Carver-Greenfield Process. The Carver-Greenfield method uses multi-effect evaporation to remove water from sludge which has been mixed with oil. Oil is separated out of the dried biosolids leaving an oil-saturated biosolids fuel and recovered oil that is reused in the process. The fuel stream is combusted to provide the heat necessary to generate steam which is used to operate the biosolids drying process. The end product can also be rendered suitable for use as fertilizer with additional removal processes (which require additional energy).

Land requirements for the installation of a Carver-Greenfield system are estimated at approximately 67,000 square feet (1.5 acres); the transportation costs to remove the ash from the facility would be the same as for conventional incineration. Gaseous emissions produced by the process must be captured and scrubbed to meet air quality standards; sidestream ammonia must be treated separately or returned to the WWTP. Process water used in cooling must also meet applicable water quality standards before being returned to the environment. Operationally, the process requires skilled technicians with experience in this type of operation.

Conclusion

The available technologies produce at least four different products (ash, dewatered digested sludge, reusable biosolid, and power) and the flexibility to respond to energy, horticultural and agricultural demands, as well as regulatory, political and environmental constraints. Should it become a worthwhile profit center, the City would benefit through contractual adjustments of its payments to the contractor. In addition, a combined facility serving other WWTPs may also be feasible due to economies of scale.

Table 7-11 summarizes the approximate capital and life cycle costs of each solids disposal option with a primary treatment level. These costs assume use of land at Sand Island WWTP.

Table 7-11
Cost Comparison - Solids Treatment and Disposal

SOLIDS TREATMENT AND DISPOSAL OPTION	CAPITAL COSTS ($)	LIFE CYCLE ($)
Landfilling	0	63,800,000
Thermal Drying	12,000,000	95,000,000
Alkaline Stabilization	11,800,000	70,000,000
Composting	77,000,000	133,000,000
Power Generation	54,000,000	117,000,000
Incineration	17,000,000	108,000,000

7.8 KULIOUOU WWPS

The flow from Kuliouou WWPS is proposed to be redirected to the Sand Island system. Redirecting the flow involves installing a new force main from the Kuliouou WWPS to the 30" gravity sewer line in the Aina Haina area along Kalanianaole Highway. The system would normally bypass the Niu Valley WWPS; however, valves will be installed to allow the sewage to be diverted into Niu Valley WWPS for redundancy. The portion of the SFM from Niu Valley to the 30" gravity sewer should be laid in the same trench as the proposed Niu Valley SFM.

7.9 SUMMARY OF PROJECTS AND PRIORITIZATIONS

Table 7-12 presents a list of the projects included in the preferred alternative and their respective prioritization to be used as a guideline for implementation. Category one (designated in the table by a "1") signifies a recommendation for the highest priority be given to the specific project; category two ("2") signifies a project of medium-high priority; category three ("3") signifies a project of medium-low priority; and category four ("4") signifies a project of lowest prioritization in relation to the other proposed projects in that option. Each category is based on a five-year increment, and assignment of categories of prioritization are based on the need for a specific project and its urgency relative to the other projects.

Table 7-13 presents a summary of estimated total costs for each of the components of the preferred alternative.

Table 7-12
(2 Pages)
Prioritization of Recommended Projects*

PROJECT		PRIORITY FOR IMPLEMENTATION
WWPS Projects	Ala Moana II WWPS Upgrades (Capacity) ****	1
	Ala Moana II WWPS Generator Upgrade	
	Moana Park WWPS Modifications **	
	Fort DeRussy WWPS Generator Facility	
	Public Baths WWPS and SFM Upgrade	
	Beachwalk (New) WWPS	
	Kahala WWPS Upgrades	
	Kuliouou WWPS Upgrades and new SFM	
	Niu Valley WWPS new SFM and Parallel Portion of Kuliouou SFM	
	Hart St. (New) WWPS ****	
	Hart St. WWPS new SFM	
	Awa St. WWPS Generator Upgrade **	
	Aliamanu I WWPS Drainage Study and Flood Control	
	Aliamanu I WWPS Upgrades (Capacity)	
	Aliamanu II WWPS Drainage Study and Flood Control	
	Sand Island Parkway WWPS and SFM Upgrades ****	
	Ala Moana I WWPS Rehabilitation Study	
	Beachwalk Existing WWPS Rehabilitation Study	
	Hart St. Existing WWPS Rehabilitation Study	

Table 7-12
(2 Pages)
Prioritization of Recommended Projects*

PROJECT		PRIORITY FOR IMPLEMENTATION
Sand Island WWTP Modifications	Chemical Treatment	1
	New Headworks	
	Clarifier Study	
	Primary Clarifiers - Nos. 7 and 8	
	Effluent Flushing Water Treatment System	
	New Regional Warehouse	
Extension of Centralized Collection into Unsewered Area	Diamond Head, Subarea 1 ***	2
	Diamond Head, Subarea 2 ***	
	Aukai Avenue ***	
	Makiki Heights, Subarea 1 ***	
	Makiki Heights, Subarea 3 ***	
	Makiki Heights, Subarea 4 ***	
	Makiki Heights, Subarea 5 ***	
WWPS Projects	Beachwalk WWPS new SFM	
	Awa St. WWPS Upgrades (Capacity)	
	Awa St. WWPS new SFM	
	Kamehameha WWPS Upgrades (Capacity)	
Sand Island WWTP Modifications	Primary Clarifier - No. 9	
	Additional Standby Generator	
	New Sludge Stabilization (Digesters) and Dewatering	
	New Islandwide Laboratory	
	Expansion of Regional Maintenance Facility	
	Conversion of Existing Laboratory Building to Sand Island Maintenance Facility	
	Final Solids Treatment and Disposal	
Extension of Centralized Collection into Unsewered Area	Pilot study of alternate sewerage systems	3
	Puowaina Punchbowl ***	
	Diamond Head, Subarea 3 ***	
	Makiki Heights, Subarea 2 ***	
	East Manoa Road, Kinohou Place	
	Mapunapuna	
	Crater Road	
	Black Point ***	
WWPS Projects	Aliamanu II WWPS Upgrades	
	Niu Valley WWPS Upgrades (Capacity)	
	Paiko Drive WWPS Upgrades	
Sand Island WWTP Modification	Gravity Thickeners - Nos. 5 and 6	
Extension of Centralized Collection into Unsewered Areas	Nuuanu Pali Drive	4
	Upper Tantalus, Roundtop	
	Upper Palolo Valley	

* Each project should be allotted 2 - 4 years for plan/design and an additional 1 - 2 years for construction.

** Under construction

*** Includes a planned Capital Improvement Program project area

**** Includes work required to accommodate additional head imposed on system by new headworks at Sand Island WWTP.

Table 7-13
Total Cost of Preferred Alternative (Million Dollars)

COMPONENTS OF PREFERRED ALTERNATIVE	CAPITAL COST	LIFE CYCLE COST
New gravity sewer lines	270.4	284.6
WWPSs*	120.5	125.3
Extending centralized collection system	13.0	16.8
WWTP	119.7	316.3
Effluent disposal	1.3	12.3
Solids treatment and disposal	**	**
Kuliouou***	5.7	5.8
TOTAL COST****	530.6	761.1

Notes:

- * Includes costs of new SFMs. Capital cost = $61.4 million. Life cycle cost = $64.6 million. Costs do not include Kuliouou.
- ** Costs depend on the choice of final solids treatment (see Table 7-11).
- *** Includes costs of new SFM. Capital cost = $5.1 million. Life cycle cost = $5.3 million.
- **** Total costs shown do not include solids treatment and disposal costs.

8
Impacts and Mitigation Measures

EIGHT

IMPACTS AND MITIGATION MEASURES RESULTING FROM THE PREFERRED ALTERNATIVE

8.1 INTRODUCTION

The complexity of developing and describing the projects and actions that comprise the preferred alternative for meeting year 2015 demand on the wastewater system is evident. This complexity makes the task of identifying and discussing potential impacts particularly challenging. Because of the far reaching implications of the proposed action, not to mention the sheer number of improvements being proposed for the 20-year planning period, a tiered structure of impact analysis is followed.

The impacts of the preferred alternative are first evaluated at a general, or programmatic level. Then, for certain major actions within the preferred alternative that are expected to occur in the earlier part of the planning period, impacts are evaluated in site-specific detail. Because the preferred alternative is recommended for implementation over a 20-year period, the later a particular construction project begins, the more difficult it is now to identify specific conditions that might then exist, determine mitigation of impacts that might then be caused by the project. Therefore, this analysis is primarily programmatic rather than detail-specific, with the exception of certain near-term projects involving known sites which are addressed in greater detail.

Despite the actual number of specific elements contained within the preferred alternative, many of the projects have common characteristics and impacts. Therefore, the impacts and mitigation measures can be generalized to most of the projects of similar type, with specific mitigation determined at the time of preliminary engineering review.

For the purpose of this discussion, the term "impact" is defined on three levels:

- **Construction Impacts** occur at the time any particular component of the preferred alternative is actually being built. They are short-term by nature and include potential "releases" to the land, surface water, groundwater, and air, as well as the disruption of traffic and other human activities related to the temporary condition of construction.
- **Operational Impacts** result from the actual use or operation of the improvement as well as the use of a specific product the improvement may create (for instance, a product that might be created from wastewater sludge and used as a soil enhancer). They are long-term by nature and include potential "releases" to the environment that might affect land, surface water, groundwater, and air quality resulting from long-term operation of the system.
- **Cumulative Impacts** are the interactions and/or accumulations of effects resulting from the implementation of one or more specific proposed actions on existing or projected environmental, social, and/or economic conditions. They may be either short- or long-term by nature. They include indirect effects, which are understood here to mean induced effects separated by time and/or distance from the causative action.

These three categories of impacts are used in this chapter to facilitate the discussion of impacts. In general, construction and operational impacts are analogous to "short-term" and "long-term" impacts as addressed in HRS Chapter 343. A summary of project costs has been presented in Chapter Seven. Although it is not possible within the context of this document to determine how all the improvements in the preferred alternative will be funded, it is possible to estimate the general impacts of the preferred alternative upon the economy of the study area. Detailed economic impact analysis is contained in Appendix B; economic evaluation of the preferred alternative is summarized in section 8.11. Project timing has been estimated in order to forecast cost and economic impacts; however, the actual timing of projects will depend on growth actually experienced and authorized levels of funding. Assumptions are made with regard to sludge treatment process selection in order to estimate cost impacts.

In instances where significant negative impacts are identified, measures are proposed to substantively mitigate the negative effect. The format of this chapter follows the general sequence of the sections presented in Chapter Three.

8.2 SOCIOECONOMIC IMPACTS

The impact of the preferred alternative upon future socioeconomic conditions is perhaps the most difficult issue to evaluate among all those addressed in this document. This difficulty is not due to a fault in the preferred alternative, but rather, to the changing condition of the regulatory and economic environment. Hawaii is undergoing an economic transformation. Plantation agriculture, once the keystone of the economy, is rapidly declining. The annual volume of visitors to Hawaii is in flux. The end of the cold war has initiated a massive reorganization of military resources and federal expenditures upon which Hawaii has traditionally depended. Environmental regulations affecting water quality, air quality, and solid waste are constantly evolving, and land use controls are subject to constant review and change, such that the related costs of compliance are difficult to predict. Consequently, it is difficult to predict how conditions will change in the course of the next three to five years, not to mention the 22 years until this study's target year of 2015.

For the purposes of this document, "socioeconomic conditions" is a term which represents three distinct concerns; population size and distribution, public health and safety (including regulations), and considerations about the distribution and availability of economic resources within the community. Together, these concerns establish the general quality of life in a community. A principal impact that government has upon socioeconomic conditions is through its provision of public services and facilities and by regulation of land use and activities impacting the environment. This evaluation is based on land use constraints and environmental regulations as they presently exist. Although they are subject to revision, it is not possible to project potential regulatory changes that may occur in the future.

8.2.1 POPULATION SIZE AND DISTRIBUTION

The size and distribution of population within the study area is and will be influenced by the availability of developable land, the adequacy of available infrastructure, and the demand for new development or redevelopment.

Construction Impacts: While construction activities associated with improvements to the collection system will temporarily disrupt normal activities in residential areas, they will not affect the basic population distribution pattern of the study area.

Operational Impacts: Implementation of the preferred alternative is intended to help reduce the potential for wastewater spills, collection system failures, and related releases to land, groundwater, and surface water. Any such reductions will be beneficial to the general public health. Since the recommended improvements are intended to help reduce the incidences of releases to the environment, population size, and distribution within the study area will not be constrained due to system inadequacies.

The potential impacts of the preferred alternative upon population size and distribution in the study area raise an important issue. As discussed in Chapter Five, the future demand for wastewater treatment and disposal was determined through the use of a series of computer models utilizing the State's and City and

County of Honolulu's official forecast data. Lack of adequate sewage infrastructure would constrain development in areas where it is planned to occur.

Cumulative Impacts: The degree of the cumulative impacts to population size and distribution will depend to a large extent upon how various elements of the preferred alternative permit new development. Increases in user fees are discussed in Section 8.11 and are not likely to constrain population growth. It is unlikely that existing residents will relocate out of an impacted area on the basis of increased sewer fees. In addition, the density of new housing allowed in any particular area can be directly affected by the presence and capacity of wastewater infrastructure. This would have a direct impact on housing availability and cost, hence on population distribution. However, the cost of sewer improvement district assessments and other sewer fees are part of the generally high cost of housing and can contribute to families' decisions to relocate to lower cost areas. Thus, while expanded infrastructure allows growth in housing, the cost of infrastructure improvements can increase the cost of living.

Mitigation: The preferred alternative mitigates impacts to projected population distribution in the study area by providing adequate sewage infrastructure, based on projected population and land use criteria derived from development predictions. The proposed improvements do not over-build and are cost effective, resulting in the lowest possible impact on user service fees and cost of living in the study area.

8.2.2 SOCIAL IMPACTS

Construction Impacts: Releases, including dust and particulate emissions from construction equipment, and noise may occur. Accidental release of raw sewage during repair or improvement of an existing sewer line or wastewater pump station is unlikely due to the normal precautions taken to prevent such an occurrence.

Mitigation: Dust at construction sites is typically controlled by periodic watering of exposed areas. The control of particulate emissions and noise from construction vehicles is limited by proper vehicle maintenance and the time of their use. Emissions from equipment can be minimized through regular maintenance and upkeep. Noise impacts can be mitigated by prohibiting construction in residential areas during off-peak traffic hours. In commercial and industrial areas, potential traffic impacts would be offset somewhat by scheduling construction during off-peak traffic hours. Traffic impacts are discussed in detail in Section 8.7.4.

Operational Impacts: Broader concerns such as the general public health will benefit from implementation of the preferred alternative. The resulting reduction in the potential for bypasses, spills, and overflows will reduce the public's exposure to raw sewage and pathogens associated with it. The efficient operation, maintenance, and upkeep of the wastewater collection and treatment system will help ensure the existing quality of life for study area residents and visitors.

Cumulative Impacts: The only significant negative cumulative impact resulting from implementation of the preferred alternative relates to the community's ability to bear the cost of the improvements. Estimated cost impacts are discussed in Section 8.11 and Appendix B.

8.2.3 ECONOMIC CONDITIONS

Construction Impacts: Individual construction projects which impact major thoroughfares may temporarily disrupt local business activity in the specific area. All projects will be designed and implemented to ensure that wastewater collection service is not reduced or compromised during construction. Construction expenditures early in the planning period will stimulate jobs and revenues in the community.

Mitigation: The degree of impact due to construction at major thoroughfares will be mitigated by segmenting sewer construction projects into units as small as a few hundred yards at a time, thereby minimizing traffic impacts and the disruption of access to businesses.

Operational Impacts: The operation of an improved collection and treatment system will have a negative impact upon the local economy, through operating costs. These costs are offset by reduction of backups and accidental spills or bypasses, thereby substantially reducing the likelihood of pollution related to sewage spills. Higher operating costs will require higher sewage fees, thereby removing purchasing power from Oahu households.

Cumulative Impacts: Without knowing how the economy may change during the coming 22 years, it is not possible to fully evaluate cumulative economic impacts. However, in general the direct positive economic impacts of construction in early years of the planning period will be more than offset by debt service payments extending beyond the end of the planning period. A more detailed discussion can be found in section 8.11 and in Appendix B.

Mitigation: Economic impacts can only be mitigated by reducing expenses and acquiring lowest possible interest rates.

8.3 PHYSICAL IMPACTS

8.3.1 GEOLOGY AND TOPOGRAPHY

Construction Impacts: Construction activities associated with the preferred alternative will have no significant impact upon the geological character or topography of the study area. Within the sewered portions of the study area, the majority of proposed projects will impact existing facilities (collection lines, pump stations, force mains, and the WWTP). Within the unsewered areas, the installation of sewer lines will neither permanently change the current topography nor alter the geology.

Operational Impacts: The post-construction operation of the preferred alternative will not impact the geology or the topography of the study area.

Cumulative Impacts: Site disturbing activities will not be compounded by other activities because in most instances subsurface lines are within sewer easements which preclude encroachment into the easement. Sewer lines are typically located within roadway and shoulder alignments to facilitate ease of access in case of the need for repair. The cumulative impact of several projects occurring at the same time in different areas within the city will have no impact upon geology or topography.

8.3.2 SOILS

Construction Impacts: Construction activities will impact soils in unsewered areas by displacing them where new sewer lines are proposed to be located. In sewered areas, improvements to the collection system are generally limited to repairs to and expansion of the existing system. Larger volumes of soil will be displaced during improvements to the Sand Island WWTP and construction of the new Beachwalk and Hart Street WWPSs. The accidental release of significant amounts of wastewater to the soil during construction is unlikely; construction operations are designed to preclude such an occurrence. With regard to improvements at the Sand Island WWTP, a portion of the facility's expansion area is presently occupied by an abandoned car lot. The soils in this area have the potential to be contaminated with oil, battery acid, or lead, although the site has not been listed by the DOH.

Mitigation: Prior to the start of construction activities in the vicinity of the abandoned vehicle lot, a site assessment will be conducted to determine if contaminated soils exist in the area. If present, contaminated soils will be removed to ensure that workers are not exposed to contaminants. This removal and disposal would be conducted according to DOH and EPA guidelines.

Displaced soils that are not contaminated will be handled by the construction contractors or City crews doing work at the sites. Excess soil, depending on its quality and usefulness, will be used as fill at other projects or disposed of in a landfill.

Operational Impacts: The potential impact on soils resulting from the operation of the wastewater collection and treatment system is limited to potential releases or exfiltration. Because the improvements in the preferred alternative are intended to reduce backups, spills, and bypasses, the potential for releases will be reduced by implementation of the preferred alternative. Solids disposal has the potential to introduce potentially toxic materials into the soil and food chain if sludge is converted to an agricultural amendment or fertilizer. However, SIWWTP sludge currently meets regulations established to prevent such contamination, and will be subject to periodic monitoring if this sludge disposal option is selected.

Cumulative Impacts: No cumulative impacts are anticipated.

8.3.3 CLIMATE

The preferred alternative will have no impact upon climatic conditions in the study area including temperature, winds, and precipitation.

8.3.4 HYDROLOGY

Construction Impacts: Potential impacts are associated with any dewatering that may be necessary during individual construction activities. Dewatering has the potential to lower the groundwater table locally and cause settling in nearby structures. Also, since excavation exposes groundwater, there is potential for direct contamination of these resources, and dewatering effluent can affect surface water quality.

Mitigation: Dewatering impacts will be localized by limiting the extent of excavations. Precautions will be taken to ensure that contaminants do not affect groundwater. Finally, if the dewatering effluent is discharged to state waters, NPDES permitting will be sought as required under HAR Chapter 11-55.

Operational Impacts: From a systemic perspective, implementation of the preferred alternative is not anticipated to have significant impact upon the general hydrology of the subject area. It will not alter or impact the percolation of rainwater into the Honolulu aquifer, nor will adversely it impact the drainage basins in the study area or the streams that transport surface runoff to the ocean.

Cumulative Impacts: No cumulative impacts to the hydrology of the study area are anticipated as a result of the preferred alternative.

8.3.5 GROUNDWATER QUALITY

Construction Impacts: Construction activities will not have significant impacts on groundwater quality in the study area.

Operational Impacts: As discussed in Chapter Four, the potential impact of the existing wastewater system upon groundwater resources is generally limited to releases from existing cesspools, exfiltration from leaking wastewater collection systems, and use of underground injection wells. The proposed expansion of the wastewater collection system into unsewered areas would eliminate many existing cesspools, thereby eliminating a possible source of impact. Improvements to increase the reliability of the collection system would help to reduce exfiltration by replacing deteriorating sewer lines. Improvements in the capacity of the collection and treatment system will have no significant impact upon the operation of existing injection wells. Underground injection of treated wastewater is not included in the preferred alternative.

Cumulative Impacts: Improvements to the collection and treatment system should reduce the potential for cumulative impacts upon the groundwater resources by reducing the number of cesspools and deteriorating sewer lines. Because injection wells are considered an alternative to the municipal system, improvements to the system's capacity may impact future decisions to construct or permit new injections wells in the study area. Thus, the potential for new injection wells to impact groundwater quality is reduced somewhat by implementation of the preferred alternative.

8.3.6 QUALITY OF INLAND AND COASTAL WATERS

As discussed in Chapter Three, inland and coastal water quality in the study area have been affected by urbanization. Many streams in the study area have been reported to contain unacceptable levels of certain pollutants, as a result of a combination of surface runoff, storm drainage, sewage, and other human activities.

Construction Impacts: Construction impacts to inland and coastal water quality will be limited to runoff from areas of exposed soil and possibly discharge of dewatering effluent during excavations.

Mitigation: Compliance with DOH and City regulations regarding construction activities will require management of dewatering discharges and minimization of potential surface runoff during construction.

Operational Impacts: Once the proposed improvements are completed, the operation of the future wastewater collection and treatment system is intended to reduce the incidence of accidental bypasses and releases. Thus, implementation of the preferred alternative will have a beneficial impact upon the quality of inland and coastal waters to the extent that these resources are impacted by the existing system.

Cumulative Impacts: Any reduction in releases to inland and coastal waters will help to reduce the cumulative impacts on coastal recreational areas resulting from non-point source pollution. However, due to the volume of surface runoff generated in the study area, the actual degree of impact that may be attributable to the current releases from the collection system, and consequently the degree of improvement attributable to improvements, cannot be determined.

8.3.7 QUALITY OF MARINE WATERS

For the purposes of this discussion, marine waters are defined as ocean waters other than the coastal waters discussed above, specifically open coastal waters, as defined in the DOH regulations. Of principal concern is the impact which the Sand Island WWTP ocean outfall may have upon these waters. The preferred alternative does not include any changes to the location or size of the existing outfall.

Construction Impacts: Because no physical alterations are proposed for the outfall or diffuser, no direct impacts upon open coastal waters are anticipated.

Operational Impacts: The operation of the improved treatment and collection system is intended to reduce the incidence of bypasses, spills, and backups in the system. As discussed above, these occurrences impact the quality of coastal and recreational waters. Open coastal waters, as defined in DOH regulations, are generally not significantly impacted in the study area by nonpoint source pollution generated from land. Therefore, the potential operational impacts of the preferred alternative are related to the quality of effluent discharged at the outfall.

The composition of the effluent to be discharged through the diffuser in the future will continue to be controlled by a variety of federal and state regulations (see Chapter Two). For the purposes of this analysis, the quality of the effluent is assumed to remain unchanged proportionally in composition.

In a study performed by Edward K. Noda & Associates in 1992, a computer model was used to predict initial dilution and dispersion of the effluent plume. A range of initial dilution ratios are associated with the outfall, depending on water density, currents, and the effluent flow rate at any particular moment. Based on the Noda model, initial dilution at future design flow rates will range from a calculated low during maximum ocean stratification of 57 for deeply submerged plumes (1 part effluent to 56 parts seawater), to a high in the thousands for surfacing plumes.

A second modeling study analyzed existing and projected (future) effluent flows to determine compliance with existing water quality standards (see Appendix C). When projected to the ZOM boundary, model results indicate continued compliance with the standards for geometric mean concentrations of all monitored parameters.

Upgrading the Sand Island WWTP's treatment level to secondary will not improve the removal of soluble constituents such as ammonia and nitrates. Secondary treatment with nutrient removal (or tertiary treatment) would be necessary to remove a significantly greater percentage of nitrogen compounds from the effluent.

If wastewater flows increase in the future and surface water quality standards remain unchanged, three alternatives can be considered to reduce the potential for exceedance of the standards outside the ZOM. These are: (1) changing the concentration of the constituent in the effluent; (2) changing the length of the diffuser to increase initial dilution; or (3) changing the size of the ZOM. Lowering the effluent concentration (via treatment) will lower the predicted concentration in the receiving waters. Increasing the length of the diffuser or the size of the ZOM would decrease the predicted concentration at the ZOM boundary through increased dilution and mixing. Expanding the ZOM would allow greater capacity for dilution within the ZOM. The three alternatives are discussed in more detail below. Because ammonia nitrogen concentrations currently most closely approach the standard, it is the constituent of concern.

Nutrient Concentration in the Effluent. The major concern with the introduction of nutrients into a water body is eutrophication. Under eutrophic conditions, the biomass of plants and animals sustained may be large, but only a few adapted species are represented. Eutrophication diminishes the ocean's quality by increasing the dissolved solids and turbidity, and by reducing dissolved oxygen. It should be noted, however, that oligotrophic (i.e., nutrient-poor) water bodies such as Mamala Bay, are capable of assimilating fairly large quantities of nutrients with no adverse impacts. Nutrients are used by phytoplankton (microscopic floating plants) in conjunction with sunlight to grow. Since phytoplankton are at the base of the food chain, limits to the growth of the plankton may limit the growth of other ocean life. On the other hand, excessive phytoplankton growth can result in decreases in water quality, such as increased turbidity and/or the depletion of dissolved oxygen below desirable levels.

The effect that nutrients have on plankton growth in receiving waters was examined by Hyperion Engineers in the book *Ocean Outfall Design* based on their work in designing the Hyperion outfall. The report included results of a University of Southern California study of the waters surrounding three sewer outfalls which found that the number of plankton varied considerably, although the concentration of the nutrients discharged from each WWTP was relatively constant. The study also found that when the number of plankton near an outfall was high, plankton concentrations were also high in waters not affected by the outfall and that when the numbers were low near the outfall they were also low elsewhere. The study concluded that the discharge of sewage into the waters surrounding the outfalls did not in itself initiate a plankton bloom (Hyperion Engineers, 1957).

The introduction of nutrients into the ocean at controlled rates can have some positive effects on ocean life forms. In a report to the California State Water Pollution Control Board, Dr. E. A. Pearson stated that, "If wastes are discharged to marine waters under properly controlled conditions, much of the organic matter and trace nutrients present in the waste ultimately become available as food to marine organisms. In some marine environments where natural nutrients are limiting, properly controlled sewage discharge may actually stimulate the biological productivity of the area." The California Fish and Game Department stated in a report that, "There may even be beneficial effects of sewage on fish life in the increase of food organisms." (Hyperion Engineers, 1957).

A review of water quality monitoring data for the Sand Island WWTP (OI Consultants, 1992; Appendix C) found that there is no evidence that the effluent has had any significant impact on the quality of the receiving waters.

The Reapplication for Secondary Treatment Modification (M&E Pacific, Inc., 1983) evaluated the Balanced Indigenous Population (BIP) to determine if the ocean waters near the Sand Island discharge were stressed. Baseline studies of plankton and larval fish showed some stimulation of phytoplankton and zooplankton near the diffuser but no significant alteration of the BIP. The report concluded:

> "Under the present level of primary effluent treatment and discharge, there is virtually no impact to either the benthic or nektonic communities. Since the benthos shows no apparent signs of stress including the sewage discharge, there are no known factors stressing the receiving waters." (pg IIB-4)

There is no evidence to show that sewage effluent is toxic to fish provided that the dissolved oxygen content of the ocean is not depleted. In fact, the Hyperion Engineers found that the most toxic constituent of sewage to the marine environment is its freshwater content. For these reasons, it has been concluded that there are no benefits associated with reducing the concentration of nutrients in the effluent through tertiary treatment or secondary treatment with nutrient removal to justify the costs.

Redesigning the Diffuser. The future design average and peak flows for the Sand Island WWTP are 90 mgd and 214 mgd, respectively. These flows are within the original design parameters for the outfall. Therefore, the hydraulic capacity of the existing outfall is sufficient to accommodate them. The cost of extending the diffuser to increase the dilution rate of the effluent, and the environmental impacts that would result during the construction of an extended diffuser are not warranted, given the lack of any negative biological or chemical impacts resulting from the discharge of effluent.

Increasing the Size of the ZOM. Increasing the size of the ZOM to accommodate the increased volume of effluent will have no significant impact upon the water quality of receiving waters in East Mamala Bay. Furthermore, the costs associated with this alternative are limited to the costs associated with permit preparation and water quality monitoring. Conditions at the outfall and ZOM appear to meet the requisite eligibility criteria in the DOH rules for potential expansion. (See Chapter Two).

Cumulative Impacts. The cumulative impact analysis discussed in Chapter Four was also conducted at future (2015) flows, assuming the same effluent composition. Similar conclusions resulted. Concentrations of ammonia nitrogen in the Sand Island WWTP plume are diluted to background levels before the plume reaches a zone of potential interaction. The analysis indicates that no cumulative impacts will occur.

8.3.8 VISUAL ATTRIBUTES

Construction Impacts: Improvements to the existing collection system, as well as extension of the collection system into unsewered areas will result in short-term visual impacts due to the presence of construction material, equipment, and crews. However, because in all instances the physical improvements are situated below grade, once construction has been completed there will be no visual evidence of the improvements. Most of the improvements proposed at the WWPSs in the study area will occur within the existing buildings. Therefore, visual impacts will be limited to the presence of construction materials, equipment, and crews.

Four of the existing pump stations require improvements which call for an expansion of existing facilities, and two new pump stations are proposed. A new building is proposed for Awa Street WWPS. However, because the need for the new structure was determined by a separate study and is not part of this analysis, it is assumed that the improvements will already be in place at the time the preferred alternative is implemented. A new generator building is also proposed for Ala Moana WWPS. A need for this building was also determined by a separate study, but the Facilities Plan proposed a larger size than that identified in the study.

The existing generator building at the Public Baths WWPS will be expanded to accommodate a new emergency generator. At the Fort DeRussy WWPS, a new generator building will be required. In all these cases, the visual impact from each of these improvements will be negligible, as the existing visual context will not be altered.

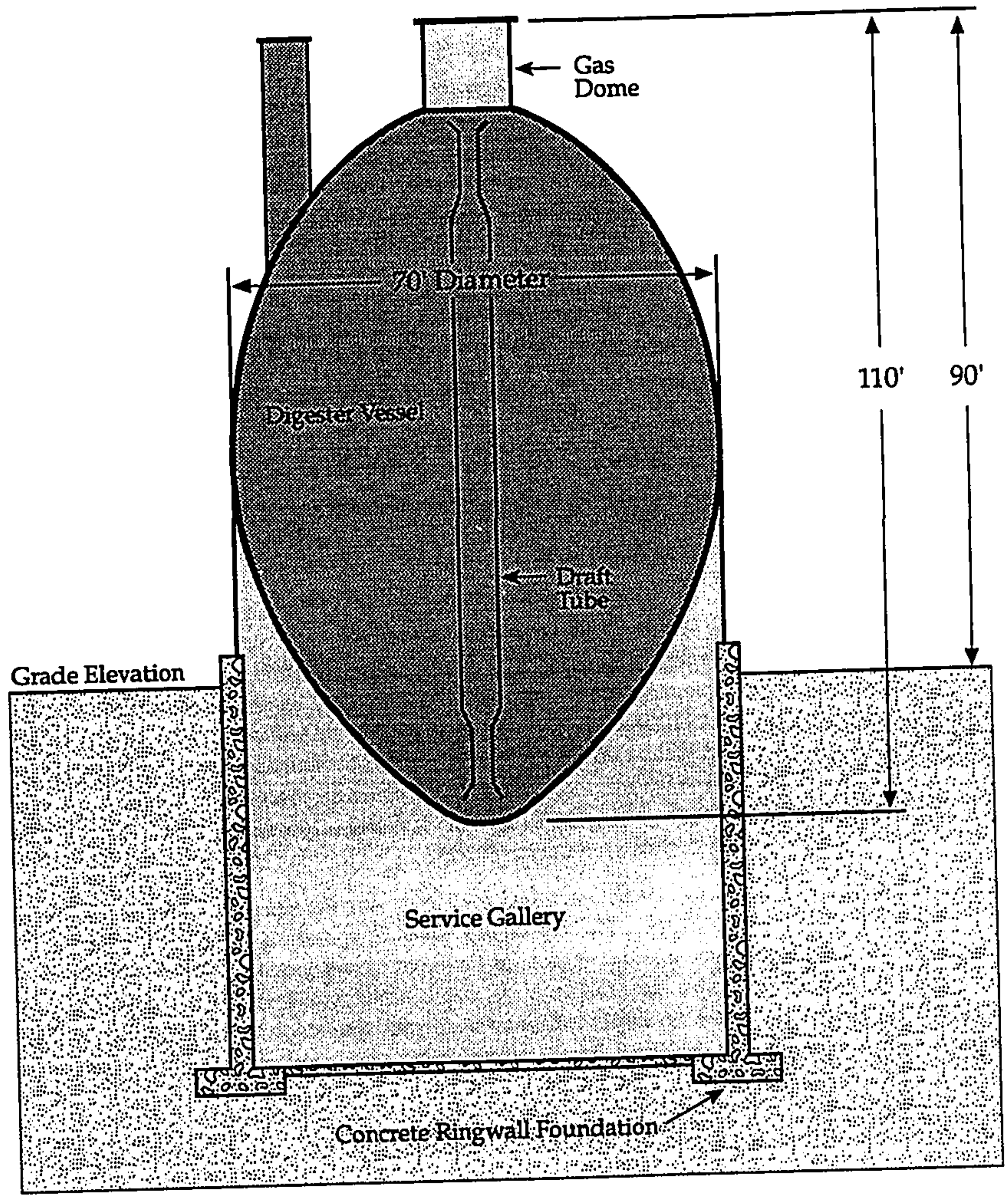
The two new proposed pump stations are associated with the Hart Street and Beachwalk WWPSs. These new sites are within already urban settings, so the overall impacts are not expected to be significant. However, one option for the Beachwalk WWPS is located in the Ala Wai Park area, which will be clearly evident during construction from Ala Wai Boulevard across the canal.

Proposed improvements to the Sand Island WWTP include additional clarifiers, anaerobic digesters, a regional laboratory, parking structure, and final sludge processing facility. The three anaerobic digesters proposed will each require a height variance. The existing height limit for the I-3 Heavy Industrial zone on Sand Island is 60 feet. The digesters will exceed this height limit by approximately 30 feet. Although they are designed to be about 110 feet tall, approximately twenty feet will be constructed below grade (see Figure 8-1). The proposed digesters will be located adjacent to the existing incinerator building which is 90 feet tall. The Sand Island WWTP is located in the Downtown segment of the Southshore viewshed as identified in *Coastal View Study* (DLU, 1987). The site is marginally within public views from portions of the airport, Kakaako, and downtown waterfront areas.

A view analysis was conducted for the proposed digesters using the existing incinerator building as an indicator. Based on the assumption that the digesters would appear to be about ten feet higher the incinerator building, the potential visual impact was evaluated from a number of viewing points throughout Honolulu. Figure 8-2 identifies the primary areas where the digesters will be plainly visible. For the purposes of analysis, primary areas were distinguished from secondary areas. In secondary areas, the digesters may be visible but the distance is so great that they will be obscured by surrounding industrial structures. Secondary areas include portions of Ewa Beach, Makakilo, upper Pearl City, Aiea, upper Saint Louis Heights, the upper stories of hotels along Waikiki Beach with western views, and some areas on the upper slopes of Diamond Head and at its most southerly point. Primary areas (identified by number on Figure 8-2) are discussed below.

1. From the extreme *ewa* end of Lagoon Drive to its intersection with Iolana Street, the digesters will be visible, but set against the backdrop of higher structures in urban Honolulu. However, when traveling east on Lagoon Drive, from the intersection of Lagoon Drive and Iolana Street (Point #1 in Figure 8-2) around the bend in the road through the approach zone at the east end

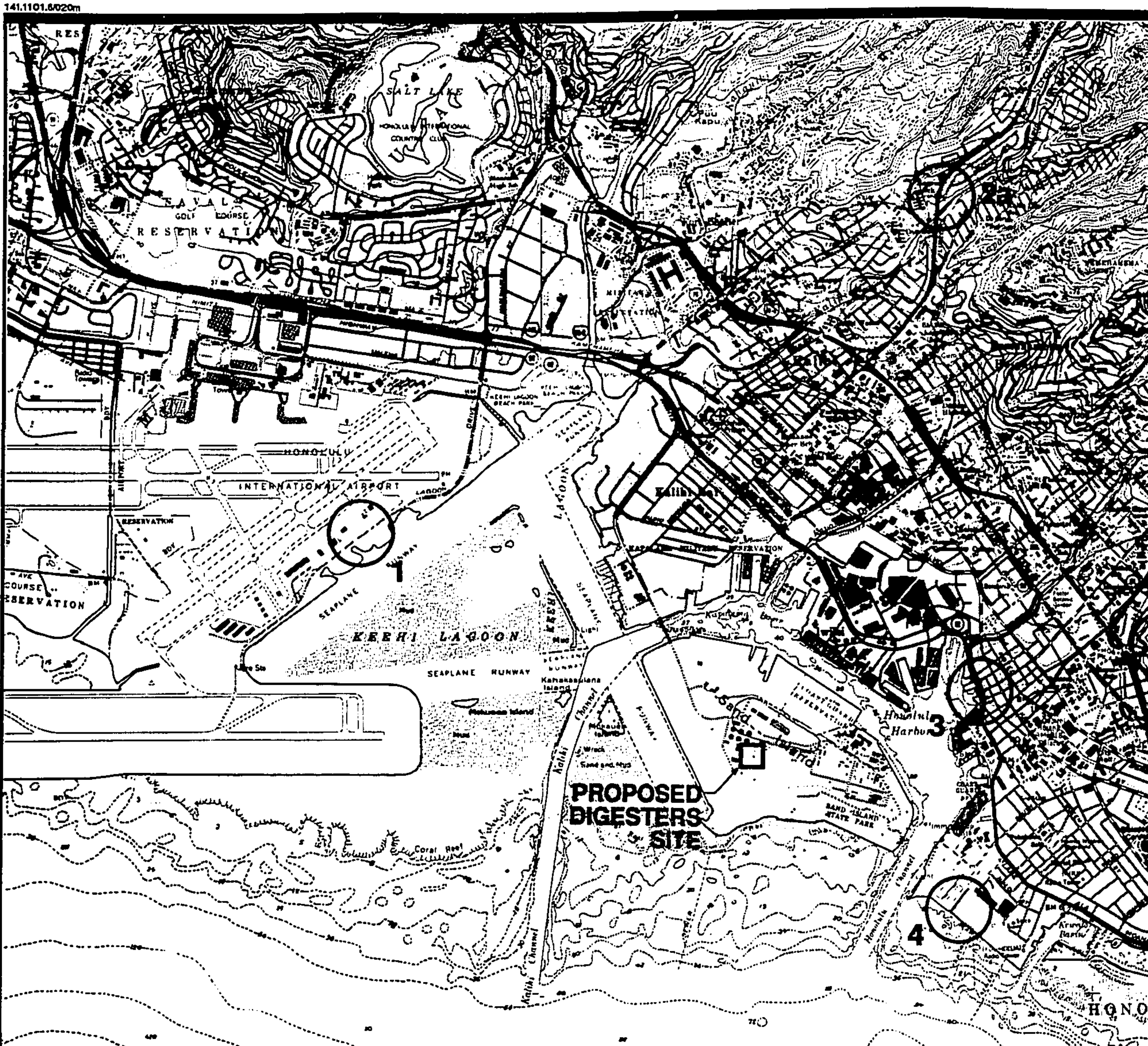
141.1101.7/015



EAST MAMALA BAY
WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT
BELT COLLINS HAWAII • DECEMBER 1993

Figure 8-1
Sludge Digester

141.1101.6/020m



EAST MAMALA BAY

WASTEWATER FACILITIES PLAN
ENVIRONMENTAL IMPACT STATEMENT

BELT COLLINS HAWAII • DECEMBER 1993

3,000 1,500 0 3,000
Scale in Feet

North

Figure 8-2
Visual Impact: Locations

of Runway 26L, to the *makai* end of the Hertz automobile sales lot, the digesters will be silhouetted against Diamond Head. For the remainder of Lagoon Drive to its intersection with Nimitz Highway, views are obscured by fences and buildings along Lagoon Drive. Because no stopping or parking is allowed along Lagoon Drive through the designated approach zone, actual viewing of the digesters from the roadway would be limited to drivers or their passengers as they negotiate the curve in Lagoon Drive. However, the digesters framed against Diamond Head will be plainly visible to individuals in Keehi Lagoon. The digesters are blocked from view at Keehi Lagoon Beach Park by development at the western end of Honolulu Harbor.

2. From higher elevations in upper Kalihi, Alewa Heights, and the Pacific Heights area, the digesters will be visible but set against Sand Island, rather than the horizon. Thus, they will be relatively indistinguishable from the adjacent fuel tanks and container cranes on the Matson property on Sand Island.

3. The digesters will be visible from the intersection of Nuuanu Avenue and Nimitz Highway, as well as from the upper floors of buildings in the downtown area with views of the harbor.

4. The digesters will be plainly visible from the western end of the new Kakaako Waterfront Park.

5. The digesters will be visible from residences above the intersection of Huali Street and Prospect Street on the southwestern slope of Punchbowl. Views from condominium buildings in the vicinity of Ward Street and Prospect Street, as well as from the Punchbowl lookout may be obscured by downtown office buildings.

6. Visibility of the digesters from the Tantalus State Recreation Area lookout will be marginal. While the digesters may be visible, they would likely blend in with the surrounding industrial development on Sand Island.

Mitigation: The visual impact resulting from the shape and size of the digesters may be mitigating by painting them with colors intended to mute their appearance. At the design stage of their development, careful attention should be given to their potential visual impact and the colors which may most effectively minimize that impact. The Federal Aviation Administration may also require each digester to be fitted with an aircraft warning light at its apex to ensure visibility by aircraft.

Operational Impacts: There are no significant visual impacts associated with the operation of the system.

Cumulative Impacts: There are no significant cumulative visual impacts associated with improvements proposed for the treatment plant on Sand Island. Because the proposed collection system upgrades and repairs will be distributed in locations throughout the study area rather than massed together, there will be no cumulative effect.

8.3.9 SONIC ENVIRONMENT (NOISE LEVELS)

Construction Impacts: The implementation of improvements to the collection and treatment system will result in a short-term increase in noise levels associated with construction equipment. Equipment generally used in such operations include back hoes, dump trucks, cranes, and flatbed trailers. The impacts of construction-related noise are dependent on noise energy at the source, its location with respect to noise receptors, its duration and time of occurrence. Different receptors have differing tolerances for noise, with such facilities as hospitals and churches being very sensitive, residences being sensitive, and urban commercial districts and industrial areas being moderately sensitive to insensitive.

In general, interference with normal speech at a distance of one meter indoors occurs when noise is in the range of up to 70-80 dBA; sleep loss may occur at 45 dBA and above. However, noise from the exterior of structures is attenuated within by a factor of about 15-20 dBA, more or less, depending on construction. 30 to 50 dBA is a reasonable range for residential interiors. Frequency and duration are major determinants of noise nuisance.

Urban areas experience ambient noise (outside) ranging from 45-60 dBA in residential areas, to 65-75 dBA for downtown areas. By comparison, a medium-sized truck operating at 30 mph causes a noise of about 70 dBA at 15 meters distance. The noise is attenuated by 3-4.5 dBA for every doubling of the distance, over flat surfaces. Medium trucks are taken to be representative of equipment used in sewer construction projects (*Environmental Impact Analysis Handbook*, Ran and Wooten, 1980).

From this general characterization, we can conclude that noise impacts from construction will affect sensitive receptors, depending on proximity to the site. Because pump stations in the study area are in urban residential areas and Sand Island WWTP is in an industrial area, construction noise from these sources is less likely to be a problem than that associated with sewer line construction in residential streets. However, this impact will be of short duration for any particular residence. One exception is the Sand Island Treatment Center (SITC) on the Sand Island WWTP site, where daytime activities could be affected by nearby construction noise. However, this facility is already subject to aviation noise from Honolulu International Airport.

State DOH standards for noise at the property line (daytime) is 55 dBA in residential, 60 dBA in apartment/commercial areas and 70 dBA in industrial areas.

Mitigation: In general, construction noise is unavoidable. Therefore, to reduce noise impacts and minimize this short-term nuisance, construction activities in residential areas will be limited to daytime during off-peak traffic hours.

Operational Impacts: There are two sources of noise associated with the operation of the wastewater collection and treatment system: pumps and generators. At the WWPSs, the pumps are generally located below grade and the noise they generate is confined to the pump station structure. Emergency generators are typically located in separate or adjoining structures, and are more prone to generating undesirable levels of noise whenever they are tested or are in operation. The Kahala WWPS, in particular, has been the source of numerous complaints from nearby residents concerning the operation of its generator.

The principal sources of noise at the Sand Island WWTP are the emergency generators, pumps, and ZIMPRO units. All of this equipment is located within structures that generally limit the impact of noise. One diesel motor pump at the effluent pump station and a diesel generator are recommended as improvements at the treatment plant. These additions are not anticipated to result in a substantive increase in noise levels.

The treatment plant is situated in a heavy industry zone, so residential-zoned areas are not impacted by noise levels. The SITC may be impacted at times by the testing of the emergency generators; however, no complaints concerning noise have been documented. Discussions with the center's director indicate that the noise generated by aircraft passing overhead is a far greater problem than noise from the treatment plant. Therefore, the improvements recommended for the treatment plant will not result in any significant increase in noise levels over current operations.

Mitigation: The installation of new or expanded generators will include provisions for adequate soundproofing in existing or proposed generator sites.

Cumulative Impacts: Because the various components of the system are widely distributed throughout the study area, there will be no significant cumulative impacts associated with noise.

8.4 NATURAL AND MAN-MADE HAZARDS

Implementation of the preferred alternative will have no discernable impact upon geologic or climatic conditions that result in natural hazards. It is assumed that the potential for the occurrences of future natural hazards is represented by the current potential. Therefore, existing flood hazard zones and seismic zones are used to evaluate sufficiency of proposed improvements.

8.4.1 FLOODS AND TSUNAMIS

Flood and tsunami pose hazards because of their potential to cause releases of untreated wastewater from the collection system, and to damage or destroy infrastructure. These releases have the potential to cause significant local health risks, particularly in conjunction with damage to homes and other infrastructure that may occur at the same time. If wastewater infrastructure is significantly damaged, the release will be prolonged.

The Sand Island WWTP is not in either a flood or tsunami zone. Of the WWPSs, the following are in special flood hazard areas:

WWPS	FLOOD ZONE	TSUNAMI INUNDATION ZONE
Moana Park	100 year, no base elevation	Yes
Kamehameha Hwy.	Edge of 100 year, 3 feet base elevation	Edge
Ft. DeRussy	100 year, 2 feet base elevation	No
Beachwalk	100 year, 2 feet base elevation	No
Kahala	100 year, 6 feet base elevation	Yes
Paiko Drive	100 year, 6 feet base elevation	Yes
Public Baths	100 year, no base elevation	Yes

There is potential for sea-level rise to aggravate the existing flood/tsunami exposure conditions. Estimates of the maximum potential increases in sea level over the next century begin at 23 to 28 inches. Geologically measured past rates of change have been as high as 32 to 39 inches per century. This rate of change would equate to four to seven inches over the study period (CZMP, DBED, January 1985). However, there is no evidence that this type of sea level rise is presently occurring.

Operational Impact. The biggest threat from catastrophic events on the system are posed by prolonged outages and releases caused by major damage to the system, as opposed to short-term releases caused by temporary outages which can be quickly corrected when flooding subsides.

Mitigation. Mitigation of this potential hazard would include design of exposed facilities such that they can sustain predicted flood/tsunami conditions without suffering major structural or functional damage. Specific measures include protective building design, placing sensitive instruments and control panels above anticipated flood elevations, use of submersible pumps, and planned modular components that could be easily replaced.

Cumulative. Flooding from rainstorms, tsunami or storm surge is likely to effect electrical systems as well as wastewater systems. In addition, damage to housing would potentially dislocate large numbers of people in an extreme event. These factors interact to impose a substantial public health threat to the extent such an extreme event is likely to occur.

8.4.2 AIR TRAFFIC HAZARDS

Sand Island WWTP is located within the controlled airport zone of Honolulu International Airport, in the departure path of Runway 8R. The structural height in the Sand Island WWTP area is limited to the elevation of the "inner horizontal surface" of the airport, 163 feet above sea level, or to the elevation of the approach/departure surface. The approach zone for runway 26L decreases in height from a ceiling of 210 feet to a ceiling of 190 feet from the eastern to western side of the Sand Island WWTP, respectively.

None of the planned improvements reach these elevations. However, aviation-hazard warnings may be required by the FAA in accordance with Publication ATR240, "Obstruction Marking Lighting," and notification to the FAA of construction affecting navigable airspace may be required in accordance with FAA Regulations, Part 77.

8.5 BIOLOGICAL IMPACTS

8.5.1 VEGETATION

Within the area served by the existing collection system, the proposed improvements will have no significant impact upon rare or endangered species in the study area. Because the pump station sites, the treatment plant site, as well as most collection lines located within road alignments and rights-of-way, are significantly disturbed areas (i.e., they are entirely paved over or existing vegetation is limited to a few exotic species; see Appendix H), little or no vegetation exists to be impacted.

With regard to the unsewered areas proposed for inclusion in the collection system, most improvements will occur within road alignments or rights-of-way, and will therefore not impact existing vegetation.

The potential production of composting material from dewatered sludge would have a positive impact on vegetation by providing a new source of soil conditioner for farms, commercial plant nurseries, and landscaped residences and commercial businesses. Appendix H contains a survey of flora in the study area.

8.5.2 FAUNA AND AVIFAUNA

No significant impacts will be generated by the proposed improvements upon fauna or avifauna. None of the existing facilities are within areas identified as significant habitat. Although the unsewered areas proposed for inclusion in the collection system are known to be inhabited by an extensive variety of birds including some native and endangered species, the construction of collection lines within roadway alignments and rights-of-way will have no foreseeable impacts, unless large trees known to be nesting places are proposed for cutting or removal.

Mitigation: The construction of collection lines in presently unsewered areas will avoid the removal of trees wherever possible to minimize potential impacts upon the avifaunal populations.

8.5.3 AQUATIC FAUNA

As discussed in Chapters Two and Four, the operation of the Sand Island WWTP and its effluent outfall are regulated through the NPDES permit process. As part of this process, the City is required to implement a monitoring program to identify potential impacts. The Sand Island WWTP's NPDES permit specifies monitoring designed to evaluate potential impacts upon aquatic fauna. To date, the monitoring program has demonstrated that no significant negative impacts attributable to the operation of the treatment plant can be identified. Neither benthic nor nektonic communities have been significantly affected by the existing outfall. Appendix C contains a discussion of the monitoring data.

Implementation of the preferred alternative is intended to improve system capacity and reliability. Improving its capacity to meet future demand will result in a greater volume of treated effluent being discharged into the receiving waters. However, analysis of existing data indicates that the projected increase in the volume of effluent discharged will not result in significant changes in ocean chemistry sufficient to cause significant impacts upon aquatic fauna. Improving the reliability of the collection and treatment system is intended to reduce the potential for wastewater spills, bypasses and releases, which in turn should result in a positive impact upon aquatic fauna by minimizing or eliminating local exposures to high concentrations of untreated wastewater.

8.6 HISTORIC & ARCHAEOLOGICAL IMPACTS

This discussion is a summary of information contained in Appendix G. That report evaluated the potential for historic resources to exist at the 25 specific locations which will be affected by specific actions that are part of the preferred alternative. These sites are identified below. No attempt was made to assess the potential archaeological value of every collection line proposed for improvement (over 300 individual projects). The potential sites of the new WWPSs were not evaluated either. These individual areas will be evaluated for potential archaeological impacts prior to the commencement of construction activity.

Facilities:

Sand Island WWTP
Aliamanu #2 WWPS
Hart Street WWPS (existing)
Awa Street WWPS
Niu Valley WWPS
Sand Island Parkway WWPS
Beachwalk WWPS (existing)
Kahala WWPS
Kamehameha Highway WWPS
Paiko Drive WWPS
Aliamanu #1 WWPS
Fort DeRussy WWPS
Public Baths WWPS
Moana Park WWPS
Kuliouou WWPS

Unsewered Areas:

Mapunapuna
Black Point
Crater Road
Diamond Head
Aukai Avenue
Punchbowl
Nuuanu Pali Drive
East Manoa Road
Tantalus/Makiki/Roundtop
Upper Palolo Valley

The assessment of the likelihood for archaeological impacts was based upon information gathered from mid-nineteenth century Land Commission Awards (LCAs), historical maps, predictions from analogous settings, and a review of the historical and archaeological literature. Assessments from this information detail only general patterns of settlement and land use, and in most cases cannot be more specific in regards to those parameters for a particular development site.

Archaeological resources may include both prehistoric (pre-contact) Hawaiian habitation deposits and historic era (post 1778) deposits. Besides the presence of traditional prehistoric Hawaiian artifacts such as faunal food remains, adzes, and gaming stones, archaeological deposits may also consist of non-portable archaeological features such as burials, rock shelters, fishponds, trails, irrigation ditches, post-holes, hearths, earth ovens, midden (trash) pits, lithic work areas, and various constructed architectural features. Historical era deposits may also consist of bottle glass, ceramics, metal, and exotic natural materials such as chert, slate, granite, or non-portable features such as privies. All these archaeological deposits are considered archaeological sites and each contains a unique and non-renewable record of evidence about the past for which no other record exists.

Although not all locations slated for improvement to the wastewater system infrastructure will be subject to the same impacts from development, this assessment is presented without regard for those differences. The assumption is that any archaeological resources present at the location will have the same potential for being impacted. The potential for archaeological deposits at each of the 25 development sites is assessed as being non-existent, or rated as having a slight, low, or high probability of occurring at a particular location.

Determinations presented in this document ultimately will be subject to further review by the State Historic Preservation Division as part of the formal consultation process provided for under HRS Chapter 6E and the National Historic Preservation Act, Section 106. All projects will be subject to the historic preservation review process.

Construction Impacts:

Sand Island WWTP and Sand Island Parkway WWPS: The WWTP and WWPS are located on an area of landfill created from dredged material on the reef flat. This took place during the creation of the Kapalama Basin in Honolulu Harbor during the 1930s (Thompson 1985). The WWTP and WWPS are adjacent to the edge of the area that was called Quarantine Island in the nineteenth century (Monsarrat 1897) that was also partially created by landfill at the end of the nineteenth century. Because these locations are on recent dredged landfill above a previously uninhabitable reef flat, archaeological deposits should be non-existent and there should be no impacts to historic resources at these sites.

Aliamanu #1 WWPS and Aliamanu #2 WWPS: Both these sites are located along Salt Lake Boulevard in the *ahupua'a* of Moanalua. These two sites are close in proximity and have similar potentials for the presence of historic resources. Relatively low rainfall would have constrained agricultural production to gourds, or possibly sweet potatoes. In addition, the soils in the area belong to the Makalapa Series of clays a series whose agricultural potential is very limited. Therefore, prehistoric settlement of the area was probably minimal.

In general, there is very little information available from the historical record from which to formulate an assessment. Based on available information, both sites have a slight potential for archaeological deposits. Although Aliamanu #2 lies on the traditional border between the *'okana* (districts) of Ewa and Kona, and the *ahupua'a* of Halawa and Moanalua there is only a slight probability that evidence of its distinction as a boundary would be present.

Awa Street WWPS: This site is located adjacent to Honolulu Harbor at the mouth of Nuuanu Stream. Early maps of Honolulu by Kotezebue in 1817 and Malden in 1825 are difficult to interpret because of changes in the harbor shoreline associated with the placement of landfill in previous wetland areas; however, the maps do indicate some settlement and cultivation of the general location. In the mid 1840s, the *ewa* side of Nuuanu Stream, which includes the project site, was considered the edge of Honolulu town (Gilman 1903) and was not depicted on early detailed maps.

The site is located on an area of landfill as indicated by the Soil Conservation Service's soil survey information (Foote et al, 1972). This may have protected buried archaeological deposits from later construction disturbances. The landfill either extends into what was once the edge of the harbor or may overlie what was once part of the pond field *(lo'i)* terraces that were depicted at this approximate location at the edge of Nuuanu Stream on early maps. It must be noted that this landfill may itself contain materials of historical interest. There is a high probability for archaeological deposits to be present at this location.

Beachwalk WWPS and Fort DeRussy WWPS: Beachwalk WWPS is located in a parking lot near the corner of Kuhio Avenue and Lewers Street. Fort DeRussy WWPS is located approximately 100 meters south of the intersection of Ala Moana Boulevard and Kalakaua Avenue. Both of these sites have similar potential for archaeological deposits.

Both sites are located in areas of fill (Foote et al, 1972) that may have preserved buried archaeological deposits from earlier construction disturbances. Beachwalk WWPS was claimed as LCA 140, Fl. 3 by Kekuanaoa and was the location of the fishpond called Loko Mo'o (Bishop 1881; Land Commission Award Book 9:494-495). The area of the Fort DeRussy WWPS is above the location of a fishpond (Loko Kaipuni) next to Waikiki Road (Kalakaua Avenue) as shown on early maps (Bishop 1881; Monsarrat 1897). There is a high probability that archaeological deposits will be present at both these sites in any areas undisturbed by previous construction (Davis, 1992).

Hart Street WWPS: This site is located in Iwilei east of Kapalama Stream. It is now approximately 70 meters from the edge of the harbor. The harbor was dredged inland to its present location in 1931 as part of the improvements to Kapalama Basin in Honolulu Harbor (Thompson, 1985). It is probable that the area around the site remained as wetlands until the first improvements were made at Honolulu Harbor, beginning in 1921, when the remainder of the area was filled in with dredge spoils. There is a high potential for the presence of deposits in the form of paleoenvironmental and geomorphological information at this site.

Kahala WWPS: Kahala WWPS is located in Waialae near the mouth of Kapapahi Stream on the border between the *ahupua'a* of Waialae Iki and Waialae Nui.

This location, adjacent to both a permanent stream and the ocean, would have been a prime location for Hawaiian habitation. Judging from the use of the stream in Waialae Nui (Webster, 1851) in the adjoining *ahupua'a*, taro was probably cultivated at or near the site and a number of inland fishponds may have been present. In addition, the site was also the location of the intersection of a number of prehistoric Hawaiian trails connecting Waikiki, Palolo, and the eastern shore of Oahu (I'i, 1982). This would suggest that the location had some importance. There is a high probability that prehistoric archaeological deposits, including human burials, exist in the undisturbed areas in and around the site.

Kamehameha Highway WWPS and the Mapunapuna Unsewered Area: Kamehameha Hwy. WWPS and the Mapunapuna unsewered area are located in the *ahupua'a* of Moanalua. Both areas are on filled lands above Ahua and Awaawaloa Fishponds. These areas were filled with material dredged from Keehi Lagoon for the construction of the seaplane landings area from 1941 to 1944 (Thompson, 1985).

There is a high probability of encountering archaeological deposits and features associated with Ahua and Awaawaloa Fishponds during subsurface work in this area that would be complimentary to data obtained in a recent paleoenvironmental survey in the nearby Fort Shafter Flats (Wickler et al, 1991).

Moana Park WWPS: This site is located on landfill at the location where the Makiki and Piinaio Streams met the ocean (Bishop 1881; Monsarrat 1897). Given the potential importance of the area surrounding the mouth of a freshwater stream at the beach, there is a high probability that archaeological deposits are present in the undisturbed sediments at this location. These were the favored locations for the construction of fishponds and preferred locations for habitation since there was readily available access to both fresh water and the ocean's resources.

Public Baths WWPS: The traditional Hawaiian name for this area was Kapua (Monsarrat, 1897). In 1876 the area immediately inland of the site was a wetland covered in sedge grass adjoining a duck pond in what is now Kapiolani Park (Lyons n.d.). Also adding to the potential of this site's importance was the route of a prehistoric Hawaiian trail that passed along the beach at this location (I'i, 1982).

The underlying sediments at this site are beach sand. Locations such as this were the preferred location for prehistoric Hawaiian burial sites. Burials recovered in the vicinity of the site include four individuals disinterred from the location of the Elk's Club (Emerson, 1902) and 25 individuals from the site of the Outrigger Canoe Club (Krauss, 1963, Yost, 1971). In total, over 40 burials have been discovered in the beach sand along the Waikiki shoreline. On May 18, 1993 an unknown number of human remains were discovered during excavations for improvements being made at the Waikiki Aquarium, which is immediately adjacent to the site. In addition to burials, there is also a high probability of encountering archaeological midden deposits related to prehistoric Hawaiian habitation of the area as has recently been demonstrated for other sites at Waikiki (Davis 1989, 1992).

Niu Valley WWPS, Paiko Drive WWPS, and Kuliouou WWPS: The Niu Valley, Paiko Drive, and Kuliouou WWPSs are located close to one another and have similar potentials for the presence of archaeological deposits. The Niu Valley WWPS is located next to Niu Stream, directly across the highway from Niuiki Circle. Niuiki Circle is the location of a filled fishpond *loko Kupapa*. Paiko Drive WWPS is located adjacent to Paiko Fishpond. Kuliouou WWPS is between Kuliouou Stream and the edge of a former fishpond (Maunalua Fishpond) that existed prior to infilling for the Hawaii Kai development. Kalanianaole Highway, which passes near all three sites, had previously served as the route of a well-traveled prehistoric Hawaiian trail from "Keahia and on to Maunalua" (I'i, 1983) through the seaward portions of the *ahupua'a* of Niu and Kuliouou within the Kona *'okana* or district (Handy and Handy, 1972). All three sites were along this important prehistoric route. In general, there is evidence of a substantial dispersed settlement along the entire coastal area with more intensive settlement inland.

Recent archaeological monitoring of construction associated with the Kalanianaole Highway widening project along the *makai* portions of Kuliouou and Niu (Erkelens and Athens, 1993) has demonstrated that there is a high probability of encountering archaeological deposits and burials resulting from prehistoric Hawaiian habitation in the vicinity of the three WWPS sites. The location of the Niu Valley WWPS, along a prehistoric coastal trail, adjacent to Niu Stream, and in the vicinity of Kupapa Fishpond, would have been a prime location for Hawaiian habitation. The Kuliouou WWPS location is also a likely Hawaiian habitation spot and the general location of the Paiko Drive WWPS would have been of importance to Hawaiians because of the trail, adjacent fishpond, and nearby Kanewai Spring. In addition, an immediately adjacent parcel (TMK 3-8-01:51) is reported to be the location of one of the summer homes of Kamehameha I (Ben Cassiday 1993, pers. comm.; Sterling and Summers, 1978). Thus, both locations have a high potential for the presence of significant archaeological deposits and human burials.

Aukai Avenue Unsewered Area: This area is located in the *ahupua'a* of Waialae Nui on the coastal plain approximately 400 feet from the present shoreline.

The area immediately offshore in Maunalua Bay was rich fishing grounds and remains so today. Attesting to the abundant marine resources available here, the offshore fishing areas along the east coast of Oahu were claimed as part of the Land Commission Awards as named "fisheries."

In spite of the somewhat poor soils in the area, it is highly probable the area was inhabited by prehistoric Hawaiians. It is therefore highly probable that archaeological deposits will be encountered during subsurface work.

East Manoa Road Unsewered Area: This area includes sections of Kinohou Place and Molulo Place located between East Manoa Road and Manoa Stream.

There is a high probability that the entire course of Manoa Stream was developed for pond field cultivation of taro. It is also probable that archaeological deposits associated with prehistoric habitation as well as the evidence of the pond field system exist at the site and should be investigated.

Diamond Head Unsewered Area and Black Point Unsewered Area: All the land around Leahi (Diamond Head) was part of a large parcel claimed by W. C. Lunalilio that was referred to as "Pau, Waikiki." There is no testimony detailing land use associated with this claim (Book 10, p. 486-487). The lee area of Diamond Head Crater is moderate to steeply sloping and was called Kaalawai by Hawaiians. A prehistoric Hawaiian trail passed along the present route of the Kalakaua Avenue, Diamond Head, and Kahala Avenue road corridor through Kaluahole (Diamond Head Point) and Kaalawai and down to Kahala (I'i, 1982). A map by La Passe from 1855 (Fitzpatrick, 1986) appears to depict a number of habitation structures in the vicinity of Kulamana Street and Royal Place suggesting that in the mid-nineteenth century there was some settlement in the area.

Diamond Head Road was constructed in 1908. Prior to this, a road referred to as "Old Beach Road," which was constructed around 1898 (Land Court Application, 1925), ran down the present route of Beach Road, along the shoreline, and uphill in the corridor that is now Kulamana Place. The route of the "Old Beach Road" is the location of approximately 2,500 feet of the area identified as Black Point.

To the east of Diamond Head lighthouse the soils are classified as Makalapa clay (Foote et al, 1972). Soils to the west of the lighthouse are of the Mamala Series of stony silty clays (Foote et al, 1972) and at Black Point are from the Molokai Series of silty clay loams (Foote et al, 1972). Although these soils are generally stony and subject to erosion, this was not a limiting factor for Hawaiian farmers (Kirch, 1985) whereas available water probably was. Rainfall is reported to be approximately 600 mm (23.6 in) annually (Giambelluca et al, 1986). Based upon similar environments in the islands, this may have been marginally sufficient for the cultivation of sweet potatoes or gourds (Kirch, 1985) in the flatter portions of Kaalawai and Kupikipikio (Black Point). Between Kaluahole and Kupikipikio were the three named fishing grounds of Keauau, Kuilei, and Kaalawai. At the shoreline *makai* of Kaikuono Place there was an unnamed spring and fishpond (Diamond Head, n.d.).

Given the marginal nature of the area for intensive cultivation and habitation, there is a low probability of encountering archaeological deposits during activities associated with improvements to the infrastructure for the majority of Black Point. However, the location of the unnamed fishpond along the shoreline near the terminus of Kaikuono Place should be regarded as having a high probability for containing archaeological resources.

Punchbowl Unsewered Area: This area is located on the slope of the northeast corner of Punchbowl Crater, called Puowaina by Hawaiians (Lyons, 1901). Soils in the area are characterized as the Tantalus Series of silty clay loam that are capable of supporting most Hawaiian cultigens. Rainfall at this site would also be considered adequate. The lower elevations around Punchbowl, below this site, were considered choice land by Hawaiians (Kame'eleihiwa, 1992). The area between Auwaiolimu and Hiilani Street is shown on the recent tax map as the location of an "old quarry." This is one of the areas where gravel was quarried in the late 1800s to maintain the roads into the upper sections of Tantalus and Round Top (Frey, 1987) and probably also for Puowaina Drive.

Although the general area around Punchbowl was probably very productive, given the steep grade in the area encompassed by the site, this specific location was probably not used prior to the construction of Puowaina Drive. The road and subdivision of the lots along that road were not in existence prior to 1915 (Iao, 1915). Based upon this assessment, there should be only a slight probability of archaeological deposits being present at this site.

Tantalus, Makiki, Round Top Unsewered Area: This area is subdivided into three different zones, each having a different potential for containing archaeological resources. These zones are best described by their characteristic soil and topographical differences (Foote et al, 1972).

Zone 1 is an area defined by its moderate to steep slope that would have prevented modification and intensive use by prehistoric Hawaiians. Hawaiians would have called this zone *wao la'au* or *wao kanaka* (Handy and Handy, 1972) reflecting its use as an area for foraging. Zone 1 encompasses soils from two of the Soil Classification Series (Foote et al, 1972). Soils in the upper elevations of Round Top are characterized as Cinder Land having "very severe limitations" on land use (Foote et al, 1972). The remainder of the steep land is characterized as belonging to the Tantalus Series of silty clay loam, which although capable of supporting most Hawaiian cultigens, was probably of too steep a grade to have been exploited in such a manner.

The upper areas of Tantalus, Makiki, and Round Top were first opened up in 1880s (Frey, 1987) with good roads being constructed in 1893 (Hawaiian Gazette 1892; Monsarrat 1897). Soon after the overthrow of the Hawaiian monarchy, the hillsides were subdivided into lots and were then sold as Land Grants, mostly to non-Hawaiians. Because these lots were awarded as Grants there are no associated records of land use testimony from the mid 1800s for Zone 1 of the site.

Zone 2 is a type of terrain and soil, which when combined with readily available water for irrigation, was called *kahawai* (Handy and Handy, 1972) and was highly valued by Hawaiian farmers for pond field cultivation of taro. Numerous archaeological features have been identified in an area similar to this zone in the upper section of Makiki Valley (Yent and Ota, 1987). Zone 2 is an area having soils characterized as one of two soil types. The section along Makiki Stream is level to gently sloping and contains soil of the Kawaihapai Series of stony clay loam. Upstream of the confluence of Kaneaole and Maunaiaha Streams, Zone 2 contains an area of moderate slope with soils characterized as Kaena stony clay. Although stony soils present difficulties to western agricultural techniques, Hawaiian horticultural practices would not have found this a limiting factor (Kirch, 1985). Habitation and cultivation of the area encompassed by Zone 2 was probably intensive, given that this was the area preferred by Hawaiians for pond field *(lo'i)* cultivation of taro.

Zone 3 is an area of gentle to moderate slope and having soils characterized as being the Tantalus Series of silty clay loam. Rainfall and the soil type are capable of supporting the cultivation of most Hawaiian food crops. Kamehameha I is reported to have established sweet potato fields at Ualaka'a located between Manoa and Makiki (Kamakau 1992; I'i 1983). Fornander (1919) gives the location for this field as being, "the whole slope of this spur of the Manoa range" suggesting the foot of Round Top (Ualaka'a), in agreement with Thrum (1892), as being the location for these fields. Kame'eleihiwa (1992) gives the location as being at foot of Tantalus. While the place name Ualakaa probable only refers to the slope at the foot of Round Top, both of these slope areas comprising Zone 3 were similarly capable of supporting the cultivation of sweet potatoes.

Zone 1 begins at Mott-Smith Drive above Lilio Place and Roosevelt School and encompasses all of Makiki Heights Drive above 200 ft. in elevation and all of Round Top Drive above 240 ft. in elevation. There is only slight probability of encountering archaeological deposits in this zone.

Zone 2 is located along Makiki Heights Drive, Makiki Street, Oneele Place, and Maunalaha Road where they are adjacent to and parallel Makiki and Maunaiaha Streams. Given that the area would have been highly valued by Hawaiians, there is a high probability of that archaeological deposits exist in this zone.

Zone 3 is located at Mott-Smith Drive above Nehoa Street to 200 ft. in elevation and in the area between the lower intersections of Makiki Street with Round Top Drive and Makiki Street with Okika Place. Zone 3 is the area known to Hawaiians as Ualakaa that was renowned for growing sweet potatoes. There is a low probability of encountering archaeological deposits in this zone.

Crater Road Unsewered Area: This location between Leahi (Diamond Head) and Kaimuki was claimed as part of LCA 8559B by W. C. Lunalilio. There is no award testimony associated with this area describing land use in the mid 1800s. Detailed maps from the late 19th century depict the area around the site as a blank (Diamond Head n.d.; Lyons, 1876; Monsarrat, 1881) suggesting little or no prehistoric use of the area. In the late 1800s the land had been used as a open range for cattle. The general area of Kaimuki around the site began to be developed in 1904 for housing construction (Honolulu Advertiser, 1936). Roads into the area were not in place until the 1940s following the expansion of Kaimuki Town as a commercial center.

Soils in the area are of the Molokai Series of silty clay loam having severe limitations because of erosion hazards and low water holding capacity (Foote et al, 1972). These factors, combined with an annual rainfall of 31.5 inches (800 mm) also suggest the area was probably not exploited by Hawaiians to any degree that would have resulted in archaeological deposits being present in the area. Therefore, there is only slight potential for archaeological deposits to be present in the area of the site.

Nuuanu Pali Drive Unsewered Area: This area is at the confluences of Moole, Nuuanu, and Makiki Streams and adjacent to a pool in Nuuanu stream called Waihaka. The Hawaiian name for the general area was Luakaha. There are no known archaeological sites in the area of the site. Nearby however, was the location of Queen Kalama and Kamehameha III's summer home known as Kanikapupu. It has been reported by Sterling and Summers (1978), who cite a fanciful newspaper article (Ralphaeson, 1925), that this residence was built on the ruins of an old *heiau*. However, earlier accounts (Johnstone, 1907) note, "The ruin at this point consists of four dilapidated walls of stone, which, it is said, certain ill informed persons delight to point out to strangers as the ruins of an old heiau."

There is no LCA testimony associated with this parcel because it was largely designated as Crown Land. Given its proximity to the numerous streams and historical information illustrating (Lyons, 1874) and describing the growing of taro at this location (I'i 1983; Kamakau 1992), there is a high probability for the existence of archaeological deposits from Hawaiian habitation and cultivation at this location.

Palolo Unsewered Area: Zone 1 of this area is land that is steeply sloping or above 600 feet in elevation. This zone was probably only exploited for the foraging of botanical resources as wao la'au or wao kanaka by Hawaiians (Handy and Handy, 1972). This area has only slight probability of containing archaeological deposits reflective of this land use.

Zone 2 of the area is the section of the road that parallels and crosses Pukele Stream. Zone 2 is level to gently sloping and contains soil of the Kawaihapai Series of stony clay loam. Areas such as this were called *kahawai* by Hawaiian farmers (Handy and Handy, 1972) and were highly valued for pond field *(lo'i)* cultivation of taro despite the stony soil (Kirch, 1985). Handy and Handy (1972) report Palolo had extensive taro pond field terraces along the length of Pukele Stream, although historical maps (Monsarrat, 1881; Wall, 1881) only depict settlement extending to approximately the present location of Anuenue School. In general, Palolo Valley was sparsely populated in the early 1900s, although the two western-most roads into the area were in existence in the late 19th century (Monsarrat, 1881; Wall, 1881; Wright, 1914). Prehistorically, habitation and cultivation of the upper section of Palolo, encompassing the area, was probably as intensive as the lower section (Nagaoka, 1985), given that this type of area, called *kahawai* (Handy and Handy, 1972), was preferred by Hawaiians for cultivation of taro. There is a high probability of encountering archaeological deposits in this zone of the site.

Zone 3 of the area comprises the slightly or moderately sloping areas of the site that are not in the immediate vicinity of Pukele Stream, which have rich soil and abundant rainfall—averaging 79 inches (2000 mm) annually, suggesting the area may have been cultivated as kula land by those inhabiting the area along Pukele Stream. There is a low probability that archaeological deposits reflecting this extensive land use will be encountered during construction associated with improvements to the sewerage system.

Mitigation: Those areas where archaeological deposits are believed to be non-existent should not require further archaeological investigation when addressing historic preservation concerns. Sites assessed as having a slight or low probability of containing archaeological deposits should be monitored by an archaeologist during initial construction excavations to confirm the preliminary assessment presented herein and to evaluate the need for further monitoring. If warranted, sites assessed as having a low probability of containing archaeological deposits should be monitored by an archaeologist during construction excavations to record the occurrence of archaeological deposits as they are encountered, and to take appropriate action, should significant deposits or human remains be encountered. Areas assessed as having a high probability of containing archaeological resources should be thoroughly investigated, prior to the final planning of the construction activities, beginning with an archaeological inventory survey of the location. At development sites assessed as having either a low or high probability of containing archaeological deposits, historic resources should be anticipated during construction activities. Mitigation may include data recovery where significant resources are encountered.

Operational Impacts: There are no identifiable operational impacts to archaeological resources.

Cumulative Impacts: There are no identifiable cumulative impacts to archaeological resources.

8.7 INFRASTRUCTURE IMPACTS

8.7.1 WATER SYSTEM

The amount of wastewater generated is a function of the amount of potable water used, and is typically figured as a percentage of the amount of water used. Water conservation measures lead to a related decrease in the amount of wastewater generated. The expansion of wastewater collection and treatment facilities will not have any impacts upon or require any upgrade to or expansion of the potable water distribution system. The preferred alternative does not include use of treated effluent for irrigation as a replacement for potable water, because the associated cost exceeds that of providing potable water.

8.7.2 DRAINAGE SYSTEM

There are potential impacts to the storm drainage and collection system in the study area due to construction activities associated with the preferred alternative. These may be in the form of storm water runoff that contains sediment, and/or increased runoff or diversion of existing flows near the specific site. However, these will be site-specific and short-term in nature. In addition, any required NPDES permits will be obtained. Cumulatively, upgrading the wastewater collection system will have a positive effect on the existing storm drainage system because it will minimize the need to periodically bypass or overflow wastewater from the wastewater collection system to the storm drain system.

8.7.3 ELECTRICAL SYSTEM AND ENERGY USE

Electrical energy requirements are not expected to cause significant difficulties for HECO. As improvements are implemented at the WWPSs and Sand Island WWTP, power demands will increase. The need for upgraded switch stations, transformers, and secondary distribution capacity to meet total demand will be incrementally affected by this increased load, contributing to the expense of the improvements. The specific immediate adequacy of electrical power distribution to each affected site will be determined in consultation with HECO customer service department in accordance with standard design practice.

Construction Impacts: Construction activities will have a negligible impact upon electrical energy consumption. However, construction activities consume significant amounts of fuel.

Construction fuel use varies widely by type of construction, hauling distance, and materials used. Individual factors such as equipment idling time and the amount of concrete and reinforcing bar or asphalt can significantly affect fuel usage. The Transportation Research Board has estimated fuel use as a function of construction costs associated with construction of highway infrastructure. (Transportation Research Board, December 1981). Assuming that the fuel used is primarily diesel, and ignoring changes in fuel costs relative to changes in other prices, it is estimated that 19 gallons of fuel are expended for every $1000 of construction cost. Adjusted for inflation, the multiplier becomes 11.8 gallons per $1000 of construction costs. When applied to the estimated average annual construction costs of approximately $30,400,000 fuel consumption is expected to be about 359,000 gallons per year.

Operational Impacts: The wastewater system consumes electricity at the pump stations and the treatment plant. Following is a summary of electrical consumption resulting from the proposed improvements.

FACILITY	MEASURED KILOWATT HOUR PER DAY (1992)	ESTIMATED KILOWATT HOUR PER DAY (2015)	PERCENT INCREASE
Ala Moana WWPS 1&2	13621.9	18527	36%
Aliamanu WWPS	87.4	106	21%
Aliamanu WWPS	47.4	47	0%
Awa Street WWPS	302.9	725	139%
Beachwalk WWPS	2480.2	6810	175%
Ft. DeRussy WWPS	673.3	1181	75%
Hart Street WWPS	4747.4	5226	10%
Kahala WWPS	1869.0	1869	0%
Kamehameha Hwy WWPS	699.8	700	0%
Kuliouou WWPS	61.3	61	0%
Moana Park WWPS	61.3	61	0%
Niu Valley WWPS	147.0	147	0%
Paiko Drive WWPS	24.2	24	0%
Public Baths WWPS	88.2	128	45%
Sand Island Parkway WWPS & Sand Island WWTP	23927.7	45480	90%

Five of the facilities, Awa Street WWPS, Beachwalk WWPS, Fort DeRussy WWPS, Sand Island Parkway WWPSs, and Sand Island WWTP, will experience large increases in electrical energy consumption. However, when viewed from the perspective of the plan's 20-year time frame, these increases are not considered to be significant.

Cumulative Impacts: In 1992, the wastewater system consumed approximately 48,700 kilowatt hours of electricity per day. With the implementation of the preferred alternative, electrical consumption will increase by 32,400 kilowatt hours to a total of 81,100 kilowatt hours per day, an increase of 66 percent. However, if the proportion of consumption to the total amount of electrical energy generated on Oahu remains relatively constant, then the overall share of electrical consumption attributable to the wastewater system is negligible compared to overall energy consumption. (This proportion is approximately 0.25 percent, based on Oahu's consumption of 7,138,600,000 kilowatt hours in 1991 as listed in the Hawaii State Data Book.) The increase of 32,323 kilowatt hours per day equates to a fuel use increase of 53.4 barrels of oil per day (using a conversion estimate of 605 kilowatt hours per barrel of oil, including conversion losses), or 19,500 barrels per year.

8.7.4 ROADWAY SYSTEM

A complete analysis of traffic impacts, including a discussion of appropriate mitigation measures is presented as Appendix F to this document. The following is a summary of that analysis.

Construction Impacts: Since the proposed improvements include a large number of locations and work will be spread over a period of 20 years or more, this analysis discusses only the general nature and degree of impacts and the need for mitigative actions on a non-site-specific basis.

Construction of relief sewer lines would occur at numerous locations throughout the study area. Virtually all of these projects would be located within major roadways and secondary or collector roadways. Construction in presently unsewered areas would be concentrated along major roadways and local streets. In general, almost all City sewer lines are placed within roadways. Ideally, the City seeks to place sewer lines within four feet of the centerline on two-way streets. This placement allows closure of only one lane (or sometimes none) for maintenance access, location of manholes where tires will not normally cross them, and approximately equal length connections to property lines on either side of the street. Only in special situations, or if there is no better alternative, are sewer lines placed along the outer portions of a street cross section, or under the shoulder.

The traffic impacts at the pump stations will be short-term and largely confined to the street that is the site of the construction work. The on-site work would be contained within the site and completed in as timely a fashion as possible. Effects on traffic should be primarily limited to the increases in vehicles accessing each site during the construction period. Added volumes of construction vehicles should not adversely affect traffic conditions on adjacent roadways.

Many of the relief sewer construction projects will be segmented to reduce impacts upon traffic flow. Temporary impacts on streets impacted by construction may include on-street parking removals, restriction of left-turns into driveways due to excavations in the center of the street, construction related traffic, and some blockage of driveways where sewer placement is along the edge of the roadway.

A large number of the projects will be located along or across major roadways providing service to large volumes of traffic. The most severe disruptive effects to traffic would result at the following locations:

- H-1 Freeway crossing near Kapalama Stream;
- Beretania Street crossing at the Civic Center; and
- Nimitz Highway/Ala Moana Boulevard

Construction of sewer force mains will be associated with seven WWPSs: Beachwalk, Hart Street, Kuliouou, Niu Valley, Public Baths, Awa Street, and Sand Island Parkway. Site-specific impacts associated with the first three WWPS locations are discussed in Appendix F; the evaluation of systemic impacts applies to all locations.

Of all the streets impacted, lengthy traffic delays will likely result from construction on Kalakaua Avenue and Ala Moana Boulevard for the Beachwalk force main. Moderate delays will occur on Ala Wai

Boulevard and McCully Street for the Beachwalk force main, on Waialae Avenue for the Kahala force main, and on Puuikena Street and Kalanianaole Highway for the Kuliouou force main project. All other streets impacted will only experience minor delays due to construction.

Expansion of Sand Island WWTP would require a sizeable construction effort for either the expanded primary or secondary treatment alternatives. Construction for expanded primary treatment would last about 18 months and would occur in the 1998 - 2000 period. If secondary treatment were implemented, construction would last approximately 36 months and would not occur before 2000.

The construction project would increase traffic volumes during peak hour periods, primarily due to the construction work force travelling to/from the project site, and during the non-peak periods, primarily as a result of transportation of construction materials and equipment. The assessment of construction traffic impacts focuses on the peak periods. The impacts of non-peak construction traffic is not assessed, given the temporary nature of the construction traffic increase, and the large number of trucks already using the area roadways.

For construction of an expanded primary treatment level project, an estimated average of 150 construction workers would be at the site each day. The size of the construction work force would thus approximate the present staffing level of the day shift at the plant. Construction of a secondary treatment project would require a much larger work force of approximately 500 persons at the site throughout most of the construction period.

The work hours of the construction workers would be determined by project contractors, unless specific hours are specified by the City during the contract bidding/negotiation process. Typical construction work hours approximate or are slightly earlier than the Sand Island WWTP day shift hours.

The number of construction worker vehicle trips was estimated for the morning and afternoon peak hours. The estimates reflect the following assumptions:

- Eighty-eight percent of the total estimated work force would be on-site on any given day;
- All would arrive and leave within a one-hour period during the morning and afternoon, respectively. Also, five percent would leave the site in the morning peak hour and arrive in the afternoon peak hour to pick up materials, run errands, etc.; and
- Eighty percent would drive.

For the construction of the expanded primary treatment project, the estimated 113 construction worker vehicle trips during the peak hours would amount to approximately three to four percent increase in traffic along the Sand Island Access Road, and a 1.25 percent increase in traffic passing through the Sand Island Access Road intersection with Nimitz Highway. For the secondary treatment option, the estimated 374 construction worker vehicles would increase peak hour traffic along Sand Island Access Road by 11 to 13 percent, and increase traffic at the intersection with Nimitz Highway by about four percent for the duration of the construction project.

During construction of the expanded primary treatment project, there would be sufficient unused area within the site to provide the one acre or more area needed to park construction worker vehicles. The existing Sand Island WWTP driveway could accommodate the construction worker traffic if most of the drivers cross to the median refuge lane during a gap in the eastbound traffic flow, and then merge into the westbound flow. However, even if all of the construction workers do this, rather than wait for a simultaneous gap in eastbound and westbound traffic flow, the service level for driveway traffic would worsen to level of service (LOS) C or D conditions, with intersection waits of 25 to 40 seconds. If about one-third or more of the temporary workers wait for the simultaneous gap in both traffic flow directions, then the existing driveway service level would worsen to LOS F with long delays to exiting plant and construction worker traffic.

Mitigation: For sewer relief construction projects, all sewer lines will be installed within the paved portion of the roadway, where possible. An attempt will be made to restrict lane closure to a single lane at a time, but in some instances, such as when a sewer line cuts across a bend in the road or goes through an intersection, more than one lane may have to be closed to permit construction. For unsewered areas undergoing construction, where the sewer lines will be in roadways, they will be installed under the paved area where possible, typically four feet to one side of the center line. An attempt will be made to restrict lane closure to a single lane. For one-lane roads, construction local traffic will be flagged through as necessary. For two-lane roads, one lane will be kept open.

For most major or secondary roads, construction work within the traffic lanes will occur during the midday hours between the morning and afternoon peak traffic periods when possible. In general, construction excavations will be covered over by steel plates or other means, and construction barricades and equipment will be moved to permit use of all traffic lanes in the peak traffic direction during the peak commuter traffic periods. Dependent upon traffic conditions, a lane may remain closed in the off-peak direction to allow more efficient construction and to minimize the duration of the construction and lane closures. Shoulders and parking lanes, where available, may be used as temporary traffic lanes during construction. Construction contractors will be required to provide traffic controls to warn and guide motorists through the work areas. Such controls might include:

- Publication of newspaper notices to alert the public of construction projects.
- Advance signing and other warnings to alert approaching motorists.
- Barriers, cones, and signing to direct vehicles through the construction zone, and
- Flagmen and/or police officers, when necessary, to control traffic flow.

For heavily used roadways:

- At the H-1 Freeway, the proposed sewer line will be tunneled beneath the freeway using an existing crossing, or if equipment is available in Hawaii at the time of construction, a microtunneling process to avoid disruption of traffic.
- Microtunneling will also be considered for the Beretania Street crossing.
- Special construction phasing and a traffic control plan for McCully Street and Kalakaua Avenue to minimize traffic disruption and safety hazards will be developed,
- If feasible, traffic impacts could be reduced by construction of the sewer lines under the *mauka* curb lane of Ala Wai Boulevard until a point beyond McCully Street, then locate the line under the left or center lanes when crossing Kalakaua Avenue,
- Microtunneling will be considered to cross Ala Moana Boulevard and possibly Kalakaua Avenue to minimize traffic disruption.
- For Kuliouou, the new force main will be constructed under the *mauka* side shoulder/bike lane along Kalanianaole Highway from near Hawaii Kai to the Aina Haina area; where possible, it would utilize the same right-of-way on the Niu Valley SFM.

The relatively low volumes of traffic on most roadways within the unsewered areas should minimize the occurrences and duration of any traffic delays. Flagmen will be posted along narrow roadways to control traffic movement. Traffic delays will be further minimized by using as short a construction zone as efficiently possible.

To mitigate the access problem during construction of an expanded primary treatment project, one or more of the following actions will be taken:

- Provide a second driveway in the eastern portion of the site for construction workers;
- Stagger plant work shift and construction worker hours to spread arriving and departing employee vehicles over about a 1-1/2 hour-long period; or
- Provide construction worker parking at the City corporation yard site where workers can exit via the Pier 51A intersection.

If a secondary treatment project is constructed, there would not be a sufficient amount (about three acres) of unused area within the project site to park worker vehicles during most of the construction period. Most of the workers would have to park at a location off-site, with a possible bus shuttle provided to the work site. Also, a single driveway on the *makai* side of Sand Island Parkway could not accommodate all worker vehicles unless it is controlled by a traffic signal.

With the secondary treatment alternative, the construction workers would have to park off-site. Candidate locations include:

- Provide construction worker parking at the City corporation yard site;
- Lease temporary parking areas within the Matson areas across from the project site, where the present driveways should be sufficient to accommodate the added traffic; or
- Provide parking within the former Kapalama Military Reservation area, or other sites along Sand Island Access Road.

Operational Impacts: Both the expanded primary treatment and secondary treatment alternatives would result in a large increase in the staffing levels at Sand Island WWTP. The level of treatment defines the number of staff needed to operate the plant; the difference in staffing levels would make a difference primarily in regards to the time of the work shift changes during the morning and afternoon commute periods. For the day shift, which extends from about 6:30AM to 3:30PM, the staffing level at the plant would increase from the 151 persons at present, to an estimated 245 persons (+62%) for expanded primary treatment, and to an estimated 301 persons (+99%) with secondary treatment. These staffing levels would be reached at full plant operations prior to Year 2015. Staff levels for the evening shift (3:00 to 11:00PM) and night shift (11:00PM to 7:00AM) would also increase, with the secondary treatment option requiring a large increase relative to existing or expanded primary treatment operations.

The expanded primary treatment option is estimated to increase the traffic to or from the site for the morning and afternoon shift peak hours to 110 and 116 vehicles, respectively, for increases of 53 and 57 percent above the existing shift hour volumes. The larger staffing levels with secondary treatment are estimated to increase traffic by 85 and 93 percent above existing levels for the morning and afternoon peak hours, respectively, to 133 and 143 vehicles.

The solids process/disposal options would directly affect the volume of heavy truck movement to and from the facility. The truck volumes would also be affected by the level of treatment. The largest trucking requirements would be for the land-filling and alkaline stabilization options. The incineration and power generation options would burn the solid waste on-site, with only the ash residue requiring removal from the site. The secondary treatment options would generally result in two to three times as many truckloads of material as the expanded primary treatment options.

Truck loading operations would occur during daylight hours, primarily within the day shift work hours (6:30AM to 3:30PM). Most of the truck traffic to and from the plant would also be expected to occur within these hours.

The State DOT vehicle classification count made at the Sand Island Bridge (Station C-202-B) on February 4, 1991, recorded approximately 3,300 large trucks among the 15,500 vehicles using the bridge between 6:00AM and 6:00PM. With a two percent annual growth rate, the volume of trucks during these hours would increase to about 5,300 vehicles in Year 2015. Given the relative growth potential for development on Sand Island, this growth rate is likely to over estimate Year 2015 traffic and is therefore on the conservative side in evaluating impacts.

The option generating the most truck activity, the secondary treatment with land-filling option, would average a total of 54 daily truck trips (27 arriving and 27 leaving the plant). This would approximate a one percent increase in truck activity on the Sand Island Parkway in 2015. Most of the other options would result in substantially less than a one percent increase in trucking activity.

Material produced by the alkaline stabilization, thermal drying, and composting options could be used as fertilizer and mulch for orchards, grass areas, and many other crops, either on Oahu or on the neighbor islands. Such material would likely be trucked to Honolulu Harbor for shipping to neighbor islands, or to Campbell Industrial Park for stockpiling or bagging.

Material produced by incineration and power generation options could be used in concrete products, or sent to a landfill. Part or all of the alkaline stabilization material might also be sent to landfills since the lime is suitable for use in covering the fresh landfill deposits at the end of each day.

Therefore, the likely routes for these trucks would be one or more of the following:

- Via Nimitz Highway to the piers serving barge traffic to the neighbor islands;
- Via Keehi interchange and H-1 Freeway to Campbell Industrial Park or the Waimanalo Gulch landfill; or
- Via Keehi Interchange, H-1 Freeway, and H-3 Freeway to the Kapaa landfill.

Mitigation: The trucking operations are not expected to substantially increase traffic at any problem locations. However, truck operations will either be scheduled to avoid exiting the existing driveway during the morning or afternoon shift changes; or a separate driveway will be provided for truck use.

Cumulative Impacts: The increased traffic volume associated with the preferred alternative does not represent a substantial increase in overall traffic volumes.

8.7.5 SOLID WASTE COLLECTION & DISPOSAL SYSTEM

Construction Impacts: Construction of the preferred alternative will result in no significant construction impacts upon the solid waste collection and disposal system.

Operational Impacts: The implementation of any of the final processing options identified in the preferred alternative will impact the solid waste disposal system. The existing treatment process results in the following products (Barrett Consulting Group, 1990):

- Landfilling Sludge Product - 53 tons per day
- Grit and Screenings Disposal at Landfill - 14 cubic yards per day

The volume of grit projected in 2015 is about 12 tons per day. This will not change regardless of the disposal option for the remaining sludge. Improvement of the treatment process at the Sand Island WWTP to Expanded Primary will result in the following disposal options and related products:

DISPOSAL OPTION	RESULTING PRODUCT (NOT INCLUDING GRIT)
Landfilling Undigested Solids	157 tons/day undigested solids (based on 70% water content), OR
Landfilling Digested Solids	95 tons/day of digested solids (based on 70% water content), OR
Thermal Drying	50 tons/day of undigested solids (based on 5% water content), OR
Thermal Drying	30 tons/day of digested solids (based on 5% water content), OR
Alkaline Stabilization	108 tons/day of undigested solids, OR
Alkaline Stabilization	65 tons/day of digested solids, OR
Composting	80 tons/day of undigested solids, OR
Incineration	4.7 tons per day of ash, OR
Power Generation	4.7 tons per day of ash

As discussed in Chapter Four, sludge is presently disposed of at the Kapaa Sanitary Landfill in Kailua. This landfill, as well as the City's only other landfill (Waimanalo Gulch), is estimated to reach full capacity before the year 2015.

Thus, in terms of impacts to landfills, the eventual selection of the preferred method of sludge disposal must accommodate the critical need to minimize the treatment system's contribution to landfills. If secondary treatment is implemented, the volume of solids requiring disposal nearly doubles.

Additional impacts include:

Landfilling — Gaseous emissions and odors are produced through the chemical interactions of landfill constituents.

Thermal Drying — Air (exhaust) emissions and noise (somewhat contained within the thermal drying building) are discharged during the thermal drying process. The thermally dried end product can be used as a soil conditioner.

Alkaline Stabilization — Lime dust emissions (alkaline additives are very dry), air (exhaust) emissions, and noise (somewhat contained within the facility) are discharged during the process. The end product of this process can be used as a soil conditioner.

Composting (In-vessel type) — In-vessel composting is an enclosed system. However, some odors escape with the warm air that builds up in the enclosed vessel. The end product of this process can be used as a soil conditioner.

Incineration — Air (exhaust) emissions and heat are discharged during incineration. Ash is an end product of this process. Emissions are regulated under the Clean Air Act, as amended.

Power Generation — Air (exhaust) emissions, heat, and a liquid side stream are discharged during the power generation process. The liquid sidestream is comprised of water soluble organics which are extracted from the sludge that is being fed into the system. This sidestream is virtually free of solids and oils; however, it must be treated to remove the soluble organics. Electricity and ash are produced by this process. Emissions are subject to regulation of stationary sources of air pollution.

Mitigation: Mitigation of solid waste disposal impacts are primarily mandated by law. Air emissions resulting from incineration are regulated under Hawaii Administrative Rules (HAR) Title 11, Chapters 59 and 60.1. Sludge treatment and disposal are regulated under 40 CFR 503 pursuant to the Clean Water Act. This regulates land application of sewage sludge to limit accumulation of harmful metals in soil or discharge to the air. Hawaii Department of Health has similar limitations for land application. Sand Island sludge meets applicable standards for land application and land fill disposal. Incineration impacts and odor are discussed below under Section 8.8.

The principal disposal impacts to be mitigated are traffic and solid waste facility (landfill) capacity. Traffic impacts have been discussed in Section 8.7.4. By selection of a sludge disposal option which beneficially reuses the sludge, landfill capacity impacts are avoided.

Cumulative Impacts: To the extent that secondary treatment approximately doubles the solids to be disposed of, this option aggravates the impacts, costs and difficulties associated with treatment and disposal. Landfilling is suggested only as a back-up disposal option for either primary or secondary treatment. The use of other waste products, such as the ash by-products of combustion from coal-fired power generation, is in keeping with the intent of the Resource Conservation and Recovery Act (RCRA) and the Hawaii Integrated Solid Waste Management Act. The alkaline stabilization method using by-product fly ash combines two waste products into a useable product, thereby contributing to efficient use of waste materials and having a positive cumulative effect on solid waste management.

8.8 AIR QUALITY

Appendix D contains a more complete report on air quality impacts. This discussion is summarized from that report.

Construction Impacts: Installation of new wastewater collection lines along various streets and roads in Honolulu will result in traffic disruption and slowdown. This slowdown and possible congestion will result in increased traffic emissions and consequent localized ambient air quality impacts during construction periods.

Mitigation: The most efficient rerouting of traffic wherever possible will help mitigate this impact.

Operational Impacts: Of the proposed modifications to the Sand Island WWTP, the aeration chambers for grit removal will increase emissions of odorous gases such as hydrogen sulfide, as well as air toxics. If secondary treatment is eventually implemented, the carbon dioxide and volatile organics emissions would increase.

In the area of solids treatment, replacement of the existing ZIMPRO stabilization process with anaerobic digestion should reduce the malodorous gas stream and sidestream of organics and ammonia associated with the existing process. The principal byproduct of anaerobic digestion is methane, a colorless, odorless gas which can be used as fuel.

Of the various alternatives for final solids processing, incineration and/or power generation clearly result in the most air quality impacts. The existing incinerators are regulated by the state of Hawaii as a stationary source of air pollutants. This option can be accomplished in compliance with standards up to certain levels of solids loading, depending primarily on concentrations of regulated pollutants in the sludge. Landfilling and agricultural/horticultural use can both be implemented with minimal air impact if done carefully to avoid fugitive emissions.

The air quality impacts of traffic in the immediate vicinity of the Sand Island WWTP due to implementation of the preferred alternative are insignificant.

Mitigation: Odors from the aeration chambers will be reduced with the same liquid oxidation catalytic system currently used. It is intended to use incineration in existing incinerators, as modified to meet air quality requirements, as a back-up solids disposal option only. However, there may be a need to quantify air toxic emissions for specific pollutants and then determine, if necessary, appropriate mitigative measures. At present sludge constituent concentrations, only lead appears to be of concern, and only at feed rate volumes that would be encountered with secondary treatment (based on 40 CFR 503 regulations using estimated dispersion and efficiency rates for the incinerator units and sludge characteristics based on a single sample).

Cumulative Impacts: Upgrading of the Sand Island WWTP and pump stations to accommodate future growth will result in an indirect, offsite impact at the power plants which burn oil in order to provide the required electricity to the wastewater facilities. The estimated additional electrical demand will result in an increase of about 30 tons of regulated pollutant emissions which represents less than 0.1 percent of Oahu's latest available emissions inventory. It is also possible that the anaerobic digesters will be of sufficient size to create a building downwash effect on the incinerator at SIWWTP during some wind conditions. If this occurs or is modeled during permit renewal, stack height modification may be required.

8.9 PHYSICAL AREAS OF PLANNING IMPORTANCE

8.9.1 WETLANDS

As discussed in Chapter Three, the only major wetland existing in the study area is situated at Salt Lake. This wetland will not be impacted by the preferred alternative. Tidal wetlands and reef flats along the shoreline will not be impacted by the preferred alternative. The potential for spills, by-passes, and overflows that would impact these areas if they were to occur are reduced by the proposed improvements.

8.9.2 COASTAL ZONE

Because the entire study area is situated within the coastal zone (under federal definitions), the preferred alternative's impact upon it may be considered to be the sum of the impacts discussed in this chapter. For projects within the designated Special Management Area (SMA), SMA permits under HRS 205A and Revised Ordinances of Honolulu Chapter 25 will be obtained, as necessary. SMA permits address mitigation of such potential effects as runoff, restricted public access, and change in environmental or recreational character of a coastal area caused by an action. Chapter Two discusses the SMA in greater detail. Other than potential temporary negative impacts to the coastal zone associated with construction from potential runoff, dewatering, and restriction of public access for safety, long-term effects of the preferred alternative are positive, as the potential for adverse impacts to coastal water quality from wastewater is reduced.

8.9.3 RECREATION AREAS

Implementation of the preferred alternative is intended to improve the wastewater system's reliability and reduce the potential for releases, bypasses and spills into coastal waters. An ocean recreation activities study was conducted by John Clark to identify and characterize nearshore recreational activities to assess potential impacts from the wastewater system improvements. The full text of this study is in Appendix E.

Construction Impacts: Construction of the various improvements may potentially impact recreational waters in the form of increased sedimentation resulting from surface runoff from construction sites. If standard construction practices are adhered to, this potential is considered to be very small. However, several recreational facilities on land will be noticeably impacted during construction and improvement of wastewater infrastructure. Sand Island WWTP is adjacent to Sand Island Recreation Area. Noise, dust and construction activity from the WWTP is likely to be evident to recreation area and beach users.

Kamehameha Highway WWPS and force main improvements will affect the North side of Keehi Lagoon Park, including four tennis courts. Access to the VFW Memorial will also be affected.

The Moana Park WWPS is located in the northeast corner of Ala Moana Park. Improvements to this facility will impact this corner of the park.

One option for the Beachwalk redundant pump station is to locate it across the Ala Wai Canal near Iolani School in the Ala Wai Park. Extending a sewage force main the length of the park in the direction of McCully Street would be required, disturbing and displacing canal-side use of an extremely popular park during construction.

Improvement to the Public Baths WWPS and force mains will affect Kapiolani Park access along Kalakaua Ave. and require excavation the length of the park *makai* of the road.

General effects of construction in the park will include visual impacts, noise, temporary loss of recreational use for areas directly affected (equipment parking, material staging, excavation).

Mitigation will include minimizing the size of areas disturbed at one time, completing work quickly once begun, and standard dust and noise mitigation practices.

Operational Impacts: There is no present or projected negative impact to recreational waters from the normal operation of the East Mamala Bay wastewater system. However, a major sewage release into the study area as a result of system malfunctions has the potential to degrade the attractiveness and the health of the nearshore waters. The impacts from this possible degradation on some of the Hawaii's most important ocean recreation sites and on its most important tourist destination would be serious and far-reaching, not only to the activities occurring there, but to the visitor industry at large.

Mitigation: Implementation of the preferred alternative is mitigation of potential impacts on ocean recreation resources caused by wastewater. However, it is clear that land-originated pollution disperses rapidly through dilution, assimilation/uptake and decay once released into the open ocean environment. Therefore, shoreline and estuarine activities are most at risk. Of these, swimming and surfing appear to be the most sensitive, due to the large number of participants.

Releases into these environments from the wastewater system are made less likely by redundancies in major WWPS and force mains, ensuring adequate system capacities, and providing back-up electrical power generation for pumps.

Cumulative Impacts: Particularly in shoreline and nearshore waters, the degrading, pervasive effects of urban runoff appears to have the most significant impact on recreational water quality in the study area. Analyses indicate that the Sand Island WWTP outfall has no discernable effect on nearshore water quality.

Cumulative effects of the Sand Island WWTP outfall with those of the nearest other outfall, Fort Kamehameha, have been examined and not found to be significant.

8.9.4 Agricultural Lands of Importance to the State of Hawaii (ALISH)

Implementation of the preferred alternative will have no significant impacts upon agricultural lands of importance within the study area. As noted in Chapter Three, these areas are relatively small and are remotely situated on ridges above residential areas.

8.9.5 Watersheds

Implementation of the preferred alternative will have no significant impacts upon watersheds within the study area. While one unsewered area (Tantalus/Roundtop) includes portions of a watershed, the inclusion of this area into the collection system will result in no significant negative impacts.

8.9.6 Marine Life Conservation Districts

Based on the data available from on-going monitoring programs, effluent discharge from the Sand Island WWTP does not significantly impact the Waikiki Marine Life Conservation District, which is the closest conservation area to the Sand Island WWTP outfall. It is anticipated that the preferred alternative will not cause any significant change from the present condition.

For the same reasons, neither the Moanalua Bay artificial reef nor the Waikiki-Diamond Head Shoreline Fisheries Management Area will be impacted by the preferred alternative.

8.9.7 SAND ISLAND TREATMENT CENTER

The Sand Island Treatment Center (SITC) is a halfway house for rehabilitation of persons with alcohol and/or drug dependencies. It is located on the Sand Island WWTP site, as shown in Figure 7-1.

The SITC is composed of several wood and metal structures totalling 16,000 square feet. Under the preferred alternative, this facility will remain. Although it will be exposed to nuisances not normal desired for such a facility, the future situation will be similar to that at present. As discussed in Section 3.8.7, despite infrequent odors from SIWWTP and noise from Honolulu International Airport, the Center's director considers the site ideal.

8.9.8 ADDITIONAL LANDS

The three new WWPS will require that additional lands be acquired. The minimum additional land areas required for each site are:

- For Ala Moana II WWPS, approximately 2,4000 square feet on TMK 2-1-15:28 owned by the State Harbors Division;
- For the New Beachwalk WWPS, approximately 29,900 square feet on TMK 2-7-36:1, Ala Wai Field and Park, owned by the State; and
- For the New Hart Street WWPS, approximately 49,000 square feet on TMK 1-5-33:2,9, portion of 16, owned by the State.

The proposed Ala Moana II and New Hart Street WWPS sites are located within areas designated on the Development Plan Land Use Map as Public Facilities. In relation to the proposed elements of the Waikiki Master Plan (see Section 2.10.3), the proposed New Beachwalk WWPS site would be located at the master plan's Ala Wai Park - *Ewa* near Ala Wai Elementary School and new pedestrian bridge over the Manoa/Palolo Canal. At least 29,900 square feet in this vicinity would need to be set aside for the pump station facilities.

8.9.9 HONOLULU HARBOR

Construction Impacts: The proposed SFM connecting the new Hart Street WWPS and SIWWTP will cross Honolulu Harbor and the mouth of Kalihi Channel. Installation of the SFM is likely to cause temporary disruption to navigation and vessel traffic in the harbor. Other potential impacts are siltation caused by the excavation and disruption to bottom dwelling biota.

Mitigation: Navigational impacts will be minimized by coordination with the Harbor Master, DOT Harbors Division and the U.S. Coast Guard. Proper markers, lighting, and notices to mariners will be used to avoid imposing navigational hazards during construction. Coordination will be affected with operators of the petroleum terminal at Pier 35 to minimize impacts on transshipment. Additional study of environmental conditions, and the character of sediments likely to be resuspended or disposed of during construction will be undertaken as part of the Department of the Army permit required under Section 10 and Section 404. Although the harbor likely represents an already stressed and silt-tolerant environment, local effects and transport of suspended sediments out of the harbor via tidal currents will be evaluated. A mitigation plan will be prepared as a part of the army permit process.

Operational Impacts: There are no identifiable operational impacts on Honolulu Harbor or the Kalihi Channel mouth from the proposed action.

Cumulative Impacts: There are no identifiable cumulative impacts from the proposed action.

8.10 PUBLIC FACILITIES

8.10.1 POLICE AND FIRE PROTECTION SYSTEMS

Implementation of the preferred alternative will have no significant impacts upon police and fire protection systems within the study area.

8.10.2 HEALTH CARE FACILITIES

Construction activities may result in short-term impacts upon specific facilities in the form of noise and increased traffic congestion during non-peak hours. However, implementation of the preferred alternative will have no significant impacts upon health care facilities within the study area.

8.10.3 SCHOOLS AND EDUCATIONAL FACILITIES

Construction activities may result in short-term impacts upon specific school facilities in the form of noise and increased traffic congestion during non-peak hours. However, implementation of the preferred alternative will have no significant impacts.

8.11 COSTS AND REVENUES IMPACTS

The evaluation of cost and revenue impacts is based on engineering analysis initially performed during the Interim Facilities Plan/DEIS phase of the planning process. Further refinements of the models and analyses completed immediately prior to final EIS publication resulted in minor changes to the costs of several components of three alternatives, which are not reflected in the economic analysis.

In cases where some construction elements cannot be determined during the facilities planning process, or where several options are feasible, one or a combination of the possible options has been selected, with the intent of developing a "worst case" cost scenario for evaluation of the economic impacts associated with the preferred alternative. The cost of the sludge disposal component is the principal example. Determination of the option that will ultimately be selected and the need for redundant disposal capability (i.e., incineration) is dependent upon factors to be evaluated in the future. Therefore, the cost values (capital and life-cycle) used in the economic analysis do not correspond directly to individual option costs, but reflect an estimated worst case, and are based on combinations of sludge disposal option costs.

The conservative assumptions in the cost figures used in the economic impact analysis cause relatively small differences in comparison to the total cost of the proposed action. Slight differences in option costs are not of a magnitude to affect the selection of the preferred alternative. Because of the use of "worst case" costs, estimated economic impacts of the project may be somewhat less than that described here. A number of other assumptions made in evaluating economic impacts are detailed in Appendix B.

8.11.1 SUMMARY OF COSTS

Chapter Six provides cost estimates for each of the alternatives. These costs are comprised of the costs of seven components.

Alternative Component Capital and Life Cycle Costs

Table 8-1 shows for each component of each alternative, a summary of capital, life cycle, and total cost. It shows the that the preferred alternative (i.e. Meet Water Quality Standards) life cycle cost (life cycle cost = capital + operations and maintenance cost) is an order of magnitude larger than the known life cycle costs of the no action and optimize existing system alternatives. The increase is due primarily to the collection-sewered areas, treatment level, and solids treatment and processing components of this alternative. Table 8-1 also shows that capital and life cycle cost increases from the preferred alternative to the secondary treatment alternative arise primarily from the treatment level and solids treatment and processing components; the capital and life cycle cost increase from the secondary treatment to the eliminate/reduce ocean discharges alternative arises from the treatment level and most significantly from the effluent disposal components. These features are shown in Figure 8-3. Only components for which there is a cost difference between the alternatives are shown. Capital cost differences show a similar pattern.

Table 8-1
Costs Used in Economic Impact Analysis
(Million Dollars)

ALTERNATIVES	COLLECTION & TREAT-MENT-SEWERED AREAS	COLLECTION & TREAT-MENT-UNSEWERED AREAS	TREATMENT LEVEL	EFFLUENT DISPOSAL	SOLIDS TREATMENT & DISPOSAL	KULIOUOU WWPS	TOTAL SYSTEM COST
No Action							
Capital	0	0	0	0	0	0	0
Life Cycle	LUMC					4.3	*4.3*
Existing System Optimization							
Capital	0	0	0	0	0	0	0
Life Cycle	IMOC		73.3		IMOC	4.3	*77.6*
Meet Water Quality Standards (Preferred Alternative)							
Capital	390.9	13.0	119.7	1.3	29.2	5.7	559.8
Life Cycle	409.9	16.8	316.3	12.3	161.0	5.8	922.1
Secondary							
Capital	390.9	13.0	430.5	1.3	*45.2*	5.7	*886.6*
Life Cycle	409.9	16.8	941.5	12.3	*197.0*	5.8	*1,583.3*
Eliminate/Reduce Ocean Discharges							
Capital	*390.9*	13.0	441.5	*310.0*	*45.2*	5.7	*1,206.3*
Life Cycle	*409.9*	16.8	1,094.5	*462.5*	*197.0*	5.8	*2,186.5*

Definitions:

LUMC: Large Unpredicted Maintenance Costs

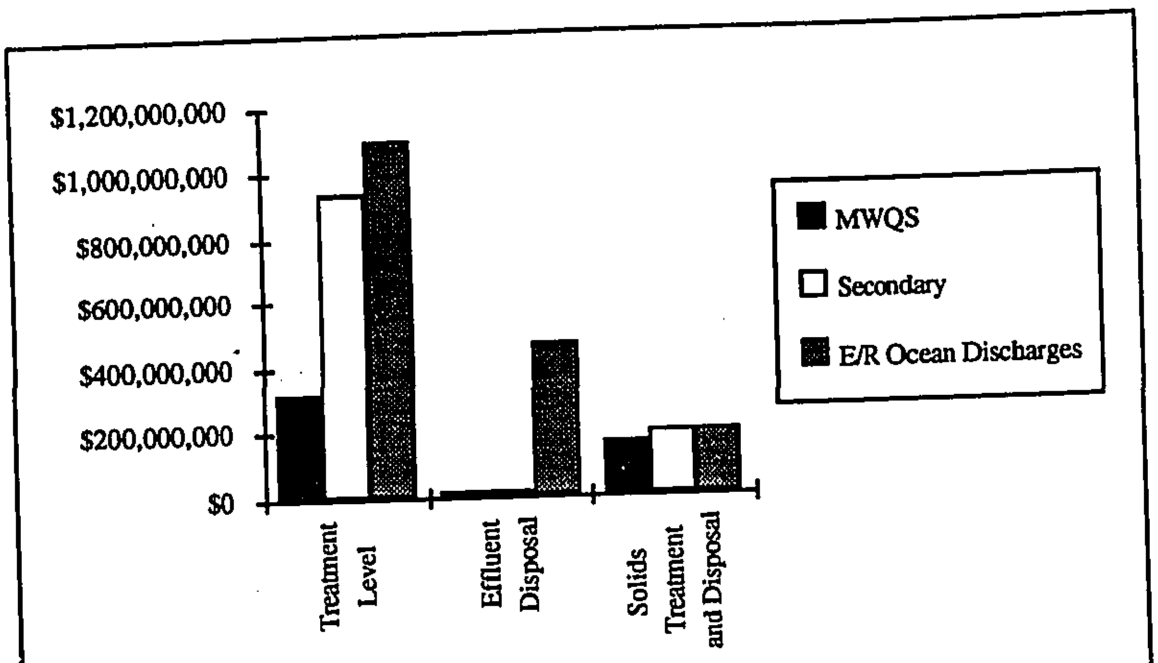
IMOC: Increased Maintenance and Operations Costs

Italics means the cost is greater than the value shown but these added costs are not estimated in the study. For the Secondary Treatment and Eliminate/Reduce Ocean Discharges alternatives, these additional costs are generally land costs.

Notes:

1. All costs presented in this table are preliminary estimates.
2. The Solids Treatment and Disposal capital and life cycle costs include alkaline stabilization as the primary sub-component. Back-up sub-components included are landfilling and incineration.
3. The Solids Treatment and Disposal life cycle costs for the Reduce/Eliminate Ocean Discharges alternative may be as much as 15 percent greater than those of the Secondary Treatment alternative.

Figure 8-3 Component Life Cycle Cost by Feasible Alternative (1993 Dollars)



MWQS = the Meet Water Quality Standards preferred alternative; E/R = Eliminate/Reduce

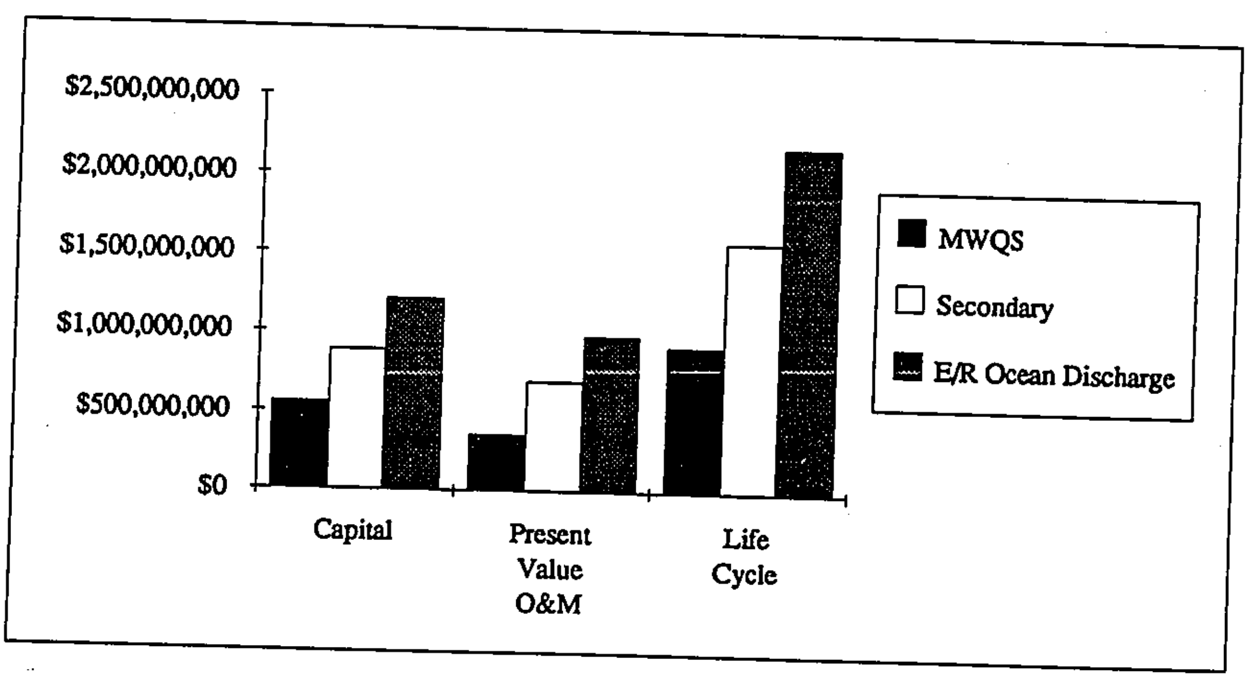
Cost Increase Relative to the Preferred Alternative

Table 8-2 shows the absolute and percentage difference in capital, operations and maintenance and life cycle cost difference of the secondary treatment and eliminate/reduce ocean discharges alternatives relative to the preferred alternative. Figure 8-4 depicts the same information. It is clear from Figure 8-4 that the secondary treatment and eliminate/reduce ocean discharges alternatives represent significant cost increases relative to the preferred alternative.

Table 8-2
Cost Increase Relative to Existing and Preferred Alternative Costs for the Secondary and Eliminate/Reduce Ocean Discharge Alternatives (1993 Dollars)

ALTERNATIVE	TOTAL SYSTEM COST	INCREASE OVER EXISTING		INCREASE OVER THE PREFERRED ALTERNATIVE	
		DOLLAR INCREASE	% INCREASE	DOLLAR INCREASE	% INCREASE
Meet Water Quality Standards (Preferred Alternative)					
Capital Present Value O&M Life Cycle	$559,696,500 $362,395,997 $922,092,497	$362,395,997	31%		
Secondary					
Capital Present Value O&M Life Cycle	$886,546,500 $696,765,997 $1,583,312,497	$696,765,997	60%	$326,850,000 $334,370,000 $661,220,000	58% 92% 72%
Eliminate/Reduce Ocean Discharge					
Capital Present Value O&M Life Cycle	$1,206,246,500 $980,312,997 $2,196,559,497	$980,312,997	85%	$646,550,000 $617,917,000 $1,264,467,000	116% 171% 137%

Figure 8-4. Absolute Cost Differences Between Feasible Alternatives (1993 Dollars)



Preferred Alternative Component Capital Cost Distribution

Figure 8-5 shows the component capital cost distribution for the preferred alternative. The major capital cost contributor is the capacity and reliability upgrades for the sewered areas collection, dwarfing all other component capital costs. In contrast, though not shown graphically, the treatment level component increases significantly as a percentage of total capital costs for the secondary treatment alternative; the effluent disposal component increases significantly as a percentage of total capital costs for the eliminate/reduce ocean discharges alternative (see Appendix B for more details).

Figure 8-6 shows the component operations and maintenance (O&M) cost distribution for the preferred alternative. The major O&M cost contributor is the treatment level. This is also true for the secondary treatment and the eliminate/reduce ocean discharges alternatives. Note that costs for the extend centralized system, effluent disposal, and Kuliouou components are insignificant and thus are not shown.

8.11.2 EXPENDITURES

It is assumed that implementation of the preferred alternative will cause City expenditures to increase, but that there will be no impact on federal and state expenditures. This is because the State Revolving Fund (SRF), funded in large part by federal grants, may not be available for use. City expenditure increases caused by Capital Improvement Projects (CIPs) are assumed to be funded by bond issues as in the past. Increased O&M costs of the DWWM are not capitalized. DWWM debt service expenditures ultimately increase because CIP capital costs are amortized over time, and become DWWM debt service expenditures when they commence. All dollar estimates presented are expressed in 1993 dollars, without consideration of inflationary effects. This is a conservative assumption because in fact some projects are likely to quality for SRF funding at a lower interest rate than available by bond issue. Therefore, debt service expenditures would be less.

Debt Service Expenditures

The existing annual debt service amount for FY 1991-92 is $16,200,000 for FY 1991-92 (DWWM personnel, pers. comm.) for all of Oahu. The actual percentage of this total that is apportionable to East Mamala Bay is unknown. DWWM Annual Report (1992) data for treatment plant and WWPS O&M costs show that East Mamala Bay's O&M costs are 20.23 percent of the Oahu total. Multiplying this percentage by the FY 1991-92 debt service for all of Oahu equals $3,276,808. This value is used as the estimated existing annual debt service amount for East Mamala Bay.

Figure 8-7 shows the preferred alternative construction costs distribution over the study period. It shows that the bulk of preferred alternative capital expenditures occur in the latter half of this decade, peaking in the year 2000. They then taper off dramatically given reduced construction expenditures at the end of the decade. This distribution is an assumption based on the need to reflect all planned improvements completed by the end of the study period. Assumption of this aggressive expenditure schedule for computing fiscal impacts probably overstates the expenditure impact and is therefore conservative. Deferring expenditures (hence construction) until later in the planning period would have the effect of pushing more of the payback period beyond the planning horizon. These preferred alternative construction expenditures lead to increased DWWM debt service expenditures over existing levels. The average annual increase for the study period over current levels attributable to the East Mamala Bay area is 845 percent; when compared to existing DWWM debt service for all Oahu, the increase is 171 percent. The increase over current debt service levels for the final year of the study period, 2015, are 1059 percent and 214 percent, respectively, for East Mamala Bay and all Oahu.

Figure 8-5 Alternative Capital Cost Distribution by Component

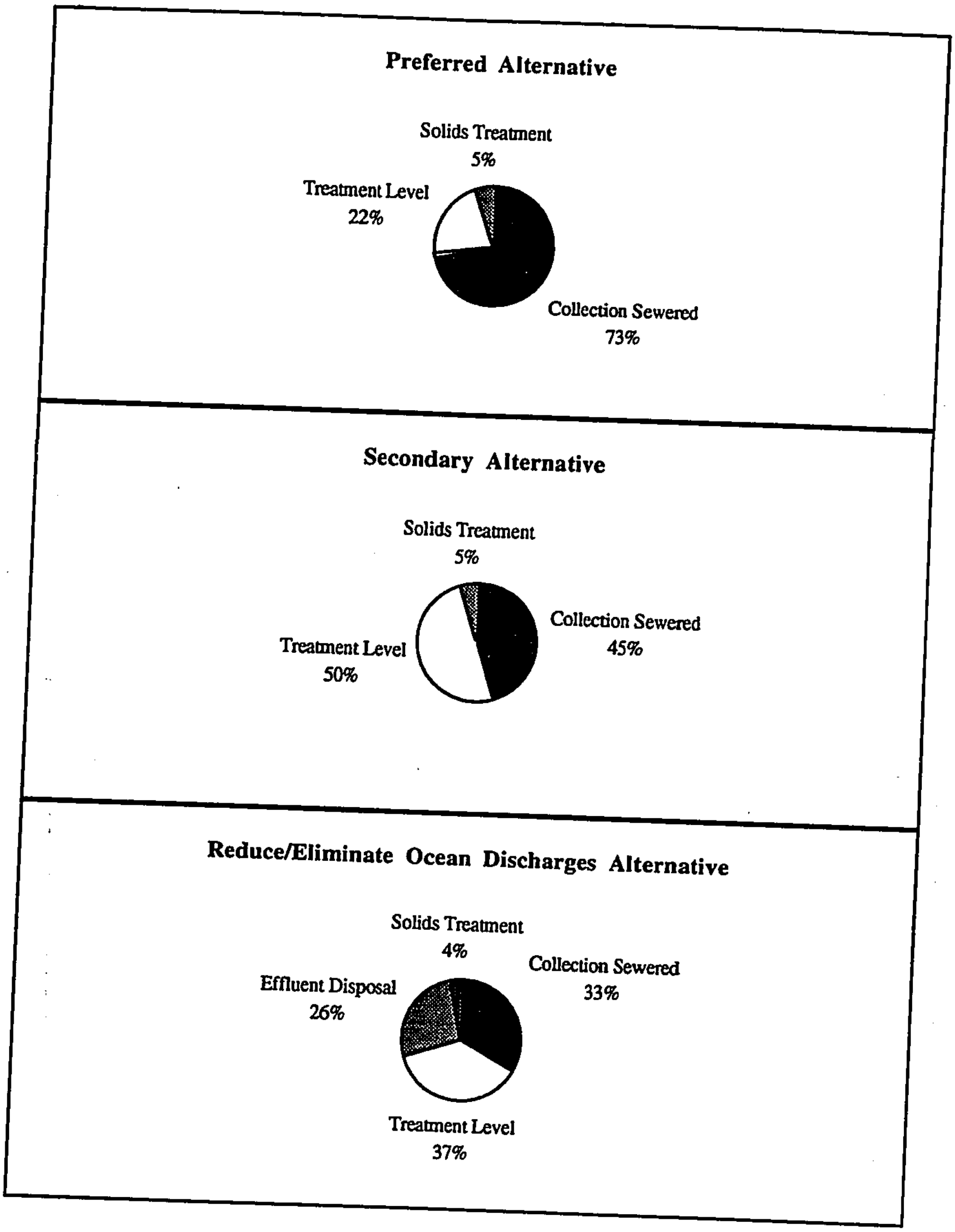


Figure 8-6 Alternative Operations and Maintenance Cost Distribution by Component

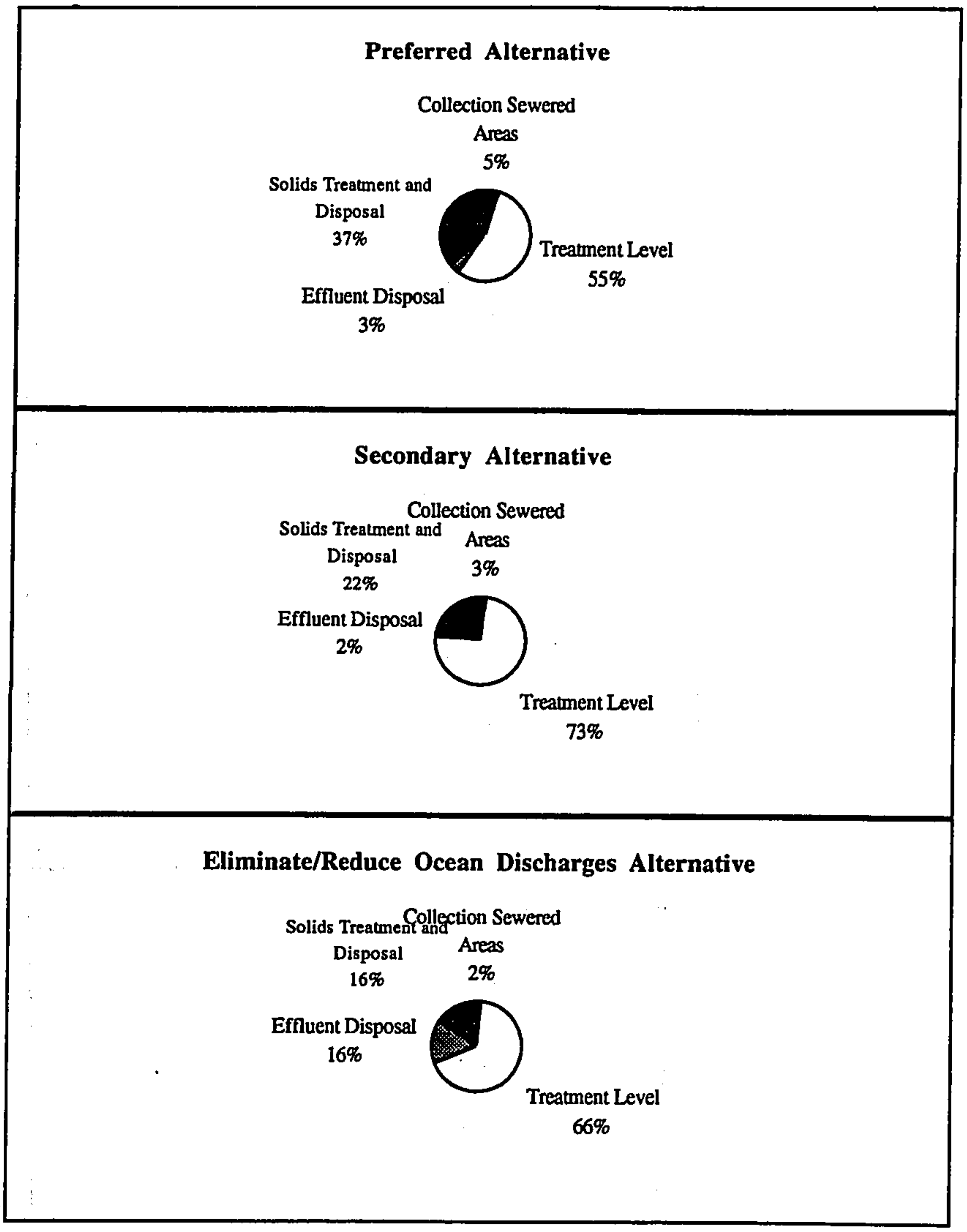
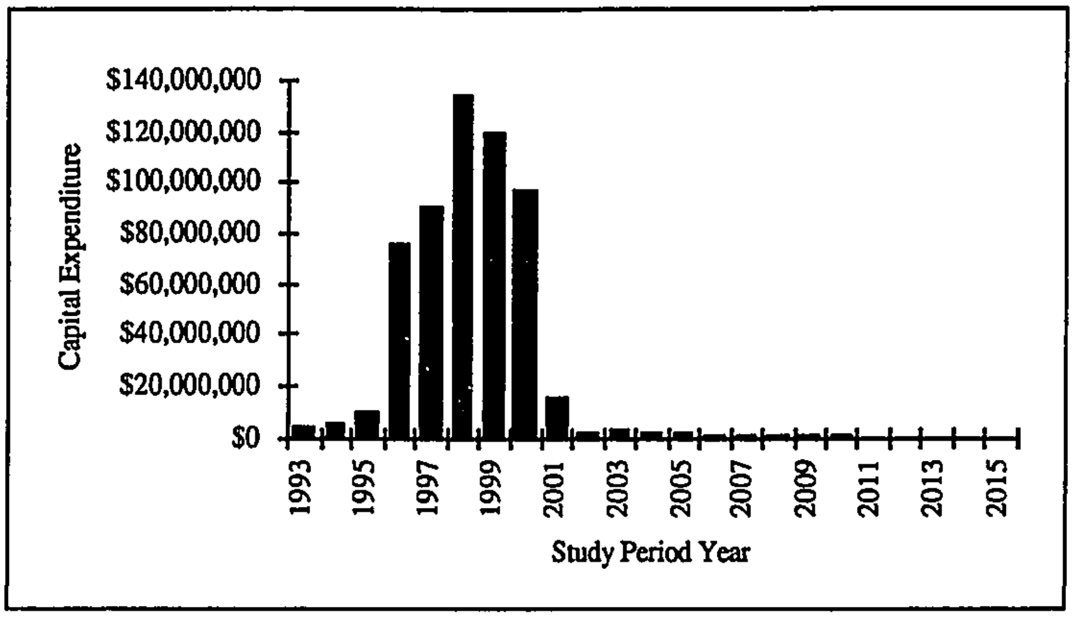


Figure 8-7 Study Period Preferred Alternative Capital Expenditure Distribution (1993 Dollars)



Operations and Maintenance Cost Expenditures

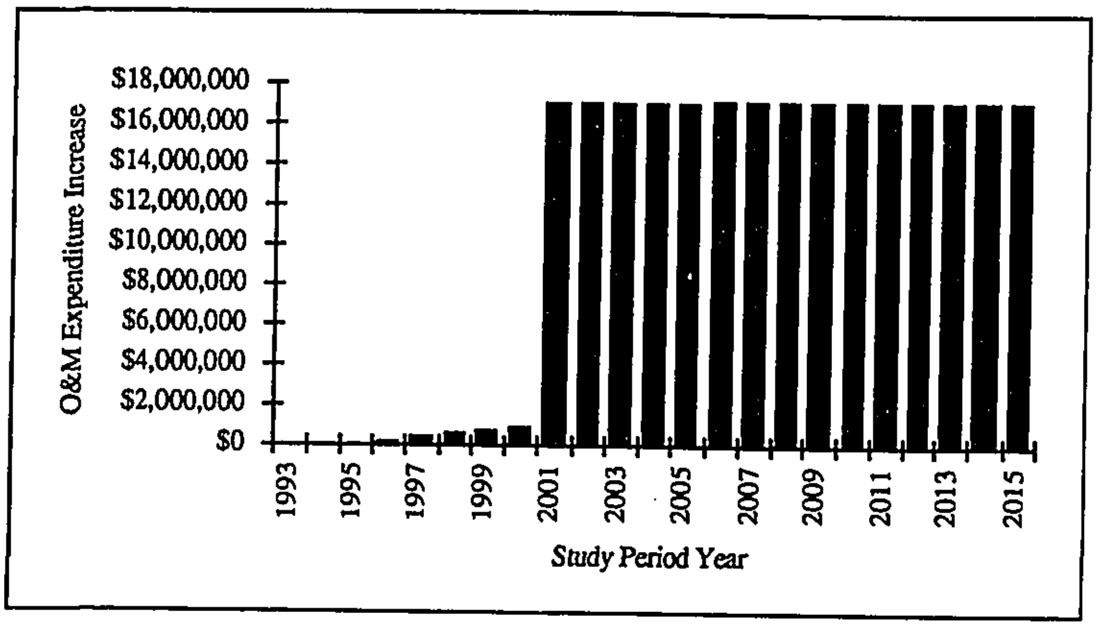
O&M costs commence for an item (e.g., WWPS upgrades) once that item's construction is completed and the item is placed into service. Implementation of the preferred alternative will lead to increased O&M costs over existing levels. Thus, DWWM O&M expenditures will increase.

Figure 8-8 shows that the preferred alternative's estimated O&M expenditures (expressed in 1993 dollars) increase progressively over existing levels for the study period; they increase dramatically at the end of the decade, and slowly thereafter to the end of the study period. The average annual O&M expenditure increases over the study period are 101 percent and 21 percent, respectively, for East Mamala Bay and all Oahu. The annual O&M expenditure increase from existing levels to 2015 is 155 percent and 31 percent, respectively, for East Mamala Bay and all Oahu.

Total Expenditures Due to the Preferred Alternative

Using the data depicted in Figures 8-7 and 8-8, the total expenditure impact of implementing the preferred alternative is estimated for East Mamala Bay and all Oahu for the study period. The results are presented in Table 8-3. Overall, implementation of the preferred alternative would cause a total average annual DWWM expenditure growth for the study period of 272 percent over 1992 levels for East Mamala Bay, and 55 percent for all Oahu. The total expenditure increase from existing levels to 2015 would be 362 percent and 73 percent, respectively, for East Mamala Bay and all Oahu.

Figure 8-8 Study Period Preferred Alternative O&M Expenditure Increase Progression (1993 Dollars)



8.11.3 REVENUES

Revenue Sources

Revenues to pay for the implementation of the preferred alternative will ultimately come from Oahu wastewater system users. This is pursuant to federal regulation (40 CFR 35.21(c)) which specifies that each user's sewer service charge must reflect each user's proportionate share of the costs to operate and maintain (i.e. O&M costs) the City's sewage treatment works. It also includes other costs (i.e. Central Administrative Service Expense, or CASE). The trend is towards sewer service charges covering all DWWM expenditures, as opposed to some percentage of the total of such costs coming from the General Fund. Consistent with this trend, all incremental additions to DWWM expenditures over existing levels due to the implementation of the preferred alternative will be paid for by revenue obtained from sewer service charge increases. In sum, DWWM expenditure increases caused by implementation of the preferred alternative lead to increased DWWM-required revenues met through sewer service charge increases. To estimate the potential impact of this revenue requirement, the cost is allocated in two ways: on a per-household basis to households in the East Mamala Bay study area, and to all Oahu households. The actual rate households may pay is different from this allocated charge because the computational methods and classifications used to determine rates are different than the method used herein. However, the allocation using all Oahu households provides a better approximation of potential impacts than does the study area-only allocation.

Table 8-3
Total Expenditure Impact of Implementation of the Preferred Alternative for East Mamala Bay and all of Oahu for the Study Period (1993 Dollars)

YEAR	TOTAL DWWM EXPENDITURE INCREASE	% INCREASE EAST MAMALA BAY	% INCREASE ALL OAHU
1993	$254,664	1.78%	0.36%
1994	$584,392	4.08%	0.83%
1995	$1,217,853	8.51%	1.72%
1996	$6,127,299	42.82%	8.66%
1997	$12,159,440	84.97%	17.19%
1998	$20,922,754	146.20%	29.57%
1999	$28,705,561	200.59%	40.57%
2000	$35,070,804	245.07%	49.57%
2001	$52,215,507	364.87%	73.80%
2002	$52,363,526	365.90%	74.01%
2003	$52,529,418	367.06%	74.25%
2004	$52,689,738	368.18%	74.47%
2005	$52,798,097	368.94%	74.63%
2006	$52,873,135	369.46%	74.73%
2007	$52,911,401	369.73%	74.79%
2008	$52,937,430	369.91%	74.82%
2009	$52,962,972	370.09%	74.86%
2010	$52,986,446	370.26%	74.89%
2011	$52,987,469	370.26%	74.89%
2012	$52,987,469	370.26%	74.89%
2013	$52,732,805	368.48%	74.53%
2014	$52,414,910	366.26%	74.08%
2015	$51,781,448	361.84%	73.19%
Averages	$38,922,371	271.98%	55.01%

Existing DWWM Sewer Service Charges and Revenues

DWWM sewer service charges are broken down into two parts: debt service capital charges and O&M charges. The 1991-92 DWWM revenue distribution by expense category and residential sewer service charge allocation across expense categories is shown in Table 8-4. The residential sewer service charge allocation allows DWWM expenditure increases to be estimated separately for capital and O&M. These separate cost increases are then aggregated to determine the overall sewer service charge increase required by the preferred alternative.

All estimated sewer service charge impacts of the preferred alternative are measured in 1993 dollars. This means there is an implicit inflation assumption that inflationary sewer service charge increases equal four percent, the assumed study period average annual inflation rate.

Table 8-4
1991-92 DWWM Revenue Distribution

EXPENSE CATEGORY	TOTAL AMOUNT	% OF TOTAL	RESIDENTIAL CHARGE ALLOCATION
O & M	$54,530,000	73.12%	$18.17
Debt Service	$16,220,000	21.75%	$5.40
CASE*	$3,830,000	5.14%	$1.28
TOTAL ALL	$74,580,000	100.00%	$24.85

*CASE - Central Administrative Service Expense

For use of federal funding, regulations require that rates reflect proportional use of the system among user classes. However, to estimate overall economic impact, this study focuses on impacts to residential households, which would include passed through costs from other use sectors (e.g., commercial). Thus, estimated charge impacts do not directly reflect the rate structure used by DWWM. Table 8-4 shows that residential users were the largest DWWM revenue source, providing 68.91 percent of total DWWM revenues. In estimating possible sewer service charge impacts, it is assumed that non-residential billing unit sewer service charge increases by charge type (i.e., base charges and block rate charges) are proportional to residential billing unit increases over the study period, such that the distribution of total DWWM revenue collected remains invariant with time given implementation of the preferred alternative. Given this assumption, the estimated 2015 DWWM required revenues for each customer classification are presented in Table 8-5.

Some portion of non-residential and governmental sewer service charges resulting from implementation of the preferred alternative could ultimately be passed on to residential users. This would be in the form of increased prices from commercial users as they pass on the sewer service charge increases to their customers (i.e. residential users). It would also be in the form of increased taxes from governmental users as they pass on their sewer service charge increases to their tax payers (i.e. residential users). However, some portion of these costs are passed to non-Oahu residents through federal taxes or visitor revenues. Given the possibility of passed-on charges, two sewer service charge increase scenarios are estimated. The first assumes that non-residential and governmental users pass on all their increases to residential users. The second scenario assumes that non-residential and governmental users do not pass on their increases to residential users. In all likelihood, residential sewer service charge and cost of living increases due to implementation of the preferred alternative will fall somewhere between the values estimated for these two scenarios. The second scenario is estimated by multiplying the sewer service charge increases estimated for the first scenario by 68.91 percent, the percentage of total existing DWWM revenues from residential sources.

Table 8-5
Feasible Alternative Required Revenues in 2015

CUSTOMER CLASSIFICATION	EXISTING REQUIRED REVENUE	FEASIBLE ALTERNATIVE 2015 TOTAL REVENUE		
		PREFERRED ALTERNATIVE	SECONDARY ALTERNATIVE	ELIMINATE/ REDUCE OCEAN DISCHARGES
Residential				
Single Family Duplex	$30,497,473	$47,275,338	$81,175,841	$112,104,090
Mixed Residential Units	$215,851	$334,599	$574,536	$793,436
Multi-Family	$19,448,812	$30,148,372	$51,767,360	$71,490,886
Mixed User	$122,136	$189,328	$325,092	$448,953
TOTAL RESIDENTIAL	$50,284,272	$77,947,637	$133,842,829	$184,837,364
Non-Residential				
	$10,629,252	$16,476,824	$28,292,130	$39,071,520
Hotels, Motels, etc.	$4,891,991	$7,583,269	$13,021,127	$17,982,218
Industrial Complex	$1,365,293	$2,116,395	$3,634,032	$5,018,610
Agriculture	$506	$784	$1,347	$1,860
Religious Institutions	$374,383	$580,346	$996,504	$1,376,175
TOTAL NON-RESIDENTIAL	$17,261,425	$26,757,617	$45,945,141	$63,450,383
Government				
U.S. Military Installations	$1,832,787	$2,841,076	$4,878,372	$6,737,047
U.S. Non-Military Installations	$73,953	$114,637	$196,842	$271,840
State	$3,211,905	$4,978,901	$8,549,203	$11,806,476
City	$306,401	$474,964	$815,555	$1,126,284
TOTAL GOVERNMENT	$5,425,046	$8,409,578	$14,439,972	$19,941,647
TOTAL ALL	$72,970,743	$113,114,833	$194,227,942	$268,229,394

Note: Existing revenue collections fell short of revenue needs by 4.7 percent. The shortfall was made up with monies from the general fund.

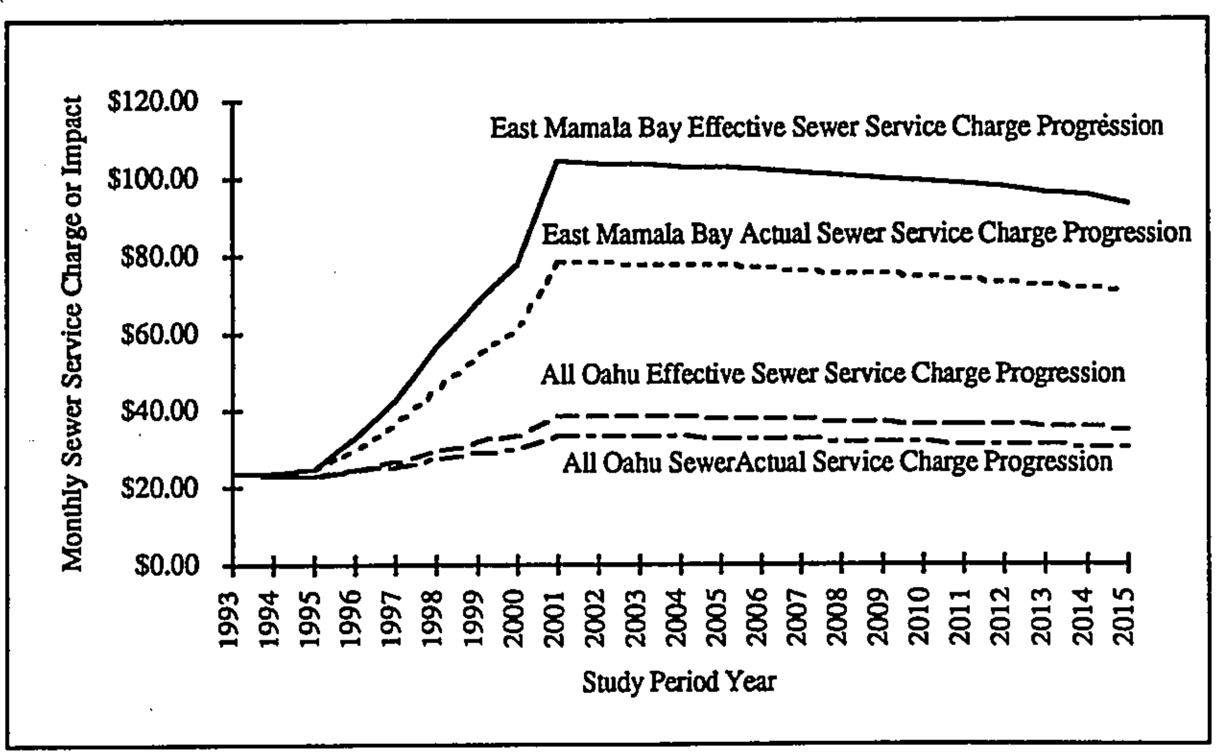
Residential Billing Unit Changes Over the Study Period

Population increases over time lead to more residential (and non-residential) billing units. Housing unit increases are used to adjust the study period sewer service charge increases for population increases. This spreads the DWWM required revenues over more billing units with time, and reduces the average per housing unit sewer service allocated cost increase over the study period.

Estimated Sewer Service Allocated Cost Over the Study Period

Figure 8-9 shows the sewer service charge increase progression over the study period if East Mamala Bay users incur the entire increase and if all Oahu users incur the entire charge increase. In each case, charges plateau at the end of the decade after rather steep rises during the remaining years of this decade. The decrease trend thereafter is because sewer service charge increases to cover increasing expenditures are spread over more billing units. If all sewer service charge expenses are passed on to East Mamala Bay residential users, the East Mamala Bay effective monthly residential sewer service charges (including increased costs of goods and services) would be $87.75 or 272 percent greater than existing charges in 1992. If all sewer service charge expenses are passed on to all Oahu residential users, assuming the same non-residential pass-through effect, the all Oahu effective monthly residential sewer service cost impact would be $35.07 in 2015, or 48.8 percent greater than existing (1992) charges. If all sewer service charge expenses are *not* passed on to all Oahu residential users, the all Oahu monthly residential sewer service cost impact would be $30.46 in 2015.

Figure 8-9 Preferred Alternative Estimated Actual and Effective Residential Sewer Service Charge Progressions (1993 Dollars)



8.11.4 BENEFITS

Benefits due to implementation of the preferred alternative take the form of various household income multiplier effects and non-pecuniary benefits. The benefits primarily accrue to the County government and residents, which also incurs the costs of implementation of the preferred alternative.

Household Income Multiplier Effects

Multiplier effects are impacts on household income that arise from CIP and DWWM expenditures caused by the preferred alternative. Household income impacts seem most relevant to this analysis as opposed to output or employment impacts of the preferred alternative since sewer service charge impacts are measured for households. Further, it allows aggregating costs and economic benefits to determine the net economic benefit (cost) of the preferred alternative using households as the common denominator. The household income multiplier is also the least distorted of the different multiplier types, output and employment being the other two.

Household income multiplier effects arise from three sources: capital expenditures, O&M expenditures, and the sale of biosolids products. Capital expenditures are assumed to have full positive (commercial construction) multiplier effect (.68) during the period the capital expenditure is made. Capital debt service expenditures are assumed to have a full negative (average household) multiplier effect (.79) from the period they commence for their duration. O&M costs are assumed to have a negative multiplier effect (.37) when they commence and for their duration due to the difference between the average household multiplier effect (.79). If households were not deprived of the money spent on O&M by the DWWM, the multiplier applied to these expenditures in the household *sector is higher than the O&M expenditure* multiplier effect of (.42) if DWWM spends the money for provision of wastewater services. Sale of biosolids products on Oahu are assumed to have a household income multiplier effect per dollar sale of biosolids product equal to that for the Other Agriculture Products sector (DBED, 1987) which equals .53.

The study period average annual household income multiplier effect from each source is shown in the table below.

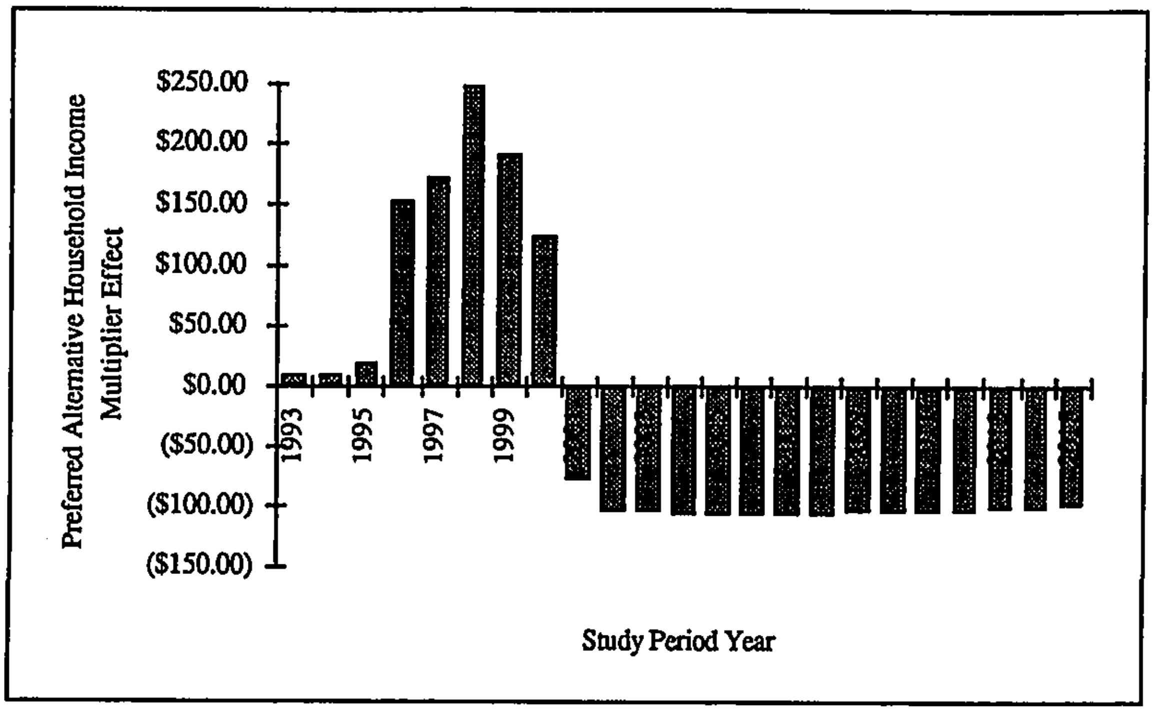
Source of Multiplier Effect	Average Annual Household Income Multiplier Effect
Construction expenditures	$55
Debt service expenditures	($69)
O&M expenditures	($13)
Total	($27)

Figure 8-10 shows the distribution of the total preferred alternative multiplier effect over the study period. It is first positive due to multiplier effects from construction expenditures which primarily occur before the end of the decade. Multiplier effects become negative at the end of the decade because (negative) multiplier effects of DWWM debt service and O&M expenditures due to the implementation of the preferred alternative overwhelm any positive multiplier effects from other sources. The distribution over time of relative economic costs and benefits is sensitive to the assumed schedule for capital expenditures.

Non-Economic Benefits

Non-economic benefits resulting from implementation of the preferred alternative are difficult or impossible to quantify directly. Areas where non-economic benefits will likely accrue are: public health and safety, environmental (physical impacts), and social impacts. With respect to each of these, there is an avoided direct economic cost in preserving water quality by implementation of the preferred alternative. These avoided direct economic costs are: negative health consequences (e.g., illness, disease) to resident and visitor populations, the localized deterioration of the East Mamala Bay aquatic environment, ground/surface water contamination, inability to develop the East Mamala Bay region in accordance with the Development Plan, and EPA fines ($25,000 per day per violation).

Figure 8-10 Total Preferred Alternative Multiplier Effect Study Period Distribution



Preserving water quality by implementation of the preferred alternative also has an indirect avoided cost to tourism in general if ocean water becomes a disamenity, and an avoided negative household income multiplier effect. A negative household income multiplier effect would occur from a non-avoided cost. Such a cost would, in all likelihood, be exogenous to the Oahu economy. A non-avoided dollar cost could be in the form of a fine for violation of the Clean Water Act ($25,000 per day per violation) which is paid to the Federal government, or of a lost tourist dollar that does not come to Hawaii because of deteriorating water quality. For the latter, the Type II multiplier is .59 which means that for each tourist dollar lost, there is a $.59 reduction in Oahu household income.

Implementation of the preferred alternative would preserve water quality and avoid all direct and indirect economic costs due to a deterioration of water quality. The technical analysis of this study further shows that the $90 million annual value of ocean recreation activities in the East Mamala Bay region is not at risk from normal WWTP operations given the level of treatment of the preferred alternative.

8.11.5 COST/BENEFITS

Implementation of any of the feasible alternatives leads to economic costs and benefits that primarily occur on Oahu. As discussed in the foregoing sections, economic costs include the debt service to amortize capital costs of implemented CIP projects over the study period, and operations and maintenance cost increases that come as a result of changes in operations. Economic benefits are household income multiplier effects arising from a feasible alternative's capital expenditures and the sale of biosolids products produced. There are also non-economic benefits, the value of which have not been estimated.

The economic costs and benefits of implementation of a feasible alternative are measured on a per Oahu residential unit (household) basis. Summing the economic costs and benefits over the study period provides an estimate of the net economic benefit (cost) of implementation of the preferred alternative to the average Oahu household.

Net Benefits (Costs)

Table 8-6 presents the results from aggregating across all the per residential unit economic costs and benefits that occur due to the implementation of the preferred alternative. It shows an average annual $149 cost per Oahu household over the study period and a $237 cost in the year 2015. These figures do not include the avoided economic costs or the non-economic benefits from implementation of the preferred alternative.

Figure 8-11 shows the distribution of new Oahu household benefits (costs) measured in *total* household income terms. Presenting the total dollar amounts provides a sense of the absolute dimension of economic impacts and their distribution due to implementation of the preferred alternative over the study period. The *total* cost of implementation of the preferred alternative in the year 2015 is $80.7 million. The average annual study period cost is $48.5 million. Figure 8-11 also shows that implementation of the preferred alternative has net economic benefit to the end of the decade. This is due to the large positive household income multiplier effects from construction expenditures during this period. These net economic benefits become costs as (positive) construction multiplier effects diminish and negative household income multiplier effects from DWWM debt service and O&M expenses become dominant. These costs continue into perpetuity, but decrease as capital costs are fully amortized over the 15 years after the study period. Delaying capitol expenditures would have the effect of distributing the positive economic benefits into future years, and further postponing the payback period.

Public Benefits of the Preferred Alternative

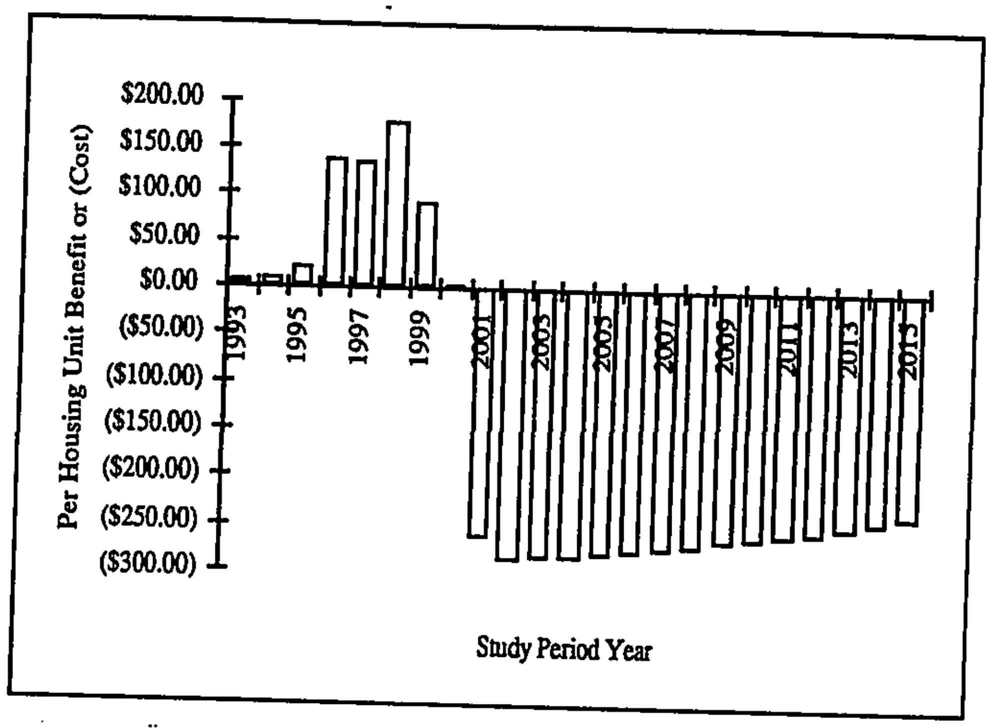
The primary reason for implementation of the preferred alternative is not for its economic benefits, but to avoid public health, safety, environmental, and social impacts and indirect costs that would occur by not implementing the preferred alternative. Thus, an economic cost/benefit assessment does not measure the total value of implementation of the preferred alternative.

The value of direct and indirect costs avoided and any non-economic benefits from implementation of the preferred alternative has not been estimated. Any valuation of these benefits on a per Oahu housing basis that exceeds $41 annually on average over the study period would cause implementation of the preferred alternative to have a positive dollar benefit to Oahu households. These benefits would begin at the end of the decade and would continue into perpetuity.

Table 8-6
Net Benefits (Costs) of the Preferred Alternative

YEAR	ANNUAL SEWER SERVICE CHARGE INCREASE	MULTIPLIER EFFECTS	BIOSOLIDS SALES BENEFITS	TOTAL BENEFIT (COST)
1993	$1.02	$8.55	$0.00	$7.53
1994	($0.77)	$9.86	$0.00	$10.63
1995	($1.33)	$19.28	$0.00	$20.61
1996	$16.40	$153.79	$0.00	$137.39
1997	$38.31	$172.72	$0.00	$134.40
1998	$70.55	$248.26	$0.00	$177.71
1999	$98.70	$192.06	$0.00	$93.36
2000	$121.16	$124.72	$0.00	$3.56
2001	$183.81	($78.67)	$0.22	($262.26)
2002	$181.60	($106.25)	$0.22	($287.63)
2003	$179.48	($105.38)	$0.22	($284.64)
2004	$177.37	($106.68)	$0.22	($283.83)
2005	$175.09	($107.29)	$0.22	($282.16)
2006	$171.73	($108.00)	$0.22	($279.52)
2007	$168.29	($107.66)	$0.22	($275.74)
2008	$164.86	($107.13)	$0.22	($271.78)
2009	$161.48	($106.38)	$0.22	($267.65)
2010	$158.15	($105.62)	$0.22	$263.55)
2011	154.85	($105.58)	$0.22	($260.21)
2012	$151.59	($104.80)	$0.22	($256.17)
2013	$147.50	($103.42)	$0.22	($250.70)
2014	$143.25	($101.92)	$0.22	($244.94)
<u>2015</u>	<u>$137.97</u>	<u>($99.70)</u>	<u>$0.22</u>	<u>($237.45)</u>
Average	$121.79	($27.18)	$0.14	($148.83)

Figure 8-11 **Study Period Distribution of Total Household Benefits (Costs) Due to Implementation of the Preferred Alternative (1993 Dollars)**



8.12 CUMULATIVE AND UNAVOIDABLE IMPACTS

Significant impacts of the preferred alternative for each of the wastewater system components have been discussed in the previous sections. Cumulative impacts are the additive and interactive impacts of these effects, or the effects in combination with those of external events.

As the proposed action itself is intended primarily to mitigate adverse effects of wastewater generation on public health and the environment, its cumulative effect is expected to be positive. The benefit is the avoided cost to society and the environment, including impairment to beneficial uses of natural resources and harm to public health, from improperly discharging untreated or under treated wastes. A second avoided cost, given the interactive effect of environmental and land use regulations, is constraint to development planning caused by infrastructure inadequacy.

The financial cost of these benefits is direct, and affects all members of the community. Although the preferred alternative is cost effective in achieving water quality regulatory compliance and meeting infrastructure demand for planned population growth, its costs are nonetheless significant.

8.12.1 TRAFFIC

Traffic impacts from disruption of roadways during construction will be locally significant, and, despite mitigation, cannot be completely avoided. Although traffic slowdowns from construction are temporary in nature, with approximately 300 separate projects extending over two decades, disruptions, bumpy roads, and slowdowns will occur at various locations over the duration of the twenty year planning period.

8.12.2 SOLID WASTE

The sludge disposal component of the preferred alternative will have a positive cumulative impact on solid waste reduction. Disposal of sludge as a waste in landfills or by incineration and discharge to the air is reduced. In addition, the alkaline stabilization treatment process, if implemented, presents opportunities by use of a second waste, bottom and fly ash from the Barbers Point fluidized bed power plant, thereby having a multiple waste reduction effect.

8.12.3 ENERGY CONSUMPTION

Fuel use will increase because of construction and because of increased operational use of electricity. Construction fuel use will extend over the planning period, with most occurring during the first 10 years, when both collection system and treatment plant improvements are occurring. Because of increased flows, pumping energy requirements will also increase over the planning period, and will continue. Both fuel growth increments were estimated in previous sections. Although the total increase is not significant (i.e., the estimated amount of fuel not being "substantially" greater than existing Oahu consumption), it does represent a growth in energy use, mostly petroleum based, and as such deserves mention as it cannot be avoided.

8.12.4 DEVELOPMENT PLANNING

The cumulative impact of the preferred alternative on development planning is that implementation avoids the cost of constraining or distorting presently approved plans. This is a positive impact. If sufficient wastewater infrastructure is not available in the Primary Urban Center and East Honolulu to accommodate anticipated growth, that growth could not occur despite the availability of suitable land under the Development Plan. The General Plan allocates between 45.1 percent and 49.8 percent of 2010 Oahu population to the Primary Urban Center, and 5.3 percent to 5.8 percent to East Honolulu. Thus, over half of Oahu's population is planned for the study area. Were infrastructure inadequate for demand, that demand for development would increase the probability of unplanned and unwanted development in other districts.

8.12.5 ECONOMIC IMPACTS

The largest cumulative and unavoidable impact of the preferred alternative is its economic cost and subsequent opportunity cost. To what other beneficial ends, either public or private, could the required expenditures be applied if not spent on the waste water system? The economic impacts are fully described in Section 8.11, and in Appendix B. It is not possible to directly compare the benefits of avoided costs with the direct cost of construction, debt service, and operation of the system; therefore, a "net" benefit or cost cannot be estimated.

The cumulative cost impact can be estimated by considering the total impact on households from the preferred alternative; capital costs are passed on to system users as debt service components of their sewage fee, in addition to operations, maintenance and administration costs. Other impacts occur to households from businesses passing on their increased costs in the prices of goods and services. An additional impact results from the lower multiplier effect from expenditures by government for construction, in which substantial proportions of the expenditures go out of state. The multiplier is substantially higher for household expenditures which would occur if the money were not expended for construction through increased sewage fees. For the preferred alternative, the estimated annual average allocated cost impact on each household, assuming the costs are distributed to all households on Oahu is:

Existing sewer fee:	$23.57 per month
Preferred alternative average allocated cost:	$30.04 per month
Percent Increase:	27.5%
Passed on costs:	$3.68 per month (assuming 100% to Oahu households)
Multiplier effects:	$2.26 per month

The total average monthly cost impact to each Oahu household of the preferred alternative, disregarding minor benefits from the reuse rather than disposal of biosolids, is $35.98 or $12.41 above the existing monthly sewer fee.

By comparison, if the secondary treatment alternative were selected, the average sewer service allocated cost alone is estimated at $35.60 per month, representing a $5.56 increase over the preferred alternative without considering pass-on and multiplier effects. Pass on effects represent an additional $6.18 cost effect, for a total of $41.78 per month without considering multiplier effects.

The cumulative economic impact of the preferred alternative cannot be substantially mitigated. The best mitigation is to implement cost effective projects and to obtain the lowest possible interest rates for bond coverage, or to obtain financing using the state revolving fund.

9

Contextual Issues

NINE
CONTEXTUAL ISSUES

9.1 RELATIONSHIP BETWEEN SHORT-TERM USES AND LONG-TERM PRODUCTIVITY

The efficient operation and maintenance of the wastewater system is vital to the public health and welfare of Oahu's residents as well as the economy of the State. To that end, utilization of land for collection line and force main easements, sites for wastewater pump stations, and a site for the Sand Island WWTP is warranted.

The siting of the wastewater system components necessarily constitutes a constraint on the full and unencumbered use of the impacted land. To every extent possible, however, major collection lines are sited within the rights-of-way of City-owned roadways. In so doing, these areas provide a dual function. Where the collection system encumbers private property with easements for the location of lateral lines, the enjoyment of the affected property is not substantively impacted, insofar as the landowner is only prevented from placing permanent structures over the easement, and not from its general use. Pump stations and the treatment plant are located on public property and do not unreasonably burden neighboring property owners or the general public.

The questions associated with the use of the ocean as a disposal site for waste generated on land have been persistent. Does the use of ocean waters for wastewater disposal detrimentally affect the ocean's other uses (e.g., as a food or recreation resource)? Based on the data evaluated, the existing conditions at the Sand Island outfall and the existing quality of the effluent being discharged cause no impairment to the ocean's other uses. Should higher levels of treatment be required in the future, no appreciable benefit is likely to occur. However, impairment to land or atmospheric resources may occur from increased sludge disposal, and significant socio-economic impairments will occur as a result of the increased cost.

9.2 IRREVERSIBLE AND IRRETRIEVABLE COMMITMENTS OF RESOURCES

Implementation of the proposed improvements will result in the irreversible and irretrievable commitment of certain natural and fiscal resources. Major resource commitments include the land on which the improvements are located and on which the facilities would be constructed, as well as money, construction materials, manpower and energy. The impacts of using these resources should be weighed against the public health and socio-economic benefits to be derived from the improved operation of the East Mamala Bay wastewater system, versus the consequences of taking no action. With the exception of those areas proposed for addition to the collection system and two new pump stations, most of the remaining improvements constitute repairs and upgrades to the existing system, and therefore do not require the acquisition of property by the City. None of the improvements included in the preferred alternative constitute an irretrievable commitment of land.

The resources required to complete the proposed projects include building materials and labor, both of which are generally non-renewable and irretrievable. The consumption of fuel for the project's energy needs during construction and operation, represents an irretrievable commitment of resources.

Perhaps the largest commitment of resources required of the preferred alternative involves the public monetary outlay. This cost can be considered in terms of the benefits that might otherwise be derived from the money, if it were not expended on wastewater collection and treatment. These benefits could be either public, such as parks or schools, or private individual benefits. The effort spent in generating the revenues required is irretrievably lost once the revenues are expended. Therefore, a primary goal of the proposed action is achieving the desired condition(s) as economically as possible.

9.3 GOVERNMENTAL POLICIES CONSIDERATIONS

As indicated in Chapter Two, the proposed project is generally consistent with the applicable provisions of the Hawaii State Plan and various Functional Plans, the County General Plan, County zoning and Special Management Area guidelines, and all pertinent federal and State environmental-related regulations. The use of the various City properties represents a permitted use and will not require rezoning.

9.4 UNRESOLVED ISSUES

There are several issues that have not and cannot be resolved within the context of this document. Following is a brief discussion of each issue.

Secondary Treatment Waiver

The current waiver of secondary treatment under which the Sand Island WWTP is operating expires in 1995. Whether it will be renewed or not is unknown. Non-renewal would result in a requirement for secondary treatment, and thus, greater funding for implementation than was projected for the preferred alternative. The preferred alternative is designed to facilitate efficient conversion to secondary treatment should the waiver not be renewed at some point in the future.

Mamala Bay Study Commission

As a result of the City's settlement with the Sierra Club and Hawaii's Thousand Friends, the court mandated as part of the Consent Decree creation of the Mamala Bay Study Commission. The Commission is an independent research body tasked with the study of the environmental effects of point and non-point source discharges into Mamala Bay. Because the Commission's deadline has been extended beyond the deadlines for the Facilities Plan and EIS, the work of the commission and its findings are not available for inclusion in this EIS. While the authors of this document believe that the commission's findings will be consistent with those of the Facilities Plan and EIS, the matter remains unresolved until the commission completes its task. Any differences between the findings of this EIS and those of the commission would be resolved by the City and County of Honolulu, DOH, and EPA.

Timing and Scope of the Proposed Projects

Due to the court consent-decree deadline established for the completion of this document, and in light of the magnitude of the project and the length of the implementation period, it is not possible to address each proposed improvement in detail. As a result, the site-specific environmental impacts of some projects are not addressed in this document, and will be dealt with through supplemental EAs or EISs prior to construction. However, all anticipated projects are covered at a programmatic level of detail. Potential impacts resulting from proposed improvements at the Sand Island WWTP as well as certain WWPS projects are covered in site-specific detail in this document.

Funding of Improvements

The scope of work for the Facilities Plan and this EIS did not include an analysis of impacts of funding the preferred alternative. The specific means, scheduling and impacts of project funding remains unresolved until the City Council has had an opportunity to review the Final Facilities Plan and initiate the requisite financial analysis.

Phasing of Improvements

The project phasing presented in this document represents a target for completion. Similar to the issue of funding, the actual phasing of the proposed improvements will be determined by the City Council and the City administration during the period leading up to the 2015 planning horizon. Therefore, the exact timing of each specific project will remain unresolved until approval from the Council is received.

Growth Projections

Capacity requirements of the wastewater system in the Facilities Plan and this EIS are based on models developed using the City and County of Honolulu Development Plans and the Planning Department's population projections within the study area (i.e., land-use and population models). The proposed improvements to the wastewater system were designed to accommodate the increased future demand, so as not to pose a constraint to the planned levels of growth.

Future changes to the Development Plans affecting build-out capacity cannot be anticipated, nor can the actual rate of population growth. Any such changes may impact both the need for and timing of projects proposed to increase future capacity.

Water Quality Standards

Analysis of the impact of the Sand Island deep ocean outfall on recreation and open-ocean water quality was based on data that has been collected by DOH and DWWM since 1990. This data was analyzed and compared with existing standards to determine present compliance, and, using mathematical dilution formulas and computer modeling, evaluate future compliance. The manner in which some monitoring data are analyzed to determine compliance is not specified in the Department of Health rules and there are a number of possible ways this may be done.

The Clean Water Act requires periodic re-evaluation of water quality standards by the states. It is anticipated that Hawaii standards will be reviewed in roughly two to three years. Changes as a result of this review may affect concentration limits and methods of data interpretation to determine compliance. These changes would affect future compliance and monitoring requirements, but they cannot be anticipated at the present time.

Re-evaluation of the guidelines for compliance with recreational water quality standards is also needed. The effectiveness of presently used indicator bacteria has been challenged. In addition, determination of any possible contribution of the wastewater system to shoreline water quality problems is confounded by the overwhelming influence of urban runoff. Presently, no data exist on which to evaluate whether or not the wastewater collection system contributes to recreational water quality problems.

Sludge Disposal Options

Several methods of sludge processing for reuse have been evaluated and found to be feasible. It has not been determined whether the City or a contractor will operate the primary system for sludge conversion and marketing. If a contractor is selected, the exact method and location will be subject to bidding and contractual negotiations, and therefore cannot be specified in this document.

Sand Island Treatment Center

The preferred alternative proposes that the Sand Island Treatment Center remain at its existing location on the Sand Island WWTP site. If, however, secondary treatment is necessary in the future, the Sand Island Treatment Center would need to be relocated to a new site off the property, which is not presently identified.

Collection System

Numerous aspects of collection system improvements remain unresolved because the system's extent prevents definitive investigation at the planning level. Decisions to extend sewerage to presently unsewered areas, for example, is uncertain given the cost impacts.

Spill containment at WWPSs is the subject of an ongoing study, the results of which are not be available for this document. Spill containment, as opposed to spill reduction or elimination, is not included in the preferred alternative. Specific implementation of collection system improvements will be based on site-specific investigations and preliminary engineering review, and may differ from the actions described herein as dictated by additional information. In addition, identification of specific improvements to gravity sewer lines to reduce infiltration and inflow will be deferred until completion of the Sewer Rehabilitation and Infiltration and Inflow Minimization Plan.

10
Parties Consulted in the EIS Process

TEN

PARTIES CONSULTED AND THOSE WHO PARTICIPATED IN THE PREPARATION OF THE EIS

This chapter addresses the role of public and agency participation in the EIS process. Public input to the Facilities Plan and EIS is mandated by 40 CFR 35 and HRS Chapter 343. This chapter summarizes measures taken in compliance with those regulations.

Public comment was solicited at three Public Meetings, held on August 31, 1992, December 14, 1992, and August 30, 1992. These meetings were intended primarily to provide information about and accept input on the East Mamala Bay Facilities Plan. However, because the EIS addresses the environmental issues associated with the Facilities Plan, comments received at the meetings were incorporated, either directly or indirectly, into the DEIS and FEIS.

In addition, the HRS Chapter 343 EIS process provides several opportunities for the public and government agencies to comment on the environmental documents. Availability of the EIS Preparation Notice (EISPN) was published in the OEQC Bulletin on January 8, 1993, beginning a 30-day period (ending February 7, 1993) during which individuals and agencies could offer comments and/or request to be a consulted party. Notice of the availability of the DEIS was published in the OEQC Bulletin on August 23, 1993. Copies of the DEIS were available at the Office of Environmental Quality Control, Legislative Reference Bureau, Municipal Reference and Records Center, UH Hamilton Library, and the Hawaii State Library (Main, Regional, and Honolulu District Branches). Comment letters were received during the ensuing 45 day comment period (ending October 7, 1993) and beyond.

This chapter contains the written comments received and letters sent in response. In addition, it contains summaries of the three Public Meetings. The chapter is arranged in the following manner:

- List of consulted parties;
- EISPN comment letters and letters sent in response;
- Summary of DEIS comment letters and affected sections in the FEIS;
- DEIS comment letters and letters sent in response;
- Summaries (Group Memories) from the three Public Meetings; and
- Individuals responsible for preparation of the EIS.

Testimony received during a formal Public Hearing held on December 21, 1993 is not included here due to timing constraints. The transcript from this Public Hearing and written testimony received between November 5, 1993 and December 21, 1993 will be transmitted to the City Council.

CONSULTED PARTIES

The agencies, organizations and individuals consulted about the project are listed below. Those who commented on the EISPN in writing or requested status as a consulted party are identified with an asterisk (*); those who submitted written comment on the DEIS are marked by a plus sign (+). Copies of the correspondence with those who submitted written comments on either the EISPN or DEIS are reproduced in this chapter.

Federal Agencies

U.S. Environmental Protection Agency
U.S. Department of Commerce, National Marine Fisheries Service
\+ U.S. Department of the Interior, Geological Survey, Water Resources Division
Oahu Consolidated Family Housing, U.S. Army, Fort Shafter
+* Department of the Army, U.S. Army Corps of Engineers
U.S. Department of the Interior, Fish and Wildlife Service
NOAA Fisheries, Pacific Area Office
U.S. Department of Housing and Urban Development
\+ U.S. Department of the Navy
\+ U.S. Department of Agriculture, Soil Conservation Service
U.S. Department of Transportation, Coast Guard

State Agencies

+* Department of Business, Economic Development and Tourism
+* Department of Health
+* Department of Land and Natural Resources
+* Department of Transportation
+* Hawaii Community Development Authority
\+ Office of Environmental Quality Control
\+ Office of State Planning
\+ Environmental Center, University of Hawaii at Manoa
+* Housing Finance & Development Corporation
Water Resources Research Center, University of Hawaii at Manoa
Sea Grant Program, University of Hawaii at Manoa
Pacific Basin Development Council
\+ Department of Education
Marine Programs, University of Hawaii at Manoa
Department of Hawaiian Homelands
\+ Department of Accounting and General servicess
Office of Hawaiian Affairs
Department of Agriculture
Department of Defense

City & County Agencies

- Office of the Mayor
- +* Department of Public Works
- +* Department of Housing & Community Development
- +* Department of Transportation Services
- + Planning Department
- +* Department of Land Utilization
- +* Board of Water Supply
- +* Department of Parks and Recreation
- + Department of Budget and Finance
- + Police Department
- Fire Department

State Legislators

- Senator Anthony K.U. Chang
- Senator Ann Kobayashi
- Senator Russell Blair
- Senator Bertrand Kobayashi
- Representative Suzanne Chun
- Representative Mazie Hirono
- * Representative Brian Taniguchi
- Representative Edward Thompson
- Representative Duke Bainum
- Representative Kenneth Hiraki
- Representative Rod Tam
- Representative Jackie Young
- Senator Steve Cobb
- Senator Mary-Jane McMurdo
- Senator Milton Holt
- Senator James Aki
- Representative David Hagino
- Representative Les Ihara, Jr.
- Representative James Shon
- Representative Emilio Alcon
- Representative Carol Fukunaga
- Representative Calvin Say
- Representative Jane Tatibouet
- Representative Dennis Arakaki

Honolulu City Council

- Councilman Gary Gill, Chairman
- Councilwoman Donna Kim
- + Councilman Steve Holmes
- Councilman Leigh-Wai Doo
- Councilman Andrew Mirikitani
- Councilman Arnold Morgado
- Councilman John Felix
- Councilman John DeSoto
- Councilwoman Rene Mansho

Neighorhood Boards

- Kuliouou/Kalani Iki #2
- Waialae/Kahala #3
- Kaimuki #4
- * Diamond Head/Kapahulu/St. Louis Hts. #5
- Palolo #6
- Manoa #7
- McCully/Moiliili #8
- Waikiki #9

Waikiki/Lower Punchbowl/Tantalus #10
Ala Moana/Kaka'ako #11
Nuuanu/Punchbowl #12
Downtown #13
Liliha/Kapalama #14
Kalihi Palama #15
Kalihi Valley #16
Aliamanu/Salt Lake/Foster Village #18

Organizations

Sierra Club
Natural Resources Defense Council
American Lung Association
Blue Ocean Preservation Society
Greenpeace
Trees of Hawaii, Inc.
Save Our Bays and Beaches
* Western Pacific Regional Fisheries Management Council
\+ Hawaii's Thousand Friends
Hawaii Heptachlor Research and Education Foundation
Rainforest Action Network
Sierra Club Legal Defense Fund
American Fisheries Society
Earthtrust
Native Hawaiian Advisory Council
Conservation Council
Native Hawaiian Legal Project
Life of the Land
The Ocean Recreation Council for Hawaii
Mamala Bay Study Commission
American Civil Liberties Union
Hui Malama Aina O Koolau
Pacific Basin Development Council
Surfrider Foundation

Private Individuals and Businesses

George Okuhara
Marsha Joyner
P&H Equipment Co.
Surs Auto Truck Service
James L.K. Tom, Inc.
Edward Mau Roofing Co., Inc.
NK Corporation
\+ William Craddick
\+ Douglas Meller
Donald S. Bowman III
Bruce K.C. Hom
T.C. Yim
Matson Terminals
Oahu Interiors
Imua Sales & Service, Inc.
Water Resources International, Inc.
Harold Kaneshiro
Hawaiian Electric Company
Sand Island Treatment Center
Mai McDowell

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

REF:OCEA:SKK

FEB 10 1993

FILE NO.: 93-372
DOC. NO.: 2203

The Honorable C. Michael Street
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Street:

SUBJECT: Environmental Impact Statement Preparation Notice (EISPN) for the East Mamala Bay Wastewater Collection, Treatment and Disposal Plan

Thank you for giving our Department the opportunity to comment on this matter. We have reviewed the submitted EISPN and have the following comments.

Brief Description:

The correspondents are consultants to the Department of Public Works, engaged in preparing an EIS for the above sewer system. The EIS is intended to outline improvement plans for the system between now and the year 2015.

The existing sewer system is described as operating at almost 90% capacity, collecting sewage from Hawaii Kai to Aliamanu (mauka of the airport), treating it at the Sand Island treatment plant and discharging effluent through the Sand Island outfall.

The EIS is intended "to substantiate the need for proposed facilities....through a systematic evaluation of alternatives." It would be prepared simultaneously with a "Draft Facilities Plan." The latter would be revised in later stages, an "Interim Facilities Plan" and a "Profinal/Final Facilities Plan;" the final details of the proposal would not be available until the third stage (p. 6). Site-specific studies of the potentially affected "biological environment" would follow determination of specific plans (p. 8).

Division of Aquatic Resources Comments:

It is unclear how the EIS process can be useful before specific information is available on what improvements the project would include, where they would be made, and what resources are present at the potentially affected location(s). In the absence of such details, it is understandable that discussion of the "environment" and major impacts must be "general in nature and limited to a regional perspective" (p. 8); such general and limited discussion just does not seem consistent with an EIS' purposes. If the EIS is to be "complete" at the stage of a "Draft Facilities Plan," it should include, therefore, commitment to revision and further review when more adequate information about the proposed project is "determined."

Characterization of "East Mamala Bay's" aquatic fauna as "limited" and "depleted" (p. 8) could be potentially misleading in the EIS. Although natural habitats in the area generally do not support fish stocks at high densities, the area nonetheless supports extensive recreational and commercial use. That is one reason why the area has been affected so significantly by human activities. The EIS should describe fishery and other resources existing, and use levels—both current and as projected to the year 2015; it should discuss potential impacts across the full range of improvement-alternative being considered for sewer facilities.

The EIS discussion of water quality (p. 9) should include specific information on the impact of leaking sewer lines. Data collected by monitoring, required for years by permits to install and operate the existing system, should be disclosed and used as basis for assessing impacts, of the system and proposed improvements, on water quality and resources in various parts of the "East Mamala" region.

The EIS discussion of "Recreation Areas" under "Sensitive Areas" (p. 10) should include the State's Moanalua Bay Artificial Reef, Waikiki Marine Life Conservation District, and Waikiki-Diamond Head Shoreline Fisheries Management Area, all adjacent to the project area (Fig. 1). The EIS should discuss impacts, if any, of expanding the Sand Island sewage treatment plant on the State's hatchery (Anuenue Fisheries Research Center) — which supports the State's recreational and commercial fisheries, and the aquaculture industry—also on Sand Island.

We agree that long-term affects of replacing old, deteriorating facilities would be beneficial (p. 12), but the EIS also should discuss short-term impacts of the necessarily extensive construction activities required (which could continue for years), and commit to measures for averting or controlling adverse impacts from other coastal construction (e.g. expanding the treatment plant, work on the outfall, etc.).

Historic Preservation Division Comments:

Specific sites for capital improvements associated with this plan have not been identified. When specific sites are identified and capital improvements are proposed we expect to review these proposals as a normal procedure under H.R.S Chapter 6E-8.

Commission on Water Resource Management Comments:

It is likely that the wastewater alternatives to be considered for this project would entail improvements that would impact streams and other waterways within the project region. For this reason, we would suggest that Table 1: Approving Agencies and Permits Needed of the EISPN be revised to include the state Commission on Water Resource Management and its stream channel alteration permit.

Thank you for your cooperation in this matter. Please feel free to contact Sam Lemmo at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

[signature]

JOHN P. KEPPELER, II
Acting Chairperson

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture
680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 531
Hawaii • Singapore • Australia • Hong Kong • Thailand •

March 4, 1993
141.1101/93P-124

Mr. John P. Keppeler, II
Acting Chairperson
Department of Land and Natural Resources
State of Hawaii
P.O.Box 621
Honolulu, Hawaii 96809

Dear Mr. Keppeler:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street dated February 10, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the DEIS when it has been completed. With regard to your specific comments, we respond as follows:

"It is unclear how the EIS process can be useful before specific information is available on what improvements the project would include..."

Please be assured that the DEIS will contain the level of detail necessary to fully evaluate site specific impacts. In order to meet a court imposed deadline for completion of the EIS by the end of 1993, we were obligated to issue the EIS Preparation Notice (EISPN) prior to the selection of a preferred alternative. However, the DEIS will focus upon the preferred alternatives which will include recommendations for collection system, treatment system, and disposal system alternatives. Each recommendation will be site specific, thereby allowing its potential impacts to be fully disclosed and evaluated.

"Characterization of East Mamala Bay's aquatic fauna as "limited" and "depleted" (p.8) could be potentially misleading in the EIS..."

As presented in the EISPN, the reference to limited and depleted is relative to "coastal areas in more rural portions of Oahu" (section 5.3.3.). Such a statement is not made to minimize the significance of the existing fauna, but rather, to simply describe it in general terms. We will fully discuss the fishery and other existing resources, current and projected use levels, and potential impacts in the DEIS.

"The EIS discussion of water quality (p.9) should include specific information on the impact of leaking sewer lines."

We will disclose in the DEIS all relevant information available concerning the impact of leaking sewer lines. This information will then become the basis for our assessment of impacts.

"The EIS discussion of "Recreation Areas" under "Sensitive Areas" (page 10) should include the State's Moanalua Bay Artificial Reef, Waikiki Marine Life Conservation District, and Waikiki-Diamond Head Shoreline Fisheries Management Area, all adjacent to the project area..."

We agree that these areas should be included and will do so in the DEIS. We also agree that an analysis of potential impacts upon the Anuenue Fisheries Research Center resulting from an expansion of the Sand Island Wastewater Treatment Plant should be included in the DEIS.

"...the EIS also should discuss short-term impacts of the necessarily extensive construction activities required...and commit to measures for averting or controlling adverse impacts from other coastal construction (e.g. expanding the treatment plant, work on the outfall, etc.)."

Chapter 343, Hawaii Revised Statutes, requires an EISPN to include a summary of major impacts. Page 12 of the EISPN presents both short- and long-term impacts. Chapter 343 also requires that a DEIS present a full evaluation of short- and long-term impacts. We intend to fully comply with Chapter 343.

"Specific sites for capital improvements associated with this plan have not been identified..."

As discussed above, the DEIS will be based upon the identification of preferred alternatives which will contain site specific actions. As presented on page 2 in Table 1 of the EISPN, an Historic Sites Review is required by the DLNR Historic Sites Division. Section 10 of the EISPN includes a commitment to consultation with all agencies identified in Table 1.

"...we would suggest that Table 1...be revised to include the state Commission on Water Resources Management and its stream channel alteration permit."

Subsequent to the selection of preferred alternatives, if we determine that a stream channel alteration permit is necessary, we will include the state Commission on Water Resources Management (CWRM) in our list of agencies to be consulted. At the time of the writing of the EISPN, however, no alteration of streams within the study area was anticipated. Hence, the CWRM was not identified.

We look forward to your agency's participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

RD OF WATER SUPPLY
ND COUNTY OF HONOLULU
UTH BERETANIA STREET
ULU, HAWAII 96843

February 1, 1993

Mr. John Goody
Belt, Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Mr. Goody:

Subject: Your Letter of January 8, 1993 Regarding the Environmental Impact Statement Preparation Notice (EISPN) for the Proposed East Mamala Bay Facilities Plan

Thank you for the opportunity to comment on the EISPN for the East Mamala Bay Facilities Plan. We have the following comments:

1. We have no objections to the proposed alternatives.
2. We understand that effluent reuse will be investigated further as an effluent disposal option in the EIS.
3. The availability of additional water will be determined when the building permit application is submitted for our review and approval. If additional water is made available, the applicant will be required to pay the prevailing water system facilities and any applicable meter installation charges.
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. Board of Water Supply approved reduced pressure principle backflow prevention assemblies should be installed on all domestic water immediately after the property valves and prior to any branch piping.

If you have any questions, please contact Bert Kuioka at 527-5235.

Very truly yours,

FOR KAZU HAYASHIDA
Manager and Chief Engineer

... man's greatest need – use it wisely

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BELT COLLINS & ASSOCIATES
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Phone: (808) 521-5361, Fax: (808) 538-
Hawaii • Singapore • Australia • Hong Kong • Thailand • S

March 4, 1993
141.1101/93P-127

Mr. Kazu Hayashida
Manager and Chief Engineer
Board of Water Supply
City and County of Honolulu
630 South Beretania Street
Honolulu, Hawaii 96813-5406

Dear Mr. Hayashida:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of February 1, 1993. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
DIVISION OF LAND SURVEY AND ACQUISITION
650 SOUTH KING STREET, 12TH FLOOR
HONOLULU, HAWAII 96813

IN REPLY REFER TO:
LA 93-61B4

February 2, 1993

MEMORANDUM

TO: GEORGE M. UYEMA, CHIEF
DIVISION OF WASTEWATER MANAGEMENT

FROM: FREDDIE C. S. CHAN, CHIEF
DIVISION OF LAND SURVEY AND ACQUISITION

SUBJECT: EAST MAMALA BAY ENVIRONMENTAL
IMPACT STATEMENT PREPARATION NOTICE

We were sent a copy of the subject preparation notice by your consultant, Belt, Collins & Associates. We hereby request to be a consulted party during the EIS process. Please note that any real property acquisition required as part of proposed improvements should be identified and the impact of such acquisition should be addressed in the environmental review process.

Please contact Robert Lum at extension 5068 if you have any questions.

FREDDIE C. S. CHAN
Chief

RL:ja

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Phone: (808) 521-5361, Fax: (808) 531
Hawaii • Singapore • Australia • Hong Kong • Thailand •

March 4, 1993
141.1101/93P-129

Mr. Freddie C.S. Chan, Chief
Division of Land Survey and Acquisition
Department of Public Works
City and County of Honolulu
650 South King Street, 12th Floor
Honolulu, Hawaii 96813

Dear Mr. Chan:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to George Uyema (LA 93-61B4) dated February 2, 1993 regarding the above project. Your division will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
DIVISION OF REFUSE COLLECTION AND DISPOSAL
650 SOUTH KING STREET, 14TH FLOOR
HONOLULU, HAWAII 96813

C. MICHAEL STREET
DIRECTOR AND CHIEF ENGINEER

FRANK J. DOYLE
CHIEF

IN REPLY REFER TO.
RE 93-020

February 2, 1993

EMORANDUM

O: MR. GEORGE UYEMA, CHIEF
DIVISION OF WASTEWATER MANAGEMENT

ROM: ROBERT YOUNG, ACTING CHIEF
DIVISION OF REFUSE COLLECTION AND DISPOSAL

UBJECT: EAST MAMALA BAY ENVIRONMENTAL IMPACT
STATEMENT PREPARATION NOTICE

/e have reviewed the Environmental Impact Statement Preparation Notice (EISPN))r the East Mamala Bay Facilities Plan transmitted to us by Belt Collins & ssociates on January 21, 1993, and have the following comments:

- Sewage sludge from the Sand Island Wastewater Treatment Plant is disposed of at the Kapaa Sanitary Landfill in Kailua. This landfill, as well as Waimanalo Gulch Sanitary Landfill in Leeward Oahu, is estimated to be at capacity before the Facilities Plan target year, 2015. We are uncertain of the capacity of landfill sites after year 2000. However, information on potential landfill sites can be found in the studies "Inventory of Potential Sanitary and Demolition Landfill Sites on the Island of Oahu" by Stanley S. Shimabukuro and Associates, Inc., August 1977, and "Revised Environmental Impact Statement for Leeward District Sanitary Landfill at Waimanalo Gulch, Final Addendum," by Shimabukuro, Endo & Yoshizaki, Inc., August 1985. These two studies are available in our office.

- Regarding the options for disposal of sewage sludge, the State of Hawaii has a goal of 50% waste diversion from landfills for the year 2000. Sewage sludge currently represents about 2% of the annual tonnage at the City's landfill. This same quantity would be 10% of projected landfill tonnage in the year 2000, with the implementation of waste diversion. New landfills are difficult to get approved and are reviewed against available alternatives. For these reasons we endorse consideration of the options listed in the EISPN (incineration, compost, alkaline additives, thermal dry, and power generation) as alternatives to landfill disposal of sewage sludge.

ROBERT YOUNG
Acting Chief

CA
COLLINS
SOCIATES
ring • Planning
ipe Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96813-5406
Phone: (808) 521-5361, Fax: (808) 538-7819
Hawaii • Singapore • Australia • Hong Kong • Thailand • Saipan

March 4, 1993
141.1101/93P-130

Mr. Robert Young, Acting Chief
Division of Refuse Collection and Disposal
Department of Public Works
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

Dear Mr. Young:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to George Uyema (RE 93-020) dated February 2, 1993 regarding the above project. Your division will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

With regard to your comments, the impact of the study area's wastewater treatment and disposal system upon Oahu's landfills is an important consideration and will be addressed in the Draft EIS. Alternatives for sludge disposal will be carefully evaluated for their impact upon the City's limited landfill capacity.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

HOUSE OF REPRESENTATIVES
STATE OF HAWAII
STATE CAPITOL
HONOLULU, HAWAII 96813

January 21, 1993

Mr. John Goody
Belt Collins & Associates
680 Ala Moana Boulevard
Honolulu, HI 96813

Dear Mr. Goody,

Thank you for sending the East Mamala Bay Environmental Statement Preparation Notice dated January 8, 1993. As you offered in the accompanying letter, I would welcome the opportunity to be a consulted party during the EIS process.

After reviewing the data, I have deep concerns for these developments: 1) further findings regarding the degree to which sewage collection systems releases contribute to non-point source contamination in the Ala Wai Canal; 2) further information regarding the prime agricultural land on Waahila ridge; and 3) the placing of the existing incinerator back into operation under Alternative 2 Solids Disposal Option.

If you have more information please do not hesitate to call my office at 586-6440. I look forward to hearing from you in the near future.

Sincerely,

Brian Taniguchi
State Representative

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture
680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii
Phone: (808) 521-5361, Fax: (808
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February 26, 1993
141.1101/93P-136

Honorable Brian Taniguchi
State Representative
State of Hawaii
State Capitol
Honolulu, Hawaii 96813

Dear Representative Taniguchi:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of January 21, 1993. In response to your request, we will provide you with a copy of the Draft EIS when it has been completed. You will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project.

With regard to your comment concerning further information about the prime agricultural land on Waahila Ridge, please note that page 11 of the Environmental Impact Statement Preparation Notice states that the Agricultural Lands of Importance to the State of Hawaii (ALISH) designation at Waahila ridge is other important, not prime agricultural land. We are enclosing for your information a copy of that portion of frame O-13 of the Department of Agricultural's ALISH map for Oahu which depicts the Manoa area, as well as a copy of the map's legend. Please note that the symbol for prime agricultural land is a striped pattern whereas the symbol for other important agricultural land is a pattern of small dots. The ALISH map is the source of our information about agricultural designations in the study area.

With regard to your concern about collection system releases which may contribute to non-point source contamination in the Ala Wai Canal, please understand that we are unable to determine the potential source of Ala Wai Canal contamination due to the limited scope of the study. To the best of our knowledge, there is no direct data available which would demonstrate that sewage from the collection system is making its way into the canal. However, several sources of information are or will be available to help identify, by inference, areas in which the wastewater collection system may be a possible contributor to Ala Wai Canal pollution.

As required by the U.S. Environmental Protection Agency, the City and County of Honolulu currently maintains records of spills and bypasses for calender years 1989-1991. A review of these records would indicate whether any spills or bypasses occurred mauka of the canal. However, these records would not indicate whether the bypass or spill resulted in direct contamination of the canal.

As part of our study, we will identify the locations of aged terra-cotta sewer lines and/or sewer lines that are currently surcharged, that is to say, sewer lines with inadequate capacity to meet peak flow. Again, however, there is no information available concerning the how much, if any, sewage may be leaking from these lines, and how leakages make their way into the canal.

Finally, with regard to the matter of placing the existing incinerator back into operation, the DEIS will evaluate this alternative and present a recommendation as to its cost and feasibility.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

Lee William Sichter

Enclosures

cc: Richard Leong, DPW

PN9

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

DIVISION OF ENGINEERING
650 SOUTH KING STREET • HONOLULU, HAWAII 96813

C. MICHAEL STREET
[redacted]
DIRECTOR AND CHIEF ENGINEER

MARVIN T. FUKAGAWA
CHIEF

IN REPLY REFER TO:

93-14-0092

February 17, 1993

Mr. John Goody
Belt Collins & Associates
680 Ala Moana Boulevard, Suite 200
Honolulu, Hawaii 96813

Dear Mr. Goody:

Subject: Your Letter of January 21, 1993, Relating to the East Mamala Bay Environmental Impact Statement Preparation Notice (EISPN), Zone 1, 2 and Por. 3

We have reviewed the EISPN for East Mamala Bay and request that any construction and/or restoration work within the City right-of-way conform to City standards.

Should there be any questions, please call Faith Kunimoto at 527-6304.

Very truly yours,

MARVIN T. FUKAGAWA
Chief

February 26, 1993
141.1101/93P-138

Mr. Marvin T. Fukagawa, Chief
Division of Engineering
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Fukagawa:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of February 17, 1993. Your division will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

All construction and/or restoration work within the City right-of-way resulting from the above project will be required to conform to City standards.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

Lee William Sichter

cc: Richard Leong, DPW

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
JOYCE T. OMINE
AL PANG
JEANNE K. SCHULTZ
CALVIN M. TSUDA

IN REPLY REFER TO:

February 10, 1993 HAR-EP 9474.93

Mr. C. Michael Street
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Street:

Subject: East Mamala Bay Environmental Impact Statement Preparation Notice

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice (EISPN) for the East Mamala Bay Facilities plan.

Although we have no review comments concerning the draft EISPN, we recognize the importance of this project and the potential impacts it may have to harbor, highway, and airport facilities. Please continue to provide us with periodic project updates.

Sincerely,

Rex D. Johnson
Director of Transportation

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture
680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 5
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March 4, 1993
141.1101/93P-125

Mr. Rex D. Johnson
Director of Transportation
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu, Hawaii 96813-5097

Dear Mr. Johnson:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street (HAR-EP 9474.93) dated February 10, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

PN 6

DONALD A. CLEGG
DIRECTOR

LORETTA K.C. CHEE
DEPUTY DIRECTOR

93-00186

February 8, 1993

MEMORANDUM

TO: C. MICHAEL STREET, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: DONALD A. CLEGG, DIRECTOR

SUBJECT: EAST MALAMA BAY
ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE (EISPN)

Thank you for sending us a copy of the (EISPN) for the East Malama Bay tributary sewer improvements.

The EISPN describes the project in very general terms. We have no comments to offer at this time but wish to be a consulted party during the EIS process.

Donald Clegg
DONALD A. CLEGG
Director of Land Utilization

DAC:smc
a.MALAMA.AS3

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 53
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March 4, 1993
141.1101/93P-126

Mr. Donald A. Clegg
Director of Land Utilization
Department of Land Utilization
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Clegg:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street (93-00186) dated February 8, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF PUBLIC WORKS
CITY AND COUNTY OF HONOLULU
DIVISION OF AUTOMOTIVE EQUIPMENT SERVICE
160 AHUI STREET
HONOLULU, HAWAII 96813

C. MICHAEL STREET
DIRECTOR AND CHIEF ENGINEER

CHRIS MIURA
CHIEF

February 3, 1993

In reply refer to:
A 93-020

Belt Collins & Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Attention: Mr. John Goody

Dear Mr. Goody:

RE: EAST MAMALA BAY ENVIRONMENTAL IMPACT STATEMENT PREPARATION NOTICE

We do not wish to be consulted during the EIS process and we have no comments to offer at this time.

Sincerely,

CHRIS MIURA
Chief

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 53
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March 4, 1993
141.1101/93P-128

Mr. Chris Miura, Chief
Division of Automotive Equipment Service
Department of Public Works
City and County of Honolulu
160 Ahui Street
Honolulu, Hawaii 96813

Dear Mr. Miura:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of February 1, 1993 (A 93-020). Should you desire any additional information concerning the above project, please do not hesitate to contact me at 521-5361

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF THE ARMY
HEADQUARTERS, UNITED STATES ARMY, PACIFIC
FORT SHAFTER, HAWAII 96858-5100

REPLY TO ATTENTION OF:

January 19, 1993

Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Sirs:

Reference is made to your letter dated January 8, 1993, on the East Mamala Bay Environmental Impact Statement Preparation Notice. We have no comment at this time but would like to be a consulted party during the EIS process. Our address is as follows:

U.S. Army, Pacific
ATTN: APEN-EV
Fort Shafter, HI 96858-5100

U.S. Army, Pacific, point of contact is Mr. George Takamiya, 438-0780.

Sincerely,

Stanley Kon
Acting Chief, Environmental Division

CF: U.S. Army Support Command, Hawaii, ATTN: APVG-GW, Schofield Barracks, HI 96857-6000

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 53
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March 4, 1993
141.1101/93P-131

Mr. Stanley Kon, Acting Chief
Environmental Division
U.S Army, Pacific
ATTN: APEN-EV
Fort Shafter, Hawaii 96858-5100

Dear Mr. Kon:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street dated January 19, 1993 regarding the above project. We will provide you with a copy of the Draft EIS when it has been completed. You will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

HAWAII COMMUNITY DEVELOPMENT AUTHORITY
KAKAAKO
John D. Waihee
Gary Caulfield
Michael N. Scarfone

Ref. Nos.: ENGR GEN 2.1.1.2/
GF COUN 5.13

January 14, 1993

The Honorable C. Michael Street
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Street:

Re: East Mamala Bay
Environmental Impact Statement
Preparation Notice

Thank you for your correspondence of January 8, 1993, transmitting the subject preparation notice for our review and comments.

Upon review of the subject document, we have no comments to make at this time. We appreciate your allowing us the opportunity to review and comment on the subject preparation notice and would like to continue to be informed of this project. Should you have any questions, please have your staff contact either Messrs. Cleighton Goo or Neal Imada at 587-2870.

Very truly yours,

Michael N. Scarfone
Executive Director

MNS/CG/NI:tn

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture
680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 5
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March 4, 1993
141.1101/93P-132

Mr. Michael N. Scarfone
Executive Director
Hawaii Community Development Authority
677 Ala Moana Blvd., Suite 1001
Honolulu, Hawaii 96813

Dear Mr. Scarfone:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street dated January 14, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
93:PPE/348

January 26, 1993

Mr. C. Michael Street
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Street:

Re: Environmental Impact Statement Preparation Notice for the East Mamala Bay Facilities Plan and Environmental Impact Statement

Thank you for the opportunity to review the subject EISPN.

We have no comments to offer at this time. However, we would appreciate being a consulted party during the EIS process.

Sincerely,

JOSEPH K. CONANT
Executive Director

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 531
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March 4, 1993
141.1101/93P-133

Mr. Joseph K. Conant
Executive Director
Housing Finance and Development Corporation
Department of Budget and Finance
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

Dear Mr. Conant:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street (93: PPE/348) dated January 26, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

MUFI HANNEMANN Director
BARBARA KIM STANTON Deputy Director
RICK EGGED Deputy Director
TAKESHI YOSHIHARA Deputy Director

January 15, 1993

Mr. C. Michael Street
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Street:

Thank you for the opportunity to review and comment on the East Mamala Bay Environmental Impact Statement Preparation Notice (EISPN). We have no comments at this time but wish to be a consulted party during the Environmental Impact Statement (EIS) process.

Sincerely,

Mufi Hannemann

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96[illegible]
Phone: (808) 521-5361, Fax: (808) 5[illegible]
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March 4, 1993
141.1101/93P-134

Mr. Mufi Hannemann, Director
Department of Business, Economic Development & Tourism
State of Hawaii
P.O.Box 2359
Honolulu, Hawaii 96804

Dear Mr. Hannemann:

East Mamala Bay Facilities Plan
<u>Environmental Impact Statement</u>

We are responding to your letter to C. Michael Street dated January 15, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

WESTERN PACIFIC REGIONAL FISHERY MANAGEMENT COUNCIL

RECEIVED
'93 JAN 22 P 12:01
BELT COLLINS & ASSOCIATES

21 January 1993

John Goody
Belt Collins & Associates
First Floor
680 Ala Moana Bl.
Honolulu, HI 96813

Dear Mr. Goody:

Thank you for sending us the preparation notice for the East Mamala Bay EIS. The Council has no comments to offer at this time, but wishes to review the Draft EIS when it becomes available.

Mahalo!

Sincerely,

Kitty M. Simonds
Executive Director

KMS:bh

A Council Authorized by the Magnuson Fishery Conservation and Management Act of 1976
BISHOP STREET • SUITE 1405 • HONOLULU • HAWAII 96813 USA • TELEPHONE (808) 541-1974 • FAX (808) 526-0824

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture
680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9
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March 4, 1993
141.1101/93P-135

Ms. Kitty M. Simonds
Executive Director
Western Pacific Regional Fishery Management Council
1164 Bishop Street, Suite 1405
Honolulu, Hawaii 96813

Dear Ms. Simonds:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of January 21, 1993. Your organization will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. In response to your request, we will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your organization's participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF THE ARMY
U.S. ARMY ENGINEER DISTRICT, HONOLULU
FORT SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF

January 22, 1993

Planning Division

Mr. John Goody
Belt, Collins and Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Mr. Goody:

Thank you for the opportunity to review and comment on the Environmental Impact Statement Preparation Notice for the East Mamala Bay Facilities Plan, Oahu, Hawaii. We have no comments to offer at this time but look forward to reviewing the Draft Environmental Impact Statement upon its completion.

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 53
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March 4, 1993
141.1101/93P-137

Mr. Kisuk Cheung, P.E.
Director of Engineering
Department of the Army
U.S. Army Engineer District, Honolulu
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of January 22, 1993. In response to your request, we will provide you with a copy of the Draft EIS when it has been completed. You will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

WALTER M. OZAWA
DIRECTOR

ALVIN K C. AU
DEPUTY DIRECTOR

February 5, 1993

TO: C. MICHAEL STREET, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

FROM: WALTER M. OZAWA, DIRECTOR

SUBJECT: EAST MAMALA BAY
ENVIRONMENTAL IMPACT STATEMENT (EISPN)

We have received a copy of your EISPN for the East Mamala Bay Facilities Plan. Although we have no comments to offer at this time, we would like to continue as a consulted party during the EIS process.

If you have any questions, please call John Morihara of our Advance Planning Branch at extension 4246.

WALTER M. OZAWA, Director

WMO:ei

BCA
BELT COLLINS
& ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 53
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March 4, 1993
141.1101/93P-139

Mr. Walter M. Ozawa, Director
Department of Parks and Recreation
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Ozawa:

East Mamala Bay Facilities Plan
Environmental Impact Statement

We are responding to your letter to C. Michael Street dated February 5, 1993 regarding the above project. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

JOSEPH M. MAGALDI, JR
DIRECTOR

AMAR SAPPAL
DEPUTY DIRECTOR

ORT-2983

February 18, 1993

Mr. John Goody
Belt Collins & Associates
First Floor
680 Ala Moana Boulevard
Honolulu, Hawaii 96813

Dear Mr. Goody:

Subject: East Mamala Bay, Environmental Impact Statement Preparation Notice

In response to your January 8, 1993 letter requesting our review of the Environmental Impact Statement Preparation Notice for the wastewater system improvement proposals, we have no comment to offer at this time.

Sincerely,

JOSEPH M. MAGALDI, JR.
Director

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 9681
Phone: (808) 521-5361, Fax: (808) 5
Hawaii • Singapore • Australia • Hong Kong • Thailand •

March 4, 1993
141.1101/93P-140

Mr. Joseph M. Magaldi, Jr., Director
Department of Transportation Services
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Magaldi:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of February 18, 1993. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5TH FLOOR
HONOLULU, HAWAII 96813
PHONE: (808) 523-4427 • FAX: (808) 527-5498

PN 19

F. FASI
MAYOR

E. JAMES TURSE
DIRECTOR

GAIL M. KAITO
DEPUTY DIRECTOR

February 24, 1993

Mr. John Goody
Belt Collins and Associates
680 Ala Moana Boulevard, 1st Floor
Honolulu, Hawaii 96813

Dear Mr. Goody:

Subject: East Mamala Bay
EIS Preparation Notice

Thank you for informing us of the proposed project. We do not have any substantive comments to offer at this time but would appreciate receiving a copy of the Draft EIS when it is available.

Sincerely,

E. JAMES TURSE
Director

BCA
BELT COLLINS & ASSOCIATES
Engineering • Planning
Landscape Architecture

680 Ala Moana Boulevard, First Floor, Honolulu, Hawaii 96
Phone: (808) 521-5361, Fax: (808)
Hawaii • Singapore • Australia • Hong Kong • Thailand

March 4, 1993
141.1101/93P-165

Mr. E. James Turse, Director
Department of Housing and Community Development
City and County of Honolulu
650 South King Street, 5th Floor
Honolulu, Hawaii 96813

Dear Mr. Turse:

East Mamala Bay Facilities Plan
Environmental Impact Statement

Thank you for your letter of February 24, 1993. Your agency will continue to be consulted throughout the process of preparing the Environmental Impact Statement (EIS) for the above project. We will provide you with a copy of the Draft EIS when it has been completed.

We look forward to your participation as a consulted party for this project. Your comments on the Draft EIS will be valued. Again, thank you for your interest.

Very truly yours,

John Goody

cc: Richard Leong, DPW

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

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

In reply, please refer to:

March 2, 1993

93-007/epo

Mr. John Goody
Belt Collins & Associates
680 Ala Moana Blvd., Suite 100
Honolulu, Hawaii 96813

Dear Goody:

Subject: East Mamala Bay
Environmental Impact Statement
Preparation Notice

Thank you for allowing us to review and comment on the subject document. We do not have any comments to offer at this time. We will comment on the Draft Environmental Impact Statement.

If you should have any questions, you may contact Mr. Arthur Bauckham, Environmental Health Specialist of the Environmental Planning Office at 586-4337.

Very truly yours,

JOHN C. LEWIN, M.D.
Director of Health

SUMMARY OF DEIS COMMENT LETTERS REQUIRING SUBSTANTIVE CHANGE TO EIS

RESPONDENT	COMMENT SUMMARY	FEIS CHANGE LOCATION
Federal Agencies		
U.S. Geological Survey (Mr. W. Meyer)	No substantive comments requiring change to EIS	No change
U.S. Army Corps of Engineers (Mr. K. Cheung)	Address need for Dept. of Army permits (Rivers and Harbors Act; Sect. 404)	Sect. 2.9.5 added
U.S. Navy (Mr. M. D. Claussen)	No substantive comments requiring change to EIS	No change
Dept. of Agriculture, Soil Conservation Service (Mr. N. Conner)	No substantive comments requiring change to EIS	No change
State Agencies		
Dept. of Accounting and General Services (Mr. G. Matsuoka)	No substantive comments requiring change to EIS	No change
Dept. of Business, Economic Development and Tourism (Mr. M. Kaya)	No substantive comments requiring change to EIS	No change
Dept. of Business, Economic Development and Tourism (Mr. M. Hannemann)	Requested EIS address planned localized density changes	Sect. 5.3, Table 5-1
Dept. of Education (Mr. C. Toguchi)	No substantive comments requiring change to EIS	No change
Dept. of Health (Dr. B. Anderson)	No substantive comments requiring change to EIS	No change
Dept. of Health (Dr. J. Lewin)	No substantive comments requiring change to EIS	No change
Dept. of Land and Natural Resources (Mr. K. Ahue)	Requested EIS address potential need for Stream Alteration permit(s)	Sect. 2.9.4 added
	Expressed concerns regarding water quality at ZOM	Sect. 4.9 added
Dept. of Land & Natural Resources Historic Preservation (Mr. D. Hibbard)	Requested editorial corrections to archaeological subconsultant report	Appendix G
Dept. of Transportation (Mr. R. Johnson)	Address development of proposed localized development projects	Sect. 5.3, Table 5-1
	Noted misspelling of Waiakamilo Road	Table 7-2
	Requested locations of proposed new WWPS	Chapter 7, Appendix A
	Discuss potential impacts of cross-harbor SFM	Sect. 8.9.9 added
Hawaii Community Development Authority (Mr. M. Scarfone)	Requested information regarding additional land required for WWPS upgrades	Sect. 8.9.8 added
Office of Environmental Quality Control (Mr. B. Choy)	Requested discussion of unresolved issues in Executive Summary	Chapter 1
	Requested list of permits and approvals needed in Executive Summary	Chapter 1
Office of State Planning (Mr. H. Masumoto)	Requested further discussion of water quality standards, monitoring, and compliance	Sect. 4.9 added
Environmental Center, U.H. (Ms. J. Miller)	Noted discrepancy between OEQC Bulletin and EIS regarding number of system elements	Preface
	Requested definition of acronym (SM = SFM)	pg. xxvi
	Noted that ammonia, not nitrate, is nutrient of concern in discharge	pg. 1-4 (DEIS)
	Noted typographical error - 30 feet (= 30 meters)	pg. 2-18 (DEIS)
	Noted typographical error - extra word (secondary)	pg. 2-22 (DEIS)
	Questioned age of Honolulu Volcanic Series	Sect. 3.3.1

Environmental Center, U.H. (continued)	Noted missing end of sentence regarding basalt groundwater aquifer	Sect. 3.3.2
	Noted inaccuracies in discussion of caprock aquifer	Sect. 3.3.4, Figure 3-9
	Requested addition of analysis of ZOM for primary treatment	Sect. 4.9 added
	Questioned possibility of discharge to ocean via underground injection	Sect. 6.3.5
City and County of Honolulu Agencies		
Board of Water Supply (Mr. K. Hayashida)	No substantive comments requiring change to EIS	No change
City Council (Mr. S. Holmes)	Reqested clarification of DAF discussion	Sect. 6.3.2 (DEIS)
	Noted typographical error - I/I estimates	pg. 7-2 (DEIS)
	Indicated confusion regarding use of different flow models	Sect. 7.2.2
Dept. of Budget and Finance (Mr. J. Conant)	No substantive comments requiring change to EIS	No change
Dept. of Housing & Community Development (Mr. J. Turse)	No substantive comments requiring change to EIS	No change
Dept. of Land Utilization (Ms. L. Chee)	*Requested discussion of project construction time frames*	*Chapter 7, Table A-1*
	Requested addition of flood hazard regulations	Sect. 2.10.8 added, Section 7.2.2
Dept. of Parks and Recreation (Mr. W. Ozawa)	No substantive comments requiring change to EIS	No change
Dept. of Public Works, Div. of Refuse and Collection (Mr. F. Doyle)	No substantive comments requiring change to EIS	No change
Dept. of Transportation Services (Mr. J. Magaldi)	No substantive comments requiring change to EIS	No change
Planning Department (Mr. R. Foster)	Requested discussion of changes needed to DP Public Facilities and Land Use maps	Sect. 2.10.2 added
	Requested discussion of use of park lands and relation of projects to Waikiki Master Plan	Sects. 2.10.3 and 8.9.8 added
	Noted misspelling of Waiakamilo Road	Table 7-2
	Requested tables of TAZs	Appendix I added
Police Dept. (Mr. M. Nakamura)	No substantive comments requiring change to EIS	No change
Organizations and Individuals		
Hawaii's Thousand Friends (Mr. Fred Madlener)	Questioned impact on water quality at ZOM and in recreational waters	Sect. 4.9 added, Section 8.3.7
	Indicated confusion regarding discussion of relationship(s) between DP model, MK series projections, PD allocation model, 1990 census	Chapter 5
	Had several comments regarding water quality and SIWWTP plume	Sect. 4.9 added
	Potential for impacts from floods/tsunamis was not addressed satisfactorily	Sects. 7.2.2, 8.4.1
Mr. W. Craddick	Requested discussion of project priorities and criteria for ranking	Chapter 7, Table A-1
Mr. D. Meller	No substantive comments requiring change to EIS	No change

Please note: some comment letter included substantive comments that were addressed in the response letter.
Comments that did not result in changes in the EIS are not included in this table.

DEPARTMENT OF BUSINESS,
ECONOMIC DEVELOPMENT & TOURISM

JOHN WAIHEE, Governor
MUFI HANNEMANN, Director
JEANNE SCHULTZ, Deputy Director
RICK EGGED, Deputy Director
TAKESHI YOSHIHARA, Deputy Director

ENERGY DIVISION, 335 MERCHANT ST., RM. 110, HONOLULU, HAWAII 96813 PHONE: (808) 587-3800 FAX: (808) 587-3820

August 26, 1993

City and County of Honolulu
Planning Department
650 South King Street, 8th Floor
Honolulu, Hawaii 96813

Dear Sir:

Subject: East Mamala Bay Wastewater Facilities Plan
Draft Environmental Impact Statement
Island of Oahu, District of Honolulu
Tax Map Key Numbers: Zones 1 & 2 inclusive,
Zone 3 Sections 1 through 7.

We wish to inform you that we have no comments to offer on the subject Draft Environmental Impact Statement (DEIS). We are returning the DEIS.

Thank you for the opportunity to review the document.

Sincerely,

Maurice H. Kaya
Energy Program Administrator

MHK:hkeis93

cc: Department of Wastewater Management, City & County of Honolulu
Office of Environmental Quality Control
Belt Collins Hawaii

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI, MAYOR

KENNETH M. RAPPOLT, DIRECTOR
FELIX B. LIMTIACO, DEPUTY DIRECTOR

WPP 93-596

November 26, 1993

Mr. Maurice H. Kaya
Energy Program Administrator
Department of Business, Economic
Development and Tourism
State of Hawaii
335 Merchant Street, Room 110
Honolulu, Hawaii 96813

Dear Mr. Kaya:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your letter of August 26, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

JOHN WAIHEE
GOVERNOR OF HAWAII

STATE OF HAWAII
DEPARTMENT OF LAND AND NATURAL RESOURCES
STATE HISTORIC PRESERVATION DIVISION
33 SOUTH KING STREET, 6TH FLOOR
HONOLULU, HAWAII 96813

KEITH AHUE, CHAIRPERSON
BOARD OF LAND AND NATURAL RESOURCES
DEPUTIES
JOHN P. KEPPELER II
DONA L. HANAIKE

AQUACULTURE DEVELOPMENT PROGRAM
AQUATIC RESOURCES
CONSERVATION AND ENVIRONMENTAL AFFAIRS
CONSERVATION AND RESOURCES ENFORCEMENT
CONVEYANCES
FORESTRY AND WILDLIFE
HISTORIC PRESERVATION DIVISION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

September 13, 1993

LOG NO: 9260
DOC NO: 9309td13

John Goody
Vice President
Belt Collins & Associates
680 Ala Moana Boulevard
Honolulu, Hawaii 96813-5406

Dear Mr. Goody:

SUBJECT: Draft Environmental Impact Statement (DEIS) for the East Mamala Bay Wastewater Facilities Plan (File No. 94-109)
Kona, O'ahu
TMK: 1- various, 2- various, 3- various

Thank you for the opportunity to review this DEIS, which is a twenty-year plan for sewers and other wastewater facilities in the area extending from Kuliouou in the east to Red Hill in the west. The DEIS very capably summarizes archaeological information from this large area and provides responsible preliminary recommendations for archaeological research that should prove useful to planners. It is very likely, however, that information on prehistory will change substantially over the period covered by this plan and that recommendations for archaeological research to comply with historic preservation laws will change correspondingly. In some instances this might result in recommendations for an increased level of archaeological research; in others a decreased level. In any event, individual projects proposed as part of this twenty-year plan will be reviewed by our office, and this review should ensure that the preliminary recommendations in the DEIS are brought into line with current information.

The Archaeological Assessment included as Appendix G is, in substance, well done. However, the document appears to have been hastily produced, as evidenced by numerous spelling and production errors and a bibliography that is not ordered alphabetically. It would be useful to have a copy of this report in which these errors have been corrected.

If you have any questions please call Tom Dye at 587-0014.

Sincerely,

DON HIBBARD, Administrator
State Historic Preservation Division

TD:jt

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

November 26, 1993

WPP 93-592

Dr. Don Hibbard, Administrator
Historic Preservation Division
Department of Land and Natural Resources
State of Hawaii
33 South King Street, 6th Floor
Honolulu, Hawaii 96813

Dear Dr. Hibbard:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of September 13, 1993, commenting on the Draft Environmental Impact Statement (DEIS) for the East Mamala Bay Wastewater Facilities Plan.

As stated in your letter, both the available information, and thus the required site-specific archaeological research, are likely to change over the course of the 20 year study period. Thus, the probabilities of the presence of resources in specific areas, and suggested mitigation measures presented in Appendix G and in Section 8.6 of the DEIS are preliminary. As discussed in Section 8.6, further evaluation is anticipated and will be undertaken prior to any construction activity at a particular site. All such evaluations will be submitted to the State Historic Preservation Division for formal review and approval to ensure that all projects comply with historic preservation laws and regulations and that no unmitigated significant impacts to historic resources result from the proposed projects.

As requested, Appendix G has been revised to correct spelling and production errors and inconsistencies. In addition, both the text of the DEIS and Appendix G have been revised to reflect inclusion of the Kuliouou WWPS site in the evaluation of historic and archaeological resources.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

United States Department of the Interior

GEOLOGICAL SURVEY
WATER RESOURCES DIVISION
677 Ala Moana Blvd., Suite 415
Honolulu, Hawaii 96813

September 24, 1993

The Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Sir:

Subject: East Mamala Bay Wastewater Facilities Plan, Draft Environmental Impact Statement (DEIS), Honolulu, Hawaii

We are in receipt of the subject DEIS. We regret that due to prior commitments, we are unable to review the subject DEIS by the October 7th deadline.

As requested, we are returning the DEIS to your office for your future use.

Sincerely,

William Meyer
District Chief

Enclosures

cc: Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Mr. John Goody
Belt Collins Hawaii
680 Ala Moana Blvd., Suite 100
Honolulu, Hawaii 96813

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. L.
DEPUTY DIRECTOR

WPP 93-599

November 26, 1993

Mr. William Meyer, District Chief
Water Resources Division
Geological Survey
U.S. Department of the Interior
677 Ala Moana Boulevard, Suite 415
Honolulu, Hawaii 96813

Dear Mr. Meyer:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your letter of September 24, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

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

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:

September 22, 1993

93-007/epo

Mr. Robin Foster
Chief Planning Officer
Planning Department
City & County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan
Oahu, Zones 1 & 2, inclusive, Zone 3 Sections 1-7

Thank you for allowing us to review and comment on the subject document. We have no objections to the proposed improvements required of the subdistrict's municipal wastewater collection and treatment system to meet projected demand for the planning period, 1995 to the year 2015.

If you should have any questions on this matter, please contact Ms. Lori Kajiwara of the Wastewater Branch at 586-4290.

Very truly yours,

JOHN C. LEWIN, M.D
Director of Health

c: Office of Environmental Quality Control
City & County of Wastewater Management
Belt Collins Hawaii

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-598

November 23, 1993

Dr. John C. Lewin
Director of Health
State Department of Health
P. O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Lewin:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of September 22, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

United States Department of Agriculture
Soil Conservation Service
P. O. Box 50004
Honolulu, HI
96850-0001

September 7, 1993

Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street, 5th Floor
Honolulu, Hawaii 96813

Dear Mr. Leong:

Subject: Draft Environmental Impact Statement (DEIS) for the East Mamala Bay Wastewater Facilities Plan Oahu, Hawaii

We have completed our review of the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Project on Oahu and have no major concerns. Thank you for the opportunity to provide comment on such a worthy project.

Sincerely,

NATHANIEL R. CONNER
State Conservationist

cc: Michael Baginting, D.C., Honolulu Field Office, Honolulu, Hawaii
State of Hawaii, Office of Environmental Quality Control

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-597

November 24, 1993

Mr. Nathaniel R. Conner
State Conservationist
Soil Conservation Service
U.S. Department of Agriculture
P. O. Box 50004
Honolulu, Hawaii 96850-0001

Dear Mr. Conner:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of September 7, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

JOHN WAIHEE
GOVERNOR

BRIAN J. J. CHOY
Director

STATE OF HAWAII
OFFICE OF ENVIRONMENTAL QUALITY CONTROL
220 SOUTH KING STREET
FOURTH FLOOR
HONOLULU, HAWAII 96813
TELEPHONE (808) 586-4185

September 27, 1993

Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Leong:

Subject: Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan

Thank you for the opportunity to review and comment on the subject document. We have the following comment.

Pursuant to §11-200-17(b), Environmental Impact Statement Rules, the document's executive summary must concisely discuss the following:

1) Unresolved issues; and

2) Compatibility with land use plans and policies, and listing of permits or approvals.

If you have any questions, please call Jeyan Thirugnanam at 586-4185.

Sincerely,

Brian J. J. Choy
Director

c: Planning Department
Belt Collins

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-595

November 26, 1993

Mr. Brian J.J. Choy, Director
Office of Environmental Quality Control
State of Hawaii
220 South King Street, Fourth Floor
Honolulu, Hawaii 96813

Dear Mr. Choy:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your letter of September 27, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

As you state, the document's executive summary must concisely discuss: (1) unresolved issues; and (2) compatibility with land use plans and policies, and listing of permits or approvals. Specific statements regarding these two topics have been summarized from the body of the report and included in the executive summary of the Final Environmental Impact Statement.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

POLICE DEPARTMENT

CITY AND COUNTY OF HONOLULU

1 SOUTH BERETANIA STREET
HONOLULU, HAWAII 96813 - AREA CODE (808) 529-3111

F. FASI
MAYOR

MICHAEL S. NAKAMURA
CHIEF

HAROLD M. KAWASAKI
DEPUTY CHIEF

REFERENCE BS-LK

September 23, 1993

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: MICHAEL S. NAKAMURA, CHIEF OF POLICE
HONOLULU POLICE DEPARTMENT

SUBJECT: EAST MAMALA BAY WASTEWATER FACILITIES PLAN

This is in response to the request we received for comments on a draft environmental impact statement for the proposed East Mamala Bay Wastewater Facilities Plan.

The project will have no significant impact on the operations of the Honolulu Police Department and we have no comments to make at this time.

Thank you for the opportunity to review this document.

MICHAEL S. NAKAMURA
Chief of Police

By
EUGENE UEMURA
Assistant Chief of Police
Administrative Bureau

cc: Office of Environmental Quality Control
Department of Wastewater Management
Belt Collins Hawaii

DEPARTMENT OF WASTEWATER MANAGEMENT

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RA[PPOLT]
DIRECTOR

FELIX B. LIM[U]
DEPUTY DIRE[CTOR]

WPP 93-5[?]

November 26, 1993

MEMORANDUM

TO: MR. MICHAEL NAKAMURA, CHIEF
HONOLULU POLICE DEPARTMENT

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for your memorandum of September 23, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at Local 5863.

for KENNETH M. RAPPOLT
Director

DEPARTMENT OF THE ARMY
U. S. ARMY ENGINEER DISTRICT, HONOLULU
BUILDING 230
FT. SHAFTER, HAWAII 96858-5440

REPLY TO ATTENTION OF:

September 29, 1993

Planning Division

Mr. John Goody, Vice President
Belt Collins and Associates
680 Ala Moana Boulevard, First Floor
Honolulu, Hawaii 96813-5406

Dear Mr. Goody:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan, Oahu. The following comments are provided pursuant to Corps of Engineers authorities to disseminate flood hazard information under the Flood Control Act of 1960 and to issue Department of the Army (DA) permits under the Clean Water Act; the Rivers and Harbors Act of 1899; and the Marine Protection, Research and Sanctuaries Act.

a. If the activities associated with upgrading and extending the collection system involve stream crossings or other work in the waters of the U.S., a DA permit may be required. Please contact our Operations Division at 438-8554 for further information and refer to file number PO92-152.

b. The flood hazard information provided on page 3-48 is correct.

Sincerely,

Kisuk Cheung, P.E.
Director of Engineering

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPP
DIRECTOR

FELIX B. LIMTIAC
DEPUTY DIRECTOR

WPP 93-590

November 26, 1993

Mr. Kisuk Cheung, P.E.
Director of Engineering
Planning Division
Department of the Army
U.S. Army Engineer District, Honolulu
Building 230
Fort Shafter, Hawaii 96858-5440

Dear Mr. Cheung:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of September 29, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

1. Comment: If the activities associated with upgrading and extending the collection system involve stream crossings or other work in the waters of the United States, a Department of the Army permit may be required.

   Response: Stream and harbor crossings will be required to implement the preferred alternative. Stream crossings will be required for the following components. Department of the Army permits will be applied for subsequent to Preliminary Engineering Review of each project.

Water Body	Project
Kapalama Channel	Hart St. WWPS Redundant SFM
Kapalama Stream	Connections to New Hart WWPS

Water Body	Project
Ala Wai Canal	Sewer to New Beachwalk WWPS
	Connection from New Beachwalk WWPS to existing SFM
Nuuanu Stream	Awa Street redundant SFM

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863

Very truly yours,

for KENNETH M. RAPPOLT
Director

(P)1713.3

OCT 5 1993

Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Gentlemen:

Subject: East Mamala Bay Wastewater Facilities Plan
Oahu, Hawaii
Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

If there are any questions, please have your staff contact Mr. Ralph Yukumoto of the Planning Branch at 586-0488.

Very truly yours,

GORDON MATSUOKA
State Public Works Engineer

RY:jy
cc: City & County of Honolulu, Dept. of Wastewater Mgmt.
Belt Collins Hawaii
OEQC

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-603

November 26, 1993

Mr. Gordon Matsuoka
Division of Public Works
Department of Accounting & General Services
State of Hawaii
P. O. Box 119
Honolulu, Hawaii 96810

Dear Mr. Matsuoka:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your letter of October 5, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET, 5TH FLOOR
HONOLULU, HAWAII 96813
PHONE: (808) 523-4427 • FAX: (808) 527-5498

...NK F. FASI
MAYOR

E. JAMES TURSE
DIRECTOR

GAIL M. KAITO
DEPUTY DIRECTOR

October 1, 1993

MEMORANDUM

TO: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

ATTENTION: RICHARD LEONG

FROM: E. JAMES TURSE, DIRECTOR

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT FOR THE EAST MAMALA BAY WASTEWATER FACILITY PLAN

We have no comments to offer on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facility Plan.

Should you have any questions, please contact Jason Ching of our Planning and Analysis Division at 523-4368.

Thank you for the opportunity to comment.

Sincerely,

E. JAMES TURSE
Director

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

November 26, 1993

WPP 93-602

MEMORANDUM

TO: MR. E. JAMES TURSE, DIRECTOR
DEPARTMENT OF HOUSING AND COMMUNITY DEVELOPMENT

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
<u>EAST MAMALA BAY WASTEWATER FACILITIES PLAN</u>

Thank you for your memorandum of October 1, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at Local 5863.

for KENNETH M. RAPPOLT
Director

STATE OF HAWAII
DEPARTMENT OF BUDGET AND FINANCE
HOUSING FINANCE AND DEVELOPMENT CORPORATION
677 QUEEN STREET, SUITE 300
HONOLULU, HAWAII 96813
FAX (808) 587-0600

JOSEPH K. CONANT
EXECUTIVE DIRECTOR

IN REPLY REFER TO:
93:PPE/4913

October 6, 1993

Mr. Richard Leong
Department of Wastewater Management
City & County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

Dear Mr. Leong:

Re: East Mamala Bay Wastewater Facilities Plan Draft EIS

Thank you for the opportunity to review the subject document. We have no comments to offer.

Sincerely,

JOSEPH K. CONANT
Executive Director

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-601

November 26, 1993

Mr. Joseph K. Conant
Executive Director
Housing Finance and Development Corporation
State of Hawaii
677 Queen Street, Suite 300
Honolulu, Hawaii 96813

Dear Mr. Conant:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 6, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

DEPARTMENT OF PUBLIC WORKS

CITY AND COUNTY OF HONOLULU

DIVISION OF REFUSE COLLECTION AND DISPOSAL
650 SOUTH KING STREET, 14TH FLOOR
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

C. MICHAEL STREET
DIRECTOR AND CHIEF ENGINEER

FRANK J. DOYLE
CHIEF

IN REPLY REFER TO:
RE 93-182

October 7, 1993

MEMORANDUM

To: MR. KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

From: MR. FRANK J. DOYLE, CHIEF
DIVISION OF REFUSE COLLECTION AND DISPOSAL

Subject: EAST MAMALA BAY WASTEWATER FACILITIES
PLAN DRAFT ENVIRONMENTAL IMPACT STATEMENT

We have reviewed the Draft Environmental Impact Statement and have no comments to add to our February 2, 1993, memorandum, which is included in Chapter 10 of the draft EIS.

FRANK J. DOYLE

DEPARTMENT OF WASTEWATER MANAGEMENT

CITY AND COUNTY OF HONOLULU

650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-600

November 26, 1993

MEMORANDUM

TO: MR. C. MICHAEL STREET, DIRECTOR AND CHIEF ENGINEER
DEPARTMENT OF PUBLIC WORKS

ATTENTION: MR. FRANK J. DOYLE, CHIEF
DIVISION OF REFUSE COLLECTION AND DISPOSAL

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for your memorandum of October 1, 1993 on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS). A copy of all comment letters received and our responses thereto will be included in the Final EIS. We appreciate your taking the time to review the DEIS.

If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at Local 5863.

for KENNETH M. RAPPOLT
Director

KAKAKO

Ref. Nos.: ENGR GEN 2.1.2/
GF COUN 5.32

October 7, 1993

Mr. Richard Leong
Planning Section
Planning and Public Service
Division
Department of Wastewater
Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

Dear Mr. Leong:

Re: East Mamala Bay Wastewater Facilities Plan
<u>Draft Environmental Impact Statement (DEIS)</u>

We have reviewed the subject DEIS and have the following comments to offer:

1. The DEIS mentions plans to acquire State land at the existing Ala Moana Wastewater Pump Station site on Keawe Street to build a new generator building. No size requirements are given. The Kakaako Community Development District Makai Area Plan has specific land uses designated for this area. Any proposed use must be done in compliance with the Plan.

2. The proposed Sewage Collection System Improvements (Appendix A) shows an 8-inch sewer line on Auahi Street between Cooke and Coral Streets. As part of our Kakaako Improvement District 2 project, a 10-inch sewer line was installed in this portion of Auahi Street. Would this 8-inch line be in addition to the 10-inch line?

If you have any questions, please call Mr. Larry Leopardi of my staff at 587-2870.

Very truly yours,

FOR Michael N. Scarfone
Executive Director

MNS/LJL/NII:tn

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. R
DIRECTOR

FELIX B. LIMT
DEPUTY DIRE

WPP 93-593

November 26, 1993

Mr. Michael N. Scarfone
Executive Director
Hawaii Community Development Authority
677 Ala Moana Boulevard, Suite 1001
Honolulu, Hawaii 96813

Dear Mr. Scarfone:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your letter of October 7, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

1. Comment: The DEIS mentions plans to acquire State land at the existing Ala Moana WWPS site on Keawe Street to build a new generator building. No size requirements are given. The Kakaako Community Development District Makai Area Plan has specific land uses designated for this area. Any proposed use must be done in compliance with the plan.

   Response: The Makai Area Plan for the Kakaako Community Development District was made without the knowledge of the needs of this pump station. The amount of land required for the structure will be sufficient to accommodate a building 50-feet by 50-feet, and will be sited to lessen the need for additional non-City leased land. The exact amount of land required will be determined during preliminary engineering investigation. Coordination with your staff will be made at that time. The likely affected parcels are TMK's 2-1-15-43 and/or 28.

2. Comment: The proposed Sewage Collection System Improvements (Appendix A) shows an 8-inch sewer line on Auahi Street between Cooke and Coral Streets. As part of our Kakaako Improvement District 2 project, a 10-inch sewer line was installed in this portion of Auahi Street. Would this 8-inch line be in addition to the 10-inch line?

Response: The projects listed for the Kakaako Community Development District in the Preliminary Facility Plan and the DEIS are being deleted in favor of the Hawaii Community Development Authority projects in the Kakaako area.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

DEPARTMENT OF TRANSPORTATION SERVICES
CITY AND COUNTY OF HONOLULU
HONOLULU MUNICIPAL BUILDING
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

JOSEPH M. MAGALDI, JR.
DIRECTOR

AMAR SAPPAL
DEPUTY DIRECTOR

TE-3325
PL93.1.343

September 13, 1993

MEMORANDUM

TO: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: JOSEPH M. MAGALDI, JR., DIRECTOR

SUBJECT: EAST MAMALA BAY WASTEWATER FACILITIES PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)
TMK: ZONES 1 & 2: ZONE 3 SECTIONS 1-7

This is in response to the DEIS submitted to us for review by the Office of Environmental Quality Control.

Based on our review, we have the following comments:

1. Construction plans for all work within the City right-of-way should be submitted to our department for review. A traffic control plan showing temporary detours for pedestrians and vehicles should be included in these plans.

2. The timing and location of each phase of construction should be carefully planned to minimize the impact on traffic.

3. All loading areas, at the various pump stations, should be designed such that all maneuvering of vehicles occurs on-site.

Should you have any questions, please contact Lance Watanabe of my staff at local 4199.

JOSEPH M. MAGALDI, JR.

cc: Belt Collins & Associates
Department of Wastewater Management

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-591

November 26, 1993

MEMORANDUM

TO: MR. JOSEPH M. MAGALDI JR., DIRECTOR
DEPARTMENT OF TRANSPORTATION SERVICES

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for your comments to Robin Foster, Chief Planning Officer on the Draft Environmental Impact Statement (DEIS) for the East Mamala Bay Wastewater Facilities Plan dated September 13, 1993.

With respect to your two specific comments, we offer the following responses:

1. The City Department of Wastewater Management (DWWM) will submit plans for all work in City right-of-ways (expected to include principally sewer force mains, relief sewers, and installation of lines in unsewered areas) to the Department of Transportation Services for approval prior to the start of any construction activities. The plans will include temporary pedestrian and vehicular detours.

2. The projects proposed in the preferred alternative would be implemented over the course of the 20 year study period and require further studies before finalization. Therefore, exact locations and dates cannot be specified with accuracy at this time. As discussed in Section 8.7.4 of the DEIS, however, the City DWWM plans to mitigate as many of the temporary adverse traffic impacts as is possible. Mitigation measures are expected to include segmenting relief sewer projects, minimizing roadway lane closures, and managing construction times as much as feasible to avoid peak traffic

hours. Furthermore, the construction contractors will be required to provide traffic controls during construction activities impacting roadways. The Final Environmental Impact Statement has been revised to include the latter mitigation measure.

3. Preliminary investigations of the future requirements for the WWPS sites indicate that all normal operations could occur without impacting traffic. However, this concern will be addressed in detail during the design phase for each WWPS.

Again, thank you for your review of the document and your comments. If you have further questions, please feel free to contact me or our Project Engineer, Mr. Richard Leong, at 537-5863.

for KENNETH M. RAPPOLT
Director

certified # P864421892

Belt Collins & Associates
John Goody - Vice President
680 Ala Moana Boulevard, First Floor
Honolulu, HI 96813-5406

September 15, 1993

RE: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Dear Mr. Goody;

Thank you for the opportunity to comment on the Draft EIS and the Interim Facilities Plan. As a resident of Kalihi Valley I have several concerns over the adequacy of Wastewater Department planning and expenditures in this region of East Mamala service.

Residents planning new construction on residentially zoned lots that have not previously been connected to the Wastewater system are being required to build and monitor expensive holding tank systems. These holding tanks are supposed to be a short-term solution to line inadequacies that have been identified by the Wastewater Department. In the 6 years since my original holding tank was required, no expenditures by DWM to relieve line inadequacies have occurred while system demand continues to grow.

How can a Facilities Plan propose to add new unconnected areas, and expand service capability when DWM has ongoing problems with connections and discharge overload within its existing service system? A comprehensive facilities plan should first recognize and correct EXISTING DEFICIENCIES within the system. A TIMETABLE should be clearly specified and executed so that existing users are not victimized by a re-allocation of resources between neighborhoods.

I would like to formally request that the EIS / Facilities Plan FIRST: document all existing inadequacies that threaten existing use or interfere with resident's ability to connect to an existing collection system. The public should be made aware of existing inadequacies or connection conditions though a regular published report or map that can be disseminated to, and understood by the general public. These inadequacies should be corrected prior to any expansion into new or unserviced areas. SECOND: a fund expenditure plan specific to DWM should also be available and published annually. This plan should be prioritized using a cost-benefit type analysis that would ensure smaller projects and projects that benefit the greatest number of existing residents are completed first.

Respectfully, William Craddick
1556 Puolani St
Honolulu, HI 96819

cc: Councilperson Donna Kim
Councilperson Steve Holmes / Public Works

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. [illegible]
DIRECTOR

FELIX B. LI[illegible]
DEPUTY DIR

WPP 93-641

December 15, 1993

Mr. William Craddick
1556 Puolani Street
Honolulu, Hawaii 96819

Dear Mr. Craddick:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of September 15, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following responses to your concerns.

You note that due to sewage line inadequacies in your neighborhood, you have been required to build and monitor expensive holding tank systems that were supposed to be short-term solutions. We understand the difficult situation you face with the maintenance of your sewage holding tank. Normally, individual homeowners that apply for sewer connection permits are not restricted from connecting to the conventional sewerage system. However, you may be situated in a condominium or "cluster" type of development that results in a higher density which limits the City's ability to allow a conventional connection.

You state the need to recognize and correct existing deficiencies within the system. You also formally request that the EIS/Facilities Plan document all existing inadequacies that threaten existing use or interfere with a resident's ability to connect to an existing collection system. In the Facilities Plan, inadequate sewer lines are documented and priorities for relieving these inadequate sewers are listed. The Facilities Plan proposes to relieve inadequate sewers such as those that restrict the connection of your domicile, and intends to place high priority on relieving these inadequate lines. The FEIS reflects these contents of the Facilities Plan.

You comment that a timetable for construction should be specified and executed and that existing inadequacies should be corrected prior to any expansion into new or unserviced areas. As stated in section 4.5.2 of the DEIS, the City is under pressure from consent decrees to reduce or eliminate sewer line spillage. With this in mind, the City will be placing the highest funding priority on those sewers that are causing spillage and bypasses. The next priority would be placed on lines serving the largest segments of the community; i.e, generally the largest lines of the system that are presently constrained. Projects to relieve constrained lines will generally be prioritized in order of their size and service population.

Without the benefit of unlimited funding, the City DWWM is doing its best to prioritize improvements within the 6-year Capital Improvement Program budget. While you suggest that a cost/benefit-based fund expenditure plan specific to DWWM be published annually, the Capital Improvement Program serves the function of an expenditure plan. This budget goes through an approval process with the City Council. In addition, the Department of Wastewater Management publishes an annual report that contains financial information.

You also state that the public should be made aware of existing connection constraints through a regularly published report or map. Presently, the public is informed of existing connection constraints at the time an application for connection to the sewer system is submitted, usually during the design phase of development.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please contact Richard Leong at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

ARD OF WATER SUPPLY
Y AND COUNTY OF HONOLULU
SOUTH BERETANIA STREET
OLULU, HAWAII 96843

September 13, 1993

TO: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

ATTN: RICHARD LEONG

FROM: KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER K.H.
BOARD OF WATER SUPPLY

SUBJECT: BELT, COLLINS & ASSOCIATES' LETTER OF AUGUST 30, 1993 REGARDING THE DRAFT ENVIRONMENTAL IMPACT STATEMENT <u>(DEIS) FOR THE PROPOSED EAST MAMALA BAY FACILITIES PLAN</u>

Thank you for the opportunity to comment on the DEIS for the East Mamala Bay Facilities Plan. Our comments of February 1, 1993 are still applicable.

Please keep us informed on your plans for the reuse of wastewater.

If you have any questions, please contact Roy Doi at 527-5235.

cc: Belt, Collins & Associates

... man's greatest need - use it wisely

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-6

December 15, 1993

<u>MEMORANDUM</u>

TO: MR. KAZU HAYASHIDA, MANAGER AND CHIEF ENGINEER
BOARD OF WATER SUPPLY

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
<u>EAST MAMALA BAY WASTEWATER FACILITIES PLAN</u>

Thank you for your memorandum of September 13, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following in response to your comments of February 1, 1993 and your request to be kept informed on plans for the reuse of wastewater.

1. Comment: The alternatives proposed as possible solutions for the identified areas of concern are acceptable to the BWS.

   Response: None

2. Comment: We understand that effluent reuse will be investigated further as an effluent disposal option.

   Response: Effluent reuse was investigated. However, the reuse of the effluent would require the construction of a secondary wastewater treatment facility. The secondary effluent, which has high salinity from collection system infiltration, may require filtration, desalination and disinfection prior to reuse. Since no evidence has been found that the existing primary treated effluent is damaging the environment, upgrading the WWTP to secondary is not justifiable. In addition, the costs associated with producing secondary effluent, treating it to reuse standards exceed the cost of sea water desalination or BWS water supply for irrigation. For these reasons, wastewater reuse is not recommended as part of the preferred alternative for wastewater system improvements.

3. Comment: The availability of additional water will be determined when the building permit application is submitted for our review and approval. If additional water is made available, the applicant will be required to pay the prevailing water system facilities and any applicable meter installation charges.

   Response: The need for additional water by any of the upgrades at the facilities covered by the Facilities Plan will be determined during the design phase for that upgrade. However, no significant increases are anticipated after construction is completed.

4. Comment: Installation details for large water meters (3-inch and larger) are to be submitted for BWS approval prior to installation.

   Response: The need for new or larger water meters for any of the upgrades at the facilities covered by the Facilities Plan will be determined during the design phase for that upgrade. The details of their installation will be coordinated with BWS at that time and the installation details will be submitted for BWS approval.

5. Comment: Board of Water Supply approved reduced pressure principal backflow prevention assemblies should be installed on all domestic water lines immediately after the property valves and prior to any branch piping.

   Response: This item will be taken into consideration during the design phase as required.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please contact Richard Leong at Extension 5863.

KENNETH M. RAPPOLT
Director

HAWAII'S THOUSAND FRIENDS
Aloha e ko kākou 'āina, 'O ia ka mana kū pa'a. Pānoanoa ka 'āina, Mānoanoa ka po'e.
Love of our land, is the power for us to stand fast. Rare is the land, many are the people.

September 20, 1993

BELT COLLINS & ASSOCIATES
680 Ala Moana Blvd.
Honolulu, Hawaii 96813-5406

East Mamala Bay Wastewater Facilities Plan
Draft Environmental Impact Statement

Flawed study by Belt Collins recommends big increases in sewage flows, leaves the collection and pumping system subject to flooding, and opens the door to environmental lawsuits.

Hawaii's Thousand Friends is presenting this testimony in response to the Belt Collins East Mamala Bay Wastewater Facilities Plan and Draft Environmental Impact Statement dated August 1993.

FAULTY ASSUMPTIONS.
It is necessary that Belt Collins make assumptions when preparing a study such as this one. It is not necessary that it make untenable assumptions, or assumptions force-fed to it by the City & County of Honolulu. Belt Collins should have maintained it's impartiality in assessing this major work of enormous expense. But this is what it did: it assumed that in the next 20 years there would be a complete build out in East Honolulu, that there would be 30% more people in the study area; that there would be 30% more fresh water than is present now; that the zones of mixing at the sewage outfalls could stand another 30% increase in sewage; that there would be no cumulative impacts from loading the system another 30%; that there would be no storms, floods or tsunamis; that there would be a continuing stream of 301(h) waivers from EPA; that there would be continuing insurance coverage for the whole affected area; and that there would be no limiting factors of any kind affecting the study area through 2015 (see 5.2.2).

As a result of these assumptions Belt Collins projects a system where, there will be more sewers, more and bigger pumping stations, more sewage wastes, more water to become wastes, more effluent at the Sand Island outfall, and more of everything.

ANALYSIS' OF THE ASSUMPTIONS.
Reality must prevail: the population projections for the study area are guesses by planners who have to come up with some kind of figure for planning purposes. Their figures are not based on hard data of any kind. Belt Collins took the population projection to the extreme and assumed that existing buildings would tear themselves down and rebuild to the maximum area densities of individual lots. Not only is this not viable, it is not even likely, as the whole of the infrastructure would have to accompany such development and nobody has studied this problem nor made predictions of actual carrying capacity of East Honolulu. If the City puts in the Belt Collins recommended installations, the only piece of new infrastructure in place will be that of wastewater. This projection is not sensible. In Hilo a huge sewage plant was built but nothing much was ever connected to it and so it failed. This will happen again here and the waste will be staggering.

The assumption that there will be 30% more fresh water is faulty, because fresh water is in short supply right now in Honolulu and the Board of Water Supply is continuously sending out threats and advisories admonishing water users to use less water. The City may have to take its own Board of Water Supply seriously. There is no surplus of water - there is a form of water rationing. Belt Collins is wrong when it states at 5.2.4 that the water supply system is "assumed to meet projected land use and population growth," and wrong again when at 5.2.2 (p. 5-2) it says "Population growth is assumed to not be limited by availability of natural resources, such as water."

There have already been two lawsuits settled (others are pending) about the matter of wastewater disposal. The affected plant, Sand Island Waste Water Treatment Plant, was the cause of a major consent decree mandated study of the area it affects. The Mamala Bay Study commission is at present examining the condition of the Mamala Bay and will attempt to state the condition of the Bay and the remedies required (if any). There is powerful testimony that sewage is very dangerous to public health, that it does not stay below the surface down by the outfall at Sand Island as predicted, but floats to the surface about 30% of the time and moves with the surface wind and currents or across the wind direction to varying degrees. The studies of the zones of mixing have not sufficiently studied the fact that sewage rises, even though it is plain that the outfall at Sand Island is closer to the surface than it must be to benefit from the chilling effect of deep water. Nowhere are there any studies that discuss, let alone show, what would happen if sewage increased 30%. The Belt Collins Study recommends building three additional clarifiers at Sand Island without ever thinking out the effects and cumulative impact of more sewage in the zones of mixing and Mamala Bay in general.

The assumption that there will be no storms, tsunamis and flooding is patently faulty. Iwa and Iniki proved that, and insurance

305 Hahani St., Suite 282 • Kailua, HI 96734 • Phone/Fax: (808) 262-0682

companies are declining to write insurance in the supposition, contrary to the Belt Collins supposition, that there are more storms coming. The reason for more storms is that a warming of the atmosphere and oceans produces them. Storms can bring high tides and major floods, both of which will hurt the sewage collection facilities, especially the force-main pumps which are not defended, now, or in the plan, from flooding of any kind. These pumps and sewers are all in low lying areas, and flooding and infiltration will impair them drastically and immediately, causing vast releases of untreated sewage into densely populated areas of Honolulu. Attached photo (exhibit 1) shows flood waters reaching to the pump station at Ala Moana park.

Belt Collins's prediction of a stream of 301(h) waivers from the EPA is bad thinking. Sand Island Waste Water Treatment Plan is covered by a waiver good through '95, one which was not contested because there was a settlement through a consent decree. But the plant at Honouliuli has a contested 301(h) waiver in process and the whole ballast of environmental protection is shifting <u>away</u> from waivers and toward enforcement of environmental law. The notion that the City should spend huge sums on systems that will be crippled by direct application of the Clean Water Act is silly; "risky" is too charitable a word.

Because we have had two major storms in ten years in which there have been major losses, insurance on Oahu is drying up (see exhibit 2); nor will the projected build-out go forward if there is no insurance coverage. Nor can the City adequately cover <u>itself</u> from damages, especially when it will be established legally that the City did not take even the most rudimentary precautions to avoid large scale spills and contamination by sewage during flooding.

Lastly, the Belt Collins study argues that there are no limiting factors to growth in the studied area. This is painfully mistaken: traffic is horrendous, building is expensive, insurance unobtainable to some, cost of living is soaring, investment is drastically down, real estate sales are flat, water and sewage rates are skyrocketing, topographical constraints, and there is de facto water rationing, all in the study area. It is true that things could change, but to suggest a course of action, as Belt Collins does, based on <u>contrary</u> indicators is not wise.

<u>BELT COLLINS'S RECOMMENDATIONS.</u>
Turning to what Belt Collins wants we find that the number and capacity of sewers are to be drastically increased. There are problems with infiltration into the study area sewers and flooding, from whatever source, drastically worsens infiltration. It would be more logical to reduce infiltration and reduce water use, factors not advocated by this study. More sewers require more pumping stations as there is no gravitational flow for wastewater to follow along the coast where the pumping stations are and have to be; it is <u>pumps</u> that move sewage along the coast to Sand Island.

Just as the most populated areas of Honolulu are low, in flood prone areas, so too are the main pumps located low and their force mains as well.

Belt Collins recommends no measures to get the pumps off the ground or put them high in the pumping stations, nor does it seek to defend them with walls or moats or any devices whatsoever to prevent their easy flooding. The pumps are electrically driven and the power comes from HECO. The Belt Collins study finds that HECO has always provided reliable power in the past. This is not so, and the back-up diesel engine pump systems in every pump house are proof that the City does not consider HECO to be a reliable source of power. But these diesel engines are on the floors of the pump houses and they are as subject to flooding as the electric driven units. All the more reason, then, for Belt Collins to demand from HECO wires and systems that would provide power to the pump houses even when there is flooding, and recommend to the City that pump systems be raised off ground level. This Belt Collins did not do.

Our analysis shows that Sand Island Wastewater Treatment Plant is at capacity now. Belt Collins concurs, asking for three additional clarifiers. They specifically state that the new volume of sewage is not a problem because the outfall pipe can handle the additional flow. That is not the point at all. The question to be asked is whether or not the receiving waters can safely handle the increase of sewage. This is not addressed in the study. The basic assumption is that the problem is gathering up all the sewage efficiently, not what to do with it once it is gathered. In this wrong-headed assumption we see the hand of the City which has claimed consistently that when the sewage leaves the outfall it disappears without a trace. The City has stuck to this extraordinary flight of fancy in the face of overwhelming evidence, some of it provided by its own consultants, that this is not the case. We will hear more about what happens to sewage from the outfall at Sand Island from the Mamala Bay Study Commission, but we already know that it rises from the sewer difusor ports and spreads out. This cannot ever be good news for Honolulu's shoreline, and more sewage will necessarily make things worse.

The last projection we identify in the Belt Collins study is that there will be more of everything in the future and so more business as usual. There is a lack of innovation in this response (more on this later), but worse is the corollary assumption that what has been done in the past has really paid off and that more of it will be better. We have to disagree. "More of it" has brought our tourist industry to its knees. More people at Haunama Bay have destroyed its environment; more traffic has produced gridlock; more sewage has produced a dangerous shoreline where neither tourists nor locals are safe. Even if we were to assume, wrongly, but for purposes of discussion only, that the high counts of bacteria exceeding State standards along the near-shore waters of Waikiki are caused by non-point sources of pollution, in this case from urban run-off, and that the outfall activity cannot be blamed for this, how will it help the City to clean up the shoreline if it increases urban density? More density means more urban pollutants. So even if this wrong-headed argument that more is better were to be accepted, the urban run-off will be aggravated and the closing of Waikiki beaches will become a certainty. Technically they should be closed now as the bacterial counts on them exceed 7 enterococci per 100 milliliters. Increasing the flow to the Sand Island outfall is not going to help that, and increasing density in East Honolulu is going to aggravate the problem.

This leads us to identify an over-arching assumption made in this 1000 page report: that Honolulu does not have an environmental problem and that we should continue doing what we have been doing. Yes, says the report, we need a little window dressing here and little splash of decorative color there, but basically and fundamentally the house is in order and working. It isn't.

THE ROLE OF BELT COLLINS AS CITY CONSULTANT.
The City knows it has big problems with wastewater. As a first line of defense it calls on its own wastewater branch, and as a second line of defense it calls on Belt Collins for a second opinion. A sick person might do the same, asking his regular doctor for help and then getting a second opinion. If in that case the second-opinion doctor would call up the regular doctor and ask him what he had diagnosed so that he, the second opinion, could say the same thing, the patient would be in more jeopardy than he should be. This is what happened in this study: Belt Collins collated its opinions with the City's so that there would be no discrepancy. Belt Collins adopted wholesale and uncritically the assumptions the City has been making all along. But this is not what the taxpayer should be paying for. The taxpayer really wants and deserves to know what the problems are and what to do about them. That way the taxpayer can avoid taxpayer indigestion, and, if he/she must, grin and bear it. This report does not attempt a true portrait of how things are now and what they are going to be like. It certainly makes no attempt to project what reality will be like if things go wrong.

The City cannot take a broad view of its own plight because the politicians don't have the time to master details, and the decision-making of the City is fractured among numerous departments. So by employing Belt Collins the City was soliciting an over arching view that would review the City's options and make general recommendations.

But the departments of the City were not keen to be told that they had been making a mess of it and they influenced Belt Collins by "working with them". What happened is that the Study became completely sterile: it blames no one for anything; it makes no radical suggestions; it takes the "party line" on all issues; it does not depart from protocol even to brainstorm in suppositions.

It simply takes the path of least resistance; it asserts that what is, is right, and that we just need more of it. This demeanor leads inevitably to litigation because the City has not been managing its wastewater according to the Clean Water Act and although the State can muddy the waters by giving the City after-the-fact letters of permission (letters that Judge Fong found in his decision on Honouliuli to be improper), the City finally, has to tally its score with the EPA and the Clean Water Act.

We are saying here that this study by Belt Collins does not make any attempt to analyze the City's situation so as to keep it out of legal trouble or even technical trouble. If the recommendations of this report are followed, then the reconciliation between what the City does and what the Clean Water Act says it must do are more and more likely to take place in Federal Court.

It might be argued that the constraints placed on Belt Collins by the City were so narrow that general considerations were not possible. We would say that if Belt Collins did not feel free to alert the City to general hazards of the proposed cause of action it should step aside. We would feel more secure in our persons and possessions if Belt Collins would not engage in consultations that have to do with our money and security if it allowed itself to be pressed into service by its employer; worse yet, to allow its name to be used to justify the City pursuing a blind and unreasoned policy that it would not allow to be disturbed by advice from anyone, even, and principally, its own consultant is completely wrong. This report is remarkable for its lack of wide-ranging advice. It worries about nothing. It assures that things will continue just the way they are. It does not give counsel; it just recites what is and recommends more of the same administered in small increments, full of apology for the expense.

Another problem with this Study is that it repeats the mistakes of previous studies. All public testimony is ignored. Belt Collins and the City are certain that the public cannot make any observations that are worth listening to. The City knows what is best in all cases and it tells Belt Collins to dress that up and present it. The second doctor in our analogy has become the creature of the first doctor and can speak only with the first doctor's voice. We have to note that in great part Belt Collins sacrificed its independent voice to maintain harmony with the City. We appealed to Belt Collins in the public hearing previous to this one, to maintain their independent voice. They didn't do it.

Belt Collins's failure to maintain its independent voice is nowhere more obvious than in the matter of money. Belt Collins should not be overly concerned by expense. They should be concerned by what is an appropriate response to on coming circumstances. They should lay out the options of what needs to be done and the expense of these actions and allow the politicians to decide what option they want and can afford. Instead, Belt Collins has chosen a course of action for the City based on the expense of it. But at the same time Belt Collins has not evaluated the expense of an emergency that might catch the City, and its cheap solution by surprise. The financing of the improvements is presented with an excruciatingly painful apology, whereas the expense of being inundated by sewage or high bacteria counts in Waikiki are completely ignored. In short, Belt Collins has presented a too limited assessment. The insurance industry has pronounced, that whatever is, is wrong, and won't underwrite it. They are saying that storms are coming and that Honolulu will end up doing the waltz underwater. Belt Collins is saying that there has never been a problem and there will not be one in the foreseeable future. The expense of taking measures to prevent disaster is not measured against the expense of a disaster. This failure to assess risk ruins this study.

THE PERIL TO THE CITY FROM FOLLOWING BELT COLLINS'S PROPOSALS.
Because Hawaii's Thousand Friends has been a plaintiff in Clean Water Act cases we wish to lay out in some detail why the Belt Collins recommendations imperil the City. The evidence for our argument can be found in the Belt Collins study and will review the reasoning used in the study from this source.

The Belt Collins study specifically recommends against upgrading the Sand Island Sewage Treatment Plant, arguing at 9-1 that if there is up grading of the plant to secondary treatment "no appreciable benefit is likely to occur". It asks rhetorically "Does the use of ocean waters for wastewater disposal detrimentally affect the ocean's other uses (e.g. as a food or recreation resource)?" It then answers its own question by saying "Based on the data evaluated, the answer is no."

This bold statement that ignores all the evidence presented before a federal judge in a 6 week trial in 1993, is then refuted by the Study at 9-4 (p. 9-3) where it says, "No data exists on which to evaluate whether or not the wastewater collection system is a chronic contributor to recreational water quality problems." This confusing contradiction is worsened by Belt Collins's assertion at 9-4 (p. 9-3) that "The manner in which monitoring data are analyzed to determine compliance...would affect whether or not compliance is achieved." This is startling in that it argues that perception is stronger than reality. The water is, or is not polluted, according to parts of enterococci per milliliter. That is reality. But no, Belt Collins does not think so. More, at 9-4 (p.9-4) Belt Collins argues that "decisions to extend sewage to presently unsewered areas, lacking evidence of detrimental environmental effect, is uncertain given the cost impacts." So, argues Belt Collins, as nothing much is known about what sewage does, there is no need to act. What they omit to mention here is that the treatment of sewage is covered by United States law and it has been considered so important that the law, the Clean Water Act has been rewritten twice and is unequivocal in naming improperly handled sewage as dangerous and detrimental to society and the environment.

The requirements of the Clean Water Act completely elude the Belt Collins study. At 5-1 (p. 5-2) they state "If expansion of the existing zone of mixing is necessary to accommodate population growth, application therefore can be made." To Belt Collins the matter is one of permits, not one of reality. Either sewage is tolerable in the nearshore waters or it isn't. The permit, is not the issue. That is saying that if it is permitted or legal, it can't be bad for you. More, it denigrates the permitting process by claiming that if you need a permit, you simply get one; the issues of whether or not it is wise to dump are not even discussed. All Belt Collins knows about Mamala Bay is that it is acceptable to put more sewage into it. This presumption is reinforced by their statement at 1-2 (item 4) that "There are no known environmental reasons for the 301(h) waiver not to continue in the future." The question that Belt Collins should have answered is this: If you know virtually nothing about Mamala Bay, should you be putting anything whatsoever into it until you know more about it?

We say that study should come before contamination and not the reverse: we don't agree to "pollute first" and ask questions later. The burden of proof is on the polluter to show it does no harm. There is no justification for Belt Collins to say in their opening chapter that "There are no cumulative impacts," for they have argued that nothing is known on the subject. The refutation to Belt Collins's argument that no harm is being or will be done, lies in its own study. At 2-16 Table 2-11 (1) it quotes Hawaii Administrative Rules, Title 11, Department of Health, Chapter 54, Water Quality Standards (Oct 27, 1992) "Marine recreational waters along sections of coastline where enterococci content does not exceed the standard (7/100 mill) should not be lowered in quality." State standards are set to avoid harm. To break those standards is illegal because it is considered by the State legislature and Dept. of Health to be harmful. The Mamala Bay quality already breaks the 7 enterococci per 100 mill standard and adding 30% more sewage at primary levels, or below them must make things worse. More, at p. 2-17 Table 2-12 it recites that "Class A waters: no new sewage discharges within enbayment." It is obvious to us that Mamala Bay, being a bay, is covered by this stricture. Further, we should recognize once again that the outfall lies above the thermocline and that its sewage rises. We think that no new sewage can legally be dumped there.

Assume Sand Island has a valid permit now, and note that the 301(h) specifies (p. 2-22) item 8 that "There will be no new or substantial increased discharges from the point source of the pollutant to which the modification applies above that volume of discharge specified in the permit." That's clear to us our government can't dump more sewage out the outfall. By contrast the Study is woolly headed. It says at 2-22, "This waiver permit allows the use of primary secondary treatment." what does this quotation from their Study mean? Again, clear as day is the statement at 2-18 that State of Hawaii regulations require the zone of mixing "to achieve the highest attainable level of water quality." This cannot be done by pumping more primary sewage into the zone of mixing as recommended by Belt Collins.

CONCLUSION.
This cursory examination of the Belt Collins Study does not exhaust our analysis. It merely indicates that the Study is defective. We attempt to show some places where it is unnecessarily mistaken. Broadly speaking, if the premises are wrong, and we have argued that they are, the conclusions to be drawn from them cannot be sound. This Belt Collins Study is not a Study the City or anybody should rely on to carry them into the 21st Century. Nor does this Study justify an $800 million dollar budget. When that amount of money is to be spent a much more careful and impartial analysis needs to be made. We recommend that an impartial and experienced consultant be retained by the City with a broad mandate to examine the issues we recommended against a narrowly drawn contract that ensures the City will be confirmed in its previous actions.

We are not reassured by this Study. The problems the City has are not addressed. The City will be less able to cope with reality if it implements the recommendations of this Study.

We urge the City to disregard this Study and start over.

Sincerely,

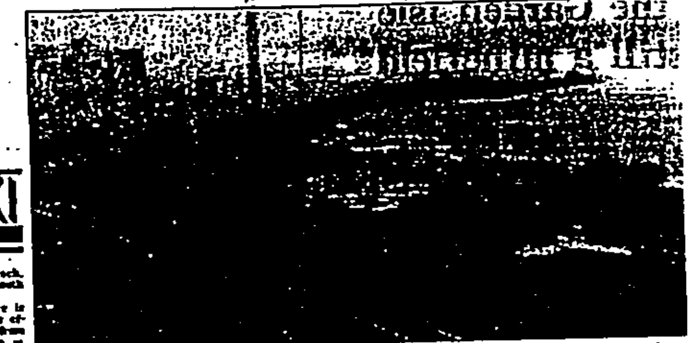
Fred Madlener
Boardmember

CC: Sierra Club Legal Defense Fund
Department of Health-Wastewater Branch
City & County of Honolulu
Hawai'i Lai-La'ieikawai Association
EPA Region 9
City Council members
Diamond Head Neighborhood Association
Neighborhood Boards in affected areas
House & Senate representatives from affected areas
Life of the Land
Fred Benco
Mamala Bay Study Commission
Board of Water Supply
City Planning Department

What if a hurricane heads for Waikiki?

Iniki has provided us a new model for shore research

By Stu Glauberman
Advertiser Staff Writer



The central part of Ala Moana Beach Park was flooded by Hurricane Iniki.

Scientists are still studying Hurricane Iniki's path and its pathology to learn more about how hurricanes can hammer the Hawaiian Islands.

Because hurricanes are infrequent in Hawaii, weather scientists don't know much about the possible heights and effects of hurricane-generated winds and overwash of high seas.

Researchers at the Joint Institute for Marine and Atmospheric Research at the University of Hawaii and their colleagues at the National Oceanographic and Atmospheric Administration have been poring over satellite maps and computer models that tell them more about Iniki.

They and others are trying to give disaster planning officials a heads-up call as to which areas of the state are particularly prone to damage.

Previously established evacuation boundaries — like those used for the tsunami evacuation maps in the telephone book — are being revised.

"Iniki gave us a whole new role model," said UH geologist Charles "Chip" Fletcher, who has been focusing on coastal effects.

There are no historical data specific to Oahu because Oahu has not been hit squarely. As a result, it's hard to predict how a fierce hurricane might affect Waikiki, for example.

Like Kauai's Poipu Beach, Waikiki Beach sits on a south shore.

Where the Poipu shore is steep — giving hurricane effects a chance to run up from deep water and rush in — Waikiki has a gently sloping shelf under the wide coastal indent called Mamala Bay.

Scientists don't know if the broad bay — from Makapuu to Barbers Point — will mitigate the overwash, or provide a huge basin of standing water for the storm to toss at Waikiki.

On the other hand, Waikiki's fringing reef might mitigate the effects.

Deputy State Civil Defense Director Roy Price says table-top planning for a direct hit on the state's most densely populated island has been under way, aided by federal hurricane vulnerability studies.

"We're prepared to deal with it," Price said.

Insurance companies have estimated that a storm of Iniki's intensity could wreak between $20 billion and $30 billion worth of damage on Oahu.

The damage estimate is 20 to 30 times larger than the city's annual operating budget, which indicates how devastating the blow would be, says Price.

Meteorologist Tom Schroeder, another of the UH scientists reviewing Iniki's wrath, says Honolulu would need more than a year to recover from such a storm.

"If Iniki had come through here, I wouldn't be talking to you now," Schroeder said. "Our infrastructure would have been gutted. We'd have a hard time recovering over a one-year time frame."

Communication in time of disaster is one of the first concerns on the part of public safety and Civil Defense agencies, according to Price.

Many improvements have been made in county and statewide communications and more are planned, including modification of Civil Defense sirens so that public address announcements can be made over the system.

For the most part, Oahu residents know where the high surf, and heavy-wind impact areas are, Price said. In a hurricane, vulnerable shores, low-lying areas and hillsides would be that much more vulnerable. People who live in those areas would be at even greater risk, he said.

"What you see is what you get."

Structural engineers who conducted damage assessment studies on Kauai with UH professors have recommended steps that homeowners can take to make their homes more wind resistant.

"People should be very conscious of whether their homes are strapped from the roof all the way down to the foundation, especially at the perimeter," said Howard Lau, past president of the Structural Engineers Association of Hawaii.

The term "strapped" refers to metal hurricane straps or clips that secure roofs to rafters, and rafters to plates or studs, all the way on down until all elements are secured to the foundation.

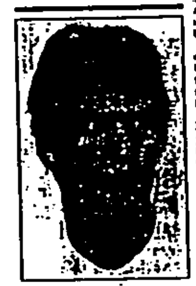
Homes subjected to heavy winds are likely to blow apart at their weakest link, Lau said.

Also, homes built with slick nails installed by nail guns may be less sturdy than homes hammered together with galvanized nails.

Engineers and architects suggest ways to [illegible] more secure [illegible] with the late[illegible] code requirements. [illegible]

Even so, says [illegible] building code requ[illegible] vision minimum [illegible]

A storm like Ini[illegible] human perseveran[illegible] [illegible] full of [illegible]



"Iniki gave us a whole new role model."
— Charles "Chip" Fletcher, UH geologist

'Turmoil' in the insurance industry

By [illegible] Hooper
Advertiser Business Writer

Norman Ho has been in the insurance business for 31 years, but he's never seen it this bad.

"This is not a business to be in today," says Ho, vice president of locally owned American Mutual Underwriters. "It was a good business but, since Iniki, everything has gone in the other direction."

Industry experts say a number of factors are responsible for Hawaii's ongoing property insurance crisis. These range from the relatively small size of the Hawaii market to concerns among insurance firms about increasing weather-related catastrophes worldwide.

"We're looking at an industry that continues to be in some turmoil — not just here, but across the country and maybe all over the world," says Linda Chu Takayama, the state insurance commissioner.

Among the reasons for the upheaval:

■ Theories about Hawaii's vulnerability to hurricanes changed when Hurricane Iniki followed Hurricane Iwa by only 10 years. "Before, it was thought that we were vulnerable only every 30 years, but now the traditional probability has telescoped," says Takayama. This month's close call from Hurricane Fernanda did nothing to ease the industry's fears. One suggested cause for the apparent increase in hurricanes worldwide? Global warming.

■ At the same time, notes Takayama, recent severe storms showed that hurricanes can cause far greater damage than previously thought — Hurricane Iniki, $1.6 billion worth of damage in Hawaii; Hurricane Andrew, $15 billion in Florida.

■ Reinsurance — a type of coverage that protects insurance companies against catastrophic losses — is becoming more scarce and more expensive. Recent weather-related catastrophes worldwide are partially responsible. According to Robert Whitehead, president and CEO of The Hawaiian Insurance & Guaranty Co. Ltd., the cost of reinsurance nationwide has gone up three to five times in the past year wherever there is hurricane exposure. As a result, primary carriers — who sell to the general public — are curtailing their writing and renewing of policies.

■ At the same time, insurance rating firms such as Best's Rating Service and Moody's Investor Services are threatening to lower their ratings for companies with broad exposure to catastrophic losses. A lower rating would make attracting investors more difficult, so firms are dropping policyholders in high-risk areas, says Takayama.

■ Hawaii's insurance market is small — with only about $64 million in homeowners premiums annually. But, says Linda Chinn, public relations director with First Insurance Co. of Hawaii, "virtually all property in the state is at high risk for windstorms. For many companies," she said in a recent statement, "the relatively small premium return (in Hawaii) does not justify the enormous risk of catastrophe exposure."

With insurers hesitant to write policies in Hawaii, property coverage for both homeowners and commercial concerns has become increasingly expensive and scarce. But some anticipated changes in the market may help attract carriers to the state.

Perhaps most important, the hurricane insurance relief fund created by the Legislature this spring is expected to be operating by the end of the year, according to Takayama. The fund, which would provide individual homeowners with up to $750,000 in hurricane coverage, also caps total payments from the industry at $500 million. State officials hope that limiting the industry's potential losses will encourage established firms to reenter the market and attract new companies to the state.

Changes to the state's no-fault automobile insurance law may also help. Repeal of the "take-all-comers" provision, which insurance firms dislike because it requires them to accept virtually all candidates, was approved by the special legislative session last week and is awaiting the governor's signature. Industry analysts predict this will brighten the property insurance picture because more auto insurance firms are attracted to Hawaii; they will also write homeowners policies.

National assistance may become available as well. This month Sen. Daniel Inouye, along with colleague Daniel Akaka and other senators, introduced a bill to create a Natural Disaster Protection Act. Inouye's office said the legislation would establish a primary insurance program to provide "affordable, comprehensive disaster protection for homeowners. It also sets up a national reinsurance program ... financed by the insurance industry.

What's your insurance company up to?

Many insurance companies have [illegible] residential homeowners insurance policies following Hurricane Iniki a year ago. Here's the status of major companies now:

Company	No. of policies	Contact	Writing new policies	Renewing existing policies	Not writing any policies
AIG Hawaii Insurance Co.	3,000	[illegible]			■
Allstate Insurance Co.	17,000	Allstate or [illegible] agent		■	
Fireman's Fund Insurance Co.	8,500	Independent agent representing Fireman's		■	
First Insurance Co. of Hawaii	10,065				■
Hawaii Property Insurance Assn.	18,000	[illegible]	■		
Hawaiian Insur. & Guaranty Co.	13,500	Independent agent representing HI&G	■	■ (1)	
Island Insurance Co. Ltd.	29,414	Independent agent representing Island		■	
Liberty Mutual Insurance Group	7,000	948-8689 (Honolulu) 487-0628 (Aiea)	[illegible]		
Pacific Insurance Co. Ltd.	14,750				■
Prudential Insur. Co. of America	3,500	Prudential agent	[illegible]		
State Farm Insurance Cos.	49,336	State Farm insurance agent	■ (4)		
Transamerica Insurance Group	20,131	Independent agent repres. Transamerica		■ (5)	
USAA	6,416	1-800-531-8111	■ (6)	■	

(1) HI&G — Selectively renewing.
(2) Liberty Mutual — Writing new policies only for those who had some kind of insurance with company for at least one year.
(3) Prudential — Only for those who have some kind of insurance with company.
(4) State Farm — Limited amount of new business per agent per month.
(5) Transamerica — Excluding hurricane coverage.
(6) USAA — Limited to active or retired military officers and their immediate families able to meet USAA underwriting standards.

EXHIBIT II

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-647

December 15, 1993

Hawaii's Thousand Friends
305 Hahani Street, Suite 282
Kailua, Hawaii 96734

Attention: Mr. Fred Madlener

Gentlemen:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of September 20, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. In this letter, we will respond to those comments that are relevant to the Facilities Plan and EIS. A copy of your letter and of this response will be included in the Final EIS.

The majority of your comments are related to population growth projections and growth constraints, the effects of growth-induced effluent discharge on the receiving marine environment, the potential effects of flooding and tsunamis on wastewater infrastructure, and the potential for continuation of the existing 301(h) waiver of secondary treatment. I will try to address your comments in the order in which they are presented in your letter, but will not replicate responses to comments that are made in more than one place.

Page 1. You list a number of matters that are labeled assumptions. These matters include "build out in East Honolulu", 30% population growth, 30% more potable water consumption, the zone of mixing's ability to "stand" 30% greater effluent, that there are no cumulative effects on the receiving waters from this growth in discharge, that the 301(h) waiver will be renewed, and that there are "no limiting factors of any kind". The specifics of these comments will be addressed below; in general, none of these matters has been dealt with by assumption, rather they have been the subject of analyses, as summarized in the DEIS.

There are several factual errors in page 1 of your letter that require correction. Section 5.4 of the DEIS discusses modeled population growth in the planning area. In the entire study area, this growth is projected to be about 20% over a twenty-year period corresponding to about 0.9% per annum, rather than 30% as your letter states. We are unaware of any projection that 30% more potable water will be required. The statement regarding the percentage increase in effluent is also in error. Table 5-8 of the DEIS summarizes projected flow increases. The increase in average flows over the planning period as depicted in the DEIS is about 14% based on an end period average flow of 88.6 MGD. This modeled flow is being further refined and is anticipated to be 90 MGD, for an increase in effluent flow of about 16%.

DEIS Section 8.3.7 evaluates water quality impacts including effects on the receiving marine environment from the Sand Island outfall alone and cumulatively with the discharge from Fort Kamehameha WWTP. DEIS Section 4.6.3 and Appendix C provide an assessment of the effects of the outfall on the marine environment at present, based on monitoring data. Projections of the impacts of future waste effluent loadings were analyzed for the Facilities Plan, and only summarized in the DEIS. The FEIS will include additional discussion and analysis that was omitted from the DEIS.

Wastewater infrastructure subject to flooding and tsunami are identified in DEIS Sections 3.4.2 and 3.4.3. The Facilities Plan identifies the need for site specific evaluation of each of these facilities to provide greater protection, and presents strategies to be considered during preliminary engineering review for projects at these facilities. These recommended actions will be incorporated into the FEIS.

Continuation of the 301(h) waiver is not assumed. These waivers are authorized for environmental situations in which secondary treatment is not needed because of the assimilative capacity of receiving waters. 40 CFR 113 provides for secondary treatment and waivers under appropriate circumstances. 40 CFR 125, Subpart G provides for marine discharge waivers and defines the circumstances and criteria for such waivers. We have evaluated monitoring data for the Sand Island Outfall and found that it presently meets the waiver criteria. The 1991 Annual Assessment Report prepared in compliance with the 301(h) waiver arrived at the same conclusion. Projections of the additional 14% future loadings did not indicate that waiver eligibility criteria would be exceeded during the study period.

Neither the Facilities Plan nor the EIS assumed that there would be no constraints to growth "of any kind". The Planning Department's population allocation model using the State's "MK series" population projection for the island as a whole and the Development Plans' allocations to individual areas, as extrapolated to the end of the planning period (five additional years), are used to project growth. The latter are constrained by such factors as availability of employment and housing. The Development Plans are the fundamental tools for managing growth. Care is taken not to develop infrastructure that exceeds DP growth capacity based on allowable land use densities. In some cases, where it appears that allowable land use densities will not be reached in the planning period, population projections are used as the criteria for upgrading of infrastructure to prevent stimulation of growth where it would not otherwise occur. DEIS Chapter 5 covers these matters.

Page 2. Population projections are extrapolations for which there is no "hard data", since there is no assurance that the future will be a continuation of the past. However, population projections in the most recent "MK series" were evaluated and the Planning Department's allocation model adjusted to reflect results of the 1990 census. Chapter 5 of the FEIS is more explicit about use of population projections. Population projections were not limited based on natural resource scarcity, such as that hypothesized for potable water. Water availability and conservation, and the environmental effects of development are obviously issues of concern for future development. However, there is no data to indicate that these factors will constrain the 20% growth projected for the study area. Use of wastewater system limitations as a growth control mechanism to reduce water requirements is not appropriate. The Development Planning process is an appropriate forum to pursue growth control matters.

As mentioned under our response to your page 1 comments, additional analytical information will be included in the FEIS regarding water quality in the ZOM. In response to your comment regarding surfacing plumes, Section 4.6.3 of the DEIS summarizes plume behavior as indicated by monitoring data and modeling results. The plume is modeled to surface approximately 15% of the time on an annual average. Initial dilution of a surfacing plume is more than double that of the submerged plume and is estimated to average a rate of 1,465 parts of ocean water to one part of effluent.

Page 3. The contribution of infiltration and inflow (I&I) to the wastewater stream is part of a separate long term study now being undertaken to improve management of the problem. The results of this study are not yet available. However, modeling of future flows use an estimated I&I reduction of 10% in determining needed capacities. As a separate but related matter, water conservation is also estimated to achieve a 5% reduction in flows in the future.

It should be noted that the I&I reduction has treatment benefits (such as reducing solids and salt loadings) in addition to reducing capacity requirements, but that water conservation measures only affect flow capacities. Section 5.5 of the DEIS addresses these matters.

Page 6. The East Mamala Bay Wastewater Facilities Plan and EIS have incorporated an extensive public participation process, exceeding that required by either the Clean Water Act or Hawaii Revised Statutes Chapter 343. At each key point in the planning process; i.e., study design and process, development of alternatives and selection criteria, and selection of a preferred alternative, the City has requested and accepted public comment. This comment, which has been diverse in its viewpoints, was evaluated and incorporated where valid. The recommended alternative was chosen based on an explicit process using criteria and criteria weighings developed with public input. The preferred alternative was chosen after two public meetings and revised subject to a third meeting. That refinement continues based on public comment received during the EIS comment period.

Page 7. The comment that evidence presented at the "Honouliuli Trial" were not taken into consideration is not correct. Although the effects and significance of discharges to the environment are site specific in nature and should not be generalized, the evidence presented at the "Honouliuli Trial" was evaluated and considered during East Mamala Bay deliberations. Findings of Fact in the case include the following:

1) Seriousness of violations was determined by considering, among other things, "actual or potential harm to human health and the environment."

2) "...there has been little measurable effect from the discharge on the environment in Mamala Bay in the studies done to date."

3) "The expert testimony regarding potential health risks is similar to the testimony about environmental impact. Plaintiffs' experts offered much speculation about the possibilities of harm, but presented no direct evidence of actual harm."

The DEIS comment in Section 9.4, regarding both the attribution of cause to exceedances of recreational water quality standards, and of the effects of computation method on determining compliance based on water quality monitoring data, are made in the section devoted to Unresolved Issues. Regarding areas in which exceedances of state recreational water quality standards are occurring, monitoring data were evaluated to determine potential sources of the bacterial contaminants. This evaluation indicated that shoreline, rather than offshore, sources were responsible. There are, however, no data to determine whether or not the wastewater collection system is contributing to the shoreline non-point source of the contaminants. Regarding computation to determine compliance, the statement in the DEIS merely reflects the fact that there are a number of ways to compute the geometric means used to determine compliance from the monitoring data; Hawaii Administrative Rules are silent on methodology.

Page 8. Possible expansion of the Zone of Mixing in the future is dependent not on existing permit conditions, such as effluent limitations, but on whether or not criteria conditions exist to permit ZOM expansion as allowed by law. In point of fact, these criteria appear to be met, based on existing data. With regard to the prohibition against additional sewage discharges into class A waters in embayments, please be aware that Mamala Bay is not an embayment as defined in HAR 11-54, but is considered open coastal waters.

We appreciate your taking the time and effort to provide thoughts on this significant matter of public policy. I hope our response has helped clarify the issues about which you expressed concern. You have raised some good points and these will be incorporated in the process of further refining and documenting future growth of the East Mamala Bay wastewater system.

Very truly yours,

KENNETH M. RAPPOLT
Director

DOUGLAS MELLER
PLANNING CONSULTANT

September 22, 1993

City Department of Wastewater Management
650 South King Street
Honolulu, Hawaii 96813
Attn: Richard Leong

City Planning Department
650 South King Street
Honolulu, Hawaii 96813
Attn: Robin Foster

Belt Collins Hawaii
680 Ala Moana Boulevard First Floor
Honolulu, Hawaii 96813
Attn: John Goody

Gentlemen:

Subject: DEIS for East Mamala Bay Wastewater Facilities Plan

I request that your EIS address whether increased discharge of nutrients into the ocean potentially could result in increased populations of stinging marine plants and animals. If there is such a possibility, then I would appreciate the City arranging for additional study of the issue by the UH Water Resources Research Center and the Hawaii Community Foundation Mamala Bay Study Commission Fund. Practically every time I go boogieboarding at deepwater reef breaks I get stung at least once or twice by some kind of microscopic plant or animal. The sensation is like a minor ant sting followed the next day by a small itchy bump. My memories may be wrong, but I don't recall this happening as often when I went surfing in the 1960s or 1970s. Box jellyfish and the windward-Oahu algae which causes welts also seem more common than when I was a kid.

State permits for ocean discharge of treated wastewater amount to "use of State lands" under Sec. 11-200-5(c), DOH EIS Rules. How will your EIS comply with Sec. 343-5(b)(1), HRS, without naming a State official as the accepting authority?

Sincerely,

Doug Meller

Douglas Meller

81 SOUTH HOTEL STREET, SUITE 312 • HONOLULU, HAWAII 96813
TELEPHONE (808) 537-2493 • FAX (808) 521-9054

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH
DIRE

FELIX
DEPUTY

WPP 93-64(

December 15, 1993

Mr. Douglas Meller
Planning Consultant
81 South Hotel Street, Suite 312
Honolulu, Hawaii 96813

Dear Mr. Meller:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your comments on the East Mamala Bay Wastewater Facilities Plan Draft Environmental Impact Statement (DEIS) dated September 22, 1993.

In response to your specific comments and questions we offer the following responses:

Nutrients associated with the wastewater discharge from the Sand Island outfall do reach the photic zone in East Mamala Bay. Because Hawaiian waters are oligotrophic (i.e., nutrient-poor), it is likely that phytoplankton utilize these nutrients and increase in concentration. It is further possible that zooplankton, such as Portuguese Man-of-War and box jellyfish, which consume the phytoplankton, could increase in numbers as a result of an increase in their food source. Several types of data suggest that this is not the case, however. Studies have shown that as a result of prevailing ocean stratification, the wastewater plume generally disperses at fairly deep depths. Surface water samples indicate nutrient levels generally well below the Department of Health's water quality standards. No known phytoplankton "blooms" (large increases in phytoplankton concentrations) have been reported in the vicinity of the outfall. In addition, stinging marine biota, such as Man-of-War, are moved by ocean waves and currents and have no internal means of motion. Thus, even if the outfall were associated indirectly with an increase in phytoplankton and stinging organisms, they would be effectively dispersed by normal waves and currents in the area. Further, we have no indication from other ocean users of an increase in incidences of stings associated with these biota (see for example, Appendix E in the DEIS).

You also questioned whether a State agency should be an accepting authority for the EIS because of the proposed action's use of State lands. The outfall already exists and the proposed action does not involve changes to the outfall or the use of other State lands. Thus, there is no land use basis for a State agency being the accepting authority for the EIS. The Facilities Plan is being prepared in accordance with 40 CFR 35, and use of the State Revolving Fund is anticipated; the State Department of Health will review the Facilities Plan and the EIS as the corresponding environmental report.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please contact Richard Leong at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

STEVE HOLMES
Councilmember
(808) 523-4035

CITY COUNCIL

CITY AND COUNTY OF HONOLULU
HONOLULU, HAWAII 96813 - 3065

October 6, 1993

Department of Wastewater Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

Attn: Mr. Richard Leong

SUBJECT: East Mamala Bay Wastewater Facilities Plan--Draft Environmental Impact Statement

Attached please find comments on the Draft Environmental Impact Statement prepared by Black & Veatch for the City Council. We appreciate your review of these comments and look forward to your written response. Thank you for your attention to this matter.

Sincerely,

[signature]

Steve Holmes, Chair
Public Works Committee

Enclosure

cc: All Councilmembers

Black & Veatch Comments

on

East Mamala Bay EIS (August 1993)

At the City's request, we have briefly reviewed the East Mamala Bay EIS. In general, the document appears to be very comprehensive and well suited to meet the Department of Wastewater Management (DWWM) needs. We have not reviewed the draft Facilities Plan. Some of our comments may be addressed in that document.

- Page 1-2 (2)(b) mentions "redundant" pump stations for Hart Street and Beach Walk and seven redundant force mains. We suspect this may be an expensive solution for eliminating bypasses and overflows.
- Page 6-8, Dissolved Air Flotation. Last sentence is not clear.
- Page 6-16 through 18, Treatment Level: Option 4d - Secondary Treatment. The prescreening of alternatives presented in this section appears superficial. We trust they are discussed in more detail in the Facilities Plan.
- Page 7-2 1st paragraph - I/I reduction is estimated at 20%. Chapter 5 (p. 5-3) indicates 10%.
- Page 7-3 1st full paragraph - We do not fully understand the logic of using more conservative flow estimates for the larger pumping stations, and less conservative flow estimates for pump stations less than 1 mgd capacity.
- Chapter 6 - There is no comparison of alternatives for pretreatment, i.e. screening, grit removal, chemical addition, and odor control. The recommended process is a very expensive solution and more cost-effective solutions may be available.
- Page 7-22, 7.5.2 Clarifiers - Based upon our prior review of primary clarifier performance at Sand Island WWTP, we believe the DWWM standards are overly conservative. It would be best to select the number of clarifiers required based on actual performance of the existing clarifiers. We believe no more than two additional primaries should be required, and these would be standby facilities to make sure that at least six units would be operating at all times.

General Comments

5

The concerns expressed in our March 28, 1993 letter to David Lum regarding proposed pretreatment and primary clarifier modifications are not addressed in the EIS. (See pages 2 and 3 of our letter, copies attached).

Modifications to the influent hydraulics at the Sand Island WWTP will be necessary to accommodate new pretreatment facilities. Has the effect of a few more feet of static head on the system's WWPS's been evaluated, or is low lift pumping being provided at the treatment plant?

tanks (4), thermal conditioning units (2), dewatering centrifuges (3), and incinerators (2). Waste ash is hauled to landfill for disposal. The average daily flow for 1991 was 70.4 mgd and for 1992 was 71.2 mgd. The flow on February 11 during our visit was between 72 and 74 mgd, with four primary settling tanks in service.

For odor control, a chelated iron absorbent system uses two fiberglass packed towers that operate in series, followed by activated carbon columns. This system is used for treating odorous gases from the grit removal basins and from the overflow weirs and launders of the primary setting tanks.

The plant has been granted a 301(h) waiver of the secondary treatment requirement until 1995. It must meet 30 percent BOD removal and 50 percent suspended solids removal, the equivalent of primary treatment. We have examined the monthly NPDES reports for 1991 and 1992, and found that suspended solids removal was above 50 percent removal for all months (actually, it was above 60 percent removal), and BOD removal was above 30 percent removal for all months but January and February of 1991 and December of 1992. See Figures 1 and 2 for BOD removals by month. The 1991 violations occurred with only three primary tanks in service; when four tanks were put into service, removal was above 30 percent. The December 1992 violation occurred with four tanks in service; when five tanks were put in service, removal was above 30 percent.

The plant has recycle flows from the gravity sludge thickening tanks and dewatering centrifuges that comprise as much as 20 percent of the BOD loading to the primary tanks; both streams are high in soluble BOD, which will not be removed in the primaries without chemical addition. See Figure 3 for a graph of BOD loadings, both soluble and settleable. The most likely cause of low BOD removal is the recycled flows and the soluble BOD associated with them. Based on the data, enhancement of the operation of the primary settling tanks is necessary only during a few months of the year. This is a valid reason for the selection of chemical pretreatment rather than preaeration of the raw sewage and recycle flows; there is a large capital cost associated with the preaeration system and it is best to use the system on a continuous basis.

Section 5 of the preliminary engineering report entitled *Sand Island Wastewater Treatment Plant Modifications, Unit 1, Phase 2A, 30% BOD Removal Facilities,* *Honolulu, Hawaii* (January 1992 by R.M. Towill Corporation) compares preaeration to chemical treatment, and recommends chemical treatment facilities at the end of the section. We agree with this conclusion; however, we do not necessarily agree with the specific bench scale testing that was done and the chemical dosages recommended. The bench scale testing did not appear to include any of the recycle flows, only raw sewage, which would have a lighter BOD loading and with much less soluble BOD than would actually need to be treated. Table 5-2 of the report has questionable results for polymer only with settling; when the dose was increased from 8 ppm to 15 ppm, suspended solids removal went up, but BOD removal went down. This does not make sense. And the polymer and $FeCl_3$ test was performed without settling; the testing should have included settling time, and would have probably yielded much better results. Both the Los Angeles Hyperion WWTP (500 mgd) and the County Sanitation Districts of Orange County Plants 1 and 2 (240 mgd) add about 0.25 ppm polymer and 20 ppm $FeCl_3$, with very good results. As stated in the report in Section 5, Hyperion's removals of BOD increased from 30 percent to 45 percent, and suspended solids increased from 65 percent to 75 percent, both of which are considerably better than the bench scale results in Table 5-2. In addition, we have examined the records of metals concentrations in the Sand Island influent sewage, and the concentrations are low. Work at the City and County of Los Angeles, where metal concentrations are also low, shows that iron is needed to enhance polymer performance. Another effect of adding polymer as the only chemical is a decrease in settled sludge density (from 4% to 3%), and therefore an increase in sludge pumping and thickener tank overflow. We recommend that the bench scale testing be redone to properly examine the $FeCl_3$ and polymer addition, and looking at other polymers, such as the Nalco chemical treatment system, with which we have had very good results on other projects.

Drawings have been developed by a consultant for installation of a polymer feed system. If the results of the bench scale testing indicate that $FeCl_3$ should be added, the drawings will have to be revised.

Another factor which could affect the treatment results at the Sand Island WWTP is the out-of-court settlement for operation of the dissolved air flotation (DAF) in the primary settling tanks. The settlement requires the reinstallation of

DEPARTMENT OF WASTEWATER MANAGEMENT
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FRANK F. FASI
MAYOR

KENNETH M. RAY
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-648

December 15, 1993

The Honorable Steve Holmes
Councilmember
City Council
City and County of Honolulu
530 South King Street, 2nd Floor
Honolulu, Hawaii 96813-3065

Dear Councilmember Holmes:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 6, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

1. Comment: Page 1-2 (2)(b) mentions "redundant" pump stations (WWPSs) for Hart Street and Beachwalk and seven redundant force mains (SFM). We suspect this may be an expensive solution for eliminating bypasses and overflows.

   Response: The intent of the "redundant" WWPSs is to replace the existing Hart Street and Beachwalk WWPSs. The word "redundant" has been changed to "new" to reflect this. The need for new WWPSs at these two sites is based on structural deficiencies in the two existing WWPSs coupled with the potential for economic and environmental impacts if either station were to fail and go off-line. The rehabilitation of the existing stations in lieu of a new station was not recommended due to the difficulty and risk of operating a bypass pumping system during the repair period to allow the existing stations to be removed from service for reconstruction. However, once the new WWPSs are brought on-line the existing WWPSs could be maintained for redundancy. The Facilities Plan recommends that a separate detailed study be conducted on the existing stations to determine the feasibility and cost of stabilizing them to extend their life as backup WWPSs.

The paragraph cited in relation to the "redundant" SFMs is confusing in the way that it is written and will be reworded. However, the following is in response to the economics of installing "redundant" SFMs. Five of the seven "redundant" SFMs are in effect new SFMs recommended to alleviate existing problems, and in all seven, the "redundancy" comes from maintaining the existing SFMs as backups.

The existing Hart Street WWPS is a major hub in the Sand Island WWCS and the continued operation of this station is extremely important. The Hart Street SFM was installed in the early 1950's and cannot be removed from service for inspection or rehabilitation as it is the only SFM that enables the transfer of sewage from the western portion of the Sand Island WWCS to the treatment plant.

The Beachwalk WWPS serves the Waikiki area from the Ala Wai Canal to Diamond Head. The necessity of continuing service from this WWPS if the existing SFM fails is extremely important because of its location in a high density shoreline recreation area of great environmental and economic sensitivity. The existing system cannot be removed from service to allow inspections or rehabilitation without causing potential wastewater release.

Sand Island Parkway and Public Baths SFMs are large diameter to handle larger projected flows without excessive head.

The Kuliouou WWPS SFM would be required to transport flow to the Sand Island Wastewater Collection System (WWCS).

Niu Valley and Awa Street SFMs are primarily to provide redundancy for the prevention of spills and bypasses, however additional operational benefits are gained. The Niu Valley SFM will carry the station's flow past the 24-inch line routed makai of Kalanianaole Highway to the larger 30-inch sewer at Aina Haina, while Awa Street SFM provides the ability to redirect the Awa Street flow from the Hart Street WWCS to the Ala Moana WWCS during emergencies.

2. Comment: Page 6-8, Dissolved Air Flotation. Last sentence is not clear.

Response: This sentence makes reference to the possibility that the next NPDES 301(h) waiver permit will require 30% removal of BOD_5 and total suspended solids (TSS) across the wastewater treatment plant (WWTP) and the probability that dissolved air flotation will not ensure compliance as stated in the preliminary engineering report by R.M. Towill entitled *Sand Island Wastewater Treatment Plant Modifications, Unit 1, Phase 2A, 30% BOD Removal Facilities, Honolulu, Hawaii*. Our intent is to meet the 30% BOD_5 removal criteria.

3. Comment: Page 6-16 through 18. Treatment Level: Option 4d - Secondary Treatment. The prescreening of alternatives presented in this section appears superficial. We trust they are discussed in more detail in the Facilities Plan.

Response: The presentation of the options contained in alternatives that were not selected as a part of the preferred alternative were made in brevity to streamline the report. Due to the conclusions reached in the evaluation of the outfall and the ability to continue the use of primary treatment, secondary treatment was not required to be a part of the preferred alternative. Therefore, every process evaluated was not described in the report. The discussion was included to show why the selected version of roughing filter/activated sludge is preferred.

4. Comment: Page 7-2 1st paragraph - I/I reduction is estimated at 20%. Chapter 5 (p.5-3) indicates 10%.

Response: The 10% reduction in I/I listed in Chapter 5 is the correct figure. The reference to 20% reduction in Chapter 7 will be changed to read 10%.

5. Comment: Page 7-3 1st full paragraph - We do not fully understand the logic of using more conservative flow estimates for the larger pump stations, and less conservative flow estimates for pump stations less than one mgd capacity.

Response: The wording in that paragraph of the DEIS is incorrect. The Development Plan land use flow model generally results in more conservative (higher) flow estimates and it was used to develop flows for the estimates for WWPSs with flows less than one mgd. The text will be corrected. The logic of considering both population-based and land use-based flow projections is derived from 40 CFR 35.2030, requiring consideration of population and demographics as well as land use. Because population projections are more accurate when aggregated at higher levels of detail, they were applied to larger elements of the system, and based on existing flows, were more accurate predictors at that level. Population projections are best used in determining timing of projects.

6. Comment: Chapter 6 - There is no comparison of alternatives for pretreatment; i.e. screening, grit removal, chemical addition, and odor control. The recommended process is a very expensive solution and more cost-effective solutions may be available.

Response: The selection of the pretreatment system was determined in the preliminary engineering report by R.M. Towill entitled *Sand Island Wastewater Treatment Plant Modifications, Unit 1, Phase 2A, 30% BOD Removal Facilities, Honolulu, Hawaii*, which was completed prior to this study. Based on an examination of various primary treatment upgrade alternatives to achieve 30% BOD_5 removal, the study recommended that the new influent barscreens and aerated grit removal channels were needed to improve the operation and reliability of the WWTP. In addition, the chemical addition facilities would be needed at certain times of the year if the 30% BOD_5 removal requirement is implemented in a future NPDES permit.

7. Comment: Page 7-22, 7.5.2 Clarifiers - Based upon our prior review of primary clarifier performance at Sand Island WWTP, we believe the DWWM standards are overly conservative. It would be best to select the number of clarifiers required based on actual performance of the existing clarifiers. We believe no more than two additional primaries should be required, and these would be standby facilities to make sure that at least six units would be operating at all times.

   Response: The Facilities Plan recommends that a separate study be commissioned prior to the construction of the new clarifiers to determine what the actual capacity of the units is and if they can be upgraded to increase their efficiency. This recommended study would then determine the actual number of units to be constructed.

8. General Comment: The selection of chemical addition in lieu of preaeration to achieve a minimum of 30% BOD_5 removal is valid since the enhanced removal is only required for a few months each year. However, the bench scale testing conducted during the preparation of the preliminary engineering report by R.M. Towill entitled *Sand Island Wastewater Treatment Plant Modifications, Unit 1, Phase 2A, 30% BOD Removal Facilities, Honolulu, Hawaii* did not adequately address the use of $FeCl_3$ in conjunction with the polymer addition. As a result of this, the use of iron compounds in combination with polymers was not properly ranked and the design of the chemical feed system was carried forward without the ability to add $FeCl_3$.

   Response: The ability of iron compounds to enhance the removal efficiencies of polymers was considered but not supported in the PER. Enhancements to the chemical feed system can be evaluated during the clarifier study which is recommended in the Facilities Plan and an iron feed system can be added at that time if the study finds that it does improve removal efficiencies at acceptable cost.

9. General Comment: Modifications to the influent hydraulics at the Sand Island WWTP will be necessary to accommodate new pretreatment facilities. Has effect of a few more feet of static head on the system's WWPS's been evaluated, or is low lift pumping being provided at the treatment plant?

Response: The effects of adding the new headworks facility was included in the recommendations for Hart Street, Ala Moana, and Sand Island Parkway WWPSs. The capacity of these WWPSs was based on an addition of six feet of static head. Fort Shafter was not evaluated in this study since it does not fall within the City's jurisdiction. However, the *Study of Fort Shafter Pump Station and Force Main in Support of the Sand Island Waste Water Treatment Plant Modification*, prepared by the U.S. Army Corps of Engineers, dated February 1992, states that no modifications to the existing station are required as a result of the addition of the new headworks at Sand Island WWTP.

Again, thank you for reviewing the DEIS and providing your comments. If there are any questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

APPROVED:

JEREMY HARRIS
Managing Director

cc: Belt Collins and Associates

STATE OF HAWAII
DEPARTMENT OF TRANSPORTATION
869 PUNCHBOWL STREET
HONOLULU, HAWAII 96813-5097

REX D. JOHNSON
DIRECTOR

DEPUTY DIRECTORS
KANANI HOLT
JOYCE T. OMINE
AL PANG
CALVIN M. TSUDA

IN REPLY REFER TO:
STP 8.5514

October 4, 1993

Mr. Robin Foster
Chief Planning Officer
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Subject: Draft Environmental Impact Statement (DEIS)
East Mamala Bay Wastewater Facilities Plan

We have reviewed the DEIS for the East Mamala Bay Wastewater Facilities Plan and offer the following comments:

1. Section 5.3 - This section discusses the presently known development projects for the study area. Unmentioned are Harbors Division projects which include the Fish Processing Center at Piers 35/36, the development of the Piers 39/40 area, and the development of Kapalama Military Reservation.

2. Section 7.2.2 - Construction activities to upgrade the existing gravity lines fronting harbor property must be coordinated with the Harbors Division to minimize impact on harbor operations.

3. Table 7.2 - On Page 7-6, there should be a explanation why the capacity of the Hart Street Pump Station is not being considered to be increased since our discussions with the Department of Wastewater Management indicate the sewerline is presently near capacity. In addition, "Waimanalo Road" should be changed to "Waiakamilo Road".

4. Appendix A, Figure A-61 - The location of the new redundant wastewater pumping station should be indicated.

5. Appendix A, Figure A-85 - The construction activities for the second force main across Honolulu Harbor to the Sand Island Wastewater Treatment Plant must be coordinated with the Harbors Division to minimize impact on harbor operations.

6. During construction, steps shall be taken to minimize traffic impacts in areas where work will adversely impact our State highway facilities. In addition, work should be done during off-peak hours and during the evenings/weekends whenever possible.

7. Plans for construction work within our State highway right-of-way must be submitted for our review and approval.

We appreciate this opportunity to provide comments.

Sincerely,

for Rex D. Johnson
Director of Transportation

c: Mr. Richard Leong - C&C Dept. of Wastewater Management
Mr. John Goody - Belt Collins Hawaii
Mr. Brian Choy - OEQC

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
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FRANK FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-644

December 15, 1993

Mr. Rex D. Johnson, Director
Department of Transportation
State of Hawaii
869 Punchbowl Street
Honolulu Hawaii 96813-5097

Dear Mr. Johnson:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 4, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

1. Comment: Section 5.3 - This section discusses the presently known development projects for the study area. Unmentioned are Harbors Division projects which include the Fish Processing Center at Piers 35 and 36, the development of the piers 39 and 40 area, and the development of Kapalama Military Reservation.

   Response: We request that preliminary plans for the Fish Processing Center at Piers 35 and 36, the development of the Piers 39 and 40 areas and the development of the Palama Military Reservations should be submitted to DWWM as soon as possible for review. The above mentioned areas have been considered on the broad land use projections of the Facilities Plan. Sewer adequacy determinations can better be evaluated based on your specific uses of these areas.

2. Comment: Section 7.2.2 - Construction activities fronting harbor property will be coordinated with the Harbor Division to minimize impact on harbor operations.

   Response: Construction activities fronting harbor property will be coordinated with the Harbor Division to minimize impact on harbor operations. Traffic impacts and the proposed mitigation procedures are discussed in Appendix F of the DEIS.

3. Comment: Table 7.2 - On Page 7-6, there should be an explanation why the capacity of the Hart Street Pump Station is not being considered to be increased since our discussions with the Department of Wastewater Management indicate the sewerline is presently near capacity. In addition, "Waimanalo Road" should be changed to "Waiakamilo Road".

   Response: Part A - Design of a 48- to 54-inch relief line along Nimitz Highway from Libby Street to Hart Street Wastewater Pump Station is underway. The Facilities Plan does not identify the stretch between Libby Street and Waiakamilo Road as surcharged based on the population model. Therefore, this stretch is not included in the preferred alternative. In the Facilities Plan, the existing Hart Street WWPS has adequate capacity. Part B - Waiakamilo Road is correct and the name will be changed.

4. Comment: Appendix A, Figure A-61 - The location of the redundant wastewater pumping station should be indicated.

   Response: The location of the proposed wastewater pumping station is the parcel of land on the Diamond Head side of the Fire Station at Waiakamilo Road and Nimitz Highway. This proposed site will be shown in the Final Facilities Plan.

5. Comment: Appendix A, Figure A-85 - The construction activities of the second force main across Honolulu Harbor to the Sand Island Wastewater Treatment Plant must be coordinated with the Harbors Division to minimize impact on harbor operations.

   Response: This comment will be taken into consideration during the planning of the new sewer force main and the coordination with State DOT-Harbors Division will begin during the preliminary engineering design phase for that upgrade.

6. Comment: During construction, steps shall be taken to minimize traffic impacts in areas where work will adversely impact our State highway facilities. In addition, work would be done during off-peak hours and during the evenings/weekends whenever possible.

Response: Concur. The impact to traffic from the construction activities and the steps to be used to mitigate them are covered in Appendix F of the DEIS.

7. Comment: Plans for construction work within our State highway right-of-way must be submitted for our review and approval.

Response: This comment will be taken into consideration during the design of any of the upgrades at the facilities covered by the Facilities Plan. Specifically all work to be performed in State right-of-ways will be submitted for DOT Highway Department's approval prior to any work being performed.

Again, thank you for reviewing the DEIS and providing your comments. If you have any further questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

PLANNING DEPARTMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

ROBIN FOSTER
CHIEF PLANNING OFFICER

ROLAND D. LIBBY, JR.
DEPUTY CHIEF PLANNING OFFICER

ET 8/93-2032

October 6, 1993

MEMORANDUM

TO: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

ATTN: RICHARD LEONG

FROM: ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS) FOR EAST MAMALA BAY WASTEWATER FACILITIES PLAN, OAHU

We have reviewed the subject DEIS and recommend the following additions and or clarifications:

1. Proposed improvements may require amendments to the East Honolulu and Primary Urban Center Development Plan Public Facilities (DPPF) Maps. The Final Environmental Impact Statement (FEIS) should disclose possible DPPF map amendment requirements for proposed improvements.

2. The East Mamala Bay Interim Facilities Plan proposes to construct a redundant WWPS within the Ala Wai Park area. The FEIS should assess how the proposed WWPS may impact the City's proposed use of parkland as described in the Waikiki Master Plan (copy enclosed).

3. On page 7-6, the DEIS incorrectly indicates that the Hart Street redundant WWPS would be located in the vicinity of the intersection of Waimanalo Road and Nimitz Highway. Is the correct street reference Waiakamilo Road?

4. The FEIS should include the TAZ tables used in the East Mamala Bay Interim Facilities Plan. TAZ tables should contain information on the present, future, and percentage change of the resident population within each zone. Information in these tables would help identify projected growth areas.

5. The FEIS should include information as to possible alternatives to sludge disposal after the City's Kapaa and Waimanalo sanitary landfills have reached their capacity.

6. The FEIS should explore further the impacts on the groundwater of the Waipio Peninsula area as a possible underground injection site. The Board of Water Supply Hydrology section has commented to us that the Waipio Peninsula area may not be a feasible location for wastewater disposal.

The information that is being requested should be summarized in the body of the report within the most appropriate sections. Other related sections should be revised as necessary to assure internal consistency.

Should you have any questions, please call Eugene Takahashi of our staff at 527-6022.

ROBIN FOSTER
Chief Planning Officer

RF:lh

Enclosure

cc: Belt Collins & Associates
Attn. John Goody

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-639

December 15, 1993

MEMORANDUM

TO: MR. ROBIN FOSTER, CHIEF PLANNING OFFICER
PLANNING DEPARTMENT

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for your memorandum of October 6, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following responses.

1. As you note, the proposed improvements may require amendments to the East Honolulu and Primary Urban Center Development Plan Public Facilities (DPPF) Maps. You suggest that the Final Environmental Impact Statement discuss possible DPPF map amendment requirements for proposed improvements. However, because the proposed improvements will need to go through further design and approval processes before they are implemented, it is premature to identify the DPPF map amendments that may result if a project is approved. After appropriate approvals have been obtained, we will initiate the process to amend the Development Plan Land Use and Public Facilities maps. Because development of the Facilities Plan and FEIS constitute only the initial stages for implementing improvement projects for the wastewater system, these documents will not discuss specific Development Plan amendments; rather, they will state that Development Plan amendments may be required.

2. You state that the potential impacts of the proposed redundant WWPS within the Ala Wai Park area on the City's use of parkland as proposed in the Waikiki Master Plan should be discussed. The FEIS will address this.

3. You are correct. The location of the Hart Street redundant WWPS is in the vicinity of the intersection of Nimitz Highway and Waiakamilo Road, not Waimanalo Road. This typographical error will be corrected in the FEIS.

4. To help identify projected growth areas, you suggest that the TAZ tables presented in the Facilities Plan be included in the EIS, and that these tables contain information on the present, future, and percentage change of the resident population within each zone. The FEIS will include one TAZ table, for resident population, that merges the two TAZ tables in the Facilities Plan and adds information on percentage change.

5. You suggest that the FEIS should include information regarding possible alternatives to sludge disposal after the City's landfills have reached their capacity. According to the Acting Chief of the Division of Refuse Collection and Disposal (DRCD), the DRCD is committed to continuing to accept sludge from Sand Island WWTP. It is presumed that there will always be a need for landfill screenings and grit from the treatment plants, and that an additional landfill site will be identified by the City. Note that in the preferred alternative for wastewater system improvements, the proposed method for sludge disposal is not landfilling; rather, landfilling is identified as a backup.

6. You state that the FEIS should explore further the impacts on the groundwater of the Waipio Peninsula area as a possible underground injection site. The underground injection option, which was explored as discussed on page 6-21 of the DEIS, was not a component of the preferred alternative because it requires that the wastewater be treated to tertiary levels, and it has high construction costs associated with it. Because the EIS focuses on the potential impacts of the preferred alternative, the impacts on the groundwater of the Waipio Peninsula will not be examined further. Similarly, the technical feasibility of siting an injection well on the Waipio Peninsula will not be explored further.

As you requested, the additional information discussed above will be included in the appropriate section of the FEIS, related sections will be revised as necessary.

Again, thank you for reviewing the DEIS and providing your comments. If you have further questions, please contact Richard Leong at Extension 5863.

Kenneth L. Rappolt

KENNETH M. RAPPOLT
Director

University of Hawaii at Manoa

Environmental Center
A Unit of Water Resources Research Center
Crawford 317 • 2550 Campus Road • Honolulu, Hawaii 96822
Telephone: (808) 956-7361

October 8, 1993
RE:0636

Mr. Robin Foster
Planning Department
City and County of Honolulu
650 South King Street
Honolulu, Hawaii 96813

Dear Mr. Foster:

Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan
(Zones 1 & 2 inclusive, Zone 3 Sections 1 through 7)
Honolulu, Oahu

The East Mamala Bay wastewater district extends from Salt Lake/Aliamanu Crater area to Niu Valley. The planning period for the project is 1995 to 2015. The proposed government action is the general improvement of the municipal wastewater collection and treatment system to meet projected demand in the year 2015 for the district.

We have been assisted in this review by Stephen Lau, Water Resources Research Center; Frank Peterson, Geology and Geophysics; Edward Laws, Ocean Engineering; Maria Sweeney, Anthropology; and Huilin Dong, Environmental Center.

GENERAL COMMENTS

Overall, our reviewers find this EIS inconsistent and incomplete. The results from ongoing research in Mamala Bay, resulting from recent litigation, were not included in this EIS. Coordination of these efforts should surely be attempted.

We notice that the project summary published in the OEQC bulletin is inconsistent with the Preface of the EIS. Regarding the components of the wastewater system, the OEQC bulletin summary named four main components: the wastewater collection system, the Sand Island Wastewater Treatment Plant, the deep ocean outfall and diffuser which extends 12,500 feet seaward form Sand Island, and the solids disposal system. However, the Preface of the EIS only identified three of the four components, and the "solids disposal

Preface of the EIS only identified three of the four components, and the "solids disposal system" was left out. The inconsistency of the OEQC and the EIS needs to be explained, and the disposal of the solids should be fully addressed.

In addition, we notice that the archaeological analyses were inadequate, as manifested on pages 8-18 which states that the impacts of the project on the 24 identified historical areas "will be evaluated prior to the commencement of the construction activity." This treatment of the archaeological impacts clearly violates Title 11, Department of Health, Chapter 200, Subchapter 7, Section 11-200-16 Content Requirements which require that the EIS document "shall fully declare the environmental implications of the proposed action and shall discuss all relevant and feasible consequences of the action." A later evaluation of the archaeological impacts also constitutes piece-mealing of the document. According to the Archaeological Assessment (appendix G) prepared by Erkelens and Athens of the International Archaeological Research Institute, Inc., it is quite clear that each specific site must be surveyed in order to give an adequate assessment. Considering that the assessment given by Erkelens and Athens is not based on actual surface or subsurface survey, an archaeologically based knowledge of the specific areas proposed for development is necessary for proper mitigation. With no preliminary on site surveys, mitigation procedures cannot possibly be decided forehand, as intimated in the report (8-19). There are also a few discrepancies in the manner that potential significance has been assessed:

1. While the 19th century landfill at the Sand Island WWTP was judged to have no potential for archaeological deposits, a similar period landfill at Awa Street WWPS was assessed with a high probability of such deposits. Also, the Hart Street WWPS dredge area was given high probability on the basis of potential for paleoenvironmental and geomorphological information while the Sand Island WWTP was not given this consideration.

2. The Hart Street WWPS, as mentioned, was rated as potentially significant for paleoenvironmental and geomorphological information while Aliamanu 1 and 2 WWPS is given "slight probability" despite it's potential for containing buried agricultural deposits.

3. Zone 3 of the Tantalus unsewered area, though noted to be renown for sweet potatoes, is given a low probability.

The conclusions reached (8-25) that there are no operational or cumulative impacts on archaeological resources clearly contradicts the majority of initial assessments made, as the majority of sites had a probability for encountering archaeological deposits. In addition, according to the Department of Land and Natural Resources (DLNR) rules governing minimal standards for archaeological assessments, not only is background historical and archaeological research necessary but assessments also require archaeological field surveys, oral historical research and inventory survey reports. These last tasks were not performed prior to the completion of this draft.

Furthermore, we are puzzled about the treatment of alternatives to primary treatment in this EIS. It is our understanding that the City is seriously contemplating using sewage for groundwater recharge purposes in the Ewa area. If that is the case, we understand that secondary treatment will be required for the sewage. The possibility of using the sewage for that purpose is not mentioned in the EIS.

Alternatives to primary treatment are all discussed as if they must be capable of handling all the anticipated flow up to the year 2015. Some appealing possibilities are then ruled out because they would perhaps not be able to handle all 88 md. Why not consider the possibility of treating some of the sewage using innovative techniques and discharging the rest with primary treatment?

Land application is certainly a possibility for a portion of the sewage. The potential sites discussed do not include the lagoon area next to the reef runway. If we are willing to seriously consider injecting all of the effluent into the ground on the Waipio Peninsula (one of the options considered on page 6-21), why not consider creating an artificial marsh for treating the sewage in the lagoon adjacent to the reef runway?

Hawaii has a year-round tropical climate, and growing plants in the sewage effluent is therefore a real possibility throughout the year. Disney World currently treats their sewage by growing water hyacinths in the effluent, and they claim that their effluent meets secondary treatment standards. Solar aquatic treatment systems are reported to also achieve secondary treatment standards at substantially less cost and in no more land area than conventional secondary treatment systems.

Some possibilities are dismissed because they are not proven technologies on the scale envisioned for the Sand Island treatment plant. If that is the case, why not set up some experiments by diverting some of the present inflow and treating it using innovative techniques such as artificial marshes or solar aquatics? If we are looking ahead to the year 2015 and are talking about spending hundreds of millions of dollars, a few years and a few hundred thousand dollars spent on researching alternatives for the type of sewage that enters the Sand Island plant might be money well spent.

As the population of Oahu grows, we are going to have to look toward water reuse. Because of our tropical climate, there are some innovative treatment methods involving photosynthetic plants which might work better than trickling filters and/or activated sludge systems, the secondary alternatives given the most attention in section 6-3-4. The attitude that "because somebody else has not done it, we are not going to try it" is not constructive.

Why not set up some experiments to see if some alternatives that take advantage of our tropical climate might not work? And they do not need to be able to treat all 88 mgd. It is irrational to ignore the impending need for water reuse, and we think now is the time to start taking a hard look at innovative forms of treatment.

SPECIFIC COMMENTS

Page 1-3. SM is not defined in the abbreviations and acronyms section.

Page 1-4. There is in fact very little nitrate in the sewage effluent. Most of the nitrogen is present as ammonium. What will be exceeded are the criteria for ammonium. The nitrate criteria will not be violated.

Page 2-18. According to Ed Noda's model, the plume from the Honouliuli outfall rises to a depth of somewhere between 30 and 50 m about 50 percent of the time. We suspect that the Sand Island plume also spreads out at depths well below 30 feet much of the time. Assuming this to be the case, why does the City sample no deeper than 60 feet, and why are only the surface and 30-foot samples used to determine compliance with water quality standards? Wouldn't it make more sense to sample where the plume is most likely to be found?

Page 2-22. It is our impression that the water quality standards for ammonium are in fact being exceeded at the boundaries of the zone of mixing. Expansion of the ZOM would seem necessary if primary treatment is to be consider adequate. What is meant by the sentence "this waiver permit allows the use of primary secondary treatment." Shouldn't the word secondary be omitted?

Page 3-9. Honolulu volcanic series volcanism began about 1 million years ago, not 30,000 years as stated.

Page 3-14. In the description of Honolulu Basalt line 3, apparently put of the following sentence is missing-"the basalt frequently acts either as a perched groundwater aquifer."??

Page 3-21. In groundwater paragraph 3, caprock is not impermeable as stated; it actually is quite permeable but is considerably less so than the underlying basalt aquifer.

Page 4-24. The projected population to be served by the Sand Island plant is about 409,000 by the year 2015 (appendix B, p6). The projected average daily flow amounts to 88 mgd (5-15). The per capita flow therefore amounts to over 200 gallons per day. If "the EPA has established a guideline of 155 gpcd for wet-water infiltration & inflow," it seems that we are looking at an excessive amount of infiltration and inflow. Note that the per capita production of wastewater is estimated to be only 76 gallons per day (5-3). This seems to be a very conservative estimate, particularly in a tropical climate.

Page 6-5. The basis for the statement that "Primary treated effluent in combination with the ocean outfall can achieve a level superior to that of biological (secondary) treatment plant effluent" is not adequately discussed in the EIS.

Page 6-21. Regarding underground injection, the document makes the assumption that injection will result in no ocean discharge. In reality this is not correct, as depending on the distance of injection from the coast, there may be considerable discharge because ultimately most injected effluent must move to the coast and discharge into coastal waters. There will of course be some purifying action during flow through the subsurface materials.

Thank you for the opportunity to review and comment on the document.

Sincerely,

Jacquelin N. Miller

Jacquelin N. Miller
Associate Environmental Coordinator

cc: OEQC
Richard Leong, Dept. of Wastewater Management
✓John Goody, Belt Collins of Hawaii
Edward Laws
Frank Peterson
Stephen Lau
Huilin Dong

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
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FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-649

December 14, 1993

Director
Environmental Center
University of Hawaii at Manoa
Crawford 317
2550 Campus Road
Honolulu, Hawaii 96822

Attention: Ms. Jacquelin Miller

Dear Sir:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 8, 1993 on the subject draft environmental impact statement. We have evaluated your comments and will address them in the order presented in your letter.

Page 1. Your letter begins with a general comment that the DEIS is "inconsistent and incomplete" because it fails to include ongoing research resulting from the recently concluded litigation. There have been several litigations involving municipal discharges into Mamala Bay. Since the most recent, involving Honouliuli, was only settled on April 23, 1993, we assume that you are referring to those studies arising out of the consent decree involving Sand Island WWTP. There was an initial attempt to coordinate the East Mamala Bay Wastewater Facilities Plan process with that of the Mamala Bay Study Commission. However, because the court-imposed deadline for completion of the Facilities Plan and EIS is December 31, 1993, and the Study Commission commenced its two-year investigations in the summer of 1993, there is no practical way for the findings of the Study Commission to be incorporated into the East Mamala Bay Wastewater Facilities Plan EIS. Findings of the Commission will be available to decision makers in the future. Therefore, this information can be taken

into account during preliminary engineering review of specific projects included in the Facilities Plan.

Your observation that the elements of the wastewater system are described differently in the preface to the DEIS and in the OEQC bulletin summary is correct. Because of the need for brevity in the OEQC Bulletin and in the DEIS preface, some of the system elements were subsumed into others for summary purposes. Both the OEQC Bulletin and DEIS preface summarize material dealt with in greater detail elsewhere. A total of seven system elements are given detailed description and analysis in the DEIS. In the OEQC bulletin, "collection system" is considered to include gravity sewers, force mains/pump stations, and Kuliouou collection. In the preface, "solids treatment" is considered under the general title of treatment, and the disposal of solids is fully addressed in the EIS. The preface of the FEIS will be changed to be more consistent with the rest of the text.

Page 2. You state that the archaeological analyses were inadequate, that the treatment of archaeological impacts violates Title 11, Department of Health, Chapter 200, Subchapter 7, Section 11-200-16, and that a later evaluation of the archaeological impacts also constitutes piece-mealing of the document. This statement reflects a misunderstanding of the respective roles of the EIS process and subsequent actions that need to be taken under state and federal historic preservation law (HRS 6E, NHPA Section 106). The requirement of the EIS is to disclose likely significant impacts of a proposed action. This is done for cultural resources by identifying resources likely to be encountered through earth disturbing activities at particular locations. The impacts and mitigation of these actions is projected with the historic preservation review process in mind, which will be required of each specific implementing project at the time it is designed.

Because of the length of time for implementation of all the projects included in the preferred alternative, it is expected that the techniques, databases, and regulations associated with historic preservation will change before completion of some of the specific projects. Thus, for the purposes of the EIS, the complete literature review was appropriate. Site-specific field data will be obtained as necessary during development of individual projects, based on the literature review. The State Historic Preservation Division has reviewed the DEIS; their comment letter indicates that because the available information is expected to "change substantially" over the course of the 20 year study period, the site-specific archaeological research that will be necessary cannot be determined at this time. As stated in the letter, and as was pointed out in Section 8.6 of the DEIS, the State Historic Preservation Division would review the archaeological research for all projects to ensure that the projects comply with historic preservation laws and regulations in effect at the time of the proposal and that no unmitigated significant impacts to historic resources result from the proposed projects. Mitigation measures specific to each project will be developed after completion of more detailed research and will be approved by the State Historic Preservation Division.

You identify three concerns referred to as "discrepancies" in the manner that potential significance has been assessed at certain sites. These are simply a misunderstanding of the specific conditions that existed at each of the sites. The Awa Street and Hart Street WWPS locations present a totally different potential for containing archaeological deposits than the Sand Island WWTP site, the Aliamanu 1 and 2 WWPS sites, and the Tantalus area; therefore, the assessments are different. Our specific responses are as follows:

1. You point out that the Sand Island WWTP was judged to have no potential for archaeological deposits, while the Awa Street WWPS and Hart Street WWPS dredge area were given high probability. At the Awa Street WWPS and Hart Street WWPS, the underlying archaeological deposits are "pondfield" sediments resulting from the previous use of the locations as taro *lo'i* and a fishpond, respectively. Because these locations inadvertently functioned as anaerobic sediment traps, it is likely that paleoenvironmental indications, such as pollen, are preserved within the deposits that underlay the WWPSs at these locations. Conversely, Sand Island WWTP is located upon dredge spoils placed upon a shallow water reef flat. There are no underlying sediments containing evidence for any hypothetical use of the location. In addition, there is no indication that the dredge material should contain any archaeological remains. These dredge spoils are therefore unlike the landfill at the Awa Street and Hart Street WWPSs, which may contain urban refuse of interest to archaeologists.

2. For the sites at Aliamanu 1 and 2 WWPSs, there is no indication that the area was ever used by Hawaiians and only a slight probability that any previous low intensity use of the area

(such as dryland cultivation) may have occurred. Furthermore, if such use of the area had taken place, it is unlikely that it would manifest itself in the archaeological record.

3. Similarly, the production of sweet potatoes (also dryland cultivation) in the Tantalus area would not be expected to leave any indication of this previous low-intensity land usage.

You state that the conclusion that no operational or cumulative impacts on archaeological resources will occur contradicts the assessments that a majority of sites had a probability of encountering archaeological deposits. Operational impacts, defined on page 8-1 of the DEIS, result from the use or operation of an improvement, and from the use of a product created by the improvement. No impacts to archaeological resources are anticipated after completion of construction activities (primarily excavation). Therefore, there will be no operational impacts to archaeological resources. Cumulative impacts result from interactions and/or accumulations of effects resulting from a number of individual projects. Because any significant construction-related impacts would be mitigated through data collection and specific project adjustments, and no operational impacts will result, it is not expected that the proposed action will contribute to cumulative impacts.

Page 3. You state that the possibility of using sewage for groundwater recharge in the Ewa area is not mentioned in the EIS. Underground injection is discussed in Section 6.3.5 of the DEIS, with the Waipio Peninsula as the potential location of the injection well. In the evaluation of alternatives, the Waipio Peninsula site was deemed infeasible due to its high costs. Since the Ewa area is located farther from Sand Island WWTP than Waipio, it would cost even more to install the necessary pipelines. While it is true that the City is contemplating using sewage effluent for groundwater recharge purposes in the Ewa area, the reclaimed effluent would come from the Honouliuli WWTP and not the Sand Island WWTP.

You ask, why not consider the possibility of treating some of the sewage using innovative techniques, such as creating an artificial marsh for treating the sewage in the lagoon adjacent to the reef runway, and discharging the rest with primary treatment.

Treatment of a portion of the effluent at a remote location for discharge would require the City to maintain two discharge permits or to build the facilities necessary to return the treated effluent back to Sand Island

WWTP for discharge through the existing outfall. Since no evidence was found that indicates that the discharge of primary treated effluent is harming the environment, the cost of building and operating these facilities is not justified. However, the wetlands option was discussed in the Facilities Plan, both as a means to achieve tertiary effluent and as a means of assisting evaporation, but it was eliminated as a possible effluent disposal option. Since the option was eliminated, it was not discussed in the DEIS.

An artificial marsh designed to treat the volume of effluent produced in the study area to tertiary quality, to allow discharge to the surface waters would require roughly 2,000 acres, if the existing Sand Island WWTP (SI WWTP) is expanded to provide the required level of pretreatment. This much land is not readily available. The lagoon adjacent to the reef runway has approximately 450 acres, which is not sufficient for the combination of evaporation and solar aquatic treatment of the projected 86 mgd of effluent. The additional cost of constructing a dual system, with approximately one fourth of the effluent volume treated by a solar aquatic system, is not presently warranted under criteria established in federal regulations.

You suggest setting up pilot studies of innovative sewage treatment methods for Sand Island WWTP. The Facilities Plan recommends that a small tertiary (secondary treatment with effluent filtration) facility be installed to produce R-1 water for internal reuse and research purposes. The FEIS reflects this recommendation. While this facility is recommended to be a Roughing Filter/Activated Sludge plant with effluent filtration to study the recommended secondary option, additional types of treatment (trickling filters, activated sludge, selector activated sludge, and combination) systems can also be studied at the facility. Systems with higher land requirements such as lagoons and aquatic plants are not practical at Sand Island WWTP because of unavailable land area.

Page 4. Specific Comments

Pg 1-3: You state that SM is not defined in the abbreviations and acronyms section. We believe you are referring to the acronym SFM. It stands for sewer force main. The list of acronyms has been modified to include this in the FEIS.

Pg. 1-4: As you pointed out, the water quality of concern is ammonia nitrogen. This paragraph is corrected in the FEIS.

Pg. 2-18: You ask why the City samples no deeper than 60 feet, and why only the surface and 30-foot samples are used to determine compliance with water quality standards. In fact, the units should be meters, not feet (i.e., the City samples at depths of 0, 30, and 60 meters). This has been corrected in the FEIS. These depths correspond to the NPDES permit requirements of surface samples taken within 0-1 meter depth, mid-depth samples taken 0-3 meter below the pycnocline, and bottom samples taken 0-3 meter above the bottom, respectively. The applicable water quality standards were developed for the upper or surface layer of water. Samples from depths of 0 and 30 meters should be compared to the standard because that layer is subject to influence from the surface interface, including wind and wave action. Deeper waters not subject to this influence are not comparable to the standard. You also ask if it wouldn't make more sense to sample where the plume is most likely to be found. In fact, the NPDES permit requirements for receiving water monitoring to determine compliance with water quality standards and the 301(h) criteria include sampling at the Zone of Initial Dilution (ZID) boundary, the Zone of Mixing (ZOM) boundary, and within the plume. Samples taken at the ZID and ZOM boundaries are evaluated to determine compliance with water quality standards. Samples taken in the plume are required to be analyzed for temperature, light transmittance and salinity profiles, with results reported quarterly discussing plume thickness and direction, sampling locations, profiles, pycnoclines and thermoclines.

Pg 2-22: It is your impression that water quality standards for ammonium are being exceeded at the boundaries of the zone of mixing. In point of fact, the geometric mean standard for all constituents is being met, including ammonia. Hawaiian waters are oligotrophic (nutrient-poor), therefore, it is reasonable to re-evaluate the water quality standards for parameters such as ammonia nitrogen, which is naturally high relative to the standard. This may occur in the future. However, it should be noted that a further difficulty in determining compliance is associated with the lack of a specified methodology in State regulations and the sample size, for which it is possible to compute a confidence interval for statistical parameters, but not a specific number with certainty. Thus, the primary recommendation is a re-evaluation of the standards and the means of determining compliance. Because monitoring has shown no evidence that public or environmental health degradation is associated with the Sand Island outfall, expansion of the ZOM is a viable option for achieving regulatory compliance, if needed in the future. As you indicated, the final sentence in the third from last paragraph on this page contains a typographical error. The FEIS reflects the correction (i.e., the word "secondary" has been deleted).

Pg. 3-9: You state that Honolulu volcanic series volcanism began about one million years ago, not 30,000 as indicated in the DEIS. There is considerable uncertainty regarding the age of the Honolulu volcanic series. Table 16.2 in *Volcanoes in the Sea* (MacDonald and Abbot, 1979) indicates ages ranging from 31,000 to 1,130,000 years before present. The FEIS reflects this uncertainty.

Pg. 3-14: The incomplete sentence you identified should read: "Honolulu Basalt frequently contains either perched or confined groundwater in the Honolulu Aquifer system." The FEIS corrects this.

Pg. 3-21: The DEIS text regarding the permeability of the caprock is, as you mentioned, incorrect. In reality, the limestone (calcareous) strata of what is commonly referred to as the "caprock" are permeable, and act as aquifers for brackish water. These layers, however, are separated by (relatively) impermeable clay aquicludes. In addition, an impermeable clay layer separates the caprock from the underlying permeable basalt (which has saline porewater). The FEIS corrects this.

Pg. 4-24: You infer that based on the projected population to be served by the Sand Island Plant by the year 2015 and the projected average daily flow, the per capita flow amounts to over 200 gallons per day. The per capita flow of 200+ gpd includes per capita wastewater generation (76 gpd) and dry-weather infiltration (134 gpd). The EPA guideline of 155 gpcd refers to wet-weather infiltration and inflow, not dry-weather infiltration. It is true that there are a number of areas in the East Mamala Bay service area that exceed the EPA guidelines for dry-weather infiltration and wet-weather infiltration and inflow; as discussed in section 4.5.2 of the DEIS, the City is performing a sewer rehabilitation and infiltration and inflow study to reduce infiltration and inflow. You also note that the per capita production of wastewater (76 gpd) appears to be conservative. In actuality, 76 gpcd is high for bedroom communities (i.e., where persons leave their home during the day) where studies show the flow generation rate from a residence to be in the range of 50 to 60 gpcd. The flow generation rate from businesses is considered separately. It is modeled under commercial/industrial wastewater flow.

Pg. 6-5: Your comment on the statement regarding primary treatment with ocean outfall not being adequately discussed in the EIS is noted. The text in the DEIS did not include the full analysis performed for the Facilities Plan. The FEIS corrects this. The corrected passage reads: "At a fraction of the cost, primary treatment in combination with the outfall (through dilution of pollutants as the primary treated wastewater mixes with seawater as it travels to the outfall zone of mixing) may achieve a level superior to that of biological (secondary) treatment plant effluent. Under this approach, the wastewater pollutants are sufficiently diluted that the ocean can assimilate them."

Pg. 6-21: You state that the assumption that underground injection will result in no ocean discharge is not correct because there may be discharge due to the injected effluent migrating to coastal waters. To clarify, the means of eliminating/reducing ocean discharge that we were focusing on was discontinuing use of the ocean outfall, and underground injection was considered in this vein. It is true that ultimately, an altered form of the diluted, injected effluent may reach coastal waters, and in this regard reduction, not elimination, of ocean discharge would be achieved. The FEIS contains a passage to clarify the issue.

Again, thank you for reviewing the DEIS and providing your comments. If there are any further questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

DEPARTMENT OF BUSINESS, ECONOMIC DEVELOPMENT & TOURISM

Central Pacific Plaza, 220 South King Street, 11th Floor, Honolulu, Hawaii
Mailing Address: P.O. Box 2359, Honolulu, Hawaii 96804 Telephone: (808) 586-2406 Fax: (808) 586-2377

JOHN WAIHEE
Governor
MUFI HANNEMANN
Director
JEANNE SCHULTZ
Deputy Director
RICK EGGED
Deputy Director
TAKESHI YOSHIHARA
Deputy Director

Ref. No. W-1495

October 4, 1993

Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

Dear Mr. Leong:

Thank you for the opportunity to review and comment on the Draft Environmental Impact Statement (DEIS) for the East Mamala Bay Wastewater Facilities Plan. Proposed sewerage improvements to "meet Water Quality Standards" will have an impact on present as well as future Honolulu Waterfront Master Plan development activities. In this regard, we offer the following comments:

- <u>Chapter 5, Future Situation</u> – Section 5.3, Land Use Projections in the Planning Area, takes into account density changes to individual parcels or groups of parcels within the study area as a result of the redevelopment activities. The Honolulu Waterfront Master Plan, completed in October 1989, recommends substantial redevelopment of underutilized areas within the Honolulu Waterfront. Although Table 5-1, Localized Density Changes, includes the Keehi Lagoon, Aloha Tower, and Kakaako areas we recommend that the City also consider other major redevelopment activities which are currently being implemented within the Honolulu Waterfront including the following (see Figure 1):

  -- <u>Kalihi/Kapalama Makai Area</u>: Major improvements within the Kalihi-Kai area involve the redevelopment of underutilized areas at Pier 60 for a 200 slip marina and marina-related commercial/light industrial activities; redevelopment of the Keehi Industrial area; development of the 84.9 acre Kapalama Development Complex (KDC) for container terminal and commercial/industrial uses; and the Kalihi-Kai Park which is Phase II of the Keehi Lagoon Canoe Racing Complex. In total, these projects represent relatively substantial density changes within the Kalihi-Kai area which will have certain implications with regard to necessary wastewater service.

  -- <u>Iwilei Makai Area</u>: Major improvements within the Iwilei Makai Area include the redevelopment and reprioritization of uses within the Piers 19 to 35 area. This will involve the planned relocation of petroleum and other non-harbor-dependent facilities to provide added space for maritime-dependent commercial/industrial activities.

  These projects, if not considered in the East Mamala Bay Facilities Plan and DEIS, may affect the proposed wastewater requirements within these areas.

- <u>Table 7-2, WWPS Modifications – Preferred Alternative</u>: Potential impacts to adjacent maritime operations (i.e., Young Brothers Interisland Barge Terminal at Piers 39/40 and the Fresh Fish Wholesale and Distribution Center at Piers 35/36) should be minimized with respect to the proposed improvements for the Hart Street Wastewater Pump Station (WWPS) (i.e., the redundant WWPS and sewer force main). Improvements to the Piers 39/40 area, to accommodate the relocation of the Young Brothers operations from Piers 24 to 29, are currently underway. Completion is scheduled for mid-1995 for all phases of work.

  A request-for-proposals (RFP) for the Fresh Fish Wholesale and Distribution Center is scheduled to be advertised by December 31, 1993. Completion of construction work is expected by early 1997.

  Both of these facilities will be fully operational before the anticipated start construction date (year 2000) for the Hart Street WWPS.

- <u>Table 7-2, WWPS Modifications</u>-- A 14-inch sewer force main (SFM) is indicated as a specific modification for the Sand Island Parkway WWPS. A figure should be added to show the location of this improvement.

- Section 8.7.4 Roadway System -- This section identifies the Kapalama Military Reservation (KMR) area for potential construction worker parking should secondary treatment for the SIWWTP be constructed. The KMR will be formally transferred to the State on October 1, 1993. A RFP for the development of the KMR and surrounding State-owned lands will be advertised by October 1993. Construction is scheduled to begin by late 1995 and be completed by late 1997. In the interim, the site will provide needed relocation space for under roof and outdoor storage needs of tenants being displaced as a result of other ongoing waterfront development activities. Remaining available space will be rented by the Department of Transportation (DOT), Airports Division to various tenants to generate revenue for airport improvements. In this regard, any use of this property will have to be coordinated with DOT.

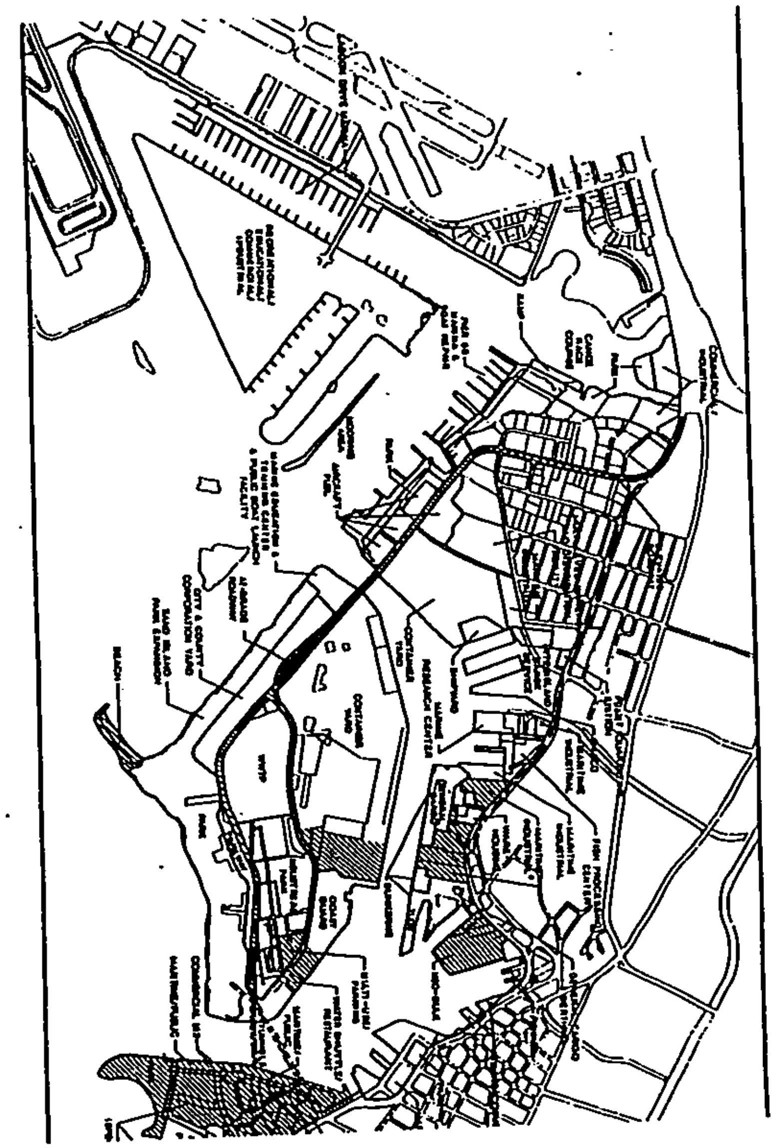
- Appendix A, Figure A-10 -- We recommend that operational impacts to the Young Brothers Interisland Terminal at Piers 39/40 be considered as a result of the proposed 30-inch sewer relief line near Auiki Street off of Nimitz Highway scheduled to commence in the year 2008. The DOT-Harbors Division should be consulted further on the alignment of this proposed improvement.

- The proposed 36-inch relief line along Nimitz Highway from Libby Street to the Hart Street Pump Station should be reflected on figures in the DEIS.

Again, thank you for the opportunity to comment on the DEIS. If you have any questions please call my Special Assistant, Mr. Daniel E. Orodenker, at 586-2531.

Sincerely,

Mufi Hannemann



DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-643

December 15, 1993

Mr. Mufi Hannemann, Director
Department of Business, Economic
Development and Tourism
State of Hawaii
P. O. Box 2359
Honolulu, Hawaii 96804

Dear Mr. Hannemann:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 4, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

1. Comment: Chapter 5, Future Situation. In reference to Table 5-1, Localized Density Changes, it is recommended that the City consider other major redevelopment activities in addition to Keehi Lagoon, Aloha Tower, and Kakaako areas which are currently being implemented with the Honolulu Waterfront which include the following:

   a. Kalihi/Kapalama Makai Area. Major improvements within the Kalihi-Kai area involve the redevelopment of underutilized areas at Pier 60 for a 200 slip marina and marina-related commercial/light industrial activities; redevelopment of the Keehi Industrial area; development of the 84.9 acre Kapalama Development complex (KDC) for container terminal and commercial/industrial uses; and the Kalihi-Kai Park which is Phase II of the Keehi Lagoon Canoe Racing Complex.

   b. Iwilei Makai Area. Major improvements within the Iwilei Makai Area include the redevelopment and reprioritization of uses within the Piers 19 to 35 area. This will involve the planned relocation of petroleum and other non-harbor-dependent facilities to provide added space for maritime-dependent commercial/industrial activities.

Response: We request that preliminary plans for your other major redevelopment activities be submitted to the Department of Wastewater Management (DWWM) as soon as possible for review. The above mentioned areas have been considered in the broad land use projections of the Facilities Plan. Sewer adequacy determination, however, can be evaluated more effectively based on your specific uses for these areas. We request close coordination between your staff and DWWM to ensure adequate implementation of your Honolulu Waterfront development.

2. Comment: Table 7-2, WWPS Modifications -- Preferred Alternative. In reference to the construction activities associated with the proposed new Hart St. WWPS and sewer force main (SFM), potential impacts to adjacent maritime operations (i.e., Young Brothers Interisland Barge Terminal at Piers 39 and 40 and the Fresh Fish Wholesale and Distribution Centers at Piers 35 and 36) should be minimized. Piers 39 and 40 are currently being improved for the relocation of the Young Brothers operations from Piers 24 to 29. Completion of construction work is scheduled for mid-1995. Construction of the Fresh Fish Wholesale and Distribution Center is scheduled for completion of construction work by early 1997. Both of these facilities will be fully operational before the anticipated starting date of construction for the new Hart St. WWPS.

   Response: We request copies of the above mentioned projects be provided to DWWM for review as soon as possible. Impacts can be addressed more efficiently in the preliminary design phase of the new Hart St. WWPS and SFM project. Mitigative measures will be taken during construction.

3. Comment: Table 7-2, WWPS Modifications. A figure should be included in the DEIS to illustrate the location of the proposed 14-inch sewer force main which is indicated as a specific modification for Sand Island Parkway WWPS.

   Response: The proposed 14-inch SFM will run along and parallel to the existing 12-inch SFM from the WWPS to the Hart Street junction box at the Sand Island WWTP. A larger SFM was proposed for Sand Island Parkway WWPS to increase the pumping capacity of this WWPS.

4. Comment: Section 8.7.4, Roadway System. Any use of available space in the Kapalama Military Reservation (KMR) area would have to be coordinated with the State DOT. Section 8.7.4 had identified the Kapalama Military Reservation area as potential construction worker parking should secondary treatment for the SIWWTP be constructed. The KMR will be formally transferred to the State on October 1, 1993. Construction of the KMR and surrounding State-owned lands is scheduled to begin work in 1995 and be completed by the late 1997. In the interim, the site will provide needed relocation space for under roof and outdoor storage needs of tenants being displaced as a result of other ongoing waterfront development activities.

Remaining available space will be rented by the DOT-Airports Division to various tenants to generate revenue for airport improvements.

Response: Should the construction of a secondary treatment facility be required, the use of any part of the Kapalama Military Reservation will be coordinated with the State DOT.

5. Comment: Appendix A, Figure A-10. It is recommended that operational impacts to the Young Brothers Interisland Terminal at Piers 39 and 40 be considered as a result of the proposed 30-inch sewer relief line near Auiki Street off of Nimitz Highway scheduled to commence in the year 2008. The DOT-Harbors Division should be consulted further on the alignment of this proposed improvement.

   Response: DOT-Harbors Division will be consulted on the alignment of the proposed 30-inch relief sewer during the design and construction phase of this project.

6. Comment: The proposed 36-inch relief line along Nimitz Highway from Libby St. to the Hart St. WWPS should be reflected on figures in the DEIS.

   Response: Design of a 48- to 54-inch relief line along Nimitz Highway from Libby Street to Hart Street Wastewater Pump Station is underway. The Facilities Plan does not identify the stretch between Libby Street and Waiakamilo Road as surcharged based on the population model. Therefore, this stretch is not shown in the relief sewer figures in the FEIS.

Again, thank you for reviewing the DEIS and providing your comments. If you have any further questions, please contact our project engineer, Richard Leong at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

DEPARTMENT OF THE NAVY
COMMANDER
NAVAL BASE PEARL HARBOR
BOX 110
PEARL HARBOR HAWAII 96860-5020

IN REPLY REFER TO:
5090(P)
Ser N4(232)/3628
14 Oct 93

Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, HI 96813

Dear Mr. Leong:

EAST MAMALA BAY WASTEWATER FACILITIES PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT

We have reviewed the subject Draft Environmental Impact Statement forwarded by Belt Collins Hawaii's letter of August 30, 1993 and provide the following comments:

a. Page 3-1, third paragraph - The Aliamanu Military Reservation Housing is serviced by two pump stations that are operated by the Navy.

b. Page 5-5 - the land use projections in the planning area does not include planned Navy housing. See enclosures (1) and (2).

c. Page 8-9, Cumulative Impacts - This portion discusses interaction between discharges from the Sand Island Wastewater Treatment Plant and discharges from the Navy's Fort Kamehameha Wastewater Treatment Plant outfall. The EIS should also discuss effects of the Navy's proposed project to extend the outfall to discharge into deeper water.

If you have any questions or desire additional information, please call Mr. Clyde Yokota at 471-3324.

Sincerely,

M. B. CLAUSSEN
Commander, CEC, U. S. Navy
Deputy ACOS Facilities and Environment
By direction of
the Commander

Encl:
(1) City and County of Honolulu ltr WWP 93-280 of July 15, 1993
(2) Commander, Naval Base Pearl Harbor ltr Ser N4(18115)/1586 of April 28, 1993

Copy to:
Belt Collins Hawaii
Attn: Mr. John Goody
680 Ala Moana Boulevard, Suite 100
Honolulu, HI 96813

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-280

July 15, 1993

Rear Admiral William A. Retz, USN
Commander
Naval Base Pearl Harbor
P.O. Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Admiral Retz:

Subject: Navy Family Housing Sewage Requirements

This letter is in response to your letter of April 28, 1993 requesting inclusion of your projected increases in Navy family housing sewage requirements in the City's East and West Mamala Bay Facilities Plans.

The following comments pertain to your specific projects and their projected wastewater flows:

A. All existing negotiated Navy sewer service contracts will continue to be honored.

B. All sewage generated from your family housing new construction and proposed for treatment either at Fort Kamehameha WWTP or Sand Island WWTP must be treated at Fort Kamehameha WWTP. The existing municipal interceptor sewers are inadequate to support your proposed projects.

C. Sewage proposed for treatment at the Honouliuli WWTP will be handled like any other private developer request. The court recently rendered a decision in the Honouliuli litigation which did not address a moratorium on sewer connections. With this in mind, the City will utilize the available capacity at the Honouliuli WWTP and will continue to allow new sewer connections on a case-by-case basis, providing that capacities are available in the collection system and at the WWTP.

If there are any questions, please contact Richard Leong at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

Encl (

5090.A2
Ser N4(18115)/1586
28 APR 1993

Mr. C. Michael Street
Director and Chief Engineer
Department of Public Works
City and County of Honolulu
650 South King Street
Honolulu, HI 96813

Dear Mr. Street:

As was discussed with Mr. Richard Leong of your staff, the following information is submitted for inclusion in to your Facilities Plan and Environmental Impact Statement for both the West Mamala Bay and East Mamala Bay Studies:

a. Projected increases in Navy family housing ~~is~~ are expected to generate approximately 1.3 million gallons of sewage per day.

b. The specific areas requiring sewage services are summarized below:

(1) Approximately 630,000 gpd directed to Honouliuli Wastewater Treatment Plant (WWTP).

(2) Approximately 240,000 gpd directed to Sand Island WWTP.

(3) Approximately 420,000 gpd directed to the Navy's Fort Kamehameha Wastewater Treatment Plant.

c. A breakdown of specific projects and flows is included as enclosure (1). Enclosure (2) provides locations for the various housing projects.

If you have any questions or desire additional information, please call Mr. Bill Liu at 471-3324.

W. K. LIU
FACILITIES ENGINEER
BY DIRECTION OF
THE COMMANDER

Encl:
(1) Flow Projection
(2) Proposed Family Housing Sites

Blind copy to:
PWC Pearl Harbor (Code 640)

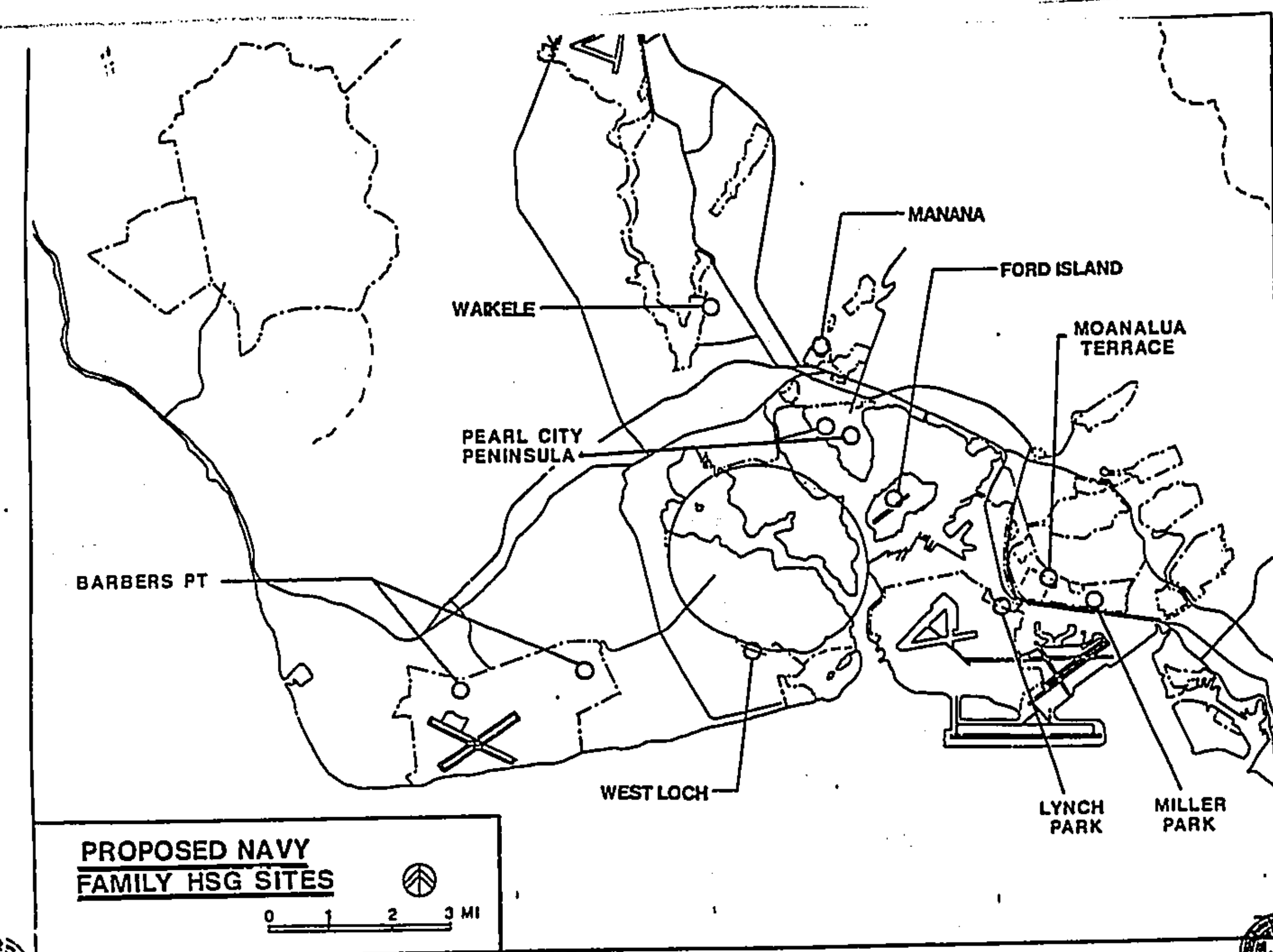
Encl (1)

FAMILY HOUSING NEW CONSTRUCTION

YEAR	LOCATION	UNITS	POPULATION	FLOW (gpd)	PLANT
FY93	Miller Park	190	665	79,800	FK or SI
FY93	Lynch Park	70	245	29,400	FK or SI
FY93	Pearl City Peninsula	160	560	67,200	HONO
FY93	Moanalua	66	231	27,720	FK or SI
FY93	Barbers Point	117	410	49,200	HONO
FY94	West Loch	368	1,288	154,560	HONO
FY94	Barbers Point	257	900	108,000	HONO
FY94	Moanalua	100	350	42,000	FK or SI
FY94	Waikele	130	455	54,600	HONO
FY95	Waikele	126	441	52,920	HONO
FY96	Pearl City Peninsula	270	945	113,400	HONO
FY96	Moanalua	100	350	42,000	FK or SI
FY97	Moanalua	50	175	21,000	FK or SI
FY98	Ford Island	670	2,345	281,400	FK
FY99	Ford Island	330	1,155	138,600	FK
FY00	Manana	68	238	28,560	HONO
	Total	3072	10,753	1,290,360	
	Total Honouliuli	1496	5237	628,440	
	Total FK	1000	3500	420,000	
	Total FK or SI	576	2016	241,920	

FK - Fort Kamehameha WWTP
SI - Sand Island WWTP
HONO - Honouliuli WWTP

Encl (2)



MANANA
FORD ISLAND
WAIKELE
MOANALUA TERRACE
PEARL CITY PENINSULA
BARBERS PT
WEST LOCH
LYNCH PARK
MILLER PARK
PROPOSED NAVY FAMILY HSG SITES
0 1 2 3 MI

End (2)

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

December 15, 1993

WPP 93-645

Commander M.D. Claussen
Department of the Navy
Naval Base Pearl Harbor
Box 110
Pearl Harbor, Hawaii 96860-5020

Dear Commander Claussen:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 14, 1993, 5090(P), Ser N4(232)/3628 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We have evaluated your comments and offer the following responses:

a. Comment: Page 3-1, third paragraph - The Aliamanu Military Reservation Housing is serviced by two pump stations that are operated by the Navy.

Response: The Army's Fort Shafter WWPS was listed as a discrete element of the East Mamala Bay wastewater system because it discharges directly into the Sand Island WWTP. As a result of this, its flow recorder information must be summed with the flow recorder information from the City's Ala Moana, Hart Street, and Sand Island Parkway WWPSs to determine the WWTPs influent flow rate. The two WWPSs that the Navy operates at the Aliamanu Military Reservation Housing discharge into the City's gravity collection system. Therefore the flow from this housing was collected into the modeled flows of the City's system as a point input at the manhole that the Military Reservation flows discharge into the City's system.

b. Comment: Page 5-5 - The land use projections in the planning area does not include planned Navy housing.

Response: Per letter dated July 15, 1993 from Kenneth M. Rappolt, Director DWWM, to Rear Admiral William A. Retz, USN, Commander Naval Base Pearl Harbor, the flows from the new family housing must be treated at Fort Kamehameha WWTP. Therefore, the flows from this planned Navy housing have no impact on the Sand Island WWCS or WWTP.

c. Comment: Page 8-9, Cumulative Impacts - You suggest that in addition to discussing cumulative impacts from discharges from the Sand Island Wastewater Treatment Plant and from the Navy's Fort Kamehameha Wastewater Treatment Plant outfall, the EIS should also discuss effects of the Navy's proposed project to extend the outfall to discharge into deeper water.

Response: The EIS evaluates the potential effect of the SIWWTP discharge at the Fort Kamehameha ZOM using existing data on both discharges and model-predicted data on the Sand Island Wastewater Treatment Plant outfall discharge. This analysis found no significant interaction will exist with the future flows at Sand Island and existing Fort Kamehameha discharge. It is our understanding that for the proposed extension of the Fort Kamehameha Wastewater Treatment Plant outfall, engineering design and environmental impact statement preparation services were solicited in June 1993. Given the timing of the Navy's proposed project, it is not practicable for the East Mamala Bay Facilities Plan EIS to discuss the effects of the Navy's proposed project.

Again, thank you for reviewing the DEIS and providing your comments. If you have any further questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

Kenneth M. Rappolt

KENNETH M. RAPPOLT
Director

DEPARTMENT OF PARKS AND RECREATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

WALTER M. OZAWA
DIRECTOR

ALVIN K C. AU
DEPUTY DIRECTOR

September 21, 1993

TO: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

ATTENTION: RICHARD LEONG

FROM: WALTER M. OZAWA, DIRECTOR
DEPARTMENT OF PARKS & RECREATION

SUBJECT: EAST MAMALA BAY WASTEWATER FACILITIES PLAN
DRAFT ENVIRONMENTAL IMPACT STATEMENT (DEIS)

Thank you for the opportunity to review the DEIS for the East Mamala Bay Wastewater Facilities Plan transmitted to us by Belt Collins & Associates on August 30, 1993.

We note with interest that the study contains little discussion of the disposal of the solid waste or sewage sludge generated by the proposed project other than to say "the preferred alternative is ... conversion to an agricultural amendment and fertilizer." It may be of use to expand your study to describe the agricultural products that will result from the wastewater treatment. This information will enable our department to assess their value for possible use for our landscape maintenance program.

If you have any questions, please call Bob Bevacqua of our Advance Planning Branch at extension 6316.

Acting WALTER M. OZAWA, Director

WMO:ei

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-638

December 15, 1993

MEMORANDUM

TO: MR. WALTER M. OZAWA, DIRECTOR
DEPARTMENT OF PARKS AND RECREATION

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for your memorandum of September 21, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following response.

1. Comment: The preferred alternative includes the conversion of the sludge to an agricultural amendment and fertilizer, but does not include sufficient description of the agricultural products to enable the Parks and Recreation Department to assess their value for possible use in landscape maintenance program.

   Response: The preferred alternative includes the ultimate reuse of the sludge for a beneficial purpose. The study examined processes that could produce either end products for use as soil amendments and fertilizers or that would produce electricity as the end product. The Facilities Plan recommends that City allow market forces to help select the most economical solution through an open bid proposal process. This process would allow specialist in each system to submit a cost to the City for developing a reuse system. This cost would reflect the expected cost of developing the infrastructure to manufacture the product and the expected revenue of its sale. This method is flexible enough to allow the City to bring the system on-line under a conventional public works design, turnkey system, or as an entirely private enterprise. The Parks and Recreation Department's present costs for soil amendments and

fertilizer would be beneficial information to the DWWM at the time vendor proposals are being evaluated.

Again, thank you for reviewing the DEIS and providing your comments. If there are any further questions, please contact Richard Leong at Extension 5863.

KENNETH M. RAPPOLT
Director

DRAFT

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

JOHN C. LEWIN, M.D.
DIRECTOR OF HEALTH

In reply, please refer to:
EMD/WB

September 24, 1993

Mr. Kenneth M. Rappolt, Director
Department of Wastewater Management
City and County of Honolulu
650 S. King Street
Honolulu, HI 96813

Dear Mr. Rappolt:

SUBJECT: East Mamala Bay Interim Facilities Plan and Environmental Impact Statements

We have received copies of the Interim Facilities Plan and the Draft Environmental Impact Statement for the East Mamala Bay study area for review and comment. As you are aware, the Construction Grants program is being replaced by the State Revolving Fund which even now is being used to fund a number of City projects. The Department is finalizing procedures for the review and approval of planning phase documents such as the Project Report (FACPLAN) and the Environmental Assessment Documents (including the Environmental Assessment, the EIS, and the Negative Declaration). To meet Federal requirements for the SRF program, a number of additional items should be addressed for each report.

Enclosed are excerpts from the draft "County Procedures Manual" which detail the necessary criteria. Appendix P contains the Project Report Criteria, while Appendix Q contains the Environmental Assessment Documents Criteria. Also included is Section VI which describes the steps involved in the Planning Phase for all SRF projects.

The East and West Mamala Bay studies will be important documents for future projects within the study areas. It is important that the City inform their consultants of the additional SRF procedures and requirements so that areas of concern can be fully addressed.

If you require further information or assistance, please contact our Wastewater Branch at telephone 586-4294.

Sincerely,

BRUCE S. ANDERSON, Ph.D.
Deputy Director for Environmental Health

DG:bhm

Enclosure

(Rev. 9/20/93)

DRAFT

COUNTY PROCEDURES MANUAL FOR PARTICIPATING IN THE HAWAII STATE REVOLVING FUND LOAN PROGRAM

PREPARED BY THE WASTEWATER MANAGEMENT BRANCH OF THE HAWAII DEPARTMENT OF HEALTH

Revised as of

September 21, 1993

DRAFT

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I. INTRODUCTION

While the federal wastewater construction grants program is being phased out, the Federal Clean Water Act of 1987 provides for the creation of a State Revolving Fund Loan Program capitalized in part by federal funds. The Federal Clean Water Act authorizes below market interest rate loan funding for construction of publicly owned treatment works (POTWs), for implementation of a nonpoint source pollution control management program, and for implementation of estuary conservation and management programs. This document only addresses the issuance of loans for wastewater treatment works. Future programs may be developed to implement loan funding for the other two possible uses.

The 1988 State Legislature passed Act 365 (Appendix A) which established a State Water Pollution Control Revolving Fund (SRF) to supplement the federal loan program. The SRF, including the federal loan funds, is intended to provide loans to the county and state agencies in perpetuity for the construction of POTWs.

This document presents the policies and procedures, general requirements, eligibility criteria and finances of the SRF Program. It is intended to guide counties and state agencies in obtaining SRF loans. Appendix B contains a flow diagram of the SRF loan procedures with questions and answers regarding SRF.

Other available documents which provide explanation of the various activities and requirements of the SRF Program include the Initial Guidance for State Revolving Funds (EPA), Operating Agreement between the State of Hawaii and EPA, and the annual Intended Use Plan (IUP).

II. PURPOSE AND OBJECTIVE

The primary purpose of the SRF Loan Program is to implement the Federal Clean Water Act and various state laws and rules including Chapter 342-34 of the Hawaii Revised Statutes (HRS) and Chapter 11-62 of the Department of Health Administrative Rules (HAR). The Program assists in financing the construction of POTWs necessary to prevent contamination of our groundwater and coastal water resources and to protect and promote the health, safety and welfare of the inhabitants of the State of Hawaii.

VI. PLANNING PHASE

The next phase involves the completion of all planning documents. The two most important documents are the Project Report and the Environmental Assessment Documents.

A. Project Report:

The Project Report addresses and analyzes the project area wastewater needs (including collection, transmission, treatment and disposal). It describes in depth how the proposed project best meets the local problems and needs, and selects a cost-effective alternative for fulfilling these needs. Reference should be made to the Federal Regulations (40 CFR 35.2030) for general guidance in preparing the report.

Appendix P describes the DOH Project Report criteria which should be addressed for each proposed project. The DOH will review the Project Report to assess the scope of the proposed project. Approval of the Project Report will set the stage for the County to submit the project Plans and Specifications.

B. Environmental Assessment Documents:

The Environmental Assessment Documents (EAD's) provide an assessment of the impact of the proposed project on the local environment. The EAD's will consist of an Environmental Assessment (EA), and may also include prior decision documents such as an EIS, FNSI, or NEG DEC if they are relevent to the project. (Prior decision documents five years old or older must be reaffirmed by DOH.)

To prepare and submit the EAD's, the County should follow the procedures and requirements of HRS Chapters 343 (Environmental Impact Statements) and the HAR Chapter 11-200. Reference should be made to A Guidebook for the Hawaii State Environmental Review Process prepared by the Office of Environmental Quality Control (OEQC). The EAD's should be submitted to the OEQC and the DOH.

The first step is the preparation of the Environmental Assessment (EA). The OEQC criteria for the EA are outlined in HAR Chapter 11-200-10 (see the OEQC Guidebook). The DOH criteria are outlined in Appendix Q. If the proposed project does not differ significantly from a project previously assessed by an EIS, FNSI, or NEG DEC, then the EA should state this fact. This statement plus a copy of the prior decision document will then constitute the EAD's for the project.

Federal and State regulations require that each SRF project undergo an environmental assessment process. The DOH is responsible to oversee this process via the State Environmental Review Process (SERP), which is described in Section C.

C. State Environmental Review Process:

The DOH, as the approving agency, is responsible to oversee, review and approve the conduct of the environmental assessment process for all SRF proposed projects so that they are in compliance with all State and Federal requirements. The environmental assessment process is described in HRS Chapter 343 and HAR Chapter 11-200. Again, refer to the OEQC Guidebook for guidance. This assessment of the possible impacts of the project on the present and future environment is required for all projects using state and/or Federal funds. Appendix R outlines the procedures of the State Environmental Review Process (SERP) for all SRF Loan Projects.

The DOH will review the EAD's to evaluate the "significance" of the impacts of the project on the environment as defined in Chapter 11-200-12 (HAR). The significance of the impact will determine the path of the environmental assessment process. If the project will have "significant impact", the County will need to prepare an Environmental Impact Statement (EIS) as outlined in the regulations. If, on the other hand, the project is found to have "no significant impact", the County must then finalize the EA and a Negative Declaration (NEG DEC) will be issued by DOH.

To encourage public participation in all projects, the County must hold at least one public hearing or meeting prior to the finalization of the EIS. In case of a Negative Declaration, the County must provide public notice by way of the local newspaper during the time of the public comment period.

D. Plans and Specifications:

Following submittal of the Project Report, the County should submit the design documents for the project, specifically the plans and specifications (P&S).

The DOH will review and approve the plans and specifications. The review will focus on the scope of work of the project, whether it will meet the discharge requirements as applicable, and whether the project will comply with the federal and state loan program requirements. The County is encouraged to submit as early as possible preliminary engineering design reports, plans and specifications to the DOH for review and comments if so desired. However, the final plans and specifications are required for DOH review and approval prior to the submittal of the loan application.

An important aspect of the DOH P&S review is the determination of the costs of the project which are "allowable" for SRF funding. Project cost items will be classified as either "eligible" or "ineligible" for loan funding. Allowable cost criteria are outlined in Appendix S. When the P&S's are approved and the allowable costs have been determined, the DOH will notify the County by letter, listing any conditions which apply to the project.

D. Value Engineering Study

During the preparation of the Project-Report, the County will assess the estimated construction cost of the proposed project. If the facilities are projected to cost more than $10 million to construct, a Value Engineering (VE) study of the project is required. The VE study should be conducted in accordance with the EPA procedures as found in the EPA publication "Value Engineering for Wastewater Treatment Works" (430/84-009).

If the recommendations from the VE study are not to be used in the project, the County shall explain why the specific recommendations are not being implemented.

E. Federal Requirements

Federal regulations require that certain conditions be met by the County for SRF loan monies prior to the approval of the loan agreement by the State. These conditions apply only to SRF loan projects which use capitalization funds from the Federal government or leveraged funds. These regulations are listed in the "Federal Requirements for SRF Loan Projects" packet which the County has previously received. Appendix H also contains these regulations.

The "General Requirements" refer to the Federal regulations dealing specifically with the construction of wastewater treatment facilities. The "Special Requirements" refer to "cross-cutting" authorities which involve applicable environmental, social, economic and miscellaneous Federal regulations which may apply to the proposed project. The "Construction Contract Documents ("Boiler Plate")" are documents which must be inserted into all SRF construction contracts and subcontracts.

The County will be required, prior to signing the loan agreement, to certify that they have complied, or will comply, with all the Federal authorities determined by EPA as applying to the loan program.

APPENDIX P

PROJECT REPORT CRITERIA

WASTEWATER BRANCH

HAWAII DEPARTMENT OF HEALTH

PROJECT REPORT CRITERIA

The Project Report should describe in detail the scope of the project and contain, at a minimum, the following information:

1. A statement of project needs and benefits, including a discussion of the water quality benefits and/or public health problems to be corrected.

2. A description of both the proposed treatment works, and the complete waste treatment system of which it is a part.

3. A description of the Best Practicable Wastewater Treatment Technology. See 40 CFR 2030(b)(2).

4. A cost-effectiveness analysis of the feasible conventional, innovative and alternative wastewater treatment works, processes and techniques capable of meeting effluent, water quality, and public health needs and requirements over the design life of the facility. The analysis must recognize environmental and other non-monetary considerations in arriving at the cost effectiveness solution. A cost-effectiveness evaluation of alternatives must include:

    a. An evaluation of alternative flow reduction methods.

    b. A description of the relationship between the capacity of alternatives and the needs to be served.

    c. An evaluation of improved effluent quality attainable by upgrading the operation and maintenance and efficiency of existing facilities as an alternative or supplement to construction of new facilities.

    d. An evaluation of alternative methods for reuse or ultimate disposal of treated wastewater and sludge material resulting from the treatment process.

    e. A consideration of systems with revenue generating applications.

    f. An evaluation of opportunities to reduce use of, or recover energy.

g. Cost information on total capital costs, and annual operation and maintenance costs, as well as estimated annual or monthly costs to residential and industrial users.

5. An evaluation of the existence of excessive infiltration/inflow in the existing sewer system.

6. An analysis of the potential open space and recreation opportunities associated with the project.

7. An evaluation of the impact of the project on water supply.

8. The following must be submitted for the selected alternative:

   a. A description of the selected alternative.

   b. A concise description of the relevant design criteria used.

   c. The estimated capital construction and annual operation and maintenance costs (identifying the Federal, State and local shares) and a description of the anticipated manner in which these costs will be financed.

   d. A summary of the cost impacts on wastewater system users.

   e. The institutional and management arrangements necessary for successful implementation.

   f. A demonstration that the selected alternative is consistent with any applicable approved water quality management plan.

   g. A summary of planned public participation in this project. The State requires that the applicant hold a least one public hearing or meeting prior to the submittal of the final EIS for projects requiring an EIS. Each project requiring a NEG DEC must publish a public notice in the local newspaper during the public comment period.

APPENDIX Q

ENVIRONMENTAL ASSESSMENT DOCUMENTS CRITERIA

WASTEWATER BRANCH

HAWAII DEPARTMENT OF HEALTH

ENVIRONMENTAL ASSESSMENT DOCUMENTS CRITERIA

The Environmental Assessment Documents (EAD's) submitted for any SRF project will contain the following:

A. An Environmental Assessment (EA) of the proposed project whick meets the requirements of HAR 11-200-10. (For guidance, see OEQC Guidebook, Chapter VI-B, EA Content Requirements.)

B. The Environmental Assessment should also address the following areas to meet SERP requirements:

1. Population projections shall conform to or be derived from the latest population projection series developed by the State Department of Business, Economic Development and Tourism (DBEDT).

2. The alternatives considered shall include the "no action" alternative.

3. The analysis of alternatives and impacts shall include:

- the primary and secondary (direct and indirect) impacts for all feasible alternatives (to include the "no action" alternative);

- the impacts on social parameters such as land use, recreation and open-space opportunities;

- the cumulative impacts such as anticipated community growth (residential, commercial, institutional, and industrial);

- the impacts on other anticipated public works projects (if any) and the planned coordination with them;

- the impacts on any individual sensitive environmental issues that have been identified through the public participation program.

C. The EA must also address the impacts of the proposed project on other Federal "cross-cutting" authorities to include the:

- Archeological and Historic Preservation Act (16 U.S.C. § 469a-1)
- Clean Air Act (42 U.S.C. § 7506(c))
- Coastal Zone Management Act (16 U.S.C. § 1456(c) (1))
- Endangered Species Act (16 U.S.C. 1536(a)(2) and (4))
- Farmland Protection Policy Act (7 U.S.C. § 4202(B))
- Fish and Wildlife Coordination Act (16 U.S.C. § 662(a))
- Floodplain Management (42 U.S.C. § 4321))
- National Historic Preservation Act (16 U.S.C. § 470(f))
- Safe Drinking Water Act (42 U.S.C. § 300h-3(e))
- Protection of Wetlands (42 U.S.C. § 4321)
- Wild and Scenic Rivers Act (16 U.S.C. § 1271)

D. Prior decision documents (EIS, FNSI, Reaffirmations, Negative Declarations), which have been issued in the past for projects in this area, may be submitted. These documents should contain information applicable or pertinent to the proposed project and have logical relevancy and bearing to the action being proposed.

If the proposed project was included in a prior-decision document as part of a larger project, but does not include major changes in project scope or new major impacts on the environment, then the County should state this information in the EA. The EA need not be an extensive document in this case.

If the prior-decision documents are five or more years old, they must be re-evaluated and reaffirmed by DOH.

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

December 10, 1993

WPP 93-634

Dr. Bruce S. Anderson
Deputy Director for Environmental Health
Department of Health
State of Hawaii
P.O. Box 3378
Honolulu, Hawaii 96801

Dear Dr. Anderson:

Subject: Draft Environmental Impact Statement
<u>East Mamala Bay Wastewater Facilities Plan</u>

Thank you for your letter of September 24, 1993, commenting on the East Mamala Bay Interim Wastewater Facilities Plan and the associated Draft Environmental Impact Statement. We have evaluated your comments and conferred with Mr. Dennis Tulang, Chief of your Wastewater Branch.

You state in your letter that to meet federal requirements for the State Revolving Fund program, additional items should be addressed in the Facilities Plan and EIS.

A review of 40 CFR 35.2030, Facilities Planning, and your Draft County Procedures Manual For Participating in the Hawaii State Revolving Fund Loan (SRF) Program (dated November 9, 1993) indicates that most of the requirements will be addressed in the Facilities Plan and EIS. Among the matters not covered are estimating costs of reconstruction following design service (beyond the planning period); identifying federal, state and local financing shares; scheduling; and identifying institutional and managerial actions required for implementation. These items are considered more project specific and should be addressed on a project by project basis during the SRF application phase. These items will be discussed in our forthcoming review meeting with your staff, scheduled for December 16, 1993, on your Draft SRF County Procedures Manual.

The Department of Wastewater Management will work closely with your staff to ensure that the East Mamala Bay Wastewater Facilities Plan and EIS meet SRF requirements.

If there are any questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

for KENNETH M. RAPPOLT
Director

bcc: E&C

DEPARTMENT OF LAND UTILIZATION
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813 • (808) 523-4432

FRANK F. FASI
MAYOR

DONALD A. CLEGG
DIRECTOR

LORETTA K. C. CHEE
DEPUTY DIRECTOR

93-06615(DT)

September 24, 1993

MEMORANDUM

TO: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

FROM: LORETTA K. C. CHEE, ACTING DIRECTOR

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT (EIS) FOR EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for the opportunity to review the above-described Draft EIS. We offer the following comments:

1. Flood Zones

The Draft EIS mentions that some of the proposals are within flood areas. How will these proposals comply with Section 7.10 (flood hazard regulations) of the Land Use Ordinance?

2. Traffic Assessment (TA)

The TA in Appendix F mentions major streets that will be affected during the sewer line construction. A construction time frame should be given for streets that will be affected.

As mentioned in the Draft EIS, a Special Management Area Use Permit (SMP) will be required for a number of the projects. We will review the proposals further during the SMP process.

LORETTA K. C. CHEE
Acting Director of Land Utilization

LKCC:ak
G:mamala.djt

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

December 15, 1993

WPP 93-637

MEMORANDUM

TO: MR. DONALD A. CLEGG, DIRECTOR
DEPARTMENT OF LAND UTILIZATION

FROM: KENNETH M. RAPPOLT, DIRECTOR
DEPARTMENT OF WASTEWATER MANAGEMENT

SUBJECT: DRAFT ENVIRONMENTAL IMPACT STATEMENT
EAST MAMALA BAY WASTEWATER FACILITIES PLAN

Thank you for your memorandum of September 24, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following responses.

1. Flood zones. You ask how proposed projects within flood areas will comply with Section 7.10 (flood hazard regulations) of the Land Use Ordinance. Discussions on flood zones have been added to the Facilities Plan and EIS. The detailed design of each proposed project, with necessary provisions for construction in the flood hazard districts, will be further addressed during the engineering design phase. Generic approaches for mitigation of flood hazards have been added to EIS Section 7.2.2.

2. Traffic Assessment. You suggest that a construction time frame should be given for major streets, mentioned in Appendix F, that will be affected during sewer line construction. At this stage in facilities planning, a specific time frame for construction has not been determined. However, a table showing the degree of priority assigned to each major sewer line improvement has been added to the Environmental Impact Statement. Those with high priority will be improved first.

3. Special Management Area Use Permits (SMP). You state that your department will review the proposals for projects in the Special Management Area further during the SMP process. Relevant documents will be submitted for your department's review on a timely basis.

Again, thank you for reviewing the DEIS and providing your comments. If there are any further questions, please contact Richard Leong at Extension 5863.

KENNETH M. RAPPOLT
Director

JOHN WAIHEE
GOVERNOR

STATE OF HAWAII
DEPARTMENT OF EDUCATION
P. O. BOX 2360
HONOLULU, HAWAII 96804

CHARLES T. TOGUCHI
SUPERINTENDENT

OFFICE OF THE SUPERINTENDENT

October 8, 1993

Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawai'i 96813

Dear Mr. Leong:

SUBJECT: East Mamala Bay Wastewater Facilities Plan
Draft Environmental Impact Statement

We have reviewed the subject draft environmental impact statement and have determined that some of our public schools in the project boundary from Salt Lake/Aliamanu Crater/Red Hill area to Niu Valley may be affected by the planned improvements to the wastewater collection and treatment system.

The Department of Education (DOE) is concerned about noise, dust, and traffic congestion during construction. We request that the DOE be included in the planning whenever the project is adjacent to or affects a public school campus. Please contact Mr. Alan Honma of the Facilities and Support Services Branch at 737-4743 to coordinate our concerns.

We request that mitigating measures be implemented near schools to prevent any disruptions to the learning environment and daily school operations. If dust and noise levels surpass Department of Health standards, we request that air-conditioning be installed for those schools affected.

Should there be any questions, please call the Facilities Branch. Thank you for the opportunity to comment.

Sincerely,

Charles T. Toguchi

Charles T. Toguchi
Superintendent

CTT:hy

cc: A. Suga, OBS
E. Masagatani, HDO
R. Lee, CDO

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

WPP 93-646

December 15, 1993

Mr. Charles T. Toguchi
Superintendent
State Department of Education
P. O. Box 2360
Honolulu, Hawaii 96804

Dear Mr. Toguchi:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 8, 1993 commenting on the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan. We offer the following responses.

Comment: The DOE is concerned about noise, dust, and traffic congestion during construction and the DOE requests that mitigating measures be implemented near schools to prevent disruptions.

Response: The most probable impact will be from sewer line construction in streets adjacent to schools. This EIS addresses these projects from a programmatic standpoint. Construction activities would create temporary negative impacts in those areas of DOE's concerns. However, each construction project will require the contractor to abide by City and State regulations on noise, dust and other areas associated with construction.

The impact of noise during construction was evaluated in section 8.3.9 of the DEIS. The study found that to some extent the impacts from noise is unavoidable but that it will be of short duration for a specific project. The primary mitigation of the impacts from this noise will be to limit construction activities to daytime periods during off-peak traffic times.

The impact from dust during construction was evaluated in Appendix D. The impact from dust is to be mitigated by maintaining compliance with State and County dust control measures, covering trucks transporting dusty materials, frequent watering of unpaved roads and areas of exposed fugitive dust emissions, and landscaping of exposed soil areas as soon as possible.

The impact from traffic congestion was addressed in Appendix F. The impact to traffic due to the construction activities will occur during midday hours between the morning and afternoon peak traffic periods. Steel plates or other means will be used to cover excavations and construction equipment and barricades will be moved to return traffic lanes to service for peak commuter traffic periods. Construction in road right-of-ways will not generally occur during peak traffic hours.

As requested, to the extent possible, the City will coordinate construction schedules that will potentially affect DOE with its Facilities and Support Services Branch.

Again, thank you for reviewing the DEIS and providing your comments. If you have any further questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

OFFICE OF STATE PLANNING
Office of the Governor
MAILING ADDRESS: P.O. BOX 3540, HONOLULU, HAWAII 96811-3540
STREET ADDRESS: 250 SOUTH HOTEL STREET, 4TH FLOOR
TELEPHONE: (808) 587-2846, 587-2800
FAX: Director's Office 587-2846
Planning Division 587-2824

Ref. No. C-273

September 30, 1993

Mr. Richard Leong
Department of Wastewater Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

Dear Mr. Leong:

Subject: East Mamala Bay Wastewater Facilities Plan
Draft Environmental Impact Statement

We have reviewed the Draft Environmental Impact Statement for the East Mamala Bay Wastewater Facilities Plan and have the following comments.

An applicable Coastal Zone Management (CZM) policy is delineated in the succeeding quotation. "Adopt water quality standards and regulating point and non-point sources of pollution to protect and where feasible, restore the recreational value of coastal waters". Increased wastewater outfall capacities may pose a threat to the recreational value of coastal waters. With the continued urbanization of developable land, coastal recreational resources become even scarcer which emphasizes the need to preserve existing facilities.

Coastal water quality is a significant issue with respect to this proposed wastewater facilities improvement project as stated in the following policy. "Promote water quantity and quality planning and management practices which reflect the tolerance of fresh water and marine ecosystems and prohibit land and water uses which violate state water quality standards".

As stated in the document,"...modeled results indicate continued compliance with water quality standards, with the possible exception of ten and two percent not to exceed standards for ammonia nitrogen". In view of these potential violations of ocean outfall water quality standards, monitoring should be conducted and corrective measures to prevent water quality violations should be employed.

Thank you for the opportunity to comment on this draft environmental impact statement. If you have any questions, please contact Harold Lau at 587-2883.

Sincerely,

Harold S. Masumoto
Director

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

December 15, 1993

WPP 93-636

Mr. Harold S. Masumoto, Director
Office of State Planning
State of Hawaii
P.O. Box 3540
Honolulu, Hawaii 96811-3540

Dear Mr. Masumoto:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank your for your comments to the Department of Wastewater Management on the Draft Environmental Impact Statement (DEIS) for the East Mamala Bay Wastewater Facilities Plan dated September 30, 1993.

We understand and concur with your department's concerns regarding coastal resources management and the need to preserve coastal waters and their beneficial uses, including recreation and fisheries. As required by the Clean Water Act, ocean water quality standards have been established to protect these and other identified beneficial uses. As discussed in the DEIS and the Facilities Plan, analysis of water quality monitoring data collected in accordance with the NPDES discharge permit indicate that all parameters meet the applicable State water quality standard, with the possible exception of ammonia nitrogen, and that the discharge from the deep ocean outfall does not impact shoreline waters. Information inadvertently excluded from the text of the EIS shows that the ten percent and two percent "not to exceed" values, as applied to the Sand Island monitoring data for ammonia, may exceed the statistical limits established in water quality standards. The ten percent and two percent standards were established in water quality standards. The ten percent and two percent standards were established as a measure of variation from the geometric mean value which represents central tendency of the measure, although the water quality regulations do not stipulate a specific methodology for compiling the dataset, and several are potentially employable. The geometric mean standard for ammonia nitrogen is clearly met by the sampled data, but the distribution of the data about the

geomean may not be within the standards. It is clear from monitoring data that there is a significant background level of ammonia in the receiving waters and that the combined concentrations of ammonia are orders or magnitude below levels that could be considered toxic. The second concern associated with ammonia-nitrogen is nutrient loading. Monitoring discloses no response in the ocean environment indicative of nutrient loading. The Final Environmental Impact Statement addresses these issues and includes information from Appendix M of the Facilities Plan which provides the analysis on which the conclusions are based. In addition, ongoing investigations of Mamala Bay by the Mamala Bay Study Commission are underway.

We further point out that, although not specifically addressed by your comments, bacterial data strongly suggests that exceedances in shoreline waters are not associated with effluent discharge from the Sand Island outfall, but are probably attributed to land-based nonpoint sources and human use of the nearshore.

The Final EIS will include a comprehensive discussion and your comments. If you have any further questions, please contact Richard Leong at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

GOVERNOR OF HAWAII

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

BOARD OF LAND AND NATURAL RESOURCES

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HISTORIC PRESERVATION
LAND MANAGEMENT
STATE PARKS
WATER AND LAND DEVELOPMENT

REF:OCEA:SKK

OCT 11 1993

FILE NO.: 94-109
DOC. NO.: 3559

The Honorable Kenneth M. Rappolt, Director
Department of Wastewater Management
City and County of Honolulu
650 South King Street, 14th Floor
Honolulu, Hawaii 96813

ATTN: Mr. Richard Leong

Dear Mr. Rappolt:

SUBJECT: Draft Environmental Impact Statement (DEIS) for the <u>East Mamala Bay Wastewater Facilities Plan, Honolulu, Oahu</u>

We have reviewed the DEIS for the proposed project transmitted by Mr. John Goody's letter dated August 30, 1993, and have the following comments:

<u>Division of Aquatic Resources</u>

The Division of Aquatic Resources comments that since the DEIS describes upgrades that will increase the capacity and improve the reliability and efficiency of the present system, there can be no patent objection to its implementation. Proposed changes will reduce harmful discharges caused by backups, spills and overflows. As such, these changes represent an improvement over the present system and are desirable. However, from the standpoint of protection of the marine environment and its living aquatic resources, there is a concern regarding the selection of a course of action which does not involve upgrade from primary sewage treatment. Considering increases in the plant capacity, new connections and the inevitable growth of existing communities, it is doubtful that this level of discharge will <u>not</u> have significant impacts by the year 2015.

Recognizing the economic constraints involved in an upgrade to a higher level of treatment, it must still be seen that long term impacts on marine organisms in the vicinity of the deep ocean outfall are likely if sewage is treated only to the primary level before discharge. This possibility was highlighted in a recent proposal to the University of Hawaii Sea Grant College Program by researchers wishing to characterize and describe the coastal distribution of cutaneous tumor observed on goldring surgeon fish

(Ctenochaetus strigosus) in the vicinity of the Sand Island outfall. The researchers cited a relatively high incidence (30-40%) of visible external tumors in this species in areas offshore of the Honolulu Airport reef runway as the basis for their interest in conducting an in-depth study. Tumor incidence in other areas was in the range of 2-50%. While there has been no research to date to fully document this occurrence or the source of the apparent carcinogen, the proposal indicates there may be cause for concern.

While the EPA has allowed a waiver of the requirement of secondary sewage treatment at several sites in Hawaii in the past, it would be prudent to begin seriously considering gradual upgrade to secondary treatment standards. The DEIS describes probable application for expansion of the zone of mixing (ZOM) as flow increases in the future and begins to exceed standards for nitrates in open waters. Rather than to continue increasing the ZOM in response to increased sewage effluent as population growth occurs, the decision should be made to significantly reduce concentrations of objectionable substances through enhanced sewage treatment. This idea begins to emerge in the present plant with the concepts of thermal drying, alkaline stabilization, composting, and use of the Carver-Greenfield method to generate a fuel by product, but is not yet fully developed.

Since so little is known about the impacts of discharging primary treatment effluent into the ocean, there is neither cause for alarm nor justification for a lack of concern. It would be preferable to err on the side of caution than to lament detrimental impacts at a later date. Table 4-6 of the DEIS confirms the existence of a number of toxic and carcinogenic substances in wastewater sludge. Although the concentration of these substances is reduced in effluent, their cumulative effect in the marine environment in the vicinity of the outfall is unknown.

Thus, while this DEIS may be adequate today and improvements to the system are desirable, it is doubtful that this system will withstand rigorous standards of environmental quality necessary to ensure the continued health and well being of marine organisms. Having developed a full range of alternatives, it is recommended that the feasibility of eventual upgrade to secondary treatment be given further consideration, since this may be the alternative that will ensure adequate protection of the marine environment.

<u>Commission on Water Resource Management</u>

The Commission on Water Resource Management's (CWRM) staff comments that contrary to what is stated in Section 2-9-5 of the DEIS, the statutory provisions of the State Water Code <u>do apply</u> to this project. The pertinent provision is that which relates to the stream protection program wherein a permit system (Section 13-169-50, Hawaii Administrative Rules) is administered by the CWRM to regulate the alteration of stream channels. Accordingly, the City Department of Wastewater Management is reminded that Stream Channel Alteration Permits (SCAP) will be required for proposed activities that directly impact stream channels within the project area.

Historic Preservation Division

The Historic Preservation Division (HPD) comments that the DEIS very capably summarizes archaeological information from this large area and provides responsible preliminary recommendations for archaeological research that should prove useful to planners. It is very likely, however, that information on prehistory will change substantially over the period covered by this plan and that recommendations for archaeological research to comply with historic preservation laws will change correspondingly. In some instances, this might result in recommendations for an increased level of archaeological research; in others a decreased level. In any event, individual projects proposed as part of this twenty-year plan will be reviewed by HPD, and this review should ensure that the preliminary recommendations in the DEIS are brought into line with current information.

The Archaeological Assessment included as Appendix G is, in substance, well done. However, the document appears to have been hastily produced, as evidenced by numerous spelling and production errors and a bibliography that is not ordered alphabetically. It would be useful to have a copy of this report in which these errors have been corrected.

Office of Conservation and Environmental Affairs

The Office of Conservation and Environmental Affairs comments that any projects to be conducted within the State Conservation District will have to comply with the Conservation District regulations of Chapter 183-41, Hawaii Revised Statutes and Title 13, Chapter 2, Hawaii Administrative Rules.

We have no other comments to offer at this time. Thank you for the opportunity to comment on this matter.

Please feel free to contact Steve Tagawa at our Office of Conservation and Environmental Affairs, at 587-0377, should you have any questions.

Very truly yours,

KEITH W. AHUE

cc: John Goody, Belt Collins Hawaii
Brian Choy, OEQC

DEPARTMENT OF WASTEWATER MANAGEMENT
CITY AND COUNTY OF HONOLULU
650 SOUTH KING STREET
HONOLULU, HAWAII 96813

FRANK F. FASI
MAYOR

KENNETH M. RAPPOLT
DIRECTOR

FELIX B. LIMTIACO
DEPUTY DIRECTOR

December 15, 1993

WPP 93-650

Mr. Keith W. Ahue, Director
Department of Land and Natural Resources
State of Hawaii
P. O. Box 621
Honolulu, Hawaii 96813

Dear Mr. Ahue:

Subject: Draft Environmental Impact Statement
East Mamala Bay Wastewater Facilities Plan

Thank you for your letter of October 11, 1993, providing comments on the subject EIS. In response to the matters you have raised, we offer the following additional thoughts and will take action as noted.

Division of Aquatic Resources expressed concerns for the long term impacts of primary treated sewage effluent on the marine environment and its living aquatic resources. The incidence and distribution of cutaneous tumors among goldring surgeon fish in the vicinity of the Honolulu Airport Reef is mentioned as an anecdotal example of the concern. Upgrading to secondary treatment is recommended by Aquatic Resources as a consequence of these concerns.

In evaluating the necessary treatment level, a number of criteria were used. The facilities plan is required in 40 CFR 35.2030 to demonstrate that the selected alternative is "...the most economical means of meeting the applicable effluent, water quality, and public health requirements over the design life of the facility, while recognizing environmental and other non-monetary considerations." For open coastal class A waters, water quality standards are designed to allow specified uses while providing for the "protection and propagation of fish, shellfish, and other wildlife".

To evaluate the need for higher levels of treatment, a detailed investigation and analysis was made of the present impacts of the Sand Island WWTP discharge on water quality and aquatic resources. Summary information was included in the DEIS and Appendix C thereto. More of this information will be included in the final EIS. Examination of water quality monitoring data, two benthic surveys and one study of fish communities along the Sand Island Deep Ocean Outfall (Brock, 1992) disclosed no evidence of significant adverse impacts on water quality, on the type or number of species present, or on the populations of benthic or nektonic organisms. There is no evidence that criteria for renewal of the 301(h) waiver of secondary treatment cannot be met.

Projections for growth in wastewater discharge flows over the study period indicate that by the year 2015, approximately 11% to 14% more effluent will be discharged. Modeling water quality impacts of this growth at the primary treatment level indicates that existing water quality standards will not be violated at the existing zone of mixing boundary under current procedures and standards. ZOM expansion may be necessary only with regard to the two and ten percent standard for ammonia. The method in State regulations for demonstrating compliance is ambiguous, and background concentrations may contribute to high readings.

Lacking evidence of significant environmental impact on water quality or on aquatic communities, there is no basis for recommending a transition to secondary treatment at the SIWWTP at this time. The elevated incidence of tumors in goldring surgeon fish is not associated with the Sand Island outfall and would not be affected by conversion to secondary treatment, as that conversion does not necessarily remove carcinogens and toxins from the waste stream. The significant cost of secondary treatment and the essential doubling of the amount of solids that would require processing and disposal under the alternative mitigate against this. However, given the administrative uncertainty in obtaining renewal of the 301(h) waiver, and given that ongoing investigations of Mamala Bay by the Mamala Bay Study Commission may develop additional information of concern, the preferred alternative is configured to allow for a relatively cost effective transition to secondary treatment in the future should the need occur.

Regarding the applicability of the State Water Code to the Facilities Planning process, Section 2-9-5 of the final EIS will be modified to reflect the need for a Stream Channel Alteration Permit should it be required by an implementing project.

Regarding Appendix G, the Archaeological Assessment will be further edited to eliminate typographical errors and other irregularities.

Again, thank you for reviewing the DEIS and providing your comments. If there are any questions, please contact our project engineer, Richard Leong, at 527-5863.

Very truly yours,

KENNETH M. RAPPOLT
Director

EAST MAMALA BAY
FACILITIES PLAN AND EIS
PUBLIC INFORMATIONAL MEETING
August 31, 1992

The meeting began with a presentation by Belt Collins and Associates describing the background leading to the study, the study area, the issues to be addressed in the study, and the public participation program.

The purpose for the meeting was presented as follows:

1) To announce and share information about the proposed study;

2) To discuss the proposed points and issues of the study and to ask the public if any major issues or concerns need to be added to the study;

3) To present the timetable for the study; and

4) To discuss the citizen participation aspects of the study.

After the presentation, the public was asked to identify any additional areas they felt needed to be addressed that hadn't been included in the presentation of the scope for the study.

Q: Will the study use effluent levels as they are set today even if the EPA sets new standards such as requirement for secondary treatment?
A: The study will conform to standards that are in existence at the time of the finalization of the study. We will definitely be looking at the question of secondary treatment.

Q: If EPA changes the ambient standards for effluent discharge will the plan take this into account?
A: Yes. [Ed. Note: As long as the changes are made prior to the finalization of the study.]

C: The Mamala Bay Commission has been formed and we hope to be able to incorporate their findings into the Facilities Plan.

Q: Will the study look at the need for toxic waste provisions and provide for any plans for toxic waste disposal?
A: We will be considering this.

Q: Why is the City and County doing this study if the Mamala Bay Commission exists to do the same thing?

A: The Mamala Bay Commission is court ordered whereas the facilities plan will look at a broad range of topics. As previously mentioned we would hope to be able to use some of the information gathered by the Commission. Hopefully, the timing will be correct so that we can incorporate the Commission's findings into our study. [Ed. Note: We will coordinate with the City if the timing is not appropriate.]

Q: Will the age and reliability of the existing collection system be studied?

A: Yes.

Q: Will the military be providing data or are they a black box?

A: We have asked the military for data.

Q: How is the needed future capacity of the system being assessed? What numbers are you using?

A: State population projections are being used along with development plan land use patterns. We are looking to take the projections out to 2015.

Q: What are your population projections based on when you tie them to land use designations?

A: We are working with the 11 categories used by the City and County. [Ed. Note: The population projections used by the City and County reflect land use policies in the General Plan and Development Plan. The projections include number of residents, hotel rooms, dwelling units, and jobs in 10 sectors.]

Q: What level of detail will be studied? Will you get into parcel by parcel?

A: We are going to work with Development Plan levels. We could perform planning down to the tax map key parcel, but for the purpose of population projection, it was decided to stay with Development Plan parceling. We will also be looking at Traffic Area Zones (TAZs) used by the City and County. We will be trying to break it down into as much detail as possible. [Ed. Note: The system can provide the parcel by parcel detail, but for Facilities Planning, this level of detail is not necessary.

Q: What is the median population per household that you will be using?

A: We will be using city standards based on 3.2 person per household. [Ed. Note: Actual City design standards are 4 persons per home and 2.8 persons per apartment unit, from which flow is calculated.]

There being no further questions, the meeting was adjourned.

East Mamala Bay Facilities Plan
and Environmental Impact Statement (EIS)
Public Information Meeting, December 14, 1992

The meeting was the second in a series of four public meetings designed to gather input from the public concerning the East Mamala Bay Facilities Plan and EIS. The agenda for the meeting was as follows.

I. **Welcome and Introduction**
(Mr. Richard Leong, Department of Public Works, Division of Wastewater Management)

II. **Meeting Format and Process**
(Mr. John Goody, Belt Collins & Associates)

III. **Configuration of Alternatives and Selection Criteria (Mr. Goody)**
- A. Future Scenarios (Mr. Goody)
- B. System component options (Mr. Leland Lee, Belt Collins & Associates)
- C. Objectives of alternatives (Mr. Goody)
- D. Selection criteria (Mr. Goody)

IV. **Discussion of Alternatives (Mr. Lee)**
- A. Description of the five alternatives (Mr. Lee)

V. **Public Comment**
- A. Comment on criteria for evaluation - additional criteria, relative importance
- B. Comment on alternatives - additional alternatives to be considered

VI. **Environmental Impact Statement (EIS)**
(Mr. Lee Sichter, Belt Collins & Associates)
- A. Process and schedule
- B. Public comment - issues to be addressed in the EIS

VII. **Closing Remarks (Mr. Leong)**

I. Welcome and Introductions

After a brief welcome and introduction by Richard Leong from the Department of Public works, Division of Wastewater Management, it was explained that this was the second public information meeting aimed at presenting the range of alternatives for the East Mamala Bay Facilities Plan and Environmental Impact Statement. Public comments on these alternatives were to be solicited.

II. Meeting Format and Process

Mr. John Goody from Belt Collins & Associates (BCA) explained the meeting format and study process, in addition to an overview of the public participation component and schedule. He reiterated that the intent of the evening's meeting was to provide information on alternatives and selection criteria and to solicit the public's input on what elements were missing and any comments on the alternatives themselves.

Ground rules were presented by Facilitator Deedee Letts which included:

(1) Extending courtesy to all who are participating and sharing their concerns;
(2) Not interrupting others while they were presenting their questions/concerns/comments;
(3) It's okay to disagree; and
(4) Wherever possible, keeping the discussion focused.

III. Configuration of Alternatives and Selection Criteria

Mr. John Goody discussed the study area and projected future conditions. There are trade-offs involved: the biochemical oxygen demand in the effluent decreases as treatment increases; however, the amount of solids to be disposed of increases as treatment level increases.

Mr. Leland Lee from Belt Collins & Associates explained the seven system components and options and how each becomes a decision module for consideration. The system components included: (1) Collection - Sewered areas; (2) Treatment - Sewered areas; (3) Collection and Treatment - Unsewered areas; (4) Treatment Level; (5) Effluent Disposal; (6) Solids Treatment and Processing; and (7) Kuliouou.

Mr. John Goody explained the five objectives used to configure the alternatives and the process used to evaluate the alternatives. Selection criteria used to evaluate the alternatives were discussed. It was noted that selection criteria need to be consistent, and understandable in order to be applied to the selection process.

Clarifying questions were fielded from the audience and included the following:

Mr. Madlener: With regard to the unsewered areas: Are they low density, sparsely populated areas?

BCA: More information needs to be obtained about population in these areas and the number of houses. But some of these unsewered areas are sparsely populated.

Unidentified Speaker: With regard to composting: How much land area would it need? How much material would be produced? How much biomass would be needed?

BCA: We have estimated that composting would require about five acres or less. There are different methods of composting which could conserve a lot of space and reduce odor.

IV. Discussion of Alternatives

Mr. Lee described the five alternatives in greater detail. The five alternatives are:

- No action
- Optimize existing system
- Meet water quality standards
- Secondary treatment
- Eliminate/reduce ocean discharge

Clarifying questions were asked and included:

Unidentified Speaker: How were the size calculations made for the treatment plant layouts which were used in the presentation?

BCA: Sizes were based on an average flow of 111 million gallons per day, with additional consideration for peak flow of approximately 200 million gallons per day.

Unidentified Speaker: Why did you specify tertiary treatment would be required if sewer effluent reuse is planned?

BCA: For underground injection, wells and injection structures could get clogged, so filtering of the effluent is needed. Also, for irrigation systems, bacteria and colloidal matter could clog the system, so filtering is necessary. Therefore, we are suggesting tertiary.

Unidentified Speaker: With regard to the handout, Alternative #2: Optimizing... states it will attain water conservation measures that would result in a decrease of wastewater generated. But that doesn't seem to be mentioned in the higher numbered alternative.

BCA:	You could achieve about a ten percent reduction of flow. But there would be very little reduction of solids, which is what we were concerned with in the design. Also, a ten percent reduction may not eliminate one of the treatment units.
Unidentified Speaker:	Can the secondary treatment alternative look at reuse as an option?
BCA:	Existing DOH rules require reused effluent to have some form of tertiary treatment, primarily filtering and disinfectant.
Unidentified Speaker:	Did you consider land application as a method of disposal for anything other than tertiary-treated effluent?
BCA:	We considered wetlands; 6,000 acres of land would be needed. A wetlands system uses flooding, and normal land application doesn't, so even more land would be needed.
Unidentified Speaker:	Consultants need to take another look at the option of land application for effluent receiving secondary treatment.
BCA:	We will consider this. Incidentally, the DOH is currently forming regulations that will require filtration of effluent for reuse for irrigation.

V. Public Comments

Mr. Madlener:	There is an assumption that is being made that there will be more influent and that this influent can be handled; and that the outfall can handle it.
Mr. Madlener:	The cumulative effect in Mamala Bay of this outfall and the outfall of Honouliuli need to be considered.
Mr. Madlener:	It is also assumed that there will be no harm to the water quality. Must be careful about making any kind of assumptions.
Mr. Madlener:	Outfall is not safe. Water quality will be harmed. Counts of bacteria along the shoreline are increasing and now exceed state standards.
Mr. Madlener:	Need to consider other factors more thoroughly (i.e., unsafe water issues).

BCA: Related to concern about more influent:

- The maximum influent figures are based on build-out of existing development plan land uses.
- Consultants reviewed population projections (MK) and modified and corrected the projections based on current year data to adjust from maximum buildout flows.
- Model flow was computed for use as a predicting mechanism.

BCA: Related to concern about cumulative effect of Mamala Bay outfalls:

- The study has not yet looked at cumulative interactions among three wastewater treatment discharges (Sand Island, Honouliuli, and Fort Kamehameha) into Mamala Bay.

BCA: Related to the assumption that outfall can handle more influent:

- Calculations show that it can handle projected flows.
- Consultants looked at State and City's NPDES data collected at that location.
- Also looked at a model that was done by Noda.
- Calculations were based on existing outfall, over a period of time. Projections of impacts were based on WQ data collected by the State and City for parameters, including benthic communities, effluent toxicity, criteria pollutants, and priority pollutants. Samples were collected from zone of mixing, nearshore, and offshore stations over a two year period.
- Looked for signs of stress or violations of health or environmental standards.
- Unable to find evidence showing any significant negative response to present conditions.

BCA: Related to unsafe water issues:

- Nearshore problems seem to correlate more with precipitation and weekend use implying land-based origin. The age of the existing collection system may potentially contribute to this source.
- Available data did not show correlation between bacterial measures from the offshore and nearshore stations, implying that nearshore contamination is not originating offshore at the ocean outfall.

Mr. Madlener: Concern with waiver issue should not depend on waivers even if we are granted one. There is no guarantee that it would continue to be granted.

BCA: There is a need to research this further.

Mr. Holmes: Legal/regulatory framework (i.e., disinfection issue, spare parts inventory, infiltration/inflow) is much more complex and must be reviewed and discussed in greater detail.

- EPA order mandates City to reduce its infiltration/inflow problems.
- Existing permit/permit requirements need to be factored in and discussed in the requirement to meet water quality standards.

Mr. Holmes: Legal/regulatory framework changes over time.
- Can assume that these standards will get tougher.
- Need to look beyond today and meet future criteria.

Mr. Holmes: Standard reported for enterococci content should be 7 not 35 per 100 mL of water.

BCA: The old standard is 35. Seven was used in the evaluation.

Mr. Holmes: Should also consider zoning and development plans for the area and factor these in. Density may be increased in this area as the City looks at intensifying the urban core rather than encouraging rural sprawl. Need to keep the rate of future growth under consideration.

Mr. Holmes: When looking at economic feasibility, must look beyond user fees and consider other alternatives.

Mr. Holmes: Should also look beyond waiver alternative.

Mr. Holmes: There needs to be a balance between fines imposed by regulatory agencies for noncompliance and what it costs to take preventative actions.

Mr. Holmes: In preparation of alternatives, isolated development hot spots need to be included and factored into projections.

Mr. Holmes: Nothing should be discarded for future consideration.

Unidentified Speaker: Who will bear the burden of proof? Is the data adequate?

BCA: Related to the adequacy of data:
- The cause of high bacteria counts is not determined; information that exists does not show any measurable cause and effect between the outfall and nearshore water pollution problems. Several years from now, the data will be much more conclusive.

Mr. Holmes: The Mamala Bay Study Plan includes bacterial indicators which may not be adequate and would lead to wrong decision-making.

Mr. Madlener: Need to look beyond an engineering point-of-view and include a biological point-of-view.

- Need biological assessment to review impacts.
- Data being collected address water quality standards.
- Use data to draw inference and determine cause and effect.

Mr. Madlener: Cost figures vary widely and dollar amounts need to be provided, especially with regards to cost effectiveness for all alternatives. Assumptions need to be aired fully.

Mr. Madlener: Cost statements have to be real and justified.

City: The intent of this Facilities Plan is to lay out all of the requirements. The specifics of the recommended alternatives will be backed up with technical and environmental information which will be contained in the report.

Mr. Holmes: Should consider federal tax incentives for alternative fuels (i.e., methane gas production). Should consider sludge disposal as an option.

Mr. Holmes: Should also be sensitive to the ways plants' by-products offset operating and maintenance costs.

Mr. Holmes: Infiltration numbers need to be seriously looked at.

VI. Environmental Impact Statement (EIS)

Mr. Lee Sichter explained the EIS process and encouraged the public to continue to be involved in the process as well as provide any issues, concerns, or comments for consideration and inclusion in the EIS. Other public comments regarding the EIS included:

Unidentified Speaker: Possible need for epidemiological study.

Mr. Madlener: Reporting methodology for cases turning up at doctors' offices or hospitals needs to be coupled with epidemiological study.

Unidentified Speaker: When will the Mamala Bay Commission study this issue and what is the time relationship between the Commission's report and this current effort?

City: The Commission study should be completed by 1994/1995. The City is mandated by the court to finish the Facilities Plan by December 31, 1993.

Mr. Madlener: Decision should be based on merits...not another political study.

V. Public Comment

Each member in attendance at the meeting was given three self-adhesive dots and asked to use them to prioritize the categories of selection criteria and the selection criteria themselves within each category. The following presents these in their order of importance to those in attendance.

CATEGORIES

Health & Safety (6 votes)

Implementation Feasibility (5 votes)

Criteria under Health & Safety

Public Health & Safety (6 votes)

Environmental (3 votes)

Regulatory (1 vote)

Criteria under Implementation Feasibility

Reliability (9 votes)

Cost (2 votes)

Technical Feasibility (0 votes)

Social (0 votes)

EAST MAMALA WASTEWATER FACILITIES PLAN AND DRAFT EIS
PUBLIC MEETING NO. 3
AUGUST 30, 1993

GROUP MEMORY

I. Welcome and Introductions

The meeting opened with remarks by Richard Leong, Project Engineer for the City and County of Honolulu, Department of Wastewater Management. Mr. Leong turned the meeting over to Mr. John Goody the senior project planner from Belt Collins Hawaii. Mr. Goody introduced his project team and the facilitator for the evening.

II. Meeting Format and Process

The facilitator explained to the group that the purpose of this evenings meeting was to 1) describe and gather input on the preferred alternative, 2) to respond to technical questions from the public present, and 3) to discuss impacts and mitigation measures. The input gathered would be considered by the planning team for incorporation into the Facilities Plan and EIS. Participants interested in receiving this group memory were asked to please sign in. Participants were also informed that written comments on the Draft EIS would be accepted up to October 7, 1993. It was also explained to the group that the function of the group memory was to briefly summarize the comments and concerns expressed by the group and that a court reporter was present to produce a transcript of the meeting. The group was asked to check the group memory and make corrections if their comments were being inaccurately recorded.

The group was reminded that this meeting was the third in a series of four meetings concerning the project and that the next meeting would be in December. The December meeting will be a public hearing to receive comments on the Final EIS. Everyone who signs in legibly tonight will be notified of that meeting place and time when it is set.

III. Summary of Presentation

The consultants next walked the group through the handout that was distributed. The issues covered were 1) an overview of the planning process to date, 2) a description of the preferred alternative, and 3) a discussion of the short and long term impacts and the proposed mitigation measures.

Overview of planning process to date

- The first meeting was held August 31, 1992, at which Belt Collins presented the project description, the planning timeline, the outcomes of the process to date. They then asked the public to identify major issues or concerns that they would like to see addressed during the process.

- The second meeting was held on December 14, 1992, the discussion at this meeting focused on the alternatives to consider in meeting the county's wastewater needs in 2015 and the criteria that should be used to assess the proposed alternatives. The public was invited to comment and express preferences about the criteria that should be used to evaluate the alternatives.
- The third meeting is this evening's.
- The fourth meeting will be held in December as an official public hearing.

Description of Preferred Alternative

The consultant presented the alternatives considered:

- No action
- Optimize operation of existing system (no capital investment)
- Make necessary investment to meet Water Quality Standards
- Secondary treatment
- Elimination/reduction of ocean discharges

The preferred alternative was chosen as **Make necessary investment to meet Water Quality Standards.** The presenter then described what combination of facility options they felt would best implement this alternative. The preferred alternative has 7 components:

- Collection - Sewered Areas
- Treatment for Sewered Areas
- Collection and Treatment - Unsewered Areas
- Treatment Level - Expanded Primary
- Effluent Disposal - Outfall
- Solids Processing and Disposal - Re-use with landfilling and incineration back-up
- Kuliouou Option - Re-direct to Sand Island WWTP

Clarifying questions on material presented so far:

Q: Is the study proposing to redirect all of the flow from the treatment plant at Sandy Beach to Sand Island?

A: No. The Hawaii Kai WWTP currently takes flows from the Hawaii Kai and Kuliouou areas; the study proposes that only Kuliouou flows be redirected to the Sand Island WWTP.

Short and Long Term Impacts

The consultant next summarized the short-term, long-term and cumulative impacts of the preferred alternative. The most significant long term negative impact is the commitment of tax dollars to the project which will preclude their use for other needs. It was noted that the cumulative cost per household factoring in multiplier effects would be approximately $11.27 a month above existing levels. Traffic impacts will be the most significant across the whole project area since the plan calls for multiple projects at various locations which will be disruptive to traffic.

IV. **Public Comment: Questions in clarification of material presented. Comments on the material presented.**

The Group Memory attempts to be true to the comments made at the meeting. If comments include inaccuracies or incorrect information, the Group Memory recorded them as presented and no attempt was made to correct any comments. All comments were taken into consideration in the Facilities Plan and EIS revisions.

Fred Madlener, Representing Hawaii's 1000 Friends
Comment: The program for this study is based on assumptions.

- There are no limits on what Mamala Bay can handle
- No information is provided as to how the new plan will handle increased outfall volume due to increasing population
- Do not see that the plan contemplates hurricanes, floods, storms, etc.
- Sees that the plan assumes there is a continual process of 301(h) waivers for the wastewater treatment plant as under the plan as described it will never meet the federal requirement for secondary treatment
- Does not see the cumulative impacts of sewerage on the ocean addressed
- Study does not appear to want to look at limiting factors

All of this results in more waste, sewerage, effluent at Sand Island, more sewerage at the outfall, and more business as usual. The plan is based on assumptions that call for improvements, but do not call for changes. The City has asked for a second opinion from Belt Collins for their general perspective and assumptions because there is no department in the City to cumulatively process all the different areas of study and information needed. Belt Collins should examine a worst case scenario. Does not see adverse factors, or how the facility will work. The sites are situated in low lying areas, and there is no information on how the City will defend the low lying pump stations in the event of a natural disaster. More attention needs to be paid to this.

Richard Leong
Response: Pump stations are in the low parts of the island to transmit sewage from the low point on its way to the treatment plant.

Jeff Highee
Question: Regarding the Kuliouou Pump Station: Has there been a feasibility study on leaving this as is versus re-directing all of the Hawaii Kai

Sewer Treatment load to the Honolulu treatment plant?

Leland Lee
Response: Kuliouou Pump Station currently has the capacity to implement this plan. Hawaii Kai is a private system and the cost of upgrading this system to meet City standards is not feasible.

Fred Madlener
Comment: Concern that what Belt Collins is recommending is setting the City up for legal ramifications.

Clara Olds
Comment: Regarding "significant economical impacts". She feels that the long term benefits of upgrading the system for our children and our children's children are not adequately played up as benefits - that when viewed this way the costs are not so astronomical. She feels that the study should reflect this view point.

John Goody
Response: Economic impact is significant. Balancing economic and environmental or public health concerns is why the criteria were developed. The cost of the preferred alternative is substantial and must be considered a significant negative impact because of the alternative public uses to which these funds cannot be put if spent on this project.

Fred Madlener
Comment: There needs to be more attention to a "worst case scenario". All potential impacts need to be looked at. What about the shoreline impacts from outfall and why are you not looking at the zone of mixing?

John Goody
Response: There have been studies on the economic value of ocean recreation in the Waikiki area. Other information sources (i.e. UH data models, stratification, bacteria samples, other consultant's models, etc.) have also been studied, and there is no evidence that this outfall is having significant effects. Significant near shore effects have been demonstrated from shoreline/urban run-off. Expending funds to improve the zone of mixing to remedy shoreline effects would be ineffective.

Fred Madlener
Comment: The benthic community around the outfall is not impacted because effluent is rising from the outfall. I see further argument in this area, need to look at the column rising from the outfall to get accurate data on impacts.

Richard Leong
Response: The Mamala Bay Study Commission is conducting a court directed study that is to answer this very issue.

V. Closing **Administrative remarks about commenting on the DEIS**
Next steps in the process and future meetings.

Participants were reminded that if there is the intent to submit written comments to the DEIS, that these should be submitted no later than October 7, 1993. These comments will be included in the Final EIS report.
A formal public hearing on the Facilities Plan will be scheduled for mid December.

ORGANIZATIONS AND INDIVIDUALS WHO ASSISTED IN THE PREPARATION OF THIS EIS

This Environmental Impact Statement was prepared for the Department of Wastewater Management by Belt Collins Hawaii with input provided by consultants. The following Belt Collins personnel and consultants were involved:

Belt Collins Hawaii

Larry Agena	-	Chief of Engineering
Leland Lee	-	Engineering Project Manager
John Goody	-	Planning Project Manager
Molly Kihara	-	EIS Project Manager
Calvin Matthews	-	Environmental Engineer
Walter Billingsley	-	Environmental Engineer
Kristie Ching	-	Environmental Engineer
Kendall Lui	-	Civil Engineer
Pam Tsugawa	-	Engineering Aide
Kathy Dadey	-	Planner
Lee Sichter	-	Planner
Dielle Havlis	-	Planning Aide

Consultants

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Flora	-	Evangeline Funk
Fauna	-	Phillip L. Bruner
Air Quality	-	Jim Morrow & Associates
Traffic	-	Wilbur Smith & Associates
Recreation	-	John Clark
Economics	-	Thomas Loudat
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Appendices

Appendix A

See Separate Volume

Appendix B

THE ECONOMIC IMPACTS OF THE EAST MAMALA BAY FACILITIES PLAN

INTRODUCTION

Mamala Bay represents one of seven municipal wastewater districts on the Island of Oahu. It in turn is divided into two subdistricts - East and West Mamala Bay. A Facilities Plan for the East Mamala Bay subdistrict was initiated because the present wastewater system is operating at 88% of its design capacity which will be exceeded given projected population growth over the next 20 years. Portions of the sewage collection system are presently operating at or near 100% capacity. The intent of the East Mamala Bay Facilities Plan (Facilities Plan) is to assure that any proposed wastewater treatment system to expand the East Mamala Bay wastewater treatment system is built on the basis of economic feasibility and optimality (i.e. selection of the most cost effective alternative) subject to environmental constraints (i.e. legally mandated minimum air and water quality standards). The intent of the Facilities Plan companion Environmental Impact Statement is to assess the environmental impacts of the Facilities Plan.

The Environmental Impact Statement outlines and reviews expected environmental impacts of the Plan. One component of the Facilities Plan is the expected economic impacts. The economic impacts include expected economic benefits and costs of Facilities Plan alternatives. The economic impact of the East Mamala Bay Facilities Plan is the primary focus of this economic impact assessment.

Objective

The objective of this analysis is to quantify the economic impacts of the East Mamala Bay Facilities Plan alternatives. Specifically, this will entail:

1. Assessing Facilities Plan alternatives estimated costs;
2. Determine Facilities Plan impacts on governmental expenditures;
3. Determine Facilities Plan impacts on governmental revenues;
4. Determine Facilities Plan benefits.

Methodologies to achieve each of the objectives are first presented. Results of the analysis follow.

METHODOLOGY

Alternatives Cost Estimation

The Facilities Plan desegregates the wastewater collection-treatment system into seven components. For each component, alternative "action" options are specified. Facilities Plan Table 6.2-1 provides a summary of the components and the options for each. Five conceptual alternatives were specified. The basis for specifying each alternative was five objectives derived from facilities requirements, a range of environmental view points, regulatory requirements and cost issues. The alternatives are: no action, optimize existing facilities, meet water quality standards, secondary treatment and eliminate/reduce ocean discharges.

Options from each wastewater system component category were eliminated for a specific alternative if it would not provide a means for that alternative to meet its objective, or it was incompatible with another component option for that alternative. Facilities Plan Table 6.3.2-1 shows the configured alternatives with compatible options.

The most desirable option for the seven system components for each respective alternative was selected using a Delphi process wherein the options per alternative component were rated. The option with the highest score was chosen for each alternative for the final alternative specification. Facilities Plan Table 7.4.1-3 shows the results of scoring the options and the alternative specification. Chapter 6 of the Facilities Plan provides cost estimates for alternative components of Table 7.4.1-3. These costs are summed to determine the total cost per alternative.

The alternatives of Table 7.4.1-3 are assessed with respect to the feasibility and optimality criterion subject to the environmental constraints. Once completed, a "preferred alternative" is selected. The method used to choose the preferred alternative was a scoring system utilizing consultant and public input. The preferred alternative chosen was the Meet Water Quality Standard alternative of Table 7.4.1-3. It not only received the highest score from the scoring process but it: a) does only what is necessary to meet regulatory, human health and environmental constraints, and b) allows for the expansion of the system to meet wastewater flows in the East Mamala Bay region.

Cost, expenditure and revenue discussions primarily focus on the preferred alternative. Comparisons of the preferred alternative with other feasible alternative discussions generally follow the preferred alternative discussion. Feasible alternatives are those that meet environmental constraints. In addition to the preferred alternative (i.e.. Meet Water Quality Standards), other feasible alternatives are secondary treatment and eliminate/reduce ocean discharges.

Values for costs, expenditures, revenues and benefits estimated, presented and discussed are either additions to existent values or projected future values if the feasible alternative is implemented.

Facilities Plan Expenditure Impacts

Implementation of a feasible alternative will only cause County expenditures to increase. There will be no impact on Federal and State expenditures. County expenditure increase via Capital Improvement Projects (CIP) expenditures normally funded by bond issues or other borrowed moneys, and via increased operations and maintenance (O&M) costs of the Division of Wastewater Management (DWWM) normally funded by current revenues. DWWM debt service expenditures ultimately increase because CIP funds to pay for the preferred alternative capital costs are amortized which become DWWM debt service expenditures when they commence.

Debt Service Expenditures

Funding sources to pay capital costs and the likelihood of receiving funding from each for implementation of the preferred alternative include the following.

Funding Source	Likelihood of Funding	Information Source
Federal EPA Grant	not likely	Dennis Tulang (DoH)
State Revolving Fund (SRF)	possible	Dennis Tulang (DoH)
County Bond Issue (CIP)	definite	Steven Ching (DWWM)
Individual Assessments	definite	Steven Ching (DWWM)

CIP = County Capital Improvement Projects moneys

The current amortization terms of the funding sources which at a minimum have a possibility of funding the preferred alternative construction expenditures are as follows (individual assessments are included in the CIP).

Source	Term (years)	Nominal Interest Rate
SRF	20	4.40%
County Bond Issue (CIP)	20	6.60%
Inflation Rate	average annual	4.00%

Chapter 7 presents preferred alternative construction schedules and costs. Using the data from these tables, and assuming all construction cost funding comes from County bond issues, allows the estimation of DWWM annual expenditures due to CIP's and the resultant amortization costs. These amortization costs lead to debt service increases over existing (i.e. 1991-92) DWWM debt service expenditure amounts.

The existing annual debt service amount is $16,200,000 (Steven Ching, DWWM) for all of Oahu. The actual percentage of this total apportionable to East Mamala Bay is unknown. DWWM Annual Report (1992) data for treatment plant and pumping station O&M cost data shows that East Mamala Bay's O&M costs are 20.23% of the Oahu total. Multiplying this percentage by the current debt service for all of Oahu equals $3,276,808. This value is used as the estimated existing annual debt service amount for East Mamala Bay.

Using the above described data and assumptions, annual construction expenditures, annual debt service expenditures and debt service increases over the existing amount caused by implementation of the preferred alternative are estimated. These are estimated for the study period for East Mamala Bay and all of Oahu. All dollar estimates are expressed in 1993 dollars.

Operations and Maintenance Cost Expenditures

Life cycle costs for a particular capital item equal the item's capital cost plus the present value of the item's operations and maintenance (O&M) costs over its life. Life cycle costs were separately estimated from engineering design parameters. Assumptions for life cycle cost determination are shown below.

Item Life	Discount Rate	Inflation Rate
50 years	8%	4%

Annual operations and maintenance costs for a particular item are calculated from the life cycle cost amount and life cycle cost determination assumptions. The formula for the determination is as follows:

$$\text{Item Annual O\&M Charge} = \frac{(\text{Life Cycle Cost} - \text{Capital Cost}) \times (1+R)}{(1-(1+I))/(1+R))/(1-(1+I)^n)/(1+R)^n)}$$

where: I = the inflation rate, R = the discount rate, and n = 50 years, the item life.

An Item's Annual O&M Charge represents the 1993 dollar O&M charge for the item. All O&M charges estimated over the study period are expressed in 1993 dollars. O&M costs commence for an item (e.g. pumping station upgrades) once that item's construction is completed and the item is placed into service.

Facilities Plan Revenues

Revenue Sources

Revenues to pay for the implementation of the preferred alternative will ultimately come from Oahu wastewater system users. This is pursuant to Federal regulation [40CFR-35.21(C)] which specifies that each user's sewer service charge must reflect each user's proportionate share of the costs to operate and maintain (i.e. O&M costs) the City's sewage treatment works. It also includes other sewer related expenses including capital amortization costs and other customer service costs (i.e. CASE or Central Administrative Service Expense). The trend is towards sewer service charges covering all DWWM expenditures as opposed to some percentage of the total of such costs coming from the General Fund. Consistent with this trend, all incremental additions to DWWM expenditures over existing levels due to the implementation of the preferred alternative will be paid for by revenues obtained from sewer service charge increases. In sum, expenditures to implement the preferred alternative lead to increased requirements for DWWM revenues which are met through sewer service charge increases.

Existing DWWM Sewer Service Charges and Revenues

DWWM sewer service charges are broken down into two component parts: debt service capital charges and O&M charges. The 1991-92 DWWM revenue distribution by expense category and residential sewer service charge allocation across expense categories are shown in Table 1. The residential sewer service charge allocation allows DWWM expenditure increases to be estimated separately for capital and O&M. These separate cost increases are then aggregated to determine the overall sewer service charge increase required by a feasible alternative. All estimated sewer service charges are measured in 1993 dollars.

Table 1: Existing DWWM Sewer Service Charge Distribution By Expense Category and Residential Service Charge Allocation

Expense Category	Total Amount	% Of Total	Residential Charge Allocation
OM&R	$54,530,000	73.12%	$18.17
Debt Service	$16,220,000	21.75%	$5.40
CASE*	$3,830,000	5.14%	$1.28
TOTAL ALL	$74,580,000	100.00%	$24.85

*CASE= Central Administrative Service Expense

Sewer service charge impacts are estimated for residential rates only. Table 2 shows that residential users were the largest DWWM revenue source providing 68.91% of total DWWM revenues. It is assumed that non-residential billing unit sewer service charge increases by charge type (i.e. base charges and block rate charges) are proportional to residential billing unit increases over the study period, such that the distribution of total DWWM revenues collected remains invariant with time given implementation of the preferred alternative.

Non-residential and governmental sewer service charges resulting from implementation of the preferred alternative could ultimately be passed on to residential users. This would be in the form of increased prices from non-residential users if they pass on their sewer service charge increases to their customers (i.e. residential users). It would be in the form of increased taxes from governmental users if they pass on their sewer service charge increases to their tax payers (i.e. residential users). Given this possibility, the sewer service charge increase impact assuming that non-residential and governmental users pass on their increases to residential users is also estimated. In all likelihood, the full impact to residential users of sewer service charge increases to all users due to implementation of the preferred alternative will fall somewhere between residential sewer service charge increases and the sewer service charge increase impact assuming that non-residential and governmental users pass on their increases to residential users.

Table 2: Existing DWWM Customer Revenue Distribution

Customer Classification	Total Revenue	% Of Total
Residential		
Single Family Duplex	$30,497,473	41.79%
Mixed Residential Units	$215,851	0.30%
Multi-Family	$19,448,812	26.65%
Mixed User	$122,136	0.17%
TOTAL RESIDENTIAL	$50,284,272	68.91%
Non-Residential		
Commercial	$10,629,252	14.57%
Hotels, Motels, etc.	$4,891,991	6.70%
Industrial Complex	$1,365,293	1.87%
Agriculture	$506	0.00%
Religious Institutions	$374,383	0.51%
TOTAL NON-RESIDENTIAL	$17,261,425	23.66%
Government		
U.S. Military Installations	$1,832,787	2.51%
U.S. Non-Military Installations	$73,953	0.10%
State	$3,211,905	4.40%
City	$306,401	0.42%
Total Government	$5,425,046	7.43%
TOTAL ALL	$72,970,743	100.00%

Note: 1991-92 revenue collections fell short of revenue needs by 4.7%. The shortfall was made up with moneys from the General Fund.

Residential Billing Unit Changes Over The Study Period: Population increases over time lead to more residential (and non-residential) billing units. The proxy for residential billing units for this analysis is housing units. Using study population projections and Department of Business Economic Development and Tourism (1993) estimates of housing units and residents per unit (3.93), estimated housing units (i.e. billing units) are projected for the study period. Housing unit increases are standardized (1993 = 1) and used to adjust the study period sewer service charge increases for the fact that the DWWM required revenues are spread over more billing units with time. This reduces the average per billing unit sewer service charge increase and impacts from increases estimated over the study period. Table 3 shows the Facilities Plan estimates and the estimated number of housing units for East Mamala Bay and the standardized billing unit used to make adjustments for billing unit changes over the study period.

Table 3: Estimated Population, Housing Units and Standardized Billing Units

Year	Study EMB Resident Population	Estimated EMB Housing Units	Standardized Billing Units
1990	339,640	86,328	
1991	343,512	87,312	
1992	347,384	88,296	
1993	351,255	89,280	1.0000
1994	355,127	90,264	1.0110
1995	358,999	91,248	1.0220
1996	360,794	91,704	1.0272
1997	362,589	92,161	1.0323
1998	364,384	92,617	1.0374
1999	366,179	93,073	1.0425
2000	367,974	93,529	1.0476
2001	370,182	94,091	1.0539
2002	372,390	94,652	1.0602
2003	374,597	95,213	1.0665
2004	376,805	95,774	1.0727
2005	379,013	96,335	1.0790
2006	382,045	97,106	1.0877
2007	385,077	97,877	1.0963
2008	388,110	98,647	1.1049
2009	391,142	99,418	1.1136
2010	394,174	100,189	1.1222
2011	397,149	100,945	1.1307
2012	400,124	101,701	1.1391
2013	403,099	102,457	1.1476
2014	406,074	103,213	1.1561
2015	409,049	103,970	1.1645

EMB = East Mamala Bay

Facilities Plan Benefits

Benefits due to implementation of the preferred alternative take the form of various household income multiplier effects and non pecuniary benefits. The benefits primarily accrue to the County which also incurs all the costs of implementation of the preferred alternative.

Household Income Multiplier Effects

Multiplier effects are impacts on household income that arise from CIP and DWWM expenditures caused by the preferred alternative. Household income impacts seem most relevant to this analysis as opposed to output or employment impacts of the preferred alternative, since sewer service charge impacts are measured for households. This allows aggregating costs and economic benefits to determine the net economic benefit (cost) of the preferred alternative using households as the common denominator. The household income multiplier is also the least distorted of the different multiplier types, output and employment being the other two.

Household income multiplier effects arise per dollar of implementation expenditure. The effects are: (1) direct effects which measure the change in household income arising as a direct result of preferred alternative expenditures; (2) indirect effects which measure household income generated indirectly as businesses that directly receive preferred alternative expenditure dollars spend them locally to buy materials and services to meet preferred alternative implementation requirements; and (3) induced effects which measures changes in household income as recipients of local (direct and indirect) income from preferred alternative expenditures spend this income which then recycles in the economy creating additional household income. A multiplier that measures all three effects is called a Type II multiplier. All multipliers used in this analysis are Type II household income multipliers.

__Multiplier Analysis Capital Expenditure Assumptions__: Various assumptions must be made to measure preferred alternative caused multiplier effects. First, there are no leakage's of preferred alternative CIP expenditures from Oahu. That is, all capital expenditures required by the preferred alternative are made on Oahu. Realistically, this will not occur since most mechanical and hydraulic equipment and materials must be purchased out-of-state. That is, there will be leakages. What these leakages will be is impossible to measure at this time. The effects of not measuring these leakages will be mitigated to some extent by the fourth assumption noted below.

The second assumption is that CIP spending on the preferred alternative has an equivalent multiplier (i.e. economic) impact as CIP spending for any alternative City and County capital expenditure. That is, assuming there are CIP expenditures, there is a $0 opportunity cost for CIP expenditures on the preferred alternative as opposed to some other CIP expenditure. A third assumption is that the preferred alternative capital expenditure funding, regardless of source, is exogenous to Oahu. This means that there will be a full positive (commercial construction) multiplier effect (.68) the period the capital expenditure is made.

The fourth and final assumption, a corollary to the third, is that all dollars spent on debt amortization (both interest and principal) via DWWM debt service expenditures are exogenous to Oahu. That is, they all leave the island and have a full negative multiplier effect the period they are made. This will not likely occur and some debt service expenditures will not leave the state (i.e. are endogenous to Oahu). It is impossible however, to determine what proportion of debt service expenditure dollars are exogenous/endogenous to Oahu. The multiplier measuring this negative multiplier effect is an average of multipliers for representative household expenditure categories presented below.

One important result of these assumptions is that there will be an inter temporal transfer of income from users who use the system after the study period to study period users. This occurs because the economic benefit of study period preferred alternative capital expenditures occurs during the study period but the (amortization) costs of these expenditures extend beyond the study period. It should be noted that benefits will accrue to post study period users due to any inter temporal income transfers. These are non-pecuniary benefits and avoided costs discussed below.

__Multiplier Analysis O&M Expenditure Assumptions__: One final assumption relates to preferred alternative caused DWWM O&M cost increases which begin in 1994. Households directly pay for part of these cost increases via residential sewer service charge increases. As noted above, households may indirectly pay for the remainder as well if one assumes that preferred alternative caused non-residential and non-DWWM government sewer service charge increases are passed on to households by these users via increased prices and taxes. If they are not passed on, the effect is assumed to be the same as if they were. This means that residential and non-residential income and non-DWWM government revenue, collectively income for sewer service charge increases, that goes to pay preferred alternative caused sewer service charge increases have the same opportunity cost. The opportunity cost is expenditures that would have been made had the income for sewer service charge increases not been transferred from the residential, non-residential and non-DWWM government units to DWWM for services. The benefits of such expenditures are lost to these units. It is impossible to measure the value of these lost benefits.

Further, these expenditures could be made in a sector of the economy that has a multiplier effect different than the multiplier effect that occurs due to spending this income for DWWM wastewater services. Multipliers (DBED, 1987) for waste water services and representative household expenditures categories are shown below.

Expenditure Category	Multiplier
Waste Water Services	.42
Representative Household Categories	
Retail	.83
Eating & Drinking	.62
Personal Services	.93
Average of Household Categories	.79

In each instance, the representative expenditure category where the income for sewer service charge increases is expended if it is not used by DWWM for preferred alternative caused O&M expenditures, exceeds the waste water service multiplier. This means that preferred alternative caused O&M expenditure increases would have a negative multiplier effect during the study period. This negative multiplier would continue beyond the study period as well.

The negative impact of preferred alternative DWWM O&M expenditure increases over the study period is measured by assuming a multiplier of .42 for these expenditures and an average of the representative expenditure categories of 0.79 for residential, non-residential and non-DWWM government expenditures that are lost.

Direct Economic Benefits from the Sale of Useful Outputs

The Sand Island Wastewater Treatment Plant (SIWWTP) has the potential to produce various products that have economic value. These are produced from Plant effluent and biosolids waste. Whether or not and what usable products are produced depends on the solids treatment component option selected for the feasibility alternative.

Reused Effluent Water: No Facilities Plan effluent disposal option selected for any feasible alternative produces a salable water product. The Facilities Plan selection process resulted in the outfall option for the preferred and secondary alternatives. Wastewater effluent outfalled is not available for further use and thus has no potential economic value.

The same is true for the reduce/eliminate ocean discharge option for which the Facilities Plan selection process resulted in the selection of the underground injection option for effluent disposal. Wastewater injected could have an indirect economic value because it may enhance natural and irrigation recharge of groundwater aquifers from which irrigation water is drawn. The value of this benefit is beyond the scope of this analysis to estimate.

The reduce/eliminate ocean discharge alternative is the only alternative with an effluent disposal option that has the potential to produce an effluent product with economic value. This option is the reuse option. The net cost increase in treating water to tertiary levels implicit in this option are approximated. Further, the reuse option is only relevant if tertiary treatment were selected for some reason other than effluent reuse.

Reused Effluent Water Valuation: The net economic benefit of wastewater reuse is a function of the cost of the reuse system and the value of the reusable water produced. The Facilities Plan provides cost estimates for a reuse system where the effluent is used for irrigation purposes. The value of the effluent for this analysis is the marginal cost to the Board of Water Supply for providing the same amount of new water from the next cheapest source. For this to make sense, it is assumed that the reused wastewater is a perfect substitute for Board of Water Supply water used for irrigation purposes. The implicit logic is that by using effluent wastewater for irrigation purposes, replacing potable water, costs of future potable water development to meet increased demand are avoided. The costs to develop any such new potable water source is the marginal cost for new water. This (avoided) cost is the implicit value of the reused water.

The Facilities Plan provides estimates of the Board of Water Supply (BWS) marginal costs for new water development. Two sources are used for comparison; the estimated cost for new potable water development from BWS sources, and the cost of potable water from sea water desalination using reverse osmosis (RO). Both are presented as it is unlikely that new, untapped, sustainable water sources equivalent to the projected waste water volume exist on Oahu (Chester Lau, BWS). Thus, the true marginal cost of new water development lies somewhere between these two values.

It is further assumed that all of the effluent can be used when it becomes available. This event is highly unlikely but making this assumption allows the maximum potential economic benefit to be determined for effluent reuse. The effluent is assumed to be virtually pathogen free reclaimed water (i.e. R-1). Thus, there are no constraints to its use for irrigation.

The quantity of effluent water assumed reused and valued is 20.21 million gallons per day (MGD) assumed in the Facilities Plan. Reuse of the entire amount of SIWWTP effluent (88 MGD in 2015) was not attempted for several reasons. First, the City could not get a commitment for the purchase of 1.4 MGD in an agricultural environment (see Facilities Plan Section 6.2.6.2). Thus, demand for effluent water reuse does not exist *at this time nor* will it likely exist for a considerable time into the future for SIWWTP irrigation quality effluent being generated in an urban environment. Second, the total cost of implementing the reuse option for the eliminate/reduce ocean discharge alternative would require cost estimates not available at this time. Using all the SIWWTP effluent would require that the City purchase land for its reuse. The amount, location and cost of such land are unknown. Transmission capital and life cycle costs would be higher than estimated to transmit all SIWWTP effluent water to the point of reuse. These engineering costs are unknown. Linearly scaling the transmissions costs for a 20.21 MGD reuse system would not provide an accurate result since transmission and storage costs increase proportionately more than a linear rate with increased distance from point of transmission (i.e. SIWWTP).

Reuse of 20.21 MGD SIWWTP effluent for irrigation water increases costs relative to the eliminate/reduce ocean discharges alternative costs presented above. This is due to substituting the effluent reuse cost for the effluent injection cost for the effluent disposal system component. The Facilities Plan presents estimated capital and life cycle costs (Section 6.2.6) for transmission and storage systems for 20.21 MGD effluent reuse. These cost differences between the effluent injection (for 20.21 MGD) and effluent reuse options are netted from the estimated value of the reused water over the study period. The table immediately below shows Facilities Plan estimated costs for the effluent disposal component options of effluent injection and effluent reuse, and their differences. The cost differences over the study period are netted from the estimated value of the reused water.

Item	Capital Cost	Life Cycle Cost
Underground Injection Well	$71,194,318	$106,228,124
Effluent Reuse for Irrigation	$72,100,000	$190,100,000
Difference	($905,682)	($83,871,876)

Biosolids Products: Biosolids (also referred to as sludge or solids) are residual byproducts of waste water treatment. In the multi-step process of treating and handling biosolids, potentially usable or disposable products are created along the way. Uses could be for agricultural or horticultural purposes (soil enhancement) or for energy creation or as a fuel. The market response to biosolids products will continually evolve as the products are produced and utilized. There may be no market, significant obstacles to marketing, or a favorable market for biosolids products as people overcome stigmas related to their use. Furthermore, a well designed facility will have several options for biosolids disposal to meet both changing market and regulatory environments.

Six options for the final processing or disposal of the biosolids are examined in the study. These include: land filling, thermal drying, alkaline stabilization, composting, incineration, and power generation. There is no one "best" final processing method. "Best" depends on the market and can change with time. There was no final biosolids processing component option selected for the preferred alternative. Rather, biosolids final processing and potential sale was assumed privatized under the premise that biosolids final processing and sale would be profitable.

It is impossible to predict the nature of the market and the timing of its changes. Thus, predictions related to the value of biosolids products are speculative. The maximum possible benefit from biosolids final processing and sale is estimated. To estimate this maximum possible benefit requires making several assumptions. First, the private entity produces and markets a product equivalent to the city of Houston which sells all of its biosolids products at a minimum price of $9 per ton with a price escalation based on nitrogen content up to $15 per ton. The mid-point of this range (i.e. $12/t) is used to value the biosolids products produced. Houston also participates in any profit from sales at a rate of 10%. This value is ignored for this analysis. The second assumption is that all the biosolids products produced are sold the period they are produced. That is, a market exists for all biosolids products produced.

Biosolids production levels for the year 2015 for the preferred alternative and the secondary alternative come from Section 6.2.6 of the Facilities Plan. The biosolids production from the eliminate/reduce ocean discharges alternative is estimated to be 15% greater than the secondary alternative amount. The 2015 biosolids amounts are scaled back using the estimated number of Oahu residential units over the study period to determine biosolids production levels for years previous to 2015 .

The direct economic benefits from the sale of biosolids products on Oahu are the household income multiplier effects. The multiplier used to determine the household income multiplier effect per dollar sale of biosolids product is that for the Other Agriculture Products sector (DBED, 1987) which equals .53.

RESULTS

Costs of Facilities Plan Alternatives

Alternative Component Capital and Life Cycle Costs

Table 4 shows for each component its capital, life cycle and total cost for each of the alternatives shown in Facilities Plan Table 7.4.1-3. The cost totals for the No Action and Existing System Optimization alternatives are underestimated. For each of these alternatives it is impossible to estimate any unexpected or expected increased operations and maintenance costs, regulatory costs for violations of the Federal Clean Water and Air Acts ($25,000 per day per violation) that would likely occur, legal costs related to violations litigation, and non-pecuniary costs including public health and safety and environmental costs from facility system failures that could also occur. No Action and Existing System Optimization alternatives also allow the continuation of spills and bypasses which are prohibited by the Clean Water Act. Thus, these alternatives do not meet environmental constraints and for this reason they are not feasible or assessed further.

Table 4 shows the that the preferred (i.e. Meet Water Quality Standards) alternative life cycle cost is an order of magnitude larger than the "known" life cycle costs of the No Action and Existing System Optimization alternatives. The increase is due primarily to the collection-sewered areas, treatment level, and solids treatment and processing components of this alternative. Table 4 also shows that capital and life cycle cost increases from the preferred alternative to the secondary treatment alternative arise primarily from the treatment level component and to a smaller extent from the solids treatment and processing component; and that the capital and life cycle cost increase from the secondary treatment to the reduce/eliminate ocean discharges treatment alternative arises primarily from the effluent disposal component and to a smaller extent from the treatment component. These features are shown more clearly in Figure 1 which shows per component life cycle cost differences for each feasible alternative. Only components for which there is a cost difference between the alternatives are shown. Per component capital cost differences for each feasible alternative are not shown since the pattern is the same as that shown in Figure 1.

Cost Increase Relative to the Preferred Alternative

Table 5 presents the absolute and percentage capital, operations and maintenance and life cycle cost (life cycle costs = capital + operations and maintenance costs) difference between the secondary and eliminate/reduce ocean discharges feasible alternatives relative to estimated existing O&M costs and relative to the preferred alternative. It shows that existing O&M costs would increase by 31%, 60%, and 85% from implementation of the preferred, secondary and eliminate/reduce ocean discharges alternatives respectively.

Figure 2 graphically depicts the relative cost differences between the preferred and the secondary and eliminate/reduce ocean discharges alternatives. It shows that the secondary and reduce/eliminate ocean discharge alternatives represent significant cost increases relative to the preferred alternative.

The capital and operations and maintenance cost impacts for the secondary and reduce/eliminate ocean discharge alternatives are estimated using their relative costs difference from the preferred alternative shown in Table 5. Specifically, once these costs are estimated for the preferred alternative they are then estimated for the secondary and reduce/eliminate ocean discharge alternatives by multiplying the appropriate percentage increase over the preferred alternative shown in Table 5.

Table 4: Component and Total Cost Per Alternative

Alternative	System Component Costs: Collection-Sewered Areas	Treatment Sewered Areas	Treatment & Collection-Unsewered Areas	Treatment Level	Effluent Disposal	Solids Treatment & Processing	Kuliouou Processing	TOTAL SYSTEM COST	Non-System Costs: Legal Violations Fines	Legal Costs	Non-Pecuniary Costs	Opportunity Cost if Forced to Upgrade
No Action									likely	likely	likely	
Capital	$0	$0	$0	$0	$0	$0	$0	$0				
Life Cycle	LUMC	LUMC					$4,287,000	*$4,287,000*				
Existing System Optimization									likely	likely	likely	
Capital	$0	$0	$0	$0	$0	$0	$0	$0				
Life Cycle	IMOC	IMOC		$73,300,000		IMOC	$4,287,000	*$77,587,000*				
Meet Water Quality Standards (Preferred Alternative)												
Capital	$390,924,500		$12,972,000	$119,650,000	$1,300,000	$29,200,000	$5,650,000	$559,696,500				possible
Life Cycle	$409,938,497		$16,824,000	$316,280,000	$12,300,000	$161,000,000	$5,750,000	$922,092,497				
Secondary												
Capital	$390,924,500		$12,972,000	$430,500,000	$1,300,000	*$45,200,000*	$5,650,000	*$886,546,500*				
Life Cycle	$409,938,497		$16,824,000	$941,500,000	$12,300,000	*$197,000,000*	$5,750,000	*$1,583,312,497*				
Eliminate/Reduce Ocean Discharge												
Capital	*$390,924,500*		$12,972,000	$441,500,000	*$310,000,000*	*$45,200,000*	$5,650,000	*$1,206,246,500*				
Life Cycle	*$409,938,497*		$16,824,000	$1,094,500,000	*$462,547,000*	*$197,000,000*	$5,750,000	*$2,186,559,497*				

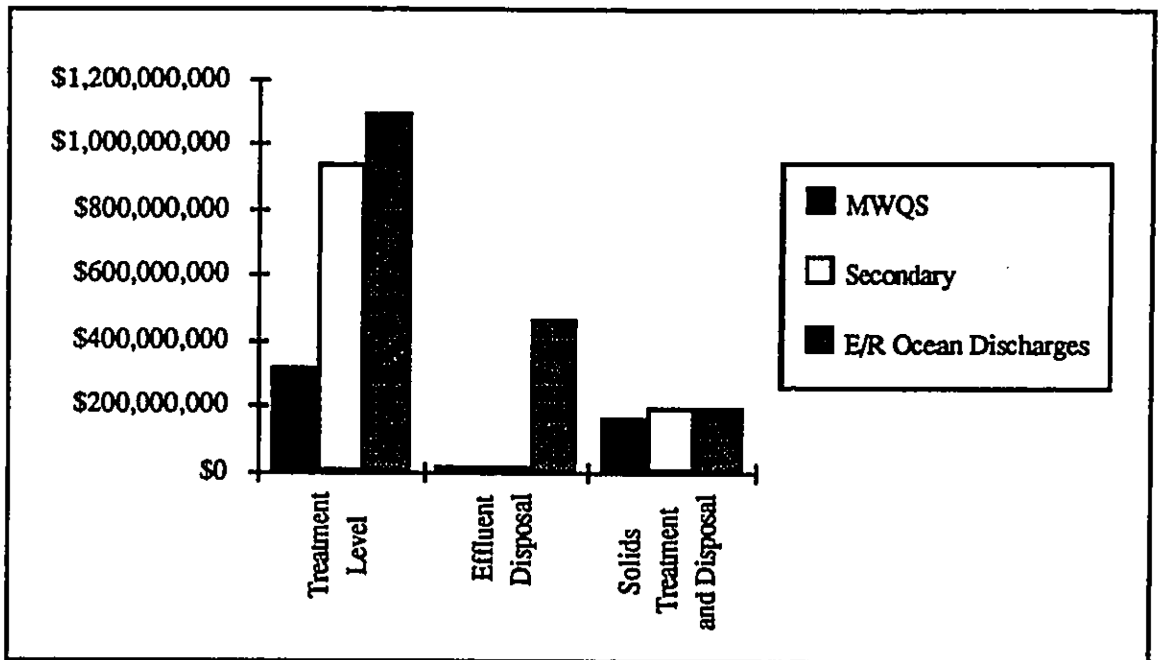
Definitions

LUMC: Large Unpredicted Maintainence Costs

IMOC: Increased Maintainence and Operations Costs

Italics means the cost is greater than the value shown but these added costs are not estimated in the study. For the secondary and eliminate/reduce ocean discharge alternatives, these additional costs are generally land costs.

Figure 1: Component Life Cycle Cost by Feasible Alternative (1993 dollars)

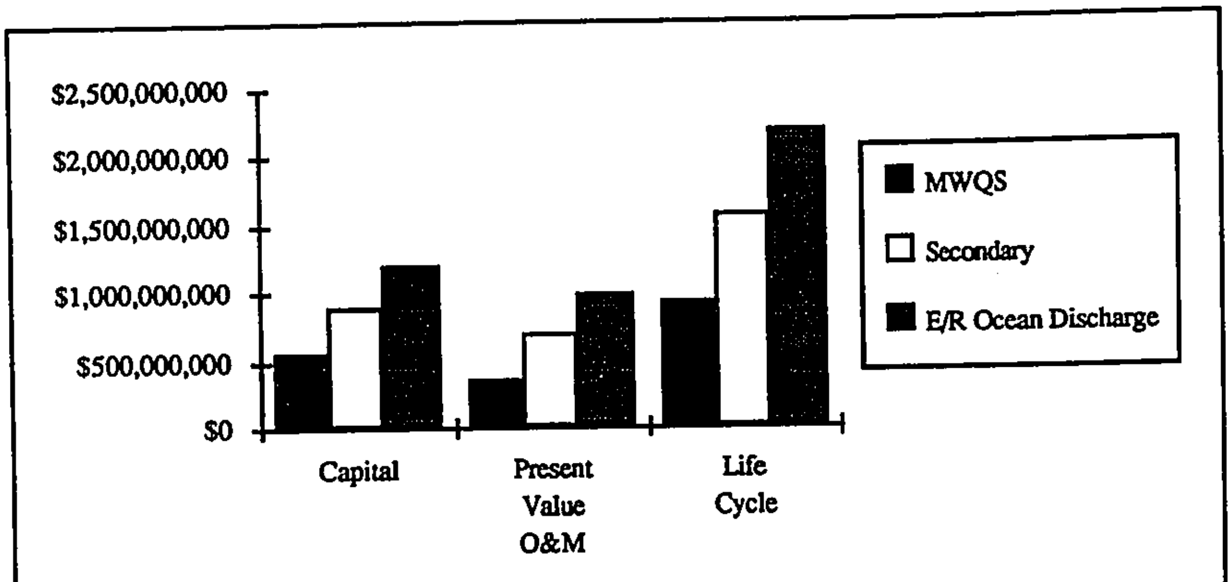


MWQS = the Meet Water Quality Standards preferred alternative; E/R = Eliminate/Reduce

Table 5: Cost Increase Relative to Existing and Preferred Alternative Costs for the Secondary and Eliminate/Reduce Ocean Discharge Alternatives (1993 dollars)

Alternative	TOTAL SYSTEM COST	Increase Over Existing: Dollar Increase	Increase Over Existing: % Increase	Increase Over the Preferred Alternative: Dollar Increase	Increase Over the Preferred Alternative: % Increase
Meet Water Quality Standards (MWQS)					
Capital	$559,696,500				
Present Value O&M	$362,395,997	$362,395,997	31%		
Life Cycle	$922,092,497				
Secondary					
Capital	*$886,546,500*			$326,850,000	58%
Present Value O&M	*$696,765,997*	$696,765,997	60%	$334,370,000	92%
Life Cycle	*$1,583,312,497*			$661,220,000	72%
Eliminate/Reduce Ocean Discharge					
Capital	*$1,206,246,500*			$646,550,000	116%
Present Value O&M	*$980,312,997*	$980,312,997	85%	$617,917,000	171%
Life Cycle	*$2,186,559,497*			$1,264,467,000	137%

Figure 2: Absolute Cost Differences Between Feasible Alternatives (1993 dollars)



Component Capital Cost Distribution for Each Alternative

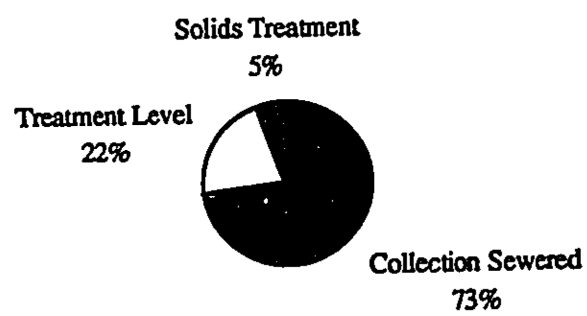
Figure 3 presents component capital cost distributions for the preferred, secondary, and reduce/eliminate ocean discharge alternatives. The major capital cost contributor is the capacity and reliability upgrades for the sewered areas collection for the preferred alternative dwarfing all other component capital costs. The treatment level component increases significantly as a percentage of total capital costs for the secondary alternative. Effluent disposal increases significantly as a percentage of total capital costs for the reduce/eliminate ocean discharge alternative.

Component Operations and Maintenance Cost Distributions for Each Alternative

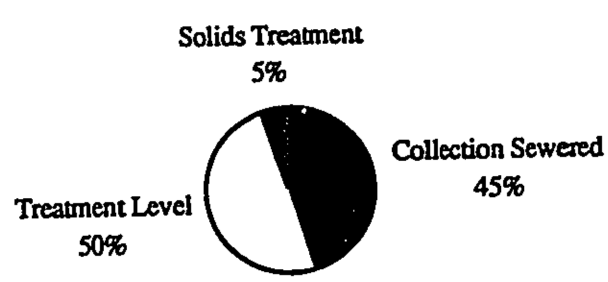
Figure 4 presents component operations and maintenance (O&M) cost distributions for the preferred, secondary, and reduce/eliminate ocean discharge alternatives. The major O&M cost contributor is the treatment level for each feasible alternative. Solids treatment and disposal also comprises a significant proportion of O&M costs for each feasible alternative. Effluent disposal O&M costs comprise a significant proportion of total O&M costs for the eliminate/reduce ocean discharges alternative in contrast to the other feasible alternatives. Note, centralized system extension and Kuliouou O&M costs were such an insignificant percentage of total O&M costs for each alternative they were not presented.

Figure 3: Alternative Capital Cost Distribution by Component

Preferred Alternative



Secondary Alternative



Reduce/Eliminate Ocean Discharges Alternative

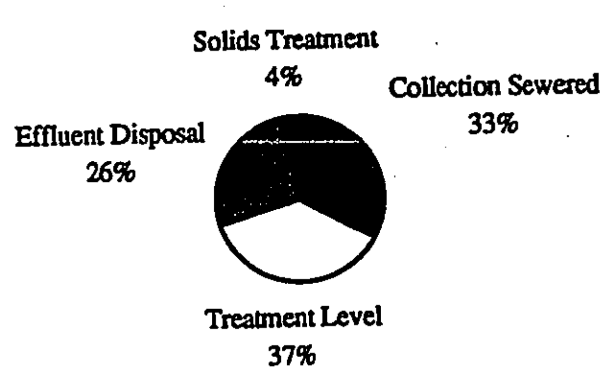
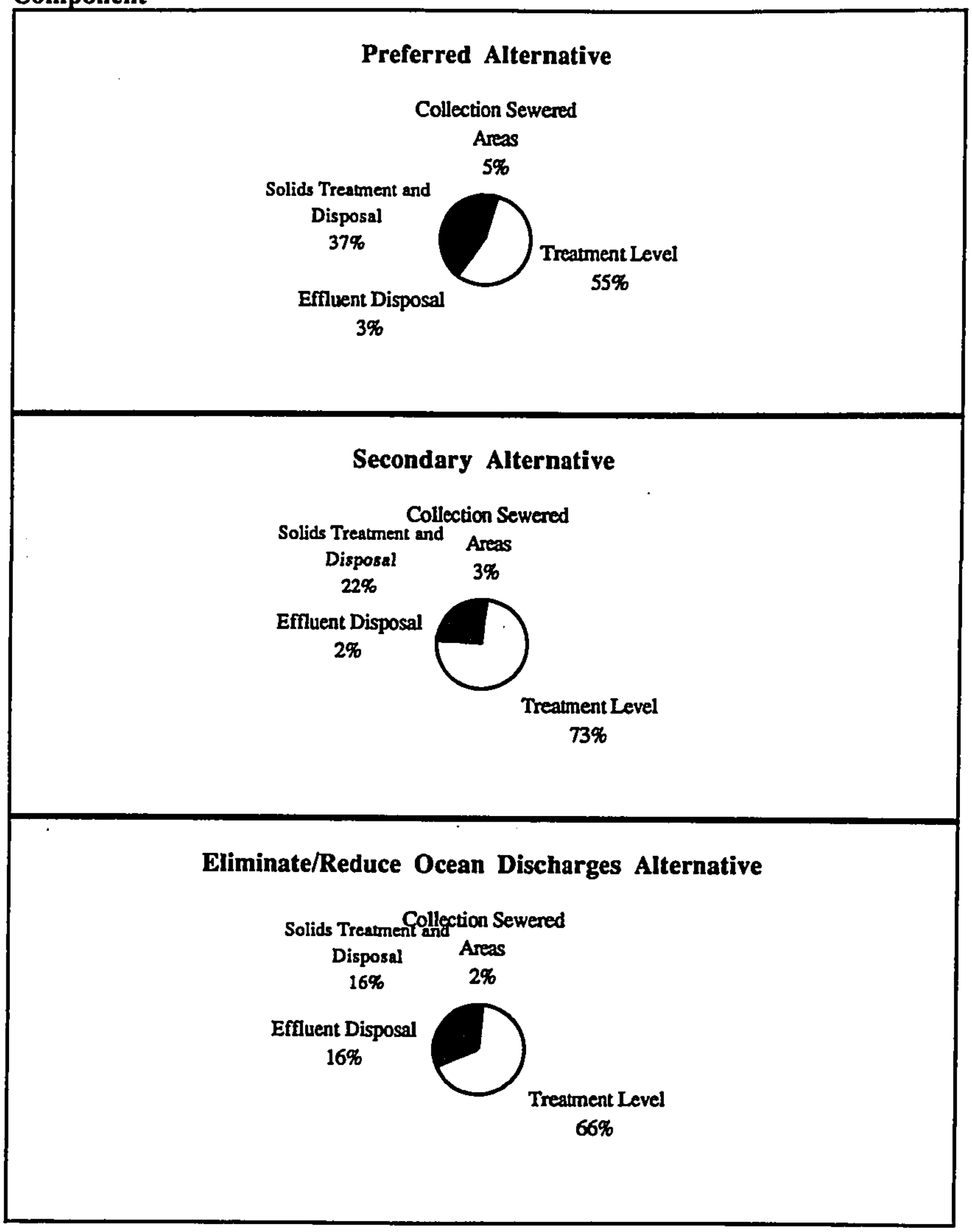


Figure 4: Alternative Operations and Maintenance Cost Distribution by Component



Preferred Alternative Caused County Expenditures

Debt Service Expenditures

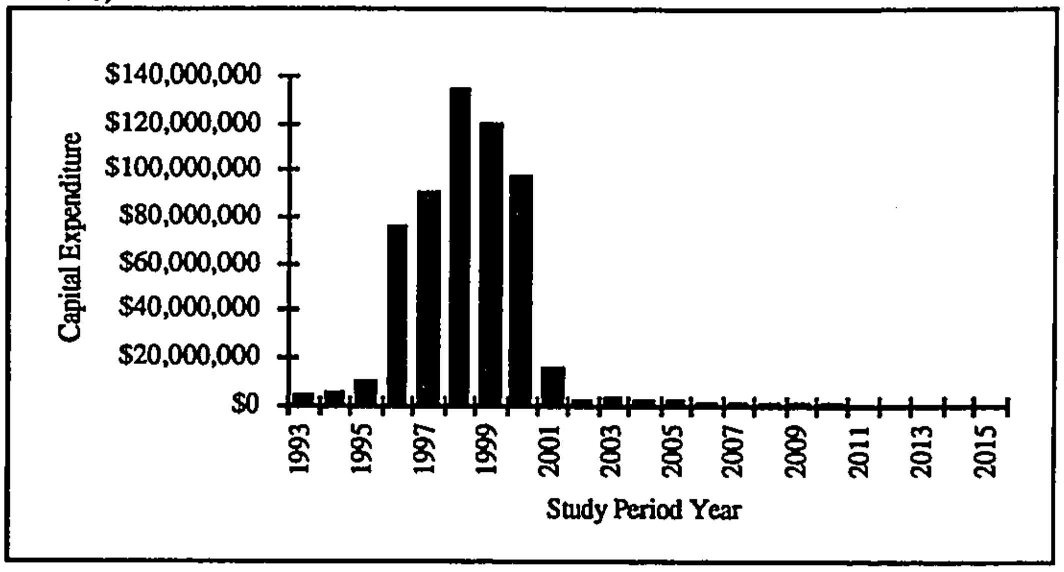
Table 6 shows preferred alternative annual construction expenditures and their resultant DWWM debt service expenditure costs. Debt service increases over the current debt service amounts are shown for East Mamala Bay and all of Oahu. East Mamala Bay increases assume that all preferred alternative caused debt service increases fall on East Mamala Bay users. The average annual increase over current levels for the study period for East Mamala Bay and all Oahu are 845% and 171% respectively. The increase over current debt service levels for 2015 are 1059% and 214% for East Mamala Bay and all Oahu respectively.

Table 6: The Preferred Alternative Estimated Annual Construction Expenditure and Debt Service Absolute and Percentage Increases Over Existing Amounts for East Mamala Bay and All of Oahu for the Study Period (1993 dollars)

Year	Annual Construction Expenditure	Annual Debt Service Increase	% Debt Service Increase: East Mamala Bay	% Debt Service Increase: All Oahu
1993	$3,970,000	$254,664	8%	2%
1994	$4,955,714	$572,559	17%	4%
1995	$9,875,132	$1,206,020	37%	7%
1996	$74,917,236	$6,011,746	183%	37%
1997	$90,542,211	$11,819,769	361%	73%
1998	$134,722,627	$20,461,838	624%	126%
1999	$119,102,548	$28,101,925	858%	173%
2000	$96,547,248	$34,295,154	1047%	212%
2001	$14,830,911	$35,246,514	1076%	218%
2002	$2,232,288	$35,389,709	1080%	218%
2003	$2,536,107	$35,552,393	1085%	219%
2004	$1,814,756	$35,668,804	1089%	220%
2005	$1,355,782	$35,755,774	1091%	221%
2006	$692,572	$35,800,200	1093%	221%
2007	$493,406	$35,831,851	1093%	221%
2008	$376,084	$35,855,976	1094%	221%
2009	$365,939	$35,879,449	1095%	221%
2010	$365,939	$35,902,923	1096%	222%
2011	$0	$35,902,923	1096%	222%
2012	$0	$35,902,923	1096%	222%
2013	$0	$35,648,259	1088%	220%
2014	$0	$35,330,364	1078%	218%
2015	$0	$34,696,903	1059%	214%
Averages	$24,334,630	$27,699,506	845%	171%

Figure 5 presents the preferred alternative construction costs distribution over the study period. It shows that the bulk of preferred alternative capital expenditures occur the latter half of this decade peaking in the year 2000. They then taper off dramatically given reduced construction expenditures at the end of the decade.

Figure 5: Study Period Preferred Alternative Capital Expenditure Distribution (1993 dollars)



<u>Interest Rate Changes and Their Impact on Debt Service Expenditures</u>: Interest rate changes relative to the 6.60% bond interest rate used for the analysis change the debt service expenditure. Interest rates could change due to market changes or some portion of capital expenditure funding coming from the State Revolving Fund (SRF), the interest rate for which is two-third's the bond rate.

Table 7 shows changes in preferred alternative debt service expenditures due to alternative debt amortization interest rates. Over the range of interest rates shown, a 1% increase (decrease) in interest rates leads to an approximate 12% increase (decrease) in the study period annual average debt service expenditure. It also shows that if all of the preferred alternative capital costs are funded by the SRF the average annual debt service expenditure is almost 19% less than if these expenditures are funded entirely by bonds. This analysis underlies the importance of project timing and seeking capital funds when market interest rates are low, or from low interest sources.

Table 7: Changes to Debt Service Expenditures Due to Interest Rate Changes (1993 dollars)

Amortization Interest Rate	Average Annual Debt Service Expenditure	Change from Bond Interest of 6.60%: Dollar Change	Change from Bond Interest of 6.60%: Percentage Change	Debt Service Change Over Current Levels: East Mamala	Debt Service Change Over Current Levels: Over Current
4.40% (SRF)	$22,473,131	($5,226,375)	-18.87%	686%	139%
5.50%	$25,008,405	($2,691,101)	-9.72%	763%	154%
6.60% (Bonds)	$27,699,506	$0	0.00%	845%	171%
7.70%	$30,541,586	$2,842,079	10.26%	932%	189%
8.80%	$33,528,777	$5,829,271	21.04%	1023%	207%

<u>Secondary and Eliminate/Reduce Ocean Discharges Alternatives</u>: Capital expenditures for the secondary and eliminate/reduce ocean discharges alternatives would be 58% and 116% (see Table 5) greater than these expenditures for the preferred alternative shown in Table 6. Their

distribution would be approximately the same as that for the preferred alternative except peak expenditures would extend approximately 3 years longer than those for the preferred alternative.

Operations and Maintenance Cost Expenditures

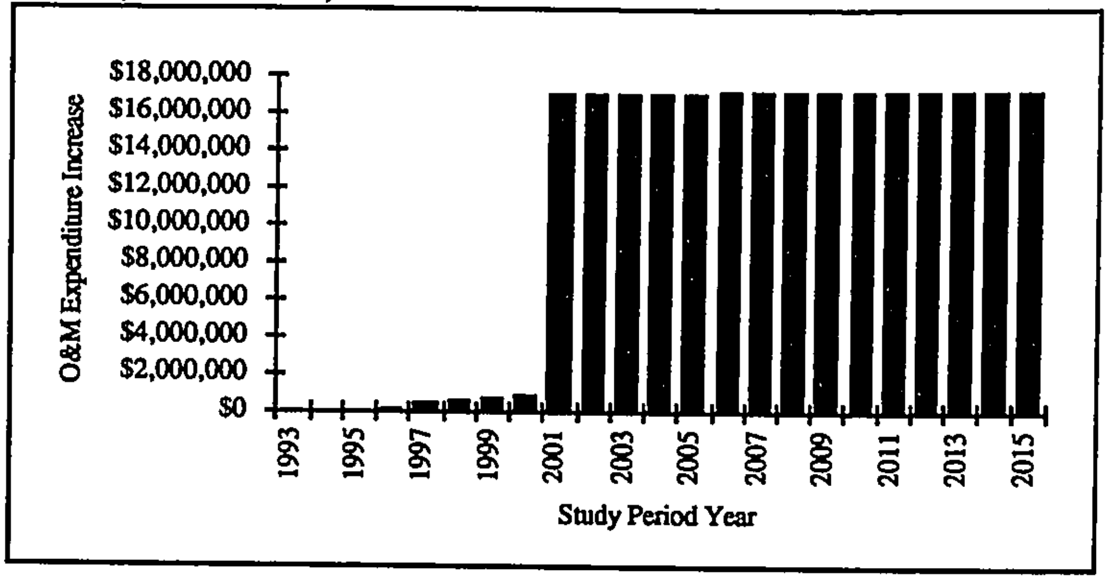
The estimated annual preferred alternative O&M cost expenditure increase is shown in Table 8. The average annual O&M expenditure increase over the study period is 102% and 21% for the East Mamala Bay and All Oahu respectively. The O&M expenditure increase in 2015 is 155% and 31% over existing O&M expenditure levels respectively for East Mamala Bay and All Oahu.

Table 8: The Preferred Alternative Estimated O&M Cost Increase Over Existing O&M Levels in Absolute and Percentage Terms for East Mamala Bay and All Oahu for the Study Period (1993 dollars)

	Preferred Alternative Caused O&M	O&M % Increase Over Existing	
Year	Increase	East Mamala	All Oahu
1993	$0	0.00%	0.00%
1994	$11,833	0.11%	0.02%
1995	$11,833	0.11%	0.02%
1996	$115,554	1.05%	0.21%
1997	$339,672	3.08%	0.62%
1998	$460,916	4.18%	0.85%
1999	$603,636	5.47%	1.11%
2000	$775,651	7.03%	1.42%
2001	$16,968,993	153.85%	31.12%
2002	$16,973,817	153.89%	31.13%
2003	$16,977,025	153.92%	31.13%
2004	$17,020,934	154.32%	31.21%
2005	$17,042,323	154.51%	31.25%
2006	$17,072,935	154.79%	31.31%
2007	$17,079,551	154.85%	31.32%
2008	$17,081,455	154.87%	31.32%
2009	$17,083,523	154.88%	31.33%
2010	$17,083,523	154.88%	31.33%
2011	$17,084,545	154.89%	31.33%
2012	$17,084,545	154.89%	31.33%
2013	$17,084,545	154.89%	31.33%
2014	$17,084,545	154.89%	31.33%
2015	$17,084,545	154.89%	31.33%
Averages	$11,222,865	101.75%	20.58%

Figure 6 shows the preferred alternative O&M expenditures increases progression over existing levels for the study period. It shows that preferred alternative O&M expenditures increase dramatically at the end of the decade and slowly thereafter to the end of the study period.

Figure 6: Study Period Preferred Alternative O&M Expenditure Increase Progression (1993 dollars)



East Mamala Bay Specific O&M Cost Increases: Table 9 shows existing O&M expenditures and the year the preferred alternative would alter and increase these O&M expenditures in absolute and percentage terms for East Mamala Bay pumping stations and the Sand Island Treatment Plant. Table 9 shows that total pumping station and treatment plant O&M increases due to the preferred alternative lead to a 12% and 115% increase over existing O&M costs respectively. Taken together, the total impact of the preferred alternative would lead to a 87% increase over existing O&M expenditures for these East Mamala Bay wastewater system components.

Secondary and Eliminate/Reduce Ocean Discharges Alternatives: O&M expenditures for the secondary and eliminate/reduce ocean discharges alternatives would be 92% and 171% (see Table 5) greater than these expenditures for the preferred alternative shown in Table 8. Their O&M expenditure increase progression would be approximately the same as that for the preferred alternative except the dollar levels would be greater than those for the preferred alternative.

Table 9: Preferred Alternative Impacts on Operations and Maintenance Costs for Selected East Mamala Bay Components (1993 dollars)

Item	Existing O&M Expenditure	Preferred Alternative O&M Commences	Preferred Alternative Annual O&M Expenditure	Increase Over Existing
Waste Water Pumping Stations				
Ala Moana I	$592,842	1997	$39,365	6.6%
Ala Moana II	$376,912	1997	$19,989	5.3%
Kamehameha Highway	$184,220	2001	$14,379	7.8%
Awa Street	$69,071	1994	$9,617	13.9%
Sand Island Parkway	$35,435	2001	$11,833	33.4%
Aliamanu #1	$56,599	1999	$7,779	13.7%
Aliamanu #2	$98,672	1999	$10,607	10.7%
Moana Park	$109,100	2001	$1,179	1.1%
Public Bath	$108,136	2001	$32,199	29.8%
Beachwalk w/o Ft. DeRussy	$215,897	1997	$73,638	34.1%
Hart	$612,753	1998	$94,287	15.4%
Fort DeRussy	$92,603	2001	$18,716	20.2%
Kahala	$165,804	2001	$31,916	19.2%
Niu Valley	$116,827	2001	$11,362	9.7%
Kuliouou to Niu Valley	$76,364	2001	$9,806	12.8%
Paiko	$76,035	2001	$5,940	7.8%
Sub-Total	$2,987,271		$353,245	11.8%
Waste Water Treatment Plant				
Sand Island	$8,042,626	2001	$9,269,788	115.3%
TOTAL	$11,029,898		$9,623,033	87.2%

1991-92 O&M: "Annual Report - 1991-92," DWWM, Dept. of Public Works, C&C of Honolulu

Total Expenditures Due to the Preferred Alternative

Using the data of Tables 6 and 8, the total expenditure impact to DWWM of implementing the preferred alternative is estimated as a percentage change for East Mamala Bay and for all of Oahu. The results are presented in Table 10. Overall, implementation of the preferred alternative would cause an average annual DWWM expenditure increase for the study period of 272% above existing levels for East Mamala Bay and 55% considering All Oahu. The total expenditure increase in 2015 would be 362% and 73% over existing total DWWM expenditure levels respectively for East Mamala Bay and All Oahu.

Table 10: Total Expenditure Impact of Implementation of the Preferred Alternative for East Mamala Bay and All of Oahu for the Study Period (1993 dollars)

Year	Total DWWM Expenditure Increase	% Increase East Mamala Bay	All Oahu
1993	$254,664	1.78%	0.36%
1994	$584,392	4.08%	0.83%
1995	$1,217,853	8.51%	1.72%
1996	$6,127,299	42.82%	8.66%
1997	$12,159,440	84.97%	17.19%
1998	$20,922,754	146.20%	29.57%
1999	$28,705,561	200.59%	40.57%
2000	$35,070,804	245.07%	49.57%
2001	$52,215,507	364.87%	73.80%
2002	$52,363,526	365.90%	74.01%
2003	$52,529,418	367.06%	74.25%
2004	$52,689,738	368.18%	74.47%
2005	$52,798,097	368.94%	74.63%
2006	$52,873,135	369.46%	74.73%
2007	$52,911,401	369.73%	74.79%
2008	$52,937,430	369.91%	74.82%
2009	$52,962,972	370.09%	74.86%
2010	$52,986,446	370.26%	74.89%
2011	$52,987,469	370.26%	74.89%
2012	$52,987,469	370.26%	74.89%
2013	$52,732,805	368.48%	74.53%
2014	$52,414,910	366.26%	74.08%
2015	$51,781,448	361.84%	73.19%
Averages	$38,922,371	271.98%	55.01%

Table 11 shows existing total expenditures and total 2015 and study period average total expenditures with implementation of the preferred alternative. The 2015 percentage increase for O&M expenditures is consistent with the corresponding value shown in Table 5. The 2015 total increase (73%) represents the expected long term DWWM expenditure increase over existing levels due to the preferred alternative.

Table 11: Existing Total Expenditures and Total Expenditures with The Preferred Alternative (1993 dollars)

Item	Expenditure Amount: Debt Service	Expenditure Amount: Operations & Maint.	TOTAL
Existing Levels	$16,200,000	$54,530,000	$70,730,000
Levels with Preferred Alternative			
2015	$50,896,903	$71,614,545	$122,511,448
Study Period Average	$43,899,506	$65,752,865	$109,652,371

Item	% Increase over Existing: Debt Service	% Increase over Existing: Operations & Maint.	TOTAL
Existing Levels			
Levels with Preferred Alternative			
2015	214%	31%	73%
Study Period Average	171%	21%	55%

Secondary and Eliminate/Reduce Ocean Discharges Alternatives: Total expenditures increases for the secondary and eliminate/reduce ocean discharges alternatives would be approximately 72% and 137% (see Table 5) greater than the total expenditure increases for the preferred alternative shown in Table 10. Table 12 shows existing total expenditures and total expenditures with the secondary and eliminate/reduce ocean discharges alternatives implementation. The 2015 percentage increase for O&M expenditures is consistent with the corresponding values shown in Table 5. The 2015 total increase represents the expected long term DWWM expenditure increase over existing levels due the secondary (124%) and eliminate/reduce ocean discharges (171%) alternatives implementation.

Table 12: Existing Total Expenditures and Total Expenditure Increases with The Secondary and Eliminate/Reduce Ocean Discharges Alternatives (1993 dollars)

	Expenditure Amount					
	Secondary Alternative			E/R Ocean Discharges Alternative		
Item	Debt Service	Operations & Maint.	TOTAL	Debt Service	Operations & Maint.	TOTAL
Existing Levels	$16,200,000	$54,530,000	$70,730,000	$16,200,000	$54,530,000	$70,730,000
Levels with Respective Alternative						
2015	$71,159,104	$87,377,852	$158,536,956	$90,978,059	$100,745,195	$191,723,254
Study Period Average	$60,075,386	$76,107,807	$136,183,193	$75,897,412	$84,888,836	$160,786,247

	% Increase over Exisitng					
	Secondary Alternative			E/R Ocean Discharges Alternative		
Item	Debt Service	Operations & Maint.	TOTAL	Debt Service	Operations & Maint.	TOTAL
Existing Levels						
Levels with Respective Alternative						
2015	339%	60%	124%	462%	85%	171%
Study Period Average	271%	40%	93%	369%	56%	127%

REVENUE AND SEWER SERVICE CHARGE IMPACTS

Feasible Alternative Revenue Impacts

Table 13 shows fiscal impacts of each feasible alternative on DWWM required revenues in the year 2015. The 2015 values for the secondary and reduce/eliminate ocean discharges are underestimated given that their respective costs are underestimated as noted in Table 4.

Table 13: Feasible Alternative Required Revenues in 2105 (1993 dollars)

Customer Classification	Existing Total Revenue	Feasible Alternative 2015 Total Revenue: Preferred Alternative	Secondary Alternative	E/R Ocean Discharges
Residential				
Single Family Duplex	$30,497,473	$47,275,338	$81,175,841	$112,104,090
Mixed Residential Units	$215,851	$334,599	$574,536	$793,436
Multi-Family	$19,448,812	$30,148,372	$51,767,360	$71,490,886
Mixed User	$122,136	$189,328	$325,092	$448,953
TOTAL RESIDENTIAL	$50,284,272	$77,947,637	$133,842,829	$184,837,364
Non-Residential				
Commercial	$10,629,252	$16,476,824	$28,292,130	$39,071,520
Hotels, Motels, etc.	$4,891,991	$7,583,269	$13,021,127	$17,982,218
Industrial Complex	$1,365,293	$2,116,395	$3,634,032	$5,018,610
Agriculture	$506	$784	$1,347	$1,860
Religious Institutions	$374,383	$580,346	$996,504	$1,376,175
TOTAL NON-RESIDENTIAL	$17,261,425	$26,757,617	$45,945,141	$63,450,383
Government				
U.S. Military Installations	$1,832,787	$2,841,076	$4,878,372	$6,737,047
U.S. Non-Military Installations	$73,953	$114,637	$196,842	$271,840
State	$3,211,905	$4,978,901	$8,549,203	$11,806,476
City	$306,401	$474,964	$815,555	$1,126,284
Total Government	$5,425,046	$8,409,578	$14,439,972	$19,941,647
TOTAL ALL	$72,970,743	$113,114,833	$194,227,942	$268,229,394

E/R = Eliminate/Reduce

Preferred Alternative Sewer Service Charge Impacts

Table 14 shows estimated actual sewer service charges to residential users due to implementation of the preferred alternative. It shows East Mamala Bay (All Oahu) debt service plus O&M sewer service charges would be 163% (27%) and 200% (29%) greater than existing levels for the study period average and in 2015 respectively. The residential user monthly debt service plus O&M sewer service charge would be $62 ($30) and $71 ($30) for the study period average and in 2015 respectively, versus the existing debt service plus O&M sewer service charge of $23.57.

Table 14: Estimated Actual Sewer Service Debt Service Plus O&M Charges Over the Study Period Due to Implementation of the Preferred Alternative (1993 dollars)

	East Mamala Bay					All of Oahu				
	Impact of the Preferred Alternative			Billing Unit Adjustment		Impact of the Preferred Alternative			Billing Unit Adjustment	
Study Period Year	Debt Service Charge	O&M Charge	Total Charge	Adjusted Charge	Increase Over Existing	Debt Service Charge	O&M Charge	Total Charge	Adjusted Charge	Increase Over Existing
existing	$5.40	$18.17	$23.57	$23.57		$5.40	$18.17	$23.57	$23.57	
1993	$5.69	$18.17	$23.86	$23.86	1.23%	$5.46	$18.17	$23.63	$23.63	0.25%
1994	$6.06	$18.18	$24.24	$23.97	1.70%	$5.54	$18.17	$23.71	$23.45	-0.53%
1995	$6.78	$18.18	$24.96	$24.42	3.59%	$5.68	$18.17	$23.85	$23.34	-0.99%
1996	$12.24	$18.30	$30.54	$29.73	26.12%	$6.79	$18.20	$24.98	$24.32	3.17%
1997	$18.84	$18.55	$37.39	$36.22	53.66%	$8.12	$18.25	$26.37	$25.54	8.36%
1998	$28.66	$18.69	$47.35	$45.65	93.63%	$10.11	$18.28	$28.38	$27.36	16.07%
1999	$37.34	$18.85	$56.20	$53.91	128.68%	$11.86	$18.31	$30.17	$28.94	22.78%
2000	$44.38	$19.05	$63.43	$60.55	156.85%	$13.29	$18.35	$31.64	$30.20	28.10%
2001	$45.46	$37.43	$82.90	$78.66	233.66%	$13.51	$22.07	$35.57	$33.75	43.18%
2002	$45.63	$37.44	$83.06	$78.35	232.36%	$13.54	$22.07	$35.61	$33.59	42.47%
2003	$45.81	$37.44	$83.25	$78.06	231.15%	$13.58	$22.07	$35.65	$33.42	41.78%
2004	$45.94	$37.49	$83.43	$77.78	229.93%	$13.60	$22.08	$35.68	$33.26	41.10%
2005	$46.04	$37.51	$83.56	$77.44	228.49%	$13.62	$22.08	$35.71	$33.09	40.38%
2006	$46.09	$37.55	$83.64	$76.90	226.22%	$13.63	$22.09	$35.72	$32.85	39.33%
2007	$46.13	$37.56	$83.69	$76.34	223.82%	$13.64	$22.09	$35.73	$32.59	38.27%
2008	$46.16	$37.56	$83.72	$75.77	221.40%	$13.65	$22.09	$35.74	$32.35	37.21%
2009	$46.18	$37.56	$83.74	$75.20	219.02%	$13.65	$22.09	$35.74	$32.10	36.17%
2010	$46.21	$37.56	$83.77	$74.65	216.67%	$13.66	$22.09	$35.75	$31.86	35.14%
2011	$46.21	$37.56	$83.77	$74.09	214.30%	$13.66	$22.09	$35.75	$31.62	34.13%
2012	$46.21	$37.56	$83.77	$73.54	211.96%	$13.66	$22.09	$35.75	$31.38	33.13%
2013	$45.92	$37.56	$83.48	$72.75	208.59%	$13.60	$22.09	$35.69	$31.10	31.93%
2014	$45.56	$37.56	$83.12	$71.90	205.00%	$13.53	$22.09	$35.62	$30.81	30.70%
2015	$44.84	$37.56	$82.40	$70.76	200.16%	$13.38	$22.09	$35.47	$30.46	29.22%
Average	$36.89	$30.91	$67.80	$62.20	163.83%	$11.77	$20.75	$32.52	$30.04	27.45%

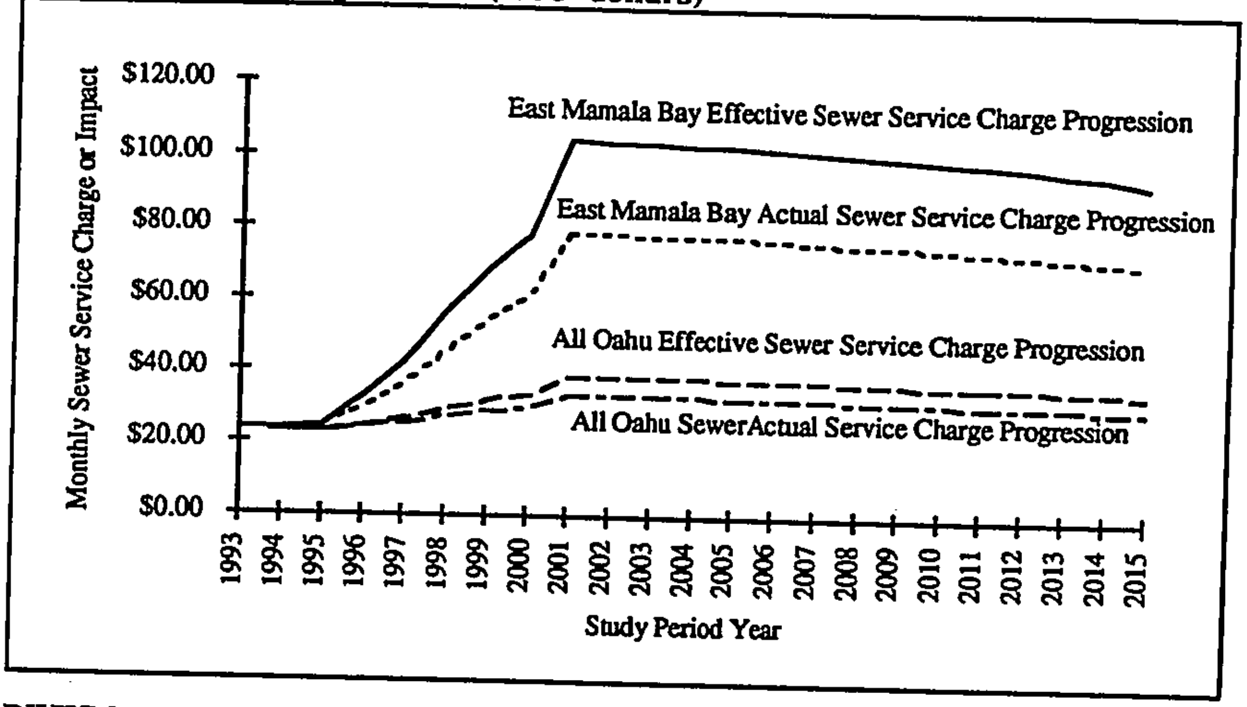
Table 15 shows the estimated effective sewer service charge to residential users if non-residential and government users pass on their sewer service charge increases to residential users. In other words, residential users, due to the implementation of the preferred alternative, directly incur the impact of (residential) sewer service charge increases and indirectly incur (via increased prices and taxes) the impact of sewer service charge increases of non-residential and government users. It shows an East Mamala Bay (All Oahu) debt service plus O&M impact of 241% (43%) and 297% (49%) greater than existing levels for the study period average and in 2015 respectively. The total residential user debt service plus O&M impact would be $80 ($34) and $94 ($35) for the study period average and in 2015 respectively, versus the existing debt service plus O&M sewer service charge of $23.57.

Table 15: The Estimated Effective Sewer Service Charge to Residential Users Due to Preferred Alternative Sewer Service Charge Increases if Non-Residential And Governmental Users Pass On Their Increases To Residential Users (1993 dollars)

	East Mamala Bay					All of Oahu				
	Impact of the Preferred Alternative			Billing Unit Adjustment		Impact of the Preferred Alternative			Billing Unit Adjustment	
Study Period Year	Debt Service Charge	O&M Charge	Total Charge	Adjusted Charge	Increase Over Existing	Debt Service Charge	O&M Charge	Total Charge	Adjusted Charge	Increase Over Existing
existing	$5.40	$18.17	$23.57	$23.57		$5.40	$18.17	$23.57	$23.57	
1993	$5.82	$18.17	$23.99	$23.99	1.78%	$5.49	$18.17	$23.66	$23.66	0.36%
1994	$6.35	$18.19	$24.54	$24.27	2.95%	$5.60	$18.17	$23.77	$23.51	-0.27%
1995	$7.39	$18.19	$25.58	$25.03	6.18%	$5.81	$18.17	$23.98	$23.46	-0.47%
1996	$15.32	$18.36	$33.68	$32.79	39.09%	$7.41	$18.21	$25.62	$24.94	5.80%
1997	$24.90	$18.73	$43.63	$42.26	79.28%	$9.35	$18.28	$27.63	$26.77	13.54%
1998	$39.15	$18.93	$58.08	$55.99	137.50%	$12.23	$18.32	$30.55	$29.45	24.94%
1999	$51.75	$19.16	$70.92	$68.03	188.57%	$14.78	$18.37	$33.15	$31.80	34.89%
2000	$61.97	$19.45	$81.42	$77.72	229.67%	$16.85	$18.43	$35.27	$33.67	42.83%
2001	$63.54	$46.12	$109.66	$104.05	341.39%	$17.16	$23.82	$40.99	$38.89	64.98%
2002	$63.77	$46.13	$109.90	$103.67	339.75%	$17.21	$23.83	$41.04	$38.71	64.19%
2003	$64.04	$46.14	$110.18	$103.31	338.25%	$17.27	$23.83	$41.09	$38.53	63.45%
2004	$64.23	$46.21	$110.44	$102.95	336.72%	$17.30	$23.84	$41.14	$38.35	62.70%
2005	$64.38	$46.24	$110.62	$102.52	334.88%	$17.33	$23.85	$41.18	$38.16	61.90%
2006	$64.45	$46.29	$110.74	$101.82	331.91%	$17.35	$23.86	$41.21	$37.88	60.71%
2007	$64.50	$46.30	$110.81	$101.07	328.76%	$17.36	$23.86	$41.22	$37.60	59.49%
2008	$64.54	$46.31	$110.85	$100.32	325.57%	$17.37	$23.86	$41.23	$37.31	58.28%
2009	$64.58	$46.31	$110.89	$99.58	322.43%	$17.37	$23.86	$41.24	$37.03	57.08%
2010	$64.62	$46.31	$110.93	$98.85	319.33%	$17.38	$23.86	$41.24	$36.75	55.91%
2011	$64.62	$46.31	$110.93	$98.11	316.19%	$17.38	$23.86	$41.24	$36.48	54.74%
2012	$64.62	$46.31	$110.93	$97.38	313.10%	$17.38	$23.86	$41.24	$36.21	53.59%
2013	$64.20	$46.31	$110.51	$96.30	308.50%	$17.30	$23.86	$41.16	$35.87	52.14%
2014	$63.68	$46.31	$109.99	$95.14	303.58%	$17.19	$23.86	$41.05	$35.51	50.64%
2015	$62.63	$46.31	$108.94	$93.55	296.84%	$16.98	$23.86	$40.84	$35.07	48.77%
Average	$51.09	$36.66	$87.75	$80.38	240.97%	$14.65	$21.91	$36.55	$33.72	43.05%

Figure 7 presents the East Mamala Bay and All Oahu adjusted charges and impacts of Tables 14 and 15. It shows that values peak at the end of the next decade after rather steep rises during the earlier years of this period. The decreases thereafter are due to spreading impacts (i.e. increased DWWM required revenues) over more residential units.

Figure 7: Preferred Alternative Estimated Actual and Effective Residential Sewer Service Charge Progressions (1993 dollars)



DWWM sewer service charge increases generally lag required DWWM expenditure increases. This causes temporary revenue shortfalls that must be covered by the general fund (Steven Ching, DWWM). In light of the steep sewer service charge increase to the end of the decade shown in Figure 7 and assuming the preferred alternative is implemented, it may behoove rate setters to increase rates at a more rapid progression than is shown. This would help prevent DWWM revenue shortfalls and thereby eliminate General Fund dollar infusions to cover the shortfalls.

Secondary and Reduce/Eliminate Ocean Discharge Alternatives Impact on Sewer Service Charges for All Oahu

Figure 8 presents estimated actual sewer service charge increase progressions over the study period for the secondary and reduce/eliminate ocean discharge alternatives for all Oahu. For each alternative, charge progressions to the end of decade are steeper than that for the preferred alternative. The decreases thereafter are due to spreading charges (i.e. increased DWWM required revenues attributable to residential users only) over more residential units.

Figure 8: Secondary and Reduce/Eliminate Ocean Discharge Alternatives Estimated Actual Sewer Service Charge Progressions for All Oahu (1993 dollars)

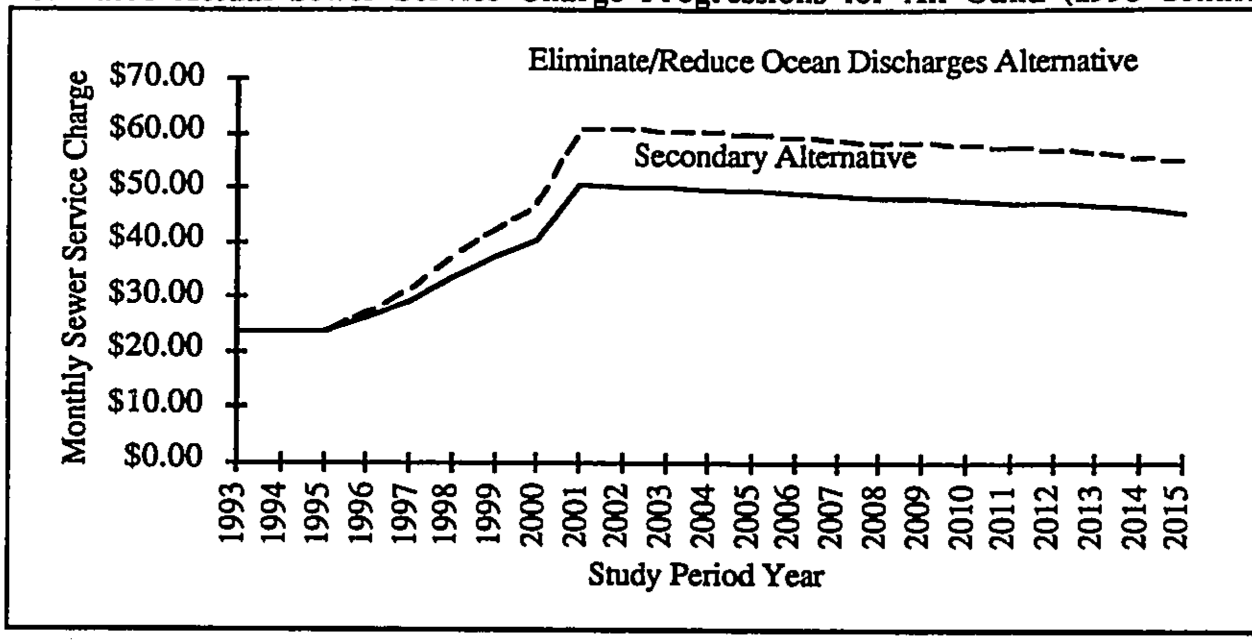


Table 16 shows for residential users the average monthly study period actual sewer service charge, its increase over existing sewer service charges in total dollar and percentage terms, and its increase over preferred alternative sewer service charge increases in total dollar and percentage terms for each feasible alternative. Table 17 shows for residential users the average monthly study period effective sewer service charge increases if non-residential and government users pass on their charge increases to residential users, its increase over existing sewer service charges in total dollar and percentage terms, and its increase over preferred alternative impacts in total dollar and percentage terms for each feasible alternative. The values in each table are for All Oahu for 2015 and the study period annual average.

The percentage change values shown in Table 16 and 17 are consistent with but not equal to corresponding values presented in Tables 5 and 11 above. Tables 16 and 17 percentage increases over existing in 2015 are less than the corresponding values of Table 11 due to the fact that expenditure increase are spread over more billing units with time. Table 16 values also assume only 68.91% of the total DWWM required revenues due to expenditure increases are passed on to residential users.

Table 16 and 17 percentage increases over the preferred alternative in 2015 are greater than the corresponding values of Table 5 due to the way percentage values are calculated. Given that sewer service charges are spread over more billing units with time lowers the increase to an individual residential unit that would otherwise occur. Measuring a percentage change relative to a smaller value mathematically results in a larger percentage change. Thus, Tables 16 and 17 percentage increases relative to the preferred alternative will be greater than the corresponding values shown in Table 5.

Table 16: Feasible Alternative Estimated Actual Residential User Sewer Service Charges for All Oahu Residential Users (1993 dollars)

2015 Estimated Effective Charges

Alternative	Sewer Service Charge	Increases Over Existing Charge		Increases Over Preferred Alternative	
		Dollar Increase	Percentage Increase	Dollar Increase	Percentage Increase
Preferred	$30.46	$6.89	29%	$0.00	0%
Secondary	$37.57	$14.00	59%	$7.11	103%
E/R Ocean Discharges	$44.12	$20.54	87%	$13.66	198%

Study Period Estimated Effective Average Annual Charges

Alternative	Sewer Service Charge	Increases Over Existing Charge		Increases Over Preferred Alternative	
		Dollar Increase	Percentage Increase	Dollar Increase	Percentage Increase
Preferred	$30.04	$6.47	27%	$0.00	0%
Secondary	$35.60	$12.02	51%	$5.55	81%
E/R Ocean Discharges	$40.74	$17.17	73%	$10.70	155%

Note: The increases relative to the existing sewer service charges and relative to the preferred alternative are to allow a comparison with Tables 11 and 5 above respectively.

Table 17: Feasible Alternative Residential Estimated Effective Sewer Service Charge Increases for All Oahu Assuming Non-Residential Users Pass on Their Charge Increase to Residential Users (1993 dollars)

2015 Estimated Effective Charges

Alternative	Sewer Service Charge	Increases Over Existing Charge		Increases Over Preferred Alternative	
		Dollar Increase	Percentage Increase	Dollar Increase	Percentage Increase
Preferred	$35.07	$11.50	49%	$0.00	0%
Secondary	$45.39	$21.81	93%	$10.31	90%
E/R Ocean Discharges	$54.89	$31.31	133%	$19.82	172%

Study Period Estimated Effective Average Annual Charges

Alternative	Sewer Service Charge	Increases Over Existing Charge		Increases Over Preferred Alternative	
		Dollar Increase	Percentage Increase	Dollar Increase	Percentage Increase
Preferred	$33.72	$10.15	43%	$0.00	0%
Secondary	$41.78	$18.20	77%	$8.06	70%
E/R Ocean Discharges	$49.25	$25.68	109%	$15.53	135%

Preferred Alternative Multiplier Effects

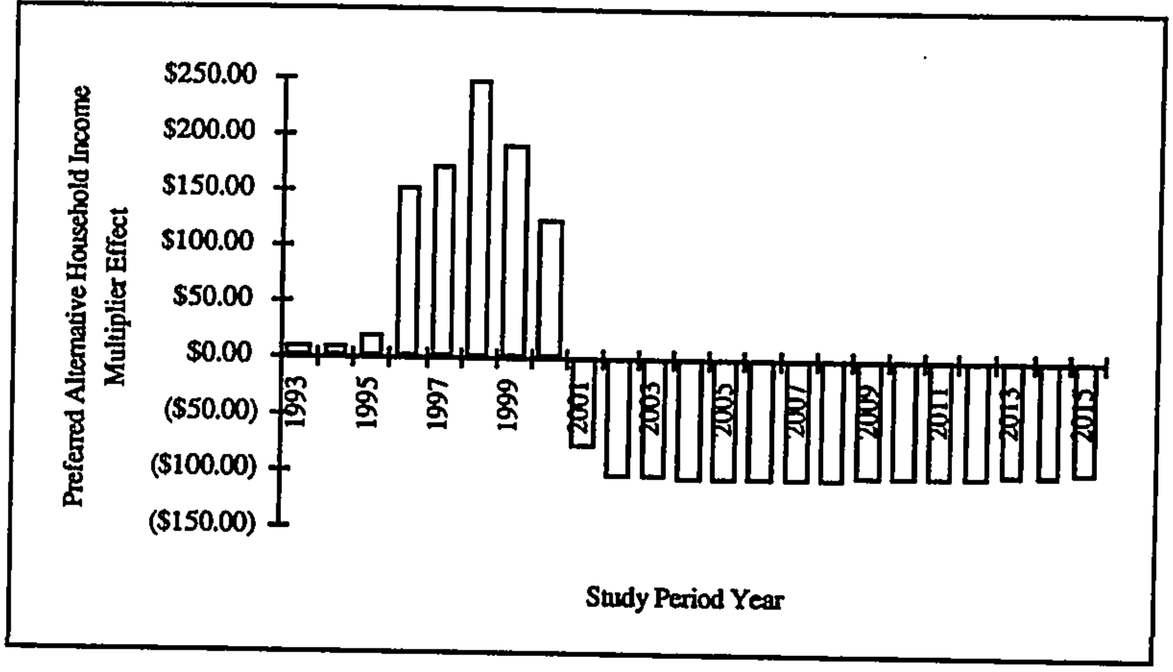
Table 18 presents estimated multiplier effects to the average Oahu household over the study period due to the preferred alternative's implementation and the total household income effect. This includes household income multiplier effects due to preferred alternative caused CIP expenditures, DWWM debt service costs, and DWWM O&M costs. Table 18 shows an average per Oahu household income multiplier effect over the study period from preferred alternative implementation of ($27) and a total household income effect of ($9.6) million. In 2015 the per Oahu household income multiplier effect is ($100) and the total household income effect is ($34) million.

Table 18: Preferred Alternative Caused Household Income Multiplier Effects Per Oahu Household and In Total (1993 dollars)

	Multiplier Effect Per Oahu Household				
Study Period Year	CIP Multiplier Effects	Debt Service Multiplier Effects	O&M Cost Multiplier Effects	Total Preferred Alternative Multiplier Effect	Total Oahu Household Income Multiplier Effect
1993	$9.24	($0.69)	$0.00	$8.55	$2,497,566
1994	$11.41	($1.54)	($0.01)	$9.86	$2,911,238
1995	$22.50	($3.21)	($0.01)	$19.28	$5,753,896
1996	$169.84	($15.90)	($0.14)	$153.79	$46,131,262
1997	$204.24	($31.11)	($0.42)	$172.72	$52,064,876
1998	$302.41	($53.59)	($0.57)	$248.26	$75,206,252
1999	$266.04	($73.23)	($0.74)	$192.06	$58,470,181
2000	$214.60	($88.94)	($0.95)	$124.72	$38,155,064
2001	$32.77	($90.86)	($20.58)	($78.67)	($24,212,306)
2002	$4.90	($90.69)	($20.47)	($106.25)	($32,894,772)
2003	$5.54	($90.57)	($20.35)	($105.38)	($32,818,435)
2004	$3.94	($90.33)	($20.28)	($106.68)	($33,417,699)
2005	$2.93	($90.02)	($20.19)	($107.29)	($33,806,783)
2006	$1.48	($89.42)	($20.07)	($108.00)	($34,304,439)
2007	$1.05	($88.79)	($19.92)	($107.66)	($34,467,451)
2008	$0.79	($88.16)	($19.76)	($107.13)	($34,567,080)
2009	$0.77	($87.53)	($19.61)	($106.38)	($34,593,373)
2010	$0.76	($86.92)	($19.46)	($105.62)	($34,611,996)
2011	$0.00	($86.27)	($19.32)	($105.58)	($34,861,216)
2012	$0.00	($85.62)	($19.17)	($104.80)	($34,861,216)
2013	$0.00	($84.39)	($19.03)	($103.42)	($34,659,183)
2014	$0.00	($83.02)	($18.89)	($101.92)	($34,406,986)
2015	$0.00	($80.94)	($18.76)	($99.70)	($33,904,440)
Average	$54.57	($68.77)	($12.99)	($27.18)	($9,617,262)

The negative household income multiplier effects of DWWM debt service and O&M expenditures that occur over the study period overwhelm the positive multiplier effects from CIP expenditures. Figure 9 shows that this occurs at the end of the decade. Figure 9 also shows that the negative per Oahu household income multiplier effect peaks in 2006 and decreases thereafter. The decrease is due to diminishing preferred alternative debt service costs and increasing population.

Figure 9: Preferred Alternative Multiplier Effect Study Period Distribution (1993 dollars)



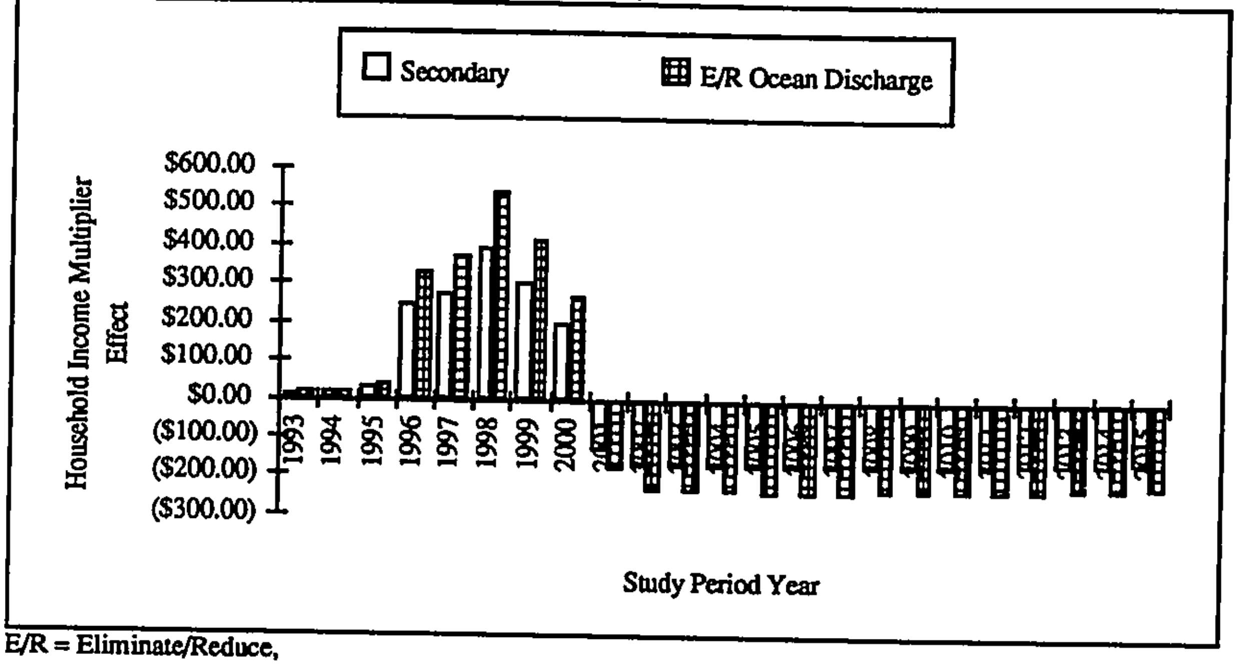
It should be noted that all preferred alternative caused DWWM debt service and O&M expenditures and their incumbent multiplier effects do not show up during the study period. The preferred alternative caused debt service payments for CIP expenditures continue for 15 years beyond the end of the study period. Preferred alternative caused DWWM O&M expenditures extend to perpetuity. These (negative) multiplier effects are not measured in this analysis since it only covers the study period. To give a sense of the magnitude of these negative effects, the table below shows that the present value of preferred alternative caused DWWM debt service expenditures (i.e. total amortization costs) exceed the present value of preferred alternative CIP expenditure household income multiplier effects by $160,260,797 or 55%.

Item	Present Value
Total Amortization Cost	$519,657,403
CIP Multiplier Effects	$335,055,271
Difference	$184,602,132

Secondary and Reduce/Eliminate Ocean Discharges Alternative Multiplier Effects

Figure 10 shows estimated household income multiplier effects over the study period due to the implementation of the secondary and reduce/eliminate ocean discharges alternatives. The pattern of the multiplier effects parallels that for the preferred alternative but the absolute values are 75% and 142% larger than those for the preferred alternatives.

Figure 10: Secondary and Reduce/Eliminate Ocean Discharges Multiplier Effect Study Period Distribution (1993 dollars)



E/R = Eliminate/Reduce,

Direct Economic Benefits from the Sale of Useful Outputs

Reused Effluent Water: The eliminate/reduce ocean discharges alternative is the only alternative with the possibility of effluent water reuse (for irrigation). Reuse is one of several effluent disposal options and was not selected as the effluent disposal option for the eliminate/reduce ocean discharges alternative by the Facilities Plan selection process. Hence, valuation of effluent water reuse is separate from the remainder of this analysis.

Table 19 presents on a per Oahu household basis, the estimated additional (i.e. over underground injection, the effluent disposal option selected) cost for effluent reuse, the estimated total (maximum potential) value of reused effluent water, and the net (of additional costs) value (or avoided potable water development cost) of reused effluent water over the study period. Net values do not begin to accrue until 2004 the year after a secondary treatment plant's construction is assumed completed. At this time, the net per Oahu household value (net avoided costs) of effluent reuse is between $42 and $59. This value decreases over the study period as constant reused effluent water quantities (20.21 MGD) and their incumbent value are spread over more Oahu residential units.

Effluent Reuse in Perspective: The reused effluent water estimated value presented in Table 19 likely overstates its true (market) value. This is the case for two reasons. First, demand for effluent water reuse as irrigation water does not exist at this time nor will it likely exist for a considerable time into the future for SIWWTP existing or projected irrigation quality effluent levels in an urban environment. Secondly, effluent water was valued at the maximum potential value for potable water. In a market situation, reclaimed effluent water is not a perfect substitute for potable water as assumed for the effluent valuation of Table 19. Thus, using potable water development (avoided) costs to value effluent water likely overstates its true economic value.

Table 19: Net Value (Avoided Cost) Of Reused Effluent Water per Oahu Household for the Eliminate/Reduce Ocean Discharges Alternative (1993 dollars)

		Estimated Total Value of Reused Water		Net Value of Reused Water	
Study Period Year	Additional Cost for Reuse	BWS Development Cost	RO Development Cost	BWS Development Cost	RO Development Cost
1993	$0.00	$0.00	$0.00	$0.00	$0.00
1994	$0.00	$0.00	$0.00	$0.00	$0.00
1995	$0.00	$0.00	$0.00	$0.00	$0.00
1996	$0.00	$0.00	$0.00	$0.00	$0.00
1997	$0.00	$0.00	$0.00	$0.00	$0.00
1998	$0.00	$0.00	$0.00	$0.00	$0.00
1999	$0.00	$0.00	$0.00	$0.00	$0.00
2000	$0.00	$0.00	$0.00	$0.00	$0.00
2001	$0.00	$0.00	$0.00	$0.00	$0.00
2002	$0.00	$0.00	$0.00	$0.00	$0.00
2003	$0.00	$0.00	$0.00	$0.00	$0.00
2004	$12.67	$54.39	$71.33	$41.72	$58.66
2005	$12.60	$54.07	$70.92	$41.47	$58.32
2006	$12.50	$53.64	$70.36	$41.14	$57.86
2007	$12.40	$53.22	$69.80	$40.82	$57.40
2008	$12.30	$52.80	$69.26	$40.50	$56.95
2009	$12.21	$52.39	$68.72	$40.19	$56.51
2010	$12.11	$51.99	$68.19	$39.88	$56.08
2011	$12.02	$51.60	$67.68	$39.58	$55.66
2012	$11.93	$51.22	$67.18	$39.28	$55.24
2013	$11.84	$50.84	$66.68	$38.99	$54.84
2014	$11.76	$50.47	$66.19	$38.71	$54.43
2015	$11.67	$50.10	$65.71	$38.43	$54.04
Average	$6.35	$27.25	$35.74	$20.90	$29.39

BWS = Board of Water Supply; RO = Reverse Osmosis

The per gallon (avoided cost) net value assigned to the effluent water in Table 19 was $0.00213. The current Board of Water Supply per gallon charge for irrigation water is $0.00071. The break-even per gallon value that must be assigned to reused effluent water for the reuse option to have the same average benefit over the study period as the (selected) underground injection option is $0.00055 per gallon. Using either of these alternative valuations for the reused effluent water would decrease the reuse options net benefit relative to what was estimated in Table 19 by 42% and 61% or to an average study period value of $15 and $10 respectively.

A second perspective related to the eliminate/reduce ocean discharges alternative with an assumed reuse effluent disposal option also merits notice. The objective of the Facilities Plan is to devise a wastewater system (i.e. alternative) that meets water quality standards. It is not to reuse effluent water. This objective is met by both the preferred and the eliminate/reduce ocean discharges alternatives. The difference is that the preferred alternative does so at a minimum cost. The table below shows the cost increase to go beyond meeting the water quality standards via the preferred alternative to effluent reuse via the eliminate/reduce ocean discharges alternative.

Item	Preferred Alternative	E/R Ocean Discharge w/ Reuse	Cost Increase	Percentage Increase for Reuse
Capital Cost	$559,696,500	$1,207,152,182	$647,455,682	115.68%
Life Cycle Cost	$922,092,497	$2,270,431,373	$1,348,338,876	146.23%

The table shows that the increase in capital and life cycle costs to meet water quality standards with the option of effluent reuse for irrigation (i.e. the eliminate/reduce ocean discharges alternative with effluent reuse) is 116% and 146% respectively greater than to merely meet water quality standards (i.e. the preferred alternative). In absolute dollar terms, capital and life cycle costs are $647 million and $1.35 billion more to meet water quality standards with the option of effluent reuse than to merely meeting water quality standards. Thus, there is a significant incremental increase in expenditure of dollar resources to obtain the effluent reuse option. If these dollars have a $0 opportunity cost then the reuse option makes sense. But in a an environment of scarce resources these dollars have a significant public and private opportunity cost. In sum, effluent reuse is a very expensive option of questionable economic benefits.

__Direct Economic Benefits from the Sale of Biosolids Products__: Table 20 shows the estimated tons of biosolids produced and the household income multiplier effects from biosolids products sale over the study period for each of the feasible alternatives. The estimated household income multiplier effects represent the maximum possible economic benefit from biosolids sale in terms of income per Oahu household. Benefits would not begin until the end of the decade when the expanded primary treatment for the preferred alternative would commence operation. This maximum benefit may be over-stated for the secondary and reduce/eliminate ocean discharge alternatives as land costs required for some types of biosolids processing for each have not been estimated in the Facilities Plan. Sufficient land is available at the SIWWTP for all biosolids processing options of the preferred alternative.

__Non Pecuniary Benefits__

Non pecuniary benefits caused by the implementation of the any of the feasible alternatives cannot be directly quantified due to the nature of the benefit itself or the inability to predict benefits (or avoided costs) and estimate their value. Areas where non pecuniary benefits will likely accrue are: public health and safety, environmental (physical impacts), and social impacts. With respect to each of these, there is an avoided direct economic cost in preserving water quality by implementation of a feasible alternative. These avoided direct economic costs are: negative health consequences (e.g. illness, disease) to resident and visitor populations, the localized deterioration of the East Mamala Bay aquatic environment and ground/surface water contamination, constraints to additional development in East Mamala Bay, and EPA fines ($25,000 per day per violation).

Preserving water quality by implementation of the preferred alternative also has an indirect avoided cost to tourism in general if ocean water becomes a disamenity, and an avoided negative household income multiplier effect. A negative household income multiplier effect would occur from a non-avoided cost. Such a cost would, in all likelihood, be exogenous to the Oahu economy. This non-avoided dollar cost would be in the form of a fine for violation of the Clean Water Act ($25,000 per day per violation) which is paid to the Federal government, or of a lost tourist dollar that does not come to Hawaii because of deteriorating water quality. For the latter, the Type II multiplier is .59 which means that for each tourist dollar lost, there is a $.59 reduction in Oahu household income.

Table 19: Estimated Per Oahu Household Economic Benefits from Biosolids Products Sale (1993 dollars)

Study Period Year	Tons of Biosolids Produced per Year: Preferred Alternative	Secondary	E/R Ocean Discharges	Household Income Multiplier Effects: Preferred Alternative	Secondary	E/R Ocean Discharges
1993	0	0	0	$0.00	$0.00	$0.00
1994	0	0	0	$0.00	$0.00	$0.00
1995	0	0	0	$0.00	$0.00	$0.00
1996	0	0	0	$0.00	$0.00	$0.00
1997	0	0	0	$0.00	$0.00	$0.00
1998	0	0	0	$0.00	$0.00	$0.00
1999	0	0	0	$0.00	$0.00	$0.00
2000	0	0	0	$0.00	$0.00	$0.00
2001	10,570	28,738	33,048	$0.22	$0.59	$0.68
2002	10,633	28,909	33,245	$0.22	$0.59	$0.68
2003	10,696	29,080	33,443	$0.22	$0.59	$0.68
2004	10,759	29,252	33,640	$0.22	$0.59	$0.68
2005	10,822	29,423	33,837	$0.22	$0.59	$0.68
2006	10,909	29,659	34,107	$0.22	$0.59	$0.68
2007	10,996	29,894	34,378	$0.22	$0.59	$0.68
2008	11,082	30,129	34,649	$0.22	$0.59	$0.68
2009	11,169	30,365	34,920	$0.22	$0.59	$0.68
2010	11,255	30,600	35,190	$0.22	$0.59	$0.68
2011	11,340	30,831	35,456	$0.22	$0.59	$0.68
2012	11,425	31,062	35,721	$0.22	$0.59	$0.68
2013	11,510	31,293	35,987	$0.22	$0.59	$0.68
2014	11,595	31,524	36,253	$0.22	$0.59	$0.68
2015	11,680	31,755	36,518	$0.22	$0.59	$0.68
Average	7,237	19,675	22,626	$0.14	$0.39	$0.45

E/R = Eliminate/Reduce

Implementation of any of any of the feasible alternatives would preserve water quality and avoid all direct and indirect economic costs due to a deterioration of water quality. The technical analysis of this study (see Section 6.2.6.1) further shows that the $90 million annual value of ocean recreation activities (Section 3.8) in the East Mamala Bay region is not at risk given the level of treatment of each feasible alternative.

COST/BENEFITS

Implementation of any of the feasible alternatives leads to economic costs and benefits that primarily occur on Oahu. Economic costs are the debt service costs required to amortize up front capital costs to physically implement the components of a feasible alternative over the study period, and Department of Wastewater Management operations and maintenance cost increases that come about after a feasible alternative component becomes operational. Economic benefits are household income multiplier effects arising from a feasible alternative's capital expenditures and the sale of biosolids products produced. There are also non pecuniary benefits, the value of which have not been estimated.

The economic benefits (costs) of implementation of a feasible alternative are measured in terms of household income. Summing the economic costs and benefits over the study period provides an estimate of the annual net economic benefit (cost) of implementation of a feasible alternative.

Net Benefits (Costs) of the Preferred Alternative

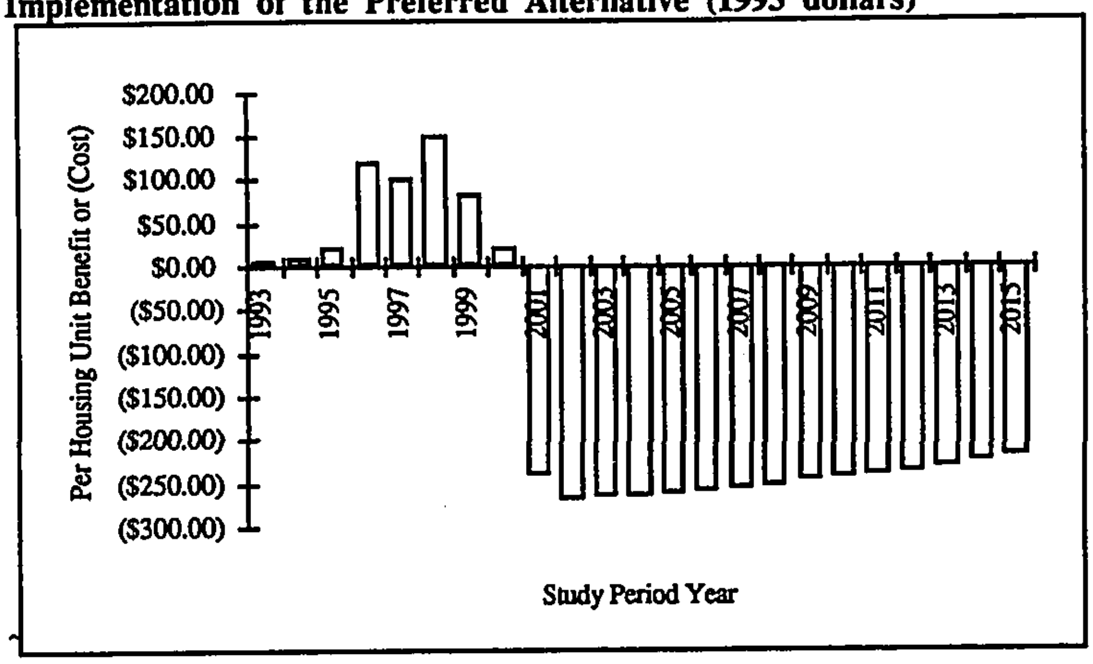
Table 21 presents the results from aggregating across all the per Oahu housing (household) unit annual economic benefits (costs) that occur due to the implementation of the preferred alternative. It shows an average annual $148 cost per Oahu residential unit over the study period and a $237 cost in 2015.

Table 21: Net Per Oahu Household Direct Economic Benefit (Cost) over the Study Period from Implementation of the Preferred Alternative (1993 dollars)

	Per Oahu Household Benefit (Cost)			
Year	Annual Sewer Service Charge Increase	Multiplier Effect	Biosolids Sales Benefits	TOTAL BENEFIT (COST)
1993	$1.02	$8.55	$0.00	$7.53
1994	($0.77)	$9.86	$0.00	$10.63
1995	($1.33)	$19.28	$0.00	$20.61
1996	$16.40	$153.79	$0.00	$137.39
1997	$38.31	$172.72	$0.00	$134.40
1998	$70.55	$248.26	$0.00	$177.71
1999	$98.70	$192.06	$0.00	$93.36
2000	$121.16	$124.72	$0.00	$3.56
2001	$183.81	($78.67)	$0.22	($262.26)
2002	$181.60	($106.25)	$0.22	($287.63)
2003	$179.48	($105.38)	$0.22	($284.64)
2004	$177.37	($106.68)	$0.22	($283.83)
2005	$175.09	($107.29)	$0.22	($282.16)
2006	$171.73	($108.00)	$0.22	($279.52)
2007	$168.29	($107.66)	$0.22	($275.74)
2008	$164.86	($107.13)	$0.22	($271.78)
2009	$161.48	($106.38)	$0.22	($267.65)
2010	$158.15	($105.62)	$0.22	($263.55)
2011	$154.85	($105.58)	$0.22	($260.21)
2012	$151.59	($104.80)	$0.22	($256.17)
2013	$147.50	($103.42)	$0.22	($250.70)
2014	$143.25	($101.92)	$0.22	($244.94)
2015	$137.97	($99.70)	$0.22	($237.45)
Average	$121.79	($27.18)	$0.14	($148.83)

Figure 11 presents the distribution of net direct economic benefits (costs) per Oahu household. It shows that implementation of the preferred alternative has a net economic benefit to the end of the decade. This is due to the large positive household income multiplier effects from construction expenditures during this period. These net economic benefits become costs as (positive) construction multiplier effects diminish and negative household income multiplier effects from DWWM debt service and O&M expenses increase. These costs and their negative household income multiplier effects continue into perpetuity but do decrease per household given more Oahu households with time and as capital costs are fully amortized over the 15 years post the study period.

Figure 11: Study Period Distribution of Total Household Benefits (Costs) Due to Implementation of the Preferred Alternative (1993 dollars)



Net Benefits (Costs) of the Secondary and Eliminate/Reduce Alternatives

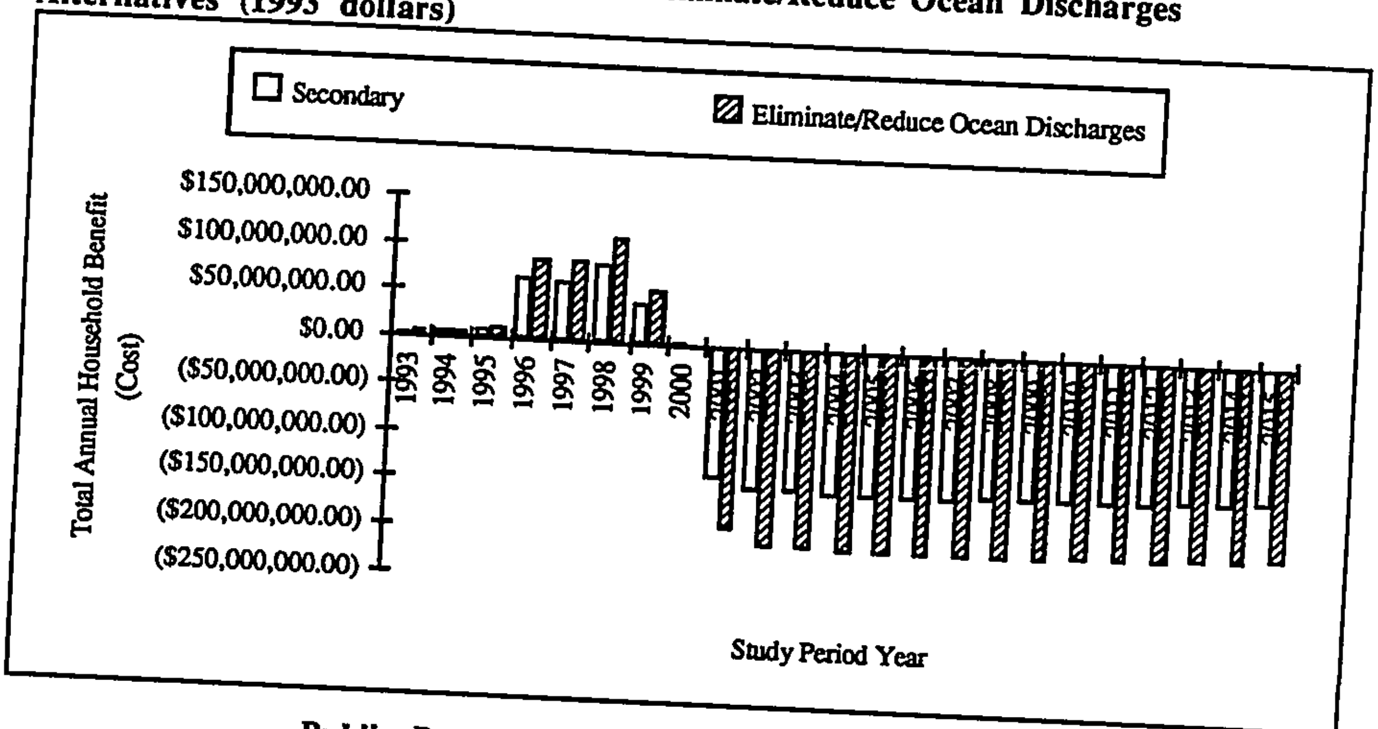
Table 22 presents the results from aggregating across all Oahu households total economic benefits (costs) that occur due to the implementation of the secondary and eliminate/reduce ocean discharges alternatives. The values for the preferred alternative are also presented for comparison. Table 22 shows an average annual study period total economic cost of $48 million, $86 million and $121 million, and a 2015 annual cost of $81 million, $144 million and $204 million total cost to Oahu households for the preferred, secondary and eliminate/reduce ocean discharges alternatives respectively.

Table 21: Total Oahu Household Benefit (Cost) over the Study Period from Implementation of a Feasible Alternative (1993 dollars)

Year	Preferred Alternative	Secondary Alternative	Eliminate/ Reduce Ocean Discharges
1993	$2,199,847	$3,484,508	$4,741,065
1994	$3,138,646	$4,433,607	$5,702,430
1995	$6,151,329	$8,673,868	$11,143,415
1996	$41,211,526	$63,907,761	$86,128,882
1997	$40,515,639	$62,441,995	$83,951,543
1998	$53,834,442	$83,228,868	$112,065,549
1999	$28,422,106	$42,655,293	$56,688,798
2000	$1,087,994	($977,622)	($2,854,552)
2001	($80,712,879)	($139,226,639)	($193,406,649)
2002	($89,048,743)	($152,735,744)	($211,975,445)
2003	($88,646,701)	($152,403,362)	($211,711,116)
2004	($88,913,687)	($153,151,946)	($212,923,151)
2005	($88,909,780)	($153,459,689)	($213,532,279)
2006	($88,781,442)	($153,688,204)	($214,104,879)
2007	($88,275,506)	($153,306,089)	($213,843,353)
2008	($87,691,887)	($152,798,467)	($213,410,414)
2009	($87,034,363)	($152,173,866)	($212,818,336)
2010	($86,366,754)	($151,532,212)	($212,202,769)
2011	($85,916,956)	($151,228,256)	($212,041,963)
2012	($85,216,745)	($150,527,115)	($211,340,602)
2013	($84,016,780)	($149,034,378)	($209,562,184)
2014	($82,692,731)	($147,345,094)	($207,516,343)
2015	($80,749,415)	($144,674,904)	($204,135,868)
Average	($48,539,689)	($86,497,291)	($121,606,879)

Figure 12 shows that the distribution of the benefits and costs for the secondary and eliminate/reduce ocean discharges alternative is similar to that for the preferred alternative but more accentuated due to larger dollar values involved.

Figure 12: Study Period Distribution of Total Household Benefits (Costs) Due to Implementation of the Secondary and Eliminate/Reduce Ocean Discharges Alternatives (1993 dollars)



Public Benefits of the Feasible Alternatives

The primary reason for implementation of a feasible alternative is not for its economic benefits but to avoid public health and safety, environmental, and social impact direct and indirect costs that could incur by not implementing one of the feasible alternatives. Thus, an economic cost/benefit assessment does not measure the total value of implementation of a feasible alternative.

The value of direct and indirect costs avoided and any non-economic benefits from implementation of a feasible alternative have not been estimated. Any valuation of these avoided costs and non-economic benefits on a per Oahu household basis that exceeds $148, $265 and $373 on average over the study period for the preferred, secondary and eliminate/reduce ocean discharges alternatives respectively, would cause its implementation to have a positive dollar benefit to Oahu households. These benefits would begin at the end of the decade and would continue into perpetuity.

Appendix C

OI CONSULTANTS, INC.

East Mamala Bay Study

Review of Monitoring Program
for Sand Island WWTP

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East Mamala Bay Study

Review of Monitoring Program for Sand Island WWTP

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September, 1992

East Mamala Bay Study

Review of Monitoring Program for Sand Island WWTP

Review Process

The monitoring program for the Sand Island WWTP was reviewed on the basis of several criteria:

1. Was the monitoring done on schedule?

2. Were the proper analyses performed on samples from the correct locations?

3. Did the data collected show that the permit conditions were met? If not, where and how frequently were they exceeded?

4. Are the data sufficient to conclude whether public health was threatened or environmental degradation occurred? If so, did such conditions occur?

We have not performed any site reviews to examine the laboratory practices of the analytical staff. Our assumption is that the State Department of Health has the responsibility to establish acceptable procedures and to insure that appropriate laboratory practices are followed.

Monitoring Program

Monitoring for the Sand Island WWTP is to be conducted at several different points along the treatment stream: influent and effluent monitoring, receiving water monitoring, sediment and biological monitoring, and outfall and diffuser monitoring. Each monitoring portion has its own requirements for scheduling, analysis and reporting.

<u>1. Effluent Monitoring</u>

Monitoring Program

The effluent monitoring program as set forth in the NPDES permit consists of continuous measurement of flow, daily measurement fecal coliform and enterococcus bacteria, 5 day per week monitoring of BOD_5, suspended solids, and pH; twice weekly measurement of oil and grease; weekly measurements of temperature; and semiannual measurements of priority pollutants.

Monitoring Results

Measured daily flow (mgd) for the monitoring period are presented in Figure 1; also shown is the permit flow upper limit. In general, the daily flow has remained constant or decreased slightly over the monitoring period. Occasional spikes in flow have been observed, but they have been of short duration. On only two occasions have the daily flows exceeded the permit limit.

Of particular note for consideration of impacts to receiving water is the lack of pronounced seasonality in the effluent volume flow. The data show no evidence of systematic increased flow during any season.

Weekly and monthly average values for BOD_5 and suspended solids are presented in Figure 2. Limits for weekly and monthly data for both parameters are also indicated. Again, the levels of BOD_5 and suspended solids in the effluent appear to be decreasing with time. Since the flow is also decreasing, this means that the total mass of BOD and suspended solids has been decreasing, not just being diluted by an increased flow. Neither parameter has exceeded the applicable permit levels.

2. Receiving Water Monitoring

Monitoring Schedule

Permit No. HI0020117 for the discharge of treated wastewater from the outfall of the Sand Island wastewater treatment plant to Mamala Bay became effective on February 20, 1990. The permit specifies that bacteriological samples be collected on a schedule of 5 days per month at the Shoreline stations; five days per month for bacteriological analyses and quarterly for other analyses at the Nearshore stations; and quarterly at the Offshore stations.

The sampling schedules for the five day per month bacteriological analyses have been generally well met for both the Shoreline and Nearshore stations. Data reviewed here began on October 25, 1990, and continued on a five day schedule with little variation.

Quarterly sampling requirements were not met during 1990 (when surveys were performed only in March and December), but have been met in 1991 and the first half of 1992. While surveys have been performed within each calendar quarter since late 1990, the time between collections has ranged from one month to over five months.

Monitoring Procedures

Sampling and analysis for bacteriological parameters at the Shoreline and Nearshore stations have been essentially complete. Collection and analysis for fecal coliforms and enterococci have occurred at the specified stations.

Sampling and analysis for other water quality parameters at the Nearshore and Offshore stations have only been completely performed in 1992. The first sample collection in March 1990 collected samples only from the Nearshore (N1-N5), diffuser (Z), and Zone of Mixing (ZM1-4) stations; collections were not made at the Boundary (B1-6) or Plume (PZ-P2) stations. Sample collection was more complete, although not totally so, in January 1991. Data for temperature, salinity, dissolved oxygen, pH and extinction coefficient were not collected at Boundary or Plume stations. For the balance of 1991, sample collection was complete except for the determination of extinction coefficients.

We have found that a consistent and systematic mistake in the determination of the extinction coefficient has occurred. It appears from the data sheets that the extinction coefficient is calculated from a measured determination of the Secchi disk depth. For most systems, the relationship between Secchi depth and extinction coefficient "k" is given by:

$k = 1.7/SD$.

From the data tables, it appears that a factor of 0.85 instead of 1.7 has been used. Since no information on methodology has been included in any reports, the interpretation is that a systematic underestimation of extinction coefficient has occurred. The result of the apparent miscalculation is an underestimation of extinction coefficient by a factor of 2.

Monitoring Results

Data from the 6-day monitoring for bacteria at nearshore and shoreline stations are presented in Figures 3 and 4. Significant events of high bacterial levels were observed at both nearshore and shoreline stations for both bacterial types. Since the permit regulations set allowable limits on the basis of geometric means rather than individual samples, the running geometric means for five consecutive samples for both fecal coliforms and enterococcus were calculated and plotted over time (Figures 5 - 8). No regulatory limits exist for marine recreational waters for fecal coliforms. The data in Figures 5 and 6 clearly show concurrent spikes in fecal coliform abundance at the nearshore stations in late 1990 and February-March, 1992, and extremely high numbers at shoreline station 5 in 1991 and 1992. The same general patterns were seen for enterococcus (Figures 7 and 8). The limit for enterococcus levels as set in the permit (35 per 100 ml) has been superseded by the revised State of Hawaii regulations for recreational waters, which established a stricter limit (7 per 100 ml). This stricter limit is indicated in Figures 7 and 8 by a thin line. The geometric mean data for all stations exceed this regulatory limit at some time during the monitoring period.

The question arises, does the Sand Island effluent contribute to this exceedance of recreational water quality? One means of examining this question is to look at the relationship between bacterial levels in samples taken at pairs of stations located along a line from the discharge point to the shoreline. Stations NS2 and SS2, NS3 and SS3, and NS5 and SS5 lie along such alignments, with the nearshore (NS) stations located between the diffuser and the shoreline (SS) stations. Scatter plots of fecal coliform and enterococcus from the paired stations are presented in Figure 9. If there were a consistent pattern of flow from the diffuser to the shore, the data should show some evidence of concurrently high levels of bacteria in both nearshore and shoreline samples. Such a pattern was never seen. These data concur with the results of recent physical oceanographic models of the effluent plume dynamics (Noda, 1992). The model results suggest that the plume reaches the shoreline less than 0.3% of the time (1 day of the year), and that during such times the plume has been diluted by a factor of 1,800 to 2,500.

If the bacterial levels are not associated with the effluent, one could hypothesize that they had a terrestrial source, and were carried into the receiving waters in surface flow. If such were the case, one would expect higher levels of bacteria during wet seasons (generally taken in Hawaii as November - April) as compared to dry seasons (May - October). The bacterial data for the shoreline stations were grouped by month (Figure 10). There is a strong seasonal pattern in the data, with generally low fecal coliform and enterococcus levels during the summer (March - August) and higher levels during the wetter winter (September - February). This pattern suggests that shoreline bacterial levels are strongly affected by terrestrial sources.

A second hypothesis one could pose is that the bacterial levels are generated *in situ*, i. e., from local human contact. In order to examine this hypothesis, the data for the shoreline stations were sorted by day of the week (Figure 11). The data clearly show that bacterial levels are consistently higher during the weekend (Saturday - Monday), when beach use is higher.

One would be led to conclude, then, that the wastewater treatment plant does not have a significant impact on the water quality of the nearby recreational waters.

The results of the quarterly water quality monitoring program are summarized in Table 1. In this table, the geometric means for the samples collected are presented for all monitoring stations. In almost all cases, the geometric means for all stations are well below the levels set by the permit or state water quality standards. Exceptions are the slightly elevated levels of chlorophyll at NS 1 and 2, which may be a reflection of waters leaving the Keehi Lagoon; and somewhat elevated light extinction, also at nearshore stations, and also potentially due to other sources.

Monitoring Conclusions

From the above data, one would conclude that the effluent discharge has not had any significant impact on the quality of the receiving waters.

3. Sediment and Biological Monitoring

A. Sediment Chemistry

Sediment chemical analyses for 1990 were performed by SAIC (San Diego), and a report presenting the analytical data was submitted in December, 1990. Only data for cyanide in sediment samples for 1991 was available for review.

Volatile Organics:

Methylene chloride was found in quantifiable levels in samples from stations Z and B-6. Toluene was detected in samples from stations B-1, B-3, B-4, B-6 and Z. However, the levels of toluene were below the reporting (quantitation) limit.

The sludge sample contained detectable (but below quantitation) levels of methylene and toluene. The sludge sample contained quantifiable levels of benzene, ethyl benzene, styrene, m & p-xylenes and o-xylene.

No volatile organics were found in tissue samples at reporting levels.

Semivolatile Organics:

bis (2-ethylhexyl) phthalate was found at levels below the quantitation level in almost all sediment samples. Some SVO's were found in detectable but not quantifiable levels in most samples. Quantifiable levels of benzoic acid were found in sample B-1.3; phenanthrene was found in quantifiable levels in samples B-3.1, B-5, and B-6.3; fluoranthrene was found in quantifiable levels in samples B-3.2, B-6.1, B-6.2 and B-6.3; pyrene was found in quantifiable levels in samples B-1.2, B-3.1 and B-3.2; crysene was found in quantifiable levels in samples B-3.1, B-3.2, B-4 and Z; benzo(k)fluoranthrene was found in quantifiable levels in sample B-3.1; benzo(a)pyrene was found in quantifiable levels in samples B-3.1, B-3.2, B-6.1, B-6.2; indeno(1,2,3-cd)pyrene was found in quantifiable levels in sample B-3.2; benzo(g,h,i)perylene was found in quantifiable levels in samples B-3.1 and B-3.2.

The sludge sample contained quantifiable levels of only bis(2-ethylhexyl)phthalate.

Benzoic acid was measured in tissue samples from kahala and taape. bis (2-ethylhexyl) phthalate was detected in kahala at levels below the quantitation level.

Organochlorine Pesticides and PCB's:

gamma-chlordane levels were slightly above detection levels in samples B-3.1 and B-3.2; alpha-chlordane was slightly above detection levels in sample B-3.2. Barely quantifiable levels of

4,4'-DDE were found in samples B-3.1 and B-3.3. The PCB AR-1254 was found in quantifiable levels at station Z.2.

The sludge sample contained quantifiable levels of only beta-BHC, dieldrin and 4,4'-DDE.

Levels of 4,4'-DDE were slightly above detection levels in kahala and akule; beta-BHC was detected at very low levels in kahala and taape.

<u>Organophosphorus Pesticides</u>:

No detectable levels of organophosphorus pesticides were found in sediment, sludge or tissue samples.

<u>Trace Metals</u>:

Trace metals were found in low concentrations in all sediment, sludge and tissue samples. However, only lead was found in unusually high concentrations, in sample B-6.1.

<u>Dioxin</u>:

No detectable levels of dioxin were found in sediment, sludge or tissue samples.

B. Benthic Fauna

A report summarizing the benthic faunal monitoring for 1990 has been completed (Bailey-Brock et al, 1991). The abstract of that report is reproduced below.

Benthic infauna in the vicinity of the Sand Island ocean outfall were sampled at seven stations along the diffuser isobath in August 1990. Stations were located within and on the boundary of the Zone of Initial Dilution (ZID) and at distances between 1.2 and 2 km from the ZID boundary. Sediment grain size distributions were generally similar at all stations, consisting mainly of fine to coarse sands. Values for percent volatile solids, total nitrogen, and oxidation-reduction potential showed no indication of significant organic buildup in the sediment at any station. Total non-mollusk species abundance and species richness were significantly elevated at two (Stas. B4, Z) of four stations near the ZID due to an abundance of worms. Cluster analysis indicated that the station within the ZID (Sta. Z) differed maximally from all other stations in non-mollusk community composition. However, species diversity and evenness for both non-mollusks and mollusks were similar at all stations. The response patterns of benthic infauna near the Sand Island outfall show little indication of a strong influence being exerted by the diffuser effluent.

The report summarizing the 1991 survey was unavailable for review.

C. Fish Analysis

No reports summarizing any fish surveys were available for review.

D. Coral Reef Survey

No reports summarizing any coral reef surveys were available for review.

4. Outfall and Diffuser Monitoring

Visual observation of the outfall and immediate vicinity have been performed utilizing an ROV. Reports for 1990 and 1991 have found the diffuser pipe ports to be operational and free from any constrictive debris, and the concrete pipe, ballast rock and armour stone all in good condition.

Conclusions

1. Was the monitoring done on schedule?

While the reports for bacteriological analyses appear to have been submitted in a timely manner, the other parts of the monitoring program have been less timely and generally incomplete. Not until 1992 was the quarterly water quality monitoring program completed at all stations, and even then one sampling period was completely missed.

The report summarizing the 1990 benthic faunal surveys was technically complete, but was submitted several months after the required 120 days. As of this data, the 1991 report was "still in draft form - not permitted to send out."

No report addressing either fish communities or coral reefs was available for review. Whether such surveys were done is not known.

Sediment chemical analyses for 1990 were performed by SAIC (San Diego), and a report presenting the analytical data was submitted in December, well within the reporting period. However, as of this date no data are available for the 1991 sampling period.

2. Were the proper analyses performed on samples from the correct locations?

Bacteriological samples from 6-day sampling of nearshore and shoreline samples appear to have been correctly analyzed, as were the biological sampling for infauna for 1990 and the sediment analyses for 1990. Quarterly water quality monitoring was incomplete until the two cruises in 1992. There is no data to show if analyses for priority pollutants in water samples were performed. Only a cover sheet for the 1990 fish monitoring was received, so no review of techniques or results is possible. Examination of the physical condition of the diffuser pipe was completed successfully.

3. Did the data collected show that the permit conditions were met? If not, where and how frequently were they exceeded?

Bacteriological data for the shoreline and nearshore samples show that the enterococcus standards for recreational waters were often exceeded. However, the data suggest that the sources of the bacteria are other than the effluent discharge, probably a combination of terrestrial and human contact.

Water quality parameters were generally below the levels established for nearshore waters.

The response patterns of benthic infauna near the outfall show little indication of a strong influence being exerted by the diffuser effluent, despite the presence of low levels of potentially toxic materials, especially at station B-3, at the nearshore boundary of the ZID.

4. Are the data sufficient to conclude whether public health was threatened or environmental degradation occurred? If so, did such conditions occur?

The bacterial data for the shoreline and nearshore stations are complete and sufficient to evaluate the potential impacts due to the effluent discharge. It does not appear that any public health impacts have occurred.

The water quality data is marginally sufficient to make a determination regarding environmental impact; it does not appear that any significant impact has occurred. The values for the water quality parameters were generally consistent over the sampling period; more complete sampling might have revealed differences, but the plume model suggests that most of the plume moves offshore along a path not sampled by the current station arrangement.

The data on sediment and tissue chemistry and infauna for 1990 are complete and sufficient to make a determination regarding impacts; the data do not suggest any significant impacts have occurred.

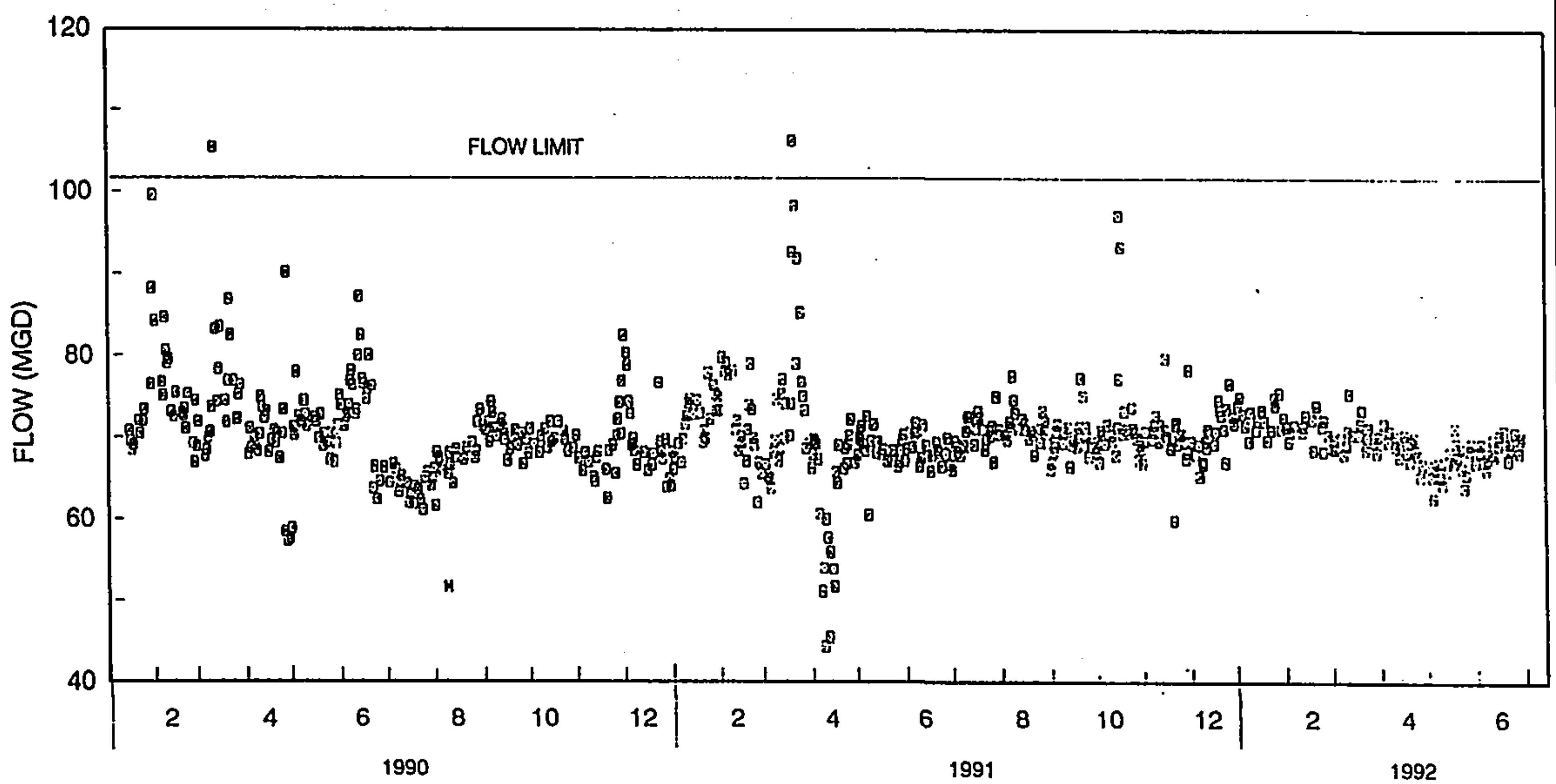
References

Bailey-Brock, J. H., W. J. Cooke, E. A. Kay, W. G. Nelson and A. R. Russo. 1991. Benthic faunal sampling adjacent to Sand Island Outfall, O'ahu, Hawai'i, August, 1990. Water Resources Research Center Special report 01.28.91. 91 pp.

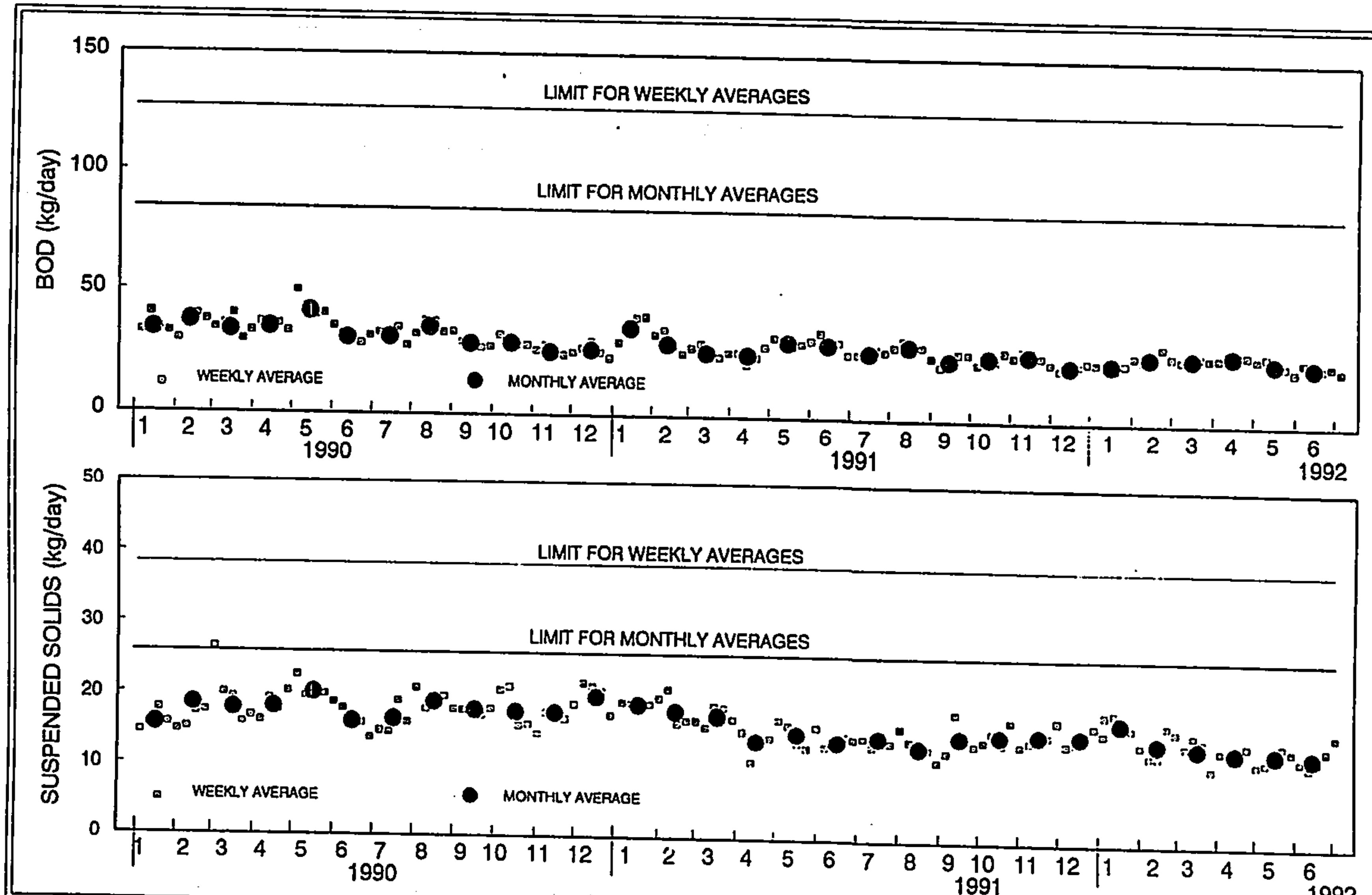
Noda, E. K. and Associates. 1992. Mathematical modeling of dynamics of Sand Island WWTP effluent plume. Unpublished technical report.

Table 1. Geometric means of water quality data collected during "quarterly" monitoring surveys for the Sand Island WWTP discharge. Also presented are the geometric mean permit limits applicable to different receiving water regions.

Station		NO3 (ug/l)	NH4 (ug/l)	TKN (ug/l)	TN (ug/l)	PO4 (ug/l)	TP (ug/l)	TSS (mg/l)	Turb (NTU)	Chlor (ug/l)	Fecal (#/100ml)	Entero (#/100ml)	pH (unit)	Light (m^{-1})	Secchi (m)	O&G (mg/l)
Z	In ZID	1.59	2.19	95.05	96.33	2.17	9.95	0.50	0.07	0.17	64.95	25.74	8.27	0.03	26.89	0.26
P2	In Plume	1.27	3.73		102.84		9.94	0.50	0.12	0.14	67.51	27.02		0.03		0.31
P1	In Plume	1.32	4.30		106.41		10.13	0.50	0.13	0.13	77.34	31.97		0.03		0.25
P2	In Plume	1.23	2.24		90.99		8.21	0.50	0.09	0.10	21.41	17.29		0.18		0.34
B3	ZID Boundary							0.50	0.10							0.61
B4	ZID Boundary							0.50	0.09							0.68
B5	ZID Boundary							0.50	0.11							0.42
ZM1	ZOM Boundary	1.18	2.07	78.95	88.80	1.35	9.19	0.50	0.06	0.12	10.41	5.96	8.27	0.03	25.49	
ZM2	ZOM Boundary	1.16	2.23	92.02	81.66	2.21	9.12	0.50	0.06	0.14	60.69	26.02	8.27	0.03	26.90	
ZM3	ZOM Boundary	1.12	2.62	75.23	83.24	2.06	9.48	0.50	0.06	0.12	9.62	6.61	8.27	0.03	25.38	
ZM4	ZOM Boundary	1.45	2.89	92.38	93.70	2.59	9.19	0.50	0.07	0.14	20.80	11.84	8.27	0.03	25.91	
N1	Nearshore	2.03	1.43	48.63	50.70	2.93	7.38	0.50	0.20	0.35	2.74	2.20	8.25	0.33	2.76	0.47
N2	Nearshore	1.69	1.57	52.20	53.28	2.27	6.98	0.50	0.12	0.32	1.20	1.45	8.26			0.80
N3	Nearshore	1.75	1.81	48.76	49.89	2.05	7.19	0.50	0.09	0.25	1.00	2.39	8.26			0.69
N4	Nearshore	1.10	1.35	50.59	50.94	1.90	6.78	0.50	0.10	0.11	1.28	2.55	8.27	0.22	4.28	0.91
N5	Nearshore	1.38	2.35	105.25	114.06	2.33	9.70	0.50	0.09	0.13	5.50	6.15	8.28	0.03	26.47	0.49
B1	Reference	1.10	1.19		93.98		8.06	0.50	0.10	0.11	25.61	11.87				0.50
B2	Nearfield	1.06	2.01		87.17		8.58	0.50	0.10	0.10	33.49	12.47				0.63
B6	Reference	1.16	1.35		89.42		7.96	0.50	0.10	0.09	6.85	4.97				0.73
NTE Beyond ZID									0.50					0.20		
NTE Beyond ZOM		5.0	3.5		~~250~~ 150		20			0.30			8.1 ± 0.5			
NTE in Recreational Waters (NPDES Permit)												35				
NTE in Recreational Waters (current DOH regulations)												7				



OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY DAILY EFFLUENT FLOW FROM SAND ISLAND TREATMENT PLANT	Figure 1



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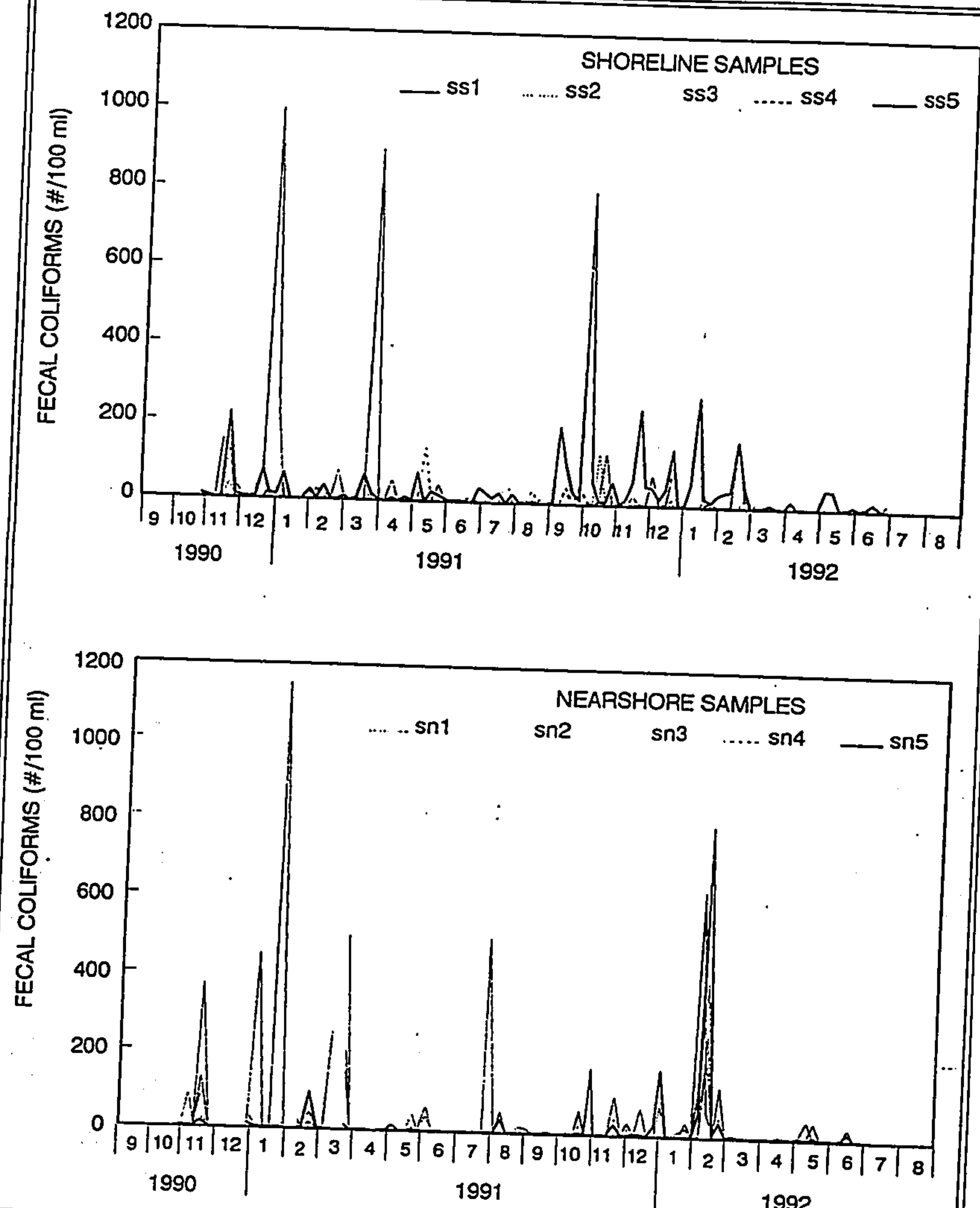
EAST MAMALA BAY STUDY

EFFLUENT QUALITY

Figure 2



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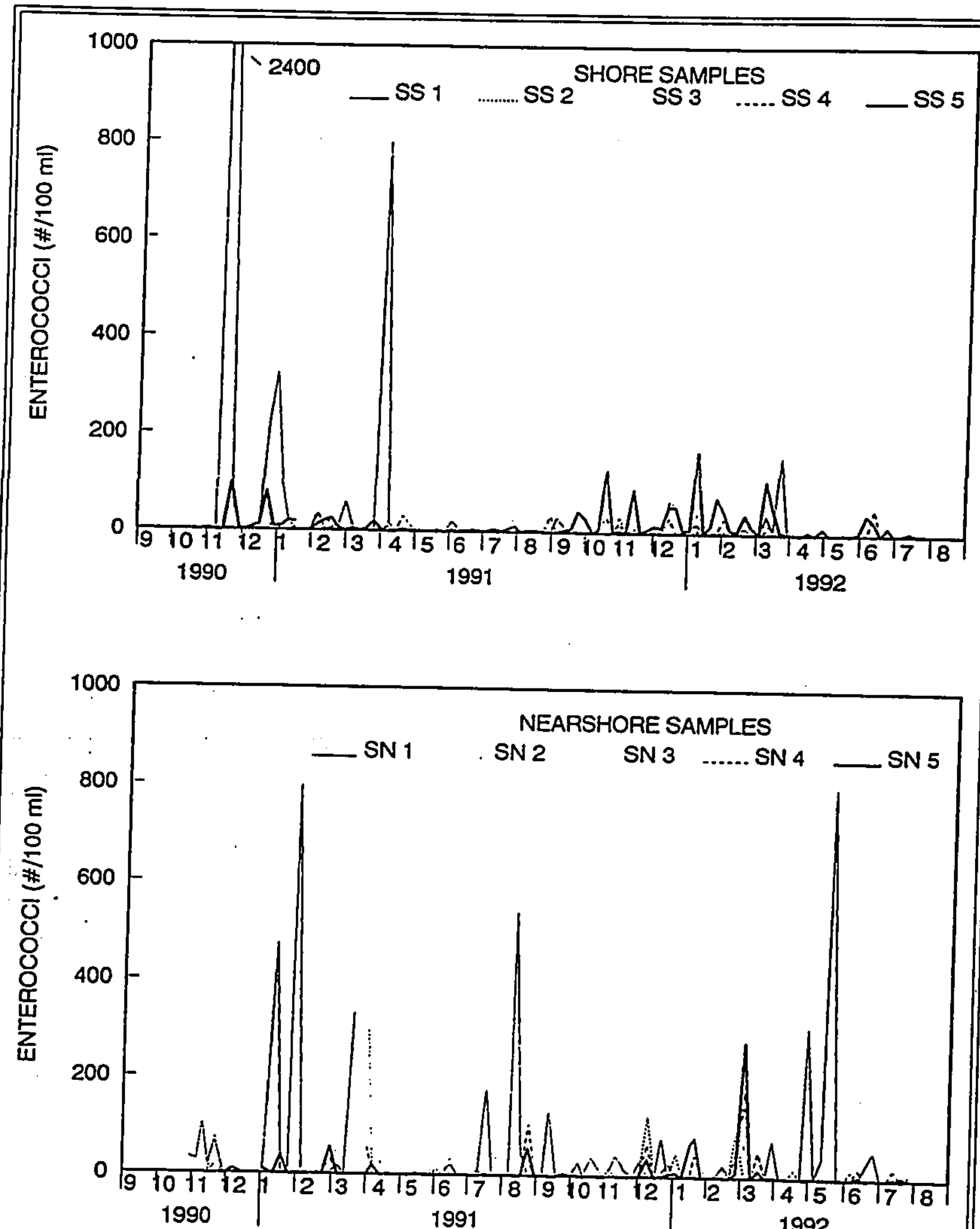
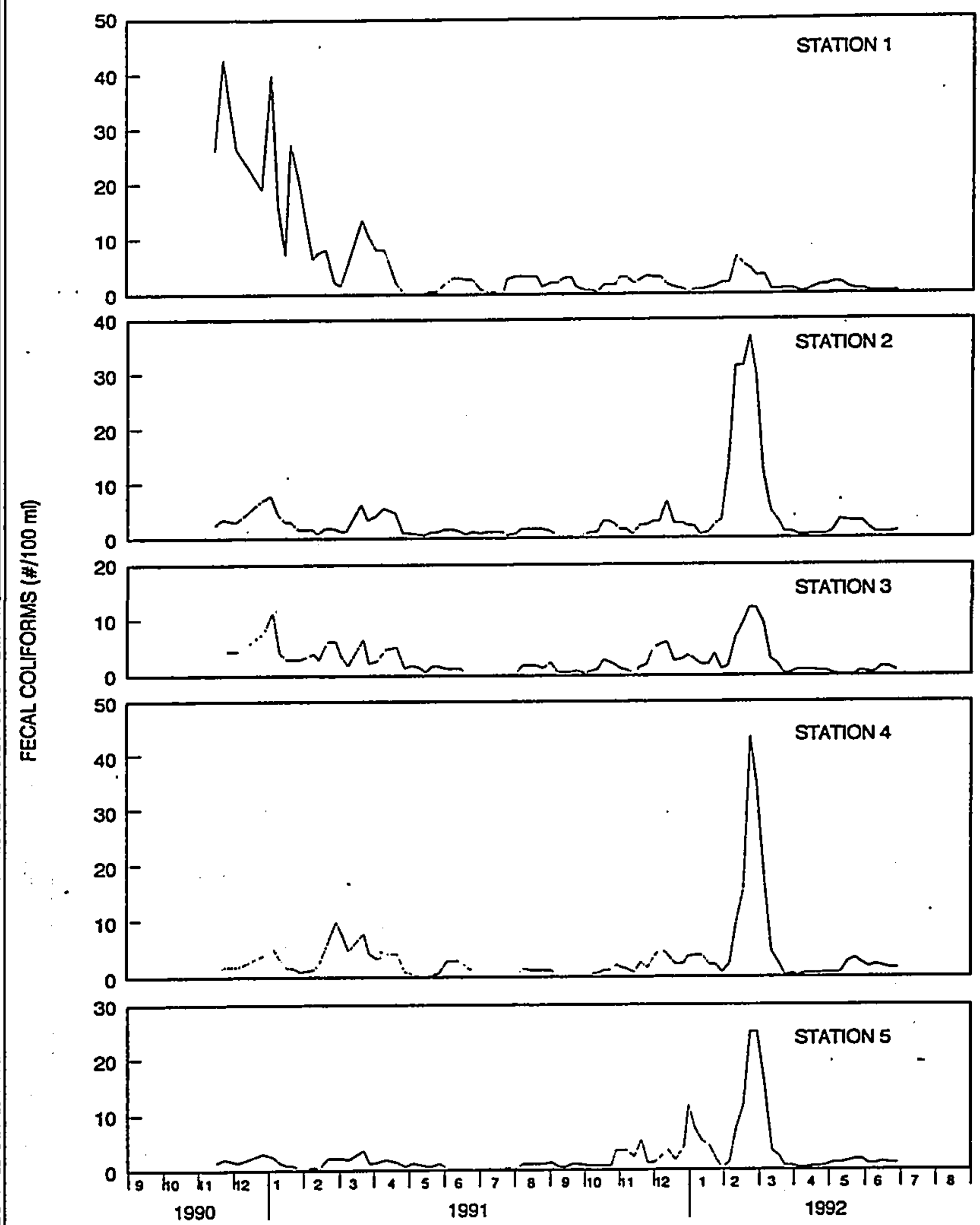
EAST MAMALA BAY STUDY

FECAL COLIFORM LEVELS
AT SHORELINE AND NEARSHORE STATIONS

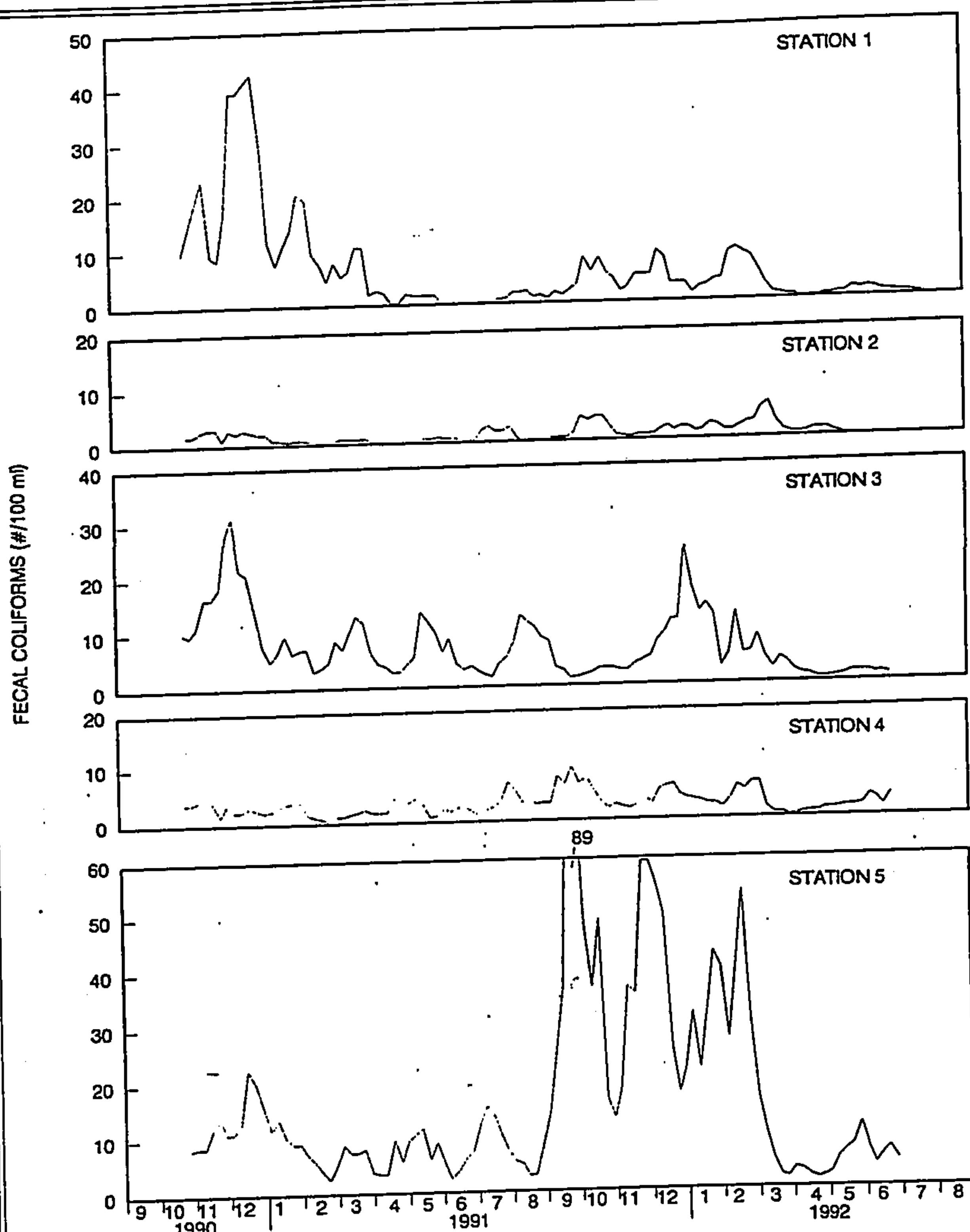
Figure
3



OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY ENTEROCOCCUS LEVELS AT SHORELINE AND NEARSHORE STATIONS	Figure 4



OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY FECAL COLIFORM RUNNING MEAN VALUES AT NEARSHORE STATIONS	Figure 5



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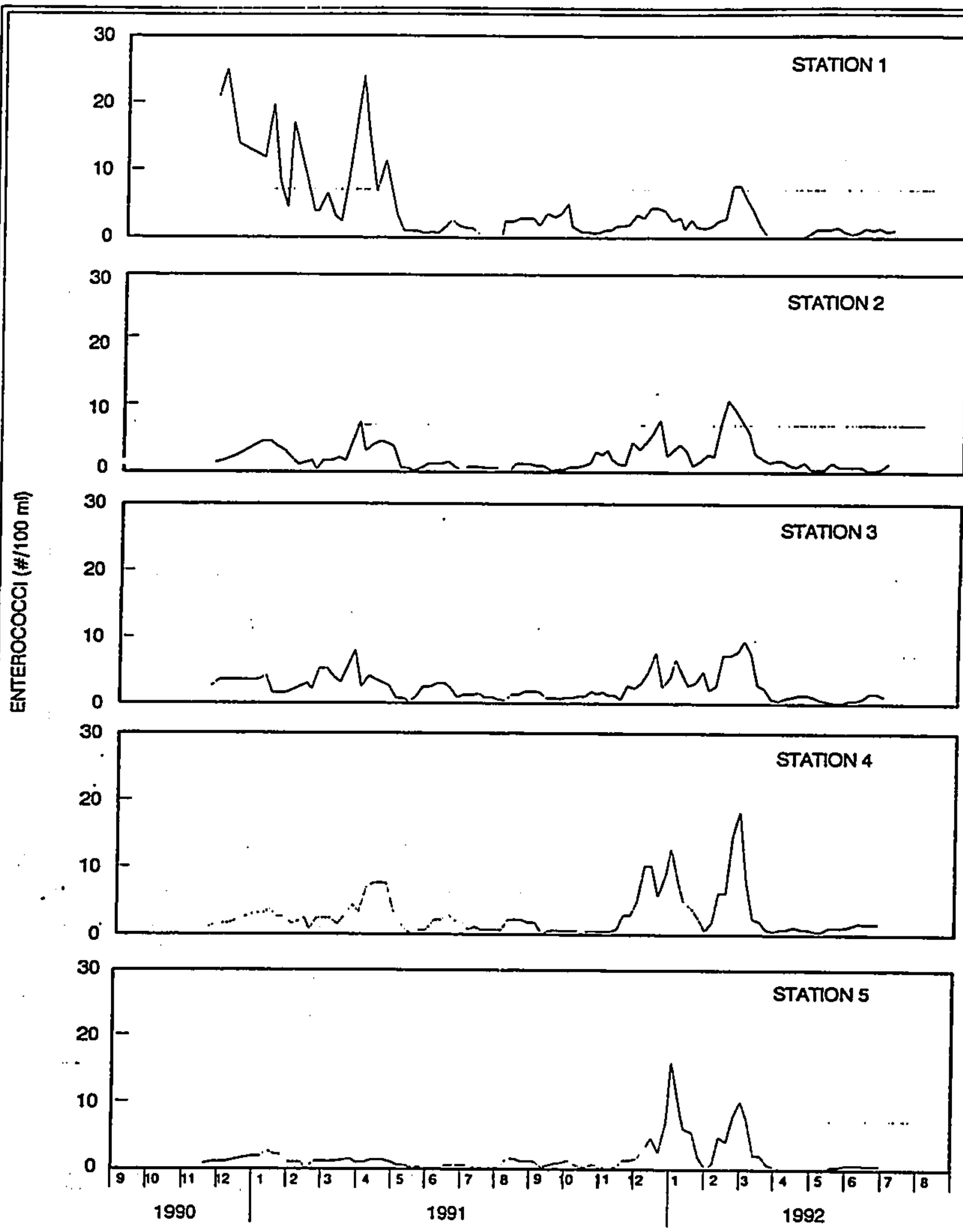
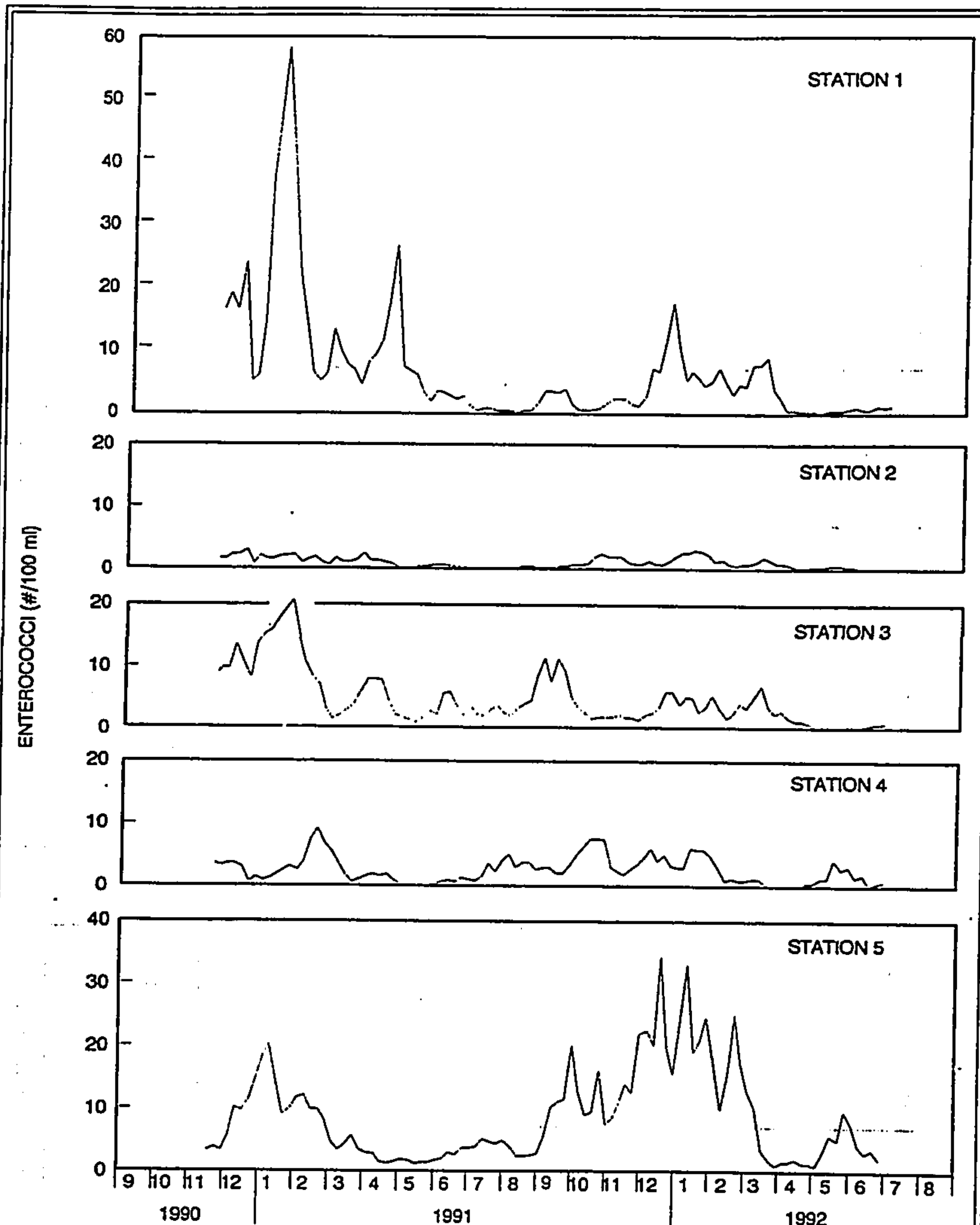
EAST MAMALA BAY STUDY

FECAL COLIFORM RUNNING MEAN VALUES AT SHORELINE STATIONS

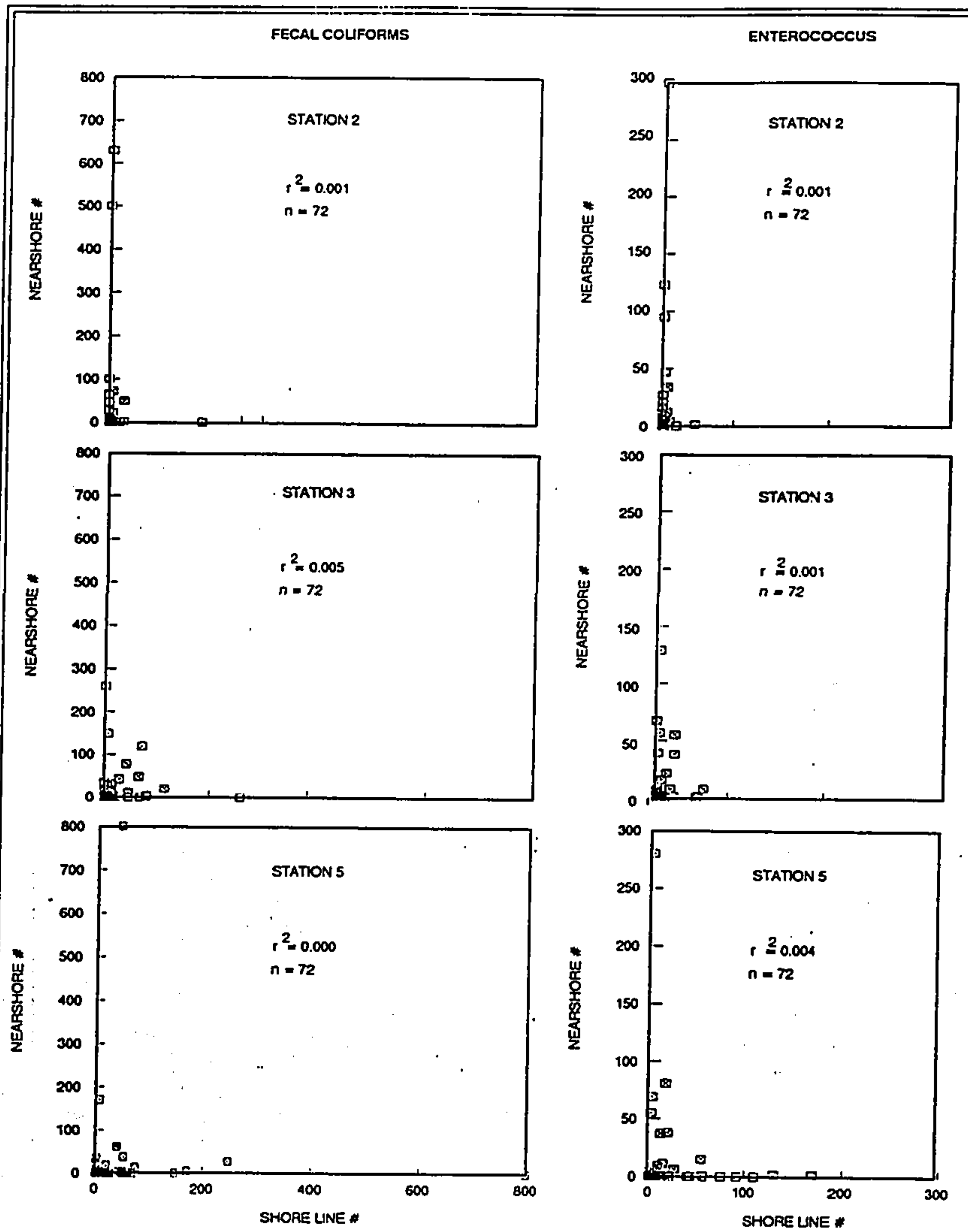
Figure 6



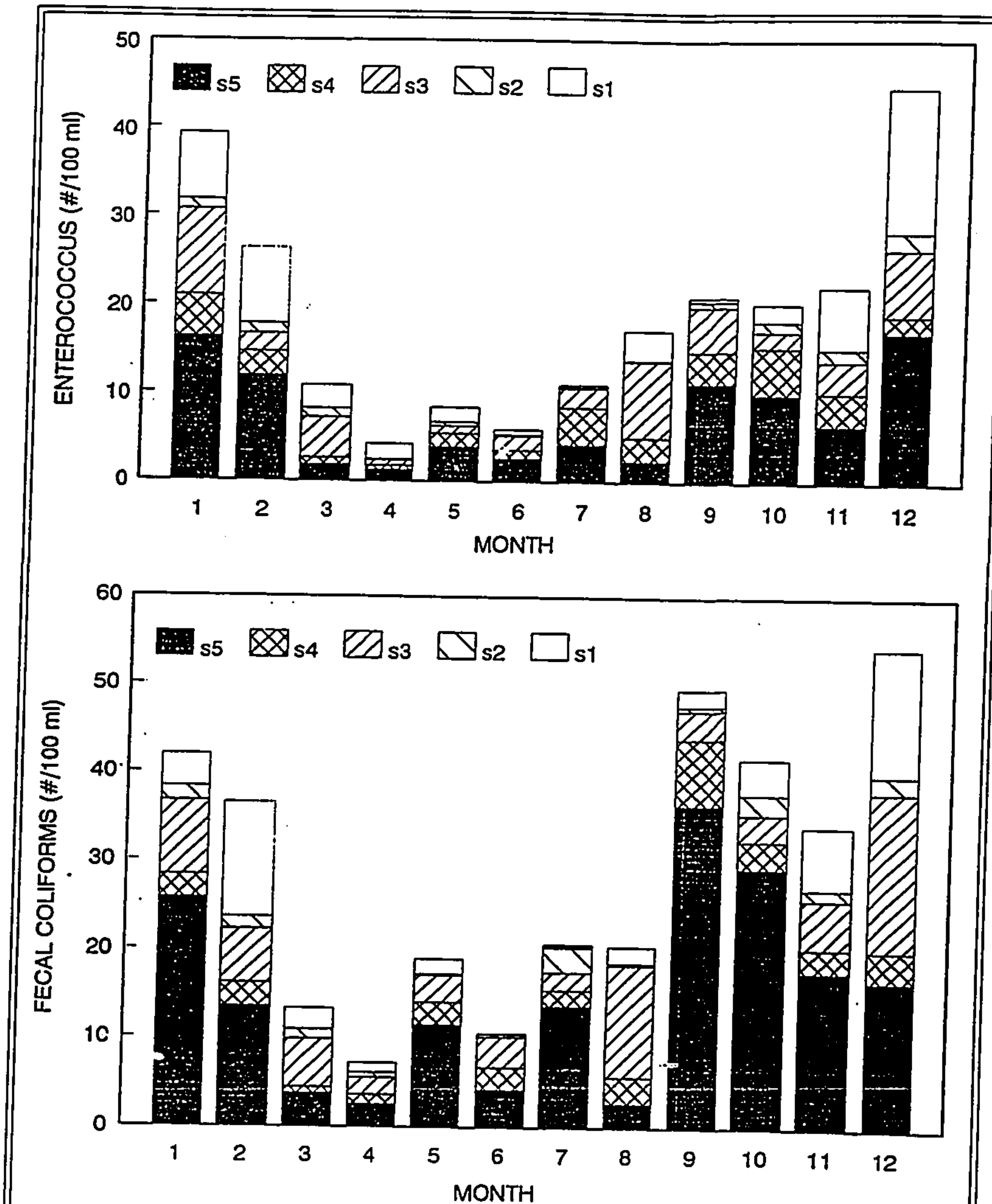
OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY ENTEROCOCCUS RUNNING MEAN VALUES AT NEARSHORE STATIONS	Figure 7



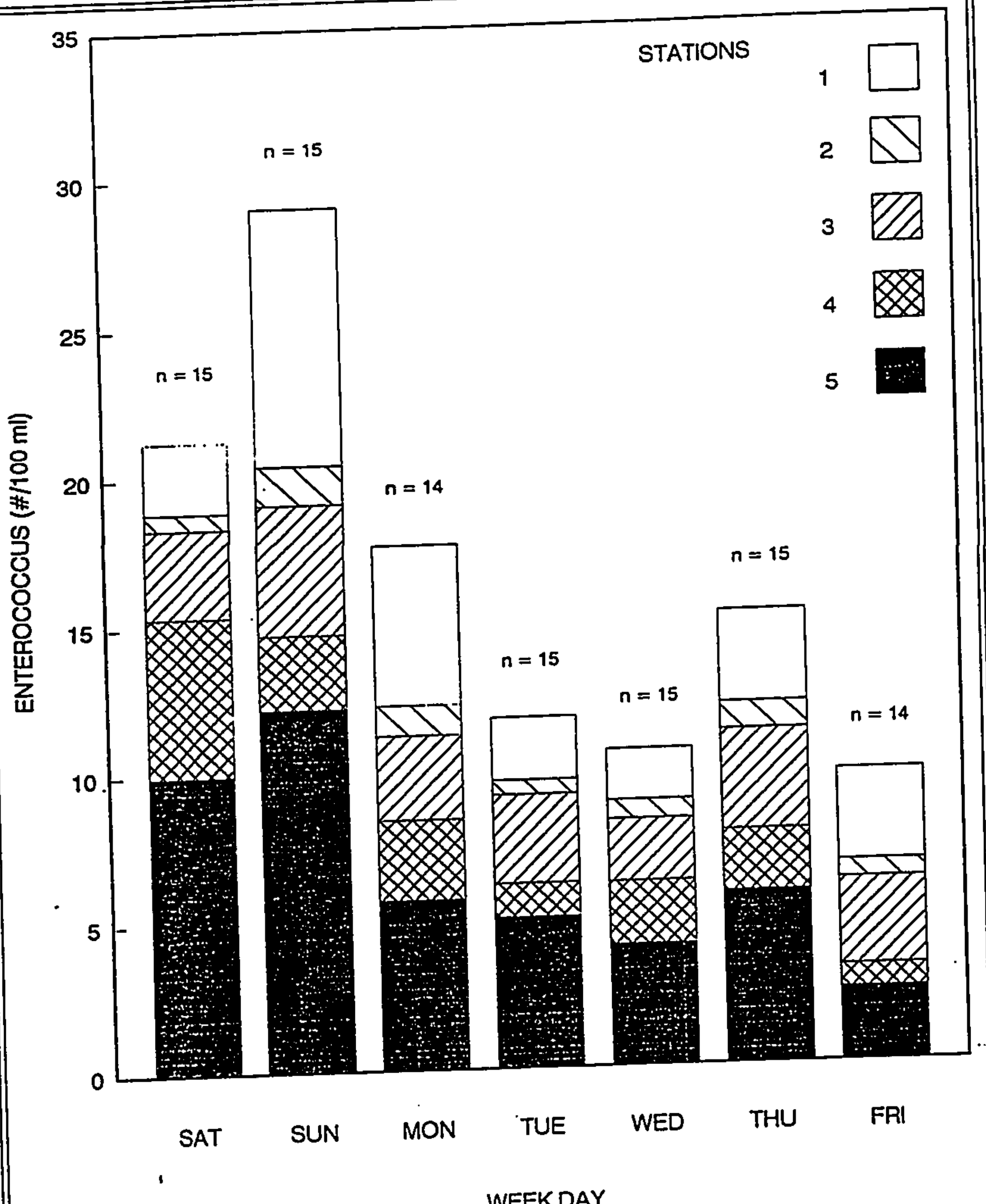
OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY ENTEROCOCCUS RUNNING MEAN VALUES AT SHORELINE STATIONS	Figure 8



OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY RELATIONSHIP BETWEEN NEARSHORE AND SHORELINE BACTERIA LEVELS	Figure 9



OI Consultants, Inc. Makapuu Point Waimanalo, Hawaii 96795	EAST MAMALA BAY STUDY BACTERIA LEVELS - SHORELINE STATIONS MONTHLY GEOMETRIC MEANS	Figure 10



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EAST MAMALA BAY STUDY

ENTEROCOCCUS LEVELS - SHORELINE STATIONS
DAY OF THE WEEK GEOMETRIC MEANS

Figure 11

DILUTION MODELING

The NPDES permit for the Sand Island WWTP effluent discharge states that the geometric mean concentration of ammonia-nitrogen cannot exceed 0.0035 mg/l in surface waters (taken as the top 30 m) outside of the established zone of mixing (ZOM). Currently, the average daily discharge of effluent from the Sand Island outfall is approximately 77.5 million gallons per day (mgd), and concentration of ammonia-nitrogen in 24-hour composite samples of the effluent ranges from 13.47 mg/l to 22.73 mg/l.

With the projected expansion of sewage generation in the East Mamala Bay sewage district, there will be an increase in the average daily outfall discharge from 77.5 mgd to approximately 90 mgd. This increase in effluent volume has the potential to raise pollutant concentrations in Mamala Bay receiving waters, and may result in violations of the existing NPDES permit. Violation of water quality standards would require either expansion of the zone of mixing, or upgrading the Sand Island WWTP to higher levels of treatment to reduce concentrations of the offending pollutant. In order to determine the extent of pollutant increases in East Mamala Bay receiving waters, modeling of existing and future discharge conditions was performed.

The modeling package used is the EPA-supported *Dilution Models for Effluent Discharges*. This package, which was provided by the EPA marine research laboratory in Newport, Oregon, includes two initial dilution models, "RSB" and "UM," one far-field dispersion model based upon Brooks (Fischer, 1979), and a model interface and manager, "PLUMES," for preparing input and running the models. PLUMES is intended for use with effluent plumes discharged into marine and some freshwater bodies. Both buoyant and dense plumes, single sources and many diffuser outfall configurations may be modeled.

Initial dilution is the dilution achieved in a plume due to combined effects of momentum and buoyancy of the fluid discharged from the outfall ports, and from ambient turbulent mixing in the vicinity of the plume (Baumgartner, et al, 1993). The rate of dilution is initially quite rapid, and decreases markedly after the momentum and buoyancy of the effluent dissipate. The initial dilution model that was applied in this study was UM. UM is an upgrade and expansion of the UMERGE model (Muellenhoff et al.,1985). UM is considered to be a better model than RSB for predicting initial dilutions in waters with low ambient density stratification, as is the case in Mamala Bay.

For each PLUMES modeling scenario, applicable diffuser geometry (including number and spacing of ports, length, and depth) is input with ambient water conditions. Ambient conditions include current direction and profiles of current speed, density, salinity, and temperature at various depths in the vicinity of the diffuser. Most of the ambient data for the Mamala Bay model were taken from the *Reapplication for Secondary Treatment Modification, Sand Island Treatment Facility, M&E Pacific, Inc., 1983*. This report contains the only comprehensive ambient condition data, and given the needs of the model, is more appropriate than more current data available from other sources. The data are not sufficient to compute meaningful measures of variation or probability distributions, so the models are not probabilistic in nature. The aggregated ambient data profiles for each of the four seasons are shown in the four tables below:

WINTER AMBIENT PROFILE

DEPTH (FT)	CURRENT SPEED	SALINITY	TEMPERATURE (°C)
0	0.022 m/s	34.59	25.02
25	0.022 m/s	34.63	24.49
50	0.030 m/s	34.68	24.39
100	0.030 m/s	34.76	24.16
200	0.0415 m/s	34.75	24.07
250	0.042 m/s	35.22	24.21

Note: angle of diffuser alignment to current = 80°

SPRING AMBIENT PROFILE

DEPTH (FT)	CURRENT SPEED	SALINITY	TEMPERATURE (°C)
0	0.1 m/s	34.756	24.67
25	0.09 m/s	34.798	24.58
75	0.075 m/s	34.856	24.46
150	0.06 m/s	34.965	24.01
200	0.075 m/s	34.998	23.82
250	0.08 m/s	35.026	23.24

Note: angle of diffuser alignment to current = 10°

SUMMER AMBIENT PROFILE

DEPTH (FT)	CURRENT SPEED	SALINITY	TEMPERATURE (°C)
0	0.022 m/s	35.08	27.29
100	0.030 m/s	35.10	25.92
150	0.030 m/s	35.10	25.78
200	0.039 m/s	35.11	25.56
250	0.05 m/s	35.11	25.17

Note: angle of diffuser alignment to current = 86°

FALL AMBIENT PROFILE

DEPTH (FT)	CURRENT SPEED	SALINITY	TEMPERATURE (°C)
0	0.051 m/s	35.00	25.93
25	0.051 m/s	35.13	25.83
50	0.048 m/s	35.32	25.94
100	0.045 m/s	35.13	25.78
150	0.042 m/s	34.97	25.57
200	0.039 m/s	34.98	24.70
250	0.040 m/s	35.18	24.23

Note: angle of diffuser alignment to current = 70°

Two sets of models were run for each of the four seasons. Based upon the range of existing sampling data, a minimum (13.470 mg/l) and maximum (22.73 mg/l) concentration of effluent ammonia-nitrogen were modeled in each set. The first set of runs models existing outfall flow and dilution characteristics. Existing outfall flow is approximately 77.5 mgd. This is done so that a comparison can be made between model predictions and existing measured conditions to determine confidence in the model. The second set of runs models future dilutions; the only input parameter that is different from existing inputs is a projected average daily effluent flow of 86 mgd. (Note that refinements to the Facilities Plan resulted in a projected average daily flow of 90 mgd; this increase is not anticipated to significantly affect modeled results.) The models produce near-field and far-field profiles of plume rise and ammonia-nitrogen concentrations at various distances from the outfall.

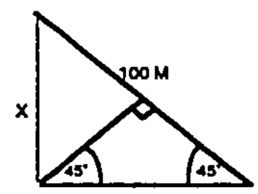
NEAR-FIELD PREDICTIONS

The UM initial dilution model provides predictions of pollutant concentration, dilution, and plume diameter (thickness and width perpendicular to the centerline of the plume) at various depths and distances down-current. It also predicts where individual plume elements merge together, where the vertical trapping layer occurs, and where individual plume elements overlap. Plume element overlap is a common occurrence in situations where ambient current velocities are low, and upstream intrusion is possible. This model does not predict upstream intrusion and it assumes that initial dilution is complete when plume element overlap occurs. The model computes a plume width at the end of the near-field, and the rest of the near-field predictions are used in the Brooks (Fischer, 1979) model to predict far-field dispersion. Since the point where plume elements overlap is assumed to be the end of the near-field, and the near-field thickness is assumed to be equal to far-field plume thickness, the trajectory angle of the plume centerline can be used to calculate a corresponding vertical thickness. An example of this conversion is shown below for the diagrammed plume rise:

$$\sin 45^\circ = \frac{X}{100\ \text{m}}$$

$$X = \sin 45^\circ * 100\ \text{m}$$

$$X = 70.72\ \text{m}$$



where **45°** is the plume centerline trajectory angle above horizontal, **100 m** is the actual plume diameter at the end of the near-field, and **X** is the corresponding vertical plume thickness.

FAR-FIELD PREDICTIONS

The Brooks Far-Field Dispersion Model (Fischer, 1979) predicts ammonia-nitrogen concentrations and dilutions at certain distances down-current, as well as the time required for the plume to travel that distance. The model is best applied in situations in which there is a large initial dilution, and it assumes that vertical mixing is negligible. Lateral mixing in the plume is considered to be a function of diffusion, and the final far-field calculation made during each time step determines the local average pollutant concentration in the plume.

Two sets of concentration and dilution predictions are given. One is based upon the 4/3 Power Law (Roberts), and the second is based upon a constant eddy diffusion coefficient. Where the two sets of output were similar (within a 100 dilution factor), they were averaged to provide a conservative estimate. When larger differences occurred (in situations where the ambient current was nearly parallel to the diffuser), the 4/3 Power Law prediction was used. The 4/3 Power Law approach is often considered more appropriate for coastal waters because the predicted dilution is a function of the plume area, and larger areas of open ocean wave actions and currents allow for greater dilutions (Grace, 1978).

Although the far-field model does not predict plume widths, plume width at distances down-current can be calculated as a function of flux. Flux is the volume through a given area, and it can be assumed that flux will be equal at any distance from the diffuser. The volume through a given area at a point down-current from the diffuser is equal to the product of effluent volume and the dilution divided by the product of plume thickness and width. Since the initial dilution, effluent volume, plume width and thickness are known, a ratio can be established to predict the plume width at a distance *x* down-current:

$$\frac{Vo*Do}{Wo*To} = \frac{Vo*Dx}{Wx*To}$$

where **Vo** is the initial effluent volume, **Do** is the dilution at the end of the near-field, **Wo** is the plume width at the end if the near-field, **To** is the plume thickness, **Dx** is the dilution at a distance x downstream, and **Wx** is the corresponding plume width. Since the plume thickness **(To)** and the effluent volume **(Vo)** are equal constants on both sides of the equation, the following simplified ratio of dilution to widths:

$$\frac{Do}{Wo} = \frac{Dx}{Wx}$$

The PLUMES output provides initial plume dilution (**Do**) and width (**Wo**), as well as far-field dilutions (**Dx**). Therefore, the far-field plume width can be estimated using the following equation:

$$Wx = \frac{Dx*Wo}{Do}$$

RESULTS

From the resulting concentration and width profiles, it can be estimated which monitoring stations would be affected by the effluent plume in a given season. The concentrations of ammonia-nitrogen can be estimated at ZOM monitoring stations impacted by the plume, and a geometric mean ammonia-nitrogen concentration at the edge of the zone of mixing can be computed.

The PLUMES model package generates predictions of plume depth and location, as well as concentration of ammonia-nitrogen. In order to compute an estimated geometric mean pollutant concentration at the edge of the zone of mixing, concentrations at two depths for each of the four sampling stations (ZOM1-ZOM4) must be generated for each season (4 quarters). At specific ZOM stations and depths where the model predicts concentrations to be affected by the plume (i.e.. what is referred to as a plume "hit"), concentrations are taken from the model. At stations and depths not impacted by the plume, ambient concentrations are used. These data are then geometrically averaged. The following table is a matrix and geometric mean calculation of measured data at the ZOM stations for 1990 through 1992:

MEASURED AMBIENT ZOM DATA

STATION	ZM1		ZM2		ZM3		ZM4	
DEPTH(M)	0	30	0	30	0	30	0	30
Fall	1.73	1.41	4.00	1.73	2.00	1.73	1.00	1.41
Winter	1.41	2.00	2.00	2.00	2.45	2.00	2.00	2.45
Spring	1.73	3.16	2.24	1.41	1.73	8.94	3.46	5.20
Summer	1.41	4.12	1.41	2.83	1.00	2.65	1.00	1.00
Geometric Mean (µg/L) for the Existing Ambient Conditions								***2.03***

Since there were 30 data sets available for 1991, 32 for 1992, and only 8 available for 1990, model runs were only compared with 1991 and 1992 data. The model runs only predicted "hits" at three of the 32 monitoring stations throughout the year; one each in the winter, spring, and summer seasons. Because of the great density difference between effluent and ambient water in the fall, the model does not predict the plume to rise above 40 meters depth. The three ZOM station "hits" were consistent throughout all of the model scenarios and were located at ZM1 at 30 m depth in the spring, and at ZM2 at 30 m depth in the winter and summer. The resulting matrices combining 1991 and 1992 data with modeled "hits" and calculated geometric mean concentrations of ammonia-nitrogen at the edge of the zone of mixing are shown in the following four tables:

Existing Effluent Flows and Low Effluent Ammonia (13.47 mg/l)

STATION	ZM1		ZM2		ZM3		ZM4	
DEPTH(M)	0	30	0	30	0	30	0	30
Fall	1.73	1.41	4.00	1.73	2.00	1.73	1.00	1.41
Winter	1.41	2.00	2.00	17.80	2.45	2.00	2.00	2.45
Spring	1.73	18.80	2.24	1.41	1.73	8.94	3.46	5.20
Summer	1.41	4.12	1.41	22.30	1.00	2.65	1.00	1.00
Geometric Mean (µg/L)								*2.45*

Existing Effluent Flows and High Effluent Ammonia (22.73 mg/l)

STATION	ZM1		ZM2		ZM3		ZM4	
DEPTH(M)	0	30	0	30	0	30	0	30
Fall	1.73	1.41	4.00	1.73	2.00	1.73	1.00	1.41
Winter	1.41	2.00	2.00	29.90	2.45	2.00	2.00	2.45
Spring	1.73	31.76	2.24	1.41	1.73	8.94	3.46	5.20
Summer	1.41	4.12	1.41	37.54	1.00	2.65	1.00	1.00
Geometric Mean (µg/L)								*2.57*

Future Effluent Flows and Low Effluent Ammonia (13.47 mg/l)

STATION	ZM1		ZM2		ZM3		ZM4	
DEPTH(M)	0	30	0	30	0	30	0	30
Fall	1.73	1.41	4.00	1.73	2.00	1.73	1.00	1.41
Winter	1.41	2.00	2.00	19.30	2.45	2.00	2.00	2.45
Spring	1.73	20.10	2.24	1.41	1.73	8.94	3.46	5.20
Summer	1.41	4.12	1.41	23.20	1.00	2.65	1.00	1.00
Geometric Mean (µg/L)								*2.46*

Future Effluent Flows and High Effluent Ammonia (22.73 mg/l)

STATION	ZM1		ZM2		ZM3		ZM4	
DEPTH(M)	0	30	0	30	0	30	0	30
Fall	1.73	1.41	4.00	1.73	2.00	1.73	1.00	1.41
Winter	1.41	2.00	2.00	32.48	2.45	2.00	2.00	2.45
Spring	1.73	33.94	2.24	1.41	1.73	8.94	3.46	5.20
Summer	1.41	4.12	1.41	39.69	1.00	2.65	1.00	1.00
Geometric Mean (µg/L)								*2.59*

The latitudes and longitudes of the ZOM stations and centerpoint of the Sand Island WWTP diffuser used in this analysis were the same as those described in the NPDES permit.

CONCLUSIONS

None of the modeled scenarios predict a geometric mean ammonia-nitrogen concentration greater than the NPDES permit standard of 3.5 µg/L at the ZOM boundary. Therefore, the existing ZOM, as specified in the permit will not need to be adjusted. If however, future modeling finds that the geometric mean concentrations are above water quality standards, model iterations and geometric means could be created and back-calculated to determine the approximate size and location of the ZOM needed to comply with applicable water quality standards.

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BACTERIAL INDICATORS

In general, water-borne diseases are caused by pathogenic organisms. A major potential source of these organisms is human sewage. Monitoring of the pathogenic content of sewage may provide an indication of the potential that a community may be exposed to illnesses. However, measurement of most pathogens can be very complex and costly for the following reasons:

1. Viruses, bacteria, and parasites are the three major groups of pathogens in sewage. Differences in the physical and chemical structure, physiology, and genetic make-up of these three groups result in different methods for recovery and identification. Table 1 presents common pathogenic organisms that can occur in sewage.

    To date, no documented cases of AIDS infections caused by wastewater exposure have been reported. Recent research by Casson of HIV et al. (1992) reported that wastewater samples inoculated with HIV indicated a good survivability to 12 hours, with a 2-3 log function decrease in effectiveness at 48 hours (exponential decay by a factor of 100 to 1,000). It is important to note that this survivability does not imply an effect on humans from viral contact in ocean waters.

Table 1
Pathogenic Organisms in Sewage

BACTERIA	VIRUSES	INTESTINAL PARASITE
Salmonella typhi	Enteroviruses	*Schistosoma spp.*
S.paratyphi	Poliovirus	*Ascaris lumbricoides*
other spp.	Echovirus	*Trichuris trichuria*
Shigella spp.	Coxsackieviruses	*Taenia spp.*
Vibrio cholerae	New enteroviruses	*Diphyllobothrium latum*
Mycobacterium tuberculosis	Hepatitis type A	*Ankylostoma duodenale*
Leptospira icterohaemorrhagiae	Norwalk virus	*Necator americanus*
Campylobacter spp.	Rotavirus	*Entamoeba histolyica*
Listeria monocytogenes	Reovirus	*Giardia lamblia*
Candida albians	Adenovirus	*Naegleria spp.*
Yersinia enterocolitica	Parvovirus	*Acanthamoeba spp.*
Enteropathogenic Esheirchia coli		*Cryptosporidia*
Pseudomonas aeruginosa		
Klebsiella spp.		
Staphylococcus aureus		
Aeromonas hydrophila		
Mycobacterium paratuberculosis		
Erysipellothrix rhusopathiae		
Bacillus anthracis		
Clostridium spp.		
Yersinia pestis		
Brucella spp.		

Source: Sterritt, R.M. and Lester, J.N. 1988, *Microbiology for environmental and public health engineers*, pg. 239.

2. Differences may exist between species, variants, and serotypes even within the same genus. Thus, the methods for detection of pathogens even of same genus can be very different.
3. Certain pathogens such as the Hepatitis type A virus cannot be routinely detected and cultured.
4. Pathogens are usually present in low concentrations in the waters, so detection can be difficult. Moreover, the threshold concentrations of pathogens which could affect public health vary for each organism.
5. The absence of one or two pathogens which might be analyzed does not indicate the absence of other pathogens.
6. Testing for all the potential pathogens is time consuming, very expensive, and requires highly skilled labor and sophisticated laboratory facilities.

There is no existing evidence that monitoring for all potential pathogens is warranted for the protection of public health. Nevertheless, in general, water quality monitoring for the presence of pathogenic organisms is important to ensure protection of public health.

Indicator Bacteria Used

To minimize the health risks associated with pathogen infections, at a reasonable cost, receiving water is monitored through the measurement of indicator bacteria. Indicator species have been shown to be associated with pathogenic organisms, but are not pathogens themselves. Ideally, a valid indicator organism should: (1) be present and occur in greater numbers than any pathogens of concern; (2) not be able to proliferate to a greater extent than the pathogens of concern; (3) be more resistant than the pathogens of concern; and (4) yield characteristic and simple reactions enabling, as far as possible, an unambiguous identification of the group (Dutka, 1973). In addition, the relationship between the presence of the indicator and the outbreaks of diseases should be established; i.e., an epidemiological study should be conducted to establish the correlation between the concentration of the indicator and the incidence of diseases. Enterococci and *E. coli* (i.e., fecal coliform) are the indicator organisms currently used in Hawaii, although neither of these organisms nor any other known meet all the criteria above.

Studies conducted by EPA (1984) at marine and fresh water bathing beaches indicate that the rates of swimming-associated gastroenteritis is directly related to the quality of the bathing water and that enterococci and *E. coli* are reliable bacterial indicators of marine and fresh water quality.

Problems with Existing Indicator Bacteria

Hawaii has different meteorological, hydrological, and ecological conditions than those in the continental states. Because of its subtropical location and volcanic substrate, it has been determined that bacterial criteria based on temperate, continental conditions, and may not be applicable to Hawaii. Fujioka and Shizumu (1983, 1985, and 1988) have reported that freshwater streams in Hawaii contain naturally high levels of fecal coliform and fecal streptococci (including enterococci). In other words, high concentrations of fecal coliform and fecal streptococci do not necessarily indicate fecal pollution or the presence of pathogenic organisms. Furthermore, the bacterial medium KF agar, which is approved by Standards Method (1989), induces false-positive counts for fecal streptococci in marine waters in Hawaii (Fujioka, 1984). Studies have shown that sunlight, which is generally more predominant in Hawaii than the continental U.S., effectively inactivates indicator bacteria in marine water (Fujioka, et al., 1981). In addition, Hardina and Fujioka (1991) reported that soil is commonly the source of *E. coli* and enterococci in Hawaii's streams. Soil samples obtained near a stream bank, 11 yards (10 m) from a stream bank, as well as from a grassy area on the university campus were determined to be sources of both *E. coli* and ors were obtained from the surface of the soil as well as from samples at depths ıtimeters).

1 at the use of enterococcus density as the sole indicator for water-borne diseases and Charoenca, 1991). Evidence was gathered showing that enterococcus ım bird/small mammal droppings may persist in the soil for long periods of time, ıring periods of rainfall (Fujioka, 1990; Fujioka and Charoenca, 1991). Thus, :ators may be consistent with the absence of pathogen contamination, but the ' true.

ı rates of poliovirus type 1 in sea water samples is approximately 48 hours for laboratory conditions, after which 90 percent of the initial population is dead, ıs) and 72 to 120 hours for complete inactivation (Loh, Lau and Fujioka, 1980). vival time for viruses in sea water, the T90 for coliform bacteria in Mamala Bay ss than 1 hour (City and County of Honolulu, DPW, 1971). These data strongly imply that coliform is less resistant to the off-shore sea water environment than poliovirus type 1. Because poliovirus 1 is a pathogen of concern, the less resistant nature of coliforms invalidates it as an appropriate indicator in Hawaii's marine water environment.

Alternative Indicator—*C. perfringens*

The EPA has recognized the problems associated with application of the existing bacteria indicators in Hawaii. In the Sand Island NPDES permit, EPA required the monitoring of another alternative indicator, *Clostridium perfringens (C. perfringens)* during the chlorination study portion of the permitting period.

C. perfringens is an anaerobic spore-forming gram-positive bacillus. It is a straight rod, approximately 0.9 to 1.3 μm in width and 3.0 to 9.0 μm in length, often with oval subterminal spores. The natural habitat of *C. perfringens* is the intestinal tract of human and warm-blooded animals where it readily multiplies and forms spores. It is a fecal bacteria which can be consistently recovered at moderate densities from feces and sewage. It forms spores which are very stable to environmental disturbance and is expected to survive longer than the most resistant enteric pathogens (Cabelli, 1977). Therefore, *C. perfringens* is very useful in evaluating water quality in harsh environmental conditions such as chlorination, extreme pH, or temperature.

Results of Bacterial Monitoring

Sewage-borne viral pathogens entering the ocean become a potential problem only if they survive and are present in populated areas, recreational areas, or seafood-producing waters. Loh, Lau and Fujioka (1980) reported that human enteric viruses were not detected in sea water samples taken from outside the ZOM. They were recovered only when the sample volume within ZOM was doubled from 100 to 200 gallons. The failure to isolate human enteric viruses outside the ZOM strongly suggests that the outfall design essentially fulfills the basic requirements for the 301(h) waiver from the EPA for secondary treatment.

Because water quality standards for bacteria are frequently exceeded in shoreline portions of East Mamala Bay, OI Consultants Inc. (1992) evaluated recent data to investigate the source. Shoreline and nearshore bacteria monitoring data were examined for gradients that would indicate the direction of movement. The study did not find concurrent occurrences of high levels of bacteria in nearshore and shoreline samples. However, the difference was not statistically significant for all pairs of stations evaluated. These results are similar to the results of recent physical oceanographic models of the effluent plume dynamics (Noda, 1992). Average currents in the vicinity of Sand Island are parallel to the shore and were not found to transport submerged plumes toward the shore. The probability of the plume reaching the shoreline is approximately 0.1 to 0.3 percent of the time, when the plume has been diluted by a factor of 1,800 to 2,500 in nearshore and shoreline area (Noda, 1992). It is concluded that the sewage outfall does not have significant impacts on shoreline recreational waters.

OI Consultants, Inc. (1992) correlated bacterial levels to season and to the extent of recreational use (see Appendix L). Elevated bacterial levels corresponded to seasons of greater precipitation and days of higher recreational use. The report concluded that the elevated bacteria levels resulted primarily from terrestrial sources and recreational use of the nearshore area. Furthermore, based on a report by Fujioka et al. (1992), effluent being discharged into Mamala Bay contained 22,900,000 CFU *E.coli*/100ml, 277,000 enterococci/100ml and 23,500 *C. perfringens* /100ml. The plume is unlikely to surface within the area of the ZOM. However, evidence of the wastewater plume was detected at the bottom of the ZOM, especially at sites SI6 and SI7 (see Figure 4.7.1-1), middle and bottom depths of offshore or nearshore samples, showing limited transportation of sewage in the subsurface layer.

This report also assessed three indicator bacteria. *E. coli* was considered very unstable in sea water; however, it is a good indication of recent contamination. *C. perfringens* was determined to be very stable in marine waters and a good indicator of the presence of wastewater. However, the true value of *C. perfringens* as an indicator for disease incidences in seawater is not well-established by any epidemiological study. Therefore, enterococci is considered most appropriate for marine water quality monitoring.

Finally, a bacterial gradient analysis was conducted. Data obtained from December 1988 to December 1992 at nearshore and shoreline stations (City and County of Honolulu, Planning and Public Services Branch) were used. The purpose of this analysis was to investigate the origin of the bacterial contamination observed in the nearshore. Both fecal coliform and enterococci levels were examined. The working hypotheses were:

1. If contamination originated from the outfall, the source should be constantly contributing bacterial pollution into surrounding waters, and a gradient of higher concentrations offshore and lower concentrations nearshore would be observed.
2. If bacteria moved toward the shoreline from a source other than the outfall, elevated bacterial levels should be found concurrently in nearshore and shoreline samples, but because of dilution and die-off over time, higher concentrations would occur closer to the source.

Gradients were examined in two directions: one parallel to the shoreline, the other perpendicular to the shoreline.

Gradient Parallel to the Shoreline

Nearshore surface stations were examined in pairs (SN1 vs. SN2, SN2 vs. SN3, SN3 vs. SN4, SN4 vs. SN5). Results from a sample collected at one station on a particular day was compared with results from the paired station on the same day. The differences between the two were categorized as: (1) indicating a westward gradient of bacterial contamination; (2) indicating an eastward gradient; or (3) indicating no gradient parallel to shore. Table 2 presents the number of events in each category for an each of the four pairs.

Table 2
Number of Events in Each Category
for the Four Pairs of Stations

DIRECTION OF GRADIENT	SN1-SN2		SN2-SN3		SN3-SN4		SN4-SN5	
	FC	ENT	FC	ENT	FC	ENT	FC	ENT
Westward	61	64	75	66	58	39	66	39
Eastward	50	58	49	56	66	67	35	93
No gradient	108	96	121	112	99	116	117	61
Total	219	218	245	234	223	222	218	193

Note: FC represents fecal coliform, Ent. represents enterococci. See Figure 4.7.1-1 for locations of sample stations.

For fecal coliform data, the incidence of no east-west gradient events was higher than the number of westward or eastward gradients for all four pairs. For enterococci, this is true for three pairs. Overall, there is no statistically significant gradient detected in the direction parallel to the shoreline along nearshore stations. This trend indicates that multiple shoreline sources, rather than a single off-shore source, are the principal contributors of the measured bacterial indicators, the data further indicate that the shore-parallel gradients change direction in the vicinity of SN3 near the entrance to Honolulu Harbor.

Gradient Perpendicular to the Shoreline

The bacterial concentrations at nearshore and shoreline stations were compared. The differences were categorized as (1) indicating an offshore gradient of bacterial contamination, (2) indicating a shoreward gradient, or (3) indicating no gradient perpendicular to the shore. Table 3 presents the number of events for each category for each of the four pairs.

Table 3
Number of Events in Each Category for the
Four Pairs of Stations

DIRECTION OF GRADIENT	SN3-SS3		SN4-SS3		SN5-SS4		SN5-SS5	
	FC	ENT.	FC	ENT	FC	ENT	FC	ENT
Offshore	135	42	160	111	103	75	157	109
Shoreward	36	97	82	119	46	100	26	79
None	29	36	13	25	81	62	40	47
Total	200	175	255	255	230	237	223	235

Note: FC represents fecal coliform, Ent. represents enterococci. See Figure 4.7.1-1 for locations of sample stations.

Fecal coliform data indicate an offshore gradient at all four pairs of stations, while enterococci does not. This may due to the relatively fast die-off rate for fecal coliform in sea water (T90 for fecal coliform is two to three times shorter than T90 for enterococci) which makes it a sensitive indicator of recent contamination. The probability that the observed fecal coliform gradient is a result of chance alone, rather than being representative of an actual trend, is only 5 percent (assuming a binomial probability distribution). This difference between fecal coliform and enterococci may also indicate that currents, rather than diffusion, are more important in movement of these indicator organisms. Samples with concentrations higher than 7 CFU/100 ml are shown in Table 4.

Table 4
Number of Events in Each Category for Two Pairs of Stations with Enterococci Levels Exceeding 7 CFU/100 ml

DIRECTION OF GRADIENT	SN3-SS3	SN4-SS4
Offshore	59	38
Shoreward	28	10
None	2	0

Analysis of the results indicates that the predominant bacterial gradient is offshore from a land-based source. Similarly, the source of enterococci in samples exceeding recreational WQS appears to be land- or nearshore-based. There is only a 1.5 percent probability that these gradients could have been generated by chance.

Appendix D

AIR QUALITY IMPACT REPORT
(AQIR)

East Mamala Bay Facilities Plan

28 July 1993

PREPARED FOR:

Department of Public Works
City and County of Honolulu

and

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1. INTRODUCTION

The City and County of Honolulu Department of Public Works is proposing a series of improvements to its existing wastewater management system in the East Mamala Bay area which extends from the Honolulu International Airport eastward to Kuliouou (Figure 1). This will include modification and expansion of the Sand Island Wastewater Treatment Plant, upgrading of various pump stations throughout the area, and extension of sewerage into presently unsewered areas.

The intent of this report is to assess the air quality impact of the proposed action. There are in fact a variety of potential air pollution sources associated with it, and these sources and their emissions may be characterized as:

- short- and long-term
- direct and indirect
- onsite and offsite
- regulated and unregulated
- viable
- odorous

The report will assess the impact of these sources and emissions in light of existing regulations and standards, existing air quality, and local meteorological conditions.

2. APPLICABLE REGULATIONS AND STANDARDS

2.1 Ambient Air Quality Standards. A summary of State of Hawaii and national ambient air quality standards is presented in Table 1 [1,2]. Note that Hawaii's standards are not divided into primary and secondary standards as are the Federal standards. Primary standards are intended to protect public health with an adequate margin of safety while secondary standards are intended to protect public welfare through the prevention of damage to soils, water, vegetation, man-made materials, animals, wildlife, visibility, climate, and economic values [3]. Some of Hawaii's standards are clearly more stringent than their Federal counterparts but, like their Federal counterparts, may be exceeded once per year. The State of Hawaii also has fugitive dust regulations for particulate matter (PM) emanating from construction activities [4]. There simply can be no visible emissions from fugitive dust sources.

2.2 Emission Limitations. The U.S. Environmental Protection Agency recently promulgated final rules pertaining to the incineration of sewage sludge [5]. Those rules require compliance with national emission standards for beryllium (10 grams per 24 hr) [6] and mercury (3,200 grams per 24 hr) [7].

They indirectly limit emissions of arsenic, cadmium, chromium and nickel by limiting the sludge content of those metals. The actual numerical values of the limits are calculated on a case-by-case basis and depend on the modeled property line concentrations and measured pollution control efficiency of a particular source. A 100 ppm, as a monthly average, limitation is also placed on the concentration of total hydrocarbons in the exhaust gas from the sludge incinerator.

The Clean Air Act Amendments of 1990 (1990 CAAA) also recognized publicly owned treatment works (POTW), i.e., sewage treatment plants, as sources of toxic air pollutants. In the first phase, the Act mandated promulgation of "maximum achievable control technology" (MACT) standards for POTW not later than five years after enactment of the 1990 CAAA [8]. MACTS will be developed for both new and existing sources. New sources must comply immediately upon the effective date of the applicable MACT(s) while existing sources may be given up to three years to comply.

In the second phase, EPA must quantify the residual risk remaining after application of MACT and determine what additional control is required to protect public health with an "ample margin of safety." This will result in either more legislation or, if Congress does not act, more regulations from EPA [9].

3. EXISTING AIR QUALITY

The State Department of Health maintains a limited network of air monitoring stations around the state to gather data on the following regulated pollutants:

- total suspended particulates (TSP)
- particulate matter <10 microns (PM_{10})

- sulfur dioxide (SO_2)
- carbon monoxide (CO)
- ozone (O_3)
- lead (Pb)

In the case of TSP, PM_{10}, and SO_2, measurements are made on a 24-hour basis to correspond with the averaging period specified in the standards. Samples are collected once every six days in accordance with U.S. Environmental Protection Agency (EPA) guidelines. Carbon monoxide and ozone, however, are measured on a continuous basis due to their short-term (1-hour) standards. Lead concentrations are determined from the TSP samples which are sent to an EPA laboratory for analysis. Note that the lead standard is a quarterly average.

Recent air quality data from stations in the Honolulu area are presented in Table 2 and indicate compliance with both state and national ambient air quality standards [10].

4. CLIMATE AND METEOROLOGY

4.1 Temperature and Rainfall. The National Climatic Data Center in its 1982 annual summary for Honolulu notes that:

> "Hawaii's equable temperatures are associated with the small seasonal variation in the amount of energy received from the sun and the tempering effect of the surrounding ocean. The range of temperature averages only 7 degrees between the warmest months (August and September) and the coolest months (January and February) and about 12 degrees between day and night. Daily maximums run from the high 70's in winter to the mid-80's in summer, and daily minimums from the mid-60's to the low 70's. However, the Honolulu Airport area has recorded as high as 93 degrees and as low as 53" [11].

Rainfall in the project area ranges about 24 - 31 inches per year. In accordance with Thornwaite's scheme for climatic classification, the area would be considered semiarid steppe to subhumid grassland [12].

4.2 Surface Winds. Meteorological records were reviewed from the

Honolulu International Airport and Hickam Air Force Base (AFB). It is quite evident that northeast tradewinds predominate during much of the year (Table 3). A closer examination of the data, however, indicates that low velocities (less than 10 mph) occur frequently and that the "normal" northeasterly tradewinds tend to breakdown in the Fall giving way to more light, variable wind conditions through the Winter and on into early Spring. It is during these times that Honolulu generally experiences elevated pollutant levels. This seasonal difference in wind conditions can be seen clearly in Figures 2 and 3.

Of particular interest from an air pollution standpoint were the stability wind roses prepared for the period January 1955 to December 1968 at Hickam Air Force Base [13]. These data indicated that stable conditions, i.e., Pasquill-Gifford stability categories E and F [14], occur about 28% of the time. It is under such conditions that the greatest potential for air pollutant buildup from groundlevel sources exists.

5. LONG-TERM IMPACTS

5.1 Sand Island WWTP.

5.1.1 General. Wastewater treatment plants are clearly potential emitters of a variety of pollutants from their inherent water and sludge treatment processes. Air toxics, odorous pollutants, and viable particles, i.e., microorganisms, can arise from preliminary treatment, equalization basins, secondary aeration/oxidation, primary treatment and collection systems. Sources of the toxic chemicals include water supplies, industrial sources, commercial sources, household products and activities, and the treatment processes themselves. The Water Pollution Control Federation (WPCF) held a workshop in July 1989 which focused on air toxic emissions from WWTPs and concluded that such plants routinely emit a number of 1990 CAAA listed air toxics [15]. Table 4 lists a number of such pollutants. Sludge incineration is also an obvious potential source of criteria pollutants as well as air toxics.

5.1.2 Expanded Primary Treatment.

5.1.2.1 Liquid Treatment. The proposed improvements in the expanded primary option offer some potential for increased emissions. Specifically, the new screenings area and aerated grit removal chambers involve increased turbulence which enhances emissions of volatile pollutants and odorous gases from the water.

While the two additional clarifiers will be much more quiescent, they too can result in volatile organics and odor emissions due to their large exposed surface areas and flow over weirs. Air sampling may be necessary later to better characterize the nature and quantities of such emissions.

5.1.2.2 Solids Treatment. Replacement of the existing pressurized heat treatment (Zimpro) system with anaerobic digestion for solids stabilization should reduce emissions. The Zimpro system produces a malodorous gas stream as well as sidestreams with high concentrations of organics and ammonia whereas anaerobic digestion produces primarily colorless, odorless methane with lesser quantities of odorous gases.

Final processing of the sludge by incineration, landfilling or agricultural/horticultural use can also result in air emissions. The first results in a variety of particulate and gaseous emissions while the latter two result in emissions only if care is not exercised to avoid fugitive dust.

Based on a projected 47 tons per day of sludge, one can estimate pollutant emissions from incineration. The estimates based on EPA emission factors [16] and assuming the presence of a wet scrubber are presented in Table 5.

Based on the EPA standards for beryllium (Be) and mercury (Hg) [6,7], one can also estimate the allowable concentrations of those toxic metals in the sludge assuming that they are all emitted and none remain in the bottom ash (Table 6). This is a conservative approach since some percentage of the metals do in fact remain in the ash; therefore, the actual allowable concentration of these metals in the sludge would be higher.

As noted in Section 2, emissions of selected heavy metals are regulated by limiting their concentration in the sludge. Estimates of the allowable sludge concentrations of arsenic, cadmium, nickel and chromium were made pursuant to the EPA formula [5] and are presented in Table 7.

5.1.3 Secondary Treatment

5.1.3.1 Liquid Treatment. The air impacts of secondary treatment are similar to the proposed expanded primary in that the principal source of emissions will be the aerated grit chambers. The addition of a roughing filter (trickling filter), however, provides more surface area and flowing water which can result in additional emissions of both air toxics, odors, and viable particles. This option will not add new primary clarifiers which can be emission sources, but will add final clarifiers which should be lower emitters than the primary units.

5.1.3.2 Solids Treatment. The secondary treatment option generates significantly more solids than the primary system and thus requires additional processing equipment over and above what would be added in the expanded primary system. Emissions would not be expected to be significantly different with the exception that the increase volume incinerated (85 tons per day) would have proportionately increased emissions (see Table 5).

Conservative estimates of the allowable concentrations of beryllium and mercury in the sludge were again calculated for the higher sludge production rate and are presented in Table 6. It is evident that with the higher sludge rate, the allowable concentrations of the two hazardous elements in the sludge goes down. As noted above, this approach is conservative in assuming 100% emission of the metals present when the actual percentage is lower; thus, allowable concentrations would be higher than those shown in the table.

The increased sludge production would also lower the allowable concentrations of As, Cd, Ni, and Cr pursuant to 40 CFR 503 as shown in Table 7.

5.2 Viable Emissions. Wastewater by its very nature is contaminated with a variety of microorganisms some of which are capable of causing disease in humans. These organisms can be entrained in the air at some of the same locations that the gaseous air pollutants are also released. Processes involving turbulence and drops of elevation can cause release. There has been concern in the past about the possible health implications of airborne organisms both to WWTP workers and the nearby general public. While EPA-funded studies have confirmed the presence of many organisms in the vicinity of waste treatment facilities, there has been no firm confirmation of increased disease rates attributable to facility operations [17,18,19].

5.3 Electrical Generation. Expansion of the Sand Island WWTP and upgrading of pump units throughout the service area will necessitate the generation of electricity by power plants. The estimated electrical demand of the proposed improvements is 4.5 million kilowatt-hours per year.

Currently, most of Oahu's electrical energy is generated at Hawaiian Electric Company's (HECO) Kahe Generating Station located near Nanakuli on the leeward coast. This is currently a six-unit, approximately 650-megawatt facility firing low-sulfur fuel oil. Other oil-fired generators are located at Waiau and Campbell Industrial Park. A coal-fired plant is also located at the industrial park. For the purposes of this analysis, low sulfur (0.5%) fuel oil-firing was assumed. Estimates of annual emissions were computed based on EPA emission factors and the fuel required to meet a 4.5 million Kwhr demand. The results are presented in Table 8.

5.4 Mobile Source Impacts

5.4.1 Emission Factors. Automotive emission factors for carbon monoxide (CO) were generated for calendar years 1993 and 2003 using the Mobile Source Emissions Model (MOBILE-4.1) [17]. To localize emission factors as much as possible, the August 1988 age distribution for the City & County of Honolulu [18] was input in lieu of the national statistics normally used.

5.4.2 Microscale Analysis. Analyses such as this generally involve estimation of concentrations of non-reactive pollutants.This is due to the complexity of modeling pollutants which undergo chemical reactions in the atmosphere and are subject to the effects of numerous physical and chemical factors which affect reaction rates and products. For projects involving motor vehicles as the principal air pollution source, carbon monoxide is normally selected for modeling because it has a relatively long half-life in the atmosphere (about 1 month) [19], and it comprises the largest fraction of automotive emissions. In this instance, a microscale screening analysis was performed for the Sand Island Parkway in the vicinity of the Sand Island WWTP. The updated version of an EPA guideline model CALINE-4 [20,21] was employed with an array of receptors spaced at distances of 10 - 30 meters from the road edge. Because of the existing level of development and traffic in the area, a background CO concentration of 1.0 milligram per cubic meter (mg/m^3) was assumed. Worst case meteorological conditions were selected for the p.m. peak traffic hours. A wind speed of 1 meter per second, an acute wind/road angle, and neutral stability (Pasquill-Gifford Class "D") [22], were all selected to maximize concentration estimates in the vicinity of the intersections. Review of the traffic data and preliminary modeling indicated that northeasterly winds were most likely to produce the maximum CO concentrations near the intersections under study; thus, this wind direction was input for the modeling. Maximum one-hour carbon monoxide (CO) concentrations were then computed for the peak traffic hours. The analyses were performed for existing conditions (1993) and future conditions (2003) both with and without the proposed project options as described in the traffic impact assessment [23]. The results are summarized in Figure 4 and indicate minimal impact.

6. SHORT-TERM IMPACTS

The principal source of short-term air quality impact will be construction activity both at the Sand Island WWTP and in the areas in which new sewerage will be installed. Construction vehicle activity will increase automotive pollutant concentrations along the principal access roads as well as in the vicinity of the project site itself. During off-peak hours, the additional construction vehicle traffic should not exceed road capacities although the presence of large trucks can reduce a roadway's capacity as well as lower average travel speeds thereby contributing to additional air pollution emissions. This may be particularly noticeable in those areas where new sewerage is being installed. The stop-and-go traffic will result in substantially higher localized emissions as compared to more normal free-flow traffic.

The site preparation and earth moving will create particulate emissions as will building and on-site road construction. Construction vehicles movement on unpaved on-site roads will also generate particulate emissions. EPA studies on fugitive dust emissions from construction sites indicate that about 1.2 tons/acre per month of activity may be expected under conditions of medium activity, moderate soil silt content (30%), and precipitation/evaporation (P/E) index of 50 [14]. Since much of the project area has a P/E index less than 50, this suggests a greater potential for fugitive dust generation.

9. DISCUSSION AND MITIGATION

9.1 <u>Direct Project Impact</u>. The proposed improvements at the Sand Island WWTP should have minimal impact on air quality. Compliance with existing standards and regulations pertaining to criteria pollutants, hazardous air pollutants, and air toxics will insure protection of public health. WWTPs have been identified by EPA as emitters of toxic air pollutants and thus will be subject to the use of "maximum achievable control technology" (MACT) in the near future. Emissions from the incinerators are substantially below the "major source" threshold; thus, the facility would not be subject to federal Prevention of Significant Deterioration (PSD) rules. Odor control has been effective at the existing operation and will be expanded during this proposed upgrade. Some reduction of emissions is possible with the replacement of the existing thermal stabilization process (Zimpro) with anaerobic digestion.

9.2 Electrical Generation Impacts. The emissions estimates for electrical generation and solid waste disposal may be compared to the 1980 county emissions inventory in Table xx in order to provide some perspective on their significance. The project's contribution to county emissions appears to be less than 0.1%.

9.3 Mobile Source Impact. The long-term impact on mobile source activity and emissions is negligible.

9.4 Construction Impacts. As noted in Section 8, there is some potential for fugitive dust due to the dry climate; thus, it will be important for adequate dust control measures to be employed during construction. Dust control could be accomplished through frequent watering of unpaved roads and areas of exposed soil. The EPA estimates that twice daily watering can reduce fugitive dust emissions by as much as 50%. The following measures will also help reduce the short-term impacts associated with construction activities:

- compliance with state/county dust control requirements
- covers for open trucks transporting dusty materials
- soonest possible landscaping of exposed soil areas

As for traffic-related impacts, minimizing construction vehicle activity during peak traffic hours and maintaining the smoothest possible traffic flow through sewerage installation sites will help reduce the impact on local air quality.

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TABLES

TABLE 1

SUMMARY OF STATE OF HAWAII AND FEDERAL AMBIENT AIR QUALITY STANDARDS

Pollutant	Sampling Period	NAAQS Primary	NAAQS Secondary	State Standards
TSP	Annual geometric mean	---	---	60
	24-hr	---	---	150
PM_{10}	Annual	50	50	---
	24-hr	150	150	---
SO_2	Annual	80	---	80
	24-hr	365	---	365
	3-hr	---	1,300	1,300
NO_2	Annual	100	---	70
CO	8-hr	10	---	5
	1-hr	40	---	10
O_3	1-hr	235	---	100
Pb	Calendar Quarter	1.5	---	1.5

KEY:
- TSP - total suspended particulate matter
- PM_{10} - particulate matter < 10 microns
- SO_2 - sulfur dioxide
- NO_2 - nitrogen dioxide
- CO - carbon monoxide
- O_3 - ozone
- Pb - lead

All concentrations in micrograms per cubic meter (ug/m^3) except CO which is in milligrams per cubic meter (mg/m^3).

TABLE 2

ANNUAL SUMMARY OF AIR MONITORING DATA
HONOLULU, HAWAII
1990

Pollutant	Period (mo)	No. Samples	Range (ug/m^3)	Mean (ug/m^3)
TSP	12	53	13 - 47	30
PM_{10}	12	54	08 - 36	15
SO_2	12	60	<5 - <5	<5
CO	12	362	0.1 - 7.1	1.5
O_3	12	340	04 - 116	36
Pb	12	58	0 - 0	0

NOTES:

1. TSP = total suspended particulate matter.
   PM_{10} = particulate matter equal to or less than 10 microns.
   SO_2 = sulfur dioxide
   CO = carbon monoxide
   O_3 = ozone
   Pb = lead
2. All concentrations in ug/m^3 except CO in mg/m^3.
3. TSP, SO_2 and CO data from Department of Health Building in downtown Honolulu.
4. PM_{10} and Pb data from Liliha Street site.
5. O_3 data from Sand Island site.
6. Source: Reference 9

TABLE 3

JOINT FREQUENCY DISTRIBUTION
OF WIND SPEED AND DIRECTION
HONOLULU INTERNATIONAL AIRPORT

Direction	Wind Speed (knots)						
	0-3	4-7	8-12	13-18	19-24	>24	Total
N	.0149	.0261	.0075	.0020	.0002	.0000	.0506
NNE	.0114	.0219	.0106	.0046	.0005	.0000	.0490
NE	.0114	.0449	.0829	.0853	.0204	.0018	.2466
ENE	.0088	.0637	.1559	.1209	.0224	.0014	.3731
E	.0039	.0179	.0329	.0210	.0023	.0001	.0782
ESE	.0021	.0056	.0050	.0015	.0003	.0001	.0146
SE	.0021	.0059	.0091	.0049	.0006	.0002	.0228
SSE	.0023	.0074	.0123	.0038	.0008	.0002	.0268
S	.0025	.0104	.0127	.0033	.0005	.0003	.0296
SSW	.0011	.0041	.0053	.0017	.0003	.0000	.0125
SW	.0007	.0031	.0058	.0022	.0003	.0001	.0122
WSW	.0006	.0017	.0031	.0022	.0005	.0001	.0082
W	.0019	.0030	.0021	.0009	.0002	.0001	.0082
WNW	.0027	.0051	.0012	.0003	.0001	.0000	.0094
NW	.0084	.0153	.0031	.0008	.0003	.0000	.0279
NNW	.0087	.0166	.0041	.0012	.0002	.0000	.0308
Total	.0835	.2527	.3534	.2567	.0496	.0043	1.000

TABLE 4

AIR TOXICS ASSOCIATED WITH WASTEWATER TREATMENT PLANTS

CATEGORY	AIR TOXICS
Conventional Wastwater Constituents	ammonia chlorine hydrogen sulfide
Important Target Compounds	benzene chloroform p-dichlorobenzene ethylbenzene ethylene dichloride 1,1,1-trichloroethane trichloroethylene vinylidene chloride xylenes
Potential Chlorination By-Products	carbon tetrachloride chloroform methylene chloride
Potential Anaerobic Digestion Products	trichloroethylene vinyl chloride
Potential Digester Gas Combustion By-Products	acrolein benzene 1,3-butadiene formaldehyde polycyclic aromatic hydrocarbons
May Be Added in Treatment Process	dimethylamine
Other Possible Compounds of Concern	benzidine gasoline vapors napthalene phenol

SOURCE: Reference 10

TABLE 5

ESTIMATES OF ANNUAL EMISSIONS
FROM SLUDGE INCINERATION

POLLUTANT	ADVANCED PRIMARY (T/yr)	SECONDARY (T/yr)
PM	11.1	20.1
SO_2	6.9	12.4
CO	< 1	< 1
HC	8.6	15.5
NOx	42.9	77.6
Pb	< 1	< 1
Hg	< 1	< 1
HCl	2.6	4.7

NOTES:

1. Advanced primary treatment assumes 47 T/da sludge incineration; secondary treatment assumes 85 T/da.
2. PM and Hg emissions based on actual source test data on existing Unit #1 (November 1992).
3. Other emission factors taken from Table 2.5-1, EPA Publication AP-42, and assume presence of wet scrubber (Reference 16).

TABLE 6

ESTIMATED CONCENTRATIONS OF BERYLLIUM AND MERCURY IN SLUDGE WHICH ALLOW COMPLIANCE WITH NESHAPS

POLLUTANT	EXPANDED PRIMARY (47 T/da)	SECONDARY (85 T/da)
Beryllium (Be)	0.2 ppm	0.1 ppm
Mercury (Hg)	75 ppm	42 ppm

NOTES:
1. Be standard is 10 g/24 hrs.
2. Hg standard is 3,200 g/24 hrs.
3. Concentrations based on assumption of 100% emission of Be and Hg in sludge.

TABLE 7

ESTIMATED CONCENTRATIONS OF ARSENIC, CADMIUM, NICKEL AND CHROMIUM IN SLUDGE WHICH ALLOW COMPLIANCE WITH 40 CFR 503

POLLUTANT	EXPANDED PRIMARY (47 T/da)	SECONDARY (85 T/da)
Arsenic (As)	14.1 mg/kg	7.8 mg/kg
Cadmium (Cd)	34.9 mg/kg	19.3 mg/kg
Nickel (Ni)	1,226 mg/kg	677 mg/kg
Chromium (Cr)	39.2 mg/kg	21.7 mg/kg

NOTES:

1. Computed from the formula found at 40 CFR 503.43.
2. Control efficiency assumed to be 0.85 with a wet scrubber.
3. Dispersion factor = 22 $ug/m^3/g/sec$ based on the annual concentration derived from ISC modeling with 1982 meteorology from Honolulu International Airport.

TABLE 8

EMISSIONS INVENTORY
CITY & COUNTY OF HONOLULU
1980

Source Category	Emissions (T/yr)				
	PM	SO_2	NOx	CO	HC
Steam electric plants	2,092	36,736	12,455	1,065	184
Gas utilities	14	0	199	0	0
Fuel combustion in agriculture	1,088	579	358	0	31
Refinery Industry	622	7,096	2,149	266	2,584
Petroleum Storage	0	0	0	0	1,261
Metallurgical Industries	28	96	40	0	0
Mineral products Industry	6,884	1,883	597	0	31
Municipal Incineration	42	145	2,029	0	184
Motor vehicles	1,413	1,014	17,270	239,198	22,853
Construction, farm and industrial vehicles	184	193	2,507	3,729	338
Aircraft	382	145	1,751	5,594	1,476
Vessels	42	386	438	533	123
Agricultural field burning	1,399	0	0	15,982	1,692
TOTAL	14,191	48,274	39,792	266,367	30,758

FIGURES

FIGURE 1
PROJECT LOCATION

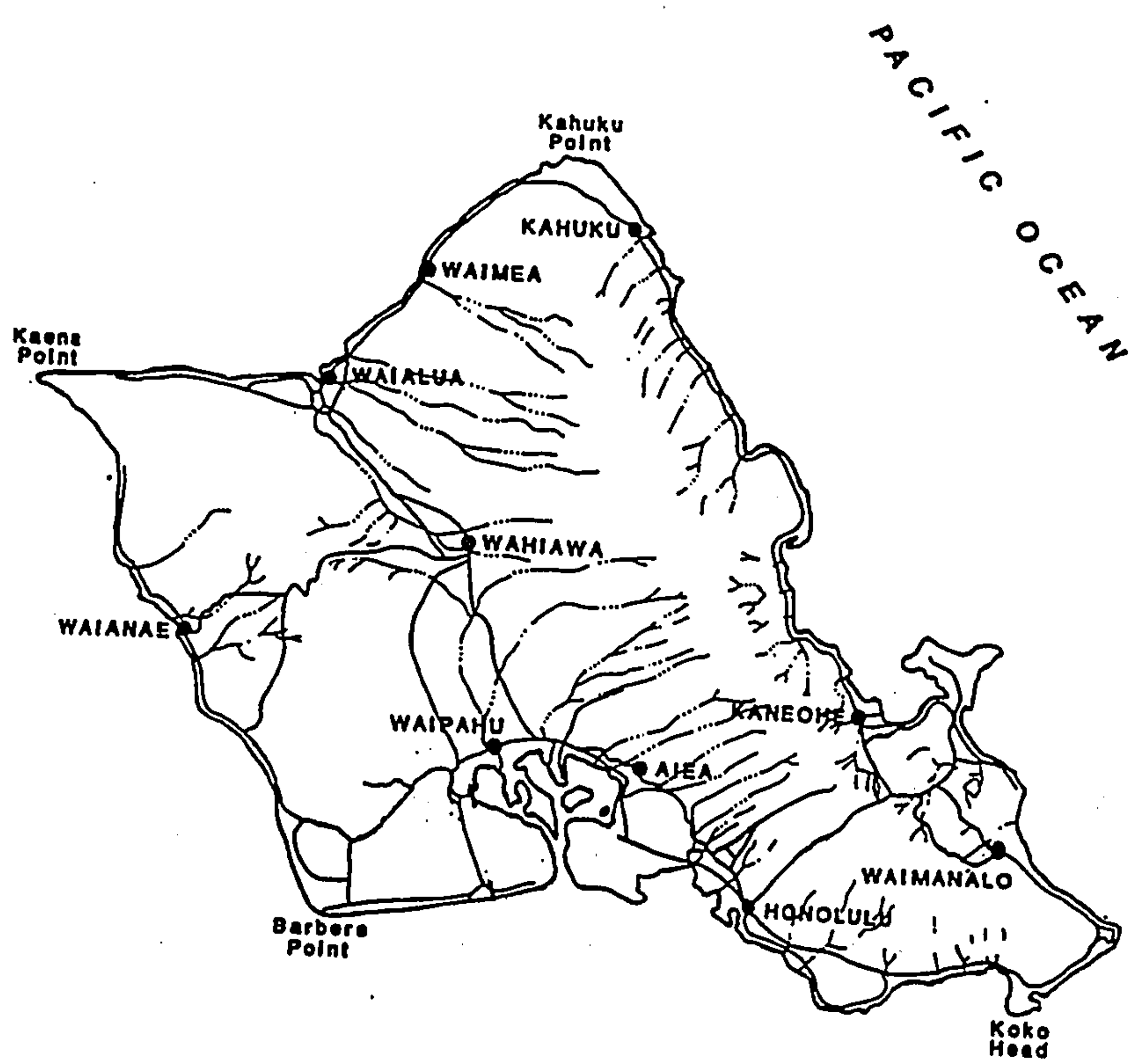
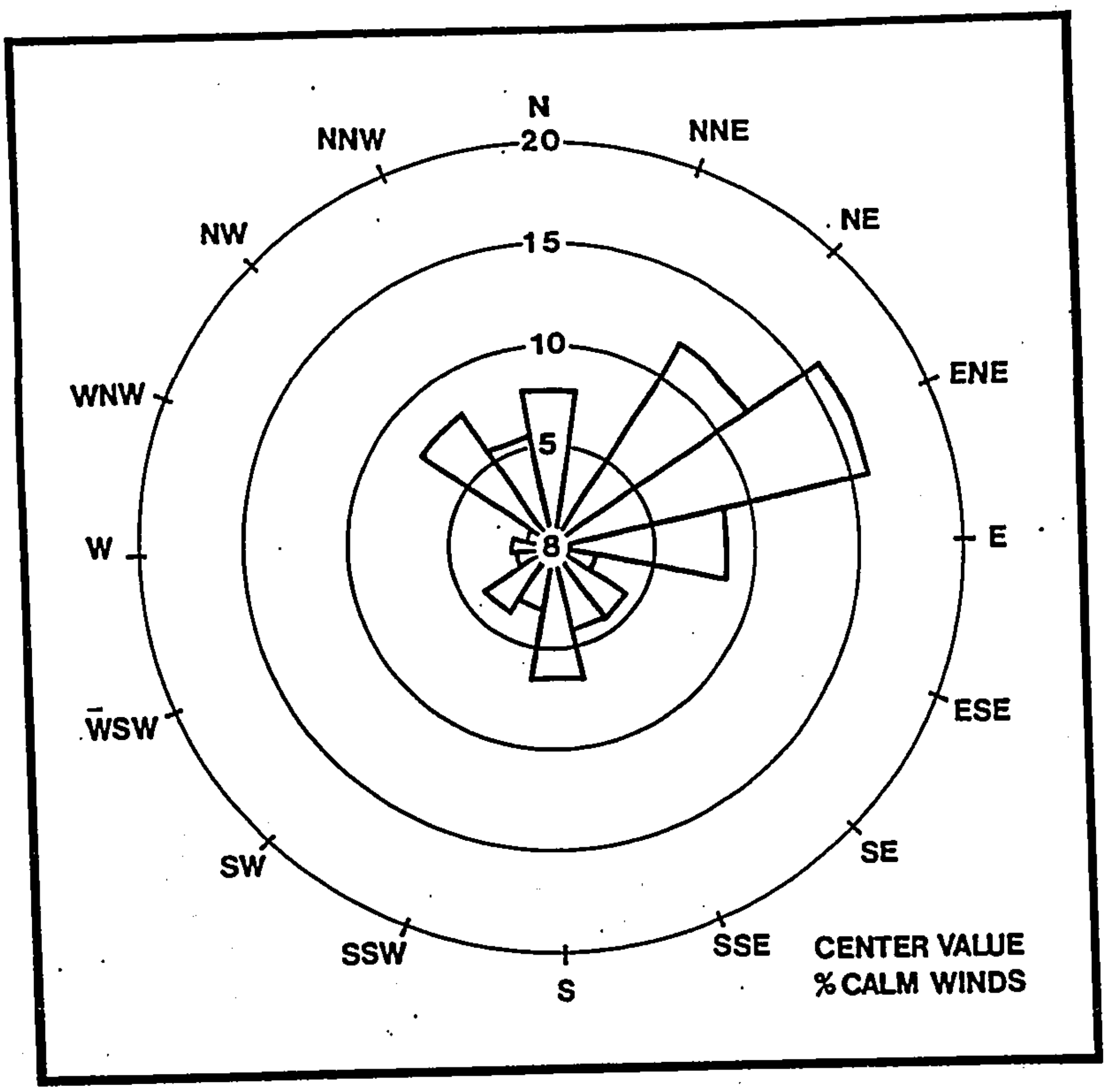


FIGURE 2

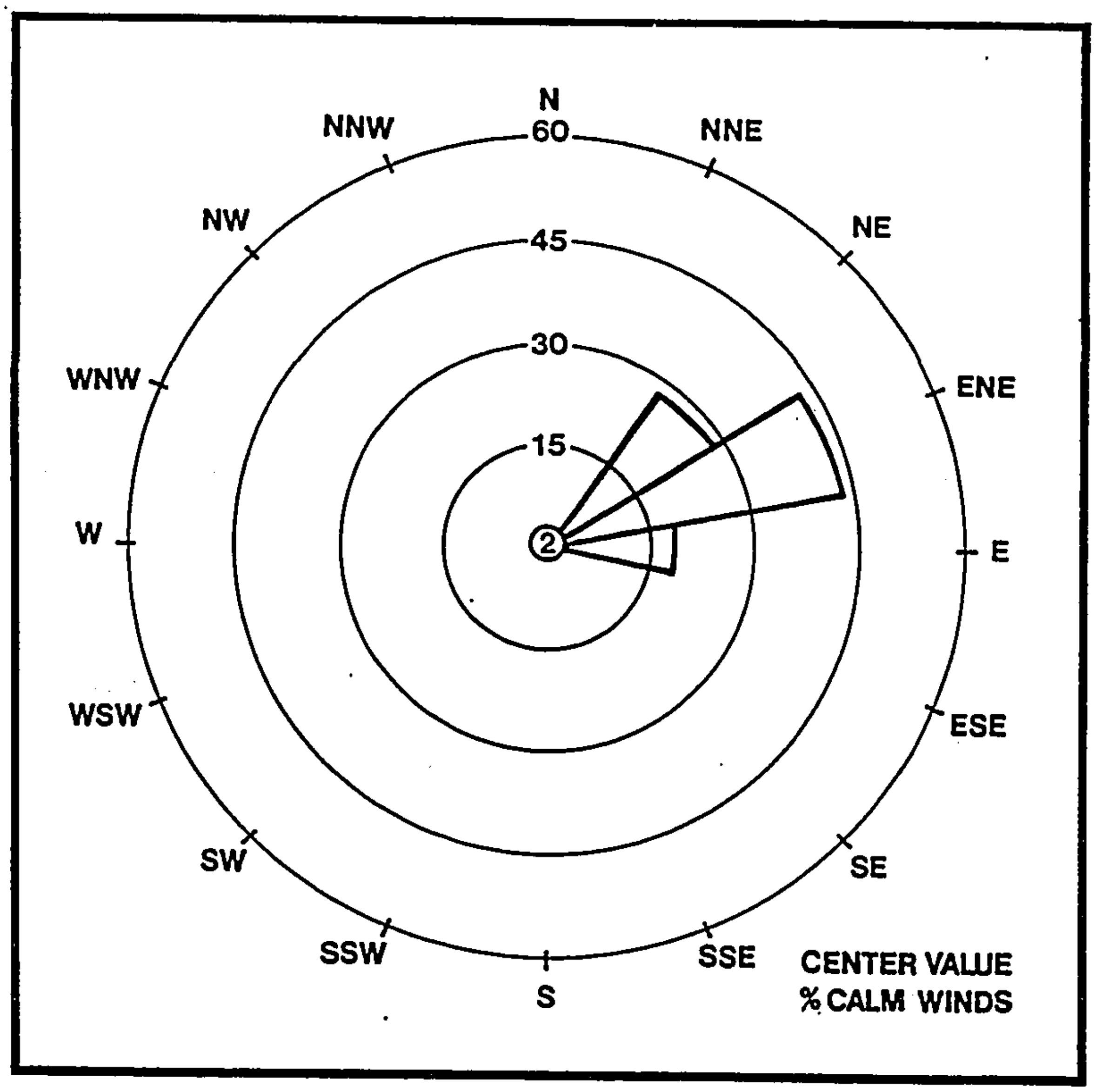
JANUARY WINDROSE
HONOLULU INTERNATIONAL AIRPORT



SOURCE: National Weather Service (1940-67)

FIGURE 3

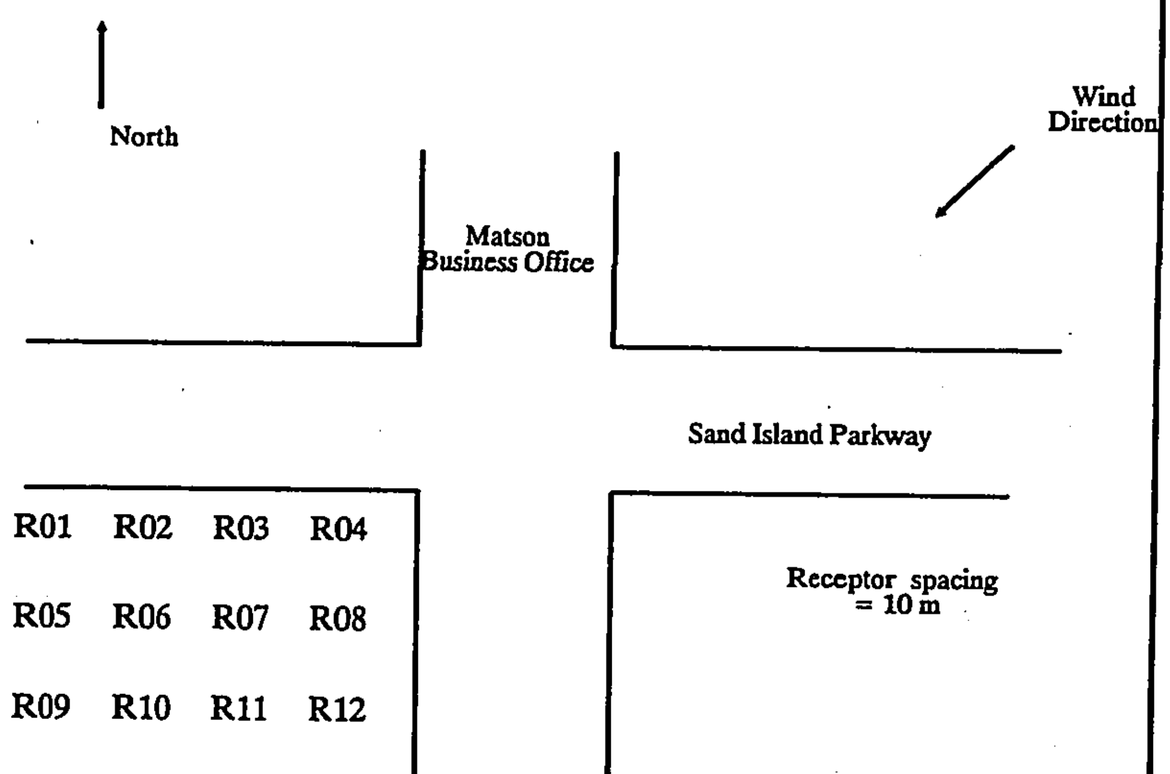
AUGUST WINDROSE
HONOLULU INTERNATIONAL AIRPORT



SOURCE: National Weather Service (1940-67)

FIGURE 4

ESTIMATES OF MAXIMUM 1-HOUR CARBON MONOXIDE CONCENTRATIONS
Sand Island Parkway at Sand Island WWTP
P.M. Peak Traffic Hour
1993 - 2003



Concentration (mg/m^3)

Receptor	1993	2003 w/o proj	2003 w/Opt 1	2003 w/Opt 2
R01	2.7	2.2	2.3	2.3
R02	2.7	2.2	2.3	2.3
R03	2.7	2.2	2.3	2.3
R04	2.7	2.2	2.3	2.3
R05	2.3	1.9	2.0	2.0
R06	2.3	1.9	1.9	2.0
R07	2.3	1.9	1.9	2.0
R08	2.3	1.9	2.0	1.8
R09	2.1	1.7	1.8	1.8
R10	2.1	1.7	1.8	1.8
R11	2.1	1.7	1.8	1.8
R12	2.1	1.7	1.8	1.8

Appendix E

EAST MALAMA BAY
SHORELINE ACTIVITIES STUDY

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June 1993

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1.0 Introduction

This shoreline activities study was conducted for Belt Collins & Associates. It is intended to provide background information for the East Mamala Bay Facilities Study and EIS, a study of the Sand Island Sewage Treatment Plant and the wastewater collection system that services the plant. The study and EIS are assessing the environmental impacts of improvements to the East Malama Bay wastewater management system that will be needed to meet the projected growth in wastewater flows in the year 2015.

1.1 Purpose

The purpose of this study is:

a. To identify and characterize the general nature of the shoreline and the nearshore recreational activities from the Reef Runway to Hawaii Kai
b. To identify and characterize the specific character of the shoreline and the nearshore recreational activities from the Reef Runway to Diamond Head
c. To comment on the potential impacts of a release from the wastewater management system on shoreline and nearshore recreational activities

1.2 Area Description

The study area extends from the west end of the Reef Runway to Hawaii Kai. This reach of shoreline includes almost the entire length of the city of Honolulu. In order to facilitate the inventory and the evaluation of the study area, three sub-areas were recognized. They are as follow:

a. Sub-area 1: Reef Runway to Kewalo Basin
b. Sub-area 2: Kewalo Basin to Diamond Head
c. Sub-area 3: Diamond Head to Koko Head

1.3 Methodology

The information assembled in this study came primarily from the following sources:

- the literature cited in the References
- interviews with representatives of the ocean activity user groups found in the study area
- field surveys conducted in 1993.

The ocean activity user groups included both commercial groups such as commercial fishermen and non-commercial groups such as subsistence fishermen and recreational surfers. Whether commercial or non-commercial, the ocean activity user groups were limited to those groups who practice in-water activities, that is activities that place the users below the high water mark and/or directly in the ocean. Peripheral shoreline user groups such as sunbathers were not included, and user groups in motorized vessels such as tour groups on dinner cruises were not included.

The economic assessment of the commercial groups and the potential impact of a wastewater release on them was made by Michael Markrich, an associate editor for Hawaii Business magazine.

2.0 General Character of the Study Area

The shoreline from the Reef Runway to Hawaii Kai includes almost the entire seaward extremity of the city of Honolulu. It includes Honolulu Harbor, the largest deep draft harbor in the state; the city's Downtown area, the business hub of the state; Waikiki Beach, the major visitor destination in Hawaii, and the residential communities of Diamond Head, Kahala, Waialae, Aina Haina, Niu Valley, Kuliouou, and Hawaii Kai. The study area encompasses the state's primary business/commercial and tourist centers, in addition to some of its largest and most affluent residential communities.

The shoreline from the Reef Runway to Diamond Head is known as East Mamala Bay and is primarily artificial, the result of extensive dredging of reef areas, the construction of artificial structures, and the filling of former mudflats, fishponds, and shallow reefs. The shoreline from Diamond Head to Koko Head is known as Maunalua Bay and has also been considerably altered by artificial structures, primarily seawalls bordering residential properties. In spite of the proliferation of artificial structures, the shoreline of the study area still provides many opportunities for ocean recreation, including swimming, surfing and canoeing at world-famous Waikiki Beach.

2.1 General Character of Sub-area 1: Reef Runway to Kewalo Basin.

The shoreline from the Reef Runway to Kewalo Basin fronts Downtown Honolulu, the commercial/industrial center of the state. It includes the Reef Runway, an airport runway on a low-lying, man-made island on the shallow reef offshore Honolulu International Airport, and Honolulu Harbor, the largest deep-draft harbor in Hawaii. Use of this sub-area is dominated by commercial maritime activities concentrated on 60 piers in the harbor. The Final Report of the Honolulu Waterfront Master Plan provides a comprehensive inventory of the businesses and activities that occur here.

In addition to the Reef Runway, Sand Island is another of the prominent artificial geographical features in this sub-area. It is a low-lying, man-made island that was built on the shallow reef between Honolulu Harbor and the open ocean. The island was designed to protect the harbor from adverse ocean conditions and was created over a number of years by the deposition of spoil material from harbor dredging operations. Today, it is 505 acres in size and includes, among other facilities, the Sand Island Wastewater Treatment Plant. The treated effluent from the plant is discharged through an ocean outfall which terminates two miles offshore at a depth of 240 feet.

The nearshore waters of the sub-area once contained some of the most extensive and biologically productive reefs in Hawaii, but little remains of these reefs today. They were covered by major landfills such as the Honolulu International Airport, the Reef Runway, Sand Island, the harbor piers and lower Kakaako. The former reefs were also dredged extensively to create the harbor basin, the harbor entrance channels, and the seaplane runways in Keehi Lagoon. Remnants of these reefs front the Reef Runway, Sand Island and Kakaako Waterfront State Park and are still popular fishing sites. A small artificial reef, the Look Laboratory Artificial Research Reef, is located at an undisclosed site offshore the laboratory in the lower Kakaako area.

This sub-area is subject to intensive commercial and industrial use, but is also well-used by the public. It includes three public beach parks: Keehi Lagoon Beach Park, Sand Island State Park, and Kakaako Waterfront State Park, and two residential areas: Keehi Lagoon Boat Harbor where some boat owners live aboard their vessels and a small fishing community on Mokauea Island, an island in the lagoon. Keehi Lagoon Boat Harbor also includes public boat launching ramps which are heavily used by trailered boat owners accessing the lagoon and the waters offshore. In summary, this sub-area harbors an intense, dynamic mixture of commercial, industrial, residential and recreational uses.

2.2 General Character of Sub-area 2: Kewalo Basin to Diamond Head.

The shoreline from Kewalo Basin to Diamond Head fronts Waikiki, the state's major tourist destination. It includes Kewalo Basin, a boat harbor that houses a commercial fishing fleet and a fleet of cruise, excursion and deep sea charter fishing boats that service Oahu's visitor industry; and the Ala Wai Boat Harbor, the only harbor located within Waikiki.

The nearshore waters of the sub-area are characterized by shallow fringing reefs on either side of Waikiki Beach. At the center of the beach offshore the Royal Hawaiian, the Outrigger Waikiki and the Moana-Surfrider Hotels the shoreline is recessed and forms a bay. The bottom of the bay consists of small patch reefs that are not as extensive or well-developed as those at its margins and large pockets of sand. This combination of smaller reefs at greater depths and large volumes of sand makes the center of Waikiki Beach one of the best swimming areas on the south shore. It also provides excellent surfing opportunities for novices and the best canoe surfing site in the state.

Waikiki encompasses approximately three square miles of high- density development. It is bounded by the Ala Wai Canal to the north and west, Diamond Head to the east, and the Pacific Ocean to the south. Waikiki Beach, two miles of artificial beach and imported sands, fronts the entire resort community. Alterations to Waikiki's shoreline date back to the early 1900s when attempts were made to control beach erosion. Remedial measures over the years have included construction of a variety of seawalls and groins, but the net effect has been negligible. Erosion is still a problem.

Two of Honolulu's largest and most important urban beach parks, Ala Moana Beach Park and Kapiolani Regional Park, are located within this sub-area. They are very popular and heavily used by local residents for a wide variety of recreational activities and sporting events. Other smaller beach parks include Kewalo Basin State Park, Duke Paoa Kahanamoku Beach Park, Kuhio Beach Park, Makalei Beach Park, Leahi Beach Park, Diamond Head Beach Park, and Kuilei Cliffs Beach Park.

Ala Moana Beach, Waikiki Beach, Kapiolani Regional Park and Diamond Head Beach are four of Hawaii's focal points for ocean recreation sporting events. These sites offer good venues for competition in a variety of ocean sports because they are in the lee of the island where the ocean is comparatively calm; they are in close proximity to the island's major residential communities; and they are part of or close to Waikiki's resources and its ready-made spectators. Examples of large ocean sports events include the Waikiki Roughwater Swim, the Local Motion Surf Into Summer surfing contest, and the Walter MacFarlane Outrigger Canoe Regatta.

At the east end of Waikiki the State has established the Diamond Head Special Management Area. It is unique in Hawaii among resource management areas. Known as a kipuku, it is alternately opened and closed for fishing every two years. Also offshore the east end of Waikiki is the Atlantis Artificial Reef. It is the primary dive site for Atlantis Submarines Inc., a tour company that operates privately-owned submersibles as a public attraction. The submersibles or submarines are self-powered, highly maneuverable, vessels that provide close up viewing of reefs and marine life for large numbers of passengers.

2.3 General Character of Sub-area 3: Diamond Head to Koko Head.

The shoreline from Diamond Head to Koko Head is known as Maunalua Bay and is bordered by six residential communities: Kahala, Waialae, Aina Haina, Niu, Kuliouou, and Hawaii Kai. This reach of shoreline has been almost completely altered by the construction of seawalls fronting the beach homes and by the construction of landfills. Two of the less conspicuous landfills are Wailupe Peninsula and Niu Peninsula, both of which were formerly Hawaiian fishponds. A more conspicuous landfill is Maunalua Bay Beach Park which was created from the dredged spoil material from Koko Marina.

The long, narrow beaches along this reach are typical of protected Hawaiian coasts and are among the narrowest beaches in the islands. In many places they are completely submerged at high tide. Gravel and coral rubble are often mixed with the sand, and sections of certain beaches consist almost entirely of detrital material that has been transported to the shoreline by streams. Both stream and ocean currents also carry this detrital material beyond the beaches and create mudflats on the reefs nearby.

The nearshore waters of the sub-area are characterized by wide, shallow and flat fringing reefs. The reef offshore Maunalua Bay Beach Park is considered to be one of Hawaii's shallowest reefs. Both natural and artificial channels cut through the reefs. The natural channels are primarily the result of fresh water stream runoff inhibiting coral growth and eroding the reefs, while the artificial channels are the result of dredging. Some of these channels are used by boating traffic such as those at Wailupe and Hawaii Kai and all of them are bordered by surfing sites. The fringing reefs are used by a variety of fishermen and gatherers.

Hawaii's first artificial reef, the Maunalua Bay Artificial Reef, was constructed offshore the Kahala Hilton Hotel in 1961. It consisted of car bodies and sections of concrete pipe. Little remains of the reef today after years of decomposition and battering by high surf and severe storms such as Hurricane Iwa.

3.0 Specific Character of the Study Area

This section identifies the individual ocean activities that occur in the study area. The activities are listed alphabetically in each sub-area under the following general categories: beachcombing, canoe paddling (including kayaking), fishing, jet skiing, parasailing, scuba diving, sailing, surfing, swimming, tidepooling, waterskiing and windsurfing.

3.1 Specific Character of Sub-area 1: Reef Runway to Kewalo Basin.

Canoe Paddling. Outrigger canoe paddling is Hawaii's official ocean team sport, and annually attracts approximately 10,000 participants state-wide. The short course regatta season begins in the spring and ends with the state championships in August. Then the long distance racing season begins and ends with the Molokai-to-Oahu race in October. While none of Oahu's canoe clubs train in the sub-area, Keehi Lagoon Park is one of the premier racing sites on the island. The 72-acre park has a Canoe Facility (a viewing and judging stand) and a small artificial beach for launching and landing canoes during regattas.

Fishing. Many of the fishing activities in the sub-area take place from boats. The boats are launched either from Keehi Lagoon Boat Harbor or from the Ala Wai Boat Harbor. One group of commercial akule fishermen comes from as far away as Hawaii Kai. Very little fishing traffic originates to the west of the sub-area, even though the Air Force maintains a boat ramp and a marina at Hickam Harbor, adjacent to the west end of the Reef Runway.

Approximately five groups of commercial net fishermen regularly fish the waters offshore the sub-area. Using large fence and bag nets they are usually after schooling fish such as akule, weke, and taape. They fish from Barber's Point to Makapuu Point, depending on the weather and surf conditions and where they fished last. In addition to the commercial net fishermen, other smaller groups of subsistence fence and bag net fishermen also visit the sub-area.

Approximately five groups of subsistence gill (moemoe) net fishermen regularly fish along Kalihi Channel and the perimeter of the Reef Runway. They usually set their nets in the early evening and pick them up after dark. In addition to the larger groups of gill net fishermen, other smaller groups of subsistence gill net fishermen also visit the sub-area.

Some of the commercial and subsistence fishermen set fish traps in the offshore waters. One of the more productive areas is around the mouth of the outfall, Kukae Springs as one fisherman identified it, and all fishermen seem to have some reservations about personally eating the fish caught at this site.

Spear and thrownet fishing by both commercial and subsistence fishermen occurs primarily in the nearshore waters at the Reef Runway, Sand Island State Park and Kakaako Waterfront Park. Some of the fish commonly caught are kole, manini, aholehole, uouo and mullet. There is some concern about ciguatera poisoning in the reef fish from offshore the Reef Runway. Although the actual incidents of poisoning have been primarily to the west in Waianae, several commercial fishermen noted that some fish markets will not buy certain fish caught between Waianae and the Reef Runway.

A small fishpond is located on Mokauea Island. The fish in the pond are harvested by the island's residents.

The ocean bottom beyond the reefs in the entire study area is generally regarded as marginally productive for reef fish. With few exceptions the bottom is typically a featureless, limestone plain that offers little relief and therefore shelter for large numbers of reef fish. While these areas do not attract most varieties of fish, they often provide good habitat for octopus or "squid" as most local fishermen call them. Squidding occurs offshore Sand Island State Park, along the edges of the main harbor channel, and offshore Kakaako Waterfront Park to depths of 100'.

Crab netting takes place within Keehi Lagoon and Honolulu Harbor near the rivermouths and bridges for bottom dwelling crabs such as Samoan crabs. The Reef Runway is noted for its large populations of aama crabs, a popular luau dish.

Seaweed gathering primarily for manauea, or ogo, occurs at Sand Island State Park, but these grounds are considered to be almost completely depleted. Some opihi picking occurs on the outer perimeter of the Reef Runway, but these grounds are also considered to be almost completely depleted.

Pole fishing takes place along almost the entire shoreline of the sub-area. Popular sites include the Reef Runway (where fishermen park at the end of Lagoon Drive and bicycle around the extensive perimeter of the runway to reach their favorite sites), Sand Island State Park, several piers within Honolulu Harbor such as Piers 1 and 2, and Kakaako Waterfront Park. At certain times of the year schooling fish such as halalu, or juvenile akule, aggregate in Honolulu Harbor, attracting large numbers of pole fishermen to the harbor shoreline.

Aquarium fish collecting takes place offshore Kakaako Waterfront Park. The Look Laboratory Artificial Research Reef is also located in this area.

Jetskiing. At least one commercial jetskiing rental operation uses Keehi Lagoon. Their base of operations is concentrated on several of the small tidal islands on the west side of Kalihi Channel. Customers are transferred to and from the islands by boat from Keehi Lagoon Boat Harbor.

Scuba Diving. One dive site used by commercial tour operations is located offshore the Reef Runway. It is known as Reef Runway and is regarded as a secondary site.

Surfing. At least six surfing sites are located within the sub-area (Appendix A). The most popular are the two sites offshore Sand Island State Park. They are used primarily by surfers from the Kalihi/Kapalama/Salt Lake areas.

Surfers are banned by a State Department of Transportation ordinance from Point Panic, a surfing site used primarily by bodysurfers. The ordinance, however, does not exclude bodyboards, so bodyboard riders are also found at Point Panic. The Honolulu Bodysurfing Club (HBC), the unofficial caretaker of Point Panic, is in the process of trying to have the site designated exclusively for bodysurfing. HBC conducts an annual bodysurfing contest at Point Panic, the Hawaiian Bodysurfing Championships.

Bodyboarders also ride the other breaks in the sub-area, especially those at Sand Island State Park. Bodysurfers are found only at Point Panic.

Swimming. The limited recreational swimming that occurs in this sub-area is confined primarily to the beach at Sand Island State Park. The State recently announced plans to build a second beach, Kakaako Beach, at the west end of Kakaako Waterfront State Park. Their plan is to extend the park seaward along the main entrance channel to the harbor and construct a beach on the Waikiki side of the extension. The beach is intended to serve Downtown residents as well as other city residents.

Waterskiing. Hawaiian waters offer very few opportunities for waterskiing. Two of the primary sites on Oahu are Hickam Harbor, adjacent to the Reef Runway, and Keehi Lagoon, inshore of the Reef Runway. The Keehi site utilizes the former World War II seaplane runways and is probably the most intensively used waterskiing site in the State. Waterskiing competitions are held here by the Oahu Waterskiing Association.

Marine Education and Training Center. The University of Hawaii in conjunction with the State Department of Business, Economic Development and Tourism (DBED&T) is developing a marine education and ocean recreation center on an 8 acre parcel at the northwest corner of Sand Island. Instructors from the Heminway Leisure Center at U.H.-Manoa began teaching a variety of ocean recreation sports in the summer of 1989. Working out of a temporary office and storage shed, they give lessons in kayaking, sailing (on Sunfish and Lasers) and windsurfing, to 600 students and non-students a year. Classes are held on weekends during the fall and spring semesters and on weekdays during the summer. During the summer months they do not offer lessons on the weekends because of the extensive waterskiing traffic in the same area.

The Marine Education uses the channel fronting the Sand Island Sewage Treatment Plant as their primary site for instruction. Instructors report that the relocation of the boats that formerly moored in the channel has created one of the best protected sailing areas on Oahu's south shore. The instructors report that they do not kayak or sail close to the east end of the channel because of strong odors from the plant, but have not have any other problems such as infections that might be associated with plant.

3.2 Specific Character of Sub-area 2: Kewalo Basin to Diamond Head.

Beachcombing. The prevailing winds and nearshore currents in the study area do not deposit debris on the beaches as they do on Windward beaches, so there are few opportunities for traditional beachcombing. However, a variation of beachcombing, treasure hunting, is practiced by a number of individuals. Treasure hunters usually arm themselves with a waterproof metal detector and comb the beaches and wading areas at Ala Moana Beach Park and in Waikiki. They hunt for lost coins, rings and watches. Beach boys and others in Waikiki also snorkel in the nearshore waters in Waikiki looking for treasure. They snorkel where people swim and in the impact zone at Canoes surf in Waikiki where tourists are taken for surfing lessons.

Canoe Paddling. Outrigger canoe clubs train in at least three sites, all of which are located on the Ala Wai Canal: Magic Island at the mouth of the canal, Ala Wai Field midway along the canal, and Ala Wai Golf Course at the head of the canal. The Ala Wai Canal is one of the few inland bodies of water on Oahu that is large and calm enough to accommodate large numbers of outrigger canoes. The canal is, therefore, highly regarded as a training site.

Outrigger canoe paddling and kayaking also take place outside of the canal. Both canoes and kayaks transit the offshore waters beyond the reefs.

Fishing. Some commercial net fishing takes place, but the Waikiki area is not highly regarded as a productive fishing grounds. The protected special management, or kipuku, area between Diamond Head lighthouse and the Natatorium effectively increases fish populations during the two years it is closed to fishing, but as soon as it is opened, net fishermen immediately deplete the schools.

Subsistence gill (moemoe) net fishermen set their nets from Diamond Head to Black Point. Thrownet fishermen are also found in this area, especially during mullet season.

Some of the commercial and subsistence fishermen set fish traps in the offshore waters.

Spear fishing by subsistence fishermen occurs primarily in and around the reefs throughout the entire sub-area.
Squidding occurs along the edges of Kewalo Channel, offshore Waikiki out to the 100' Hole, offshore Black Point out to the 120' Drop Off, and in the nearshore waters at Diamond Head and Kaalawai.

Crab netting takes place primarily within the Ala Wai Canal.

Seaweed gathering primarily for manauea, or ogo, occurs in Waikiki near Fort DeRussy and at Kaalawai for manuea and waewaeiole, but these grounds are considered to be almost completely depleted.

Pole fishing, primarily spinning for papio, takes place along almost the entire shoreline of the sub-area. Black Point is a traditional site for ulua fishing.

Parasailing. At least two commercial parasailing businesses conduct their operations offshore Waikiki and Ala Moana.

Sailing. Sailing is not normally regarded as an in-water sport, but members of both the Hawaii Yacht Club and the Waikiki Yacht Club sail small, low craft such as Sunfish that expose them to direct contact with the ocean.

Scuba Diving. Three dive sites used by commercial tour operations are located offshore: Rainbow Reef, Magic Island, and Diamond Head Marker. Rainbow Reef and Diamond Head Marker are regarded as a secondary sites, but Magic Island is a primary site and one of the most important dives sites in the study area.

Commercial dive tour operations offer shore and boat dives. From the standpoint of time, convenience and low capital expenditures, shore dives are more favorable. Only a van is needed to reach the dive site. Magic Island is shore dive site located in a public beach park with ample parking and facilities. The edge of the boat channel at the dive site offers immediate access to a moderately deep (30-50') dive. The site is diveable most of the year while other popular north and west shore dive sites are closed to diving during the winter high surf season. These factors, combined with Magic Island's proximity to Waikiki and the visitor population, make it a popular dive site.

Submersibles. Atlantis Submarines Inc. provides an alternate diving experience for non-scuba divers and anyone else interested in a submarine ride. A shuttle boat at the Hilton Hawaiian Village (HHV) pier takes passengers to the dive site, an artificial reef located approximately one mile offshore the Natatorium. There the passengers board the submarine for their tour. Upon completion of the tour, passengers disembark the submarine and are returned to the HHV pier.

Surfing. At least 54 surfing sites are located within the sub-area (Appendix A), the highest concentration of surfing sites of any section of shoreline in the state. During periods of high surf, primarily during the summer months, the large number of surfing sites means a large number of surfers in the water. Most surfing sites average 15-20 surfers per site, but on days when the waves are good, the more popular sites average 40-50 surfers per site. On days when the waves are excellent, the most popular sites such as Canoes in Waikiki and Diamond Head may average 100 surfers per site. On a Saturday or Sunday of good summer surf, using 20 surfers per site as a conservative average, there are more than 1000 surfers in the waters between Kewalo Basin and Black Point.

Canoes is the name of the primary surfing break in Waikiki. It is an important site to the visitor industry because it is an excellent beginner's break that almost always has surf. For this reason Waikiki is the most concentrated area in the State for surfing lessons and other beach concession activities. The waves at Canoes, as its name implies, are also ideal for outrigger canoe surfing. The Waikiki beach concessions are the only ones in the state (and probably the only ones in the world) that offer canoe surfing on a daily basis.

Bodyboarders ride many of the breaks in the sub-area, especially those offshore Ala Moana Beach Park, the east end of Waikiki and Diamond Head. Bodysurfers and paipo board riders are found at The Wall and at Cunhas in Waikiki. Surf ski riders are found at Tonggs, Old Mans and other similar breaks with gentler waves. On a good day of summer surf, if all the participants in all wave-riding sports are counted, there are probably at least 1200 people in the surf between Kewalo Basin and Black Point.

Surfing and bodyboarding competitions are held at Ala Moana Beach Park, Waikiki and Diamond Head. These are popular events that may attract hundreds of competitors such as Local Motion's Surf into Summer held at Queens in Waikiki.

Swimming. This sub-area has one of the highest concentrations of recreational swimmers of any section of shoreline in the state. It does not have the best beaches, but it has two of Honolulu's largest urban beach parks, Ala Moana and Kapiolani, and has good proximity to the resident population of Honolulu and the visitor population of Waikiki. These factors all contribute to very high counts of swimmers.

In addition to the recreational swimmers, this sub-area has the highest concentration of ocean fitness swimmers of any section of shoreline in the state. The fitness swimmers usually train in two areas. The first is the long, straight swimming area at Ala Moana Beach Park. A former boat channel, it is a measured 1000 meter swim course that is heavily used by fitness swimmers. It is also used for competitive ocean swims and serves as the swim portion of several biathlons and triathlons.

The second training area for fitness swimmers is Kaimana Beach where a large channel through the reef leads to the open ocean. Kaimana Beach is the start of Hawaii's largest ocean swim competition, the Waikiki Roughwater Swim, which annually attracts approximately 1000 swimmers. The swim ends a little over two miles away at the Hilton Hawaiian Village. The race course of the Waikiki Roughwater Swim is an unmarked but well used corridor for ocean swimmers.

Tidepooling. At least three important tidepooling sites are used by organized groups to examine marine life and study marine phenomena. These sites are the shallow reefs fronting Kewalo Basin State Park, the Waikiki Aquarium and Diamond Head Lighthouse.

Windsurfing. Diamond Head is one of the major windsurfing sites on Oahu. The combination of the trade winds wrapping around Diamond Head and the surf offshore make a very popular wave-jumping and wave-riding site. The surfing breaks at Diamond Head that windsurfers use are Cliffs, fronting the center lookout, and Mansions and Browns between Cliffs and Black Point. Windsurfing competitions are also held here. During periods of strong west winds some windsurfers sail and surf at Number Threes and Number Fours, two surfing breaks fronting Fort DeRussy in Waikiki. Due to vessel restrictions within Waikiki's shorewaters, windsurfers are not supposed to sail in the areas between the beach and the offshore reef.

3.3 Specific Character of Sub-area 3: Diamond Head to Koko Head.

Canoe Paddling. Outrigger canoe clubs train in one site at the west end of Maunalua Bay Beach Park in Hawaii Kai. They paddle in the boat channel that parallels the park.

Kayakers often transit the offshore waters for training and competition. Koko Marina is the finish of the annual Molokai to Oahu kayak race.

Fishing. Some commercial net fishing takes place, but Maunalua Bay is not highly regarded as a productive fishing grounds.

Subsistence gill (moemoe) net fishermen set their nets from Black Point to Portlock Point. Thrownet fishermen are also found in this area, especially during mullet season. Some torch fishing occurs along this reach, especially on the shallow reefs near Aina Haina and Paiko.

Some of the commercial and subsistence fishermen set fish traps in the offshore waters.

Spear fishing by subsistence fishermen occurs primarily at the outer edges of the reefs. Most of the nearshore areas are shallow and unproductive.

Squidding occurs extensively from boats in an area most fishermen know as Hawaii Kai. The grounds extend from offshore Hawaii Kai to Wailupe, but are accessed from the Hawaii Kai ramps which gives the area it name. With few exceptions the bottom is typically a featureless plain that offers little relief and shelter for reef fish, but is extremely attractive to octopus. For many years this site has been considered to be one of the most productive squid grounds on Oahu, although some fishermen now feel that the resource has been considerably depleted.

Crab netting takes place along some of the reef channels.

Some seaweed gathering occurs in Kahala for manuea and waewaeiole, but these grounds are considered to be almost completely depleted.

Pole fishing, primarily spinning for papio, takes place along almost the entire shoreline of the sub-area. Portlock Point is a traditional shore casting site for ulua fishing.

Jetskiing. At least one commercial jetskiing business conducts their operations offshore Maunalua Bay Beach Park in Hawaii Kai.

Paddleboarding. Paddleboard racing is an activity that is practiced by a small but dedicated group of ocean recreation enthusiasts. A number of competitions are held around the island each year, several of which finish at Waialae Beach Park in Kahala.

Parasailing. At least one commercial parasailing business conducts their operations offshore Hawaii Kai.

Scuba Diving. Five dive sites used by commercial tour operations are located in Maunalua Bay: Fantasy Reef, Kahala Barge, Big Eel Reef, Turtle Canyon and Portlock Point.

Surfing. At least 33 surfing sites are located at the edges of the reefs and channels in Maunalua Bay (Appendix A). These sites are not as highly regarded for quality waves as the sites in Ala Moana and Waikiki, but have become popular within the last ten years with the increases in the surfing and bodyboarding populations.

Bodyboarders ride many of the breaks in the sub-area.

Swimming. Recreational swimming in this sub-area is limited primarily to small sand pockets at Kahala Beach and to the Kahala Hilton Hotel where an artificial beach was dredged out of the former rocky shoreline. The shoreline between the hotel and Portlock Point consists of shallow reefs and mudflats and is not appealing to most swimmers.

Portlock Point is a popular swimming site during periods of low surf. Swimmers jump off the rocky ledges into deep water at the outer edge of the point.

Windsurfing. At least two popular windsurfing sites are located in Maunalua Bay: Kahala, offshore Waialae Beach Park, and Toes, offshore Kawaikui Beach Park in Aina Haina. Some beginning windsurfing occurs at high tide at Mudflats offshore Maunalua Bay Beach Park.

4.0 Ocean Activity Trends

The user populations in almost all ocean activities have increased substantially in the last ten years, especially in bodyboarding, surfing and windsurfing. The increases have been due to a number of factors including general population growth, an increase in popularity of ocean activities among Hawaii's youth, new and improved ocean activities equipment and a greater emphasis on the visitor industry by ocean recreation businesses. The result has been severe competition for the same resources by different user groups, including consumptive and non-consumptive users and commercial and non-commercial users. Probably the best example is the nearshore waters of Waikiki where just about every form of ocean activity takes place or would take place if it was permitted.

The end result of heavy and conflicting demands on finite resources is governmental regulation, usually in the form of restrictions. The shorewaters of Waikiki are controlled by state Department of Transportation regulations that dictate very specifically who can do what where. The same types of regulations have been applied to Maunalua Bay offshore Hawaii Kai.

Heavy demands on finite resources have also taken the form of resource depletion. A common complaint heard in the study area and around Oahu is that consumptive resources such as fish, shellfish and seaweed are substantially depleted, if not completely exhausted. The end result of these pressures has been the establishment of protected areas such as the Diamond Head Special Management Area and Marine Life Conservation Districts (MLCDs) such as Hanauma Bay, adjacent to the east end of the study area.

Another restrictive trend is the attempt by various groups to establish more MLCDs. Some of this movement has been due to concerns about resource depletion, but much of it has been due to pressure from commercial snorkeling and scuba operations. These businesses have dive spots that they frequent regularly and it is their best interest to insure that substantial marine life populations are available for viewing at these sites. Many of these operations feed the fish which conditions them to remain at the sites in large numbers. At the same time, however, these sites are subject to fishing pressures from the general public. In an effort to protect these areas, dive operations and sympathetic snorklers and divers recommend that consumptive activities be permantly banned. The Atlantis Artificial Reef is one example. The recent proposal by Representative Duke Bainum of Waikiki to convert all of the nearshore waters of Waikiki into an MLCD is another.

By 1986 the situation had escalated to the point that the 13th State Legislature passed a resolution requesting the Department of Transportation to formulate a recreational motorcraft management plan to reduce conflicts between motorcraft and other recreational users. In carrying out this resolution, the Director of the Department of Transportation directed that all potentially conflicting forms of ocean recreation and ocean use should be included within the scope of the managment plan. In 1988 a final report was completed and titled "A Statewide Ocean Recreation Management Plan." The plan is a good example of the restrictive trends that are occurring in Hawaii.

One of the problems that needs to be addressed in restricting activities is the issue of consumptive versus non-consumptive activities. Another problem is the issue of resident activities, including native Hawaiian rights, such as fishing rights, versus visitor activities. Tourist ocean recreation directly impacts resident ocean recreation. Many of the ocean recreation activity sites are the same for both. In extreme situations residents may eventually be pressured out of an area by overwhelming populations of visitors. Hanauma Bay is a good example.

As the state becomes increasingly dependent on tourism as its major industry, these types of pressures on the marine environment will continue to escalate, and more pressure will mean more regulation for everyone, resident and visitor alike.

5.0 Potential Impacts of a Release on Shoreline Activities

The Sand Island Sewage Treatment Plant and its wastewater collection system service almost the entire city of Honolulu. This extensive system borders approximately 25 miles of shoreline while the plant itself is located at the shoreline where it discharges its effluent at sea. Although the potential for a release is slight, there is always the possibility that one might occur through human error or through a structural or equipment failure and that the release might find its way into the nearshore waters of the study area.

The impacts that would occur from a release are construction, operational and cumulative impacts.

- Construction impacts occur at the time any particular component of the system is actually built. They are temporary by nature and include potential releases to the environment that include land, surface water, groundwater and air, as well as the disruption of traffic patterns and other human activities.

- Operational impacts result from the actual use of the system components as well as the use of specific products the system may create. For example, a composting product might be created from wastewater sludge and used as a soil enhancer. Operational impacts are long-term by nature and include potential releases to the environment that might affect land, surface water, ground water and air. They may directly or indirectly affect the general public's health and well-being.

- Cumulative impacts result when the system is operational and the effects of its construction, operation and by-products are combined with pre-existing environmental, social or economic conditions. These impacts may be either short- or long-term by nature. They include construction and operation costs as well as secondary effects and indirect effects.

Secondary effects would include the impact of a major sewage spill on the state's economy. Appendix B offers a discussion of the potential economic impacts of a major release on the ocean recreation industry in the study area.

Indirect effects might include the defamation of Hawaii's international reputation as a visitor destination with an environmentally pristine ocean.

5.1 Impacts on Specific Shoreline Activities

A major sewage release into the study area would degrade the attractiveness and the health of the nearshore waters. The impacts from both of these forms of degredation on some of the Hawaii's most important ocean recreation sites and on its most important tourist destination would be serious and far-reaching. The visual impact of the waters of Waikiki being innundated with effluent would have widespread consequences not only to the activities occurring there, but also to the visitor industry at large. If the release consisted of untreated sewage and added a health risk to the water, the impacts on the shoreline activities and the visitor industry would be considerably increased.

The impacts of a release on shoreline activities would vary depending on the specific activity and on the specific hazards of the release. The activities identified in this study are in-water activities that require the participants to get wet to some degree and the degree of immersion would largely determine the impact on the activity and whether the activity could continue in the affected area. Canoe paddling, kayaking and jet skiing can be practiced in polluted waters, but swimming, surfing, scuba diving and other sports in which the body's orifices are constantly in or exposed to the water should not be practiced in polluted waters. If the release posed an extremely high health risk, then all in-water activities would be prohibited.

5.2 Impacts on Specific Shoreline Sites

Some activities could be suspended temporarily or relocated to other sites. More than 90 surfing sites were identified in the study area, so displaced surfers could temporarily relocate to alternate sites. Some surfing sites, however, have no alternates. The surfing site called Canoes in Waikiki, for example, is the primary site in the state for novice surfing lessons and commercial outrigger canoe rides. There is no other site that can substitute for it, especially in proximity to Waikiki. The Ala Wai Canal is one of the major calm water practice sites on Oahu for outrigger canoe racing. Although the its waters are of marginal water quality, the canal is heavily used by many canoe clubs. If a release prohibited use of the canal, most of the canoe clubs that use it would be without a practice site. Other sites in the study area that would be considered irreplaceable are Keehi Lagoon for waterskiing, Point Panic for bodysurfing, Magic Island for scuba diving, Diamond Head for windsurfing, and Ala Moana, Waikiki and Kaimana Beaches for swimming.

Of all the three sub-areas in the study, Sub-area 2: Kewalo Basin to Diamond Head would suffer the greatest impact from a major release, and within the sub-area Waikiki would be the one site that would be of the most concern. The Waikiki shoreline supports one of the highest concentrations of beach goers in Hawaii and is a focal point for many shoreline activities and the sporting events associated with those activities. It is also the single most important visitor destination in the state. Waikiki and other areas could survive temporary suspensions of their shoreline activities, but could not tolerate long-term suspensions or continued deterioration of the natural resources.

One of the secondary impacts of a high risk release would be an intensification of the competition for existing shoreline activity sites. If a release reduces the number of available sites for an activity, but the population of users in the activity remains the same, more users will be concentrated in fewer sites. This type of secondary impact may in turn accelerate resource depletion in new areas. A good example of this occurred on the Big Island when the lava flow that overran Kalapana destroyed a surfing site called Drainpipes. The Big Island has very few surfing sites, especially on the east side of the island where Drainpipes was the only major site. Surfers on the west side now report that the east side surfers are crowding into their surfing sites. An example on Oahu occurred when commercial scuba tours were prohibited from operating at Hanauma Bay. The tour operators moved their operations several miles down the road to Makai Pier fronting Sea Life Park, heavily impacting an area that was formerly little-used.

5.3 Projected Impacts after Improvements to the System

The sites where shoreline and nearshore recreational activities take place are parks in the ocean. These sites obviously do not have any facilities, but they are just as identifiable to their users as any park on land. They are permanent sites with identifiable dimensions; they contain specific natural resources that make certain activities possible; and they have great recreational value. The surfing site Tennis Courts is as important a park to surfers as Ala Moana Beach Park inshore of it is to its myriad users. As Oahu's resident and visitor populations continue to increase, the demand for all types of recreation will increase with them. User populations vying for terrestrial and ocean parks will increase commensurately.

Historically, increased demands for land-based recreational resources have lead to stricter park regulations and permitting systems and/or the development of new parks, while increased demands for ocean recreation resources have been largely ignored and the users left to themselves. Ocean recreation sites center on specific natural features that make the recreation activity possible, so these sites can not be expanded to accommodate growing user populations. Although surfers, windsurfers and bodyboarders all compete for the same waves at Diamond Head, there is no way to improve the reef to create more waves and space for all of them.

As serious conflicts between user groups have developed and continued, government has intervened, but user populations in the ocean still continue to grow. Impacts from sewage releases in the future will, therefore, have greater consequences because they will be impacting greater numbers of people.

APPENDIX A

BEACH PARKS

1 Keehi Lagoon Park
2 Sand Island State Park
3 Kakaako Waterfront State Park
4 Kewalo Basin State Park
5 Ala Moana Beach Park
6 Duke Paoa Kahanamoku Beach Park
7 Kuhio Beach Park
8 Kapiolani Regional Park
9 Makalei Beach Park
10 Leahi Beach Park
11 Diamond Head Beach Park
12 Kuilei Cliffs Beach Park
13 Waialae Beach Park
14 Wailupe Beach Park
15 Kawaikui Beach Park
16 Kuliouou Beach Park
17 Maunalua Bay Beach Park

DIVE SITES

1 Reef Runway
2 Rainbow Reef
3 Magic Island
4 Diamond Head Marker
5 Fantasy Reef
6 Kahala Barge
7 Big Eel Reef
8 Turtle Canyon
9 Portlock Point

SURFING SITES

Sub-area 1

1 Reef Runway
2 Paradise
3 Sand Island #1
4 Sand Island #2
5 Flies
6 Point Panic

Sub-area 2

7 Kewalos
8 In Betweens
9 Shallows
10 Big Rights
11 Concessions
12 First Hole
13 Second Hole
14 Tennis Courts
15 Big Lefts
16 Baby Haleiwas
17 Bombora

18 Americas
19 Magic Island
20 Ala Moana Bowl
21 Rock Pile Lefts
22 Rock Pile
23 In Betweens
24 Kaisers
25 Number Fours
26 Number Threes
27 Paradise
28 Populars
29 First Break
30 Canoes
31 Malihinis
32 Queens
33 Baby Queens
34 Steamer Lane
35 Cunhas
36 Baby Cunhas
37 The Wall
38 Publics
39 Castles
40 Publics Rights
41 Natatoriums
42 Lifeguards
43 Old Mans
44 Ricebowl
45 Tonggs
46 The Winch
47 Graveyards
48 Suicides
49 Sleepy Hollow
50 Doubles
51 Lighthouse
52 Rights
53 Cliffs
54 Cyclones
55 Mansions
56 Browns
57 Mahoneys
58 Pattersons
59 The Harbor
60 Kaikoos
61 Black Point
62 Kellogs
63 Razors
64 Kahala
65 Wailupe
66 Bones
67 Suicides
68 Wailupe Lefts
69 Ainas
70 Jockos
71 Ledges

72 Secrets
73 Signs
74 Baby Toes
75 Toes
76 Snipes
77 Blue Hole
78 Reverse
79 Paikos
80 Zeros
81 First House
82 Tunas
83 Manatans
84 Rocks
85 Turtles
86 Consistents
87 Sometimes
88 Channels
89 First Point
90 Fingers
91 China Walls
92 Poles
93 Second Reef

WINDSURFING SITES

1 Number Threes
2 Diamond Head
3 Mansions
4 Browns
5 Kahala
6 Toes
7 Mudflats

APPENDIX B

To: John Clark
From: Michael Markrich
Subject: Ocean Recreation Industry Expenditures

Abstract

The 25 miles of near shore waters between Hawaii Kai and Sand Island provide a venue for an ocean recreation industry valued annually at $52 million dollars in direct revenues by means of survey conducted by the Hawaii State Department of Business and Economic Development. This important sector of Hawaii's tourism industry is made up of competitive sailing events,tour boats, ocean swims and triathalons, snorkeling, scuba diving and canoe racing. These visitor expenditures are directly dependent on the clarity and healthfulness of near shore waters. Any event that harms the attractiveness and health of near-shore waters of East Honolulu threatens the future of the ocean recreation sector of the tourism industry.

Introduction

The ocean recreation industry involves state wide expenditures of more than $500 million dollars annually. It is a vital part of Hawaii's main industry of tourism. Survey information from the Hawaii Visitors Bureau indicates that ocean recreation in the form of sunbathing on a beach, swimming or interacting with the ocean is one of the most important incentives for visitors to come to Hawaii. It is the number one incentive for Westbound visitors from the Mainland.

For many years ocean recreation was limited to a few organized activities such as charterboat fishing, scuba diving, competitive sailing and traditional Hawaiian water sports such as ocean swims, canoe paddling and surfing. These organized activities were enjoyed by visitors but were highly labor intensive; for this reason ocean recreation and sports activities remained a small though often profitable component of the tourism industry. But as technology developed during the 80's means were found to involve visitors with an ocean experience on a large scale commercial basis directly with the ocean by means of such vehicles as commercial submarine rides, jet skis and kayaks. At the same time this change took place, traditional sports such as native Hawaiian canoe paddling grew and found the means to involve outsiders. In addition, sports such as competitive sailing and ocean swimming (as a part of triathalons) became commercialized and grew into large scale international competitive events.

As the ocean recreation industry grew in size it became increasingly vulnerable to changes in water quality. Since most tourism takes place on the island of Oahu, maintenance of water quality off is not only important to the future of the ocean recreation but to the long term well being of Hawaii tourism.

This report examines each sector of the ocean recreation industry within the 25 mile radius activity between Hawaii Kai and Sand Island and reports on the relative value of activities there. The information was gathered from a larger study commissioned by the Hawaii State Department of Business and Economic Development.

Direct & Indirect Revenue

Direct revenue involves all direct spending associated with a particular activity. Indirect revenue involves spending associated with visitors and external spending and is calculated by means of the United States Department of Commerce Entertainment Multiplier (.74)

Competitive Ocean Racing

Competitive Sailing in East Honolulu waters takes three forms: local yacht club races, large scale professional competitive race series based out of Honolulu such as the Kenwood Cup and lastly races in which East Honolulu is the destination such as the Transpac. Because the Transpac and the Kenwood Cup occur on alternate years an average was made of the total over a two year period: ($14,000,000) and applied to the estimate of competitive sailing for one year. This average which includes the relatively small amount spent on local sailing competition (approximately 80% of which takes place off Waikiki) is estimated at approximately $7 million dollars.

Indirect expenditures for Transpac were estimated to be $1,147, 961. The Transpac spending is based on the spending of 510 visiting crew members and approximately 300 family members and well wishers. Estimates for indirect expenditures for Kenwood Cup total $7,705,346. This number involves the spending of 35 boat owners, 420 crew members as well as an estimated 2,500 friends, spectators and participants. Total indirect expenditures based on the two estimates of indirect expenditures totaled $8,853,307. This amount divided by two is equal to $4,426, 653.

Tour Boats

Twenty-six vessels of the Oahu tour boat industry operate between Hawaii Kai and Sand Island. These vessels range from tourist catamarans moored off Waikiki to state-of-the art swathe vessels and submarines The vessels offer tourists dinner cruises as well as snorkeling, cocktail and sailing excursions: The total gross revenue was for 1990 $40,813,000. The vessels employ over 700 people. Since the clients are predominately visitors it can be estimated that indirect revenues can be calculated to be $40,813,000 (.74) or $30,201, 620.

Ocean Swims and Triathlons

In 1990 there were 13 ocean swims, biathlons triathlons that involved a group of 3,000 regular participants from Oahu as well as hundreds of international participants. These events both amateur and commercial ranged in size from the small scale events organized by the Outrigger Canoe Club to large international events such as the Waikiki Roughwater Swim. In addition there were several other significant large scale commercial run-bike and ocean swim triathlons events such as the Tinman and the Waterfront Triathlons. Smaller events that included an ocean swim component included the Magic Island Biathlon. Total direct revenues involving ocean swims in East Honolulu total $972,700 annually.

Hawaiian Canoe Racing

The Waikiki-Sand Island area is an extremely important center of outrigger canoe racing activity. Approximately 20 different clubs make use of the area for training for at least 210 days per year. Each day of training costs at least $40 for the four clubs that use outboard motors and launches in the area to facilitate training. (4x$40x210 = $33,600). All 20 clubs spend at least $2,000 annually for maintenance costs. ($2,000 x20= $40,000) (Estimate Walter Guild, Outrigger Canoe Coach, 1993),
Two important regattas are held in the area. The Waikiki Beach Boys Regatta sponsored by the Hui Wa'a Organization and Water McFarlane Regatta sponsored by the OHCRA. Each regatta involves expenditures estimated to be $60,000 annually in terms of organizational expenditures, and spending by spectators and participants. (2x$60,000= $120,000)

In addition to these races there are approximately 10 long distance races that are held in the area by OHCRA, Hui Wa'a, as well as high school and women's groups. It is estimated that each long -distance race involves expenditures of $3,000. This totals $30,000 (10 x $3,000).

The area is also the end point for two large Molokai Races; Bankoh Molokai Ho'e and Na Wahine O Ke Kai. These races involve total expenditures of $355,500 and $166,800 respectively. Although most of the funds are spent on Molokai for airfare, overnight expenditures and other costs, assuming that only 10% of all expenditures are spent Oahu for awards celebrations, participant expenses and club costs it can be estimated that East Oahu expenditures totaled at least $52,230 ($355,500 + $166,800= 522,300) x (.10) for the two races.
Total canoe racing expenditures for the area total the following ($33,600+ $40,000 + $120,000 + $30,000 + $52,230) = $275,830.

Indirect expenditures involve only those expenses in which visitors are involved. The Bankoh Moloka'i Hoe and the Na Wahine O Ke Kai involve 18 and 7 crews from out-of-state respectively. Expenditures for the out-of-state teams (of 12 people), and their supporters (estimated at one fourth of the total number) are estimated to be $207,000 for the Bankoh and $70,000 for Na Wahine O Ke Kai total $277,000. This number multiplied by the (.74) entertainment multiplier totals ($277,000) x (.74) causes indirect expenditures of $204,980.

Because most of the out-of-state teams stay in Waikiki hotels prior to the race it can be estimated that at least 50% of the indirect expenses are spent in the Waikiki area. This number totals $102,490.

Total direct and indirect expenditures for Outrigger Canoe Racing in the Waikiki area total $378,320 ($275,830+ $102,490).

Canoe Rides at Waikiki

Each day at Waikiki 6 canoes offer rides to visitors at a cost of $5 per person. With 5-9 people per canoe it was estimated by the Beach Services at the Outrigger Hotel that an average of 50 people went out canoe surfing every good day when there were waves. Assuming there are waves 250 days per year it can be estimated that 12,500 ride canoes every year-yielding gross revenues of $62,500.

Indirect revenues ($62,500 x .74) total $46,250.

Scuba Diving

The scuba diving industry is a popular sport among both visitors and residents. Many of the important scuba diving sites are included in the waters from Magic Island to Hawaii Kai. Assuming that at least half (Estimate by Ray Tabata, University of Hawaii Sea Grant College Program leader of a Hawaii State Scuba Diving Survey 1986) of the commercial scuba diving activity takes place in the 25 miles between Sand Island and Hawaii Kai, it can be estimated that total commercial scuba diving activities in this sector equal $4, 062,500. Since 90% of this activity involves visitors , the indirect expenditures total $3,006,250 ($4,062,500 x (.74).

Surfing and Windsurfing Activity

Surfing and Windsurfing activity along the waters of East Honolulu involve large amounts of recreational surfing, surf lessons by professional beach boys and a few semi-professional and amateur contests involving commercial sponsorship.

In terms of recreational surfing and windsurfing there are an estimated 54 surfing sites between Kewalo Basin and Sand Island. It is estimated that when conditions are favorable 20-40 people participate at every break and that between 1,000 and 2,000 surfers regularly surf these breaks. (Royal Hawaiian Hotel Beach Service estimate). Assuming that an average local surfer spends at least $100 per year on such necessities as surf wax, a surf board, a surfboard leash and miscellaneous swim suits and T-shirts, it can be estimated that surfing expenditures for an average of 1500 surfers total $150,000 per year (1500 X $100).

In addition to these recreational surfers, there are five concessions on Waikiki beach where surfboards are rented and surfing lessons given. According to the Beach Services at the Moana Hotel, it was estimated that an average of 20 visitors per day take lessons at a cost of $25 per hour. This number estimated over a period of 250 days per year totals 5,000 people annually. Gross revenues of lessons are estimated to be approximately $125,000 per year.

The number of sales of lessons is small compared to rentals. According the beach service approximately 120 tourists rent surfboards everyday at the rate of $4 per hour. Assuming that each tourist spent two hours on a surfboard 250 days per year it can be estimated that 31,250 people per year try surfing at an gross revenue of $250,000 per year. Total revenues for tourist surfers per year are estimated to be $375,000.

Indirect expenditures involving tourists can be estimated to be $375,000 x .74 or $277,500.

There are also a number of small scale commercial and pro-am surf contests held on Oahu each year. They include the Zippy's Hawaiian Island Creation Surf Meet and the China Uemura Longboard Classic.
The value of the surfing contests with sponsors in the area is estimated to be approximately $20,000 per year. (Indirect revenues here are negligible because of few of these contests involve tourists).

Parasails

In 1990 there were four parasail companies operating on Oahu between Sand Island and Hawaii Kai. These companies reported revenues of $1,566,582. . Indirect expenditures totaled $1,159,270.

Jetskis

There are currently three companies operating off Sand Island. They are Coconut Ocean Sports, Seawind Challenge and Jet ski Hawaii. Total annual gross revenue for these operations is estimated to be $1,000,000. Off Waikiki there is one company known as Waikiki Beach Services and in Hawaii Kai in the waters off Portlock two companies operate: Marine Sports and Aloha Ocean Sports

There is also a company that specializes in the sale and services of jet-skis to the tourist industry. Total direct gross revenues for these companies in 1993 were approximately $2,097,500.

Indirect expenditures ($2,097,500) x (.74) total $1,552,150.

Activity	Estimated Direct Revenue	Estimated Indirect Revenue
Competitive Ocean Sailing	$7,000,000	$4,426,653
Tour Boats	$40,813,000	$30,201,620
Outrigger Canoe Racing	$275,830	$102,490
Waikiki Canoe Rides	$62,500	$46,250
Recreational Surfing	$525,000	$277,500
Surfing Contests	$20,000	-
Parasail	$1,566,582	$1,159,270
Jet Ski	$2,097,500	$1,552,150
Total	$52,360,412	$37,765,933

Conclusion

Total annual spending of the ocean recreation industry between Hawaii Kai and Sand Island is estimated to be valued at approximately $52 ,360,412 in direct revenues and $37,765,933 in indirect revenues.

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Appendix F

TRAFFIC ASSESSMENT

EAST MAMALA BAY FACILITIES PLAN

Department of Wastewater Management

City and County of Honolulu

Prepared for

Belt Collins & Associates

by

Wilbur Smith Associates

July 9, 1993

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INTRODUCTION

The City and County of Honolulu Department of Wastewater Management is planning a major expansion and renovation of collection and treatment facilities for the East Mamala Bay section of Honolulu's wastewater system. The East Mamala Bay system is centered upon the Sand Island Wastewater Treatment Plant (SIWWTP), which treats all effluent collected by the system. The collection area of the East Mamala Bay system extends from the Honolulu International Airport area to the Kuliouou area of East Honolulu.

Potential improvements for the East Mamala Bay Wastewater system have been identified in a study by Belt Collins & Associates. The components of the plan encompass the following:

1. Improvement to the SIWWTP
   Plans for expansion and upgrading the treatment plant include two key alternatives:
   - Expanded primary treatment; and
   - Secondary treatment.

   Each approach entails different levels of staffing and materials transportation via roadway.

2. Upgrading and renovation of wastewater pump stations throughout the system.

3. Extension of sewer lines into areas currently with no sewer system.

4. Increased capacity and/or replacement of sewers.

The magnitude of these modifications will likely result in implementation extending over a 20-year period or longer.

■ Study Purpose and Scope ■

The effects of most of the planned improvements on area traffic conditions are likely to be temporary impacts during construction at each individual improvement location. The exception is the SIWWTP, where the improvements are expected to result in permanent staffing increases and materials transportation.

This traffic study focuses upon the future impacts of the upgrading of the SIWWTP. The study assesses the traffic increases and impacts on traffic conditions with either expanded primary treatment or secondary treatment at SIWWTP. Traffic conditions are analyzed at two key locations:

1. The plant driveway intersection with Sand Island Parkway; and
2. The Sand Island Access Road intersection with Nimitz Highway.

An analysis year of 2003 is used, since either of these treatment options could be completed by that year.

Traffic conditions at these two intersections are also analyzed for the construction period at the SIWWTP. This analysis is made because of the large number of construction workers (150 to 500 each day) that would be working at the plant over an extended time period (two to three years). The analysis of the SIWWTP construction impacts was made for the Year 2000 since this year is common to the anticipated construction period for either expanded primary (1998-2000) or secondary treatment (2000-2003).

The traffic impacts for the pump stations and sewer installation will be short-term and largely confined to the street that is the site of the construction work. Since these improvements will include a large number of locations, with the work spread over a period of 20 years or more, this study discusses only the general nature and degree of impacts and the need for mitigative actions on a nonsite-specific basis. The traffic requirements and mitigative actions for individual street sections should be addressed in greater detail as part of the future design efforts of individual project locations.

■ Organization of the Report ■

The initial sections of the report address the permanent traffic effects of the improvements at the SIWWTP, including an assessment of both the expanded primary and secondary treatment alternatives. The discussion is divided into three sections:

- Existing Conditions;
- Year 2003 Conditions Without the Project; and
- Year 2003 Conditions With the Two Treatment Alternatives.

A following section addresses construction impacts at the SIWWTP, primarily as it relates to worker impacts on peak hour traffic conditions. The final section discusses traffic impacts and mitigative actions for construction work on pump stations and sewer lines.

EXISTING CONDITIONS

The project site is located along the makai side of the Sand Island Parkway across from the Matson business offices and container terminal (see Figure 1). The existing Sand Island Wastewater Treatment Plant (SIWWTP) occupies the western half of the project site, while the eastern half is largely undeveloped land. A halfway house is located on the undeveloped half of the site.

The undeveloped area adjacent to the west side of the site is planned as the future corporation yard for the City and County of Honolulu. Industrial uses occupy the properties east of the site, while the area between the south boundary of the site and the south shoreline of Sand Island is a portion of the Sand Island State Recreation Area.

Existing SIWWTP Operations

The existing SIWWTP provides primary treatment of waste water collected in the East Mamala Bay area of Honolulu. City staff based at the site include plant operations and maintenance personnel, laboratory personnel, branch (field) maintenance workers, and administrative personnel. Assigned staff levels for the weekday day shift are presently as follows:

Administration	21
Plant Operations	42
Laboratory	33[1]
Branch Maintenance	55
Total	151

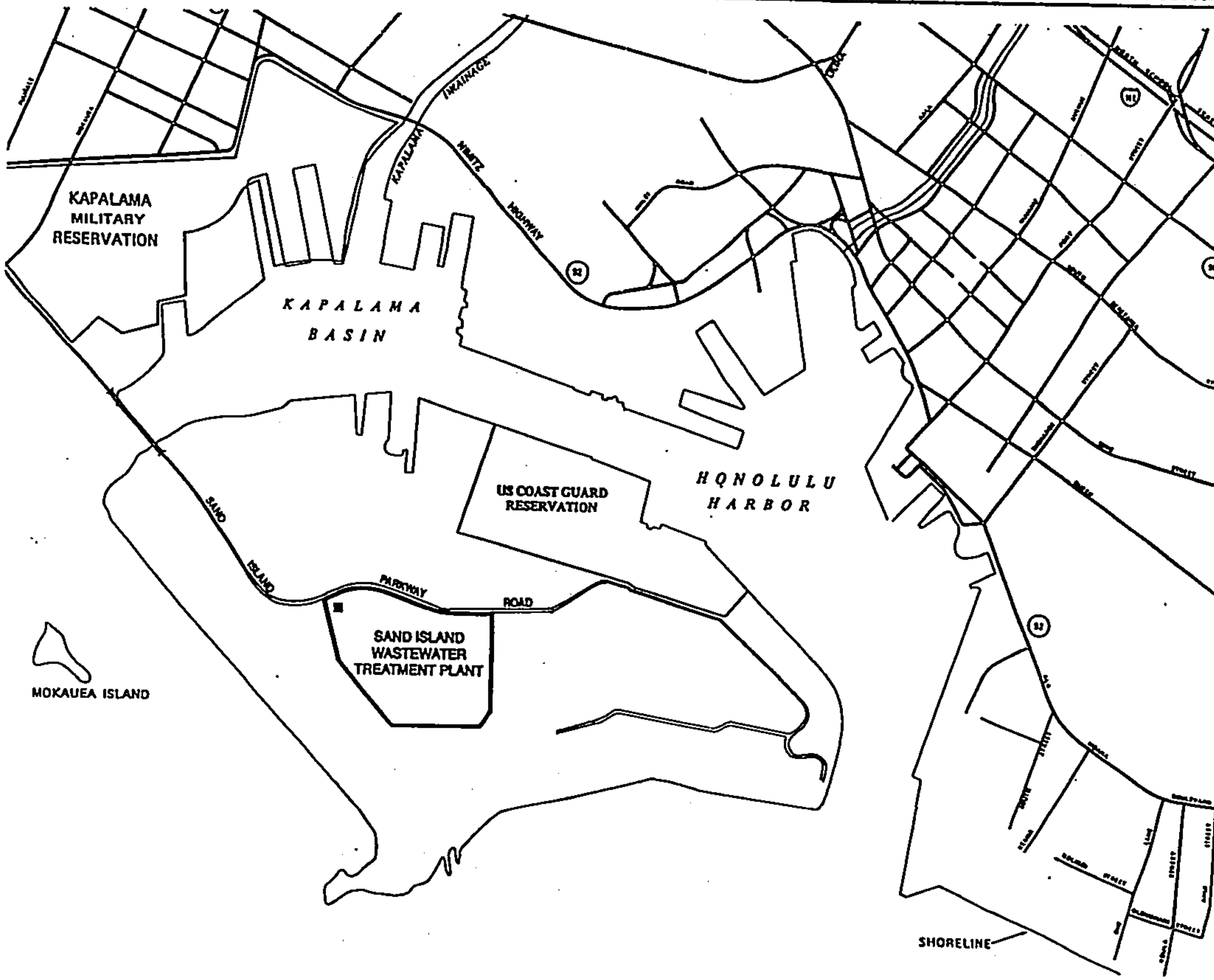
The day shift personnel begin work at 6:45 or 7:00 AM and end their shift at 3:15 or 3:30 PM.

Also, plant operations normally has seven persons working a 3:00 PM to 11:00 PM evening shift, and seven persons on an 11:00 PM to 7:00 AM night shift.

Access Roadways

Regional access to the Sand Island area is primarily provided by Nimitz Highway and the Sand Island Access Road. Kalihi Street also serves those trips to/from Windward Oahu and some eastern portions of Honolulu.

[1] Includes employees in five newly filled positions who were undergoing training off-site at the time of the traffic survey.



WILBUR SMITH ASSOCIATES

Figure 1
LOCATION MAP

Nimitz Highway (FAP Route 92) is the major roadway that links Pearl Harbor, the industrial areas around the Honolulu International Airport and Honolulu Harbor, and downtown Honolulu. It provides access to the H-1 Freeway at the Keehi interchange just west of the Sand Island Access Road. Nimitz Highway is a divided roadway with three lanes in each direction east of Sand Island Access Road, and four lanes in each direction between Sand Island Access Road and the Keehi interchange.

Sand Island Access Road (FAP Route 64) provides access to the Kalihi Kai area and to Sand Island. The roadway is a four-lane divided roadway with left-turn lanes provided at intersections and major highways. The intersection with Nimitz Highway is controlled by a traffic signal, and double left-turn lanes are provided to accommodate the large volumes of traffic turning left to or from Nimitz Highway.

Kalihi Street provides access from the Kalihi Kai area mauka through the Kalihi area to the H-1 Freeway and the Likelike Highway. The street provides two lanes in each direction.

Sand Island Parkway is the extension of Sand Island Access Road onto Sand Island. Between the project site and the Sand Island bridge, the Parkway is a divided, access-controlled roadway with two lanes in each direction. East of the project driveway, the road narrows to two lanes. Near the project, the speed limit is 25 mph. The only traffic signal is located at Pier 51A Road, one block west of the project driveway.

■ Project Driveway ■

The SIWWTP driveway intersects the Sand Island Parkway opposite the driveway which provides access to the Matson business office and personal automobile shipping office. The Matson container terminal driveway, with high volumes of trucks, is located about 100 yards east of the SIWWTP driveway.

The divider median area of the Sand Island Parkway ends several hundred feet to the west of the project driveway. In place of the divider, two additional lanes are provided in the median area through the SIWWTP driveway intersection, to the intersection of the Matson container terminal driveway. One additional lane is provided in each direction. At the SIWWTP driveway, the additional eastbound median lane is marked for either left-turns (to Matson business office) or through traffic, with the lane ending at the Matson container terminal driveway as a left-turn lane. On the east side of the SIWWTP driveway, the additional westbound median lane is marked for left-turns into the SIWWTP driveway, while west of the SIWWTP driveway, the lane is marked as a merge lane into the westbound through lanes.

The additional median lane arrangement provides a refuge area and acceleration lane for traffic turning left from the SIWWTP driveway. During peak traffic periods, this permits exiting left-turn vehicles to cross the eastbound traffic flow, and then find a gap in which to merge into the westbound traffic flow, rather than waiting to find a simultaneous gap in both traffic flows of sufficient length in which to make the left-turn as one movement.

A second driveway is provided for the project site near the halfway house. The driveway into the site is gated, with this driveway normally used only by the halfway house.

Traffic Volumes

Existing traffic volumes were developed from recent State of Hawaii Department of Transportation (State DOT) counts, and from special peak period turning movement counts made by Wilbur Smith Associates on May 12, 1993. Typical weekday traffic volumes on the major roadways in the project vicinity are as follows:

Nimitz Highway at Sand Island Access Road	91,500
Sand Island Access Road	30,300
Kalihi Street mauka of Nimitz Highway	13,600
Sand Island Parkway	21,000

Weekday morning and afternoon "peak hour" volumes for this study reflect 6:30 AM to 7:30 AM and 3:00 PM to 4:00 PM, since these periods encompass the shift changes at SIWWTP. Traffic volumes at key locations are depicted in Figure 2.

The highest traffic volumes occur on Nimitz Highway on the ewa side of the Sand Island Access Road. Turning volumes to/from Sand Island Access Road are also much higher for the Ewa side of the intersection.

At the project driveway, virtually all vehicles enter from or exit to the west. During the morning peak hour, 55 vehicles entered and 17 exited the driveway. In the afternoon peak hour, 66 vehicles exited while 8 vehicles entered the driveway.

Methodology for Analyzing Levels-of-Service

The Transportation Research Board (TRB), a division of the National Science Foundation, has developed standardized methods for use in evaluating the effectiveness and quality of service for roadways and streets. Different methodologies are available for analyzing traffic signal-controlled intersections and unsignalized intersections, both of which were used in evaluating present and future conditions for this study.

The TRB evaluation methods use a concept known as level-of-service (LOS). This concept describes facility operations on a letter basis from A to F, which signify excellent to unacceptable conditions, respectively. The methods generally compare traffic volumes on a facility to the facility's theoretical capacity. Capacity is estimated based on the facility's physical characteristics (e.g. number of lanes), traffic conditions (e.g. types of vehicles), and type of traffic controls. The comparisons are frequently referred to as the volume-to-capacity (V/C) ratio. The methodologies are described in the *1985 highway Capacity Manual* (1985 HCM).[2]

[2] *Highway Capacity Manual, Special Report 209*, Transportation Research Board, 1985.

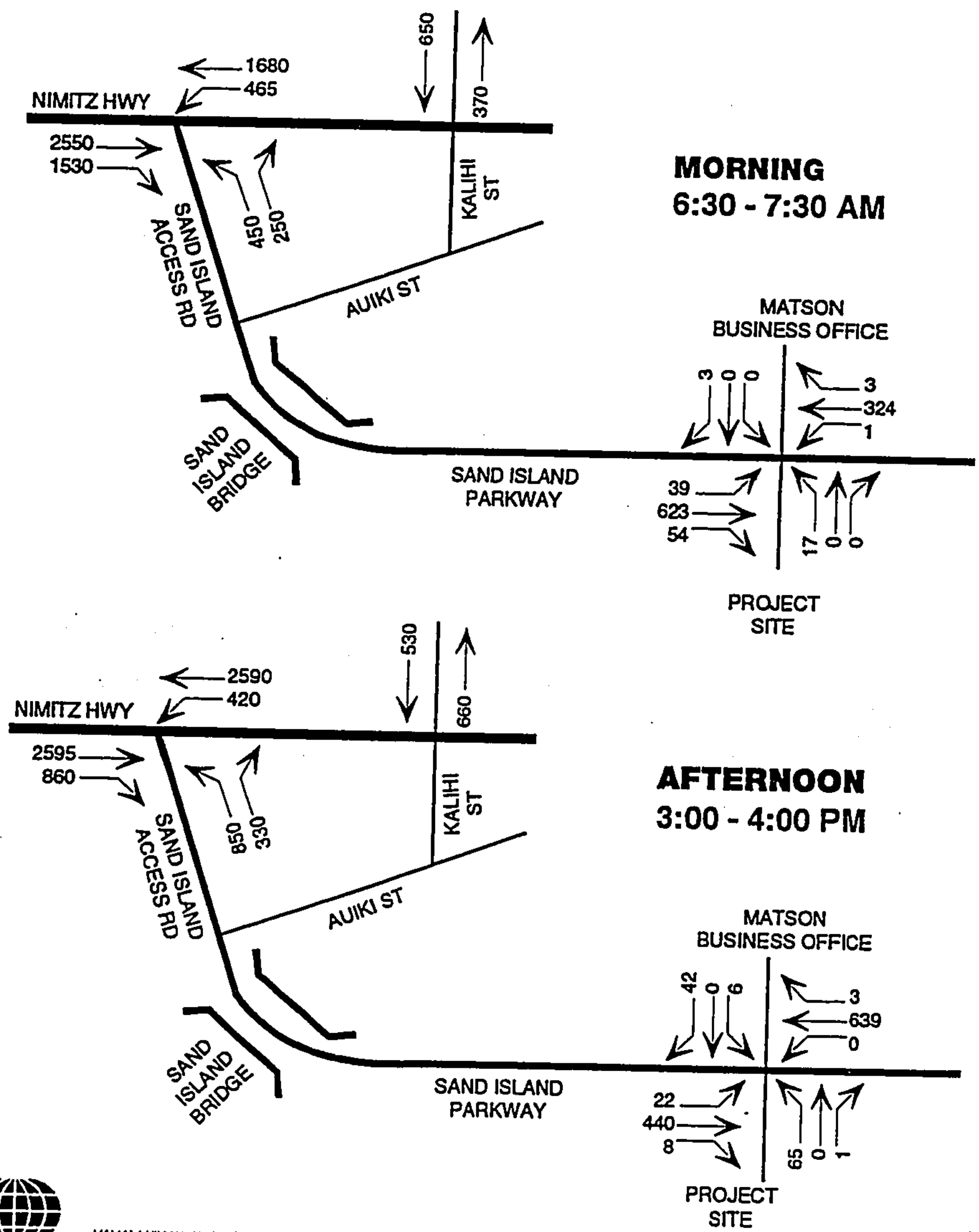


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Figure 2
EXISTING WEEKDAY PEAK HOUR VOLUMES

Signalized Intersections — The operations approach was used in analyzing signalized intersections in this analysis. As with analysis of other types of traffic facilities, signalized intersection analysis also calculates the V/C ratio. Modern signals allocate time in a variety of ways, from the simplest two-phased pretimed signal, to the most complex multi-phase actuated signal. Signal phasing and timing control the various traffic streams which meet at an intersection. As such, they are key in the evaluation of intersection level-of-service. While capacity is evaluated in terms of the V/C ratio, with the operations approach, level-of-service is based on average delay (seconds/vehicle) rather than the V/C ratio.

The level-of-service criteria for signalized intersections is defined in Figure 3.

Unsignalized Intersections — In T-intersection and four-leg two-way STOP unsignalized intersection analysis, a standard procedure provides a comparative measure of delay at STOP and YIELD controlled intersections for those movements which must yield to conflicting movements at the intersection. The movements which must yield include:

- Left-turn out of the side street;
- Right-turn out of the side street; and
- Left-turn into the side street.

Through vehicles on the major streets are not required to yield to other movements at T- and two-way controlled intersections. The general indicator of intersection delay is determined by calculating the one-hour capacity for each key movement, based on conflicting traffic volumes, and then comparing the number of vehicles making that maneuver to the calculated capacity. The unused or "reserve" capacity for that movement is then used to identify a level-of-service for that movement. Unlike signalized analysis, an overall intersection level-of-service is not calculated but rather a level-of-service is calculated for each lane group.

The level-of-service criteria for unsignalized intersections is defined in Table 1.

The **OPERATIONS LEVEL METHODOLOGY**, which is described in the Transportation Research Board's Highway Capacity Manual, defines Level of Service (LOS) for signalized intersections in terms of delay. Technically, delay is the amount of time an average vehicle must wait at an intersection before being able to pass through the intersection. For signalized intersections, the relationship between LOS and delay is based on the average stopped delay per vehicle for a fifteen minute period.

LEVEL OF SERVICE 'A' - Delay 0.0 to 5.0 seconds

Describes operations with very low delay, i.e., less than 5 seconds per vehicle. This occurs when signal progression is extremely favorable. Most vehicles arrive during the green phase and are not required to stop at all.

Corresponding V/C ratios usually range from 0.00 to 0.60.

LEVEL OF SERVICE 'B' - Delay 5.1 to 15.0 seconds

Describes operations with delay in the range of 5 to 15 seconds per vehicle generally characterized by good signal progression and/or short cycle lengths. More vehicles are required to stop than for LOS 'A' causing higher levels of average delay.

Corresponding V/C ratios usually range from 0.61 to 0.70.

LEVEL OF SERVICE 'C' - Delay 15.1 to 25.0 seconds

Describes operations with delay in the range of 15 to 25 seconds per vehicle. Occasionally, vehicles may be required to wait more than one red signal phase. The number of vehicles stopping at this level is significant although many still pass through the intersection without stopping.

Corresponding V/C ratios usually range from 0.71 to 0.80.

LEVEL OF SERVICE 'D' - Delay 25.1 to 40.0 seconds

Describes operations with delay in the range of 25 of 40 seconds per vehicle. At LOS 'D', the influence of congestion becomes more noticeable. Many vehicles stop, and the proportion of vehicles not stopping declines. The number of vehicles failing to clear the signal during the first green phase is noticeable.

Corresponding V/C ratios usually range from 0.81 to 0.90.

LEVEL OF SERVICE 'E' - Delay 40.1 to 60.0 seconds

Describes operations with delay in the range of 40 to 60 seconds per vehicle. These high delay values generally indicate poor signal progression, long cycle lengths and high V/C ratios. Vehicles frequently fail to clear the intersection during the first green phase.

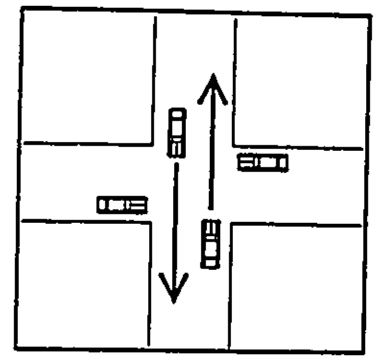
Corresponding V/C ratios usually range from 0.91 to 1.00.

LEVEL OF SERVICE 'F' - Delay 60.1 seconds plus

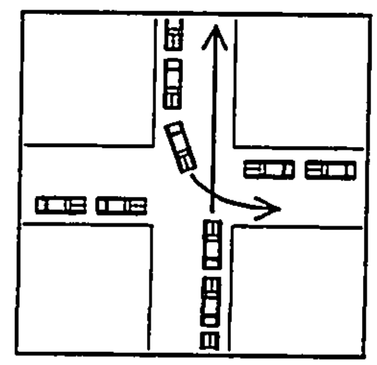
Describes operations with delay in excess of 60 seconds per vehicle. This condition often occurs with oversaturation, i.e., when arrival flow rates exceed the capacity of the intersection.

Corresponding V/C ratios of over 1.00 are usually associated.

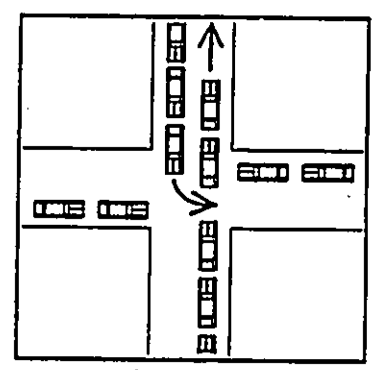
SOURCE: Transportation Research Board, "Operations Level Methodology-Signalized Intersections", Highway Capacity Manual, Special Report 209, 1985.



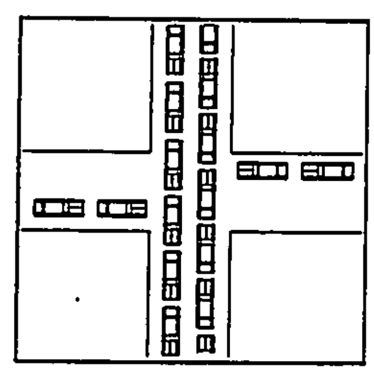
LOS 'A'



LOS 'C'



LOS 'D'



LOS 'F'

Figure 3
LEVEL OF SERVICE DIAGRAM

Table 1 Level-of-Service Criteria for Unsignalized Intersections		
LOS	Reserve Capacity (pcph)	Expected Delay
A	400 or More	Little or no delays
B	300 - 399	Short traffic delays
C	200 - 299	Average traffic delays
D	100 - 199	Long traffic delays
E	-0- - 99	Very long traffic delays
F	Negative Value	Exceeds capacity with extreme traffic delays

LOS = Level-of-service; pcph = passenger cars per hour.
Source: *Highway Capacity Manual*, Chapter 10.

■ Intersection Conditions ■

An analysis of traffic conditions at the SIWWTP driveway intersection with Sand Island Parkway was made in accordance with the methodology set forth in the 1985 HCM for unsignalized intersections. Because of the unusual layout of the intersection, with an eastbound median refuge/acceleration lane as described in the "Project Driveways" section, the intersection conditions were analyzed for two operational configurations.

- An analysis was made as a conventional four-way unsignalized intersection with the traffic exiting the SIWWTP and Matson driveways each having to wait for a simultaneous gap in traffic flow in both directions in order to exit the driveway and complete the turning maneuver; and

- For traffic exiting the SIWWTP driveway, an analysis was made to determine the service level for crossing only the eastbound traffic flow, with the exiting traffic then using the median refuge acceleration lane to merge into the eastbound flow.

The results of the analysis, summarized in Table 2, indicate that the critical left-turn volumes from the SIWWTP are within the capacity for this movement during both the morning and afternoon peak hours. The analysis as a conventional four-way intersection indicates a LOS D for the morning and LOS E for the afternoon. The analysis for crossing only the eastbound traffic indicates better service levels of LOS C and LOS B during the morning and afternoon periods, respectively.

Table 2

LEVEL-OF-SERVICE AT SIWWTP DRIVEWAY INTERSECTION
EXISTING CONDITIONS
East Mamala Bay Facilities Plan

Time Period/Movement	Peak Hour Vehicle Equivalents(1)	Capacity	Reserve Capacity	LOS
Analysis as Conventional Four-Way Intersection				
6:30 AM - 7:30 AM Period				
Left-turn from SIWWTP	20	162	142	D
Right-turn from SIWWTP	-0-	797	797	A
Left-turn from Matson	-0-	157	157	D
Right-Turn from Matson	4	986	982	A
Eastbound Left into Matson	51	812	761	A
Westbound Left into SIWWTP	4	502	498	A
3:00 PM - 4:00 PM Period				
Left-turn from SIWWTP	76	126	50	E
Right-turn from SIWWTP	1	925	924	A
Left-turn from Matson	7	141	134	D
Right-turn from Matson	49	816	767	A
Eastbound Left from Parkway	29	529	500	A
Westbound Left from Parkway	-0-	690	690	A
Analysis of Crossing Only the Eastbound Traffic to the Median Refuge Lane				
6:30 AM - 7:30 AM Period				
Left-turn from SIWWTP	20	291	271	C
3:00 - 4:00 PM Period				
Left-turn from SIWWTP	76	450	374	B

SIWWTP = Sand Island Wastewater Treatment Plant
LOS = Level-of-Service
(1) Vehicle count adjusted to reflect effects of roadway grade and vehicle types.

Wilbur Smith Associates; July 1993

Field observations at the driveway indicated that vehicles exiting the plant actually experienced very little delay. The traffic signal at Pier 51A Road provides frequent gaps in the eastbound traffic flow which allow the left-turn vehicles to cross to the median and then merge into the westbound traffic. Only when a queue of 4 or 5 vehicles exited the SIWWTP at the same time was there any significant delay, that being the cumulative delay experienced by the last several vehicles in the queue. The field observations indicate that the left-turn movement from the SIWWTP driveway tends to operate primarily as the median refuge lane approach, with the service level primarily a function of the availability of gaps in the eastbound flow, not a simultaneous gap in both directions. This is used as the basis for analysis of future year conditions, although the analysis is made for both operational approaches.

An analysis was also conducted for the Sand Island Access Road intersection with Nimitz Highway. The intersection is presently operating at or near capacity conditions during both the 6:30-7:30 AM and 3:00-4:00 PM periods. The analysis results are as summarized in Table 3.

Table 3
EXISTING NIMITZ HIGHWAY - SAND ISLAND ACCESS ROAD INTERSECTION CONDITIONS

Time Period	V/C	Average Delay per Vehicle	LOS
6:30 - 7:30 AM	0.93	64.2 seconds	F
3:00 - 4:00 PM	1.03	47.4 seconds	E

V/C = Volume-to-Capacity Ratio.
LOS = Level-of-Service.

Wilbur Smith Associates; July 1993

FUTURE TRAFFIC CONDITIONS WITHOUT THE SAND ISLAND WASTEWATER TREATMENT PLANT PROJECT

The construction work at the SIWWTP could begin as early as 1998 for Expanded Primary Treatment, or Year 2000 with Secondary Treatment. Completion is expected in Years 2000 and 2003 for Expanded Primary and Secondary Treatment, respectively. Forecast conditions are presented for Years 2000 and 2003 with the SIWWTP expansion project, as a base from which to identify the incremental impacts of project construction (2000) and operations (2003).

The analysis reflects continued operation of SIWWTP at its present staffing levels.

■ Roadway Improvements ■

The major roadway modification anticipated in the area by Year 2000 is the proposed Makai Boulevard viaduct roadway, which the State DOT plans to build along the section of Nimitz Highway between Keehi interchange and Pacific Street. The viaduct is planned for use by high occupancy vehicles (HOV), and thus would divert some traffic from Nimitz Highway as well as from parallel roadways.

A grade separation of the Sand Island Access Road-Nimitz Highway intersection to eliminate the conflict between the left-turn volumes and the eastbound Nimitz Highway through traffic is under consideration. The base analyses presented herein reflect the existing intersection, although the mitigative effects of this separation are discussed.

The section of Sand Island Access Road mauka of Auiki Street is also planned for widening to six lanes by 2000. However, this would not affect the capacity of the Nimitz Highway intersection unless it also includes a third left-turn lane into or out from Sand Island Access Road.

■ Years 2000 and 2003 Traffic Volumes Without Project ■

Traffic growth in the Sand Island Access Road and the Nimitz Highway travel corridors are expected to increase as a result of several projects within these corridors, as well as from growth to new or redeveloped projects outside of the area. Projects planned along the Sand Island Access Road corridor include the following:

- New City Corporation Yard west of the SIWWTP;
- State Marine Education Center next to Sand Island bridge;
- Redevelopment of the Kapalama Military Reservation; and
- New marina area along Keehi Lagoon eastern shore.

Estimates of the cumulative traffic increases as a result of these developments as well as other projects in the Kalihi Kai and airport areas were made during the recent development of the new Honolulu International Airport Master Plan, as prepared by Edward K. Noda and Associates. The traffic study[3] for the Master Plan forecast traffic volumes for the Year 2010. Those forecasts for 2010 peak hour traffic increases at the intersection of Nimitz Highway and Sand Island Access Road have been used to develop average annual traffic growth rates for that intersection, and the resultant 2000 and 2003 traffic volumes.

Traffic growth along the Sand Island Parkway was based upon the average growth rate determined from State DOT counts at the bridge between 1986 and 1991. The resultant average annual growth rates, and the level of traffic increases from 1993 through 2000 and 2003, are summarized in Table 4.

Table 4

TRAFFIC GROWTH RATES ON AREA ROADWAYS WITHOUT PROJECT

Roadways	Period	Annual Growth Rate	Increase 1993-2000	Increase 1993-2003
Nimitz Highway	AM	2.50%	18.9%	28.8%
	PM	2.25%	16.8%	24.9%
Sand Island Access Road	AM	2.50%	18.9%	28.0%
	PM	2.25%	16.8%	24.9%
Sand Island Parkway	AM/PM	2.00%	14.9%	21.9%
Kalihi Street	AM/PM	2.60%	19.7%	29.3%

Wilbur Smith Associates; July 1993

Years 2000 and 2003 Intersection Conditions

Traffic conditions at the intersection of Nimitz Highway and Sand Island Access Road were analyzed with the present intersection laneage and signal controls. The analysis reflects construction of a Makai Boulevard viaduct, with a diversion of Nimitz HOV peak direction traffic to the viaduct.

The analysis results, summarized in Table 5, indicate that volumes at the Nimitz Highway intersection would be significantly above the theoretical capacity of the intersection during both the 6:30-7:30 AM and 3:00-4:00 PM periods for either 2000 or 2003. Vehicle delays would be expected to increase.

3 *Honolulu International Airport Ground Access Study, Draft*, prepared by Wilbur Smith Associates for E.K. Noda and Associates, November 1992.

Table 5

NIMITZ HIGHWAY—SAND ISLAND ACCESS ROAD INTERSECTION CONDITIONS
YEARS 2000 AND 2003 WITHOUT PROJECT

Year	6:30 - 7:30 AM			3:00 - 4:00 PM		
	V/C	ADPV	LOS	V/C	ADPV	LOS
Existing	0.93	64.2	F	1.03	47.4	E
2000	1.10	75.4	F	1.20	*	F
2003	1.17	84.5	F	1.29	*	F

V/C = Volume-to-Capacity Ratio.
ADPV = Average Delay per Vehicle, in seconds.
LOS = Level-of-Service.
* = *Calculation of delay is infeasible when V/C is greater than 1.20.*

Analysis results for the SIWWTP driveway intersection with Sand Island Parkway are summarized in Table 6 for Years 2000 and 2003 without the treatment plant expansion. The conditions are presented for the critical left-turn movement from the SIWWTP driveway, both with the left-turn vehicles crossing the eastbound traffic to reach the median refuge lane and then merging into the westbound traffic, and for the exiting vehicles needing a sufficient traffic gap in both travel directions to complete the left-turn maneuver in one movement (conventional intersection).

When analyzed with the refuge lane (gap needed only in eastbound traffic), the left-turn movement is projected to operate at a very acceptable service level (LOS C) in the morning and evening peak hours for both 2000 and 2003. The volume of left-turn traffic should have no problem merging with the westbound traffic.

When analyzed without use of the refuge area, the left-turn vehicles would experience much longer delays (LOS D or E). For the afternoon peak hour, the reserve capacity would be approaching zero in both 2000 and 2003, indicative of very long delays for vehicles exiting the driveway if the drivers wait for a gap in the traffic in both directions.

Table 6

SIWWTP DRIVEWAY INTERSECTION SERVICE LEVELS
YEARS 2000 AND 2003 WITHOUT PROJECT
East Mamala Bay Facilities Plan

Time Period/Movement	Year	Peak Hour Vehicle Equivalents[1]	Capacity	Reserve Capacity	LOS
Analysis With Median Refuge/Merge Lane					
Morning - Left-turn from SIWWTP Driveway	2000	22	245	223	C
	2003	22	223	201	C
Afternoon - Left-turn from SIWWTP Driveway	2000	77	402	324	B
	2003	77	381	304	B
Analysis As Conventional Intersection					
Morning - Left-turn from SIWWTP Driveway	2000	22	124	102	D
	2003	22	110	88	E
Afternoon - Left-turn from SIWWTP Driveway	2000	77	94	17	E
	2003	77	87	9	E

SIWWTP = Sand Island Wastewater Treatment Plant
LOS = Level-of-Service
(1) Vehicle count adjusted to reflect effects of roadway grade and vehicle types.

Wilbur Smith Associates; June 1993

FUTURE TRAFFIC WITH THE SAND ISLAND WASTEWATER TREATMENT PLANT PROJECT

The City and County of Honolulu Department of Wastewater Management is considering several alternative approaches for the expansion of the SIWWTP facilities, including both expanded primary treatment and secondary treatment. Although expanded primary treatment is the recommended level of treatment, if the current waiver from secondary treatment is not renewed by the U.S. Environmental Protection Administration in 1995, the plant must be upgraded to secondary treatment. In addition, a determination of the best method for solids (biosolids) disposal is beyond the scope of the EIS process. Thus, the analyses consider the traffic effects of several project variations, which include:

1. Both plant expansion to the expanded primary treatment level and to the secondary level; and

2. Different methods to process and dispose of the solid materials resulting from wastewater treatment at the plant.

The level of treatment would primarily affect area traffic through the different numbers of staff needed to operate the plant with expanded primary treatment versus secondary treatment. The difference in staffing levels would primarily affect traffic at the time of the work shift changes during the morning and afternoon commute periods.

The solids process/disposal options would directly affect the volume of heavy truck movement to/from the facility. The truck volumes would also be affected by the level of treatment.

■ Project Description ■

The project alternatives would utilize a portion or all of the undeveloped eastern half of the plant site for expansion of the plant facilities. The planned increase in plant capacity would be expected to accommodate forecast treatment needs through the Year 2015 or beyond.

Both the expanded primary treatment and secondary treatment alternatives would result in a large increase in the staffing levels at SIWWTP. For the day shift, which extends from about 7:00 AM to 3:30 PM, the staffing level at the plant would increase from the 151 persons at present, to an estimated 245 persons (+62%) for expanded primary treatment, and to 301 persons (+99%) with secondary treatment (see Table 7). These staffing levels would be reached at full plant operations prior to Year 2015.

Staff levels for the evening shift (3:00 to 11:00 PM) and night shift (11:00 PM to 7:00 AM) would also increase, with the secondary treatment option requiring a large increase relative to existing or expanded primary treatment operations.

Table 7

ESTIMATED SAND ISLAND WASTEWATER TREATMENT PLANT STAFF REQUIREMENTS FOR FULL PLANT OPERATIONS(1)
East Mamala Bay Facilities Plan

Work Shift	Existing	Expanded Primary Treatment	Secondary Treatment
Day Shift			
Administration	21	23	25
Operations	21	25	58
Maintenance	21	25	46
Laboratory	33	111	111
Branch Maintenance	55	61	61
Total Day Shift	151	245	301
Evening Shift	7	9	24
Night Shift	7	9	22

(1) Staff levels at full operations expected to be reached by Year 2015.
Source: Belt Collins & Associates

Wilbur Smith Associates; July 1993

A number of options are under consideration for processing and disposal of solid materials remaining after treatment. The options are:

- **Landfilling** — The dewatered and treated solids would be trucked to the Kapaa landfill (near Kailua) for disposal. Although the City's Waimanalo Gulch landfill (near Kahe Point) is not presently used for disposal of SIWWTP solids, the site may be utilized if and when the Kapaa landfill reaches full capacity. Ultimately, both of these sites may be full by Year 2015, and a new site will be necessary to meet Oahu's solid waste disposal needs.

- **Thermal Drying** — The material would be dried, with the resultant material either used for agricultural purposes (i.e. fertilizer pellets for orchards) or disposed of in landfills.

- **Alkaline Stabilization** — Lime would be trucked in and mixed with the materials. Resultant material can be used for lining/covering landfills at the end of every day, or used for agricultural purposes.

- **Composting** — Material would be composted within a containment vessel on-site at SIWWTP, with resultant material packaged or shipped in bulk for use as mulch and fertilizer for agricultural and grass care purposes.

- **Incineration** — Material would be incinerated on-site with residue disposed of at landfill.

- **Power Generation** — Material would be incinerated on-site for power cogeneration project, with residue disposed of at landfill site.

Each of these disposal options would vary in the number of trucks needed to haul material out from the plant, or also to move material in, as in the case of the alkaline stabilization option.

Access to the expanded facilities at SIWWTP would continue to be provided by the existing two-lane driveway.

■ Peak Hour Vehicle Trip Generation ■

Special trip generation rates were developed to estimate project traffic during the morning and afternoon peak commute hour shift changes. The trip rates were derived from the vehicles entering/exiting the plant driveway during the May 12, 1993 traffic survey, and the present staffing level at the plant. The resultant trip generation rates for the shift change peak hours are:

6:30 to 7:30 AM Peak Hour	Vehicles Entering = 0.364 X Day Shift Staff Vehicles Exiting = 0.274 X (Night Shift plus Branch Maintenance Staff)
3:00 to 4:00 PM Peak Hour	Vehicles Entering = 0.129 X (Night Shift plus Branch Maintenance Staff) Vehicles Exiting = 0.437 X Day Shift Staff

The trip rates were applied against the estimated staff levels at full operation with expanded primary treatment and with secondary treatment. The estimated numbers of peak hour trips are summarized in Table 8.

Table 8

SIWWTP PROJECT VEHICLE TRIP GENERATION(1)
COMMUTER PEAK HOURS

Scenario	6:30 - 7:30 AM			3:00 - 4:00 PM		
	To Plant	From Plant	Total	To Plant	From Plant	Total
Existing	55	17	72	8	66	74
Expanded Primary Treatment(2)	90	20	110	9	107	116
Secondary Treatment(2)	110	23	133	11	132	143

(1) Total vehicle trips, including trips to existing plant facilities.
(2) Trips when plant reaches full operation at or prior to Year 2015.

Wilbur Smith Associates; July 1993

The expanded primary treatment option is estimated to increase the traffic to or from the site for the morning and afternoon shift peak hours to 110 and 116 vehicles, for increases of 53 and 57 percent, respectively, above the existing shift hour volumes. The larger staffing levels with secondary treatment are estimated to increase traffic by 85 and 93 percent above existing levels for the morning and afternoon peak hours, respectively, to 133 and 143 vehicles.

■ Peak Hour Traffic Volumes ■

Estimates of the directional distribution and routing of trips to and from the plant site were based upon *Hali 2005 Study* trip origins-destinations for the Sand Island-Kalihi Kai area, and upon traffic patterns observed during the traffic counts. The proportional distribution of trips for the three major approach routings were estimated as follows:

Nimitz Highway, ewa of Sand Island Access Road	55.1%
Nimitz Highway, diamondhead of Sand Island Access Road	36.1%
Kalihi Street, mauka of Nimitz Highway	9.8%

For purposes of this impact assessment, the project traffic generation at full plant operation (full staffing levels) was assumed to occur in the Year 2003. Full staffing levels (Table 7) might not be reached until nearer Year 2015, which served as the basis for sizing of the plant capacity.

The resultant traffic volumes for the morning and afternoon shift peak hour periods are depicted in Figure 4 for expanded primary treatment and in Figure 5 for secondary treatment. The figures also identify the changes (noted in parenthesis) from the present SIWWTP traffic volumes. The increases in the peak direction (entering in morning, out in afternoon) would be mostly employee automobiles, while the off-peak direction increases would include City maintenance vehicles, usually pickups or small trucks, as well as employee vehicles.

The peak hour increases on the Sand Island Parkway/Access Road would range between 37 vehicles (morning, expanded primary treatment) and 68 vehicles (afternoon, secondary treatment). The proportional increase in traffic on this roadway, near the Sand Island Bridge, would range between 2.8 and 4.6 percent, respectively.

Beyond the Sand Island Access Road, where the project traffic is split between the two directions of Nimitz Highway and Kalihi Street, both the numerical and proportional increases would be much smaller. In all cases, the proportional increase in peak hour traffic would be less than 1 percent and generally less than 0.5 percent.

■ Peak Hour Traffic Conditions ■

The existing driveway, with the present STOP condition, would be sufficient to serve the increased peak hour traffic volumes with either the expanded primary or secondary treatment alternatives. This is based upon most of the plant employees continuing to exit the driveway and cross to the refuge lane in the median when a gap occurs in the eastbound traffic flow. The exiting vehicles could then merge into the westbound traffic flow. As summarized in Table 9, the service level for the left-turn from the SIWWTP driveway would remain at acceptable levels—LOS D in the morning with the heavy eastbound traffic passing by the driveway, and LOS C in the afternoon—for both the expanded primary and secondary treatment options.

However, the traffic turning left from the SIWWTP driveway during the afternoon peak hour could experience severe delays (LOS F in Table 9) if the majority of these drivers were to wait for a gap in both eastbound and westbound traffic flows on Sand Island Parkway before making their turn. This could occur with either expanded primary treatment or secondary treatment. Such a change could result from several factors:

- Large trucks exiting the SIWWTP driveway during the shift change peak hours;
- Reduction in sight distance from the driveway;
- Behavioral change among exiting drivers; or
- Larger than forecast traffic increases.

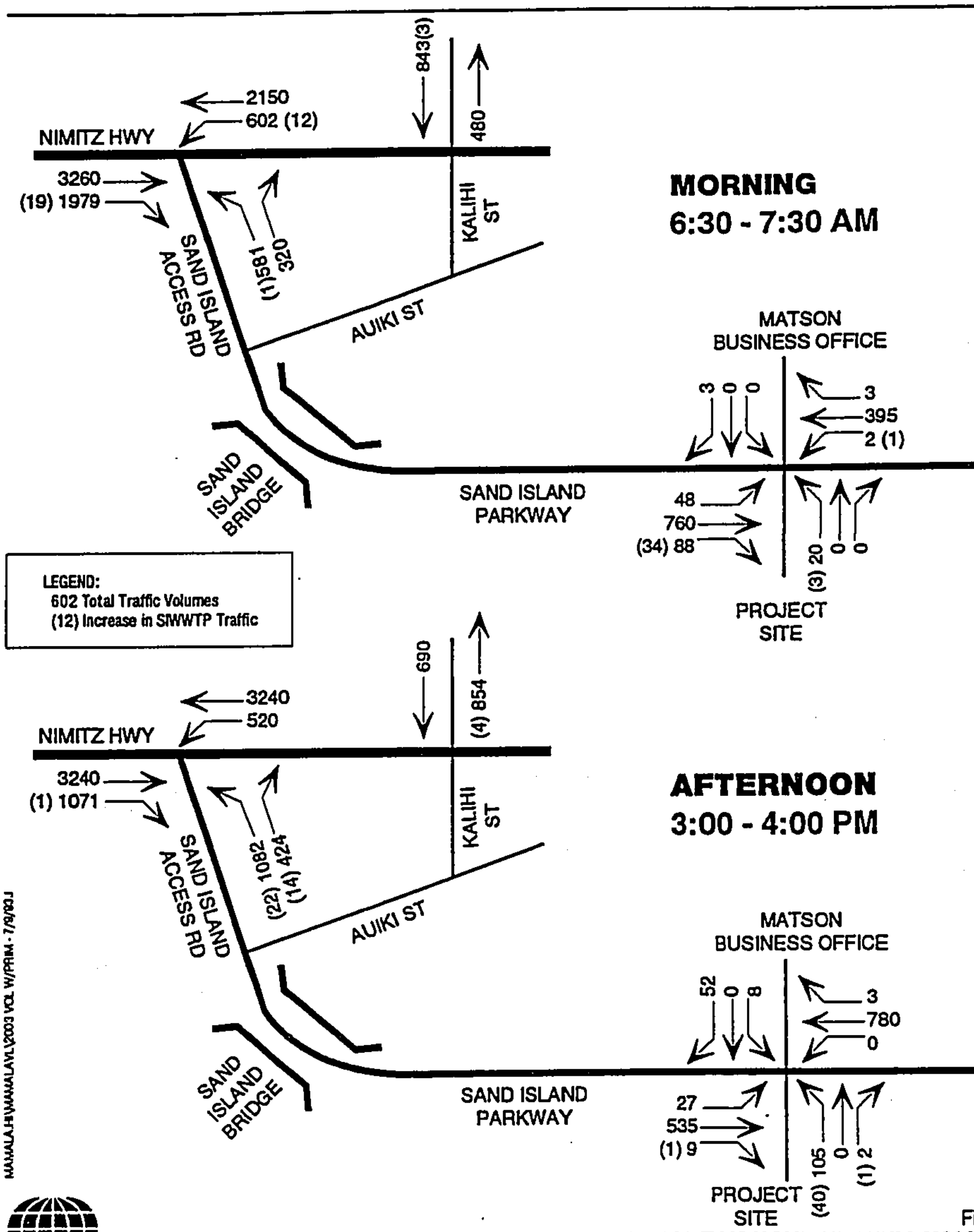


Figure 4
YEAR 2003 WEEKDAY PEAK HOUR TRAFFIC VOLUMES WITH EXPANDED PRIMARY TREATMENT

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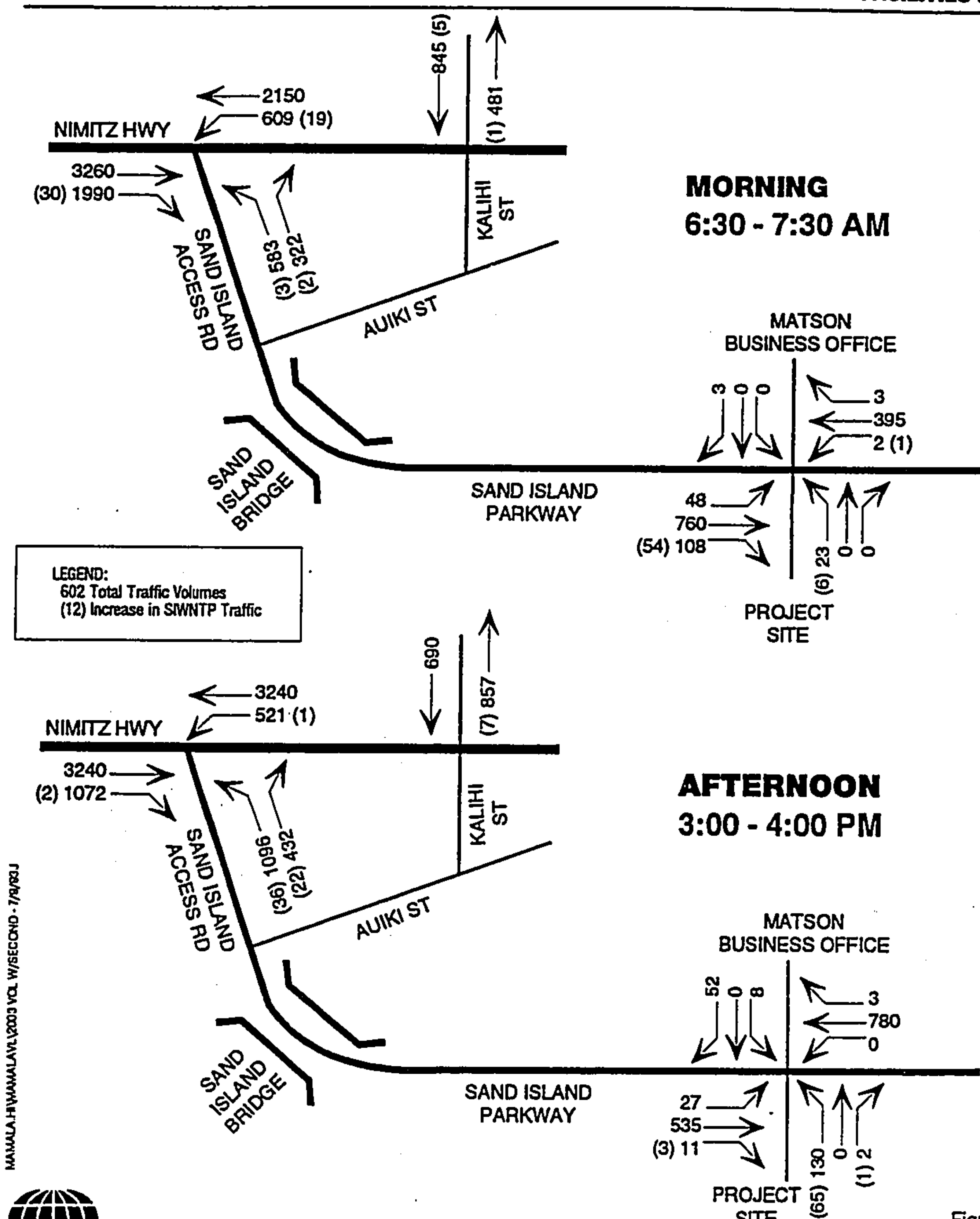

Figure 5
YEAR 2003 WEEKDAY PEAK HOUR TRAFFIC VOLUMES
WITH SECONDARY TREATMENT

WSA WILBUR SMITH ASSOCIATES

Table 9

SAND ISLAND WASTEWATER TREATMENT PLANT DRIVEWAY INTERSECTION SERVICE LEVELS YEAR 2003 WITH PROJECT
East Mamala Bay Facilities Plan

Time Period/ Movement	Scenario	Peak Hour Vehicle Equivalents[1]	Capacity	Reserve Capacity	LOS
Analysis With Median Refuge/Merge Lane					
Morning Left-turn from SIWWTP Driveway	No Project	22	223	201	C
	Expanded Primary	26	216	190	D
	Secondary	30	213	183	D
Afternoon Left-turn from SIWWTP Driveway	No Project	77	381	304	B
	Expanded Primary	126	381	255	C
	Secondary	155	379	224	C
Analysis As Conventional Intersection					
Morning Left-turn from SIWWTP Driveway	No Project	22	110	88	E
	Expanded Primary	26	107	81	E
	Secondary	30	105	75	E
Afternoon Left-turn from SIWWTP Driveway	No Project	77	87	9	E
	Expanded Primary	126	87	-39	F
	Secondary	155	87	-68	F

SIWWTP = Sand Island Wastewater Treatment Plant
LOS = Level-of-Service
(1) Vehicle count adjusted to reflect effects of roadway grade and vehicle types.

Wilbur Smith Associates; July 1993

If such changes occur and cannot be directly addressed (reschedule trucks, remove sight distance restriction), future driveway conditions could be improved by one of the following actions:

1. Install a traffic signal at the driveway, or at another intersection to the east to provide gaps in the westbound traffic flow; or

2. Provide a second driveway to Sand Island Parkway within the eastern part of the site (could be open only during shift change hours or gate-controlled, operated by authorized employee cards); or

3. Provide connection from SIWWTP employee parking to the traffic signal-controlled Pier 51A Road intersection (through the planned City Corporation Yard).

If a traffic signal is installed at the driveway intersection, the intersection would operate at LOS A or B, with the Year 2003 peak hour volumes approximating one-half of the intersection capacity.

Traffic volumes at the intersection of Nimitz Highway and Sand Island Access Road are expected to exceed the capacity of that intersection, either with or without the SIWWTP project. As summarized in Table 10, either treatment alternative would contribute a small incremental increase to the intersection volume-to-capacity ratio.

■ Increase In Truck Traffic ■

The various alternative treatment level/disposal options would result in different levels of trucking activity to remove solid waste materials from the plant. The average daily truckloads of material at full plant capacity (Forecast Year 2015) are presented in Table 11 for each option. The estimates of the outbound truckloads are based on tonnage estimates provided by Belt Collins & Associates and the use of large trucks with a 21-ton capacity. A like number of inbound truck trips would arrive at the plant for the pickup of the material. These arriving trucks would be empty with the exception of the alkaline stabilization option, for which a portion of the trucks would arrive with loads of lime for use in the process.

The largest trucking requirements would be for the landfilling and alkaline stabilization options. The incineration and power generation options would burn the solid waste on-site, with only the ash residue requiring removal from the site. The secondary treatment options would generally result in between two and three times as many truckloads of material as the expanded primary treatment options.

Truck loading operations would occur during daylight hours, primarily within the day shift work hours (6:30 AM to 3:30 PM). Most of the truck traffic to/from the plant would also be expected to occur within these hours.

Table 10

NIMITZ HIGHWAY-SAND ISLAND ACCESS ROAD INTERSECTION CONDITIONS WITH COMPLETED SAND ISLAND WASTEWATER TREATMENT PLANT PROJECT
East Mamala Bay Facilities Plan

Scenario	V/C	ADPV	LOS
Morning Peak Hour (6:30 - 7:30 AM)			
Existing	0.93	64.2	F
Year 2003 Without Project	1.17	84.5	F
Year 2003 With Expanded Primary Treatment	1.18	87.0	F
Year 2003 With Secondary Treatment	1.18	88.0	F
***Afternoon Peak Hour* (3:00 - 4:00 PM)**			
Existing	1.03	47.4	E
Year 2003 Without Project	1.29	*	F
Year 2003 With Expanded Primary Treatment	1.29	*	F
Year 2003 With Secondary Treatment	1.30	*	F

V/C = Volume-to-Capacity Ratio.
ADPV = Average Delay per Vehicle (in seconds).
LOS = Level-of-Service.
* = Calculation of vehicle delay time is infeasible when V/C is greater than 1.20.

Wilbur Smith Associates; July 1993

Table 11

DAILY TRUCKING NEEDS(1) WITH SIWWTP EXPANSION ALTERNATIVES

Disposal Option	Average Outbound Truckloads(2) of Material Produced Daily	
	With Expanded Primary Treatment	With Secondary Treatment
Landfilling	10.0	27.0
Alkaline Stabilization(3)	6.3	18.4
Thermal Drying	3.1	8.4
Composting	5.5	7.3
Incineration	0.2	0.5
Power Generation	0.2	0.5

(1) Estimates reflect Year 2015 usage levels.
(2) Based on average of 21 tons of material per truck.
(3) Requires inbound loads of lime, which would be brought in on same vehicles hauling away stabilized material.
Source: Belt Collins & Associates

The State DOT vehicle classification count made at the Sand Island Bridge (Station C-202-B) on February 4, 1991, recorded approximately 3,300 large trucks among the 15,500 vehicles using the bridge between 6:00 AM and 6:00 PM. With a two percent annual growth rate, the volume of trucks during these hours would increase to about 5,300 vehicles in Year 2015 when the SIWWTP reaches the levels of operation producing the truckloads noted in Table 11.

The option generating the most truck activity, the secondary treatment with landfilling option, would average a total of 54 daily truck trips (27 arriving/27 leaving the plant). This would approximate a one percent increase in truck activity on the Sand Island Parkway in 2015. Most of the other options would result in substantially less than a one percent increase in trucking activity.

Material produced by the alkaline stabilization, thermal drying, and composting options could be used as fertilizer and mulch for orchards, grass areas, and many other crops, either on Oahu or on the neighbor islands. Such material would likely be trucked to Honolulu Harbor for shipping to neighbor islands, or to Campbell Industrial Park for stockpiling or bagging.

Material produced by incineration and power generation options could be used in concrete products, or sent to a landfill. Part or all of the alkaline stabilization material might also be sent to landfills since the lime is suitable for use in covering the fresh landfill deposits at the end of each day.

Therefore, the likely routes for these trucks would be one or more of the following:

- Via Nimitz Highway to the piers serving barge traffic to the neighbor islands;
- Via Keehi interchange and H-1 Freeway to Campbell Industrial Park or the Waimanalo Gulch landfill; or
- Via Keehi Interchange, H-1 Freeway, and H-3 Freeway to the Kapaa landfill.

The trucking operations are not expected to substantially increase traffic at any problem locations. However, it is recommended that either: 1) truck operations be scheduled to avoid exiting the existing driveway during the morning or afternoon shift changes; or 2) a separate driveway be provided for truck use.

TRAFFIC CONSIDERATIONS DURING CONSTRUCTION AT THE SAND ISLAND WASTEWATER TREATMENT PLANT

Expansion of the SIWWTP would require a sizeable construction effort for either the expanded primary or secondary treatment alternatives. Construction for expanded primary treatment would last about 18 months and would occur in the 1998 - 2000 period. Construction for secondary treatment would last 36 months and, because of a longer time needed for design, would occur in the 2000 - 2003 period.

The construction project would increase traffic volumes during the peak commute periods, primarily due to the construction work force travelling to/from the project site, and during the midday periods, primarily as a result of transportation of construction materials and equipment. The construction traffic should primarily effect traffic conditions during the commute periods, at or near the project site. The assessment of construction traffic impacts focuses on these peak periods. The impacts of midday construction traffic is not assessed, given the temporary nature of the construction traffic increase, and the large number of trucks already using the area roadways.

■ Peak Hour Construction Traffic Increases ■

For construction of an expanded primary treatment level project, an average of 150 construction workers would work at the site each day. This size of the construction workforce would thus approximate the present staffing level of the day shift at the plant. Construction of a secondary treatment project would require a much larger workforce of 500 persons at the site throughout most of the construction period.

The work hours of the construction workers would be determined by project contractors, unless specific hours are specified by the City during the contract bidding/negotiation process. Typical construction work hours approximate or are slightly earlier than the SIWWTP day shift hours.

The number of construction worker vehicle trips was estimated for the morning and afternoon peak hours. The estimates reflect the following assumptions:

- Eighty-eight percent of the workforce would work on-site on any given day;
- All would arrive and leave within a one-hour period during the morning and afternoon, respectively. Also, five percent would leave the site in the morning peak hour and arrive in the afternoon peak hour to pick up materials, run errands, etc.; and
- Eighty percent would drive.

The resultant peak hour traffic estimates are summarized in Table 12.

Table 12

ESTIMATED CONSTRUCTION WORKER VEHICLE TRIPS
DURING PEAK HOUR PERIODS ON AN AVERAGE WORK DAY

Treatment Level	Average Work Force	AM Peak Hour		PM Peak Hour	
		To Site	From Site	To Site	From Site
Expanded Primary	150	106	7	7	106
Secondary	500	352	22	22	352

Wilbur Smith Associates; July 1993

For the construction of the expanded primary treatment project, the estimated 113 construction worker vehicle trips during the peak hours would amount to approximately three to four percent increase in traffic along the Sand Island Access Road, and a 1.25 percent increase in traffic passing through the Sand Island Access Road intersection with Nimitz Highway. For the secondary treatment option, the estimated 374 construction worker vehicles would increase peak hour traffic along Sand Island Access Road by 11 to 13 percent, and increase traffic at the intersection with Nimitz Highway by about four percent for the duration of the construction project.

■ Construction Worker Parking and Access ■

During construction of an expanded primary treatment project, there would be sufficient unused area within the site to provide the one acre or more area needed to park construction worker vehicles. The existing SIWWTP driveway could accommodate the construction worker traffic if most of the drivers cross to the median refuge lane during a gap in the eastbound traffic flow, and then merge into the westbound flow. However, even if all of the construction workers do this, rather than wait for a simultaneous gap in eastbound and westbound traffic flow, the service level for driveway traffic would worsen to LOS C or D conditions. If about one-third or more of the temporary workers wait for the simultaneous gap in both traffic flow directions, then the existing driveway service level would worsen to LOS F with long delays to exiting plant and construction worker traffic.

To mitigate the driveway problem during construction of an expanded primary treatment project, one or more of the following actions should be taken:

1. Provide a second driveway in the eastern portion of the site for construction workers;

2. Stagger plant work shift and construction worker hours to spread arriving and departing employee vehicles over about a 1-1/2-hour-long period; or

3. Provide construction worker parking at the City corporation yard site where workers could exit via the Pier 51A intersection.

With construction of a secondary treatment project, there would not be sufficient amount (about 3 acres) of unused area within the project site to park worker vehicles during most of the construction period. Most of the workers would have to park at a location off-site, with a possible bus shuttle provided to the work site. Also, a single driveway on the makai side of Sand Island Parkway could not accommodate all worker vehicles unless it is controlled by a traffic signal.

With the secondary treatment alternative, the construction workers would have to park off-site. Candidate locations include:

1. Provide construction worker parking at the City corporation yard site;

2. Lease temporary parking areas within the Matson areas across from the project site, where the present driveways should be sufficient to accommodate the added traffic; or

3. Provide parking within the former Kapalama Military Reservation area, or other sites along the Sand Island Access Road.

TRAFFIC EFFECTS OF CONSTRUCTION FOR WASTEWATER PUMP STATIONS

The East Mamala Bay Facilities Plan includes construction projects to expand capacity and/or improve reliability at the wastewater pump stations (WWPS) located within the collection area. Construction work at most WWPS would involve modifications to equipment and facilities within the WWPS site. Planned modifications at several of the WWPS would include off-site construction work, primarily the construction of sewer force mains to connect adjacent WWPS.

Construction work, either on-site or off-site, is planned for the following WWPS locations:

Ala Moana Park	On-Site
Aliamanu I	On-Site
Aliamanu II	On-Site
Awa Street (Nimitz/Nuuanu Stream)	On-Site
Beachwalk (Waikiki)	On-Site and Off-Site
Fort DeRussy (Waikiki)	On-Site
Hart Street (Pier 35)	On-Site and Off-Site
Kahala	On-Site and Off-Site
Kamehameha Highway (Keehi Lagoon)	On-Site and Off-Site
Kuliouou	On-Site and Off-Site
Niu Valley	On-Site
Public Baths (Kapiolani Park)	On-Site
Paiko Drive (East Honolulu)	On-Site
Sand Island Parkway	On-Site

The off-site construction for the Kuloiuou WPSS involves the construction of a sewer line from the WPSS to the Aina Haina area to connect it to the Sand Island system. The Kuliouou WPSS presently connects to the Hawaii Kai treatment plant system.

■ On-Site Construction ■

On-site construction at WPSS would encompass installation of additional or replacement equipment; modification to the pipes, valves, and electrical systems; and/or modifications to the WPSS buildings. The construction work should be contained within the site, with the work lasting less than one year at each WPSS.

Effects on traffic should be primarily limited to the increases in vehicles accessing each site during the construction period. These would include construction equipment, vehicles delivering equipment and construction materials, and worker vehicles. The added volumes of vehicles should not adversely affect traffic conditions on the adjacent roadways. At each site, the small number of construction-related vehicles and equipment should be parked on-site or in nearby parking areas where the vehicles would not impede traffic flow on the adjacent streets.

■ Off-Site Construction ■

Off-site construction of sewer force mains would be included with the modifications at five of the WWPS. For four of these, the sewer line construction would extend along or cross public roadways. The force main construction for Kamehameha Highway WWPS, located at the northwest corner of Keehi Lagoon Beach Park, would extend makai of and parallel to Nimitz Highway from the pump station to the kokohead side of Kalihi Street. The force main would not cross any roadways, but would cross a driveway to the Disabled American Veterans (DAV) facility.

The key roadways directly affected by force main sewer construction for the four WWPS—the Beachwalk, Hart Street, Kahala, and Kuliouou WWPS—are listed in Table 13. The table identifies the location of the construction work and the length of the sewer line constructed in the street. Also included are key traffic factors for each segment:

- Approximate weekday daily volume on the street at or near the work site, as obtained from recent City and State traffic counts, or estimated by Wilbur Smith Associates;
- The number of traffic lanes during the midday period. At some locations, on-street parking is restricted during either or both morning and afternoon peak traffic periods to provide additional traffic lanes; and
- The presence of on-street parking lanes or improved shoulder areas (including bicycle lanes) that could be used temporarily for traffic purposes during construction.

Table 13 also includes a rating of those construction locations that could result in moderate or severe disruption of traffic flow, based on a subjective assessment by Wilbur Smith Associates. The assessment reflects the magnitude of traffic volumes, potential for traffic use of parking or shoulder areas, and the magnitude likely duration of the construction. Almost all locations would result in some motorist inconvenience or delay.

General guidelines for construction of sewer lines within roadways are discussed in the next section of the report. The following paragraphs address key considerations regarding the locations affected by WWPS sewer force main connections.

The Beachwalk Wastewater Pump Station

The Beachwalk WWPS sewer construction along Ala Wai Boulevard, between Kaiolu Street and Kalakaua Avenue, and across Ala Moana Boulevard could potentially result in severe disruption to traffic circulation along these roadways. Traffic volumes in the Waikiki area remain high during most of the midday period when construction would typically occur. Potential special mitigative actions include the following:

- Due to traffic circulation constraints along McCully Street and Kalakaua Avenue near the construction site, a special construction phasing and traffic control plan should be prepared for this section to minimize traffic disruption and safety hazards;
- If feasible, traffic impacts could be reduced by construction of the sewer line under the mauka curb lane of Ala Wai Boulevard until beyond McCully Street, then locate the line under the left or center lanes when crossing Kalakaua Avenue; and
- If equipment is available in Hawaii at the time of construction, microtunnelling should be used to cross Ala Moana Boulevard and possibly Kalakaua Avenue to minimize traffic disruption.

The Kuliouou Wastewater Pumping Station

The Kuliouou WWPS work is planned to include construction of a new sewer main under the mauka side shoulder/bike lane area along Kalaianaole Highway from near Hawaii Kai to the Aina Haina area. The construction may require closure of the adjacent traffic lane at the construction site during certain periods of the project as installation proceeds down the roadway. The work would disrupt traffic to/from streets and driveways on the mauka side of the roadway. Other than Hawaii Loa Ridge (Puuikena Street), all other areas have more than one street outlet.

TRAFFIC EFFECTS OF CONSTRUCTION FOR SEWER LINES

Sewer lines are planned for construction to replace or supplement older, smaller lines where additional capacity is needed to accommodate future effluent flows, and to extend sewer service into a number of areas which presently do not have sewer connections. Construction of relief sewer lines would occur along several hundred street segments spread throughout the SIWWTP collection area, extending from the Middle Street area to East Honolulu. Virtually all of these relief sewer lines would be located within major roadways and secondary or collector roadways. Sewer construction into presently unsewered areas would be concentrated within six residential neighborhood areas and one commercial area, and would involve construction along both major roadways and local streets.

The construction of these sewer lines would take place between 1994 and 2010. Construction within various areas should last less than one year each, with the construction period for individual projects (streets) dependent upon the length and complexity of the project.

■ Guidelines for Sewer Line Installation ■

In general, almost all City sewer lines are placed within roadways. Ideally, the City seeks to place sewer lines within four feet of the centerline on two-way streets. This placement allows closure of only one lane (or sometimes none) for maintenance access, location of manholes where tires will not normally cross them, and approximately equal length connections to property lines on either side of the street. Only in special situations, or if there is no better alternative, are sewer lines placed along the outer portions of a street cross section, or under the gutter.

For construction of sewer lines within areas already having sewers, the following guidelines apply:

- All sewer lines will be installed within the paved portion of the roadway;
- An attempt will be made to restrict lane closure to a single lane at a time, but in some instances, such as when a sewer line cuts across a bend in the road or goes through an intersection, more than one lane may have to be closed to permit construction; and
- In streets which already have numerous utility lines in them, the only open area available for sewer line installation may require the closure of two lanes for installation.

Unsewered areas include locations that are semi-rural in character (upper Palolo Valley and Tantalus areas) as well as more urbanized areas. Guidelines for these areas include:

- A lateral from the main to every unsewered lot will be required;
- Where the sewer lines are in roadways (predominant location) they will be installed under the paved area, typically four feet to one side of the center line;
- An attempt will be made to restrict lane closure to a single lane at a time, but in some instances, such as when a sewer line cuts across a bend in the road or goes through an intersection, more than one lane may have to be closed for construction;
- For one-lane roads, construction would close the road, except that local traffic can pass with minor delays; and
- For two-lane roads one lane will be kept open.

For most major and secondary roadways, construction work within the traffic lanes will occur during the midday hours between the morning and afternoon peak traffic periods. In general, construction excavations would be covered over by steel plates or other means, and those construction barricades and equipment moved to permit use of all traffic lanes in the peak traffic direction during the peak commuter traffic periods. Dependent upon traffic conditions, a lane may remain closed in the off-peak direction to allow more efficient construction and to minimize the duration of the construction and lane closures.

Shoulders and parking lanes, where available, may be used as temporary traffic lanes during construction.

During construction, the contractors would be required to provide traffic controls to warn and guide motorists through the work areas. This may include:

- Publication of newspaper notices to alert the public of construction projects;
- Advance signing and other warnings to alert approaching motorists;
- Barriers, cones, and signing to direct vehicles through the construction zone; and
- Flagmen and/or police officers, when necessary, to control traffic flow through the construction zone.

Location of Relief Sewer Construction Projects

Construction of relief sewers is planned for more than 150 locations. These projects include a large number of projects that are one block or less in length, as well as a number of longer projects of one-half mile (4 to 10 blocks) or more. The projects include both State highways and City streets.

The majority of construction locations are on two-lane, two-way streets which provide access to and local circulation within residential or commercial areas. Construction activities would likely result in short-term traffic and parking inconveniences for area residents, businesses, and workers. These temporary effects may encompass:

- On-street parking removals;
- Restriction of left-turns into driveways due to excavations in the center of the street;
- Addition of construction-related traffic; and
- Some blockage of driveways where sewer placement is along edge of roadway.

A large number of the relief sewer projects would be located along or across key major roadways providing service to large volumes of traffic. A listing of these roadways is provided in Table 14, which identifies the location of the construction work and the length of the sewer lane constructed in the street. Also included are key traffic factors for each segment:

- Approximate weekday daily volume on the street at or near the work site, as obtained from recent City and State traffic counts, or estimated by Wilbur Smith Associates;

- The number of traffic lanes during the midday period. At some locations, on-street parking is restricted during either or both morning and afternoon peak traffic periods to provide additional traffic lanes; and

- The presence of on-street parking lanes or improved shoulder areas (including bicycle lanes) that could be used temporarily for traffic purposes during construction.

Table 14 also includes a rating of those construction locations that could result in moderate or severe disruption of traffic flow, based on a subjective assessment by Wilbur Smith Associates. The assessment reflects the magnitude of traffic volumes, potential for traffic use of parking or shoulder areas, and the magnitude and likely duration of the construction. Almost all locations would result in some motorist inconvenience or delay.

The most severe disruptive effects to traffic would likely occur at the following locations:

H-1 Freeway crossings near Kapalama Stream and east at Kam. IV Street, due to large volumes of traffic throughout the day;

Beretania Street crossing in the Civic Center (Lauhala Street) due to large traffic volumes and midday congestion at nearby Punchbowl Street intersection; and

Nimitz Highway/Ala Moana Boulevard due to length of project and the large volume of midday traffic and existing levels of congestion.

At the H-1 Freeway, the sewer line should be routed beneath the freeway using an existing crossing, or a microtunneling process should be used to avoid any disruption to this key traffic artery. Microtunnelling should also be considered for the Beretania crossing.

Table 13
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MAJOR STREETS[1] AFFECTED BY WASTEWATER PUMP STATION
OFF-SITE CONSTRUCTION
East Mamala Bay Facilities Plan

WWPS and Affected Streets	Construction Limits	Approx. Length (feet)	Present Daily Traffic	Lanes	Curb Parking or Paved Shoulder	Potential for Disruption[2]
Beachwalk Wastewater Pump Station						
Kuhio Ave.	Crossing at Kaiolu St.	---	23,000	5	--	✔
Kaiolu St.	Kuhio to Ala Wai Ave.	300	2,500	2	2 Sides Parking	✔
Ala Wai Blvd.	Kaiolu St. to McCully	1,200	35,000	3	1 Side Parking	o
	McCully to Kalakaua	400	20,000	3	--	o
	Kalakaua to Ala Moana	900	9,000	2	2 Sides Parking	✔
McCully St.	Crossing at Ala Wai Blvd.	---	38,000	5	--	o
Kalakaua Ave.	Crossing at Ala Wai Blvd.	---	45,000	5	--	•
Ala Moana Blvd.	Crossing near Atkinson	---	47,000	6	--	•
Ala Moana Park Rd.	Crossing at Ala Moana Blvd.	---	9,000	2	--	✔
Hart Street Wastewater Pump Station						
Sand Island Parkway	Crossing at SIWWTP	---	15,000	4	--	✔
Kahala Wastewater Pump Station						
Kahala Ave.	WPSS to Kealaolu	250	5,000	2	--	✔
Kealaolu Ave.	Kahala to Waialae	1,800	5,500	2	--	✔
Waialae Ave.	Crossing east of Kilauea	---	---	6	--	o
Kilauea Ave.	Crossing at Waialae	---	9,500	5	--	✔

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Table 13
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MAJOR STREETS(1) AFFECTED BY WASTEWATER PUMP STATION
OFF-SITE CONSTRUCTION
East Mamala Bay Facilities Plan

WWPS and Affected Streets	Construction Limits	Approx. Length (feet)	Present Daily Traffic	Lanes	Curb Parking or Paved Shoulder	Potential for Disruption(2)
Kahala Wastewater Pump Station (continued)						
Hunakai St.	Walalae to Keanu	150	7,000	3	2 Sides Parking	✔
Kuliouou Wastewater Pump Station						
Kalanianaole Hwy	WPSS to Nenue St.	10,800	50,000	3 Eastbound	--	✔
Kuliouou St.	Crossing	---	3,000	2	--	✔
Elelupe St.	Crossing	---	1,500	2	--	✔
East Halemaumau	Crossing	---	5,000	5	--	✔
West Halemaumau	Crossing	---	2,500	3	--	✔
Hawaii Loa St.	Crossing	---	2,000	2	--	✔
Puuikena St.	Crossing	---	2,000	3	--	o
East Hind Dr.	Crossing	---	3,500	3	--	✔
Kalanianaole Hwy.	Crossing	---	52,000	6	--	o

(1) Includes those streets affected by sewer force main construction.
(2) Qualitative assessment by Wilbur Smith Associates based on field observations.
- ● Expect lengthy delays; includes streets where flagman and alternating traffic flow needed.
- o Expect moderate traffic delays.
- ✔ Expect minor or no delay.

Wilbur Smith Associates; July 1993

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MAJOR STREETS[1] AFFECTED BY SEWER LINE CONSTRUCTION
RELIEF SEWERS
East Mamala Bay Facilities Plan

Affected Streets	Construction Area	Approx. Length[2] (feet)	Present Daily Traffic	Lanes[3]	Curb Parking or Paved Shoulder[4]	Potential for Disruption[5]
Kalihi St.	Silva to Kalani St.	1,700	16,000	4	2P	✓
	Dillingham to Haka Dr.	1,800	13,000	4	--	✓
Dillingham Blvd.	Kalihi St. to Waiakamilo	1,600	35,000	5	--	o
H-1 Freeway	Crossing East of Kam IV Rd.	---	205,000	4 EB; 3/2 WB	--	●
	Crossing at Auld Lane	---	215,000	6	--	●
King Street	Crossing at Kokea St.	---	25,000	5	--	✓
	Iwilei Rd. to Nuuanu Stream	400	10,000	4/1	--	✓
	Crossing at Alapai St.	---	22,000	5	--	✓
	Cooke St. to Ward Ave.	900	28,000	4	2P	✓
	Victoria to Keeaumoku	3,100	32,000	4	2P	o
	McCully to Isenberg	1,100	29,000	4	2P	✓
	Crossing at Manoa Stream	---	25,000	-	--	✓

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MAJOR STREETS[1] AFFECTED BY SEWER LINE CONSTRUCTION
RELIEF SEWERS
East Mamala Bay Facilities Plan

Affected Streets	Construction Area	Approx. Length[2] (feet)	Present Daily Traffic	Lanes[3]	Curb Parking or Paved Shoulder[4]	Potential for Disruption[5]
Beretania St.	King St. to Aala St.	500	20,000	4	2P	✔
	Crossing at Lauhala St.	---	45,000	6	--	●
	Victoria to Piikoi	1,400	28,000	3	2P	✔
	Near Keeaumoku	600	30,000	4	2P	✔
	Kalakaua to Isenberg (4)	900	25,000	2-4	1-2P	✔
Nuuana Ave.	Vineyard to Kukui	500	20,000	4	1P	✔
Nimitz/Ala Moana	Fort St. to Ward Ave. (3)	5,100	70,000	6	--	●
Punchbowl St.	Beretania to Miller St.	800	40,000	4-5	--	o
Alapai St.	King St. to Beretania	800	22,000	4	--	o
South St	Auahi St. to King St. (2)	2,500	10,000	3	1-2P	✔
Ward Ave.	Ala Moana to Kapiolani	2,100	32,000	4	2P	✔
Kapiolani Blvd.	West of Ward	600	38,000	6	--	✔
	East of Keeaumoku	500	40,000	6	--	✔
	Kamakee St. to Atkinson Dr.	4,300	40,000	6	--	✔
	West of University	400	40,000	6	--	✔
Piikoi St.	Kapiolani to Beretania	2,300	24,000	4	2P	✔

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MAJOR STREETS[1] AFFECTED BY SEWER LINE CONSTRUCTION
RELIEF SEWERS
East Mamala Bay Facilities Plan

Affected Streets	Construction Area	Approx. Length[2] (feet)	Present Daily Traffic	Lanes[3]	Curb Parking or Paved Shoulder[4]	Potential for Disruption[5]
Punahou St.	Young to King	300	20,000	5	--	✓
Kalakaua Ave.	Makaloa to Ala Wai	1,600	40,000	5	--	o
Lewers St.	Kalia to Kuhio	1,300	6,000	2	2P	✓
University Ave.	Kapiolani to Date	600	10,000	4	2P	✓
Atkinson Dr.	Ala Moana Blvd. to Kapiolani	800	23,000	5-6	--	✓

(1) Includes only major and secondary streets; excludes some short sections on major streets and any projects on local streets.

(2) Length of sewer line installation along street; for some streets, length is total for several shorter projects.

(3) Number of through or continuous turn lanes during midday.

(4) Where potentially useable by traffic during construction.

(5) Qualitative assessment by Wilbur Smith Associates based on field observations.
- ● Expect lengthy delays; includes streets where flagman and alternating traffic flow needed.
- o Expect moderate traffic delays.
- ✓ Expect minor or no delay.

Wilbur Smith Associates; July 1993

Location of Unsewered Area Projects

Construction of sewer lines to service presently unsewered properties is planned for the following areas:

- **Mapunapuna Industrial area;**
- **Puowaina Road residential area mauka of Punchbowl Crater;**
- **Nuuanu Pali Road area near Alewa Heights Spring;**
- **Makiki Heights-Round Top-Tantatus residential areas;**
- **Kinohou Place section of Manoa Valley;**
- **Upper Palolo Valley along LA-1 Road;**
- **Crater Road in Kaimuki; and**
- **Lighthouse, Black Point, and Aukai Avenue areas in the Diamond Head-Kahala area.**

The sewer lines primarily would be constructed within the roadways serving these areas. Most of these roadways are two-lane, two-way secondary roads or local streets. Sections of one-lane roadways are located in the Upper Palolo Valley and Makiki Heights-Round Top-Tantalus areas.

Sewer construction would have similar effects on traffic circulation to those discussed for two-lane roads in the preceding section. In addition, for the one-way roadways and many of the narrow two-lane roadways with narrow shoulder areas, traffic would be able to move in only one direction at a time through the construction area. Flagmen would be posted to alternate traffic flow between the two directions, and most vehicles would experience delays while waiting for traffic to clear. The length of these delays should be minimized by using as short a construction zone as efficiently possible.

The major streets affected by extension of sewer lines to these unsewered areas are listed in Table 15. Relatively low traffic volumes on most of these roadways should minimize the occurrences and duration of any traffic delays.

Table 15
(Page 1 of 2)

MAJOR STREETS[1] AFFECTED BY SEWER LINE CONSTRUCTION
TO UNSEWERED AREAS
East Mamala Bay Facilities Plan

Affected Streets	Construction Area	Approx. Length[2] (feet)	Present Daily Traffic	Lanes[3]	Curb Parking or Paved Shoulder[4]	Potential for Disruption[5]
Diamond Head Road	Near Lighthouse	1,500	11,000	2	--	✔
	West of Fort Ruger Park	900	11,000	2	--	✔
Round Top Dr.	Nehoa St. to Kalalopua	22,000	3,000	2	--	●
Tantalus Dr.	Kolonahe Pl. to Nahuina Tr.	13,000	1,000	2	--	●
Makiki Heights Road	Round Top Dr. to Tantalus Dr.	6,500	1,000	2	--	●
Puowaina Dr.	Near Hookui St.	600	5,000	2	--	✔
Auwaiolimu St.	Hookui St. to Kapahu St.	800	8,000	2	1P	✔
Nuuanu Pali Dr.	Near Alewa Heights Spr.	2,000	1,000	2	--	✔
Ahua St.	Kilihau St. to Mokumoa St.	2,300	10,000	2	2P	✔
Mapunapuna St.		2,300	5,000	2	2P	✔
Kilihau St.	Puuloa Rd. to Kakoi St.	1,400	4,000	2	2P	✔
Puuloa St.	Crossing at Kilihau St.	--	27,000	4/2	--	✔
Mokumoa St.	Mapunapuna St. to Ahua St.	1,100	4,000	2	2P	✔

Table 15
(Page 2 of 2)

MAJOR STREETS[1] AFFECTED BY SEWER LINE CONSTRUCTION TO UNSEWERED AREAS
East Mamala Bay Facilities Plan

(1) Includes only major and secondary streets; excludes some short sections on major streets and any projects on local streets.

(2) Length of sewer line installation along street; for some streets, length is total for several shorter projects.

(3) Number of through or continuous turn lanes during midday.

(4) Where potentially useable by traffic during construction.

(5) Qualitative assessment by Wilbur Smith Associates based on field observations.
- ● Expect lengthy delays; includes streets where flagman and alternating traffic flow needed.
- o Expect moderate traffic delays.
- ✓ Expect minor or no delay.

Wilbur Smith Associates; July 1993

Appendix G

ARCHAEOLOGICAL ASSESSMENT FOR THE EAST MAMALA BAY SEWERAGE DISTRICT, O'AHU DRAFT ENVIRONMENTAL IMPACT STATEMENT

by

Conrad Erkelens
J. Stephen Athens

INTERNATIONAL ARCHAEOLOGICAL RESEARCH INSTITUTE, INC.
HONOLULU, HAWAI'I

1993

ARCHAEOLOGICAL ASSESSMENT FOR THE EAST MAMALA BAY SEWERAGE DISTRICT, O'AHU DRAFT ENVIRONMENTAL IMPACT STATEMENT

by

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October 1993

Archaeological Assessment for the East Mamala Bay Sewerage District, O'ahu

- - Draft Environmental Impact Statement - -

INTRODUCTION

The purpose of this report is to characterize the potential for archaeological deposits (representing historic resources) in specific areas on O'ahu that may be impacted by planned improvements to the infrastructure of the present sewerage system in the East Mamala Bay subdistrict. In total, the potentials for historic resources at 25 locations are reviewed based upon information gathered from mid-nineteenth century Land Commission Awards (LCAs), historical maps, predictions from analogous settings, and a review of the historical and archaeological literature. Assessments from this information detail only general patterns of settlement and land use and in most cases cannot be more specific in regards to those parameters for a particular development site.

Archaeological deposits that represent historical resources include both prehistoric *(pre-European) Hawaiian habitation deposits and historic era (post 1778) deposits.* Besides the presence of traditional prehistoric Hawaiian artifacts such as faunal food remains, adzes, and gaming stones, archaeological deposits also consist of non-portable archaeological features such as burials, rockshelters, fishponds, trails, irrigation ditches, post-holes, hearths, earth ovens, midden (trash) pits, lithic work areas, and various constructed architectural features. Historical era deposits may also consist of bottle glass, ceramics, metal, and exotic natural materials such as chert, slate, granite, or non-portable features such as privies. All these archaeological deposits are considered archaeological sites and each contains a unique and non-renewable record of evidence about the past for which no other record exists.

Although not all locations slated for improvement to the sewerage system infrastructure will be subject to the same impacts from development, this assessment will be presented without regard for those differences. The assumption is that any archaeological resources present at the location will have the same potential for being impacted. The potential for archaeological deposits at each of the 25 development sites is assessed as being non-existent, or rated as having a slight, low, or high probability of occurring at a particular location.

Recommendations presented in this preliminary document should not be considered final since they will ultimately be subject to further review by the State Historic Preservation Division. With that caveat in mind, the following assessment categories and recommendations are presented for use in the initial planning stage of this project.

Those areas where archaeological deposits are believed to be non-existent should not require further archaeological investigation when addressing historic preservation concerns. Sites assessed as having a slight probability of containing archaeological deposits should be monitored by an archaeologist during initial construction excavations to confirm the preliminary assessment presented herein and to evaluate the need for further monitoring. Sites assessed as having a low probability of containing archaeological deposits should be monitored by an archaeologist during construction excavations to record the occurrence of archaeological deposits as they are encountered. Areas assessed as having a high probability of containing archaeological resources should be thoroughly investigated, prior to the final planning of the construction activities, beginning with an archaeological inventory survey of the location. At development sites assessed as having either a low or high probability of containing archaeological deposits, historic resources should be expected to be impacted during construction activities.

It should be emphasized that, contrary to popular belief, archaeological resources and human burials often exist in subsurface contexts under a variety of urban settings where previous construction activities have taken place. Media coverage of recent archaeological investigations at three sites in downtown Honolulu (located at Bethel Street, the Kekaulike Site, and Marin Tower) may be helping to change this misconception, however the extent of the archaeological resources in urban settings is still not fully appreciated by most urban planners. During IARII's Marin Tower Project (Goodwin 1992) a wealth of historical artifacts and the burial remains of 17 individuals were recovered from an area previously covered by a multi-storied building and parking lot. Similarly, recent experience on the Kalanianaole Highway Project (Erkelens 1992) on O'ahu has demonstrated that right-of-way corridors and the area directly under existing roads cannot be considered devoid of archaeological resources simply because asphalt has been laid on the surface or utilities have been laid underground at those locations (cf. Hammatt 1991).

The lesson that has been reinforced by these projects and by a number of other examples throughout the State is that an archaeological investigation of a subject parcel prior to the start of construction activities is, in the long run, both cost effective and efficient. Information provided by an archaeological investigation is the first step in the development of a Mitigation Plan addressing the legislated requirements for dealing with human burial remains or significant historic resources (archaeological deposits). Prior archaeological investigations not only limit delays that can be caused by the discovery of archaeological resources during construction, but they can often provide important environmental and geologic data relating to the site Such information has, in a number of cases, proven to be of great benefit to planners.

DEVELOPMENT SITES

SITES 1 AND 12
Sand Island WWTP (TMK 1-5-41:5)

The Sand Island Wastewater Treatment Plant (WWTP) and the Sand Island Parkway Wastewater Pump Station (WWPS) are located on an area of landfill (see Foote et al. 1972:Plate 62) created from dredged material placed on the reef flat. This took place during the creation of the Kapalama Basin in Honolulu Harbor during the 1930s (Thompson 1985:50). The WWTP and WWPS are adjacent to the edge of the area that was called Quarantine Island in the nineteenth century (Monsarrat 1897) that was also partially created by landfill at the end of the nineteenth century. Therefore, because the locations for Sites 1 and 12 are on recent dredged landfill above a previously uninhabitable reef flat, archaeological deposits should be non-existent and there should be no impacts to historic resources at these sites.

SITES 2 AND 3
Aliamanu #1 WWPS (TMK 1-1-21:10) and Aliamanu #2 WWPS (TMK 1-1-23:103)

Both these sites are located along Salt Lake Boulevard in the *ahupua'a* of Moanalua. These two sites are close in proximity and have similar potentials for the presence of historic resources. Because rainfall is only approximately 800 mm (31 in) annually, it would have constrained agricultural production to gourds or possibly sweet potatoes. In addition, the soils in the area belong to the Makalapa Series of clays (Foote et al. 1972:87). This series represents a Vertisoil whose agricultural potential is very limited. Therefore, prehistoric settlement of the area was probably minimal.

Nineteenth century LCA testimony does not add any information to our knowledge concerning land use in the general area. Both sites were contained within the 9,045 acre parcel recorded as LCA 7715 that was awarded to Lot Kamehameha (Kamehameha V). The present route of Salt Lake Boulevard is approximately the same route for a road that appears on a 1917 map of O'ahu (Marshall and Davis 1917). Earlier historic maps of Halawa and Moanalua (Lyons 1876; Monsarrat n.d.) depict the area in the vicinity of the sites as blank, suggesting little or no use of the general area. The prehistoric Hawaiian trail (I'i 1983:95), which connected Halawa in the Ewa district to Honolulu in the Kona district, bypassed the Aliamanu area entirely. The route of this trail was located inland of Aliamanu Crater and the shield volcano that is now known as Red Hill (Monsarrat n.d.). Only one archaeological site, a rockshelter near Salt Lake Elementary School (Site 80-13-500), has been identified in the Salt Lake - Aliamanu area (Barrera 1979).

In general, there is very little information available from the historical record from which to formulate an assessment. Based on available information, we believe both Sites 2 and 3 have a slight potential for archaeological deposits. Although Site 3 (Aliamanu #2 WWPS (TMK 1-1-23:103)) lies on the traditional border between the *'okana* (districts) of Ewa and Kona, and the *ahupua'a* of Halawa and Moanalua there is only a slight probability that evidence of its distinction as a boundary would be present at Site 3.

SITE 4
Awa Street WWPS (TMK 1-5-40:03)

This site is located adjacent to Honolulu Harbor at the mouth of Nuuanu Stream. Early maps of Honolulu by Kotezebue in 1817 (Fitzpatrick 1986:49) and Malden in 1825 (Fitzpatrick 1986:63) are difficult to interpret because of changes in the harbor shoreline associated with the placement of landfill in previous wetland areas. However, these maps do indicate some settlement and cultivation of the general area around the Awa Street WWPS. In the mid 1840s, the Ewa side of Nuuanu Stream, which includes the project site, was considered the edge of Honolulu town (Gilman 1903) and was therefore not depicted in detail on early maps.

Site 4 is located at the mouth of Nuuanu Stream and was part of Land Grant 3541 to the Oahu Railway and Land Company. There are no narrative records of land use associated with this property. This area is located in proximity to the recent excavations and ongoing research at the Marin Tower Site (Goodwin 1992) and the Kekaulike Site (Denham 1993). These archaeological sites have been shown to contain an abundance of archaeological material from both the pre-European and historical time periods. Site 4 is located on an area of landfill as indicated by the Soil Conservation Service's soil survey information (Foote *et al.* 1972). This may have protected buried archaeological deposits from previous construction disturbances. The landfill at Site 4 either extends into what was once the edge of the harbor or may overlie what was once part of the pondfield *(lo'i)* terraces that were depicted at this approximate location at the edge of Nuuanu Stream on early maps. It must be noted that this landfill may itself contain materials of historical interest. There is a high probability for archaeological deposits to be present at this location.

SITES 5 AND 6
Beachwalk WWPS (TMK 2-6-18:11) and Fort DeRussy WWPS (TMK 2-6-05:1)

Site 5 is located in a parking lot near the corner of Kuhio Avenue and Lewers Street. Site 6 is located approximately 100 m south of the intersection of Ala Moana Boulevard and Kalakaua Avenue. Both of these sites are located in Waikiki and have similar potentials for archaeological deposits. In general, the majority of the Waikiki Plain was devoted to extensive pondfield cultivation of taro and aquaculture in numerous fishponds (Barratt 1988; Bloxam 1925:35-36; Nakamura 1979; Thrum 1922; Vancouver 1798:I, 161-164).

Both sites are located in areas of fill (Foote *et al.* 1972) that may have preserved buried archaeological deposits from earlier construction disturbances. Site 5 was claimed as LCA 140, Fl. 3 by Kekuanaoa and was the location of the fishpond called *Loko* Mo'o (Bishop 1881; LCR n.d.b:494-495). The Beachwalk WWPS is located near the middle of that fishpond.

The area of Site 6 at Fort DeRussy is above the location of a fishpond (*Loko* Kaipuni) next to Waikiki Road (Kalakaua Avenue) as shown on early maps (Bishop 1881; Monsarrat 1897). There is a high probability that archaeological deposits will be present at both these sites in any areas undisturbed by previous construction (cf. Davis 1992).

SITE 6 (SEE SITE 5)

SITE 7
Hart Street WWPS (TMK 1-5-34:06)

Site 7 is located in Iwilei to the east of Kapalama Stream. Site 7 is now approximately 70 m from the edge of the harbor. The harbor was dredged inland to its present location in 1931 as part of the improvements to Kapalama Basin in Honolulu Harbor (Thompson 1985:50). Early maps show Site 7 as being located above the middle of a large (40+ acre) fishpond labeled as "old pond" by Monsarrat (1913). This fishpond was part of LCA 11215:2 claimed by Keliiahounui and may have been known as *Loko* Kuwili (Wright 1918). An early 20th century Land Court Application (Wright 1918) depicts a "line of fill" inland of Site 7 in an area labeled "rice fields" on an earlier map (Monsarrat 1897). It is probable that the area around Site 7 remained as wetlands until the first improvements were made at Honolulu Harbor, beginning in 1921, when the remainder of the area was filled in with dredge spoils. There is a high potential for the presence of archaeological deposits in the form of paleoenvironmental and geomorphological information at this site.

SITE 8
Kahala WWPS (TMK 3-5-23:42)

Site 8 is located in Waialae near the mouth of Kapapahi Stream, which served as the border between the *ahupua'a* of Waialae Iki and Waialae Nui. This land was part of LCA 10613 that awarded the whole *ahupua'a* of Waialae Iki to A. Paki, the father of Bernice Bishop.

This location, adjacent to both a permanent stream and the ocean resources, would have been a prime location for Hawaiian habitation. Judging from the use of the stream in Waialae Nui (Webster 1851) in the adjoining *ahupua'a*, taro was probably cultivated at or near Site 8 and a number of inland fishponds may have been present. In addition, Site 8 was also the location of the intersection for a number of prehistoric Hawaiian trails connecting Waikiki, Palolo, and the eastern shore of O'ahu (I'i 1983:92). This would suggest the location had some importance. A map by La Passe from 1855 (Fitzpatrick 1986:82-83) depicts a village with structures and fields at this location. In addition, based upon recent experience in Wailupe, Niu, and Kuliouou (Erkelens 1992) in identical geographical contexts, there is a high probability that prehistoric archaeological deposits, including human burials, exist in the undisturbed areas in and around Site 8.

SITES 9 AND 19
Kamehameha Hwy. WWPS (TMK 1-1-03:28) and the Mapunapuna Unsewered Area (TMK 1-1-05)

Sites 9 and 19 are located in the *ahupua'a* of Moanalua. Site 19 covers a large area that can be described as being bounded by Mapunapuna, Mokumoa, Ahua, and Kilihau Streets Site 9 is located across Nimitz Highway next to Keehi Lagoon Beach Park. Both of these locations are associated with the area awarded in LCA 7715 to Lot Kamehameha (Kamehameha V). Based on early maps of the areas (Harvey 1936; Monsarrat 1913; U. S. Army Corps of Engineers 1933), it is apparent that both sites are on an areas of landfill above Ahua and Awaawaloa Fishponds. These areas were filled with the material dredged from Keehi Lagoon for the construction of the seaplane landings area from 1941 to 1944 (Thompson 1985:99).

There is a high probability of encountering archaeological deposits and features associated with Ahua and Awaawaloa Fishponds during subsurface work in this area that would be complimentary to data obtained in a :ecent paleoenvironmental in the nearby Fort Shafter Flats (Wickler *et al.* 1991).

SITE 10
Moana Park WWPS (TMK 2-3-37:10)

This site is located on landfill at the location where the Makiki and Piinaio Streams met the ocean (Bishop 1881; Monsarrat 1897) and was claimed as part of LCA 2790 by Lota Kamehameha. It is probable that this location was not reclaimed wetland but did have fill placed upon it to raise the elevation as part of the reclamation of the area now occupied by Ala Moana Shopping Center and Park. This reclamation project began in 1922 (Honolulu Advertiser 1922) and later included the widening of Ala Moana Boulevard to four lanes in 1939. Ala Moana Blvd. was again widened in 1949 to the present configuration.

Given the potential importance of the area surrounding the mouth of a freshwater stream at the beach, there is a high probability that archaeological deposits are present in the undisturbed sediments at this location. These were the favored locations for the construction of fishponds and preferred locations for habitation since there was readily available access to both fresh water and the ocean's resources.

SITE 11
Public Bath WWPS (TMK 3-1-31:07)

This site is located at the beach at Waikiki in proximity to the Natatorium. The traditional Hawaiian name for this area was Kapua (Monsarrat 1897) and it was claimed by Pehu in LCA 5931:2. In 1876 the area immediately inland of the site was a wetland covered in sedge grass adjoining a duck pond in what is now Kapiolani Park (Lyons n.d.). Also adding to the potential of this site's importance was the route of a prehistoric Hawaiian trail that passed along the beach at this location (I'i 1983:92).

The underlying sediments at Site 11 are beach sand. Locations such as this were the preferred location for prehistoric Hawaiian burial sites. Burials recovered in the vicinity of Site 11 include four individuals disinterred from the location of the Elk's Club (Emerson 1902) and 25 individuals from the site of the Outrigger Canoe Club (Krauss 1963; Yost 1971:122). In total, over 40 burials have been discovered in the beach sand along the Waikiki shoreline. On May 18, 1993 an unknown number of human remains were discovered during excavations for improvements being made at the Waikiki Aquarium, which is immediately adjacent to Site 11. In addition to burials, there is also a high probability of encountering archaeological midden deposits related to prehistoric Hawaiian habitation of the area as has recently been demonstrated for other sites at Waikiki (Davis 1989, 1992).

SITE 12 (SEE SITE 1)

SITE 13
Aukai Avenue Unsewered Area (TMK 3-5-04)

This location, approximately one block of a residential street, is located in the *ahupua'a* of Waialae Nui on the coastal plain approximately 122 m (400 ft) from the present shoreline. Abbot (1992:30) notes that this area was noted for its sweet potato fields by Menzies in 1792. A large land parcel that includes the site was claimed by Kaleiheana as part of LCA 228B. There is no informative testimony associated with this claim that would inform us about land uses for this area in the mid-1800s (LCR n.d.a:369-370).

The soil at this location is described as Jaucas sand soils (Foote *et al.* 1972:48), which contain accumulated salts and have poor water retention characteristics. Rainfall is reported to be approximately 600 mm (23.6 in) annually (Giambelluca *et al.* 1986). While this may have been marginally sufficient for the cultivation of sweet potatoes or gourds, it would have been a difficult environment for sustained subsistence from horticultural practices alone. The area immediately offshore in Maunalua Bay was rich fishing grounds and remains so even today. Attesting to the abundant marine resources available here, the offshore fishing areas along the east coast of O'ahu were claimed as part of the Land Commission Awards as named "fisheries" (Wright 1922, 1925).

In spite of the somewhat poor soils in the area, it is highly probable the area was inhabited by prehistoric Hawaiians and that archaeological deposits are present in the area. The *makai* portions of Wailupe, Niu, and Kuliouou, which are locations also characterized by Jaucas sand soils, have recently been found to contain abundant prehistoric archaeological deposits (Erkelens 1992). In addition, a number of human burials were also encountered in those areas during recent construction associated with the Kalanianaole Highway improvements. It is therefore highly probable that archaeological deposits will be encountered during subsurface work at the location of Site 13.

SITE 14
East Manoa Road / Kinohou Place Unsewered Area (TMK 2-9-37)

This site includes sections of Kinohou Place and Molulo Place located between East Manoa Road and Manoa Stream. The area was within the traditional land division (*'ili*) of Pulena and was associated with LCAs numbered 1920, 1930, 1940, and 6450 (Baldwin 1882). A prehistoric Hawaiian trail passed next to the site along the present route of East Manoa Road connecting Waikiki "to Kapulena and Kolewalu" (I'i 1983:92). Thrum referred to East Manoa Road as the "central road of the valley" (1892:113). Land use in the area included "taro land" referred to in LCA 1920 (Book 8, p. 692) claimed by Paaluhi and an inland fishpond called *Loko* Kuwili associated with LCA 6450 (Book 9, p. 678) claimed by Kaunuoha. Thrum said the entire valley was cultivated in taro in 1892 (1892:113) although it had probably been farmed by Chinese immigrants since approximately 1845 when the Chinese cemetery was established nearby.

There is a high probability that the entire course of Manoa Stream was developed for pondfield cultivation of taro. It is also probable that archaeological deposits associated with prehistoric habitation as well as the evidence of the pondfield system exist at the site and should be investigated.

SITES 15 AND 18
Diamond Head Unsewered Area (TMK 3-1-34, -35, -37, -42) and Black Point Unsewered Area (TMK 3-1-38, -39, -40, -41, and 3-5-01, -02)

All the land around Leahi (Diamond Head) was part of a large parcel claimed by W. C. Lunalilio in LCA 8559B that was referred to as "Pau, Waikiki." There is no testimony detailing land use associated with this claim (Book 10, p. 486-487). The lee area of Diamond Head Crater is moderate to steeply sloping and was called Kaalawai by Hawaiians. A prehistoric Hawaiian trail passed along the present route of the Kalakaua, Diamond Head, Kahala Avenue road corridor through Kaluahole (Diamond Head Point) and Kaalawai and down to Kahala (I'i 1983:92, 94). A map by La

Passe from 1855 (Fitzpatrick 1986:82-83) appears to depict a number of habitation structures in the vicinity of Kulamana Street and Royal Place suggesting that in the mid-nineteenth century there was some settlement in the area.

Diamond Head Road was constructed in 1908. Prior to this, a road referred to as "Old Beach Road", which was constructed around 1898 (Land Court Application 1925), ran down the present route of Beach Road, along the shoreline, and uphill in the corridor that is now Kulamana Place. The route of the "Old Beach Road" is the location for approximately 800 linear meters (2500 ft) of the area identified as Site 18.

To the east of Diamond Head lighthouse the soils are classified as Makalapa clay (Foote *et al.* 1972:87). Soils to the west of the lighthouse are of the Mamala Series of stony silty clays (Foote *et al.* 1972:93) and at Black Point are from the Molokai Series of silty clay loams (Foote *et al.* 1972:96). Although these soils are generally stony and subject to erosion, this was not a limiting factor for Hawaiian farmers (Kirch 1985:31) whereas available water probably was. Rainfall is reported to be approximately 600 mm (23.6 in) annually (Giambelluca *et al.* 1986). Based upon similar environments in the islands, this may have been marginally sufficient for the cultivation of sweet potatoes or gourds (cf. Kirch 1985:31) in the flatter portions of Kaalawai and Kupikipikio (Black Point). Between Kaluahole and Kupikipikio were the three named fishing grounds of Keauau, Kuilei, and Kaalawai. At the shoreline *makai* of Kaikuono Place there was an unnamed spring and fishpond (Diamond Head n.d.).

Given our understanding of the marginal nature of the area for intensive cultivation and habitation, there is a low probability of encountering archaeological deposits during activities associated with improvements to the infrastructure for the majority of Sites 15 and 18. However, the location of the unnamed fishpond along the shoreline near the terminus of Kaikuono Place should be regarded as having a high probability for containing archaeological resources.

SITE 16

Punchbowl Unsewered Area (TMK 2-2-05, -06, -14 and 2-4-41)

Site 16 is located on the slope of the northeast corner of Punchbowl Crater, called Puowaina by Hawaiians (Lyons 1901:182). Soils in the area are characterized as the Tantalus Series of silty clay loam that are capable of supporting most Hawaiian cultigens. Rainfall at this site would also be considered adequate. The lower elevations around Punchbowl, below Site 16, were considered choice land by Hawaiians (Kame'eleihiwa 1992:90). The area between Auwaiolimu and Hiilani Street is shown on the recent tax map as the location of an "old quarry." This is one of the areas where gravel was quarried in the late 1800s with prison labor to maintain the roads into the upper sections of Tantalus and Round Top (cf. Frey 1987) and probably also for Puowaina Drive.

Although the general area around Punchbowl was probably very productive, given the steep grade in the area encompassed by Site 16, this specific location was probably not used prior to the construction of Puowaina Drive. The road and subdivision of the lots along that road were not in existence prior to 1915 (Iao 1915). Based upon this assessment there should be only slight probability of archaeological deposits being present at this Site 16.

SITE 17
Tantalus, Makiki, Round Top Unsewered Area (TMK 2-3, 2-5; 3-4-26, -27; 3-5)

The area covered by Site 17 must be subdivided into three different environmental zones, each having a different potential for containing archaeological resources. These zones are best described by their characteristic soil and topographical differences (cf. Foote *et al.* 1972:Sheet 62).

Zone 1 is an area defined by its moderate to steep slope that would have prevented modification and intensive use by prehistoric Hawaiians. Hawaiians would have called this zone *wao la'au* or *wao kanaka* (Handy and Handy 1972:56) reflecting its use as an area for foraging the botanical resources of the uplands. Zone 1 encompasses soils from two of the Soil Classification Series (Foote *et al.* 1972). Soils in the upper elevations of Round Top are characterized as Cinder Land having "very severe limitations" on land use (Foote *et al.* 1972:29). The remainder of the steep land is characterized as belonging to the Tantalus Series of silty clay loam, which although capable of supporting most Hawaiian cultigens was probably of too steep a grade to have been exploited in such a manner.

The upper areas of Tantalus, Makiki, and Round Top were first opened up in 1880s (Frey 1987) with good roads being constructed in 1893 (Hawaiian Gazette 1892:10; Monsarrat 1897). Soon after the overthrow of the Hawaiian monarchy, the hillsides were subdivided into lots and were then sold as Land Grants, mostly to non-Hawaiians. Because these lots were awarded as Grants there are no associated records of land use testimony from the mid 1800s for Zone 1 of Site 17.

Zone 2 at Site 17 is a type of terrain and soil, which when combined with readily available water for irrigation, was called *kahawai* (Handy and Handy 1972:56) and was highly valued by Hawaiian farmers for pondfield cultivation of taro. Numerous archaeological features have been identified for an area similar to Site 17 in the upper section of Makiki Valley (Yent and Ota 1980). Zone 2 is an area having soils characterized as one of two soil types. The section along Makiki Stream is level to gently sloping and contains soil of the Kawaihapai Series of stony clay loam. Upstream of the confluence of Kaneaole and Maunaiaha Streams, Zone 2 contains an area of moderate slope with soils characterized as Kaena stony clay. Although stony soils present difficulties to western agricultural techniques, Hawaiian horticultural practices would not have found this a limiting factor (cf. Kirch 1985:31). Habitation and cultivation of the area encompassed by Zone 2 was probably intensive given that this was the area preferred by Hawaiians for pondfield (*lo'i*) cultivation of taro..

Zone 3 is an area of gentle to moderate slope and having soils characterized as being the Tantalus Series of silty clay loam. Rainfall and the soil type are capable of supporting the cultivation of most Hawaiian food crops. Kamehameha I is reported to have established sweet potato fields at Ualaka'a located between Manoa and Makiki (Kamakau 1992:190; I'i 1983:68, 69). Fornander (1919:532) gives the location for this field as being, "the whole slope of this spur of the Manoa range" suggesting the foot of Round Top (Ualaka'a), in agreement with Thrum (1892:110), as being the location for these fields. Kame'eleihiwa (1992:59) gives the location as being at foot of Tantalus. While the place name Ualaka'a probable only refers to the slope at the foot of Round Top, both of these slope areas comprising Zone 3 were similarly capable of supporting the cultivation of sweet potatoes.

Zone 1 is begins at Mott-Smith Drive above Lilio Place and Roosevelt School and encompasses all of Makiki Heights Drive above 200 ft in elevation and all of Round Top Drive above 240 ft in elevation. There is only slight probability of encountering archaeological deposits in this zone of Site 17.

Zone 2 is located along Makiki Heights Drive, Makiki Street, Oneele Place, and Maunalaha Road where they are adjacent to and parallel Makiki and Maunaiaha Streams. Given that the area would have been highly valued by Hawaiians, there is a high probability of that archaeological deposits exist in this zone of Site 17.

Zone 3 is located at Mott-Smith Drive above Nehoa Street to 200 ft in elevation and in the area between the lower intersections of Makiki Street with Round Top Drive and Makiki Street with Okika Place. Zone 3 is the area known to Hawaiians as Ualakaa that was renowned for growing sweet potatoes. There is a low probability of encountering archaeological deposits in this zone of Site 17.

SITE 18 (SEE SITE 15)

SITE 19 (SEE SITE 9)

SITE 20
Crater Road Unsewered Area (TMK 3-2-33, -34, -35, -36)

This location between Leahi (Diamond Head) and Kaimuki was claimed as part of LCA 8559B by W. C. Lunalilio. There is no award testimony associated with this area describing land use in the mid 1800s. Detailed maps from the late 19th century depict the area around the site as a blank (Diamond Head n.d.; Lyons 1876; Monsarrat 1881) suggesting little or no prehistoric use of the area. In the late 1800s the land had been used as a open range for cattle. The general area of Kaimuki around Site 20 began to be developed in 1904 for housing construction (Honolulu Advertiser 1939:6). Roads into the area of Site 20 were not in place until the 1940s following the expansion of Kaimuki Town as a commercial center.

Soils in the area are of the Molokai Series of silty clay loam having severe limitations because of erosion hazards and low water holding capacity (Foote *et al.* 1972:154). These factors combined with an annual rainfall of 800 mm (31.5 in) also suggest the area was probably not exploited by Hawaiians to any degree that would have resulted in archaeological deposits being present in the area. Therefore, there is only slight potential for archaeological deposits to be present in the area of Site 20.

SITE 21
Nuuanu Pali Drive Unsewered Area (TMK 2-2-55)

This area is at the confluences of Moole, Nuuanu, and Makuku Streams and adjacent to a pool in Nuuanu stream called Waihaka. The Hawaiian name for the general area was Luakaha. There are no known archaeological sites in the area of Site 21. Nearby however, was the location of Queen Kalama and Kamehameha III's summer home known as Kanikapupu. It has been reported by Sterling and Summers (1978:307), who cite an fanciful newspaper article (Ralphaeson 1925), that this residence was built on the ruins of an old *heiau*. However, earlier accounts (Johnstone 1907:164) note, "The ruin at this point consists of four dilapidated walls of stone, which, it is said, certain ill informed persons delight to point out to strangers as the ruins of an old heiau."

There is no Land Commission Award testimony associated with this parcel because it was largely designated as Crown Land. Given its proximity to the numerous streams and historical information illustrating (Lyons 1874) and describing the growing of taro at this location (I'i 1983:153; Kamakau 1992:293), there is a high probability for the existence of archaeological deposits from Hawaiian habitation and cultivation at this location.

SITE 22

Palolo Unsewered Area (TMK 3-4-12, -19, -21)

Site 22 encompasses an area at the back of Palolo Valley including "LA-1 Road" (known to residents of the area as La'i Road) and a number of other private roads. Zone 1 of Site 22 is land that is steeply sloping or above 600 ft in elevation. This zone was probably only exploited for the foraging of botanical resources as *wao la'au* or *wao kanaka* by Hawaiians (Handy and Handy 1972:56). This area has only slight probability of containing archaeological deposits reflective of this land use.

Zone 2 of Site 22 is the section of the road that parallels and crosses Pukele Stream. Zone 2 is level to gently sloping and contains soil of the Kawaihapai Series of stony clay loam. Areas such as this were called *kahawai* by Hawaiian farmers (Handy and Handy 1972:56) and were highly valued for pondfield (*lo'i*) cultivation of taro despite the stony soil (cf. Kirch 1985:31). Handy and Handy (1972:483) report Palolo had extensive taro pondfield (*lo'i*) terraces along the length of Pukele Stream although historical maps (Monsarrat 1881; Wall 1881) only depict settlement extending to approximately the present location of Anuenue School. In general, Palolo Valley was sparsely populated in the early 1900s although the two western-most roads into the area were in existence in the late 19th century (Monsarrat 1881; Wall 1881; Wright 1914). Prehistorically, habitation and cultivation of the upper section of Palolo (encompassing Site 22) was probably as intensive as in the lower section (cf. Nagaoka 1985) given that this type of area, called *kahawai* (Handy and Handy 1972:56), was preferred by Hawaiians for the cultivation of taro. There is a high probability of encountering archaeological deposits in this zone of Site 22.

Zone 3 comprises the slightly or moderately sloping areas of Site 22 that are not in the immediate vicinity of Pukele Stream, which have rich soil and abundant rainfall (averaging 2000 mm [79 in] annually), suggesting the area may have been cultivated as *kula* land by those inhabiting the area along Pukele Stream. There is a low probability that archaeological deposits reflecting this extensive land use will be encountered during construction associated with improvements to the sewerage system.

SITES 23, 24, AND 25

Niu Valley WWPS (TMK 3-8-01:34), Paiko Drive WWPS (TMK 3-7-10:52), and Kuliouou WWPS (TMK 3-8-04:79)

Sites 23, 24, and 25 are located close to one another and have similar potentials for the presence of archaeological deposits. The Niu WWPS is located next to Niu Stream directly across the highway from Niuiki Circle. Niuiki Circle is the location of a the filled fishpond *Loko* Kupapa. Paiko Drive WWPS is located on Paiko Drive adjacent to Paiko Fishpond. The Kuliouou WWPS on May Way is at a location between Kuliouou Stream and what was the edge of Maunalua Fishpond prior to the "reclamation" if the area by landfilling for the Hawaii Kai Development. Presently the Kalanianaole Highway passes near all three sites providing a thoroughfare between Honolulu, Hawaii Kai, and the remainder of the windward coast. This right-of-way had previously served as the route of a well traveled prehistoric Hawaiian trail from "Keahia and on to Maunalua" (I'i 1983:94) through the seaward portions of the traditional land divisions constituting the *ahupua'a* of Niu, and Kuliouou within the *Kona 'okana* or district (Handy and Handy 1972). All three sites are located along this important prehistoric route.

Rainfall along this eastern coastline has a median annual average of 500-760 mm (20-30 in) per year (Giambelluca *et. al* 1986). Permanent streams exist in Niu and Kuliouou valleys and provide drainage for orographic rain falling on the leeward side of the Ko'olau Range farther inland. The water table in Niu and Kuliouou although somewhat variable, is with 3 to 4 feet (1 to 1.5 m) of the surface giving rise to the presence of numerous springs. The traditional name for spring adjacent to Kupapa (Niu) Fishpond has been lost but was known as "Lucas Spring" in the 1930s. At Kuliouou, adjacent to Paiko Fishpond, was Kanewai Spring (Board of Water Supply records, Allen Morisako 1993: pers. comm.). It is probable that numerous other unrecorded springs also exist in the area.

It has been apparent from recent field observations (Erkelens and Athens 1993) that the near shore area of Niu and Kuliouou was at one time an aeolian calcareous sand dune, extending back from the beach at least 100 meters. Mollisoils predominate in the general area and can be characterized as well drained, relatively young soils that generally develop on coralline bedrock or alluvial deposits (Foote *et. al* 1972:212; Armstrong 1973). In the specific areas of the three WWPS, the soils are from the Mokuleia Series (Foote *et. al* 1972:95) consisting of a fine sandy loam with occasional areas of Jaucas Sand. This environmental data suggests the area in the vicinity of Sites 23, 24, and 25 is capable of supporting the entire range of traditional Hawaiian cultigens.

All available historical information concerning these two locations is summarized in Erkelens and Athens (1993). Notable were the British expedition of Portlock and Dixon, which anchored in Maunalua Bay immediately offshore of Kuliouou in 1786 (Portlock 1794; Beresford 1964), Mathison's narrative of his trip through the area in 1822 (1825:387), and the visit to Niu in 1845 by Lt. John Dale, a member of the United States Exploring Expedition (Dale 1845; Forbes 1992:126-128). Mathison, in particular, mentions a village, "containing perhaps one hundred huts" (1825:387) that was most likely at or near the location of the *Kuliouou* WWPS (Site 25). In general, there is evidence from these sources of a substantial dispersed settlement along the entire coastal area with more intensive settlement located inland.

Although land use information from the mid-1800s is generally available for many Hawaiian locations, the *ahupua'a* of Kuliouou had only one LCA with the remaining land being sold as Grants, which did not require the tenant/purchaser to give any testimony to prove a claim. As a result, there is no descriptive information accompanying these land parcels. The *ahupua'a* of Niu is unique in that the whole valley was awarded (LCA 802) to Alexander Adams as a single claimant so again there is no land use data available from LCA testimony for this large area (Day 1984; McClellan 1972). However, based upon the corpus of LCA testimony for Wailupe from the mid-1800s (an analogous environment) the majority of the agricultural production along the east coast of O'ahu may have been dedicated to the cultivation of non-labor intensive dryland crops. There is however, testimony that pondfield taro was grown adjacent to the streams at some locations. The mid-nineteenth century trend to produce marketable dryland crops may have resulted from economic pressures to cultivate items such as potatoes for whalers and the Pacific Coast trade (Kuykendall 1982) and is not necessarily indicative of the previous traditional Hawaiian usage of the area. Also indicative of the productive resources near the site locations were a number of offshore fisheries. Land Court Applications in the early 1900s for Kuliouou (Wright 1922) sought to secure rights to a portions of the Niu, Kuliouou 1, and Kuliouou 2 Fisheries. This is in addition to the *loko kuapa* of Kupapa (Niu) Fishpond, Paiko Fishpond, and Maunalua Fishpond.

Following the end of the Pacific Coast gold rush and the decline of the whaling industry in 1860s (Daws 1974; Kuykendall 1965), the raising of livestock had become more important in the area (Pacific Commercial Advertiser 1857; Bowser 1880) and land that had been previously cultivated in dry land crops was converted to use as pasturage. Throughout the first half of the twentieth century the area remained very rural with dairies in both Niu and Kuliouou and numerous small farms raising pigs, chickens, and a variety of vegetable crops (Henry 1959). Dramatic changes to the area occurred as the large land parcels were subdivided into residential lots beginning in the 1940s. The last major transformations to take place in the area began in 1953 when Niu (Kupapa) Fishpond (Honolulu Star

Bulletin 1953:III(1)) was filled and subdivided into house lots along Nuiiki Circle and lasted until the 1960s when Maunalua Fishpond was filled to create the Hawaii Kai residential area.

McAllister's archaeological survey of O'ahu (1933:69-70) and Sterling and Summers (1978:270-275) compendium of that and other material, recorded Kupapa, Paiko, and Maunalua fishponds, burial caves in Niu (exact location unspecified), and the religious sites (*heiau*) named Kawauoha (in Wailupe, exact location unspecified), Kulepeamoa (Site 50-80-15-1972), Kauiliula, and Ahukini (in Kuliouou, exact location unspecified). Additional archaeological investigations that have taken place in the area include Barrera (1978, 1979), Clark (1977), Connolly (1974), Emory and Sinoto (1961), McMahon (1988), and Sinoto (1982). With the possible exceptions of the two part inventory survey by Barrera (1978, 1979) the work by Emory and Sinoto (1961), and McMahon (1988), the remaining studies were extremely brief in duration and provided no useful information for archaeological purposes. Emory and Sinoto's work documented the presence of archaeological deposits from Hawaiian habitation in a rockshelter located between Niu and Kuliouou dating to approximately 1000 years before present (946 +/- 180 BP; uncalibrated). The investigations by Barrera (1978, 1979) and McMahon (1988) were limited in scope to inland portions of Niu and Kuliouou and did not recover evidence of prehistoric habitation.

Recent archaeological monitoring of construction associated with the Kalanianaole Highway widening project along the *makai* portions of Kuliouou and Niu (Erkelens and Athens 1993) has demonstrated that there is a high probability of encountering archaeological deposits and burials resulting from prehistoric Hawaiian habitation in the vicinity of the three WWPS sites. The location of the Niu Valley WWPS, along a prehistoric coastal trail, adjacent to Niu Stream, and in the vicinity of Kupapa Fishpond, would have been a prime location for Hawaiian habitation. The same is the case for the location of the Kuliouou WWPS along the coastal trail between Kuliouou Stream and Maunalua Fishpond. Similarly the general location of the Paiko Drive WWPS would have been of importance to Hawaiians because of the trail, adjacent fishpond, and nearby Kanewai Spring. In addition, an immediately adjacent parcel (TMK 3-8-01:51) is reported to be the location of one of the summer homes of Kamehameha I (Ben Cassiday 1993, pers. comm.; Sterling and Summers 1978:273). In short, all three locations have high potentials for the presence of significant archaeological deposits and human burials.

SUMMARY OF ARCHAEOLOGICAL ASSESSMENTS FOR THE EAST MAMALA BAY SEWERAGE DISTRICT SITES

SITE	LOCATION	TMK	PRESENCE OF ARCHAEOLOGICAL DEPOSITS	PRELIMINARY RECOMMENDATION
1 & 12	Sand Island WWTP and Sand Island Parkway WWPS	1-5-41:5	none	final review by SHPD
2 & 3	Aliamanu #1 and Aliamanu #2 WWPS	1-1-21:10 & 1-1-23:103	slight probability	archaeological monitoring / further evaluation
4	Awa Street WWPS	1-5-40:03	high probability	subsurface testing prior to construction
5 & 6	Beachwalk and Fort DeRussy WWPS	2-6-18:11 & 2-6-05:1	high probability	subsurface testing prior to construction
6	(see Site 5)			
7	Hart Street WWPS	1-5-34:06	high probability	subsurface testing prior to construction
8	Kahala WWPS	3-5-23:42	high probability	subsurface testing prior to construction
9 & 19	Kamehameha Hwy. WWPS and the Mapunapuna Unsewered Area	1-1-03:28 & 1-1-05	high probability	subsurface testing prior to construction
10	Moana Park WWPS	2-3-37:10	high probability	subsurface testing prior to construction
11	Public Bath WWPS	3-1-31:07	high probability	subsurface testing prior to construction
12	(see Site 1)			
13	Aukai Avenue Unsewered Area	3-5-04	high probability	subsurface testing prior to construction

SITE	AREA	TMK	PRESENCE OF ARCHAEOLOGICAL DEPOSITS	RECOMMENDATION
14	East Manoa Road Unsewered Area	2-9-37	high probability	subsurface testing prior to construction
15 & 18	Diamond Head Unsewered Area and the Black Point Unsewered Area	3-1-34, -35, -37, -38 -39, -40, -41, 42, and 3-5-01, -02	low probability (majority of area) high probability (small area)	archaeological monitoring during construction subsurface testing prior to construction
16	Punchbowl Unsewered Area	2-2-05, -06, -14 and 2-4-41	slight probability	archaeological monitoring / further evaluation
17	Tantalus, Makiki, and Round Top Unsewered Area	2-3, 2-5; 3-4-26, -27; and 3-5	Zone 1 - slight probability Zone 2 - high probability Zone 3 - low probability	archaeological monitoring / further evaluation subsurface testing prior to construction archaeological monitoring during construction
18	(see Site 15)			
19	(see Site 9)			
20	Crater Road Unsewered Area	3-2-33, -34, -35, -36	slight probability	archaeological monitoring / further evaluation
21	Nuuanu Pali Drive Unsewered Area	2-2-55	high probability	subsurface testing prior to construction
22	Palolo Valley Unsewered Area	3-4-12, -19, -21	Zone 1 - slight probability Zone 2 - high probability Zone 3 - low probability	archaeological monitoring / further evaluation subsurface testing prior to construction archaeological monitoring during construction
23 24 25	Niu Valley WWPS, Paiko Drive WWPS, Kuliouou WWPS	3-8-01:34 3-7-10:52 3-8-04:79	high probability	subsurface testing prior to construction

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Appendix H

EAST MAMALA BAY DEIS BOTANICAL SURVEY REPORT

for
BELT COLLINS AND ASSOCIATES
680 ALA MOANA BOULEVARD, FIRST FLOOR
HONOLULU, HAWAII 96813-5406

by
Evangeline J. Funk, Ph.D.
Botanical Consultants
Honolulu, Hawaii
1993

<u>SITE 7 HART STREET</u> waste water pump station is weedier than most pump station sites. There is koa haole (*Leucaena leucocephala* (Lam.) deWit), sour bush (*Pluchea symphytifolia* (Mill.) Gillis), and Chinese violet (*Asystasia gangetica* (L.) T. Anderson) growing on the surrounding fense. Inside the fence some oleander (*Nerium oleander* L.), Hibiscus, coconut trees and a fiddle fig (*Ficus lyrata* Warb.) have been planted.

<u>SITE 8 KAHALA</u> waste water pump station is located next to the beach park parking lot. The surrounding area is paved except for one very large banyan tree on Kahala Avenue and some additional landscaping.

<u>SITE 9 KAMEHAMEHA HIGHWAY</u> waste water pump station. Located next to Keehi Lagoon Beach Park, this site is partly paved and landscaped with coconut and Milo trees (*Thespesia populnea* (L.) Soland. ex Correa), as well as, a hibiscus hedge.

<u>SITE 10 ALA MOANA PARK</u> waste water pump station is located at the diamondhead end of Ala Moana Park. It is surrounded by mowed lawns, some Plumeria, Seagrape (*Coccoloba uvifera* (L.) L.), and Hong Kong orchid trees (*Bauhinia blakeana* Dunn) as well as Hibiscus and Bougainvillea shrubs.

<u>SITE 11 PUBLIC BATHS</u> waste water pump station (Waikiki Aquarium). This pump station is located within Kapiolani Park. There is no paving or lawan. There is a mock orange hedge (*Murraya paniculata* (L.) Jack) around the building.

<u>SITE 12 SAND ISLAND PARKWAY</u> waste water pump station is located in the northwestern portion of the Sand Island facility. The area is mostly mowed grass with some kiawe and monkey pod trees (*Samanea saman* (Jacq.) Merr.) trees along the parkway.

<u>SITE 13 AUKAI STREET</u>. This is a paved street will well tended lawns covering the parkway. There are some coconut trees which may intrude upon the parkway area.

<u>SITE 14 EAST MANOA ROAD</u>. This site consists of two narrow, paved, alley ways. One is an unnamed easment the other is called Kinohau Place. A short section of the easement, from the end of the paving to Manoa Stream, goes through undeveloped land which has a dense growth of hau (*hibiscus tiliaceus*L.), California grass (*Brachiaria mutica* (Frosk.) Stapf.), monkey pod (*Samanea saman* (Jacq.) Merr.), banana, and guava (*Psidium guajava* L.) trees growing on it.

<u>SITE 15 DIAMOND HEAD</u>. This site consists of three parts. One is a short, narrow, paved spur off Hibiscus Street on the slopes of Diamond Head. It is paved up to the garage doors. There are some narrow mock orange hedges, hibiscus, and bouganvillea shrubs to be found in very small planting sites.

The second part of the site is along Makalei Place. This too is on the slopes of Diamond Head. It is a steep, narrow, paved road with lawns in the parkway. The sidewalk is on the makai side of the street as well as one very big banyan tree (*Ficus microcarpa* L. fil.). Some mango (*Mangifera indica* L.), and Eucalyptus sp. trees and Scaevola shrubs are found along the right-of-way.

The third section of Site 15 is along Diamond Head Road. The entire area is paved with small sections of lawn to be found in some of the parkways.

<u>SITE 16 PUNCHBOWL</u>. Site 16 includes parts of Auwaiolimu, Hookui and Puowaina Streets and Puowaina Drive. Most of the study area is on the mauka side of Punchbowl. Much of the area is too steep for development, however the streets are paved and along Puowaina Drive the tended lawns come down to the

pavement. Along Hookui Street there is koa haole and various types of grasses and along Auwaiolium Street the koa haole is draped with various types of weedy vines.

SITE 17 TANTALUS. This site consist of two parts. A short section of Tantalus Drive above Makiki Heights Drive. In this area the street is paved and road shoulders are kept mowed. There are no houses. There are many monkey pod and kowa hole trees which are draped with *Scindapsus aureus* (lind. and Andre) Engl., Maile pilau (*Paederia foetida* L.) and ivory fruited gourd (*Coccinia grandis vines (l.) Voight).*

The second part of this site extends from Makiki Heights Drive down to the intersection with Round Top Drive for about one kilometer. Here again, the road is paved and the rosd shoulders are kept mowed. The koa haole, guinea grass (Panicum maximum Jacq.), ivory gourd, African tulip trees (*Spathodea campanulata* Beauv.), *Wedelia trilobata* and other adventives crowd in on the right-of-way when ever possible, but the frequent mowing keeps the area fairly open and clear.

SITE 18 BLACK POINT. Site 18 is made up of a series of short, narrow, winding, paved streets located on the eastern slope of Diamond Head and a long stretch of partially developed beach land. The streets are paved, landscaped, kept very neat and tidy. In some places the proposed line will go through private yards which are also landscaped.

Along the beach, above the high water mark, there are some hau trees, koa haole, St. Augustine grass (*Stenotaphrum secundatum* (Walt.) Ktze), seashore rushgrass (*Sporobolus virginicus* (L.) Kunth), coconut trees, tree heliotrope (*Tournefortia argentea* L. fil.), Kou (*Cordia subcordata*), ivory gourd, African tulip trees, *Wedelia trilobata* and other planted and volunteer species.

SITE 19 MAPUNAPUNA. Located in the industral part of Honolulu, this site includes part of Ahua, Mapunapuna, Mokumoa, Kaihikapu, Awaaloa, and Kilihali streets. All of the included sections of these streets are paved and the only vegetation in the area consists of weeds and grasses which come up through the cracks of the side walks and streets.

SITE 20 CRATER ROAD. This site is composed of a portion of Crater Road, Ocean View Drive and several small spurs or alley ways. The entire area is developed and the streets and lanes are paved. Beyond the pavement, the home owners have landscaped their properties.

SITE 21 NUUANU PALI ROAD. This site is part of the upper end of the Old Pali Highway. The road is paved and the shoulders are kept clear, but the full length of the site is lined with trees. All of the plants found on this site are introduced including the Kukui trees.

SITE 22 PALOLO VALLEY. This site consists of La'i Road and two unnamed branches. These are country roads. They have all been paved, but not for a long, long time. They are rutted and are full of potholes. In some places it appears that the vegetation along the road is being controlled, but for the most part, the weeds and grasses invade the road right-of-way. Many types of trees, shrubs, forbs, and grasses line these roads. However, only one native species was found. Along La'i Road one mamake (*Pipturus albidus* (Hook. & Arnott) A. Gray) shrub is growing near the stream. The remainder of the vegetation is made-up of introduced weedy species.

AVIFAUNAL AND FERAL MAMMAL SURVEY FOR THE PROPOSED EAST MAMALA BAY HONOLULU SEWER SYSTEM PROJECT, OAHU

Prepared for

Belt Collins & Associates

by

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28 April 1993

INTRODUCTION

The purpose of this report is to summarize the findings of a three day (21,22,24 April 1993) bird and mammal field survey of twenty-two sites proposed for sewer improvements in the East Mamala Bay Project, Oahu (Fig. 1,2,3,4,5,6). Also included are references to pertinent literature as well as unpublished faunal reports.

The objectives of the field survey were to:

1- Document what bird and mammal species occur on the property or may likely be found there given the type of habitats available.

2- Provide some baseline data on the relative (estimated) abundance of each species.

3- Determine the presence or likely occurrence of any native fauna, particularly any that are considered "Endangered" or "Threatened".

4- Evaluate the quality of the habitats for native wildlife and note any special or unique areas that may exist at these proposed development sites.

GENERAL SITE DESCRIPTION

Figures One, two, three, four, five and six indicate the twenty-two sites surveyed for birds and mammals. Habitat at these locations included residential/urban, industrial and mixed native/introduced forest. Figure seven lists the 22 sites covered in the survey.

Weather during the field survey was variable with clear cool mornings and partly cloudy afternoons. Winds were strong at 20-30 mph.

STUDY METHODS

Field observations were made with binoculars and by listening for vocalizations. Survey periods were concentrated during peak bird activity times of early morning and late afternoon. Counts were made of all birds seen or heard at each of the twenty-two sites. These data provide the basis for the abundance estimates given in this report (Table 1). Published and unpublished reports of birds known from similar habitat were also consulted in order to acquire a more complete picture of the possible species that might be expected in the areas surveyed (Pratt et al. 1987; Hawaii Audubon Society 1989; Pyle 1987, 1988, 1989; Bruner 1988, 1992a, 1992b, 1992c, 1993a, 1993b).

Data on feral mammals were limited to visual observations and evidence in the form of scats and tracks. In addition, information on feral mammals was obtained through personal communication. No attempts were made to trap mammals in order to gather data on their relative (estimated) abundance and distribution. Such effort was deemed extravagant and unecessary.

Scientific names used in this report follow those given in Hawaii's Birds (Hawaii Audubon Society 1989); Field Guide to the Birds of Hawaii and the Tropical Pacific (Pratt et al. 1987) and Mammal Species of the World (Honacki et al. 1982).

RESULTS

Resident Endemic (Native) Land Birds:

Two Common Amakihi (Hemignathus viren) were recorded at site 21 (Nuuanu Pali unsewered area) and three were tallied at Tantalus (site 17). Common Amakihi are not presently listed as threatened or endangered. Another native forest bird which may also occur at sites 17, 21 and 22 (Palolo unsewered area) is the 'Elepaio (Chasiempis sandwichensis). This species has declined dramatically on Oahu in the last decade (Pyle 1987, 1988, 1989). An increase in competition from introduced birds may in part be responsible for this situation. 'Elepaio are not listed as threatened or endangered but perhaps should be considered for this designation and protection. Short-eared Owl or Pueo (Asio flammeus sandwichensis) occur in forests on Oahu (Pratt et al. 1987). Pueo are listed as an endangered species on Oahu by the State of Hawaii Division of Forestry and Wildlife. None were recorded on the survey. The number of Pueo on Oahu is probably quite low and their present abundance in the areas covered by this survey is unknown. The only other native forest bird that may also occur in the forested portions of the proposed project is the Apapane (Himatione sanguinea). This species is not listed as threatened or endangered although its numbers have also declined on Oahu in the last 20 years (Pyle 1987, 1988, 1989).

Resident Waterbirds:

No waterbirds were recorded on the survey. Habitat suitable for waterbirds was found at site 21 (Nuuanu Pali unsewered area). The drainage canal at site eight (Kahala) may also provide usable habitat. I have personally seen ducks at both locations in previous years. In 1984, I observed two Black-necked Stilts (Himantopus mexicanus knudseni) foraging at the mouth of the canal at site eight. This species is listed as endangered. They forage in a variety of wetland habitats such as taro patches, flooded pasture and mudflats.

Migratory Indigenous (Native) Birds:

Two migratory species were recorded. Pacific Golden Plover (*Pluvialis fulva*) were counted at several sites (Table 1). This species is a common winter migrant arriving in Hawaii in August and departing for its arctic breeding grounds in late April. They are territorial and are easily observed on lawns and in parks (Johnson et al. 1981). Ruddy Turnstone (*Arenaria interpres*) were also located at a few of the sites (Table 1).

Resident Indigenous (Native) Seabirds:

No nesting seabirds were observed on the survey. The only seabirds that nest in urban Honolulu and in this region are the White Tern (*Gygis alba*) and Wedge-tailed Shearwater (*Puffinus pacificus*). The terns prefers large trees like ironwoods and banyans (Bruner 1992c). White Terns were seen flying overhead at several sites (Table 1). Wedge-tailed Shearwaters have nested in burrows at Black Point (pers. observation).

Exotic (Introduced) Birds:

A total of 20 species of exotic birds were recorded during the field survey (Table 1). Pratt et al. 1987; Hawaii Audubon Society 1989; Pyle 1987, 1988, 1989; and Bruner 1988, 1992a, 1992b, 1993a, 1993b, confirm that this array of introduced birds would be expected in this area. In addition the Barn Owl (Tyto alba), Cattle Egret (Bubulcus ibis), Hwamei (Garrulax canorus) and Red-billed Leiothrix (Leiothrix lutea) are also known from this region.

Feral Mammals:

The introduced Small Indian Mongoose (Herpestes auropunctatus) was seen at several sites. Feral cats were also noted. No trapping was conducted in order to assess the relative abundance of these feral mammals. In addition rats and mice undoubtedly also are common at each of the sites.

Oahu records of the endemic and endangered Hawaiian Hoary Bat (Lasiurus cinereus semotus) are limited (Tomich 1986; Kepler and Scott 1990). Lorin Gill of Moanalua Gardens Foundation reported seeing a bat in the Tantalus area in late December 1992 (pers. comm.). At 1840 hours on the 22 April I also observed a bat flying back and forth over the trees in the Tantalus area (site 17). Our knowledge of the bat's distribution and behavior is extremely limited. They are known to roost solitarily in trees and occurs in upland forests as well as in coastal habitats. This species is insectivorous and forages at dusk.

DISCUSSION AND CONCLUSIONS

This field survey was necessarily brief and thus can provide only a limited perspective of the wildlife which utilize the area. The number and relative abundance of each species may vary throughout the year due to available food resources and reproductive success. Exotic species sometimes prosper only to later disappear or become a less significant part of the ecosystem (Williams 1987; Moulton et al. 1990). Long term studies could provide a more comprehensive view of the bird and mammal populations in a particular area. Nevertheless some general conclusions related to birds and mammals at the twenty-two sites can be provided. The following comments summarize the findings of this survey.

1- Each site was traversed on foot or by car. Counts of birds were used to make conclusions about estimated abundance at these locations (Table 1).

2- The only endemic bird recorded was the Common Amakihi. This species is not endangered and occurs regularly in native and mixed forested habitat on Oahu.

3- Migratory species (plover and turnstone) were found in areas with large open lawns. White Terns were noted flying overhead at several sites. No Shearwaters were located at Black Point but are known to occur in this area.

4- The survey recorded the normal array of exotic birds expected for these sites. A male Great-tailed Grackle, known to occur in the area of Site One (Sand Island WWTP) was observed. Workers at the plant claim that two male grackles were resident in this area up until about one year ago. Only one bird has been seen recently. This species is not listed in Hawaii's Birds (Hawaii Audubon Society 1989) since there is no resident breeding population.

5- One endangered Hawaiian Hoary Bat was recorded in the Tantalus area. This bat forages in forest as well as urban habitat.

RECOMMENDATIONS

1- Large trees that may need to be removed should be checked to see if they contain any nesting White Terns. In addition native trees like Koa and Ohia should not be cut down as they provide foraging habitat for Common Amakihi.

2- Water resources such as those at Site 21 and eight should be protected. Waterbirds and shorebirds can utilize this habitat.

3- The expansion of the Sand Island WWTP involves the development of lands that are presently of poor quality for birds. Formerly the area was used for the storage of "junk" cars. Piles of tires still remain at the site. The nearby Keehi Lagoon and its associated islets and reef flats are important foraging and resting habitats for migratory shorebirds and native waterbirds like the endangered Black-necked Stilt (Bruner 1993b). Expansion of the Sand Island WWTP must be aware of this nearby resource and avoid disturbing this important area. Special care must be taken to insure that contamined soils are not blown or washed into the lagoon. The prior use of the lands for dumping cars probably has left soil contamined with oil and other toxic substances.

Fig. 1. Location of faunal survey sites 1,4,7,12.

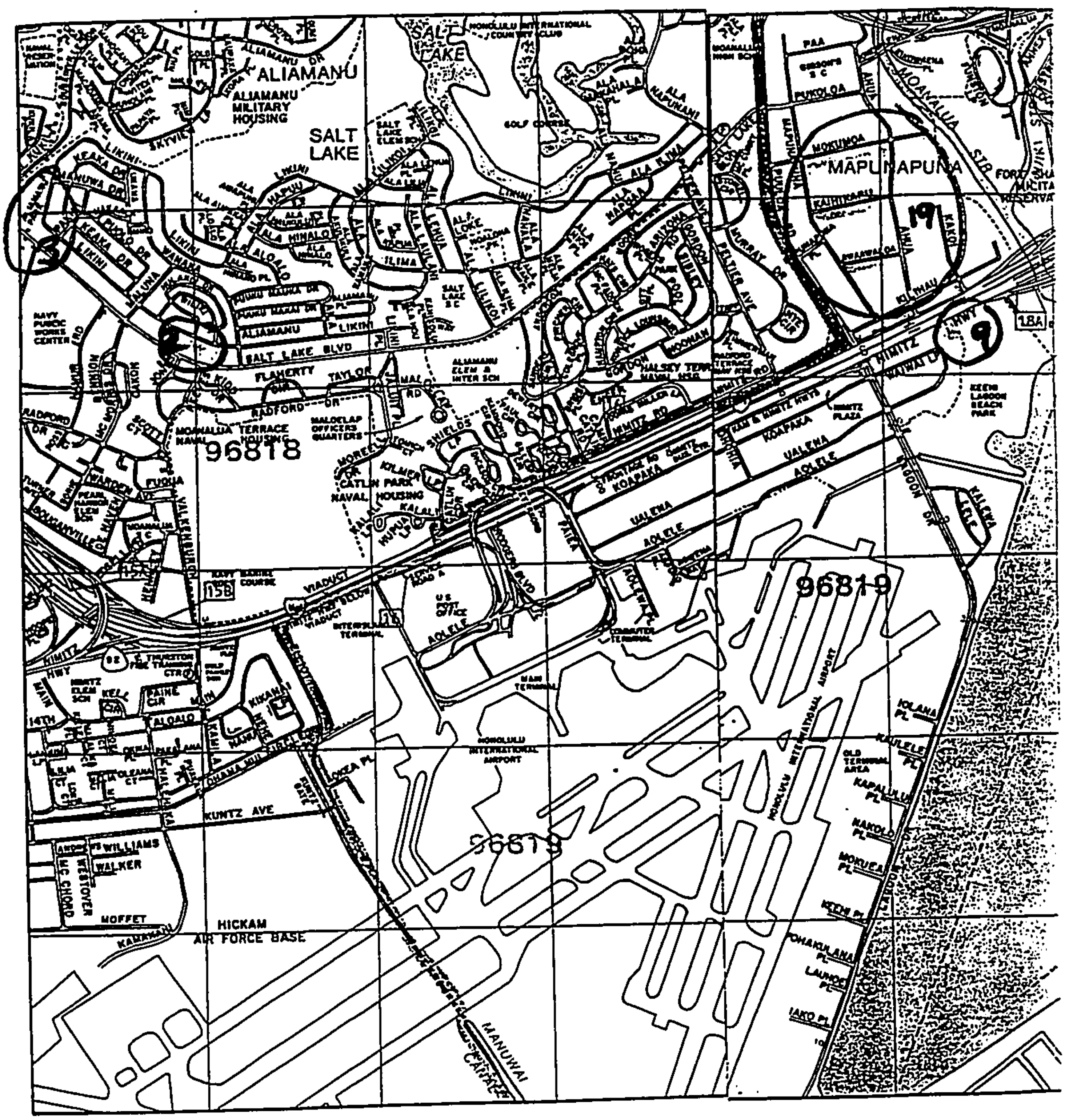

Fig. 2. Location of faunal survey sites 2,3,9,19.

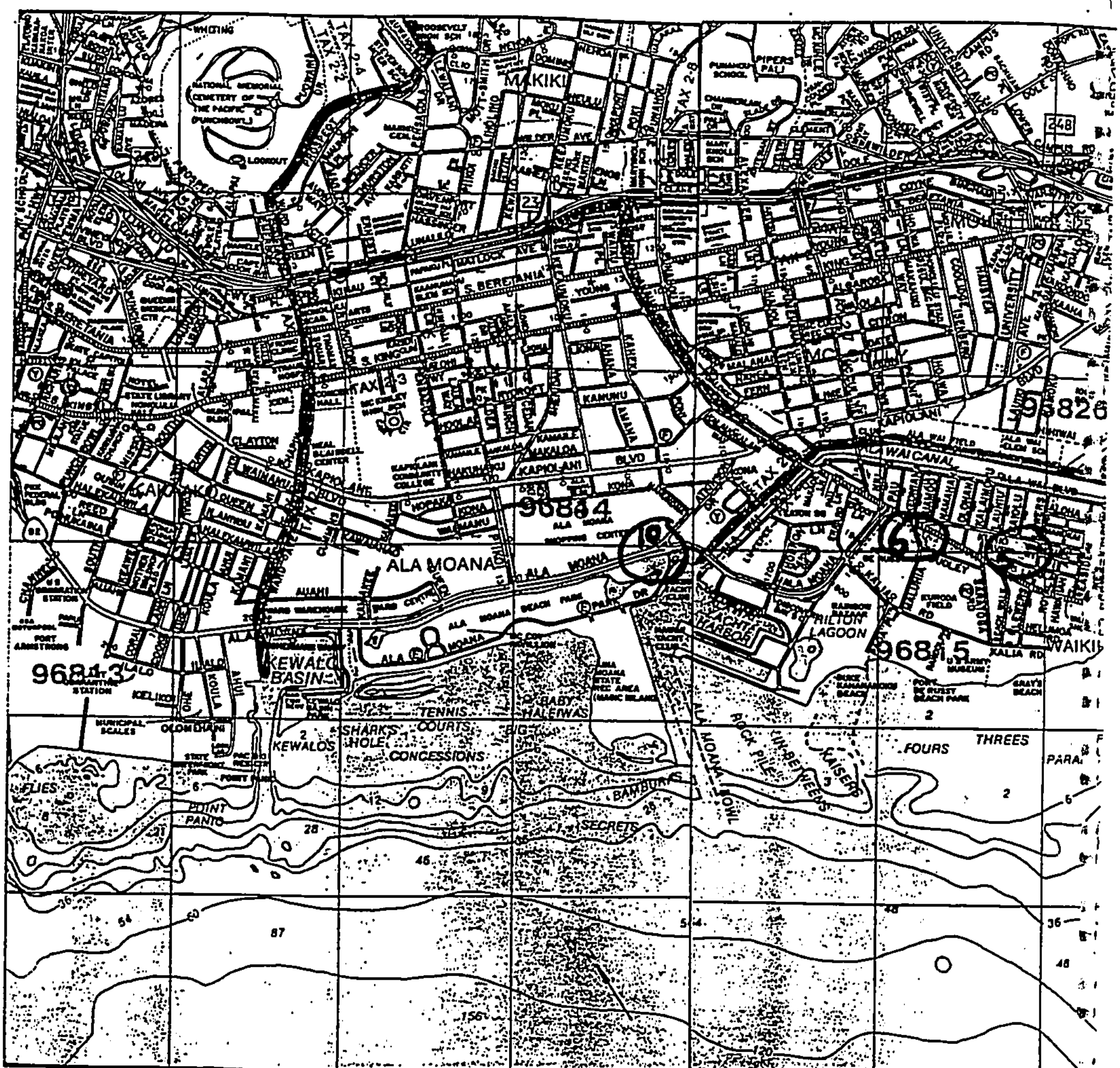

Fig. 3. Location of faunal survey sites 5,6,10.

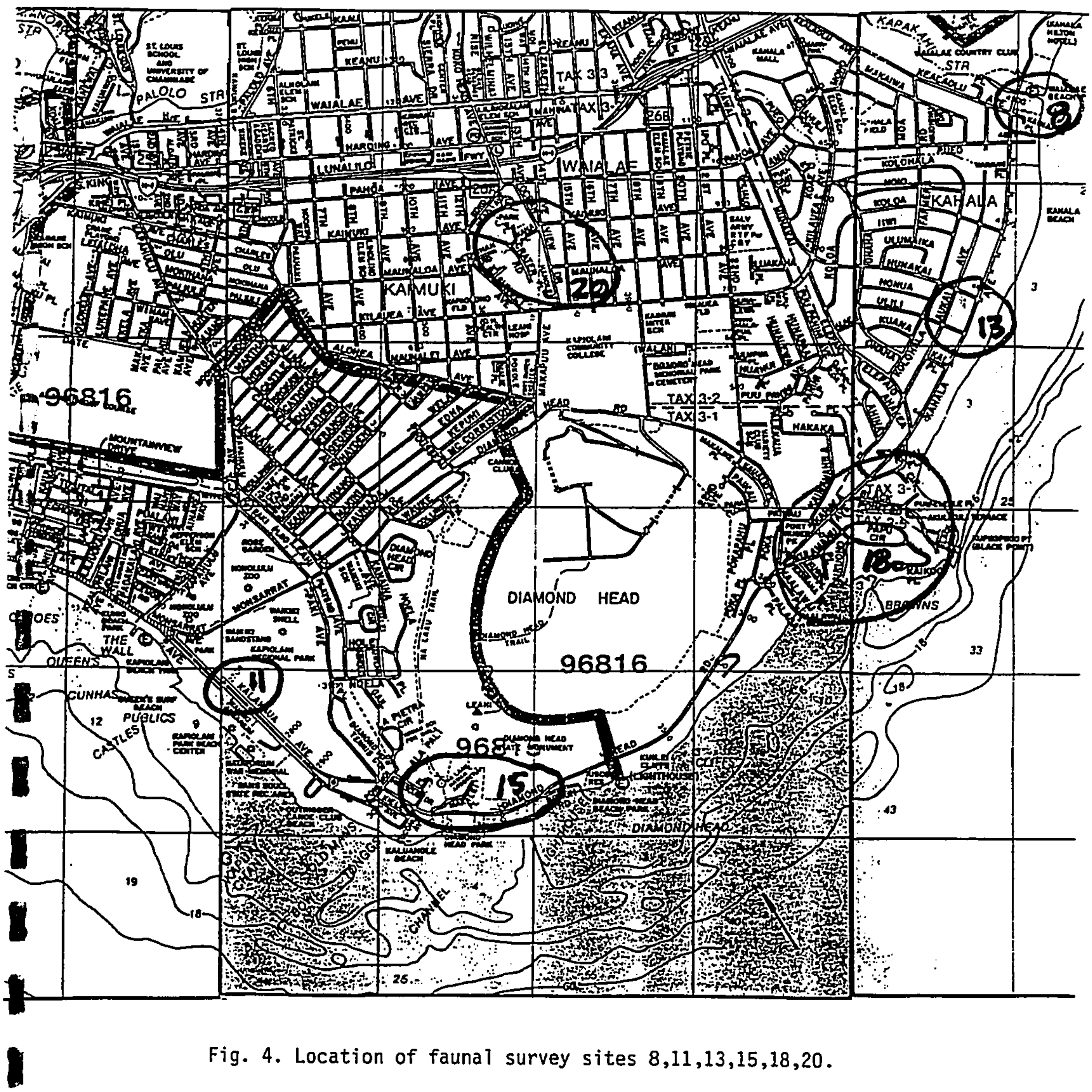

Fig. 4. Location of faunal survey sites 8,11,13,15,18,20.

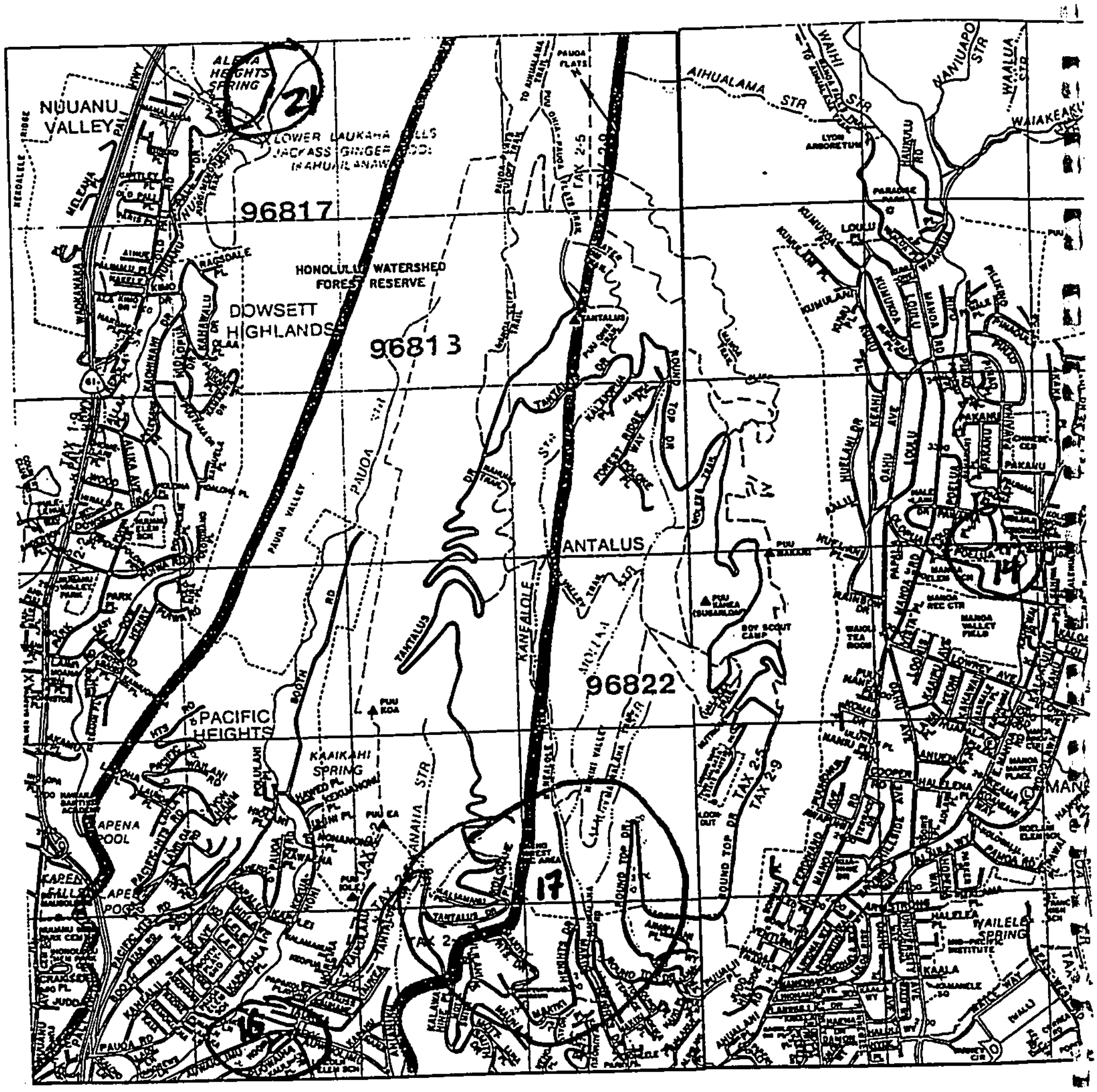

Fig. 5. Location of faunal surveys sites 14,16,17,21.

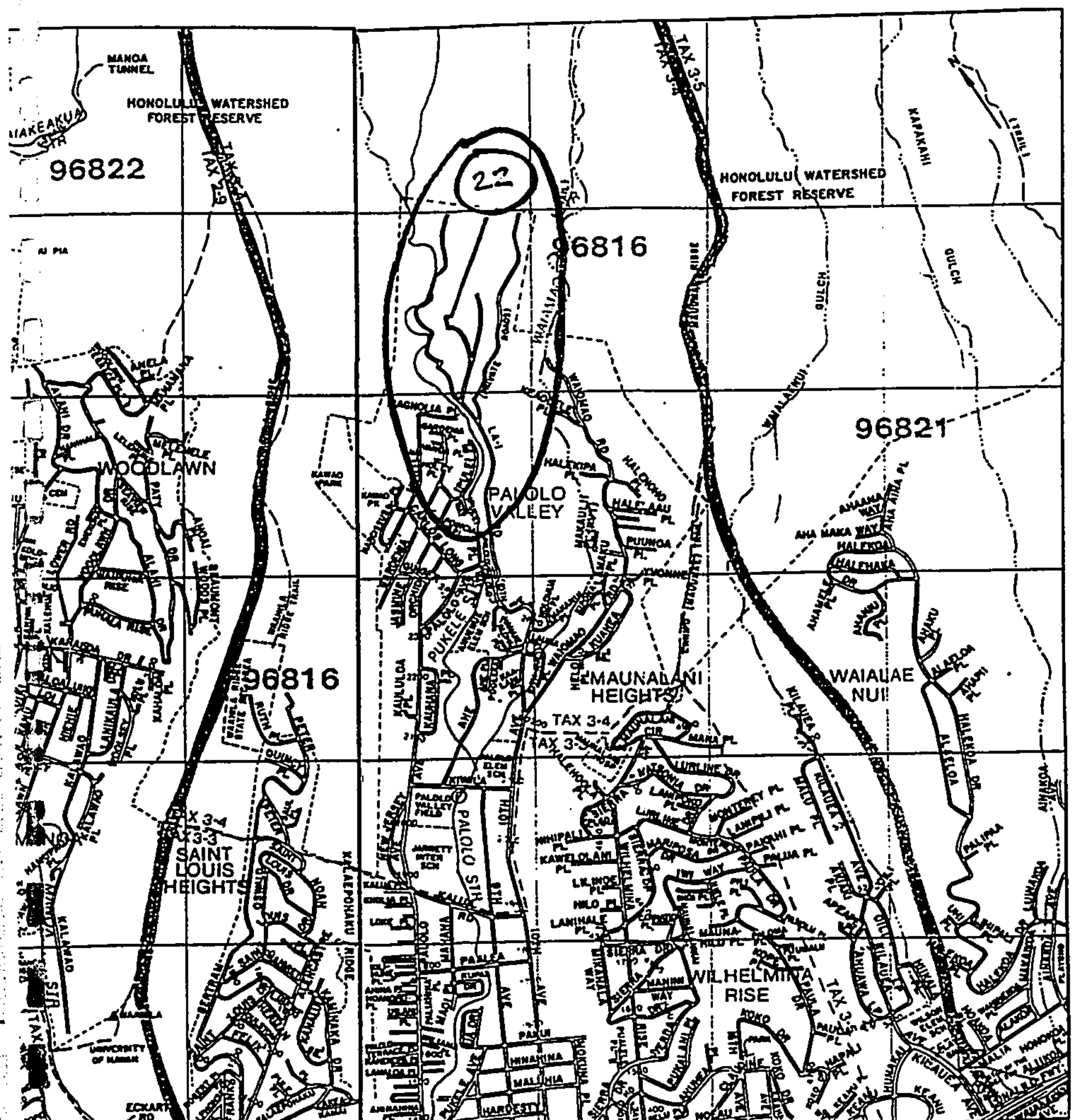

Fig. 6. Location of faunal survey site 22.

	DEVELOPMENT SITES	TMK	CONSULTANT STUDIES:
1	Sand Island WWTP	1-5-41:5	(primary site)
2	Aliamanu #1 WWPS	1-1-21:10	
3	Aliamanu #2 WWPS	1-1-23:103	(principal site)
4	Awa Street WWPS	1-5-40:03	(principal site)
5	Beachwalk WWPS	2-6-18:11	
6	Ft. DeRussy WWPS	2-6-05:por 1	
7	Hart Street WWPS	1-5-34:06	(principal site)
8	Kahala WWPS	3-5-23:42	
9	Kam. Hgwy. WWPS	1-1-03:28	
10	Moana Park WWPS	2-3-37:10	(principal site)
11	Public Baths WWPS	3-1-31:07	
12	Sand Island Parkway WWPS	1-5-41:por 5	(included in primary site)
13	Aukai Street Unsew. Area	3-5-04:	
14	E. Manoa Rd. Unsew. Area	2-9-37:	
15	Diamond Head Unsew. Area		
16	Punchbowl Unsew. Area		(principal site)
17	Tantalus Unsew. Area		(principal site)
18	Black Point Unsew. Area		(principal site)
19	Mapunapuna Unsew. Area		
20	Crater Road Unsew. Area		
21	Nuuanu Pali Rd. Unsew. Area	2-2-54:	(principal site)
22	Palolo Unsew. Area		

Fig. 7. List of the 22 sites covered in the faunal survey.

TABLE 1

Native and introduced birds recorded at 22 sites proposed for an East Mamala Bay sewer improvement project, Oahu.

COMMON NAME	SCIENTIFIC NAME	ESTIMATED ABUNDANCE * Site 1	2	3	4	5	6	7	8	9	10	11
Native												
White Tern	_Gygis alba_	-	-	-	-	-	-	-	R	-	-	U
Pacific Golden Plover	_Pluvialis fulva_	R	-	R	-	-	-	-	U	-	-	R
Ruddy Turnstone	_Arenaria interpres_	-	-	-	-	-	-	-	U	-	-	-
Common Amakihi	_Hemignathus virens_	-	-	-	-	-	-	-	-	-	-	-
Introduced												
Rock Dove	_Columba livia_	-	-	-	-	C	R	-	C	-	-	A
Spotted Dove	_Streptopelia chinensis_	C	U	U	R	U	R	-	U	U	-	U
Zebra Dove	_Geopelia striata_	A	C	C	R	A	C	U	C	C	C	A
Common Myna	_Acridotheres tristis_	A	C	A	R	C	U	U	A	U	C	C
Red-vented Bulbul	_Pycnonotus cafer_	A	C	A	R	C	C	-	A	-	C	A
Red-whiskered Bulbul	_Pycnonotus jocosus_	-	-	-	-	-	-	-	-	-	-	-
Great-tailed Grackle	_Quiscalus mexicanus_	R	-	-	-	-	-	-	-	-	-	-
Northern Mockingbird	_Mimus polyglottus_	R	-	-	-	-	-	-	-	-	-	-
Northern Cardinal	_Cardinalis cardinalis_	R	-	-	-	-	-	-	-	-	-	-
Red-crested Cardinal	_Paroaria coronata_	C	R	U	-	U	-	-	U	-	R	R
Japanese White-eye	_Zosterops japonicus_	U	-	-	-	-	-	-	R	-	-	R
House Finch	_Carpodacus mexicanus_	C	-	-	-	-	-	-	C	-	U	U
Yellow-fronted Canary	_Serinus mozambicus_	-	-	-	-	-	-	-	C	-	-	-
Japanese Bush-warbler	_Cettia diphone_	-	-	-	-	-	-	-	-	-	-	-
House Sparrow	_Passer domesticus_	C	-	-	-	C	C	-	C	U	U	C
Java Sparrow	_Padda oryzivora_	C	-	-	-	-	-	-	-	-	-	-
Common Waxbill	_Estrilda astrild_	C	-	-	-	-	-	-	-	-	-	-
Nutmeg Mannikin	_Lonchura punctulata_	U	U	-	-	-	-	-	-	-	-	-
Chestnut Mannikin	_Lonchura malacca_	U	-	-	-	-	-	-	-	-	-	-
White-rumped Shama	_Copsychus malabaricus_	-	-	-	-	-	-	-	-	-	-	-

TABLE 1 (cont.)

COMMON NAME	SCIENTIFIC NAME	ESTIMATED ABUNDANCE * Site 12	13	14	15	16	17	18	19	20	21	22
Native												
White Tern	*Gygis alba*	-	-	-	R	-	-	R	-	-	-	-
Pacific Golden Plover	*Pluvialis fulva*	-	-	-	R	-	R	-	-	-	R	-
Ruddy Turnstone	*Arenaria interpres*	-	-	-	-	-	-	-	-	-	-	-
Common Amakihi	*Hemignathus virens*	-	-	-	-	-	R	-	-	-	R	-
Introduced												
Rock Dove	*Columba livia*	-	-	-	-	-	-	-	-	-	-	-
Spotted Dove	*Streptopelia chinensis*	R	U	U	U	-	C	R	-	-	R	R
Zebra Dove	*Geopelia striata*	C	C	C	A	C	A	A	C	-	C	C
Common Myna	*Acridotheres tristis*	C	C	C	C	C	R	C	R	A	C	C
Red-vented Bulbul	*Pycnonotus cafer*	C	C	C	A	A	A	A	-	C	A	A
Red-whiskered Bulbul	*Pycnonotus jocosus*	-	-	R	-	-	C	-	-	-	C	C
Great-tailed Grackle	*Quiscalus mexicanus*	-	-	-	-	-	-	-	-	-	-	-
Northern Mockingbird	*Mimus polyglottus*	-	-	-	-	-	-	-	-	-	-	-
Northern Cardinal	*Cardinalis cardinalis*	-	-	-	U	-	C	U	-	-	C	C
Red-crested Cardinal	*Paroaria coronata*	-	-	R	U	-	-	C	-	U	-	R
Japanese White-eye	*Zosterops japonicus*	-	-	-	C	-	A	C	-	U	A	A
House Finch	*Carpodacus mexicanus*	-	-	-	-	R	C	-	-	-	C	C
Yellow-fronted Canary	*Serinus mozambicus*	-	-	-	-	-	-	-	-	-	-	-
Japanese Bush-warbler	*Cettia diphone*	-	-	-	-	-	C	-	-	-	C	C
House Sparrow	*Passer domesticus*	R	U	U	U	R	-	R	C	-	-	-
Java Sparrow	*Padda oryzivora*	-	-	-	-	-	-	C	-	-	-	C
Common Waxbill	*Estrilda astrild*	-	-	-	-	-	-	-	-	-	-	-
Nutmeg Mannikin	*Lonchura punctulata*	-	-	-	-	-	-	-	-	-	-	-
Chestnut Mannikin	*Lonchura malacca*	-	-	-	-	-	-	-	-	-	-	C
White-rumped Shama	*Copsychus malabaricus*	-	-	-	-	-	U	-	-	-	C	C

KEY TO TABLE 1

Estimated abundance = Number of birds seen or heard at each site

A = abundant (ave. 20+)

C = common (ave. 10-20)

U = uncommon (5-10)

R = rare (1-5)

- = (no birds recorded)

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Appendix I

APPENDIX I

POPULATION PROJECTIONS

The State of Hawaii's resident population is divided among four counties: Hawaii County, Maui County, City and County of Honolulu, and Kauai County. The state's resident population experienced a growth rate of 25.3 percent during the 1970s and 14.9 during the 1980s. Table I-1 summarizes the resident population by county.

Table I-1
Resident Population by County

COUNTY	APRIL 1, 1970	APRIL 1, 1980	APRIL 1, 1990	PERCENT CHANGE	
				1970-1980	1980-1990
Hawaii County	63,468	92,053	120,317	45.0	30.7
Maui County	46,156	70,991	100,504	53.8	41.6
City & Co. of Honolulu	630,528	762,565	836,231	20.9	9.7
Kauai County	29,761	39,082	51,177	31.3	30.9
TOTAL	769,913	964,691	1,108,229	25.3	14.9

Source: DBEDT, The State of Hawaii Data Book 1991, p. 20

Oahu residents comprise approximately 75 percent of the State's population. The City and County of Honolulu records population in terms of its distribution within the eight Development Plan areas. Resident population for each Development Plan area for the year 1990 is shown in Table I-2.

According to the Planning Department's records, the study area on Oahu included approximately 339,640 residents in 1990. This is approximately 41 percent of the resident population of Oahu and is located primarily in the Primary Urban Center development plan area with a portion in East Honolulu.

Table I-3 shows the 1990 resident population by TAZ as provided by the City's Planning Department in its socioeconomic forecast. (A detailed discussion of this forecast is in Section 5.3.) To assist in the ready identification of these TAZs, commonly known neighborhoods or points of interest within the TAZ boundary have also been included. The delineation of TAZs is shown in Figure 2-6. Table I-3 also shows the study area's projected resident population for 2010 and 2015, and the percentage change from 1990.

Table I-2
Resident Population Year 1990

DEVELOPMENT PLAN AREA	1990	PERCENT OF TOTAL RESIDENT POPULATION OF OAHU
Primary Urban Center	432,023	51.66%
Ewa	42,983	5.14%
Central Oahu	130,474	15.60%
East Honolulu	45,654	5.46%
Koolaupoko	117,694	14.07%
Koolauloa	14,263	1.71%
North Shore	15,729	1.88%
Waianae	37,411	4.47%

Source: Planning Department, the City and County of Honolulu

Table I-3
(5 Pages)
Resident Population by TAZ for the Service and Study Areas

TAZ	1990	PRIMARY NEIGHBORHOOD OR POINT OF INTEREST	2010	CHANGE FROM 1990 TO 2010	2015 RESIDENT POPULATION	CHANGE FROM 1990 TO 2015	% OF STUDY AREA TOTAL
1	0	Chinatown	466	NEW	482	NEW	.12%
2	2,399	Chinatown	2211	(7.8%)	2,289	(4.6%)	.56%
3	2,480	Chinatown	2700	8.9%	2,795	12.7%	.68%
4	0	Chinatown	200	NEW	207	NEW	.05%
5	0	Chinatown	1527	NEW	1,581	NEW	.38%
6	0	Chinatown	351	NEW	363	NEW	.09%
7	0	Downtown	427	NEW	442	NEW	.11%
8	2,672	Downtown	2468	(7.6%)	2,555	(4.4%)	.62%
9	0	Downtown	459	NEW	475	NEW	.12%
10	452	Downtown	329	(27.2%)	341	(24.6%)	.08%
11	0	Downtown	117	NEW	121	NEW	.03%
12	0	Downtown	0	NO	0	NO	.00%
13	0	Downtown	0	NO	0	NO	.00%
14	539	Downtown	498	(7.6%)	516	(4.3%)	.13%
15	0	Downtown	0	NO	0	NO	.00%
16	0	Downtown	0	NO	0	NO	.00%
17	0	Downtown	0	NO	0	NO	.00%
18.01	0	Downtown	0	NO	0	NO	.00%
18.02	0	Downtown	0	NO	0	NO	.00%
18.03	181	Downtown	497	174.6%	514	184.0%	.12%
19	0	Downtown	0	NO	0	NO	.00%
20	0	Aloha Tower	0	NO	0	NO	.00%
21	408	Sand Island	408	0.0%	422	3.4%	.10%
22.01	97	Iwilei	1383	1325.8%	1,432	1376.3%	.35%
22.02	0	Iwilei	0	NO	0	NO	.00%

Table I-3
(5 Pages)
Resident Population by TAZ for the Service and Study Areas

TAZ	1990	PRIMARY NEIGHBORHOOD OR POINT OF INTEREST	2010	CHANGE FROM 1990 TO 2010	2015 RESIDENT POPULATION	CHANGE FROM 1990 TO 2015	% OF STUDY AREA TOTAL
22.03	1,660	Iwilei	1973	18.9%	2,042	23.0%	.50%
22.04	0	Iwilei	854	NEW	884	NEW	.21%
22.05	0	Iwilei	1156	NEW	1,197	NEW	.29%
23	4,208	Aala	3863	(8.2%)	3,999	(5.0%)	.97%
24	1,609	Kapalama	1487	(7.6%)	1,539	(4.4%)	.37%
25	2,144	Kapalama	2068	(3.5%)	2,141	(0.1%)	.52%
26	6,185	Kapalama	8521	37.8%	8,821	42.6%	2.14%
27.01	0	Lower Kalihi	0	NO	0	NO	.00%
27.02	3,372	Lower Kalihi	3107	(7.9%)	3,216	(4.6%)	.78%
27.03	32	Lower Kalihi	30	(6.3%)	31	(3.1%)	.01%
27.04	0	Lower Kalihi	0	NO	0	NO	.00%
28	3,570	Sand Island Industrial Area	3378	(5.4%)	3,497	(2.0%)	.85%
29	5,857	Lower Kalihi	13029	122.5%	13,487	130.3%	3.27%
30	3,575	Upper Kalihi	5547	55.2%	5,742	60.6%	1.39%
31	5,040	Upper Kalihi	6111	21.3%	6,326	25.5%	1.53%
32	2,390	Upper Kalihi	2202	(7.9%)	2,279	(4.6%)	.53%
33	3,433	Upper Kalihi	3161	(7.9%)	3,272	(4.7%)	.79%
34	2,781	Upper Kalihi	2569	(7.6%)	2,659	(4.4%)	.64%
35	1,827	Upper Kalihi	1688	(7.6%)	1,747	(4.4%)	.42%
36	5,680	Upper Kalihi	5455	(4.0%)	5,647	(0.6%)	1.37%
37	4,077	Upper Kalihi	4514	10.7%	4,673	14.6%	1.13%
38	2,952	Fort Shafter	2737	(7.3%)	2,833	(4.0%)	.69%
39	6,894	Tripler	6606	(4.2%)	6,838	(0.8%)	1.66%
40	2,758	Moanalua Valley	2896	5.0%	2,998	8.7%	.73%
41	8,835	Aliamanu Housing Area	8136	(7.9%)	8,422	(4.7%)	2.04%
42	16,332	Salt Lake	22538	38.0%	23,330	42.8%	5.66%
43	5,845	Mapunapuna/Industrial	5386	(7.9%)	5,575	(4.6%)	1.35%
44	36	Mapunapuna/Industrial	36	0.0%	37	2.8%	.01%
45	3,182	Navy Marine GC & Residential	2932	(7.9%)	3,036	(4.6%)	.74%
46*	120	Navy Marine GC & Residential	111	(7.5%)	114	(5.0%)	.03%
48	1,003	Airport/Industrial	984	(1.9%)	1,019	1.6%	.25%
49*	0	Honolulu International Airport	0	NO	0	NO	.00%
50*	0	Honolulu International & Hickam AFB	0	NO	0	NO	.00%
51	4,724	Liliha	4761	0.8%	4,928	4.3%	1.20%
52	2,978	Liliha	2913	(2.2%)	3,015	1.2%	.73%
53	5,991	Kamehameha Heights	5673	(5.3%)	5,872	(2.0%)	1.42%
54	4,837	Alewa	4627	(4.3%)	4,790	(1.0%)	1.16%
55	3,687	Upper Nuuanu	3672	(0.4%)	3,801	3.1%	.92%
56	5,264	Upper Nuuanu	5309	0.9%	5,496	4.4%	1.33%
57	5,429	Pacific Heights	5586	2.9%	5,782	6.5%	1.40%
58	5,632	Punchbowl	5530	(1.8%)	5,724	1.6%	1.39%
59.01	1,536	Civic Center	1415	(7.9%)	1,465	(4.6%)	.36%
59.02	3,206	Civic Center	3080	(3.9%)	3,188	(0.6%)	.77%
59.03	0	Civic Center	0	NO	0	NO	00%

Table I-3
(5 Pages)
Resident Population by TAZ for the Service and Study Areas

TAZ	1990	PRIMARY NEIGHBORHOOD OR POINT OF INTEREST	2010	CHANGE FROM 1990 TO 2010	2015 RESIDENT POPULATION	CHANGE FROM 1990 TO 2015	% OF STUDY AREA TOTAL
60.01	706	Kakaako	977	38.4%	1,011	43.2%	.25%
60.02	0	Kakaako	694	NEW	718	NEW	.17%
60.03	0	Kakaako	1719	NEW	1,779	NEW	.43%
60.04	15	Kakaako	383	2453.3%	398	2540.0%	.10%
60.05	0	Kakaako	287	NEW	297	NEW	.07%
60.06	0	Kakaako	875	NEW	906	NEW	.22%
60.07	0	Kakaako	631	NEW	653	NEW	.16%
60.08	0	Kakaako	287	NEW	297	NEW	.07%
60.09	0	Kakaako	287	NEW	297	NEW	.07%
61.01	0	Ward Area (Kakaako)	0	NO	0	NO	.00%
61.02	0	Ward Area (Kakaako)	612	NEW	634	NEW	.15%
61.03	0	Ward Area (Kakaako)	3460	NEW	3,582	NEW	.87%
61.04	0	Ward Area (Kakaako)	599	NEW	620	NEW	.15%
61.05	0	Ward Area (Kakaako)	0	NO	0	NO	.00%
61.06	0	Ward Area (Kakaako)	0	NO	0	NO	.00%
61.07	0	Ward Area (Kakaako)	0	NO	0	NO	.00%
61.08	2,325	Ward Area (Kakaako)	2335	0.4%	2,417	4.0%	.59%
62	0	Ala Moana Shopping Cntr.	0	NO	0	NO	.00%
63.01	0	Kapiolani	2452	NEW	2,538	NEW	.62%
63.02	2,369	Kapiolani	4079	72.2%	4,222	78.2%	1.02%
64.01	5,235	Kapiolani	5360	2.4%	5,548	6.0%	1.35%
64.02	0	Kapiolani	0	NO	0	NO	.00%
64.03	0	Kapiolani	0	NO	0	NO	.00%
64.04	0	Kapiolani	363	NEW	376	NEW	.09%
64.05	0	Kapiolani	0	NO	0	NO	.00%
65	4,688	Thomas Square Area	14237	203.7%	14,737	214.4%	3.57%
66	1,136	Makiki	1051	(7.5%)	1,088	(4.2%)	.26%
67	5,924	Makiki	5781	(2.4%)	5,984	1.0%	1.45%
68	3,080	Makiki	3037	(1.4%)	3,144	2.1%	.76%
69	4,757	Makiki	4658	(2.1%)	4,820	1.3%	1.17%
70	5,177	Makiki	5081	(1.9%)	5,260	1.6%	1.28%
71	878	Makiki Heights	875	(0.1%)	906	3.4%	.22%
72	853	Tantalus	788	(7.6%)	816	(4.3%)	.20%
73	3,537	Manoa	3616	2.2%	3,743	5.8%	.91%
74	3,851	Woodlawn	3835	(0.4%)	3,970	3.1%	.96%
75	4,238	Manoa	4014	(5.2%)	4,155	(1.9%)	1.01%
76	1,383	Manoa	1667	20.5%	1,726	24.8%	.42%
77	4,075	St. Louis Heights	3840	(5.8%)	3,975	2.5%	.96%
78	4,998	Punahou	4736	(5.2%)	4,905	(1.9%)	1.19%
79	4,340	University of Hawaii	4378	0.9%	4,532	4.4%	1.10%
80.01	2,838	McCully	3501	23.4%	3,624	27.7%	.88%
80.02	1,175	McCully	1091	(7.1%)	1,129	(3.9%)	.27%
80.03	0	Moiliili	0	NO	0	NO	.00%
80.04	0	Moiliili	1277	NEW	1,322	NEW	.32%
80.05	944	Moiliili	870	(7.8%)	901	(4.6%)	.22%

Table I-3
(5 Pages)
Resident Population by TAZ for the Service and Study Areas

TAZ	1990	PRIMARY NEIGHBORHOOD OR POINT OF INTEREST	2010	CHANGE FROM 1990 TO 2010	2015 RESIDENT POPULATION	CHANGE FROM 1990 TO 2015	% OF STUDY AREA TOTAL
81.01	0	McCully	0	NO	0	NO	.00%
81.02	2,053	McCully	1928	(6.2%)	1,984	(2.9%)	.48%
81.03	0	McCully	0	NO	0	NO	.00%
81.04	2,176	McCully	2005	(7.9%)	2,075	(4.6%)	.50%
82.01	3,286	McCully	3106	(5.4%)	3,215	(2.1%)	.78%
82.02	0	McCully	0	NO	0	NO	.00%
82.03	0	Moiliili	833	NEW	862	NEW	.21%
83.01	3,016	McCully	2974	(1.4%)	3,079	2.1%	.75%
83.02	0	McCully	113	NEW	117	NEW	.03%
83.03	0	McCully	113	NEW	117	NEW	.03%
84.01	0	Moiliili	0	NO	0	NO	.00%
84.02	0	Moiliili	110	NEW	114	NEW	.03%
84.03	5,687	Moiliili	5567	(2.1%)	5,763	(1.3%)	1.40%
84.04	0	Moiliili	542	NEW	561	NEW	.14%
85.01	7,292	Moiliili	6720	(7.8%)	6,956	(4.6%)	1.69%
85.02	0	Moiliili	0	NO	0	NO	.00%
85.03	0	Iolani School	444	NEW	460	NEW	.11%
86	3,691	Ala Wai GC & Kaimuki HS	3403	(7.8%)	3,523	(4.6%)	.85%
87.01	0	Waikiki	184	NEW	190	NEW	.05%
87.02	2,017	Waikiki	3420	69.6%	3,540	75.5%	.86%
87.03	0	Waikiki	0	NO	0	NO	.00%
87.04	1,806	Waikiki	2440	35.1%	2,526	39.9%	.61%
87.05	0	Waikiki	0	NO	0	NO	.00%
88.01	0	Waikiki	0	NO	0	NO	.00%
88.02	3,037	Waikiki	3406	12.2%	3,526	16.1%	.86%
88.03	0	Waikiki	0	NO	0	NO	.00%
88.04	0	Waikiki	876	NEW	907	NEW	.22%
88.05	0	Waikiki	0	NO	0	NO	.00%
89.01	0	Waikiki	996	NEW	1,031	NEW	.25%
89.02	6,000	Waikiki	10060	67.7%	10,414	73.6%	2.53%
90	1,190	Waikiki	754	(36.6%)	781	(34.4%)	.19%
91.01	0	Waikiki	68	NEW	70	NEW	.02%
91.02	0	Waikiki	84	NEW	87	NEW	.02%
91.03	4,411	Waikiki	4984	13.0%	5,159	17.0%	1.25%
91.04	0	Waikiki	0	NO	0	NO	.00%
92.01	0	Waikiki	0	NO	0	NO	.00%
92.02	492	Waikiki	249	(49.4%)	258	(47.6%)	.06%
92.03	0	Waikiki	0	NO	0	NO	.00%
92.04	815	Waikiki	653	(19.9%)	676	(17.1%)	.16%
93.01	0	Honolulu Zoo	0	NO	0	NO	.00%
93.02	2,536	Kapiolani Park	2489	(1.9%)	2,576	1.6%	.62%
94	3,911	Kapahulu	3606	(7.8%)	3,733	(4.6%)	.91%
95	3,664	Kapahulu	3452	(5.8%)	3,573	(2.5%)	.87%
96	2,595	Kaimuki	2392	(7.8%)	2,476	(4.6%)	.60%
97	4,488	Kaimuki	4330	(3.5%)	4,482	(0.1%)	1.09%

Table I-3
(5 Pages)
Resident Population by TAZ for the Service and Study Areas

TAZ	1990	PRIMARY NEIGHBORHOOD OR POINT OF INTEREST	2010	CHANGE FROM 1990 TO 2010	2015 RESIDENT POPULATION	CHANGE FROM 1990 TO 2015	% OF STUDY AREA TOTAL
98	3,081	Palolo	2837	(7.9%)	2,937	(4.7%)	.71%
99	3,118	Palolo	2946	(5.5%)	3,050	(2.2%)	.74%
100	4,072	Palolo	4037	(0.9%)	4,179	2.6%	1.01%
101	3,194	Palolo	3766	17.9%	3,898	22.0%	.95%
102	2,760	Wilhemina Rise	3607	30.7%	3,734	35.3%	.91%
103	3,779	Maunalani Heights	3775	(0.1%)	3,908	3.4%	.95%
104	2,334	Waialae Nui	2151	(7.8%)	2,227	(4.6%)	.54%
105	3,858	Kaimuki	3724	(3.4%)	3,855	(0.0%)	.93%
106	2,993	Waialae	2999	0.2%	3,104	3.7%	.75%
107	1,311	Diamond Head	1297	(1.1%)	1,343	2.4%	.33%
108	3,024	Kahala	3164	4.6%	3,275	8.3%	.79%
109	720	Waialae Country Club	494	(31.4%)	511	(29.0%)	.12%
110	2,771	Aina Koa	2606	(6.0%)	2,698	(2.6%)	.65%
111	3,372	Waialae Iki	3704	9.8%	3,834	13.7%	.93%
112	5,617	Hawaii Loa Ridge & Aina Haina	5017	(10.7%)	5,193	(7.5%)	1.26%
113*	5,742	Niu Valley and Kuliouou	6318	10.0%	6,540	13.9%	1.59%
119*	178	Red Hill Coast Guard Housing	174	(2.2%)	168	(5.9%)	.04%
Total Service Area	339,840		395,171	16.3%	409,049	20.4	98.5%
Total Study Area	342,511		398,330	16.1%	412,319	20.4	100%

( ) Negative numbers are shown in brackets.

* The 1990, 2010, and 2015 numbers do not represent the population of the entire TAZ because the entire TAZ is not in the service or study area. The population shown for each TAZ except 113 is included in both the study area and service area. For TAZ 113, it is assumed that the Kuliouou population comprises 50%. Therefore, 100% of TAZ 113 (shown in the table) is in the study area, and 50% of TAZ is in the service area (which does not include Kuliouou).

Sources: (1) 1990 and 2010 data from City Planning Department, July 1992.
(2) 2015 data extrapolated by Belt Collins as described in text.
(3) Change from 1990 calculated as:

$$\frac{\text{2010 or 2015 population} - \text{1990 population}}{\text{1990 population}}$$

where the 1990 population is zero, the change from 1990 is noted as "New". Where the 1990 and 2010 or 2015 population are zero, the change from 1990 is noted as "No."