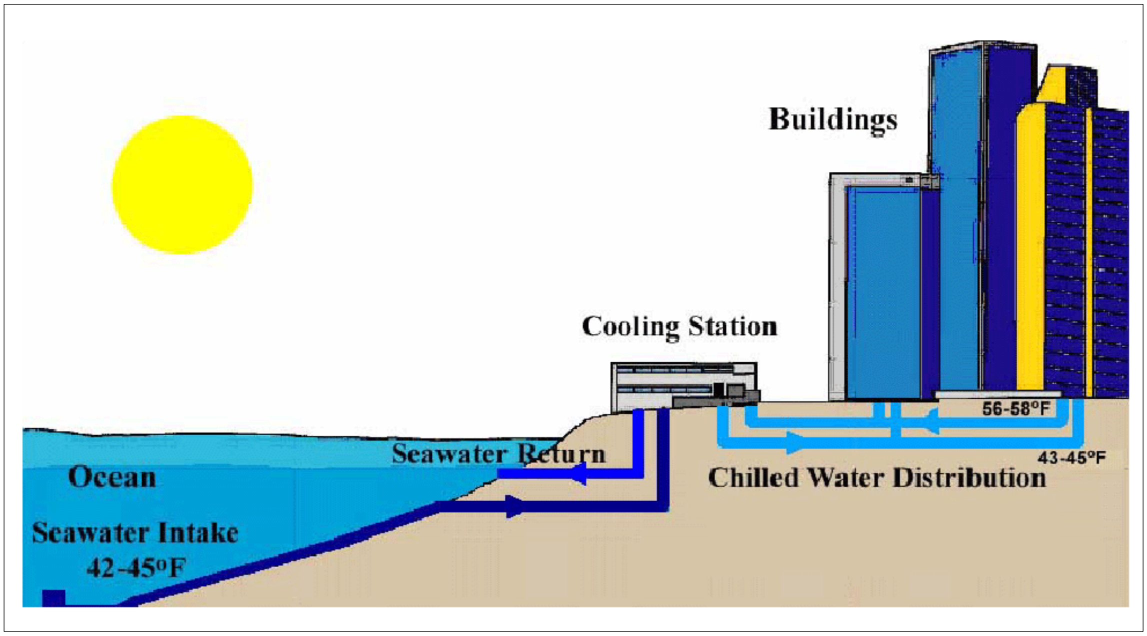
Honolulu Seawater Air Conditioning



Environmental Impact Statement
Preparation Notice

Prepared for:
Honolulu Seawater Air Conditioning, LLC

Prepared by:
TEC Inc.

August, 2007

Honolulu Seawater Air Conditioning

Environmental Impact Statement Preparation Notice

Prepared Pursuant to:
Hawaii Administrative Rules
Title 11, Chapter 200

Accepting Authority:
State of Hawaii, Office of Planning

Prepared for:
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Summary

Applicant: Honolulu Seawater Air Conditioning, LLC

Accepting Authority: State of Hawaii, Office of Planning

Brief Description of the Proposed Action: The objective of the HSWAC project is to provide reliable, lower-cost air conditioning for major government and commercial buildings in downtown Honolulu while reducing electricity use and the environmental and economic impacts associated with generation of electricity from imported oil and maintenance of conventional air conditioning systems. The action consists of installing seawater intake and return pipes offshore of Honolulu; constructing a pumping station on shore; and installing a system of distribution pipes beneath the streets of downtown Honolulu. The pumping station will house, in addition to the seawater pumps, freshwater pumps, heat exchangers and auxiliary chillers.

TMKs: 2-1-1, 2, 10-14, 16-18, 24-27, 29, 30, 32, 33, 35-37, 40, 42, 46, 47, 54, 55, 59 & 60: various parcels (por.)

Property Owners and Lessees: Submerged lands (to three miles offshore) are owned and regulated by the State of Hawaii. Submerged lands beyond three miles and up to 200 miles from the shoreline are under the jurisdiction of the United States of America. The preferred and alternative sites for the pumping station are owned by Kamehameha Schools, which has negotiated a development agreement with KUD International, LLC (KUD) for the preferred site. HSWAC, LLC would be a tenant of KUD. Lands beneath the streets are owned by the State of Hawaii and the City and County of Honolulu.

State Land Use Designations: Submerged lands (to three miles) are in the Conservation District. The remainder of the system is on land designated Urban.

County Development Plan Land Use Classification: Primary Urban Center Development Plan; Industrial, District Commercial and Institutional (Civic Center).

County Zoning: B-2 Community Business; BMX-4 Central; P-2 General; A-2 Apartment

Special Land Use Designations: Kakaako Community Development District, Special Management Area (SMA), shoreline setback, Capital Special District

Individuals, Community Groups and Agencies Consulted: U.S. Army Corps of Engineers; USEPA; National Marine Fisheries Service; State of Hawaii Departments of Land and Natural Resources (Land Division, Office of Conservation and Coastal Lands), Health, Transportation; Hawaii Community Development Authority; State Office of Planning; Office of Environmental Quality Control; City and County of Honolulu Departments of Design and Construction, Planning and Permitting, Downtown Neighborhood Board, Ala Moana/Kakaako Neighborhood Board

Determination: The Accepting Authority has determined that an Environmental Impact Statement is required because the project "affects or is likely to suffer damage by being located in an environmentally sensitive area(s) such as a flood plain, tsunami zone, beach, erosion-prone area, and/or coastal waters" (EIS Rules, Section 11-200-12, B.11).

Reasons Supporting the Determination: May affect sensitive coral reef areas and coastal water quality.

Name, Address and Telephone Number of Contact Person: George Krasnick, TEC, Inc., 1001 Bishop Street, ASB #1400, Honolulu, HI 96813, (808) 528-1445

Agencies to be Consulted in Preparation of the EIS: All of the above, plus City and County of Honolulu Department of Transportation Services.

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TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

ACRONYMS AND ABBREVIATIONS

$	Dollars
%	Percent
μg	Microgram
μg/m^3	Microgram per Cubic Meter
μM	Micromole
μmole/kg	Micromole per Kilogram
“	Inches
<	Less Than
≤	Less Than or Equal to
§§	Sections
©	Copyright
3-D	Three Dimensional
°	Degrees
°F	Degrees Fahrenheit
AAQS	Ambient Air Quality Standards
AC	Air Conditioning
ACOE	US Army Corps of Engineers
AD	anno Domini
APE	Area of Potential Effect
BLNR	Hawaii Board of Land and Natural Resources
Blvd.	Boulevard
BMPs	Best Management Practices
Btu	British Thermal Unit
CDUA	Conservation District Use Application
CDUP	Conservation District Use Permit
CF	Capacity Factor
cf	Compare
CFR	Code of Federal Regulations
CO	Carbon Monoxide
CO$_2$	Carbon Dioxide
CORMIX	Cornell Mixing Zone Expert System
CPD	Coastal Programs Division, NOAA
CWA	Clean Water Act
CWB	Hawaii Department of Health Clean Water Branch
CZM	Coastal Zone Management
dB	Decibel(s)
DBEDT	Hawaii Department of Business, Economic Development and Tourism
DLNR	Hawaii Department of Land and Natural Resources
DOH	Hawaii Department of Health
EO	Executive Order
EEZ	Exclusive Economic Zone
EFH	Essential Fish Habitat
EIS	Environmental Impact Statement
EISPN	Environmental Impact Statement Preparation Notice
EPA	US Environmental Protection Agency
ESA	Endangered Species Act
FEIS	Final Environmental Impact Statement
FEMA	Federal Emergency Management Agency
FIRM	Flood Insurance Rate Map
FMP	Fishery Management Plan
FONSI	Finding of No Significant Impact
ft	Foot or Feet
ft/sec	Feet per Second
GPD	Gallons per Day
GSP	Gross State Product
HAPC	Habitat Area of Particular Concern
HAR	Hawaii Administrative Rules
HCDA	Hawaii Community Development Authority
HDD	Horizontal Directional Drilling
HDPE	High Density Polyethylene
HECO	Hawaiian Electric Company, Inc.
HPD	Hawaii Department of Land and Natural Resources, Division of Historic Preservation
HRS	Hawaii Revised Statutes
HSWAC	Honolulu Seawater Air Conditioning, LLC
ID	Improvement District
JABSOM	John A. Burns School of Medicine
kg	Kilogram
kips	Kilopounds
kV	kilovolt
kW	Kilowatt
kWh	Kilowatt Hour
L	Limited Subzone of the Conservation District
l	liter
L$_{dn}$	Day-Night Sound Level
LLC	Limited Liability Corporation
LUC	Land Use Commission
LUO	Land Use Ordinance
m	Meter or Meters
MBTA	Migratory Bird Treaty Act
mg/l	Milligrams per Liter
MGD	Million Gallons per Day
MHI	Main Hawaiian Islands
MMPA	Marine Mammal Protection Act
MOE	Makai Ocean Engineering
MPA	Marine Protected Area

mph	Miles per Hour
MSA	Magnuson-Stevens Act
MSL	Mean Sea Level
MSW	Municipal Solid Waste
MUS	Management Unit Species
MW	Megawatt
N	North
NAAQS	National Ambient Air Quality Standards
NELHA	Natural Energy Laboratory of Hawaii Authority
NEPA	US National Environmental Policy Act
NHP	Hawaii Natural Heritage Program
nm or nmi	Nautical Mile(s)
NMFS	US National Marine Fisheries Service
NO_2	Nitrogen Dioxide
NOAA	US National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NPSH	Net Positive Suction Head
ntu	Normal Turbidity Unit
NWHI	Northwestern Hawaiian Islands
OEQC	Office of Environmental Quality Control
OMPO	Oahu Metropolitan Planning Organization
OP	Hawaii Office of Planning
OTEC	Ocean Thermal Energy Conversion
p	Probability
P	Protected Subzone of the Conservation District
PCB	Polychlorinated Biphenyls
PM	Particulate Matter
ppm	Parts per Million
ppt	Parts per Thousand
PRIA	Pacific Remote Island Areas
PUC	Primary Urban Center
R	Resource Subzone of the Conservation District
ROV	Remotely Operated Vehicle
RPS	Renewable Portfolio Standards
SAAQS	State of Hawaii Ambient Air Quality Standards
SCUBA	Self-contained Underwater Breathing Apparatus
SDWA	Safe Drinking Water Act
sec	Second(s)
SHPO	Hawaii Department of Land and Natural Resources State Historic Preservation Officer
SIHP	State Inventory of Historic Places
SMA	Special Management Area
SO_2	Sulfur Dioxide
SWAC	Seawater Air Conditioning
UIC	Underwater Injection Control
USACE	US Army Corp of Engineers
USC	US Code
USEPA	US Environmental Protection Agency
USGS	US Geological Survey
VOC	Volatile Organic Compound
WPRMFC	Western Pacific Regional Fishery Management Council
WWTP	Wastewater Treatment Plant
yr	Year
ZOM	Zone of Mixing

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1.0 INTRODUCTION

1.1 Purpose of and Need for the Proposed Action

There is a need, based on economic, environmental and energy independence considerations, to increase the use of renewable energy resources and decrease the use of imported oil to generate electricity in Hawaii. Further, there are mandates at the Federal level and policies at the State level to increase energy efficiency and renewable energy use, reduce potable water consumption and decrease toxic chemical use in their facilities. The State of Hawaii has also established mandates for increased use of renewable energy resources through a Renewable Portfolio Standard. The purpose of the HSWAC project is to significantly contribute to meeting these needs.

1.2 Energy Consumption in Hawaii

Hawaii is the most oil-dependent of the 50 states, importing oil for nearly 89% of its primary energy (DBEDT, 2004). Most of this oil is from foreign nations. In 2003, Hawaii’s energy use grew to 320 trillion Btu, up 4.6% over 2002. Petroleum use increased 4.2%, to slightly more than 284 trillion Btu. Coal use was up 6.3%. In total, coal and oil represent 94% of Hawaii’s energy consumption (DBEDT, 2004). Energy consumers in Hawaii spent $3.69 billion for energy in 2003, or 19% more than in 2002, principally due to high oil prices. This was about 7.6% of Hawaii’s $48.2 billion Gross State Product (GSP) (DBEDT, 2004).

The amount spent for energy, as well as the fraction of GSP used for energy purchases, have both increased significantly since 2003. Imported crude oil prices have more than doubled, and average electricity rates have increased by nearly 40%, during the period of 2003 to 2006.

Electricity sales continued to rise faster than the de facto population and GSP. In 2003, electricity sales per capita were 159% more than in 1970, while de facto population grew 71% and real GSP increased 127%. 2003 electricity sales increased 2.5% over 2002. This also resulted in a modest 1.6% increase in electricity sales per capita (DBEDT, 2004).

Renewable energy production in Hawaii increased by 9.7% in 2003, in large part due to Puna Geothermal Venture resuming full operation, plus additional solar water heating and photovoltaics coming on line. However, Hawaii’s renewable energy use in 2003 was only two-thirds that in 1990, primarily due to the loss of biomass-generated electricity provided by now-closed sugar factories. In 1990, biomass provided more energy than all renewable sources in 2003 combined (DBEDT, 2004).

Hawaii’s heavy dependence on imported oil for energy has negative consequences for the economy and the environment. Hawaii’s abundant potential renewable energy sources could replace a significant amount of imported oil in electricity production. On Oahu, Hawaiian Electric Company (HECO) continues to promote renewable energy use. In its recently released Draft Integrated Resource Plan: 2006 - 2025 (HECO, 2005), HECO makes “…a strong commitment to increase the use of indigenous renewable resources and decrease the use of imported oil.” Every barrel of oil saved by using renewable energy sources translates into more dollars available to the local economy, in addition to the many environmental benefits. The Honolulu Seawater Air Conditioning (HSWAC) project represents one of the largest potential substitutions of a renewable resource for imported oil now being planned for Oahu.

1.3 Government Mandates for Energy Efficiency and Renewable Energy Use

On June 2, 2004, with the signing of Act 95, Session Laws of Hawaii 2004, Hawaii’s original renewable portfolio standard (RPS) goal was replaced with an enforceable standard. Under the new standard, 20% of Hawaii’s electricity is to be generated from renewable resources by the end of 2020. Interim targets for renewables’ percentage of electricity sales are:

- 7% by December 31, 2003;
- 8% by December 31, 2005;

- 10% by December 31, 2010;
- 15% by December 31, 2015; and
- 20% by December 31, 2020.

Existing renewables, about 8.2% of electricity generation statewide in 2003, can be counted in the total. In addition to electricity produced by various renewable sources, the new law also includes energy savings technologies including seawater air conditioning (SWAC) district cooling in its definition of “renewable energy.”

On January 24, 2007, President Bush signed Executive Order (E.O.) 13423, “Strengthening Federal Environmental, Energy, and Transportation Management”. This E.O. promotes energy efficiency, water conservation, and the use of renewable energy sources. It establishes goals for energy reduction in Federal facilities of 3% annually through 2015 or 30% by the end of 2015, relative to 2003. It also promotes reduction of greenhouse gas emissions and the use and disposal of toxic and hazardous material.

Act 96, enacted May 12, 2006, requires State facilities to improve their energy efficiency and to use renewable energy resources. Act 96 established “new planning and budget preparation goals for state agencies that incorporate green building practices; the installation of renewable energy resources such as cost-effective solar water heating systems; increased conservation, waste reduction, and pollution prevention directives; the procurement of environmentally preferable products, including fuel-efficient vehicles and alternative fuels; and the use of energy-savings contracts for the provision of energy services and equipment.”

Government buildings in the downtown Honolulu area would be able to meet more than 80% of Federal mandates and substantially address State requirements for energy efficiency and renewable energy use by connecting to the HSWAC system. They would also be able to further water conservation goals and reduce the use of ozone-depleting substances and other toxic and hazardous chemicals.

1.4 The Seawater Air Conditioning Concept and Existing Systems Worldwide

SWAC uses infinitely renewable, deep cold seawater instead of electricity-intensive refrigeration systems to air condition one or more buildings. Typical air conditioning systems use Freon®-based chillers to cool water which is then used to cool the air that is circulated throughout the building. In a SWAC system, rather than cycling water through a chiller, the water is routed through a heat exchanger. Fresh water circulates through one side of a system of titanium (or other corrosion-resistant alloy) plates, transferring its heat to the cold seawater on the other side of the plates. The fresh water loop is closed, that is, the water circulates around and around from connected buildings to the heat exchanger, while the cold seawater passes through the heat exchanger only once before being returned to the sea. The main components of a basic seawater air conditioning system are a seawater distribution system including the supply pipe, pumps, and return pipe; a fresh water circulation distribution network, including pumps, that provides chilled water that circulates through each building; and heat exchangers that transfer heat from the fresh water circulation distribution loop to the seawater.

The feasibility of using cold seawater to cool buildings has been studied and analyzed for many years. A number of SWAC (and cold lake water air conditioning) systems are now in operation around the world. In 1975, the US Department of Energy funded a program entitled "Feasibility of a District Cooling System Utilizing Cold Seawater" (Hirshman et al., 1975). Several locations were studied and the two most favorable sites were Miami/Ft. Lauderdale and Honolulu. The study, however, noted that one of the limiting technical factors was the inability to deploy large diameter pipelines to depths of 1,500 feet and more. This technical challenge has since been addressed and demonstrated with a number of large diameter deep-water pipelines being deployed at the Natural Energy Laboratory of Hawaii at Keahole Point, Hawaii. Water pumped from 2,200 feet deep has been used to air condition buildings there since 1986, and plans have recently been approved to provide cold deep seawater air conditioning to the adjoining Keahole International Airport.

In 1995, Stockholm Energy (nowadays Fortum) started supplying properties in central Stockholm, Sweden with cooling from a district cooling system. Most of the cooling is produced by using cold water from the Baltic Sea. There are at present more than 65,000 tons connected load to the district cooling system in Stockholm and Sweden currently has more than 80,000 tons of SWAC and lake cooling.

Several large-scale lake water cooling projects have come on line in recent years. In 1999, a 63-inch diameter, 10,000-foot long pipeline was installed to link Cornell University and nearby Lake Cayuga. The pipeline accesses cold water at a depth of 250 feet. The system, which can provide 20,000 tons of cooling, is supplying air conditioning to the Cornell University Campus and the Ithaca City Schools.

More recently Enwave in Toronto, Canada completed Phase I of a district cooling system that utilizes cold water from Lake Ontario to provide air conditioning to buildings in Toronto. The lake water is initially brought to a cooling station through three 63-inch pipes where it is used to cool a fresh water distribution system that provides air conditioning to the downtown buildings. After the coldness of lake water has been used for air conditioning the water itself is used in the city’s potable water system. The system is designed for 58,000 tons -- the equivalent of 32 million square feet of building space. Compared to traditional air conditioning, this system reduces electricity use by 75 percent and eliminates 40,000 tons of carbon dioxide production annually, the equivalent of taking 8,000 cars off the streets.

The Intercontinental Resort and Thalasso Spa Bora Bora opened May 1, 2006 and features a number of unique attributes. The innovative, eco-friendly, air-conditioning system deploys a 7,874-foot pipe to a depth of 3,000 feet (the deepest ocean pipe in the world) off the reef of Bora Bora. The pipe pumps cold, deep-sea water through a titanium heat exchanger, transferring the cold into the fresh water circuit that then powers the air conditioning throughout the hotel.

A number of other seawater and lake water district cooling systems are now under study or in design, including systems in Miami, Hong Kong, Guam and elsewhere. The engineering design and deep water pipeline installation challenges have been met; SWAC systems today are feasible, reliable and economical.

1.5 The HSWAC Project Objective

The objective of the HSWAC project is to provide reliable, lower-cost air conditioning for major government and commercial buildings in downtown Honolulu while reducing electricity use and the environmental and economic impacts associated with generation of electricity from imported oil and maintenance of conventional air conditioning systems.

1.6 Potential Benefits of the HSWAC Project

SWAC systems have significant economic and environmental benefits when compared with traditional electric air conditioning systems. The net public benefits of SWAC systems in general, and the Honolulu SWAC system in particular, greatly exceed any potential adverse effects.

Stable Cooling Costs: Honolulu has some of the highest electricity costs in the nation, and these costs have been increasing faster than the rate of inflation. SWAC systems provide customers with reduced and stable cooling costs.

- Average commercial electricity rates in Honolulu in 2006 were more than 17 cents/kWh.
- These costs have increased at a real (inflation-adjusted) rate of more than 2.2% per year over the period 1990 to 2006. Annual increases, with inflation, are nearly 4.2% per year.
- At this rate, real electricity costs will increase by more than 73% over the 25-year book life of a SWAC project (with inflation, the cost increase is nearly 176%).
- The energy cost is a small fraction of the total cost for a SWAC system and SWAC life cycle costs will, therefore, remain more stable.

Renewable Energy Use: SWAC uses a vast and renewable energy resource – cold, deep seawater.

- SWAC will greatly help the State of Hawaii and HECO meet new RPS requirements.

- More than 90% of the energy savings from SWAC are due to the use of an abundant, renewable energy resource – cold, deep seawater.
- With limited land area and high electrical demand, Oahu will have the greatest challenge in meeting RPS. SWAC is the renewable energy technology that can provide the greatest near-term benefits to Oahu.
- The 25,000-ton HSWAC project would provide renewable energy benefits equal to:
    - 42 MW of photovoltaics (at a Capacity Factor [CF] = 0.21);
    - 28 MW of wind (at a CF = 0.32); or
    - 14 MW of municipal solid waste (MSW) or biomass combustion (at a CF = 0.65).

Reduced Oil Dependence: Hawaii is more than 90% dependent on imported fossil fuels, most of this is oil. A SWAC system can significantly reduce imports of crude oil.

- The 25,000-ton HSWAC project would reduce crude oil imports by up to 174,000 barrels per year.

Reduced Potable Water Use: SWAC systems eliminate the need for cooling towers and, as a result, reduce potable water use, toxic chemical use, and the production of sewage.

- The 25,000-ton HSWAC project would save up to 265 million gallons of potable water per year.
- The 25,000-ton HSWAC project would reduce sewage generation by up to 114 million gallons per year.
- SWAC systems eliminate the need for cooling water treatment chemicals.

Environmental Benefits: Reduced use of fossil fuels provides for significant reductions in greenhouse gas emissions and other air and water pollutants. SWAC systems greatly reduce the use of harmful chemicals (refrigerants) used in conventional cooling systems.

- The 25,000-ton HSWAC project would reduce the production of pollutants from fossil fuel combustion by up to the following amounts:
    - Carbon dioxide (CO_2) emissions – 83,000 tons/year
    - Volatile organic compounds (VOC) emissions – 5 tons/year
    - Carbon monoxide (CO) emissions – 27 tons/year
    - Particulate matter less than 10 microns in aerodynamic diameter (PM_{10}) emissions – 18 tons/year
    - Nitrogen oxides (NO_x) emissions – 165 tons/year
    - Sulfur oxides (SO_x) emissions – 161 tons/year
- By reducing the production of greenhouse gases (primarily CO_2), the effect of global warming is also reduced.
- SWAC reduces the amount of heat released to the environment (ocean and atmosphere). Electricity production is only about 32.5% efficient; the rest of the energy is rejected as waste heat (cooling water + stack gas losses + radiation and other minor losses). SWAC reduces thermal pollution of the environment by about one-third compared with conventional, electricity-powered air conditioning systems.

Energy Efficiency and Demand Side Management Benefits: Energy savings with SWAC systems are 75%, or more, compared to conventional A/C systems.

- Each ton of SWAC eliminates the need for about 3,100 kWh/year of energy use.
- The 25,000-ton HSWAC project would save up to 77 million kWh per year. This is equivalent to more than 27,000 residential solar water heating systems.
- Each ton of SWAC eliminates the need for up to 0.63 kilowatts of new (likely-to-be-fossil-fueled) generation capacity.
- The 25,000-ton HSWAC project would eliminate the need for up to 16 MW of new generation. This is equivalent to more than 21,000 residential solar water heating systems.
- This reduced demand for new energy generation is equivalent to one year of HECO's projected load growth.
- The reduced need for expensive new electricity generation capacity will help to keep Oahu's electric rates lower for longer.

Reduced Operations and Maintenance Costs: Large-scale, district cooling systems have lower operating and maintenance costs than individual building air conditioning systems.

Local Economic Development: A SWAC project will generate millions of dollars in construction spending. In addition to construction jobs, a number of long-term, well-paid jobs will also be created. Other local economic development benefits will accrue from money that stays in Hawaii, and is not used to purchase oil.

Government Energy Goals and Mandates: SWAC systems will help the City and County of Honolulu, the State of Hawaii, and the Federal government to meet goals and mandates for energy efficiency and renewable energy use.

- Government buildings would be able to meet more than 80% of State and Federal mandates for energy efficiency and renewable energy use by just connecting to a SWAC system.

Secondary Benefits: There are a number of potential uses of the seawater that leaves the SWAC system. Among these are: (1) auxiliary cooling for power plants, industrial facilities, and cooling systems; (2) flushing of harbors and canals; and (3) cold water agriculture and aquaculture.

Reliable Cooling: SWAC systems are simple, and technically and economically feasible today. They use industrial-grade, off-the-shelf components. Seawater supply systems have demonstrated reliability over many years in sometimes hostile environments. Deep water cooling systems have been successfully installed and operated in a number of areas worldwide from Stockholm, Sweden to NELHA on the Big Island of Hawaii. Large-scale district cooling systems are successful, low-cost, energy-efficient, environmentally-friendly and are used worldwide. District cooling and heating systems currently operated by Market Street Energy Company, LLC (the parent company of Honolulu Seawater Air Conditioning, LLC) have a reliability of 99.99%, much superior to the typical reliability of local electric utilities, or conventional, on-site air conditioning.

Customers: SWAC systems provide convenient, reliable, renewable energy, low and stable-cost cooling.

1.7 Project Setting

The HSWAC project is proposed for the downtown area of Honolulu, on the leeward shores of Oahu (Figure 1-1). The island of Oahu is part of the City and County of Honolulu. Four areas near downtown Honolulu (Figure 1-1) would be used in four discrete functions associated with construction and operation of the HSWAC system:

- Seawater intake and return pipes would be deployed offshore of Honolulu in the area between Honolulu Harbor and Kewalo Basin;
- A cooling station would be built on a site in the Makai District of the Kakaako Community Development Area;
- Freshwater distribution pipes would be installed beneath streets in the downtown Honolulu area; and
- A shoreline site in Keehi Lagoon would be used for materials staging and pipeline assembly.

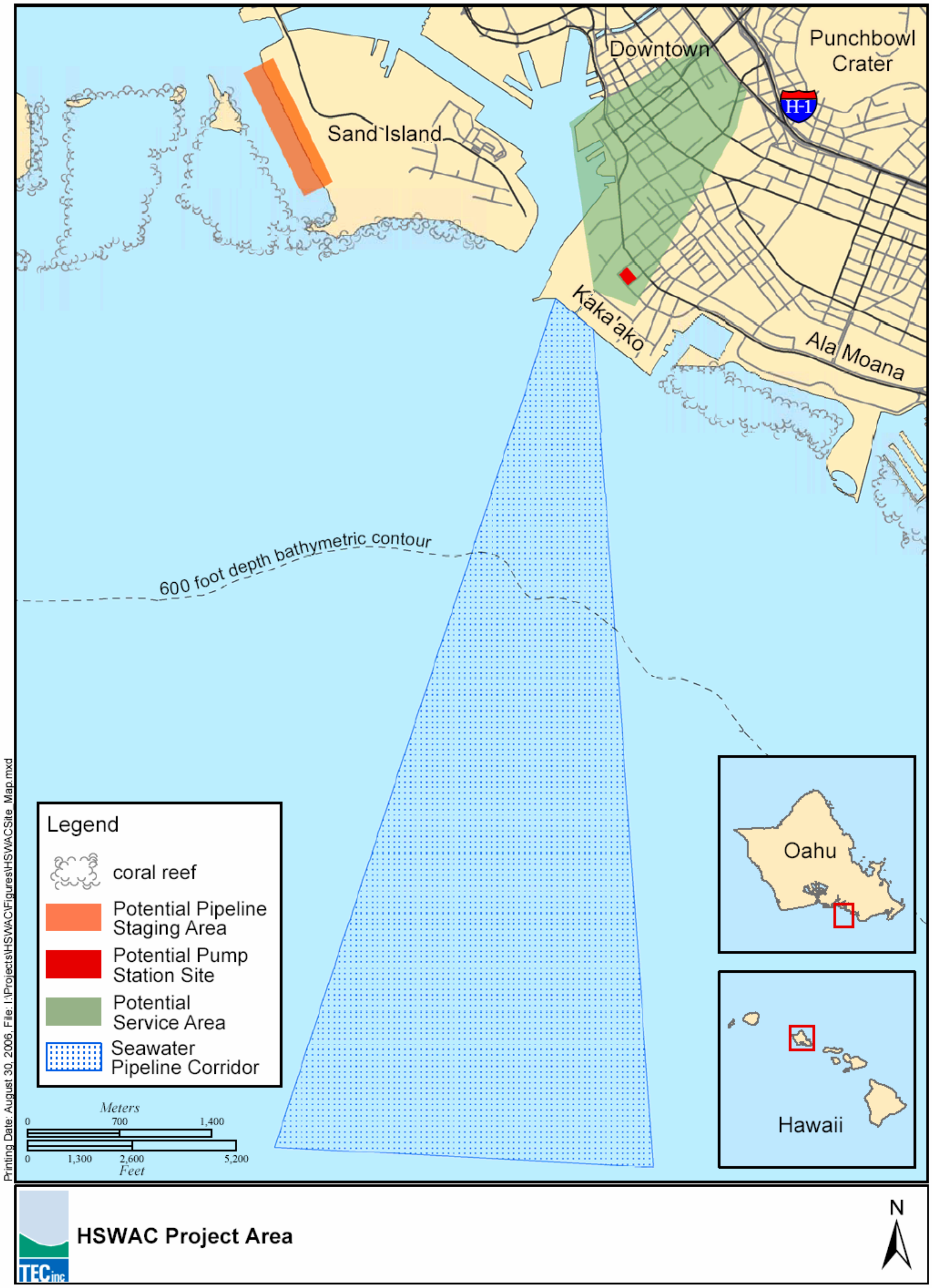

Figure 1-1: HSWAC Project Area

2.0 DESCRIPTION OF THE PROPOSED ACTION

2.1 Introduction

This chapter describes the proposed action (preferred alternative) by major system component: seawater pipes, cooling station, and freshwater distribution pipes. The next chapter describes the alternatives considered for each of the major components. The overall capacity of the proposed system was established in consideration of the potentially available cooling load in downtown Honolulu, the costs to connect buildings of various sizes and locations, system capital and operating costs, the availability of appropriate equipment, and the offshore bathymetry and seawater characteristics. The proposed system capacity, in turn, determined the sizes of the major system components. Component sizes, their respective operating environments, and life-cycle costs determined component materials, for example, high density polyethylene (HDPE) for the seawater pipes, etc.

Although a wide range of alternative equipment types was evaluated, there would be little or no differences in their respective environmental impacts and they are not considered alternatives for purposes of this assessment. The equipment selected for use in the project is described under the proposed action. Similarly, system component size and material composition determined in large measure the required construction methodologies.

Where system requirements did not allow for alternatives, the respective potential environmental impacts of their installation or operation are considered unavoidable, although mitigation measures may be employed to reduce impact intensity, duration or extent. In the case of the seawater intake and return pipes, alternative methods of installation are possible (i.e., cut and cover through near shore reefs rather than horizontal directional drill beneath them), but their potential impacts are so much greater than those of the proposed action that they realistically would not be acceptable to the responsible regulatory agencies or the general public and are not proposed as viable alternatives here.

Alternatives to the proposed action, therefore, are limited to: (1) competing technologies that do not provide all of the energy savings, demand reduction, potable water savings, reduced sewage generation, and pollution reduction benefits that are achievable with SWAC and (2) various cooling station sites, staging areas, and seawater and chilled water distribution routes to be used with a SWAC system.

Competing technologies include: (1) independently cooled buildings with on-site chillers using Freon® compounds and cooling towers (as presently used); (2) district cooling using deep wells for condenser cooling of chillers; (3) district cooling with central, conventional chillers; and (4) district cooling with ice making chillers and ice storage.

For the seawater distribution system pipes, alternatives include pipe alignment on the seafloor and depth of intake and discharge. For the staging area, a number of alternative sites were evaluated. For the cooling station, preferred and alternative sites have been identified, although system considerations limit how far the cooling station can be from the shoreline. A preferred route has been identified for the freshwater distribution system, but many permutations of the route are possible and, in fact, some details of the final route may not be known until the list of buildings to be served is finalized.

2.2 Project Overview

The HSWAC project would provide 25,000 tons of centralized air conditioning for downtown Honolulu. The primary means of cooling would be through the use of deep, cold seawater accessed through a long offshore intake pipeline. The system is shown conceptually in Figure 2-1.

The primary system components are as follows:

- Seawater intake and return pipes;
- Seawater cooling station (cooling station) containing;
    - Seawater pumps;
    - Freshwater pumps;

  - Heat exchangers;
  - Auxiliary chillers; and
- Chilled (fresh) water distribution system.

Each of these components is described further below. A staging area would be required for materials storage and pipeline assembly and testing. This area is described below as well.

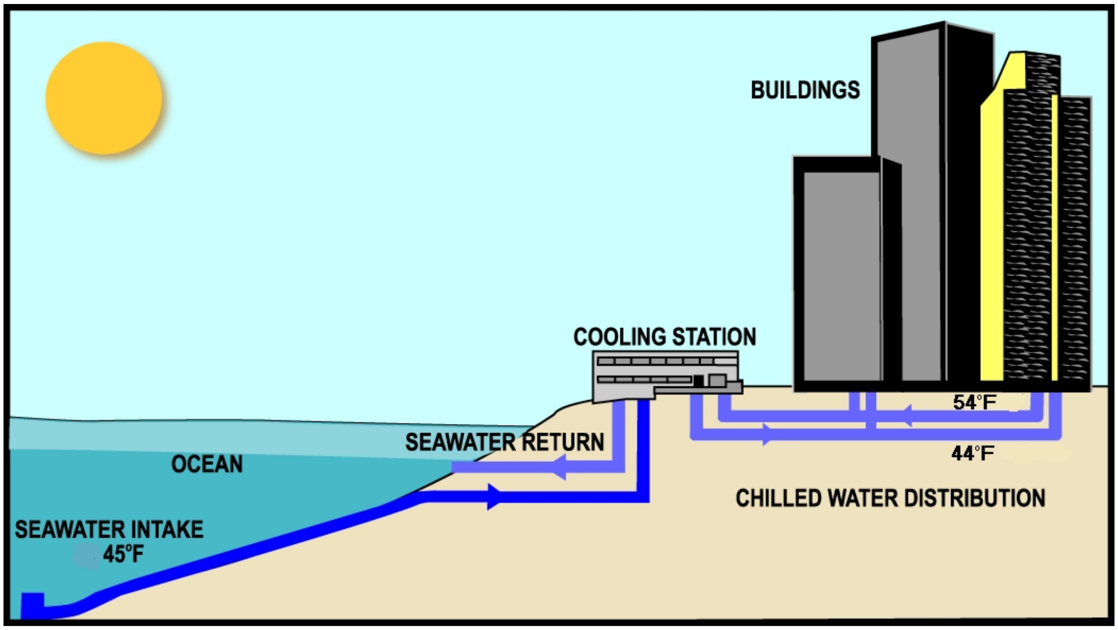

Figure 2-1: Conceptual Drawing of Major Components of the HSWAC System
(Source: HSWAC, LLC)

Figure 2-2 is a schematic drawing of HSWAC system operations. Cold seawater is pumped through heat exchangers and then condensers in auxiliary chillers before being returned to the sea. Freshwater circulates through the heat exchangers and the auxiliary chillers before returning to the connected buildings.

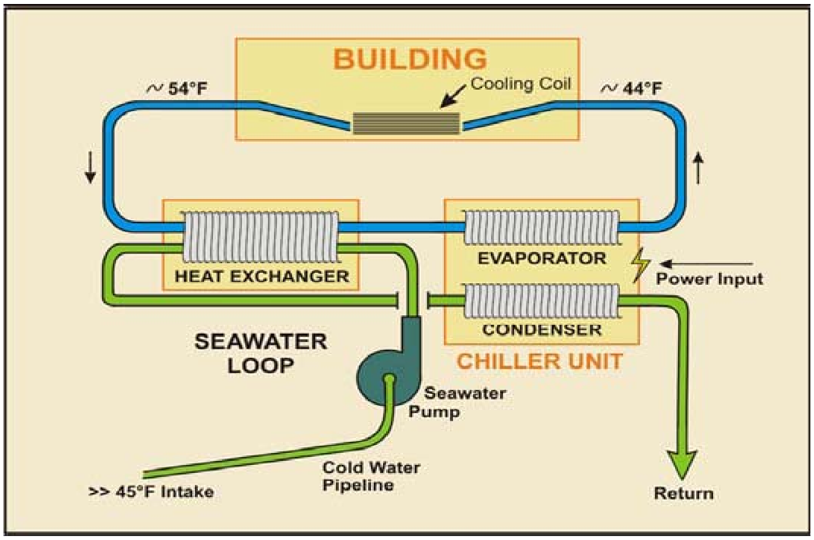

Figure 2-2: Schematic Drawing of the HSWAC System with Chiller Enhancement
(Source: MOE, 2005a)

2.3 Seawater Intake Pipe

2.3.1 Description

A 63-inch diameter high density polyethylene (HDPE) pipe would supply cold seawater to the heat exchangers on shore. The maximum flow rate through the pipe would be 44,000 gpm. The average temperature of the intake water would be approximately 45°F.

The length of the pipe from shore to the intake location would be approximately four miles. Individual pipe segments would be heat-fused to form longer segments and these longer segments would be flanged together to form a single pipe. The pipe would terminate in a right-angle elbow, such that water would be drawn down into the pipe from about ten feet above the bottom. Water depth at the intake point would be approximately 1,600 feet. The design life of the pipeline and drilled shaft would be 75 years. From the shoreline two 48-inch supply pipes will be horizontal directionally drilled under the seabed approximately 2,200 ft offshore to a depth of about 40 to 45 feet. The horizontal directional drilling process is shown in Figure 2-3.

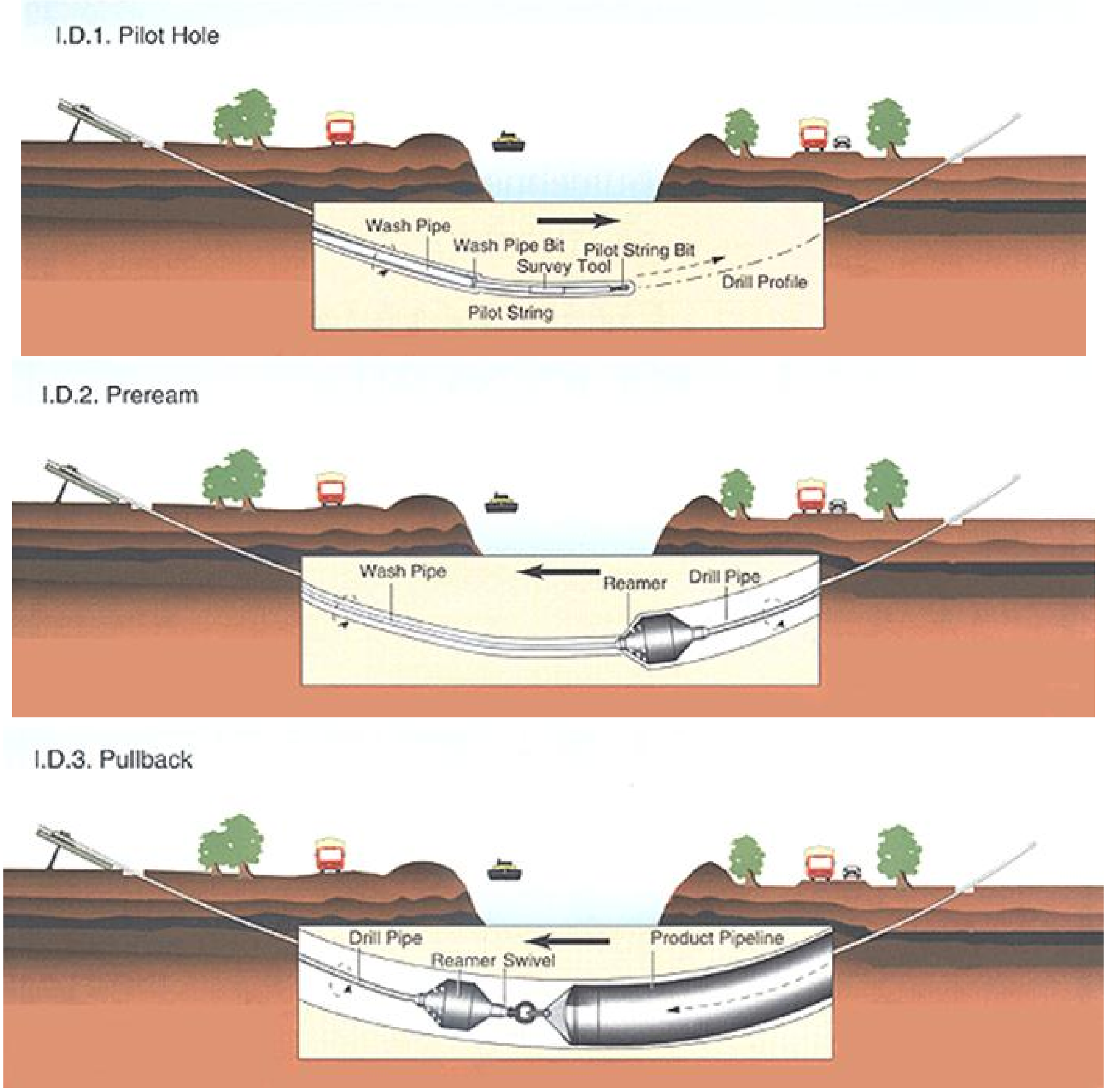

Figure 2-3: Horizontal Directional Drilling

The shoreward end of the pipe will be trenched or directionally-drilled and terminate in the cooling station. A cleanable screening system of ¾" – 1" mesh to filter out larger organisms that may become entrained in the intake flow would be situated in line before the pumps.

The route of the pipe from the underwater breakout point to the intake location will be finalized after detailed bathymetric surveys. To protect the pipe from the effects of large storm waves, it would be buried in a trench from the breakout point of the directionally-drilled section to a depth of 80 feet, a distance of approximately 3,200 feet off shore.

Different anchoring methods would be required for different zones of the pipe. After emerging from the tunnel, the first is the bottom-mounted anchor zone. This zone would employ gravity concrete anchors that are rigidly attached to the seabed by piles or soil nails. The bottom mounted anchor zone would extend from about 80 feet deep to 130 feet deep, a distance of about 900 feet.

From 130 feet deep to the end of the pipeline at 1,600 feet deep, a distance of 14,600 feet, the pipe would be held in place solely by gravity anchors (Figure 2-4). This zone is called the gravity anchor zone. Each anchor would weigh approximately 17,800 pounds in air, and would provide an effective weight of 10,300 pounds when submerged. Joining hardware would be fabricated from steel or ductile iron bolts and fittings that have been galvanized in zinc, with additional zinc anodes to provide long life in seawater. Approximately 505 pipe weights would be required for the intake pipe.

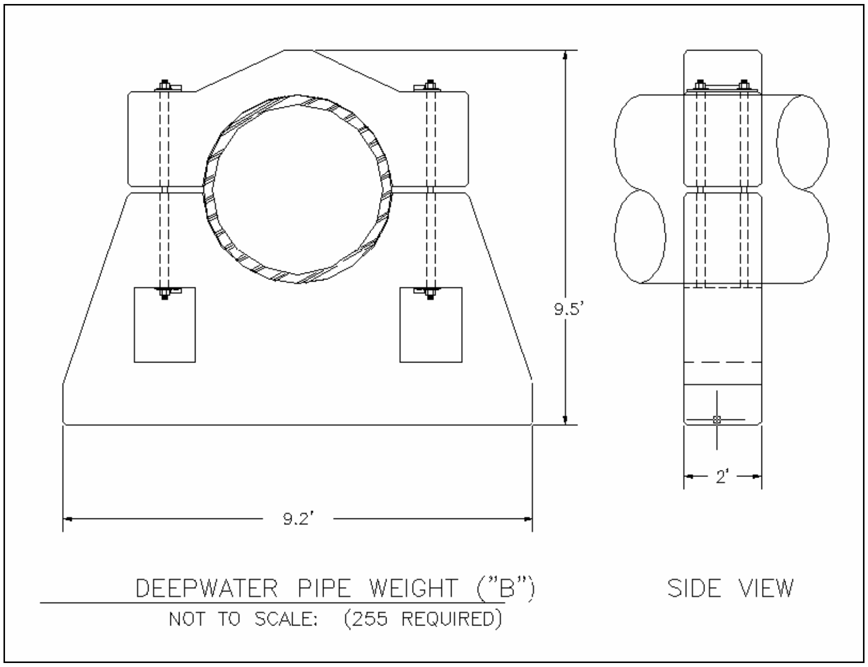

Figure 2-4: Typical Anchor Collars for Use on an HDPE Pipeline
(Source: MOE, 2005a)

Figure 2-4 illustrates a typical concrete anchor design. The concrete collar is a split design that allows the two halves to be bolted onto the pipeline. The heavier bottom would keep the pipeline stable during deployment and help to prevent any roll during installation. The pipeline would be supported above the seabed to reduce the hydrodynamic forces on it.

In the region shallower than 350 feet deep, the pipe weight design would be modified to present a more streamlined, snag-resistant design so that cables dragging from tugs or barges would not become entangled. Figure 2-5 shows the features of this anti-snag pipe weight.

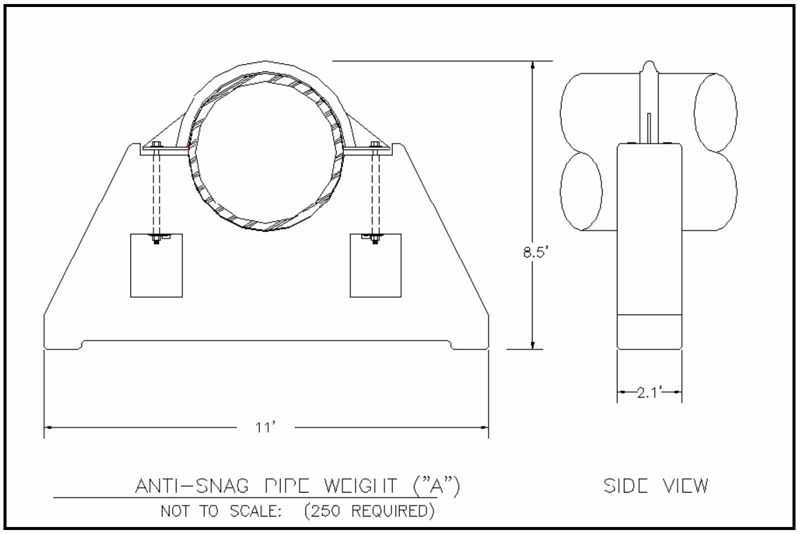

Figure 2-5: Snag-Resistant Pipe Weight for Use in Shallow Depths
(Source: MOE, 2005a)

HDPE pipelines are limited in maximum suction. Over time, pipelines can oval and eventually collapse if too high suction pressure is applied. In order to increase the suction capability of this pipeline, ductile iron stiffeners would be added to the outside of the pipeline. Each stiffener would be coated and additionally protected with zinc anodes. Figure 2-6 illustrates similar stiffeners in place on a floating pipeline.

Figure 2-6: A 63-inch Pipeline with Ductile Iron Stiffeners
(Source: MOE, 2005a)

In this installation, the stiffeners would be critical to long-term performance of the pipeline. Specially-designed stiffeners that would allow a cable to slide over the pipe would be designed and installed on shallow sections of the pipe.

2.3.2 Installation

Three ~56-inch diameter shafts would be horizontal directionally drilled from behind the shoreline near the drainage canal west of the Kakaako Waterfront Park under the shoreline and near shore area, emerging at a depth of 40 to 45 feet. Two of the shafts would be used to install 48-inch pipes for seawater supply pipes and one shaft would be used for the seawater return pipe. Materials excavated in drilling of the shaft would be extracted from the shaft and disposed of on land. Drilling mud, i.e. bentonite clay, would be used to flush the cuttings from the drilling and to stabilize the hole.

From 40 to 45 feet depth to approximately 80 feet depth two 63-inch HDPE pipes would be installed in a trench.

The HDPE pipe would be constructed from 40 to 80 feet segments on-shore. A staging area of approximately 5 acres near the shore would temporarily be required to store pipe, concrete anchor blocks and other components, and to fuse the pipeline lengths into longer segments. An area along the western side of Sand Island is preferred for staging of the pipelines.

The pipe segments are fused together into longer (~3,300-foot) segments, sealed and equipped with the concrete anchors while launched into the water using a temporary "railway". These floating segments would be stored (moored) in the water pending completion of all segments. Final assembly of the pipe would be done by connecting the segments by lifting the ends slightly above the water, removing the seals and bolting the flanged ends together.

Deployment of the pipe would be done once all the segments are assembled. The pipeline would be towed into place, the land side temporarily secured to allow the pipeline to be put under tension, and the pipeline sunk in a controlled manner from shallow to deep water by controlled flooding. At least three tugs would be used to maneuver the pipeline to its final position. As the pipeline would be deployed off the south side of Oahu, deployment would likely be scheduled during the winter, when large southern swells are absent. The pipe would be pulled into place in a single day and sunk at night to avoid increased HDPE temperature, and thereby a lower pressure rating, due to solar irradiation during the deployment.

The deployment process is illustrated in Figure 2-7. The air-filled and anchor-weighted HDPE pipeline would be floated on the surface of the ocean and controllably submerged by flooding from the shore end and venting air on the offshore end. At all times, the pipeline configuration would be in equilibrium, with the air-filled portion supporting the flooded section. To avoid kinking the pipeline at the two bends, the seaward end would be pulled (90 to 100 kips tension) by a tug boat during deployment. An ROV would be used to monitor the deployment.

Because of the size of this pipeline (length and diameter), the volume of water to initially fill it would be very large. At a deployment flow of 5,000 gpm, the total flooding would take eight hours. At least another eight hours would be required for contingency delays and lowering the end of the pipe. Once the pipeline is completely flooded, the blind flange would be removed from the end of the pipeline and the end would be lowered to the seafloor at 1,600 feet depth. The ROV would inspect the location and condition of the pipeline prior to release of the lowering cable.

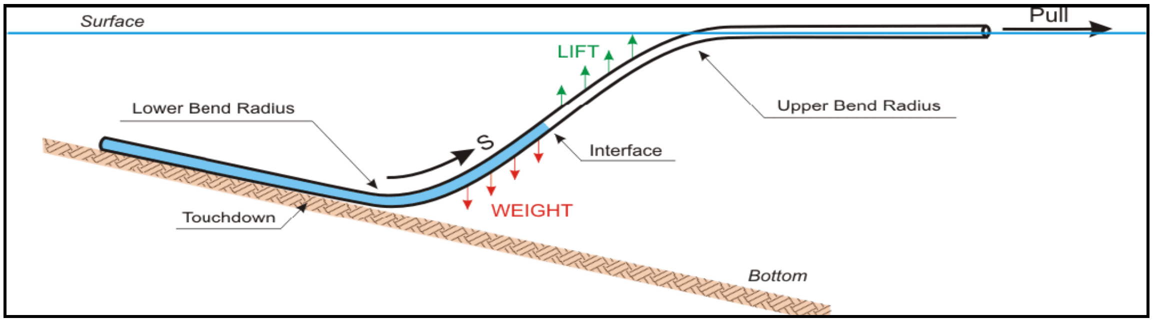

Figure 2-7: Controlled Submergence of an HDPE Pipeline
(Source: MOE, 2005a)

The nearshore end of the pipeline would be close to but not connected to the tunnel at this point. A spool piece would be prepared to fill the gap and flange bolted in place by divers. Any trenched portion of the pipeline then would be backfilled.

2.3.3 Operation

Because of the low density of fouling and other organisms at the intake depth, neither fouling nor impingement/entrainment of plankton or nekton is expected to be a problem. Such has been the experience at the Natural Energy Laboratory of Hawaii Authority (NELHA), where similar pipes draw water from about 2,200 feet deep for cooling, aquaculture, agriculture, alternative energy research and recently, desalinated drinking water. Intake screens at the pumps can be removed for cleaning if it becomes necessary, but at a water velocity of 5.1 feet per second, most fish would be able to avoid being entrained. Should significant fouling occur, the interior of the pipe could be cleaned by pulling a “pig” through, although that has not been necessary at Keahole Point. The integrity of the pipe and anchors would be checked every four to five years (or following a large storm event) with divers and ROVs.

Once the pipe is in place, its location would be added to the appropriate nautical charts of the area. Large ocean-going vessels would be prohibited from anchoring on the pipeline, but there would be no restrictions on recreational uses of overlying waters. Small boat anchors would not harm the pipeline.

The economical service life of the pipe is minimally 25 years. By incorporating appropriate safety factors into the seawater supply pipe design, installing pipe stiffeners, and by maintaining operating flow rates (pressure losses) below design guidelines, the useful service life of this pipe is designed to be in excess of 75 years. The HDPE pipe is extremely rugged with a wall thickness up to 3 inches. However, if the pipe were to receive damage for some reason, the contingency plan would include running the auxiliary chillers in the cooling plant, utilizing available but warmer seawater, and those remaining chillers in customer buildings. Simultaneously, temporary repairs would take place, until a permanent repair could be evaluated and put in place, utilizing available contractors on the island with marine construction capabilities and equipment.

2.4 Seawater Return Pipe

2.4.1 Description

The seawater return pipe would be constructed of the same material using the same techniques, have the same type of anchors and be of the same diameter (i.e., 48 inches for the directionally drilled section and 63 inches elsewhere) as the intake pipe. The return volume would equal the intake volume in this open loop system. The temperature of the return seawater would be approximately 58°F at peak demand, but this may vary with system demand, customer installations and return pipe insulation.

The return seawater pipe would terminate at a location determined based on plume modeling and a zone-of-mixing analysis. The return pipe would begin at the cooling station and pass through a directionally-drilled shaft from the shoreline to 40 to 45 feet depth, similar to the intake pipe. The breakout point for the return pipe would be at the same depth as for the intake pipe, and again some trenching would be required to protect the pipe from large storm waves. The return pipe would be buried in a trench from the shaft breakout point to a depth of 80 feet, a distance of approximately 1,000 feet. Water depth at that location is approximately 130 feet.

Seaward of the trench, the pipe would lie on the bottom, attached with pre-cast concrete sleeves (gravity anchors) bolted to the hard substrate. The return flow pipe would terminate in a diffuser, as described in Section 2.4.3.

2.4.2 Installation

Assembly and installation of the return seawater pipe would proceed as for the intake pipe.

2.4.3 Operation

Warmed water would be returned to the ocean through a diffuser. A negatively buoyant plume would be formed, at the discharge depth. The outfall would be located in 80 to 200 feet of water near the trench breakout location. This corresponds to a distance offshore of between 3,200 and 4,800 feet, respectively.

Based on published research and related government regulation, a mixing zone and a dilution requirement are proposed for the return water flow. Reviewing relevant regulations and using recent zone of mixing (ZOM) permits as a guideline, a 1,000-foot radius mixing zone is proposed. Computer simulations using CORMIX hydrodynamic software, showed that under either steady state or an unsteady state accounting for tidal oscillations, a 60-port 330-foot diffuser located at a depth of 120 feet would provide the necessary dilution. The diffuser would be oriented perpendicular to the shoreline and the ports installed at a 60° vertical inclination. Dilution of the return flow would be increased by the currents in that portion of Mamala Bay, which tend to run parallel to the shore. The distance between ports was chosen to minimize the merging effect between different discharge plumes. The port size and height were chosen to increase discharge speed and plume sinking time to further increase dilution in the near-field mixing process.

Several other diffuser design factors were considered. To prevent backflow or other intrusions, “duck-bill” check valves, which only open if there is enough internal pressure, could be installed on the diffuser ports. Ports would be of a breakaway design such that they would pull free of the pipe if a lateral load exceeding 1,000 pounds were applied to them. This would largely eliminate greater potential damage from boat anchors or cable dragging. At the proposed diffuser depth, divers can carry out inspection, maintenance and repair work if necessary.

2.5 Staging Area

A temporary staging area is needed for storage of pipe sections, gravity anchors, stiffeners and other materials during the pipeline assembly process. The area must be near the shoreline so that the pipeline sections can be placed into the water for storage and testing prior to being connected and towed to the deployment site. A number of potential locations were considered (see Section 3.4), but the preferred location would be along the western shore of Sand Island. This area would be restored to its original condition after the seawater pipes have been deployed.

2.6 Cooling Station

The seawater pumps, heat exchangers and auxiliary chillers would be housed in a cooling station. These components are described in separate sections below. This section describes the cooling station structure itself.

2.6.1 Location

A number of candidate sites were evaluated for suitability for a cooling station. Technical and siting criteria evaluated included:

- Exposure to waves and tsunami run-up;
- Probable soil conditions;
- Probable contamination and old buried utilities;
- Access corridors for tunneling and trenching;
- Distances for tunneling and trenching both toward the sea and toward downtown;
- Size of the site for development; and
- Existing structures on the site.

The preferred location for the cooling station is on a lot seaward of 677 Ala Moana Blvd. Alternative locations considered are discussed in the next chapter.

2.6.2 Footprint and Layout

Two alternative types of cooling stations were considered: wet sump and dry sump. Wet sumps involve excavation of some form of deep open well or pit filled with water. Various pump styles can be used: Vertical style well pumps can be mounted over it; submersible pumps can be lowered in on a fixed rail system with an integral discharge riser pipe; dry style centrifugal pumps can be mounted in a dry sump alongside the wet well. In all cases for a wet well serving a large diameter deep water intake pipe, some form of screen or strainer box at the connection of the intake pipe in the well is needed to prevent potential debris to enter the sump. It is desirable for the intake pipe to follow a slight uphill grade in its attachment to the wet sump to allow any entrained air to be naturally vented into the sump.

The second type of cooling station is a dry sump – direct connect type. A dry sump cooling station is constructed inside a room that is located adequately below mean sea level to allow the Net Positive Suction Head (NPSH) requirements of the selected pumps to be satisfied. Therefore, like the wet sump, the exterior of the dry sump would have to provide a waterproof barrier to the entry of groundwater into the room. With direct connection to the intake pipeline, the cooling station assembly must include a suction strainer to prevent potential debris to enter a pump.

The intake pipe terminates in a suction manifold that may be located inside or outside of the dry sump. This manifold would provide a fixed number and size of flanged pipe stubs for pump attachments. The direct connect pumps are usually horizontal shaft centrifugal style pumps. Isolation valves are located on either side of the pump to allow removal and check valves are located on the discharge side to allow parallel pump operation. Another pipe manifold is provided on the discharge side of the pumps, and from this manifold on, the dry sump, direct connect type cooling station is identical to the wet sump type cooling station.

Given the location of the HSWAC cooling station within urban Honolulu and the limited space available at cooling station sites under consideration, a dry sump - direct connect pump arrangement may be most practical and economical for this cooling station. However, both dry- and wet-sumps are being evaluated at this time.

A variety of potential layouts for the cooling station have been evaluated. The cooling station has certain physical requirements in order to allow efficient operation, maintenance and replacement. These include:

- Adequate space, both horizontal and vertical for all pumps, heat exchangers, chillers, electrical distribution panels and controls to allow easy accessibility and convenience in repair/replacement of each component,
- A means, such as overhead cranes, to move equipment in and out of the cooling station,
- A location that allows construction of a dry sump slab about 20 feet below mean sea level (MSL) to satisfy seawater pump suction pressure, and
- Consideration of flooding issues due to failure of a pipe fitting or manifold and potential tsunami inundation.

A variety of cooling station layouts would satisfy most of the above stated criteria. The simplest arrangement would be located on a large enough site to allow all components, except the seawater pumps, to be installed on one level. This would require a site of about 100 feet by 250 feet minimum.

A two-story facility with pumps in the basement (seawater pump room), approximately 30 feet below ground level in Kakaako makai of Ala Moana Boulevard, and heat exchangers and chillers on the ground floor of a parking structure is proposed. The overall space required is 30,400 square feet, 5,100 square feet in the basement and 25,300 square feet at grade. This arrangement is sketched in Figure 2-8.

The cooling station could easily be housed in the lower levels of a larger building primarily intended for other purposes, such as offices, residences or parking. At the preferred site, the cooling station is envisioned to lie within a larger structure developed by others.

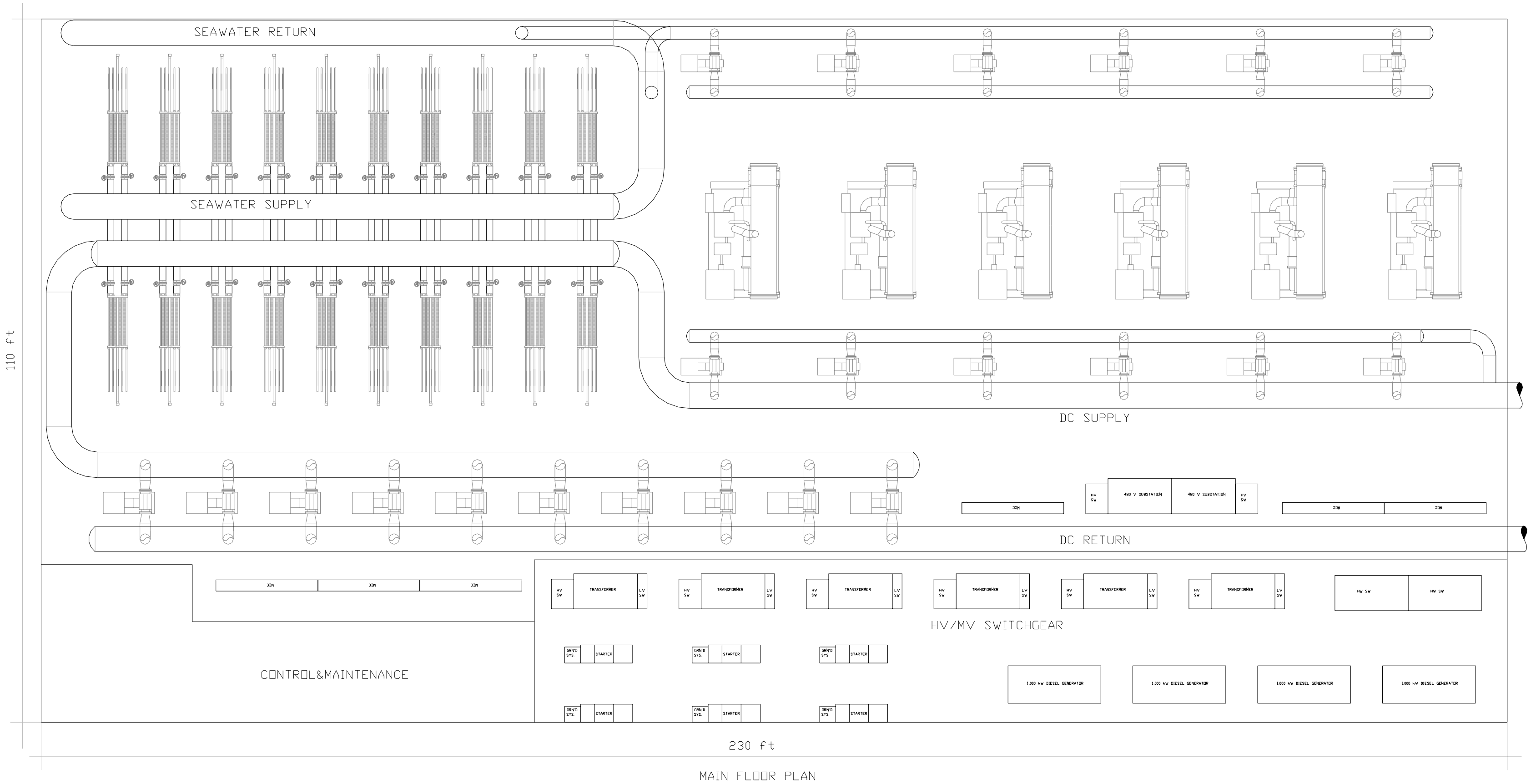

Figure 2-8: Cooling Station Main Floor Plan

Figure 2-9: Cooling Station Seawater Pump Room Plan and Section

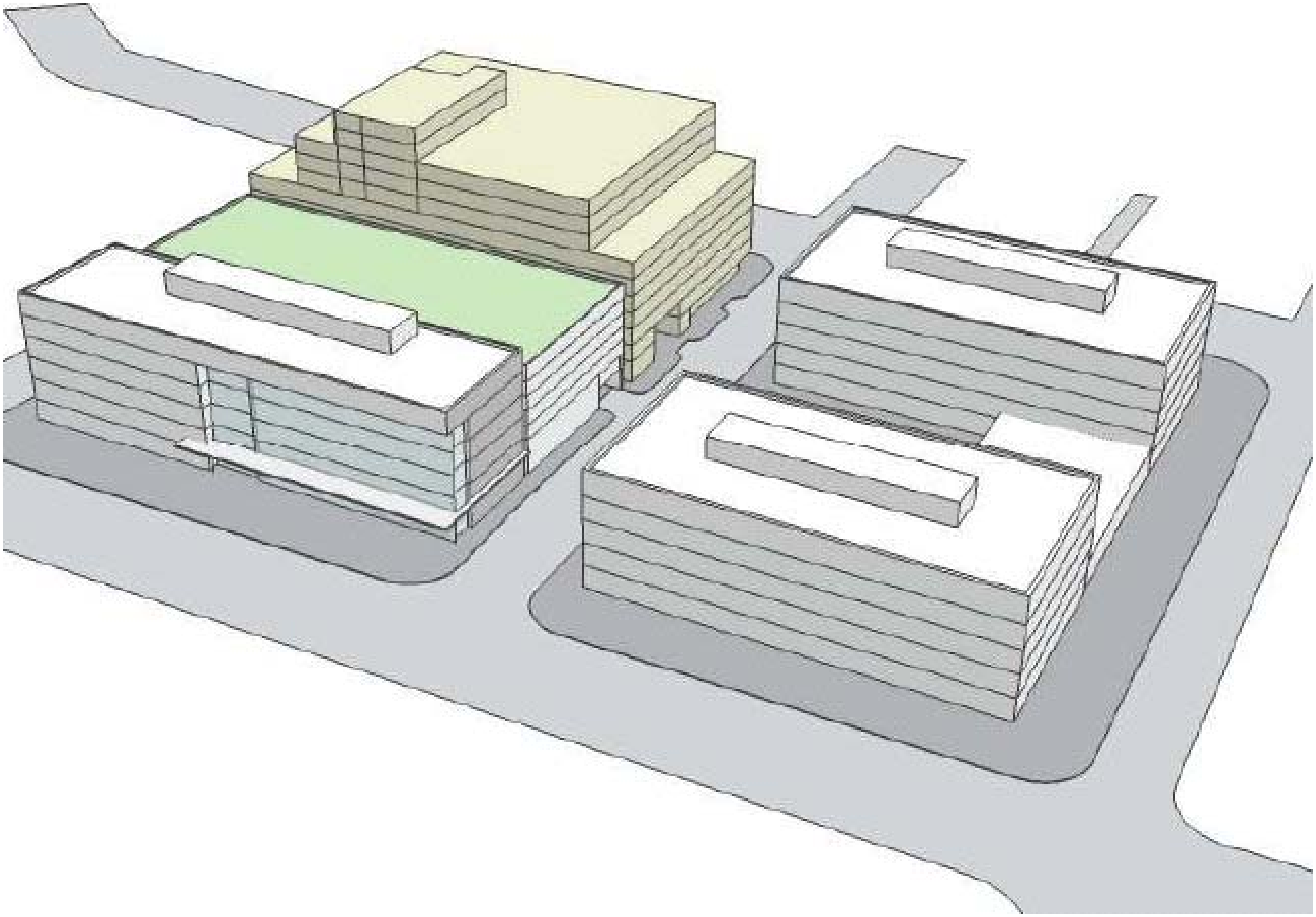

Figure 2-10: Potential Total Development at Preferred Site for Cooling Station

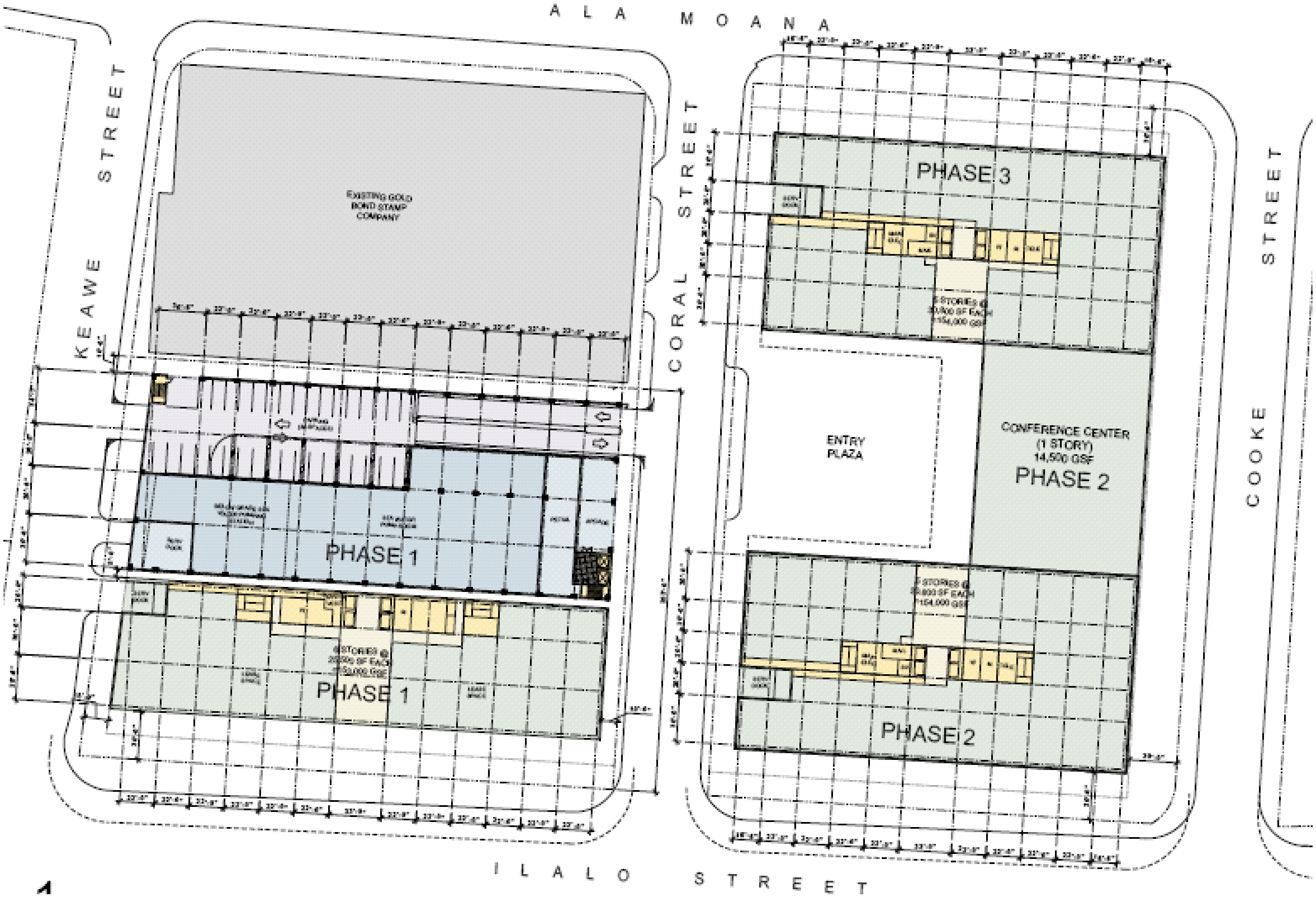

Figure 2-11: Floor Plan of Potential Total Development at Preferred Site

2.6.3 Cooling Station Equipment

Alternative designs for the cooling station equipment, such as pumps, heat exchangers, chillers, piping, electrical gear, control system, etc., have been evaluated. These considerations are summarized in this section.

2.6.3.1 Seawater Pumps and Associated Equipment

Two large variable-speed pumps would draw cold seawater from a common intake manifold. At least one redundant pump would be installed. The seawater pumps used by HSWAC would be large high horsepower units made from corrosion resistant materials or with corrosion resistant coating. Their long term, reliable and efficient operation would be critical to delivering chilled water to district cooling customers in Honolulu.

2.5.3.2 Heat Exchangers

The heat exchangers would be of the plate and frame type, with at least one spare heat exchanger frame installed for redundancy. The frames would be of carbon steel with 0.02-inch Grade 1 titanium (or other corrosion-resistant alloys such as Hastalloy) heat exchanger plates.

A single plate heat exchanger unit consists of numerous closely spaced thin metal plates that have a hole near each corner and have been stamped with a corrugated pattern. The plates are suspended from a steel carrying bar and clamped between heavy steel flanges using long threaded rods. The gap between each plate is sealed with a narrow rubber gasket that is compressed as the rods are tightened. Each plate has inlet and outlet ports that lead to four flanged pipe connections on the frame. Figure 2-12 shows an exploded view of a typical heat exchanger.

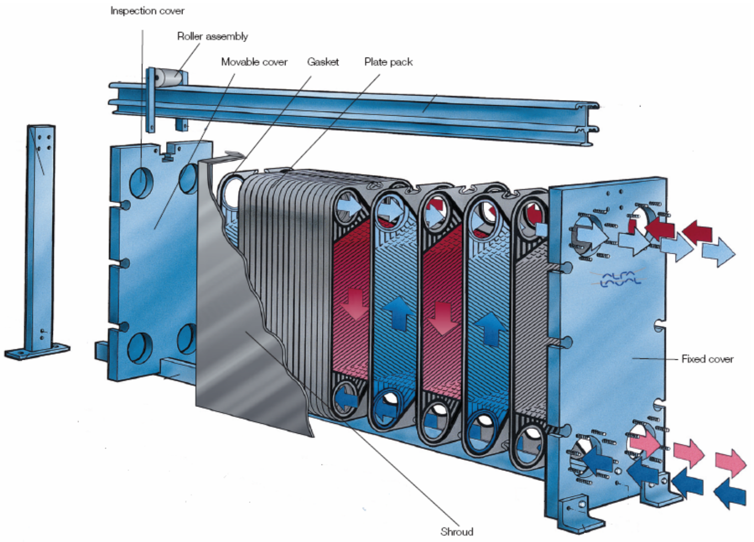

Figure 2-12: Exploded View of a Plate Heat Exchanger
(courtesy of Alfa-Laval)

The HSWAC system would use from 10 to 20 large plate heat exchanger units to provide the bulk of the cooling capacity. The freshwater returning from the connected buildings at 54°F would pass through the heat exchangers where it would transfuse heat into the cold 45°F seawater. The seawater would exit the heat exchanger after warming up to approximately 53°F.

The design life of the heat exchangers is estimated at 25 years.

2.6.3.3 Auxiliary Chillers

The temperature of the seawater intake water would vary seasonally and with tidal influences. To maintain an optimum temperature in the fresh water distribution loop, auxiliary chillers would be available to provide supplemental chilling when necessary.

The return seawater from the heat exchangers would be used for condenser cooling of the chillers thereby substantially increasing their efficiency. The temperature of the return seawater from the heat exchangers at peak demand would be increased from approximately 53°F to 58°F after being used for condenser cooling of the chillers.

2.6.4 Construction

Construction of the cooling station would require excavation and dewatering because the seawater pump room must extend below sea level to allow for sufficient pump suction head. The elevation of the main floor will be dependent on the integration of it into surrounding structures.

2.6.5 Operation

Most cooling station operations would be automated. It is anticipated that the facility would be staffed by about six people.

2.7 Chilled Water Distribution System

2.7.1 Description

A system of pipes would be installed beneath the streets of downtown Honolulu to provide chilled freshwater into customer buildings. Because each building is unique in its piping and chiller placement, connection points to the common chilled water loop and the amount of internal piping required to implement the conversion would be individually determined. The building could be either indirect connected, with a heat exchanger separating the building system and the distribution system, or direct connected (Figure 2-13). The decision between indirect or direct connection is mainly based on distribution system pressure, building height and building system design pressure.

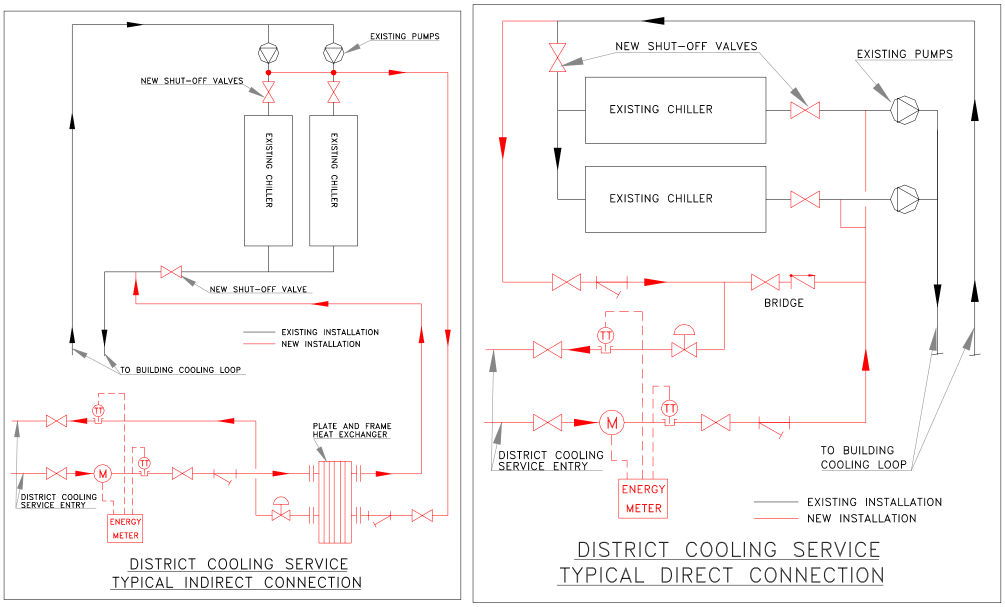

Figure 2-13: Typical Connection of Buildings

Depending on the specific locations of HSWAC's customers, the total length of the distribution system may vary from approximately 15,000 to 17,000 feet. Distribution pipes would be larger in diameter closer to the cooling station and smaller at greater distances. Pipe sizes would vary between 8 inches and 42 inches, with a length-weighted average of 26 inches. These pipes are typically welded steel with a polyethylene jacket. However, other pipe materials, primarily HDPE, will also be considered. Steel supply lines would be insulated with 1-1/2 -inch polyurethane foam. The total volume of fresh water in the distribution system would be close to one million gallons.

The currently anticipated route is described as follows and shown on Figure 2-14. From the mauka-Diamond Head corner of Ilalo and Keawe Streets, 42-inch pipes would be laid in Keawe Street mauka to Pohukaina Street. Microtunneling or directional drilling would be used to pass under Ala Moana Boulevard without obstructing traffic flows on this critical artery. A jacking pit would be required either on Keawe Street makai of Ala Moana, or on the adjacent currently unused sewage pumping station property. Keawe Street has low quality pavement and relatively low traffic volumes, but it is highly congested with buried utilities. It would be necessary to install the chilled water pipes above existing sewer mains, but below existing storm drains.

The tunnel beneath Ala Moana Boulevard would end in the corner of the parking lot at CompUSA, from where the pipe would be installed in a trench beneath the Ewa sidewalk of Keawe Street to Auahi Street. Mauka of Auahi Street, Keawe Street is less congested with utilities and the trench could go beneath either the street or sidewalk. The poor quality of the pavement may make street installation preferable there, but locations of existing utilities would be the determining factor.

At Pohukaina Street, the 42-inch pipes turn left and proceed to Punchbowl Street. Pohukaina Street has relatively low traffic volumes and limited existing utility installations. Along this reach, several smaller lateral lines are projected to serve commercial and State buildings.

At Punchbowl Street, the mains turn right and proceed one block to Halekauwila Street. The mains would run beneath the sidewalk on this reach. If it is necessary to tunnel beneath Punchbowl Street to minimize traffic impacts, a jacking pit would be required at either Pohukaina or Halekauwila Streets. Halekauwila Street has relatively low traffic volumes and few buried utilities, but is narrow.

After proceeding Ewa for one block on Halekauwila Street, the mains turn mauka on Mililani Street. Between Halekauwila and Queen Streets, Mililani Street is a pedestrian mall with some delivery truck traffic. Mauka of Queen Street, Mililani Street is a low traffic, low utility and low quality pavement street, although it is used by tour buses.

From Mililani Street the mains turn left on Merchant Street and pass in front of the main Post Office. This portion of Merchant Street has limited traffic, mostly to access Post Office parking. The mains proceed Ewa on Merchant Street to past Fort Street Mall.

At Richards Street, the mains split into a 36-inch main heading Ewa on Merchant Street, and a 30-inch main heading mauka on Richards Street intended to serve various State buildings and Queen's Hospital. After several connections from Richards Street, the size of the mains decreases to 24 inches and they proceed mauka to Hotel Street. To minimize disruption of bus traffic on Hotel Street, the 16-inch main heading Ewa could be placed under the mauka sidewalk. The 24-inch branch heading Diamond Head to the State Capitol and Queens Hospital could be routed across the lawn and through the Capitol's parking garage. By using the parking garage and exiting through the mauka garage entrance, trenching across Beretania Street would be avoided. From the garage, the 24-inch lines can be trenched in the sidewalk or adjacent lawn beside the Department of Education building on Miller Street. To access Queen's Hospital, tunneling under Punchbowl Street would likely be necessary to minimize traffic impacts. Jacking pits could be placed on Miller Street. Another tunnel under Punchbowl Street would be necessary to provide service to the State's Kalanimoku Building.

After passing Richards Street, the 36-inch mains under Merchant Street proceed Ewa to Alakea Street, after which the main size is reduced to 30 inches. At Alakea Street, smaller branch lines (16 and 18 inches) head makai and mauka. The mains continue Ewa on Merchant Street to Bishop Street where smaller branch lines again proceed mauka and makai.

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Figure 2-14: Distribution System Route and Pipe Sizes

The chilled water would be 100% fresh water. A closed-loop system with a low make-up water rate could be maintained without corrosion protection additives due to the lack of oxygen. However, to ensure a sufficient corrosion protection about 50 ppm of molybdate would be added.

2.7.2 Construction

In general, the distribution pipes would be buried in trenches dug in streets or beneath sidewalks (Figure 2-15). All existing utility installations would be accurately mapped and agreements made for new or shared easements. In most cases, "cut and cover" trenching would be done. Where potential traffic disruption is too great, such as on Ala Moana Boulevard, microtunneling or horizontal directional drilling (HDD) would be used to create a conduit for the pipe beneath the roadway without interrupting traffic flows. To the extent possible, routing has been done considering potential traffic impacts.

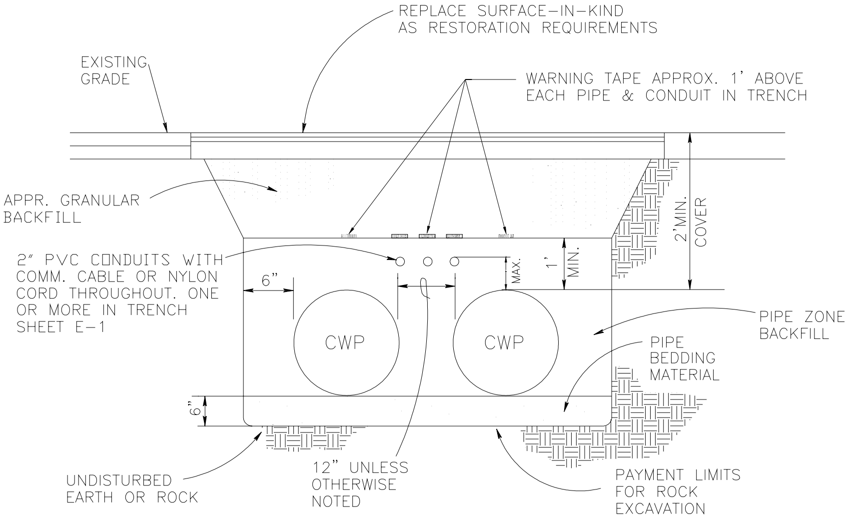


Figure 2-15: Typical Trench Section

2.7.3 Operation

The distribution system would be controlled from the cooling station. Much of the operation would be automated. The distribution pumps would be variable-speed controlled based on maintaining a set differential pressure in the system. When the customer load increases the distribution pump speed will increase. With increasing distribution pump speed the seawater pump speed will increase as well as the load on the auxiliary chillers to maintain a maximum supply temperature of 44°F.

2.8 Project Cost and Schedule

In 2004, planning and engineering design began. The permitting, including completion of the EIS, is expected to be completed in 2008. The Basis of Design (HSWAC, 2007) and the Conceptual Design (MOE, 2005a) are complete and preliminary design has begun. Final design is expected to be completed in 2008. Plans and specifications suitable for contractor bidding would be prepared and offered for bid in mid 2008. Selection of contractors and beginning of construction is expected shortly thereafter. The system is expected to be on-line by December 2009.

The project is anticipated to cost approximately $145 million. Approximately $100 million of this would be financed using special purpose revenue bonds approved by the Hawaii State Legislature. The remainder would be from additional non-tax-exempt bonds and equity sources.

3.0 ALTERNATIVES TO THE PROPOSED ACTION

3.1 No Action

The No Action Alternative would not implement a seawater air conditioning system in downtown Honolulu. Buildings would continue to be independently cooled with on-site chillers using Freon® compounds. Individual buildings would continue to operate cooling towers and use toxic chemicals for condenser cooling water treatment.

Potential savings of electricity, potable water, sewer capacity and capital would be foregone. Potential reductions in emissions of air pollutants associated with burning fuel oil for electricity would not be realized.

3.2 Alternative Ways to Achieve the Project Objective

There are at least three other ways in which a district cooling system for downtown Honolulu could be proposed, although none would achieve the HSWAC project objective or produce the net benefits of a SWAC system.

3.2.1 District Cooling Using Deep Wells

The Honolulu Board of Water Supply has implemented a small district cooling system for the John A. Burns School of Medicine (JABSOM). The system uses cold water drawn from deep wells. However, the deep groundwater does not provide cold enough temperatures to use directly for air conditioning. The minimum temperature of the groundwater (i.e., 69^{o}F) is cool enough to use for condenser cooling for conventional chillers and thereby slightly increases the efficiency of the air conditioning system. Cooling towers are eliminated, but chillers are still required and well water pumps are added. A larger-scale well-based condenser cooling system designed for downtown Honolulu would experience the same constraint, and many of the potential benefits associated with the HSWAC system would not be realized using groundwater.

3.2.2 District Cooling using Central Conventional Chillers

In areas without access to cold seawater or lake water, district cooling systems may still be practical. In such systems, a few large central chillers replace many individual building chillers, and cooling towers are still required. While there are possible economic and environmental benefits to such systems, primarily resulting from slightly reduced energy consumption, and other benefits of scale, there is no renewable energy component. Many of the benefits of the HSWAC system would not be realized with a conventionally-powered district cooling system.

3.2.3 District Cooling Using Ice Making Chillers and Ice Storage

A district cooling system based on production of ice was proposed for downtown Honolulu by a subsidiary of Hawaiian Electric Industries in 1999 (Dames & Moore, 1999). The concept was to produce ice at a central facility during the night when electricity rates are lower. The ice would be used to produce chilled water, which would be pumped through a system of underground pipes to customer buildings throughout downtown. The chilled water would be used in a closed loop and ultimately used within each customer building. The benefits of such a system primarily stem from electricity rate savings rather than energy savings. Ice storage systems may actually use more energy. The primary advantage of this type of system is that it shifts electricity demand from peak hours to off-peak hours, deferring expansion of electricity generating capacity. As for central chiller-based systems, cooling towers will still be required and many of the benefits of the HSWAC system would not be realized with an ice storage system.

3.3 Alternative Seawater Intake Pipe Routes and Terminal Locations

The economic feasibility of the project depends on sourcing seawater cold enough to necessitate little if any supplemental chilling of the distribution water. Ideally this temperature would be approximately 42°F, or less, for a chilled water delivery temperature of 44°F. However, there is an economic trade-off between installing a longer, deeper pipe to access colder seawater and providing some supplemental chilling of the distribution water. And, owing to friction losses, a longer pipe also provides less seawater flow due to suction pressure limitations of the HDPE pipe, and could thereby provide less cooling capacity although colder water could be reached. For the HSWAC project, this decision was driven substantially by the bathymetry offshore of Honolulu and the unit cost of fabrication and deployment of the intake pipe. Beyond about 1,000 feet deep, the bottom slope flattens considerably compared with the relatively steep slopes seen at shallower depths.

In a preliminary system analysis and optimization, MOE (2004) analyzed the system configuration based on lifetime levelized costs. Four intake depths were evaluated (1,500 feet to 1,800 feet). Optimization of the economics results in sourcing seawater of approximately 45°F at a depth of 1,600 feet, and providing approximately 25% supplemental cooling of the distribution water.

The preferred break-out point for the drilled shaft and the offshore route of the seawater intake pipe were determined in consideration of the following factors:

- Bathymetry,
- Biological characteristics, and
- Use of the area.

Bathymetry was considered to find the shortest pipe length required to get to the desired 1,600 foot isobath. A bend in the pipe is acceptable if it is necessary to avoid shallower obstructions. The primary biological criterion was avoidance of areas of high coral coverage (see Section 4.6.2.1). The breakout point for the seawater intake shaft was selected to be 40 to 45 feet deep . This point is approximately 2,200 feet offshore, and is the closest point to shore where the scattered corals present at shallower depths in the area can be avoided. Beyond that point, the intake pipe would be buried in a trench out to a depth of 80 feet.

The presence of the pipe would have no effect on current uses of the offshore area. Because it would increase bottom relief, it may enhance fishing opportunities at depths beyond where the pipe emerges from the trench. The primary concern with respect to use of the area was to protect the pipe from barge tow cables.

Tug-towed barges entering and exiting Honolulu Harbor use very long tow wires which, in the shallow water near the harbor entrance, drag on the seabed. The greatest potential problem is when barges are towed out of Honolulu Harbor and turn to the east, as most do. These tugs turn quickly as they pass buoy #2 (depending on the captain) to align with the prevailing weather and save time in making Diamond Head. They leave the harbor with about 250 to 350 feet of cable out for a single barge and for dual tows pulling two barges they typically have 250 to 350 feet for the lead barge and 400 to 600 feet for the second barge. In the harbor and in the channel, cables drag on the bottom. As soon as the barge makes the turn east and they are aligned and towing in a straight line, they pay out cable. They prefer to do this as quickly as possible, as length gives them damping in the tow line. While paying out line, they always drag cable on the seabed. Tugs entering the harbor shorten their tow lines in deep water and cable drag would be less problematic for the pipeline.

3.4 Alternative Seawater Return Pipe Routes and Terminal Locations

Three alternative locations for return water disposal were evaluated: Honolulu Harbor, shallow coastal waters and deep coastal waters.

Located on Mamala Bay, Honolulu Harbor is Hawaii's major port facility. The harbor was created by freshwater flows from Nuuanu Valley which inhibited coral growth within a small reef basin and cut several channels through the surrounding reef. The main channel, which was the deepest, was flanked to the west by shallower outlets. Between these outflows rose occasional spots of earth and coral - the beginnings of Sand Island. Of significance, the harbor water is used by HECO as heat sink for condenser cooling of its power plant, as well as waste discharges. The Honolulu Generating Station is permitted (NPDES clean water permit #HI0000027) to discharge effluent in the quantities shown in Table 3-1.

Table 3-1: Hawaiian Electric Company Honolulu Generating Station Permitted Discharges to Honolulu Harbor

Operation	Average Flow	Description
Condenser Cooling	187 MGD	Ocean Discharge
Turbine Condensate	20,000 GPD	Neutralization
Boiler Blowdown	15,000 GPD	Neutralization
Misc. Low Volume Waste (intermittent)	24,000 GPD	Neutralization
Treated Metal Cleaning Waste (intermittent)	65,000 GPD	Chemical Precipitation and Neutralization
Stormwater (intermittent)	36,000 GPD	---

A harbor discharge of HSWAC return seawater would be most convenient, and would have the potential for considerable system cost savings, if adequate dilution of the return water was possible.

Two approaches, flux analysis and temperature analysis, were taken in order to estimate the achievable dilution in the harbor. Considering Honolulu Harbor as a discrete water body, estimates of the significant fluxes were made (tidal flush and streamflow) and achievable dilution implied. The expected level of dilution was found to be 6.2.

Using technical data and permit compliance records available for the aforementioned HECO discharge, an approximation of the achievable dilution was deduced. Specifically, temperature measurements distributed spatially within the zone of mixing were used in conjunction with ambient values and discharge values to derive a relationship in terms of mixing. From the data analyzed, the lower and upper bounds of dilution were 2.9 and 21, respectively.

The results of the two initial mixing analysis methods are in close agreement; an approximation of the achievable dilution within the harbor is likely to be in the bounds 2.9 to 21. This implies discharge into the harbor could result in exceedances of water quality standards for nitrate + nitrite, ammonia, dissolved oxygen and potentially for temperature. Initial analysis, therefore, indicates the dilution requirement cannot be met and therefore returning seawater to Honolulu Harbor is not considered feasible.

The CORMIX Mixing Zone Expert System was used in the offshore discharge analysis because it represents a robust and versatile computerized methodology for predicting both the qualitative features (e.g., flow classification) and the quantitative aspects (e.g., dilution ratio, plume trajectory) of the hydrodynamic mixing processes.

A conservative approach was taken for the analysis of the offshore discharge. Both steady (small prevailing current) and unsteady flow (tidal cycle) cases were considered. A steady state simulation at 0.5 ft/sec current was performed to serve as a reference and validation for the unsteady tidal simulation in the subsequent analysis. The proposed multiport diffuser was modeled at a depth of 120 feet. The jet speed at the diffuser ports was calculated as 6.7 ft/sec. Dilution is 168 at the fringe of the proposed ZOM (1,000 feet). Under this scenario, dilution has exceeded our target dilution of 147. It has been shown that CORMIX tends to underestimate far-field dilution, which makes a 1,000-foot mixing zone a safe choice. Additional details of the modeling will be presented in the EIS.

3.5 Alternative Staging Areas

Location of a site for pipe assembly and materials staging was discussed with representatives of the Harbors Division of the State Department of Transportation. Several possible sites were considered on Oahu including Kalaeloa Harbor (Barbers Point) and the long channels used for small boat moorings and seaplanes between the reef runway, Keehi Lagoon and Sand Island. Each of these sites has the advantage of being very close to the heaviest industrial infrastructure in the Hawaiian Islands on the south side of Oahu.

The Harbors Division representatives suggested that a contractor could use the curved northern shoreline of Kalaeloa harbor for pipe assembly and mooring. This space would allow assembly of pipe sections, each of which is approximately 3,300 feet long. About five such pipe sections would be necessary to complete the deep water pipe assembly. The curved shoreline area along the northern edge of this harbor is currently unused. It was mentioned that shore protection has been installed in the northern corner of the harbor to protect it from surge motion during the winter months.

Figure 3-1 illustrates the waterways located west of Honolulu Harbor which could be used for pipe assembly. Four channels have been dredged out in this region and each has different levels of existing use. The characteristics and uses of each channel are described below:

- Location A: parallels lagoon drive, roughly 8,200 feet long, dredged to 12 feet, used by single seaplane. Very few moored vessels.
- Location B: approximately parallels reef runway, roughly 7,700 feet long, dredged to 12 feet, used by jet skis. Could also be used by seaplane. Very few moored vessels.
- Location C: Parallels Sand Island Access Road, roughly 4,900 feet long, dredged to 12 feet, widely used for small boat mooring, Keehi Marine Center located onshore here.
- Location D: Parallels western shore of Sand Island, roughly 3,900 feet long, dredged to 12 feet, lightly used for small boat moorings, channel at southern end is closed off - no access to ocean.

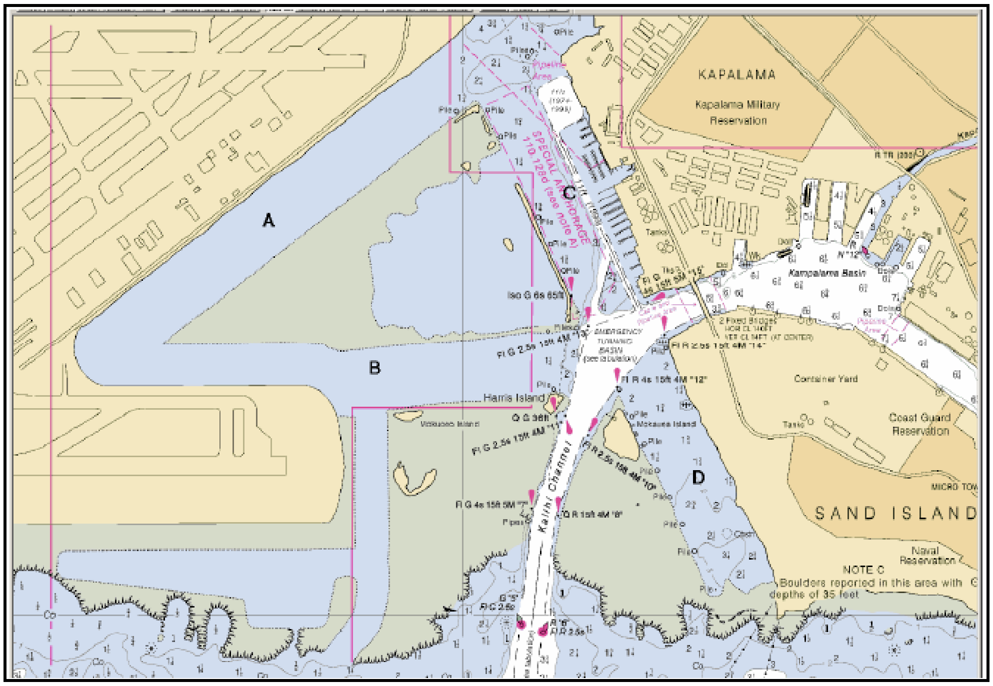


Figure 3-1: Possible Pipeline Assembly Areas in Keehi Lagoon

(Source: MOE, 2005a)

Two other locations were evaluated and rejected:

- Kaneohe Bay: This large bay on the windward side of Oahu is well protected and large, but is a favorite recreation site, has many sailboats at all times, is a popular dive location, has many shallow spots, and is the home of the Hawaii Institute of Marine Biology. For all of these reasons, we believe that using this site would not get community acceptance.
- Kaunakakai Harbor: This harbor on Molokai was considered, but it is too small, it is at a remote and much more costly location, and the tow distance to Honolulu is considerable.

The preferred location would be in Keehi Lagoon at Location D. Five sections of pipeline could be easily stored in this region. As the pipeline is towed out of the harbor for deployment, each section would be pulled into Location C and then moved out the main west harbor entrance. Joining of one section to another could occur in the main channel between Locations C and D.

3.6 Alternative Cooling Station Locations

A number of locations for the cooling station were evaluated. Exploratory efforts were made to coordinate development with the anticipated further development of the Aloha Tower area of the waterfront, but plans for that complex were too preliminary to allow the HSWAC project to proceed in a timely manner. Likewise, HECO was approached about the possibility of using a portion (currently unused) of their Honolulu Generating Station. This alternative had several interesting potential synergistic effects, including using SWAC water to cool the HECO generators thereby increasing their efficiency and reducing fuel use, and blending cool SWAC water with warm discharge water from the generating station to reduce potential thermal impacts of both. Unfortunately, it was not possible to reach an agreement with HECO to implement this alternative and it was subsequently abandoned.

A survey of all remaining potentially feasible sites for the cooling station indicated that they were all within the Makai District of the Kakaako Redevelopment Area, under the control of the Hawaii Community Development Agency (HCDA). These sites were evaluated using the following technical criteria:

- Exposure to waves and tsunami run-up;
- Probably soil conditions;
- Probable contamination and old buried utilities;
- Access corridors for the seawater pipes to the seashore;
- Distances to the sea and toward downtown;
- Site size; and
- Existing structures on (and under) the site.

In preliminary discussions, HCDA identified several parcels under their control that might be available, however, none of the HCDA-controlled sites were technically adequate. Several potentially available sites in the Makai District of Kakaako that are privately owned were subsequently evaluated. These include: (1) the parking lot adjacent to the Honolulu Generating Station; (2) the parking lot makai of 677 Ala Moana Blvd.; and (3) the parking lot Diamond Head of 677 Ala Moana Blvd. The second alternative above was selected as the preferred site. Other sites under consideration include Lot 1 (a site that is being investigated by the State of Hawaii Office of Hawaiian Affairs [OHA] as the location for their offices and cultural center) and above the drainage canal Ewa of Kaka’ako Waterfront Park. The now open drainage canal would then be renovated and converted to a box drain with the cooling station main floor potentially straddling the box drain.

4.0 NATURAL ENVIRONMENT, POTENTIAL IMPACTS AND MITIGATION MEASURES

4.1 Climate

The climate of the project area is characterized by abundant sunshine, persistent tradewinds, and moderate and constant temperature and humidity. The average temperature recorded at the Honolulu International Airport ranges from 70°F in the coolest month to 84°F in the warmest month (with extremes of 52 and 96°F). The average amount of annual rainfall varies greatly with location, for example from 18.3 inches at the airport to 152.1 inches in Manoa valley (DBEDT, 2003). The project site is located in an area that would likely have a climate similar to that at the airport location. Insolation (incoming solar radiation) in the project area is approximately 1,840 Btu/ft^2-day (DBEDT, 2005).

4.2 Air Quality

Ambient concentrations of air pollutants are regulated by both national and State ambient air quality standards (AAQS) (Table 4-1). As shown in the table, national and State AAQS have been established for particulate matter (PM), sulfur dioxide (SO_2), nitrogen dioxide (NO_2), carbon monoxide (CO), ozone and lead. The State has also has a standard for hydrogen sulfide. Particulate matter includes dust, soot, smoke, and liquid droplets.

Sulfur oxides, which include SO_2, are colorless gases emitted primarily by power plants, refineries and volcanic activity. Nitrogen dioxide is a brownish, highly corrosive gas with a pungent odor that is formed from nitrogen oxides emitted during combustion of fossil fuels by electric utilities, industrial boilers and vehicles. Carbon monoxide is a colorless, odorless and tasteless gas produced by the incomplete combustion of fossil fuels, primarily motor vehicles. Ozone is formed in the atmosphere by a chemical reaction of nitrogen oxides and volatile organic compounds in the presence of sunlight. Although an ozone layer in the upper atmosphere shields the earth from harmful ultraviolet radiation, high ozone levels at ground level can cause harmful effects to humans and plants. Lead is a naturally occurring substance that has been used extensively in paint and gasoline. Hydrogen sulfide is a colorless malodorous gas with the smell of rotten eggs, mainly associated with sewage or volcanic emissions.

Table 4-1: Summary of State of Hawaii and National Ambient Air Quality Standards

Pollutant (all units in μg/m^3)	**Averaging Time**	**Maximum Allowable Concentration**		
		National Primary [a]	**National Secondary [b]**	**State of Hawaii [c]**
Particulate Matter (≤10 microns)	Annual 24 Hours	50 150	50 150	50 150
Particulate Matter (≤2.5 microns)	Annual 24 Hours	15 65	15 65	- -
Sulfur Dioxide	Annual 24 Hours 3 Hours	80 365 -	- - 1300	80 365 1300
Nitrogen Dioxide	Annual	100	100	70
Carbon Monoxide	8 Hours 1 Hour	10,000 40,000	- -	5,000 10,000
Ozone	8 Hours 1 Hour	157 235	157 235	- 100
Lead	Calendar Quarter	1.5	1.5	1.5
Hydrogen Sulfide	1 Hour	-	-	35

[a] Designated to prevent adverse effects on public health. Source: 40CFR Part 50

Pollutant (all units in μg/m³)	Averaging Time	Maximum Allowable Concentration		
		National Primary [a]	National Secondary [b]	State of Hawaii [c]
[b] Designated to prevent adverse effects on public welfare, including effects on comfort, visibility, vegetation, animals, aesthetic values, and soiling and deterioration of materials. Source: 40CFR Part 50.				
[c] Designated to protect public health and welfare and to prevent significant deterioration of air quality. Source: HAR 11-59-1.				

The national AAQS are stated in terms of primary and secondary standards for most of the regulated air pollutants. National primary standards are designed to protect public health with an "adequate margin of safety.” National secondary standards define levels of air quality necessary to protect public welfare from "any known or anticipated adverse effects of a pollutant.” The State AAQS are designed "to protect public health and welfare and to prevent the significant deterioration of air quality.” The AAQS specify a maximum allowable concentration for a given air pollutant for one or more averaging times to prevent harmful effects. Averaging times vary from one hour to one year depending on the pollutant and type of exposure necessary to cause adverse effects.

The Hawaii State Department of Health (DOH) operates a network of nine air quality monitoring stations at various locations on Oahu. Each station monitors only certain air quality parameters. The closest monitoring station to the project area is located at 1250 Punchbowl Street within the project area. An air pollutant emission summary for downtown Honolulu at this station for the years 2000 to 2002 is shown in Table 4-2 (DOH, 2002). There were no exceedances of the standards for the measured parameters. The project area is an attainment area for all national and State AAQS. Although CO measurements taken at the monitoring stations suggest that concentrations are in compliance with the State standards, CO concentrations near congested intersections could exceed the State AAQS at times.

Table 4-2: Annual Summaries of Ambient Air Quality Measurements in Downtown Honolulu
(Source: DOH, 2002)

Pollutant	Average Time	SAAQS (μg/m^3)	NAAQS (μg/m^3)	Maximum Concentration (μg/m^3)			Number of Exceedances SAAQS			Number of Exceedances NAAQS		
				2000	2001	2002	2000	2001	2002	2000	2001	2002
CO	1 hr	10,000	40,000	3,990	5,244	3,990	0	0	0	0	0	0
	8 hrs	5,000	10,000	1,753	2,209	1,582	0	0	0	0	0	0
PM$_{10}$	24 hrs	150	150	83	63	90	0	0	0	0	0	0
	Annual	50	50	14	16	15	0	0	0	0	0	0
PM$_{2.5}$	24 hrs	---	65	52	56	53	---	---	---	---	---	0
	Annual	---	15	14	14	4	---	---	---	---	---	0
SO$_2$	3 hrs	1,300	1,300	65	45	30	0	0	0	0	0	0
	24 hrs	365	365	9	25	9	0	0	0	0	0	0
	Annual	80	80	1	2	3	0	0	0	0	0	0

Construction Impacts

The project would involve on-shore trenching to install chilled water pipelines from the cooling station to all serviced facilities and construction of the cooling station. Short-term direct and indirect impacts on air quality could occur during project construction. For a project of this nature, there are two potential types of air pollutant emissions that could directly result in short-term air quality impacts during project construction: (1) fugitive dust and (2) exhaust emissions from on-site construction equipment. Indirectly, there also could be short-term impacts from slow-moving construction equipment traveling to and from the project site, from a temporary increase in local traffic caused by commuting construction workers, and from the disruption of normal traffic flow caused by lane closures on adjacent roadways.

The amount of trenching that would be needed is approximately 16,000 feet and trenches would be excavated from 3.5 to 9.5 feet wide (averaging 6 feet) for a total of 98,000 ft^2 of exposed soil during the construction. Pipeline installation time is estimated at 9 months, however the construction approach would be to open no more than 200 feet of trench at any given time in one location. The cooling station footprint is 25,000 ft^2 and approximately 10,000 ft^2 at grade would be needed for construction laydown areas and support areas. An additional 30,000 ft^2 would be needed as a construction staging area at the entrance to the directional drilling tunnel to install the pipeline from the cooling station seaward. This results in a total of 65,000 ft^2 that would be required in the cooling station area. The amount of time with potentially bare soil exposed for these operations is estimated at six months.

The State of Hawaii Air Pollution Control Regulations (Hawaii Administrative Rules [HAR] Chapter 11-60.1) prohibits visible emissions of fugitive dust from construction activities at the property line. To mitigation fugitive emissions, a dust control plan for the project construction would be prepared in advance. This plan would include techniques to minimize dust such as water spray, wind screens, covering soil piles, establishing temporary ground cover, or halting work during windy conditions. All construction equipment would meet State emission control regulations. Pipeline trenches would be no greater than 9.5 feet in width to minimize exposed soil.

Oahu and the proposed project location are in attainment of AAQS. The impact from the proposed action would be an increase in pollutants from operation of construction equipment. However, exhaust emissions from construction vehicles and equipment are not considered major stationary sources and there are no standards or criteria set for non-stationary equipment. Based on this information, exhaust emissions during construction of the proposed project would not have significant impacts on air quality.

Operations Impacts

The cooling station produces no regulated air emissions and, by significantly reducing the amount of electricity needed for air conditioning, the project would reduce the annual emissions from fossil fuel consumption by the following estimated amounts: CO_2 83,000 tons, VOCs 5 tons, CO 27 tons, PM_{10} 18 tons, NO_x 165 tons, SO_x 161 tons.

Chillers currently in use by customers of the proposed project services would no longer be needed or would in specific cases only be used occasionally as a backup under emergency conditions. Therefore, refrigerants being used in some equipment would be removed. Additional information will be provided in the EIS.

4.3 Natural Hazards

4.3.1 Hurricanes

Hurricane season in Hawaii begins in June and lasts through November. Hurricanes are low pressure systems where wind rotates counterclockwise (northern hemisphere) at speeds of 74 mph or greater. If windspeed is between 39 and 73 mph, then it is a tropical storm. If windspeed is below 39 mph, then it is a tropical depression. The general term for all three categories is tropical cyclone. The Saffir/Simpson Scale classifies hurricanes into five categories according to wind speed and damage potential.

Table 4-3: Saffir/Simpson Hurricane Scale (Source: Oahu Civil Defense Agency)

	Description of Damage	Wind Speeds (mph)	Storm Surge (feet)	Examples
1	Minimal	74 - 95	4 – 5	Iwa, 92 mph, Nov 1982
2	Moderate	96 - 110	6 - 8	none
3	Extensive	111 - 130	9 - 12	Uleki, 128 mph, Sep 1992
4	Extreme	131 - 155	13 - 18	Iniki, 145 mph, Sep 1992
5	Catastrophic	>155	>18	Emilia & Gilma, 161 mph, Jul 1994, John, 173 mph, Aug 1994

Hazards associated with hurricanes include high winds, heavy rainfall, flooding, storm surge and high surf. During the last 50 years, many tropical storms and hurricanes have come close to the Hawaiian Islands, but there have only been three direct hits and all of them made first landfall on Kauai.

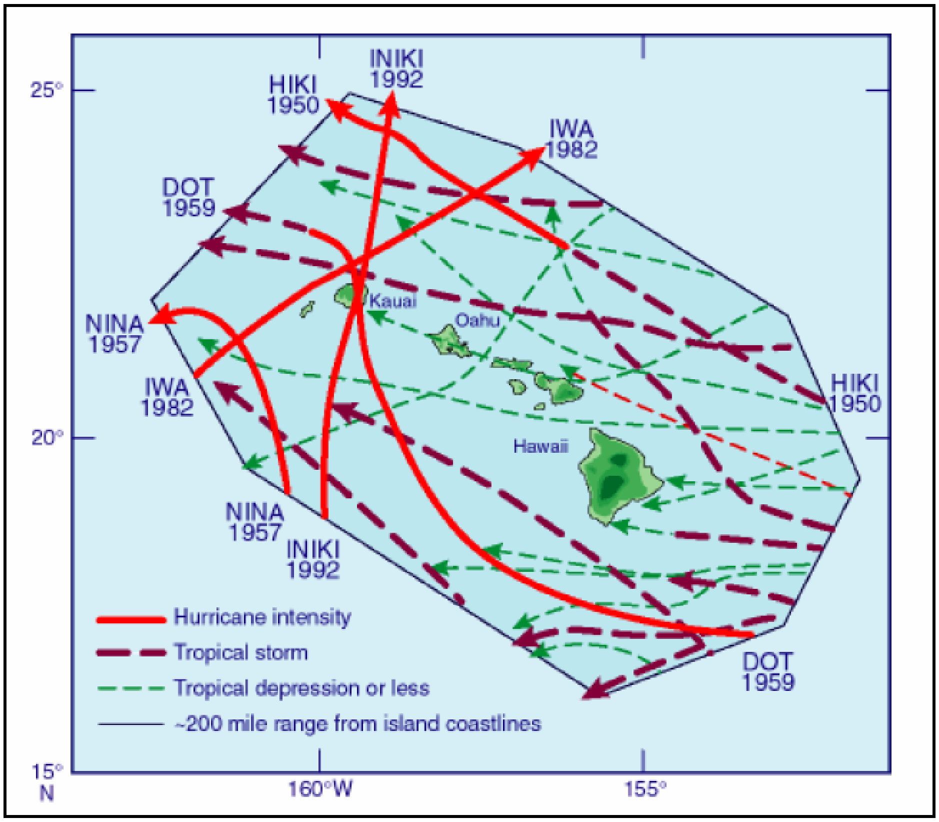


Figure 4-1: Hurricane and Tropical Storm Tracks through the MHI
(Source: UH Manoa Storm Evolution and Energetics Research Group)

4.3.2 Tsunami

Tsunami are waves with very long wavelengths that are generated by seismic events such as earthquakes, landslides or volcanism. The sudden movement typical of these kinds of events causes a rapid displacement of water forming high-energy waves that can travel long distances while retaining most of that energy. Ships in the open ocean often do not notice tsunami waves because the amplitude of these waves is usually less than 3.3 feet when in water that is sufficiently deep. However, as the wave approaches land and water depth decreases, the wave's energy is translated into a higher amplitude resulting in a surge of fast moving water that can quickly inundate a coastline (Oahu Civil Defense, 2005).

The cooling station would be located close (approximately 1,000 feet) to the tsunami evacuation zone in Kakaako. The Honolulu Harbor Channel, Kewalo Basin, Olomehani Street and the waterfront form the boundaries of this tsunami evacuation zone (Oahu Civil Defense, 2005).

The Pacific Tsunami Warning Center in Ewa Beach monitors seismic events and ocean surface levels in the Pacific Region to detect when and where tsunamis are generated and whether warnings are needed. The Pacific Tsunami Warning Center is the operational center for the international Tsunami Warning System program (Pacific Tsunami Warning Center, 2005).

4.3.3 Floods

The Federal Emergency Management Agency (FEMA) assigns flood zones to areas based on the risk of flooding within that zone. These areas are indicated on Flood Insurance Rate Maps (FIRMs). A Non-Special Flood Hazard Area is an area that is in a low- to moderate-risk flood zone and is not in any immediate danger from flooding caused by overflowing rivers or hard rains. (Floodsmart.gov, 2005)

All landside project areas, including the cooling station and distribution loop, are located within FIRM Zone X, which is a Non-special Flood Hazard Area and corresponds to outside the 500-year floodplain.

4.3.4 Earthquakes

The USGS uses a computer model to estimate probabilities that an earthquake of a certain magnitude would occur within a certain time period. Below is a table of the probability that an earthquake of 5.0 magnitude or greater would occur within 31 miles of Honolulu.

Table 4-4: Earthquake Probability
(Source: USGS Earthquake Probability Mapping Website, 2005)

Time period	Probability of Occurrence
10 years	15 %
15 years	20 %
20 years	25 %
25 years	30 %
30 years	35 %

Potential Impacts of Natural Hazards on the HSWAC System

The cooling station could be susceptible to damage from a tsunami. Both the cooling station and the offshore pipelines would be susceptible to damage from hurricanes and their associated storm surge. Any portion of the system could be susceptible to damage or destruction by a sufficiently large seismic event.

Mitigation of the potential impacts of natural hazards on the HSWAC system began in earliest planning. The primary mitigation strategy is to employ appropriate engineering designs for the facilities.

The HDPE seawater pipe is extremely rugged and is buried to a depth of about 80 feet, thereby reducing the impact from hurricanes, storm surges, etc.

The cooling station will be built at the minimum in accordance with the City and County of Honolulu Building Code which includes standards for wind and seismic load. In the case of the cooling station, hazard impact mitigation was one of the criteria used in evaluating potential sites. Beyond reducing the vulnerability of the facilities to natural hazards by appropriate siting and design, minimization of the effects of hazard-related damage may be possible in some situations. For example, if power were lost in the Kakaako area for example, backup power would be provided to run seawater and chilled water distribution system pumps. However, it would not be possible to run the auxiliary chillers. Cooling would be possible to deliver to buildings with power still available, however at a slightly higher supply temperature of 46 to 47 ^{o}F.

4.4 Geology, Topography and Soils

4.4.1 Land-side Conditions

The topography of the project area is generally flat (less than 5 percent slope) with elevations 5 to 15 feet above MSL. An exception is the large mound located in Kakaako Waterfront Park near the preferred cooling station site. This mound was originally formed as a debris mound between 1927 and 1977 when the area was an incinerator landfill and was 400 feet wide by 1,700 feet long and 15 to 55 feet in elevation (Wilson Okamoto & Associates, 1998). The mound was resculptured in conjunction with the development of the park. At its highest point the mound is currently 53 feet in elevation (Wilson Okamoto & Associates, 1998).

The Kakaako Peninsula lies on the Honolulu coastal plain, an emerged fossil reef formed approximately 120,000 years ago (MacDonald and Abbott, 1970). Within the project area, coral reefs and eroded volcanic material have formed a wedge of sedimentary rock and sediments, referred to as caprock, which rests on the underlying volcanic rock. Caprock is composed predominantly of coral-algal limestone, interlaid with clays and muds. The downtown Honolulu area consists mainly of silty sand and coral gravel dredged from Honolulu Harbor that has been deposited on the caprock; it is unconsolidated, with high porosity and permeability (City and County of Honolulu, 2002). However, some other fill material of denser and stiffer consistency is also found in some areas.

The ocean-side fronting Kakaako Waterfront Park is underlain by a coral layer between 5 and 20 feet below mean sea level (MSL). Soft lagoonal deposits made up of sand, silt, and clay are found above the ancient reef, and are especially prominent in a buried stream channel which extends below Ala Moana Boulevard between Keawe and Ohe Streets to the Ocean. Soft alluvial soils within the channel area extend to depths of 50 to 65 feet below sea level. These deposits are covered by 5 to 10 feet of dredged coral fill (Wilson Okamoto & Associates, 1998).

To implement the project would require obtaining a grading, grubbing, and stockpiling permit from the City and County of Honolulu. Obtaining this permit would require a project-specific erosion control plan. With implementation of the procedures required for obtaining this permit, adverse impacts to topography, soils, or geology would not occur.

4.4.2 Ocean Bathymetry and Bottom Types

A shallow reef fronts the man-made boulder revetment (sea wall) between Fort Armstrong and Kewalo Basin along the seaward side of Kakaako Park, which contains the former landfill. The revetment was constructed on a limestone bench in 6 to 15 feet of water. The nearshore bottom types to -30 feet are mixed limestone associated with shallow reef formations. A complex reef bottom type consisting of a mixture of limestone boulders and outcrops, as well as sand; hard bottom, rubble, or boulders predominates (AECOS, 1981). The reef platform slopes gradually offshore to a depth of about -30 feet, then drops steeply to -40 feet. In general the bottom is predominately consolidated limestone out to the -18 foot contour, changing to grooved limestone with increasing amounts of sand and silt coverage out to -33 ft. Rubble and sand predominate at -65 feet. A sandy section with widely scattered boulders is present at -8 feet off the western portion of Kakaako Park (AECOS, Inc., 1979).

An underwater survey in depths of 40 to 80 feet. was performed on January 6th 2005 using SCUBA gear, camera equipment, soil testing equipment and general measuring tools; a region was studied around the proposed location of tunnel breakout. The survey consisted of two detailed zone dives and a period of underwater towing to capture video footage over a greater area offshore of Kakaako Park bounded by Honolulu Harbor Channel on the west and Kewalo Basin on the East (MOE, 2005a)

The bottom type identified during the survey generally consisted of variable grade, medium to coarse sands with broken coral. The loose sediment layer was observed to be at least 6 inches thick at all locations surveyed. The area of intended pipeline was mostly coral rubble dredge spoils. The slopes encountered never exceeded 15 degrees. In the area of intended pipeline, slopes were variable, typically between 1 and 9 degrees. There were no undesirable localized bathymetric or geotechnical conditions.

Mamala Bay, offshore of Honolulu, has been a disposal area for dredged material from nearby Pearl and Honolulu Harbor for more than a century. Honolulu Harbor has been the primary commercial port for the State of Hawaii since before the turn of the century (Scott, 1968). The harbor is the result of dredging what was originally the drainage basin of Nuuanu Stream. Dredging began before 1900, and periodic maintenance dredging still occurs. Until about 1960, spoils were dropped just outside of the harbor, generally to the east of the Sand Island Sewage Treatment Plant Ocean Outfall (Brock, 1998). The US Geological Survey (USGS), US Army Corps of Engineers (USACE), and US Environmental Protection Agency (USEPA) have been studying the dredged material and their impacts on the marine environment for decades.

Environmental studies show that the native seafloor sediment is primarily a muddy carbonate sand, with areas of outcrop and carbonate rubble that include shell, coral and limestone (Chave and Miller, 1977a, 1977b, 1978a, 1978b; Tetra Tech, 1977; USEPA, 1980). Sediment sampling and bottom photography conducted during each phase of the 1977/1978 studies show that there is considerable variation in the composition of the seafloor in and around the disposal sites. Surficial sediment varies from primarily sand to sediment with substantial carbonate rubble (shell, coral and limestone), and the native seafloor sediment consists primarily of carbonate and basalt fragments that constitute about 90% and 10% of the sediment, respectively (Chave and Miller, 1977a, 1977b, 1978a; Neighbor Island Consultants, 1977; Tetra Tech, 1977; Goeggel, 1978; USEPA, 1980).

The 1977/1978 site designation studies show that grain size distributions of sediment collected from the disposal sites during each phase of the study vary considerably from sample to sample, and range from sandy gravel to muddy sand. Pre-disposal sediment is poorly sorted, averaging 85% sand and 15% mud (silt and clay). Similarly, dredged material is also poorly sorted, but is substantially coarser, containing 49.3% pebbles, 13.8% granules and 36.9% sand. Grain size distributions of sediment collected after a disposal action varied considerably from sample to sample, and post-disposal samples lack mud, are poorly sorted, and vary from predominantly sand (about 80%) to predominantly gravel (about 75%) (Tetra Tech, 1977).

Bottom photography conducted during the 1977/1978 dredging cycle also shows that anthropogenic debris litters the seafloor of Mamala Bay (Chave and Miller, 1977a, 1977b, 1978a, and 1978b; Tetra Tech 1977). Video and still photography collected during a USGS survey conducted in May 1994 (Torresan, et al, 1994b) documents the debris to include military ordnance, barrels, and a variety of canisters, tires, and lengths of wire rope.

The proposed project would have no significant impact on bathymetry or marine geology. Construction impacts would be mainly associated with sea-floor trenching for intake and discharge pipeline and disposal of excavated materials. Identified temporary impacts are elevated turbidity surrounding the excavation area and minor physical alteration of the marine bottom. In general, the seabed is least biologically productive near the Honolulu Harbor entrance channel. Productivity increases slightly as one moves eastward away from the harbor. Because the benthic and fish communities are poorly developed on the rubble slope or sand/rubble, the deployment of the pipe would have little or no negative impact. The deployed pipe would probably serve as a stimulus for the development of sessile benthic species and the shelter created by the pipe would locally enhance fish communities (Brock, 2005).

Additional detailed investigation and mapping would be conducted when more specific directional drilling breakout points are identified. Areas of high coral coverage would be identified and avoided to minimize impacts. Impacts would be further minimized by implementing BMPs during construction, such as proper silt containment and proper handling and disposal of excavated material.

4.5 Surface and Groundwater Resources

The subsections below describe the surface water, groundwater and coastal marine water resources in the project area, and potential impacts to them of construction and operation of the HSWAC system.

4.5.1 Surface Waters

There are no streams within the project area, the closest being Nuuanu Stream, approximately 1,000 feet from the nearest proposed segment of the distribution system. The runoff from the Kakaako Waterfront Park area is collected by a storm drain system and routed to the Keawe Steet open channel or Kewalo Basin. Runoff from the downtown Honolulu portion of the proposed project is collected by a storm drain system and routed to Honolulu Harbor.

Construction of the cooling station foundation would require dewatering and appropriate treatment before discharge to surface waters. In addition, installation of some of the large distribution pipelines near the harbor may also require dewatering. It is anticipated that only short lengths of the pipeline (no more than several hundred feet) would require dewatering based on the 10 to 30 foot depths to groundwater in most areas. Groundwater levels would be affected by tidal fluctuations due to the proximity to the harbor. The total quantity of water to be removed is currently unknown.

Under the proposed action, the dewatering effluent would be discharged under a National Pollutant Discharge Elimination System (NPDES) discharge general permit. Best Management Practices (BMPs) would be used to remove suspended particulates and meet all other permit requirements prior to discharge. Treatment may include settling ponds or tanks, filtration systems, or both. Water would be tested to ensure that discharges meet general water quality parameters and toxic contaminant parameters as specified in the permit.

The project would also require a grading, grubbing, and stockpiling permit from the City and County of Honolulu. Obtaining this permit would require a project-specific soil erosion control plan. With treatment of dewatering fluids and the erosion control plan, no adverse impacts to surface waters would occur as a result of the proposed project.

4.5.2 Groundwater

The project area is underlain by the Nuuanu Aquifer System, which is part of the Honolulu aquifer sector on the island of Oahu (Mink and Lau, 1990). This system includes an unconfined basal aquifer in sedimentary non-volcanic lithology. The groundwater in this aquifer is designated as currently used and has a moderate salinity (1,000 to 5,000 mg/l of chloride) and high total dissolved solids concentration. Close to the ocean the chloride level may reach 15,000 mg/l (equivalent to seawater). The groundwater is classified as neither drinking water nor ecologically important, replaceable, and with a high vulnerability to contamination. In the project area this aquifer is further underlain by a lower aquifer of the same system, the Honolulu Basal Aquifer, Nuuanu System. The aquifer is confined in flank compartments. The aquifer is currently being used as a drinking water source. The groundwater has a low salinity (250 to 1,000 mg/l chloride) and is classified as being irreplaceable, with a low vulnerability to contamination.

In 1977, the Underground Injection Control (UIC) Line was established by the State of Hawaii as part of the Federal Safe Drinking Water Act (SDWA) to protect the quality of the State's underground sources of drinking water from pollution by subsurface disposal of spent fluids. The UIC Line separates aquifers or portions of aquifers that supply public or private drinking water from exempt aquifers (aquifers or portions of aquifers that do not supply drinking water and can accept spent fluids). The UIC program established rules regulating the location, construction, and operation of all injection wells. Injection wells on Oahu are permitted only seaward of the UIC Line. The UIC line in the project vicinity runs along King St. (DOH, 1984). There are numerous injection wells for waste discharge into the caprock in central Honolulu, including those for thermal effluent, car-wash return, and rainwater. Pollutants in these discharges do not reach the Southern Oahu Basal Aquifer, due to upward artesian pressure in this aquifer.

Groundwater would be encountered during the construction process but no contaminants would be introduced to the groundwater. Most of the project occurs seaward of the UIC line, where the uppermost aquifer is considered less valuable. No adverse impacts to groundwater would occur as a result of the proposed project.

There would be a benefit as a result of implementation of the proposed action. Reduction of potable water usage is estimated to be up to 265 million gallons per year. This would reduce the amount of water that would otherwise need to be obtained from groundwater.

4.5.3 Coastal Marine Waters

Coastal waters in the vicinity of the project site, including Honolulu Harbor, are Class A marine waters according to DOH Water Quality Standards (Hawaii Administrative Rules [HAR] Chapter 11-54). Class A waters are to be protected for recreational and aesthetic enjoyment. Any other use shall be permitted as long as it is compatible with the protection and propagation of fish, shellfish, and wildlife, and with recreation in and on these waters. These waters shall not act as receiving waters for any discharge that has not received the best degree of treatment or control compatible with the criteria established for this class.

Two streams, Kapalama and Nuuanu, and numerous ditches and storm drains discharge into Honolulu Harbor, along with associated pollutants. Honolulu Harbor is also ringed with industry. Pollution is well known in the harbor; poor conditions are described as early as 1920 in references cited by Cox and Gordon (1970).

Water quality in the Kapalama Basin portion of the harbor is particularly poor because of discharges from Kapalama Stream. The parameters of greatest concern in the Harbor are nutrients, metals, suspended solids, pathogens, and turbidity (DOH, 1998). Coliform bacteria, nitrogen, phosphorus, and turbidity levels in the water regularly exceed State water quality standards. In 1978 and subsequent DOH sampling, heavy metals, chlorinated pesticides, polychlorinated biphenyls (PCBs), chlordane, and dieldrin (a toxic chlorinated organic compound used in insecticides) have been identified in harbor waters.

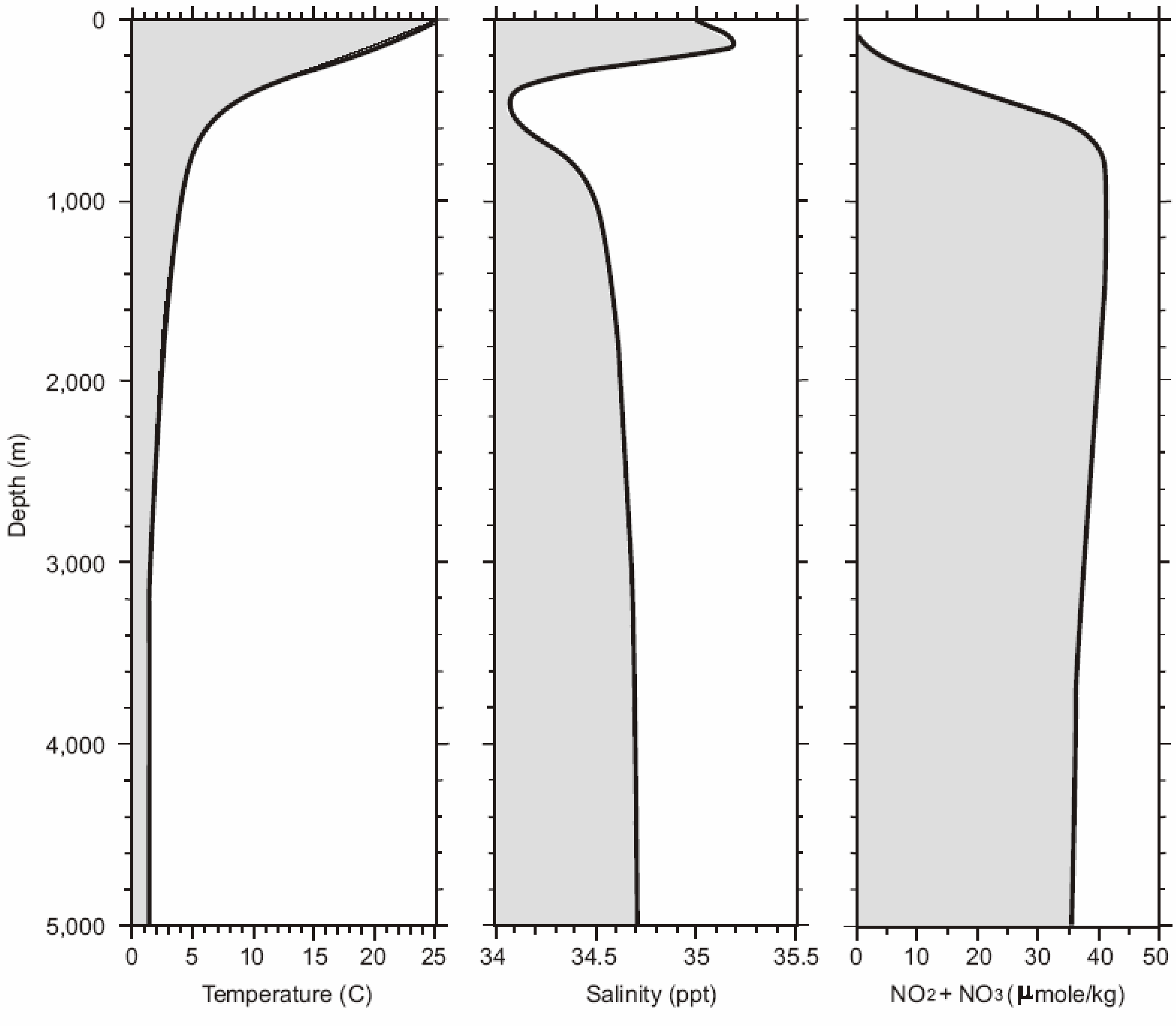
Mamala Bay includes the ocean area from Diamond Head to Kalaeloa (Barbers Point) on the southern coast of Oahu. Mamala Bay has been a disposal area for dredged material from nearby Pearl Harbor and Honolulu Harbor for more than a century. Honolulu Harbor has been the primary commercial port for the State of Hawaii since before the turn of the century (Scott, 1968). Storm drainage into Honolulu Harbor and nearby Keehi Lagoon carries runoff from Honolulu's streets and suburbs into Mamala Bay. Several regulated and unregulated point sources of pollution discharge into Mamala Bay. In addition to the three wastewater treatment plant (WWTP) outfalls (Sand Island, Fort Kamehameha, and Honouliuli), other discharges to Mamala Bay include the Ala Wai Canal (into which Manoa Stream discharges); Nuuanu, Kapalama, Kalihi, and Moanalua Streams; other small streams and drainage channels; and Pearl Harbor.

Sewage has been pumped into the ocean offshore of Kewalo and Sand Island since the 1930's. The early inputs were all raw sewage released in shallow-water (not exceeding 20 feet in depth). The actual points of release varied through time as different pipes were constructed and used. The multitude of perturbations that occurred in shallow-water from these early sewage inputs continued until the construction of the present deep-water outfall in 1978 (Brock, 1998).

While in operation, the Honolulu landfill (now part of the Kakaako Waterfront Park) received both burned and unmodified wastes from urban Honolulu (personal observations by R. Brock) at a period of time when concern over pollution from anthropogenic sources was less than now. Because the landfill filled in a section of old coastline in excess of 330 feet seaward, these materials along the seaward side are exposed to seawater and there is a potential for leaching of pollutants (Brock, 1998).

Figure 4-2 depicts the average vertical profiles of temperature, salinity, and major nutrients computed from a series of monthly surface-to-bottom measurements made between 1988 and 1995 at Ocean Station Aloha located north of Oahu. Essentially the same conditions would be expected south of Oahu.

Near the surface, the water column is mixed by wind and has uniform properties; the depth of the turbulent layer varies from nearly 400 feet in winter to less than 100 feet in summer. Below the mixed layer there is a sharp decrease in temperature (a thermocline), from 77 ˚F) at the surface to 41˚F at 2,300 feet depth, then a gradual decrease to 36˚F at 16,400 feet depth. The salinity distribution reflects the sinking of water from the north: higher salinity water of 35.2 parts per thousand (ppt) at 500 feet depth, traceable to the high surface salinity water north of Hawaii; and low salinity water of 34.1 ppt at 1,670 feet depth, traceable to low surface salinity water further to the northwest. Below this depth, salinity increases gradually to 34.7 ppt for abyssal waters. The concentration of nutrients is low at the surface, but increases steadily to the bottom. Similar vertical distributions are found for phosphate and silicate (Flament, et al., 1996).



Source: University of Hawaii, no date

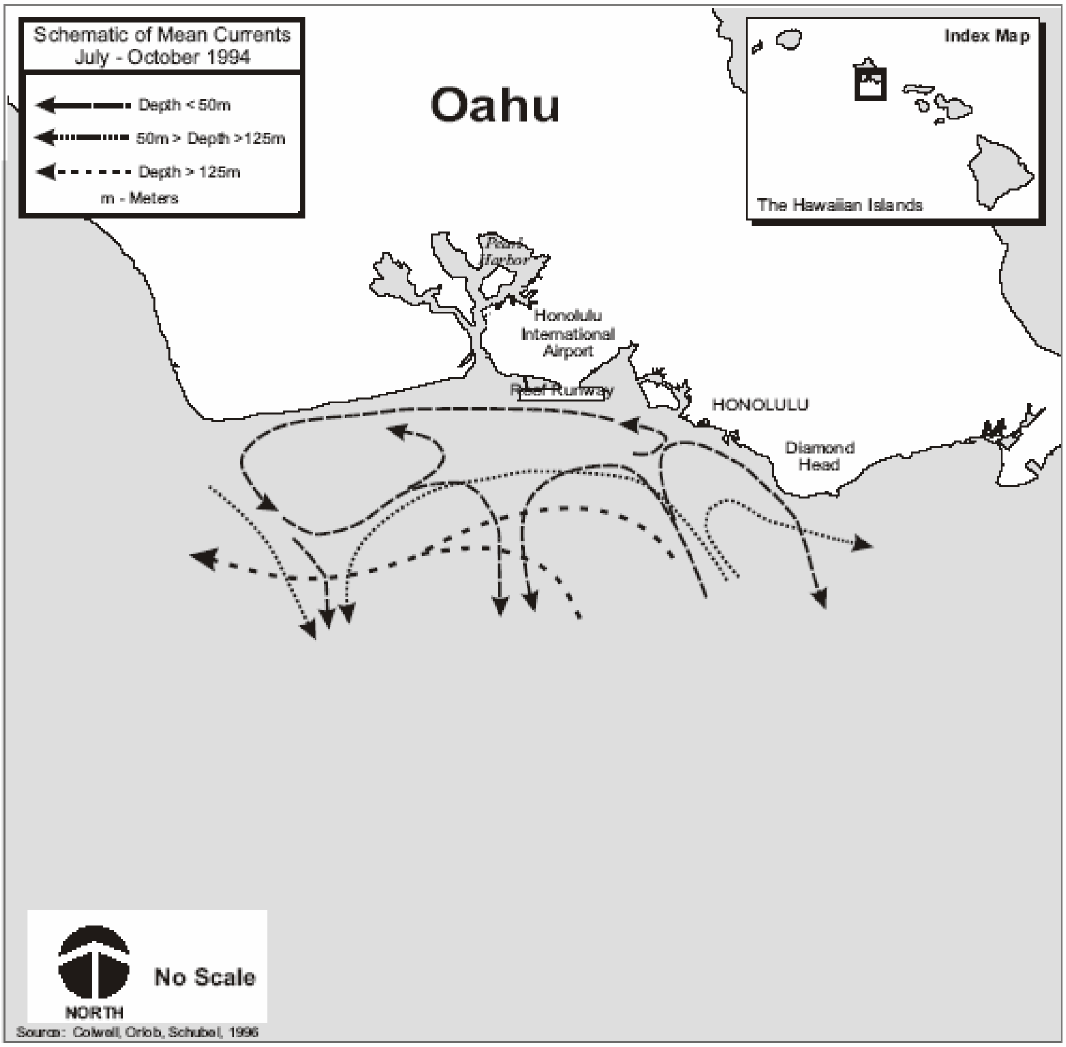
Legend: *C – Celsius; ppt – Parts per thousand;* *NO_2 – Nitrite;* *NO_3 – Nitrate; m – Meters*

Figure 4-2: Average Vertical Distribution of Temperature, Salinity, and Major Nutrients in Hawaiian Waters

Ocean circulation in Mamala Bay is extremely complex, driven largely by tidal fluctuations with major components paralleling the shoreline, but influenced seasonally by thermal stratification and trade and Kona winds. Oceanographic processes that have significant effects on circulation in Mamala Bay can be divided into the following categories: (1) those caused by surface tides (semi-diurnal, with a period of 12.4 hours, and diurnal, with a period of 24.8 hours) and (2) those that result from other factors including wind forcing, propagation of long period waves and circulation in deep offshore coastal waters (SAIC, 1995).

The semi-diurnal tidal wave, moving in a southwesterly direction in the Pacific Ocean appears to split near the North Shore of Oahu, creating two progressive tide waves, one propagating along the east side of the island and the other along the west side. Coastal trapping causes these two waves to curve around the headlands at Barbers Point and Diamond Head and to merge within Mamala Bay before continuing toward the southwest. As a result, strong tidal velocities measured at Barbers Point and Diamond Head are oriented parallel to the depth contours and directed towards the middle of the bay. Weak currents result where the flows merge from opposite directions. Converging flows at flood tide cause a downwelling (downward flow) at the center of the bay, which reverses at ebb tide. Consequently, large changes in stratification occur over the tidal cycle with the water column often becoming homogeneous at different sites (SAIC, 1995).

Peak currents of about 20 inches per second were measured at the Sand Island wastewater treatment plant outfall located about 3 miles southeast of the Reef Runway in approximately 250 feet of water. Figure 4-3 shows a schematic of the mean current circulation patterns in Mamala Bay (Colwell, Orlob, and Schubel, 1996).



Source: Colwell, Orlob, Schubel, 1996

Figure 4-3: Schematic of Mean Circulation Patterns for Mamala Bay

During the Mamala Bay Study (Grigg, 1995), water quality sampling was performed for a year during baseline conditions (trade winds 10 to 20 mph, waves < 6.6 feet, and rainfall, 0.5 in/day). All measures of nutrients and other chemical parameters remained relatively constant at both surface and bottom stations in Mamala Bay (Tables 4-5 – 4-7).

Even though sampling spanned an entire year, only small deviations in all parameters were encountered. Salinity ranged between 34.5 and 34.6 ppt, phosphate, nitrate and ammonium values ranged between undetectable levels and 0.15 µM; turbidity ranged between 0.25 and 0.37 ntu and chlorophyll-a ranged between 0.07 and 2.44 µg/L. Only silicate exhibited much variation and that was limited to the nearshore station near the Ala Wai Canal. A small but significant ($p < 0.01$, Spearman Rank Correlation) trend of increasing ammonium from east to west was also observed (Grigg, 1995).

Table 4-5: Mamala Bay Baseline Water Quality Parameters
(Source: Grigg, 1995)

BASELINE	SURFACE		BOTTOM	
Parameter	Mean	Range	Mean	Range
Salinity (ppt)	34.55 ± 0.03	34.48 - 34.60	34.55 ± 0.02	34.52 - 34.61
Phosphate (µM)	0.13 ± 0.01	0.11 - 0.15	0.13 ± 0.01	0.11 - 0.15
Nitrate (µM)	0.03 ± 0.02	0.01 - 0.07	0.04 ± 0.02	0.00 - 0.08
Ammonium (µM)	0.04 ± 0.02	0.00 - 0.07	0.05 ± 0.02	0.01 - 0.08
Silicate (µM)	1.87 ± 0.48	1.08 - 2.68	1.76 ± 0.46	1.04 - 2.25
Turbidity (ntu)	0.29 ± 0.03	0.25 - 0.37	0.28 ± 0.02	0.25 - 0.32
Chlorophyll (µg/l)	0.16 ± 0.14	0.09 - 0.24	0.17 ± 0.06	0.07 - 0.24

An obviously critical characteristic of Mamala Bay waters for the feasibility of the HSWAC system is the temperature profile through the water column, and considerable effort has been made to understand the causes and limits of its variability. In the EIS, information will be provided on:

- Prior studies and measurements of Mamala Bay temperatures;
- Temperature fluctuations in Mamala Bay due to tides and internal waves;
- Measurements made in December, 2004, at the nominal intake location for HSWAC;
- Mathematical models simulating time and spatially varying temperatures in Mamala Bay; and
- Recommendations for reducing the temperature fluctuations and their impact on system operations.

A brief summary is included here. Seawater temperature variation at 1,600 feet water depth in Mamala Bay was calculated from three sources of data.

- The first report was published in 1995 (Hamilton et al.) from a study which consisted of pressure sensors and thermistors deployed at various depths and locations throughout Mamala Bay for a period of 1.5 years. The deepest and closest mooring relative to the preliminary intake location (named E4) was positioned approximately 3.7 nmi southeast of the intake location in a water depth of 1,665 feet (Figure 4-4). The deepest thermistor attached to this mooring was at a water depth of 1,476 feet.
- The second source of data was a recent depth/pressure sensor deployment (named HSWAC1) in the general vicinity of the preliminary intake location at 1,600 feet water depth. The data were collected by MOE, for a period of 11 days.
- The third source of data was based on a second deployment (named HSWAC2) that occurred immediately following the first MOE deployment and lasted for a period of 20 days.

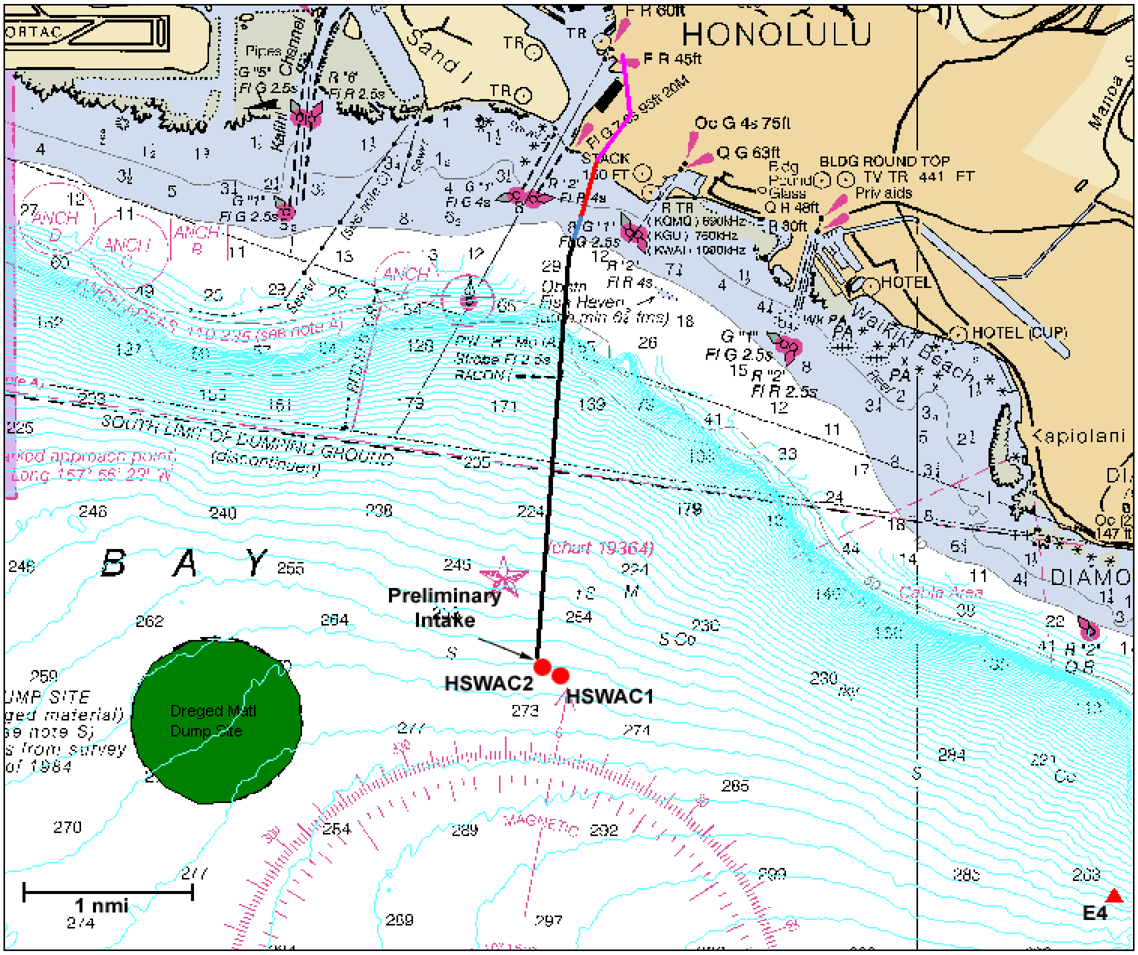


Figure 4-4: Relative Positions of the 1995 Mamala Bay Study Mooring E4, the 11-day November 2004 MOE Deployment (HSWAC1), the 20-day December 2004 MOE Deployment (HSWAC2), and the Preliminary Intake Position. (Source: MOE, 2005b)

A summary of temperature data taken at 1,476 feet (from the Mamala Bay study), extrapolated to 1,600 feet, is as follows:

- The average temperature for this site was found to be 44.7˚F;
- The maximum temperature was 48.1˚F; and
- The minimum temperature was 42.1˚F.

Although the range of 27,246 temperature readings taken for about 1.5 years during the Mamala Bay study was 6.05 ˚F the standard deviation was only 0.68 ˚F. A thorough understanding of the temperature regime at the intake location will be essential to development of realistic projections of cooling capacity, energy usage and economic performance. This understanding will be presented in detail in the EIS.

During normal operation, return seawater would have the same properties as intake seawater, except that it would be warmer. The return water would be at a maximum temperature of 58˚F. This will vary based on air conditioning demand and customer installations. The depth of the return will be established in consultation with the regulatory agencies. It is anticipated that a Zone of Mixing (ZOM) permit will be necessary for the return water. The creation of a ZOM in Class A open coastal waters delineates a limited area in which water quality standards may be exceeded.

A small discharge of drilling mud (bentonite clay) is possible at breakout, unless water is substituted as a lubricant for the final cuts. Bentonite clay non-toxic and would be rapidly dispersed by prevailing currents.

There would be a benefit as a result of implementation of the proposed action. Reductions of sewage discharges of up to 114 million gallons per year are estimated. This would reduce the load to the Sand Island wastewater treatment plant and the volume of wastewater discharged to Mamala Bay.

4.6 Biological Resources

4.6.1 Terrestrial

Animal and plant species meeting appropriate criteria are protected under the Federal Endangered Species Act of 1973 (16 U.S.C. §§ 1531-1544, as amended) (ESA) and Hawaii's Endangered Species Law (Chapter 195D HRS). Hawaii currently has 373 species on the Federal endangered species list, more than any other state. The current list includes four mammals, 34 birds, five sea turtles, 42 snails, 15 arthropods and 273 plants.

The terrestrial portions of the project area are among the most highly urbanized areas of the state and appropriate habitats for endangered or threatened species are rare to nonexistent. There are no designated critical habitats in the project area. According to records maintained by the Hawaii Natural Heritage Program (NHP 2003) there are historical sightings of two Federal and State threatened and endangered species in the proposed project area:

- Hawaiian hoary bat or ʻopeʻapeʻa (*Lasiurus cinereus semotis*) – one sighting reported from 1990 at Queens Medical Center and one sighting reported from the 1890s at Beretania and Fort Streets.
- ʻIwiwi (*Centaurium sabaeoides*), a vascular plant – one sighting reported from the 1800s near (Pier 4; Coast Guard Building).

The endangered plant is no longer present and project activities would not be expected to affect any bats that might be present. White terns (fairy terns; *Gygis alba*) are also present in the proposed project area. White terns are tolerant of people and noise, and are found scattered throughout urban and suburban areas of the southern shore of Oahu where a total of 694 adult white terns and 221 nests were observed from October 2001 through January 2003 (Vanderwerf, 2003). The white tern population on Oahu was listed as threatened by the State of Hawaii in 1986 (Hawaii Administrative Rules, Title 13, Part 2, Chapter 124). This listing was presumably based on its limited distribution and small population size, although the white tern is a common seabird that nests on many islands throughout the tropical and subtropical Pacific, Atlantic, and Indian Oceans (Harrison, 1983), including the Northwestern Hawaiian Islands. White terns were first documented on Oahu in 1961 according to Vanderwerf (2003). White terns would be surveyed prior to construction in the project area. If any are nesting within 100 feet of construction activity, noise and visual barriers would be used to prevent any disturbance to the birds.

Vegetation within the study area consists of maintained plantings, such as roadway medians, shoulders and ruderal (weedy) patches. Several streets within the project area contain mature vegetation within medians and streetscapes; particularly noteworthy is South King Street. A few trees within the proposed project area meet the criteria for "Exceptional Trees," which are defined as "a tree or grove of trees with historic or cultural value, or which by reason of its age, rarity, location, size, aesthetic quality, or endemic status has been designated by the city council as worthy of preservation" (Revised Ordinances of Honolulu Section 41-13.7, June 3, 2003). The locations of these trees with respect to proposed project facilities will be shown and potential impacts of construction activities analyzed in the EIS.

4.6.2 Marine

As for the terrestrial flora and fauna described above, marine flora and fauna and certain marine habitats are protected by the Federal Endangered Species Act of 1973 (16 U.S.C. §§ 1531-1544, as amended) (ESA) and Hawaii's Endangered Species Law (Chapter 195D HRS), but also by the Marine Mammal Protection Act (16 U.S.C. §§ 1361-1421h, as amended) (MMPA), and the Migratory Bird Treaty Act (16 U.S.C. §§ 703-712, as amended) (MBTA). Protection of certain habitats (essential fish habitat and coral reefs) is afforded by the Magnuson-Stevens Fishery Conservation and Management Act (16 U.S.C. §§

1801-1882, as amended) (Magnuson-Stevens Act or MSA) and Executive Order 13089 Coral Reef Protection, respectively

The marine areas proposed for use are among the most historically degraded coastal habitats in the state, having been subjected to municipal waste dumping, sewage discharges, dredged material dumping and other waste disposal activities. This area has limited marine biological resources. The nearshore area is maintained in an early successional stage by seasonal high surf events, occasional storm surge and, near the Honolulu Harbor entrance channel, dragging of barge tow cables on the bottom. Nevertheless, to avoid the existing zone of sparse coral formations (described below), horizontal directional drilling would be used to tunnel beneath the shoreline and nearshore reefs off Kakaako Waterfront Park. Preliminary marine surveys have been done in the pipeline corridor and the results of these surveys are summarized below. Also described are: essential fish habitat (EFH), threatened and endangered marine species, non-listed marine mammals, migratory birds associated with the marine environment, and shorebirds.

4.6.2.1 Coral Reefs

A marine biological survey of the area has been completed (Brock, 2005). The proposed pipe route traverses an area that historically has been seriously impacted by industrial discharges, sewage disposal, freshwater runoff into Honolulu Harbor, and disposal of dredged materials. In addition, the present-day Kewalo Shoreline Park is built on a former Honolulu dump that was closed in the early 1960s. The seaward (or makai) side of the dump is contained by placement of a boulder riprap that was constructed on a limestone bench in water from 7 to 16 feet in depth.

While in operation, the dump received both burned and unmodified wastes from urban Honolulu at a period of time when concern over pollution from anthropogenic sources was less than now. The dump filled in a section of old coastline to a point greater than 330 feet seaward, and waste materials along the seaward side are exposed to seawater with possible leaching of pollutants to surrounding waters. The nearshore area offshore of the park where the proposed pipe would be installed is not a pristine coral reef environment. Brock (2005) found four biotopes (zones) proceeding seaward:

- The biotope of scoured limestone is present along the entire length of the boulder riprap fronting the park and commercial area to the west. The width of this biotope varies considerably from about 130 feet to more than 330 feet with the widest area being in the far western part of the Kakaako limestone platform. Present in this biotope are areas of sand and coralline rubble; these materials are moved about by impinging waves that create the scouring action which inhibits the successful establishment and growth of corals. Coral cover is very low in the biotope of scoured limestone biotope (much less than 0.1%) which is probably due to the scouring created by occasional high surf events that commonly impact this coastline during the summer months.
- The biotope of scattered corals is situated seaward of the biotope of scoured limestone starting from about 160 feet to over 330 feet from the shoreline at depths commencing in 13 to 20 feet and ending in depths from about 40 to 60 feet. This biotope is the most common feature of the Kakaako limestone platform and occupies a band about 1,000 feet in width and about 3,000 feet in length between the Honolulu Harbor entrance channel and the abandoned sewer line near the Kewalo Basin entrance channel. Thus the biotope encompasses about 75 acres. Along the shallower inner reaches of this biotope corals are scattered but with increasing depth (i.e., 26 to 40 feet), coral coverage increases such that in small areas of 220 to 1,600 ft^2, coverage may approach 75%. A gross overall mean estimate of coral coverage in this biotope is 5%. Corals are commonly seen on the ridges that lie above the sand-scour that occurs during periods of high surf.
- Seaward of the biotope of scattered corals is the biotope of dredged rubble. In this zone, the spur and groove formations that are common elements of the biotope of scattered corals become less obvious with the ridges or spurs often appearing as relatively flat limestone with little coral present; the intervening channels are filled in with coral rubble. Much of this rubble appears to be quite angular and ranges from a couple of inches to about 2.5 feet in diameter, but the majority of it is small. This coral rubble is what remains of the dredging activities in Honolulu Harbor and these tailings were deposited in the area probably from about 1920 through about 1960. With time and sufficient material, the old seaward face of the limestone platform was extended

seaward probably adding anywhere from 33 to 130 feet onto the outer edge of the platform. This biotope is recognizable at depths from about 30 to 40 feet and extends seaward sometimes as a relatively steep slope or otherwise as a gentle slope from 66 to 200 feet in width and at its deepest point is found at depths up to about 80 to 95 feet where a sand/rubble bottom is encountered. The distance between the most seaward obvious spur and groove formations with reasonable coral coverage to the top of the more offshore rubble slope ranges from 66 feet to over 160 feet. In the zone of dredged rubble, benthic and fish communities are not well-developed. The relatively unstable nature of the substratum does not promote coral growth; most corals seen in this biotope are small. Mean coral coverage in this biotope is less than 0.1%.

- Below the rubble slope is the biotope of sand where the substratum flattens and is comprised of sand and coral rubble. The diversity of marine life on the sand/rubble plain seaward of the 100-foot isobath is not well-developed.

It is apparent that the area intended for deployment of intake and return pipes is significantly degraded and is not a pristine coral reef environment. Impacts of pipeline installation will be transient and insignificant.

Operation of both intake and return pipes, however, may have impacts on marine biota. Operation of the intake may result in impingement and entrainment of marine organisms. Clean Water Act (CWA) Section 316(b) requires the USEPA to ensure that the location, design, construction, and capacity of cooling water intake structures reflect the best technology available for minimizing adverse environmental impacts associated with impingement and entrainment of organisms in intake pipes. The proposed HSWAC project would utilize the following approaches to reduce entrainment (and impingement):

- The intake location is approximately four miles offshore at a depth of 1,600 feet. The euphotic zone (zone of photosynthetic light) typically does not extend beyond the first 330 feet) of depth. At the intake depth biological productivity is much less than at shallower depths and the lower density of organisms reduces the potential for impingement and entrainment.
- No intake screens would be used at the end of the pipe, and the velocity of the intake (approximately 5 ft/sec.) would limit fish entrainment. However, a coarse mesh screen will be considered during the final design of the intake to minimize any entrainment.
- Use of variable speed pumps can provide for greater system efficiency and reduced flow requirements (and associated entrainment) by 10 to 30 percent.

Impacts of the return seawater flows would depend on the final agreed upon discharge depth, but would be related to any differences between the return water and ambient conditions of temperature and inorganic nutrient concentrations. Potential impacts will be described in the EIS after the terminal point of the return pipe is selected.

4.6.2.2 Essential Fish Habitat

The MSA defines essential fish habitat (EFH) as those waters and substrates necessary to fish for spawning, breeding, feeding, or growth to maturity. “Waters,” when used for the purpose of defining EFH, include aquatic areas and their associated physical, chemical, and biological properties that are used by fish, and may include historical areas of use where appropriate. Substrate includes sediment, hard bottom, underlying structures, and associated biological communities. Regional Fishery Management Councils are responsible for identifying and describing EFH for each Federally-managed species, minimize to the extent practicable adverse effects on such habitat caused by fishing and non-fishing activities, and identify other actions to encourage the conservation and enhancement of such habitat.

The designation of EFH by the Western Pacific Regional Fishery Management Council (the Council), which has responsibility for the EEZ around Hawaii and other U.S. flagged island areas in the Pacific, was based on groups of species managed under its five existing fishery management plans (FMP): pelagics, bottomfish and seamount groundfish, precious corals, crustaceans and coral reef ecosystems.

In addition to EFH, the Council identified habitat areas of particular concern (HAPC) within EFH for all FMPs. In determining whether a type or area of EFH should be designated as a HAPC, the area had to meet one or more of the following criteria:

- the ecological function provided by the habitat is important,
- the habitat is sensitive to human-induced environmental degradation,
- development activities are or will be stressing the habiat type, or
- the habitat type is rare.

The following table summarizes the approved EFH and HAPC designations for each life stage of Federally-managed species managed under fishery management plans (FMP) for the western Pacific region.

Table 4-6: Essential Fish Habitat (EFH) and Habitat Areas of Particular Concern (HAPC) for all Western Pacific FMPs

(Source: WPRFMC, 2004) (All areas are bounded by the shoreline and the outer boundary of the EEZ, unless otherwise indicated.)

FMP	EFH (Juveniles and Adults)	EFH (Eggs and Larvae)	HAPC
Pelagics	Water column down to 3,300 feet	Water column down to 660 feet	Water column above seamounts and banks down to 3,300 feet
Bottomfish and Seamount Groundfish	Bottomfish: Water column and bottom habitat down to 1,320 feet Seamount Groundfish: (adults only) water column and bottom from 260 to 2,000 feet, bounded by 29°-35°N and 171°E-179°W	Bottomfish: Water column down to 1,320 feet Seamount Groundfish: (including juveniles) epipelagic zone (0 to 660 feet) bounded by 29°-35°N and 171°E-179°W	Bottomfish: All escarpments and slopes between 130 to 920 feet, and three known areas of juvenile opakapaka habitat Seamount Groundfish: not identified
Precious Corals	Keahole Point, Makapuu, Kaena Point, Westpac, Brooks Bank, 180 Fathom Bank deep water precious corals (gold and red) beds and Milolii, Auau Channel and S. Kauai black coral beds	Not applicable	Makapuu, Westpac, and Brooks Bank deep water precious corals beds and the Auau Channel black coral bed
Crustaceans	Bottom habitat from shoreline to a depth of 330 feet	Water column down to 500 feet	All banks within the NWHI with summits less than 100 feet
Coral Reef Ecosystems	Water column and benthic substrate to a depth of 330 feet	Water column and benthic substrate to a depth of 330 feet	All MPAs identified in FMP, all PRIAs, many specific areas of coral reef habitat (see FMP)

The marine portions of the proposed project would take place within EFH for all life stages of pelagic, bottomfish, crustacean and coral reef management unit species (MUS). In addition, the project area contains bottomfish HAPC. Potential impacts to EFH and HAPC will be evaluated in the EIS, after the location of the terminal end of the seawater return pipe is identified.

4.6.2.3 Threatened and Endangered Species

Endangered marine mammals listed for Hawaii include the Hawaiian monk seal (*Monachus schauinslandi*), humpback whale (*Megaptera novaeangliae*), fin whale (*Balaenoptera physalus*), and sperm whale (*Physeter catodon*), although the northern right whale (*Eubalaena glacialis*), blue whale (Balaenoptera musculus), sei whale (*Balaenoptera borealis*), and the Steller sea lion (*Eumetopias jubatus*) may also occur in the central Pacific Ocean. Of the endangered whales, however, only the humpback whale occurs around Hawaii in waters shallow enough to potentially be affected by the proposed project. There is no critical habitat designated for humpback whales, but some protections are afforded by the Humpback Whale National Marine Sanctuary. A portion of the Sanctuary extends along the southeastern coast of Oahu, but ends east of the HSWAC project area.

Installation of the intake and return pipes would preferably occur in winter because ocean conditions along the southern shores of Oahu are calmer then than in summer. However, winter is also when humpback whales migrate into Hawaiian waters to breed and calve. The volume of vessel traffic in Mamala Bay makes the habitat less attractive to whales than more isolated coastal areas, but humpbacks may still occur there. Offshore project activities would be done from stationary or very slowly moving vessels so risk of a collision with a project vessel would be minimal. Most of the pipeline installation work would be done close to or on the bottom rather than in the water column, and would be limited in duration to about 24 hours, but there is a concern about a juvenile or adult whale striking a partially deployed pipe during the critical hours when the pipe is being sunk into place. A lookout system such as a picket line of tender vessels will be positioned around the work area during the deployment operation to minimize this risk, as well as temporarily secure the area from other vessel traffic.

In addition to endangered whales, listed sea turtles occur in the project area. All species of sea turtles are listed under the ESA as either endangered or threatened. Five species of sea turtles occur in the region. Two are considered endangered: the leatherback (*Dermochelys coriacea*) and the hawksbill (*Eretmochelys imbricata*). The other three are considered threatened: the green (*Chelonia mydas*), the loggerhead (*Caretta caretta*) and the olive ridley (*Lepidochelys olivacea*). The leatherback, loggerhead and olive ridley are highly pelagic species which do not nest in Hawaii. Their preferred foraging habitats and migratory pathways are well north of Hawaii in the transition zone between subtropical and temperate waters. It would be highly unusual for one of these turtles to be seen in Mamala Bay. Green and hawksbill turtles, however, do nest in Hawaii. While hawksbill turtles are relatively rare, green turtles are very common in Mamala Bay and, despite the volume of vessel traffic, are often seen close to shore and in harbors and marinas. It is not expected that the slowly moving vessel traffic associated with the project would result in significant impacts to sea turtles.

There are three listed species of seabirds that occur in the central Pacific region. The short-tailed albatross (*Phoebastria albatrus*) is an endangered species found primarily around the Pacific Rim. It is occasionally seen in the central Pacific on Midway Island at the northern end of the NWHI. It has never been sighted south of Kauai and it would be a major ornithological event were it to be seen in Mamala Bay.

The second listed seabird species in Hawaii is the endangered Hawaiian petrel (*Pterodroma phaeopygia*). The species is known to breed only within the MHI. Its nesting sites are currently restricted to elevations above 7,200 feet where vegetation is sparse and the climate is dry. Nesting colonies are found on Maui and Kauai, but there are no known nesting sites on Oahu. Nesting takes place between March and November. During the remainder of the year, these birds forage far out to sea. It is unlikely that Hawaiian petrels would forage in Mamala Bay, and no impacts to this species would be expected from the proposed project.

There is also one listed threatened seabird in Hawaii: Newell’s shearwater (*Puffinus auricularis newelli*). This species nests only in the MHI. It was once widespread, but is now reduced to a few remnant breeding colonies on Molokai, Hawaii and mainly on Kauai because of loss of nesting habitat and predation by introduced species. It does not currently nest on Oahu and would not be expected to forage in Mamala Bay.

There are four endangered waterbirds that occur on Oahu: Hawaiian moorhen (*Gallinula chloropus sanvicensus*), Hawaiian duck (*Anas wyvilliana*), Hawaiian coot (*Fulica alai*), and Hawaiian black-necked stilt (*Himantopus mexicanus knudseni*). These birds may overfly the project area, but their nesting and foraging areas are in wetlands. The closest waterbird habitat to the project area is in Pearl Harbor. The HSWAC project would not affect waterbird nesting or foraging habitat.

4.6.2.4 Non-listed Marine Mammals

Marine mammals not listed as threatened or endangered under the Endangered Species Act (ESA) that have been observed in the central Pacific region are listed in Table 4-7. These species are protected under the MMPA.

Table 4-7: Marine Mammals Not Listed as Threatened or Endangered Under the ESA but Observed in the Central Pacific Ocean

Common Name	Scientific Name
Pacific white-sided dolphin	*Lagenorhynchus obliquidens*
Rough-toothed dolphin	*Steno bredanensis*
Risso’s dolphin	*Grampus griseus*
Bottlenose dolphin	*Tursiops truncatus*
Pantropical spotted dolphin	*Stenella attenuata*
Spinner dolphin	*Stenella longirostris*
Striped dolphin	*Stenella coeruleoalba*
Melon-headed whale	*Peponocephala electra*
Pygmy killer whale	*Feresa attenuata*
False killer whale	*Pseudorca crassidens*
Killer whale	*Orcinus orca*
Pilot whale, short-finned	*Globicephala macrorhynchus*
Blainsville’s beaked whale	*Mesoplodon densirostris*
Cuvier’s beaked whale	*Ziphius cavirostris*
Bryde’s whale	*Balaenoptera edeni*
Pygmy sperm whale	*Kogia breviceps*
Dwarf sperm whale	*Kogia simus*
Minke whale	*Balaenoptera acutorostrata*
Dall’s porpoise	*Phocoenoides dalli*
Fraser’s dolphin	*Lagenodelphis hosei*
Longman’s beaked whale	*Indopacetus pacificus*
Northern elephant seal	*Mirounga angustirostris*
Northern fur seal	*Callorhinus ursinus*

One stock of non-endangered marine mammals, the Hawaii stock of the false killer whale, is classified as “strategic” under the MMPA, owing to serious injuries documented in the Hawaii-based longline fishery (Carretta et al., 2003). Strategic stocks are those that have a level of human-induced mortality that exceeds the number of animals that can be safely removed from the stock without interfering with that stock’s ability to reach or maintain its optimum sustainable population level.

4.6.2.5 Migratory Birds

Thirty-nine species of migratory seabirds are known to occur in the Hawaiian Island chain. Twenty-two of these species breed in Hawaii. The foraging range of some of these species is estimated to be between 98 and 300 miles. Seabirds (e.g., red-footed boobies (*Sula sula*), masked boobies (*Sula dactylatra*), white-tailed tropicbirds (*Phaethon lepturus*), red-tailed tropicbirds (*Phaethon rubricauda*), sooty terns (*Sterna fuscata*), brown noddies (*Anous stolidus*), and others from the colonies located at Kaula, Niihau, Kauai, and Oahu may be observed foraging in the coastal pelagic waters that surround all of these islands.

5.0 BUILT ENVIRONMENT DESCRIPTION, POTENTIAL IMPACTS AND MITIGATION MEASURES

5.1 Archaeological and Historical Resources

Three concerns were raised in scoping with respect to archaeological, historic and cultural resources: (1) the possibility of uncovering archaeological or cultural remains including human burials in excavations for HSWAC system components, (2) use of or impacts to historic structures in downtown Honolulu, and (3) impacts to traditional Hawaiian cultural activities. Assessment of the potential significance of impacts to these resources and potential mitigation measures to minimize their significance are described below.

The Area of Potential Effect (APE) lies mostly within the Downtown and Kakaako sections of modern-day Honolulu. Although the Downtown and Kaka`ako sections are extensively developed, and indeed undergoing continuous development, the areas are rich in historic and cultural resources. The EIS will list selected archaeological projects and findings made over the last 35 years within the APE.

According to records maintained by the State Historic Preservation Division, a number of significant historic properties – listed on the Hawai`i and/or National Register of Historic Places – are located within the APE. Nearly all of these properties are architectural in nature, and include historic government and commercial buildings connected to important events in Honolulu in the 19th and 20th centuries A.D. Properties identified with five historic districts – all of which are within the APE – contain these Register properties: the Chinatown Historic District (50-80-14-9986), the Merchant Street Historic District (50-80-14-9905), the Hawai`i Capitol Historic District (SIHP No. 50-80-14-1321), City and County of Honolulu Art Deco Parks (50-80-14-1388), and Fire Stations of O`ahu (SIHP No. 50-80-14-1346).

Archaeological properties within the APE have been documented primarily through work done in the last 35 years. Although significant sites were known from early surveys of traditional properties (cf. McAllister, 1933), the bulk of our knowledge on archaeological sites is derived from a variety of projects that included subsurface testing and monitoring of construction work in the downtown and Kakaako areas.

While the earliest settlements in the Hawaiian Islands and on O`ahu were probably located on the Windward coasts, much if not all of the project area was occupied by the 16th and 17th centuries A.D. By this time, the *ahupua`a* system of land tenure – with its coast-to-mountains land units – was firmly in place, and its tenets governed land use within the APE. At this time, general site types included coastal fish ponds, behind which lay irrigated taro fields and, in drier areas, fields for other crops such as sweet potato. Habitation sites, both single and clustered, were also present throughout the area as were trails from this part of the O`ahu coastline to Waikīkī on the east and Pearl Harbor and `Ewa on the west.

Fishponds have been documented in work along N. King Street (Athens and Ward, 1994; Kennedy and Riley 1996) and Nimitz Highway (Cultural Surveys Hawaii, 2001). Although long buried due to in-filling activities, fish pond sediments have been obtained through controlled coring, with resulting radiocarbon dates as early as the 14th century A.D. (Kennedy and Riley, 1996).

Habitation sites dating from pre-Contact times have been more difficult to document within the urban project sites, but several sites have contained evidence of habitation dating to at least late pre-Contact times (i.e., 17th – 18th centuries A.D.) if not earlier: Kekaulike `Ewa and Diamond Head (Kennedy and Riley, 1996; Goodwin, 1997); Harbor Court (Lebo et al., 2002); the Marin Tower site (Goodwin et al., 1996); and within the Capitol District (Denham and Kennedy, 1992).

Post-Contact sites in the Downtown and Kakaako areas are much more numerous, and typically represent residential, commercial, government, and other activities. Such sites are characterized by deposits that may include structural elements and foundations (cf. Garland 1996, Perzinski et al., 2000), habitation and commercial debris associated with specific ethnic groups (Perzinski et al., 2000), and even site areas that may be identified with known historic personages such as Don Francisco de Marin (cf.

Goodwin et al., 1996). While roadway excavations are not as likely to produce such cultural materials, they may be present, as numerous monitoring projects have indicated (cf. Elmore and Kennedy, 2001).

The Downtown and Kakaako areas have also become known for the considerable number of human burials that have been encountered during construction work in the area. The vast majority of these finds appear to date to the post-Contact era, including interments from the 19th and early 20th centuries A.D. While a number of finds are limited to one or two burials, there are several instances of large numbers of interments. The largest known burial area is associated with Honuakaha Cemetery, near South Street and Quinn Lane; these burials are those of the dead from the smallpox epidemic of 1853 (Hammatt et al., 1994; Pfeffer et al., 1993). Other, smaller cemetery areas have been found, including 30 individuals whose remains were recovered during the Queen Street Extension Project, and 26 individuals whose remains were recovered during construction of the Smith-Beretania Park (Cultural Surveys Hawaii, in prep.; Pacific Legacy, in prep.).

In order to ensure proper identification and treatment of all historic properties within the APE, a sensitivity map will be developed which indicates the relative likelihood – low, moderate, and high – of encountering subsurface historic sites, including burials. Predictions of sensitivity, and the potential existence of historic sites, will be made on the basis of a number of factors: the extent and nature of prior ground disturbance or development, underlying soil characteristics as documented by the US Department of Agriculture and any available soil boring logs, any available oral historical or historical information, and previous archaeological work and finds on the subject parcel or nearby areas.

The nature and extent of prior ground disturbance and development may be a reliable indicator of the probable presence or absence of subsurface historic sites. If prior buildings or structures, or roadway development, have not had deeply excavated foundations or pilings, or if there has been little or no prior installation of such features as underground storage tanks or wastewater systems, it is more likely that historic sites, including human burials, are still present below the ground surface.

With regard to underlying soil characteristics, there is a generally higher probability of subsurface finds, including burials, expected from areas underlain by sand deposits, and a generally lower probability of subsurface finds, including human burials, expected from areas underlain by fill soils and/or alluvial soils.

5.2 Cultural Impact Assessment

The results of a cultural impact assessment will be presented in the EIS. The cultural impact assessment would follow the *Guidelines for Assessing Cultural Impact* published by the Office of Environmental Quality Control (OEQC), as amended in 2000 and approved by the Governor as Act 50 that same year. The cultural impact assessment would focus on identifying traditional cultural properties and traditional cultural practices in the *ahupua`a* located within the project area. In addition, documentary archival research would also be conducted. Primary source materials that would be reviewed would include (but not be limited to) Mahele records, land court records, testimonies, oral histories, and Hawaiian language newspaper articles.

Individuals and/or organizations that may have knowledge of traditional cultural properties, or traditional cultural practices, in the project area would be identified and interviewed by a qualified ethnographer. The interviews would be recorded if consent is given and transcribed for the assessment report. Field visits accompanied by the informants would be encouraged.

Any impacts to identified traditional cultural properties or cultural practices would be identified and described. If impacts to cultural properties and practices are identified, appropriate mitigation measures would be presented and discussed.

5.3 Infrastructure and Public Services

5.3.1 Utility Installations

Utilities that will be discussed in the EIS include: electricity, potable water, sewage, solid waste, gas, and telephone.

All necessary permits would be obtained before construction. Utility companies with underground lines in the project area would be consulted before work begins. The utility companies generally provide a map of their distribution lines, or a service technician to mark lines on the concrete prior to construction. Construction crews would follow utility company guides to avoid impacting existing lines, but if there is a breach in an existing utility line, it would be repaired at HSWAC's cost assuming HSWAC is at fault.

Utilities service for the HSWAC system would only be required at the cooling station site. The site is within the Kakaako Community Development District Improvement District, which has undergone significant utility upgrades in recent years. Existing utilities at that site are as follows. A 15-inch sewer main runs under Ilalo Street adjacent to the site. The line is enlarged to 21 inches at Keawe Street, just Ewa of the site. There is a 6-inch lateral connection to the sewer line at the western corner of the parcel. It is anticipated that adequate sewer capacity will be available. A sewer connection agreement must be obtained with the City and County of Honolulu.

An existing 12-inch water main runs under Ilalo Street. An 8-inch lateral connection to parcel 12 is in place. New fire hydrants were installed along Ilalo Street as part of the Improvement District 9 (ID9) project. It is expected that adequate water supply will be available at the site.

Drainage improvements were made to Ilalo Street as part of the ID9 project. There is a storm drain opening on Ilalo Street opposite the site which feeds a 11.5 x 9 feet box drain in Ilalo Street. At Keawe Street the storm drain turns makai and parallels an existing 8 x 4 feet box drain that runs makai on Keawe Street.

Fire hydrants are installed throughout the Kakaako Makai District area. Data for the hydrants closest to the preferred site are as follows.

FH 4075 located on Keawe Street between Ala Moana Boulevard and Ilalo Street
Static Pressure: 74 psi
Flow at 20 psi Residual Pressure: 4,000 gpm

FH 1725 located on Ala Moana Boulevard between Coral Street and Cooke Street
Static Pressure: 74 psi
Flow at 20 psi Residual Pressure: 4,000 gpm

FH 4864 located on Cooke Street between Ala Moana Boulevard and Ilalo Street
Static Pressure: 74 psi
Flow at 20 psi Residual Pressure: 4,000 gpm

Recently completed improvements to Ilalo Street included underground ducts for the electrical, telecommunications and cable television systems. The improvements included provision of service conduit stubs into the preferred site. HECO's primary electrical infrastructure on Ilalo Street consists of six each 6-inch conduits and related manholes. Service stubs for parcels along Ilalo Street consist of two each 4-inch conduits. HECO will provide either primary or secondary electrical service based upon load and the customer's request. The primary distribution service system voltage is 25 kV. If primary service is required, HSWAC will have to provide for HECO primary metering equipment, primary switching and a HSWAC-owned transformer. If secondary service is requested, HECO will provide a primary switch and pad-mounted transformer, and HSWAC will extend its secondary service conductors for the transformer to the structure. Alternatively, if a transformer vault is provided in the building, HECO would install its switch and transformer in the vault and extend primary conductors in customer-installed conduits to the transformer. Metering and secondary service equipment would typically be installed either inside the building in a dedicated room or outside the building. In either case, the metering and secondary service equipment must be accessible to HECO personnel.

Hawaiian Telcom telecommunications system infrastructure on Ilalo Street consists of eight each 4-inch conduits and related manholes. Service stubs for the parcels along Ilalo consist of four each 4-inch conduits. When new buildings are constructed, Verizon will have to provide cabling to support the facilities.

5.3.2 Roadways, Parking, Traffic and Pedestrian Access

Requests for information regarding recent traffic studies for the Downtown and Kakaako areas were submitted to both the State Department of Transportation and the City and County of Honolulu Transportation Services Department. The preferred distribution pipeline route was chosen to follow less congested streets wherever possible. The construction crew would primarily use trenching to lay the distribution pipes. However, to minimize traffic impacts, horizontal directional drilling or microtunneling would be employed when crossing streets with high traffic volumes.

Impacts to traffic during construction would be unavoidable. Most of the work would be done in City streets, where the following standard restrictions are designed to mitigate impacts:

- No work is permitted during morning and afternoon peak traffic hours,
- Off-duty policemen are needed to direct traffic when working on major/busy intersections,
- The contractor must provide a minimum of two lanes for through traffic unless the street is too narrow to make this practicable, in which case work may proceed in half the roadway while keeping the other half open to traffic and alternating the flow of traffic,
- When work is done in pedestrian walkways, an alternate walkway for pedestrians must be provided,
- When activities cross intersections, safe crossings must be provide for vehicles and pedestrians,
- Driveways must be kept open,
- During non-working hours, work areas must be covered with non-skid bridging material, and
- No equipment storage or stockpiling is permitted in the street right of way.

5.3.3 Public Services

It is not expected that the HSWAC project would significantly impact public services. The project would not stimulate population growth, encourage population redistribution, or indirectly result in increased demands on any public service.

5.4 Land Use

5.4.1 Land Use Regulations

In Hawaii, land use and development controls are shared by the State and the counties. At the State level, these controls are enabled, for the most part, by the State Land Use Law and its coastal zone management program, as described below.

5.4.1.1 The Hawaii State Plan

The *Hawaii State Plan (Chapter 226 HRS)* identifies the goals, objectives, policies, and priorities for the State and provides a basis for determining priorities and allocating limited resources, such as public funds, services, human resources, land, energy, water, and other resources. The Plan provides an overall framework for land use through the State Land Use Law and then requires each of its four counties to be responsible for local planning and zoning ordinances.

The HSWAC project is in conformance with the Plan. HSWAC is compatible with the State goals identified in the plan and serves to advance the goal of achieving *“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"* by providing a clean, non-polluting air-conditioning system for the downtown and Kakaako areas of Honolulu that utilizes the renewable energy source of seawater from the adjacent Pacific Ocean.

Objective and policies for the economy--potential growth activities

The proposed HSWAC project would support the objective of *"development and expansion of potential growth activities that serve to increase and diversify Hawaii's economic base"* by:

1. Facilitating investment in energy-related industries,
2. Enhancing Hawaii's role as a center for technology by show-casing its state-of-the-art seawater air-conditioning system, and
3. Facilitating the State's policy of accelerating research and development of new energy-related industries based on ocean resources.

Objectives and policies for the physical environment--land-based, shoreline, and marine resources

The mitigating measures proposed for the HSWAC project are in conformance with the *"State's planning for the physical environment with regard to land-based, shoreline, and marine resources and the achievement of the following objectives"* by:

1. Prudent use of Hawaii's marine resources, and
2. Effective protection of Hawaii's unique and fragile environmental resources.

Planning for the project has strived to achieve the marine resources objectives and policies of the State by:

1. Ensuring compatibility between land-based and water-based activities and natural resources and ecological systems,
2. Taking into account the physical attributes of areas when planning and designing activities and facilities, and
3. Designing and managing the project so that construction and operation of HSWAC's seawater systems would use the natural resources within the environs of the proposed pipeline corridor without generating costly or irreparable environmental damage.

Objectives and policies for the physical environment--land, air, and water quality

a) Planning for the HSWAC project has taken into consideration the State's physical environment with regard to land, air and water quality and would support achievement of the objective of *"Maintenance and pursuit of improved quality in Hawaii's land, air and water resources."*
b) Operation of the proposed project would be in conformance with the State policy to achieve the land, air and water quality objectives by maintaining or improving aural and air quality levels that may enhance the health and well-being of Hawaii's people.

Objective and policies for facility systems--in general

a) The proposed HSWAC project supports the direction of planning for the State's facility systems in general in achievement of the objective of energy systems that support statewide social, economic, and physical objectives.
b) HSWAC is in conformance with the following State policies:
   (1) By using seawater, a renewable resource, the project would promote prudent use of resources and accommodate changing public demands and priorities; and,
   (2) Ensure that required facility systems can be supported within resource capacities and at reasonable cost to the user.

Objectives and policies for facility systems—energy

a) The HSWAC project would facilitate achievement of the following objectives for the State's facility systems with regard to energy by:
(1) Providing a dependable, efficient, and economical element of the State's energy systems capable of supporting the needs of the people;
(2) By using seawater as its primary resource, increasing energy self-sufficiency and thus increasing the ratio of indigenous to imported energy use; and,
(3) Through the use of non-polluting fuel, reducing greenhouse gas emissions from energy supply and use.

b) HSWAC would facilitate the achievement of the State's energy objectives and be in conformance with the following policies by:
(1) Developing renewable energy sources; and,
(2) Reducing greenhouse gases in utility applications.

Priority Guidelines for Energy Use and Development

The HSWAC project is in conformance with the following priority guidelines of the Hawaii State Plan:

1. The HSWAC project would develop a commercial district air-conditioning system utilizing a renewable energy source (seawater); and,
2. Encourage the use of energy conserving technology in residential, industrial, and other buildings.

5.4.1.2 State Land Use Law (Chapter 205, HRS)

The State exercises the first level of control through this state-wide zoning law which is administered by the State Land Use Commission (LUC). The LUC establishes land use district boundaries for the entire State. All lands in the State are classified into one of four districts: Urban, Rural, Agricultural or Conservation. State-wide, 4.8 percent of the land area is classified Urban, 48 percent Conservation, 47 percent Agricultural and 0.2 percent Rural.

On the island of Oahu, 26 percent of the land area is classified Urban by the LUC, 33.4 percent is classified Agriculture and 40.6 percent is in the State Conservation District. There are no lands classified Rural on Oahu. State Land Use Districts on the Island of Oahu are shown on Figure 5-1.

Determining and enforcing land use controls in the Urban District are primarily the responsibilities of the respective counties, and jurisdiction over Rural Districts is shared by the LUC and country governments. Uses permitted in the highest productivity categories in the Agriculture District are governed by statute and uses in the lower-productivity categories are established by the LUC. Conservation Districts are administrated by the State Board of Land and Natural Resources (BLNR) and uses are governed by rules promulgated by the State Department of Land and Natural Resources (DLNR).

State Land Use Boundary Amendments (reclassification, etc.) are obtained by petitioning the LUC which will then initiate a process that includes quasi-judicial public hearings. Granting the petition is dependent upon the approval of at least six of the nine Commissioners. The law was amended in 1985 to allow applicants for land use changes of 15 acres or less to apply directly to the counties. The Commission no longer handles such requests except when the lands are in the Conservation District.

5.4.1.3 Coastal Zone Management (Chapter 205A, HRS)

The Federal Coastal Zone Management (CZM) Program, created through passage of the Coastal Zone Management Act of 1972, is a Federal-State partnership dedicated to comprehensive management of the nation's coastal resources. It is administered at the Federal level by the Coastal Programs Division (CPD) of NOAA. The CPD supports states through financial assistance, mediation, technical services and information, and participation in priority state, regional, and local forums. Day-to-day management decisions are made at the state level in states with Federally-approved coastal management programs.

The Hawaii State CZM program was approved in 1977 (Chapter 205 A, HRS). In response to the goals of the Federal CZM Act of 1972, Hawaii declared in its CZM plan that "since no point in Hawaii is further than 29 miles from the ocean, all lands of the State and the area extending seaward from the shoreline to the limit of the State's police power and management authority, including the United States territorial sea are part of Hawaii's coastal zone." In other words, the entire State is within the coastal zone.

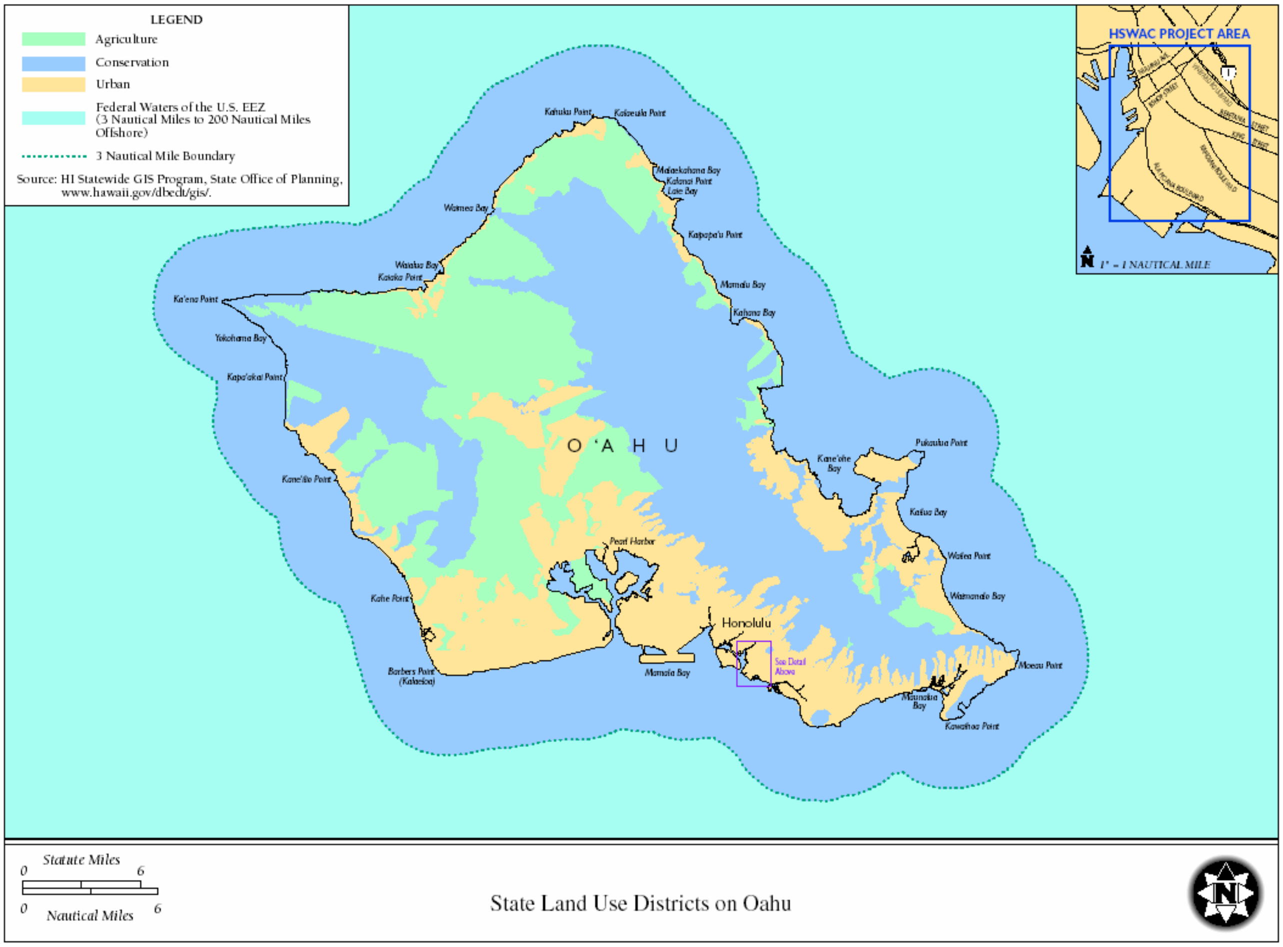


Figure 5-1: State Land Use Districts on Oahu

The State Office of Planning (OP) administers the CZM program, including allocation of Federal and State funds and coordination with the counties and the public in preparing guidelines to further specify and clarify the objectives and policies of Chapter 205A. In addition, OP is responsible for the review of Federal programs, Federal permits, Federal licenses, and Federal development proposals for consistency with the coastal zone management program.

The CZM program includes a permit process to control development within designated Special Management Areas (SMA). "Special management area" means the land extending inland from the shoreline, as determined and mapped by the individual counties and filed with either the planning commission or elected council of each county. Although SMA actions are usually administered at the county level, OP serves as the lead agency for administering the SMA permit process for State-controlled areas such as Kakaako.

Part III of the CZM Act (Chapter 205 A, HRS) defines "Shoreline Area" as including "all of the land area between the shoreline and the shoreline setback line." The shoreline setback line is defined as a line established by the BLNR, or the respective county where it is located, which runs inland from the shoreline at a horizontal plane. Act 205A establishes setbacks along shorelines of not less than twenty feet and not more than forty feet inland from the certified shoreline. The planning departments of each county are required to adopt rules prescribing procedures for determining the shoreline setback line. The shoreline setback is intended to serve as a buffer against coastal hazards and erosion, and to protect view-planes.

The proposed project complies with provisions and guidelines contained in Chapter 205A, where applicable. The relationship of the HSWAC project to objectives and policies of the CZM Program is discussed in the following paragraphs.

Recreational Resources

The CZM objective is to provide coastal recreational opportunities accessible to the public. Although the HSWAC project would not provide new opportunities, operation of the facility would not permanently foreclose existing activities. During the construction and maintenance phases of the pipelines and associated equipment the affected areas would be closed to the public for safety reasons. The following policies would guide the construction and operation phases of the project:

1. Coastal resources uniquely suited for recreational activities that cannot be provided in other areas would be protected;
2. If and when coastal resources having significant recreational value are unavoidably damaged by development activities, whenever possible they would be replaced;
3. Public access to and along shorelines with recreational value would be provided whenever such access does not risk public safety and/or does not interfere with facility operations; and,
4. Point and non-point sources of pollution would be monitored and necessary actions would be taken to protect the recreational value of coastal waters.

Historic Resources

The objective of the CZM program is to protect, preserve, and, where desirable, restore those natural and manmade historic and prehistoric resources in the coastal zone management area that are significant in Hawaiian and American history and culture. If such should occur in any area of the HSWAC project, all State and Federal Historic Preservation procedures and regulations would be followed.

Scenic and Open Space Resources

A CZM program objective related to scenic and open space resources seeks to “protect, preserve, and, where desirable, restore or improve the quality of coastal scenic and open space resources.” The makai area plan of the Kakaako Community Development District has identified viewplanes in the area. Any above-ground facilities of the HSWAC project would be designed and located to minimize the alteration of natural landforms and existing public views to and along the shoreline. The proposed cooling station would lie inconspicuously within another structure immediately makai of an existing massive multi-story office building and would comply with Makai Area Design Guidelines. It would have no effect on views in any direction.

Coastal Ecosystems

The CZM program objective relating to coastal ecosystems is to “protect valuable coastal ecosystems, including reefs, from disruption and minimize adverse impacts on all coastal ecosystems.” To achieve this objective, the project would exercise an overall conservation ethic during the design, construction and operation of the HSWAC system. Preservation of valuable coastal ecosystems, including reefs of significant biological or economic importance, has been and will continue to be an important criterion in the selection of the offshore pipe corridor and alignments. To avoid impacts at the shoreline and in nearshore waters, horizontal directional drilling would be used to tunnel beneath these areas. In addition, selection of the method and design of the system for seawater return flows would take into consideration the tolerance of the marine ecosystem, and maintain and enhance water quality through the development and implementation of water pollution control measures.

Economic Uses

HSWAC would provide improvements that support the State's economy in suitable areas that ensure that coastal dependent development is located, designed, and constructed to minimize adverse visual and other environmental impacts in the coastal zone management area.

Coastal Hazards

The CZM program objective with regard to coastal hazards is to "reduce hazard's to life and property from tsunami, storm waves, stream flooding, erosion, subsidence, and pollution." The cooling station could be susceptible to damage from a tsunami. Both the cooling station and the offshore pipelines would be susceptible to damage from hurricanes and their associated storm surge. Any portion of the system could be susceptible to damage or destruction by a sufficiently large seismic event.

Mitigation of the potential effects of natural hazards on the HSWAC system began in earliest planning. The primary mitigation strategy is to employ appropriate engineering designs for the facilities. In the case of the cooling station, hazard impact mitigation was one of the criteria used in evaluating potential sites. In some instances negative effects of natural hazards would be unavoidable. If power were lost island-wide for example, it would not be possible to run the pumps or auxiliary chillers.

All landside project areas, including the cooling station and distribution loop, are located within FIRM Zone X, which is a Non-special Flood Hazard Area designating lands outside the 500-year floodplain. This is an area that is in a low- to moderate-risk flood zone and is not in any immediate danger from flooding caused by overflowing rivers or hard rains (Floodsmart.gov, 2005).

Managing Development

Not Applicable.

Public Participation

The HSWAC project has held numerous public information and scoping meetings in the preparation of this EIS.

Beach Protection

Not applicable.

Marine Resources

The CZM program objective for marine resources is to "Promote the protection, use, and development of marine and coastal resources to assure their sustainability." During the field studies undertaken in support of the EIS, inventories of marine life, habitats, etc. were undertaken in order to locate a suitable pipe alignment that would not adversely impact ocean coastal resources. During the operation of the project additional information would be collected to increase the understanding of how ocean development activities relate to and impact these resources.

5.4.1.4 Kakaako Community Development District

Makai Area Plan

The Hawaii State Legislature created the Hawaii Community Development Authority (HCDA) in 1976 to initiate and guide the revitalization of the underdeveloped urban community in the Kakaako District.

Among other things, this Plan establishes land use principles and zones and design standards for Kakaako. The preferred site for the HSWAC cooling station is designated “Commercial” in the Makai Area Plan Land Use Map. The Commercial designation permits a wide range of commercial land uses.

Makai Area Rules

The Makai Area Rules were established by the HCDA to supersede all previous ordinances and rules relating to the use, zoning, planning, and development of land and construction within the Makai District.

According to the Land Use Zone Rules, the purpose and intent of Commercial-zoned parcels is as follows:

1. To provide a sub-district where a variety of commercial uses may coexist with the emphasis on developing a predominantly commercial multi-storied area providing employment opportunities;
2. To create a vibrant and working environment by regulating the density and bulk of buildings in relation to the surrounding land by requiring open space and encouraging the development of job opportunities within the area;
3. To provide freedom of architectural design, encourage the development of attractive and economic building forms; and
4. Promote the most desirable use of land and direction of building development in accord with a well-considered plan, promote stability of commercial development, protect the character of the district and its particular suitability for particular uses and finally to conserve the value of the land and buildings.

Permitted commercial uses include offices, medical laboratories, governmental services administrative, parking garages (enclosed), and uses customarily accessory and clearly incidental and subordinate to the principal uses and structures. The HSWAC project would support the purpose and intent of the Commercial zone by providing a commercial use with employment opportunities based on the particular suitability of the area to access nearby seawater. Although the architectural design of the cooling station is not complete, it is expected that the integrated structure’s design will complement surrounding buildings and comply with Makai Area Design Guidelines.

Makai Area Design Guidelines

“The purpose of the Design Guidelines is to supplement the objectives of the Makai Area Plan. The Design Guidelines are intended to guide physical development of the Makai Area including architectural character, environmental quality and visual impression created by individual project components.”

Objective

The objective is to create “an outstanding world-class urban environment that is appropriate for the waterfront setting, comfortable and interesting to pedestrians, and responsive to the existing and planned public amenities.”

Project Design Guidelines

“New developments should enhance public accessibility to the public open spaces, help to create a pedestrian environment and have appropriate architectural design that relates positively to the public realm and urban design principles expressed in the Makai Area Plan.”

Site Development

- Configure buildings/developments to take advantage of public amenities, allow for pedestrian interaction and create social interaction.
- Articulate buildings to reduce overall mass.

Building Hierarchy and Character

Buildings in the Makai Area should fall into two categories.

- Signature Buildings that are to be unique icons. Examples of signature buildings/structures include the Sydney Opera House, the Eiffel Tower, and the Space Needle in Seattle. These are recognizable buildings/structures whose identities are synonymous with their location.
- Secondary Buildings that provide emphasis to building complexes without competing with signature buildings. These buildings are to be based on the “multi-cultural” architectural tradition of ‘kamaaina’ buildings. Examples include the Honolulu Academy of Arts, the Alexander & Baldwin Building and the Kamehameha School for Girls building. Architectural elements typically consists of double-pitched tile roofs, masonry walls with stucco-like finishes and decorative grills.

Architectural Appearance and Character

- Building design features and materials should respond to the tropical climate, conserve natural resources, and promote quality and permanence. The use of natural day-lighting, natural ventilation, and shading devices is encouraged.
- Open spaces should be an extension of public amenities including streets and parks.
- Open space should be scaled appropriately to encourage pedestrian activity and circulation. Providing amenities such as comfortable seating is encouraged.
- Arcades and passageways are encouraged as appropriate forms of open space.
- Articulate building facades.
- Provide indirect outdoor lighting to enhance landscaping, architectural features and promote pedestrian safety.
- Colors and surfaces should generally be absorptive rather than reflective. Signature Buildings may be exempt.
- Appropriate colors include warm earth tones, natural colors of stone, coral and cast concrete colors.
- Roofs of secondary buildings should be in a range of green or greenish blue to blend with surrounding vegetation or reflect the ocean setting.
- Paving in plazas and walkways should be patterned and a combination of earth colors.
- Roof styles should match the appropriate architectural character of the building. Large monolithic roofs should be avoided.
- Rooftop service and mechanical areas should be screened from view by parapets, solid enclosures, trellises, and false pitch roofs.
- Street level service and mechanical areas should be screened by enclosures, walls or landscaping.

Landscape Treatment

- Trees, shrubs, and ground cover should be varied in color and height.
- Vegetation, especially trees, should be used to enhance roadways, soften building exteriors, and screen service areas.
- Small-scale landscape features such as entry gardens, courtyards, should be compatible with and match the larger park-like landscaping.
- Projects adjacent to the Kaka‘ako Waterfront Park should incorporate landscape design elements from the park in order to provide a natural transition from private to public open spaces.

Parking Structures and Loading Areas

- Parking at grade fronting public sidewalks is discouraged where it may impact pedestrian activity.
- Situate surface parking lots and parking structures within the interior of lots where practical.
- Parking structures within public view should be designed as an integral element of the project.
- Visible floors of the parking garage should be horizontal only, ramped and sloping floors should be shielded from public view.

- Lights within a parking structure should be shielded from public view and visible ceilings should be painted a dark color.
- The ground floor should be lined with retail or other active uses.
- Reduce the visual impact of parking structures through the planting of vertical trees, canopy trees if space allows, and/or planter boxes at every level.

The HSWAC cooling station would comply with Makai Area Design Guidelines. It would however, be a minor part of a secondary building, and as such, many of the guidelines would apply to the larger development. The HSWAC cooling station would conform to the intent to “line the ground floor” of parking structures with retail establishments provided that at least some space can be provided for external access doors needed to move bulky equipment in and out when necessary.

5.4.1.5 State Conservation District Policies and Regulations

The ocean side portions of the proposed HSWAC project would be located in the State Conservation District. As defined in Chapter 13-5, subchapter 1, HAR, “Conservation district means those lands within the various counties of the State and State marine waters bounded by the conservation district line.” The purpose of the Conservation District is to “conserve, protect and preserve the important natural resources of the State through appropriate management and use to promote their long-term sustainability and the public health, safety and welfare."

Pursuant to Hawaii Revised Statutes (HRS) Chapter 183C and Chapter 190D, the BLNR regulates marine activities by the issuance of a Conservation District Use Permit (CDUP). Marine activities are defined as, “ocean thermal energy conversion (OTEC); mariculture; and other energy or water, research, scientific, and educational activities in, on, or under State marine waters or submerged lands.” Under this definition, HSWAC’s pipes are a permitted use. In addition to a CDUP, HSWAC must obtain a lease or easement for use of marine waters (Part III 190D-21 HRS).

The coastal land and marine waters to be used by the proposed project are in the Resource (R) Subzone of the Conservation District. This subzone includes (among others), lands and State marine waters seaward of the upper reaches of the wash of waves, usually evidenced by the edge of vegetation or by the debris left by the wash of waves on shore to the extent of the State’s jurisdiction, unless placed in a (P) or (L) subzone.

The objective of the Resource subzone is to “develop, with proper management, areas to ensure sustained use of the natural resources of those areas.” Energy activities are a permitted marine activity in this subzone. The proposed use would not cause substantial adverse impact to existing natural resources within the surrounding area; affect scenic vistas or viewplains; nor be materially detrimental to the public health, safety and welfare.

5.4.1.6 City and County of Honolulu Land Use Controls

The City and County of Honolulu encompasses the entire island of Oahu and most of the Northwestern Hawaiian Islands. According to the 2000 Census, 72.3 percent of the State’s population resides in the City and County of Honolulu, primarily on the island of Oahu.

The City and County of Honolulu guides and directs land use and growth through a three-tier system of objectives, policies, planning principles, guidelines and regulations. They are the General Plan, the Development Plans (or Sustainable Community Plans in some areas), and implementing ordinances and regulations. These are described below with reference to the proposed project area.

Oahu General Plan

The General Plan for the City and County of Honolulu is a comprehensive statement of objectives and policies which sets forth the long-range aspirations of Oahu’s residents and the strategies of actions to achieve them. It is the focal point of a comprehensive planning process that addresses physical, social, economic and environmental concerns affecting the City and County of Honolulu. It is a two-fold document: (1) a statement of the long-range social, economic, environmental, and design objectives for the general welfare and prosperity of the people of Oahu, and (2) a statement of broad policies which facilitate the attainment of the objectives of the Plan.

Purpose of the General Plan

The General Plan is a guide for all levels of government, private enterprise, neighborhood and citizen's groups, organizations, and individual citizens in eleven areas of concern: (1) population; (2) economic activity; (3) the natural environment; (4) housing, (5) utilities and transportation; (6) energy; (7) physical development and urban design; (8) public safety; (9) health and education; (10) culture and recreation; and (11) government operations and fiscal management. The eleven subject areas provide the framework for the City's expression of public policy concerning the needs of the people and the functions of government.

It should be noted that all marine waters within three miles of the Oahu coastline are considered part of Oahu in terms of the applicability of the objectives and policies in this General Plan. Although most of Oahu's coastal marine waters are included in the State Land Use Conservation District and, thus, are beyond the effective jurisdiction of the City and County of Honolulu. They may be included, however, in Development Plans, as may be appropriate.

Objectives and Policies

Although all eleven areas of concern addressed in the General Plan were taken into consideration in the planning of the project, the following three areas are directly relevant to the HSWAC project: (1) economic activity; (2) the natural environment; and (3) energy. An analysis of the relationship of the project to each of these areas of concern follows:

(1) Economic Activity
An economic activity objective of the General Plan is to make full use of the economic resources of the sea. The policy to "encourage the development of aquaculture, ocean research, and other ocean-related industries" applies to the HSWAC project in that it would develop and use ocean resources to air-condition buildings in downtown Honolulu.

(2) Natural Environment
The City's policies seek to protect and enhance our natural attributes by mitigating against the degradation of these assets. As described in this EIS, the design, construction and operations of the HSWAC project would conform to City policies for the natural environment. In addition, by its substitution of seawater for electricity used in air conditioning chillers, the HSWAC project would mitigate against degradation of air and water quality by fossil fuel burning and discharge of thermal effluents to nearshore waters.

(3) Energy
The General Plan's energy policies and objectives address development, utilization, and conservation stressing reduction in dependence on imported energy sources. The objectives are: (1) to maintain an adequate, dependable and economical supply of energy for Oahu residents; (2) to fully utilize proven alternative sources of energy; and, (3) to develop and apply new, locally available energy resources. The HSWAC project supports the following energy policies:

   - Support programs and projects which contribute to the attainment of energy self-sufficiency on Oahu;
   - Give adequate consideration to environmental, public health, and safety concerns, to resource limitations, and to relative costs when making decisions concerning alternatives for conserving energy and developing natural energy resources;

- o Support and participate in research, development, demonstration, and commercialization programs aimed at producing new, economical, and environmentally sound energy supplies; and
- o Promote programs to more efficiently use energy in existing buildings.

Development Plans

The second tier of Honolulu's land use control system is the Development Plan(s). The Revised Charter of the City and County of Honolulu 1973, as amended, requires that Development Plans provide conceptual schemes for implementing and accomplishing the development objectives and policies of the General Plan. For this purpose, Oahu is divided into eight geographic planning regions: East Honolulu, Koolaupoko, Koolauloa, North Shore, Waianae, Central Oahu, Ewa and the Primary Urban Center (Figure 5-2).

The Primary Urban Center (PUC) is home to almost half the island's population and three-quarters of Oahu's jobs. It is the capital of the State of Hawaii, the State's commercial and financial center, and the home of its premier educational and cultural institutions. It is the heart of Hawaii's economic, political and cultural life. Because of its dense development pattern, the PUC is further subdivided into three portions: west, central and east.

A revision of the Primary Urban Center Development Plan was adopted in 2004 (Article 2, Chapter 24, Revised Ordinances of Honolulu 1990, as amended). It designates the PUC as the principal region of Oahu for future growth in residential population and jobs[1]. Intended land uses in the central portion of the PUC are shown on Figure 5-3. Proposed developments are evaluated against how well they fulfill the development plan's vision for the PUC and how closely they meet the policies, principals, and guidelines selected to implement that vision.

In addition to the two Charter-mandated county planning tiers described above, development plans are supplemented by two additional planning mechanisms: the functional planning process and special area planning. Functional plans, some of which are mandated by State or Federal regulations, provide long-range guidance for the development of public facilities such as the water system, wastewater disposal and transportation. Special area plans are intended to give specific guidance for neighborhoods, communities and specialized resources.

Implementing Ordinances and Regulations

Implementing ordinances and regulations, including the Land Use Ordinance (LUO) (Honolulu's zoning code) and the City's Capital Improvement Program comprise the third tier of Honolulu's land use control system. The LUO (Ordinance No. 86-96 1986, as amended) establishes zoning and development standards for Oahu lands under City and County jurisdiction. The City and County also defines, implements, and administers the permit process for SMAs and shoreline setback areas delegated to it by the State.

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[1] The PUC and the Ewa Region are the areas to which major growth in population and economic activity on Oahu will be directed over the next twenty years and beyond. Plans for the other six regions are now called "Sustainable Community Plans" to reflect the relative stability of these communities.

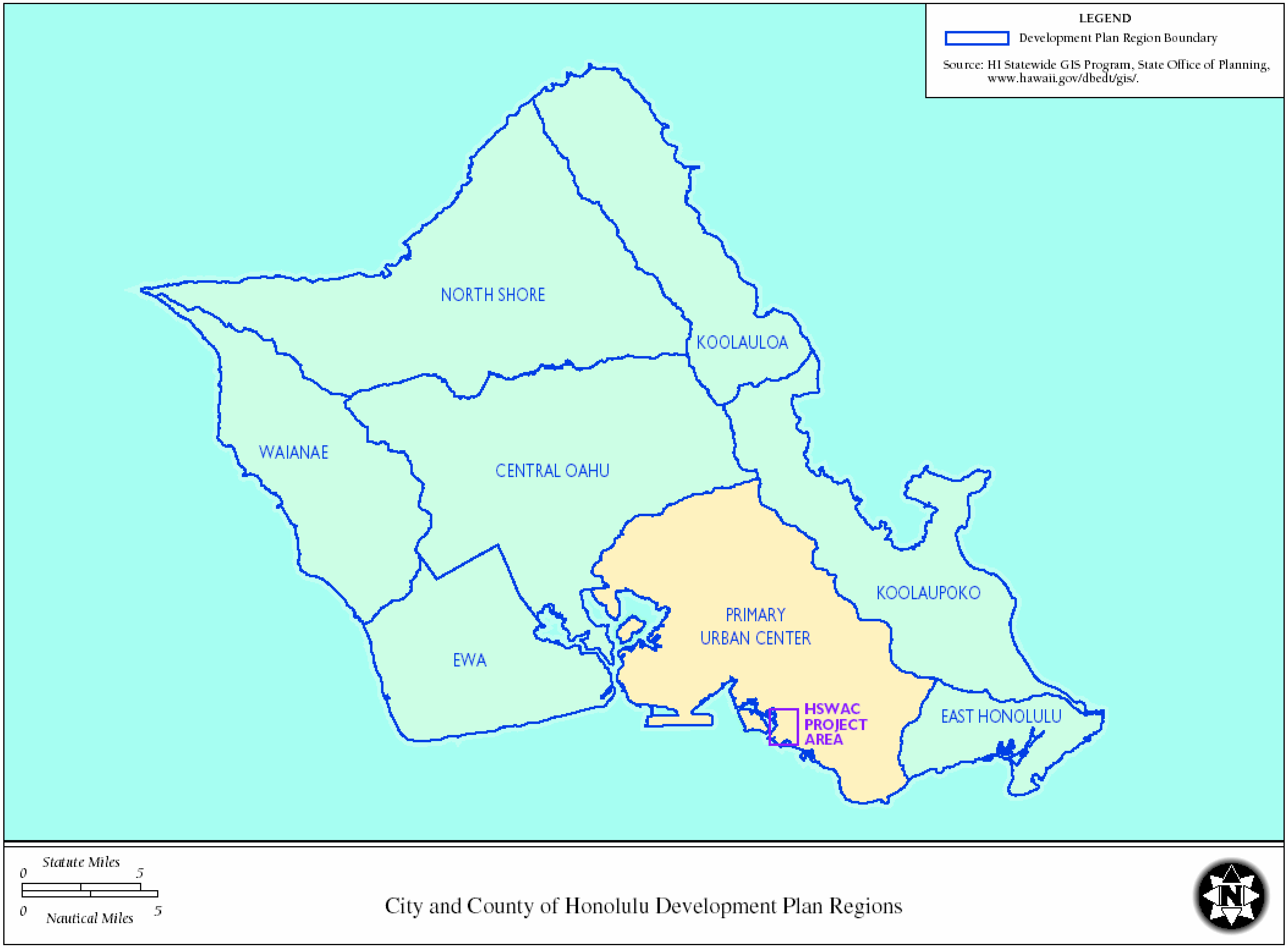
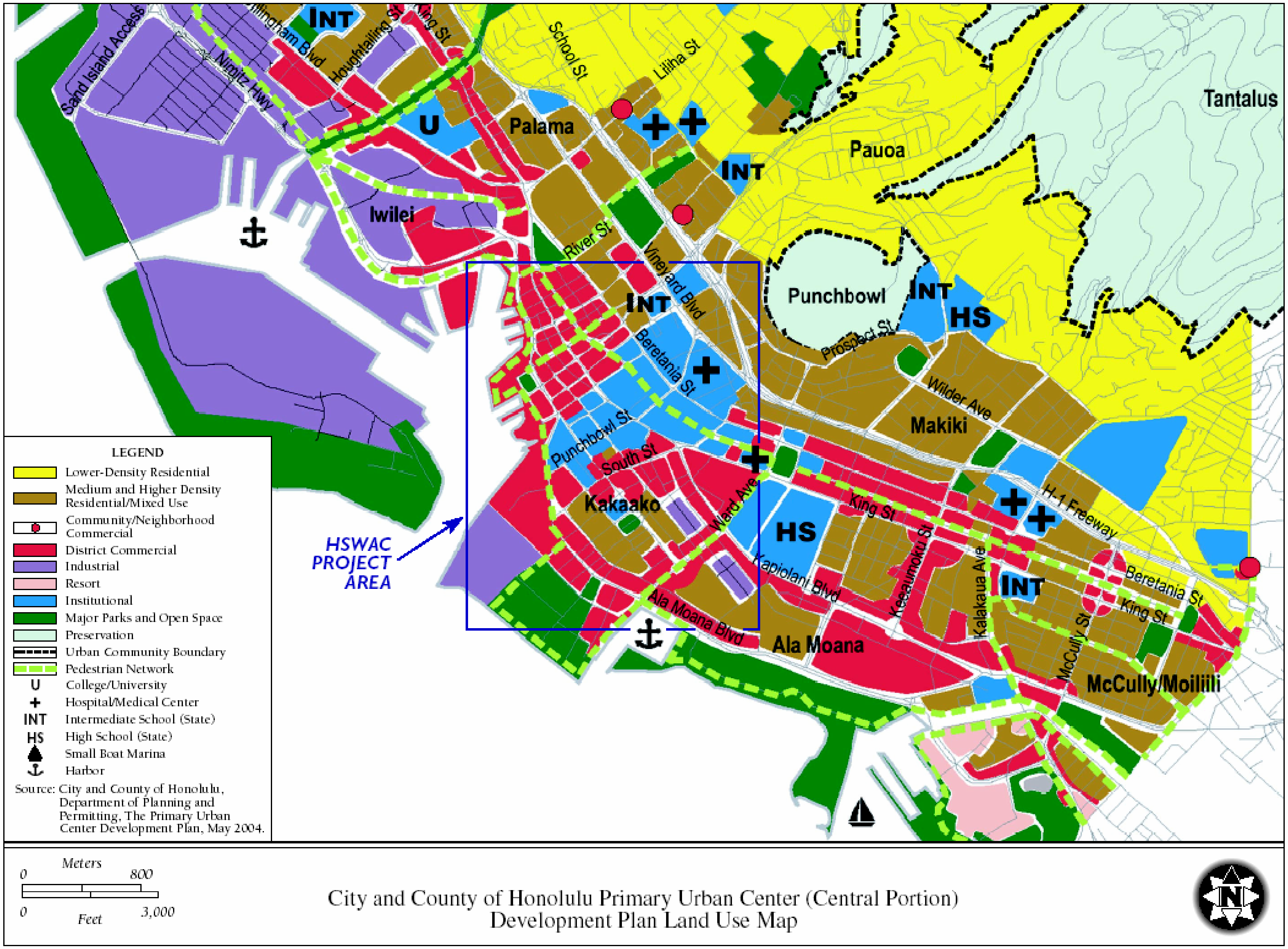


Figure 5-2: City and County of Honolulu Development Plan Regions



Source: City and County of Honolulu, Department of Planning and Permitting, The Primary Urban Center Development Plan, May 2004.

Figure 5-3: City and County of Honolulu Primary Urban Center (Central Portion) Development Plan Land Use Map

5.4.1.7 The Project Area

The HSWAC project is proposed for the downtown and Kakaako areas of Honolulu. The Oahu Metropolitan Planning Organization (OMPO), in its current Transportation for Oahu Plan (Carter Burgess, 2001), estimates the 2000 resident population of these two areas at 20,466, about 2.3 percent of the total Oahu resident population. The 2000 employment in these two areas is estimated at 89,251, about 18.3 percent of the total employment on the island of Oahu. Based on these figures, and assuming all employees are included in the estimate of day population, the HSWAC project could service a combined day and night population of roughly 109,700, about 13 percent of Oahu's 2000 resident population. [Note: these are very rough estimates that do not account for double counting of those who both live and work in the area.] HSWAC would also utilize approximately 8 acres of nearshore and offshore areas for seawater intake and return seawater discharge pipes.

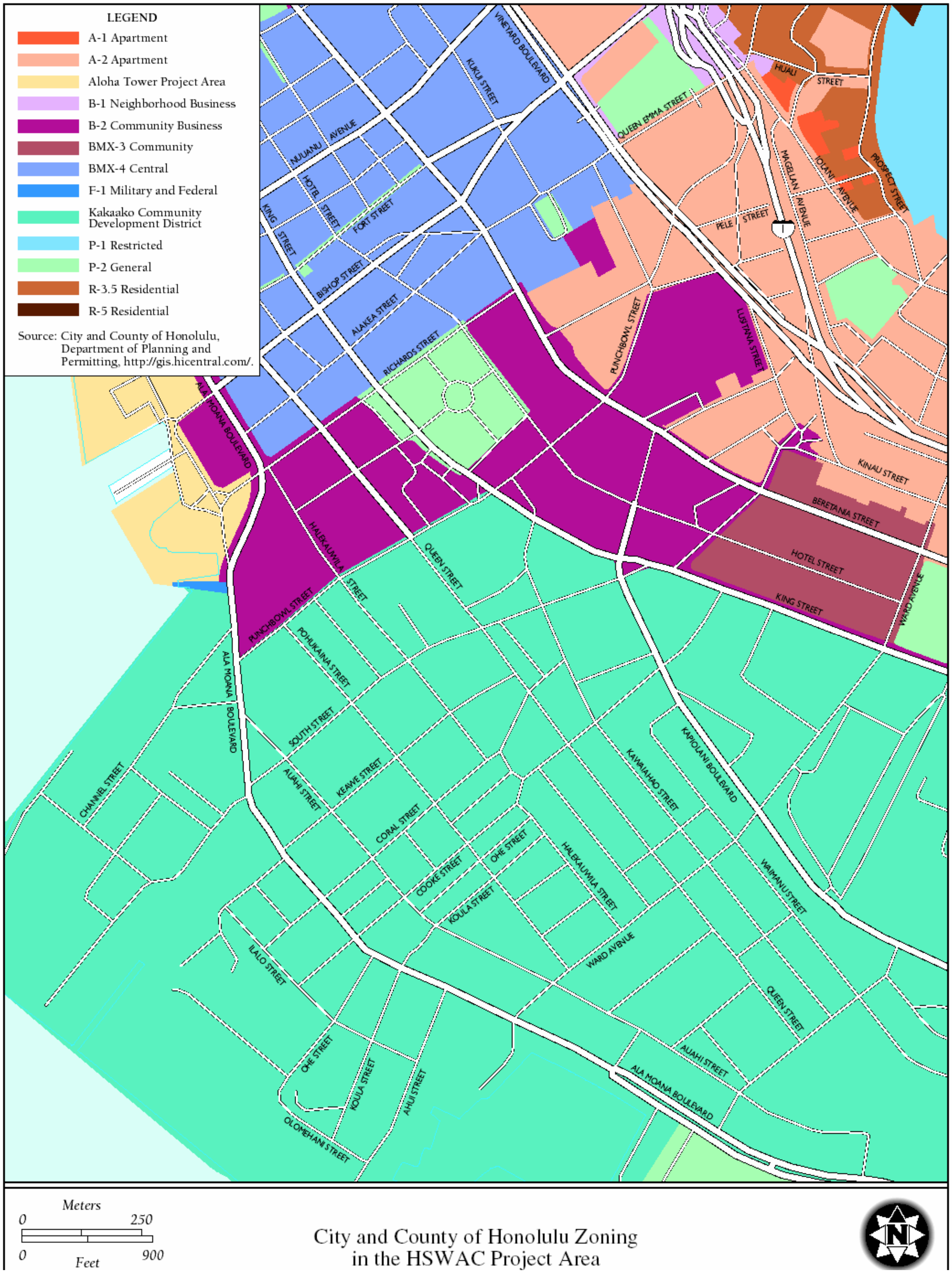
Landside Development

The land side of the HSWAC project, including the cooling station and the underground chilled water distribution system, would be located within the State Urban District. Activities and uses in State Urban Districts are managed by the respective county as provided by ordinances or regulations of that county.

The landward facilities of the HSWAC system would also be located within the central portion of the Primary Urban Center of the City and County of Honolulu. The HSWAC chilled water distribution system would be installed in several zoning districts of the PUC including: A-2 Apartment; B-2 Community Business; BMX-4 Central; and P-2 Preservation General (Figure 5-4). Utilities installations are an approved use within any zoning district.

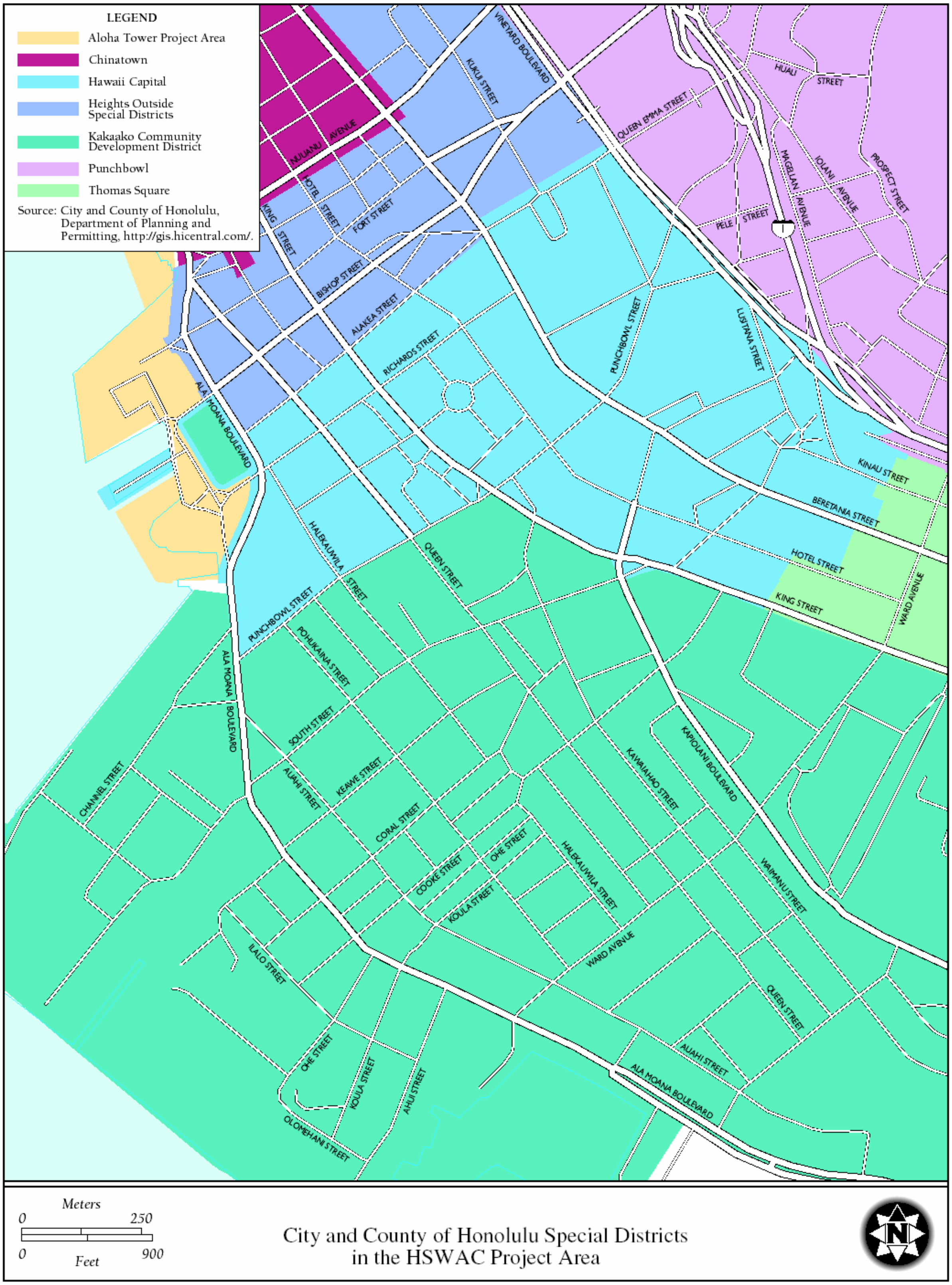
The City and County of Honolulu LUO also establishes the boundaries of and development standards for Special Districts. The HSWAC chilled water distribution system would serve buildings within the Hawaii Capitol Special District. Special Districts in and near the HSWAC project area are shown on Figure 5-5.

The cooling station and portions of the chilled water distribution system would be located within the Kakaako Community Development District. This area is not under the jurisdiction of the City and County of Honolulu, but rather falls under the State's Hawaii Community Development Authority (HCDA). HCDA has its own separate zoning districts (Figure 5-6) and development rules. Because the State retains control of the Kakaako Community Development District land use, the Office of Planning (OP) administers the SMA permit process within the area. The boundaries of the SMA in the project area are shown on Figure 5-7.



Source: City and County of Honolulu, Department of Planning and Permitting, http://gis.hicentral.com/.

Figure 5-4: City and County of Honolulu Zoning in the HSWAC Project Area



Source: City and County of Honolulu, Department of Planning and Permitting, http://gis.hicentral.com/.

Figure 5-5: City and County of Honolulu Special Districts in the HSWAC Project Area

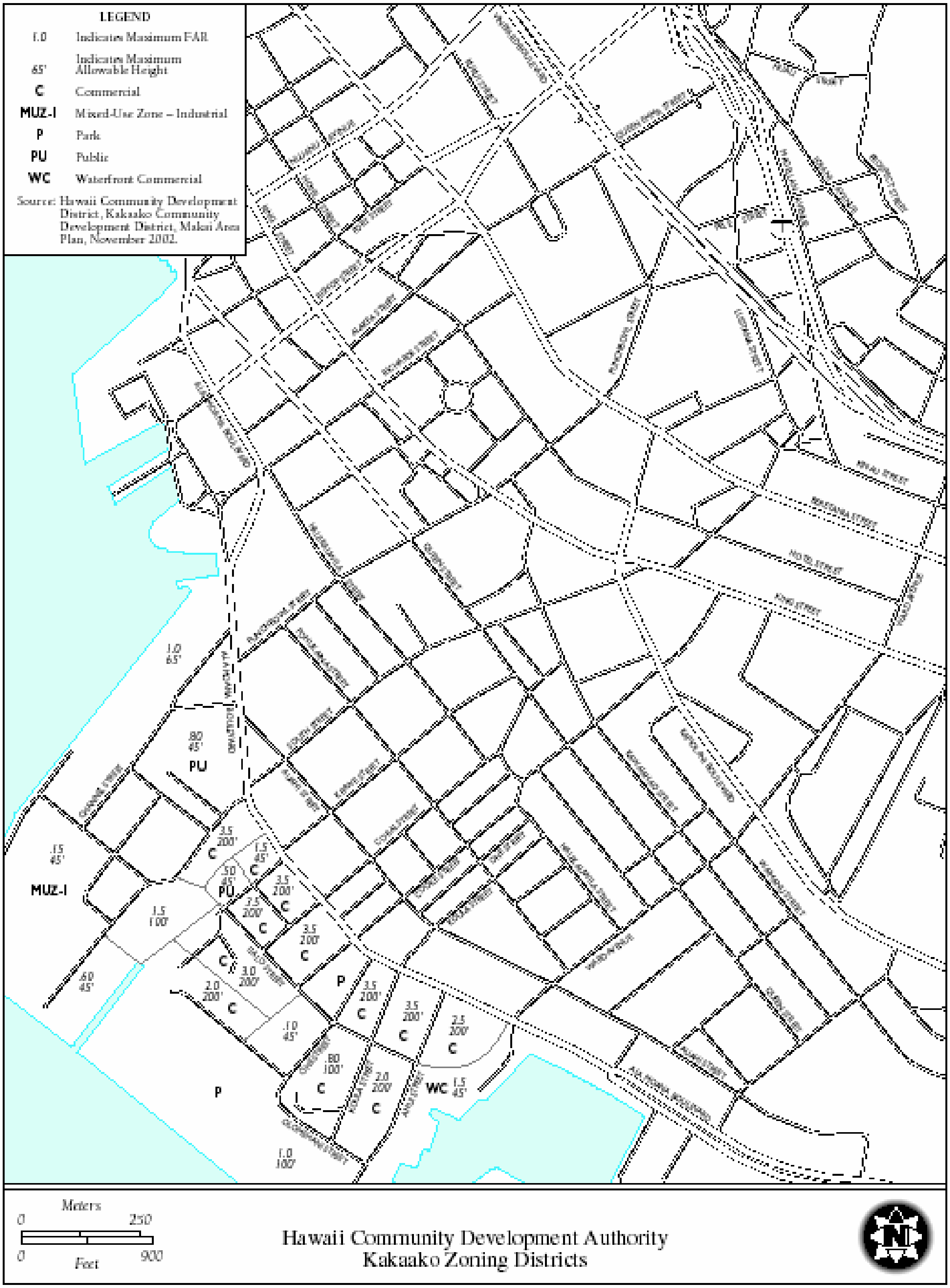


Figure 5-6: Hawaii Community Development Authority Kakaako Zoning Districts

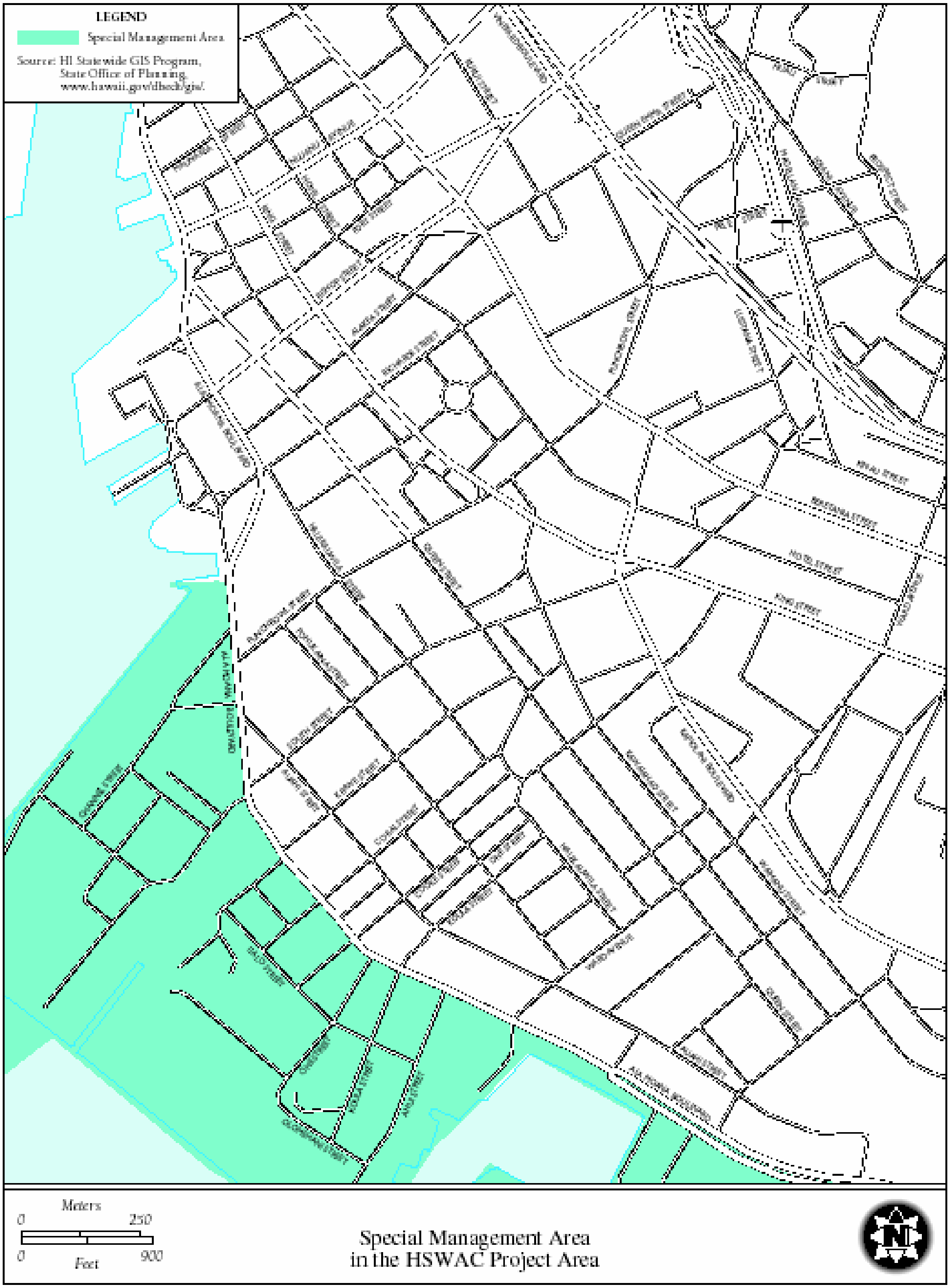


Figure 5-7: Special Management Area in the HSWAC Project Area

Off-Shore Facilities

The seawater intake pipe would be installed beneath and on top of the offshore seabed. All submerged lands and surface waters within the State's jurisdiction (from the shoreline out three miles) are in the State Conservation District. State Conservation districts are governed by the Department of Land and Natural Resources pursuant to HRS Chapter 183C. A Conservation District Use Permit would be required to implement the HSWAC project.

The HSWAC seawater intake pipe would extend beyond the three-mile limit of State jurisdiction into Federal waters of the U.S. Exclusive Economic Zone. No special requirements are triggered by this. A Department of the Army permit is required for the proposed work inside the three-mile boundary.

5.4.1.8 Federal Land Use Controls

The seaward most portion of the intake pipeline would extend beyond three miles from shore, into Federal waters. The 1976 Fishery Conservation and Management Act (Public Law 94-265) (the Magnuson Act, and later, after amendments, the Magnuson-Stevens Act or MSA) established U.S. jurisdiction from the seaward boundary of the coastal states out to 200 nm for the purpose of managing fishery resources. Passage of the Magnuson Act was the first unilateral declaration of jurisdiction over a 200-nm zone by a major power. Presidential Proclamation 5030 of March 10, 1983, established the U.S. exclusive economic zone (EEZ), declaring, "to the extent permitted by international law ... sovereign rights for the purpose of exploring, exploiting, conserving and managing natural resources, both living and non-living, of the seabed and subsoil and the superjacent waters" in the 200-nm zone. The assertion of jurisdiction over the EEZ of the U.S. altered the legal basis for economic exploration and exploitation, scientific research, and protection of the environment by the U.S. The U.S. Congress confirmed presidential designation of the EEZ in 1986 amendments to the Magnuson Act. No specific land use permits are required for activities within the Federal portion of the EEZ. However, the Army Corps of Engineers exercises authority to control development within navigable waters of the U.S, as described in the following paragraphs.

The legislative origins of the ACOE permitting program are the Rivers and Harbors Acts of 1890 (superseded) and 1899 (33 U.S.C. 401, *et seq.*). Various sections establish permit requirements to prevent unauthorized obstruction or alteration of any navigable water of the United States. The most frequently exercised authority is contained in Section 10 (33 U.S.C. 403) which covers construction, excavation, or deposition of materials in, over, or under such waters, or any work which would affect the course, location, condition, or capacity of those waters.

In 1972, amendments to the Federal Water Pollution Control Act added what is commonly called Section 404 authority (33 U.S.C. 1344) to the program. The Secretary of the Army, acting through the Chief of Engineers, is authorized to issue permits, after notice and opportunity for public hearings, for the discharge of dredged or fill material into waters of the United States at specified disposal sites. Selection of such sites must be in accordance with guidelines developed by the Environmental Protection Agency (USEPA) in conjunction with the Secretary of the Army; these guidelines are known as the 404(b)(1) Guidelines. The discharge of all other pollutants into waters of the U. S. is regulated under Section 402 of the Act. The Federal Water Pollution Control Act was further amended in 1977 and given the common name of "Clean Water Act" and was again amended in 1987 to modify criminal and civil penalty provisions and to add an administrative penalty provision.

Also in 1972, with enactment of the Marine Protection, Research, and Sanctuaries Act, the Secretary of the Army, acting through the Chief of Engineers, was authorized to issue permits for the transportation of dredged material to be dumped in the ocean. This authority also carries with it the requirement of notice and opportunity for public hearing. Disposal sites for such discharges are selected in accordance with criteria developed by the USEPA in consultation with the Secretary of the Army.

The geographic jurisdiction of the Rivers and Harbors Act of 1899 includes all navigable waters of the United States which are defined (33 CFR Part 329) as, "those waters that are subject to the ebb and flow of the tide and/or are presently used, or have been used in the past, or may be susceptible to use to transport interstate or foreign commerce." This jurisdiction extends seaward to include all ocean waters within a zone three nautical miles from the coast line (the "territorial seas"). Limited authorities extend across the outer continental shelf for artificial islands, installations and other devices (see 43 U.S.C. 333 (e)). Activities requiring Section 10 permits include structures (e.g., piers, wharfs, breakwaters, bulkheads, jetties, weirs, transmission lines) and work such as dredging or disposal of dredged material, or excavation, filling, or other modifications to the navigable waters of the United States.

The Clean Water Act uses the term "navigable waters" which is defined (Section 502(7)) as "waters of the United States, including the territorial seas." Thus, Section 404 jurisdiction is defined as encompassing Section 10 waters plus their tributaries and adjacent wetlands and isolated waters where the use, degradation or destruction of such waters could affect interstate or foreign commerce.

Activities requiring Section 404 permits are limited to discharges of dredged or fill materials into the waters of the United States. These discharges include return water from dredged material disposed of on the upland and generally any fill material (e.g., rock, sand, dirt) used to construct fast land for site development, roadways, erosion protection, etc.

The geographic scope of Section 103 of the Marine Protection Research and Sanctuaries Act of 1972 is those waters of the open seas lying seaward of the baseline from which the territorial sea is measured. Along coast lines this baseline is generally taken to be the low water line. Thus, there is a jurisdictional overlap with the Clean Water Act. By interagency agreement with EPA, the discharge of dredged material in the territorial seas is regulated under the Section 103 criteria rather than those developed for Section 404.

Section 307 of the Coastal Zone Management Act of 1972, as amended (16 U.S.C. 1458(c)), requires an applicant for a Corps permit to certify that the proposed project is in compliance with an approved State Coastal Zone Management Program and that the State concur with the applicant’s certification prior to the issuance of a Corps permit. The Corps’ standard permit form contains a statement notifying the permittee that the Federal permit does not remove any requirement for state or local permits. This has the effect of making the Corps’ permit unusable without these additional authorizations. If the state or local permit is denied before the Corps has made its decision, the Corps permit is also denied.

In summary, while the HSWAC project would involve installation of a pipeline extending into EEZ waters under Federal jurisdiction, it is the activities in waters under State jurisdiction that actually trigger the Federal permitting process.

5.4.2 Land Ownership and Uses

Submerged lands out to three miles are owned by the State of Hawaii and managed as part of the Conservation District by the BLNR. Submerged lands seaward of State jurisdiction are owned by the Federal government. The preferred site for the cooling station is owned by Kamehameha Schools and is under the jurisdiction of the Hawaii Community Development Authority. The distribution system would be installed mostly under streets and sidewalks owned by the City and County of Honolulu, but some segments would pass under State-owned highways.

There are a large variety of ocean and coastal activities in the nearshore and offshore waters of Mamala Bay. These activities include recreational and commercial fishing, swimming, board and body surfing, sailing, canoe paddling, scuba diving, shell collecting, aquarium fish collecting and others. During construction, there would be some restriction on access to the immediate construction area for safety reasons. Once the pipelines are deployed and secured, there would be no restrictions on uses of the area.

5.5 Social and Economic Characteristics

The HSWAC project is not expected to have any significant impact on the social character of Honolulu. The project would have positive economic impacts on system customers because SWAC systems provide customers with reduced and stable cooling costs as a result of their relative independence from fuel price escalation. In addition, large-scale, district cooling systems have lower operating and maintenance costs than individual building air conditioning systems. Other Oahu businesses and residents would indirectly benefit because the HSWAC system would eliminate about one year of HECO's projected load growth. This reduced need for expensive new electricity generation capacity will help to keep Oahu's electric rates lower for longer.

The HSWAC project may displace conventional on-site chiller and cooling tower equipment and service vendors in the downtown area. The HSWAC project will have a capacity of 25,000 tons of cooling from conventional on-site chillers and cooling towers from an estimated 48,000 tons of potential cooling available from buildings in the intended service area.

A SWAC project will generate millions of dollars in construction spending. In addition to construction jobs, long-term, well-paid jobs will also be created. Other local economic development benefits will accrue from money that stays in Hawaii, and is not used to purchase oil. The net effect is expected to have a positive impact on the social character of Honolulu.

5.6 Noise

Ambient noise limits in the downtown area are 60 decibels (dB) from 7 am until 10 pm and 50 dB at all other times. Noise permits allow the noise level to exceed these limits during construction, with work hours limited to Monday through Friday, 7 am to 6 pm and Saturday from 9 am to 6 pm. A noise variance is necessary for nighttime work when noise limits are exceeded. The variance takes longer to process (approximately 3 months) than the permit because of the required public meeting and comment period (personal communication, DOH Noise Branch).

Noise in the Kakaako district was surveyed as part of the Kakaako Makai Waterfront Master Plan and the 1990 Supplemental EIS for the Kakaako Makai Area. The three main sources of noise in the Kakaako district are traffic, aircraft and industrial equipment. Noise from industrial equipment was between 72 and 80 dB.

The Day-Night Sound Level (L_{dn}) is more appropriate for describing noise from a source that generates noise both day and night. The L_{dn} is an average of noise levels over a 24-hour period. The average includes a penalty for noise generated between 10 pm and 7 am. The noise level from traffic on Ala Moana Blvd to someone 50 feet from the street was 60 L_{dn}. Noise from aircraft in the area proposed for the cooling station was between 60 and 65 L_{dn} (Darby and Assoc., 1989).

Typical noise mitigation measures employed, in addition to the time of day restrictions, include use of proper mufflers on any gas or air-powered equipment and restricting night work to less noisy tasks.

5.7 Visual Resources

After construction, the only visible portion of the HSWAC system would be the cooling station. The cooling station would comply with Makai Area Design Guidelines and at the preferred location views of the cooling station would be blocked by existing buildings on both the mauka and makai sides.

6.0 FINDINGS AND DETERMINATION

6.1 Significance Criteria

Under Hawaii's EIS Law, Chapter 343 Hawaii Revised Statutes, certain categories of proposed actions "trigger" an environmental assessment. The HSWAC project triggers an environmental assessment under Chapter 343 for several reasons, including: 1) it proposes to use State and county lands, 2) it proposes to use State conservation district lands, and 3) it proposes to use lands within the shoreline area. If the proposed action is not expected to result in significant impacts to the environment, the environmental assessment results in a Finding of No Significant Impact (FONSI). If however, significant impacts to the environment may occur as a result of the proposed action, then an environmental impact statement is required. Criteria for determining the significance of a proposed action are included in HAR, Chapter 200, Hawaii's EIS Rules. The following paragraphs present the 13 significance criteria and discuss them in relation to the HSWAC project. The developers of the system, however, understand the importance of extensive public involvement in shaping the plans for such a high profile project, and have planned to prepare an EIS from the outset.

(1) Involves an irrevocable commitment to loss or destruction of any natural or cultural resource;

The HSWAC project would not significantly impact natural resources. Archaeological and cultural impact assessments would be completed as part of the EIS process, and it is expected that archaeological mitigation in the form of construction monitoring would be required.

(2) Curtails the range of beneficial uses of the environment;

The HSWAC project would not curtail the range of beneficial uses of the environment. In fact, it would expand the range of beneficial uses of coastal marine waters.

(3) Conflicts with the state's long-term environmental policies or goals and guidelines as expressed in Chapter 344, HRS, and any revisions thereof and amendments thereto, court decisions, or executive orders;

The environmental policy and guidelines established in Chapter 344, HRS, are stated below and discussed with reference to the proposed project.

> ***[§344-3] Environmental policy.*** *It shall be the policy of the State, through its programs, authorities, and resources to:*
> *(1) Conserve the natural resources, so that land, water, mineral, visual, air and other natural resources are protected by controlling pollution, by preserving or augmenting natural resources, and by safeguarding the State's unique natural environmental characteristics in a manner which will foster and promote the general welfare, create and maintain conditions under which humanity and nature can exist in productive harmony, and fulfill the social, economic, and other requirements of the people of Hawaii.*
>
> The objective of the HSWAC project is to replace fossil fuel-generated electricity used for air conditioning downtown buildings with renewable resources. In addition, pollution of several types will be reduced. Potable water use and sewage generation will also be reduced.
>
> *(2) Enhance the quality of life by:*
> *(A) Setting population limits so that the interaction between the natural and artificial environments and the population is mutually beneficial;*
>
> The proposed project will have no direct, indirect or cumulative impacts on population.

(B) Creating opportunities for the residents of Hawaii to improve their quality of life through diverse economic activities which are stable and in balance with the physical and social environments;

The project would create short-term opportunities for workers in the construction industry, contributing to the stability of that industry and the social environment of the community. It would also create permanent skilled jobs based on renewable energy development.

(C) Establishing communities which provide a sense of identity, wise use of land, efficient transportation, and aesthetic and social satisfaction in harmony with the natural environment which is uniquely Hawaiian; and

The HSWAC project is feasible because of the unique setting in which it is proposed, that is, a major city in close proximity to deep, cold ocean waters.

(D) Establishing a commitment on the part of each person to protect and enhance Hawaii's environment and reduce the drain on nonrenewable resources.

The HSWAC project represents one of the largest potential sources of nonrenewable resource savings in the State and would reduce levels of air, water, and thermal pollution discharged to Hawaii’s environment.

[§344-4] Guidelines. *In pursuance of the state policy to conserve the natural resources and enhance the quality of life, all agencies, in the development of programs, shall, insofar as practicable, consider the following guidelines:*
(1) Population.
(A) Recognize population impact as a major factor in environmental degradation and adopt guidelines to alleviate this impact and minimize future degradation;

Adoption of such guidelines is a government function, not something the HSWAC project can accomplish.

(B) Recognize optimum population levels for counties and districts within the State, keeping in mind that these will change with technology and circumstance, and adopt guidelines to limit population to the levels determined.

Adoption of such guidelines is a government function, not something the HSWAC project can accomplish.

(2) Land, water, mineral, visual, air, and other natural resources.
(A) Encourage management practices which conserve and fully utilize all natural resources;

The most basic premise of the HSWAC project is to replace nonrenewable energy resources with renewable energy natural resources.

(B) Promote irrigation and waste water management practices which conserve and fully utilize vital water resources;

The HSWAC project would result in a savings of up to 265 millions gallons of potable water annually.

(C) Promote the recycling of waste water;

The HSWAC project would result in a reduction of up to 114 million gallons of wastewater annually, thereby reducing the need to recycle that amount of water.

(D) Encourage management practices which conserve and protect watersheds and water sources, forest, and open space areas;

By reducing potential potable water usage and wastewater generation, the HSWAC project would reduce demand on groundwater resources and requirements for wastewater disposal.

(E) Establish and maintain natural area preserves, wildlife preserves, forest reserves, marine preserves, and unique ecological preserves;

This guideline does not apply to the proposed action.

(F) Maintain an integrated system of state land use planning which coordinates the state and county general plans.

This guideline does not apply to the proposed action.

(G) Promote the optimal use of solid wastes through programs of waste prevention, energy resource recovery, and recycling so that all our wastes become utilized.

The HSWAC project would not generate significant quantities of solid wastes.

(3) Flora and fauna.
(A) Protect endangered species of indigenous plants and animals and introduce new plants or animals only upon assurance of negligible ecological hazard;

Appropriate measures to protect endangered species would be taken in construction and operation of the HSWAC system. All regulations and guidelines for minimization of invasive species introductions would be complied with in importing construction materials.

(B) Foster the planting of native as well as other trees, shrubs, and flowering plants compatible to the enhancement of our environment.

Landscaping of the undeveloped portions of the cooling station site would be done in accordance with HCDA guidelines.

(4) Parks, recreation, and open space.
(A) Establish, preserve and maintain scenic, historic, cultural, park and recreation areas, including the shorelines, for public recreational, educational, and scientific uses;

This guideline does not apply to the proposed action.

(B) Protect the shorelines of the State from encroachment of artificial improvements, structures, and activities;

The HSWAC project does not propose any shoreline structures at its preferred cooling station site. Any shoreline structures at alternative cooling station sites would be covered or otherwise obscured or incorporated into other proposed structures. To avoid impacts at the shoreline and in nearshore waters, horizontal directional drilling would be used to tunnel beneath these areas.

(C) Promote open space in view of its natural beauty not only as a natural resource but as an ennobling, living environment for its people.

The HSWAC cooling station would be located on a previously developed site and would not affect either mauka or makai views through the area. It would be an inconspicuous portion of a larger structure. If the cooling station is sited at one of the alternative sites, additional open and public areas may be created.

(5) Economic development.
(A) Encourage industries in Hawaii which would be in harmony with our environment;

The proposed project directly would benefit the construction industry and the community of marine industries. Either of these industries can be accomplished in harmony with the environment, although generally it is the function of government to establish regulations to insure this happens. Development of SWAC projects will help to expand the environmentally beneficial renewable energy industry in Hawaii.

(B) Promote and foster the agricultural industry of the State; and preserve and conserve productive agricultural lands;

The proposed project does not involve agriculture or agricultural lands. However, the potable water saved by SWAC systems could be used for agricultural purposes.

(C) Encourage federal activities in Hawaii to protect the environment;

HSWAC would allow Federal agencies to meet mandates for reducing potable water use, energy usage and various types of waste generated from their facilities as well as increase renewable energy usage.

(D) Encourage all industries including the fishing, aquaculture, oceanography, recreation, and forest products industries to protect the environment;

HSWAC oceanographers are developing plans for construction and operation of the HSWAC system with the intention of minimizing impacts to the environment.

(E) Establish visitor destination areas with planning controls which shall include but not be limited to the number of rooms;

This guideline does not apply to the proposed action.

(F) Promote and foster the aquaculture industry of the State; and preserve and conserve productive aquacultural lands.

This guideline does not apply to the proposed action.

(6) Transportation.
(A) Encourage transportation systems in harmony with the lifestyle of the people and environment of the State;

This guideline does not apply to the proposed action.

(B) Adopt guidelines to alleviate environmental degradation caused by motor vehicles;

This guideline does not apply to the proposed action.

(C) Encourage public and private vehicles and transportation systems to conserve energy, reduce pollution emission, including noise, and provide safe and convenient accommodations for their users.

This guideline does not apply to the proposed action.

(7) Energy.
(A) Encourage the efficient use of energy resources.

HSWAC represents one of the greatest short-term potential energy savings developments now contemplated for urban Honolulu.

(8) Community life and housing.
(A) Foster lifestyles compatible with the environment; preserve the variety of lifestyles traditional to Hawaii through the design and maintenance of neighborhoods which reflect the culture and mores of the community;

This guideline does not apply to the proposed action.

(B) Develop communities which provide a sense of identity and social satisfaction in harmony with the environment and provide internal opportunities for shopping, employment, education, and recreation;

This guideline does not apply to the HSWAC project.

(C) Encourage the reduction of environmental pollution which may degrade a community;

The HSWAC project would reduce air pollution, wastewater generation, toxic chemical use and disposal, and thermal pollution.

(D) Foster safe, sanitary, and decent homes;

This guideline does not apply to the proposed action.

(E) Recognize community appearances as major economic and aesthetic assets of the counties and the State; encourage green belts, plantings, and landscape plans and designs in urban areas; and preserve and promote mountain-to-ocean vistas.

Landscaping of the undeveloped portions of the cooling station site would be done in accordance with HCDA guidelines. The HSWAC cooling station would be located on a previously developed site and would not affect either mauka or makai views through the area.

(9) Education and culture.
(A) Foster culture and the arts and promote their linkage to the enhancement of the environment;

This guideline does not apply to the HSWAC project.

(B) Encourage both formal and informal environmental education to all age groups.

The extensive public information program already undertaken by the HSWAC project team has aided and will aid in the environmental education of interested groups. HSWAC also proposed to create a visitor center and/or displays to educate the general public about SWAC technology.

(10) Citizen participation.
(A) Encourage all individuals in the State to adopt a moral ethic to respect the natural environment; to reduce waste and excessive consumption; and to fulfill the responsibility as trustees of the environment for the present and succeeding generations; and

Knowing that a project can have the many environmental benefits of the HSWAC project would encourage individuals to support such projects in the future.

(B) Provide for expanding citizen participation in the decision making process so it continually embraces more citizens and more issues.

This guideline does not apply to the proposed action.

(4) Substantially affects the economic or social welfare of the community or state;

HSWAC will directly economically benefit its customers and indirectly benefit all electricity rate payers on Oahu by forestalling electricity load growth and the need to bring additional fossil fuel electricity generating units on line.

(5) Substantially affects public health;

By reducing various forms of pollution, the HSWAC project would have a positive effect on public health.

(6) Involves substantial secondary impacts, such as population changes or effects on public facilities;

HSWAC would have none of these effects.

(7) Involves a substantial degradation of environmental quality;

The environmental quality within the proposed zone of mixing at the return seawater diffuser would be degraded from ambient conditions with respect to temperature, dissolved oxygen, and inorganic nutrient concentrations. However, these impacts will be limited to a relatively small zone of mixing and will not substantially degrade the environment.

(8) Is individually limited but cumulatively has considerable effect upon the environment or involves a commitment for larger actions;

The proposed project is an individual action, and does not involve a commitment to any larger program of development.

(9) Substantially affects a rare, threatened, or endangered species, or its habitat;

This project does not substantially affect rare, threatened or endangered species or their habitats and appropriate measures will be be taken in construction and operation of the HSWAC system.

(10) Detrimentally affects air or water quality or ambient noise levels;

The HSWAC project would have positive impacts on air quality by reducing the need for fossil fuel electrical power generation. The water quality within the relatively small proposed zone of mixing at the return seawater diffuser would be degraded from ambient conditions with respect to temperature, dissolved oxygen, and inorganic nutrient concentrations. Thermal pollution of the environment will be reduced by 30%. Impacts of the proposed project to ambient noise during construction will be mitigated by adherence to applicable regulations, which will limit effects to acceptable levels protective of public health.

(11) Affects or is likely to suffer damage by being located in an environmentally sensitive area such as a flood plain, tsunami zone, beach, erosion-prone area, geologically hazardous land, estuary, fresh water, or coastal waters;

The project is not likely to suffer damage owing to its robust construction and the fact that all pipes are located underground or on the ocean bottom. However, the project site is in the coastal zone. It is susceptible to flooding and tsunami inundation. In the event of a major natural disaster, the facilities could suffer damage or destruction.

(12) Substantially affects scenic vistas and viewplanes identified in county or state plans or studies; or,

The cooling station would not obstruct the view corridors cited in the LUO or the public views defined in the Development Plan for the Primary Urban Center.

(13) Requires substantial energy consumption.

HSWAC would result in a significant reduction in energy consumption on Oahu.

6.2 Determination

The State Office of Planning has determined that an EIS is required for the HSWAC project.

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7.0 PERMITS AND APPROVALS REQUIRED

Table 7-1 summarizes the discretionary permits and approvals required for implementation of the proposed HSWAC project. A number of other, ministerial permits (e.g., grading, building, etc.) would be required for construction. Easements would be required offshore and through both city and State roadways.

Table 7-1: Permits and Approvals Required for the HSWAC Project

Permit, Approval, or Supplemental Document	Lead Agency	Prerequisites	Other Requirements
Hawaii Community Development Authority (HCDA) Project Eligibility Permit and Development Permit	HCDA	Lease agreement, project description, site plans (including drawings of elevations, sections, floor plans and 3-D renderings), landscaping plan, assessments of traffic, noise and conformance to Makai Area Plan and Rules, development timetable, landowner approval.	May require Public Hearing if rules modification or variance is requested.
Coastal Zone Management (CZM) Program Consistency	State of Hawaii, Office of Planning (OP)	Application demonstrating consistency of the project with the CZMP. Usually submitted with Draft EIS.	Publication of consistency notice in OEQC's *Environmental Notice.*
Hawaii Revised Statutes (HRS) Chapter 6E clearance	State of Hawaii, Department of Land and Natural Resources, Division of Historic Preservation (HPD), State Historic Preservation Officer (SHPO)	Final site for pump house and final routes for seawater pipes and distribution system.	Public notification required if the project is not otherwise required to hold a Public Hearing or give other public notification.
State of Hawaii Environmental Impact Statement (EIS) as per Hawaii Revised Statutes (HRS) Chapter 343	State of Hawaii, OP is the Accepting Authority (AA); Office of Environmental Quality Control (OEQC) reviews and publishes public notice in its *Environmental Notice.*	Complete project description, all necessary supporting studies of environmental resources and potential impacts.	Cultural Impact Assessment
Shoreline Setback Variance	State of Hawaii, OP	Final plans, environmental impact analysis, landowner approval.	Public Hearing (combined with SMA Public Hearing).
Special Management Area (SMA) Use Permit	State of Hawaii, OP	HCDA Development Permit; CZM Consistency Determination, final plans, environmental impact analysis.	Public Hearing, may result in a contested case.

Permit, Approval, or Supplemental Document	**Lead Agency**	**Prerequisites**	**Other Requirements**
Conservation District Use Permit (CDUP) for Marine Waters	State of Hawaii, Department of Land and Natural Resources (DLNR) processes the Conservation District Use Application (CDUA), the Board of Land and Natural Resources (BLNR) grants the CDUP.	FEIS, SMA Permit, Shoreline Setback Variance, site and construction plans, landowner's consent.	Maps, photographs, plans (including: location/area, site, emergency response, business, management). Public Hearing (20 days notice required). Contested case may be initiated.
National Pollutant Discharge Elimination System (NPDES) Individual Permit	State of Hawaii, DOH CWB, U.S. EPA reviews	Project description, survey and monitoring reports of existing biota, water quality, and uses of the area, discharge description, assessment of discharge impacts (i.e., EIS), schedule, construction plans.	Public Hearing may be requested. Monitoring of discharge and periodic reporting would be required after permit is granted.
Zone of Mixing (ZOM) Approval for Return Seawater	State of Hawaii, DOH CWB, U.S. EPA reviews	Receiving water and discharge characterization, assessment of discharge impacts (i.e., EIS).	Plume modeling, map of proposed ZOM boundaries.
Clean Water Act, Section 401 Water Quality Certification	State of Hawaii, Department of Health (DOH), Clean Water Branch (CWB), U.S. Environmental Protection Agency (EPA) reviews	Project description, survey and monitoring reports of existing biota, water quality, and uses of the area, discharge description, assessment of discharge impacts (i.e., EIS), schedule, construction plans. NPDES permit.	Site-specific Best Management Practices (BMP) Plan. Applicable Monitoring and Assessment Plan. Mitigation/Compensation Plan needed if "special aquatic sites" (e.g., coral reefs) are affected. Public Hearing may be requested.
Permit to Discharge Process Wastewater	U.S. EPA	Draft NPDES permit prepared by DOH.	Public notification or Public Hearing.
Essential Fish Habitat (EFH) Consultation (only required if U.S. ACOE determines project may have adverse effect on EFH)	U.S. Army Corps of Engineers (ACOE) consults with U.S. National Marine Fisheries Service (NMFS)	DEIS	Western Pacific Fishery Management Council may comment on actions that adversely affect EFH.
Endangered Species Act (ESA) Section 7 Consultation (only required if U.S. ACOE determines project may have adverse effect on a listed threatened or endangered species or its designated critical habitat)	U.S. ACOE consults with U.S. NMFS and/or U.S. FWS depending on species/habitat jurisdiction	DEIS	
National Environmental Policy Act (NEPA) EIS	U.S. ACOE approves, U.S. EPA reviews	Complete project description, all necessary supporting studies of environmental resources and potential impacts.	

Permit, Approval, or Supplemental Document	Lead Agency	Prerequisites	Other Requirements
Department of the Army Permit	U.S. ACOE	NEPA EIS, all previous approvals and permits at state and county levels, EFH and ESA Consultations.	Vicinity, plan and elevation drawings. Possible Public Hearing.

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8.0 CONSULTATION

8.1 Agencies, Organizations and Individuals Consulted to Date

The HSWAC development team has been extremely proactive in initiating dialog with the community. Well before initiating assessment of the potential environmental impacts of the project, the team consulted Federal, State and county agencies, elected representatives, utilities, community and business groups, environmental organizations, and of course, potential customers of the HSWAC system. As these consultations have proceeded, a mailing list has been developed, and a series of newsletters about the project has been produced and distributed to all identified interested parties. A list of the agencies, organizations and individuals consulted to date follows. Contacts made for the purpose of marketing the system are not included.

U.S. Congress
Senator Daniel K. Akaka
Senator Daniel K. Inouye
Representative Neil Abercrombie
Representative Ed Case

Federal Agencies
U.S. Army Corps of Engineers
U.S. Coast Guard
U.S. Environmental Protection Agency
U.S. Fish and Wildlife Service
U.S. National Marine Fisheries Service
U.S. Navy

State Elected Officials
Governor Linda Lingle
Senator Robert Bunda, 22nd District
Senator Suzanne Chun Oakland, 13th District
Senator J. Kalani English, 6th District
Senator Carol Fukunaga, 11th District
Senator Fred Hemmings, 25th District
Senator Russell S. Kokubun, 2nd District
Senator Ron Menor, 17th District
Senator Brian T. Taniguchi, 10th District
Senator Gordon Trimble, 12th District
Representative Kirk Caldwell, 24th District
Representative Cindy Evans, 7th District
Representative Galen Fox, 23rd District
Representative Robert N. Herkes, 5th District
Representative Kenneth T. Hiraki, 28th District
Representative Sylvia Luke, 26th District
Representative Barbara C. Marumoto, 19th District
Representative Hermina M. Morita, 14th District
Representative Calvin K.Y. Say, 20th District
Representative Brian Schatz, 25th District
Representative Dwight Y. Takamine, 1st District
Representative Cynthia Thielen, 50th District
Representative Glenn Wakai, 31st District
Representative Tommy Waters, 51st District

State Agencies
Department of Accounting and General Services
Department of Budget and Finance
Department of Business, Economic Development and Tourism
Department of Commerce and Consumer Affairs
Department of Health
Department of Land and Natural Resources
Department of Taxation
Department of Transportation
Hawaii Coastal Zone Management Program
Hawaii Community Development Authority
Hawaii Strategic Development Corporation
Office of Environmental Quality Control
Office of Hawaiian Affairs
Office of Planning
Public Utilities Commission
University of Hawaii
University of Hawaii Environmental Center

County Elected Officials
Mayor Mufi Hannemann
Mayor Jeremy Harris
Honorable Donovan M. Dela Cruz, City Council Chair
Honorable Charles K. Djou, Councilmember District 4
Honorable Steve Holmes, former Councilmember
Honorable Ann H. Kobayashi, Councilmember District 5
Honorable Barbara Marshall, Councilmember District 3
Honorable Rod Tam, Councilmember District 6

County Agencies
Managing Director
Board of Water Supply
Department of Budget and Fiscal Services
Department of the Corporation Counsel
Department of Design and Construction
Department of Environmental Services
Department of Facility Maintenance
Department of Land Utilization
Department of Planning and Permitting

Department of Transportation Services

Oahu Neighborhood Boards
Ala Moana/Kakaako Neighborhood Board
Downtown Neighborhood Board

Public Utilities
Hawaiian Electric Company
Hawaiian Telecom

Business, Education, Energy, and Technology Organizations
AIA Honolulu Committee on the Environment
American Association of Heating Refrigeration and Air Conditioning Engineers – Hawaii
American Institute of Architects
American Water Works Association – Hawaii
Building Industry Association of Hawaii
Building Owners and Managers Association
Engineering Alumni Association of the University of Hawaii
Enterprise Honolulu
Hawai'i 2050 Sustainability Task Force
Hawaii Building Engineers Association
Hawaii Energy Policy Forum
Hawai'i Energy Reliability Advisory Committee
Hawaii Environmental Council
Hawaii Ocean Safety Team
Hawaii Ocean Science & Technology
Hawaii Renewable Energy Alliance
Hawaii Science and Technology Council
Hawaii Solar Energy Association
Hawaii Technology Trade Association
International Facility Management Association
Kamehameha Schools
Marine Technology Society
Pacific Century Fellows
Rebuild Hawaii Consortium
The Chamber of Commerce of Hawaii
Waikiki Improvement Association

Trade Unions
Plumbers & Fitters Local 675

Media
Associated Press – Honolulu
Building Industry Magazine
HawaiiBusiness
Hawaii Public Radio
Honolulu Magazine
Honolulu Star Bulletin
Honolulu Weekly
Pacific Business News
The Honolulu Advertiser
Trade Publishing Company

Environmental Organizations
Ahahui Malama I Ka Lokahi
Ahupua`a Action Alliance
Ala Wai Watershed Association
Conservation Council for Hawaii
EarthJustice Legal Defense Fund
Earth Trust
Environmental Action Group
EnviroWatch, Inc.
Green House Hawai`i
Greenpeace Foundation
Hawaii Association of Environmental Professionals
Hawaii Audubon Society
Hawai`i Biological Survey
Hawaii Coral Reef Initiative
Hawaii Ecosystems at Risk Project
Hawaii Environmental Holdings
Hawai`i Nature Center
Hawaii's 1,000 Friends
Kahea
Life of the Land
People's Water Conference
Save Our Seas
Save Our Surf
Sierra Club
Sierra Club – University of Hawaii
The Nature Conservancy of Hawai`i
The Outdoor Circle
The Trust for Public Land
Union of Concerned Scientists

8.2 Distribution of the EISPN

The distribution list for the EISPN would include all of the consulted parties above, as well as those parties not on the list, but identified (as mandatory or recommended) in the Document Distribution Chart in OEQC's *Environmental Guidebook*. The latter include only the nearest State library and the Honolulu Star-Bulletin.

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