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11th Air Control Wing
11th Civil Engineering Operations Squadron
Elmendorf AFB, Alaska

FINAL

Eareckson AFS, Alaska
(Formerly Shemya AFB, Alaska)
1993 IRP BASEWIDE & LIMITED SOURCE INVESTIGATION WORK PLAN

DECEMBER 1993

By:

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PREFACE

This Work Plan describes the requirements for the expected tasks and activities needed to complete the basewide and limited source investigation activities at Eareckson Air Force Station (AFS), formerly Shemya Air Force Base (AFB), according to the requirements of Contract No. F33615-90-D-4009, Delivery Order 16, between the U.S. Air Force and Jacobs Engineering Group Inc. It was developed to make certain that all environmental data generated for the project are scientifically valid, defensible, comparable, and of known and acceptable precision and accuracy. The Work Plan has been prepared in accordance with format and content requirements, as applicable, of the *Handbook to Support the Installation Restoration Program Statements of Work* prepared by the Air Force Center for Environmental Excellence (AFCEE), Brooks AFB, dated May 1991.

The Jacobs Engineering Group Inc. Project Manager for this contract is Mr. Chris Williams. The Technical Project Manager for the AFCEE is Mr. Mike McGhee.

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This basewide and limited source investigation (LSI) Work Plan has been prepared to describe the 1993 field effort scheduled for Eareckson Air Force Station, Alaska (formerly Shemya Air Force Base). The work plan consists of six sections. Section 1.0 provides an introduction to the basewide and LSI activities to be conducted. Section 2.0 presents the environmental setting of Shemya Island, a description of the potential source units, preliminary conceptual site models, and data quality objectives. Section 3.0 contains the rationale for sampling, and discussion of the types and numbers of samples to be collected, and the analytical methods to be used. Section 4.0 presents the reporting requirements; Section 5.0 is the project schedule; and Section 6.0 contains the references used and cited within this work plan.

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NOTICE

This report has been prepared for the United States Air Force by Jacobs Engineering Group Inc. for the purpose of aiding in the implementation of a final remedial action plan under the Air Force Installation Restoration Program (IRP). As the report relates to actual or possible releases of potentially hazardous substances, its release before an Air Force final decision on remedial action may be in the public's interest. The limited objectives of this report and the ongoing nature of the IRP along with the evolving knowledge of site conditions and chemical effects on the environment and health must be considered when evaluating this report, because subsequent facts may become known which may make this report premature or inaccurate. Acceptance of this report in performance of the contract under which it is prepared does not mean that the Air Force adopts the conclusions, recommendations, or other views expressed herein, which are those of the contractor only and do not necessarily reflect the official position of the United States Air Force.

It should be noted that in May of 1993, Shemya Air Force Base was renamed Eareckson Air Force Station.

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LIST OF ACRONYMS

ACE	Alaska Cleanup Effort
ADEC	Alaska Department of Environmental Conservation
ADFG	Alaska Department of Fish and Game
AFCEE	Air Force Center for Environmental Excellence
AFFF	Aqueous Film-Forming Foam
AFS	Air Force Station
AGE	*Aerospace Ground Equipment*
Air Force	U.S. Air Force
Aleutian Arc	Aleutian Island Archipelago
AQUIRE	Aquatic Information Retrieval Toxicity Data Base
ARAR	Applicable or Relevant and Appropriate Requirement
ASTM	American Society for Testing and Materials
BEE	Bioenvironmental Engineering
BGS	Below Ground Surface
BIA	Bureau of Indian Affairs
BTEX	Benzene, Toluene, Ethylbenzene, Xylene
CEOS	Civil Engineering Operations Squadron
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CLP	Contract Laboratory Program
cm	Centimeter
COE	U.S. Army Corps of Engineers
COPEC	Contaminant of Potential Ecological Concern
CV	Coefficient of Variability
DDD	Dichlorodiphenyldichloroethane
DDE	Dichlorodiphenylethane
DDT	Dichlorodiphenyltrichloroethane

LIST OF ACRONYMS

DEQPPM	Defense Environmental Quality Program Policy Memorandum
DNAPL	Dense Nonaqueous Phase Liquid
DOD	U. S. Department of Defense
DOI	U.S. Department of the Interior
DQO	Data Quality Objective
DTIC	Defense Technical Information Center
E&E	Ecology and Environment Inc.
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
FS	Feasibility Study
FSP	Field Sampling Plan
Ft^2	Square feet
FWS	U.S. Fish and Wildlife Service
GC	Gas Chromatograph
gpm	Gallons per Minute
HARM	Hazard Assessment Rating Methodology
HRS	Hazard Ranking System
HSDB	Hazardous Substances Data Base
HSP	Health and Safety Plan
ICP	Inductively Coupled Plasma
IRP	Installation Restoration Program
IRPIMS	Installation Restoration Program Information Management System
Jacobs	Jacobs Engineering Group Inc.
JRBA	JRB Associates
LNAPL	Light Nonaqueous Phase Liquid
LOAEL	Lowest Observed Adverse Effects Level
LOEL	Lowest Observed Effects Level

LIST OF ACRONYMS

LSI	Limited Source Investigation
MAP	Management Action Plan
MCL	Maximum Contaminant Level
mg/kg	Milligrams per Kilogram
mg/L	Milligrams per Liter
MS	Mass Spectrometer
MSL	Mean Sea Level
NCP	National Oil and Hazardous Substances Pollution Control Contingency Plan
NFAD	No Further Action Document
NOAA	National Oceanic and Atmospheric Administration
NOAEL	No Observable Adverse Effects Level
NOEL	No Observable Effects Level
NPL	National Priorities List
NTIS	National Technical Information Service
OSHA	Occupational Safety and Health Administration
OU	Operable Unit
OVA	Organic Vapor Analyzer
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
POL	Petroleum, Oil, and Lubricants
ppm	Parts per Million
PRL	Preliminary Risk Level
PVC	Polyvinyl Chloride
QA	Quality Assurance
QAPP	Quality Assurance Project Plan

LIST OF ACRONYMS

QC	Quality Control
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RMAL	Rocky Mountain Analytical Laboratories
SAP	Sampling and Analysis Plan
SARA	Superfund Amendments and Reauthorization Act of 1986
SCS	Site Characterization Summary
SA	Site Assessment
TBC	To Be Considered
TCE	Trichloroethene
TCLP	Toxicity Characteristic Leaching Procedure
TFH	Total Fuel Hydrocarbons
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
μg/kg	Micrograms per Kilogram
μg/L	Micrograms per Liter
umhos	Micromhos
USAF	U.S. Air Force
USCS	Unified Soil Classification System
USGS	U.S. Geological Survey
UST	Underground Storage Tank
WIMS-ES	Work Information Management System - Environmental Subsystem

TABLE OF CONTENTS

Page

TABLE OF CONTENTS

TABLE OF CONTENTS

TABLE OF CONTENTS

List of Figures

TABLE OF CONTENTS

TABLE OF CONTENTS

Page

List of Tables

TABLE OF CONTENTS

List of Appendices

List of Plates

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1.0 INTRODUCTION

This Work Plan provides information on proposed activities associated with the basewide investigation and the limited source investigation (LSI) at Eareckson Air Force Station (AFS), Shemya, Alaska (Figure 1-1). The Work Plan provides the rationale for the proposed environmental sampling program, the data quality objectives (DQO), and the overall objectives for the project. The plan is based on the identification of potentially contaminated areas through previous studies, as well as intensive literature reviews conducted as part of the Work Plan preparation (see Sections 1.2 and 1.5).

This investigation is part of a larger program, designed to evaluate potential hazardous waste contamination at U.S. Air Force (Air Force) facilities, known as the Installation Restoration Program (IRP). Because of its primary mission in national defense, the Air Force has long been engaged in a wide variety of operations that involve the use, storage, and disposal of hazardous materials. In 1980, the U.S. Department of Defense (DOD) developed the IRP to investigate hazardous material disposal sites on DOD facilities.

The Work Plan has six sections. Section 1.0 provides background information on the Air Force IRP and its objectives, previous IRP work performed at Eareckson AFS, and the objectives of the current investigation. Section 2.0 provides a summary of the environmental setting, the current knowledge of the sites at Eareckson AFS, and the DQOs. Section 3.0 provides the purpose and objectives of the field investigations and the rationale for both the basewide approach and the LSI. Section 4.0 describes the reporting requirements and procedures that will be followed. Section 5.0 presents the anticipated schedule for the investigation. Section 6.0 presents the references used to prepare the Work Plan.

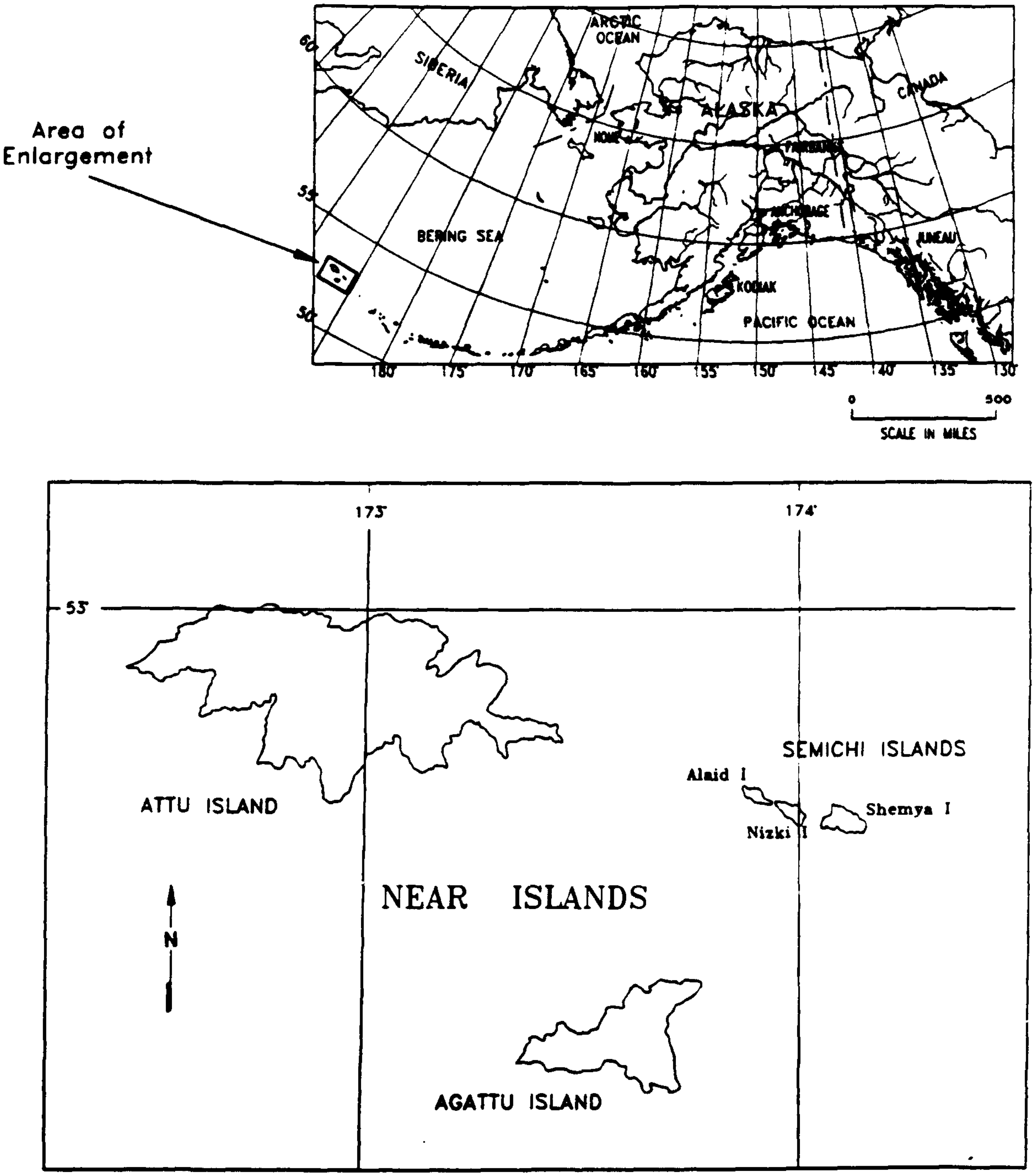
1.1 THE AIR FORCE INSTALLATION RESTORATION PROGRAM

The objectives of the Air Force IRP are to assess past hazardous waste disposal and spill sites at Air Force installations and to develop remedial action consistent with the National Oil and Hazardous Substances Contingency Plan (NCP) for those sites that pose a threat to human health and welfare or the environment. The following sections present information on the program origins, objectives, and organization.

1.1.1 Program Origins

The Resource Conservation and Recovery Act (RCRA) of 1976, as amended, is one of the primary federal laws governing the disposal of hazardous wastes. Sections 6001 and 6003 of RCRA require that federal agencies comply with local and state environmental regulations and provide information to the U.S. Environmental Protection Agency (EPA) concerning past disposal practices at federal sites. Section 3012 of RCRA requires state agencies to inventory past hazardous waste disposal sites and provide information to EPA concerning those sites.

To ensure compliance with RCRA regulations, DOD developed the IRP. The IRP was implemented to identify potentially contaminated sites, investigate those sites, and evaluate and select remedial actions for potentially contaminated facilities. The DOD issued the Defense Environmental Quality Program Policy Memorandum (DEQPPM) 80-6 regarding the IRP in June 1980. The NCP was issued in 1980 to



Map Showing the Islands in the Near Island Group

Figure 1-1

provide guidance on a process by which contaminant releases could be identified and quantified, and remedial actions selected. The NCP describes the responsibilities of federal and state governments, and the parties responsible for contaminant releases.

In 1980, Congress enacted the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). CERCLA outlines the responsibility for identifying and remediating contaminated sites in the United States and its possessions. CERCLA legislation identifies EPA as the primary policy and enforcement agency regarding contaminated sites.

Executive Order 12372, which was adopted in 1981, gave various federal agencies, including DOD, the responsibility to act as lead agencies to conduct investigations and implement remediation efforts when they are the sole or contributor to contamination on or off their properties.

DOD formally revised and expanded the existing IRP directives, and amplified all previous directives and memoranda concerning the IRP, through DEQPPM 81-5, dated 11 December 1981. This memorandum was implemented by an Air Force message dated 21 January 1982.

The Superfund Amendments and Reauthorization Act (SARA), enacted in 1986, extends the requirements of CERCLA, and modifies CERCLA with respect to goals for remediation and the process leading to the selection of a remedial action. Under SARA, technologies that provide permanent removal or destruction of a contaminant are preferable to action that only contains or isolates the contaminant. SARA also provides for greater interaction with public and state agencies and extends EPA's role in evaluating health risks associated with contamination. Under SARA, early determination of Applicable or Relevant and Appropriate Requirements (ARARs) is required, and consideration of potential remediation alternatives is recommended at the initiation of an investigation. SARA is the primary legislation governing remedial action at past hazardous waste disposal sites.

1.1.2 Program Objectives

The objectives of the IRP include the following:

- Identify and evaluate sites where contamination may be present on DOD property because of past hazardous waste disposal practices, spills, leaks, or other activities.
- Control the migration of hazardous contaminants.
- Control health hazards or hazards to the environment that may result from past DOD disposal operations.

The IRP was developed so that these objectives could be met in accordance with CERCLA, NCP, and SARA. Solutions that are developed must protect public health and the environment, meet ARARs, and be technically feasible to implement at the evaluated site.

To meet these objectives, the following program tasks will be completed:

- Develop a project database through literature search, field investigation, laboratory analysis, and data evaluation.
- Develop and implement a quality assurance (QA)/quality control (QC) program to ensure meaningful and defensible data.
- Develop and follow site and laboratory safety plans to protect the health and safety of personnel and to prevent the release of contaminants.
- Identify data gaps and recommend and implement appropriate additional or supplemental studies during the course of performing the IRP.
- Use a rigorous procedure to identify, evaluate, and select appropriate solutions.
- Conduct the IRP in compliance with applicable federal, state, and local regulations and guidances.
- Provide information regarding the nature of identified contamination, the effects of contamination on the community, the progress of the IRP, and the selected remedial alternative and its impacts on the public and appropriate regulatory agencies.

1.1.3 Program Organization

Originally, the IRP studies were organized into four phases: Phase I - Installation Assessment/Records Search; Phase II - Confirmation/Quantification; Phase III - Technology Base Development; and Phase IV - Remedial Actions. The phases of the Air Force IRP were sequential steps as compared with the steps of the Superfund remedial process, which can take place simultaneously. Although the procedures were different, the targets of the two programs were the same. In response to SARA and for the Air Force program to parallel the Superfund process, DOD directed the Air Force to implement the remedial investigation (RI)/feasibility study (FS) methodology of conducting the IRP, and to abandon the phased approach.

1.2 HISTORY OF IRP WORK AT EARECKSON AIR FORCE STATION

The following description of past IRP work at Eareckson AFS is an excerpt from the 1992 IRP Field Investigation Report by CH2M Hill (CH2M Hill, 1993a).

> Phase I work under the IRP consisted of a records search conducted by JRB Associates (JRBA) for Eareckson AFS that was completed in September 1984. This records search identified 28 sites as potentially containing hazardous material from past activities. The sites consisted of 10 petroleum, oil, and lubricants (POL) spill sites, 15 solid waste disposal sites, and three fire training sites. Eight of these sites were assessed as having a low potential for contaminant release (JRBA, 1984).

The eight sites assessed as having a low potential for contamination will not be included in subsequent investigations, based on the records search. In 1984, JRBA used the Air Force Hazard Assessment Rating Methodology (HARM) to prioritize the remaining 20 sites for purposes of IRP scheduling and budgeting (JRBA, 1984). This effort was completed in 1984. Table 1.2-1 lists the HARM score ranking for each site. These sites were determined to be likely sites of hazardous material contamination where significant potential for contaminant migration was thought to exist.

The Alaskan Air Command (now called the 11th Air Force) elected to include all 20 sites for follow-on investigations. Two of the sites (SW-13 and SW-15) were later removed from the IRP list and were not included in the 1988 investigation conducted by CH2M Hill. Four additional sites were later identified and added to the IRP list (PS-1B, HG-1, PS-11, and PS-83), resulting in a total of 22 sites identified as being potentially contaminated with hazardous materials that may pose a threat to human health or the environment.

CH2M Hill prepared a Stage I Work Plan to address the 22 IRP sites (CH2M Hill, 1988) and conducted field sampling in 1988. The general objectives of the work were to 1) determine what contaminants were present; 2) determine the effectiveness of previous restoration activities; and 3) recommend further action, whether it be remedial measures, expanded confirmation, or no further action. Three of the 22 sites were determined to contain very low or no potential for contaminant release and environmental degradation. These sites were the Old Hospital Site (HG-1), West Dock (PS-2), and Base Operations Terminal (PS-10). The results of the field investigation were presented in a final technical report (CH2M Hill, 1990). Two of the sites, West Dock (PS-2) and Base Operations Terminal (PS-10), were restored to the list for further investigations in 1992. A No Further Action Document (NFAD) was prepared by CH2M Hill for HG-1 (CH2M Hill, 1992). Data collected in 1988 were used to support the NFAD. The CH2M Hill report also presented preliminary ARARs, which are included as Appendix A to this Work Plan.

CH2M Hill also conducted a field investigation at Eareckson AFS in 1992 (CH2M Hill, 1993a). Twenty-two sites and the water gallery were investigated to varying degrees, from a reconnaissance survey with no sampling to a complete site characterization. Table 1.2-1 presents a summary of the investigations performed at each site, together with CH2M Hill's recommendations for additional work or further actions at each site. The 1992 investigation also included preliminary assessments of the risk to human health and to environmental receptors.

Twenty-seven additional IRP sites, as summarized in Table 1.2-2, have been identified from various sources, bringing the total number of IRP sites to 50. At potential source unit FT02, two additional areas adjacent to the original potential source unit have been included within the site designation. All of these sites, or potential source units, are described in Section 2.2 of this Work Plan. Original identification numbers assigned by JRBA (1984) have been changed to reflect the Air Force Work Information Management System - Environmental Subsystem (WIMS-ES) nomenclature for sites. Under WIMS-ES, the following abbreviations are used:

- FT - fire training area;
- LF - landfill;
- SS - spill site;
- ST - storage tank; and
- OT - other.

TABLE 1.2-1
SUMMARY OF RESULTS OF PREVIOUS INSTALLATION RESTORATION PROGRAM INVESTIGATIONS
EARECKSON AIR FORCE STATION, ALASKA

Former Site Identification	Current Site Identification	Site Name	HARM Score	CH2M Hill 1992 Investigations	CH2M Hill Future Action Recommendations
FT-1	FT01	Lightning Strike	74	Surface sampling, subsurface sampling, monitoring wells, geophysics, surveying	Additional investigation
FT-2	FT02	Aircraft Mockup	57	Surface sampling, subsurface sampling, monitoring wells, geophysics, surveying	Additional investigation
FT-3	FT03	Fire Department Foam Training Area	47	Geophysics	Additional investigation
SW-4	LF18	North Beach Landfill	46	Surface sampling, subsurface sampling, geophysics, surveying	Site grading and monitoring wells
SW-5	OT19	Hospital Lake	46	Surface water sampling, sediment sampling, geophysics, surveying	No further investigation
SW-10	LF24	Barrel Bay	53	Surface sampling, monitoring wells, geophysics, surveying	Remedial action (impermeable cap) and seawall stabilization
SW-12	LF26	Scrap Metal Disposal Site	54	Surface sampling, monitoring wells, geophysics, surveying	Remedial action (permeable cap)
SW-13	-	Base Sanitary Landfill	52	None (a)	None (a)
SW-15	-	Ammunitions Disposal Area	55	None (b)	None (b)
SW-14	LF28	Scrap Metal Landfill	43	Geophysics, surveying	Additional investigation
PS-1A	SS17	Transformer Oil (PCB) Spills at Cobra Dane	57	Surface sampling, subsurface sampling, surveying	No further investigation
PS-1B	SS05	Transformer Oil (PCB) Spills at Cobra Dane	NR	Surface sampling, subsurface sampling, geophysics, surveying	Additional investigation
PS-2	SS06	West Dock JP-4 Spill	49	Surface sampling, surveying	No further investigation
PS-3	SS07	West End Oil/Water Separator Ponds	68(c)/56	Geophysics	Additional investigation
PS-4	ST08	Diesel Fuel Tank No. 123	62	None	Additional investigation
PS-5	ST09	Power Plant Spills	75	Surveying	Additional investigation
PS-6	ST10	JP-4 Spill at Refueling Vehicle Maintenance Shop	52	Geophysics, surveying	POL regulated (state)

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Page 1 of 2

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TABLE 1.2-1 (continued)
SUMMARY OF RESULTS OF PREVIOUS INSTALLATION RESTORATION PROGRAM INVESTIGATIONS
EARECKSON AIR FORCE STATION, ALASKA

Former Site Identification	Current Site Identification	Site Name	HARM Score	CH2M Hill 1992 Investigations	CH2M Hill Future Action Recommendations
PS-7	SS11	Vehicle Maintenance Waste Oil Storage and Spill Area	61	Geophysics, surveying	POL regulated (state)
PS-8	SS12	Old White Alice	6(a)	Subsurface sampling, geophysics, surveying	Remedial action
PS-9	SS13	Asphaltic Drum Storage	56	Geophysics, surveying	Remedial action
PS-10	SS14	JP-4 Spill at Base Operations Terminal	47	Surface sampling, surveying	POL regulated (state)
PS-11	SS23	Current Barrel Drum Storage	NR	None	Additional Investigation
PS-83	SS25	Abandoned Tank Farm	NR	Geophysics	Additional Investigation
HG-1	SS04	Old Hospital Site	NR	None	No further Investigation
---	OT48	Water Gallery	NR	Surface sampling, well points, monitoring wells, geophysics, surveying	Water treatment to remove TCE

Notes:
IRP = Installation Restoration Program
HARM = Hazard Assessment Ranking Methodology
NR = not ranked
PCB = polychlorinated biphenyls
TCE = trichloroethene
USAF = U.S. Air Force
(a) = Active site, permitted by ADEC, removed from IRP List
(b) = Munition site handled by USAF munitions specialists; not addressed further under the IRP.

Adapted from CH2M Hill (1993b)

TABLE 1.2-2
ADDITIONAL INSTALLATION RESTORATION PROGRAM SITES
EARECKSON AIR FORCE STATION, ALASKA

Site Identification Number	Site Name
LF15	Wood Dump
LF16	Unknown
SS20	Retrograde Area (Dock)
OT21	Old Grounded Barge
SS22	Scrap Metal Storage Hardstand
SS25	World War II Fuel Tanks
OT29	Ammunitions Dump
OT30	Remove Hazardous Waste Debris ACE
SS31	Rusting Waste Oil Drums
ST32	UST 4010-2, 4012-1, 4101-3
ST33	UST 613, 615, 617
ST34	UST 614,616
ST35	UST 132-2
ST36	UST 450, 452, 452-3
ST37	UST 729, 731, 775
ST38	UST 490
ST39	UST 110-1, 110-2, 110-3, 110-4
ST40	UST 600-1, 600-3, 600-4
ST41	UST 18, 19
ST42	UST 5004-1
ST43	UST 605-1
ST44	UST 3051-5, 3051-6
ST45	AGE Fuel Spill
ST46	Abandoned Tank Farm
SS47	Barrel Storage Area
OT49	Upper Lake
ST50	Storage Tank #7

Notes:

ACE = Alaska Cleanup Effort

AGE = Aerospace Ground Equipment

IRP = Installation Restoration Program

UST = Underground Storage Tank

Source: U.S. Air Force (1992b)

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The potential source units are associated with several regulatory programs, including CERCLA and Alaska Department of Environmental Conservation (ADEC) solid waste, underground storage tank (UST), and POL programs. The potential source units and proposed regulatory programs are described in Section 2.2.

A Site Inspection (SI) was conducted at Eareckson in 1992. The SI was initiated by the Air Force and conducted by Woodward-Clyde for EPA. The purpose of this investigation was to support Hazard Ranking System (HRS) scoring by the EPA. In May 1993, information received from EPA Region X suggested that Eareckson AFS may not be proposed for the National Priorities List (NPL). Correspondence from EPA to the Air Force regarding NPL listing of Eareckson AFS is found in Appendix B.

A working draft of the Management Action Plan (MAP) for Eareckson AFS has been prepared (U.S. Air Force, 1992a). The MAP includes information on potential source units, proposed regulatory programs, the status of restoration programs and schedules, and long-term IRP strategies. The MAP also lists outstanding technical issues or decisions that require action by the Air Force and regulatory agencies.

As part of the MAP directive, the Air Force has assembled a MAP project team consisting of project managers from ADEC, the U.S. Fish and Wildlife Service (FWS), the Air Force, and contractors as required. EPA has also been involved as part of the team. MAP meetings are held quarterly with the project team to discuss the status of restoration projects, future strategies for field efforts, decision making, and technology transfer.

1.3 EARECKSON AIR FORCE STATION MISSION AND HISTORY

The following history of Eareckson AFS is an excerpt from the 1984 report by JRBA.

> Historically, Shemya Island was uninhabited. It supported a limited fur hunting trade as early as 1824 (Cohen, 1981). One of the few low-lying platforms in the windswept western Aleutian Islands, it was first developed in May 1943 by the U.S. Army, which constructed the existing 10,000-foot runway and hangars for use in the World War II campaign against the Japanese occupation forces on Attu, Agattu, and Kiska Islands (Ross, 1969). Shemya became the home of the 28th Bomber Group and later the 343rd Fighter Group. The latter was deactivated on August 15, 1946. Shemya Air Force Station activities were reduced following World War II, but the Station served as a refueling and staging point on the Great Circle Route for support and supplies during the Korean conflict. When the Korean conflict terminated, activities on Shemya were once again reduced, and, on July 1, 1954, the base was declared surplus and deactivated. Facilities were transferred to the Civil Aeronautics Authority in 1955 and subsequently leased to Northwest Airlines for support and communication purposes.
>
> The Air Force returned to Shemya in 1958 in support of various Air Force and Army strategic intelligence collection activities. Shemya was redesignated from an Air Force Station to an Air Force Base on June 21, 1968. There are currently no aircraft squadrons assigned to the Base. Instead, a number of tenant units are located at the Base. The Base mission has been, and remains, to serve as an early

warning radar installation whose principal purpose involves monitoring space and missile activities. Shemya Island is part of the Alaska Maritime National Wildlife Refuge administered by the U.S. Fish and Wildlife Service (FWS). The FWS has agreed to let the Air Force use Shemya Island as long as it is needed for national defense.

Approximately 700 personnel are assigned to the Base on an annual basis, 400 of whom operate and maintain all structures, utilities, and exterior facilities, and provide Base support. The remaining 300 persons are contractor personnel who operate and maintain DOD facilities. During the summer months, base population may increase by another 200 to 400 persons, most of whom are contractors providing construction and related support services.

In May 1993, Shemya Air Force Base was redesignated Eareckson Air Force Station. It was so named after a former Base Commander.

1.4 DESCRIPTION OF CURRENT STUDY

The following sections describe the current technical effort, including the objectives of the 1993 field effort, preparation of planning documents, and selection and supervision of subcontractors.

1.4.1 Project Objectives

The field investigation activities proposed for 1993 are primarily designed to be a scoping effort for future work. The investigation will be conducted to provide additional information on basewide environmental conditions, evaluate the management zone concept (see Section 2.3), and obtain sufficient data on selected potential source units to prepare NFADs, complete RIs, or recommend early actions, if necessary. The 1993 LSIs will meet objectives consistent with an RI, in accordance with EPA guidance (EPA, 1988). The basewide investigation meets the objectives of an RI scoping effort, as described in the guidance. Following completion of the 1993 field investigation activities, a Site Characterization Summary (SCS) Technical Report will be prepared (see Section 4.6) to summarize data obtained during the 1993 field investigation.

The 1993 field investigation program includes the following field and technical tasks:

- performing the basewide investigation;
- performing the LSI; and
- preparing NFADs, screening alternatives, FSs, and proposed plans, as required.

The objectives of the above three tasks are as follows:

- support future interagency agreement negotiations;
- support Defense Priority Model scoring or other ranking system models;
- facilitate a basewide understanding of the island's surface water and groundwater conditions;

- collect data for characterization of naturally occurring background conditions;
- evaluate preliminary human health and environmental risks associated with on- and off-island releases;
- determine which potential source units may require no further action and complete RIs where limited data are required; and
- prepare FSs where complete RI data exist.

The 1993 field investigation includes two components: basewide investigation and LSI; in addition, documents will be prepared based on the results of previous investigations. Each of the three technical efforts has a specific scope of work and objectives.

The objectives for the basewide field effort include the following:

- Collect basewide surface water, sediment, soil, and groundwater data to assess island-wide conditions and to determine whether contamination is widespread or associated with potential source units. These data will assist in identifying and refining preliminary ecological and human receptors and migration pathways. The data from the basewide investigation will also allow future investigations to be more focused on contaminant pathways and receptors of concern.
- Evaluate whether the management zone concept will be useful for future investigations. This approach is discussed in Section 2.3.
- Collect additional data within Management Zone 7 to assess the practicality of investigating other management zones or groups of sources within zones in future efforts. Management Zone 7 includes several related potential source units.
- Collect critical data on background soils, surface water, sediment, and groundwater conditions to support future negotiations of cleanup levels, and risk assessment scenarios for future work.
- Collect data needed for modeling future contaminant transport pathways.
- Perform a basewide ecological survey to identify critical habitats and receptors. This survey, coupled with data, will allow the formation of preliminary statements about island-wide/basewide ecological risk.

The DQOs and technical approach to the basewide field investigation are discussed in Sections 2.5.1 and 3.1 of this Work Plan, respectively.

The objective of the LSI is to collect data at 13 potential contaminant source units and one additional area of concern to confirm or deny the presence of contamination at levels that exceed an acceptable level of risk. These 13 potential source units were selected for the LSI because limited data are necessary to determine whether no further action is warranted, complete the RI, or provide information to determine whether early actions are necessary.

The DQOs and technical approach for the LSI at the 13 potential source units and one area of concern are described in Sections 2.5.2 and 3.2 of this Work Plan, respectively. The rationale for conducting the LSI at selected potential source units and for delaying specific investigation at the remaining 37 potential source units is described in Section 2.1.

In the field, the basewide investigation and LSI will be coordinated as much as possible to prevent duplication of effort and to facilitate the use of the support facilities at Eareckson. Data from each investigation will be reviewed for input and interpretation into the other. Additional discussion on the coordination of the basewide investigation and LSI is found in Section 3.3 of this Work Plan.

In addition to the field investigation tasks, the following technical tasks have been identified as a result of the background literature review:

- preparation of an NFAD for source unit SS12, based on discussions with ADEC and the Air Force; and

- preparation of a screening and detailed screening of alternatives report, an FS, and a proposed plan of action for potential source units LF24 and LF26, as recommended by CH2M Hill and confirmed by Jacobs during the literature search.

These documents are described in Sections 4.2 and 4.4 of this Work Plan, respectively.

1.4.2 Planning Documents

In addition to this Work Plan, a Sampling and Analysis Plan (SAP) and a Health and Safety Plan (HSP) have been prepared as companion documents.

The SAP includes two main sections: a Quality Assurance Project Plan (QAPP) and a Field Sampling Plan (FSP). The QAPP, Section 1.0 of the SAP, outlines the following quality requirements for the project:

- DQOs for measurement data;
- analytical procedures;
- sample handling and custody procedures;
- calibration procedures;
- data reduction, validation, and reporting;
- internal QC checks for field and laboratory operations;
- performance and system audits;
- procedures to assess data precision, accuracy, and completeness;
- corrective actions; and
- QA reports.

The FSP details all sample collection procedures, including sampling for surface water, groundwater, surface soil, subsurface soil, and sediments. Also described are procedures for site reconnaissance, geologic mapping, installation of well points, borehole drilling, monitoring well installation, aquifer testing, stream flow measurements, and the ecological survey. The FSP includes a discussion of the field QA/QC program, as well as record keeping in the field and site management. The FSP is Section 2.0 of the SAP.

The HSP includes all procedures to be followed in the field to ensure the health and safety of all field personnel and to prevent the inadvertent release of contaminants into the environment. A description of possible contaminants of concern along with their respective health risks is included. Accident reporting procedures and directions to the medical aid building, as well as medical evacuation procedures, are components of the HSP.

1.4.3 Subcontractors

The following sections describe the types of subcontracts that will be required for the 1993 field investigation at Eareckson.

1.4.3.1 Laboratories

Jacobs Engineering Group Inc. (Jacobs) will subcontract the following laboratories to provide analytical services:

- Enseco/Rocky Mountain Analytical Laboratories (RMAL) (Denver, Colorado), fixed laboratory services;
- Enseco/CRL (Garden Grove, California), onsite field laboratory services; and
- Enseco/CAL (Sacramento, California), dioxin analyses by method SW8280.

The process used by Jacobs to select these laboratories included review of the laboratory QAPP, Statement of Qualifications, most recent Air Force Center for Environmental Excellence (AFCEE) audit report, most recent EPA Performance Evaluation sample results (Water Pollution and Water Supply), and any associated corrective actions.

The decision to employ the use of a field laboratory is based on several factors. Eareckson AFS is an isolated and remote location; therefore, rapid turnaround of analytical results is not possible from a fixed laboratory. Also, the costs associated with sample shipment would prohibit the sole use of a fixed laboratory. The field analytical services provided by Enseco/CRL at Eareckson AFS will effectively support the basewide and LSI field sampling programs. Quick-turnaround screening data would facilitate the placement of monitoring wells and minimize the number of samples to be shipped to the fixed laboratory by identifying the critical sample locations.

The requirements for the field laboratory are less stringent than those identified for the fixed laboratory. These requirements are specified in the SAP, Section 1.0. The field laboratory will be staffed by two Enseco/CRL chemists and will include four gas chromatographs (GC). The GCs used will be model HP5890. The laboratory will supply additional equipment, such as glassware, reagents, and standard materials, that are critical to the analytical operation. A minimum of two years of hands-on laboratory experience will be required of all field laboratory chemists. An audit of the field laboratory will be conducted during the 1993 field effort. The field laboratory will conduct analyses for selected volatile compounds by methods SW8010, SW8020, and SW8015 modified. The total fuel hydrocarbons will be reported from two separate analyses. These analyses will be modifications of SW8015. The modified SW8015 method is a laboratory method very similar to the Alaska modification to SW8015. Gasoline range organics are the purgeable fuel hydrocarbon components, and diesel range organics are the semivolatile extractable fuel hydrocarbon components that will be analyzed by GC/flame ionization detector (FID). The field laboratory will characterize and identify the fuel hydrocarbons based on standard chromatograms of gasoline, diesel, JP-4, JP-8, and kerosene. See Appendix C of the SAP for the field laboratory's standard operating procedures for these methods. The field laboratory will provide rapid turnaround (24 hours), written results to the field sampling coordinator to ensure a maximum benefit to the field sampling program. These results will be for sample analyses only. The final analytical report will include a narrative, sample analyses results, and results from calibration standards, method blank, matrix spike, matrix spike duplicate, laboratory control spike, laboratory control spike duplicate, and QC check samples. The final report will be submitted by the field laboratory at the conclusion of the field activities. The sample analytical results from these analyses will be stored with all other field measurement results. Electronic deliverables will not be required for the field laboratory.

Sample locations requiring Air Force Level II (equivalent but not identical to EPA Level IV) analytical results, either through the document search or the field screening process, will be analyzed by Enseco/RMAL, located in Denver, Colorado. Laboratory capacity and capabilities have been reviewed by Jacobs personnel. An audit of Enseco/RMAL will be conducted before the receipt of any samples from Eareckson AFS to identify and address any project-specific requirements. This audit will include verification that proper corrective actions are implemented by the laboratory to comply with the AFCEE audit results. The project QA coordinator will ensure that all analytical work performed by Enseco/RMAL complies with the project-specific requirements and the Air Force IRP Handbook (U.S. Air Force, 1991c). Appendices A and B of the SAP list the deliverables that will be provided by the laboratory to comply with the required Air Force Level II analytical quality level. The analyses to be performed by Enseco/RMAL will include the following:

Parameter	Method
Volatile organics (water)	SW8260
Volatile organics (soil)	SW8240
Gasoline-Range Organics (GRO) and Diesel-Range Organics (DRO)	SW8100/SW8015 Alaska modified
Chlorinated pesticides and polychlorinated biphenyls (PCBs)	SW8080
Semivolatile organics by GC/mass spectrometry (MS)	SW8270
Inductively coupled plasma (ICP) screen for metals	SW6020
Soil cation exchange capacity (CEC)	SW9081
Soil moisture content	ASTM D4643
Grain size analysis	ASTM D422
Specific gravity	ASTM D854
Permeability	ASTM D2434
Unified Soil Classification System (USCS) designation	ASTM D2487

Unconfined compression	ASTM D2166
Atterberg limits	ASTM D4318
Common anions	E300.0
Mercury (Manual Cold-Vapor Technique)	SW7470 (liquid waste)
Mercury (Manual Cold-Vapor Technique)	SW7471 (solid or semisolid waste)

In addition, Enseco/CAL located in Sacramento, California, will receive samples from Enseco/RMAL for analyses by method SW8280. Standard chain-of-custody procedures will be followed for sample handling and shipment. Section 3.0 describes and identifies the specific sample locations for these analyses to be performed by Enseco.

1.4.3.2 Other Subcontractors

Data Validation. For this project, two types of data validation will be performed. The first type includes the review and qualification of project data based on the information contained in the analytical data summary forms. No raw data are reviewed during this type of validation. The EPA Contract Laboratory Program (CLP) equivalent data validation level is referred to as Level C. This type of data validation will be performed on 90 percent of the data packages generated by Enseco/RMAL.

The remaining 10 percent of data generated by Enseco/RMAL will undergo data validation equivalent to EPA CLP Level D. In addition to the review of data summary forms, this type of validation includes a review of the raw data. For example, validation would include an examination of actual GC/MS analyses to ensure that compounds had been identified properly and calculations performed correctly. The 10 percent of project data that will undergo this more rigorous validation will be selected by the project QA coordinator. Selection will be based on how critical the sample location is and the representativeness of the analyses.

Data validation will be conducted by QuantaLex, Inc., located in Lakewood, Colorado. Data validation will be performed in accordance with the Air Force IRP Handbook (U.S. Air Force, 1991c) and EPA guidance. Those analyses not within the scope of the national functional guidelines will be validated using protocols identified by the data validation firm. All analytical methods identified in the SAP will be validated. Appendix C of the SAP contains a brief description of the scope of work for data validation.

Drilling. Drilling services will be provided by the 11th Civil Engineering Operations Squadron (CEOS). At a minimum, the 11th CEOS will provide the following:

- all drilling equipment, including, but not limited to, hollow-stem auger, auger flights, protection gear for the 11th CEOS personnel, support vehicles, diesel fuel, and associated labor;
- all drilling materials and labor required for monitor well construction and development, including protective casing and posts for each aboveground monitoring well;

- all equipment necessary to decontaminate the drilling rig and its accessories and all drilling materials such as casing, excluding decontaminating sample collection equipment, and providing pesticide-grade hexane and methanol and deionized water for which Jacobs is responsible;

- Occupational Safety and Health Administration (OSHA)-certified and qualified crew to decontaminate drilling rig and drilling materials, install and develop monitoring wells, and drill soil boreholes; Jacobs will be responsible for collecting soil and water samples, and for purging monitoring wells before sample collection;

- drums to collect potentially hazardous material, and transportation of contained hazardous material to the holding area designated by the Station; and

- transportation of all government drilling equipment and materials from Elmendorf Air Force Base to Eareckson AFS and back; the Air Force will also transport all contractor-supplied equipment and materials to and from Eareckson on a one-time basis each way.

Surveying. Surveying well and borehole locations will be performed by a State of Alaska registered surveyor, who will be provided by the 11th CEOS. Surveying will be conducted in accordance with procedures outlined in the Air Force Handbook (U.S. Air Force, 1991c). All locations will be surveyed with a vertical accuracy of at least 0.01 foot. Horizontal accuracy for a third-order Class I survey, as specified by the Air Force Handbook, is specified to be 1 part in 10,000. Vertical accuracy for a third-order Class I survey is specified to be 2.0 millimeters by K 1/2 where K is the distance between adjacent points in kilometers. The absolute value of accuracy is relative to the distance between survey points. For example, the horizontal and vertical accuracy for adjacent points 1 mile apart would be 0.52 feet and 0.008 feet, respectively, while the horizontal and vertical accuracy for adjacent points 1,000 feet apart would be 0.10 feet and 0.004 feet, respectively.

1.5 LITERATURE REVIEW

An intensive literature search and review of available background information was conducted for this Work Plan. The literature review supplemented the records search conducted by JRBA in 1984 and maximized the use of existing data to plan the 1993 field investigation.

The background literature was obtained from the following sources:

Source	Location
11th CEOS/CEVR	Elmendorf AFB, Alaska
11th CEOS/CEOR	Elmendorf AFB, Alaska
11th CEOS/DEEM	Elmendorf AFB, Alaska
Eareckson AFS, CEO	Eareckson AFS, Alaska
Elmendorf Base Historian's Office	Elmendorf AFB, Alaska

Elmendorf Bioenvironmental Engineering	Elmendorf AFB, Alaska
U.S. Army Corps of Engineers (COE) Alaska District (chemistry, geology, and surveying)	Anchorage, Alaska
U.S. Army Corps of Engineers (COE)	Washington, District of Columbia
U.S. Geological Survey	Anchorage, Alaska and Denver, Colorado
National Cartographic Information Center	Denver, Colorado
FWS	Anchorage, Alaska
Public Library	Anchorage, Alaska
EROS Data Center	Sioux Falls, South Dakota
National Oceanic and Atmospheric Administration	Washington District of Columbia
Alaska Department of Fish and Game	Anchorage, Alaska
11th Weather Squadron	Eareckson AFS, Alaska

Information obtained from the sources listed above included the following:

- aerial photographs;
- IRP and environmental compliance reports;
- COE contaminant assessment reports;
- maps, site plans, and plates;
- Station photographs;
- ecological management plans and refuge management information;
- logs from more than 1,500 soil boreholes and test pits;
- Alaska Cleanup Effort reports; and
- climatological databases.

The information was reviewed to gather background data about previous investigations conducted on Shemya Island and other Aleutian islands, previous waste handling practices, past Station activities, environmental setting, potential source units, and current Station conditions.

The information that was obtained during the literature review is incorporated into the following sections of the Work Plan and, as appropriate, into the SAP. Section 2.0 summarizes the information pertaining to the environmental setting on Shemya Island. Section 2.0 also includes the historical and current conditions and status of potential source units identified during the literature search conducted by JRBA and other data gathering activities. The rationale for the 1993 field investigation activities is described in Section 3.0 and is based on the results of the literature review. Throughout the Work Plan, the sources of information and the results of the literature review are included for reference. Each reference is also listed in Section 6.0 (References). References to records and information obtained from the 11th CEOS do not include the specific division because many of the records are contained in more than one division file.

2.0 SUMMARY OF EXISTING INFORMATION

Information contained in this section was obtained through a background literature review of available documents, maps, and photographs, as previously described in Section 1.5. This information includes descriptions of the environmental setting of Shemya Island, potential source units, preliminary conceptual site models, and DQOs for the 1993 field investigation.

2.1 SHEMYA ISLAND ENVIRONMENTAL SETTING

The environmental setting of Shemya Island is described in the following sections. A summary of information obtained from review of existing data is presented, as well as a discussion of data gaps.

2.1.1 Demography

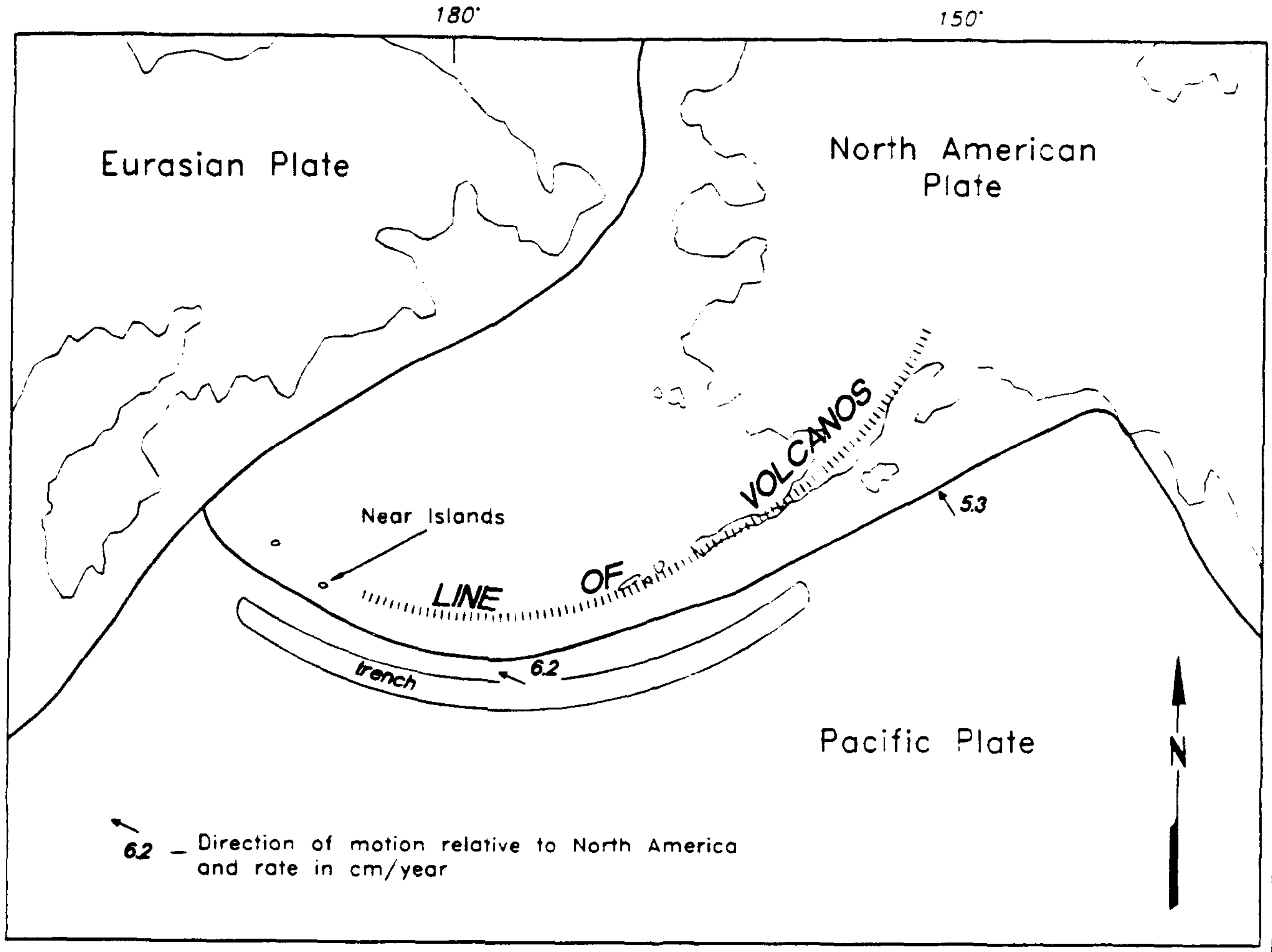
There are approximately 700 people assigned to Eareckson AFS. Approximately 400 of those people are Air Force personnel who operate and maintain the structures, utilities, and exterior facilities, and provide Station support. Assignments are one year in duration. During the summer season, the Station population may increase by an additional 200 to 400 people (primarily contractors that provide construction and support services) (U.S. Air Force, 1992a). Transient population includes environmental contractors and government agency representatives. Dependents are not allowed on Eareckson AFS (i.e., the assignment is an unaccompanied tour); therefore, the Station has a demographic cross section unique to remote stations. In addition, Air Force personnel are frequently transitional as a result of their one-year assignments.

2.1.2 Geology

A discussion of the geology and geomorphology of Shemya Island is presented below.

2.1.2.1 Regional Geology

Shemya Island is situated near the western end of the Aleutian Island Archipelago (Aleutian Arc). The Aleutian Islands, along with the Aleutian Range on the Alaska Peninsula, form an arcuate feature, more than 1,500 miles long and 100 to 300 miles wide, that is seismically active. This volcanic arc formed at the boundary between the North American and Pacific tectonic plates where the Pacific plate is being consumed by subduction beneath the North American plate. Figure 2.1.2-1 shows the Aleutian Arc, the North American and Pacific plates, and relative motions of the plates. The Pacific plate is being subducted beneath the North American plate along the Aleutian Arc at a rate of approximately 6 centimeters (cm) per year (LePichon, 1968). In the western Aleutian Islands, this motion is not pure dip-slip but contains an element of strike-slip motion because of the geometry of the arc (Isacks, et al., 1968). The number of volcanoes and rate of volcanism are relatively less in the western Aleutian Arc than in the eastern Aleutian Arc, for this reason. The western Aleutian Arc volcanics are dominated by eruptions of andesite and basaltic andesite composition. Only very minor quantities of more silicic material such as rhyolite are known (Coats, 1962).



(modified from Le Pichon, 1968 and Isacks, Oliver and Sykes, 1968)

Figure 2.1.2-1

Plate Tectonic Relationships
in the Aleutian Island Archipelago

The Aleutian Islands are extremely active both seismically and volcanically because of their position along a consuming plate boundary. Approximately 7 percent of the world's earthquakes occur along the Aleutian Arc (TRA/Farr, 1988). The Prince William Sound earthquake of 1964 had a magnitude of 8.4 to 8.6 on the Richter scale; the largest recorded seismic event in North America (Foster, 1969). Areas of land mass were uplifted by as much as 8 meters during this event (Plafker, 1965). Shemya Island experienced major seismic events in 1965 and 1975 with magnitudes greater than 7.5 on the Richter scale.

Many of the western Aleutian Islands have volcanoes that are believed active. These islands include Kasatochi, Great Sitkin, Kanaga, Tanaga, Gareloi, Semisopochnoi, Little Sitkin, Segula, and Kishka, which are located at distances of approximately 150 to 450 miles east of Shemya Island. The volcanoes are made up of interbedded basaltic and andesitic lava flows, pyroclastics, mud flows, and volcaniclastic sediments. Based on historic observations dating from 1760, a mild eruption can be expected ,ı average of every six years in the western Aleutian Islands (Coats, 1956). The ‹ ·treme westernmost section of the Aleutian Island chain is relatively inactive both seismically and volcanically. Shemya Island has probably not been a site of active volcanism since late Tertiary or early Quaternary (Gates, et al., 1971).

Shemya Island is part of the Near Islands Group, the westernmost group of islands in the Aleutian Islands (Figure 1-1). The group consists of Attu, Agattu, Shemya, Alaid, and Nizki islands; the latter three islands are called the Semichi Islands. Attu is the largest of the Near Islands with an area of about 300 square miles. The Semichi Islands each have an area of less than 6 square miles. The Near Islands are composed of rocks ranging in age from Mesozoic through late Tertiary/early Quaternary age (Gates, et al., 1971). In contrast with the majority of the Aleutian Islands, the Near Islands do not have any Holocene or historically active volcanoes. The present morphological character of these islands has been determined mainly by preglacial marine and subaerial erosion.

The following paragraphs are modified from *Geology of the Near Islands, Alaska* (Gates, et al., 1971).

The oldest rocks of the Near Islands are a thick, heterogeneous sequence of cherts, argillites, graywacke, conglomerate, tuff, tuff breccia, and pillow lavas deposited in a tectonically and volcanically active marine environment. These rocks are late Mesozoic to early Tertiary in age. The depositional environment has considerable relief, indicating there may have been ancestral islands during this period. This heterogeneous rock sequence forms the basement rocks on Attu and Agattu. Uplift accompanied by deformation then led to subaerial erosion of the basement rocks. The detritus was uncomfortably deposited as marine gravels, conglomerates, and graywackes on the basement rocks. These rocks now constitute the Krugloi, Nevidiskov, Chuniksak, and Chirikof formations found on parts of Attu and Agattu. Gabbro and diabase dikes, sills, and small irregular plutons were then intruded into both the basement rock and overlying formations. Minor, small plutons of soda granite and keratophyre were probably emplaced at this time.

The area was uplifted during the middle Tertiary period accompanied by extensive dip-slip and strike-slip faulting. All of the Near Islands except Shemya were emergent at this time. Stream gravels, volcanic mudflows, and hornblende-bearing lava flows were deposited on a subaerial erosion surface known as the Massacre Bay formation of eastern Attu. At approximately this time, the muds and silts that formed the basement rocks of Shemya were being deposited in a marine environment. Later, submarine andesitic and basaltic tuffs were erupted accompanied by small plugs of basalt in the area that would become Shemya. Dip-slip and strike-slip faulting continued in the area of the Near Islands throughout the late Tertiary period. Shemya Island probably emerged from the sea at this time.

Glacial effects of the Pleistocene Wisconsinan Age are prominent on the mountainous highlands of Attu and Agattu. The Semichi Islands, although at much lower elevations were probably covered by ice sheets that spread beyond the present shorelines and may have merged into a single ice sheet. Post-glacial erosion and deposition have been slight in most places. Post-glacial weathering of bedrock and movement of debris on slopes has been accomplished largely by frost action. A marine bench cut in bedrock along many shorelines backed by inactive sea cliffs suggests post-glacial lowering of sea level or regional uplift of about 5 to 10 feet (Stearns, 1941). Fault scarplets cutting the turf mantle at locations on Attu suggest that faulting, deformation, and uplift are still occurring in the Near Islands.

2.1.2.2 Geology of Shemya Island

Shemya Island is just over 4.5 miles long and is approximately 1.9 miles wide. The surface of the island is a gently rolling plateau sloping uniformly to the southwest and south-southwest from altitudes of 200 to 275 feet at the crest of the north shore cliffs down to 25 to 75 feet along the south shore. The bedrock surface of the island was interpreted by Gates, et al. (1971) as a wave-cut platform that is covered by a veneer of marine gravel and sands. The platform was subsequently glaciated with partial removal of the marine deposits and with deposition of tills and outwash sand and gravel. Bedrock surfaces near the west and east quarries contain local evidence of both marine planation and glaciation (Gates, et al., 1971). However, there is no clear distinction or unconformity seen in extensive exposures of sand and gravel to indicate separate glacial and marine deposits.

Steep sea cliffs dominate the shoreline of Shemya, particularly on the north side. Shore platforms, which are generally narrow, have developed around Shemya Island. The sea cliffs are currently covered by thick growths of vegetation and are no longer being actively eroded. Archeological evidence shows that most sea cliffs throughout the Near Islands have been inactive for at least several centuries. The inactive cliffs indicate a general post-glacial change of relative sea level in the Near Islands of about 5 to 6 feet (Stearns, 1941).

Unconsolidated surface material on Shemya Island can be readily broken down into three types: sand, gravel, and peat. Some of the sand and gravel deposits may have originated as glacial till or marine deposits. Frost-breaking of rock may be responsible for a significant fraction of the sand and gravel deposits on the island. The relatively uniform distribution of precipitation through the year, the low evaporation rate, and the abundance of moisture-retaining vegetation and peat combine to maintain a high-moisture content in the ground, which is conducive to strong frost action. A ubiquitous mantle of frost-broken material is present that shows a wide range of particle sizes from silt and sand to coarse gravels (Gates, et al., 1971). Examination of approximately 1,500 geotechnical borehole logs from hollow-stem auger boreholes, backhoe trenches, and pits indicated that there is little physical differentiation between unconsolidated deposits of sand and gravel and the upper zone of the bedrock. Gates, et al. (1971) indicate that the bedrock surface has been "shattered" by frost action in many places. The thickness of the frost-shattered zone is dependent on the strength properties of the underlying bedrock lithology. Exposures on Agattu show that the thickness of the zone is greater than 6 feet, locally (Gates, et al., 1971).

Sand deposits of considerable thickness have also been formed on Shemya Island as eolian deposits. The low-lying western one-third of the island and a 1,000- to 3,000-foot wide zone along the south side of the island are covered by sand dunes. Aerial photographs taken in early 1943, which predate military activities on the island, show that many of these sand dunes were still active at the time the photographs were taken. The source of this sand has been from adjoining beaches. Boreholes revealed that these sand deposits are locally greater than 40 feet thick. Local eolian sand deposits up to 15 feet thick also cap the cliffs along the northern edge of the island. These sand deposits are composed of material blown from the beach below the cliffs by strong onshore winds (Gates, et al., 1971).

There has been little erosion or redeposition of unconsolidated clastic material on Shemya Island since the end of glaciation. Low relief over much of the island combined with a thick covering of vegetation has prevented the remobilization of clastic materials, with the exception of beach sands, to the sand dunes.

Peat deposits of varying thickness cover much of Shemya Island. Peat is a component of muskeg, which comprises a surficial layer of living vegetation and a sublayer of peat (partially decomposed plant debris) (MacFarlane, 1969). According to MacFarlane (1969), peat deposits generally accumulate when excess water and restricted drainage result in oxygen-depleted, acidic conditions that inhibit the decay of plant debris. Conditions of oxygen demand and pH within the peat deposits of Shemya Island are not known. Deposits of peat up to 15 feet thick occur locally on the island. Most of the peat deposits are from grass roots down to a substratum of bedrock or clastic material. However, examination of borehole logs indicates that, locally, peat deposits may be covered by up to 10 feet of sand or gravel particularly in areas of Station construction. Such sand and gravel deposits that overlie peat probably represent fill related to construction, although they are generally not described as such in the borehole logs.

A series of maps has been prepared using approximately 1,500 borehole logs provided by the Alaska Corps of Engineers. Although most of these boreholes were drilled for geotechnical purposes, valuable information regarding the geology and hydrogeology of Shemya Island was also obtained. The boreholes were not evenly distributed over the island; therefore, the degree of confidence for the basewide maps varies with locality. The maps show distribution and thickness of unconsolidated materials and depth to bedrock.

Figure 2.1.2-2 shows that surface distribution of unconsolidated materials has been subdivided into sand, gravel, and peat. This map is not intended to indicate that only a single category of material is present at any given location on the island, but, rather, that the majority of material encountered in boreholes consisted of a given type. This map is broadly confirmed by the earlier observations of Gates, et al. (1971). The western one-quarter of the island is covered with thick sand deposits. Thicknesses of sand greater than 40 feet were recorded at the northern end of Runway B. Extensive sand deposits are found all along the south margin of the island, and along the island margin south and west of the New Cobra Dane. In contrast to what Gates, et al. (1971) reported, sand deposits were encountered in boreholes along the northern margin of the island only between Grace Lake and Old White Alice; the remainder of the northern margin consists of gravel or peat deposits.

Peat deposits form a highly irregular zone that runs diagonally across the island, roughly from the New Cobra Dane southeast to the eastern end of the main runway. Peat deposits in the northern portion of this zone often rest directly on bedrock, or on a veneer of gravel resting on bedrock. The peat deposits in the southeastern portion of the zone generally are over sand or gravel deposits.

Gravel deposits, as determined from borehole logs, comprise a highly irregular zone that is parallel to the peat zone on its northeast side. Gravel deposits greater than 20 feet thick are widespread west of Myrtle Lake (Figure 2.1.2-2).

Figure 2.1.2-3 is an isopach map showing the thickness of unconsolidated surface deposits. This map shows that most of the island is covered by deposits ranging in thickness from 10 to 20 feet. There is an irregular zone running diagonally across the island in a southeast-northwest direction in which deposits of unconsolidated material are less than 10 feet thick. This zone roughly correlates with the zone of peat deposits.

Geologically, Shemya Island is very young. The bedrock units range in age from middle to late Tertiary or early Quaternary (between approximately 30 million and 2 million years before present). The entire bedrock sequence was planed off by marine erosion in late Tertiary or early Quaternary time, then uplifted and tilted slightly to the south. Figure 2.1.2-4 shows the bedrock geology of Shemya Island. Bedrock on the western half of the island consists mainly of fine-banded argillites, limey argillites, siltstone, graywackes, and conglomerates that dip 30 to 60 degrees northwest (Gates, et al., 1971). At the head of Alcan cove, lavas have been silicified and pyritized. Oxidation of the sulfides in the surface and near surface environment in this area could produce acidic groundwater conditions in which metals could be mobile. Bedded tuffaceous sedimentary rocks crop out along the southern coast to the western tip of the island. Locally, these rocks show evidence of folding and faulting.

The eastern half of the island is composed of submarine pyroclastics and hypabyssal intrusives. These rocks overlie the sedimentary rocks exposed on the western half of the island. The pyroclastic rocks are found chiefly on the northeastern part of the island and dip gently to the northwest. The pyroclastics are cut by basalt pipes, which may be feeders for some of the pyroclastics. The youngest bedrock units are feldspar and hornblende porphyry intrusives that crop out along the northeast and southeast shores and locally inland.

Bedrock lithology is only rarely described in the borehole logs provided by the Alaska COE. The descriptions presented tend to be very terse, with the exception of a few deep boreholes. However, the information available from borehole logs broadly correlates with the geologic map by Gates, et al. (1971) shown in Figure 2.1.2-4.

On Shemya Island, intense shatter zones that cut the island are related to faulting; however, displacement is unknown because of the lack of distinctive marker horizons. The Near Islands have been cut by numerous faults, which are best exposed on Attu. Many more faults probably exist on Shemya Island in addition to those indicated on the geologic map (Figure 2.1.2-4), but lack of distinctive marker horizons, coupled with lack of exposure, has made recognition of faults difficult.

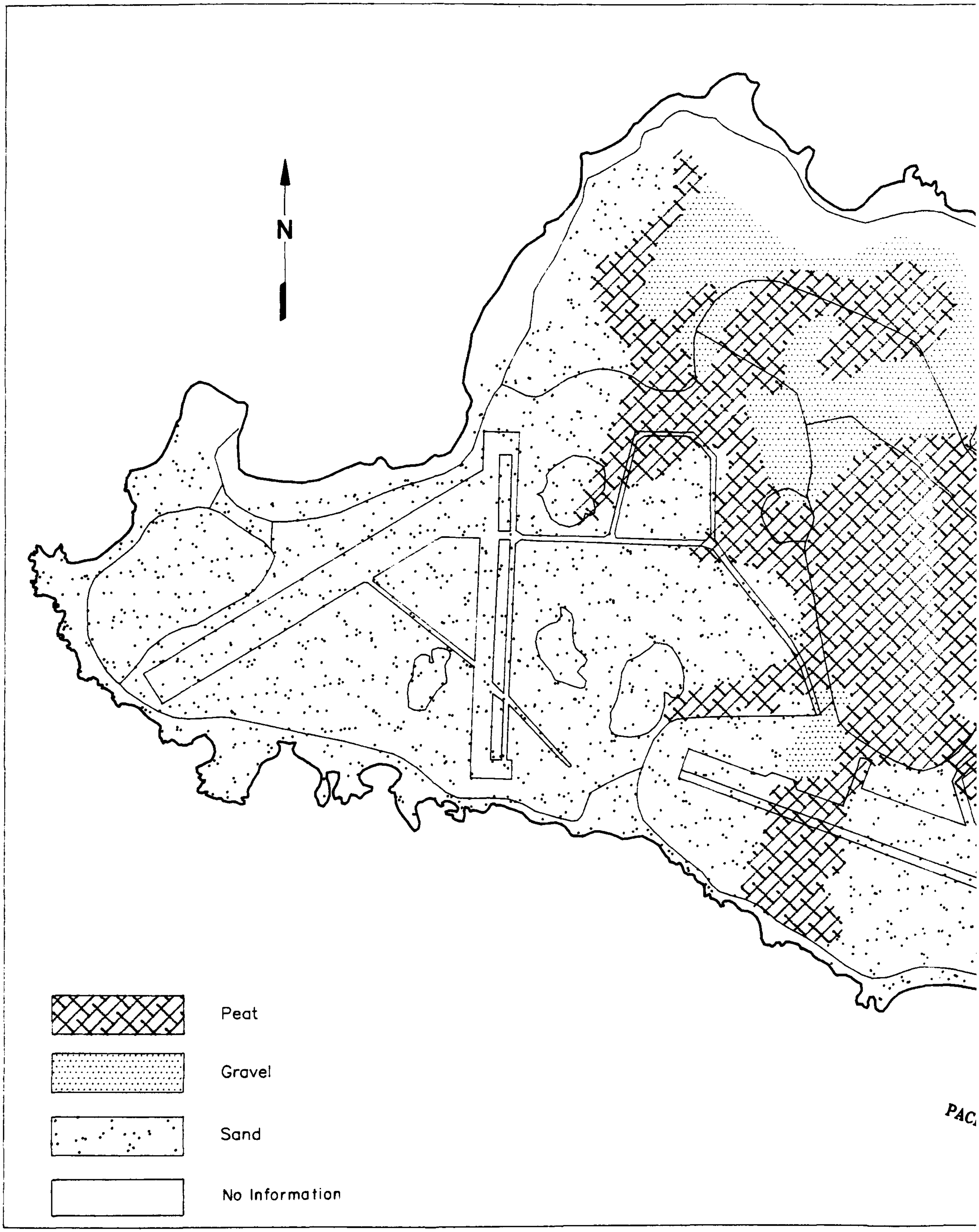
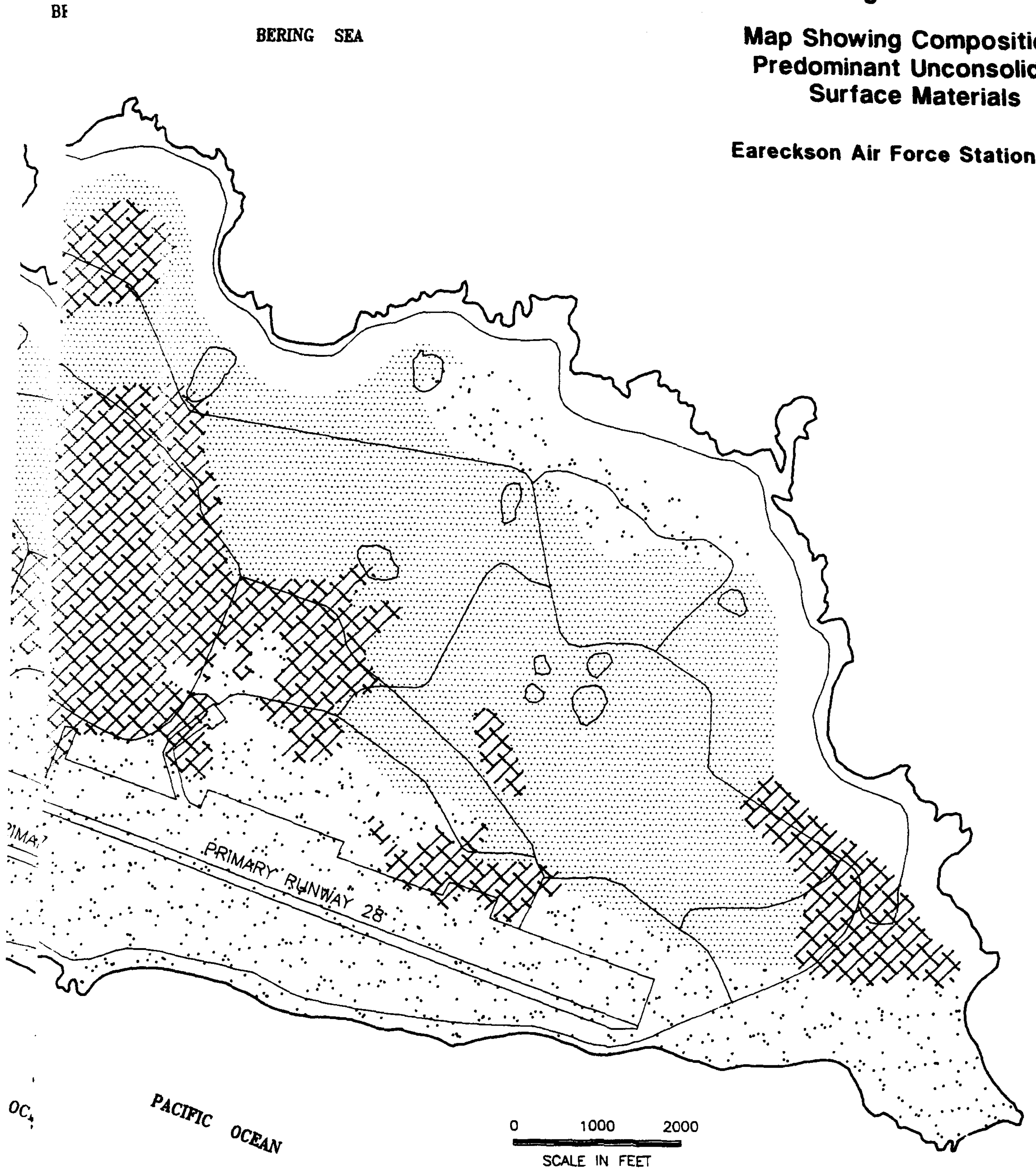

N
Peat
Gravel
Sand
No Information
PAC

Figure 2.1.2-2

Map Showing Composition of Predominant Unconsolidated Surface Materials

Eareckson Air Force Station, Alaska



(oversized)

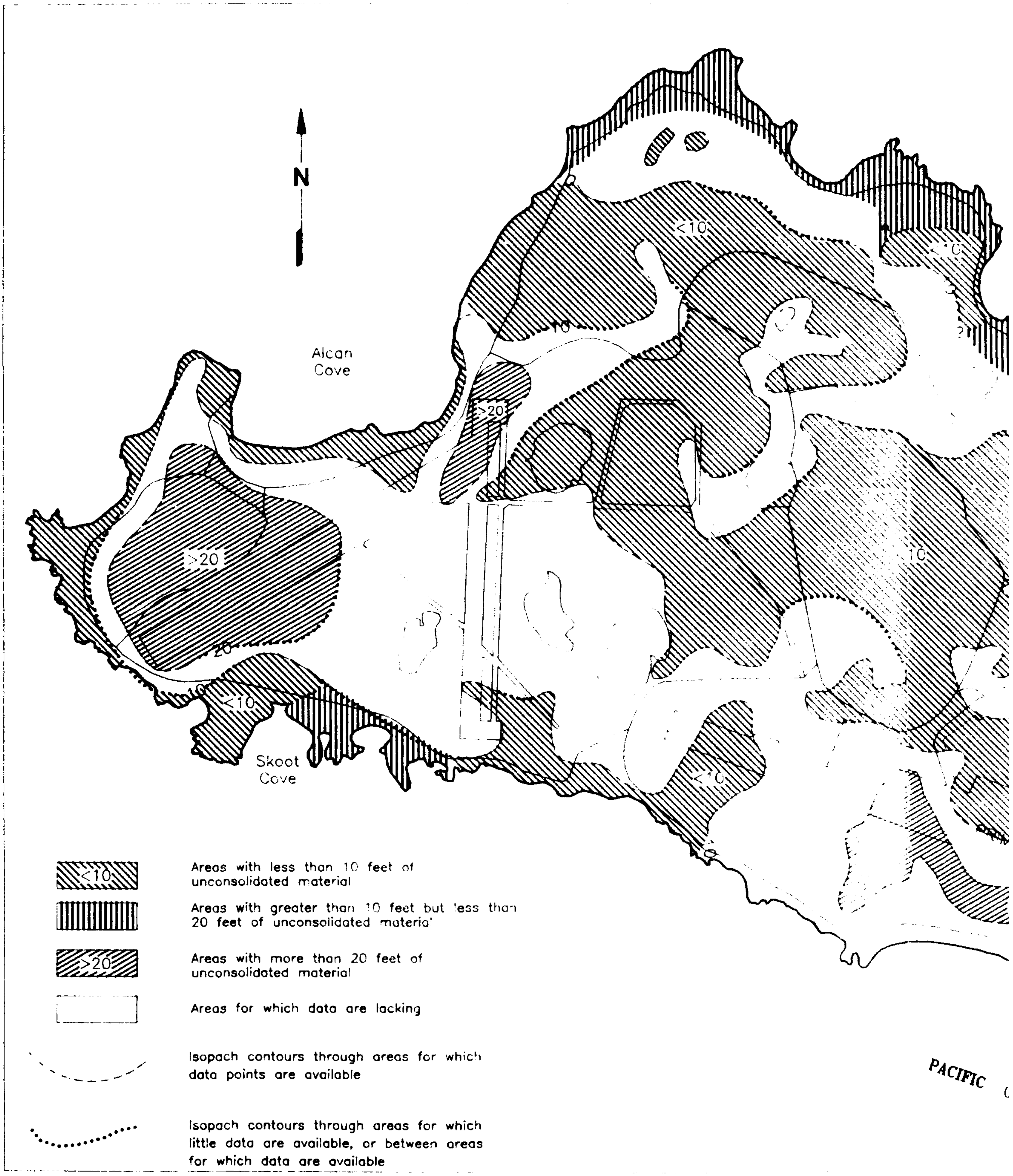
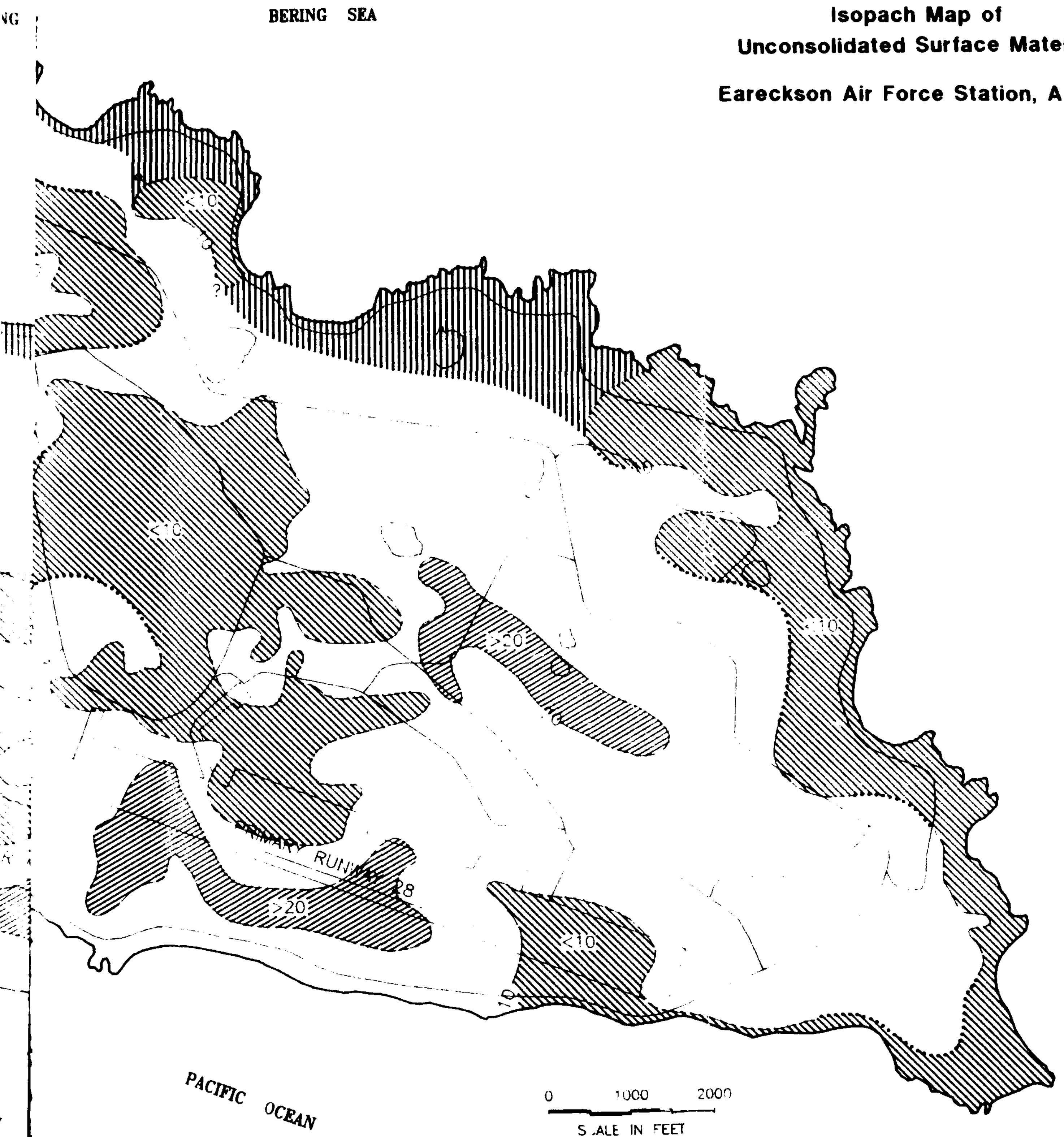

N
Alcan
Cove
Skoot
Cove
<10
>20
10
20
PACIFIC
Areas with less than 10 feet of unconsolidated material
Areas with greater than 10 feet but less than 20 feet of unconsolidated material
Areas with more than 20 feet of unconsolidated material
Areas for which data are lacking
Isopach contours through areas for which data points are available
Isopach contours through areas for which little data are available, or between areas for which data are available

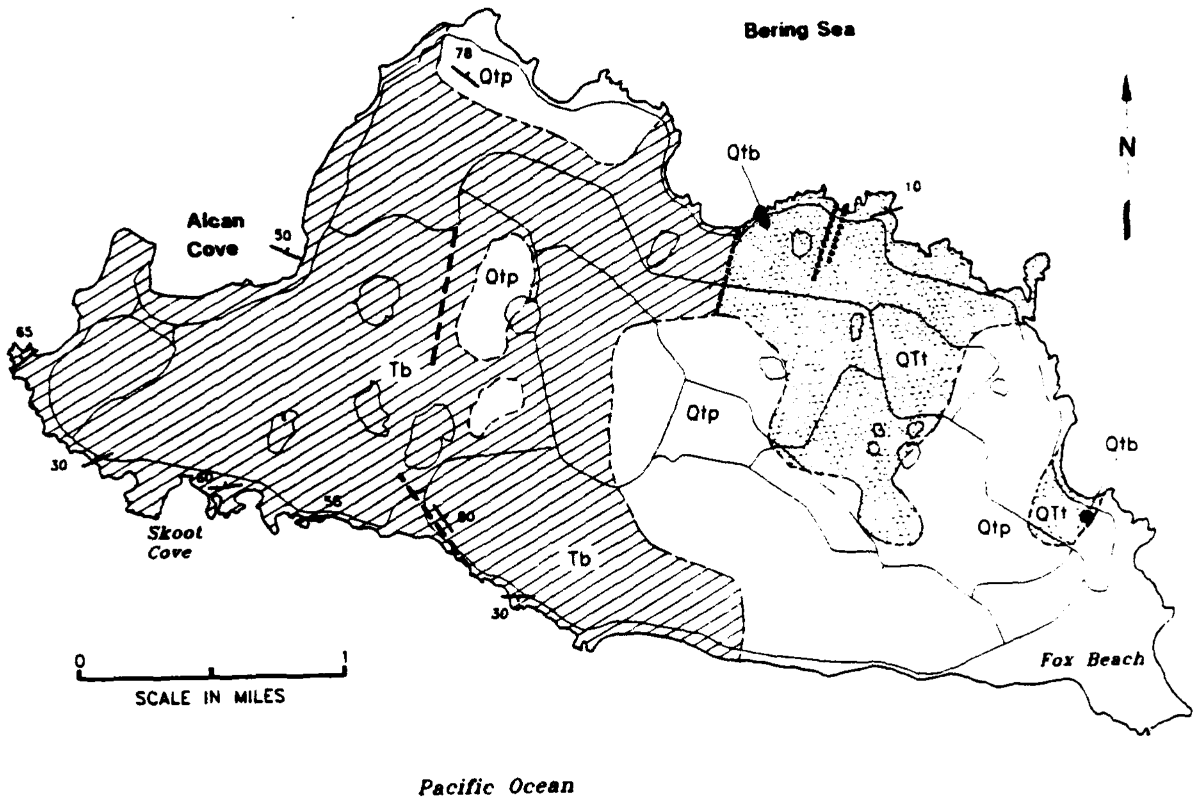
Figure 2.1.2-3

Isopach Map of Unconsolidated Surface Material

Eareckson Air Force Station, Alaska



(oversized)



EXPLANATION

Qtb	Basalt porphyry	Tertiary or Quaternary	
Qtp	Hornblende porphyry *Includes some porphyry rich in plagioclase phenocrysts*		
QTt	Andesitic and basaltic tuff and tuff-breccia		
Tb	Basement rocks *Siliceous and limy argillite and conglomerate; Includes some tuff-breccia*	Tertiary	

Contact
Dashed where approximately located

Fault
Dashed where approximately located, short dashed where fracture or fault is inferred from mapping or aerial photographs

65 Strike and dip of beds

Figure 2.1.2-4

Geologic Map of Shemya Island
Eareckson Air Force Station, Alaska

Source: Gates et al., 1971

Additional faults can be inferred from bedrock topography. Bedrock topography broadly follows surface elevation on the island (Figure 2.1.2-5). However, a bedrock topography map prepared by Jacobs shows the presence of subsurface drainage and ridges on the bedrock surface. The bedrock drainages represent zones through which the bedrock lithologies are considerably less competent than in adjacent areas. The bedrock drainages indicate linear trends, and possibly represent fault zones or zones of structural weakness. The inferred faults are shown on the map showing bedrock topography (Figure 2.1.2-5). This interpretation is supported by the USGS (Gates, et al., 1971) geologic map (Figure 2.1.2-4) that shows faults east of Headquarters Lake and north of Lower Lake, which are continuous with faults inferred by Jacobs from the bedrock surface.

2.1.3 Groundwater

There are two potential aquifers on Shemya Island. The shallow aquifer occurs in surface deposits of unconsolidated material and the deep aquifer occurs in bedrock. The primary source of water for Station activities on the island is a water gallery that collects water from the shallow aquifer. The backup water supply consists of two bedrock wells in the deep aquifer.

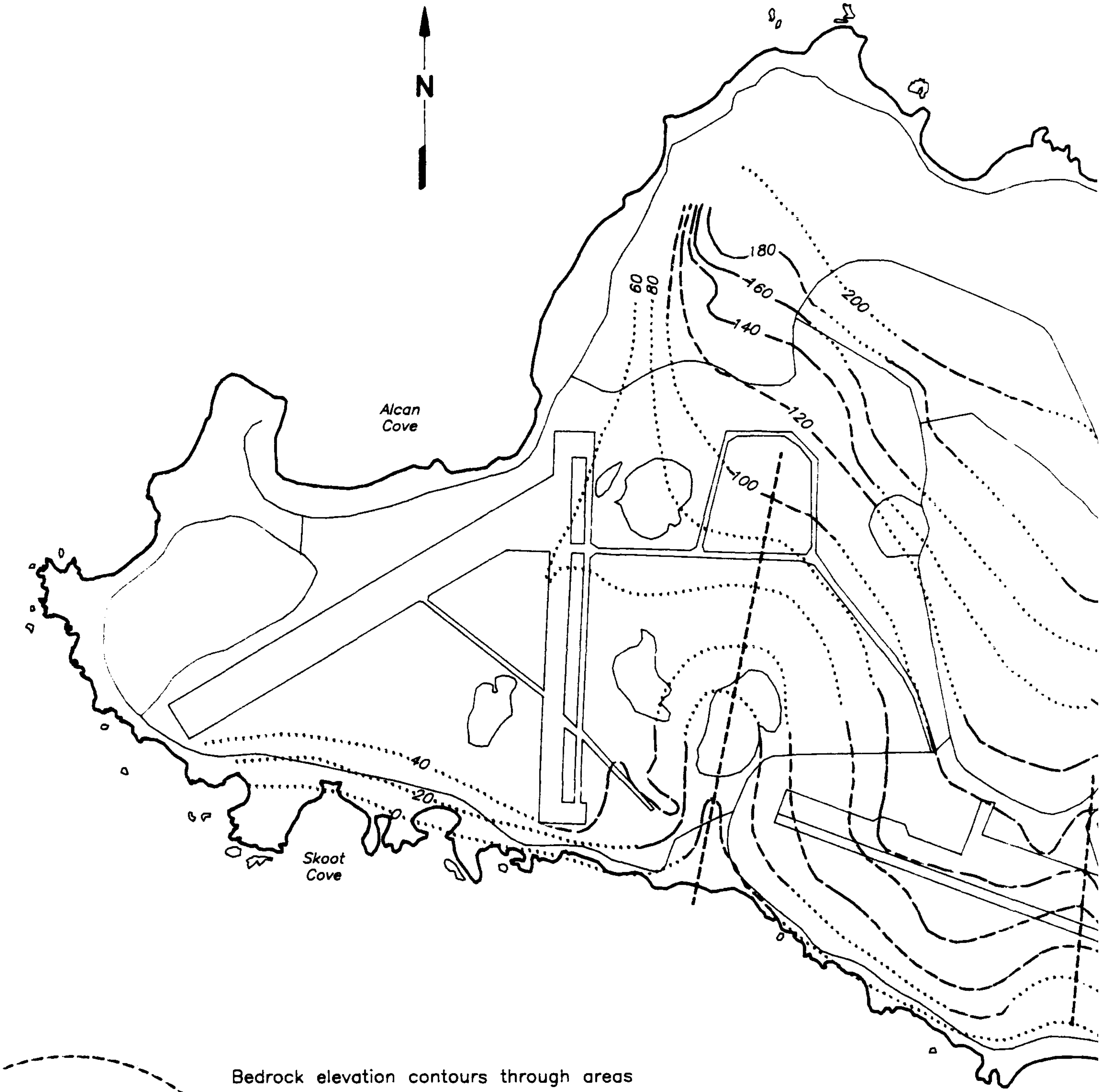
There may be an aquiclude that separates the deep aquifer from the shallow aquifer. According to Smith (1958), there is "an impervious layer of decomposed igneous rock, weathered to silt consistency overlying the rock of the island, and precluding the inflow of any appreciable quantity of surface water. Jointing in the rock is deep and extensive, but the joints are closed with decomposition products carried down from the surface." It is not known where Smith made his observations of the aquiclude and whether they are broadly or only locally applicable. It is also not known how effective this aquiclude is in blocking the flow of water from the shallow aquifer to the deep aquifer.

2.1.3.1 <u>Shallow Aquifer</u>

The shallow aquifer occurs in surface deposits of unconsolidated material. These deposits consist of sand and gravel, although locally, deposits of peat are important aquifer hosts. Most of the clastic unconsolidated material originated as eolian or glacial deposits, although there is evidence that indicates some of the deposits may be of marine origin (see Section 2.1.2). Water in these aquifer materials occupies primary openings, or space between particles. The porosity of the surface unconsolidated deposits on Shemya Island has not been measured.

The primary source of groundwater recharge for the shallow aquifer is precipitation. Infiltration rates for surface materials on Shemya Island have not been measured. Precipitation appears to be rapidly transmitted to springs as can be seen from Figure 2.1.3-1, which shows that the discharge rate for Gallery Spring changes very rapidly with changes in precipitation (Feulner, et al., 1976).

The shallow aquifer is generally 5 feet to 10 feet below ground surface (bgs) and beneath unconfined conditions (Brown, 1991). The bottom of the shallow aquifer is the interface between unconsolidated surface materials and bedrock. Borehole log lithologic descriptions indicate that in many places this interface may be gradational, possibly a result of strong disruption in the bedrock surface by frost action. An aquiclude resulting from weathering decomposition of lithic materials may also be present near the bottom of the unconsolidated material/bedrock interface (Smith, 1958).



Bedrock elevation contours through areas for which data points are available

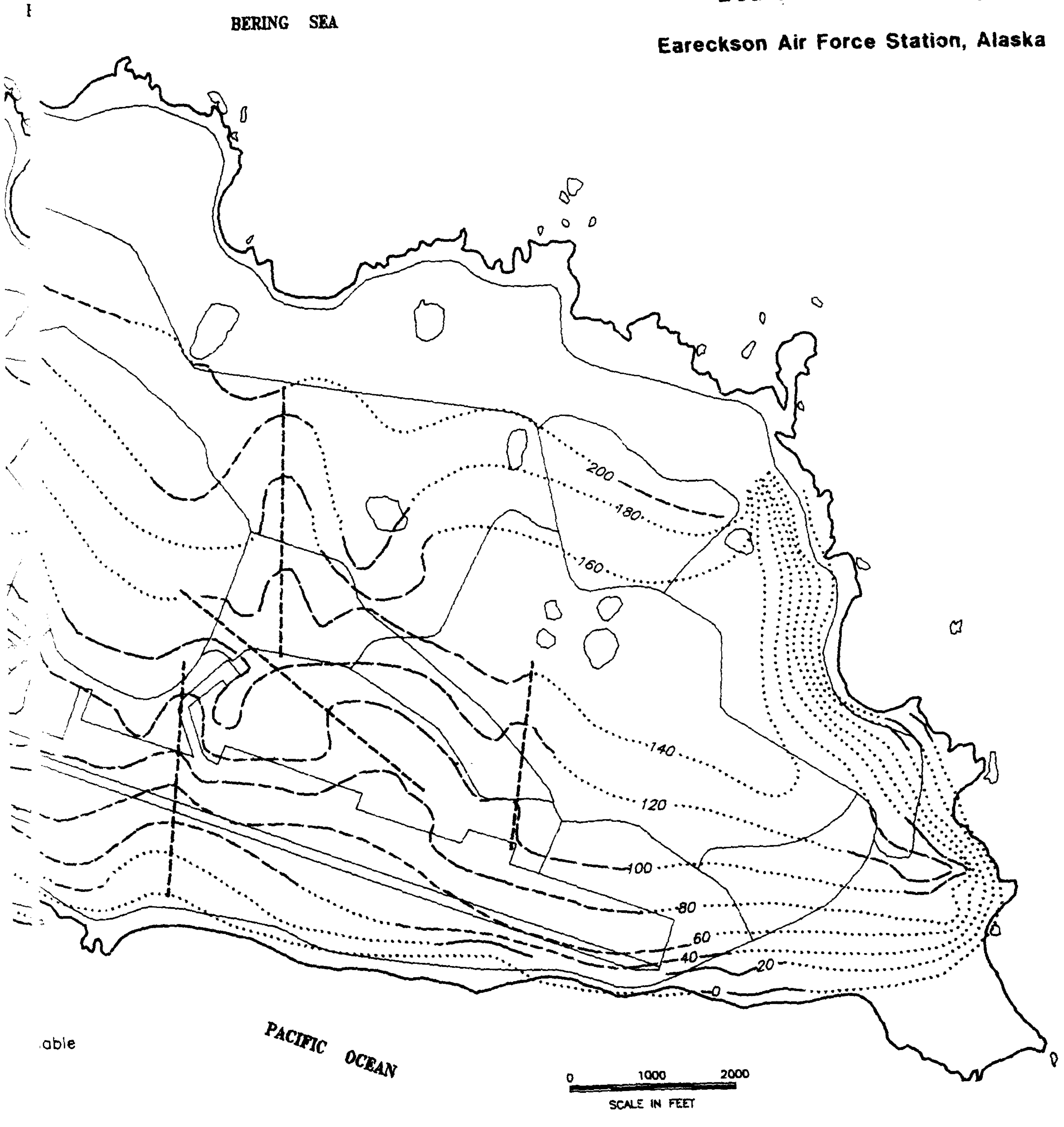
Bedrock elevation contours through areas for which little data are available or between areas for which data are available

Possible structural zones inferred from bedrock topography

Figure 2.1.2-5

Bedrock Elevation Map

Eareckson Air Force Station, Alaska



(oversized)

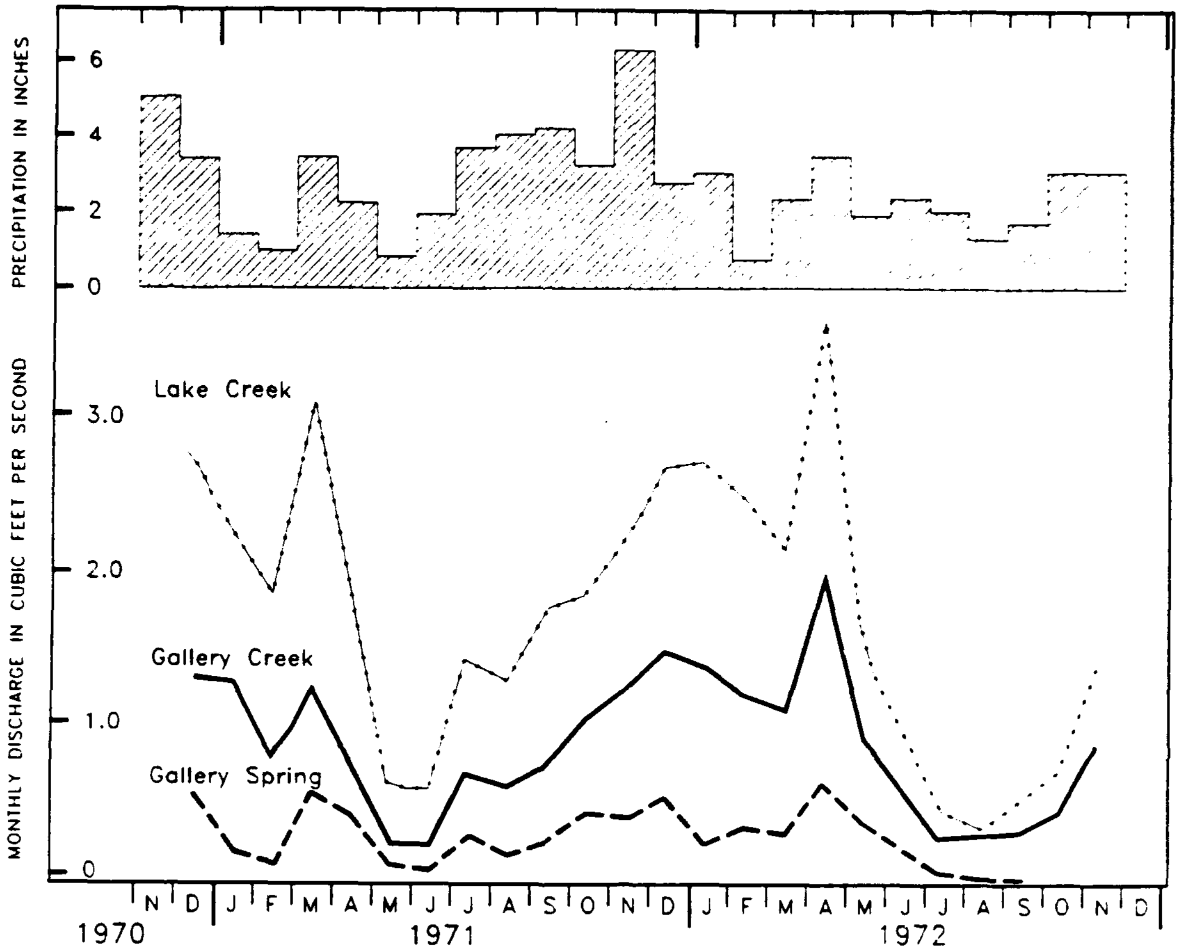


Figure 2.1.3-1

Precipitation Data from a Gauge Near the South Shore and Discharge Measurements from Gauging Stations, Shemya Island (Gates et al., 1971)

A potentiometric surface map of the shallow aquifer has been prepared using data from approximately 1,500 borehole logs and is shown as Figure 2.1.3-2. It should be noted that the potentiometric surface map was prepared from data collected at various dates and from boreholes in which groundwater conditions may not be representative of static conditions. Water-level information is not recorded in all borehole logs, and some monitoring wells were dry. It is not known if the apparently dry boreholes failed to intersect the water table, or if they were abandoned before groundwater could migrate into the borehole.

Table 2.1.3-1 presents specifications for previously constructed monitoring wells in the shallow aquifer. Existing wells are shown on Plate 1. The potentiometric surface map includes only select areas of the island because the locations of the available data for groundwater are not uniformly distributed. The bulk of the available groundwater data is for locations immediately north of the main runway and between the western end of the main runway and Runway B. The potentiometric surface map indicates that groundwater flow north of the main runway is generally to the south, and groundwater flow east of Lower Lake is generally to the west.

The hydraulic gradients indicated by the potentiometric map generally range from 0.028 to 0.054 and average approximately 0.035. These values reflect the overall topographic gradient of the island. Locally, over limited distances of 200 feet or less, hydraulic gradient values can approach 0.10. On the western side of the island in the area of Runways B and C, hydraulic gradients are relatively low with values of 0.010 and less. This area is characterized by a relatively subdued topography and thick deposits of eolian sand.

In general, the direction of groundwater flow in the shallow aquifer mimics the flow of surface water, because both the surface topography and bedrock topography slope to the south over much of the island. However, the potentiometric surface map indicates that there is little apparent correlation between groundwater drainage divides and surface drainage basin divides, which are now defined by relatively subtle topographic features and have been significantly modified by the construction of roads, ditches, culverts, pipelines, and other constructed features since military occupation of the island. Bedrock topography and other hydrogeologic features, such as areas of groundwater infiltration or variable hydraulic conductivities, do not correspond to those features that control the surface water drainage divides. The greatest discrepancy between the shallow aquifer and surface water drainage divides is in Management Zone 3A (Figure 2.1.3-2). Management zones are described in Section 2.3. Potentiometric surface contours are not deflected as they cross the east surface drainage divide of Management Zone 3A. The potentiometric surface contours at elevations of 125 and 130 feet in the center of Management Zone 3A are strongly bent to the south. These contours indicate a prominent groundwater divide in the shallow aquifer in the center of the surface water drainage basin 3A because groundwater flow is perpendicular to potentiometric surface contours. This indicates that the direction of groundwater flow may locally be divergent from the flow of surface water, although generally the direction of both groundwater and surface water migration is similar.

The potentiometric surface map also shows the presence of a west-southwest trending groundwater ridge near the western end of the main runway. It is not known if this ridge represents a zone in which relatively greater amounts of water

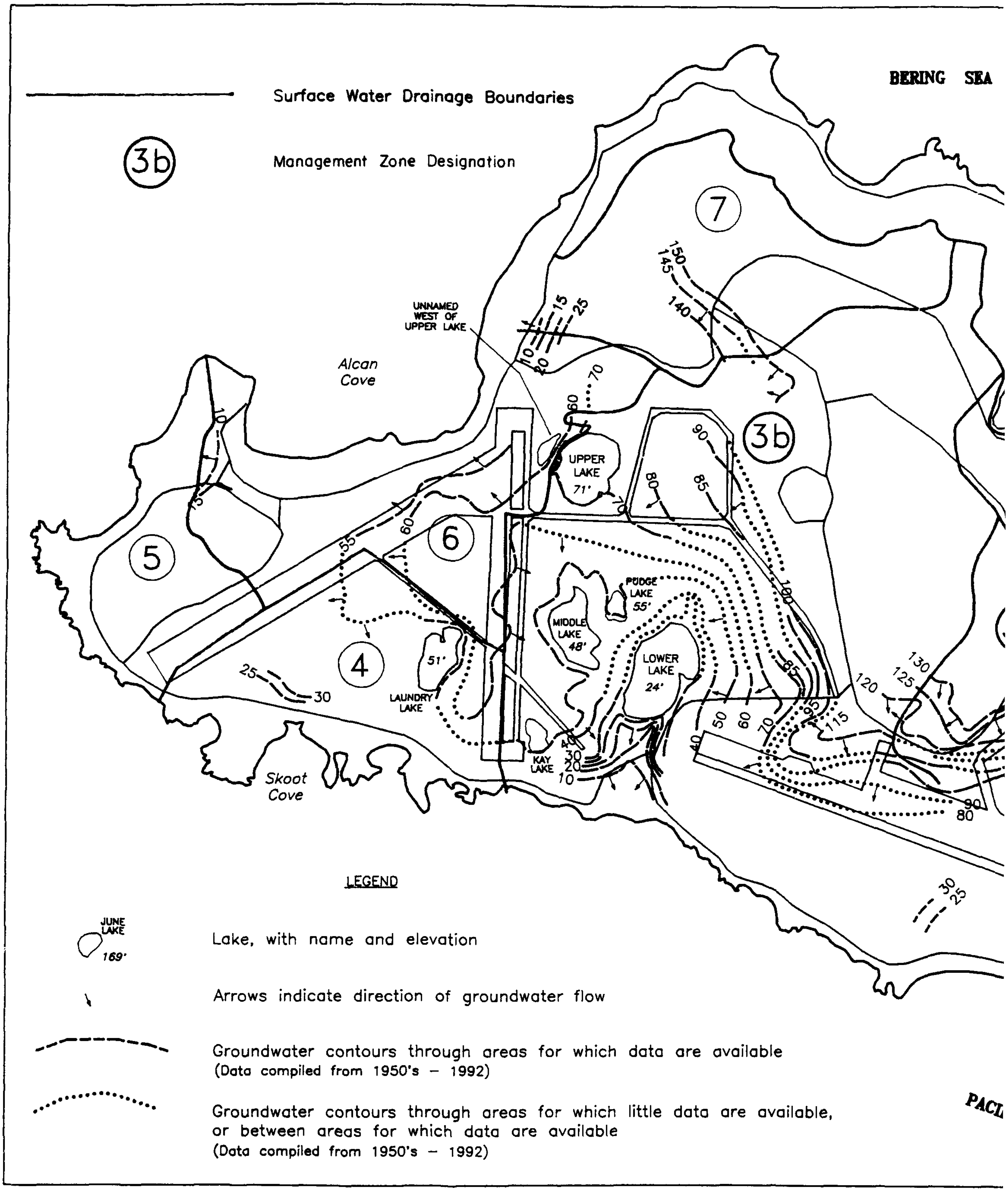
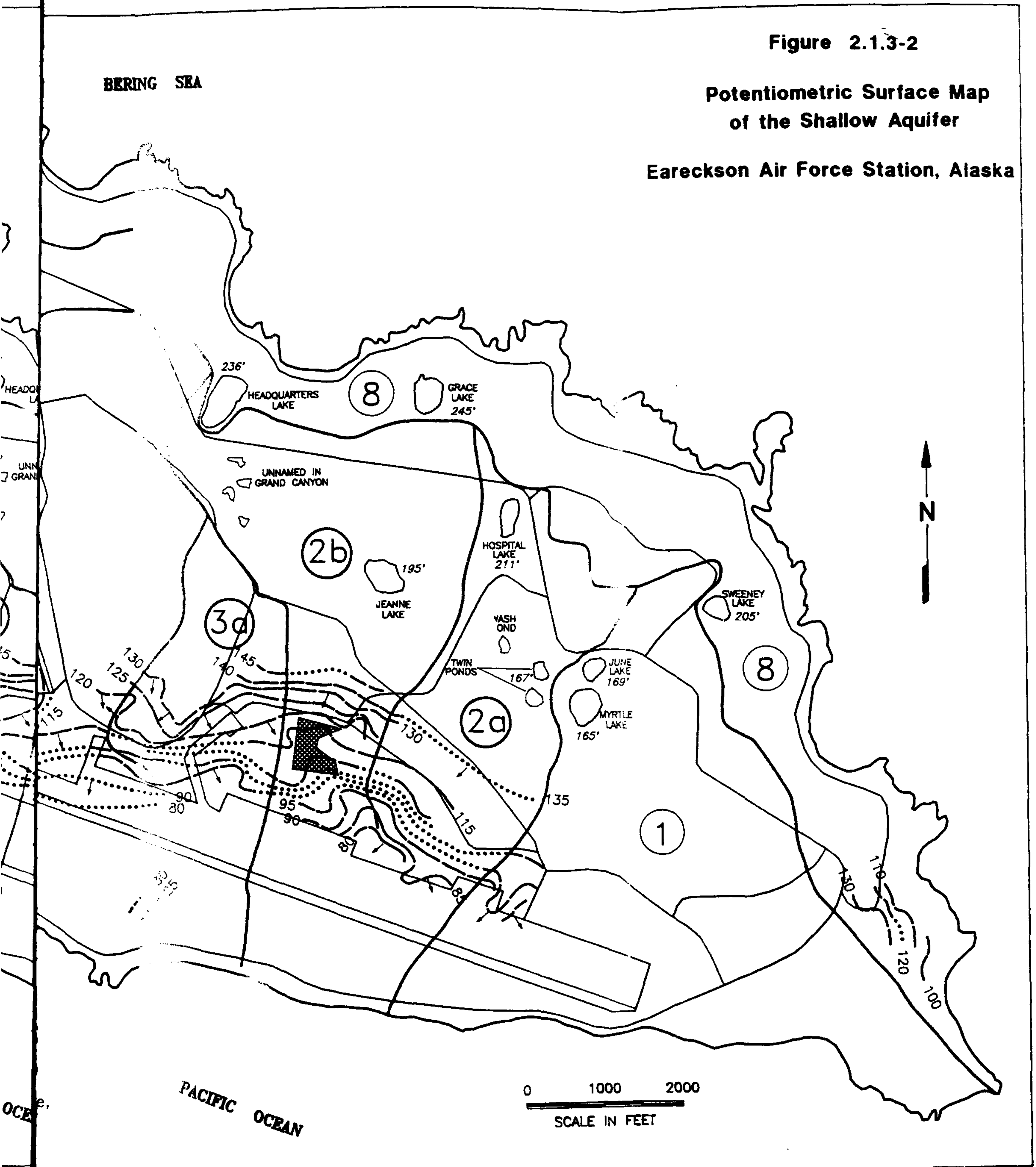

Surface Water Drainage Boundaries
3b
Management Zone Designation
BERING SEA
Alcan Cove
Skoot Cove
UNNAMED WEST OF UPPER LAKE
UPPER LAKE 71'
PUDGE LAKE 55'
MIDDLE LAKE 48'
LOWER LAKE 24'
LAUNDRY LAKE
51'
KAY LAKE
7
3b
6
5
4
PACI
LEGEND
JUNE LAKE 169'
Lake, with name and elevation
Arrows indicate direction of groundwater flow
Groundwater contours through areas for which data are available
(Data compiled from 1950's – 1992)
Groundwater contours through areas for which little data are available, or between areas for which data are available
(Data compiled from 1950's – 1992)

Figure 2.1.3-2

Potentiometric Surface Map of the Shallow Aquifer

Eareckson Air Force Station, Alaska



(oversized)

TABLE 2.1.3-1
MONITORING WELLS AND PIEZOMETERS
EARECKSON AIR FORCE STATION, ALASKA

Well Number	Const. By	Coordinates North (Feet)	Coordinates East (Feet)	Coordinates Elevation (MSL)	Size	Material	Total Depth (BGS)	Screened Interval (BGS)	Water Level (BGS)	Adequate for floating product
WGW1	CH2M Hill	19,175,387 *	1,001,792 *	134.5 **	2" ID .010 slot	PVC***	18.5	14.0 – 18.5	NA	Unknown
WGW2	CH2M Hill	19,175,378 *	1,001,848 *	130.5 **	2" ID .010 slot	PVC***	22.5	10.0 – 20.0	NA	Unknown
WGW3	CH2M Hill	19,175,337 *	1,001,832 *	121.3 **	2" ID .010 slot	PVC***	12.5	6.5 – 11.5	NA	Unknown
WGW4	CH2M Hill	19,175,346 *	1,001,787 *	122.9 **	2" ID .010 slot	PVC***	13.0	8.0 – 13.0	NA	Unknown
WGW5	CH2M Hill	19,175,462 *	1,001,785 *	130.2 **	2" ID .010 slot	PVC***	15.0	10.0 – 15.0	NA	Unknown
WGW6	CH2M Hill	19,175,483 *	1,001,690 *	132.3 **	2" ID .010 slot	PVC***	16.5	11.5 – 16.5	NA	Unknown
WGW7	CH2M Hill	19,175,359 *	1,001,742 *	123.9 **	2" ID .010 slot	PVC***	14.0	8.0 – 13.0	NA	Unknown
WGW8	CH2M Hill	19,175,489 *	1,001,637 *	131.9 **	2" ID .010 slot	PVC***	17.0	12.0 – 17.0	NA	Unknown
FT1W1	CH2M Hill	19,175,241 *	991,114 *	12.7 **	2" ID .010 slot	PVC***	18.5	13.5 – 18.5	NA	Unknown
FT2W1	CH2M Hill	19,178,557 *	993,552 *	67.0 **	2" ID .010 slot	PVC***	11.5	5.5 – 11.5	NA	Unknown
FT2W5	CH2M Hill	19,178,722 *	993,608 *	67.0 **	2" ID .010 slot	PVC***	12.2	5.2 – 12.2	NA	Unknown
FT2W7	CH2M Hill	19,178,624 *	993,864 *	66.8 **	2" ID .010 slot	PVC***	11.0	5.0 – 11.0	NA	Unknown
SW10W1	CH2M Hill	19,175,278 *	992,346 *	10.1 **	2" ID .010 slot	PVC***	13.5	8.5 – 13.5	NA	Unknown
SW10W2	CH2M Hill	19,175,504 *	991,808 *	19.5 **	2" ID .010 slot	PVC***	18.5	13.5 – 18.5	NA	Unknown
SW10W3	CH2M Hill	19,175,590 *	992,098 *	24.3 **	2" ID .010 slot	PVC***	17.0	12.0 – 17.0	NA	Unknown
SW12W1	CH2M Hill	19,175,225 *	993,126 *	9.1 **	2" ID .010 slot	PVC	10.5	5.5 – 10.5	NA	Unknown
SW12W3	CH2M Hill	19,175,217 *	993,269 *	40.2 **	2" ID .010 slot	PVC	24.0	19.0 – 24.0	NA	Unknown
AP970	COE	31,790	119,281	32.0	NA	NA	19.0	NA	16	No
AP947	COE	34,127	115,253	97.6	NA	NA	23.6	NA	12.6	No
AP1018	COE	33,735	116,342	88.3	NA	NA	3.7	NA	0.6	No
AP1019	COE	33,875	116,374	94.3	NA	NA	9.0	NA	2.7	No
AP1020	COE	34,076	116,516	97.8	NA	NA	8.0	NA	0.4	No
AP1206	COE	40,673	111,272	223.7	NA	NA	22.5	20.0 – 22.5	Dry	Temporary
AP1217	COE	40,977	109,269	160.8	.010 slot	NA	19.0	14.1 – 19.1	15.0	Yes
AP1218	COE	40,820	109,237	151.1	.010 slot	NA	19.0	14.0 – 19.0	10.0	No
AP1219	COE	40,987	109,040	152.2	.010 slot	NA	19.0	14.0 – 19.0	10.0	No
AP1220	COE	36,283	114,457	144.8	1.5" ID .010 slot	PVC	14.0	7.9 – 10.4	Dry	No
AP1221	COE	36,208	114,562	138.7	1.5" ID .010 slot	NA	23.0	13.0 – 15.5	5.5	No
AP1222	COE	36,157	114,664	142.5	1.5" ID .010 slot	PVC	19.0	14.2 – 16.7	10.0	No
AP1223	COE	36,162	114,434	137.5	1.5" ID .010 slot	PVC	24.0	19.0 – 21.5	12.5	No
AP1224	COE	36,081	114,546	135.6	1.5" ID .010 slot	PVC	24.0	NA	5.7	Unknown
AP1225	COE	36,064	114,627	137.7	1.5" ID .010 slot	PVC	19.0	10.0 – 12.5	7.0	No
AP1226	COE	35,986	114,492	129.6	1.5" ID .010 slot	PVC	14.0	8.5 – 11.0	3.3	No
AP1227	COE	35,972	114,555	130.5	1.5" ID .010 slot	PVC	19.0	8.5 – 11.0	2.4	No
AP1230	COE	34,582	114,083	95.1	2" ID .010 slot	NA	15.0	NA	NA	Temporary
AP1265	COE	35,630	114,233	115.1	NA	NA	24.5	18.7 – 23.7	NA	Temporary
AP1310	COE	36,032	114,703	139.0	NA	NA	14.0	6.5 – 11.5	7.2	Yes
AP1311	COE	35,940	114,810	135.0	NA	NA	19.0	11.5 – 16.5	7.0	No
AP1312	COE	35,945	114,854	140.4	NA	NA	19.0	18.1 – 23.1	11.0	No
AP1313	COE	35,902	114,927	140.9	NA	NA	19.0	13.4 – 18.4	9.8	No
AP1314	COE	35,903	114,929	140.7	NA	NA	9.0	0.0 – 8.5	2.6	Yes
AP1315	COE	35,983	114,971	146.0	NA	NA	19.0	14.0 – 19.0	13.8	No
AP1316	COE	36,056	114,846	143.6	NA	NA	24.0	18.7 – 23.7	9.6	No
AP1317	COE	36,110	114,747	144.5	NA	NA	24.0	18.3 – 23.3	11.5	No
AP1318	COE	35,945	114,623	134.1	NA	NA	12.0	6.8 – 11.8	7.1	Yes
AP1319	COE	35,806	114,878	136.7	NA	NA	24.0	18.4 – 23.4	8.0	No
AP1320	COE	35,840	114,900	134.0	NA	NA	19.0	13.8 – 18.8	9.0	No
AP1321	COE	35,883	114,892	140.4	NA	NA	19.0	13.9 – 18.9	9.7	No
AP1322	COE	35,827	115,120	144.9	NA	NA	21.0	13.7 – 18.7	16.0	Yes
AP1323	COE	35,860	114,740	125.0	NA	NA	19.0	13.6 – 18.6	6.0	No
AP1324	COE	36,076	114,603	139.0	NA	NA	19.0	13.5 – 18.5	NA	Unknown
AP1325	COE	36,175	114,620	142.6	NA	NA	25.0	13.5 – 18.5	NA	Unknown
AP1326	COE	35,645	113,859	123.1	NA	NA	14.0	8.0 – 13.0	10.3	Yes
AP1327	COE	35,460	113,981	120.0	NA	NA	19.0	13.7 – 18.7	6.9	No
AP1470	COE	40,779	109,091	139.0	2" ID .010 slot	PVC	10.5	1.8 – 8.8	9.5	No

TABLE 2.1.3-1 (continued)
MONITORING WELLS AND PIEZOMETERS
EARECKSON AIR FORCE STATION, ALASKA

Well Number	Const. By	Coordinates North (Feet)	East (Feet)	Elevation (MSL)	Size	Material	Total Depth (BGS)	Screened Interval (BGS)	Water Level (BGS)	Adequate for floating product
AP1471	COE	40,949	108,918	19.8	2" ID .010 slot	PVC	8.5	2.5 - 8.5	1.0	No
AP1473	COE	34,620	114,175	98.0	2" ID .010 slot	PVC	14.0	1.3 - 11.3	6.5	Yes
AP1478	COE	34,738	114,071	96.0	2" ID .010 slot	PVC	10.0	1.6 - 9.6	8.5	Yes
AP1480	COE	34,710	114,170	98.0	2" ID .010 slot	PVC	10.0	2.0 - 10.0	4.5	Yes
AP1486	COE	41,385	111,531	247.6	2" ID .010 slot	PVC	10.5	1.6 - 9.6	Dry	No
AP1508	COE	39,630	102,774	14.7	2" ID .010 slot	PVC	11.3	9.0 - 10.9	9.0	Yes
AP1518	COE	36,088	110,096	95.0	2" ID .010 slot	PVC	15.5	3.8 - 13.8	13.5	Yes
AP1519	COE	36,065	110,076	89.0	2" ID .010 slot	PVC	20.5	8.0 - 18.0	7.5	No
AP1520	COE	36,092	109,945	88.1	2" ID .010 slot	PVC	20.5	8.0 - 18.0	18.7	No
AP1521	COE	36,149	110,042	83.0	2" ID .010 slot	PVC	10.5	3.2 - 8.2	8.1	Yes
AP1522	COE	37,203	110,061	81.0	2" ID .010 slot	PVC	10.5	3.8 - 8.8	7.3	Yes
AP1524	COE	36,403	109,906	80.0	2" ID .010 slot	PVC	10.0	0.7 - 8.0	8.0	Yes
AP1525	COE	36,463	109,931	80.0	2" ID .010 slot	PVC	10.0	1.6 - 8.6	3.4	Yes
AP1529	COE	39,961	110,133	172.4	2" ID .010 slot	PVC	12.5	0.3 - 10.3	6.5	Yes
AP1537	COE	36,235	114,177	136.0	2" ID .010 slot	PVC	9.5	1.7 - 8.7	7.0	Yes
AP1589	COE	40,973	107,124	34.0	2" ID .010 slot	PVC	10.5	1.5 - 8.5	7.5	Yes
AP1591	COE	40,814	106,793	16.9	2" ID .010 slot	PVC	10.0	1.5 - 8.5	2.6	Yes
AP1594	COE	36,407	110,297	95.0	2" ID .010 slot	PVC	14.5	5.8 - 15.8	5.6	No
AP1596	COE	36,603	110,401	106.2	2" ID .010 slot	PVC	14.5	4.0 - 14.0	4.1	Yes
AP1597	COE	36,474	110,350	100.2	2" ID .010 slot	PVC	9.5	0.0 - 10.0	7.1	Yes
AP1598	COE	36,691	110,122	91.8	2" ID .010 slot	NA	9.0	0.0 - 9.9	4.4	Yes
AP1600	COE	39,879	109,672	132.0	NA	NA	9.0	0.0 - 9.0	Dry	No
AP1609	COE	35,778	114,364	119.1	2" ID .010 slot	PVC	20.0	10.2 - 20.2	0.5	No
AP1610	COE	35,631	114,227	114.0	2" ID .010 slot	PVC	20.0	8.9 - 18.9	2.0	No
AP1611	COE	35,635	114,116	120.0	2" ID .010 slot	PVC	16.5	6.6 - 16.6	7.5	Yes
AP1612	COE	35,557	114,162	122.6	2" ID .010 slot	PVC	20.0	9.7 - 19.7	13.0	Yes
AP1614	COE	35,415	113,806	120.8	2" ID .010 slot	PVC	14.0	4.0 - 14.0	4.2	Yes
AP1615	COE	35,457	113,671	130.7	2" ID .010 slot	PVC	20.0	10.0 - 20.0	5.5	No
AP1617	COE	35,889	114,133	134.0	2" ID .010 slot	PVC	25.5	5.4 - 25.4	17.0	Yes
AP1619	COE	35,909	113,823	129.1	2" ID .010 slot	NA	6.5	0.0 - 5.8	Dry	No
AP1620	COE	38,950	102,580	32.0	2" ID .010 slot	PVC	29.0	20.0 - 30.0	23.5	Yes
AP1622	COE	38,974	102,715	30.5	2" ID .010 slot	PVC	29.0	19.7 - 29.7	22.0	Yes
AP1627	COE	38,793	107,634	77.4	2" ID .010 slot	NA	24.0	4.6 - 14.6	Dry	No
AP1637	COE	42,023	108,022	157.1	2" ID .010 slot	PVC	9.0	2.5 - 9.0	Dry	No
AP1652	COE	41,530	108,810	155.0	2" ID .010 slot	PVC	14.5	0.0 - 15.0	4.5	Yes
AP1659	COE	34,210	115,267	97.0	2" ID .010 slot	PVC	20.0	7.9 - 17.9	15.7	Yes
AP1670	COE	38,360	103,430	28.0	2" ID .010 slot	PVC	16.0	0.0 - 14.0	2.5	Yes
AP1672	COE	38,230	103,750	32.0	2" ID .010 slot	PVC	10.5	0.0 - 9.4	1.0	Yes
AP1673	COE	33,460	111,800	28.0	2" ID .010 slot	PVC	9.0	0.0 - 9.0	1.77	Yes
AP1674	COE	33,530	111,780	30.0	2" ID .010 slot	PVC	10.5	0.0 - 10.0	1.0	Yes
AP1675	COE	33,460	111,890	28.0	2" ID .010 slot	PVC	10.5	0.0 - 9.4	1.0	Yes
AP1680	COE	40,172	110,269	171.9	2" ID .010 slot	PVC	17.5	7.1 - 17.1	Dry	No
AP1685	COE	34,903	115,516	118.5	2" ID .010 slot	PVC	19.4	8.0 - 18.0	7.5	No

NOTES:
* = Universal Transverse Mercator Metric Grid
** = elevation of measuring point above mean sea level
*** = Schedule 40
BGS = feet below ground surface
COE = U.S. Army Corps of Engineers (associated coordinates based on unknown origin)
ID = inside diameter
MSL = feet above mean sea level
NA = not available
PVC = polyvinyl chloride
Adequate for floating product means well screen interval intersects upper surface of groundwater.

[illegible]AE13-1 17-Jan-94 Page 2 of 2 100% Recycled are infiltrating into the shallow aquifer, or whether conditions in the subsurface limit or slow the migration of groundwater out of the area.

Potentiometric surface contours indicate that Lake Creek and the lower part of Gallery Creek are gaining streams. There are no data available for the area drained by upper Gallery Creek or in the immediate vicinity of any of the lakes, so it is not possible to speculate as to whether these bodies of surface water are gaining or losing. Potentiometric contours are deflected from their natural trend in the vicinity of the water gallery (Figure 2.1.3-2). This apparent low may be the result of the withdrawal of significant quantities of groundwater in this area, causing a drawdown in the water table elevation.

It is not known or documented if aquifer tests, such as pumping tests or slug tests, have been conducted on the shallow aquifer. There is no measured information available about aquifer properties such as hydraulic conductivity or specific yield. Selected values for specific yield and specific retention are shown in Table 2.1.3-2. Using this table, values for these properties can be estimated for the sand, and sand and gravel deposits on Shemya Island. Selected ranges of hydraulic conductivities are shown in Figure 2.1.3-3 for aquifer materials that may be similar to those on Shemya. Transmissivity for the shallow aquifer can be estimated by using the equation:

$$T = Kb$$

Where,

T = transmissivity
K = hydraulic conductivity
b = the thickness of the aquifer

Assuming values of hydraulic conductivity equal 10^2 feet/day and an aquifer thickness of 10 feet, the shallow aquifer would have a transmissivity of 10^3 feet^2/day.

Groundwater velocity for the shallow aquifer can be estimated by using the equation:

$$v = Kdh/ndl$$

Where,

v = average groundwater velocity
K = hydraulic conductivity
dh/dl = the gradient
n = the porosity

The average gradient is approximately 0.035, and assuming values of hydraulic conductivity equal 10^2 feet/day, and a porosity of 0.25, the average groundwater velocity of the shallow aquifer can be estimated to be 14 feet/day.

The overall water quality, which includes major cations, chloride, fluoride, silica, nitrate, phosphorus, sulfate, zinc, bicarbonate, hardness, and dissolved solids, has not been specifically studied on an island-wide basis in the shallow aquifer except in the vicinity of the water gallery. However, too few analyses have been conducted near the water gallery to characterize the quality. Table 2.1.3-3 presents groundwater quality data for both the shallow and deep aquifers. Water quality data for the shallow aquifer are primarily representative of the water gallery area because of its importance as the main water supply source. The water quality analyses of Feulner and others (Feulner, et al., 1976) indicate that water gallery water closely

TABLE 2.1.3-2
SELECTED VALUES OF POROSITY, SPECIFIC YIELD, AND SPECIFIC RETENTION FOR VARIOUS AQUIFER HOST MATERIALS (SOME OF WHICH MAY BE SIMILAR TO AQUIFER HOST MATERIALS ON SHEMYA ISLAND)
EARECKSON AIR FORCE STATION, ALASKA

Material	Primary Openings	Secondary Openings	Porosity	Specific Yield	Specific Retention
Soil	55	-	55	40	15
Clay	50	-	50	2	48
Sand	25	-	25	22	3
Gravel	20	-	20	19	1
Limestone	10	10	20	18	2
Sandstone (semiconsolidated)	10	1	11	6	2
Granite	-	0.1	.1	.09	.01
Basalt (young)	10	1	11	8	3

Values in percent by volume

Reference: Heath (1982)

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Figure 2.1.3-3

Hydraulic Conductivity of Selected Rock Types (from Heath, 1982)

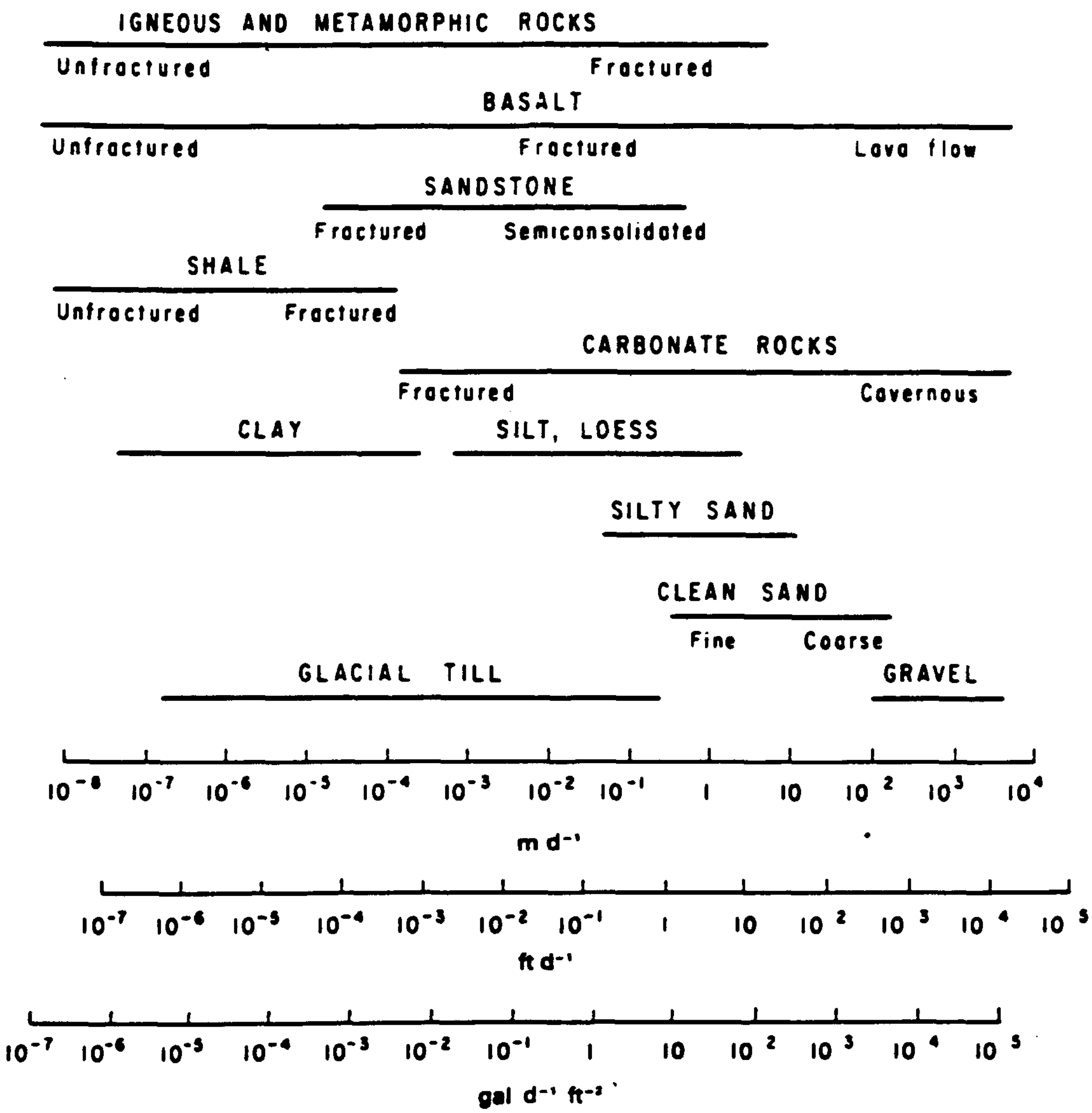

TABLE 2.1.3-3
SELECTED GROUNDWATER QUALITY DATA FOR SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Well No.	No./ID	Date Sampled	Pumping Time (hours)	Temp (oC)	pH	Specific Conductance (µmhos/cm)	Color	Turbidity (NTU)	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Iron (µg/L)	Lead (µg/L)
3(1)	187-58-B	05/23/58	48	NT	7.66	NT	NT	NT	21.4	62.8	NT	500	NT
4(1)	207-58-O	05/31/58	48	NT	7.27	NT	NT	NT	62.6	80.0	NT	900	NT
4(1)	237-58	06/22/58	48	NT	7.45	NT	NT	NT	81.6	73.2	NT	400	NT
4(2)	Well 4	09/61		6.0	7.8	564	0	NT	39	53	0.0	100	NT
4(3)	88WW401W/	10/08/88	0.25	9.4	7.5	672	CLEAR	NONE	NT	NT	NT	NT	5.0
5(1)	192-58-E	05/29/58	60	NT	7.46	NT	NT	NT	46.0	65.6	NT	700	NT
7(1)	207-58-A	05/26/58	50	NT	7.18	NT	NT	NT	65.0	55.6	NT	1,500	NT
7(1)	207-58-B	06/06/58	100	NT	6.97	NT	NT	NT	67.4	61.2	NT	1,300	NT
29(1)	247-58-A	06/14/58	6	NT	7.40	NT	NT	NT	104.8	69.6	NT	300	NT
29(1)	247-58-C	06/20/58	69	NT	7.30	NT	NT	NT	104.8	66.0	NT	300	NT
29(2)	Well 29	09/61	NT	5.0	7.90	971	0	NT	91	88	0.0	30	NT
Gallery(2)+		08/28/70	NT	NT	8.2	421	10	NT	22	58	0.2	280	NT
		01/26/72	NT	5.0	7.2	425	0	NT	22	60	0.1	170	NT

TABLE 2.1.3-3 *(continued)*
SELECTED GROUNDWATER QUALITY DATA FOR SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Well No.	Magnesium (mg/L)	Manganese (µg/L)	Nitrate (as N) (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)	Silica (mg/L)	Bicarbonate (as $CaCO_3$) (mg/L)	Hardness (as $CaCO_3$) (mg/L)	Dissolved Solids (mg/L)	TRPH
3(1)	21.0	400	0*	NT	NT	48.3**	12.2	29.6	148.8	139.6	NT	NT
4(1)	31	TRACE	0.4*	NT	NT	75.0**	70.0	14.2	261.0	284.0	NT	NT
4(1)	34.1	TRACE	0*	NT	NT	57.6**	113.5	15.0	248.2	344.4	NT	NT
4(2)	20	280	.02	27	4.8	46	27	15.0	227	180	317	NT
4(3)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	1.2
5(1)	25.7	100	0*	NT	NT	23.9**	35.0	18.0	131.3	208.6	NT	
7(1)	50.1	900	0*	NT	NT	71.4**	238	32.0	196.8	368.5	NT	
7(1)	58.2	1,200	0*	NT	NT	53.8**	242	24.0	186.9	408.0	NT	
29(1)	26.1	0	0*	NT	NT	58.7**	86.0	16.3	306.8	369.5	NT	NT
29(1)	26.1	0	0*	NT	NT	55.5**	83.5	18.0	310.2	369.5	NT	NT
29(2)	33	100u	0.02	NT	8.5	63	97	14.0	352	362	566	NT
Gallery(2)+	14	380t	0.34	NT	3.6	40	12	16	135	111	235	NT
	14	370d	0.02	NT	3.6	39	11	18	132	108	233	NT

Notes:

(1) = Tabulation of water analyses of water from Shemya Island, Alaska 1958. No units are given with this source; units are assumed.
(2) = Feulner, et al. 1976
(3) = U.S. Air Force 1988a
d = dissolved
t = total
u = undifferentiated
ID = identification
NT = not tested
TRPH = Total Recoverable Petroleum Hydrocarbons
NTU = Nephelometric Turbidity Unit
$CaCO_3$ = Calcium Carbonate

* = all results from this source for nitrates are suspect
** = potassium and sodium
\+ = These are shallow aquifer wells; all other wells on this table are deep bedrock wells.
°C = degrees Celsius
µmhos/cm = micromhos per centimeter
mg/L = milligrams per liter
µg/L = micrograms per liter

resembles water from Lake Creek, Gallery Creek, and Gallery Spring in concentrations of silica, iron, manganese, calcium, sodium, potassium, bicarbonate, sulfate, chloride, nitrate, dissolved solids, hardness, specific conductance, and pH. The similarity of water quality data for both groundwater and surface water in Lake and Gallery creeks is consistent with the observation from potentiometric surface contours that these streams may be gaining streams. Based on limited data, water from the shallow aquifer appears to be slightly alkaline, moderately hard, with a relatively high chloride content, and can be classified as sodium calcium bicarbonate type. The host aquifer material in the water gallery area is described as peat (Brown, 1991).

The shallow aquifer has been locally contaminated by Station activities since military occupation of the island began. Most of the contaminants are petroleum-based fuels and lubricants, however volatiles and semivolatiles are also found. Locally, free product light nonaqueous phase liquid (LNAPL) has been recorded in borehole logs and monitoring wells compiled by the Alaska Corps of Engineers. Seeps with sheen were also observed during site visits in late 1992. Trichloroethene (TCE) and benzene have been detected at concentrations near their maximum contaminant levels (MCL) in water from the water gallery (U.S. Air Force, 1991b). TCE has been detected in soils at the Old Cobra Dane and at Hangar 5. Leaking sanitary sewer lines are also releasing fecal coliform bacteria and probably nutrients to the shallow aquifer (U.S. Air Force, 1988b). Monitoring wells indicate that the shallow aquifer is highly contaminated at some of the source units. Sources, contaminants, and concentrations are more fully described in Section 2.2.

2.1.3.2 Deep Aquifer

The deep aquifer is hosted by bedrock materials on the island. These materials consist mainly of argillites, mudstones, and andesitic-basaltic volcanic flows, tuffs, and intrusions. The bedrock lithologies are heterogeneous both laterally and vertically as a result of the island's geologic origin (see Section 2.1.2.2). Open space available to be occupied by water in the bedrock materials is both primary as pore space, vugs, vesicles, and intergranular space, and secondary as fractures, joints, and dissolution features. The relative importance of primary versus secondary openings for groundwater storage has not been determined. However, it is probable that most of the available groundwater is stored in secondary openings (Feulner, et al., 1976). Information available for the deep aquifer comes from approximately 30 wells, most of which were drilled during or shortly after World War II to replace water supply sources that had either become contaminated or were unreliable as sources of Station water supply. The deep aquifer wells were incapable of being used as the primary water source for the Station because of problems that included low yields and salt water intrusion and contamination. By 1949, it was reported that all of these wells had been abandoned because of failure, contamination, or salt water intrusion, although it is not specified which wells or the total number of wells abandoned for any given reason (Smith, 1958). A water gallery was constructed in the shallow aquifer for use as a primary water supply, and two of the better producing deep aquifer wells have been maintained as a backup water supply. The known locations of the deep aquifer wells are shown in Figure 2.1.3-4.

Recharge to the deep aquifer is primarily a result of leaks or infiltration from the shallow aquifer. Direct recharge of the deep aquifer by surface water or precipitation is possible only in the Grand Canyon area and along the cliffs or at other locations where bedrock is directly exposed at the surface. Direct recharge of

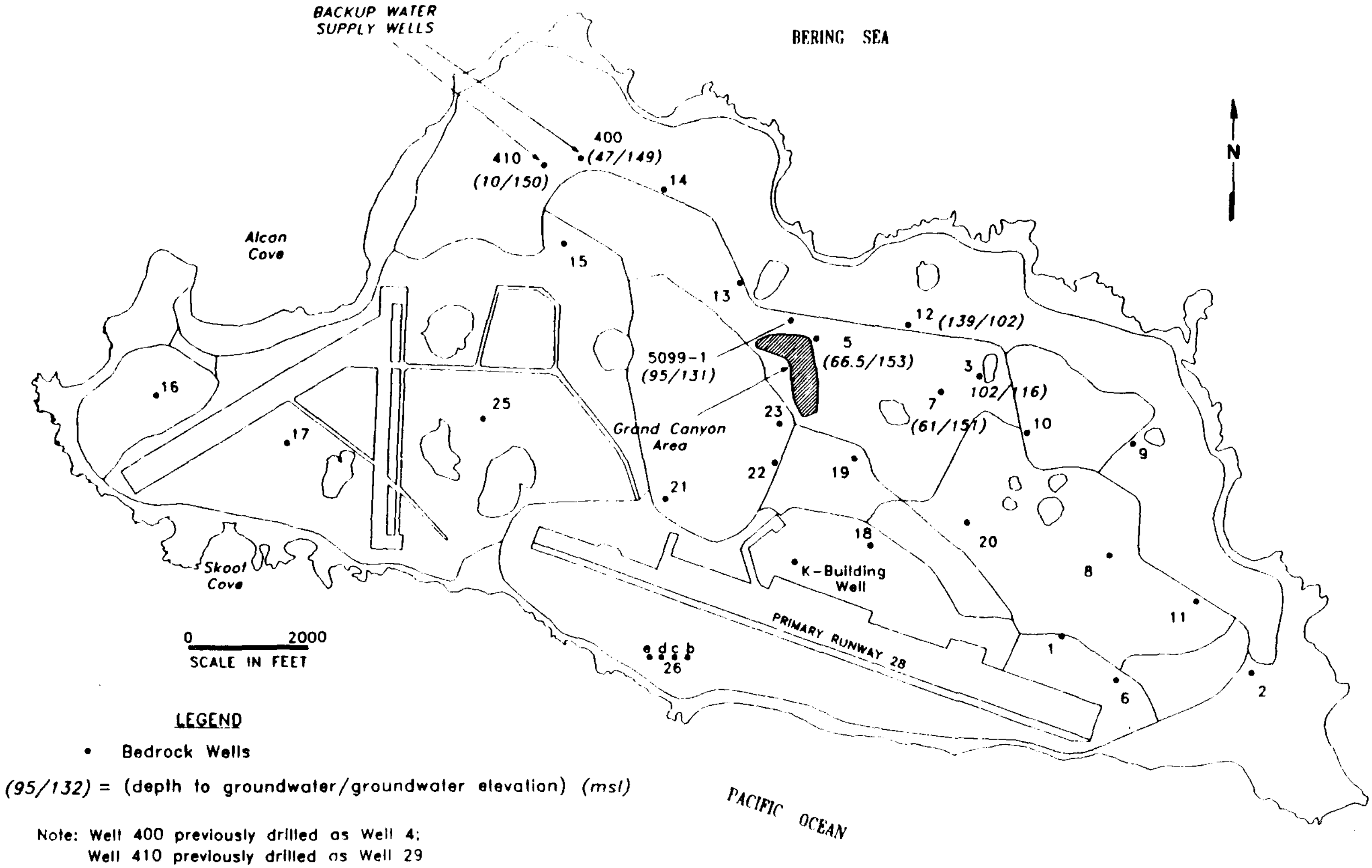

Figure 2.1.3-4

Locations of Bedrock (Deep Aquifer) Wells on Shemya Island

Eareckson Air Force Station, Alaska

the deep aquifer by surface water or precipitation is probably minor because these areas cover a relatively small portion of the surface area of the island. Recharge of the deep aquifer is probably not uniform over the island, depending on factors that include but are not limited to the local topography of the bedrock surface, lithology of the bedrock, intensity of fracturing and depth to which fracturing extends, and the presence and effectiveness of any aquitards that might be located between the shallow and deep aquifers.

Groundwater in the deep aquifer is reported by Brown (1991) to generally be 50 feet bgs. Deep aquifer wells for which data are available have intercepted groundwater at depths ranging from 10 to 139 feet bgs (Smith, 1958). Groundwater data available for the deep aquifer bedrock wells are shown in Table 2.1.3-4 along with some basic well data. These data were collected by COE in 1958 and the initial groundwater levels are believed to represent static conditions in the deep aquifer (Smith, 1958). The base of the deep aquifer is effectively the interface between freshwater and saline water, and is inferred to be at or about sea level because many of the deep aquifer wells were drilled to depths approximating sea level. Salt water intrusion was also a problem with many of these wells.

A potentiometric surface map of the deep aquifer cannot be constructed, because data are too limited and data points are too widely spaced. Figure 2.1.3-4 shows deep aquifer groundwater elevations for seven locations along the northern side of the island. Groundwater elevation is approximately 150 feet, but ranges from 102 to 153 feet in elevation above mean sea level (MSL). The variability of groundwater elevation may, in part, reflect the heterogeneities of recharge to the deep aquifer and fracture-controlled fluid flow. The deep aquifer may be under confined conditions, at least locally, which can be inferred from data from Well 5099-1, where the static water level is approximately 21 feet higher than the water-bearing interval (U.S. Air Force, 1990c).

Pumping tests were done on six of the deep aquifer wells in 1958 by COE (Smith, 1958). The wells tested included 3, 5, 7, 12, 400 (formerly 4), and 410 (formerly 29). These data were presented graphically showing drawdown, discharge rates, and duration of pumping. The primary purpose of these tests was to determine the long-term yield and maximum pumping rate of each well. Pumping test and recovery data are also available from well 5099-1 (U.S. Air Force, 1990c). These pumping tests are all single well tests. Observation wells were not available, or were not monitored. Single well tests are generally less useful than tests with multiple observation wells because effective well radius and storage coefficients cannot be determined. Transmissivity can be determined from single well tests if the head loss in the well is representative of head loss in the aquifer adjacent to the well. This condition was not met in the COE pump tests in at least one well, as determined from recorded observations of cascading water. Insufficient data have been recorded from these pump tests to estimate transmissivities of the deep aquifer at these locations. Specific capacity is the only aquifer property that can be determined from the 1958 pump tests. Specific capacity values are shown in Table 2.1.3-4. There are three main groupings of wells based on the specific capacities. Wells 400, 5, 410, and 5099-1 have specific capacities that range from 1.73 to 2.94 gallons per minute (gpm)/foot of drawdown; wells 7 and 12 have specific capacities that range from 0.22 to 0.42 gpm/foot of drawdown; and well 3 has a specific capacity of 0.078 gpm/foot of drawdown.

TABLE 2.1.3-4
SELECTED DATA FOR DEEP AQUIFER WELLS ON SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Well Number	Approximate Surface Elevation	Total Depth of Hole	Depth to Groundwater (BGS)	Groundwater Elevation (Calculated)	Drawdown (Feet)	Production Rate (gpm)	Water Bearing Interval (BGS)	Specific Capacity (Calculated)
1	128	146	NA	NC	NA	NA	NA	NC
2	134.15	120	NA	NC	NA	NA	NA	
3	218.75	205	102'	116	88	6.9	NA	0.078 gpm/ft for 24 hours
5	220.00	121.25	66.5	153	26	45	NA	1.73 gpm/ft for 30 hours
6	105.00	150.50	NA	NC	NA	NA	NA	NC
7	212.00	166	61	151	60 76	25.25 23	NA	0.42 gpm/ft for 105 hours 0.30 gpm/ft for 30 hours
8	140.00	143	NA	NC	NA	NA	NA	NC
9	205.00	198	NA	NC	NA	NA	NA	NC
10	205.00	200	NA	NC	NA	NA	NA	NC
11	155.00	151	NA	NC	NA	NA	NA	NC
12	241.00	255	139	102	51	11	NA	0.22 gpm/ft for 24 hours
13	234	238	NA	NC	NA	NA	NA	NC
14	235	220	NA	NC	NA	NA	NA	MC
15	135	100	NA	NC	NA	NA	NA	NC
16	40	40	NA	NC	NA	NA	NA	NC
17 abandoned	NA	NA	NA	NC	NA	NA	NA	NC
18	130	96	NA	NC	NA	NA	NA	NC
19	160	108	NA	NC	NA	NA	NA	NC
20	140	135	NA	NC	NA	NA	NA	NC
21 dry hole	NA		NA	NC	NA	NA	NA	NC
22	145	150	NA	NC	NA	NA	NA	NC
23 abandoned	NA	NA	NA	NC	NA	NA	NA	NC
24 not drilled	NA	NA	NA	NC	NA	NA	NA	NC

TABLE 2.1.3-4 (continued)
SELECTED DATA FOR DEEP AQUIFER WELLS ON SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Well Number	Approximate Surface Elevation	Total Depth of Hole	Depth to Groundwater (BGS)	Groundwater Elevation (Calculated)	Drawdown (Feet)	Production Rate (gpm)	Water Bearing Interval (BGS)	Specific Capacity (Calculated)
25 dry hole	NA	NA	NA	NC	NA	NA	NA	NC
26a not drilled	NA	NA	NA	NC	NA	NA	NA	NC
26b	46.36	89.75	NA	NC	NA	NA	NA	NC
26c	44.78	90.03	NA	NC	NA	NA	NA	NC
26d	47.01	60.67	NA	NC	NA	NA	NA	NC
26e	48.72	75.00	NA	NC	NA	NA	NA	NC
26f dry hole	NA	NA	NA	NC	NA	NA	NA	NC
400 (formerly 4)	196	120 (2)	37' 47' (3)	149	17.5	51.5	NA	2.94 gpm/ft for 24 hours
410 (formerly 29)	160	118 104 (2)	10' 12' (4)	146 148	42 45	87 89	NA	2.07 gpm/ft for 36 hours 1.97 gpm/ft for 36 hours
5099-1 (1)	227 (est.) (1)	135(1)	95.3'(1)	131	5(1)	60(1)	125+(1)	2.95 gpm/ft for 6 hours
K building test well	127	113(4)	75'(4)	52'	15(1)	20	83 - 108(1)	NC

Notes:

(1) = U.S. Air Force, 1990c
(2) = U.S. Air Force, 1991b
(3) = U.S. Air Force, 1989a
(4) = U.S. Air Force, 1975
BGS = below ground surface
gpm = gallons per minute
ft = foot
NA = not available
NC = not calculated

Source: All data are from Smith (1958) unless otherwise noted.

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Page 2 of 2

It is possible to estimate approximate values for transmissivity based on values of specific capacity. Figure 2.1.3-5 shows the general relationship between specific capacity and transmissivity (U.S. Department of the Interior [DOI], 1985). According to DOI, the transmissivity values estimated from specific capacities based on pumping periods of several hours or longer tend to be conservatively low because well inefficiency increasingly overshadows the effects of drawdown with time. Wells 5, 5099-1, 400, and 410 are estimated to have approximate transmissivity values ranging between 500 to 1,000 square feet (ft^2)/day based on Figure 2.1.3-5. Wells 3, 7, and 12 are estimated to have transmissivity values that range between 35 to 130 ft^2/day, based on Figure 2.1.3-5. It should be emphasized that transmissivity values determined from Figure 2.1.3-5 are approximations only.

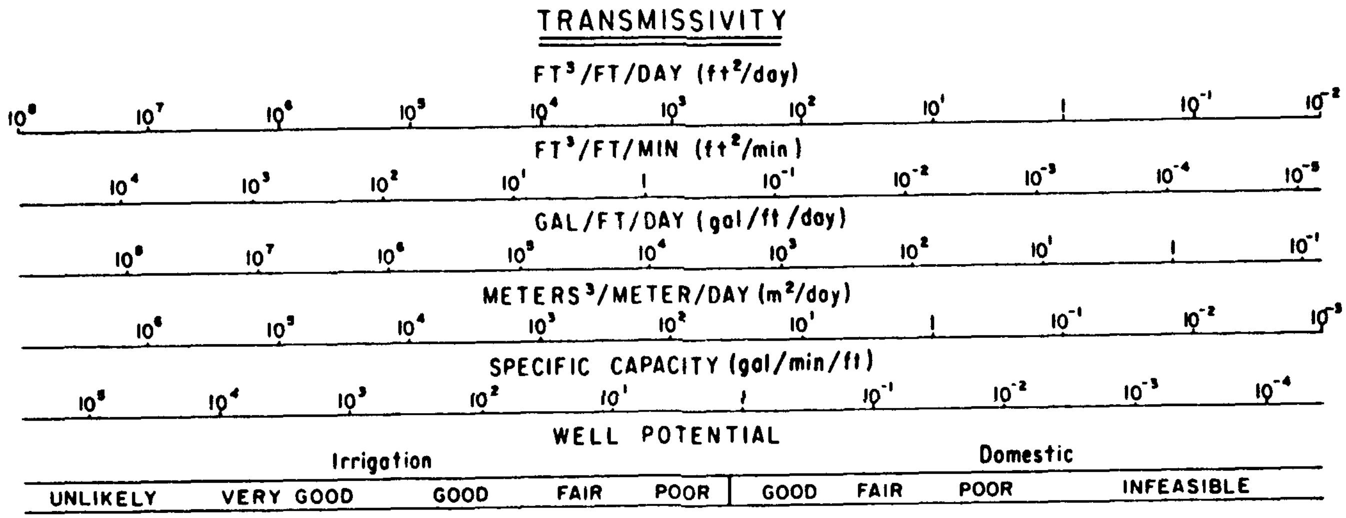
Sufficient data have been recorded during the pumping test on well 5099-1 to construct a time-drawdown curve. Aquifer properties can be approximated using AQTESOLV software (Duffield and Rumbaugh, 1991) which uses the Moench solution for a leaky aquifer based on measurements from the pumping well. Transmissivity values can be estimated to be 0.318 ft^2/minute. The storage coefficient, which is estimated to be 0.0772, is believed to be representative because the Moench solution corrects for wellbore effects. During the recovery period for this well, fluctuations were noted and were interpreted to be a result of tidal action (U.S. Air Force, 1990c).

Wells 400 and 410 (formerly 4 and 29) are the most productive wells on the island in the deep aquifer, and have been developed for use as a supplementary water supply. These wells are thought to lay along a north-south trending fault or fracture zone, which is probably responsible for the higher yield of water from these wells (U.S. Air Force, 1991b). This structural zone is shown in Figure 2.1.2-5. Because these wells are separated by a distance of 710 feet in an east-west direction, they indicate either that the fault/fracture zone is very wide at this location, or that the fault/fracture zone has split into several segments. Results from pumping tests and well monitoring in 1958 show that there was no hydraulic connection between these two wells during the interval of testing and monitoring. This structural zone projects to the south through Lower Lake. If the structure is present along this projection, it must be laterally inhomogeneous in terms of its aquifer properties because wells 15 and 25, which are located along the projection, have not been recorded as productive wells. However, well 15, which was examined by COE during its pumping test program in 1958, was noted to be significantly contaminated with petroleum product. The well may not have been pump tested for this reason. The total depth of well 25 is unknown, and it is simply recorded as a "dry hole."

Alternatively, based on groupings according to specific capacities, wells 400, 5, 410, and 5099-1 form a north-northwest trend, which may be related to bedrock structure or lithology. However, this trend is highly speculative because it is based on very limited data gathered along this north-northwest trend.

Limited water quality data are available for the deep bedrock aquifer and are shown in Table 2.1.3-3. Most of these data were collected by COE (Smith, 1958) during its pumping test program in 1958, and by the USGS in 1961 (Feulner et al., 1976). Units of concentration were not given for the COE data and had to be assumed.

The results reported by the USGS and COE for wells 400 (formerly 4) and 410 (formerly 29) show considerable variation in the reported concentrations of analytes. The water quality was either changing rapidly, was highly variable during this time



NOTES: Transmissivity (T) = KM where
K = Permeability
M = Saturated thickness of the aquifer
Specific capacity values based on pumping period of approximately 8-hours but are otherwise generalized.

Comparison of transmissivity, specific capacity, and well potential (from U.S. Department of Interior, 1985).

Figure 2.1.3-5

interval, or there were sampling and/or analytical biases that account for the different results.

Saltwater intrusion has been a major problem for an unknown number of the 30 deep aquifer wells constructed during and after World War II (Brown, 1991). Eighteen of the 30 wells were drilled to within 20 feet MSL, with 11 of these to elevations of 0 to 45 feet as shown in Table 2.1.3-4.

Little is known about the contamination in the deep bedrock aquifer because there are so few wells that intercept it. In 1958, well 15 was reported to contain petroleum and fuel products, and well 410 (formerly 4) contained trace petroleum products after six hours of pumping (Smith, 1958). A small accumulation of oil was observed in both wells 400 and 410 during rehabilitation in 1975 (U.S. Air Force, 1975). This oil may have been released from turbine pumps that were removed from the wells at the time. Water samples collected from both wells 400 and 410 in August 1984 were reported to have contained PCB concentrations of 1.0 micrograms per liter (μg/L) (Brown, 1991). In 1990, a material described as a "heavy, black, oily substance that had an oily feel and visible sheen" was bailed from well 7 during an attempt to rehabilitate this well (U.S. Air Force, 1990c). Continued bailing did not lessen the apparent concentration of this contaminant and the rehabilitation effort was discontinued and the well abandoned. Limited information indicates that at least some of the wells constructed during or after World War II in the deep aquifer were completed. Open hole below bedrock well construction methods were generally not known or available for these wells, particularly the method of sealing the well casing against the formation to the surface. It is not certain that the contamination observed in these wells is representative of groundwater contamination, or if it represents local contamination which has migrated down the borehole/well casing interface. If the former is true, it is possible that there is widespread contamination of the deep aquifer. This contamination could result from infiltration of contaminated water from the shallow aquifer into the deep aquifer. There are insufficient shallow aquifer monitoring wells near potentially contaminated bedrock wells to confirm this possibility.

The deep aquifer could also be contaminated directly in areas such as the Grand Canyon where bedrock is directly exposed at the surface. Contamination of the deep aquifer generally would be slow relative to the shallow aquifer because of its probable lower relative transmissivities. However, migration in fractures could be very rapid and more productive zones in the deep aquifer would be more susceptible to contamination. If contaminants are migrating downward along the well casing, contamination of the deep aquifer may be local to the immediate vicinity of the affected wells. However, if this is the case, then these wells are serving as pathways conducting contaminants from the surface or shallow aquifer directly into the deep aquifer.

2.1.4 Surface Water

Precipitation is the primary factor controlling the amount and availability of surface water on Shemya Island. The island receives approximately 31 inches of precipitation annually, typically in the form of rain, mist, and snow. The approximate volume of water, which is precipitated on the island annually, is 396,000,000 cubic feet, based on a surface area of 3,520 acres or 5.5 square miles and 31 inches of annual precipitation. If loss of water to evapotranspiration and other factors is assumed to be negligible, then most of this water is available as recharge to surface water and groundwater. Similarly, assuming a negligible uptake of this available water, most of this would be expected to exit the island as surface and subsurface flow. These assumptions cannot be confirmed because water mass balance studies have not been conducted (CH2M Hill, 1993b).

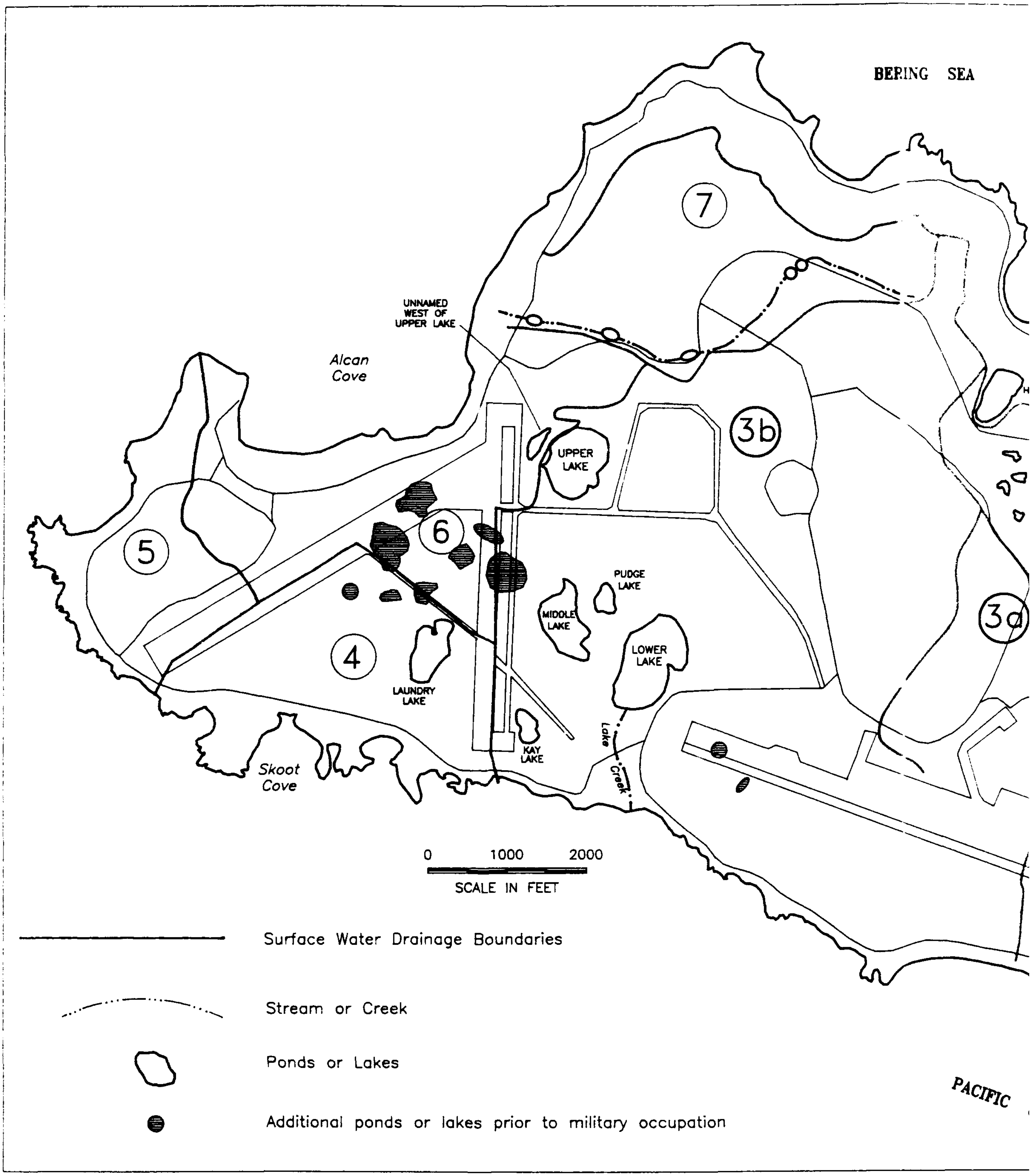
2.1.4.1 Types of Surface Water Bodies

Surface water is present as three general types of water bodies: 1) lakes and ponds, 2) streams and creeks, and 3) springs and seeps. All lakes and ponds occur naturally and, with minor exceptions, have not been significantly altered during military occupation and development of the island. The major surface water bodies on the island are shown in Figure 2.1.4-1. There are 16 ponds and lakes on the island that have been named, as well as numerous smaller unnamed ponds. Aerial photographs taken in 1943, before military occupation of the island, show at least eight additional small lakes and ponds located in the area of Runways B and C and two additional ponds in the area occupied by the western end of the active runway. These lakes and ponds are shown on Figure 2.1.4-1. The largest lake on the island is Lower Lake, which covers an area of 16.9 acres. Approximately 2 percent of the surface area of the island is covered with lakes or ponds. Table 2.1.4-1 summarizes physical data for the lakes on the island. There are only very limited published data available on area, volumes, and depths of the lakes and ponds. The total volume of water storage in lakes was estimated at 30 million gallons in 1956 (CH2M Hill, 1993b). Lake depths are generally unknown; however, available information indicates that depths range from 1.0 to 7.4 feet (Feulner, et al., 1976). Depths of most of the lakes and ponds probably occur within this shallow range based on the subdued surface topography and on the probable origin of the lakes.

There appears to be a correlation between the presence of lakes and the type of surface unconsolidated material as shown in Figure 2.1.2-3. Lakes and ponds are present in areas of clastic deposits of sand and gravel, but are not present in areas dominated by organic deposits of peat.

The origin of lakes and ponds on Shemya Island may be related to one or more mechanisms common to the Near Islands (Schaeffer, 1971). These are marine, glacial, and frost-produced ponds. Although not implicitly specified by Schaeffer (1971), it appears that the latter two mechanisms are more applicable to Shemya. Many of the smaller ponds exhibit features common to frost-produced ponds (e.g., do not lie along distinct water courses; exist in poorly drained, flat, or gently sloping areas; and are characterized by low rims of turf raised along their downslope sides). These water bodies typically have a small diameter, are no more than 3 feet deep, and outflow is by seepage through the rims and not by surface outlets (Schaeffer, 1971). The larger lakes on the island probably originated as features related to glacial scour or till deposits.

Numerous streams and creeks are present on the island. These water bodies are all less then 2 miles in length. The gradient of most of the streams is approximately 0.035, based on the overall topography of the island. Most, but not all, of the streams and creeks drain the island to the southern coastline (Feulner, et al., 1976). The surface divides, which separate these drainages, are discussed in more detail in the next subsection. The natural flow of streams and creeks has been altered to some extent, most notably near the southern coast, by the construction of runways, roads, ditches, and culverts. Based on gauging and precipitation records, streamflow rate responds directly and rapidly to precipitation. Exceptions to this occur during winter months when snowfall is the main form of precipitation. Stream discharge data are available for two creeks (Feulner, et al., 1976): Lake Creek and


BERING SEA
7
UNNAMED WEST OF UPPER LAKE
Alcan Cove
3b
UPPER LAKE
6
5
PUDGE LAKE
MIDDLE LAKE
LOWER LAKE
3a
4
LAUNDRY LAKE
KAY LAKE
Lake Creek
Skoot Cove
0 1000 2000
SCALE IN FEET
Surface Water Drainage Boundaries
Stream or Creek
Ponds or Lakes
Additional ponds or lakes prior to military occupation
PACIFIC

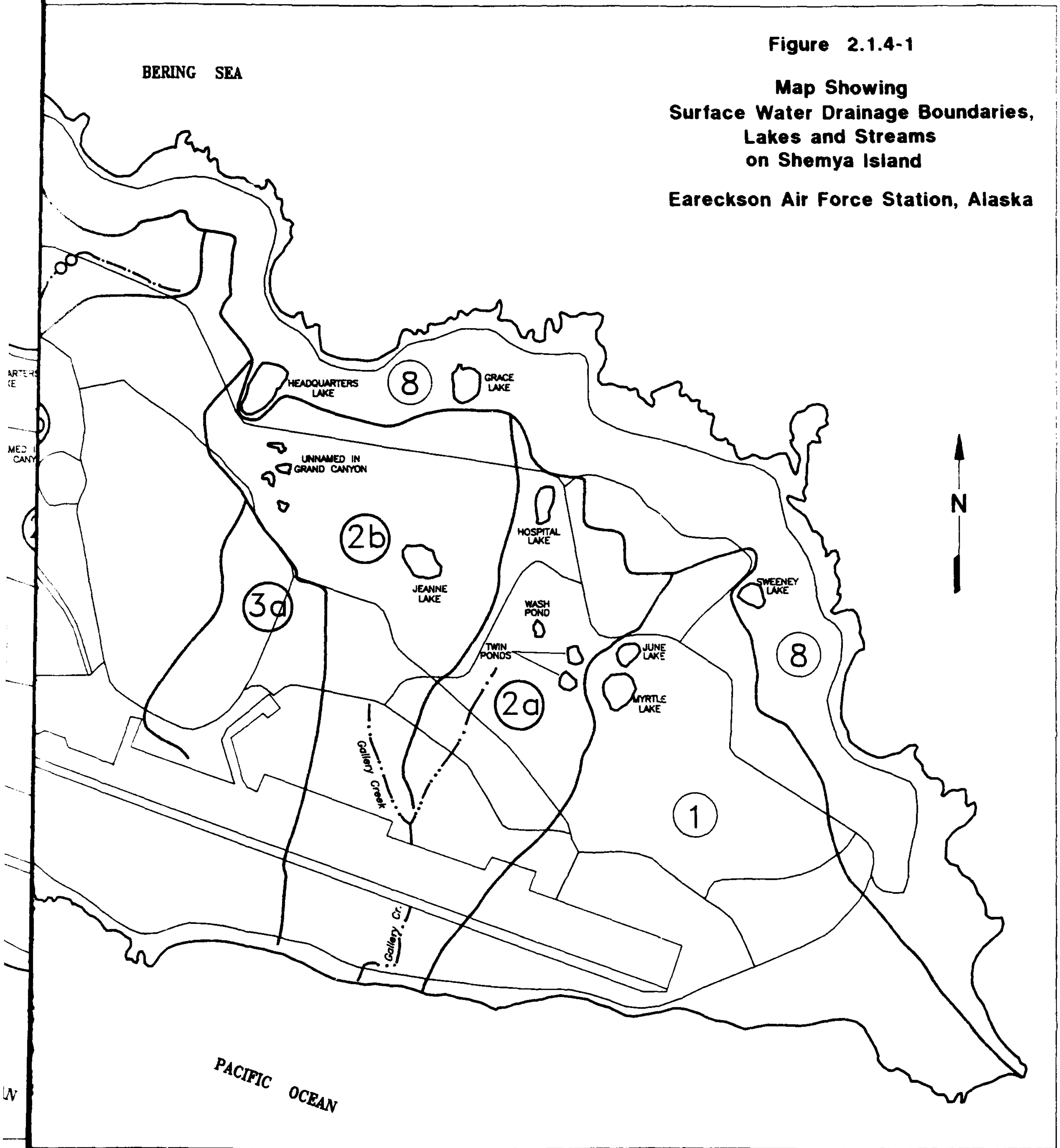


Figure 2.1.4-1

Map Showing Surface Water Drainage Boundaries, Lakes and Streams on Shemya Island

Eareckson Air Force Station, Alaska

(oversized)

TABLE 2.1.4-1
PHYSICAL DATA FOR MAJOR LAKES ON SHEMYA ISLAND
EARF 'KSON AIR FORCE STATION, ALASKA

Name	Depth (Feet)	Size (Acres)	Elevation (Feet)	Management Zone
Myrtle		3.1	165	1
June		1.3	169	1
Twin Ponds (2 bodies)		1.3	167	2a
Hospital	4.0	1.8	211	2a
Wash Pond		0.4	164	2a
Jeanne		3.3	195	2b
Unnamed in Grand Canyon		1.3 total	138-142	2b
Upper	1	12.0	71	3b
Middle	5.0	8.4	48	3b
Lower		16.9	24	3b
Pudge	7.4	1.6	51	3b
Kay		2.2	55	3b
Laundry		6.2	51	4
Unnamed west of Upper Lake		1.1	57	6
Sweeney		1.6	205	8
Grace		2.9	245	8
Headquarters		5.3	236	8

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Gallery Creek. The Lake Creek drainage basin is located in the south-southwest portion of the island and drains an area of approximately 910 acres, which is 26 percent of the island's surface area. The Gallery Creek drainage basin is located in the south-central portion of the island and drains an area of approximately 620 acres, which is 18 percent of the island's surface area. Monthly discharge rates for Lake Creek ranged from over 3.5 to less than 0.5 cubic feet per second between November 1970 and December 1972. The rate of flow from Gallery Creek during the same time period ranged from slightly over 2 to less than 0.5 cubic feet per second. Average discharge rates were estimated for Lake and Gallery creeks based on hydrographs published by Feulner, et al. (1976).

Lake Creek was estimated to have an annual average discharge rate of 2 cubic feet per second and annual average discharge rate for Gallery Creek was estimated at 1 cubic foot per second. This volume represents approximately 25 percent of the total volume of precipitation that falls on the island per year. The combined surface areas of these two drainage basins cover 1,530 acres or 43 percent of the island's surface. These calculations indicate that, during the years for which measurements were recorded, surface water discharge from these drainages account for nearly 60 percent of the total precipitation that falls in these drainage basins. Discharge for other streams and creeks on the island either has not been measured or the data are not available.

Few seeps and springs on Shemya Island have been mapped or documented. However, most of the shallow groundwater on the island discharges along streams or at the southern coastline as seeps and springs (Feulner, et al., 1976). Some of the lakes on the island may also be spring fed. Gallery Spring, located near the south-central portion of the island, contributes to water collected at the water gallery for Station use. Discharge measurements taken between late 1970 and late 1972 range between approximately 0.75 to less than 0.25 cubic feet per second for this spring. Assuming an average discharge of 0.33 cubic feet per second the estimated total annual discharge of Gallery Spring would be about 10 million cubic feet.

Other seeps and springs on Shemya Island have not been specifically documented. Additional seeps and springs are known to exist on the island based on observations during site visits in late 1992 and in early and mid-1993.

2.1.4.2 <u>Drainage Basins and Divides</u>

Surface water drainages have been extensively mapped on the island (U.S. Air Force, 1987). Most of these drainages are natural and are controlled by topography. Several drainages, however, are the result of man-made structures such as roads, runways, ditches, pipelines, and culverts. As a whole, Shemya Island can be divided into a number of drainages and drainage basins, each separated by divides, which may be natural or man-made.

Aerial photographs taken in 1943, predating military occupation and development of Shemya Island, indicate that drainages (streams and creeks) flow south to southwest over much of the island. Notable exceptions are in the western portion of the island, where drainages are not apparent. Drainages in the northwest portion of the island flow southerly and then to the west. Most of the drainages have a dendritic morphology. Dendritic drainages are characteristic of drainages developed on bedrock that is structurally and lithologically uniform.

To estimate the locations of surface water drainage divides on the island, all surface drainages were mapped from published sources. The most detailed source of this information is the 1 inch equals 100 feet scale Composite Utility Maps of the Station. Most drainages are controlled by topography; however, some drainages follow ditches, pipelines, and roads, and in some cases cut diagonally across topographic highs. Interpretation of surface water drainages and topography where drainages were not present or mapped, was used to construct a surface water divide and drainage basin map. These divides and drainage basins are shown in Figure 2.1.4-1. A total of eight drainage basins and four subbasins have been designated. Table 2.1.4-2 lists the physical characteristics of the individual divide basins. Subbasins are distinguished from basins in that the separating divides could not be projected down to the ocean as could be done with basins. The divide that separates drainage basins 2a and 2b terminates at the confluence of two streams. The divide that separates drainage basins 3a and 3b could only be traced to the north side of the active runway.

The divides for drainage basins 1 through 3 trend roughly north-south (Figure 2.1.4-1). These are the main drainage basins on the island and they cover over 60 percent of the island's surface. The remaining drainage basins are relatively minor. Surface water drainage is discharged into the Pacific Ocean on the southern side of the island and into the Bering Sea on the northern side of the island.

The lithology or composition of the unconsolidated surface deposits appears to have had little impact on drainage development with the exception of the eolian sand deposits. The eolian sand deposits on the western side of the island and along its southern coast lack well developed drainages. This observation is more accurate for aerial photographs that predate development of the island. Ditches and culverts currently cause surface water to flow through some of these areas.

2.1.4.3 Surface Water Quality

Surface water bodies on Shemya Island can be broadly defined by the type of water quality. A trilinear diagram showing classification of streams, springs, lakes, and groundwater based on existing data is shown in Figure 2.1.4-2. Lake water can be classified as sodium chloride-type water, possibly as a result of salt spray during storms. Lake water is relatively softer than stream and creek water, and is interpreted to have a high organic content from its color (Feulner, et al., 1976). The lakes on Shemya Island may also be classified as distrophic lakes that are found in muskeg regions. Table 2.1.4-3 lists selected water quality data available for some lakes on Shemya. Lake water pH tends to be neutral; however, pH has ranged from 5.3 to 8.7 in the past.

Stream water has a relatively high chloride content and can be classified as sodium calcium bicarbonate type (Figure 2.1.4-2). Stream water is moderately hard (Feulner, et al., 1976). Table 2.1.4-4 lists all water quality data available for streams and springs. Additional water quality data will be collected during the 1993 field effort.

In addition to allowing classification of waters by preponderance of major ions, the trilinear diagram (e.g., Figure 2.1.4-2) can also be used to help infer possible mixing of waters from different sources. In general, mixtures of two different waters will tend to lie on a straight line on a trilinear diagram. Furthermore, if two groups of data tend to converge along straight lines to a common point, a common source of some of the ions may be inferred (Davis and DeWiest, 1966).

TABLE 2.1.4-2
PHYSICAL PROPERTIES OF DRAINAGE BASINS ON SHEMYA ISLAND EARECKSON AIR FORCE STATION, ALASKA

Drainage Basin (see figure 2.1.4-1)	Approximate Surface Area (acres)	Drainages, Lakes	Physiography
1	520	Myrtle Lake, June Lake, No distinct drainages	Slopes gently to south
2a	230	Twin Ponds, Wash Pond, Hospital Lake, defined drainage from Wash Pond down to Main Runway	Slopes gently to south
2b	390	Jeanne Lake, Gallery Spring, well defined drainage contains Gallery Creek	Slopes gently to south
3a	130	Drainage controlled primarily by roads, ditches, pipelines and runway. Lower portion is contained in storm sewers	Slopes gently to south to the main runway where it enters storm sewer system.
3b	910	Upper Lake, Lower Lake, Middle Lake, Pudge Lake, Kay Lake. Well defined drainage below Lower Lake to coast, contains Lake Creek	Gentle slopes southwesterly to southerly
4	180	Laundry Lake. No well defined drainages. Drainage divides are runways and taxi ways	Gentle slopes, generally south
5	90	No distinct drainage	Moderate to gentle slopes generally to west
6	210	No distinct drainages	Slopes gently to moderately to north
7	210	Well defined drainage which contains oil/water separator	Moderate to gentle slopes to west
8	650	Headquarters Lake, Grace Lake, Sweeny Lake, no well defined drainages	Generally very steep. Consists of cliffs along north coast and a small area of relatively level platform at top of cliffs.

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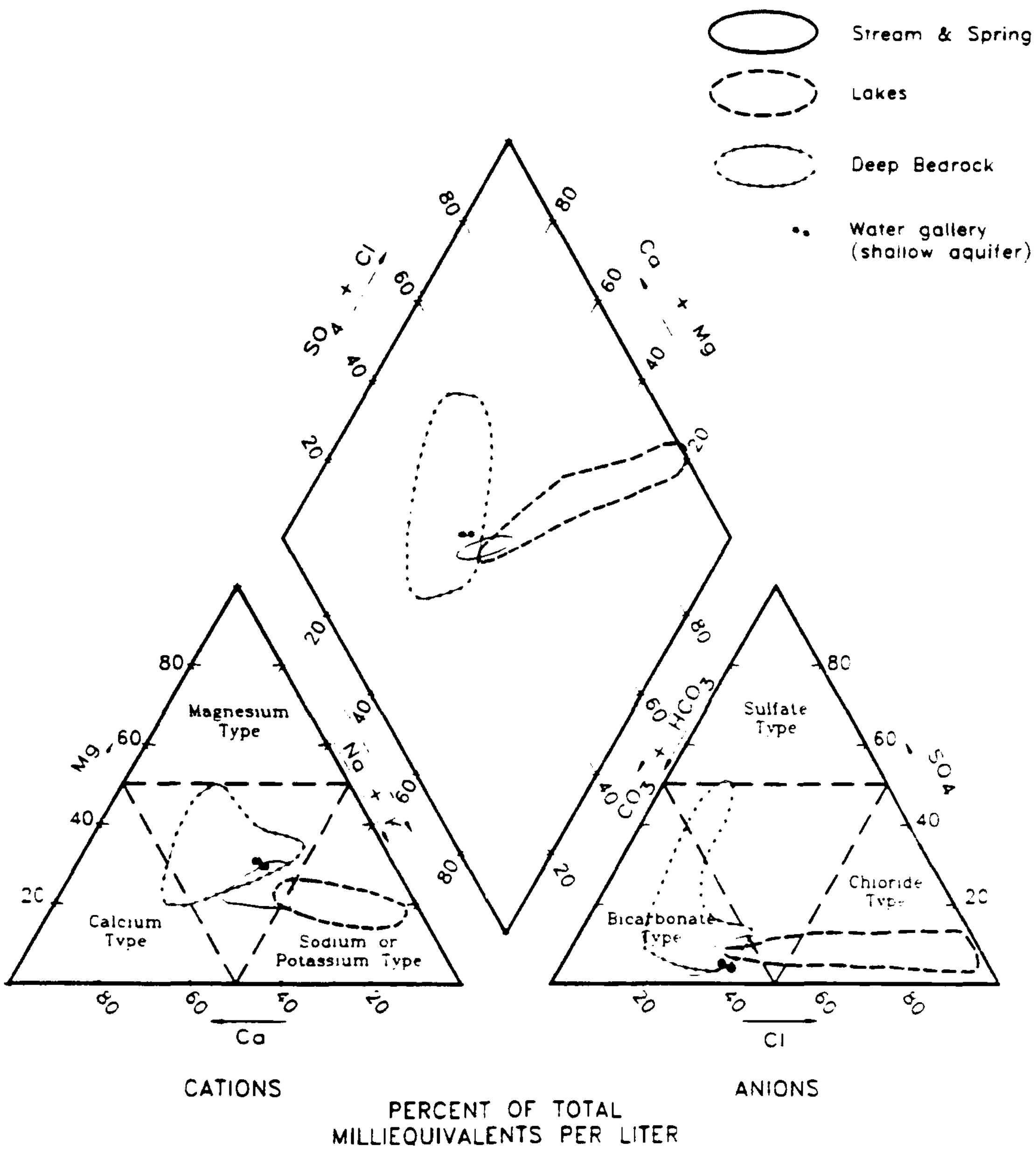

Figure 2.1.4-2

Classification of Stream, Spring, Lake and Groundwater on Shemya Island Using Trilinear Diagram Eareckson Air Force Station, Alaska

TABLE 2.1.4-3
LAKE WATER QUALITY DATA FOR SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Lake	No./ID	Date Sampled	Depth (ft)	Temp (°C)	pH	Specific Conductance (µmhos)	Color Pt-Co	Turbidity (NTU)	Aluminum (mg/L)	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Iron (mg/L)	Lead (mg/L)	Magnesium (mg/L)	Manganese (mg/L)
Upper(1)	15-297763	08/27/70	NT	NT	7.2	282	10	NT	NT	12	61	0.1	0.11	0.005	6.0	0.140t
Upper(1)	15-297763	01/28/72	1.0	1.0	6.7	300	20	NT	NT	10	64	0.0	0.35d	NT	5.8	NT
Upper(2)	GN880010	08/29/88	NT	NT	NT	NT	NT	NT	200	NT	NT	NT	NT	<0.02	NT	NT
Upper(3)	88WALUPO1WA	10/10/88 to 10/16/88	NT	8.8	6.7	282	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Upper(4)	89FPR001WA	04/30/89	NT	15	7.46	NT	NT	6.0	NT	10	62.6	NT	NT	NT	6.4	NT
Upper(4)	89FPR002WA	04/30/89	NT	15	7.50	NT	NT	6.6	NT	10	62.6	NT	NT	NT	6.4	NT
Upper(4)	89FPR003WA	04/30/89	NT	15	7.50	NT	NT	7.5	NT	10	63.6	NT	NT	NT	6.4	NT
Upper(4)	89FPR004WA	04/30/89	NT	15	7.56	NT	NT	5.2	NT	10	64.2	NT	NT	NT	5.8	NT
Middle(1)	15-297762	08/27/70	NT	NT	7.5	389	20	NT	NT	20	56	0.2	0.200t	0.004	11	0.780t
Middle(1)	15-297762	01/28/72	5.0	1.0	7.0	388	5	NT	NT	18	76	0.1	0.080d	NT	9.0	0.020d
Middle(5)	?	08/88	NT	NT	NT	NT	NT	NT	201	NT	NT	NT	NT	<0.080	NT	NT
Lower(1)	15-297768	08/27/70	NT	NT	6.7	404	100	NT	NT	28	50	0.3	0.080t	0.008	11	0.480t
Lower(1)	15-297768	01/28/72	NT	NT	7.0	369	30	NT	NT	13	78	0.1	0.320t	NT	7.2	0.020d
Lower(5)	?	08/88	NT	NT	NT	NT	NT	NT	287	NT	NT	NT	NT	<0.080	NT	NT
Lower(3) (inlet)	88WALUPO2WA	10/10/88 to 10/16/88	NT	7.3	7.07	685	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Lower(3) (outlet)	88WALUP13WA	10/10/88 to 10/16/88	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Grace(1)	15-297755	08/27/70	NT	NT	6.6	253	30	NT	NT	2.8	61	0.3	0.750t	0.008	4.6	3.100t
Grace(3)	88WALUP11WA	10/10/88 to 10/16/88	NT	8.3	7.2	NT	710	40	NT	NT	NT	NT	NT	NT	NT	NT
Headquarters(1)	15-297757	08/27/70	NT	NT	6.7	220	30	NT	NT	3.0	54	0.1	0.220t	0.004	4.1	0.080t
Headquarters(3)	88WALUP10WA	10/10/88 to 10/16/88	NT	8.1	7.2	NT	540	56	NT	NT	NT	NT	NT	NT	NT	NT
June(1)	15-297750	08/27/70	NT	NT	7.0	228	40	NT	NT	11	40	0.1	0.220t	0.007	4.3	0.080t
Pudge(1)	15-297764	08/27/70	NT	NT	5.8	201	50	NT	NT	1.4	62	0.1	0.600t	0.005	3.6	0.040t
Pudge(1)	15-297764	01/28/72	7.4	1.0	5.3	236	60	NT	NT	3.8	63	0.1	0.330t	NT	4.0	0.080t
Hospital (6)	SS-001	1992	4.0	NT	NT	NT	NT	NT	0.217	6.61	NT	NT	0.338	ND	4.73	0.008
Hospital (6)	SS-003	1992	4.0	NT	NT	NT	NT	NT	0.226	6.60	NT	NT	0.344	ND	4.78	0.009
Hospital (6)	SS-004	1992	4.0	NT	NT	NT	NT	NT	0.237	6.58	NT	NT	0.516	ND	4.78	0.010
Hospital (6)	SS-005	1992	4.0	NT	NT	NT	NT	NT	0.315	6.75	NT	NT	0.458	ND	4.87	0.014
Hospital (6)	SS-006	1992	4.0	NT	NT	NT	NT	NT	0.230	6.54	NT	NT	0.342	ND	4.73	0.008
Hospital (6)	SS-007	1992	4.0	NT	NT	NT	NT	NT	0.220	6.54	NT	NT	0.333	ND	4.70	0.008

TABLE 2.1.4-3 *(continued)*
SELECTED LAKE WATER QUALITY DATA FOR SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Lake	Mercury (µg/L)	Nitrate (as N) (mg/L)	Phosphorus (as P) (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (mg/L)	Silica (mg/L)	Zinc (mg/L)	Bicarbonate (mg/L)	Alkalinity: Hardness (as CaCO3) (mg/L)	Alkalinity: Dissolved Solids (mg/L)	Total bacteria/ fecal coliform Bacteria (Colonies/100 ml)	TPH (mg/L)	VOCs (µg/L)	O&G (mg/L)
Upper(1)	0.008	1.06	0.00	2.4	32	6.6	1.3	NT	43	54	147	NT	NT	NT	NT
Upper(1)	NT	0.07	0.04	2.2	35	6.6	1.0	NT	38	49	146	NT	NT	NT	NT
Upper(2)	<0.001	NT	NT	NT	nt	NT	NT	<0.050	NT	NT	NT	NT	NT	NT	NT
Upper(3)	NT	NT	NT	NT	nt	NT	NT	NT	NT	NT	NT	TNTC/TNTC	16.0	benzene 0.1 toluene ND xylene ND napthalene 0.2 1,2,3-trichloro-benzene 0.1	NT
Upper(4)	NT	0.17	0.048	2.1	38.0	7	NT	NT	NT	25	147	122/4	NT	NT	NT
Upper(4)	NT	0.16	0.068	2.2	40	8	NT	NT	NT	25	151	76/2	NT	NT	NT
Upper(4)	NT	0.16	0.068	2.1	38	7	NT	NT	NT	25	161	NT	NT	NT	NT
Upper(4)	NT	0.16	0.044	2.1	38	8	NT	NT	NT	25	141	62/1	NT	NT	NT
Middle(1)	0.001	1.10	0.03	2.3	43	11	4.5	NT	120	85	213	NT	NT	NT	NT
Middle(1)	NT	0.05	0.02	2.0	43	13	6.4	NT	69	83	204	NT	NT	NT	NT
Middle(5)	<0.001	NT	NT	NT	NT	NT	NT	<0.050	NT	NT	NT	NT	NT	NT	2.3
Lower(1)	0.0008	5.45	0.30	4.3	48	14	9.8	NT	114	108	243	NT	NT	NT	NT
Lower(1)	NT	0.07	0.02	2.6	44	15	7.0	NT	44	61	169	NT	NT	NT	NT
Lower(5)	<0.001	NT	NT	NT	NT	NT	NT	<0.050	NT	NT	NT	NT	NT	NT	1.3
Lower(3) (inlet)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	TNTC/TNTC	1.94	benzene ND toluene 2.1 xylene ND napthalene ND 1,2,3-trichloro-benzene ND	NT
Lower(3) (outlet)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	TNTC/TNTC	2.70	benzene NT toluene NT xylene NT napthalene NT 1,2,3-trichloro-benzene NT	NT
Grace(1)	0.0006	1.54	0.16	2.5	38	9.8	0	NT	5.0	26	127	NT	NT	NT	NT
Grace(3)	NT	NT	0.084	NT	NT	NT	NT	NT	NT	NT	NT	60/0	NT	ND	NT
Headquarters(1)	0.014	0.57	0.07	2.0	32	9.8	0	NT	6.0	21	109	NT	NT	NT	NT
Headquarters(3)	NT	NT	0.82	NT	NT	NT	NT	NT	NT	NT	NT	100/0	3.1	ND	NT
June(1)	0.013	0.50	0.00	1.7	26	9.8	1.3	NT	41	45	116	NT	NT	NT	NT
Pudge(1)	0.014	0.27	0.03	1.5	28	8.2	0.3	NT	2.0	16	98	NT	NT	NT	NT
Pudge(1)	NT	0.05	0.03	1.7	33	6.4	0.7	NT	3.0	26	116	NT	NT	NT	NT
Hospital (6)	NT	ND	NT	1.44	32.3	NT	NT	0.013	NT	NT	NT	NT	0.17	methylene chloride 10.0	NT
Hospital (6)	NT	0.07	NT	1.49	32.3	NT	NT	0.005	NT	NT	NT	NT	ND	methylene chloride 3.0	NT
Hospital (6)	NT	ND	NT	1.41	32.0	NT	NT	0.004	NT	NT	NT	NT	0.08	methylene chloride 3.0	NT
Hospital (6)	NT	0.04	NT	1.53	32.8	NT	NT	0.009	NT	NT	NT	NT	0.08	methylene chloride 10.0	NT
Hospital (6)	NT	1.38	NT	1.44	32.1	NT	NT	0.004	NT	NT	NT	NT	0.07	methylene chloride 3.0	NT
Hospital (6)	NT	1.39	NT	1.42	31.9	NT	NT	ND	NT	NT	NT	NT	0.08	methylene chloride 3.0	NT

Notes:
(1) = Feulners et al., 1976
(2) = U.S. Air Force, 1988a
(3) = U.S. Air Force, 1989b
(4) = U.S. Air Force, 1988c
(5) = U.S. Air Force, 1988b
(6) = CH2M Hill, 1993b

°C = degrees celsius
$CaCO_3$ = calcium carbonate
d = dissolved
ft = feet
ID = identification
ND = not detected
NT = not tested
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter
mL = milliliter

t = total
TNTC = too numerous to count
TPH = total petroleum hydrocarbons
O&G = oil and grease
VOCs = volatile organic compounds
µg/L = micrograms per liter
µmhos = micromhos

TABLE 2.1.4-4
STREAM AND CREEK WATER QUALITY DATA FOR SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Stream/Springs	No/ID	Date Sampled	Discharge (ft^3/sec)	Temp (°C)	pH	Specific Conductance (μmhos)	Color	Turbidity (NTU)	Calcium (mg/L)	Chloride (mg/L)	Fluoride (mg/L)	Iron (μg/L)	Lead (μg/L)
Lake Creek	15-297767	4/25/72	2.7	4.0	7.7	409	35	NT	24	60	0.2	280d	NT
Lake Creek	15-297767	7/07/72	0.94	10.5	7.3	505	15	NT	32	64	0.2	300d	NT
Gallery Creek	15-297773	4/25/72	1.51	4.5	7.7	429	25	NT	30	59	0.2	630d	NT
Gallery Creek	15-297773	7/07/72	0.35	6.0	7.9	503	10	NT	43	61	0.1	340d	NT
Gallery Spring	15-297771	4/25/72	0.66	4.5	7.2	419	0	NT	24	59	0.1	240d	NT
Gallery Spring	15-297771	7/07/72	0.19	4.5	7.8	421	5	NT	23	58	0.1	660d	NT

TABLE 2.1.4-4 (continued)
STREAM AND CREEK WATER QUALITY DATA FOR SHEMYA ISLAND
EARECKSON AIR FORCE STATION, ALASKA

Magnesium (mg/L)	Manganese (mg/L)	Mercury (µg/L	Nitrate (as N) (mg/L)	Phosphorus (mg/L)	Potassium (mg/L)	Sodium (mg/L)	Sulfate (SO_4) (mg/L)	Silica (mg/L)	Bicarbonate (mg/L)	Hardness (as $CaCO_3$) (mg/L)	Dissolved Solids (as $CaCO_3$) (mg/L)
9.8	160d	NT	.05	NT	2.4	42	20	7.5	114	101	223
13	190d	NT	.38	NT	3.1	52	21	9.4	166	133	279
11	290d	NT	.20	NT	3.3	39	13	13	140	120	239
13	440d	NT	.77	NT	3.3	40	12	20	183	160	286
14	360d	NT	0.00	NT	2.3	41	13	18	134	118	238
14	410d	NT	0.02	NT	3.3	39	11	20	135	116	236

NOTES:

d = dissolved
°C = degrees Celsius
ft3/sec = cubic feet per second
µmhos = micromhos
ID = identification
NT = not tested
NTU = Nephelometric Turbidity Unit
mg/L = milligrams per liter
µg/L = micrograms per liter
N = nitrogen
SO_4 = Sulfate
$CaCO_3$ = Calcium Carbonate
SOURCE: Feulner, et al. (1976)

With reference to Figure 2.1.4-2, we can note that the lake waters, in particular, tend to follow a linear trend, suggesting that lake waters from different parts of the island might represent mixtures of water from different sources. Furthermore, lake waters and deep bedrock waters tend to follow two different linear trends that converge in the area where stream and spring waters plot, suggesting that the streams and springs might represent mixtures of lake water and groundwater.

Trilinear plots will be prepared of water quality data collected during 1993. Waters from different sources will be categorized by preponderance of major ions, and evidence of trends in the data suggestive of mixing of waters from different sources will be assessed.

Only limited water quality data are available for surface water bodies on the island. Data for many of the water bodies on Shemya do not exist. The water quality data that are shown in Tables 2.1.4-3 and 2.1.4-4 are from various investigations that include, but are not limited to, 1) general water quality for drinking purposes, 2) fire protection system pumphouse, 3) suitability of water for fish stocking, and 4) specific IRP source units. These data are not quantitatively comparable because analytical techniques are not given and may be different, detection limits appear to vary considerably, and units are not always reported. In addition, the presence or absence and quantity of precipitation that may have been occurring as sampling was conducted is not reported. Precipitation can be expected to significantly impact the chemistry of surface water. Chemistry of surface water can also be expected to change seasonally in response to differences in factors that include, temperature, biological activity, oxidation-reduction potential, and the runoff potential of precipitation. Data are too limited to evaluate the apparent variation in aqueous chemistry of sample subsets from individual source bodies because of these factors.

However, some broad, qualitative conclusions can be drawn from the data set provided by Feulner, et al. (1976). Analytical and sampling inconsistencies can be minimized by using data from a single source, however, at a cost of having a small sample population. Stream and creek water chemistry more closely resembles groundwater chemistry than it does lake water chemistry. The pH of lakewater is very nearly neutral in comparison with stream water that is slightly alkaline. Stream and creek water has a higher overall content of silica, calcium, magnesium, and bicarbonate, and has higher total dissolved solids. Stream water has a nitrate content that is considerably lower than lake water. The concentration of most cations and anions increases in stream water as the discharge rate decreases. The composition of water from Gallery Spring appears to remain relatively constant both at high and low discharge rates. This may indicate that the residence time of groundwater in the source aquifer is sufficiently long for chemical equilibration with the subsurface environment to occur at either high or low flow rates.

The differences in aqueous chemistry between lake, stream, and spring water may be explained in part if the recharge sources for the lakes are largely distinct from that of the streams and springs. Lake water chemistry is what would be expected for waters that drained at and near the surface through muskeg and into the lakes. These waters are low in dissolved constituents, have a low carbonate content, pH conditions would be strongly to moderately acidic, and organic content would be relatively high (Ruttner, 1963). The recharge source for lakes is assumed to be predominantly from surface water runoff.

Surface waters that infiltrate gravel and sand deposits and bedrock would have slightly neutral to alkaline pH as a result of aqueous reactions with the silicate material. The reaction with silicate material would also increase the content of silica, magnesium, calcium, and potassium, which are major rock-forming elements. Groundwater would discharge into gaining streams.

Surface water contamination is widespread on Shemya and consists primarily of fuels, oils, and lubricants. Bodies of surface water were contaminated early in the history of the military occupation of the island. Initially, 16 surface lakes and ponds were used as a water supply for the Station, but by the mid-1940s, these were abandoned because of contamination resulting from fuel and munitions handling practices. Although fuel handling practices have improved, surface water samples analyzed in 1988 (U.S. Air Force, 1988b) indicate that fuel-, oil-, and grease-contaminated surface waters are still present. During site visits by Jacobs in the fall and winter of 1992 and the spring of 1993, petroleum product seeps were observed and continue to discharge contaminants to man-made ponds. Lower and Upper Lakes have both been found to have high concentrations of fecal coliform bacteria (U.S. Air Force, 1988b). The source of the bacteria is probably upgradient sanitary sewer lines that may be leaking.

Sources, concentrations, and contaminants are more fully described in Section 2.2 where individual source areas are discussed.

2.1.5 Climatology/Meteorology

Weather on Shemya Island is dominated by a persistent low pressure system referred to as the "Aleutian Low," which causes North Pacific storms to track through the *Aleutian Islands*. The islands have a maritime climate that is relatively mild for the latitude. Summer fogs are severe and frequent.

The weather and meteorology for the island are monitored and recorded by Detachment 3, 11th Weather Squadron. Temperature, windspeed, and precipitation data have been reviewed for the most recent eight-year period dating from January 1985 through February 1993. These data are summarized and discussed in the following sections.

2.1.5.1 <u>Precipitation</u>

Annual precipitation on Shemya Island averages 30.3 inches. Monthly precipitation averages 2.52 inches, but ranges from a high of 4.11 inches to a low of 1.22 inches. Table 2.1.5-1 indicates that precipitation rates are higher for the months of July through December, with maximum precipitation falling in August. Relatively lower precipitation rates may be expected between January and June, with lowest precipitation falling during April and May. Precipitation occurs as snowfall during the months of November through May. Trace but not measurable amounts of snow have been recorded in October during some years. Monthly snowfall averages are shown in Table 2.1.5-1. Average annual snowfall is approximately 76 inches per year excluding the month of January 1987. This month has been excluded from averaging because extremely high snowfall of 54.9 inches for this month would have strongly skewed averages in an upward direction.

Maximum recorded total precipitation in a 24-hour period was 2.07 inches in August 1987, and maximum snowfall in a 24-hour period was 11.6 inches in January 1987. The highest total monthly precipitation was 9.36 inches in August 1990.

TABLE 2.1.5.−1
COMPARISON OF WEATHER DATA FOR THE PERIOD JULY 1943 TO NOVEMBER 1972
WITH DATA FOR THE PERIOD JANUARY 1985 TO FEBRUARY 1993
EARECKSON AIR FORCE STATION, ALASKA

TEMPERATURE (° Fahrenheit)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	ANNUAL MEAN TEMPERATURE (° Farenheit)
Jan 85 – Feb 93	30.6	31.74	32.21	36.1	39	43.1	47.3	49.7	48.1	44.2	37.5	33.2	39.4
Jul 43 – Nov 72	32	31	32	35	38	42	46	49	48	42	36	33	39
PRECIPITATION (inches)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	ANNUAL MEAN PRECIPITATION (inches)
Jan 85 – Feb 93	2.75	2.07	2.01	1.22	1.32	1.79	3.03	4.11	3.04	2.83	3.06	3.07	30.33
Jul 43 – Nov 72	2.4	1.9	2	1.8	1.9	1.4	2.7	2.9	2.7	3.4	3.3	2.6	29
WIND SPEED (knots)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	ANNUAL MEAN WIND SPEED (knots)
Jan 85 – Feb 93	17.3	18.2	18.26	15	14.06	12.1	11.27	12.24	13.6	15.9	17.45	17.9	15.3
Jul 43 – Nov 72	18	18	18	16	15	12	12	12	14	18	19	18	16
SNOWFALL (inches)	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec	ANNUAL MEAN SNOWFALL (inches)
Jan 85 – Feb 93	17.4*	14.3	11.2	5	1.1	0	0	0	0	0	6.8	16.5	72
Jul 43 – Nov 72	12	14	12	4	1	0	0	0	0	1	8	12	64

* January 1987 results omitted from the average

Sources: U.S. Air Force (1974)
Unpublished data sheets from Detachment 3, 11th Weather Squadron

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100% Recycled

Precipitation averages for the January 1985 to February 1993 are shown in Figure 2.1.5-1.

Precipitation falls an average 328 days per year, ranging from a low of 302 days (1987) to a high of 344 days with precipitation (1991).

2.1.5.2 Temperature

The mean annual temperature on Shemya Island is 39.4 degrees Fahrenheit (°F). The maximum temperature recorded was 65°F in July 1989, and the minimum recorded temperature was 18°F in February 1990. August is the warmest month with a mean temperature of 49.7°F, and January was the coldest month with a mean temperature of 30.6°F. Monthly variations of high, low, and mean temperatures are shown in Figure 2.1.5-2.

2.1.5.3 Wind

Wind direction is evenly distributed and there is no true prevailing direction. The average annual mean wind speed on Shemya Island is 15.3 knots. Mean wind speeds vary seasonably from a low of 11 to 13 knots from June through August and a high of 17 to 19 knots from November through March (Figure 2.1.5-3). Peak wind speeds up to 98 knots have been recorded (November 1990). Average monthly peak wind speeds are shown in Figure 2.1.5-3. June through August have average monthly peak wind speeds less than 40 miles per hour. Average peak wind speeds for the rest of the year range between 50 and 65 miles per hour.

2.1.6 Biological Resources

Eareckson AFS is located within the Alaska Maritime National Wildlife Refuge. The refuge extends from Forrester Island in southeastern Alaska to Attu Island at the tip of the Aleutian chain.

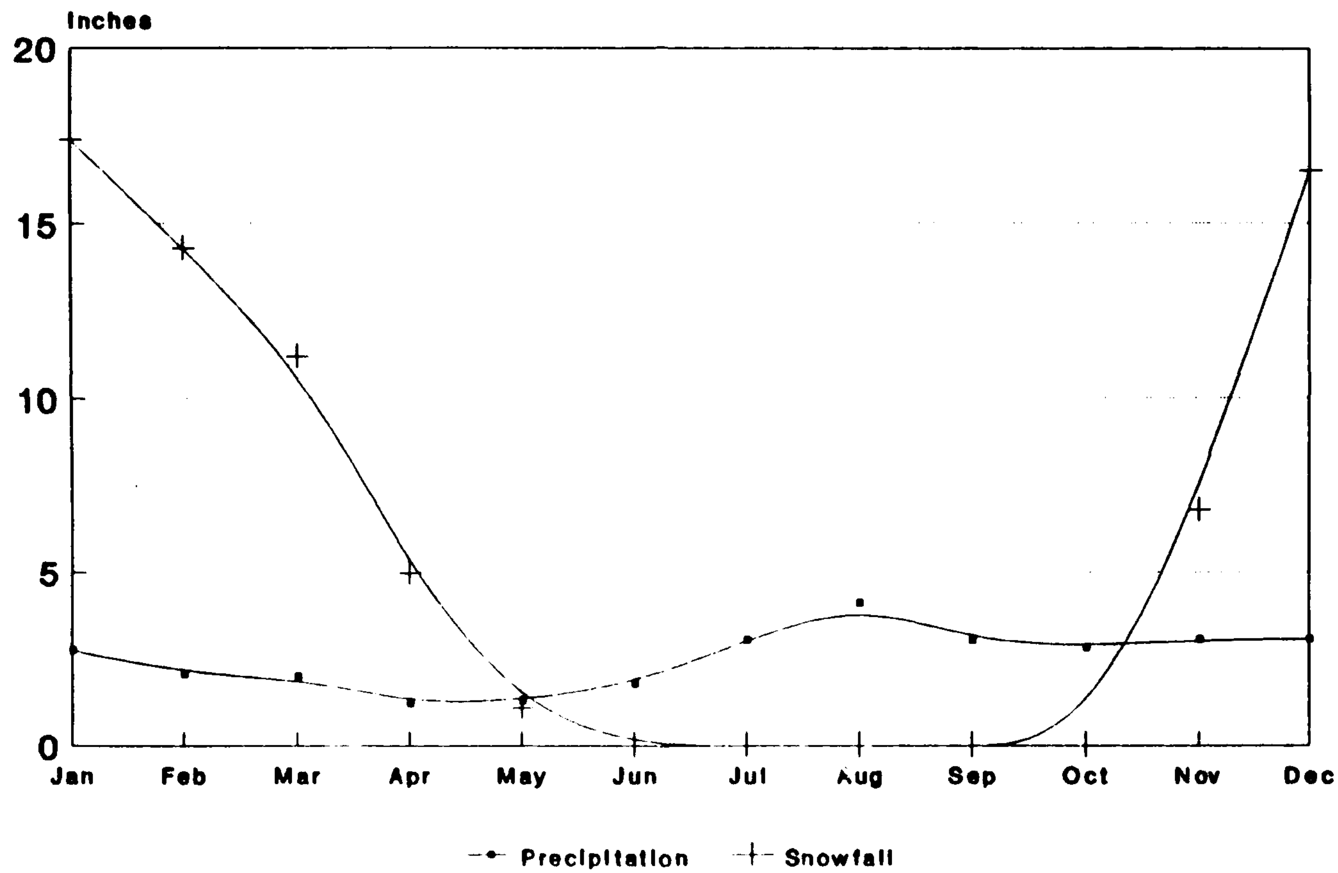
The refuge contains a variety of vegetative communities and provides key habitat for birds and mammals, both terrestrial and marine. Coastal terrain is especially favorable to large concentrations of seabirds. There are approximately 3,000 headlands, islands, islets, and pinnacle rocks within the refuge. These areas are used annually by about 40 million nesting seabirds, 80 percent of Alaska's seabird population. Shemya Island supports a nesting population of 170,000 seabirds DOI, 1988).

Under the Alaska Lands Act, each island within the refuge is to be managed under a selected alternative. Shemya Island has been placed in Alternative A, which is the no action alternative. Alternative A maintains the existing range and intensity of management and recreational and economic uses currently being undertaken on Shemya Island. This alternative is consistent with the future projections by the FWS that Shemya Island will remain an active military installation (DOI, 1988).

The following is a summary of the biological resources known to exist on Shemya Island. Figure 2.1.6-1 shows the habitat locations for a variety of faunal species on and adjacent to Shemya.

Figure 2.1.5-1

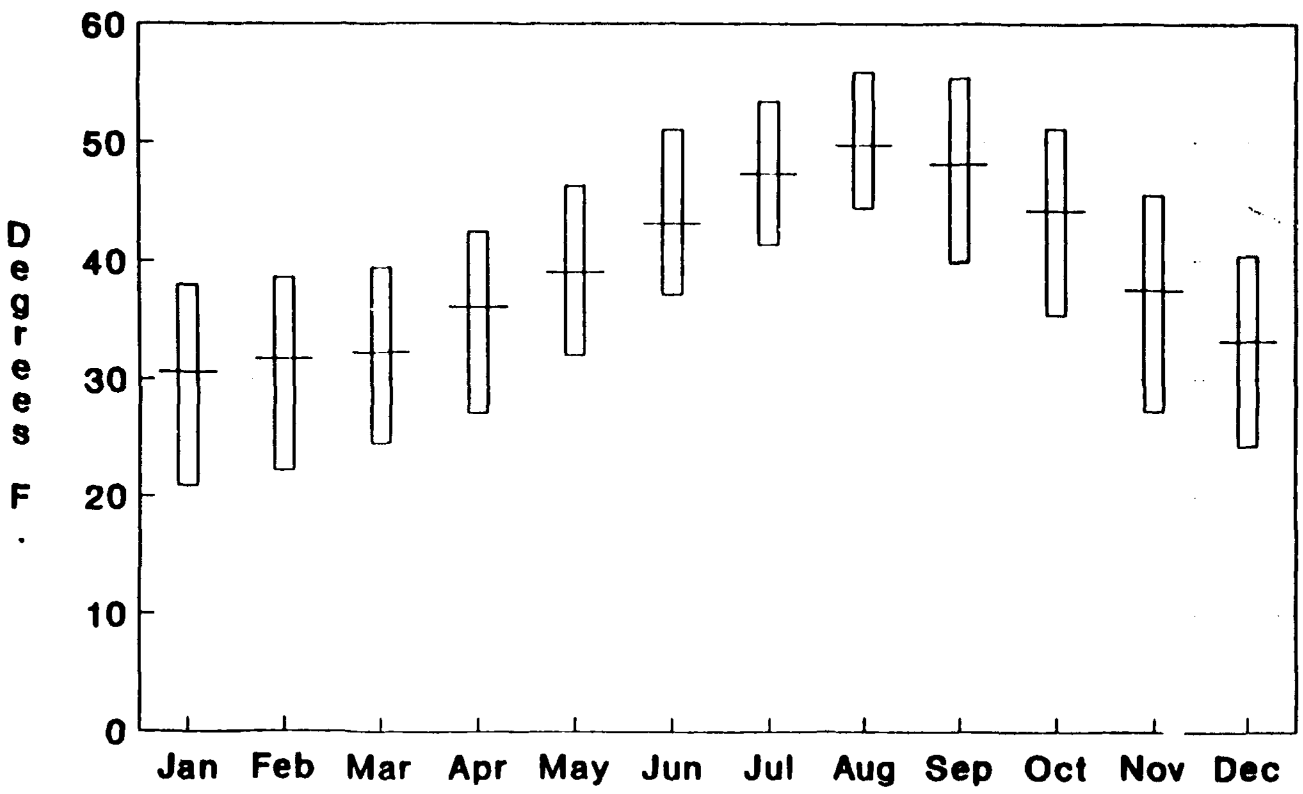
Monthly Precipitation on Shemya Island



Data from January 1985 to February 1993

Figure 2.1.5-2

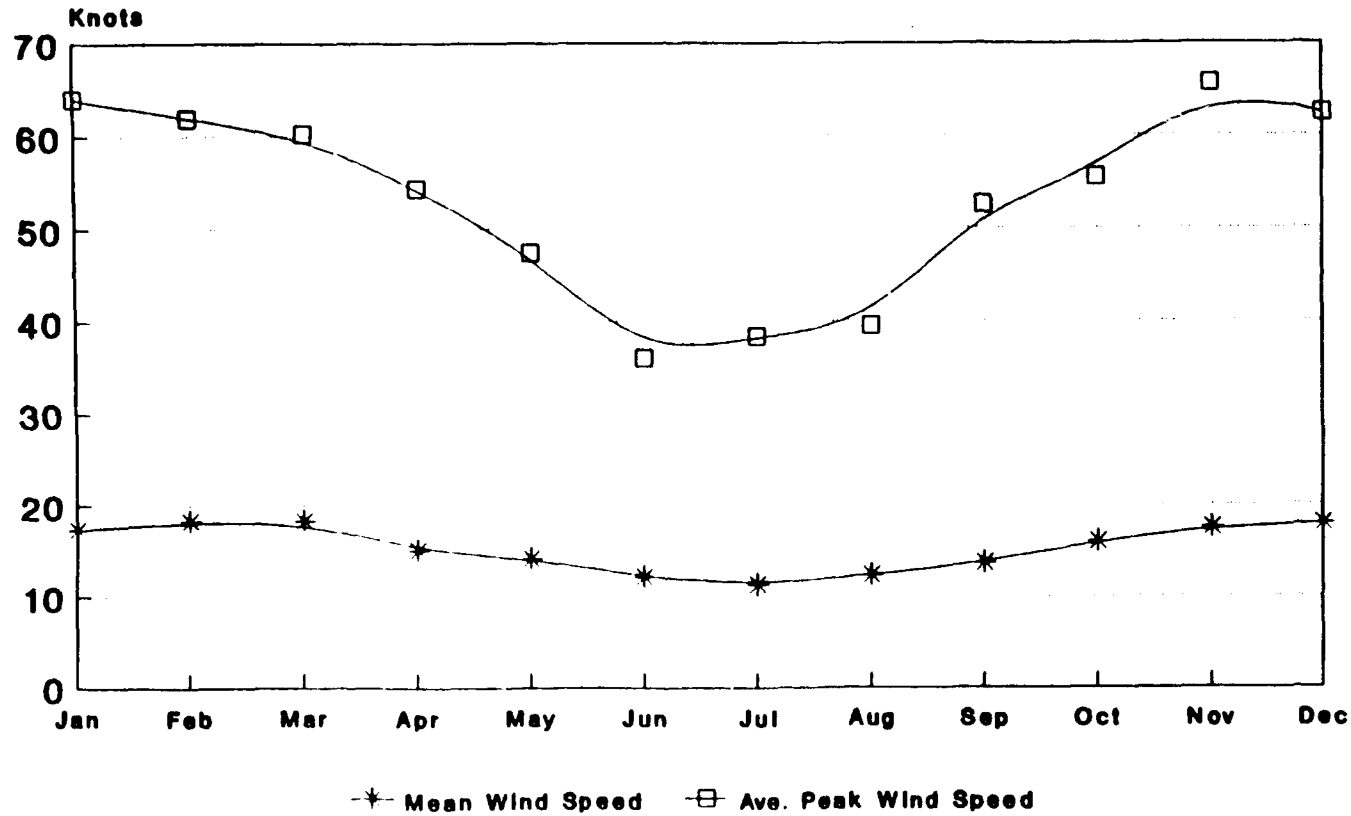
Monthly High, Low, and Mean Temperatures on Shemya Island



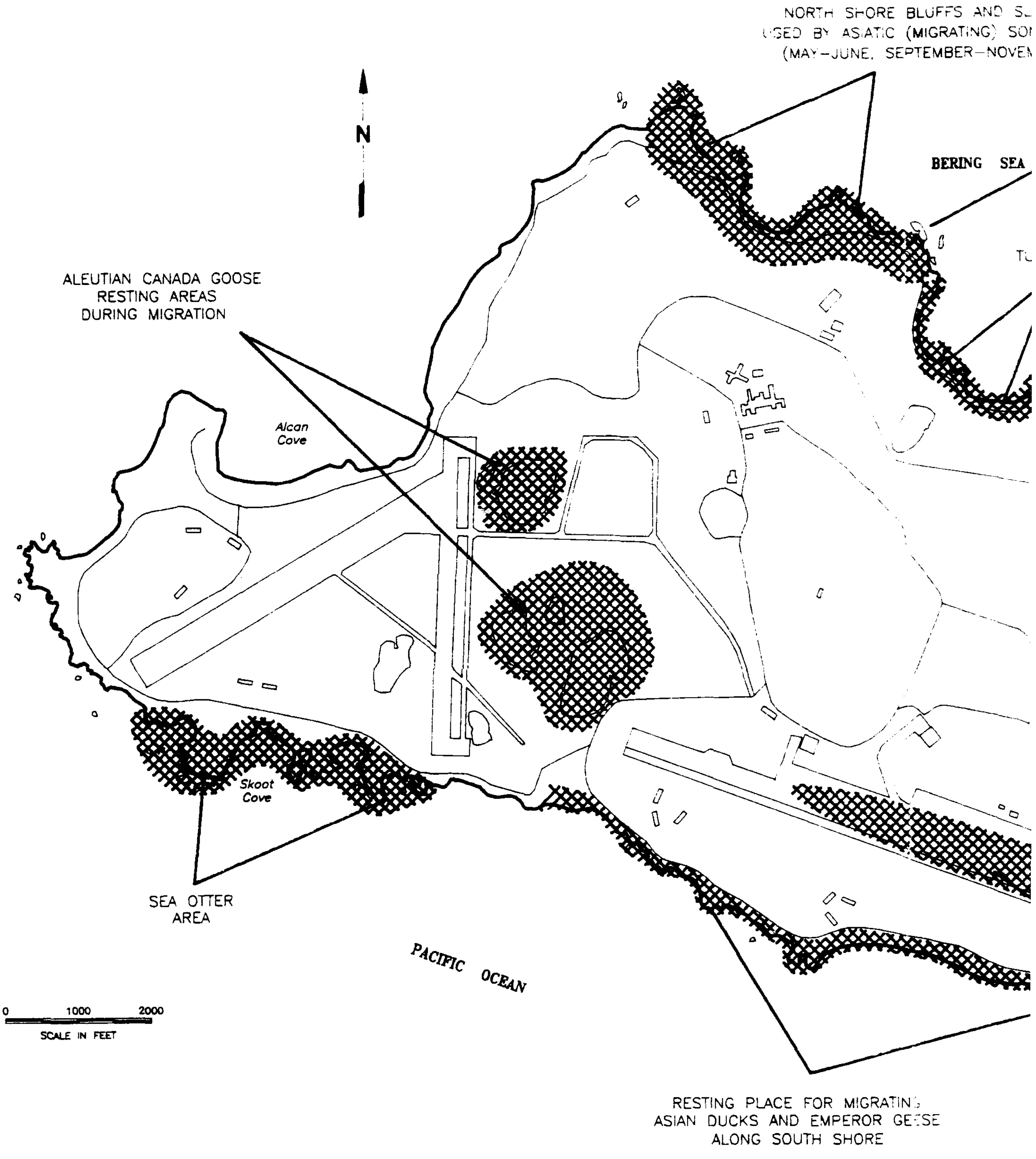
Data From January 1985 to February 1993

Figure 2.1.5-3

Monthly Mean and Peak Wind Speeds on Shemya Island



Data from January 1985 to February 1993

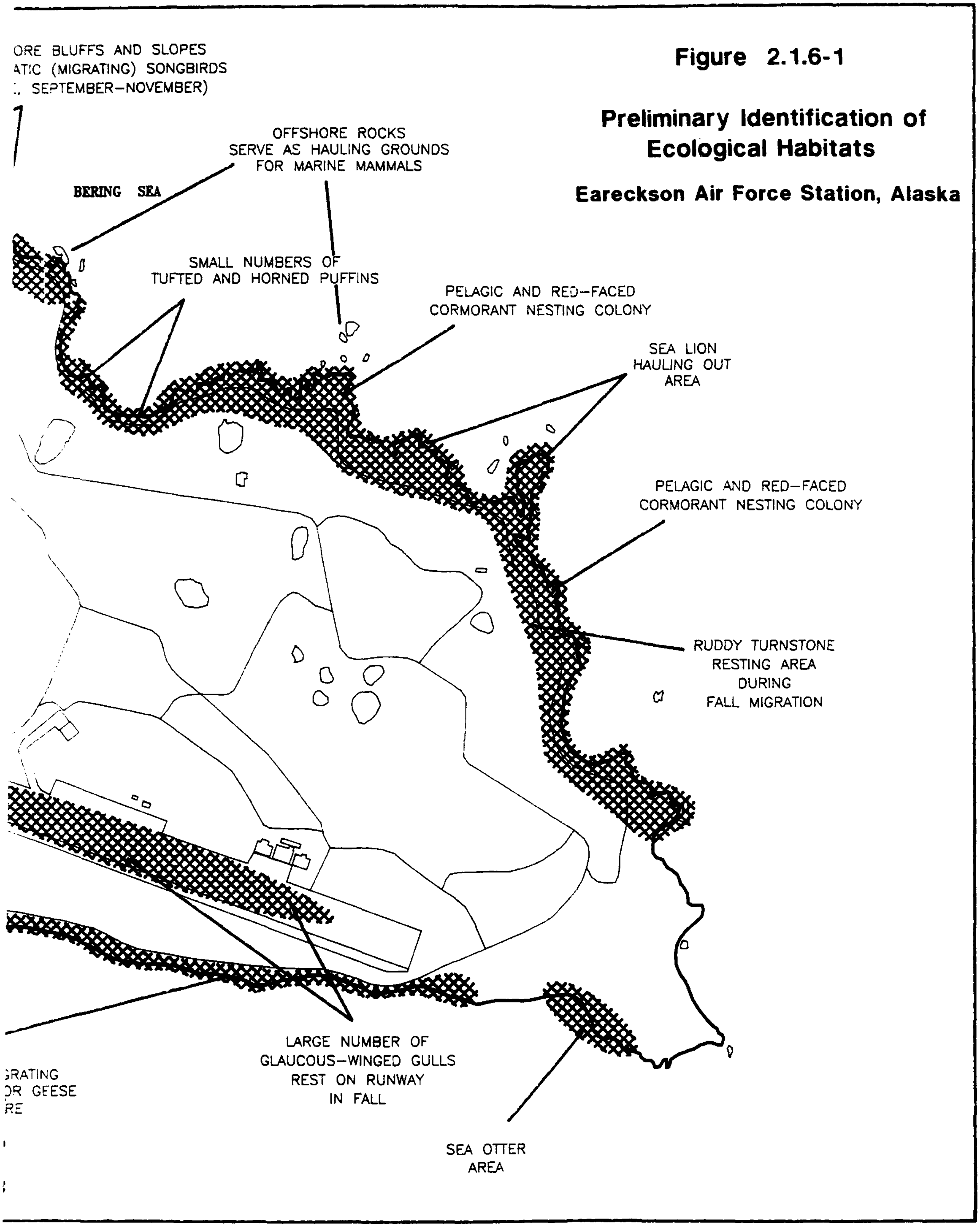


SOURCE: U.S. Air Force. 1987(May). Directorate of Engineering and Services DCS/LEE
Base Comprehensive Planning Directorate AFR 86–4
Shemya AFB, Alaska

Figure 2.1.6-1

Preliminary Identification of Ecological Habitats

Eareckson Air Force Station, Alaska



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2.1.6.1 Flora and Fauna of Shemya Island

Unlike the middle and eastern portions of the Aleutian chain, the Near Islands are relatively older geologically than the other islands in the middle and eastern portions of the Aleutian chain. Various factors combine to place the Near Islands into a floral and vegetational province that differs from the remainder of the Aleutian chain. Among these factors are the islands' relative geological age, their proximity to the Asian mainland, and climatic variations from the middle and eastern portions of the chain.

Flora. Three major plant communities have been identified on Shemya Island: wet tundra, moist tundra, and alpine tundra (Selkregg, 1974). Wet tundra is characterized by a continuous vegetation cover of mosses, lichen, and grasses, interspersed with areas of standing water. Wet tundra primarily occurs in areas of low topographic relief and is present in the central and southwestern portions of Shemya Island. In areas with better drainage, the moist tundra plant community predominates. It is characterized by a near continuous vegetative cover consisting of mosses, grasses, and sedges. These two plant communities (wet and moist tundra) occupy the greater portion of Shemya Island.

Although Shemya has an alpine tundra classification (Selkregg, 1974), it is unlikely that this plant community occurs on the island (TRA/Farr, 1988). Shemya Island's low topographic relief and elevation preclude the geological and climatic features necessary for the alpine tundra community (TRA/Farr, 1988).

The dominant plant species on Shemya Island are grasses (*Elymus* spp.) and sedges (*Carex* spp.). Grasses (*Elymus* spp.) are found just inland from the beaches and on the island's south side, on low bluffs. Sedges dominate the interior meadowlands (wet tundra) of the island. Club moss (*Lycopodium* spp.) forms a tundra-like mat on some parts of the island, primarily along the northern bluffs of the island (Zeillemaker, 1987).

Under definitional criteria applied by COE, the majority of Shemya Island falls within a wetlands classification. The only areas excluded from this classification are beaches, cliffs, lakes, largely disturbed areas (e.g., runways), and other areas that have been altered by construction in support of Station activities.

The wetlands designation is based on COE jurisdictional definition and does not convey information on habitat types and values that would be considered if the FWS were responsible for evaluating the wetlands status of Shemya Island. In 1987, the Air Force and FWS discussed a cooperative agreement to have the FWS conduct a habitat survey and produce a more detailed wetlands designation for the island. No information regarding whether this cooperative agreement has been completed is available (TRA/Farr, 1988).

Fauna. This subsection summarizes the faunal species that occur on and around Shemya Island. Information presented includes terrestrial mammals, marine mammals, and birds (resident and migrant).

Terrestrial Mammals - There are no large terrestrial mammals on Shemya Island. Arctic fox (*Alopex lagopus*), introduced by the Russians in the 1800s, is the largest mammal on the island. The highest densities of arctic fox are located on the east side of the island. Rodents and insectivores (shrews) comprise the remainder of the terrestrial mammal population. The deer mouse (*Peromyscus maniculatus*) is believed to have been introduced to the island from arriving planes. Ships and barges docking at Shemya Island may also have introduced rodents onto the island.

Marine Mammals - Marine mammals are present on and around the island. Harbor seals (*Phoca vitulina*), sea otters (*Enhydra lutris*), sea lions, and several whale species have been observed (Selkregg, 1974; Zeillemaker, 1987). Selkregg (1974) notes a stellar sea lion (*Eumetopias jubatus*) population hauling ground along the southeast coastal shoreline of Shemya Island. Zeillemaker (1987) indicates at least one hauling ground for stellar sea lions on the north side of Shemya Island with a population of approximately 500 animals. Each year the National Marine Fisheries Service conducts aerial surveys of stellar sea lion populations in Alaska. The aerial surveys are completed to assess the status of the species, which was listed as threatened under the Endangered Species Act of 1973 (see Section 2.1.6.2) (NOAA, 1992).

Sea otters are reportedly found in all coastal waters surrounding Shemya Island. Sea otters reportedly favor the southwest coastline because of the presence of kelp beds and suitable habitat for resting and pupping. Pupping occurs from March through May. Aerial surveys of sea otter habitat and population are conducted for Shemya Island by the Marine Mammals Management Branch of the DOI (DOI, 1992). Frequency of these surveys is currently unknown.

Birds - The island is used as a year-round habitat for neritic seabirds and raptor species. A major seabird colony is located on adjacent Nizki Island. Most of the islets, bluffs, and rocks surrounding Shemya Island serve as bird colonies for both neritic and pelagic seabirds. Neritic seabirds are species that use the belt of relatively shallow coastal waters, whereas pelagic species reside mainly on the open sea. Pelagic cormorants, red-faced cormorants, and tufted puffins are known to nest on the bluffs located on the north side of Shemya. In general, pelagic seabird numbers appear to be normal for the size of the island and the existing habitat suitability (FWS, undated).

Tufted and horned puffins are concentrated at the cliff rookery on the north side of the island. Neither species is found in plentiful numbers on the island. The glaucous-winged gull population is dispersed around the periphery of the island, with the largest population located along the north side where they gather in flocks of up to 50 birds on the rocks or beaches. Large numbers of gulls rest on the runways in the fall after the young fledge from the offshore islet colonies. Ruddy turnstones can be found along the north shoreline during fall migration.

Terrestrial bird species are not abundant on the island. The lapland longspur is the most abundant land bird during the summer, but its population appears to be less than normal for the habitat available (FWS, undated). The lapland longspur occurs in both the interior and periphery of the island. The snow bunting occurs mainly on the island periphery along the north side bluffs and shoreline. Overall, the terrestrial bird species populations appear to be lower than normal for the size of the island and the quality of habitat that exists (FWS, undated). Their numbers may be limited because of the presence of arctic fox, domestic dogs, and military presence.

Shemya Island has been characterized as a low-density waterfowl habitat (Selkregg, 1974). It is speculated that man's activity is a primary reason for low population numbers (Zeillemaker, 1987). For the most part, waterfowl use the lakes of Shemya Island as resting places during migration. The Upper, Middle, and Lower lakes complex (see Figure 2.1.4-1) serves as a migratory feeding and resting area for waterfowl, including the Aleutian Canada goose, a threatened species (see Section 2.1.6.2). Emperor geese, a species on the decline, use the south shore of Shemya Island from November to April for winter resting and feeding. The emperor geese congregate from the sewage lagoon, east to the runway along the coastal shoreline. Harlequin ducks are quite numerous and are seen in salt water surrounding Shemya. Common eider ducks are also seen in the water surrounding Shemya Island.

The north shore bluffs, vegetated with thistle (*Cirsium* spp.) and cow parsnip (*Heracleum* spp.) provide important resting habitat for migrating Asiatic songbirds.

2.1.6.2 Threatened and Endangered Species

An endangered species, as defined by the Endangered Species Act of 1973, is a species that is in danger of extinction throughout all or a significant part of its range, whereas threatened species are those likely to become endangered within the foreseeable future. A total of six endangered or threatened faunal species use Shemya Island or the adjacent waters; however, none of the identified faunal species are permanent residents of Shemya Island. No endangered or threatened floral species have been identified at Shemya Island. The following subsections identify the endangered and threatened species of concern and where known, the habitat types they use on Shemya.

Avian Species. Based on FWS records over the past nine years, the threatened Aleutian Canada goose (*Branta canadensis leucopareia*) has occurred irregularly on Shemya Island during migration in the months of May, September, and early October. Critical habitats that support the Aleutian Canada Goose include Upper, Middle, and Lower lakes, Laundry Lake, North Point, and North Beach ledge. Geese use Shemya Island as a staging and resting area during migration. Aleutian Canada geese do not nest on Shemya Island because of the presence of arctic foxes. The habitats used by the geese have been identified by the Air Force as sensitive or critical habitat on the island.

Marine Mammals. The right whale (*Balaena glacialis*) and humpback whale (*Megaptera novaeangliae*) are seasonal visitors to the waters surrounding Shemya Island. Both species are designated as endangered by the FWS. The right whale is observed in the area from April to September. The humpback whale uses the area surrounding Shemya for feeding and as a migration corridor. The humpback is observed in the area from May to October.

The stellar sea lion (*Eumetopias jubatus*) is a threatened species as defined by the Endangered Species Act of 1973. The stellar sea lion uses the northeast coastal shoreline and adjacent offshore rocky habitat for pupping and hauling grounds.

The sea otter (*Enhydra lutris*) is a protected species. The sea otter primarily uses the southern coastal areas of Shemya Island for feeding, pupping, (March through May), and as haulout grounds.

2.1.6.3 Fishery Resources

Fishery resources on and surrounding Shemya Island include marine fishes, freshwater fishes, and potentially anadromous fishes. Freshwater fish are not considered a significant resource on Shemya Island. Commercial fishing surrounding Shemya Island is considered minor (DOI, 1988).

Marine fishes. Principal marine fishes and invertebrates of the Aleutian Islands include halibut, Pacific Ocean perch, Pacific cod, sablefish, yellowfin sole, walleye pollock, sandlance, Pacific herring, tanner crab, and king crab. Tanner crab occur in the coastal waters around Shemya Island.

Freshwater fishes. Rainbow trout were stocked on Shemya Island for years, but the stocking programs were discontinued in the mid-1970s. In the mid to late 1980s, several water quality and habitat studies were conducted to determine the potential for increasing the recreational freshwater fishing opportunities on Shemya Island. The studies were completed to assess the viability of stocking Salmonids in several of the lakes on the island. The Alaska Department of Fish and Game (ADFG) determined the depth of all lakes, the oxygen and acid content of selected lakes, and the availability and suitability of food within selected lakes. During these studies, dolly varden were captured from Middle and Lower lakes (see Figure 2.1.4-1). Based on these studies, ADFG determined that silver salmon could successfully be introduced into these two lakes. In 1985, 500 pounds of silver salmon fingerlings were released into Middle and Lower lakes (U.S. Air Force, 1985).

Water quality studies determined that the oxygen content in the two lakes was ideal and that the acid content in the lakes would not hinder fish reproduction and survival (U.S. Air Force, 1985).

Anadromous fishes. Anadromous fishes of the Near Islands primarily include pink and chum salmon, although sockeye and coho salmon occur in some areas. Although there are no significant salmon runs on Shemya Island, significant numbers of pink salmon spawn on nearby Agattu and Attu islands. A few sockeye, coho, and chum salmon also spawn on these islands. Dolly varden/arctic char occur in the waters surrounding Shemya Island. There is one small stream in the northwest corner of Shemya Island that reportedly has anadromous fish, but these are expected to be dolly varden/arctic char (ENSR, 1991).

2.1.7 Cultural/Archeological Resources

The history of the Aleutian Islands can be characterized by several periods: aboriginal prehistory, early Russian and European influence, early American influence, World War II, and post-war developments. The following sections were extracted from the *Shemya Air Force Base Comprehensive Plan* (TRA/Farr, 1988).

2.1.7.1 Prehistory

Aleuts are thought to have inhabited small villages along the shoreline, ranging in size from under 30 to approximately 300 inhabitants, although villages in the west were generally very small. Different village sites, usually located on promontories, spits and narrow peninsulas, were occupied seasonally, and individual families also claimed fishing and hunting grounds used on a seasonal basis.

Because of the region's incomplete archaeological record, opinion differs concerning the local population's origin and development. Cultural links to Siberia and northern Japan have been identified, and archaeological finds suggest the Aleutian Islands have been inhabited by marine subsistence hunters for at least 8,000 years, and possibly as long as 10,000 years. One theory is that the modern population descended in isolated fashion from migrants via the Bering Sea land bridge. Another is that the modern Aleut population evolved from groups arriving at different times (Black, 1980; Black, 1984).

The population inhabiting the Near Islands, on Attu, Agattu and Shemya, was alternatively known as Alait, Aleut, or Sasixman. A distinctive Near Islands language was encountered by early Europeans.

The Alaska Department of Natural Resources lists four archaeological sites on Shemya Island, according to a Cultural Resources Survey conducted by the COE District Archaeologist:

- ATU-003: small site with bone and flaked stone;
- ATU-021: archaeological site;
- ATU-022: small site; and
- ATU-023: small archaeological site.

The general vicinity of each site is presented in Table 2.1.7-1. The survey did not, however, identify any aboriginal remains, even though artifacts washed up on island beaches were occasionally encountered by personnel conducting fieldwork on the Base Comprehensive Plan.

2.1.7.2 Russian and European Influence

The second Kamchatka Expedition, commanded by Vitus Bering in 1741, established the basis for Russian claims over what are now considered the Aleutian Islands. Attu is among the islands thought to have been sighted during the return voyage. The first fur hunting expeditions reached the area within a few years, and the entire Aleutian Archipelago was being explored by the end of the decade.

During ensuing decades, fur trade intensified, with the largest number of new expeditions dispatched to the area between 1760 and 1780. Relations with the indigenous population varied depending on specific circumstances and the posture of residents and expeditions involved. Conflicts were sporadic and localized. Local populations also moved, on occasion, to better participate in the Russian fur trade.

Russian exploration and economic exploitation continued to extend east along the Pacific Coast, eventually reaching northern California. During 1778, English Captain James Cook entered the Aleutians on his third voyage. Cook's exploration formed the basis for English claims along the northwest coast, and helped stimulate English and American activity in the North Pacific, as well as the northern extension of Spanish claims. By the late 1770s, the number of sponsoring Russian companies or associations had declined, with vessel ownership concentrated in the hands of a few large merchants. As this trend continued, key figures such as Sarychev, Shelkhov, and Baranof, whose names grace the map today, rose to prominence in Russian Alaska.

As the end of the century approached, the Russian presence in the Western Aleutians generally diminished, as their efforts became concentrated farther to the east. Between imported disease and resettlement to other hunting areas, the local population generally languished. The Aleut population relied predominantly on subsistence hunting with minimal Russian trade during the early 1800s.

TABLE 2.1.7-1

ARCHAEOLOGICAL SITES IDENTIFIED ON SHEMYA ISLAND

EARECKSON AIR FORCE STATION, ALASKA

SITE IDENTIFICATION NUMBER	SITE LOCATION	CULTURAL AFFILIATION	ARCHAEOLOGICAL PERIOD	COMMENTS
ATU-003	South of the west end of airport, on southern coast of Shemya Island	Aleut	Prehistoric	Airport construction destroyed portion of site. This may be last remaining site on Shemya Island.
ATU-021	Northern coast of Shemya Island	Aleut	Prehistoric	BIA investigations were unable to locate the site and believe it may have been destroyed.
ATU-022	Northern coast of Shemya Island	Aleut	Prehistoric	BIA investigations were unable to locate the site and believe it may have been destroyed.
ATU-023	Northeastern coast of Shemya Island	Aleut	Prehistoric	BIA investigations were unable to locate the site and believe it may have been destroyed.

Source: Alaskan Heritage Resources Survey (1988)

NOTE:
BIA = Bureau of Indian Affairs

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In the 1820s the Russian government required the Russian-American Company to establish schools and hospitals, and to support the Eastern Orthodox Church in the Aleutians. The population, in general, tended to stabilize over the ensuing period.

As United States boundaries were extended in the west, and English, Canadian, and American whalers, sealers, and sea otter hunters claimed freedom of the seas and Russian resources were drained in the Crimean War and other commitments, Russia's hold in the North Pacific weakened. The Russian government finally decided to sell its American interests to the United States; the transaction actually occurred during 1867.

Today, two Russian graves are found along West Beach Road in the Alcan Cove vicinity.

2.1.7.3 Early American Influence

An extensive North Pacific expedition was conducted by the U.S. Navy between 1852 and 1863, including a surreptitious reconnaissance of the Aleutian Islands. Subsequent to American purchase of Alaska in 1867, the U.S. government's presence in the Aleutians was sporadic at best. W.H. Dally surveyed the Aleutians during 1871-72 for the U.S. government, and also compiled information about the local flora and fauna and remnants of the Aleut culture.

As the end of the century approached, declining stocks and increasing foreign competition promoted efforts to control the fur industry take. In 1911, the United States and Russia negotiated a treaty with Japan and Canada on sealing and also included measures to protect the sea otter. In 1913, the majority of the Aleutian Islands was placed in an Aleutian Islands Reservation, a forerunner of today's Aleutian Islands Unit of the refuge.

During the late 1800s and early 1900s, several other economic development activities were undertaken in the Aleutians. A cod salting station was built on Pope Island in 1876, and a number of cod and herring packing ventures were launched subsequently. Salmon canneries were later established at Squaw Harbor, Sand Point, Ikatan Bay, and False Pass. Gold was discovered at Unga Island in 1886, and the resulting Apollo Mine led to establishment of a new community there.

A well-protected harbor at Unalaska (Dutch Harbor) facilitated marine commerce, and the community thrived as a supply base for gold seekers on their way to Nome or up the Yukon river via St. Michael.

At various times, attempts were made to establish commercial sheep, cattle, and reindeer raising ventures, but without much financial success. Fox trapping dated from the Russian era, and as the sea otter population declined from over-hunting, fox farming became a significant industry. This activity prospered until the mid-1930s when fox fur prices declined during the Depression. Recently, the FWS sponsored efforts to eradicate the fox population from some islands, such as Agattu, to protect local bird populations.

Whaling was another important activity. The Aleuts have hunted whales since before the arrival of the Russians. By 1852, over 200 ships were active in the Bering Sea as the American fleet expanded their whaling activities. A whaling venture established at Akutan in 1907 continued until 1939.

2.1.7.4 World War II

World War II had a profound and lasting impact on the Aleutians. On Shemya Island, the military presence that dominates the island today was established. On 3 June 1942, Japanese air forces attacked Unalaska/Dutch Harbor and nearby Fort Mears, and a second attack was launched the following day. Within a few days, some 1,250 Japanese troops had invaded Kiska Island. Attu Island was also taken with local residents placed in captivity, and later transferred to Kiska, and then to Japan. The U.S. Navy evacuated Atka, burning the community to prevent its use by Japanese forces. Aleuts from other communities, including Akutan, Nikolski, St. Paul, and Unalaska, were also evacuated, with a majority of them spending World War II in Southeast Alaska. Half of those removed never returned to their homes again.

Later in the year, American forces landed at Adak Island and began building the major base for the Aleutians campaign. By the height of the conflict, the Army, Navy, and Air Force had all moved their command headquarters to Adak, and some 96,000 individuals were based there. During May 1943, a major assault of Attu Island was launched. American forces were able to capture the island, but only after more than 2,300 Japanese casualties, and a like number of Americans were killed, wounded, or otherwise incapacitated. Near the close of the battle, the U.S. Army's 4th Infantry Regiment and 18th Engineering Regiment constructed an airfield on Shemya Island for use against the Japanese occupational forces. By late June, American forces were poised to invade Kiska. Unbeknownst to the Americans, however, the Japanese had secretly evacuated the island, and invasion forces found it essentially deserted in August. From this point, the United States continued to build up its defenses, using the Aleutians as a base from which to bomb the Kurile Islands and other Japanese occupied territories.

The existing 10,000-foot runway and birchwood hangars at Shemya were built in 1943 to accommodate B-29 bombers. Some 25,000 military personnel lived on the island during 1944 and 1945.

2.1.7.5 Post War Development

The 28th Bomber Group was deactivated in October 1945, and was replaced by the 343rd Fighter Group. This group was deactivated in August 1946. During the Korean conflict in the early 1950s, activities again increased at Eareckson AFS, which functioned as a refueling and staging point for air support and supplies on the Great Circle Route. Station support was provided by the 5021st Air Base Squadron. As the Korean conflict ended, activities at Shemya dwindled once more and the Station was deactivated and declared surplus in July 1954. The facility was transferred to the Civil Aeronautics Authority the following year, and was then leased to Northwest Airlines, a commercial carrier, for support and communications activities.

The Air Force returned to Shemya during 1958 in support of various Air Force and Army strategic intelligence collection activities. The 5040th Air Base Squadron was activated in July of that year to provide support functions. The squadron was redesignated the 5073rd in 1962, and was upgraded to the air base group level during 1975, continuing as the host unit up to the present. Shemya was upgraded from an Air Force Station to an Air Force Base in 1968, as its early warning radar detection and monitoring activities expanded in importance. Upgrading and expansion of Station facilities have continued up to the present time, in reflection of increased mission facilities. In May of 1993, Shemya Air Force Base was redesignated Eareckson AFS.

2.2 POTENTIAL CONTAMINANT SOURCES

A literature review was conducted as described in Section 1.5. Based on the results of the literature review, recent site reconnaissance, and conversations with personnel familiar with Eareckson AFS, information was compiled to provide site descriptions of potential source units and areas of interest. A total of 50 potential source units were identified during this process. The following sections present summaries of the available information about these units. Because of the volume of information contained in the summaries, a current status section was included to categorize the sites in table format. The investigation activities that were selected based on this information are presented in Section 3.0.

2.2.1 IRP Source Units

The 50 IRP source units described below have been placed in one of four categories: Proposed CERCLA Source Units (Section 2.2.1.1); Proposed State POL Source Units (Section 2.2.1.2); Proposed State Solid Waste Source Units (Section 2.2.1.3); or Proposed State UST Source Units (Section 2.2.1.4). Placement of a source unit in a particular category was based on regulatory criteria for various environmental programs (POL, CERCLA, etc.) and on the most current Management Action Plan for Eareckson AFS. These regulatory determinations are preliminary and may change as new information becomes available. Potential source units are shown in Figure 2.2.1-1.

If the source unit has been identified with another designation, the former designation is noted in parenthesis after the current identifier. Because many of the units have had extensive previous investigations, concentrations of analytes detected in samples have been expressed in ranges and contaminant categories. Complete analytical results are available in referenced information sources. References to background concentrations and concentrations that are above or below risk levels/criteria in the following subsections are solely from previous investigations and calculations performed by CH2M Hill for their 1988 and 1992 efforts. CH2M Hill calculated preliminary risk levels (PRLs) for both human risk and ecological risk. PRLs calculated to support the 1993 basewide and LSI activities are described in Section 2.4.1.

As discussed in Section 2.1.6 and shown in Figure 2.1.6.-1, a preliminary identification of ecological habitats was performed. Potential source units will be evaluated for ecological significance during the ecological survey described in Section 3.1.3. It is noted in the potential source unit descriptions where they were identified as being potential habitat during the preliminary habitat identification.

2.2.1.1 <u>Proposed CERCLA Source Units</u>

FT01 (former ID: FT-1) - Lightning Strike Pit

<u>Site Description and History</u>. The Lightning Strike Pit is located near the southwest corner of the island, approximately 500 feet south of South Road and at the east end of Skoot Cove beach. FT01 is bound by bedrock outcrops 30 to 40 feet high on the west and the Pacific Ocean on the south and east. The site slopes gently to the north and is approximately 100 feet in diameter. It appears that this area may

have been constructed by building up the western end of the breakwater along the beachhead across Skoot Cove. The only road access to the site is from the north where a narrow flat piece of land leads to the main portion of the island. Surface water drains to the ocean (CH2M Hill, 1993b). The entrance to FT01 is posted that the area is restricted access. A log blocks the FT01 entrance road.

FT01 was used as a fire training area from the early 1970s to mid-1980s. Contaminated JP-4 and power plant waste oil were ignited and then extinguished with aqueous film-forming foam (AFFF). In recent years, the area has been used for barbecues and bonfires by Station personnel (CH2M Hill, 1993b).

During the spring of 1985, debris and tar barrels were removed from the Lightning Strike Pit area (U.S. Air Force, undated a).

Sea otters are documented to use the coastal areas for feeding, pupping, and hauling out. The area around FT01 may have ecological significance.

Previous Investigations and Findings. In September 1987, CH2M Hill conducted a site reconnaissance and reported that no barrels or drums were visible, and no oil-stained soil cover was noted. The area had been graded, and crushed rock had been placed over the disturbed area by the 5099th CEOS (CH2M Hill, 1993b).

CH2M Hill conducted a field investigation of the site in the fall of 1988 and reported that an area with a diameter of approximately 100 feet contained stained and darkened soil. Soil sampling results from a backhoe pit excavated near the center of the area indicated that leaded and unleaded fuel contamination was present to a depth of 4 feet. Total petroleum hydrocarbons were detected in backhoe soil samples at concentrations ranging from 2,000 to 2,300 milligrams per kilogram (mg/kg), total lead was detected at concentrations of 320 mg/kg at the 2-foot depth and 280 mg/kg at the 4-foot depth, di-n-butyl phthalate was detected at the 4-foot depth at a concentration of 0.55 mg/kg, and 2-butanone was detected at 1.4 mg/kg. One of the backhoe pits from which soil samples were collected was placed near the center of the disturbed area and excavated to 4 feet. Ash and oxidized residues, broken glass, metal debris, and darkened soil were exposed in this pit (CH2M Hill, 1993b).

In 1992, CH2M Hill conducted a geophysical survey. Isolated locations of buried metal and possible buried metal were identified. TPH concentrations ranged from less than 25 mg/kg to 1,255 mg/kg in 23 surface soil samples collected from the vicinity of FT01. Three surface soil samples were analyzed for volatile organic compounds. One surface soil sample had a xylene concentration of 26.8 micrograms per kilogram (μg/kg). Subsurface soil sample locations were based on the results of the surface soil samples. Subsurface soil samples collected with a backhoe contained benzene, toluene, ethylbenzene, and xylene (BTEX) concentrations ranging from undetected to 1,700 μg/kg. Semivolatile organic compounds ranged from undetected to 760 μg/kg. Dioxins were detected in three of the four samples analyzed for dioxins; concentrations ranged from 0.1 μg/kg to 4.9 μg/kg. Three monitoring wells were attempted, however, only one well was completed at FT01. Water was not encountered in two of the boreholes. Groundwater sample results indicated that metals were below MCLs; no other compounds were detected in the groundwater sample. The water level in the well was approximately 13 feet bgs. Based on sodium content, saltwater intrusion was considered probable. The soil sample from the well borehole had a TPH concentration of 1,062 mg/kg (CH2M Hill, 1993b).

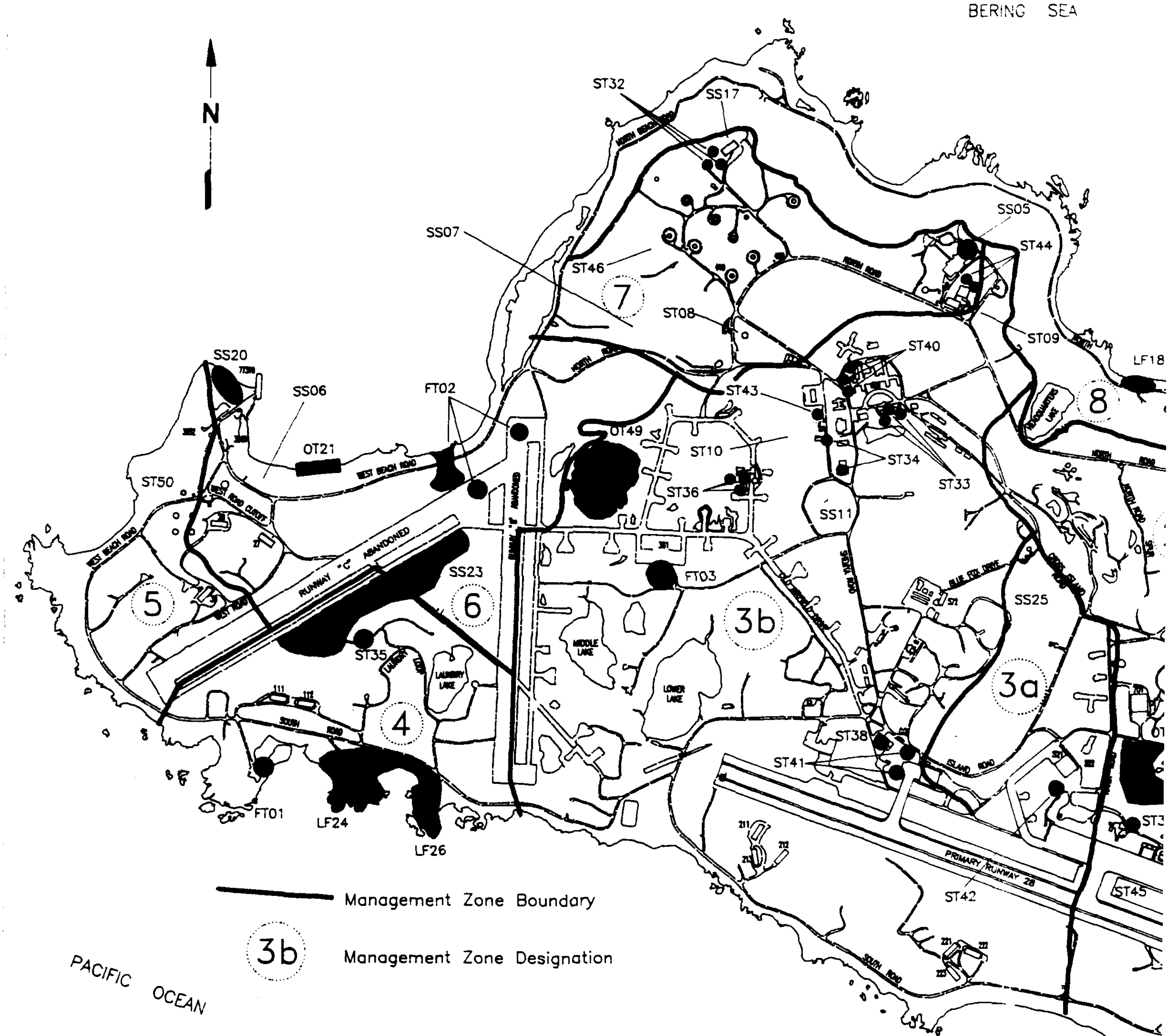
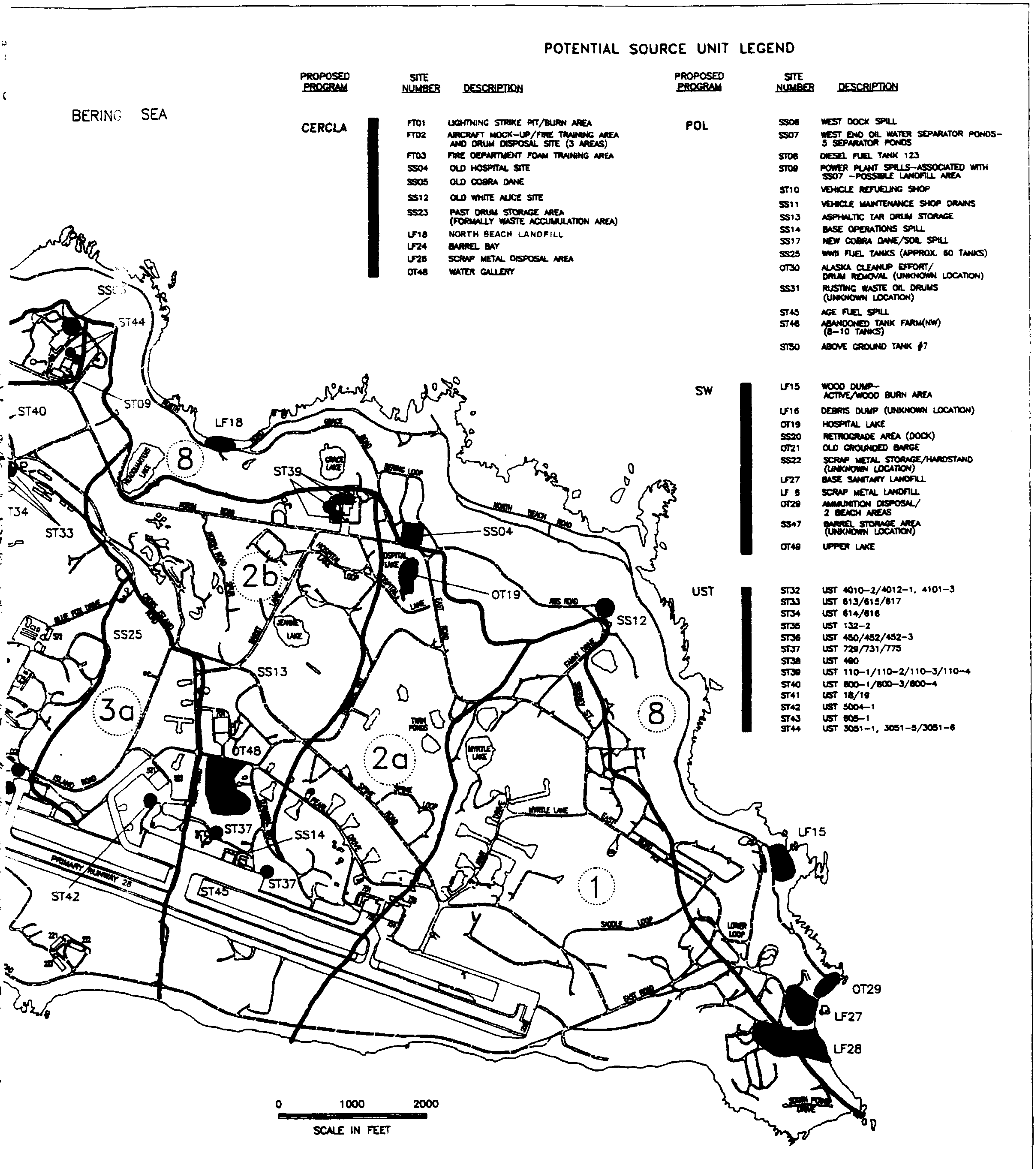


Figure 2.2.1-1

Installation Restoration Program
Potential Source Units and Proposed Regulatory Programs
Eareckson Air Force Station, Alaska

DATE PREPARED: AUGUST 1993


POTENTIAL SOURCE UNIT LEGEND
PROPOSED PROGRAM
SITE NUMBER
DESCRIPTION
CERCLA
FT01 LIGHTNING STRIKE PIT/BURN AREA
FT02 AIRCRAFT MOCK-UP/FIRE TRAINING AREA AND DRUM DISPOSAL SITE (3 AREAS)
FT03 FIRE DEPARTMENT FOAM TRAINING AREA
SS04 OLD HOSPITAL SITE
SS05 OLD COBRA DANE
SS12 OLD WHITE ALICE SITE
SS23 PAST DRUM STORAGE AREA (FORMALLY WASTE ACCUMULATION AREA)
LF18 NORTH BEACH LANDFILL
LF24 BARREL BAY
LF26 SCRAP METAL DISPOSAL AREA
OT48 WATER GALLERY
POL
SS06 WEST DOCK SPILL
SS07 WEST END OIL WATER SEPARATOR PONDS-5 SEPARATOR PONDS
ST08 DIESEL FUEL TANK 123
ST09 POWER PLANT SPILLS-ASSOCIATED WITH SS07 -POSSIBLE LANDFILL AREA
ST10 VEHICLE REFUELING SHOP
SS11 VEHICLE MAINTENANCE SHOP DRAINS
SS13 ASPHALTIC TAR DRUM STORAGE
SS14 BASE OPERATIONS SPILL
SS17 NEW COBRA DANE/SOIL SPILL
SS25 WWII FUEL TANKS (APPROX. 60 TANKS)
OT30 ALASKA CLEANUP EFFORT/ DRUM REMOVAL (UNKNOWN LOCATION)
SS31 RUSTING WASTE OIL DRUMS (UNKNOWN LOCATION)
ST45 AGE FUEL SPILL
ST46 ABANDONED TANK FARM(NW) (8-10 TANKS)
ST50 ABOVE GROUND TANK #7
SW
LF15 WOOD DUMP-ACTIVE/WOOD BURN AREA
LF16 DEBRIS DUMP (UNKNOWN LOCATION)
OT19 HOSPITAL LAKE
SS20 RETROGRADE AREA (DOCK)
OT21 OLD GROUNDED BARGE
SS22 SCRAP METAL STORAGE/HARDSTAND (UNKNOWN LOCATION)
LF27 BASE SANITARY LANDFILL
LF 8 SCRAP METAL LANDFILL
OT29 AMMUNITION DISPOSAL/ 2 BEACH AREAS
SS47 BARREL STORAGE AREA (UNKNOWN LOCATION)
OT49 UPPER LAKE
UST
ST32 UST 4010-2/4012-1, 4101-3
ST33 UST 613/615/617
ST34 UST 614/616
ST35 UST 132-2
ST36 UST 450/452/452-3
ST37 UST 729/731/775
ST38 UST 490
ST39 UST 110-1/110-2/110-3/110-4
ST40 UST 600-1/600-3/600-4
ST41 UST 18/19
ST42 UST 5004-1
ST43 UST 605-1
ST44 UST 3051-1, 3051-5/3051-6
BERING SEA
ST44
ST09
ST40
LF18
8
ST39
ST33
SS04
2b
OT19
SS12
SS25
SS13
3a
8
OT48
2a
ST37
SS14
ST37
ST45
ST42
LF15
1
OT29
LF27
LF28
0 1000 2000
SCALE IN FEET

(oversized)

Current Status. All contaminants detected at FT01 were below preliminary risk levels for human health and ecological risk, with the exception of dioxin. The extent of dioxin contamination was not determined during the 1992 investigation (CH2M Hill, 1993b).

The extent of dioxin contamination will be determined during the RI. Currently, EPA is reevaluating the standards for dioxins, and guidelines are expected to be available in 1993.

FT02 (former ID: FT-2) - Aircraft Mockup; Fire Training Area; Abandoned Drum Disposal Site

Site Description and History. FT02 consists of three distinct areas associated with past training activities at Eareckson AFS. These three areas are described below.

Aircraft Mockup This area is located at the northeast end of abandoned Runway C, approximately 600 feet southeast of West Beach Road. The site was used as a fire training area from 1983 to 1988. Waste oil, diesel, and JP-4 were ignited and then extinguished with AFFF. Cylindrical tanks were configured to resemble an aircraft fuselage and placed in two concentric berms; the inner bermed area was approximately 90 feet in diameter at the time of CH2M Hill's 1992 investigation, and the outer bermed area was approximately 170 feet in diameter. The earthen berms were 1 foot high. The area was covered with 3 to 5 inches of asphalt, and within the bermed area, the asphalt appeared to be partially decomposed from fuel and heat. Additionally, a catch basin is located approximately 125 feet east of the bermed area (CH2M Hill, 1993b).

In 1977, the area around the inactive runways and hard stands was cleaned up (U.S. Air Force, undated b). During late spring 1985, the "old fire mock-up" was excavated and backfilled. A total of 1,100 yards was backfilled. (U.S. Air Force, undated a). It is unknown which fire training area the document refers to. CH2M Hill indicates that surface debris was removed from the "newer area" during their 1992 investigation (CH2M Hill, 1993b). It is assumed that the "newer area" is the Aircraft Mockup Area.

Fire Training Area. Based on a review of aerial photographs and interviews conducted by the Air Force with the Station fire department, this area is located at the north end of abandoned Runway B. It was used from the early 1970s to the mid-1980s. From the review of the 1986 aerial photographs, it appears to be similar in size and configuration to the Aircraft Mockup. CH2M Hill (1988) indicates that this area was contaminated with JP-4, waste oil, and AFFF. All debris was removed as part of the Alaska Cleanup Effort by the 5099th CEOS in July 1985, and soil was excavated to below discoloration (approximately 3 to 4 feet) and then backfilled with imported fill. Excavated material was disposed of on the west end of the island.

An "old fire training pit" was cleaned up in May 1985 as part of the Alaska Cleanup Effort (U.S. Air Force, undated c). It is unknown if the pit is the Fire Training Area.

Abandoned Drum Disposal Site. Reportedly, 55-gallon drums were disposed of or buried approximately 150 feet northwest of the Aircraft Mockup on the west side of Runway C. These drums are located within a drainage that leads over the bluff above West Beach Road and eventually discharges to the ocean (CH2M Hill, 1993b). Aerial photographs from 1986 show a long narrow area between the runway and the bluff that may be a former drainage. It appears that the drainage may contain fill. During a site visit by the 11th CEOS in February 1993, an LNAPL sheen was observed on the water in the drainage. The origin of the drainage is unknown, but it may be associated with an underground culvert that runs under the abandoned runway and/or groundwater seepage.

All three areas may be used as a resting or feeding area for birds. These areas may have potential ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a field investigation of the Aircraft Mockup in the fall of 1988. Soil samples collected with a backhoe to a depth of 4 feet indicated that the soil was contaminated with TPH, volatile organics, and semivolatile organics to at least 4 feet (CH2M Hill, 1993b).

CH2M Hill also conducted a field investigation during the summer of 1992 in the area around the Aircraft Mockup. A geophysical survey identified buried utilities, isolated buried metal, and possible buried metal at several locations. Soil samples collected from beneath the asphalt had concentrations of TPH ranging from less than 200 mg/kg to 5,000 mg/kg. One sample collected from the catch basin contained TPH at 1,150 mg/kg. Surface soil samples collected from the inner bermed area had concentrations of TPH ranging from 164 mg/kg to 29,883 mg/kg. Soil samples collected from both the inner bermed area and outer bermed area contained detectable concentrations of BTEX. Soil samples collected from three soil boreholes advanced within the inner bermed area contained detectable concentrations of BTEX and semivolatiles. Soil samples collected from one borehole outside the inner bermed area showed significantly lower concentrations of BTEX and semivolatiles than found in surface and backhoe soil samples. The first sample from each borehole was analyzed for dioxins and furans. These compounds were not detected in soil samples. Three wells were completed and sampled at the Aircraft Mockup area. Groundwater samples were analyzed for volatile and semivolatile organics, pesticides/PCBs, and metals. Water from well 1 contained detectable concentrations of TPH, BTEX, and semivolatiles. The results from the other two wells indicate no organic contamination. All three wells contained relatively high concentrations of zinc (59 μg/L to 87.6 μg/L) and chromium (13.5 μg/L to 15.6 μg/L) (CH2M Hill, 1993b).

Investigations specific to the Abandoned Drum Disposal Area and Fire Training Area have not been conducted.

Current Status. Benzene and methylene chloride detected in one groundwater sample collected at the Aircraft Mockup were above human health risk criteria. However, methylene chloride is a common laboratory contaminant. TPH concentrations in five soil samples exceeded human health risk criteria. Benzene concentrations in soil were determined to be an ecological threat, although not a human risk (CH2M Hill, 1993b).

The 11th CEOS proposes to excavate and remove the drums at the Abandoned Drum Disposal Area during the summer of 1993. Further investigation of the groundwater in the vicinity of the Aircraft Mockup will be performed during the 1993 LSI to determine the extent of contamination and to collect additional data to conduct an FS. Monitoring wells installed during the LSI will also serve as collection points to monitor the effectiveness of soils removal and groundwater contaminant concentrations. Surface water samples will be collected from the drainage that runs under the runway and through the Abandoned Drum Disposal Area during the 1993 LSI to determine whether contaminants are discharging to the ocean. Depending on the results of the investigation, an early action may be necessary. The 11th CEOS plans to place sorbent booms in the drainage to mitigate any contamination discharging to the ocean. There have been no previous investigations at the Fire Training Area. Samples will be collected during the 1993 LSI to provide preliminary information pertaining to residual contamination from past activities. The 1993 LSI at FT02 is described in Section 3.2.

FT03 (former ID: FT-3) - Fire Department Structural Training Area

Site Description and History. This potential source unit is located approximately 1,000 feet southeast of Upper Lake, in the west-central portion of the island. The site is bordered on the south by rolling tundra and to the north by the foundation and floor of an old hangar. FT03 consisted of a small concrete structure, about 30 feet by 15 feet by 15 feet, on the edge of the concrete on-grade slab of the original hangar and a 25-foot-diameter waste pile located just north of the building (CH2M Hill, 1990). This concrete structure was used as a structural fire training area. Wood, paper and miscellaneous combustible materials were burned in the structure along with JP-4 and diesel fuel. Holes in the concrete pad allowed fluids (i.e., diesel, JP-4, and AFFF) to drain through the foundation into the underlying soils (CH2M Hill, 1993b; JRBA, 1984).

The 11th CEOS removed the debris from this area and placed backfill material at this site. The building was removed in 1988, and the former hangar area is currently being used to stockpile asphalt removed from adjacent hardstands. The asphalt is stockpiled in mounds approximately 7 feet high and covers almost the entire area (CH2M Hill, 1993b).

Surface water from this site tends to flow southeast toward Lower Lake (CH2M Hill, 1993b). However, because of the adjacent tundra, most water infiltrates and moves within the soil profile except during intense rainfall periods (CH2M Hill, 1993a).

It is unknown whether FT03 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a limited investigation of the site in the fall of 1988. A borehole was placed just north of the building in an area of darkened soils. A dark gray, poorly graded, fine sand was observed to a depth of 5.5 feet, underlain by either a dense, sandy gravel or bedrock. No groundwater was observed in the borehole during the investigation (CH2M Hill, 1990).

Analytical results of soil samples from the borehole show TPH levels of 170 mg/kg and 700 mg/kg, at 2 feet and 5.5 feet, respectively. Reported lead levels of 2.3 to 3.7 mg/kg were stated to be within background levels (CH2M Hill, 1990). Volatile organic analysis results indicated methylene chloride concentrations at 0.015 and 0.017 mg/kg at 2 and 5.5 feet, respectively. Acetone concentrations were 0.013 and 0.021 mg/kg at 2 and 5.5 feet, respectively (CH2M Hill, 1993b). Methylene chloride and acetone are common laboratory contaminants.

During the 1992 field investigations, CH2M Hill conducted a geophysical survey at FT03. The objective of the investigation was to identify buried features to be avoided during future drilling. Approximately 0.6 acre was covered by the investigation. A large area of buried metal was identified in the center of the site; however, the southern limit of the area was not fully defined. Little or no metal extends northward beneath the rubble pile. Buried metal was also encountered in the extreme southwest part of the site, but the limits were not defined during the 1992 field investigation (CH2M Hill, 1993b).

Current Status. CH2M Hill has stated that the concentrations of compounds detected in 1988 were all below the preliminary risk levels for human health and ecological risk established for the project (CH2M Hill, 1993a). However, the full extent of contamination at this source unit has not been determined. This source unit is recommended for remedial investigations in 1994. No investigation activities are planned at FT03 in 1993.

SS04 (former ID: HG-1) - Old Hospital Site

Site Description and History. This potential source unit is located northwest of the intersection of North Road and East Road, in the northeast portion of the island. This area, located behind the DOD Anders site, consists of foundation debris, which was thought to be contaminated with mercury from communication equipment instrumentation and/or a former hospital (CH2M Hill, 1990). Air Force personnel have stated that the buildings that were once located at the site may have been used to store mercury and PCB-contaminated waste material (CH2M Hill, 1992).

It is unknown whether SS04 has ecological significance.

Previous Investigations and Findings. SS04 was not identified in the initial Phase I report, but was added to the IRP by the Air Force in 1987. The CH2M Hill investigation team was unable to find any visible signs of mercury contamination in the building areas inspected (CH2M Hill, 1990).

Soil sampling was performed at SS04 in 1987. Since environmental contamination at this site may have occurred during building demolition, or was a result of mishandling of stored materials, sample locations were placed around the building foundation perimeters. Soil samples were collected from the surface to a depth of 2 feet and represent a composite sample over this depth interval (CH2M Hill, 1992).

Each sample was analyzed for mercury, extraction procedure (EP) toxicity metals, and PCB compounds. One sample was analyzed for dioxin/furans. Mercury, EP toxicity metals, PCBs, and dioxin/furans were all below detection limits or below regulatory action levels (CH2M Hill, 1992).

Current Status. Based on the analytical results of soil sampling conducted in 1987, and the fact that no visible signs of mercury contamination could be found, an NFAD was prepared for SS04 in October 1992. The NFAD has been accepted by ADEC.

SS05 (former ID: PS-1B) - Old Cobra Dane

Site Description and History. The Old Cobra Dane site is located along the northern coast in the central part of the island, between North Road and North Beach Road adjacent to Power Plant Road. SS05 is the location of a former oil spill. Specific quantities of the spill are unknown, but the oil spilled was thought to contain PCBs (CH2M Hill, 1993b).

The exact location of the oil spill could not be determined, but inspection of the area on the north side of Building 3050 (adjacent to Old Cobra Dane) revealed several areas of darkened soil. Building 3050 was reportedly routinely used to store or repair electrical transformers. The Old Cobra Dane building has been dismantled and the area has been graded over (CH2M Hill, 1990). Old Cobra Dane was located directly adjacent to the power plant (ST09) where numerous POL spills have been reported.

CH2M Hill reported that there is some potential that the spill site in question may have been located to the south of the Old Cobra Dane building. However, the area to the south was part of a construction site in 1992 and has been completely disturbed, destroying any potential surface evidence of past spills (CH2M Hill, 1993b).

The vegetation around the site is grass and tundra. Surface water runoff from this site generally flows to the west and then south toward SS07, the West End Oil/Water Separator. Near the north end of SS05, surface water appears to flow north, over the cliff. The drainage was dry during a 1993 site visit and appeared to divert surface water resulting from precipitation events. Much of the area around Old Cobra Dane has been disturbed, leaving bare soil exposed (CH2M Hill, 1993b).

It is unknown whether SS05 has ecological significance.

Previous Investigations and Findings. During 1988 field investigations, three soil samples were taken at depths of approximately 1 to 2 feet. Two locations were sampled within stained soil areas (each less than 10 feet in diameter) and a third was sampled in a shallow drainage ditch approximately 50 feet north of Building 3050. An oily odor was observed in the samples collected. TPH was detected in all three samples and ranged from 21,000 mg/kg at 1 foot to 200,000 mg/kg at 2 feet. (Note: CH2M Hill's 1993 Final Report states that TPH at the 2 foot level was 129,000 mg/kg [CH2M Hill, 1993b]). One sample was analyzed for PCBs/pesticides; none were detected (CH2M Hill, 1990).

During CH2M Hill's 1992 field investigation, a geophysical survey was conducted that identified three utility lines at the site. In addition, two soil samples were collected, one surface sample (0 to 6 inches depth) and one subsurface sample (6 to 24 inches depth). A variety of metals and volatiles were detected in the surface soil sample. Metals concentrations were elevated compared with background concentrations, most notably mercury at 5.4 mg/kg. Metals concentrations ranged from beryllium at 0.52 mg/kg to iron at 42,200 mg/kg. Results indicated a concentration of bis (2-ethylhexyl) phthalate at 88,000 μg/kg. Bis(2-ethylhexyl)phthalate is a common laboratory and field contaminant. Trace amounts of other volatile organic compounds ranging from 4 μg/kg of 1,1,1-trichloroethane to 34 μg/kg of 4,4'-dichlorodiphenyldichloroethane (DDD) were also detected. Cyanide was also detected in the surface soil sample at 2.2 mg/kg (CH2M Hill, 1993b).

TPH, volatile organics, metals, and cyanide were detected in the subsurface sample. TPH was reported at 38,503 mg/kg in the subsurface sample. Volatile organics ranged from 31 μg/kg for 1,2-dichloroethane to 2,200 μg/kg for trichloroethene. Metals ranged in concentration from 0.7 mg/kg of mercury to 41,300 mg/kg for aluminum. Arsenic was detected at 6.1 mg/kg. This arsenic concentration is above the preliminary risk level established for the project (5.7 mg/kg). The background arsenic concentration established during the 1992 investigation for soil/sediment is 8.3 mg/kg. Cyanide was detected at 3.3 mg/kg (CH2M Hill, 1993b). It is unknown whether the cyanide detected is naturally occurring.

The Woodward-Clyde 1992 site investigation report also reported two pesticides (heptachlor epoxide at 4.5 μg/kg and alpha-chlordane at 4.9 μg/kg) were detected in the subsurface soil sample (Woodward-Clyde, 1992).

Current Status. TPH and arsenic concentrations have exceeded the preliminary risk levels for human health risk established for this site. Cadmium, aluminum, antimony, iron, and silver in soil were determined to be potential risks to terrestrial receptors at the site (CH2M Hill, 1993b). These contaminants are not expected to be associated with the spilled material.

The 1988 and 1992 field investigations concentrated on the most heavily stained areas and did not delineate the lateral or vertical extent of contamination. This site has therefore been recommended for further sampling to determine the full nature and extent of contamination (CH2M Hill, 1993b). This potential source unit is recommended for further investigation in 1994.

SS12 (former ID: PS-8) - Old White Alice

Site Description and History. The Old White Alice site is located along the bluff at the northeast corner of the island and is isolated from other potential source units. The site is at the eastern termination of AWS Road and Fanny Drive (CH2M Hill, 1993b).

Old White Alice is an old communication facility, which has been dismantled and replaced with an Alascom building. During operation of Old White Alice, a spill from a PCB transformer was reported. Major building construction in the area has included removing soil and backfilling with imported fill material; therefore, surface evidence of past spills is not visible (CH2M Hill, 1993b).

It is unknown whether SS12 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a field investigation at this area in 1988 and reported that there was visual evidence of past spills. During the investigation, two soil boreholes were located at the northwest and southwest corners of the new facility in areas that appeared undisturbed. Soil samples collected from 2 to 4 feet in depth had TPH concentrations ranging from 120 to 220 mg/kg; PCBs ranging from 36 mg/kg to 54 mg/kg (Arochlor 1254 and 1260); 4,4-dichlorodiphenyltrichloroethane (4,4-DDT) ranging from 3.33 mg/kg to 4.2 mg/kg; and methoxychlor ranging from 3.2 mg/kg to 4.2 mg/kg. Groundwater was observed in the northwest borehole at a depth of 5.7 feet (CH2M Hill, 1993b).

CH2M Hill conducted a geophysical survey of the area during the 1992 field investigation. A single buried metal object was located at the southwest corner of the survey area. Five soil samples were collected from three boreholes within the parking area, at depths of approximately 4 to 5 feet. One sample contained Arochlor 1260 at a concentration of 140 μg/kg; however, PCBs were not detected in any other samples. TPH concentrations ranged from 30 mg/kg to 1,959 mg/kg (CH2M Hill, 1993b).

Current Status. The area has been capped with clean fill. Old White Alice was recommended for no further action, and an NFAD was prepared. ADEC rejected the NFAD because PCBs were present in concentrations above Toxic Substances Control Act (TSCA) Standards. Negotiations for resolution are planned for 1993. Further documentation activities will be based on the results of the negotiations.

LF18 (former ID: SW-4) - North Beach Landfill

Site Description and History. The North Beach Landfill covers approximately 15 acres along the north shore of Shemya Island. It is bordered on the east, south, and west by 200-foot-high grass-covered slopes and on the north by the Bering Sea. The area is relatively flat and is covered with various debris, such as peat from other parts of the island. The debris is estimated to be up to 8 feet deep (CH2M Hill, 1993b).

It should be noted that the area investigated by CH2M Hill in 1988 as SW-4 (subsequently LF18) was not the same area investigated by them in 1992 as SW-4. In 1988, CH2M Hill conducted a field investigation at a site near the intersection of North Beach and Grace roads (CH2M Hill, 1990). In 1992, they investigated the site shown as LF18 in this Work Plan. In their report on the 1992 investigation, CH2M Hill refers to both sites as the same location (CH2M Hill, 1993b). Following direction from the Air Force, Jacobs will conduct an LSI at the site investigated as LF18 by CH2M Hill in 1992. As a result, the 1988 CH2M Hill data are not discussed further in this section or in this Work Plan.

It is unknown whether LF18 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a civil and geophysical survey of the area during the 1992 field investigation. Extensive areas of buried material were located. Surface and subsurface soil samples were collected using a backhoe during the 1992 investigation. TPH concentrations in soil samples ranged from 6.8 mg/kg to 1,373 mg/kg. Volatile organic compounds were detected in the soil samples at concentrations ranging from 2 μg/kg to 30 μg/kg. Phthalates were detected in soil samples at concentrations ranging from 60 μg/kg (estimated) to 1,000 μg/kg. The pesticide 4,4'-DDD was detected in soil samples at three locations in concentrations ranging from 4.8 μg/kg (estimated) to 5.6 μg/kg (estimated). PCB compound Arochlor 1260 was detected in soil samples from five locations at concentrations ranging from 59 μg/kg to 110 μg/kg. Groundwater was encountered at 8 and 7 feet in Trenches 1 and 3, respectively. Groundwater from Trench 3 had an oily sheen (CH2M Hill, 1993b).

Current Status. Contaminant concentrations in soil did not exceed human health risk criteria (CH2M Hill, 1993b).

Samples will be collected at LF18 during the 1993 LSI to determine whether groundwater and surface water have been impacted. If groundwater and surface water have not been impacted significantly, an NFAD will be prepared and submitted to ADEC for review after the 1993 field investigation.

SS23 (former ID: PS-11) - Past Drum Storage Area

Site Description and History. SS23 consists of five asphalt pads (hardstands) located along the southeast side of abandoned Runway C, near the southwest corner of the island. Three of the pads are 150-foot-diameter asphalt pads described in CH2M Hill's *Final Technical Report* from the 1988 field investigation (CH2M Hill, 1990). These three pads are described below as the northeast pad, the center pad, and the southwest pad. During the 1992 field investigation, CH2M Hill noted that five hardstands were being used at the site (CH2M Hill, 1993a); however, the other two pads were not described in the report (CH2M Hill, 1993b). The area comprising SS23 is shown on Figure 2.2.1-1.

The northeast pad comprised the Empty Drum Storage Pad. During the 1988 field investigation, this area contained several hundred drums; some of which were placed on pallets, some on the ground, and others stacked horizontally on top of each other, four or five drums deep (CH2M Hill, 1990).

The center pad contained the Waste Drum Storage Area, although very few drums were reported to be stored there at the time of the 1988 sampling. The pad appeared to be primarily used as a diesel refueling area supplied by two aboveground storage tanks. The tanks were contained within an earthen berm. However, the transfer valves for the tanks were located outside of this containment area, and evidence of spills was observed on the ground surface (CH2M Hill, 1990).

The southwest pad was identified as a Used Petroleum Drum Storage Area. Several hundred drums were observed in this area at the time of CH2M Hill's 1988 sampling (CH2M Hill, 1990). The condition of the drums during the 1988 field investigation ranged from good to poor, with some leaking drums observed. No containment of surface runoff from this area was observed (CH2M Hill, 1990).

During the 1992 field investigation, five hardstands in this area were observed being used: four for drum storage and one for aboveground tanks of fuel oil for heating systems (CH2M Hill, 1993b). (Note: Elsewhere in the same report, it is stated that only two of the five hardstands were being used for drum storage. No mention is made in the final report as to whether the center pad listed above was still being used for diesel refueling.)

It is unknown whether SS23 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a limited investigation of SS23 in the fall of 1988. Soil boreholes were completed downgradient of the northeast, center, and southwest pads. Sample results indicated that TPH concentrations were above background levels at the center and southwest pads. TPH concentrations at the center pad were 50,000 mg/kg at a depth of 1 foot and 33,000 mg/kg at 2 feet. (Note: Table 4-12 in the 1990 report shows 33,000 mg/kg at 2 feet; text states 35,000 mg/kg). (Note: In the 1993 CH2M Hill report, concentrations of TPH for the center pad are listed as 33,000 mg/kg at 2 feet and 42,000 mg/kg at 1 foot [CH2M Hill, 1993b].)

Concentrations of TPH at the southwest pad ranged from 320 mg/kg to 360 mg/kg at the 1-foot depth. Methoxychlor was also detected at the center pad at 0.009 mg/kg (CH2M Hill, 1990). (Note: This value was reported at 0.09 mg/kg in CH2M Hill's 1993 final report [CH2M Hill, 1993b].)

In the CH2M Hill report on the 1992 field investigations, four other parameters were listed as detected in these samples from the 1988 field investigation. Naphthalene was detected in one 2-foot sample at 1.9 mg/kg, while di-n-butylphthalate was estimated at 0.2 and 0.26 mg/kg at 2- and 4-foot depths, respectively, at one borehole (PS-11-8) from the southwest pad. Volatile organics detected included xylenes (one sample estimated at 0.01 mg/kg at 1-foot depth) and trichloroethene (two samples, 0.012 and 0.064 mg/kg at 1- and 2-foot depths, respectively). It is not clear from the report where the xylenes and trichlorethene were detected (CH2M Hill, 1993b).

No sampling was performed during the CH2M Hill 1992 field investigation. However, it was reported that the number of drums stored at the site had been greatly reduced since the 1988 inspection (CH2M Hill, 1993b).

Current Status. CH2M Hill stated that there are areas within SS23 that have TPH concentrations above the human health preliminary risk levels developed for the site. The total area with TPH concentrations above the human health preliminary risk levels has not yet been defined (CH2M Hill, 1993a). All other contaminants found were below their respective preliminary risk levels (CH2M Hill, 1993b).

To fully determine the extent of contamination at this source unit, further investigation of SS23 has been recommended for 1994.

Note: In the 1993 final report, CH2M Hill references a sample from a "nearby" groundwater well that had 30 milligrams per liter (mg/L) TPH (CH2M Hill, 1993b). However, in the 1990 Stage 1 Final Technical Report, this well is a piezometer installed by the Corps of Engineers (AP-31) and is located 700 feet east of Building 701 (Hangar 4) (CH2M Hill, 1990). It is part of a system installed to monitor conditions around the water gallery and is not nearby to SS23. Additional groundwater data are not available for SS23.

LF24 (former ID: SW-10) - Barrel Bay

Site Description and History. Barrel Bay is located on a flat area overlooking Skoot Cove, near the southwest corner of the island. LF24 was used to store and dispose of 55-gallon drums along the ocean bluffs. The estimated area of the site is 9.8 acres. The area was used for drum storage and disposal after World War II. The number of drums disposed of at Barrel Bay is reported to be in the hundreds of thousands. The types of wastes contained in the drums are unknown. Many of the drums were believed to have contained fuel. Attempts to remove drums embedded in the hillside have caused severe sloughing. Seeps of iron-stained leachate were discharging from the hillside of the cove (JRBA, 1984). Wave action has exposed the landfill, and truck bodies, batteries, and engines are visible in the bank (CH2M Hill, 1993b). LF24 is adjacent to LF26, the Scrap Metal Disposal Area.

The 11th CEOS removed the debris, backfilled with gravel and riprap, and graded the area in July 1987. During a September 1987 site visit by CH2M Hill, barrels and drums were not observed at the site. However, various types of debris such as vehicle axles, rims, tires, gas cylinders, electrical cable, and pipe were observed (CH2M Hill, 1993b).

Because sea otters use the coastal areas for feeding, pupping, and hauling out, LF24 may have potential ecological significance.

Previous Investigations and Findings. In the fall of 1988, two backhoe pits were excavated into the debris at Barrel Bay. Soil samples collected from the pits contained TPH concentrations of 16,000 mg/kg at the 2-foot depth and 14,000 mg/kg at the 4-foot depth. One volatile organic compound, 2-butanone, was detected at both 2- and 4-foot depths. Bis(2-ethylhexyl)phthalate was detected at concentrations ranging from 0.98 mg/kg to 5.3 mg/kg at 2 feet and 0.56 mg/kg to 2.9 mg/kg at 4 feet. Arsenic, barium, chromium, lead, nickel, and zinc were detected above background concentrations in the soil samples (CH2M Hill, 1993b).

During 1992 field investigations, a geophysical survey was conducted. Buried metal was located along the southern border of the area, along the top of the bank. Buried metal was identified at several locations on the beach, and the geophysical survey indicated that buried metal is present up to the ocean, and possibly in the water. The survey was conducted at high tide. Two areas of buried material and buried utilities were also identified (CH2M Hill, 1993b).

Twenty-two surface soil samples and three groundwater samples were collected for analysis. TPH concentrations in soil samples ranged from undetected to 16,244 mg/kg. BTEX concentrations ranged from undetected to 114 μg/kg. Concentrations of other volatile organic compounds ranged from 7 μg/kg (estimated) to 26 μg/kg (estimated). Phthalate concentrations ranged from undetected to 680 μg/kg (estimated). Phthalates are common laboratory and field contaminants. Semivolatile organic compound concentrations ranged from undetected to estimated 390 μg/kg. PCB concentrations ranged from undetected to 150 μg/kg in surface soil samples. Pesticide concentrations ranged from undetected to 15 μg/kg. One subsurface soil sample collected from a monitoring well borehole had a PCB concentration of 110 μg/kg. TPH concentrations in borehole soil samples ranged from 42 mg/kg to 149 mg/kg. Two subsurface soil samples had toluene concentrations of 2 μg/kg and 3 μg/kg (CH2M Hill, 1993b).

Benzene was detected in two groundwater samples at concentrations of 4 μg/L and 5 μg/L. Toluene was detected in two groundwater samples at concentrations of 2 μg/L and 3 μg/L. Total xylenes were detected in two groundwater samples at concentrations of 3 μg/L and 7 μg/L. Semivolatile organic compounds were detected in one water sample ranging from 1 μg/L to 12 μg/L (CH2M Hill, 1993b).

Surface soil samples collected by Woodward-Clyde in 1992 contained PCBs ranging from 23 μg/kg (estimated) to 150 μg/kg (estimated). 4,4'-dichlorodiphenyl trichloroethane (DDT) was detected in one surface soil sample at a concentration of 2.5 μg/kg (estimated).

Current Status. Concentrations of arsenic in two surface soil samples exceeded human health risk criteria. The benzene concentrations in groundwater from well 2 was at the MCL. Water from well 3 exceeded the ecological water quality criteria standard for 2-methylnaphthalene and fluorene. There is a potential ecological risk to terrestrial receptors from cadmium concentrations in soil and sediment and risk to aquatic receptors from chromium, barium, lead, and zinc concentrations in sediment. These metals concentrations are also above background (CH2M Hill, 1993b).

CH2M Hill recommended in the *1992 IRP Field Investigation Report* (1993b) that an impermeable cap be placed over the landfill area and a seawall be constructed. Data from Barrel Bay will be evaluated, screening of alternatives will be performed, and a proposed plan will be prepared as described in Section 4.4 to evaluate the applicability of the proposed recommended remedial action technology. Screening of alternatives will be conducted concurrently with the 1993 field investigation.

LF26 (former ID: SW-12) - Scrap Metal Disposal Area

Site Description and History. The Scrap Metal Disposal Area, or Million Dollar Dump, is located southwest of the south end of abandoned Runway B, east of Skoot Cove, and near Building 750. It is situated on a graded rock outcrop at the end of the Rocket Launch Control Trailer service road approximately 800 feet east of

Barrel Bay (LF24). LF26 is located on approximately 3 acres on a finger of land that juts into the ocean. Several buildings are located near this landfill. Vehicle axles, gasoline motors, engine blocks, and other scrap metal were observed during a site visit in September 1987 by CH2M Hill. Signs of campfires were also observed, suggesting that the area may be used for recreational purposes (CH2M Hill, 1993b).

JRBA reported that scrap metal and wood has been dumped over the cliff onto the beach. The rusting and deteriorating metal is creating seeps of iron leachate (JRBA, 1984).

Most of the area was backfilled with large rock and graded for stabilization by the 11th CEOS.

Sea otters use the coastal areas for feeding, pupping, and hauling out; therefore, LF26 may have potential ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a field investigation at LF26 in the fall of 1988. Soil samples were collected with an auger from an area left uncovered by the rock backfill. TPH was detected at a concentration of 1,480 mg/kg at the 14-inch depth and 380 mg/kg at the 2-foot depth. No volatile or semivolatile organic compounds were detected. Metals detected above background concentrations include arsenic, barium, chromium, lead, nickel, and zinc (CH2M Hill, 1993b).

During the 1992 field investigation performed by CH2M Hill, a civil and geophysical survey were conducted. Three large areas of buried metal and a buried power line were identified during the survey. Seventeen surface soil samples were collected and analyzed for volatile and semivolatile organic compounds, pesticides and PCBs, and metals. One sample was analyzed for toxicity characteristic leaching procedure (TCLP) metals. TPH concentrations ranged from undetected to 85 mg/kg. Volatile organic compounds ranged from undetected to 19 μg/kg. Phthalates ranged from undetected to 5,000 μg/kg. Phthalates are common laboratory and field contaminants. PCBs were detected in soil samples ranging from undetected to 89 μg/kg. Pesticides were detected ranging from undetected to 34 μg/kg (CH2M Hill, 1993b).

Two groundwater monitoring wells were installed and sampled at LF26. Subsurface soil samples were collected from the well boreholes. Soil samples collected at the 5-foot depth had concentrations of ethylbenzene (780 μg/kg), toluene (990 μg/kg), and xylene (2,680 μg/kg). Subsurface soil samples collected at 7.7 feet had concentrations of acetone (21 μg/kg), benzene (49 μg/kg), toluene (150 μg/kg), xylene (16 μg/kg), and bis(2-ethylhexyl)phthalate (41 μg/kg). Subsurface soil samples collected at 20 feet had concentrations of carbon disulfide (2 μg/kg), benzene (9 μg/kg), toluene (19 μg/kg), xylene (5 μg/kg), and bis(2-ethylhexyl)phthalate (52 μg/kg). Groundwater samples contained arsenic (62.8 mg/L to 66.9 mg/L), chromium (19.2 mg/L to 80 mg/L), copper (52.9 mg/L to 255 mg/L), zinc (163 mg/L to 369 mg/L), carbon disulfide (4 μg/L), benzene (2 μg/L), bis(2-ethylhexyl)phthalate (1 μg/L), and toluene (1 μg/L) (CH2M Hill, 1993b). Acetone is a common laboratory contaminant. Bis (2-ethylhexyl)phthalate is a common laboratory and field contaminant. The source of carbon disulfide is unknown; this is the only reported detection of this compound.

Woodward-Clyde collected and analyzed soil samples in 1992. Pesticides 1,1-dichloro-2,2-bis(p-chlorophenyl)ethylene (4,4-DDE), 4,4-DDD, 4,4-DDT, and

Arochlor 1254 were detected at estimated and very low concentrations in one sample. Volatile and semivolatile organic compounds were not detected in the samples. One groundwater sample was collected and analyzed. No PCBs, pesticides, or volatile and semivolatile organic compounds were detected (Woodward-Clyde, 1992).

Current Status. CH2M Hill recommended that the landfill be remediated with a permeable cap, possibly in conjunction with LF24. Data from the Scrap Metal Disposal Area will be evaluated, screening of alternatives will be performed, and a proposed plan will be prepared as described in Section 4.4 to evaluate the applicability of the recommended remedial action technology. Screening of alternatives will be conducted concurrently with the 1993 field investigation.

OT48 - Water Gallery

Site Description and History. The water gallery is located in the south central part of the island, south of Hangar 4 and east of Hangar 3. Since the early 1950s, potable water has been collected by a permanent infiltration gallery system. The gallery used four horizontal infiltration collectors to intercept groundwater from the shallow aquifer. The peat aquifer has a high water capacity and low permeability (JRBA, 1984). The water gallery was renovated in 1992 and currently uses eight horizontal infiltration collectors.

In the original system, water was collected in a central gallery holding tank with a capacity of approximately 24,000 gallons at a rate of approximately 140 gallons per minute (gpm) of water from the watershed. The water was then chlorinated and pumped to three water storage reservoirs with an approximate combined capacity of 800,000 gallons (JRBA, 1984). Although subject to seasonal variations in water quantity, the water gallery supply is usually adequate to serve the Station population. The renovated system is capable of routinely pumping 220 gpm and a maximum of 300 gpm. Two groundwater wells, identified as 400 and 410, are located on the west side of the island and currently serve as the island's supplementary water supply (U.S. Air Force, 1991b). These wells are located in the Abandoned Tank Farm (ST46) and are not discussed further as part of the water gallery description.

POL and TCE have been detected in samples from the water gallery. Usually, concentrations of contaminants are below MCLs; however, on one occasion, TCE concentrations were reported slightly above the MCL (CH2M Hill, 1993b).

Spill areas and potential source units are located within and near the water gallery. Operations at Eareckson AFS have left the water gallery vulnerable to contamination. In addition, a sanitary waste sewer line traverses the watershed near the infiltration gallery. Catastrophic events, such as earthquakes, could also compromise the water system. Potential source units and activities on the west side of the island have the potential to contaminate the water gallery watershed via fractured bedrock and gentle topography crossing the divide (U.S. Air Force, 1991b).

As a result of previous investigations and the past and current operations in the water gallery vicinity, much of the water gallery was rebuilt and remediated in 1992. Additional improvements and source mitigation efforts are planned for completion in 1993. To assure ongoing protection of the drinking water source, the Air Force has prepared a Water Gallery Protection Plan.

It is unknown whether OT48 has ecological significance.

Previous Investigations and Findings. The Station Bioenvironmental Engineering (BEE) office, COE, and CH2M Hill have conducted investigations within the water gallery.

BEE has been collecting water samples from the drinking water system on Shemya Island since 1989. A summary of the analytical results is available in CH2M Hill (1993b). They report that TCE and chlorination by-products have been routinely detected in the samples (CH2M Hill, 1993b). Average TCE concentration in the water is 3.1 μg/L, and it ranges from undetected to 5.5 μg/L. Since 1989, TCE has exceeded the MCL of 5 μg/L on one occasion. Since the renovations in 1992, two water samples have been collected, and TCE was not detected in either sample.

COE has drilled boreholes and installed monitoring wells in and around the water gallery on several occasions beginning in 1984. Soil and water sample analyses were not available. During 1989, COE performed an investigation of the water gallery to determine groundwater flow patterns, identify POL contamination, and determine the depth to bedrock. The information was necessary to design the changes to the collection system. POL contamination was detected in some of the soil samples. TCE was not detected in water or soil samples (CH2M Hill, 1993b).

CH2M Hill's 1992 investigation included soil sampling, installing monitoring wells and well points, and conducting a geophysical survey. Utility lines and buried metal were identified during the geophysical survey. All of the results from surface soil samples showed some TPH, volatile organic, semivolatile organic, metal, and pesticide or PCB contamination. Water samples from well points contained benzene, toluene, or xylene contamination. Water samples from the water collection tubes contained varying concentrations of TCE. Water samples from six monitoring wells contained TCE, toluene, ethylbenzene, and xylene. Two of the monitoring wells did not contain contaminants. Some of the soil samples collected during drilling activities contained varying concentrations of TPH and BTEX. Soil samples collected from backhoe pits contained BTEX compounds (CH2M Hill, 1993b).

The area of significant contamination found around Hangar 4 was excavated in 1992 after CH2M Hill's investigation. Drinking water quality is a priority on Shemya, and ongoing efforts will be made to detect and remediate suspected contamination within the drainage basin.

Current Status. The source of TCE contamination was not determined during CH2M Hill's 1992 field investigation. Several water samples from the water gallery exceeded human health risk criteria (CH2M Hill, 1993b).

The 11th CEOS is developing design plans for an air stripper at the water gallery to pretreat the untreated water. Preparation of a monitoring plan is proposed for sampling gallery pipes, sumps, water taps, and existing monitoring wells on a monthly or quarterly schedule. Further investigations will be conducted in 1994.

Potential source units within the watershed will be given top priority for early action. Efforts are under way to limit the types of operations and activities within the watershed to those that do not have the potential to impact water quality.

2.2.1.2 Proposed State Petroleum, Oil, and Lubricant Source Units

SS06 (former ID: PS-2) - West Dock Spill

Site Description and History. This potential source unit is located approximately 1,200 feet south of the dock near Alcan Cove on the northwest tip of the island. According to the IRP Phase 1 report, the site is the result of a leak in the JP-4 distribution line at the West Dock on July 15, 1983 (JRBA, 1984). About 100 gallons of fuel were spilled (JRBA, 1984).

Sorbent material was applied to the spill area and the pipeline was repaired with a metal sleeve. All remedial actions were reported complete the day after the spill (CH2M Hill, 1993b).

It is unknown whether SS06 has ecological significance.

Previous Investigations and Findings. During the 1988 investigation, no sign of the spill was apparent. No vegetation stress or discoloration of the soils was observed. No samples were collected from this site in 1988 (CH2M Hill, 1993b). SS06 was proposed for no further action in the Final Technical Report for the 1988 field investigations (CH2M Hill, 1990). However, ADEC requested that confirmation samples be collected to support the no further action recommendation.

Again during the 1992 investigation, evidence of the spill was not seen. According to the report on the spill, four surface soil samples were collected approximately 1,200 feet from the dock. The samples were taken from along the abandoned pipeline next to the West Beach Road and were all analyzed for TPH. Analytical results showed that TPH concentrations in two samples were less than the detection limit, and the other two samples had concentrations of 137.14 mg/kg and 144.92 mg/kg, respectively. One additional surface soil sample had a concentration of 439 mg/kg These levels are below the preliminary risk level identified for the 1992 field investigation (CH2M Hill, 1993b).

Current Status. Since the TPH concentrations from this previous spill site are below the preliminary risk levels, SS06 has been proposed for no further action (CH2M Hill, 1993b). CH2M Hill is currently preparing an NFAD for this source unit; therefore, no further investigations are proposed for this site during 1993. Recommendations for further investigations, if appropriate, will be made only after resolution of the NFAD status by ADEC, which is expected later in 1993.

SS07 (former ID: PS-3) - West End Oil/Water Separator Ponds

Site Description and History. The West End Oil/Water Separator Ponds are located in the northwest part of the island. It consists of a series of five unlined, earthen ponds connected by shallow surface ditches. This series of ponds extends from an area southwest of the power plant, to a point near the intersection of North Road and North Beach Road, where Pond 5 discharges into a tidal basin and then to the Bering Sea just north of Alcan Cove (CH2M Hill, 1990).

The ponds were constructed by the 5099th CEOS and were designed to intercept a portion of the oil-contaminated surface waters draining from areas to the northeast before they reach the ocean (CH2M Hill, 1990).

North of the ponds are a series of aboveground storage tanks for JP-4 and diesel (ST46), and New Cobra Dane (ST32). To the south are the abandoned Runways B and C. To the east is the main Station headquarters. To the northeast of the ponds is the power plant (ST09) and Old Cobra Dane (SS05). Finally, to the west is the Bering Sea (CH2M Hill, 1993b).

Ponds 1 and 2 are located approximately 1,000 feet west of the power plant and intercept surface runoff from the power plant area. The ditch from the power plant discharges to Pond 1. The two ponds are adjacent to each other and are connected by a 10-foot-long culvert. Pond 2 discharges to a shallow ditch that meanders across the tundra into a culvert that carries drainage into Pond 3 (CH2M Hill, 1990). During a site visit in October 1992, Jacobs personnel observed floating product on Pond 1 and seeps of product along the banks of the pond.

Pond 3 is located approximately 1,500 feet southwest of Pond 2. It is downgradient of the Tank Farm area and several hundred feet west-southwest of Tank 123 (ST08). In addition to discharge from Pond 2, Pond 3 receives runoff from the Tank Farm area where a drainage converges with the oil/water separator ditch below Tank 123. Pond 3 discharges into a submerged pipe, which, in turn, discharges into a ditch that follows a natural drainage into Pond 4 (CH2M Hill, 1990). Seepage and staining were observed along the banks of Pond 3 and within the drainage directly below Tank 123 (ST08).

Pond 4 is located approximately 1,000 feet west of Pond 3. In addition to discharge from Pond 3, Pond 4 collects runoff from the ditch between Ponds 3 and 4. A submerged pipe directs discharge from Pond 4 to a natural drainage ditch into Pond 5 (CH2M Hill, 1990).

Pond 5 is located approximately 1,000 feet downgradient and to the west of Pond 4. Discharge from Pond 5 is carried through by a submerged pipe to a ditch that parallels North Beach Road. This ditch then enters a culvert that carries it beneath North Beach Road and into the Bering Sea tidal flats area (CH2M Hill, 1990).

During the 1988 field investigation, several potential POL seeps were observed about 100 feet northeast of the Pond 5 discharge point along the shoreline. Darkened soils and sheens were seen in small tidepools in this area (CH2M Hill, 1990).

Ecological risks associated with SS07 are 1) dermal absorption exposure to various water birds from floating product observed on ponds and 2) potential impacts to the tidal pool from the oil/water separator discharges. The ecological risk assessment is presented in detail in Section 3.1.3 of this Work Plan.

Previous Investigations and Findings. CH2M Hill conducted investigations at this potential source unit during the fall of 1988 and performed a geophysical survey during the 1992 field season. In addition, two 1989 COE memoranda document floating product in several wells located in the vicinity of SS07. Information from these various investigations is summarized below.

Pond 1 measures approximately 62 feet by 38 feet and has an estimated capacity of 66,000 gallons. Little water was observed in this pond, but sediments were blackish in color and a strong POL odor was noted (CH2M Hill, 1990).

Pond 2 measures approximately 66 feet by 52 feet and has an estimated capacity of 77,000 gallons. Pond 2 was observed at about 75 percent capacity and discharged at an estimated rate of 1 gpm. Discharge water appeared gray and cloudy, and had an oily sheen (CH2M Hill, 1990).

Pond 3 measures approximately 115 feet by 76 feet and has an estimated capacity of 265,000 gallons. Pond 3 was observed at about 50 percent capacity and discharged at an estimated rate of 20 gpm. Inflow to Pond 3 from Pond 2 is very minor with the majority of the discharge from Pond 2 thought to be infiltrating into the shallow aquifer before reaching Pond 3. Pond 3 primarily receives drainage from the Tank Farm area via a large ditch located on the north side of the pond. Discharge from Pond 3 appeared yellow and slightly cloudy (CH2M Hill, 1990).

Pond 4 measures approximately 32 feet by 77 feet and has an estimated capacity of 46,000 gallons. The flow rate was estimated to be 20 gpm, and the water appeared to be slightly yellow. Soil samples, collected to a depth of 4 feet from the ditch between Ponds 3 and 4, were visibly saturated with POL. The boreholes could not be advanced beyond this 4-foot depth because of dense gravels or bedrock (CH2M Hill, 1990).

Pond 5 measures approximately 43 feet by 105 feet and has an estimated capacity of 69,000 gallons. Estimated discharge from the pond in September 1988 was 20 gpm and the water appeared to be slightly yellow. It was noted that discharge from the pond did not have a visible oily sheen, but after the water passed through the North Beach Road culvert, an oily sheen was observed. Soil samples collected in the ditch between Ponds 4 and 5 were visibly saturated with POL. This condition was observed to the lowest depth of sampling at 4 feet. The boreholes could not be advanced beyond this depth because of dense gravels or bedrock (CH2M Hill, 1990).

During the 1988 field investigation, sediment and soil samples were collected from drainages that connect each pond. Sample depths ranged from 1 to 4 feet. Additionally, surface water samples were collected at the drainage outlets of Ponds 2, 3, 4, and 5 (CH2M Hill, 1990). Samples were analyzed for TPH and lead (CH2M Hill, 1993a).

A total of 11 soil or sediment and five surface water samples were analyzed for TPH. Analytical results for TPH in soil and surface water were reported as follows (CH2M Hill, 1990):

Pond No.	TPH - Soil/Sediment mg/kg	TPH - Surface Water mg/L
1	17,600	2.5
2	1,520 to 17,600	3.6
3	130 to 141,000	3.1
4	130 to 141,000	1.7
5	710	2.2

Additionally, Pond 2 soil samples showed 374 mg/kg lead and Pond 3 soil samples showed 50.9 mg/kg of lead. Soil samples from the other ponds were within background levels for lead (CH2M Hill, 1993b).

During their 1992 field investigation, CH2M Hill conducted a limited geophysical survey in the vicinity of Ponds 1 through 4 (Pond 5 was not investigated). The following results of the geophysical survey were reported (CH2M Hill, 1993b):

- Ponds 1 and 2 - Reconnaissance survey was performed around both ponds out to a distance of about 50 feet. A utility line was located on the south side of the road. A culvert connects the two ponds. A small area of buried metal was present near southeast side of Pond 2.

- Pond 3 - Reconnaissance survey was performed surrounding the pond, although it was concentrated in the area between the pond and the roads on the north and east sides. Two probable utility lines were detected near the road on the north side of the pond, and what appeared to be a small piece of scrap metal on the southeast side of the pond, between the road and the pond, was found.

- Pond 4 - Reconnaissance survey was performed on the north side of the pond only. No anomalies were detected.

In addition to the investigations performed by CH2M Hill in 1988 and 1992, investigations by COE have documented floating product in several wells located within the vicinity of the oil/water separator. Floating fuel product was observed in well AP-1471, located east of Pond 5 (COE, 1989d). Floating product was also detected in two wells located near Tank 123 (ST08). Approximately 6 inches of floating product were measured in well AP-1218, located southeast of Tank 123 (COE, 1989e), and in well AP-1470, located southwest of Tank 123, 0.5 to 1.5 feet of floating fuel product was measured (COE, 1989d; COE, 1989e).

Current Status. The extent of contamination at this site has not been fully determined. As noted above, TPH and lead were detected at elevated levels in the soil and sediment and surface water samples, and floating product was measured in several wells in the vicinity. This potential source unit is recommended for an LSI in 1993 to accomplish the following:

- Determine if the discharge to the tidal pool is an immediate risk to human health or the environment.

- Determine if an early action is needed to remove floating product from any of the wells or ponds.

- Obtain information to focus the 1994 investigations.

The LSI for SS07 is described in detail in Section 3.2.2 of this Work Plan.

ST08 (former ID: PS-4) - Diesel Fuel Tank 123

Site Description and History. Diesel Fuel Tank 123 is located in the northern portion of the island near the intersection of North Road and Shemya Road. Tank 123 is a 490,000-gallon, diesel fuel, aboveground storage tank located approximately 500 feet south of the Abandoned Tank Farm (ST46). The tank is located where a drainage from the Tank Farm (ST46) enters the oil/water separator drainage ditch. The tank is surrounded by an unlined, earthen dike. The area around the tank has been graded and no vegetation grows in the area. The Abandoned Tank Farm

(ST46) contains a total of nine additional aboveground storage tanks spread over an area one-quarter mile in diameter (CH2M Hill, 1993b).

During construction of the tank, overburden soils were removed, and the base of the tank was placed directly on bedrock. The bottom of the tank is approximately 15 feet below grade. JRBA reported that Tank 123 was located over a natural spring or seepage, and it had a ruptured top seam that was repaired in July 1987 (JRBA, 1984). Records indicate that several spills have occurred at this site. The most significant incident was a 67,000-gallon spill in May 1984. The entire quantity was reported to be recovered and either reused or burned. The tank was also reported to be overfilled within one month of CH2M Hill's September 1988 field investigation (CH2M Hill, 1990). Spills and runoff drain to the west via surface and subsurface runoff toward Pond 3 within SS07, or to the southwest toward Upper Lake (CH2M Hill, 1993b).

CH2M Hill reported that the dike and area around Tank 123 appeared clean during their 1987 site visit. There was no oil sheen in the dike water or downstream of the sluice gate. Fill material has been placed around the tank, and contaminated dike material was removed in 1991. A drain system was installed around the inside of the dike to intercept any spilled fuel, and the tank was retrofitted and brought into compliance by the 11th CEOS (CH2M Hill, 1993b).

An oil spill cleanup was performed as part of the Alaska Cleanup Effort (ACE) in 1985 (U.S. Air Force, undated b). It is not clear whether this cleanup was a result of the 67,000-gallon spill in May 1984.

It is unknown whether ST08 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a site visit in 1987 and reported that the dike and area around Tank 123 appeared clean. There was no sign of spills or leaks from the tank or fill or discharge lines. There was no oily sheen on the water in the dike area or downstream of the sluice gate (CH2M Hill, 1987).

COE performed a field investigation in the vicinity of Tank 123 in 1988. They reported that drainage from two unlined oil separation ponds (SS07) northeast of Tank 123 flows to a third unlined oil separation pond west of Tank 123. Fuel sheens were observed on standing water in the drainage between the ponds. Samples from one piezometer and one monitoring well in the vicinity contained floating product (COE, 1989i). In May 1989, 6 inches of floating product were measured in two monitoring wells at Tank 123 (COE, 1989e).

The pumphouse area southwest of Tank 123 was visibly stained with POLs, extending in a 50-foot radius from the pumphouse. The total volume of contaminated soil was estimated to be 3,180 cubic yards. Monitoring well AP-1470, located near the pumphouse, had 1.5 feet of floating product in the well at the time of the investigation. The water table was encountered at about 9 feet bgs in this area (COE, 1989b and 1989h).

COE installed three piezometers around the tank to obtain OVA headspace measurements and water levels. The installation date of these piezometers is unknown. OVA headspace measurements and water levels were recorded during CH2M Hill's 1988 investigation in each of the piezometers. OVA headspace was measured at background concentrations in two of the piezometers and 50 ppm in the third piezometer. Water levels ranged from greater than 15.3 feet (total well depth) to 16.8 feet bgs (CH2M Hill, 1993b).

Two soil boreholes were sampled downslope from the tank during CH2M Hill's 1988 investigation. One soil borehole was drilled to 3.5 feet, and the second soil borehole was drilled to 9.5 feet. Analysis of soil samples from the boreholes detected TPH concentrations ranging from 75 to 230 mg/kg. Di-n-butylphthalate was detected at a concentration of 0.59 mg/kg in the 3.5-foot borehole. No PCBs or pesticides were detected. The soil samples contained low levels of methylene chloride, acetone, 2-butanone, toluene, xylenes, styrene, chloromethane, vinyl acetate, and 4-methyl 2-pentanone. A strong diesel odor was present in the area around the tank during sampling (CH2M Hill, 1993b).

No field investigation activities were conducted at ST08 during 1992.

Current Status. Soils analyses results indicate that minor amounts of contamination have been found outside the tank dike. The area within the dike has been remediated. One downgradient monitoring well installed by the COE contained floating product. Groundwater contamination in the vicinity of ST08 will be evaluated during the 1993 basewide field investigation (Section 3.1.2). Further investigations will be conducted in 1994.

ST09 (former ID: PS-5)- Power Plant Spills

Site Description and History. The power plant (Building 3501) is located near the northern coast in the central part of the island and is northeast and adjacent to the intersection of North Road and Power Plant Road. Several documented diesel fuel spills have occurred around the power plant since 1978. All vegetation has been removed and the area is graded flat. During the 1987 site visit by CH2M Hill, the power plant was undergoing expansion, and concrete pads for aboveground fuel tanks were being installed. During CH2M Hill's 1988 site visit, there was evidence of diesel fuel spillage in several areas around the power plant in the vicinity of the aboveground fuel tanks. Darkened soils were observed around the south perimeter of the main building (CH2M Hill, 1993b).

JRBA reported that all liquid wastes were diverted and contained in sumps beneath the power plant generators. Waste liquids spilled into the sumps included diesel fuel, used lubricating oil, and wash-down water containing detergents and solvents. The oil/water separators were often used beyond their capacity. Routine operational releases were made to ditches in the immediate area which drained to a water detention pond constructed within what is believed to have been an abandoned Quonset hut foundation. The ditches contained oil stains, and there was an oil sheen on the water surface (JRBA, 1984).

Spills and leaks that do not seep into the ground, flow to a roadside drainage ditch and eventually into the main drainage that transports the material to the West End Oil/Water Separator Ponds (SS07) (CH2M Hill, 1985).

Between January and May 1985, contaminated soil was removed in the vicinity of the power plant (U.S. Air Force, undated b). Contamination was caused by overflow from the used oil storage tanks (U.S. Air Force, undated c). In 1986, the 5099th CEOS assisted the 5073rd with containment of an oil spill at the power plant (U.S. Air Force, undated d).

Three USTs are associated with the power plant (ST44). The tanks contain or contained diesel fuel and waste oil.

It is unknown whether ST09 has ecological significance.

Previous Investigations and Findings. During the 1988 field investigation by CH2M Hill, soil borehole samples were collected from depths of 2 to 9 feet around the perimeter of the building, and one groundwater sample was collected from the bottom of a soil borehole on the south side of the building. Oily liquid was observed in one of the boreholes southwest of the building (CH2M Hill, 1993b).

TPH concentrations in the soil samples ranged from 15,000 mg/kg at 2 feet to less than 210 mg/kg at 9 feet. Semivolatile organic compounds were detected in the soil samples at concentrations ranging from 0.53 μg/kg (estimated) to 8.2 μg/kg. Toluene, ethylbenzene, and xylenes were detected in the soil samples at concentrations ranging from 0.06 μg/kg (estimated) to 1.76 μg/kg (estimated) The groundwater sample had a TPH concentration of 100 mg/L (CH2M Hill, 1993b).

A mapping survey of the power plant area was conducted during the 1992 field investigation by CH2M Hill (CH2M Hill, 1993b).

Current Status. Releases from the power plant eventually flow to the West End Oil/Water Separator Ponds (SS07). Some cleanup activities have been conducted around the power plant. Groundwater contamination in the vicinity of ST09 will be evaluated during the 1993 basewide field investigation (Section 3.1.2). Well points in Management Zone 7 will provide some source-specific data. Further investigations will be conducted in 1994.

ST10 (former ID: PS-6) - Vehicle Refueling Shop

Site Description and History. The Vehicle Refueling Shop (Building 605) is located along Shemya Road in the north-central part of the island and is part of the Vehicle Maintenance Shop. Floor drains in Building 605 discharge to an oil/water separator. One report (CH2M Hill, 1993b) indicates that the separator drains into a 55-gallon drum, and another report (JRBA, 1984) indicates that discharges from the separator flow through a small pipe to an area west of Building 605. This discharge is identified by a 200-foot by 20-foot area of stressed vegetation that has a burned appearance, is oriented in an east-west direction, and drains downslope (CH2M Hill, 1993b). ST10 is located near SS11, Vehicle Maintenance Shop Drains (Section 2.2.1.2).

A field investigation by the 11th CEOS was conducted in 1989. They report that floor drains from Building 605 and 614 were emptying POL products into a common area southwest of the buildings. Heavy POL stains extended at least 200 feet along the drainage and formed a 100-foot plume at the lower end. They report that the drainage continues to the existing satellite communications facilities, and the contamination may be covered by vegetation. It appeared that Building 605 contributed the majority of the POL to the drainage. The floor drain in Building 605 emptied into a barrel that overflowed into the drainage. They report that personnel in the building cleaned the oil/water separator twice per year (COE, 1989f).

ST10 is also the area associated with a 100-gallon JP-4 spill that occurred when the oil/water separator failed to contain the spilled fuel. During CH2M Hill's 1987 site visit, oil spills were evident in the immediate vicinity of the separator outlet, and a strong petroleum odor was noted. During the 1988 site visit, CH2M Hill noted that antifreeze may have been discharging from the outlet pipe (CH2M Hill, 1993b).

In March 1985, a waste oil cleanup was completed at the vehicle maintenance area (U.S. Air Force, undated b). In spring 1993, the 11th CEOS removed 4,600 cubic yards of soil in the vicinity of ST10 and SS11. Contaminant pathways appeared to follow buried utility lines and other man-made structures.

It is unknown whether ST10 has ecological significance.

Previous Investigations and Findings. Site reconnaissance of the area was conducted by CH2M Hill in 1987 (CH2M Hill, 1993b).

CH2M Hill performed a field investigation during the summer of 1988 at Building 605. Stressed vegetation was observed in the discharge area. Also at that time, it was noted that antifreeze was discharging from the small pipe, and aluminum cans in the area of stressed vegetation showed evidence of chemical corrosion. During this investigation, three soil boreholes were placed along the longitudinal axis of the area of stressed vegetation. These boreholes were advanced to bedrock, which was encountered between 3.5 to 8 feet in depth. No groundwater was encountered in these boreholes (CH2M Hill, 1993b).

TPH concentrations in soil samples collected from the boreholes ranged from 27,000 mg/kg at 2 feet to 170 mg/kg at 6 feet. Three of the six soil samples exceeded background concentrations of barium; two soil samples exceeded background concentrations of chromium; five soil samples exceeded background concentrations of lead; and five exceeded background concentrations of zinc. One soil sample had a PCB concentration of 1 mg/kg. No semivolatile organic compounds were detected. Low levels of the following volatile organic compounds were detected in soil samples: methylene chloride, acetone, 2-butanone, BTEX, and chlorobenzene (CH2M Hill, 1993b). Methylene chloride, acetone, and 2-butanone are common laboratory contaminates.

A site tour by CH2M Hill in 1991 indicated that water being discharged from Building 605 had a thick, oily sheen on it. In 1992, the Air Force reported that the oil/water separator inside Building 605 had been repaired and future discharges would not contain any petroleum products (CH2M Hill, 1993b).

In 1988, the COE installed monitoring wells in the vicinity of ST10. One well, AP-1529, contained floating product that was 2 to 3 inches thick.

In October 1992, the 11th CEOS conducted a field investigation at Buildings 605 and 616 for new construction proposed in the area. Analytical results indicated that diesel-range organics ranged from 2.92 ppm to 3097.78 ppm in soil samples collected at the 1-foot depth. Diesel-range organics ranged from 1.14 ppm to 12.55 ppm at the 5-foot depth. The analytical results indicated that approximately 0.25 acre and 1,600 cubic yards should be excavated and backfilled (U.S. Air Force, 1992a).

During CH2M Hill's 1992 field investigation, sampling grid markers set up by the 11th CEOS were surveyed, and a geophysical survey was conducted. Underground utilities were located, and isolated buried metal was found at three locations (CH2M Hill, 1993b).

Current Status. Some of the soil samples collected in 1988 exceeded human health risk criteria for TPH. Barium, chromium, lead, and zinc concentrations exceeded background concentrations in all of the soil samples (CH2M Hill, 1993b).

Contaminated soils were excavated in May 1993 in the vicinity of ST10. Groundwater in the vicinity of ST10 will be evaluated during the LSI. Because product was observed in a monitoring well installed by the COE (AP-1529), well points and monitoring wells will be installed to determine whether an early action is required. The monitoring wells will also assist in evaluating the effectiveness of previous removal efforts. Further investigations will be conducted in 1994.

SS11 (former ID: PS-7) - Vehicle Maintenance Shop Drains (Building 616)

Site Description and History. The Vehicle Maintenance Shop is located in Building 616 on Shemya Road, south of the main Station headquarters in the north-central part of the island. This area is used for maintenance, repair, and storage of Station vehicles. SS11 is located near the Vehicle Refueling Shop (ST10).

The area was reported to have the potential for environmental concern because automobile batteries and drums were stored on pallets and wooden stands outside the buildings. The drums were labeled as containing dry-cleaning solvent, hydrochloric acid, and 10W oil. An oil/water separator connects the building floor drains (CH2M Hill, 1993b).

Two drainage outlets discharge from the oil/water separator. One outlet is located at the southwest corner of the building, and the other outlet is located at the northwest corner of the parking area on the west side of Building 616. These two drainages flow for approximately 30 to 40 feet before they converge and flow into a culvert beneath the road. The culvert discharges onto the tundra and eventually flows toward Lower Lake (CH2M Hill, 1993b).

JRBA reported that stained soils around the building indicate the frequent past practice of dumping vehicle oil onto the ground. An estimated 1 gallon of hydrochloric acid was dumped on the ground behind the building each year (JRBA, 1984).

It is unknown whether SS11 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted site reconnaissance in September 1987 and did not find evidence of a petroleum release. Stressed vegetation was found around the two drainage outlets (CH2M Hill, 1993).

CH2M Hill conducted a field investigation at SS11 during 1988, and it was noted that paint residues and solvent vapors were being discharged from the northern outlet. During this investigation, three locations were sampled within the drainages from the outlets. Groundwater was encountered in a borehole in the south drainage, but depth to water was not noted (CH2M Hill, 1993b).

Four soil samples were collected from the boreholes. TPH concentrations in soil samples ranged from below detection levels to 2,600 mg/kg. All four soil samples exceeded background concentrations of barium; three soil samples exceeded background concentrations of lead; and all four soil samples exceeded background concentrations of zinc. Pesticides and PCBs were not detected. Volatile organic compounds detected in the samples included methylene chloride, acetone, and 2-

butanone. Concentrations of volatile organic compounds were very low (CH2M Hill, 1993b).

The 11th CEOS conducted a field investigation at Buildings 616 and 605 in October 1992. Diesel-range organics concentrations ranged between undetected and 2,420.94 ppm at the 1-foot depth and from 0.24 ppm to 127.97 ppm at the 5-foot depth. The data indicate that approximately 0.15 acre and 1,000 cubic yards of soil need to be excavated. The highest levels of petroleum contamination occurred on the eastern side, along an existing gravel road and to the west, perpendicular to the road for a distance of 100 feet (U.S. Air Force, 1992a).

During the 1992 field investigation performed by CH2M Hill, a sampling grid set up by the 11th CEOS was surveyed, and a geophysical survey of the site was conducted. An area of buried metal was found in the center of the southern half of the site. No samples were collected (CH2M Hill, 1993b).

Current Status. None of the contaminants detected in soil samples during CH2M Hill's 1988 field investigation exceeded human health risk criteria (CH2M Hill, 1993b).

Floating product was observed in a monitoring well installed by the COE (AP-1525) located in the vicinity of the vehicle maintenance/refueling area. Well points and monitoring wells will be installed during the LSI to determine whether an early action is necessary.

The 11th CEOS completed remediation activities in the drain area in the spring of 1993. Approximately 1,000 cubic yards of contaminated soils were removed. Further investigations will be conducted in 1994.

SS13 (former ID: PS-9) - Asphaltic Tar Drum Storage

Site Description and History. The Asphaltic Tar Drum Storage Area is located in the central part of the island approximately 600 feet north of Building 701 (Hangar 4). JRBA reported that there was a large quantity of 55-gallon drums of Pavex, a proprietary asphalt product used for roadway construction, located near Building 747 (JRBA, 1984). The report indicated that the drums were on a hardstand and some of the drums were leaking. During CH2M Hill's 1988 field visit, the Pavex drums had been removed and two 100-foot diameter, tar-covered asphalt pads were evident. The Pavex cover was 3 to 6 inches thick and relatively soft, readily showing footprints and tire tracks. Also, the field team observed the remains of rusted drums and a pool of tar on the ground near Building 701. The pads are located on opposite sides of Barst Lane Road (CH2M Hill, 1993b).

In 1985, 4,163 drums of tar were removed during the ACE (U.S. Air Force, undated b).

It is unknown whether SS13 has ecological significance.

Previous Investigations and Findings. During CH2M Hill's field investigation in 1988, a soil borehole was placed on the downslope edge of each pad. Soil samples were collected from each borehole at depths of 3.5 feet. Groundwater was encountered at approximately 2 feet near the north pad. Samples were analyzed for volatile organic compounds and TPH. TPH concentrations ranged from 180 to 200 mg/kg. Methylene chloride concentrations ranged from an estimated 0.005 mg/kg to 0.021

mg/kg. Acetone concentrations ranged from an estimated 0.009 mg/kg to an estimated 0.042 mg/kg (CH2M Hill, 1993b).

During the 1992 field investigation by CH2M Hill, a geophysical survey was conducted at the Asphaltic Tar Drum Storage Area. An area of buried metal was identified north of the road in the western half of the site. A buried utility line was also located. No samples were collected during the 1992 investigation (CH2M Hill, 1993b).

Current Status. Because this site is within the water gallery watershed, the 11th CEOS plans to excavate the tar-like substance, any contaminated soil, and the buried metal in 1993. The 11th CEOS will prepare and submit an NFAD after completion of the removal activities. No further action will be required at the Asphaltic Tar Drum Storage.

SS14 (former ID: PS-10) - Base Operations Spill

Site Description and History. On 9 August 1983, a cracked fuel tank in a damaged C-5A aircraft spilled approximately 50 gallons of JP-4 on the asphalt parking area near the Station Operations Terminal. According to the Phase I report, the Station Fire Department hosed the fuel off the asphalt with water, which then drained into the sandy soils south of the runway (JRBA, 1984). According to documentation prepared by CH2M Hill to support a No Further Action decision, "the resulting mixture of water and fuel was observed to have flowed off the apron onto the ground between the parking apron and the runway" (CH2M Hill, 1993a). The fuel-saturated soils were excavated, stored in barrels, and disposed of at the fire training area (JRBA, 1984).

It is unknown whether SS14 has ecological significance.

Previous Investigations and Findings. CH2M Hill's 1988 site investigations revealed a 50-foot by 8-foot area along the south side of the taxiway that may have been the spill site. However, there was no sign of the spill in the soil, and the vegetation appeared normal (CH2M Hill, 1990).

The Final Technical Report for the 1988 field investigations recommended that SS14 be eliminated from further investigation (CH2M Hill, 1990). Documentation to support no further action was prepared and included as Appendix G in the Final Technical Report (CH2M Hill, 1993b).

Again during CH2M Hill's 1992 field investigation, no visual evidence of the historical spill was noticeable in the area. Four surface soil samples were collected from SS14. Samples were taken from the south side of the aircraft parking area where the fuel and water mixture was reported to have infiltrated into the sandy soil. All four samples were analyzed for TPH at the onsite laboratory. The results showed TPH concentrations ranging from 4,617 to 16,683 mg/kg (CH2M Hill, 1993b). These results are less than the PRLs established for the 1992 field investigations (CH2M Hill, 1993a).

Current Status. SS14 is located within an area currently used for aircraft servicing (CH2M Hill, 1993b). The full extent of contamination at this potential source unit has not yet been determined. SS14 may be recommended for further investigations during 1994, based on the results of the 1993 basewide field investigation (Section 3.1).

SS17 (former ID: PS-1A) - New Cobra Dane

Site Description and History. The New Cobra Dane facility is located along the coastline at the northwesternmost point of the island. The Cobra Dane is located on a bluff, overlooking the Bering Sea approximately 200 feet below to the west (CH2M Hill, 1993).

A 1,000-gallon underground tank (sometimes referred to as an Askarel tank) existed just outside the front entrance to Cobra Dane. This tank served as storage for residues collected in several floor trenches in the basement of Cobra Dane during spill response activities. These residues moved through underground lines from the floor trenches to the tank. When fluids overflowed the sump, the tank was emptied by pumping through an aboveground 2-inch pipe and a garden hose. The tank was last pumped in 1985 (CH2M Hill, 1993a). Several transformer oil spills at this site have been reported since the facility was brought online in 1977 (JRBA, 1984).

It is unknown whether SS17 has ecological significance.

Previous Investigations and Findings. During CH2M Hill's 1988 investigation, two soil samples from an auger borehole and one sample of the fluid in the tank were collected. The soil sample location was placed outside the estimated areal extent of the tank, along the west perimeter (CH2M Hill, 1993a). TPH in the soil was detected at 5,100 mg/kg at 3 feet and 100 mg/kg at 6 feet. No pesticides or PCBs were detected in the soil and no groundwater was observed in the borehole. Results from the tank fluid sample showed TPH at 43,000 mg/L, and pesticides or PCBs were not detected. The tank contents measured 36 inches deep at the time of sampling. The fluid consisted of "water phase, an oil-water emulsion and a greenish, dense, nonaqueous liquid phase" (CH2M Hill, 1990).

The underground tank was removed in June 1992 by COE (CH2M Hill, 1993b). Analytical results from soil samples taken during the removal activities were not reported in the draft *1992 IRP Field Investigation Report* (CH2M Hill, 1993a).

During their 1992 field investigations, CH2M Hill collected three soil samples at SS17; one from the surface near the former tank location and two from boreholes at the approximate bottom of the tank excavation. All three samples were analyzed for volatiles, semivolatiles, pesticides/PCBs, and metals. Numerous semivolatile compounds were detected in the surface sample. These semivolatile compounds are generally associated with coal tar derivatives and could have come from asphalt. Volatile and semivolatile concentrations ranged from 9 μg/kg methylene chloride to 1,100 μg/kg fluoranthene. Some elevated heavy metals were also found in the surface sample. Metal concentrations ranged from 0.25 mg/kg beryllium to 19,800 mg/kg aluminum (CH2M Hill, 1993b).

The two subsurface samples were taken at depths of 11.3 and 11.5 feet. No semivolatiles or pesticides or PCBs were detected in either sample. One volatile organic compound was detected in one of the subsurface samples (toluene at 1 μg/kg at the 11.5 ft depth). As with the surface soil sample, several metals were detected in one or both of the subsurface samples. Metals concentrations ranged from 0.11 mg/kg of mercury to 59,600 mg/kg of iron (CH2M Hill, 1993b).

According to CH2M Hill, none of the compounds detected at SS17 were above the PRLs established for the 1992 IRP field investigation. Aluminum, cobalt, and iron in soil were determined to be potential risks to terrestrial receptors at the site (CH2M Hill, 1993b).

Current Status. An NFAD is being prepared for SS17 by CH2M Hill.

SS25 (former ID: PS-83) - World War II Fuel Tanks

Site Description and History. This potential source unit is located along the northwest side of Cross Island Road, northwest of Taxiway 3, in the south-central portion of the island.

SS25 is the site of a dismantled bulk fuel storage area. Reportedly there were 60 or more 40,000 gallon fuel tanks within a one-half by one-quarter mile area. All that remain are tank excavations, earthen containment berms, and abandoned pipelines (CH2M Hill, 1990).

It is unknown whether SS25 has ecological significance.

Previous Investigations and Findings. During the 1988 field investigation, several oily water seeps were observed along the downslope eastern perimeter of this area, adjacent to Cross Island Road (CH2M Hill, 1990). Three soil samples, to a depth of 4 feet, were collected near these seeps. Results yielded TPH values from 420 to 1,100 mg/kg at the 2-foot depth and 430 mg/kg at the 4-foot depth. Nitrophenol was detected at 5 mg/kg. It was also reported that 4-nitrophenol was detected at 13.0 mg/kg at this site. Groundwater was encountered at a depth of 3 to 4 feet (CH2M Hill, 1990). Table 4.11 in CH2M Hill's report (1990) also shows butanone at a range of 0.070 mg/kg at 3 feet to 0.098 mg/kg at 2 feet. 2-Butanone is a common laboratory contaminant.

CH2M Hill's report on the 1992 field investigations presented additional findings for the 1988 samples. The report states that two semivolatiles were detected, including di-n-butylphthalate (estimated at 0.26 mg/kg) and nitrophenol (26 mg/kg). Volatiles detected in most samples included methylene chloride (ranging from 0.22 to 0.33 mg/kg), acetone (ranging from 0.24 to 2.6 mg/kg), and 2-butanone (ranging from 0.13 to 0.49 mg/kg). Benzene was detected at an estimated concentration of 0.084 mg/kg in one sample (CH2M Hill, 1993b). Also, toluene was detected at an estimated concentration of 0.067 mg/kg in one sample (CH2M Hill, 1993b). Phthalates, methylene chloride, acetone, and 2-butanone are common laboratory contaminants.

During the 1992 field investigation, a geophysical survey was conducted at SS25 to check for large areas of buried metal. The survey covered approximately 20 acres. Most of the anomalies were detected in the southern third of the site around the old bermed areas. Few anomalies were detected in the open areas that comprise the majority of the site. Anomalies encountered in open areas appear to be associated with cable (probably communication cables) crossing the site (CH2M Hill, 1993b).

Current Status. The nature and extent of contamination at SS25 has not been fully characterized. This site has been recommended for further investigation in 1994.

OT30 - Alaska Cleanup Effort/Drum Removal

Site Description and History. The location of this potential source unit is unknown. The limited information currently available suggests that some type of removal action occurred at this site. The types of wastes present or formerly present at this site are unknown but may include miscellaneous POL wastes.

It is unknown whether OT30 has ecological significance.

Previous Investigations and Findings. Some type of removal action is believed to have occurred at this site in the past. All waste has reportedly been removed from this site.

Current Status. Since the location of this source unit is unknown, OT30 has been proposed for removal from the IRP (Jacobs, 1993). A decision document will be prepared.

SS31 - Rusting Waste Oil Drums

Site Description and History. The location of this potential source unit is unknown. Waste oil stored in rusting drums led to the listing of this site. It is unknown whether SS31 has ecological significance.

Previous Investigations and Findings. Some type of removal action is believed to have occurred at this site in the past. The drums have reportedly been removed.

Current Status. Since the location of this source unit is unknown, SS31 has been proposed for removal from the IRP (Jacobs, 1993). A decision document will be prepared.

ST45 - Aerospace Ground Equipment Facility Fuel Spill

Site Description and History. The Aerospace Ground Equipment (AGE) Fuel Spill area is located adjacent to the AGE Facility, Building 729. Building 729 is located north of the active runway in the south-central portion of the island.

Building 729 is a 2,772 square foot building, constructed in 1966. An abandoned dry well is located on the north side of Building 729. A drainage pipe originating inside of the building was also observed in the area north of the building (U.S. Air Force, undated e).

Two 500-gallon aboveground storage tanks were located on the west side of Building 729 in 1981. One tank contains unleaded gasoline (i.e., MOGAS) and the other tank contains jet fuel (JP-4). A drainage ditch is located north and west of Building 729. Runoff from the drainage ditch is south toward the active runway (U.S. Air Force, undated e).

A 1,000-gallon UST was installed on the south side of the facility in 1970 (U.S. Air Force, undated e). This UST, UST 729-1, contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. Diesel fuel was delivered by tanker truck and served Building 729 (ENSR, 1991). UST 729-1 was removed and replaced with an aboveground tank in 1990 (U.S. Air Force, undated e; U.S. Air Force, 1990a).

An underground sewage line is also located on the south side of the building. A 242-foot portion of this 6-inch sewer line was removed and replaced in 1990 (U.S. Air Force, undated e; U.S. Air Force, 1990a).

It is unknown whether ST45 has ecological significance.

Previous Investigations and Findings. Contamination of the soils and groundwater in the areas north, west, and south of Building 729 was documented during 1988 and 1989 field investigations. Contaminants detected were TPH, BTEX, and polynuclear aromatic hydrocarbons (PAHs). In addition, noncoliform bacteria, too numerous to count, were detected in wells south of Building 729, indicating that the sewer line in that area was leaking (U.S. Air Force, undated e).

As a result of signs of stressed vegetation in the area north of Building 729, disposal of waste POL and other solvents was suspected at that location. The area west of Building 729 was observed to be "generally saturated with fuel." In the area south of Building 729, it was noted that due to improper venting of the UST, numerous spills had occurred during filling. Also, as noted above, the sewer line in this area was suspected of leaking (U.S. Air Force, undated e). In addition, during excavation of the sewer line, a manhole was discovered west of Building 729. A 50-gallon steel drum had been stuck in the manhole and was assumed to have become a small waste oil disposal site because of its contents of oily rags and POL-contaminated soil (U.S. Air Force, 1990a).

In the spring of 1990, removal actions were completed by the 5099th CEOS. Approximately 2,560 cubic yards of soil were excavated from areas north and west of Building 729, and approximately 240 cubic yards of soil were excavated from the area south of Building 729. Also, approximately 200 cubic yards of soil were removed from the sewer line area where the 50-gallon steel drum had been buried (U.S. Air Force, 1990a). The excavated areas were backfilled with clean material (U.S. Air Force, undated e).

Soil samples were collected during excavation activities to confirm detections of TPH, BTEX, and heavy metals. One soil sample collected at a 3-foot depth north of Building 729 showed toluene at 7.3 mg/kg, xylene at 32.0 mg/kg, and ethylbenzene at 1.0 mg/kg. Heavy metals and TPH were detected in a soil sample collected northwest of Building 729 at 4 feet. TPH (diesel) concentrations in that sample were detected at 43 mg/kg and heavy metals detected were arsenic (98.1 mg/kg), barium (12.228 mg/kg), cadmium (2.7 mg/kg), chromium (32.7 mg/kg), lead (4.8 mg/kg), and silver (9.6 mg/kg). A groundwater sample collected from well AP-1480, north of Building 729, showed TPH (gasoline with some heavier hydrocarbons) at 50 μg/L (U.S. Air Force, 1990b).

Detections of contaminants southwest of Building 729 included TPH from three different confirmatory soil samples. Two soil samples collected at the bedrock interface in boreholes southwest of Building 729 showed TPH (diesel) at 200 mg/kg (8-foot depth) and 250 mg/kg (9- to 10-foot depth). Another soil sample located southwest of Building 729 showed TPH (gasoline) at 810 mg/kg (U.S. Air Force, 1990b).

Detections of contaminants southeast of Building 729 (in the area near the former UST) included heavy metals and BTEX from two soil samples ranging in depth from 3 feet to 8.5 feet. Metals detected included arsenic (106.7 to 201.2 mg/kg), barium (17.0 to 19.8 mg/kg), cadmium (2.9 to 4.6 mg/kg), chromium (33.9 to 36.9 mg/kg), lead (6.1 to 10.9 mg/kg), selenium (11.9 mg/kg), and silver (1.2 to 7.9 mg/kg). BTEX detected included benzene at 0.03 mg/kg, ethylbenzene at 0.37 mg/kg, toluene at 0.09 to 0.80 mg/kg, and xylenes at 0.05 to 2.50 mg/kg (U.S. Air Force, 1990b).

During 1989 field activities, oil sheens were observed at well AP-1480 (north of Building 729) and well AP-1473 (south of Building 729). In addition, water samples collected in 1988 and 1989 showed the following maximum TPH concentrations: 1.2 ppm (well AP-1480), 3.2 ppm (well AP-1478, located northwest of Building 729), 5.8 ppm (piezometer AP-1230, located south of Building 729), and 14.6 ppm (well AP-1473).

Current Status. Because of the contaminants detected in the 1988/1989 groundwater samples and results of the 1990 soil and groundwater sample analyses, this potential source unit has been recommended for further investigations in 1994.

ST46 - Abandoned Tank Farm (NW)

Site Description and History. The abandoned tank farm consisted of numerous, large-capacity tanks previously used to provide diesel fuel to the power plant. The tank farm is located between North Road and North Beach Road near the northernmost point of the island (COE, 1989h).

Shemya's two supplementary water supply wells are located within the abandoned tank farm (673 Air Base Group, undated).

Specifications are available for nine of the tanks (104, 105, 109, 110, 111, 119, 120, 121, and 122) located within the tank farm. Ten tanks comprised the tank farm. Tank 123 is discussed in ST08. The nine tanks noted above are aboveground, 487,000-gallon capacity tanks with welded-steel construction. The construction dates are unknown. All of the tanks were used to store No. 2 diesel fuel. The tanks did not have leak detection systems. Unlined dikes surround each of the tanks. Diesel fuel was originally offloaded at the dock area and piped to the tanks via 10-inch diameter pipelines. Currently, aboveground tanks designated 124 and 125 provide the storage requirements of the power plant. Tank 119 was used to store contaminated petroleum waste for an unknown period of time (COE, 1989h). Tank 119 was probably originally used as bulk storage of No. 2 diesel fuel. In May 1989, Tank 119 contained approximately 98,000 gallons of POL. Laboratory analysis indicated that the tank contained primarily diesel fuel with some heavier components (COE, 1989h).

There were approximately 16 steel tanks used before the 100-series tanks. Runoff from ST46 flows into the West End Oil/Water Separator Pond 3 (SS07) (CH2M Hill, 1985).

JRBA (1984) reported that the tanks had dents in their sides as a result of earthquakes, and the tank sides, top, bolts, connectors, valves, and pipes were corroded.

It is unknown whether ST46 has ecological significance.

Previous Investigations and Findings. The Army COE conducted an investigation at the abandoned tank farm in October 1988 to investigate POL contamination. The areas around the 10 tanks were included in the investigation (104, 105, 109, 110, 111, 119, 120, 121, 122, and 123), as well as pipeline routes, the area around the existing pumphouse, and along the ravine that drained surface water around the tank farm (COE, 1989h). The investigation specific to Tank 123 is described in ST08.

Analytical results from shallow soil samples indicate extensive POL contamination associated with the tank farm area. In general, all soil samples were analyzed for TPH, volatile organic compounds, and PAHs. Volatile organic compounds and PAHs were either not detected or were present at very low concentrations. All of the containment floors had POL-contaminated soil, with volumes ranging from 125 to 435 cubic yards. These volumes are relatively small because bedrock was typically encountered 1.5 to 2 feet below the ground surface. TPH ranged from nondetect to the low tens of thousands of ppm (COE, 1989h).

The dikes of three tanks (119, 121, and 122) were sampled and found to be contaminated with POL. The volume of contaminated soil associated with these dikes of the three tanks was estimated to be 2,880 cubic yards (Tank 119), 3,300 cubic yards (Tank 121), and 5,750 cubic yards (Tank 122) (COE, 1989b and 1989h).

Surface soil along the pipelines was visibly stained 2 to 3 feet away from the pipeline. Four soil samples were collected from stained areas. TPH concentrations in the soil samples ranged from 587 ppm to 13,900 ppm. The total volume of contaminated soil associated with the pipelines was estimated by the COE to be 4,500 cubic yards (COE, 1989b and 1989h).

The pumphouse area southwest of Tank 123 was visibly stained with POLs, extending in a 50-foot radius from the pumphouse. The total volume of contaminated soil was estimated to be 3,180 cubic yards. Monitoring well AP-1470, located near the pumphouse, had 1.5 feet of floating product in the well at the time of the investigation. The water table was encountered at about 9 feet bgs in this area (COE, 1989b and 1989h).

Eareckson's two supplementary water supply wells are located within the abandoned tank farm and are completed in the bedrock aquifer. Several investigations of these wells have been performed, primarily to provide information on storage capacity and water quality. Most recently, the COE performed a 23-day pumping test on the two wells and collected water quality samples. The two wells were previously designated as Nos. 4 and 29; currently, they are designated as Nos. 400 and 410, respectively. The wells were each pumped at approximately 30 gpm. A drawdown of 10 feet at well 400 and 12 feet at well 410 was reported. Most of the drawdown occurred during the first 15 minutes of pumping and had generally stabilized after six hours of pumping (COE, 1989a). The results of these tests were recorded graphically by the COE and tables show drawdown, discharge rates, and duration of the pumping tests. Individual time-drawdown observations were not recorded. It is not possible to construct time-drawdown curves to determine either transmissivity or storage coefficient.

Water samples were analyzed for heavy metals, TPH, and volatile organic compounds. Chromium and lead were detected at trace levels (below MCLs) in water samples collected early in the test; however, they were not detected in subsequent water samples. According to the COE report, the trace levels of TPH detected in the water samples could be attributed to oil associated with the pumps and well casing. Ten different volatile organic compounds were detected during the test, each at trace levels. According to the COE, these levels could be attributed to laboratory contamination, field sampling contamination, and analytical limitations. None of the detected compounds exceeded MCLs (COE, 1989a).

The most notable observation during the test was a sulfur odor that developed after two days of pumping and continued throughout the 23-day pumping test in well 410. Analyses of groundwater from both wells showed elevated sulfate concentrations; however, the concentrations were well below MCLs (COE, 1989a). In 1992, additional groundwater samples were collected at the backup wells. TPH was not detected in either well sample.

Current Status. Groundwater in the vicinity of ST46 will be evaluated as part of the 1993 basewide field investigation (Section 3.1.2). Well points may provide some source-specific data. Further investigation may be required in 1994.

ST50 - Aboveground Tank #7

Site Description and History. ST50 is located at the extreme western end of the island near the intersection of West Beach Road and West Road Cutoff.

ST50 is a 440,000-gallon aboveground tank, identified as Tank #7. The tank was proposed to store water for the deluge system. Previous contents were petroleum products and possibly JP-4. The tank is constructed of bolted steel, and the year it was built is unknown. It is not equipped with alarms, and is located in an unlined bermed area. Tank #7 has not stored fuel since 1980 (ENSR, 1991). Deluge system water was not stored in the tank because it had residual contamination and minor leaks.

It is unknown whether ST50 has ecological significance.

Previous Investigations and Findings. The COE collected soil samples from hand-dug boreholes near Tank #7 and conducted a subsurface investigation at Tank #5, located near Tank #7. Fuel product was detected in the soils and water near Tank #5. Soil contamination was visible at the 14- to 30-foot depth. BTEX, TCE (12 μg/L), acetone, methylene chloride, and 2-butanone were detected in groundwater samples. The water table was encountered at 21 feet bgs. Semivolatile organic compounds were also detected in groundwater near Tank #5. Significant concentrations of heavy metals were not detected adjacent to Tanks #5 or #7 (COE, 1989g). Acetone, methylene chloride, and 2-butanone are common laboratory contaminants.

Two holes were hand-dug to a depth of 12 to 18 inches in the floor of the Tank #7 dike because slopes were too steep for the drill rig. One surface grab sample was collected from near the low spot inside the Tank #7 dike. One soil sample collected near Tank #7 had a concentration of 960 ppm, which was the highest TPH concentration detected during the investigation of the tanks. Volatile organic compounds were not detected. Estimated concentrations of PAHs were detected in all of the soil samples. Contaminants were not detected in borehole soil samples collected outside the tank dike. The COE indicated that, because of the high concentrations of POL found in the hand-dug holes at Tank #7, the contamination may extend deeper (COE, 1988a).

Current Status. Groundwater may be evaluated in the vicinity of ST50 during the 1993 basewide field investigation (Section 3.1.2). Further investigations may be required in 1994.

2.2.1.3 Proposed State Solid Waste Source Units

LF15 - Wood Dump - Active Wood Burn Area

Site Description and History. This source unit is located near the eastern tip of the island, approximately 1,800 feet east of Building 3013 and 1,800 feet north of site OT29. LF15 is a bermed area, with a size of approximately 100 feet by 40 feet (Jacobs, 1992). It is located on the beach below the bluffs. Telephone poles, posts, wood debris, and other landfill trash are currently burned in this area. Field notes from Jacobs' 1992 site visit indicated that several solid waste sites were observed in the area (Jacobs, 1992). A 1986 aerial photograph indicates that up to three burn areas may have once existed in this location. The area adjacent to LF15 is habitat for emperor geese and puffins.

Previous Investigations and Findings. No previous investigations have been performed at this site.

Current Status. This potential source unit is recommended for an LSI during the 1993 field season to evaluate its potential as a no further action source. The LSI for LF15 is discussed in detail in Section 3.2.1.

LF16 - Debris Dump

Site Description and History. The location of this potential source unit is unknown. Miscellaneous debris and scrap metal were reportedly disposed of at this site (Jacobs, 1992). It is unknown whether LF16 has ecological significance.

Previous Investigations and Findings. No previous investigations have been performed at this site.

Current Status. Since the location of this potential source unit is unknown, LF16 has been proposed for removal from the IRP (Jacobs, 1993). A decision document will be prepared.

OT19 (former ID: SW-5) - Hospital Lake

Site Description and History. This potential source unit is located approximately 200 feet west of the intersection of North Road and East Road in the northeast part of the island.

Hospital Lake was used as a disposal area for old ammunition after World War II. The lake is approximately 200 feet by 450 feet. It covers approximately 2 acres, with a depth of approximately 4 feet (CH2M Hill, 1993b). No particular portion of the lake has been identified as the disposal area. No significant tributaries drain into or from the lake. At the northern end of the lake, a small drainage ditch flows into the lake. Flow from the ditch appears to be intermittent and correlated with precipitation (CH2M Hill, 1990).

It is unknown whether OT19 has ecological significance.

Previous Investigations and Findings. Following an accident with a live round in the 1980s, Navy divers were brought in to remove ammunition. It is not known whether all of the ammunition was removed, or whether any decomposition of the materials had occurred before removal (CH2M Hill, 1993b).

During the September 1988 field investigation, no evidence of discarded ammunition or other materials was noted (CH2M Hill, 1993a). One surface water sample and one sediment sample were collected near the drainage outlet of the lake and one sediment sample was collected near the inlet. At the time of sampling, no significant inflow or outflow of lake water was observed at the sampling points (CH2M Hill, 1990).

Organic vapor analyzer (OVA) measurements of 31 ppm and 74 ppm were observed in the sediments collected at the lake's inlet and outlet, respectively. The sediments sampled within the lake consisted primarily of brown organic silts with minor amounts of rounded gravel along the south shore. The lake water, when placed in a clear sample container, had a noticeable yellow color and a slight foggy appearance (CH2M Hill, 1990).

Barium (94.7 mg/kg), zinc (58.7 mg/kg), and TPH (200 mg/kg) were detected in the sediment samples. Levels for all other parameters (organics and metals) were non-detectable or were at or below background (CH2M Hill, 1990).

During the 1992 field investigation, water and sediment samples were taken and a geophysical survey was performed. A single isolated metal object was detected at the southern tip of the lake, with two other potential metal objects also identified in the lake. The bottom survey showed a fairly uniform lake bottom with an average depth of 4 feet (CH2M Hill, 1993b).

Six surface water samples and four lake sediment samples were collected. TPH, nitrate/nitrite, metals, and some volatiles were detected in the surface water samples. Results from surface water included the following: TPH ranging from 0.06 mg/L to 0.17 mg/L; nitrate/nitrite ranging from 0.038 mg/L to 1.41 mg/L; copper at 9.6 μg/L; zinc at 13.3 μg/L; and bis (2-ethylhexyl) phthalate at 1 μg/L (CH2M Hill, 1993b).

Metals and volatiles were detected in the sediment samples. Volatiles ranged from 5.8 μg/kg 4,4'-DDD to 130.00 μg/kg bis (2-ethylhexyl) phthalate. Metals ranged from 34.1 mg/kg chromium to 101 mg/kg zinc (CH2M Hill, 1993b).

Current Status. CH2M Hill has reported that all the constituents detected at OT19 were less than the human health preliminary risk levels for this site. However, the preliminary ecological risk assessment indicated potential risk to terrestrial and aquatic receptors near or in the lake, based on the metals concentrations. Chromium, copper, lead, barium, and zinc in sediment and water samples were above the PRLs for ecological risk and also above background soil concentrations (CH2M Hill, 1993b).

A No Further Action Document for OT19 is currently being prepared by CH2M Hill; however, it is likely that the NFAD will be rejected based on exceedance of ecological risk factors. Based on the reasons for rejection, further activities will be proposed for 1994.

SS20 - Retrograde Area (Dock)

Site Description and History. This potential source unit is located adjacent to the dock on the northwest point of the island. Potential contaminants consist of metal scrap, which are predominantly dock pilings (Jacobs, 1992). Some debris was removed from this location during 1977 and 1978 as part of the ACE. The area is currently covered by large diameter rock backfill.

A Milcon Project is scheduled for this area during the summer of 1993 (Jacobs, 1992). The project consists of construction of new revetments for the barge docking facilities (COE, 1993).

It is unknown whether SS20 has ecological significance.

Previous Investigations and Findings. Drilling and sampling was performed at the dock area during December 1992. Two boreholes were located directly west and immediately south of the proposed construction area. Drilling was not performed directly within the areas of proposed excavation because these areas lie entirely within the breadth of the existing seawall riprap and are covered by large boulders and seaborne debris (COE, 1993).

Six samples were analyzed by modified method 8015, Hydrocarbon Scan (gasoline, diesel No. 2, jet fuel, kerosene, bunker oil, heavy fuel, and mineral spirits). Up to 130 mg/kg of heavy fuel (residual range petroleum hydrocarbons) were detected in four of the six samples analyzed. No other fractions were detected (COE, 1993).

Current Status. Because the stated potential contaminant is metal scrap, this source area is recommended for an LSI in 1993 to determine if any metals contamination exists in the area. If action levels for TPH, metals, and volatile organics are not exceeded, this source unit will be recommended for no further action. The LSI for SS20 is discussed in detail in Section 3.2.1.

OT21 - Old Grounded Barge

Site Description and History. The Old Grounded Barge is located on the beach in Alcan Cove, approximately 1,200 feet southeast of the dock on the northwest point of the island. The fuel barge was stranded on the beach after it ran aground in 1958. At the time it ran aground, it reportedly had fuel on board (TRA/Farr, 1988).

JRBA reports that the barge is half buried in the sand. After unloading its fuel supply, the barge was grounded on the beach at Alcan Cove. It is unknown how much fuel, if any, spilled during the accident. JRBA did not recommend the site for HARM scoring (JRBA, 1984).

No visual evidence of contamination was present at the barge during a site visit by Jacobs personnel in October 1992. Standing water was observed in the tanks below the deck.

OT21 was not identified during the preliminary habitat identification as potential habitat.

Previous Investigations and Finding. There have been no previous investigations at this site.

Current Status. A site reconnaissance of the area will be made during the 1993 field investigation. Samples will be collected at locations around the barge. If the barge is determined not to be a potential source unit, an NFAD will be prepared and submitted to ADEC for review.

SS22 - Scrap Metal Storage/Hardstand

Site Description and History. The location of the Scrap Metal Storage area is unknown. However, it is reported that the material stored on the hardstand is metal scrap.

It is unknown whether SS22 has ecological significance.

Previous Investigations and Findings. There have been no previous investigations at this site.

Current Status. It is recommended that SS22 be removed from the IRP as a potential source unit. There is insufficient information to recommend any investigation activities or to prepare an NFAD at this time. If more information becomes available in the future, the area will be reevaluated.

LF27 - Base Sanitary Landfill

Site Description and History. The Base Sanitary Landfill is located near the southeast corner of the island, immediately north of LF28, and approximately 800 feet south-southwest of OT29.

This site has historically been and is currently used to dispose of Station solid waste and municipal debris under a permit issued by ADEC. The Comprehensive Plan (TRA/Farr, 1988) states that the landfill may be reaching its capacity and a new location has been reserved as an alternate location. The Station is also reviewing alternative disposal practices to conserve existing capacity.

It is unknown whether LF27 has ecological significance.

Previous Investigations and Findings. No investigations are known to have been conducted at this site.

Current Status. This landfill is permitted by the state to accept sanitary waste. Because it is managed in accordance with state regulations, it is recommended that the landfill be removed from the IRP as a potential source unit. The landfill will eventually be closed by the 11th CEOS in accordance with existing permit requirements.

LF28 (former ID: SW-14) - Scrap Metal Landfill

Site Description and History. The Scrap Metal Landfill is located at the extreme southeast corner of the island, approximately 500 feet south-southeast of LF27 (CH2M Hill, 1990).

This landfill was used in the past to dispose of scrap metal. The period of use is unknown, but the last known use was before 1989. The site is approximately 3.1 acres and averages 10 feet above grade. The surface of the landfill currently appears as a series of sandy hummocks interspersed with broken concrete (CH2M Hill, 1993b).

JRBA (1984) reported that some domestic wastes were combined with the scrap metal. It is unknown whether LF28 has ecological significance.

Previous Investigations and Findings. CH2M Hill conducted a field investigation of the site in 1988. Two hand-augered soil sample locations were advanced on the downslope side of the landfill. One soil sample was located at the southwest corner of the landfill, and the other was located at the southeast corner of the landfill. At both sample locations the auger was refused at 5 to 5.5 feet bgs. Groundwater and metal debris were not observed during the sampling period. TPH concentrations in soil samples ranged from 250 mg/kg to 460 mg/kg. Metals detected above background in the soil samples included: nickel, zinc, and lead. Semivolatile organic compounds were not detected. Volatile organic compounds detected in the soil samples included methylene chloride, acetone, and 2-butanone (CH2M Hill, 1993b). These compounds are common laboratory contaminates.

CH2M Hill conducted a geophysical survey of the landfill area during their 1992 field investigation. Several extensive areas of buried metal were identified in the southern portion of the landfill. In addition, an area of scattered buried metal, small areas of buried metal, and a buried utility line were identified during the survey (CH2M Hill, 1993b).

Current Status. Contaminant concentrations collected during previous investigations in soil samples were below human health and ecological risk criteria (CH2M Hill, 1993b).

Groundwater and surface soil samples will be collected during the 1993 LSI to determine whether contamination is present above risk levels. If the landfill is not determined to be a source unit, an NFAD will be prepared and submitted to ADEC for review.

OT29 - Ammunition Dump

Site Description and History. The Ammunition Dump is located near the southeast corner of the island, approximately 700 feet south-southwest of LF27. The area of interest is a small portion of a rocky beach(es) immediately below steep cliffs.

The site was used to dispose of ammunition following World War II. Various munitions, including 50 caliber, are present. Reportedly, the disposal site is partially under water during high tide. The rocks on the beach below the cliffs are stained whitish-yellow, thought to be produced by a heavy metal oxide leachate from oxidizing ammunition.

This area may be used by marine mammals as a haul out area, and it may have ecological significance.

Previous Investigations and Findings. No investigations are known to have been conducted at this site.

Current Status. Because of the danger of unexploded ordnance, steep cliffs, and the remoteness of the site, the area is posted with Keep Out signs and is off limits to all Station personnel. It is recommended that the debris be removed because of the potential explosive hazard it presents. Samples will be collected during the 1993 LSI to determine whether the landfill is significantly impacting sediment and surface water in the vicinity. If the disposal area is determined not to be a potential source unit, an NFAD will be prepared and submitted to ADEC for review. It is recommended that an ordnance disposal crew remove all exposed explosives.

SS47 - Barrel Storage Area

Site Description and History. Information pertaining to this potential source unit is not currently available. This includes location, waste type, and previous removal actions. It is unknown whether SS47 has ecological significance.

Previous Investigations and Findings. There have been no known previous investigations identified to date.

Current Status. Since the location of this potential source unit is unknown, SS47 has been proposed for removal from the IRP (Jacobs, 1993). A decision document will be prepared.

OT49 - Upper Lake

Site Description and History. Upper Lake is located in the west-central part of the island at the edge of the abandoned runways. It was common practice for military personnel to use the lakes on Shemya as ammunition disposal areas. Ordnance is visible in Upper Lake. Information pertaining to the types and quantities of ammunition that may have been disposed of is not available.

The lakes on Shemya Island may be critical habitat for the Aleutian Canada goose and other birds. Upper Lake may also be used for sport fishing by Station personnel.

Previous Investigations and Findings. Water quality samples were collected and observations were made by USGS personnel on three occasions: 5 May 1958, 27 August 1970, and 28 January 1972. Lead and mercury were detected in the sample collected in 1970 at 5 μg/L and 0.8 μg/L, respectively. The pH ranged from 6.6 to 7.2. The depth of the lake was recorded in 1972 as 1 foot (Feulner, et al., 1976).

During the POL contamination investigations at Shemya (COE, 1989g), Upper Lake was evaluated for the site of a proposed fire protection system pumphouse. A monitoring well was installed; however, it did not produce water. Low levels of fuel were found in soil samples collected from the borehole. The COE speculated that the contaminants could be leaching from roadbed material, a JP-4 pipeline, numerous stored drums and equipment, and fire-fighting burn pits in the area. Tests on water samples from Upper Lake showed potential for a high seasonal biomass and the possibility for corrosion due to a high pH (8.7) (COE, 1989g).

In October 1988, water quality samples were collected from Upper Lake by COE. They report that the samples were contaminated with total and fecal coliform bacteria, trace levels of benzene (0.1 μg/L), naphthalene (0.2 μg/L), 1,2,3-trichlorobenzene (0.1 μg/L), and TPH (16 mg/L). An oil sheen and green algae were observed on the water. They note that the lake is located near a staging area for the asphalt plant (COE, 1989c). In an undated trip report, the COE speculates that the elevated levels of bacteria and the algae bloom observed during the October 1988 sampling are a result of sewage contamination (COE, undated).

An aquatic bioassay sample was collected from Upper Lake in July 1988 by the Air Force for the FWS. The results indicated that water from Upper Lake is not acutely toxic to Daphnia pulex in a 24-hour screening test (U.S. Air Force, 1988b).

Current Status. Because any ammunition in the lake could present an explosion hazard, it is recommended that the material be removed by a specially trained ordnance team. Water and sediment samples will be collected from the lake during the 1993 field investigation in support of both the basewide effort and LSI. If the lake is determined not to be a source unit, an NFAD will be prepared and submitted to ADEC for review.

2.2.1.4 Proposed State Underground Storage Tank Source Units

ST32 - USTs 4010-2, 4012-1, and 4101-3

Site History and Description. The USTs were located near the northernmost tip of the island, north of the former diesel fuel tank farm (ST46). Specifications are unavailable for UST 4101-3 (ENSR, 1991). The tanks have been removed (Ecology and Environment Inc. [E&E], 1993).

UST 4010-2 was a 3,000-gallon steel tank built in 1975. UST 4010-2 contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. The tank was fed via tank truck and provided fuel to Building 4010 (ENSR, 1991). The date of removal is unknown (E&E, 1993).

UST 4012-1 was a 600-gallon steel tank built in 1981. UST 4012-1 contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. Diesel was delivered via tank truck, and this UST supplied Building 4012 (ENSR, 1991). The date of removal is unknown (E&E, 1993).

The ecological significance of ST32 is unknown.

Previous Investigations and Findings. There have been no known investigations performed to date specific to these USTs. A UST field survey was performed at Eareckson AFS in 1992 by E&E (1993), but the three tanks had been removed. The COE has conducted limited investigations in the diesel fuel tank farm (ST46) and have identified the entire northern tip of the island, including the USTs, as an area with soil TPH levels greater than 100 mg/kg or other potential health hazards; however, the tanks are not suspected to be the source of the extensive contamination (COE, 1989e).

Current Status. These tanks were removed in the past. Information pertaining to potential releases is not available. This potential IRP source unit has been proposed for removal from the IRP by the Air Force. An NFAD is currently not proposed.

ST33 - USTs 615, 617 and ABOVEGROUND TANK 613

Site Description and History. These three tanks are situated near the south side of Buildings 613, 615, and 617. The tanks are located approximately 500 feet south of Building 600 in the north-central part of the island. The exact designation of these tanks is questionable and may actually be 613-1, 615-1, and 617-1 (ENSR, 1991).

Tank 613-1 is a 900-gallon, aboveground horizontal cylinder used to store No. 2 diesel fuel. The year of construction is unknown. The tank is constructed of welded steel. The tank is not equipped with alarms or secondary containment. Diesel is delivered by tank truck and used at Building 613 (ENSR, 1991).

ENSR (1991) reports that UST 615-1 is a 4,200-gallon tank, and E&E (1993) reports that the UST is a 4,000-gallon tank. The tank is constructed of steel and was built in 1971. The tank contains No. 2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel is delivered via tank truck and is used at Building 615 (ENSR, 1991). E&E (1993) reports that a 2-foot by 2-foot stained area is associated with the UST.

UST 617-1 is a 700-gallon steel tank built in 1970. The tank contains #2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel is delivered via tank truck and is used at Building 617 (ENSR, 1991).

The ecological significance of ST33 is unknown.

Previous Investigations and Findings. There have been no investigations identified to date for these tanks. A field survey was performed for USTs 615 and 617 in 1992 by E&E (1993).

Current Status. Because USTs 615 and 617 will be monitored in accordance with the ADEC UST program, the Air Force has proposed these USTs for removal from the IRP. The tanks are exempt from registration as a result of their use classification (E&E, 1993). Aboveground tank 613 was removed in the past; information pertaining to potential releases from the tank is not available. The Air Force has proposed that this tank be removed from the IRP as a potential source unit.

ST34 - Tanks 614 and 616

Site Description. These tanks are located near Buildings 614 and 616 in the north-central portion of the island. The designations of these tanks are 614-1, 616-2, and 616-3 (ENSR, 1991).

Tank 614-1 is an aboveground 1,000-gallon tank. This tank was built in 1969 and is constructed of welded steel. The tank contains No. 2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel is delivered by tank truck and this tank serves Building 614 (Vehicle Operations) (ENSR, 1991). E&E (1993) reports that a 6-foot by 6-foot stained area is associated with the tank. The tank is currently active.

UST 616-2 is a 300-gallon tank constructed of steel in 1973. It is located west of Vehicle Maintenance. The tank contained waste oil (ENSR, 1991). The tank is not equipped with alarms or secondary containment (ENSR, 1991). E&E (1993) recommends that the tank be removed. ENSR (1991) reports that the tank volume is 200 gallons. The inflow and outflow points are unknown. The tank is currently inactive.

UST 616-3 is a waste oil tank located west of Vehicle Maintenance. The volume and year of construction are unknown. The tank served as the oil/water separator in Building 616. It is currently inactive.

The ecological significance of ST34 is unknown.

Previous Investigations and Findings. There have been no investigations identified to date for the two USTs. The COE conducted an investigation in 1989 at the gas station located approximately 300 feet north of Building 614. Extensive soil and groundwater contamination were documented, although it is unknown if fuel related contaminants migrated to or from UST 614-1 (COE, 1989f). Extensive field investigations and a removal action were performed at ST10 and SS11 located near Buildings 605 and 616.

Current Status. UST 616-2 and 616-3 are inactive. The 11th CEOS will remove the USTs and conduct site assessment (SA) activities to determine whether the tanks have leaked and whether removal of soils has mitigated contamination. Based on the results of the SA, the tanks will be evaluated for inclusion as IRP source units or a decision document will be prepared and the area will be closed. Tank 614 is currently active and a decision document will be prepared.

ST35 - UST 132-2

Site History and Description. UST 132-2 is located near the western end of the island. The tank is approximately 800 feet east of the middle of abandoned Runway C (ENSR, 1991).

UST 132-2 is a 3,500-gallon steel tank built in 1962. The tank contained No. 2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel fuel was delivered via tank truck and was used by Building 132 (ENSR, 1991). The tank is currently inactive.

The ecological significance of ST35 is unknown.

Previous Investigations and Findings. There have been no investigations identified to date. A field survey was performed at the tank in 1992 by E&E (1993).

Current Status. UST 132-2 is inactive and was recommended for removal in accordance with the ADEC UST program (E&E, 1993). The 11th CEOS will conduct SA activities to determine whether the tank has leaked, and the tank will be removed. Based on the results of the SA, the tank will be evaluated for inclusion as an IRP source unit or a decision document will be prepared.

ST36 - USTs 452-4 (450), 452-5 (452), and 452-3

Site Description and History. These USTs are located around Buildings 450 and 452 in the north-central portion of the island (ENSR, 1991).

Tank 452-4 (450) was formerly designated in the Eareckson AFS UST computer database. It is located southeast of satellite communications. It is a 300-gallon tank that was used to store waste oil. The year of installation is unknown (E&E, 1993). The tank is currently inactive.

Tank 452-3 is a 6,000-gallon diesel fuel UST built in 1979. It is located north of satellite communications. E&E identified a 6-foot by 6-foot stained area associated with the tank (E&E, 1993). The tank is currently inactive.

Tank 452 has been renamed 452-5. It is located northwest of satellite communications. It is a 7,000-gallon diesel fuel UST built in 1969 (E&E, 1993).

The ecological significance of ST36 is unknown.

Previous Investigations and Findings. There have been no investigations identified to date at these USTs.

Current Status. The USTs are currently inactive. The 11th CEOS plans to conduct SA activities to determine whether the tanks have leaked, and the tanks will be removed. Based on the results of the SA, the tanks will be evaluated for inclusion as IRP source units or a decision document will be prepared.

ST37 - USTs 731 and 775

Site Description and History. The USTs are located immediately north of the active runway near the south central part of the island (ENSR, 1991). Both USTs are active.

UST 731-1 is a 1,500-gallon steel tank built in 1979. The tank contains No. 2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel is delivered by tank truck and is used by Building 731, which is located south of the Airfield Terminal (ENSR, 1991). A 4-foot by 3-foot stained area is associated with UST 731-1 (E&E, 1993).

UST 775-1 is an 800-gallon steel tank built in 1976. The tank contains No. 2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel is delivered by tank truck and is used by Building 775 (ENSR, 1991). The tank is located west of the Airfield Terminal (E&E, 1993).

The ecological significance of ST37 is unknown.

Previous Investigations and Findings. No known investigations have been identified that are specific to USTs 731 and 775.

Current Status. ADEC registration is required for UST 775 based on the E&E field survey. UST 731 is exempt from registration based on its use classification (E&E, 1993). A decision document will be prepared, and the USTs will be regulated in accordance with the ADEC UST program.

ST38 - UST 490

Site Description and History. UST 490 is adjacent to Building 490, which is located near the intersection of Shemya Road and Cross Island Road, northeast of the Fire Station (ENSR, 1991).

UST 490-1 is an active 1,500-gallon steel tank built in 1976. The tank contains No. 2 diesel fuel (ENSR, 1991). The tank is not equipped with alarms or secondary containment, however, there are two product sensor probes associated with it (U.S. Air Force, 1991a). Diesel is delivered via tank truck and is used by Building 490 (ENSR, 1991).

The COE (1988b) reports that a dry well is also associated with the Fire Station.

The ecological significance of ST38 is unknown.

Previous Investigations and Findings. A field survey was performed by E&E in 1992. Three holes were drilled by the COE in 1988, and soil samples were collected. Soil sample analytical results are not available, however, they report that field headspace analysis and visual reconnaissance indicate that the area is relatively clean of fuel, oil, or solvent contamination (COE, 1988b).

Current Status. The UST is exempt from ADEC registration based on its use classification (E&E, 1993). A decision document will be prepared.

ST39 - USTs 110-1, 110-2, 110-3, and 110-4

Site Description and History. The four USTs surround Building 110, DOD Anders, and are located in the north-central part of the island, between Grace Lake and North Road. UST 110-1 is located north of Building 110. USTs 110-2 and 110-3 were located northwest of Building 110, and UST 110-4 was located southwest of Building 110 (ENSR, 1991).

According to ENSR (1991), UST 110-1 is a 1,500-gallon tank, and according to E&E (1993), the UST has a capacity of 3,300 gallons. It is constructed of steel and was built in 1970. The tank contains No. 2 diesel fuel. The tank is not equipped with alarms or secondary containment. Diesel is delivered via tank truck and is used by Building 110. The tank is currently active (ENSR, 1991).

UST 110-2 was a 3,600-gallon steel tank. It was built in 1959. The tank contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. Diesel was delivered via tank truck, and the tank served Building 110 (ENSR, 1991). The tank is currently inactive (E&E, 1993).

UST 110-3 was a 4,000-gallon steel tank. It was built in 1962. The tank contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. Diesel was delivered via tank truck, and the tank served Building 110 (ENSR, 1991). The tank is currently inactive (E&E, 1993).

UST 110-4 was a 3,000-gallon steel tank. It was built in 1961. The tank contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. Diesel was delivered via tank truck, and the tank served Building 110 (ENSR, 1991). The tank is currently inactive (E&E, 1993).

The ecological significance of ST39 is unknown.

Previous Investigations and Findings. The COE conducted a field investigation in October 1988 near several underground and aboveground storage tanks. A total of four boreholes were drilled and sampled (AP-1543 through AP-1546). One additional hole was hand-dug and sampled (AP-1547). Analytical results indicate TPH-contaminated soils are present near the tanks. Low concentrations of some BTEX compounds were also detected. No monitoring wells are known to exist near Building 110 (COE, 1989d).

In October 1992, TERRASAT conducted a site assessment for three USTs at Building 110. Soil samples were collected from five test pits excavated 5 feet from the USTs. Soil samples had concentrations of TPH ranging from 340 ppm to 11,000 ppm. Visual contamination was noted beneath the USTs (TERRASAT, 1992).

Current Status. According to E&E (1993), UST 110-1 requires ADEC registration. The 11th CEOS will conduct SA activities at tanks 110-2, 110-3, and 110-4 to determine whether the tanks have leaked, and the tanks will be removed. Based on the conditions documented at the time of removal and the volume of soil removed/remediated, the area will be evaluated for inclusion as an IRP source unit or the tanks will be closed. Decision documents will be prepared for these USTs.

ST40 - USTs 600-1, 600-3, and 600-4

Site Description and History. The USTs are adjacent to Building 600 and are located in the north-central part of the island. The location and specifications for UST 600-4 are unavailable (ENSR, 1991). The date of removal is unknown (E&E, 1993).

UST 600-1 is 20,000-gallon welded-steel tank. It was built in 1991. The alarm system includes vapor monitors, and the tank is double walled. The tank contains No. 2 diesel. Diesel is delivered via tank truck and is used by Building 600 (ENSR, 1991).

UST 600-3 was estimated to be a 4,000-gallon tank, and it is constructed of welded steel. The date of construction is unknown. E&E (1992) lists UST 600-3 as 600-5 in the Eareckson AFS UST computer database. This tank is only half buried, and there is a berm surrounding the tank and a liner beneath the tank. The tank is not equipped with alarms. The tank contains No. 2 diesel fuel. Diesel is delivered via tank truck and is used by Building 600 (ENSR, 1991).

The ecological significance of ST40 is unknown.

Previous Investigations and Findings. There have been no known investigations identified specific to the tanks. A field survey was performed at this site in 1992 by E&E (1993).

Current Status. UST 600-1 is active and exempt from ADEC registration based on its use classification. It is currently monitored in accordance with the state UST program (E&E, 1993). USTs 600-3 and 600-4 have been removed in the past. Information pertaining to releases is not available. A decision document will be prepared for UST 600-1.

ST41 - USTs 504-1 (18) and 504-2 (19)

Site Description and History. This site includes two large USTs located off the active runway near the termination point of Taxiway 2.

Both USTs are 40,000-gallon steel tanks. They were built in 1973. The tanks contain JP-4. Both tanks maintain high-level shutoff alarms, but do not have secondary containment. JP-4 is pumped from nearby tanks 1, 2, 3, 4, and 6 through a 6-inch-diameter pipeline to USTs 504-1 (18) and 504-2 (19). A 6-inch diameter pipeline runs to an aircraft hydrant located at Taxiway 2 (ENSR, 1991). The tanks are listed as 504-1 and 504-2 in the Eareckson AFS UST computer database (E&E, 1992).

The ecological significance of ST41 is unknown.

Previous Investigations and Findings. There have been no known previous investigations identified to date. A field survey was performed in 1992 by E&E.

Current Status. In 1991, UST 504-1 (18) was reported empty, and UST 504-2 (19) was inactive but contained 20,000 gallons of JP-4. E&E (1993) reports that the USTs require ADEC registration. A decision document will be prepared for the tanks.

ST42 - UST 50004-1

Site Description and History. UST 50004-1 was located in the south-central part of the island, approximately 500 feet east of the middle of Taxiway 3 off the active runway (ENSR, 1991).

UST 50004-1 was a 15,000-gallon steel tank. The construction date is unknown. The tank contained No. 2 diesel fuel. The tank was not equipped with alarms or secondary containment. Diesel was delivered via tank truck, and the tank served Building 50004 (ENSR, 1991). The date of removal is unknown.

The ecological significance of ST42 is unknown.

Previous Investigations and Findings. There have been no known investigations identified at this site.

Current Status. UST 50004-1 was not located during an extensive field survey. Based on visual evidence and personnel interviews, it is assumed that the tank was removed in the past. Information pertaining to releases is not available (E&E, 1993).

ST43 - UST 605-1

Site Description and History. UST 605-1 is located adjacent to Building 605 near the center of the island, off Shemya Road (ENSR, 1991). Potential source unit ST10 is close to ST43.

UST 605-1 is a 1,000-gallon steel tank. It was built in 1970. The tank contains No. 2 diesel fuel (ENSR, 1991). The tank is not equipped with alarms or secondary containment, however, there are two product sensor probes associated with the tank (U.S. Air Force, 1991a). Diesel is delivered via tank truck and is used by Building 605 (ST10) (ENSR, 1991).

It is unknown whether ST43 has ecological significance.

Previous Investigations and Findings. No investigations have been performed to date that are specific to the tank. A field survey was performed at this site in 1992 by E&E. The 11th CEOS reported extensive POL contamination west of Building 605 from an oil/water separator inside the building. Samples were not collected during their field investigation at Building 605; however, extensive soil and groundwater contamination was reported at the gas station, located 300 feet upgradient of Building 605 (COE, 1989f).

The 11th CEOS completed an extensive investigation in 1992 and removal action in 1993 in the vicinity of Building 605 (ST10).

Current Status. E&E (1993) reports that UST 605-1 is exempt from ADEC registration based on its use classification. A decision document will be prepared for the tank.

ST44 - UST 3051-1, 3049-3 (3051-5), and 3049-6 (3051-6)

Site Description and History. These USTs are located adjacent to Building 3051 off North Road in the north-central part of the island. USTs 3051-5 and 3051-6 have been renamed 3049-3 and 3049-6 in the Eareckson AFS UST computer database (E&E, 1993).

UST 3051-1 is located west of the former power plant and is currently inactive. The volume of the tank and date of installation are unknown. The tank stored waste oil (E&E, 1993).

UST 3049-3 is a 20,000-gallon welded-steel tank built in 1976. It contains No. 2 diesel fuel (ENSR, 1991). The tank is not equipped with alarms or secondary containment, however, there are two product sensor probes associated with it (U.S. Air Force, 1991a). It is located southeast of the power plant (ENSR, 1991).

UST 3049-6 is a 40,000-gallon welded-steel tank built in 1976 (ENSR, 1991). The tank is not equipped with alarms or secondary containment, but there are two product sensor probes associated with it (U.S. Air Force, 1991). It stores No. 2 diesel fuel. It is located southeast of the power plant (ENSR, 1991).

USTs 3049-3 and 3049-6 outflow to aboveground tank 3049-4 (ENSR, 1991).

The ecological significance of ST44 is unknown.

Previous Investigations and Findings. Investigations specific to these USTs have not been conducted. A UST field survey was performed in 1992 by E&E.

Current Status. UST 3051-1 is currently inactive. The 11th CEOS will conduct SA activities to determine whether the tank has leaked, and the tank will be removed. Based on the results of the SA, the tank will be evaluated for inclusion as an IRP source unit or a decision document will be prepared.

E&E (1993) reports that USTs 3049-3 and 3049-6 require ADEC registration and will be monitored in accordance with the state UST program. The Air Force has proposed that the active USTs be removed from the IRP.

2.2.2 Current Status

Tables 2.2.2-1 through 2.2.2-4 present a summary of the status of each of the 50 IRP source units discussed in Section 2.2.1. Each of the 50 sources units has been placed in one of four categories: Proposed CERCLA Source Units (Table 2.2.2-1); Proposed State POL Source Units (Table 2.2.2-2); Proposed State Solid Waste Source Units (Table 2.2.2-3); or Proposed State UST Source Units (Table 2.2.2-4). These regulatory determinations are preliminary and may change as new information becomes available. Each table lists the source unit identification number, former identification number (if applicable), and description. Following this information is a matrix providing a checklist of the proposed actions for the source unit. The potential proposed actions include the following nine categories.

- LSIs are required. Results from the LSI will determine whether the source unit requires no further action, early action, or more investigation. LSIs will be conducted during 1993 field investigations.

- No further action is required. For these source units, preparation of an NFAD is under way or is recommended.

TABLE 2.2.2-1
PROPOSED COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS(9) SA	Comments
FT01	FT-1	Lightning Strike Pit					X	X				Area is restricted to prevent unauthorized access.
FT02	FT-2	Aircraft Mockup	X			X	X					Previous sample results are available; samples will be collected to complete the RI.
	-	Fire Training Area	X									SI activities will be conducted to determine whether area is a potential source unit.
	-	Abandoned Drum Disposal Area	X									The drainage running beneath the runway and discharging to the ocean will be sampled.
FT03	FT-3	Fire Department Structural Training Area					X	X				Need to determine full extent of contamination.
SS04	HG-1	Old Hospital Site		X								NFAD has been accepted by ADEC.
SS05(4)	PS-19	Old Cobra Dane						X	X			TPH and arsenic in soil samples have exceeded PRLs for human health. Cadmium, aluminum, antimony, iron, and silver in soil were determined to be potential risks to terrestrial receptors. Need to determine full extent of contamination.
ST10	PS-6	Vehicle Refueling Shop	X			X		X				Well in the area had floating product.
SS12	PS-8	Old White Alice		X			X					CH2M Hill prepared NFAD; approval is pending.
LF18	SW-4	North Beach Landfill	X				X					Evaluate whether groundwater has been affected.
SS23	PS-11	Past Drum Disposal Area					X	X				Area is still active.
LF24	SW-10	Barrel Bay					X			X		FS documentation will be prepared in 1995.

TABLE 2.2.2-1 (continued)
PROPOSED COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION AND LIABILITY ACT SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg Deter (7)	FS(8)	11th CEOS(9) SA	Comments
LP20	SW-12	Scrap Metal Disposal Area					X			X		FS documentation will be prepared in 1993
OT46	-	Water Gallery				X		X				Groundwater quality in the Water Gallery watershed will be evaluated during the basewide investigation. An air stripper will be installed in 1993

Notes:

(1) = LSI category includes potential source units that require additional information for the purposes of possible NFA, possible early action, possible FS, and regulatory determination
(2) = NFA includes potential source units that have had NFADs prepared, have NFADs that are currently being prepared, and that will have NFADs prepared based on previously collected data
(3) = Decision Document potential source units include those that will be proposed for deletion from the current IRP list; specific rationale for deletion is included in the Work Plan
(4) = Early Action includes remediation activities currently proposed for Fiscal Year 1993 and 1994
(5) = Past Action includes any past remediation activities conducted at potential source units
(6) = RI includes potential source units that will require further investigation regardless of whether 1993 field investigation activities are conducted
(7) = Regulatory determination includes potential source units that may require analytical data to determine whether they will be included in the CERCLA program
(8) = FS includes potential source units that require no additional investigation to complete a screening of alternatives
(9) = 11th CEOS SA includes inactive USTs that require an SA before removal
(a) = Unit is located in Management Zone 7 and groundwater will be evaluated as part of the basewide field investigation

ADEC = Alaska Department of Environmental Compliance
CEOS = Civil Engineering Operations Squadron
FS = Feasibility Study
ID = Identification
IRP = Installation Restoration Program
LSI = Limited Source Investigation
NFA = No Further Action
NFAD = No Further Action Document
PRL = Preliminary Remediation Level
Reg Deter. = Regulatory Determination
RI = Remedial Investigation
SA = Site Assessment
SI = Site Investigation
TPH = Total Petroleum Hydrocarbon
UST = Underground Storage Tank

TABLE 2.2.2-2
PROPOSED PETROLEUM, OIL AND LUBRICANTS SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS SA	Comments
SS08	PS-2	West Dock Spill		X			X					NFAD is being prepared
SS07(a)	PS-3	West End Oil/Water Separator	X					X	X			Floating product has been found in ponds and monitoring wells. LSI to evaluate discharge to tidal pool and to focus the 1994 RI
ST08(a)	PS-4	Diesel Fuel Tank 123					X	X				·nk 123 has been retrofitted.
ST09(a)	PS-5	Power Plant Spills					X	X				Releases from the Power Plant are diverted to the West End Oil/Water Separator (SS07)
SS11	PS-7	Vehicle Maintenance Shop Drains	X			X		X				Well in area had floating product. Excavation activities in the area are proposed
SS13	PS-9	Asphaltic Tar Drum Storage Area		X		X	X					Tar and drums will be removed in 1993. Area is located within the watershed of the Water Gallery (OT48).
SS14	PS-10	Base Operations Spill					X	X				Site of 1983 JP-4 Spill, which was reportedly cleaned up. TPH has been detected in soils at 18,883 mg/kg.
SS17	PS-1A	New Cobra Dane		X			X					NFAD is being prepared.
SS25	PS-83	World War II Fuel Tanks					X	X				Site consists of tank excavations, earthen containment berms, and abandoned pipelines.
OT30	-	Alaska Cleanup Effort/Drum Removal			X		X					Location Unknown
SS31	SS-23	Rusting Waste Oil Drums			X		X					Location Unknown
ST45	-	AGE Fuel Spill					X	X	X			UST 729 is included with the fuel spill

s:\...\222-2 12-Jan-94

Page 1 of 2

TABLE 2.2.2-2 (continued)
PROPOSED PETROLEUM, OIL AND LUBRICANTS SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS SA	Comments
ST46(a)	-	Abandoned Tank Farm					X	X				Basewide field investigation may provide source-specific data. The tanks have been removed; earthen berms remain.
ST50	-	Aboveground Tank #7						X				Basewide field investigation may provide source-specific data.

Notes:

(1) = LSI category includes potential source units that require additional information for the purposes of possible NFA, possible early action, possible FS, and regulatory determination.
(2) = NFA includes potential source units that have had NFADs prepared, have NFADs that are currently being prepared, and that will have NFADs prepared based on previously collected data.
(3) = Decision Document potential source units includes those that will be proposed for deletion from the current IRP list; specific rationale for deletion is included in the Work Plan.
(4) = Early Action includes remediation activities currently proposed for Fiscal year 1993 and 1994.
(5) = Past Action includes any past remediation activities conducted at potential source units.
(6) = RI includes potential source units that will require further investigation regardless of whether 1993 field investigation activities are conducted.
(7) = Regulatory determination includes potential source units that may require analytical data to determine whether they will be included in the CERCLA program.
(8) = FS includes potential source units that require no additional investigation to complete a screening of alternatives.
(9) = 11th CEOS SA includes inactive USTs that require an SA before removal.
(a) = Unit is located in Management Zone 7 and groundwater will be evaluated as part of the basewide field investigation.

AGE = Aerospace Ground Equipment
CEOS = Civil Engineering Operations Squadron
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FS = feasibility study
ID = identification
LSI = limited source investigation
mg/kg = milligrams per kilogram
NFA = no further action
NFAD = no further action document
Reg Deter. = Regulatory Determination
RI = remedial investigation
SA = site assessment
UST = underground storage tank

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Page 2 of 2

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TABLE 2.2.2-3
PROPOSED SOLID WASTE SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS(9) SA	Comments
LF15	–	Wood Dump – Active Wood Burn Area	x									No previous investigations have been performed.
LF16	–	Debris Dump			x							Location is unknown.
OT19	SW-5	Hospital Lake		x			x					NFAD is being prepared.
SS20	–	Retrograde Area (Dock)	x									Drilling and sampling were performed at the dock area during December 1992. LSI to evaluate for metals contamination.
OT21	–	Old Grounded Barge	x									No previous investigations have been performed.
SS22	–	Scrap Metal Storage/Hardstand			x							Location is unknown.
LF27	–	Base Sanitary Landfill			x							Landfill operates under a state permit.
LF28	SW-14	Scrap Metal Landfill	x									Groundwater at LF28 will be evaluated. Previous investigations indicate that soils contamination is below human risk criteria.
OT29	–	Ammunition Dump	x									Because the ammunition may pose a potential explosive hazard because of the ecological significance of Upper Lake, it is recommended that the material be removed and disposed of properly.

TABLE 2.2.2-3 (continued)
PROPOSED SOLID WASTE SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS(9) SA	Comments
SS47	–	Barrel Storage Area			x							Location unknown.
OT49	–	Upper Lake	x									Upper Lake has ecological significance.

Notes:
(1) = LSI category includes potential source units that require additional information for the purposes of possible NFA, possible early action, possible FS, and regulatory determination.
(2) = NFA includes potential source units that have had NFADs prepared, have NFADs that are currently being prepared, and that will have NFADs prepared based on previously collected data.
(3) = Decision Document potential source units includes those that will be proposed for deletion from the current IRP list; specific rationale for deletion is included in the Work Plan.
(4) = Early Action includes remediation activities currently proposed for Fiscal Year 1993 and 1994.
(5) = Past Action includes any past remediation activities conducted at potential source units.
(6) = RI includes potential source units that will require further investigation regardless of whether 1993 field investigation activities are conducted.
(7) = Regulatory determination includes potential source units that may require analytical data to determine whether they will be included in the CERCLA program.
(8) = FS includes potential source units that require no additional investigation to complete a screening of alternatives.
(9) = 11th CEOS SA includes inactive USTs that require an SA before removal.

CEOS = Civil Engineering Operations Squadron
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FS = feasibility study
ID = identification
LSI = limited source investigation
NFA = no further action
NFAD = No Further Action Document
RI = remedial investigation
Reg. Deter. = Regulatory Determination
SA = site assessment
UST = underground storage tank

a/eaafs/tables/t222-3 12-Jan-94

Page 2 of 2

TABLE 2.2.2-4
PROPOSED UNDERGROUND STORAGE TANK SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS(9) SA	Comments
ST32	-	USTs 4010-2, 4012-1, and 4101-3			X							USTs were removed.
ST33	-	USTs 615 and 617 and Aboveground Tank 613			X							USTs 615 and 617 are active and monitored under the state UST program. Tank 613 was removed.
ST34	-	Tanks 614 and 616			X						X	Tanks 616-2 and 616-3 are currently inactive. Tank 614 is currently active and is recommended for deletion from the IRP.
ST35	-	UST 132-2									X	The tank is currently inactive.
ST36	-	USTs 452-4 (450), 452-5(452), and 452-3									X	The tanks are currently inactive.
ST37	-	USTs 731 and 775			X							USTs 731 and 775 are monitored under the state UST program.
ST38	-	UST 490			X							The tank is active and monitored under the state UST program.
ST39	-	USTs 110-1, 110-2, 110-3 and 110-4			X						X	Tank 110-1 is currently active. Tanks 110-2, 110-3, and 110-4 are inactive and will be removed.
ST40	-	USTs 600-1, 600-3, and 600-4			X							UST 600-1 is active. USTs 600-3 and 600-4 were removed.
ST41	-	USTs 504-1(18) and 504-2 (19)			X							Tanks have been renamed 504-1 and 504-2 and are currently active.
ST42	-	UST 50004-1			X							Tank was removed or misidentified.

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Page 1 of 2

100% Recycled

TABLE 2.2.2-4 (continued)
PROPOSED UNDERGROUND STORAGE TANK SOURCE UNITS
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit ID	Source Unit Former ID	Description	LSI(1)	NFA(2)	Decision Document (3)	Early Action(4)	Past Action(5)	RI(6)	Reg. Deter.(7)	FS(8)	11th CEOS(9) SA	Comments
ST43	-	UST 805-1			X							Tank is currently active.
ST44	-	USTs 3051, 3049-3 (3051-5) and 3049-6 (3051-6)			X						X	Tank 3051 is currently inactive. Tanks 3049-3 and 3049-6 are currently active.

Notes:

(1) = LSI category includes potential source units that require additional information for the purposes of possible NFA, possible early action, possible FS, and regulatory determination.
(2) = NFA includes potential source units that have had NFADs prepared, have NFADs that are currently being prepared, and that will have NFADs prepared based on previously collected data.
(3) = Decision Document potential source units includes those that will be proposed for deletion from the current IRP list; specific rationale for deletion is included in the Work Plan.
(4) = Early Action includes remediation activities currently proposed for Fiscal Year 1993 and 1994.
(5) = Past Action includes any past remediation activities conducted at potential source units.
(6) = RI includes potential source units that will require further investigation regardless of whether 1993 field investigation activities are conducted.
(7) = Regulatory determination includes potential source units that may require analytical data to determine whether they will be included in the CERCLA program.
(8) = FS includes potential source units that require no additional investigation to complete a screening of alternatives.
(9) = 11th CEOS SA includes inactive USTs that require an SA before removal.

CEOS = Civil Engineering Operations Squadron
CERCLA = Comprehensive Environmental Response, Compensation, and Liability Act
FS = feasibility study
ID = identification
IRP = Installation Restoration Program
LSI = limited source investigation
NFA = no further action
NFAD = No Further Action Document
RI = remedial investigation
Reg. Deter. = Regulatory Determination
SA = site assessment
UST = underground storage tank

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Page 2 of 2

- Decision documents are required. Several source units are in the process of being removed from the IRP. Active USTs, and sources for which the location is unknown, are examples of source units that may be removed from the IRP. (Source units that have no known location cannot be further investigated. Active USTs should be transferred to the appropriate state regulatory program.) Removal is usually accomplished through decision documents submitted to the appropriate regulatory agencies requesting signed concurrence. These areas are no longer considered source units under the IRP.

- Early action is required. These source units may require some type of early remedial action, such as removal of tar and drums containing asphalt at SS13. Typically, early actions occur before a final remedy at a site.

- Past actions have occurred. These source units have had some type of past action associated with the site. Past actions at a source unit can include such activities as installation of a fence to provide controlled access to a site, cleanup of a past spill, or removal of drums.

- RIs are required. RIs are more extensive investigations than LSIs. During the RI, the nature and extent of contamination is defined, and information is gathered to prepare a screening of alternatives for final remedy of a source unit. RIs may be performed during the 1994/1995 field investigations.

- A regulatory determination is required. Some source units, such as SS07, the oil/water separator, may require additional information to determine the appropriate regulatory program for cleanup. SS07 is currently listed under the POL program; however, if other hazardous contaminants are detected or if this source unit is determined to pose an immediate threat to human health or the environment, it may need to be evaluated under CERCLA.

- FSs are required. These source units have had RI fieldwork completed, and the necessary data have been collected to begin the FS with no further field investigations required.

- 11th CEOS SA. These source units will be investigated by the 11th CEOS. SAs for these sites are scheduled for late 1993 or early 1994.

Table 2.2.2-5 provides an overview of the various activities to be performed during 1993 and 1994. All LSIs will be performed in 1993. As shown in Table 2.2.2-5, LSIs will be performed for a variety of reasons: 1) to support no further action; 2) to determine if early actions are required at a source unit; 3) to gather enough additional data at a particular source unit to proceed with the FS; 4) to determine regulatory program status; and, 5) to focus future RIs. A total of 12 source units and one additional area (Building 525) will have LSIs performed during 1993.

Table 2.2.2-5 also describes a variety of office support functions that will occur concurrent with the 1993 field investigations. NFADs will be prepared for several sites that are believed to have enough information to support the no further action decision. In addition, a variety of sites will be proposed for administrative delisting, and the appropriate documentation will be prepared to support delisting. Finally, for two source units (LF24 and LF26), sufficient data exist to perform screening of alternatives and prepare a FS. Appropriate documentation will be prepared for a total of 22 source units during 1993.

TABLE 2.2.2-5
CURRENT STATUS SUMMARY
EARECKSON AIR FORCE STATION, ALASKA

Limited Source Investigation (LSI) Jacobs Field Investigation				Document Preparation Concurrent with 1993 Field Investigation					Future Activities		Basewide Investigation(4) Jacobs Field Investigation 1993
Possible NFA(1)	Possible EA(2)	Possible FS(3)	Other	Jacobs NFAD	CH2M Hill Proposed NFAD	Decision Document	Jacobs Feasibility Study	11th CEOS NFAD	11th CEOS DEMG UST	RI 1994/1995	Possible Basewide
LF15 LF18 SS20 OT21 LF28 OT29 OT49	SS07/ST08 (7) FT02 (abandoned drum disposal area) ST10/SS11 Bldg. 525	FT02 (aircraft mockup)	SS07(5) FT02(6) (fire training area)	SS12	SS04 SS06 SS17 OT19	LF16 SS22 LF27 OT30 SS31 ST32 ST33 ST37 ST38 ST40 ST41 ST42 ST43 SS47	LF24 LF26	SS13	ST34 ST35 ST36 ST39 ST44	FT01 FT03 SS05 SS07 ST06 ST09 ST10 SS11 SS14 SS23 SS25 ST45 ST46 OT48 ST50	SS05 SS07 ST06 ST09 ST10 SS11 SS25 ST46 OT48 ST50

(1) No further action: LSI activities will be conducted to support an NFA decision, if appropriate.
(2) Early action: LSI activities will be conducted to determine whether an early action may be necessary.
(3) Feasibility study: LSI activities will be conducted to complete the RI and begin screening of alternatives.
(4) Basewide field investigation may provide source unit-specific area.
(5) Regulatory program determination: CERCLA/POL
(6) Site investigation data will be collected.
(7) Evaluate presence of floating product to determine if early action is required.

CEOS = Civil Engineering Operations Squadron
CERCLA = Comprehensive Environmental Response, Compensation and Liability Act
EA = Environmental Assessment
FS = Feasibility Study
LSI = Limited Source Investigation
NFA = No Further Action
NFAD = No Further Action Document
POL = Petroleum, Oil, and Lubricants
RI = Remedial Investigation

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Also listed in Table 2.2.2-5 are the source units for which investigations may occur in the future. This list is comprised of source areas for which the RI is scheduled for 1994 and UST source areas that will be investigated by 11th CEOS/DEMG. A total of 20 source units will be investigated in this category. Two source units, SS07 and ST08, will be investigated under both the LSI in 1993 and the RI in 1994.

Finally, Table 2.2.2-5 lists source units for which the basewide investigations (discussed in Section 3.1.1) may provide source unit-specific information. Many of these source units are located within Management Zone 7, which will be given specific emphases in the 1993 basewide investigation (see Section 3.1).

2.3 PRELIMINARY IDENTIFICATION OF BASEWIDE MANAGEMENT ZONES

In an effort to summarize the known physical conditions, plan investigations, and interpret data collected from these investigations, the island has been divided into a limited number of preliminary management zones. Figure 2.3-1 illustrates these zones and provides the numeric designation assigned to each management zone. The management zone concept described in the following paragraphs and used throughout this Work Plan is designed to facilitate and integrate the basewide investigations. Potential source units discussed in Section 2.2 are included in basewide management zones.

The following are the objectives for the division of the island into management zones:

- enable investigations to proceed independently, if required (i.e., allow more detailed studies at specific zones);
- allow for more local planning and interpretation of investigations and data;
- possibly eliminate entire management zones or portions of management zones from future investigation;
- identify all pertinent hydrological information that may be needed in future site investigations and remedial design;
- define characteristics of island geology;
- provide pertinent information to define, assist, and support fate and transport determinations/decisions; and
- assist in identifying any possible contamination source areas and sites.

It is more efficient to study a few hundred acres rather than the whole island so that the study will result in a more complete understanding of specific potential source units within each management zone, as well as the overall physical conditions of the island. The data can then be used to provide the basis for contaminant transport pathways and receptor information.

The most complete set of island data is topography. There is limited interpretation of the physical characteristics of the island from previous investigations including subsurface conditions. Therefore, topography has been used to identify management zones. The management zones were designated following a thorough

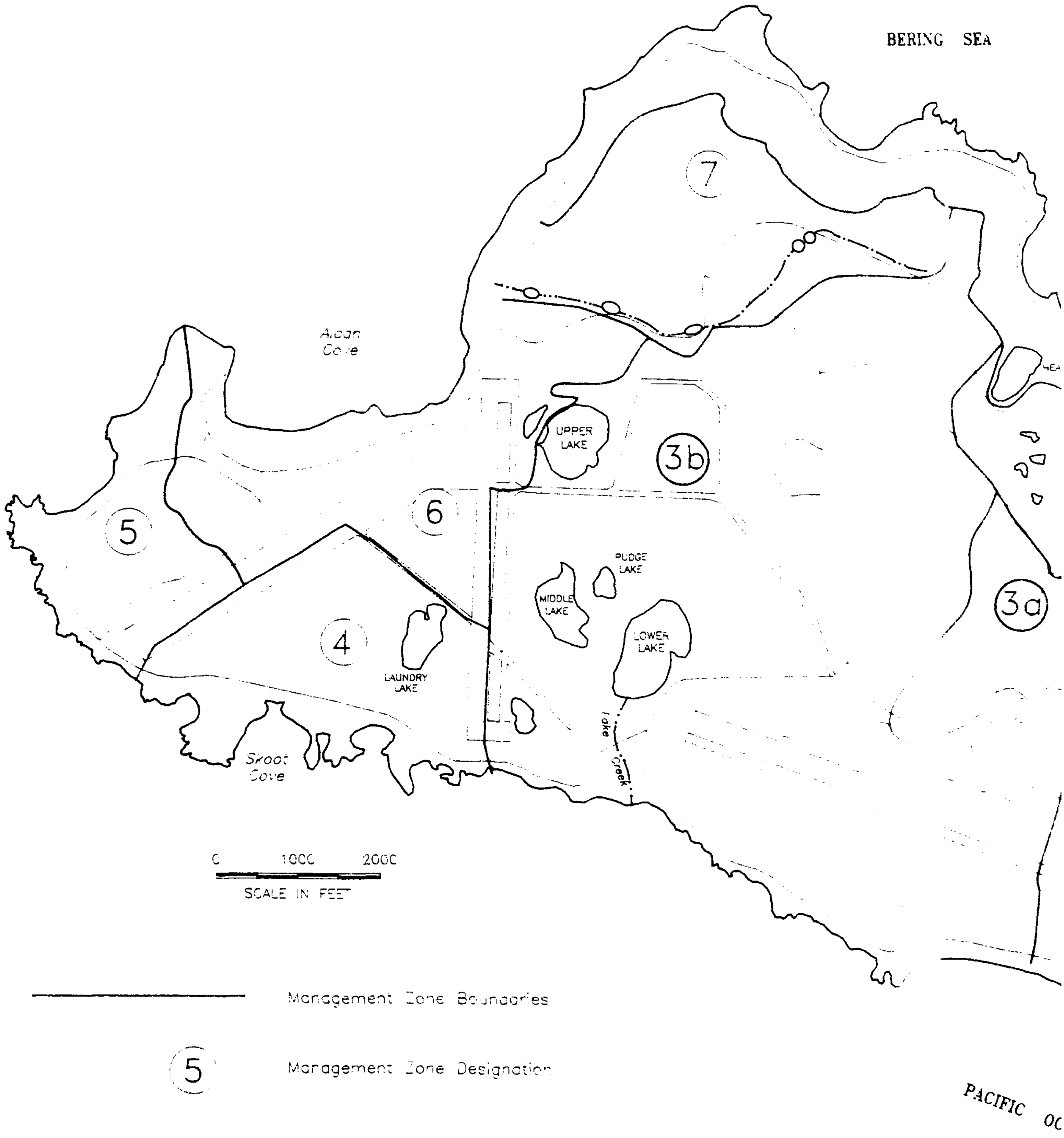
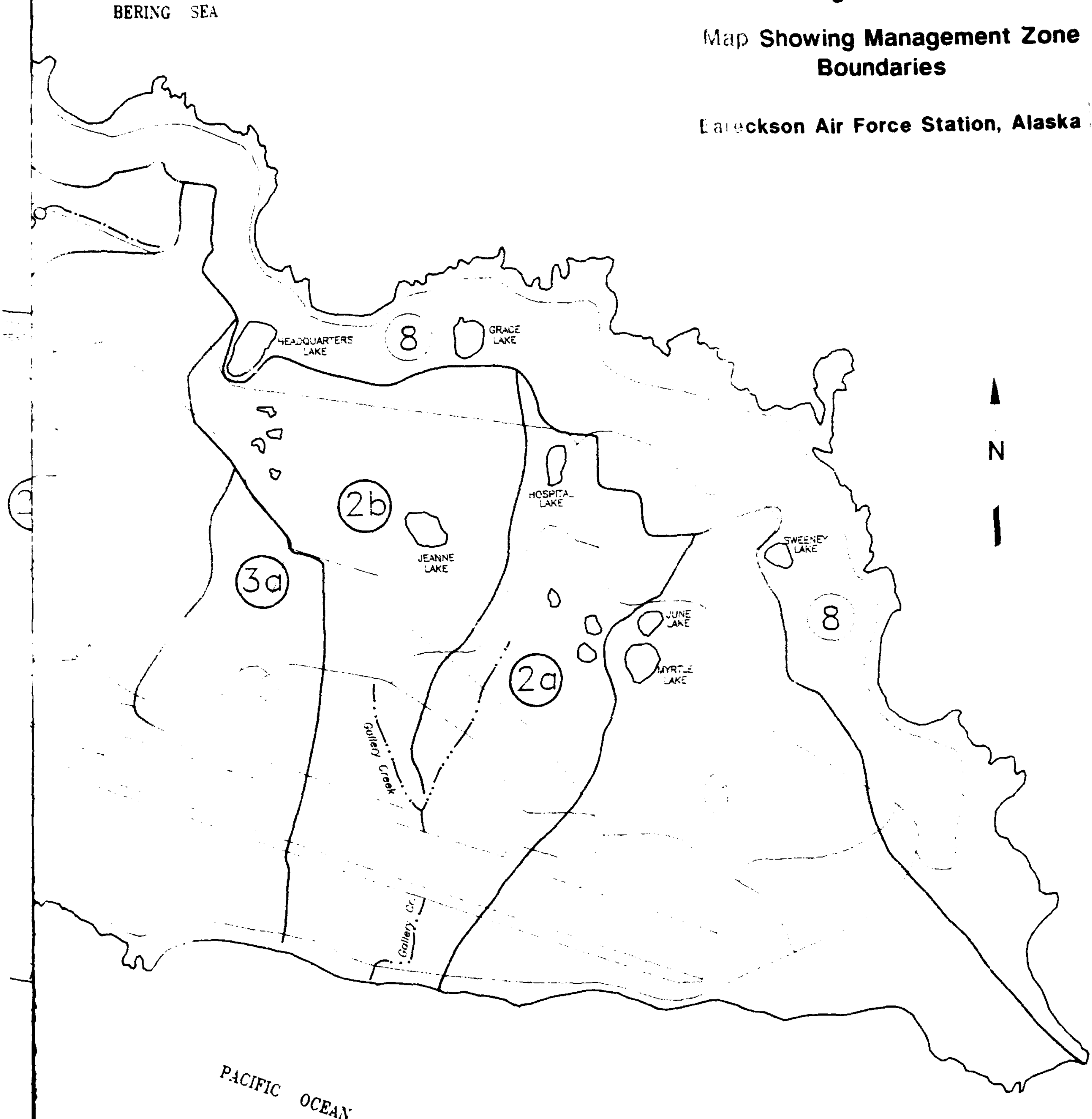

BERING SEA
7
Alcan
Cove
UPPER
LAKE
3b
5
6
PUDGE
LAKE
MIDDLE
LAKE
LOWER
LAKE
3a
4
LAUNDRY
LAKE
Lake
Creek
Skoot
Cove
0 1000 2000
SCALE IN FEET
Management Zone Boundaries
5
Management Zone Designation
PACIFIC OC

Figure 2.3-1

Map Showing Management Zone Boundaries

Eareckson Air Force Station, Alaska



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review and interpretation of available topographic/surface features maps. The initial step was to plot all known and inferred surface water drainages. These included both natural and artificial drainages as previously detailed in Section 2.1.4. From the visible drainage patterns, and in conjunction with topographic features, surface water divides were inferred. These divides were used to outline the eight management zone boundaries.

The management zones illustrated in Figure 2.3-1 have not been field verified and are preliminary. It is assumed that precipitation falling within any management zone also exits the island within the same zone (assuming that recharge or discharge of shallow groundwater is limited). A moderate degree of confidence presently exists that shallow groundwater beneath any management zone is primarily confined to that management zone. Finally, a low degree of confidence currently exists that deep groundwater and flora and fauna included in the ecological program are specific to any one management zone.

The management zone concept appears particularly appropriate for surface waters on Shemya Island. Under no known circumstance does surface water cross the boundary of a management zone. This includes lakes, ponds, streams and creeks. As noted above, field verification will be required to confirm or refine the map illustrating the management zones. The specific areas of the island that require verification include the southern extension of management zones 3a and 3b, the area near the intersection of the abandoned fighter runways (zones 3b, 4 and 6), and the area near the power plant (zones 3b, 7, and 8). These and all management zone boundaries will be confirmed, refined, and mapped during the site reconnaissance and field verification program discussed in Section 3.1.1, and in the SAP.

At present, it is unknown whether topography or the top of bedrock is the controlling factor in the flow of shallow groundwater. Interpretation of island topography (Section 2.1.2.2) and the top of bedrock (Figure 2.1.2-5) suggest that either factor could control the flow of shallow groundwater. In general, topography mimics the top of bedrock, and groundwater elevations, where known, follow both. The potentiometric surface of the shallow groundwater (Figure 2.1.3-2) appears to be consistent with the management zone concept as, for the most part, shallow groundwater does not cross management zone boundaries. The exceptions may be the management zones previously listed that require confirmation. Also, much of the northern half of the island and smaller areas in the southern half of the island lack groundwater elevation data so comparison to management zones could not be made. Attempts to determine the applicability of management zones relative to shallow groundwater will be conducted using water level measurements during the site reconnaissance and field verification program and during basewide investigations.

Because of limited available data on the bedrock aquifer and the complexities associated with fracture flow media, it is probable that flow in this aquifer is independent of the identified management zones. In addition, because of the mobility of many potential ecological receptors, the concept of management zones may not be entirely appropriate for the ecological survey. On the other hand, ecological exposure points will generally occur within unique management zones. The management zone concept will be evaluated during the basewide investigation to determine its usefulness to all surface, subsurface, and ecological applications.

In summary, eight management zones have been identified on Shemya Island. These zones are based on topography and surface water divides and, to a lesser degree, on presumed shallow groundwater flow. The purpose of the management zone approach is to more efficiently plan future investigations and assist in interpreting the data from the 1993 field investigation. By dividing the island into zones, emphasis can be given to one or more zones, yet combining all data will lead to a better overall understanding of the island. It should be noted that the management zone concept presented above is not intended to be a preliminary identification of operable units (OUs). If the island is included on the NPL in the future, OUs will likely be specified, but the criteria for identification of OUs would probably differ from the criteria used to define management zones.

The 1993 effort will focus on Management Zone 7 as a pilot study. Because of the location of Management Zone 7 relative to several potential source units, potential discharge off the island, and location of the two Station supplementary water supply wells, an emphasis will be placed on Management Zone 7 during the basewide investigation. The objectives of the focused study are to 1) evaluate the general management zone concept, 2) provide information about the potential source units, and 3) determine whether early actions may be necessary. Also, the usefulness of fate and transport modeling to evaluate current and future risk scenarios will be determined.

The focused investigation at Management Zone 7 is not specifically described in Section 3.1; however, distributions of sample points in the zone are shown in figures that support the objectives, rationale, and tasks of the basewide investigation.

2.4 CONCEPTUAL MODELS

Conceptual models have been developed for all of Eareckson AFS, for Management Zone 7 as an example of a management zone model, and for individual LSI source units. Each of these conceptual models is described below. In general, the conceptual models identify contaminants present, contaminant source units, release mechanisms, contaminant transport media, exposure routes, and receptors. To the extent possible, contaminant concentrations at receptors are also identified.

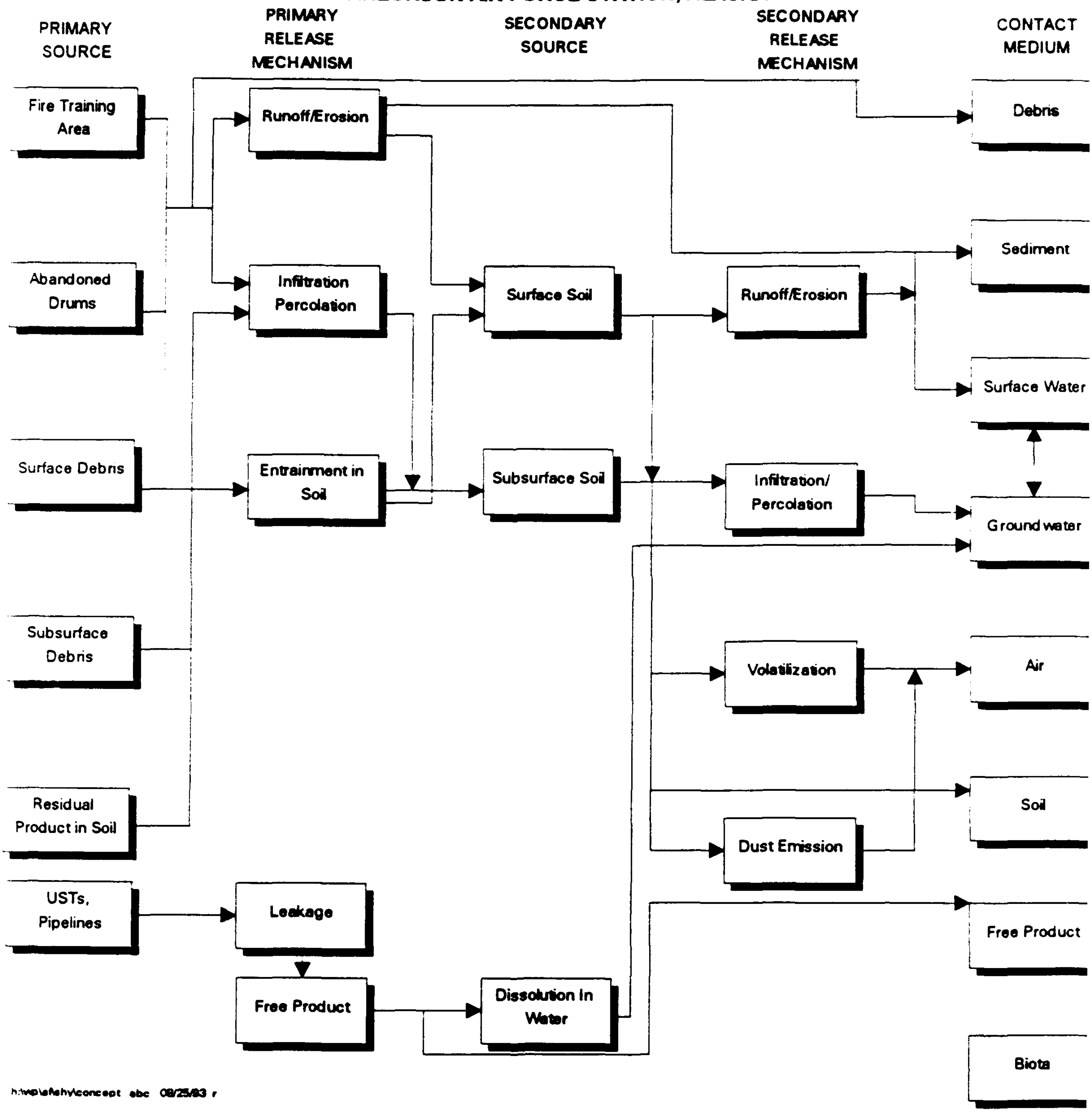
2.4.1 Basewide Conceptual Model

The basewide conceptual model defines contaminants, transport pathways, and receptors in a general fashion for the entire island. The model is very comprehensive and provides a framework that encompasses subsequent conceptual models for more limited parts of the island, such as individual management zones or LSI contaminant source units. Features of the model are illustrated in Figure 2.4.1-1 and Table 2.4.1-1. The risk assessment summarized in Table 2.4.1-1 generally represents only the more probable exposure scenarios of Figure 2.4.1-1.

2.4.1.1 Contaminant Identification

Contamination has been detected in all environmental media, except air, on the island. These media include groundwater, surface water, surface soil, sediment, and subsurface soil. Contaminants include a wide variety of trace metals, volatile halogenated organics, pesticides and PCBs, polynuclear aromatic hydrocarbons, BTEX compounds, dioxins and furans, and TPH. Levels of contaminants in various

FIGURE 2.4.1-1
BASEWIDE CONCEPTUAL MODEL
EARECKSON AIR FORCE STATION, ALASKA



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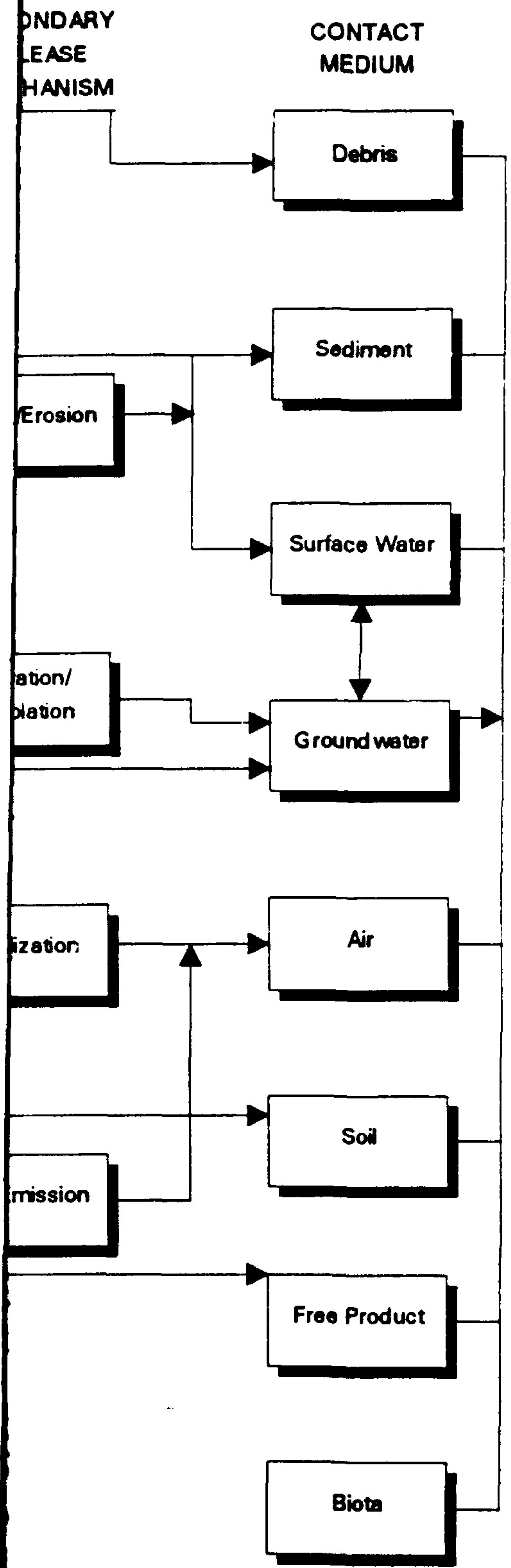


Possible Receptors

Human				Ecological	
Exposure Route	Base Residents	Recreational	Base Industrial	Aquatic	Terrestrial

Inhalation					
Ingestion					C,F
Dermal Contact		C,F	C,F		C,F

Inhalation					
Ingestion		C,F	C,F	C,F	C,F
Dermal Contact		C,F	C,F	C,F	C,F

Inhalation					
Ingestion		C,F	C,F	C,F	C,F
Dermal Contact		C,F	C,F	C,F	C,F

Inhalation	C,F				
Ingestion	C,F		C,F		
Dermal Contact	C,F				

Inhalation		C,F	C,F		C,F
Ingestion					
Dermal Contact					

Inhalation					
Ingestion	C,F	C,F	C,F		C,F
Dermal Contact	C,F	C,F	C,F		C,F

Inhalation					
Ingestion				C,F	C,F
Dermal Contact		C,F	C,F	C,F	C,F

Inhalation					
Ingestion	C,F	C,F	C,F	C,F	C,F
Dermal Contact					
Plant Uptake					

C = Current F = Future

(oversized)

TABLE 2.4.1-1
CONCEPTUAL MODEL SUMMARY – BASEWIDE
EARECKSON [illegible] FORCE STATION, ALASKA

Source Identification	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
Fifty separate sources have been identified through various regulatory and installation restoration programs.	Source units include USTs, POL spills and leaks, landfills, firefighting training areas, potential PCB spills, and munitions disposal areas.	Ranges of contaminant concentrations in background samples from various media: Surface Soils/Sediment (5 Samples) Aluminum 5,280(*)-18,900(*) mg/kg Arsenic <3.2-8.3(S) mg/kg Barium 8.5(*B)-26.3(*B) mg/kg Beryllium '<0.79-0.42(B) mg/kg Calcium 6,040(*)-99,000(*) mg/kg Chromium 6.1(B)-18.2 mg/kg Cobalt <2-9.4(B) mg/kg Copper 14.1-26.5 mg/kg Iron 4,630-19,500 mg/kg Lead <2.5(*W)-1.6(*) mg/kg Magnesium 2,950(B)-8,000 mg/kg Manganese 19.2(*B)-241(*) mg/kg Nickel <27.5-33.8 mg/kg Potassium <656-1,370 mg/kg Silver <0.32-0.47(B) mg/kg Sodium 1,890-4,430 mg/kg Vanadium 11.8(B)-60.1 mg/kg Zinc <26.2-33.6 mg/kg Bis(2-ethylhexyl) phthalate <0.89-0.63(BJ) μg/kg Acetone <0.67-0.002(BJ) μg/kg Methylene Chloride <0.011-0.17(a) μg/kg TPH (one analysis) 100 μg/kg Subsurface Soil (2 Samples) Aluminum 8,030(*)-21,300(*) mg/kg Barium 13(*)-43(*) mg/kg Cadmium <1.8(*)-1.1(*) mg/kg Calcium 1,130(*)-3,330(*) mg/kg Chromium 18(*)-22(*) mg/kg Cobalt <2.7(*)-1.3(*) mg/kg Copper 12(*)-16(*) mg/kg Iron 10,900(*)-29,300(*) mg/kg Lead <16(*)-14(*) mg/kg Magnesium 779(*)-1,910(*) mg/kg Manganese 11(*)-16(*) mg/kg Molybdenum <2.7(*)-1.3(*) mg/kg Nickel 6.2(*)-15(*) mg/kg	Contamination has been detected in all environmental media except air (groundwater, surface water, surface soil/sediment, and subsurface soil). Contaminants include a wide variety of trace metals, volatile halogenated organics, pesticides, PCBs, polynuclear aromatic hydrocarbons, BTEX compounds, dioxins and furans, and TPH. Levels of contaminants in various media are specified in the conceptual model summaries for Management Zone 7 and for the Limited Source Investigations.	Groundwater	Human Station residents via ingestion, inhalation, and dermal contact. Station commercial/industrial workers (and contractor personnel) via ingestion. Ecological Aquatic and terrestrial receptors if contaminants migrate from groundwater to surface water/sediment. Direct routes are ingestion and dermal contact if groundwater reaches surface water/sediment.	Human Potential risks to humans because of the presence of all the contaminants listed as present or potentially present in groundwater are likely to be of greatest concern if they are routinely ingested. Ecological Aquatic and terrestrial receptors not thought to come in contact with groundwater. However, potential risks to receptors if contaminated groundwater migrates to surface waters or wetland areas (see groundwater/sediment model).

TABLE 2.4.1-1
CONCEPTUAL MODEL SUMMARY – BASEWIDE
EARECKSON AIR FORCE STATION, ALASKA

Source Identification	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
		Potassium <900(*)-430(*) mg/kg Selenium <21(*)-15(*) mg/kg Silver <2.7(*)-1.3(*) mg/kg Sodium 709(*)-1,280(*) mg/kg Vanadium 49(*)-52.5(*) mg/kg Zinc 9.0(*)-16(*) mg/kg				
		Groundwater (1 Sample) Aluminum 4,190 μg/l Antimony 31.1 μg/L Arsenic 2.0 μg/L Barium 3.3(J) μg/L Beryllium 0.5 μg/L Cadmium 2.7 μg/L Calcium 27,800 μg/L Cobalt 8.8 μg/L Copper 20.7(J) μg/L Iron 5,880 μg/L Lead 6.9 μg/L Magnesium 29,700 μg/L Manganese 803 μg/L Mercury 0.2 μg/L Nickel 17.3 μg/L Potassium 2,750(J) μg/L Selenium 2.9 μg/L Silver 1.5 μg/L Sodium 44,000 μg/L Thallium 1.6 μg/L Vanadium 20.6(J) μg/L Zinc 25.6 μg/L Water (Standing Water in Grand Canyon Quarry) (1 Sample) TPH 27 μg/L Barium 4 μg/L Zinc 7 μg/L		Surface Water/ Sediment	Human Station residents via occasional ingestion and dermal contact during recreational activities. Station commercial/industrial workers (and contractor personnel) via occasional ingestion and dermal contact. Ecological Aquatic organisms may be exposed, some continuously, to contaminants. Direct routes are ingestion and dermal contact (including respiration). Terrestrial organisms may be exposed. Direct routes are ingestion of surface water/sediment. Generally, dermal contact is assumed to be minor. Some contaminants may be subject to plant uptake and subsequent transport up the food chain.	Human Potential risks to humans because of the presence of all the contaminants listed as present, or potentially present, may be of concern if they are routinely contacted, which does not seem likely. Ecological Potential risks to aquatic receptors. Risks are greatest to organisms residing where contaminants may concentrate (e.g., if contaminants concentrate in sediments, benthic macroinvertebrates would potentially be at greater risk). Potential risks to terrestrial species that drink water or feed in aquatic habitats.

TABLE 2.4.1-1 (continued)
CONCEPTUAL MODEL SUMMARY – BASEWIDE
EARECKSON AIR FORCE STATION, ALASKA

Source Identification	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
				Soil	Human Station residents via dermal contact and ingestion, especially during recreational activities. Station commercial/industrial workers (and contractor personnel) via ingestion and dermal contact. Ecological Aquatic organisms not exposed. Terrestrial organisms exposed via ingestion and dermal contact. Presumed less contact through inhalation.	Human Potential risks to humans because of the presence of all the contaminants listed as present, or potentially present, may be of concern if they are routinely directly contacted, which does not seem likely. Concern would be great if soil were potentially contaminated and likely to be exposed in residential areas and if there were children, which does not seem likely. Ecological Potential risks to aquatic organisms only if contamination migrates to surface water/sediment (see surface water/sediment model). Potential risks to terrestrial organisms. Greater risk for species most directly associated with soil (e.g., through feeding, nest sites, etc.).
				Air	Human Station residents via inhalation during recreational activities. Station commercial/industrial workers (and contractor personnel) via inhalation	Human Potential risks to humans are likely to be minimal because conditions at Eareckson AFS would encourage rapid and substantial dispersion of any air contaminants

TABLE 2.4.1-1
CONCEPTUAL MODEL SUMMARY – BASEWIDE
EARECKSON AIR FORCE STATION, ALASKA

Source Identification	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
					Ecological Terrestrial organisms via inhalation. Plant uptake potential. Aquatic organisms not thought to be exposed.	Ecological Potential risks assumed to be minimal for most Shemya species. Special habitat and life history traits could result in exposure for some species (e.g., burrowing or subterranean terrestrial species).
				Free Product or Debris	Human Station commercial/industrial workers (and contractor personnel) via dermal contact. Possible dermal exposure during recreational activities. Ecological Terrestrial and aquatic organisms via dermal contact, possible ingestion.	Human Potential risks to humans are likely to be minimal as it is highly unlikely that free product would be routinely contacted. Ecological Birds and other species can be affected by physical contact with oil. Other risks would be those described for surface water/sediment.

NOTES:
AFS = Air Force Station
BTEX = benzene, toluene, ethylbenzene, and xylene
mg/kg = milligrams per kilogram
PCB = polychlorinated biphenyls
POL = petroleum, oil, and lubricants
TPH = total petroleum hydrocarbons
USTs = underground storgage tanks
μg/kg = micrograms per kilogram
μg/L = micrograms per liter

DATA QUALIFIERS:
a = Estimated trace value
B = Estimated because of blank contamination
J = Less than practical quantitation limit but greater than or equal to instrument detection limit
S = Determined by method of standard additions
W = Post-digestion spike out of control limits, and less than practical quantitation limit but sample absorbance less than 50% of spike absorbance greater than or equal to instrument detection limit
* = Duplicate analysis not within control limits

media are specified in the conceptual model summaries for Management Zone 7 (Section 2.4.2), and for the LSIs (Section 2.4.3).

Background concentrations of contaminants in various media are summarized in Table 2.4.1-1. The background concentrations were derived from analyses of soil and water samples from background locations as reported by CH2M Hill (1990, 1993b) and Woodward-Clyde Consultants (1992). Almost all of the contaminants reported in background samples are metals and other inorganics. However, bis(2-ethylhexyl)phthalate, acetone, and methylene chloride were reported in some surface soil samples. These are all common laboratory contaminants and most of the reported data are qualified as estimated due to blank contamination, so these organic chemicals are believed to be laboratory artifacts. TPH was reported in a sediment sample and a water sample from the Grand Canyon quarry. This suggests that the quarry area should not be considered an appropriate background location.

2.4.1.2 <u>Source Units</u>

Several different types of source units have been identified in different parts of the island. The source units include USTs, POL spills and leaks, landfills, fire-fighting training areas, potential PCB spills, and munitions disposal areas. In general, a given contaminant source unit consists of only one of these types of sources, but several different types of source units may be present within a given management zone.

2.4.1.3 <u>Release Mechanisms</u>

Contaminants have been released to the environment at Shemya Island in many different ways. Spills of POLs and PCB-contaminated oils have taken place at land surface. Subsurface leaks of contaminated liquids have occurred from USTs and pipelines. In some areas, free product has been observed floating on the shallow water table. Surface and subsurface debris, including large numbers of abandoned drums, are present at landfill and drum disposal areas. Fuels have been released to the surface at fire training areas.

Primary and secondary release mechanisms are illustrated in Figure 2.4.1-1. Contaminants present at the surface, such as fuel spills, surface landfill debris, and material released form abandoned drums, can be transported to other surface soil or sediment areas by erosion and runoff. Contaminants can also be carried into the subsurface by infiltration and percolation. Subsurface debris, subsurface liquid leaks, and residual product contained in subsurface soils can be transported to other areas of surface or subsurface soils by entrainment in soils, infiltration and percolation, and release to the surface at springs and seeps. Contaminants in free product can be transported with groundwater in the dissolved phase, or free product can flow along the water table as a separate phase. Contaminants that are transported to surface or subsurface soils can be further released by erosion ad runoff, infiltration and percolation, volatilization, and fugitive dust emission.

2.4.1.4 <u>Transport Media</u>

Depending on the nature of the source and the release mechanism, several transport pathways are possible. These transport pathways, and the media within which they occur, are illustrated in Figures 2.4.1-1 and 2.4.1-2. In general, the transport media include air, surface water, groundwater, soils, sediment, and free product. Biota such as plants and prey species may take up contaminants from debris, sediment, surface water, air, soil, and free product. Biota that have been contaminated can themselves serve as transport media if they are consumed by human or by other aquatic or terrestrial organisms. Transport media are identified as contact media in Figure 2.4.1-1 because they are media that potential receptors may contact. Note that free product and debris can serve as sources of contaminants transported through other media such as surface water and groundwater or can travel independently of such other media and serve as direct contact media. Not all media are applicable to all contaminant source units. Individual transport media effective at specific source units are discussed further below in the context of conceptual models for Zone 7 and LSI areas.

2.4.1.5 Exposures Routes

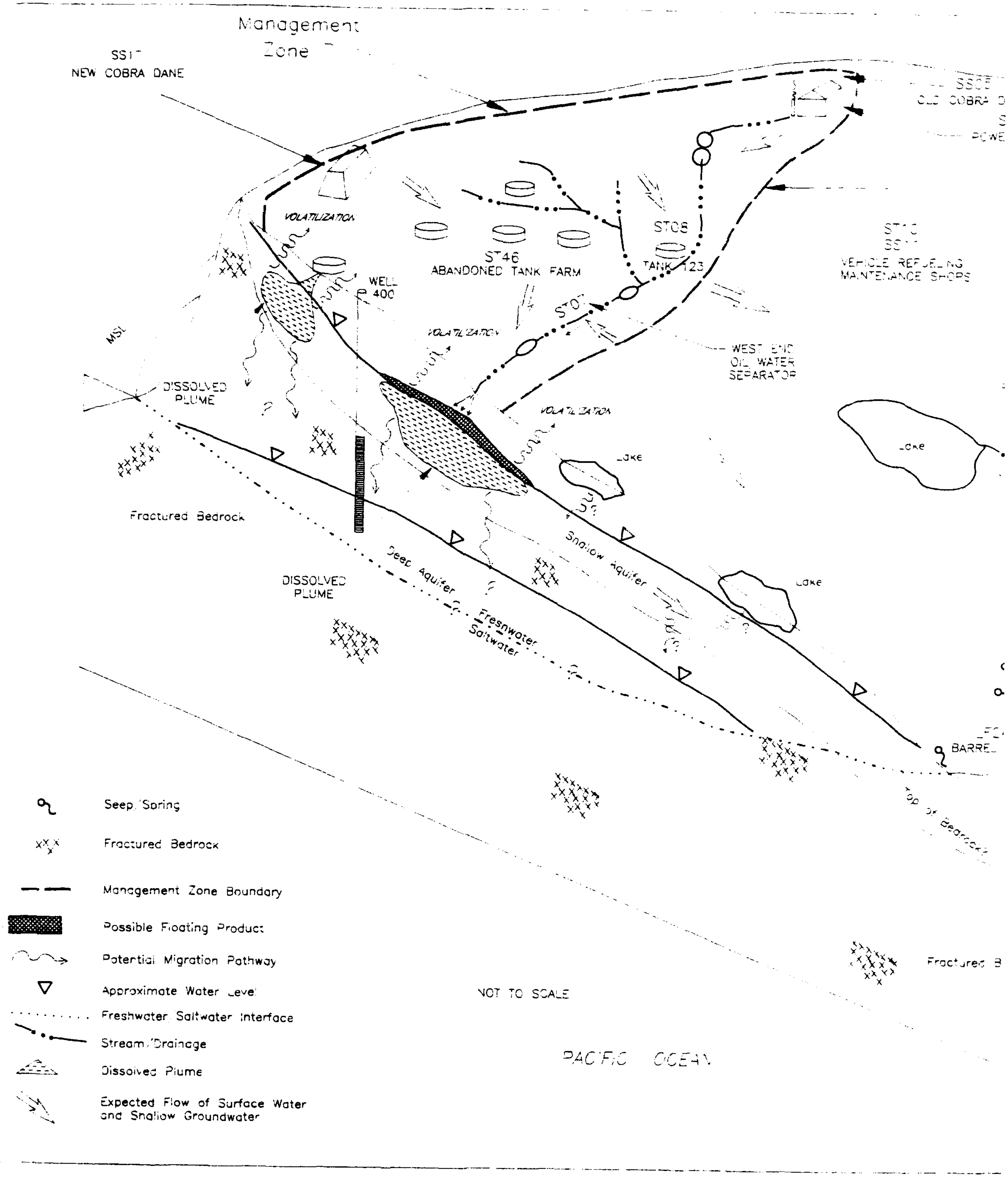
Routes of exposure to contaminants in potentially contaminated media include inhalation, ingestion, dermal contact, and plant uptake. The exposure routes applicable to different contact media are illustrated in Figure 2.4.1-1. Contact with surface debris, sediment, soils, and surface water can result in human and ecological exposure to contaminants by ingestion or dermal contact. Contact with groundwater can result in human exposure to contaminants by inhalation, ingestion, and dermal contact. Human and ecological exposure to volatile and particulate contaminants in air may also occur by inhalation. Human and ecological exposure to contaminants in free product may occur by dermal contact, and ecological exposure may occur by ingestion. Human or ecological exposure to contamination in biota may occur by ingestion.

2.4.1.6 Receptors

Human exposures to contaminated media can occur to Station residents, recreational users of Station facilities, and industrial workers, which include both military personnel and civilian construction workers. Because groundwater provides the principal domestic water supply for the Station, all residents, permanent and transient, may have some exposure to contaminants in groundwater from the water gallery or back-up bedrock supply wells. Recreational users of Station facilities can come in contact with contaminated debris, sediments, soil, surface water, and possibly free product seeps; recreational visitors may also inhale volatile vapors or contaminated dust in areas where such contaminants are emitted. Industrial Station workers, primarily engaged in construction or possibly remediation activities, could potentially contact all of the contaminated media discussed above: debris, sediment, soil, surface water, groundwater, air, or free product. Human exposure is also possible through consumption of contaminated biota such as game fish.

Ecological receptors include both aquatic and terrestrial biota. Aquatic biota may come in contact with contaminated sediment or surface water, or free product that has discharged into surface waters, including sediments. Terrestrial biota, like humans, can be exposed to surface debris, sediment, surface water, air, and free product. Either aquatic or terrestrial biota might consume contaminated biota lower in the food chain.

All of these possible receptors are illustrated in Figure 2.4.1-1.



Management Zone
SS17 NEW COBRA DANE
VOLATILIZATION
ST46 ABANDONED TANK FARM
ST08
TANK 123
VEHICLE REFUELING MAINTENANCE SHOPS
WELL 400
WEST END OIL WATER SEPARATOR
MSL
DISSOLVED PLUME
Lake
Fractured Bedrock
Shallow Aquifer
Deep Aquifer
Freshwater
Saltwater
BARREL
Top of Bedrock
Fractured B
NOT TO SCALE
PACIFIC OCEAN
Seep/Spring
Fractured Bedrock
Management Zone Boundary
Possible Floating Product
Potential Migration Pathway
Approximate Water Level
Freshwater Saltwater Interface
Stream/Drainage
Dissolved Plume
Expected Flow of Surface Water and Shallow Groundwater

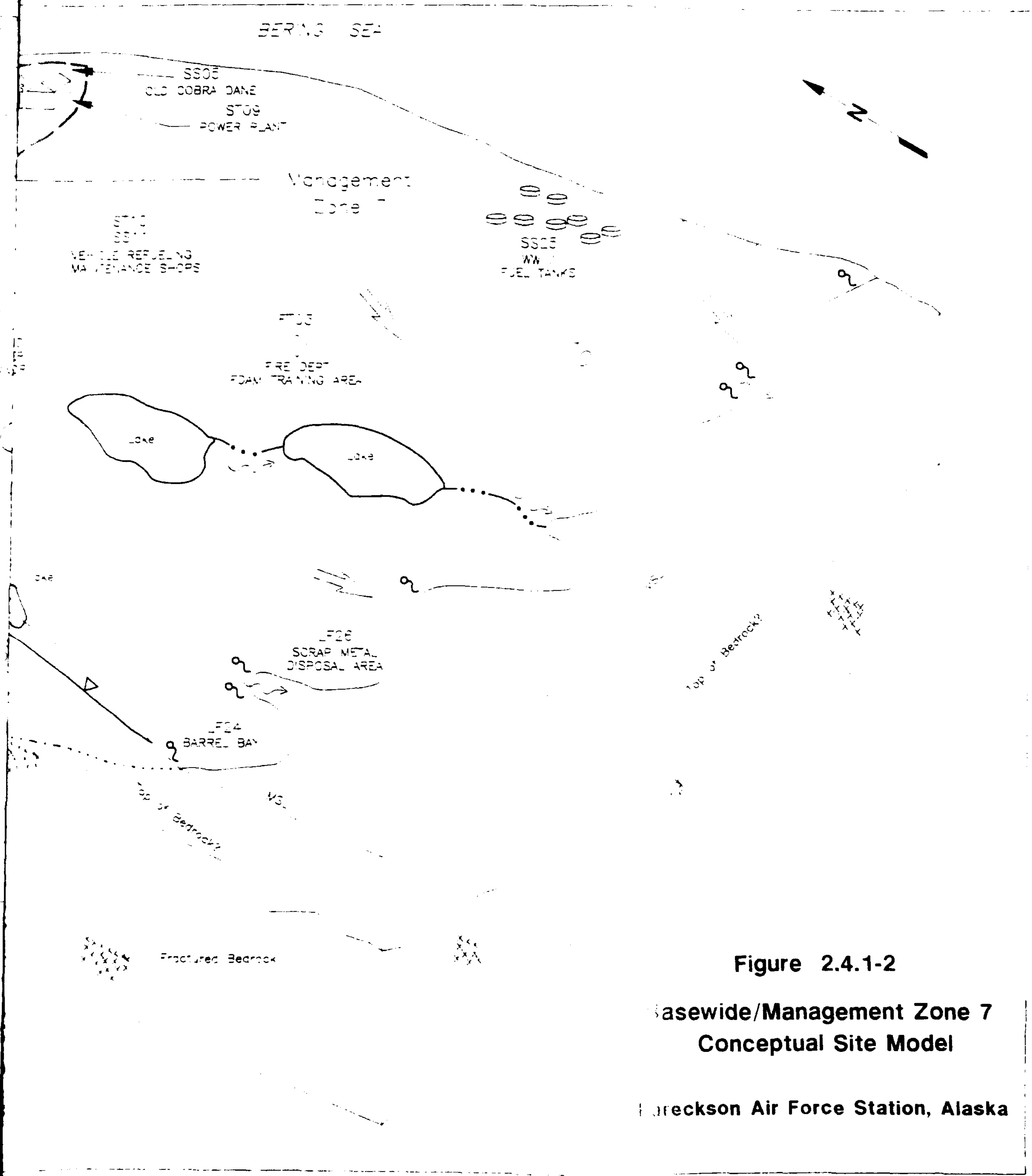


Figure 2.4.1-2

Basewide/Management Zone 7 Conceptual Site Model

Eareckson Air Force Station, Alaska

(oversized)

2.4.1.7 Contaminant Concentrations at Receptors

Contaminant concentrations at receptors cannot practically be identified on a basewide basis. Where sufficient data are available, contaminant concentrations are identified below for source units at Management Zone 7 and LSI areas.

During the course of the 1993 and 1994 field studies, considerable data will be collected regarding the concentrations of contaminants at exposure points, and in some instances, at receptors. The basewide investigations will also produce considerable data regarding the physical properties of potential contaminant pathways on the island. These data will permit modeling of contaminant transport through various environmental media, either from contaminant sources to exposure points or from exposure points to back-calculate contaminant concentrations at potential source units. Specific modeling approaches have not yet been determined, although the EPA MULTIMED model for simulating multimedia exposure concentrations may be appropriate for this purpose.

To provide points of comparison for observed contaminant concentrations, in addition to the background concentrations summarized in Table 2.4.1-1, PRLs have also been developed. These PRLs are based on a reasonable maximum exposure to industrial workers, such as military personnel or civilian contractor personnel. PRLs have been developed for contaminants observed in background samples, source units within Management Zone 7, and LSI units.

The PRLs, summarized in Table 2.4.1-2, are derived from formulas provided by EPA (1991). The following exposure assumptions have been made:

• Target hazard index	1.0*
• Target excess individual lifetime cancer risk	10^{-4}, 10^{-5}, 10^{-6}*
• Oral slope factor	chemical-specific
• Oral reference dose	chemical-specific
• Inhalation reference dose	chemical-specific
• Soil/sediment ingestion rate	50 mg/day
• Groundwater ingestion rate	2 L/day*
• Groundwater inhalation rate	15 m^3/day
• Body weight	70 kg*
• Exposure frequency-soil	180 days/yr
• Exposure frequency-groundwater	350 days/yr*
• Exposure duration	20 years
• Averaging time-carcinogenic	70 years*
• Averaging time-noncarcinogenic	20 years
• Volatilization factor	0.5*

Values marked with an asterisk are default values stated by EPA (1991). The slope factors and reference doses are chemical-specific and are obtained from standard sources as indicated by EPA (1989, 1991). Target excess cancer risks of 10^{-5} and 10^{-4} are considered to obtain a range of PRLs for carcinogenic risk. The soil/sediment ingestion rate of 50 mg/day and soil exposure frequency of 180 days/year are believed to be reasonable estimates of industrial worker exposure at Eareckson AFS. For example, 180 days/year is a reasonable estimate of available days per year to perform construction activities on Shemya Island because of the local climatic conditions. The exposure duration of 20 years, rather than the default value of 30 years, is a reasonable maximum for a civilian worker at the Station, considering its remote location and the one-year military tour of duty. These last

TABLE 2.4.1-2
PRELIMINARY RISK LEVELS FOR SOIL AND GROUNDWATER
ERECKSON AIR FORCE STATION, ALASKA

Contaminants	Media Where Detected*	Soil Target Risk Levels: Carcinogens (mg/kg) Target Risk = 1.0E-04	1.0E-05	1.0E-06	Soil Target Risk Levels: Noncarcinogens (mg/kg) HI = 1.0
Inorganics					
Aluminum	Soil/Sed, GW				
Antimony	Soil/Sed				1.1E+03
Arsenic	Soil/Sed	5.7E+02	5.7E+01	5.7E+00	8.5E+02
Barium	Soil/Sed, GW, SW				2.0E+05
Beryllium	Soil/Sed, GW	2.3E+02	2.3E+01	2.3E+00	1.4E+04
Cadmium(food)	Soil/Sed				2.8E+03
Cadmium(water)	GW				1.4E+03
Chromium	Soil/Sed, GW				1.4E+04
Cobalt	Soil/Sed, GW				
Copper	Soil/Sed, GW				1.1E+05
Cyanide	Soil				6.7E+04
Lead	Soil/Sed, GW, SW				
Manganese	Soil/Sed, GW				4.0E+05
Mercury	Soil, SW				8.5E+02
Nickel	Soil/Sed, GW				5.7E+04
Selenium	Soil/Sed				1.4E+04
Silver	Soil/Sed				8.5E+03
Thallium	Soil/Sed				2.8E+02
Vanadium	Soil/Sed, GW				2.0E+04
Zinc	Soil/Sed, GW,SW				8.5E+05
Organics					
2-Butanone (MEK)	Soil				1.4E+05
2-Methylnaphthalene	Soil/Sed, GW				
2-Methylphenol	GW				
4,4'-DDD	Soil, Sed	4.1E+03	4.1E+02	4.1E+01	
4-Methyl-2-pentanone (MIBK)	Soil				1.4E+05
4-Methylphenol	GW				1.4E+04
Acenaphthene	Soil				1.7E+05
Acenaphthylene	Soil				
Acetone	Soil/Sed				2.8E+05
Anthracene	Soil/Sed				8.5E+05
Benzene	Soil/Sed, GW, SW	3.4E+04	3.4E+03	3.4E+02	
Benzo(a)anthracene	Soil/Sed	1.4E+03	1.4E+02	1.4E+01	
Benzo(a)pyrene	Soil/Sed	1.4E+02	1.4E+01	1.4E+00	
Benzo(b)fluoranthene	Soil/Sed	1.4E+03	1.4F+02	1.4E+01	
Benzo(ghi)perylene	Soil/Sed				
Benzo(k)fluoranthene	Soil/Sed	1.4E+03	1.4E+02	1.4E+01	
Bis(2-ethylhexyl)phthalate	Soil/Sed	7.1E+04	7.1E+03	7.1E+02	5.7E+04
Carbazole	Soil	5.0E+04	5.0E+03	5.0E+02	
alpha-Chlordane	Soil	7.8E+02	7.8E+01	7.8E+00	1.7E+02
Chlorobenzene	Soil				5.7E+04
Chloromethane	Soil	7.6E+04	7.6E+03	7.6E+02	
Chrysene	Soil/Sed	1.4E+04	1.4E+03	1.4E+02	
Di-n-butylphthalate	Soil/Sed				2.8E+05
Dibenzo(a,h)anthracene	Soil/Sed	1.4E+02	1.4E+01	1.4E+00	
Dibenzofuran	Soil/Sed, GW				1.1E+04
1,1-Dichloroethane	Soil				2.8E+05
1,2-Dichloroethane	Soil	1.1E+04	1.1E+03	1.1E+02	
1,2-Dichloroethylene (total)	Soil	1.6E+03	1.6E+02	1.6E+01	
Diethylphthalate	Soil				2.3E+06
2,4-Dimethylphenol	GW				5.7E+04
Ethylbenzene	Soil/Sed, GW				2.8E+05
Fluoranthene	Soil/Sed				1.1E+05
Fluorene	Soil/Sed, GW				1.1E+05
Heptachlor epoxide	Soil	1.1E+02	1.1E+01	1.1E+00	3.7E+01
Indeno(1,2,3-cd)pyrene	Soil/Sed	1.4E+03	1.4E+02	1.4E+01	
Methylene chloride	Soil/Sed	1.3E+05	1.3E+04	1.3E+03	1.7E+05
Naphthalene	Soil/Sed, GW, SW				
n-Nitrosodiphenylamine	Soil	2.0E+05	2.0E+04	2.0E+03	
PCB-1260	Soil/Sed	1.3E+02	1.3E+01	1.3E+00	
Phenanthrene	Soil/Sed, GW				
Phenol	GW				1.7E+[illegible]
Pyrene	Soil/Sed				8.5E+04
Styrene	Soil/Sed	3.3E+04	3.3E+03	3.3E+02	5.7E+05
1,1,2,2-Tetrachloroethane	Soil	5.0E+03	5.0E+02	5.0E+01	
Tetrachloroethene	Soil	1.9E+04	1.9E+03	1.9E+02	2.8E+04
Toluene	Soil/Sed, GW				5.7E+05
1,2,3-Trichlorobenzene	SW				
1,1,1-Trichloroethane	Soil				2.6E+05
1,1,2-Trichloroethane	Soil	1.7E+04	1.7E+03	1.7E+02	1.1E+04
Trichloroethene	Soil/Sed	9.0E+04	9.0E+03	9.0E+02	2.8E+04
Trichlorofluoromethane	Soil				8.5E+05
Vinyl acetate	Soil				2.8E+06
Vinyl chloride	Soil	5.2E+02	5.2E+01	5.2E+00	
Xylenes	Soil/Sed, GW				5.7E+06
2,3,7,8-TCDD		6.6E-03	6.6E-04	6.6E-05	

TABLE 2.4.1-2 (continued)
PRELIMINARY RISK LEVELS FOR SOIL AND GROUNDWATER
EARECKSON AIR FORCE STATION, ALASKA

Contaminants	Media Where Detected*	Groundwater Target Risk Levels Carcinogens (mg/kg) Target Risk = 1E-04	1E-05	1E-06	Groundwater Target Risk Levels Noncarcinogens (mg/kg) HI = 1.0	MCL mg/L	Secondary MCL mg/L	Ambient Water Quality Criteria** mg/L
Inorganics								
Aluminum	Soil/Sed, GW						0.05 to 0.2	
Antimony	Soil/Sed				1.5E-02	0.006		0.146
Arsenic	Soil/Sed	7.3E-03	7.3E-04	7.3E-05	1.1E-02	0.05		2.2E-06
Barium	Soil/Sed, GW, SW				2.1E-02	2.0		
Beryllium	Soil/Sed, GW	3.0E-05	3.0E-04	3.0E-05	1.8E-01	0.004		6.8E-06
Cadmium (food)	Soil/Sed				3.7E-02			0.01
Cadmium (water)	GW				1.8E-02	0.005		
Chromium	Soil/Sed, GW				1.8E-01	0.1		0.05
Cobalt	Soil/Sed, GW							
Copper	Soil/Sed, GW				1.5E+00		1.0	
Cyanide	Soil				7.8E-01	0.2		0.2
Lead	Soil/Sed, GW, SW							0.05
Manganese	Soil/Sed, GW				5.1E+00		0.05	0.05
Mercury	Soil, SW				1.1E-02	0.002		1.44E-04
Nickel	Soil/Sed, GW				7.3E-01	0.1		0.0134
Selenium	Soil/Sed				1.8E-01	0.05		0.01
Silver	Soil/Sed				1.1E-01		0.1	0.05
Thallium	Soil/Sed				3.3E-03	0.002		0.013
Vanadium	Soil/Sed, GW				2.6E-01			
Zinc	Soil/Sed, GW, SW				1.1E+01		5	
Organics								
2-Butanone (MEK)	Soil				5.6E-01			
2-Methylnaphthalene	Soil/Sed, GW							
2-Methylphenol	GW				1.8E+00			
4,4'-DDD	Soil, Sed	5.3E-02	5.3E-03	5.3E-04				
4-Methyl-2-pentanone (MIBK)	Soil				1.9E-01			
4-Methylphenol	GW				1.8E-01			
Acenaphthene	Soil							
Acenaphthylene	Soil							
Acetone	Soil/Sed				3.7E+00			
Anthracene	Soil/Sed				1.1E+01			
Benzene	Soil/Sed, GW, SW	9.3E-02	9.3E-03	9.3E-04		0.005		6.6E-04
Benzo(a)anthracene	Soil/Sed	4.2E-03	4.2E-04	4.2E-05				
Benzo(a)pyrene	Soil/Sed	4.2E-04	4.2E-05	4.2E-06		0.0002		
Benzo(b)fluoranthene	Soil/Sed	4.2E-03	4.2E-04	4.2E-05				
Benzo(g,h,i)perylene	Soil/Sed							
Benzo(k)fluoranthene	Soil/Sed	4.2E-03	4.2E-04	4.2E-05				
Bis(2-ethylhexyl)phthalate	Soil/Sed	9.1E-01	9.1E-02	9.1E-03	7.3E-01	0.006		
Carbazole	Soil	6.4E-01	6.4E-02	6.4E-03				
alpha-Chlordane	Soil	2.1E-03	2.1E-04	2.1E-05	2.2E-03			
Chloroaniline	Soil				5.0E-02			
Chloromethane	Soil	3.5E-01	3.5E-02	3.5E-03				
Chrysene	Soil/Sed	4.2E-02	4.2E-03	4.2E-04				
Di-n-butylphthalate	Soil/Sed				3.7E+00			
Dibenz(a,h)anthracene	Soil/Sed	4.2E-04	4.2E-05	4.2E-06				
Dibenzofuran	Soil/Sed, GW				1.5E-01			
1,1-Dichloroethane	Soil				9.8E-01			
1,2-Dichloroethane	Soil	3.0E-02	3.0E-03	3.0E-04		0.005		9.4E-04
1,2-Dichloroethylene (total)	Soil	2.5E-03	2.5E-04	2.5E-05				3.3E-05
Diethylphthalate	Soil				2.9E+01			350
2,4-Dimethylphenol	GW				7.8E-01			
Ethylbenzene	Soil/Sed, GW				1.5E+00	0.7		1.4
Fluoranthene	Soil/Sed				1.5E+00			0.042
Fluorene	Soil/Sed, GW				1.5E+00			
Heptachlor epoxide	Soil	3.0E-04	3.0E-05	3.0E-06	4.7E-04	0.0002		
Indeno(1,2,3-cd)pyrene	Soil/Sed	4.2E-03	4.2E-04	4.2E-05				
Methylene chloride	Soil/Sed	8.5E-01	8.5E-02	8.5E-03	1.7E+00	0.005		
Naphthalene	Soil/Sed, GW, SW							
n-Nitrosodiphenylamine	Soil	2.6E+00	2.6E-01	2.6E-02				4.9E-03
PCB-1260	Soil/Sed							7.9E-08
Phenanthrene	Soil/Sed, GW							
Phenol	GW				2.2E+01			3.5
Pyrene	Soil/Sed				1.1E+00			
Styrene	Soil/Sed	3.4E-01	3.4E-02	3.4E-03	7.3E+00	0.1		
1,1,2,2-Tetrachloroethane	Soil	9.4E-02	9.4E-03	9.4E-04				1.7E-04
Tetrachloroethene	Soil	2.1E-01	2.1E-02	2.1E-03	3.7E-01	0.005		8.0E-04
Toluene	Soil/Sed, GW				8.3E-01	1		14.3
1,2,3-Trichlorobenzene	SW							
1,1,1-Trichloroethane	Soil				1.5E+00	0.2		18.4
1,1,2-Trichloroethane	Soil	2.2E-01	2.2E-02	2.2E-03	1.5E-01	0.005		6.0E-04
Trichloroethene	Soil/Sed	3.8E-01	3.8E-02	3.8E-03	3.7E-01	0.005		2.7E-03
Trichlorofluoromethane	Soil				1.8E+00			
Vinyl acetate	Soil				5.6E-01			
Vinyl chloride	Soil	4.3E-03	4.3E-04	4.3E-05		0.002		2.0E-03
Xylenes	Soil/Sed, GW				7.8E-01	10		
2,3,7,8-TCDD		1.8E-08	1.8E-09	1.8E-10				

NOTES:
*Soil = subsurface soil only; Sed = sediment; SW = surface water; **GW = groundwater
mg/kg = milligrams per kilogram; mg/L = milligrams per liter
**10-6 = Carcinogenic risk level for human ingestion of water and aquatic organisms, EPA Quality Criteria for Water 1986: Update #2, May 1987.

HI = hazard index
MCL = maximum contaminant level
MEK = methyl ethyl ketone
MIBK = methyl isobutyl ketone
PCB = polychlorinated biphenyl
TCDD = Dioxin

[illegible] Page 2 of 2 100% Recycled

three exposure assumptions are consistent with exposure assumptions made by CH2M Hill (1993b). The noncarcinogenic averaging time is taken equal to the exposure duration as indicated by EPA (1991).

Table 2.4.1-2 also lists MCLs for contaminants in drinking water.

2.4.2 Management Zone 7 Conceptual Model

As noted in Section 2.3, Management Zone 7 has been selected for more intensive study during the 1993 basewide investigations to serve as a model for applicability of the management zone concept at Eareckson AFS. Consequently, a conceptual model for Management Zone 7 is presented here. In general, the types of sources, release mechanisms, exposure routes, and receptors for Management Zone 7 are essentially the same as those for the basewide conceptual model, as illustrated in Figure 2.4.1-1. Also, Figure 2.4.1-2 presents a conceptual model diagram that illustrates portions of Management Zone 7. There are some differences in the characterization of primary sources, and the sources and release mechanisms can be defined more precisely, as discussed further below.

2.4.2.1 Contaminant Identification

Contaminants detected at individual source units within Management Zone 7 are outlined in Table 2.4.2-1. Contaminants detected in soils include a wide variety of trace metals, BTEX compounds, PAHs, chlorinated hydrocarbons, some pesticides, and TPH. Contaminants detected in groundwater and surface water include 1) TPH at several locations and 2) PAHs and dibenzofuran at the abandoned tank farm, contaminant source unit ST46. Free product has been detected in shallow wells located at the southwestern end of the management zone, just upgradient of the lowest oil/water separator pond, and adjacent to Tank 123 (ST08).

2.4.2.2 Source Areas

As noted in Table 2.4.2-1, six contaminant source units are located within Management Zone 7. This list excludes two UST units, ST32 and ST44, that have been proposed for administrative delisting or action by the 11th CEOS. The other source units are described briefly below.

Source unit SS05 is the site of a former oil spill at the Old Cobra Dane, just north of the power plant. Surface and subsurface soil contaminants detected in this area include trace metals, cyanide, chlorinated hydrocarbons, and pesticides.

Source unit SS07, the West End Oil/Water Separator Ponds, consists of a series of five unlined earthen ponds located along the southern part of the management zone. The ponds are connected by shallow surface ditches and intercept oil-contaminated surface waters from areas to the north and northeast. The last pond discharges into a tidal pool just north of Alcan Cove. TPH and lead have been detected in soils in this area, and TPH has been detected in water.

Source unit SS17 is a former UST located at the New Cobra Dane, in the north part of the management zone. The UST stored residues from floor trenches in the basement of the Cobra Dane. The UST may have contained residues from PCB-contaminated spill material. Contaminants detected in surface soils include trace metals and a variety of PAH compounds. Contaminants detected in subsurface

TABLE 2.4.2-1
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification: Current	Source Identification: Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations			Migration Pathway	Exposed Population	Risk Assessment
SS 05	PS-1B	Old Cobra Dane - Former oil spill (quantity unknown), possibly containing PCBs. Exact location unknown; believed to be on north side of Building 3050.	Background contaminant concentrations in various media are given in the basewide conceptual model summary.	Surface Soil:			Groundwater	Human Station residents via ingestion, inhalation, and dermal contact. Station commercial/ industrial workers (and contractor personnel) via ingestion. Ecological Aquatic and terrestrial receptors if contaminants migrate from groundwater to surface water/sediment. Direct routes are ingestion and dermal contact if groundwater reaches surface water/sediment.	Human Potential risks to humans as a result of the presence of all the contaminants listed as present or potentially present in groundwater are likely to be of greatest concern if they are routinely ingested. Ecological Aquatic and terrestrial receptors not thought to come in contact with groundwater. However, potential risks to receptors if contaminated groundwater migrates to surface waters or wetland areas (see groundwater/ sediment model).
				Aluminum	27,900	mg/kg			
				Arsenic	3 40	mg/kg			
				Barium	189 00	mg/kg			
				Beryllium	0 52	mg/kg			
				Cadmium	28 90	mg/kg			
				Calcium	16,500 00	mg/kg			
				Chromium	34.70	mg/kg			
				Cobalt	20.20	mg/kg			
				Copper	145.00	mg/kg			
				Cyanide	2.20	mg/kg			
				Iron	42,200.00	mg/kg			
				Lead	51.70	mg/kg			
				Magnesium	18,500	mg/kg			
				Manganese	1,110.00	mg/kg			
				Mercury	5.40	mg/kg			
				Nickel	38.90	mg/kg			
				Potassium	1,510.00	mg/kg			
				Selenium	3.60	mg/kg			
				Sodium	4,050 00	mg/kg			
				Thallium	0.65	mg/kg			
				Vanadium	142.00	mg/kg			
				Zinc	201.00	mg/kg			
				4,4'-DDD	34.00	µg/kg			
				bis(2-Ethylhexyl) phthalate	88,000.00	µg/kg			
				1,1,1-Trichloroethane	4.00	µg/kg			
				Methylene chloride	14.00	µg/kg			
				Trichloroethene	10.00	µg/kg			
				Subsurface Soil:					
				TPH	200,000	mg/kg			
				1,1,1-Trichloroethane	610	µg/kg			
				1,1,2-Trichloroethane	29	µg/kg			
				1,1-Dichloroethane	130	µg/kg			
				1,2-Dichloroethane	45	µg/kg			
				1,2-Dichloroethene	97	µg/kg			
				Trichloroethene	2,200	µg/kg			
				Toluene	14	µg/kg			
				Vinyl chloride	95	µg/kg			
				Heptachlor epoxide	4 5	µg/kg			
				alpha-Chlordane	4 9	µg/kg			

TABLE 2.4.2-1 (continued)
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification: Current	Source Identification: Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations		Migration Pathway	Exposed Population	Risk Assessment
SS 05 (cont'd.)				Subsurface Soil (continued)		Surface Water/ Sediment	Human Station residents via occasional ingestion and dermal contact during recreational activities. Station commercial/ industrial workers (and contractor personnel) via occasional ingestion and dermal contact Ecological Aquatic organisms may be exposed, some continuously, to contaminants. Direct routes are ingestion and dermal contact (including respiration) Terrestrial organisms may be exposed. Direct routes are ingestion of surface water/sediment. Generally, dermal contact is assumed to be minor Some contaminants may be subject to plant uptake and subsequent transport up the food chain	Human Potential risks to humans as a result of the presence of all the contaminants listed as present, or potentially present, may be of concern if they are routinely contacted, which does not seem likely Ecological Potential risks to aquatic receptors. Risks are greatest to organisms residing where contaminants may concentrate (e.g., if contaminants concentrate in sediments, benthic macroinvertebrates would potentially be at greater risk) Potential risks to terrestrial species that drink water or feed in aquatic habitats
				Aluminum	58,600 mg/kg			
				Arsenic	8.7 mg/kg			
				Barium	45.3 mg/kg			
				Beryllium	0.73 mg/kg			
				Cadmium	24.9 mg/kg			
				Calcium	8,190 mg/kg			
				Chromium	73 mg/kg			
				Cobalt	13.4 mg/kg			
				Copper	4,570 mg/kg			
				Cyanide	3.3 mg/kg			
				Iron	54,800 mg/kg			
				Lead	1,430 mg/kg			
				Magnesium	4,770 mg/kg			
				Manganese	358 mg/kg			
				Mercury	0.7 mg/kg			
				Nickel	708 mg/kg			
				Potassium	2,340 mg/kg			
				Selenium	16.1 mg/kg			
				Silver	497 mg/kg			
				Sodium	4,010 mg/kg			
				Thallium	2.9 mg/kg			
				Vanadium	44.5 mg/kg			
				Zinc	7,350 mg/kg			

TABLE 2.4.2-1
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification		Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
Current	Past						
SS-07	PS-3	West End Oil/Water Separator Ponds - Five unlined earthen ponds in the northwest part of the island. The ponds are connected by shallow surface ditches and intercept oil-connected surface waters from areas to the northeast. The ditches discharge to a tidal pool north of Alcan Cove.		<u>Soil/Sediment:</u> TPH 141,000 mg/kg Lead 374 mg/kg <u>Water:</u> TPH 3.6 mg/L	Soil	<u>Human</u> Station residents via dermal contact and ingestion, especially during recreational activities. Station commercial/ industrial workers (and contractor personnel) via ingestion and dermal contact. <u>Ecological</u> Aquatic organisms not exposed. Terrestrial organisms exposed via ingestion and dermal contact. Presumed less contact through inhalation.	<u>Human</u> Potential risks to humans as a result of the presence of all the contaminants listed as present, or potentially present, may be of concern if they are routinely directly contacted, which does not seem likely. Concern would be great if soil were potentially contaminated and likely to be exposed in residential areas and if there were children, which does not seem likely. <u>Ecological</u> Potential risks to aquatic organisms only if contamination migrates to surface water/sediment (see surface water/sediment model). Potential risk to terrestrial organisms. Greater risk for species most directly associated with soil (e.g., through feeding, nest sites, etc.).

TABLE 2.4.2-1
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification: Current	Source Identification: Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations			Migration Pathway	Exposed Population	Risk Assessment
SS 17	PS-1A	New Cobra Dane - Former 1,000-gallon UST located outside the front entrance. The UST stored residues from floor trenches in the basement of Cobra Dane. The UST may have contained residues from PCB - contaminated spill material. This source unit has been recommended for NFAD by CH2M Hill (1993b).		Surface Soil:			Air	Human Station residents via inhalation during recreational activities. Station commercial/ industrial workers (and contractor personnel) via inhalation. Ecological Terrestrial organisms via inhalation. Plant uptake potential. Aquatic organisms not thought to be exposed.	Human Potential risks to humans are likely to be minimal as conditions at Eareckson AFS would encourage rapid and substantial dispersion of any air contaminants. Ecological Potential risks assumed to be minimal for most Shemya species. Special habitat and life history traits could result in exposure for some species (e.g., burrowing or subterranean terrestrial species).
				Aluminum	12,400	mg/kg			
				Antimony	7.5	mg/kg			
				Arsenic	2.2	mg/kg			
				Barium	54.2	mg/kg			
				Beryllium	0.25	mg/kg			
				Cadmium	2.2	mg/kg			
				Calcium	6,990	mg/kg			
				Chromium	17.9	mg/kg			
				Cobalt	10.3	mg/kg			
				Copper	65.3	mg/kg			
				Iron	19,800	mg/kg			
				Lead	29.1	mg/kg			
				Magnesium	9,250	mg/kg			
				Manganese	397	mg/kg			
				Nickel	21.4	mg/kg			
				Pctassium	687	mg/kg			
				Selenium	0.65	mg/kg			
				Sodium	1,900	mg/kg			
				Thallium	0.36	mg/kg			
				Vanadium	63.8	mg/kg			
				Zinc	95.9	mg/kg			
				bis(2-Ethylhexyl) phthalate	300.00	µg/kg			
				Methylene chloride	9.00	µg/kg			
				Anthracene	120	µg/kg			
				Benzo(a)anthracene	380	µg/kg			
				Benzo(a)pyrene	390	µg/kg			
				Benzo(b)fluoranthene	510	µg/kg			
				Benzo(g,h,i)perylene	360	µg/kg			
				Benzo(k)fluoranthene	170	µg/kg			
				Carbazole	82	µg/kg			
				Chrysene	410	µg/kg			
				Dibenzo(a,h)anthracene	79	µg/kg			
				Fluoranthene	1,100	µg/kg			
				Ideno(1,2,3-cd)pyrene	440	µg/kg			
				Phenanthrene	530	µg/kg			
				Pyrene	600	µg/kg			

TABLE 2.4.2-1
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification: Current	Source Identification: Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
SS 17 (cont'd)				<u>Subsurface Soil</u>: TPH 5,100 mg/kg Aluminum 24,400 mg/kg Arsenic 2.7 mg/kg Barium 99.4 mg/kg Beryllium 0.22 mg/kg Cadmium 0.92 mg/kg Calcium 9,760 mg/kg Chromium 26.4 mg/kg Cobalt 27.3 mg/kg Copper 133 mg/kg Iron 59,600 mg/kg Lead 2.8 mg/kg Magnesium 22,700 mg/kg Manganese 1,160 mg/kg Mercury 0.17 mg/kg Nickel 23.6 mg/kg Potassium 1,140 mg/kg Selenium 1.8 mg/kg Silver 1.6 mg/kg Sodium 1,140 mg/kg Thallium 0.57 mg/kg Vanadium 213 mg/kg Zinc 107 mg/kg	Free Product or Debris	<u>Human</u> Station commercial/ industrial workers (and contractor personnel) via dermal contact. Possible dermal exposure during recreational activities. <u>Ecological</u> Terrestrial and aquatic organisms via dermal contact, possible ingestion.	<u>Human</u> Potential risks to humans are likely to be minimal because it is highly unlikely that free product would be routinely contacted. <u>Ecological</u> Birds and other species can be affected by physical contact with oil. Other risks would be as described for surface water and sediment.
ST 08	PS-4	Diesel Fuel Tank 123-North part of the island, just south of the main Fuel Tank Farm. Numerous spills have occurred, and surface soils have been remediated.		<u>Soil</u>: Acetone 0.66 mg/kg 2-Butanone 0.18 mg/kg Methylene Chloride 0.17 mg/kg Toluene 1.8 mg/kg Xylenes 0.66 mg/kg Styrene 0.65 mg/kg Chloromethane 0.069J mg/kg Vinyl Acetate 0.061J mg/kg 4-Methyl 2-pentanone 0.1 mg/kg TPH 230 mg/kg Di-n-butylphthalate 0.59 mg/kg			

TABLE 2.4.2-1
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification		Source	Background	Contaminants and Contaminated Media	Migration	Exposed	Risk
Current	Past	Unit Description	Concentrations	and Highest Measured Concentrations	Pathway	Population	Assessment
ST 09	PS-05	Power plant spills associated with SS 07 - the power plant, located near the northern coast in the central part of the island, has been the site of numerous diesel fuel spills. Some spilled material flows to the West End Oil/Water Separator Ponds (SS 07), some may infiltrate to the subsurface. Some soil remediation has been conducted.		Soil: TPH 15,000 mg/kg Acetone 0.17 mg/kg Toluene 0.081J mg/kg Ethylbenzene 0.11J mg/kg Xylenes 1.76J mg/kg Methylene Chloride 0.11J mg/kg Naphthalene 4.2 mg/kg 2-Methylnaphthalene 8.2 mg/kg Benzo(a)pyrene 5.8 mg/kg Di-n-butylphthalate 0.9J mg/kg Groundwater: TPH 100 mg/L			
ST 46	PS-83	Abandoned Tank Frrm- The tank farm, in the northwest part of the island, consisted of numerous aboveground storage tanks for diesel fuel for the power plant. Fuel was pumped from the dock area through a 10-inch pipeline. Some of the tanks have been removed, but extensive POL contamination in the area has been documented.		Surface Soil: TPH 13,900 ppm Benzene 143,280 ppb Toluene 1,934,800 ppb Ethylbenzene 573,400 ppb Xylenes 691,090 ppb Acetone 108 µg/kg Barium (EP TOX) 0.036 mg/L Fluorene 0.51 mg/kg Phenanthrene 1.8 mg/kg Di-n-butylphthalate 0.54 mg/kg Fluoranthene 1.4 mg/kg Pyrene 2.2 mg/kg Chrysene 0.99 mg/kg Benzo (b+k) fluoranthene 1.9 mg/kg			

TABLE 2.4.2-1
CONCEPTUAL MODEL SUMMARY - MANAGEMENT ZONE 7
EARECKSON AIR FORCE STATION, ALASKA

Source Identification		Source	Background	Contaminants and Contaminated Media		Migration	Exposed	Risk
Current	Past	Unit Description	Concentrations	and Highest Measured Concentrations		Pathway	Population	Assessment
ST 46 (cont'd.)				Subsurface Soil:				
				TPH	470,000 mg/kg			
				Benzene	0.150 mg/kg			
				Ethylbenzene	11.9 mg/kg			
				Toluene	0.270 mg/kg			
				Xylenes	33.9 mg/kg			
				Acenaphthene	3.95 mg/kg			
				Acenaphthylene	0.82 mg/kg			
				Anthracene	26.3 mg/kg			
				Benzo(a)anthracene	30 mg/kg			
				Benzo(b+k)fluoranthene	6.29 mg/kg			
				Benzo (g,h,i) pyrene	2.51 mg/kg			
				Benzo (a) pyrene	4.66 mg/kg			
				Chrysene	15.1 mg/kg			
				Dibenzo (a,h) anthracene	3.61 mg/kg			
				Fluoranthene	40 mg/kg			
				Fluorene	8.15 mg/kg			
				Indeno (1,2,3-cd) pyrene	1.83 mg/kg			
				2-Methylnaphthalene	12 mg/kg			
				Naphthalene	20.6 mg/kg			
				Phenanthrene	20 mg/kg			
				Pyrene	22.3 mg/kg			
				Acetone	0.108 mg/kg			
				Dibutylphthalate	0.54 mg/kg			
				Barium (EP TOX)	0.39 mg/L			
				Lead	48 mg/kg			
				Groundwater:				
				Naphthalene	20 µg/L			
				2-Methylnaphthalene	25 µg/L			
				Dibenzofuran	5 µg/L			
				Fluorene	14 µg/L			
				Phenanthrene	9.1 µg/L			
				Benzene	2.7 ppm			
				Toluene	8.4 ppm			
				Ethylbenzene	1.4 ppm			
				Xylenes	5.6 ppm			

Notes:
AFS = Air Force Station
EP TOX = extraction procedure toxicity
J = less than practical quantitiation limit but greater than or equal to instrument detection limit
NFAD = No Further Action Document
PCB = polychlorinated biphenyl
POL = petroleum, oil, and lubricant
TPH = total petroleum hydrocarbon
UST = underground storage tank

mg/L = milligrams per liter
ppm = parts per million
ppb = parts per billion
mg/kg = milligrams per kilogram
µg/kg = micrograms per kilogram

soils include TPH and trace metals. This source unit has been recommended for an NFAD by CH2M Hill (1993b).

Source unit ST08 is the location of diesel fuel tank 123, located just south of the abandoned fuel tank farm in Management Zone 7. Numerous fuel spills occurred here, leading to contamination of soils with BTEX compounds and a variety of other organics, all at low concentrations. Surface soils within the tank berm have been remediated. One monitoring well located downgradient of the tank contained floating product.

Source unit ST09 includes diesel fuel spills at the power plant, located at the eastern end of the management zone. Some of the spilled material flows to the West End Oil/Water Separator Ponds (SS07), and some may infiltrate into the subsurface. Some soil remediation has been conducted. Contaminants detected in soils include TPH, BTEX compounds, and PAHs. TPH has been detected in groundwater.

Source unit ST46 is an abandoned tank farm located in the west-central part of the management zone, west of the power plant, and south of the New Cobra Dane. The tank farm consisted of numerous aboveground storage tanks for diesel fuel for the power plant. Fuel was piped to the tanks from the dock area through a 10-inch pipeline. Some of the tanks have been removed, but extensive POL contamination has been documented. Contaminants detected in soils include TPH, BTEX compounds, PAHs, lead, and barium. Contaminants detected in groundwater include PAHs and dibenzofuran.

2.4.2.3 Release Mechanisms

Contaminants have been released by way of surface spills, possible tank leaks, and possible spills and leaks from USTs and pipelines. In addition, contaminants transported downstream through the oil/water separator system can be released to soils adjacent to the ponds and ditches and can possibly infiltrate into subsurface soils and groundwater. Contaminants present in surface soils can be released to surface waters by way of erosion and runoff, and to the subsurface by infiltration and percolation. Contaminants can also be released from free product by dissolution into groundwater.

2.4.2.4 Transport Media

Contaminants released at source units within Management Zone 7 can be transported by several mechanisms through several media. Principal transport mechanisms include erosion and runoff, infiltration and percolation, surface water transport, free product transport, and possibly, fugitive dust and volatiles emissions. Contaminants present in surface soils can be transported by erosion and runoff, infiltration and percolation, and possibly, volatilization and dust emissions. Contaminants in subsurface soils will be transported primarily by percolation to groundwater, although release by volatilization and dust emission is possible during subsurface excavation. Free product floating on the water table can be transported by gravity along the water table slope, with free product motion also influenced by the motion of underlying groundwater. Free product can also be dissolved into the groundwater.

Contaminants that enter the shallow groundwater can then be transported downgradient until the groundwater is discharged to the surface at springs or seeps. The shallow groundwater can also potentially percolate downward and enter fractures or pore space within the deep bedrock aquifer. This possibility is of particular concern in Management Zone 7, because the two supplemental wells for Station water supply, wells 400 and 410, are located within the abandoned tank farm area of Management Zone 7.

2.4.2.5 Exposure Routes

All of the exposure routes identified in the basewide and LSI conceptual models, Figures 2.4.1-1 and 2.4.1-2, also apply at Management Zone 7. The major sources of human exposure are probably potential contact of construction and remedial workers with contaminated soil and surface water. The groundwater exposure route is the same as for the Station as a whole, because all personnel are exposed to groundwater as Station residents. Surface water and sediment exposures to aquatic biota and to ecological receptors further up the food chain are potentially somewhat higher here than at other management zones because the oil/water separator drainage, which drains most of the management zone, discharges into a large tidal pool at the west end of the island. Ecological receptors can also be exposed to soil through dermal contact and inhalation of particulates.

2.4.2.6 Receptors

The potential receptors of contamination at Management Zone 7 are essentially the same as those identified for the basewide conceptual model. As noted above, human exposure may be less significant because the principal Station water supply is not located within the management zone. However, because of the tidal pool located at the west end of the zone and the large areas within the abandoned tank farm that might provide habitat for terrestrial biota, ecological receptors may be more of a concern than human receptors in the management zone.

2.4.2.7 Contaminant Concentrations at Receptors

Contaminant concentrations at receptors have not yet been determined. However, the maximum concentrations of various contaminants in different media at Management Zone 7 are given in Table 2.4.2-1. These maximum concentrations can be 1) taken as preliminary estimates of possible concentrations at receptors and 2) compared with the PRLs summarized in Table 2.4.1-2. Benzo(a)pyrene exceeds the 10^{-6} carcinogenic risk level for soil samples at source units ST09 and ST46. Arsenic exceeds the 10^{-6} carcinogenic risk level for soil at source unit SS05. However, the arsenic value reported at this location, 8.7 mg/kg, is less than the maximum arsenic level observed in background soil samples. BTEX compounds in groundwater samples from source area ST46 exceed various risk levels. Benzene (2.7 ppm) exceeds the MCL and carcinogenic risk level. Toluene (8.4 ppm) exceeds the MCL and the noncarcinogenic hazard level. Ethylbenzene (1.4 ppm) exceeds the MCL, and total xylenes exceed the noncarcinogenic hazard level.

Data collected during the basewide investigations and the more comprehensive investigation at Management Zone 7 will permit modeling of contaminant transport through various environmental media, either from contaminant sources to exposure points or from exposure points to back-calculate contaminant concentrations at potential source units. Specific modeling approaches have not yet been determined, although the EPA MULTIMED model for simulating multimedia exposure concentrations may be appropriate for this purpose. Management Zone 7 is intended, in part, to serve as test of modeling approaches applicable to management zones.

2.4.3 Limited Source Investigation Conceptual Models

Conceptual models for each of the proposed LSI areas are described briefly below. In general, the LSI models incorporate limited aspects of the basewide conceptual model described in Figures 2.4.1-1 and 2.4.1-2 and Table 2.4.1-1. Only the most likely contaminant pathways and exposure routes are described below. The LSI models are summarized in greater detail in Table 2.4.3-1.

2.4.3.1 Source Unit LF15

This source unit is the active burn area located at the eastern tip of the island, on the beach below bluffs. Telephone posts, wood debris, posts, and trash are currently burned here. No previous investigations have been conducted at this area. Contaminated media are likely limited to surface and shallow subsurface soils. Contaminated media are expected to be minimal because this potential source unit has only been operational for the last few years. Exposure of Station workers to contaminated soils is possible, and also possibly to vapors or dust emissions. Contaminants could be transported limited distances to the ocean by way of erosion and surface runoff, with subsequent exposure to terrestrial and aquatic biota possible. LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.2 Source Unit LF18

LF18 is a 15-acre landfill area on the north shore of the island. It is bordered on the north by the Bering Sea and on other sides by steep, grass-covered slopes. It is relatively flat, covered with debris, and estimated to be up to 8 feet thick. A portion of the unit is used by Station personnel for recreational access to a local "jade" mine. Soil samples from the site contained metals, low levels of volatile organic compounds, phthalates, 4,4'-DDD, and PCB 1260. However, contaminant concentrations in soil did not exceed human health risk criteria (CH2M Hill, 1993b).

Exposure of Station workers to contaminated soils and dust emissions during construction activities is possible. Visitors to the "jade" mine may be similarly exposed. However, soil contaminant concentrations do not exceed human health risk levels. Contaminants could be transported very limited distances to the ocean by way of erosion and surface runoff or groundwater discharge, with subsequent exposure to terrestrial and aquatic biota possible.

A comparison of observed contaminant concentrations at LF18 with the PRLs of Table 2.4.1-2 indicates that only arsenic in soil exceeds a risk level (the 10^{-6} carcinogenic risk level). However, arsenic has also been detected above the 10^{-6} risk level in background soils.

LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.3 Source Unit LF28

This source area is the scrap metal landfill located at the southeast corner of the island, adjacent to the sanitary landfill. Scrap metal, and possibly rubble and domestic waste, have been disposed of at the site. Contaminants detected in soils include TPH, three trace metals, and three organics detected at levels less than

TABLE 2.4.3-1
LIMITED SOURCE INVESTIGATION UNIT MAXIMUM CONTAMINANT CONCENTRATIONS
EARECKSON AIR FORCE STATION, ALASKA

Source Identification Current	Source Identification Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
LF 15		Active Burn Area – Eastern tip of island, 1,800 feet east of Bldg. 3013, on the beach below bluffs. Telephone poles, posts, wood debris, and trash are burned here.	Background contaminant concentrations in various media are given in the basewide conceptual model summary.	No previous investigations.	Groundwater	<u>Human</u> Station residents via ingestion, inhalation, and dermal contact. Station commercial/ industrial workers (and contractor personnel) via ingestion. <u>Ecological</u> Aquatic and terrestrial receptors if contaminants migrate from groundwater to surface water/sediment. Direct routes are ingestion and dermal contact if groundwater reaches surface water/sediment.	<u>Human</u> Potential risks to humans because of the presence of all the contaminants listed as present or potentially present in groundwater are likely to be of greatest concern if they are routinely ingested. <u>Ecological</u> Aquatic and terrestrial receptors not thought to come in contact with groundwater. However, potential risks to receptors if contaminated groundwater migrates to surface waters or wetland areas (see groundwater/sediment model).
LF 16	SW-4	Landfill – A 15-acre area. It is relatively flat, and estimated to be up to 8 feet thick. The surface is covered with various types of debris.		<u>Subsurface Soils:</u> TPH 1,373 mg/kg Acetone 380 µg/kg Bis(2-ethylhexyl)phthalate 60 µg/kg 2-Butanone 82 µg/kg Diethylphthalate 1,000 µg/kg Di-n-butylphthalate 160 µg/kg Methylene Chloride 54 µg/kg Tetrachloroethylene 2 µg/kg Toluene 38 µg/kg Trichlorofluoromethane 55 µg/kg Xylenes 29.8 µg/kg Aluminum 17,700 mg/kg Antimony 9.9 mg/kg Arsenic 25 mg/kg Barium 47.2 mg/kg Beryllium 0.43 mg/kg Cadmium 1.4 mg/kg Chromium 107 mg/kg Cobalt 10.8 mg/kg Copper 224 mg/kg Iron 157,000 mg/kg Lead 534 mg/kg Manganese 698 mg/kg Nickel 96.5 mg/kg Selenium 25 mg/kg Silver 3.1 mg/kg Thallium 44.8 mg/kg Vanadium 103 mg/kg Zinc 143 mg/kg			

TABLE 2.4.3-1 (continued)
LIMITED SOURCE INVESTIGATION UNIT MAXIMUM CONTAMINANT CONCENTRATIONS
EARECKSON AIR FORCE STATION, ALASKA

Source Identification Current	Source Identification Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
LF 18 (cont'd)				Surface Soils: TPH 371 mg/kg Acetone 14 µg/kg Bis(2-ethylhexyl)phthalate 91 µg/kg 4,4'-DDT 5.6 µg/kg Di-n-butylphthalate 140 µg/kg PCB (Aroclor 1260) 110 µg/kg Aluminum 28,300 mg/kg Barium 131 mg/kg Beryllium 0.32 mg/kg Cadmium 1.8 mg/kg Chromium 22.8 mg/kg Cobalt 19.9 mg/kg Copper 65.4 mg/kg Iron 41,300 mg/kg Lead 108 mg/kg Manganese 805 mg/kg Nickel 20.6 mg/kg Silver 2.8 mg/kg Thallium 92.4 mg/kg Vanadium 137 mg/kg Zinc 94.2 mg/kg	Surface Water/ Sediment	Human Station residents via occasional ingestion and dermal contact during recreational activities. Station commercial/industrial workers (and contractor personnel) via occasional ingestion and dermal contact. Ecological Aquatic organisms may be exposed, some continuously, to contaminants. Direct routes are ingestion and dermal contact (including respiration). Terrestrial organisms may be exposed. Direct routes are ingestion of surface water/sediment, generally dermal contact is assumed to be minor. Some contaminants may be subject to plant uptake and subsequent transport up the food chain.	Human Potential risks to humans because of the presence of all the contaminants listed as present, or potentially present, may be of concern if they are routinely contacted, which does not seem likely. Ecological Potential risks to aquatic receptors. Risks are greatest to organisms residing where contaminants may concentrate (e.g., if contaminants concentrate in sediments, benthic macroinvertebrates would potentially be at greater risk) Potential risks to terrestrial species that drink water or feed in aquatic habitats
LF 28	SW-14	Scrap Metal Landfill - Southeast corner of the island, adjacent to sanitary landfill. Scrap metal disposal, and possible disposal of rubble and domestic waste.		Soil: TPH 460 mg/kg Methylene Chloride 0.48 mg/kg Acetone 0.15 mg/kg 2-Butanone 0.04 mg/kg Nickel 23 mg/kg Zinc 122 mg/kg Lead 38.1 mg/kg			
OT 21		Old Grounded Barge - Fuel barge aground on the beach in Alcan Cove. Fuel was removed from the barge after it ran aground in 1958		No data have been collected			
OT 29		Ammunition Dump - Area of WWII munitions disposal on a rocky beach near the southeast corner of the island. An area of potential ecological significance.		No data have been collected			

TABLE 2.4.3-1 (continued)
LIMITED SOURCE INVESTIGATION UNIT MAXIMUM CONTAMINANT CONCENTRATIONS
EARECKSON AIR FORCE STATION, ALASKA

Source Identification: Current	Source Identification: Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
OT 40		Upper Lake – In the west-central part of the island, near the abandoned runways. Area of WWII munitions disposal, and possible receptor of POL and sewage contamination.		Surface Water: TPH 16 mg/L 1,2,3-Trichlorobenzene 0.1 µg/L Benzene 0.1 µg/L Naphthalene 0.2 µg/L Lead 5 µg/L Mercury 0.8 µg/L pH 8.7 µg/L	Soil	Human Station residents via dermal contact and ingestion, especially during recreational activities. Station commercial/industrial workers (and contractor personnel) via ingestion and dermal contact. Ecological Aquatic organisms not exposed. Terrestrial organisms exposed via ingestion and dermal contact. Presumed less contact through inhalation.	Human Potential risks to humans because of the presence of all the contaminants listed as present, or potentially present, may be of concern if they are routinely directly contacted, which does not seem likely. Concern would be great if soil were potentially contaminated, and likely to be exposed in residential areas, and if there were children, which does not seem likely. Ecological Potential risks to aquatic organisms only if contamination migrates to surface water/sediment (see surface water/sediment model). Potential risks to terrestrial organisms. Greater risk for species most directly associated with soil (e.g., through feeding, nest sites, etc.)
SS 07	PS-3	West End Oil/Water Separator Ponds – described on Table 2.4.2-1.		See Table 2.4.2-1			
SS 20		Retrograde Area (Dock) – Dock on Alcan Cove at western end of island. Area of metal scrap, mostly dock pilings. Some debris was removed in 1977/78.		Soil TPH 130 mg/kg			
FT 02	FT-2	Aircraft Mockup/Fire Training Area/Abandoned Drum Disposal Site – This area is generally located at the north end of abandoned runways B and C, in the vicinity of their intersection. The aircraft mockup and fire training areas were used for firefighting training. JP-4 and petroleum wastes were ignited, and then they were extinguished with AFFF. Visibly contaminated soils and surface debris have been excavated and removed. An undetermined number of 55-gallon drums have been buried just west of this area.		Surface Soils: TPH 29,360 mg/kg Benzene 14,000 µg/kg Bis(2-ethylhexyl)phthalate 2,200 µg/kg Dibenzofuran 1,700 µg/kg Ethylbenzene 88,000 µg/kg Fluoranthene 15,000 µg/kg Fluorene 2,000 µg/kg Methylene Chloride 11 µg/kg 2-Methylnaphthalene 45,000 µg/kg Naphthalene 27,000 µg/kg Phenanthrene 1,600 µg/kg Pyrene 1,300 µg/kg Toluene 440,000 µg/kg Trichloroethylene 12.5 µg/kg Xylenes 799,000 µg/kg Aluminum 16,900 mg/kg Arsenic 10.2 mg/kg Barium 43.1 mg/kg Beryllium 0.41 mg/kg Cadmium 1.5 mg/kg Chromium 17.1 mg/kg Cobalt 13.6 mg/kg Copper 52.5 mg/kg Iron 27,300 mg/kg Manganese 448 mg/kg Nickel 19.1 mg/kg Selenium 11.3 mg/kg Silver 0.25 mg/kg Thallium 67.8 mg/kg Vanadium 94.4 mg/kg Zinc 67.2 mg/kg			

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TABLE 2.4.3-1 (continued)
LIMITED SOURCE INVESTIGATION UNIT MAXIMUM CONTAMINANT CONCENTRATIONS
EARECKSON AIR FORCE STATION, ALASKA

Source Identification Current	Source Identification Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations		Migration Pathway	Exposed Population	Risk Assessment
FT 02 (cont'd)				Subsurface Soils		Air	Human Station residents via inhalation during recreational activities Station commercial/industrial workers (and contractor personnel) via inhalation Ecological Terrestrial organisms via inhalation. Plant uptake potential Aquatic organisms not thought to be exposed	Human Potential risks to humans are likely to be minimal as conditions at Eareckson AFS would encourage rapid and substantial dispersion of any air contaminants Ecological Potential risks assumed to be minimal for most Shemya species. Special habitat and life history traits could result in exposure for some species (e.g., burrowing or subterranean terrestrial species)
				Lead	2.3 mg/kg			
				TPH	23,649 mg/kg			
				Acenaphthene	730 µg/kg			
				Acetone	5,400 µg/kg			
				Methylene Chloride	3,500 µg/kg			
				Benzene	24,000 µg/kg			
				Bis(2-ethylhexyl)phthalate	790 µg/kg			
				Chlorobenzene	18 µg/kg			
				Ethylbenzene	140,000 µg/kg			
				2-Butanone	8,600 µg/kg			
				Dibenzofuran	1,200 µg/kg			
				Fluorene	1,600 µg/kg			
				2-Methylnaphthalene	32,000 µg/kg			
				4-Methyl-2-pentanone	15 µg/kg			
				Naphthalene	18,000 µg/kg			
				n-Nitrosodiphenylamine	950 µg/kg			
				Phenanthrene	1,900 µg/kg			
				1,1,2,2-Tetrachloroethane	5,000 µg/kg			
				Tetrachloroethylene	3,300 µg/kg	Free Product or Debris	Human Station commercial/industrial workers (and contractor personnel) via dermal contact. Possible dermal exposure during recreational activities. Ecological Terrestrial and aquatic organisms via dermal contact, possible ingestion	Human Potential risks to humans are likely to be minimal as it is highly unlikely that free product would be routinely contacted Ecological Birds and other species can be affected by physical contact with oil. Other risks would be as described for surface water/sediment
				Toluene	610,000 µg/kg			
				Xylenes	690,000 µg/kg			
				Aluminum	12,200 mg/kg			
				Antimony	4.1 mg/kg			
				Arsenic	11.6 mg/kg			
				Barium	26.5 mg/kg			
				Beryllium	0.63 mg/kg			
				Cadmium	1.8 mg/kg			
				Chromium	23.3 mg/kg			
				Cobalt	9.1 mg/kg			
				Copper	18.7 mg/kg			
				Iron	23,800 mg/kg			
				Manganese	259 mg/kg			
				Nickel	30.8 mg/kg			
				Silver	0.31 mg/kg			
				Thallium	61.7 mg/kg			
				Vanadium	18.4 mg/kg			
				Zinc	45.7 mg/kg			

TABLE 2.4.3-1 (continued)
LIMITED SOURCE INVESTIGATION UNIT MAXIMUM CONTAMINANT CONCENTRATIONS
EARECKSON AIR FORCE STATION, ALASKA

Source Identification: Current	Source Identification: Past	Source Unit Description	Background Concentrations	Contaminants and Contaminated Media and Highest Measured Concentrations	Migration Pathway	Exposed Population	Risk Assessment
FT 02 (cont'd)				Groundwater:			
				Benzene 512 µg/L			
				2,4-Dimethylphenol 28 µg/L			
				Ethylbenzene 690 µg/L			
				2-Methylphenol 18 µg/L			
				4-Methylphenol 31 µg/L			
				Naphthalene 32 µg/L			
				Phenol 11 µg/L			
				Toluene 898 µg/L			
				Xylenes 2,752 µg/L			
				Aluminum 62,500 µg/L			
				Barium 130 µg/L			
				Beryllium 3.1 µg/L			
				Cadmium 2.7 µg/L			
				Chromium 15.6 µg/L			
				Cobalt 9.7 µg/L			
				Copper 49.1 µg/L			
				Iron 54,700 µg/L			
				Manganese 1,760 µg/L			
				Nickel 17 µg/L			
				Vanadium 286 µg/L			
				Zinc 87.6 µg/L			
ST10/SS11		Well number AP-1529, located near Bldg. 806 in the west central part of the island. Free product has been reported floating on the water surface in this well.		No data have been collected.			
Building 828		Well number AP-1525, located north of the west end of the active runway. Free product has been reported floating on the water surface in this well.		No data have been collected.			

Notes:
AFFF = Aqueous Film Forming Foam
AFS = Air Force Station
mg/kg = milligrams per kilogram
mg/L = milligrams per liter
POL = petroleum, oil, and lubricant
TPH = total petroleum hydrocarbons
µg/kg = micrograms per kilogram
µg/L = micrograms per liter
WWII = World War II

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PRLs. Contaminants could be released by way of erosion and surface runoff, infiltration and percolation, and volatilization and dust emissions. Transport pathways would tend to be short, toward the nearby margins of the island. Exposures to construction and remedial workers are possible by ingestion and dermal contact with contaminated soils, and possibly, by inhalation of volatile and dust emissions. Terrestrial and aquatic biota could be exposed to 1) contaminated surface soils and 2) contaminated water and sediment at the shoreline. Contaminant concentrations detected in past soil samples have been below human health and ecological risk criteria (CH2M Hill, 1993b) and below PRLs. LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.4 Source Unit OT21

This source unit is the fuel barge grounded on the beach in Alcan Cove along the western side of the island. Fuel was removed from the barge after it ran aground in 1958. No data have been collected from this area, and the potential for contaminant release and subsequent exposure is remote. Except possibly for contaminants trapped in beach sediments, any contaminants released from the barge by spilling of fuel are likely to have been removed from the area by wave action. LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.5 Source Unit OT29

This source unit is an area of World War II munitions disposal on a rocky beach near the southeast corner of the island. The area is partially inundated at high tide. No data have been collected from this area. Trespassers and remedial workers may be at risk from detonation of munitions, and ecological receptors may be at risk from trace metals and chemicals released from the munitions. LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.6 Source Unit OT49

This source unit is Upper Lake, in the west-central part of the island, near the abandoned runways. This area was used for World War II munitions disposal, and may also be an area that receives POL and sewage contamination from upslope areas. Contaminants detected in the surface water of the lake include TPH, benzene, naphthalene, 1,2,3-trichlorobenzene, lead, and mercury, all at concentrations below PRLs. Contaminated water within the lake could flow downstream within the drainageway from the lake, or could infiltrate into underlying groundwater. Contaminated groundwater could discharge to the surface at springs, seeps, or discharge to streams. Exposures are likely to be limited to remedial workers or recreational users of the lake, who could come in contact with contaminated water. Terrestrial and aquatic biota in the lake, stream, and nearshore marine environment might also contact contaminated water and sediment. Both human and ecological receptors could ingest contaminated biota from the lake, such as by human consumption of game fish taken from the lake. However, because contaminant concentrations detected in the past have all been below PRLs, LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.7 **Source Unit SS20**

SS20 is located at the dock on Alcan Cove at the western end of the island. Potential contaminants include metal scrap, mostly dock pilings. Some debris was removed from the area in 1977 and 1978. Analyses of soil samples collected in 1992 indicated minimal TPH contamination, with up to 130 mg/kg of heavy fuel range petroleum hydrocarbons. Potential human exposure to contaminants at the unit appears to be essentially negligible, except possibly by dermal contact or inhalation of particulate emissions from contaminated soils. Ecological receptors might contact contaminants transported limited distances by erosion and runoff or groundwater discharge. LSI activities at this unit will provide data that are anticipated to support a no further action decision.

2.4.3.8 **Source Unit FT02**

FT02 includes the aircraft mockup, fire training area, and abandoned drum disposal site located in the vicinity of the intersection of abandoned runways B and C, near the western end of the island. The aircraft mockup and fire training areas were used for fire-fighting training. JP-4 and petroleum wastes were ignited and then extinguished with AFFF. Visibly contaminated soils and surface debris have been excavated and removed. An undetermined number of 55-gallon drums have been buried just west of this area.

Previous investigations have detected soil contamination with TPH, BTEX compounds, PAHs, metals, and halogenated solvents. Soil contaminants were detected after the soil excavation and removal activities during 1977 and 1985. Contaminants detected in groundwater include BTEX, metals, and some PAHs. Benzene and methylene chloride in groundwater, and TPH in soils, exceed human health risk criteria. Benzene in soil poses a potential ecological hazard (CH2M Hill, 1993b). A wide variety of contaminant transport pathways and receptors is possible. Human and ecological receptors could be exposed to contaminated soils by direct contact, ingestion, or inhalation. Groundwater is contaminated and could pose a threat to human and ecological receptors at points where it discharges to the surface. The surface water drainage to the west of the area has not been sampled, and poses a possible threat to 1) human receptors by direct contact or inhalation of volatiles or 2) ecological receptors by direct contact, ingestion, and inhalation.

A comparison of contaminant concentrations at this source unit with the PRLs summarized in Table 2.4.1-2 indicates that only arsenic exceeds risk levels in soils. However, arsenic has also been detected above risk levels in background soils. Benzene, xylenes, barium, and beryllium were detected above risk-based levels in groundwater samples. Benzene (0.512 mg/L) and beryllium (0.0031 mg/L) were detected at levels in excess of MCLs and carcinogenic risk levels. Total xylenes (2.752 mg/L) and barium (0.13 mg/L) were detected at levels in excess of noncarcinogenic hazard levels.

LSI activities at the unit will support a number of possible decisions. The abandoned drum disposal area will be investigated for possible early action because of the potential for discharge of contaminants to the ocean by way of surface water. The aircraft mockup area will be investigated and may be taken directly to FS. General site investigation data will be collected at the fire-training area.

2.4.3.9 Source Units ST10 and SS11 and Building 525

Source units ST10 and SS11 and Building 525 are areas where monitoring wells have detected free product floating on the water surface in the well. ST10 and SS11 include well AP-1529, located near Building 605 in the west-central part of the island. Building 525 includes well AP-1525, located north of the west end of the active runway. No data have been collected from these wells. They will be investigated to determine whether early actions are required for free product removal from the local water table.

2.5 DATA QUALITY OBJECTIVES

DQOs for both the basewide investigation and LSIs are identified in this section. The DQOs are intended to help guide the collection, analysis, and interpretation of data so that the general purposes of the 1993 investigations can be fulfilled. Those general purposes include 1) providing data to support interagency agreement negotiations in the event that Eareckson AFS is proposed for the NPL or other action, 2) conducting LSIs for the collection of supplemental data needed for disposition of individual source units, and 3) preparing work plans for data collection efforts during the 1994 and 1995 field season.

An ARAR evaluation was completed by CH2M Hill and included in their Stage 1 Final Technical Report (CH2M Hill, 1990). The ARAR evaluation is included as Appendix A to this Work Plan. The comprehensive ARARs list will be used to evaluate proposed early actions and conduct a screening of alternatives at specific areas after the 1993 field investigation activities are completed as discussed in Section 3.0. To evaluate the data generated from the 1993 field investigation activities, contaminant concentrations in environmental media will be compared with ARARs and human health and ecological risk levels described in the following sections. These risk levels were calculated using to-be-considered (TBC) criteria and guidelines described in EPA guidance (1989). TBC criteria and guidelines are used when ARARs are not available or additional information is necessary to provide protective cleanup levels.

DQOs have been developed in general conformance with EPA guidance (EPA, 1987a; 1987b). For example, the format of this section follows the topics outlined in the guidance documents. In some cases, however, the discussion is related to other sections of this document. For example, conceptual site models were discussed in Section 2.4, and sampling and other data collection activities are discussed in Section 3.0 and in the SAP, a companion document to this Work Plan.

2.5.1 Basewide Investigations

The basewide investigations are generally oriented toward obtaining information on a basewide basis that will help support future negotiations and will aid in scoping 1994 field activities. To the extent possible, the basewide investigations will address the questions of whether media-specific contamination is localized or widespread across the Station. In addition, the investigations will consider the extent to which media-specific contamination may pose a current or future risk to human health or the environment. The DQOs to meet these goals are discussed in the following paragraphs.

2.5.1.1 Identify Decision Types

The different objectives outlined above may require data to address different types of decisions. For example, data needed to establish groundwater flow directions include precise measurement of water-level depths and surveyed well locations and elevations. Data required to determine potential human health risk will include Air Force Level II laboratory analytical data deliverables for contaminants of potential concern. Air Force Level II data are equivalent to EPA Level IV data. Furthermore, the data users may include both project technical personnel as well as the cognizant decision makers. The personnel and processes leading to identification of appropriate decisions are outlined below.

Identify Data Users. The users of basewide data will include technical personnel, such as geologists, hydrologists, ecologists, and risk assessors; project management personnel, such as the members of the MAP team; and regulators, including representatives of the State of Alaska, the FWS, and possibly EPA. Through the process of quarterly MAP meetings, which have already begun, representatives of Eareckson AFS, the 11th CEOS, AFCEE, FWS, and State of Alaska, and technical consultants to various agencies, have already been intimately involved in the planning for these investigations. Following, or possibly before, any agreement negotiations, it is expected that EPA Region X (or EPA's Alaska office) personnel will also join the MAP team and enter the decision-making and approval process.

Evaluate Available Information. A thorough evaluation of available information has preceded the preparation of this Work Plan. The results of that evaluation are discussed throughout this plan, in particular within Sections 1.2, 1.5, and 2.1 through 2.3. These DQOs provide a bridge between that evaluation of existing information and the future activities planned for the fall of 1993 and beyond.

Develop Conceptual Model. Based on the review and evaluation of existing information, a basewide conceptual model has been developed and is discussed in Section 2.4.1. The model identifies contaminants of potential concern, contaminant source areas, release mechanisms, transport media, exposure routes, receptors, and contaminant concentrations at receptors.

Specify Objectives/Decisions. The objectives of the basewide investigations have been developed during MAP meetings held in the fall and winter of 1992/1993. Those objectives have been refined during the planning process leading to this Work Plan and the companion SAP. The general objectives of the basewide investigation, and decisions to be made, include the following:

- Determine whether groundwater contamination is localized or distributed basewide and whether groundwater poses current or future risks to human health and the environment.

- Determine whether surface water, spring, and seep contamination is localized or distributed basewide and whether surface water, springs, or seeps pose current or future risks to human health and the environment.

- Determine whether sediment contamination is localized or distributed basewide and whether contaminated sediments pose current or future risks to human health and the environment.

- Provide for basewide characterization of the hydrological and ecological environments to help focus future negotiations and 1994 and 1995 work plans.

- Collect data on background concentrations of potential contaminants in soils, surface water, and groundwater.

- Collect data needed for modeling of future contaminant transport through identified environmental pathways.

2.5.1.2 Identify Data Uses/Needs

Identify Data Uses. To address the basewide objectives stated above, the data collected during the 1993 field program will need to be applied to the following uses:

- Estimate the volume of water in storage in surface water bodies.

- Estimate the rate of surface water discharge exiting the island.

- Estimate the rate of groundwater discharge from the island through seeps and springs.

- Assess the degree of contamination of surface waters, seeps, and sediments (including near offshore sediments).

- Estimate background concentrations of contaminants in the various media (groundwater, surface water, and soils).

- Investigate the hydraulic connections among the shallow sand/peat aquifer, the deep bedrock aquifer, and surface water bodies (including marine waters).

- Assess hydraulic characteristics of groundwater aquifers and potential for infiltration of precipitation.

- Assess the degree of contamination of groundwater aquifers on the island.

- Identify the potential for migration of contaminated surficial soils to other environmental media.

- Conduct a basewide ecological survey.

Identify Data Types. A wide variety of data types will be collected for the uses listed above. The data to be collected will include both physical parameters and chemical constituents, as well as measurements of sample point location. In addition, surveys will be conducted for biotic communities and habitats, and for surface geological conditions.

Physical parameters will include the following:

- stream flow;

- depth of lakes;

- spring and seep flow;

- water levels in wells and well points;
- hydraulic characteristics of wells;
- lithologic properties of subsurface materials, such as grain size, color, rock type, and fracture presence and orientation; and
- physical and geochemical properties of subsurface soil samples, including grain-size distribution, bulk density, clay content, organic carbon content, cation-exchange capacity, porosity, moisture content, soil pH, and laboratory permeability.

Chemical constituents to be determined vary depending on the medium being sampled and the objective of the analyses. Screening-level samples of water and solid media will be analyzed at the onsite laboratory using GC methods. Analyses will be conducted by Method 8015 for diesel- and gasoline-range petroleum hydrocarbons, Method 8020 for purgeable aromatic volatile organics, and Method 8010 for halogenated volatile organics. Screening-level samples will be collected from streams, lakes, springs, well points, monitoring wells, surface and subsurface soils, and sediments.

A subset of samples collected will be transported to an offsite full-service laboratory for analyses of a broad spectrum of compounds, including volatile and semivolatile organics, dioxins and furans, pesticides and PCBs, trace metals, and major anions and cations in water. Analytical methods will be selected to achieve detection levels consistent with PRLs, as discussed in Section 2.4. Analytical methods for the offsite laboratory analysis are expected to include Methods SW8260/8240 for volatile organic compounds, modified Methods SW8100/SW8015 for DRO/GRO, Method SW8270 for semivolatile organic compounds, Method SW8080 for PCBs/pesticides, Method SW6020 for ICP metals, Method SW7421 for lead, Method SW7470/7471 for mercury, and Method E300.0 for major ions. Samples will be collected from streams, springs, lakes, surface and subsurface soils, and monitoring wells.

Additional data to be collected include the locations of sampling points. Both the geographic position and elevation of sampling points will be recorded.

Ecological data will be collected through literature reviews, interviews with knowledgeable Station and other personnel, an ecological survey of the site, and sampling of media that may pose particular risks to ecological receptors. The sampling activities will include the same kinds of data collection procedures as outlined above, and will be closely coordinated with the basewide physical and chemical sampling activities, as well the LSIs discussed in Section 2.6.2.

Identify Data Quality Needs. Data quality needs will vary, depending on the nature of the samples collected and the expected use of the data. Screening-level data will be used to locate samples for fixed laboratory analysis and provide preliminary estimates of the statistical variability of contaminant distributions. Because of the limited applications of screening-level data, they need not be of as high a level of quality as data required for risk assessment or remedial design, for example. Consequently, the screening-level data can employ field analyses, GC analyses with higher detection levels, stream flow and lake depth estimates rather than measurements, and less accurate topographic survey techniques.

The confirmatory samples sent for analyses to the offsite laboratory will be higher quality data. These data may be used, in 1993 or in the future, for risk assessment or remedial design purposes and thus, must meet Air Force Level II data reporting and deliverable requirements. These data will also be used to provide confirmation of the results of the onsite laboratory results. Because these data must meet Air Force Level II reporting requirements, they will require more comprehensive documentation of laboratory analyses. In general, however, both the onsite laboratory and offsite laboratory analyses will require comparable sampling, sample preservation, shipping, and documentation procedures; similar laboratory QA and QC procedures; and comparable accuracy in surveying of sample locations.

Identify Data Quantity Needs. The quantity of data needed will vary depending on the uses of the data. For example, screening-level groundwater level data from well points used to provide a preliminary estimate of the water-level gradient in an area of interest may require only a minimum of three data points (so that the gradient can be estimated by triangulation). However, to thoroughly characterize groundwater levels within a particular management zone, sufficient well point data will be required so that contouring of the shallow water-level surface can be performed in every geographic portion of the management zone. Preliminary estimates of well point requirements are given in Section 3.0 of this Work Plan. Approximately 240 well points are planned for the basewide investigations.

The numbers of new monitoring wells that will be required within a management zone currently cannot be completely defined. Well locations will be chosen at strategic locations determined from 1) the results of the field reconnaissance and 2) the screening-level water-level assessment using well points, supplemented by data from existing monitoring wells and results of the ecological survey. Preliminary estimates of the numbers of wells needed to address groundwater discharge off-island, and characterize groundwater conditions within Management Zone 7, are provided in Section 3.1. Approximately 47 shallow monitoring wells and six deep bedrock wells are planned.

Water quality and sediment samples will be collected from lakes and streams to provide preliminary indications of contaminant presence or background concentrations of potential contaminants. Because specific contaminant source units are not being targeted in this basewide sampling, a limited number of sample locations will be selected. Samples will be collected from most lakes and ponds on the island. For onsite screening analyses, one water sample will be collected from each of the 16 named lakes on the island, and from each of the five oil/water separator ponds in Management Zone 7. Hospital Lake will not be sampled because of the availability of recent data from the lake. Confirmational samples for offsite analyses with Air Force Level II data deliverables will also be collected from one or more locations in most lakes and ponds on the island. These samples will be selected based on results of the ecological survey, LSI data needs, and proximity to potential source units. When possible, sediment samples will be colocated with surface water samples and analyzed using comparable methods. Care will be taken during sample collection to prevent agitation of surface water and sediment.

Surface water and colocated sediment samples will also be collected from streams on the island. All flowing streams will be sampled at their discharge points to the ocean. In addition, samples will be collected at the confluence of two tributary streams in Management Zone 2, and in between most oil/water separator ponds in Management Zone 7. This step will permit characterization of possible variations among tributaries of water and sediment quality. Following review of data from the downgradient and off-island discharge points, additional stream and sediment sampling may be performed at select locations.

Samples will also be collected from 1) major springs on the island and 2) a limited number of seeps to be selected following a preliminary survey of the presence of seeps on the island. Approximately 15 spring and seep samples, chosen to be representative of the range of seeps identified on the island, are currently anticipated. Co-located sediment samples will also be collected. The spring/seep and sediment samples will be analyzed at the onsite laboratory, and about one-third of the samples will also be sent to the offsite laboratory for confirmational analyses.

Background soil samples for assessment of the presence of heavy metals pose a special problem, because heavy metals constitute a natural part of the soil environment. In addition, organic chemicals such as PAH compounds and some volatiles may be a natural component of peat soils. To be able to detect possible heavy metal and organic contamination within soil samples, the background distributions of these chemicals in the soils will need to be determined. This process will require that a sufficient number of samples be collected to determine the statistical properties of the distributions of chemicals of interest. In general, this requires estimating the mean, variance, and possibly, skewness and kurtosis of background distributions. The objective of the background sampling will be to provide 95 percent upper confidence or upper tolerance levels on background distributions so that individual samples from potentially contaminated areas can be compared with the background concentration ranges.

The number of background samples needed will be based on preliminary estimates of statistical distribution parameters based on previous sampling. For example, for many parameters, sufficient background sampling will have occurred so that the mean and variance of the background distribution can be estimated. Given such estimates, the number of additional samples needed to provide specified confidence limits on the mean can be determined from the following formula (Gilbert, 1987):

$$n = (Z_{1\text{-alpha}/2} * \text{sigma}/d)^2$$

where n is the total number of samples required, $Z_{1\text{-alpha}/2}$ is the standard normal deviate that cuts off (100alpha/2) percent of the upper tail of the standard normal distribution, sigma is the standard deviation of the population, and d represents the maximum allowable error in estimating the true population mean with the sample mean. If then we take the following equation:

$$d = m * \mu$$

where μ is the population mean, the following equation results:

$$n = (Z_{1\text{-alpha}/2} * CV/m)^2$$

where the coefficients of variation (CV) = sigma/μ is the coefficient of variation of the population. An estimate of n can then be obtained by letting CV be approximated by the ratio of standard deviation to mean of the background samples previously collected, and by requiring m to be some number less than one, so that the error in estimating μ by the sample mean is some fraction less than one of the true mean.

A review of background soils and sediment data from previous investigations at Shemya Island indicates that the sample CV varies between 0.27 and 1.1, with a mean of 0.65. The following table gives the number of samples required for various values of CV and m, with alpha = 0.05:

	m				
CV	0.2	0.3	0.4	0.5	0.6
0.3	9	4	3	2	1
0.5	23	11	6	4	3
0.7	45	20	12	8	5
0.9	74	33	19	12	9

For a value of CV between 0.5 and 0.7, an m of 0.4 to 0.5 would require a total of four to 12 samples. Historical data include two sediment samples and four soil samples. Thus, limited additional background soils data will be required. Eight additional soil samples and five additional sediment samples would give a background data set of 12 soil samples, seven sediment samples, for a total of 19 total samples (assuming the soil and sediment populations are the same). This should provide sufficient data for reasonable estimates of the distributions of background soil data.

In the preceding analysis, the existing background soil and sediment data were combined to provide preliminary estimates of the CVs of background distributions of potential contaminants in soil There are insufficient background data for either surface soil or sediment to estimate their CVs independently. Because natural sediments are generally transported from surface soil areas to areas of sediment deposition, natural sediments are expected to be similar in chemical and mineralogical composition to their source soils. Consequently, it is believed reasonable to combine the background surface soil and sediment data for the limited purpose of obtaining preliminary estimates of CVs.

The proposed background data set resulting from existing data and additional data to be collected during the autumn 1993 field investigations will include 12 soil samples and seven sediment samples. Based on the CVs of the combined data sets, these are expected to provide adequate background data sets for surface soils and sediments taken separately. Nonetheless, the statistical distributions of background data sets will be thoroughly reviewed to assure that sufficient background data have been collected, and additional background samples may be required during the 1994 investigations.

Evaluate Sampling and Analysis Options. Sampling and analysis options have been implicitly discussed in other parts of this Work Plan. For example, the use of screening-level data collection techniques, such as well points for groundwater sampling and use of an onsite GC laboratory, have been discussed above. Similarly, it has been noted previously that data to be used for risk assessment, remedial design, and confirmation of the onsite GC data must meet Air Force Level II reporting requirements.

Sampling and Analysis Approach. The sampling and analysis approaches for different media and different program elements (e.g., basewide versus LSI purposes) are discussed in detail in the SAP that accompanies this Work Plan. Details regarding the selection of sampling locations and techniques, and analytical methods, are provided there. The sampling and analysis approach outlined there has been developed in accordance with these DQOs.

Resource Considerations. Resource considerations are of even more importance at Eareckson AFS than at other IRP and CERCLA sites because of the relative remoteness of the Station, and the unusual climatic conditions. Limited transportation options and unavailability of facilities for procuring spare parts and equipment requires that all such materials be procured and shipped to the island in advance. Considerable logistical support is provided by the 11th CEOS, but a relatively long lead time is required to ensure availability of the support when needed in the field. Furthermore, because of limited transportation schedules to and from the island, the collection of chemical samples in the field must be closely coordinated with military and commercial flight schedules to ensure delivery of samples to the offsite laboratory within required holding times. These considerations are addressed in greater detail in the SAP.

2.5.1.3 Design Data Collection Program

The data collection program for the Eareckson AFS basewide investigation has been designed in conformance with the considerations and objectives outlined above. Details of the data collection program are provided in the SAP.

2.5.2 Limited Source Investigations

The LSIs are designed to supplement existing data to either verify that a no further action decision is appropriate for the source unit or that the site can proceed directly to FS stage with limited additional data collection. In some instances, the LSIs are designed to determine whether early action is required at a specific source unit. The LSI will also assist in determining the appropriate regulatory program for oversight of a specific source unit. In general, these decisions must be risk-based, or the data collected must be appropriate to support remedial design. Consequently, a higher level of data reporting may be required for LSIs than required for the basewide investigations. In most cases, however, the same types of data must be collected.

2.5.2.1 Identify Decision Type

The objectives outlined above may require data to address different types of decisions. For example, data required to determine potential human health or ecological risk will include Air Force Level II reporting requirements for contaminants of potential concern. Furthermore, the data users may include both project technical personnel as well as the cognizant decision-makers. The personnel and processes leading to identification of appropriate decisions are outlined below.

Identify Data Users. The users of LSI data will include the same personnel as those using the basewide data. These include technical personnel, project management personnel, and regulators. Input from all of these data users has been obtained through the process of quarterly MAP meetings and preparation of this Work Plan and the SAP.

Evaluate Available Information. A thorough evaluation of available information was performed before preparing this Work Plan. The results of that evaluation are discussed throughout this plan, in particular within Sections 1.2, 1.5, and 2.1 through 2.3. These DQOs provide a bridge between that evaluation of existing information and the activities planned for the fall of 1993 (Section 3.2) and beyond.

Develop Conceptual Model. Based on the review and evaluation of existing information, conceptual models of each area proposed for LSI have been developed and are discussed in Section 2.4.1. In general, the models identify contaminants of potential concern, contaminant source areas, release mechanisms, transport media, exposure routes, receptors, and contaminant concentrations at receptors. For source areas that can be taken to no further action decisions following completion of LSI, the models indicate that 1) one or more elements of the release/transport/exposure pathway are incomplete, or 2) contaminants are present below levels that produce an unacceptable risk to human health or the environment.

Specify Objectives/Decisions. The objectives of the LSIs have been developed during MAP meetings held in the fall and winter of 1992/1993. Those objectives have been refined during the planning process leading to this Work Plan and the companion SAP. The general objectives of the LSI, and decisions to be made, include the following:

- Collect supplementary data to support a no further action decision at a given source area. For example, in some areas where POL materials have been spilled, soil remediation has been conducted but it has not been demonstrated that underlying groundwater has not been adversely affected.

- Collect data to evaluate whether a current release that is occurring poses a human health or ecological risk so that an early action might be recommended.

- Collect supplementary data to support RI data required to move a source unit to the FS phase.

- Collect data to evaluate the regulatory program appropriate for individual source units, such as solid waste or other IRP sites.

2.5.2.2 Identify Data Uses/Needs

To address the LSI objectives stated above, specific data will need to be collected during the 1993 field program. Much of the data will be determined during the basewide investigations, such as physical properties of surface water bodies. Other data, such as site-specific chemical data, will be collected during the LSI but will be available to supplement basewide data. The data collected will need to be applied to the following uses:

- Estimate the volume of water in storage in surface water bodies directly associated with LSI source units. In most instances, these data will be available from the basewide investigations.

- Assess the degree of contamination of surface waters, seeps, or sediments (including near offshore sediments) directly associated with LSI source units. For most LSI source units, such information is largely available but may require limited supplemental or confirmatory sampling for specific media (e.g., groundwater, surface water, and soils).

- Estimate background concentrations of contaminants in the various media (groundwater, surface water, soils, and biota). The basewide investigation includes background characterization of all media. These data will allow comparisons with LSI data to assess risk at specific LSI source units.

- Investigate the hydraulic connections among the shallow sand/peat aquifer, the deep bedrock aquifer, and surface water bodies (including marine waters) directly associated with specific LSI source areas. This information will generally be available from previous studies or the basewide investigations, with only limited supplemental investigation at individual LSI source areas. However, installation of well points and monitoring wells will be needed at several LSI areas to determine local groundwater flow patterns.

- Assess the degree of contamination of groundwater aquifers directly associated with LSI source units. If sufficient data are not available, this process may require additional sampling for onsite and offsite laboratory analyses.

- Identify the potential for migration of contaminated surficial soils to other environmental media.

- Conduct an ecological survey in the immediate vicinity of LSI source units. This will require field surveys for the presence of sensitive species and habitats that might be affected by contaminant releases from LSI source units.

Identify Data Types. A wide variety of types of data will be collected for the uses listed above. Much of the data will be collected during the basewide investigations. Data to be collected specifically for the LSIs will include the following:

- Install well points to determine shallow groundwater flow directions, collect water samples for onsite screening analyses, and permit assessment of the presence of floating product on the water table where required.

- Install monitoring wells to allow for collection of water samples to be sent to the offsite laboratory and for collection of floating product samples. Monitoring wells may also be used for assessment of aquifer properties and for long-term monitoring in some areas.

- Collect surface water samples from streams or ponded water areas for onsite and confirmatory offsite chemical analyses.

- Collect surface, sediment, and subsurface soil samples for onsite and confirmatory offsite laboratory analyses.

Chemical constituents to be determined vary depending on the medium being sampled and the objective of the analyses. The analytical requirements for LSI samples will be essentially the same as those for basewide samples, as discussed in Section 2.5.1.

Additional data to be collected include the locations of sampling points. Both geographic position and elevation of sampling points will be recorded.

Identify Data Quality Needs. Data quality needs will vary, depending on the nature of the sample collected and the expected use of the data. Screening-level data will be used to locate samples for fixed laboratory analysis and provide preliminary estimates of the statistical variability of contaminant distributions. Because of the limited applications of screening-level data, they need not be of as high a level of quality as data required for risk assessment or remedial design, for example. Consequently, the screening-level data can employ field analyses, GC analyses with higher detection levels, and less accurate topographic survey techniques.

The confirmatory samples sent for analyses to the offsite laboratory will be higher quality data. These data may be used, in 1993 or in the future, for risk assessment or remedial design purposes and thus, must meet Air Force Level II data reporting and deliverable requirements. These data will also be used to provide confirmation of the results of the onsite laboratory results. Because these data must meet Air Force Level II reporting requirements, they will require more comprehensive documentation of laboratory analyses. In general, however, both the onsite laboratory and offsite laboratory analyses will require comparable sampling, sample preservation, shipping, and documentation procedures; similar laboratory QA and QC procedures; and comparable accuracy in surveying of sample locations.

Identify Data Quantity Needs. The quantity of data needed will vary depending on the uses of the data. For example, to characterize groundwater levels associated with an LSI source unit, sufficient well point data will be required so that contouring of the shallow water-level surface can be performed in the vicinity of the source unit. This procedure will generally require data from three to five well points, depending on the size of the source unit. At Source Units SS07/ST08 and ST10/SS11 and Building 525, where floating product has been detected and early actions may be required, 10 to 15 well points will be installed to determine the extent of floating product and groundwater contamination. At the FT02 Aircraft Mock-up area, a similar number of well points will be installed to assess the extent of groundwater contamination so that the FS can be developed.

Water quality and sediment samples will be collected from other media specific to LSI source units to provide indications of contaminant presence or background concentrations of potential contaminants. Sample locations will incorporate those employed for the basewide investigations, with only a limited number of additional sample locations selected. These samples will coincide, where possible, with samples required for ecological survey purposes to minimize sampling costs.

Evaluate Sampling and Analysis Options. Sampling and analysis options have been discussed in other parts of this Work Plan. For example, it has been noted that data to be used for risk assessment and remedial design must meet Air Force Level II data reporting requirements.

Sampling and Analysis Approach. The sampling and analysis approaches for different media are discussed in detail in Section 3.2 and in the SAP that accompanies this Work Plan. Details regarding the selection of sampling locations and techniques, and analytical methods, are provided in the SAP. The sampling and analysis approach outlined in the SAP has been developed in accordance with these DQOs.

Resource Considerations. Resource considerations are of even more importance at Eareckson AFS than at other IRP and CERCLA sites because of the relative remoteness of the Station, and the unusual climatic conditions. These considerations are addressed in more detail in Section 2.5.1.2 and in the SAP.

2.5.2.3 Design Data Collection Program

The data collection programs for individual LSI source areas have been designed in conformance with the considerations and objectives outlined above. Details of the data collection programs are provided in Section 3.2 and in the SAP.

3.0 INVESTIGATION ACTIVITIES

The following sections describe the investigation activities that will be conducted during the 1993 field investigation. The 1993 field investigation includes two primary components: the basewide investigation and the LSI. The basewide investigation is described in Section 3.1 and the LSI is discussed in Section 3.2. Section 3.3 describes how the two investigation components will be coordinated.

The basewide technical approach described in Section 3.1 includes sampling of surface water/seeps, groundwater, and soils; an ecological survey; and associated activities. Potential source units that have been identified on Shemya Island are described in Section 2.1. The specific potential source units that will be evaluated during the LSI are discussed in Section 3.2. The LSI at specific potential source units includes sampling of surface water, groundwater, and soils. There is one sampling program planned for the 1993 field investigations. Results of the sampling program will be used to support the objectives of both the basewide investigations and the LSI.

3.1 BASEWIDE INVESTIGATION APPROACH

The basewide investigation consists of four specific activities:

- a surface water/seep investigation;
- a groundwater investigation;
- an ecological survey; and
- a background sampling program.

The objectives of the basewide investigation include 1) supporting possible interagency negotiations, 2) providing a better understanding of current physical and chemical conditions of the island, 3) determining whether contamination is widespread or source specific, 4) determining whether on- and off-island discharges are affecting human and ecological receptors, and 5) evaluating whether the management zone concept (Section 2.3) can be applied to portions of the island to predict future risks.

The purpose of the basewide investigation is to provide an original technical approach to environmental investigations because much of the previous environmental work conducted on the island has focused on individual potential sources of contamination. Subsequently, relatively little information is available on island-wide physical and chemical conditions. A basewide investigation is necessary for evaluating contaminant transport pathways, collecting data pertaining to background conditions, preparing predictive models, and obtaining sample analytical results.

The information obtained during the basewide investigation will be used to develop, plan, and execute a further investigation, which is planned for 1994. The results of the basewide investigation will be used to determine areas of contamination related to potential source units or other areas; however, because Shemya has a localized island setting, somewhat unique methods of data interpretation may be required. The basewide investigation is proposed at Shemya to evaluate the best technical approach for future investigations planned for 1994.

Each of the four individual investigations that will be conducted under the basewide approach are designed to be interrelated. For example, samples collected from specific lakes may be used for the surface water investigation and to assess the potential risks to human and environmental receptors as part of the ecological survey requirements. In addition, the basewide approach has been designed to complement the data requirements of the LSI, where possible. Potential source unit investigations are discussed in Section 3.2.

Each of the specific investigations in the basewide investigation is discussed in the following sections. The tasks necessary to accomplish the objectives of each investigation are described in detail and include the rationale for each program. Sample locations, sample numbers, analytical methods, and other pertinent information are presented in figures and tables within each applicable section.

Management Zone 7. As discussed in Section 2.3, the island has been divided into management zones that are based on drainage divides on the island. The purpose of the management zone approach is to determine if off-island discharges, potential source units, or widespread contamination across the island are affected by drainage divides, and to divide the island into smaller segments for more manageable investigation. The goal of the management zone approach is to predict risk using modeling applications, risk assessment, and data collection. The remaining 1993 effort will focus on Management Zone 7 as a "pilot" study. Because Management Zone 7 includes a large number of potential source units, an emphasis will be placed on this zone during the basewide field investigation. Additional information about the area is necessary before contamination can be traced to a specific source. The following are objectives of this focused investigation:

- evaluate the management zone approach of basewide investigation on the island;
- provide information pertaining to specific potential source units; and
- obtain information necessary to evaluate specific areas for potential early action.

The focused investigation at Management Zone 7 is not specifically detailed in the individual investigation subsections; however, the distributions of sample points are shown in the figures that the support objectives, tasks, and rationale of the investigation.

3.1.1 Surface Water/Seep Investigation

The goal of the surface water/seep investigation is to provide information about the chemical and physical properties of surface water features on Shemya Island. Surface water features included in this investigation are lakes, ponds, streams, drainages, seeps, springs, and sediments below these features. The surface water/seep investigation is included in the basewide technical approach; however, specific samples may also be collected in support of the ecological survey and LSI. These are described in the following paragraphs, where applicable.

The following are the objectives of the surface water/seep investigation:

- Determine if contamination or potential contamination is widespread in surface water features and sediments on the island or if it may be related to potential source units.

- Provide water-quality information for surface water features not characterized during previous investigations.

- Provide physical characteristics, such as volumes and flow rates, for contaminant loading and water mass balance estimates.

The specific tasks required to meet these objectives are discussed in the following paragraphs.

Surface Water Feature Inventory. A main activity of the basewide investigation is to gather information pertaining to surface water features on the island. An island-wide site reconnaissance was conducted in June 1993 to locate and identify each surface water feature. A preliminary inventory was compiled as part of the literature review (Section 1.5), and the inventory task included verification and assessment of this preliminary inventory. The site reconnaissance identified and verified drainage divides, stream gauging locations, and proposed sample locations No on-island background locations were identified. Information pertaining to accessibility of surface water features and other logistical and administrative concerns were noted. Inventory and site reconnaissance tasks were conducted during different time periods to evaluate varying flow rates (specifically streams and seeps) as a result of precipitation. Estimates of flow rates under varying precipitation and meteorological conditions will be used in the basewide data interpretation. Visual observations noted during the site reconnaissance were recorded in the field logbook as discussed in Section 2.1.3 in the SAP. The individual tasks accomplished during the site reconnaissance are presented in Section 2.1.1 in the SAP.

Surface Water Feature Mapping. The number, size, and boundaries of surface water features on the island were assessed during the inventory, and each feature was accurately shown on a map. The base map of surface water features that will be used during the inventory and mapping tasks was compiled from a review of existing information on plat maps. Topography was the basis for the map. Figure 2.1.4-1 shows the existing compilation and interpretation of surface water features on Shemya Island. Drainage divides separating proposed management zones will also be verified and accurately located on the map. Changes to the ground surface may have occurred as a result of new construction after the publication of the plat maps.

Surface Water Feature Identification. Each unnamed prominent surface water feature was designated with an alphanumeric identifier. Prominent features are those features adjacent or related to source units, lakes, ponds, or off-island discharge points. This identifier was specified on the site reconnaissance map and in the field logbook, and will be used to identify the feature during subsequent investigation activities. The identification task was conducted as part of the inventory and mapping tasks. The actual identifier was chosen for compatibility with the nomenclature discussed in Section 2.2.7.1 of the SAP.

Surface Water Feature Sampling. Surface water and sediment samples will be collected from specific features. This task is designed to assess water quality and potential sediment contamination on the island and at off-island discharge points. Information from the literature review indicates that water-quality data for surface water features are limited. Less than half of the lakes on the island have had any type of previous sampling, and for those that have been sampled, the majority of the water-quality analyses are from the 1950s and 1970s. Analyses for hazardous substances have not been routinely performed. Minimal water quality information is available for seeps, springs, and streams. The following describes the surface water feature sampling to be performed on lakes and ponds, streams and drainages, and seeps and springs:

- Lakes/Ponds. Samples will be collected from most lakes and ponds on the island. Two different levels of reporting will be specified for these samples: onsite screening and fixed laboratory confirmation. In addition, the numbers of samples and analytical suites are different for each location, even though only one sampling program will be performed. With the exception of Hospital Lake, one water sample will be collected from each of the 16 named lakes and from the five oil/water separator ponds in Management Zone 7 (SS07) for onsite screening. Analytical methods are discussed below in Surface Water Feature Sample Analysis. Samples from Hospital Lake will not be collected during the investigation because recent data of acceptable quality and quantity are available. Sample collection procedures are described in Section 2.1.3 in the SAP.

Screening-level sediment samples will be collected from beneath lake surface water samples. Care will be taken to prevent agitation of sediments during surface water sample collection. Sediment sample collection procedures are discussed in Section 2.2.5 of the SAP. Confirmational sediment samples will also be collected with the surface water samples. The total number of screening level samples from sediments in lakes and ponds is expected to be 20. Confirmational sampling (Air Force Level II data deliverables) will also be performed at one or more locations within most lakes and ponds, depending on the results of the ecological survey, LSI data needs, and proximity to potential source units. Based on a literature review, additional confirmation samples are necessary from the western lake complex, including Lower, Middle, Upper, and Laundry lakes. This is due to preliminary identification of the western lake complex as a sensitive habitat for migrating water fowl, specifically the Aleutian Canada goose. A minimum of two sample locations from each of these lakes will be collected, with the exception of Upper Lake. If other lakes are identified as sensitive habitats during the ecological survey or meet any of the criteria specified above, additional samples may be collected.

If a lake is not determined to be a sensitive habitat, the surrounding area will be evaluated for proximity to potential source units. Lakes located sufficiently near, and downgradient of, source units will also be sampled. At such lakes a minimum of one sample location will be selected at a downgradient point. This location will be representative of conditions in the area. For example, a single sample may be collected near the lake outflow or discharge point or at the confluence of several lake discharges. Best professional judgment will be used to identify lakes to be sampled and appropriate sampling locations.

Upper Lake, designated as OT49, is also a potential source unit. A specific sampling program for Upper Lake is described in Section 3.2.1; the program includes additional sample locations. Sample data collected from Upper Lake will be used for the LSI program, the basewide surface water/seep investigation, and the ecological survey.

A total of 20 lake surface water samples is expected to be collected. An equal number of sediment samples will also be collected. Plate 2 shows the proposed locations of the lake and sediment samples for both onsite and offsite laboratory analysis, and Table 3.1.1-1 summarizes the sampling and analysis requirements for lake and sediment samples. The proposed sample locations are shown on Plate 2. Exact locations will be determined following the site reconnaissance and the ecological survey.

- Streams/Drainages. Surface water and sediment samples will be collected from points along stream courses and at or near off-island discharge points. These sample locations are shown on Plate 2. Sampling and analysis requirements are shown in Table 3.1.1-1. All flowing streams will be sampled as close as possible to their off-island discharge point. Interpretation of available maps and aerial photographs suggests that there are 22 sample locations. These locations appear

TABLE 3.1.1-1
FIELD OPERATIONS SUMMARY FOR BASEWIDE INVESTIGATION
SURFACE WATER/SEEP INVESTIGATION
EARECKSON AIR FORCE STATION, ALASKA

	Number of Samples				Fixed Laboratory Analysis								QC Samples			
Basewide Investigation	Lake	Stream/ Drainage	Seep/ Spring	Sediment	DRO & GRO Modified 8100/8015	Volatile Organics 8260/8240	ICP Metals and Hg 6020 and 7470/7471	PCBs/ Pesticides 8080	Semi-Volatile Organics 8270	Major Ions E300.0	Data Level	Field Screen	Trip Blank (1)	Equip. Blank (2)	Ambient Blank (2)	Duplicate (2)
Surface Water/ Seep Investigation	20			20	20	20 20	20 20	20 20	20 20	20	II II	20 20	4	2/2	2	2/2
		30		30	10	10 10	10 10	10 10	10 10	10	II II	30 30	6	3/3	3	3/3
			15	15	5	5 5	5 5	5 5	5 5	5 0	II	15 15	2	1/1	1	1/1

Notes:

(1) = Estimated based on 20 percent of samples collected for volatile organic analyses; 4 = fixed laboratory analysis only
(2) = Estimated based on 10 percent of total samples collected; 2/2 = onsite/fixed laboratory analysis; 2 = fixed laboratory analysis only.

DRO = diesel-range organics
GRO = gasoline-range organics
HG = mercury
ICP = inductively coupled plasma
PCBs = polychlorinated biphenyls
QC = quality control
Equip. = equipment

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on Plate 2. The exact number of off-island discharge points will be determined during the site reconnaissance or during the sampling event. Some of these sample locations will be within tidal flats, west of Management Zone 7. Eight additional stream sample locations have been identified inland. These locations are concentrated within Management Zones 2a, 2b, and 7 as shown on Plate 2. The three locations within Management Zones 2a and 2b are in close proximity to the Water Gallery, and are placed upstream and downstream of the confluence of two major tributaries to Gallery Creek in order to assess possible changes in water quality of the creek. The other five inland stream sample locations are within Management Zone 7, which contains numerous potential source units and is an area where human health or ecological risks are likely. The sampling points are along the drainage connecting the oil/water separator ponds. Additional sample locations along the streams or at other streams on the island have not been specified at this time because potential risk has not been identified, and because onsite analytical results from downgradient or off-island discharge locations are not yet available. As with the lake sampling program, an equal number of sediment samples will be collected, if possible, beneath stream sample locations. All stream samples will be collected for both onsite screening and offsite confirmation as discussed in *Surface Water Feature Analysis*.

A specific investigation is described in Section 3.2.2 for a drainage running under the runway at the Abandoned Drum Disposal Area (FT02) for the LSI. The data collected from the drainage will be used to support the LSI program, the basewide surface water/seep investigation, and the ecological survey.

A total of 30 stream surface water samples is expected to be collected. This number includes both off-island discharge locations and inland locations. The same number of sediment samples will also be collected.

- Seeps/Springs. Currently, approximately 30 seeps have been identified on the island (Plate 2). Seep/spring discharge points will only be sampled if the flow is sufficient to collect a representative sample. Sediment samples will be collected regardless of seep/spring flow. Samples will be collected from 15 specific seeps/springs based on visual observations, presence of sheens or staining, and ecological significance. Water from all seeps/springs with sufficient flow will be analyzed for field parameters using portable equipment as described in Section 2.1.3 in the SAP. Table 3.1.1-1 presents seep/spring and associated sediment sample analytical requirements. All 15 seep/spring samples will be analyzed by the onsite laboratory, and five seep/spring samples will be analyzed by the offsite laboratory as discussed in the next section.

Surface Water Feature Sample Analysis. Two levels of laboratory reporting will be used throughout the 1993 basewide and LSI. The field or onsite laboratory will provide screening-level data deliverables (results); whereas the fixed or offsite laboratory will provide Air Force Level II data deliverables. Analytical procedures and a description of laboratory deliverables are presented in Section 1.0 of the SAP.

Most surface water and sediment samples collected during the surface water/seep investigation, with the exception of certain seeps noted in *Seeps/Springs*, will be sent to the onsite laboratory for screening analysis of volatile organic compounds (SW8010/8020), and TPH (SW8015 modified). As presented in Table 3.1.1-1, a total of 35 surface water and 35 sediment samples will be screened at the onsite laboratory.

Surface water and sediment samples collected from surface water features that are determined to be potential habitats during the ecological survey or that will be sampled to support the LSI will be sent to the offsite laboratory for DRO and GRO (SW8100/SW8015 modified), halogenated and purgeable aromatic volatile organic compounds (SW8260/8240), semivolatile organic compounds (SW8270), PCBs/pesticides (SW8080), ICP metals (SW6020), and mercury (SW7470/7471). Major ions (E300.0) analyses will also be included for surface water samples. Samples will be selected for offsite analysis based on the results of the onsite laboratory screening. For planning purposes, it is assumed that 35 surface water samples and 35 sediment samples will be sent to the offsite laboratory for analysis.

A long-term surface water monitoring network may be recommended based on the results of the surface water/seep investigation. This network, if required, will be included as a recommendation in the report submitted following completion of the 1993 field investigation.

Determine Flow and Volume. If there is not sufficient flow in a surface water feature, the flow will be estimated. Where flow is sufficient, the volume in a surface water feature will be measured with portable equipment as described in Section 2.1.9 in the SAP. The flow and physical characteristics of the feature will be used to estimate its volume. The inventory of surface water features, flow estimates and measurements, and volume estimates are needed to determine water mass balance and to better define the interaction of the various surface water features on the underlying shallow aquifer. Volume estimates will be made for all standing water bodies of relative significance based on surface area and depth. The elevations of surface water bodies will be determined to aid in evaluating the relationship between surface water and the shallow aquifer. Elevations can be determined to within a 1-foot accuracy using the 1-inch to 100-foot scale plat maps. Greater accuracy can be obtained by surveying surface water elevations and monitoring wells at the same time in areas where both are present.

Surface Water/Seep Discharge Evaluation. This task is designed to determine the rate of off-island discharge of all surface water features. Determining the rate of runoff over time and over various intensities of precipitation may assist in determining volume estimates. These volume estimates and chemical water-quality data will be used to estimate contaminant loading. As time permits, surface water features will be evaluated during different precipitation and meteorological conditions.

Program Integration. The basewide surface water/seep investigation tasks listed above will be conducted in coordination with the ecological survey, the background sampling, and the LSI. The 1993 field investigation includes one sampling program. The data from the sampling program may be used to support the objectives of the surface water/seep investigation, the LSI, and the ecological survey. Surface water and sediment sampling requirements specific to the LSI are discussed in detail in Section 3.2. General requirements for the ecological survey are described in Section 3.1.3. Specific sample requirements for the ecological survey will be initially defined during the basewide and LSI site reconnaissance, and finalized following the ecological survey.

3.1.2 Groundwater Investigation

One major activity of the basewide program is to gather a variety of information about groundwater on Shemya as it pertains to both individual management zones and the island as a whole. One specific objective of this investigation is to determine if contamination or potential contamination is widespread in this medium or if it is related to source units. The basewide groundwater investigation should also provide additional understanding of groundwater properties and characteristics, contaminant transport over time, and the associated risks to human health and the environment. The tasks discussed below incorporate these and other information requirements. The general tasks that will be conducted during the groundwater investigation will be to inventory existing monitoring wells, well points, and piezometers for usability; install well points and monitoring wells, measure water levels and collect samples for analyses; determine locations of and install additional new monitoring wells; and collect samples for analyses and perform slug tests on new and existing wells. Following completion of the basewide groundwater investigation, a groundwater monitoring network should be in place capable of assessing present and future water quality at strategic locations. The groundwater monitoring network will include wells installed during the groundwater investigation and the LSI. The network may require periodic monitoring, depending on the results of the basewide investigation and the LSI.

The following tasks have been identified to assist in the interpretation of island-wide and management zone-specific hydrogeology. These tasks will assist with mathematical analyses and modeling programs that will be used to interpret the results of the groundwater investigation, identify immediate environmental threats, and identify areas where future investigations may be required.

Literature Review. The first task in the basewide groundwater investigation was to compile all existing information into a manageable form. This process included, but was not limited to, 1) identifying and extracting pertinent information from available studies, 2) constructing a well location map, 3) identifying the suitability of each well for monitoring use through well construction review, and 4) summarizing information from each well, such as depth to water, immiscible layers, water quality, and hydraulic characteristics. The results of this initial step are complete and incorporated into the *Work Plan*, where applicable.

As part of the literature review, specifications for existing shallow monitoring wells were compiled (Section 2.1.3, Table 2.1.3-1). This list was used to initiate site reconnaissance activities.

Site Reconnaissance. The next task in the groundwater investigation was to verify, to the extent possible, the findings of the literature review. This step was performed during a site reconnaissance in June 1993. The tasks included 1) performing an existing well inventory of all wells on Shemya, 2) evaluating the usability of each well, and 3) verifying, in the field, the anticipated locations of monitoring wells, well points, and soil borings.

The inventory and evaluation of existing wells is designed to provide current information on the location, use, and integrity of these wells. The literature review has identified monitoring wells and deep water wells constructed between the 1940s and 1992 (Section 2.1.3). To evaluate these for monitoring purposes (physical and chemical properties), attempts were made to locate the wells. This step was particularly appropriate because some wells may have been abandoned or destroyed as a result of vehicular damage or new construction.

During this program, all existing wells that may be included in the basewide groundwater investigation were 1) monitored for organic vapors in the well headspace, 2) measured for immiscible layers, 3) measured for groundwater depth, and 4) measured for total depth. These results should provide current information on these wells and will assist in the refinement of the basewide investigation, if needed.

Well Point Installation, Sampling, and Analysis. The first task of the groundwater investigation field effort will be to install temporary well points. These points may provide information such as depth to bedrock, water levels in the shallow sand and peat aquifer, and screening-level water quality data. Following completion of this task, many of the permanent monitoring well locations will be determined. As the data obtained from the well points are evaluated, locations of permanent monitoring wells will then be established.

Well points will be installed at biased and random locations throughout the island. A higher concentration of well points will be advanced within Management Zone 7. Plate 2 shows the preliminary location of each well point. Well point locations on Plate 2 were placed primarily to provide adequate spatial distribution of island-wide water level and water quality information. Well point locations are typically perpendicular to the expected groundwater flow direction for island wide water level estimations, and parallel to groundwater flow for comparison to stream elevations. These locations may require refinement because of structures, utilities, ease of surveying, and other factors, identified during the site reconnaissance program. Approximately 240 well points are currently estimated to be included in the groundwater investigation.

As described in Section 2.1.7 of the SAP, well points will be driven using hand tools, if possible. Following advancement, the water level will be monitored and then recorded after equilibrium has been reached. Three casing volumes of water will be purged from the well point before sampling. If the well point purges dry before three casing volumes are removed, groundwater samples will be collected as soon as the water level has recovered sufficiently to allow sample collection. At select well points, screening-level water samples will be collected. For planning purposes, it is estimated that 50 percent or 120 well points will also be sampled for onsite screening analysis. Ten percent or 24 well point samples will be analyzed for general water quality parameters (major ions) at the offsite laboratory. The onsite field laboratory will analyze most well point groundwater samples. Depending on the capacity of the onsite laboratory, greater than 50 percent of the well points may be sampled and analyzed. Specific well point locations, and the number of samples analyzed will be determined using the results of the site reconnaissance program and based on the operational limitations of the proposed approach.

The analytical suite for well point samples will include volatile organics (SW8010/8020) and TPH (SW8015 modified) at the onsite laboratory, and major ions (E300.0) at the offsite laboratory. Table 3.1.2-1 summarizes the analytical requirements for groundwater samples collected from well points.

Either during or after all measurements and samples are collected, the well points will be surveyed. Both vertical and horizontal components will be surveyed. Vertical elevations will be determined at the ground surface for each well point so that groundwater elevations can be plotted. Horizontal coordinates will allow for location of the well points on maps and figures, to reoccupy the locality if additional investigation is required, and to accurately note locations of abandoned wells. A detailed description of well point surveying is presented in Section 2.1.2.1 of the SAP.

Well points will be removed following data collection using hand methods, if possible. These well points will then be decontaminated as specified in Section 2.1.14 of the SAP and reused. A select number of well points may be left in place to monitor water levels and, possibly, water quality over time. These well points will be labeled and equipped with temporary caps.

TABLE 3.1.2-1
FIELD OPERATIONS SUMMARY FOR BASEWIDE INVESTIGATION
GROUNDWATER INVESTIGATION
EARECKSON AIR FORCE STATION, ALASKA

Basewide Investigation	Number of Samples			Fixed Laboratory Analysis							Field Screen	QC Samples			
	Ground Water (Well Points)	Ground Water (Wells)	Soil	DRO & GRO Modified 8100/8015	Volatile Organics 8260/8240	ICP Metals and Hg 6020 and 7470/7471	PCBs Pesticides 8080	Semi-Volatile Organics 8270	Major Ions E300.0	Data Level		Trip Blank (1)	Equip. Blank (2)	Ambient Blank (2)	Duplicate (2)
Groundwater Investigation	120								24		120	–	12/0	–	12/0
		74		44	44	44	44	44	44	I	74	9	4/4	4	4/4
			47								47	–	5/0	–	5/0

Notes:

(1) = Estimated based on 20 percent of samples collected for volatile organic analyses; 9 = fixed laboratory analyses only
(2) = Estimated based on 10 percent of total samples collected; 12/0 = onsite/fixed laboratory analysis; 4 = fixed laboratory analysis only.
– = not required
DRO = diesel-range organics
Equip. = equipment
GRO = gasoline-range organics
Hg = mercury
ICP = inductively coupled plasma
PCBs = polychlorinated biphenyls
QC = quality control

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Monitoring Well Installation, Sampling, and Analyses. Monitoring wells will be constructed at several locations, based on current information and the information obtained from the well point study. Plate 2 illustrates the approximate locations of monitoring wells anticipated to be constructed regardless of the findings of the well point study. These wells are generally located at strategic positions on the island, mostly at or near where shallow groundwater would be expected to migrate off the island. The purpose of these wells is primarily to monitor the quality of water migrating off the island. As illustrated on Plate 2, these wells are located along the southern and western coast of the island where groundwater is assumed to exit the island as either seeps or springs, recharge to streams, or as subsurface flow. The second area of emphasis is located within Management Zone 7. The locations of permanent monitoring wells within Management Zone 7 are designed to monitor the quality of groundwater exiting the island, and to estimate the relative impact of the various potential source units located within this zone. For example, each well located hydraulically upgradient of the groundwater discharge zone (assumed to be near the coast) has been placed to monitor groundwater quality at specific areas within the zone such as downgradient of former diesel storage tanks, the power plant, old Cobra Dane, and other potential source units. Finally, a few wells will be completed at LSI sites and incorporated into the basewide groundwater investigation as described in Section 3.2. These wells are shown on Plate 2. A description of the monitoring wells to be installed and the sampling to be conducted at these wells follows:

- Shallow Aquifer Monitoring Wells. Most monitoring wells located in the shallow sand and peat aquifer will be constructed using a drill rig equipped with hollow-stem auger. Soil samples will be collected during auger advancement for lithologic description and chemical and physical analyses. One, and possibly more samples will be collected for chemical analysis at the onsite screening laboratory as determined by the supervising geologist. This sample(s) will be determined based on visual and olfactory observations, field instrument readings, changes in lithology, and possibly other criteria such as capacity of the laboratory. Table 3.1.2-1 specifies subsurface soil analytical requirements. Specific procedures for drilling, soil sampling, and well installation are presented in Sections 2.1.4 and 2.1.6 of the SAP. At some locations, the overburden lithologies (e.g., cobbles and boulders, rip rap, etc.) may prevent the use of a hollow-stem auger. In these instances, an air rotary rig, or equivalent, capable of casing advancement during drilling will be used as described below.

  Schedule 40 polyvinyl chloride (PVC) will be used as the well screen and casing material. All wells will be 2 inches in diameter, except in areas where immiscible layers are detected or in deep bedrock locations. In these instances, 4-inch inside diameter wells will be installed using Schedule 80 PVC. Well installation procedures and well specifications are described in Section 2.1.6 in the SAP.

  A total of 24 shallow aquifer monitoring wells are anticipated to be constructed in strategic locations based on the literature review. For planning purposes, it is estimated that 23 additional shallow aquifer monitoring wells will be installed; 13 will be located basewide and 10 will be within Management Zone 7 based on the results of the site reconnaissance. A total of 47 shallow aquifer wells are anticipated to be constructed during the basewide groundwater investigation.

- Bedrock Monitoring Wells. Wells constructed in the deep bedrock will require use of air rotary or equivalent drilling methods. Coring of the bedrock will be attempted in the third well constructed in the deep bedrock. Review of existing core logs suggests that little, if any, core recovery is possible. If core recovery is achieved in the third well, coring will be attempted on subsequent deep bedrock wells. A detailed discussion on lithologic logging is presented in Section 2.1.4.5 in the SAP. Samples of bedrock will not be collected for chemical analysis.

Up to six deep bedrock monitoring wells may be constructed. These wells will be located in the central part of the island and at downgradient locations along the southern and western sides of the island. The bedrock wells will be located downgradient of known contaminant sources along geologic structures, and in presumed basewide downgradient areas (e.g., along the southern shore) to determine potential interaction between the deep and shallow aquifers. Based on the site reconnaissance six existing deep bedrock wells will be usable. Up to five existing bedrock wells will require intrusive work to determine their usability. Therefore, two new bedrock monitoring wells will be located in the northern portion of the island, and four will be located in the southern portion. Bedrock monitoring wells will be placed based on 1) fracture/fault zone identification and mapping, 2) evaluation of existing data (with particular emphasis on the occurrence of groundwater), 3) areas where hydraulic characteristics may be more representative, 4) areas where contamination or potential contamination is suspected, and 5) ease of access. Areas with known or suspected higher yields may be given preference.

- Sampling and Analysis. Following construction of new monitoring wells, water quality will be assessed from these and selected existing wells. Water quality will be sampled using the procedures detailed in Sections 2.2 and 2.3 of the SAP. Following determination of the concentration of total volatile organics at the wellhead, the depth to groundwater and the presence of immiscible layers will be noted. If possible, three borehole volumes of water will then be purged from the well while simultaneously collecting field parameter measurements. Groundwater samples will then be collected and analyzed for select species, as described in following paragraphs. Groundwater sampling procedures are detailed in Section 2.2.1 of the SAP. The wells will also be surveyed by a State of Alaska-certified surveyor following construction, as discussed in Section 2.1.12 in the SAP.

Two types of laboratory reporting will be used throughout the 1993 basewide and LSI: onsite (field) laboratory reporting and offsite laboratory reporting. The onsite laboratory will provide screening-level data deliverables (results); whereas the fixed or offsite laboratory will provide Air Force Level II data deliverables. A detailed discussion of these laboratories was previously presented in Section 1.4.3.1. Analytical procedures and related information are presented in Section 1.0 of the SAP.

Groundwater quality will be determined using several analytical methods and two different laboratories. All groundwater samples collected during this investigation will be screened by the onsite laboratory. This process includes new and existing wells in both the shallow and deep aquifers. The onsite analyses will include volatiles (SW8010/8020) and TPH (SW8015 modified). A total of 74 groundwater monitoring well samples have been identified for the onsite analysis. This number includes samples from 47 new shallow aquifers, six existing bedrock, six new bedrock, and 15 existing shallow aquifer monitoring wells. This estimate does not include monitoring wells that will be installed and sampled during the LSI. Wells specific to the LSI are described in Section 3.2.

Analyses will be performed on select monitoring well samples by the offsite laboratory. For planning purposes, it is assumed that the offsite analysis will include the following: volatile organics (SW8260), DRO and GRO (modified

SW8100/8015), pesticides and PCBs (SW8080), semivolatile organics (SW8270), ICP metals (SW6020), mercury (SW7471), and major ions (E300.0). Results of the well point installation and onsite sampling and analysis program will be used to select the appropriate analyses for groundwater samples shipped to the offsite laboratory. The number of samples sent offsite for analysis will be based on the results of the onsite analyses. The criteria used to determine the number of samples and type of analysis for groundwater monitoring well samples include 1) location of the well relative to sensitive or critical habitats, 2) location of the well relative to LSI sites, 3) location of the well relative to source units, 4) field observations during well construction, well development, and sampling for volatile screening (e.g., stained soils, floating product, pH, specific conductance, and temperature measurements, olfactory observations, etc.), and 5) onsite laboratory results.

A long-term groundwater monitoring network may be recommended or required based on the results of the groundwater investigation. This network, if required, will be included as a recommendation in the report submitted following completion of the 1993 field investigation. Transducers used in the 1993 field investigation will also be used for long-term monitoring of water levels.

Quantifying the quality of groundwater migrating off-island includes two separate tasks. The first task includes determining where and how groundwater is being discharged from the island. It is assumed that only a small component of groundwater exits the island as subsurface flow, primarily in the shallow sand and peat aquifer. Shallow groundwater most likely exits as both seeps and springs, and as recharge to surface water bodies such as lakes and streams. This hypothesis will be evaluated during performance of the groundwater investigation and the surface water/seep investigations. Once the physical characteristics of groundwater flow are better understood (especially near the coasts), the second task of determining groundwater quality can be made. This will be assessed through field sampling and onsite and offsite laboratory analysis of groundwater samples collected from new and selected existing monitoring wells. Analytical results will, at a minimum, be compared to state and federal MCLs, PRLs, and to background water quality.

Investigate the Presence/Absence of Immiscible Layers. During the basewide groundwater investigation, both LNAPL and dense nonaqueous phase liquid (DNAPL) immiscible layers will be measured. LNAPLs are expected to consist of fuel-type products, whereas DNAPLs, if present, may consist of specific chlorinated solvents (e.g., TCE and tetrachloroethene [PCE]). LNAPL and DNAPL layers will be investigated in all well points and monitoring wells by real-time measurements. An interface probe will be lowered into the well or well point and the thickness of the immiscible layer(s) will be measured, if present. If immiscible layers are detected in sensitive areas, the appropriate personnel will be notified immediately.

Investigate Preferential Pathways of Groundwater Flow in the Shallow Sand and Peat Aquifer and the Deep Bedrock Aquifer. Current interpretation of Shemya hydrogeology suggests that either topography or the top of competent bedrock is the controlling factor of shallow groundwater flow. The available data are too limited to make this determination, or to determine if man-made features, overburden lithologies, surface water bodies, or other characteristics affect shallow groundwater flow. Groundwater occurrence and flow in the deep bedrock aquifer are generally unknown, but are probably related to structural features of the bedrock (e.g., the degree and orientation of fractures). The limited bedrock water quality information available indicates that some contamination may be present, although preferential pathways are largely unknown.

Confirmation of groundwater flow in the shallow aquifer will be accomplished by constructing a detailed potentiometric surface map. By installing well points and monitoring wells throughout the island in concert with existing wells, water levels can be measured. From these measurements, a detailed potentiometric surface map will be generated. This map may lead to the identification of groundwater divides (if present) and anomalies affecting the flow of shallow groundwater. Because significant or widespread contamination in the deep bedrock aquifer is not documented based on the available information, no attempts will be made to quantify the horizontal direction of flow in this aquifer. During bedrock drilling, efforts to determine the orientation of features such as fractures and fault zones will be made. These observations will be mostly based on surface exposure of bedrock such as along cliffs and roadcuts. Although unverifiable, groundwater in the deep bedrock aquifer probably occurs as fracture flow. A groundwater flow analysis will be performed at the end of the 1993 field season for the deep bedrock aquifer. This flow analysis will be of a very general reconnaissance nature because of the wide spacing of a limited number of available observation points (approximately 12). It should be recognized that the deep bedrock aquifer may be isotropic with respect to groundwater flow because joint and fracture openings with preferential orientation cause groundwater flow not to be perpendicular to potentiometric contours.

<u>Investigate the Hydraulic Connection Between the Shallow Sand and Peat Aquifer, and the Deep Bedrock Aquifer</u>. The amount or degree of communication between the two aquifers is required primarily for contaminant migration estimates. Hydraulic communication between the shallow and deep aquifers could provide both a source of contamination to the deep aquifer (downward gradient) or could mask the concentrations in the shallow aquifer (upward gradient).

The primary approach used to investigate the degree of hydraulic communication between the two aquifers will include measuring water levels in adjacent deep and shallow wells located near both extremes of the island (highest and lowest elevations). This information can be used to determine upward and downward components of flow between the two aquifers. Well points and/or shallow monitoring wells may be installed near bedrock wells if none currently exist. Efforts will be made to use existing bedrock wells and install well points and/or shallow wells. The usefulness of these measurements on the island may be of limited value because of the apparent difference in head between the two aquifers; however, this will be evaluated following water level measurements in deep aquifer wells. Water quality will also be used for comparison by plotting data from shallow and deep aquifer wells onto trilinear diagrams. See Section 2.1.4.3 for the discussion of trilinear diagrams. This discussion, although not conclusive, suggests that shallow and bedground groundwater may be of similar anionic composition.

<u>Investigate the Hydraulic Connection Between Precipitation/Surface Water and the Underlying Shallow Aquifer</u>. At present, only limited data are available correlating the above two water sources, and these data are qualitative. To estimate the water mass balance of the island, this hydraulic connection requires quantification. This task includes investigating whether lakes, ponds, streams, and creeks are losing or gaining bodies over time and with various intensities of precipitation.

The approach used to accomplish this task will be a combination of real-time data collection and modeling efforts. The collection of real-time field data will include an inventory of available surface water such as precipitation, lakes, and streams that can enter the groundwater system. Some of the tasks will include determination of lake and pond volumes, stream gauging, and similar tasks to estimate the amount of water present. Because the effects of evapotranspiration and other related processes on this interaction are unknown, it is important to estimate how precipitation influences the amount of water available as groundwater recharge. This may be estimated, for example, by placing pressure transducers in select wells and monitoring water levels over time, and simultaneously recording precipitation. It is anticipated that up to three wells will be fitted with transducers and data loggers during the 1993 field investigation, for this purpose.

In addition to the precipitation/shallow groundwater relationship, the communication between lakes and streams and the shallow aquifer will be evaluated. Estimating these relationships will be performed using measurement of water levels in numerous well points and comparing these data with lake and stream elevations. Similarly, a detailed potentiometric surface map should provide evidence of losing or gaining water bodies. Another method to estimate the hydraulic communication is through chemical comparison. The available water quality data, although limited, suggest differences in general water quality among lakes, streams, deep groundwater, and possibly shallow groundwater, as previously discussed in Sections 2.1.3 and 2.1.4. The concentrations and possibly ratios of major ions in these water bodies will be used to further estimate the hydraulic connection between the surface waters and the shallow groundwater.

Efforts to model surface water/shallow groundwater relationships may also be performed. Such modeling may include the use of flow nets based on water level contours, water balance and chemical mass balance spreadsheet models, particle tracking models, or numerical models such as PLASM or MODFLOW. Calibration of these model(s) will be through real-time data measurements and results.

<u>Estimate the Quantity of Groundwater Discharging Off Island</u>. To assist in determining the island's water mass balance, the amount of groundwater exiting the island will be estimated. Contaminant loading values will also be estimated along with analytical data. This task should provide an estimation of the impact to the near-shore oceanic environment. To begin quantifying the amount of water exiting the island as subsurface flow from the shallow aquifer, several parameters will be estimated. The two most important parameters are hydraulic gradient and hydraulic conductivity estimations. Hydraulic gradient will be estimated from detailed potentiometric surface maps; hydraulic conductivity will be estimated from slug test analyses. In addition, the top of bedrock elevations will be assessed using well points, boreholes, and visual observations along the southern and western coasts. This information will be compared to topography. The relationship between fresh water, salt water, and tidal influences may also be examined to assist in this estimation.

<u>Investigate Whether Past Wells have been Properly Abandoned and Field Verify the Condition of Existing Monitoring Wells</u>. Abandoned wells will be visually observed to assess if they have been taken out of service or destroyed in accordance with applicable regulations. Nonsecured wells could be possible conduits for waste disposal and could add to the overall environmental problems on the island. The condition of existing monitoring wells requires verification to determine their usability and accessibility.

The technical approach used to assess whether past wells have been properly abandoned included two tasks. First, a literature review and interviews with Station personnel were conducted. Second, the locations of past wells were verified during the site reconnaissance program. This program attempted to identify past well locations and provide information on abandonment methods, if wells were located.

During the site reconnaissance, the status or condition of existing monitoring wells was noted.

Assess the Hydraulic Characteristics of the Shallow Aquifer. To estimate groundwater flow and to assist in determining monitoring well placement, basic aquifer properties are required. Examples of data that will be quantified include direction and gradient of the groundwater level and estimating hydraulic conductivities, transmissivities, and storativities. It is anticipated that the above characteristics will be estimated and measured so that groundwater divides can be determined and contaminant transport modeling can be performed.

This task will be conducted by measuring water levels, measuring aquifer thickness (assuming the top of competent bedrock is the aquitard), estimating porosity, and performing slug tests. For estimation purposes, up to 10 shallow aquifer wells will be hydraulically tested. The locations of wells subject to hydraulic testing cannot be specified until well construction is complete. Section 2.1.8 of the SAP provides aquifer testing procedures.

Hydraulic testing of the deep aquifer is not currently anticipated to be performed during the 1993 field effort. Review of available information suggests that too many variables or unknowns exist regarding the deep aquifer to justify hydraulic testing at this time. These unknowns include water quality data, contaminant transport and pathway information, and receptor information. Before recommending hydraulic testing of the deep aquifer, water quality data will be required. If it is determined that this aquifer has been significantly impacted, additional investigation, including aquifer testing will be performed during the 1994 field season.

Investigate Tidal Influences on the Aquifers. Investigation is important to determine whether tidal variations affect the flow of groundwater. For example, the southern portion of the island could be subjected to increased or decreased flow and/or changing groundwater direction. Although expected to be of limited concern relative to the shallow sand and peat aquifer, tidal variation could impact the deep bedrock aquifer.

The primary method used to investigate tidal influences will be based on water level measurements made over time. Pressure transducers and data loggers will be placed in selected wells where tidal influences may be expected, and the corresponding water levels electronically recorded. Over the same time interval, tidal fluctuations will be noted, and the two sets of data compared for possible correlation. For this approach to be accurate, other influences (e.g., precipitation or other types of recharge) must be accounted for. Based on the existing interpretation of environmental conditions of the island, only a limited potential appears likely for tides to affect the shallow groundwater. However, the deep bedrock aquifer appears more susceptible to tidal influences as evidenced by reference to salt water intrusion in many of the original bedrock water wells. For planning purposes, two shallow aquifer wells and one deep aquifer monitoring well will be monitored for tidal influence. The same three transducers used for obtaining data pertaining to tidal influence on groundwater will also be used in monitoring wells placed to determine the hydraulic connection between precipitation, surface water, and the shallow aquifer; only the time intervals of monitoring differ.

Program Integration. The basewide groundwater investigation tasks will be conducted in coordination with other basewide investigation tasks, the ecological survey, and the LSI. The 1993 field investigation includes one sampling program. The data from the sampling program may be used to support the objectives of the basewide investigation, ecological survey, and the LSI. Groundwater and soil sampling requirements specific to the LSI are discussed in detail in Section 3.2. General requirements for the ecological survey are described in Section 3.1.3.

3.1.3 Ecological Survey

The objectives of the ecological survey are to provide data on communities, habitats, and species associated with Shemya Island that can be used for preliminary ecological risk assessment activities. Where relevant, observations, results, and analytical data obtained during the sampling program and other field activities will be used in the ecological survey. The purpose of the ecological survey is to begin assessing the extent and magnitude of the potential ecological risk resulting from exposure of biota to contaminated media associated with Shemya Island.

The sampling programs tl‹ will be conducted at Shemya will provide data for the completion of a preliminary ecological risk assessment. The preliminary ecological risk assessment is similar to a Phase I ecological risk assessment as described in Air Force guidance (U.S. Air Force, 1991c, Appendix C). The ecological survey will take into consideration basewide, Management Zone 7, and source specific (LSI) contaminant concentration data; contaminant characteristics; and ecological information. The ecological survey will be conducted as an iterative process, with reevaluation and analysis of ecological risk when supplemental information is obtained during the investigation activities that will be conducted in 1994.

The ecological survey is a preliminary evaluation because of the criteria selected to assess contaminant concentrations, migration pathways, and sampling locations. Sampling locations will be selected to represent a biased, worst-case scenario that will provide conservative data for the evaluation of ecological risk. It is anticipated that analytical data (Level II deliverable data) may not be of quantity to fully represent areas (e.g., to eliminate areas or potential source units from further consideration if contaminants are not detected). Data generated during environmental media sampling will provide information regarding off-island discharge, habitat exposure points, and information pertaining to potential source units and Management Zone 7. This approach will provide only preliminary knowledge regarding ecological risk. The use of limited sampling points will allow for the identification of ecological data gaps, the determination of biotic tissue sampling needs (if appropriate), and will provide a more defined and efficient selection of Level II sampling points for the ecological risk assessment to be completed during future activities that will be conducted in 1994.

Ecological risk assessment guidance, such as the *General Guidance for Ecological Risk Assessment at Air Force Installations* (U.S. Air Force, 1991c, Appendix C) and the *EPA Risk Assessment Guidance for Superfund Environmental Evaluation Manual* (EPA, 1989) will be used to conduct the ecological survey.

The following tasks are necessary for the evaluation of ecological habitats and basewide ecological risk within Management Zone 7, and at source units assessed through the LSI. These tasks will provide data to focus and refine field sampling activities to ensure sufficient data (quality and quantity) are collected to complete an ecological risk assessment.

Species, Communities, and Habitat Identification. As indicated in EPA guidance (EPA 1989; 1992), knowledge of species, communities, and habitats is needed to select indicator species and for understanding ecosystem structure, function, and potential risk. This information is also necessary for identifying potential exposure pathways. Identification and description of habitats are necessary to understand ecosystem characteristics and are recognized steps in ecological risk assessment in the Air Force guidance (U.S. Air Force, 1991c, Appendix C).

This task will be accomplished through three activities. The first two, literature review and interviews with knowledgeable individuals will be conducted before the ecological survey. The third activity, the ecological survey, will be completed during the 1993 field investigation. One of the critical activities of the ecological survey will be to verify and map the occurrence of species and habitats, and to identify contaminant migration/exposure pathways and verify indicator species. Additionally, the ecological survey will verify the appropriateness of sample locations for environmental media sampling during the 1993 field investigation. Specific methods for the completion of the ecological survey are discussed in the following text and in the SAP:

- Identification of Species and Communities. The identification of species occurring on Shemya Island will include both vertebrate and invertebrate fauna and flora. Information obtained from the literature and from interviews, as well as that from the ecological survey, may not be uniformly detailed across the different groups of organisms. In general, a more complete survey can be performed for the vertebrate fauna than for invertebrates, and vascular plants are generally better studied than the lower plants. For all organism groups, attempts will be made to detail the level required for ecological risk assessment activities.

  Vertebrate groups that will be included in the ecological survey are birds, land and marine mammals, and freshwater and marine fish. Ecological information such as breeding status, general habitat preference, and feeding will also be provided, where possible. This information may be used to place animals into groups having similar requirements or resource usage called guilds. This "guilding" approach will be used to more widely consider the potential effect of contaminants on the larger ecosystem.

  Invertebrates are a vital component of the ecosystem, and general estimates of their potential role in exposure models (e.g., as potential food items for vertebrate species) will be inferred from the literature or from their presumed distribution if no reports can be found.

  Information on floral species will consider both vascular plants and nonvascular plants (e.g., mosses, phytoplankton, lichens). Ecological information (e.g., habitat) will be provided, where possible, for vascular species; information about nonvascular plants will also be reviewed.

  As stated previously, identification of species will be accomplished through literature review, contact with appropriate natural resource personnel, and visual confirmation during the ecological survey. For all groups, standard references will be used for names and nomenclature, and complete citations will be given for other associated information (e.g., habitat use).

- Identification of Habitats. Primary vegetated and "unvegetated" habitats will be identified, described, and mapped, as appropriate. Additionally, habitat use by different species will be identified, where possible. Some of the dominant habitats and features to be mapped are described in the following paragraphs.

The natural vegetation of the Aleutian Islands is classified as maritime tundra (TRA/Farr, 1988). Communities are composed of different mixtures of grasses, sedges, forbs, and mosses. The composition and relative abundance of species predominating in any specific area depends, in part, upon microsite conditions (e.g., moisture).

Lakes and ponds represent lacustrine habitats. Some of these areas may support fish communities, and the western lake complex is reported to be critical habitat for the Aleutian Canada goose. Small streams represent fluviatile habitats that are reported to potentially provide habitat for anadromous fish.

The vast majority of Shemya has been disturbed through construction activity, either directly or indirectly through such events as alterations in drainage patterns. Base structures are a prominent component of the landscape and these structures, along with associated human activities, exert influence on the distribution and abundance of biotic components of the area.

Major habitats that lack extensive vegetative coverage include cliffs (seabird nesting), beaches and tidal pools (foraging for birds), and rocky shores (resting areas for certain birds and haulout areas for marine mammals).

Wetland habitat is common on Shemya. According to the base comprehensive plan (TRA/Farr, 1988), most of the island falls within the wetland classification based on the jurisdictional definition of the COE. However, this is a broad category and has limited utility for natural resource considerations. Existence of other more useful wetland inventories will be determined.

Beyond information on species occurrence, habitats, and ecological characteristics, other data needed to support ecological survey activities will be identified and described or mapped, as appropriate, i.e., location of nesting colonies, or rookeries, of seabirds, and haulout areas for marine vertebrates.

- Mapping Technique. Mapping of habitats and other elements will be accomplished in the field by tracing element boundaries (as visually determined) onto transparent overlays of existing aerial photographs.

  This component of the project depends on photographs of sufficient quality that locations can be accurately determined. Currently, aerial photographs of Shemya Island flown 30 October 1986 will be used. These are black and white photographs at an approximate scale of 1:4800. To reduce distortion, elements will be mapped from the centers of individual photographs where possible. Given the low topographic relief on the island, no special techniques will be used to account for topographic variation. The photographic series is recent enough (seven years old) so that no major changes are expected in mapping elements; however, changes will be recorded as appropriate.

  Field verification will then be used to confirm that mapped habitats or elements accurately correspond to conditions on the ground. Once field mapping has been completed, hand-drawn maps (tracings) will be converted to final map stage using an AutoCAD or similar system.

Map elements include the variety of biotic and abiotic characteristics of the site. These elements will likely include vegetative communities, surface water features, rookeries, and near-shore features.

The level of detail of mapping will depend on the objective for the information. In general, information mapped on a basewide scale will, by necessity, be very coarse; information at a given LSI area will be of much greater detail. Information from Management Zone 7 will be mapped to a greater detail than that for basewide but will likely be more coarse than for an LSI area. Neither the basewide nor the Management Zone 7 maps will be used in assessing the specific character of any LSI site. Specific information will be verified for each LSI site.

With regard to natural communities, a general class of meadow may be used to broadly classify the wet or moist tundra communities.

Mapping of surface water, including lakes, ponds, streams, and seeps will be completed as described in Section 2.1.3 of the SAP.

The locations of the buildings, structures, and built-up areas are assumed to be adequately mapped, and these existing maps will be used.

Identification of wetland habitat will be considered through review of literature and interviews. No wetland delineation studies are planned for the field survey of "wetland" habitat.

Threatened/Endangered Species Identification. EPA guidance (EPA, 1989) states that, "By definition, endangered and threatened species are already at risk of extinction: the loss of only a few individuals from the population may have significant consequences for the continued existence of the species." EPA (1992) believes consideration of threatened or endangered species within ecological assessments is the framework reflective of societal values or policy goals. Air Force guidance (U.S. Air Force, 1991c, Appendix C) also recommends identifying any endangered species that inhabit or migrate through the site of concern.

Critical or sensitive habitats at the Station must be identified to begin adequately and comprehensively assessing the potential impact of contaminants on threatened or endangered species. Habitat for these species must be identified so that these species can be maintained. For these reasons, critical habitat will be determined for any species identified in the threatened or endangered category.

Identification of threatened or endangered species will be accomplished through a literature review, interviews with appropriate Air Force personnel, and discussions with federal and state natural resource agencies. This information will be confirmed or supported through literature reviews as necessary. Critical and sensitive habitats that are confirmed will be mapped during the 1993 ecological survey.

As an example, the Aleutian Canada goose, a threatened species, is reported to use the lakes complex on the western portion of Shemya Island. To confirm this information, the ecological survey will focus on reviewing potential habitats used by the Aleutian Canada goose on Shemya. Several other species will potentially be confirmed in the threatened and endangered category as well (see Section 2.1.6, Biological Resources), and critical habitats will be identified for those species also.

In addition to threatened and endangered species, species that are rare, or of particular concern to Air Force or natural resource agencies, will be identified. This may include species that are at low population numbers or whose populations are declining. Critical and sensitive habitats will be identified for these species also.

The ecological survey will also be used to determine locations for environmental media sampling as related to rare, threatened, or endangered species (see *Identification of Sample Locations*). Analyses of samples may identify contaminants and contamination migration pathways that could potentially affect critical and sensitive habitats and the species associated therewith.

Identification of Sport/Commercial Species. Consideration of potentially affected sport and commercial species is desired from both the ecological and the human health perspectives. EPA guidance (EPA, 1989) recommends that, in addition to identifying the species of sport or economic concern, potential effects on food resources for these species and their habitats be considered. Air Force guidance (U.S. Air Force, 1991c, Appendix C) also recommends the identification of "recreational and commercial uses of all ecological resources."

A preliminary literature review indicates that freshwater fish were stocked in the western lake complex on Shemya Island to provide recreational opportunities for base personnel. Additional reports indicate fishing or related recreational activities occur at the marine dock areas. Air Force personnel will be contacted to identify the species that are used recreationally and their habitats. The extent of these recreational activities will be determined through contacts with base personnel. From this information and environmental media analytical results, a partial identification of vector organisms may be made. Vector organisms represent trophic pathways to human receptors and may also be necessary for the human health risk assessment. Both current and future recreational opportunities will be considered. Results of the literature review and survey will be described and mapped.

Commercial fishing in the Aleutian Island area is an important enterprise and is of potential concern. Determining species that are of commercial importance will be determined through contact with the appropriate agencies. This process will include the Fish and Wildlife Service and the National Marine Fisheries Service, and will involve primarily marine species related to fisheries in the Aleutian Islands.

Evaluation of Ecological Toxicity, Environmental Persistence, and Bioaccumulation. Preliminary risk assessment activities include identifying contaminants of potential ecological concern (COPECs) through determining ecological toxicity, environmental persistence, and the potential for biological accumulation, as well as comparison of detected metals with background concentrations. These activities are outlined in Air Force guidance (U.S. Air Force, 1991c, Appendix C). This task is intended to identify those contaminants presumed most likely to produce, or potentially produce, adverse effects in the biotic community. This information is also used in selection and refinement of ecological receptors, development of the conceptual model for exposure pathways, and in the screening level toxicity evaluation.

Analytical results of contaminants in surface soil, surface water and sediment samples from the basewide, LSI, and Management Zone 7 investigations will be used in the identification of COPECs. The three elements of COPEC determination are discussed below:

- Ecotoxicity. Upon review of the environmental media analytical results, ecotoxicity data for each detected chemical will be obtained from published research material and from available data bases. Information from these sources will likely be highly variable as to nature of the test (chronic or acute), response variable (lethality, reproduction, growth, physiological processes, etc.), test species, and numerous other facets. Ecotoxicity data will be compared with contaminant levels to determine the potential effects of these contaminants on biota.

  Ecotoxicity data will be evaluated from the scientific literature and from established data bases. The Biological and Pollution Abstracts data bases, Integrated Risk Information System (IRIS), and the Hazardous Substances Data Base (HSDB) on the National Library of Medicine's TOXNET files, and the Aquatic Information Retrieval Toxicity Data Base (AQUIRE) are examples of established information sources.

  Most of the published literature consists of work with single species and measurement of direct toxicity to the organism (lethality) or some component of the organism's functioning (e.g., reproductive impairment or oxygen consumption). Commonly used estimates of toxicity include 1) LD50 or LC50 (administered dose concentration of stressor producing mortality in 50 percent of the test experimental population within the specific test conditions) or 2) ED50 or EC50 (dose or concentration of stressor producing a decline of 50 percent in the test variable; e.g., filtering rate of zooplankton or swimming speed of fish). The No Observable Effects Level (NOEL) or No Observable Adverse Effects Levels (NOAEL) are measures describing the threshold level of the stressor at which none of the test responses of the experimental organisms show any effect. The Lowest Observed Effects Level (LOEL) or Lowest Observed Adverse Effects Level (LOAEL) are the lowest concentrations of the stressor that produced measured effects.

  Ecotoxicological data will be evaluated to determine potential impacts on biota. Potential adverse effects will be suspected and further evaluation will be necessary if concentrations of COPECs exceed literature values of LOAEL or LOEL concentrations. Additionally, if contaminant concentrations exceed those established for environmental protection (e.g., State of Alaska water quality criteria, freshwater and saltwater sediment criteria, ambient water quality criteria), further evaluation will be warranted. Any contaminant that is suspected to potentially adversely affect biota for any other reason will also be further evaluated.

  Toxicity to species of concern (e.g., indicator species or threatened or endangered species) will be evaluated. Toxicity data from studies using those same species will be used where available. However, it is not always possible to obtain toxicological data for the particular species of concern at a site. In those cases, data from a closely related species, if possible, will be used as a surrogate to infer toxicity. It is noted that different species can show marked differences in toxicological response to the same stressor. Likewise, different life stages within the same species can exhibit different sensitivities. For these reasons, an element of uncertainty exists in extrapolations.

  Most studies evaluate only the direct toxicological response of a single species to a stressor and do not, or cannot, estimate potential indirect effects on other organisms. Indirect effects may include consequences such as loss of habitat or diminished food resources (diminished prey populations). Although studies examining potential indirect effects are rare, data will be obtained, where possible, from the literature to consider this information in ecological risk assessment activities.

Likewise, the vast majority of toxicological literature reports the effects of a single stressor on experimental organisms. It is often the case at sites of concern that there are multiple stressors acting upon the biota simultaneously. Where possible, evaluation of reports of possible multiple stressor effects will be made.

- Bioaccumulation. It is important to understand the bioaccumulation potential of COPECs because of the potential deleterious effects of bioaccumulating chemicals within the ecosystem, including situations when a chemical may be detected at low concentrations in the physical media but may be at significantly elevated concentrations in biota. PCBs, which can readily adsorb to sediments, are an example of chemicals that can be present in surface waters at concentrations below detection limits and still significantly bioaccumulate. Information on the bioaccumulation potential of COPECs will be obtained through existing data bases and the literature.

  Because species accumulate contaminants at different rates, and because environmental variables can affect these rates and ultimate concentrations within tissue, use of literature values to extrapolate between species introduces an element of uncertainty. Analysis of contaminant concentrations in the tissues of organisms at the site represents a method to determine the actual potential of the chemical(s) of concern to bioaccumulate within the food chain (EPA, 1989). Specific sites where biota may be subject to bioaccumulation of COPECs (based on chemical characteristics, analytical results of media sampling, and site ecology) will be noted during the summer 1993 ecological survey. Tissue analysis from selected biota at these locations may be recommended as a future task.

- Environmental Persistence. Information on environmental persistence of each COPEC will be considered. The site-specific characteristics such as climate, soils, and hydrology will be considered to more accurately determine the environmental persistence and other physical characteristics of COPECs. This information will be used in the identification of exposure pathways, selection of indicator species, and in the toxicological screening evaluation. Site-specific information will be collected where possible, but most information will likely be of a general nature, or specific to other environments.

Identification of Exposure Pathways and Ecological Receptors (Indicator Species). Identification of exposure pathways and ecological receptors is necessary for considering potential risk from a site and is outlined as an early step in Air Force guidance (U.S. Air Force, 1991c, Appendix C). Exposure pathways by which receptors may be exposed through direct and indirect contact with COPEC include surface soil, surface water, sediment, and ingestion of contaminated prey. Identification of exposure pathways through environmental media sampling are further addressed in Identification of Sample Locations later in this section.

Exposure pathways and indicator species are discussed below:

- Exposure Pathways. The conceptual model presented in Section 2.4 outlines the potential exposure routes for ecological receptors at Eareckson AFS.

  The primary direct exposure routes for terrestrial ecological receptors include, but are not limited to, ingestion of contaminated soil and water. Dermal contact is not thought to be a major exposure route. Because of the nature of site contaminants, inhalation is at this time considered a minor exposure pathway for terrestrial species. The major indirect exposure scenario for terrestrial receptors is ingestion of contaminated food (e.g., a fox that consumes voles that have COPECs in their tissues).

Major potential exposure routes for aquatic receptors to contaminants are likely through respiration, ingestion, and dermal contact with contaminated water and sediments. The major secondary route for exposure of aquatic receptors is through consumption of contaminated food resources (e.g., a freshwater fish that consumes macroinvertebrates that have COPECs in their tissues).

These direct exposure routes can result in direct toxicological effects on the individual organism. Any change in the distribution and abundance of an organism due to direct toxicity can result in effects elsewhere in the ecosystem, including effects on organisms or processes that are themselves not as sensitive to the contaminant. These potential indirect (secondary) effects will be addressed in risk characterization.

Exposure pathways important for assessing risk at Eareckson AFS will be confirmed during the ecological survey to be conducted during the 1993 field investigations.

- Indicator Species. Because it is not feasible to conduct risk assessments for all individual species at a site of concern, consideration of responses of certain indicator species may be developed. Response characteristics of indicators species are then related to other species occupying similar trophic positions or functional roles within the ecosystem, those species expected to be at greatest risk, or species of special concern for some other reason. Often the species or attribute of concern is not, or cannot, be assessed directly, and, for that reason, a surrogate measurement such as evaluation of an indicator species is substituted. Air Force guidance (U.S. Air Force, 1991c, Appendix C) recommends selecting an indicator (receptor or endpoint) species as an early component of risk assessment activities.

  Indicator species will be identified as part of the ecological survey. Criteria for selection of indicator species will include consideration of the following:

  - threatened or endangered species;
  - species of commercial, recreational, or economic importance;
  - species representative of different food chains and occupying different trophic levels within the ecosystem;
  - species whose distribution and abundance are likely to exert a controlling influence on other species or components of the ecosystem;
  - species likely to be chronically exposed to the contaminants of concern;
  - species that, by virtue of their habits or habitat, may be exposed to the greatest concentration of contaminants; and
  - species that are most sensitive to the contaminant.

Identification of Sample Locations. Analytical data will be collected to provide preliminary data for evaluation of ecological risk. Environmental media selected for sampling will be based, in part, on the preliminary identification of suspected exposure routes for identified receptors. In support of the ecological survey, surface soil, surface water (e.g., streams and lakes), and sediment samples will be collected to identify contaminants and contaminant concentrations, and to determine the potential for contaminant migration that may impact ecological receptors. The sample locations will be coordinated with basewide and LSI activities to locate ecological survey samples.

Background sampling will be conducted to distinguish site-related contamination (that resulting from human activity at the site) from naturally occurring concentrations, which are ambient concentrations of chemicals in the environment. Background sample locations are discussed in Section 3.1.3.

Review of available information indicates that sensitive/critical habitats occur on Shemya Island (Section 2.1.6, Biological Resources). Figure 2.1.6-1 illustrates a preliminary mapping of some of the ecological species and habitats of concern at Shemya. Sampling and analysis from these areas will be conducted during the 1993 field season. Sample locations may be adjusted based on the findings of the ecological survey during the 1993 field season. Sample locations will be selected to increase the probability of detecting contamination (e.g., visually impacted areas). Additional sample locations will be chosen that are the most representative for a given ecological receptor. The intent of this biased sampling is to provide a conservative estimate of ecological impacts by increasing the probability of sampling areas of contamination.

Preliminary sample locations within different media will be selected to assess potential pathways by which terrestrial and aquatic (marine and freshwater) species may be exposed to contaminants of concern in surface soil, surface water, and sediment at Shemya Island. Sampling and analysis protocols are discussed in the SAP. The objectives for the selection of sample locations are discussed in the following paragraphs. Sampling activities that are specific to the ecological survey will be determined during site reconnaissance.

- Surface Soil Sampling. Surface soil samples will be collected to assess potential terrestrial exposure routes to ecological receptors through vegetative uptake of contaminants from soil, ingestion of contaminated soil, ingestion of contaminated vegetation, and the ingestion of contaminated prey species by predators. Biota potentially impacted from surface soil contamination include plants, soil invertebrates, birds, small mammals, and burrowing mammals. Exposure potential to ecological receptors is related to environmental persistence, toxicological properties, and bioaccumulation potential of the contaminant. Surface soil samples will be collected in areas of known or suspected contamination during the 1993 field investigation programs.

- Surface Water/Sediment Sampling. Surface water and sediment samples will be collected to assess the potential impact on aquatic and terrestrial organisms (vertebrates and invertebrates) that may be exposed by direct contact with water or sediment through respiration, ingestion, and dermal contact, or by indirect contact through secondary ingestion of organisms that have been in contact with contaminants associated with Eareckson AFS.

  Sediment and surface water samples will be collected to characterize contaminant concentrations in these media. Sample locations will be selected to permit consideration of potential impacts to ecological receptors through the identification of contaminants, contaminant concentrations, and evaluation of migration pathways. Selection of sediment and surface water sample locations will focus on identified habitats and off-island discharge points potentially affecting the marine environment.

Program Integration. The ecological survey tasks listed above will be conducted in coordination with the other basewide investigation tasks and the LSI. The 1993 field investigation includes one sampling program. The data from the sampling program may be used to support the objectives of the basewide investigation, ecological survey, and LSI.

3.1.4 Background Sampling

The objectives of background sampling are to supplement existing background data, identify gaps in the existing data, provide additional background data, and summarize existing and additional background data into a statistically defensible format. The background sampling investigation described in the following paragraphs is applicable to overall basewide environmental conditions and will support all 1993 field investigation activities. Background concentrations and ranges will be determined for several environmental media, including surface soils, subsurface soils, surface water, groundwater, and sediment. For planning purposes, it is assumed that certain background samples for chemical analysis will be collected on the island of Nizki, and background samples for physical analysis will be collected on Shemya.

The following tasks are required to meet the objectives of the background sampling program.

Identify Areas Free of Disturbance for Possible On-Island Background Locations. Background sampling for chemical analyses of surface water, sediment, surface and subsurface soils, and groundwater will be conducted on Nizki Island. Aerial photographs of Nizki taken in 1951 show no areas of disturbance or artificial features. The northeast quarter of the island has been selected for sample collection. The entire area is readily accessible from a single landing point, and the geomorphology indicates the presence of active and inactive sand dunes, sandy and rocky beaches, tundra and grassland vegetation, and lakes and wetlands that resemble Shemya Island before military occupation.

Surface water samples will be collected from large, intermediate, and small lakes on Nizki, and also from two streams at their off-island discharge points. Sediment samples will be colocated with surface water samples. Surface and subsurface soil sample locations will be determined by randomly selecting points from a grid established on the aerial photographs. The points will be located in the field as close as possible to photograph landmarks using pace and compass techniques. Seeps will be sampled, if located. An attempt will be made to collect a background groundwater sample on Nizki by installing a well point. If well point installation on Nizki is not possible, an attempt will be made to identify a suitable background groundwater location on Shemya. Background samples will be sent to the field laboratory for screening analysis and to the fixed laboratory for Level II analysis.

Background subsurface soil samples collected for physical analyses (conductivity, grain size, specific gravity, etc.) will be collected on Shemya Island, at an undisturbed location to be determined in the field. Background samples for physical analyses should be native to Shemya, to provide accurate data for use in fate and transport modeling.

Determine the Amount and Usability of Existing Data. This task is designed to evaluate existing background data and to identify data gaps. During previous investigations at Shemya, background samples for select media have been collected. However, preliminary review of these data suggest that they are too few to reliably characterize statistical properties of background populations. (Section 2.5 provides a more thorough discussion on statistical methods and application). In addition, many of the background data results have associated qualifiers, making the data questionable for future use. Section 2.4 provides a summary of the existing background data.

Determine Basewide Ambient Background Concentrations. Ambient background concentrations are required for all media of concern including surface soils, subsurface soils, groundwater, surface water, and sediment. Background concentrations will provide data for comparison with environmental sample analytical results and will provide information about concentrations of naturally occurring substances for risk assessment.

A sufficient number of background samples will be collected from surface soils, subsurface soils, surface water, groundwater, and sediment to permit at least preliminary assessment of the statistical variability of the background populations. Following identification of sample locations, samples will be collected and analyzed.

Interpretation of background concentrations from existing and all newly collected data will be performed to establish statistical properties of background populations. Simple statistical methods, as more fully discussed in Section 2.5, have been and will be used to assess the variability of background concentrations for all media of concern. Preliminary evaluation suggests that, at a minimum, the following numbers of additional samples are required from the following media:

Surface soils:	eight samples
Subsurface soils:	five samples
Surface water:	five samples
Groundwater:	five samples
Sediments:	five samples.

These numbers of samples assume that concentrations of specific analytes will not vary significantly. If statistically significant variations are reported, it is possible that additional samples may need to be collected until the statistical criteria are met. The estimated number of samples for subsurface soils, surface water, and groundwater media are approximate because no background sampling for the media has been performed. Based on the criteria discussed in Section 2.5, these numbers of samples will assure that the error in estimating the population mean using the samples collected will be approximately 0.4 to 0.6 of the true population mean if the coefficient of the variation of the population is approximately 0.5 to 0.7.

Limited data are available on physical and chemical conditions on Nizki Island. Based on the literature review, it appears that geologically and hydrologically, Nizki and Shemya Islands are similar, and that environmental media may contain similar background concentrations on Nizki. Therefore, background sample collection of all media for chemical analysis appears appropriate on Nizki Island. As part of the literature review (Section 1.5), aerial photographs of Nizki Island have been reviewed. Information pertaining to disturbances and island features has been used to assist in locating appropriate background samples.

Two general types of laboratory reporting will be used throughout the 1993 basewide investigation and LSI. The field or onsite laboratory will provide screening-level data deliverables (results); whereas the fixed or offsite laboratory will provide Air Force Level II data deliverables. A detailed discussion of these laboratories was previously presented in Section 1.4.3.1. Analytical procedures and related information are presented in Section 1.0 of the SAP.

The analytical suite for all background samples will be limited to naturally occurring species, including metals and other inorganics. Because of the possibility of organic compound generation during the formation of peat/muskeg, select organic methods will also be included. The current suite includes volatile organics (SW8260/8240), semivolatile organics (SW8270), DRO and GRO (modified SW8100/SW8015), ICP metals (SW6020), mercury (SW7470/7471), and major ions (E300.0) for liquid samples only.

Background subsurface soil samples will also be analyzed for a variety of geotechnical and geochemical parameters. The parameters, and the rationale for their determination, are summarized below:

- Grain size distribution provides the data with which to determine the USCS soil classification and the clay content.

- USCS soil classification provides a comparison between field lithologic logging and results of the laboratory grain size analysis.

- Bulk density is a component of the calculation of the retardation coefficient used in mathematical modeling of sorption/desorption effects during contaminant transport through groundwater aquifers.

- Clay content provides a qualitative indicator of the potential for retardation of some chemical species, such as metals, during inflow through groundwater; some modeling applications use the clay content to help estimate numerical values of the retardation coefficient.

- Moisture content provides an indicator of the degree of saturation of the material and is used in some models of fluid and contaminant transport through the unsaturated zone above the water table.

- Organic carbon content is used to calculate the distribution coefficient, which describes partitioning of a chemical between the solid and aqueous phases in the subsurface.

- Cation exchange capacity is used to calculate the distribution coefficient of cationic species of trace metals.

- Porosity is used to estimate the average velocity of groundwater flow in an aquifer and is used to estimate numerical values of the retardation coefficient.

- Coefficient of permeability (hydraulic conductivity) is used to provide an indicator of the potential rate of groundwater flow through soil material and for comparison with estimates based on field aquifer tests.

As noted above, DRO and GRO organics analyses will be included in the background analytical suite because hydrocarbons may be a natural component of peat/muskeg. Also, although oily residues have apparently been observed on some beaches on

Shemya Island, they are not thought to be related to discharges from the island. It is speculated that this oil may be from ships and barges passing near the island. A sample of this oil has been collected by the Fish and Wildlife Service. Analytical results from the fuel fingerprint analysis have not yet been received.

The basewide background sampling program, as currently defined, contains both known and unknown components. The number of sample locations and respective environmental media have been established; however, the actual sample locations have not been identified. Table 3.1.4-1 summarizes the samples and analyses for the background investigation.

Program Integration. The background sampling program will be conducted to support all basewide investigations, LSI, and ecological survey activities. The 1993 field investigation includes one background sampling program.

3.2. LIMITED SOURCE INVESTIGATIONS

The data quality objectives for LSI activities were presented in Section 2.5, and preliminary conceptual site models for each LSI site is included in Section 2.4. These sections provide the types of decisions required at each potential source unit.

Specific sampling procedures and protocol are included in Section 2.0 of the FSP. For the LSI, these procedures include installing well points, monitoring wells, and soil boreholes. Hand augering, backhoe test pits, and other sampling procedures will also be performed. Specific details about the analytical methods, detection limits, and QA in support of the LSI are presented in Section 1.0 of the SAP.

As shown in Table 2.2.2-5 and described in Section 2.2.1, LSIs will be conducted for a variety of purposes. It is expected that at seven source units, information collected during the LSI will support a no further action decision. LSIs for these potential no further action source units are described in Section 3.2.1.

Five source units and one additional area will have LSIs conducted to determine if an early action(s) is required before a complete remedial investigation is performed. LSIs for potential early action source units are described in Section 3.2.2.

Section 3.2.3 describes source unit FT02 (aircraft mockup area), where the purpose of the LSI is to collect the additional data required to move this source unit to the FS. Existing RI data need to be supplemented by some additional information to begin the screening of alternatives.

Finally, Section 3.2.4 describes two source units for which LSI data will be collected for other specific purposes. LSI data at SS07 will help determine the appropriate regulatory program for this source unit (POL vs. RCRA vs. CERCLA). For source unit FT02 (fire training area), where no previous investigations have occurred, site investigation data will be collected to provide preliminary information about potential contamination resulting from past activities.

Two general types of laboratory reporting will be used for the 1993 LSI: onsite laboratory results and offsite laboratory results. The field or onsite laboratory will provide screening-level data deliverables (results); whereas the fixed or offsite laboratory will provide Air Force Level II data deliverables. A detailed discussion of these laboratories was presented in Section 1.4.3.1. Analytical procedures and related information are presented in Section 1.0 of the SAP.

TABLE 3.1.4-1
FIELD OPERATIONS SUMMARY FOR BASEWIDE INVESTIGATION
BACKGROUND INVESTIGATION
EARECKSON AIR FORCE STATION, ALASKA

Basewide Investigation	Number of Samples					Fixed Laboratory Analysis								QC Samples			
	Surface Water	Sediment	Groundwater (Well Points)	Ground-water (Wells)	Soil (1)	DRO & GRO Modified 8100/8015	Volatile Organics 8260/8240	ICP Metals and Hg 6020 and 7470/7471	PCBs/ Pesticides 8080	Semi-volatile Organics 8270	Major Ions E300.0	Data Level	Field Screen	Trip Blank (2)	Equip. Blank (3)	Ambient Blank (3)	Duplicate (3)
Background Investigation					13	13	13	13				II	–	3	1	1	1
	5					5	5	5			5	II	–	2	1	1	1
				5		5	5	5			5	II	–	2	1	1	1
		5				5	5	5				II	–	2	1	1	1

Notes:

QC samples are for fixed laboratory analysis only.

(1) = Includes eight surface soil and five subsurface soil samples
(2) = Estimates 20 percent of samples collected for volatile organic analyses
(3) = Estimated based on 10 percent of total samples collected
– = not required
DRO = diesel-range organics
Equip. = equipment
GRO = gasoline-range organics
Hg = mercury
ICP = inductively coupled plasma
PCB = polychlorinated biphenyls
QC = quality control

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100% Recycled

EARECKSON AFS, ALASK

100% Recycled

3.2.1 No Further Action Source Units

LF15 - Wood Dump - Active Wood Burn Area

Site Description. LF15 is a bermed area, with a size of approximately 100 feet by 40 feet. The bermed area is located on the beach below the bluffs. Telephone poles, posts, wood debris, and other landfill trash are actively burned in this area. A 1986 aerial photograph indicates that potentially three burn areas may have once existed in this location (Aerial photos, 1986, Frame 8-4). Several solid waste sites were observed in the area in October 1992. LF15 is also known to lie adjacent to an area that serves as habitat for emperor geese and puffins.

There have been no previous investigations at this source unit. Because the area is used for wood burning, significant contamination is not expected. The purpose of the LSI at LF15 is to collect data in support of an NFAD. Surface and subsurface soil samples will be collected, groundwater well points will be installed and surface water samples will be collected if ponded surface water is encountered within the bermed area.

Field Investigation. A site reconnaissance will be conducted to identify and map the boundaries of the bermed area. In addition, the location of any additional solid waste sites in the immediate vicinity of LF15 will be identified and mapped.

Three well points will be installed around the bermed area, as shown in Figure 3.2.1-1. A drill rig may be necessary to drive the well points in this area. Water level measurements and a groundwater sample will be taken from each well point. Samples will be field screened at the onsite laboratory for TPH and volatiles.

One groundwater sample collected from one of the well points will be sent offsite for DRO and GRO (SW8100/8015), volatile organics (SW8260), ICP metals (SW6020), and semivolatile organics (SW8270) analyses. A sample from the location with the highest detections during the field screening will be sent to the offsite laboratory for analysis. If all of the three groundwater samples are nondetections, a sample from the most downgradient sample will be sent to the fixed laboratory for confirmation analysis.

One groundwater monitoring well will be installed at LF15 for confirmation analyses. The monitoring well location will be determined in the field based on water level measurements and results of sample analysis from the well points. A groundwater sample will be collected for screening by the onsite laboratory and by the fixed laboratory for DRO and GRO (SW8100/8015), volatile organics (SW8260), metals (SW6020), PCBs/pesticides (SW8080), semivolatile organics (SW8270), and water quality (E300.0). Well placement and analysis will be consistent with the objectives of the basewide investigation.

Five near-surface soil samples will be collected from the waste/soil interface. This interface is assumed to be no deeper than 1 to 2 feet. It is assumed that shovels can be used to reach the waste/soil interface, and that samples will be collected with a spoon. These five samples will be field screened for TPH and volatiles, in addition to being sent offsite to the fixed laboratory. Offsite analytical parameters will be DRO and GRO (SW8100/8015), volatiles (SW8240), semivolatiles (SW8270), and ICP metals (SW6020) with one of these samples having an additional dioxin (SW8280) analysis. The decision as to which sample will be analyzed for dioxin will be made in the field.

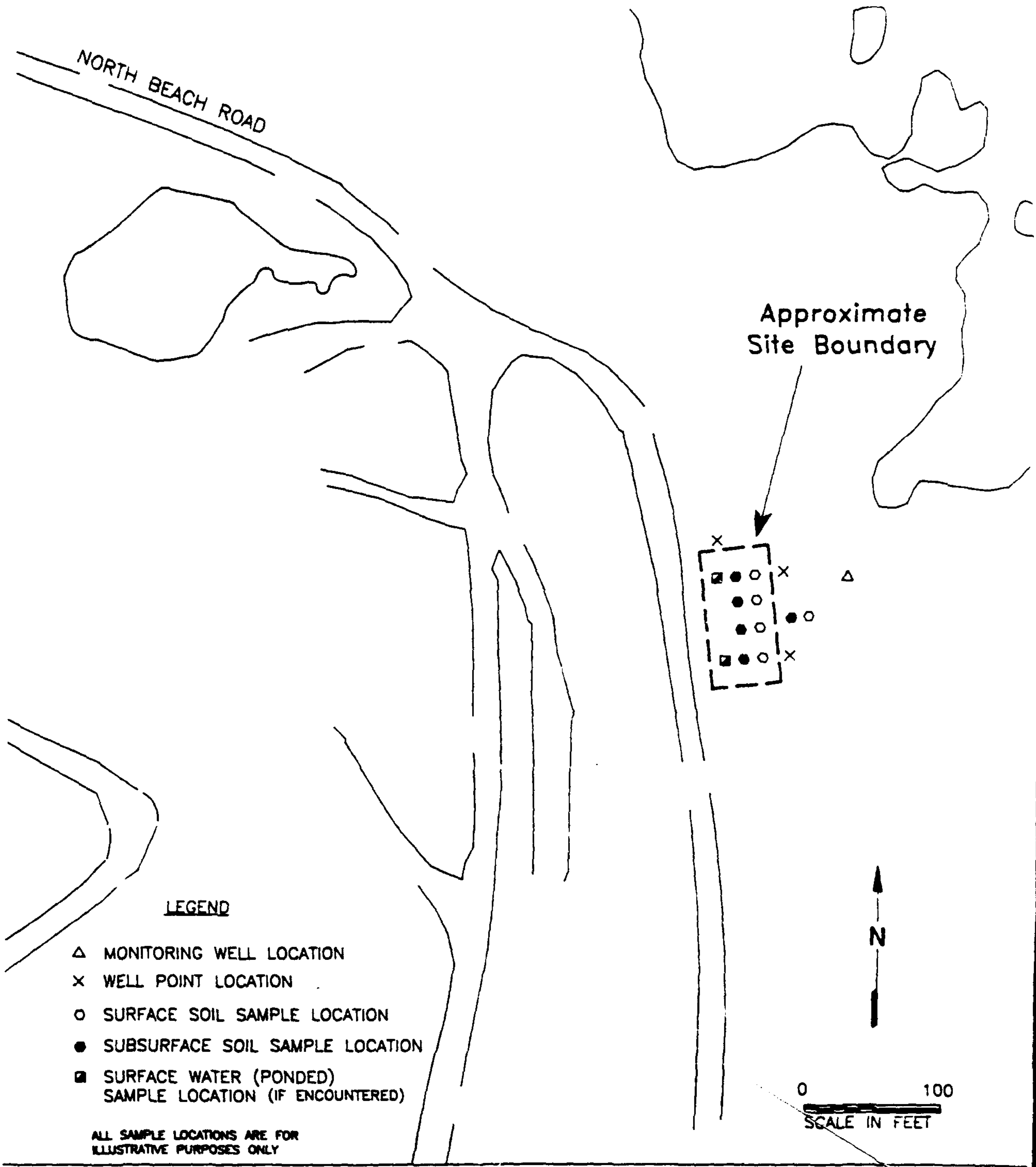

Figure 3.2.1-1

LF15 Wood Dump – Active Wood Burn Area
Sample Location Map

Eareckson Air Force Station, Alaska

The targeted depth for subsurface samples is 3 feet below surface. It is assumed that a hand auger will be required for collection of subsurface samples. Samples will be collected in the same locations as the waste/soil interface samples. Offsite analysis will include DRO and GRO, volatiles, semivolatiles, and ICP metals. One of the five subsurface samples will also be analyzed for dioxin.

Two optional surface water samples will be collected from LF15, if ponded water is found within the bermed area. These samples, if collected, will be field screened for TPH and volatiles, and analyzed offsite for DRO and GRO, volatiles, semivolatiles, ICP metals and lead.

During the ecological survey (see Section 3.1.3), this site will be evaluated for potential ecological impacts. Further sampling may be conducted at LF15, if required to support an evaluation of ecological risk.

LF18 North Beach Landfill

Site Description. North Beach Landfill covers 15 acres along the northern shore of Shemya Island. The landfill was used to dispose of barrels and practice bombs.

CH2M Hill conducted field investigations in 1992. TPH, volatile organic compounds, semivolatile organic compounds, pesticides, and PCBs were detected in soil samples. Contaminant concentrations in soil were determined to be below human health risk criteria. Groundwater and surface water have not been evaluated.

The purpose of the LSI at North Beach Landfill is to collect groundwater data in support of a NFAD. Soils data were collected in previous investigations. Ponded surface water, if present, will also be sampled during the LSI.

Field Investigation. Ponded surface water will be collected at four locations at the North Beach Landfill. Surface water sample locations are shown in Figure 3.2.1-2. The surface water samples will be collected to determine whether the landfill is affecting surface water and runoff from the area. All four surface water samples will be sent to the onsite laboratory for field screening analysis of volatiles and TPH. Based on the sample analysis results, one surface water sample will be sent to the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8260), pesticides/PCBs (SW8080), semivolatile organic compounds (SW8270), and ICP metals (SW6020) analyses.

Five well points will be installed to evaluate whether groundwater has been significantly affected. All five well points will be installed hydraulically downgradient to determine if groundwater flowing beneath the landfill has been significantly impacted. A groundwater sample will be collected from each of the five well points. All five groundwater samples will be analyzed by the onsite laboratory for TPH and volatiles. Based on the results of the field screening, up to three groundwater samples will be sent to the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8260), semivolatile organic compounds (SW8270), pesticides/PCBs (SW8080), and ICP metals (SW6020) analyses.

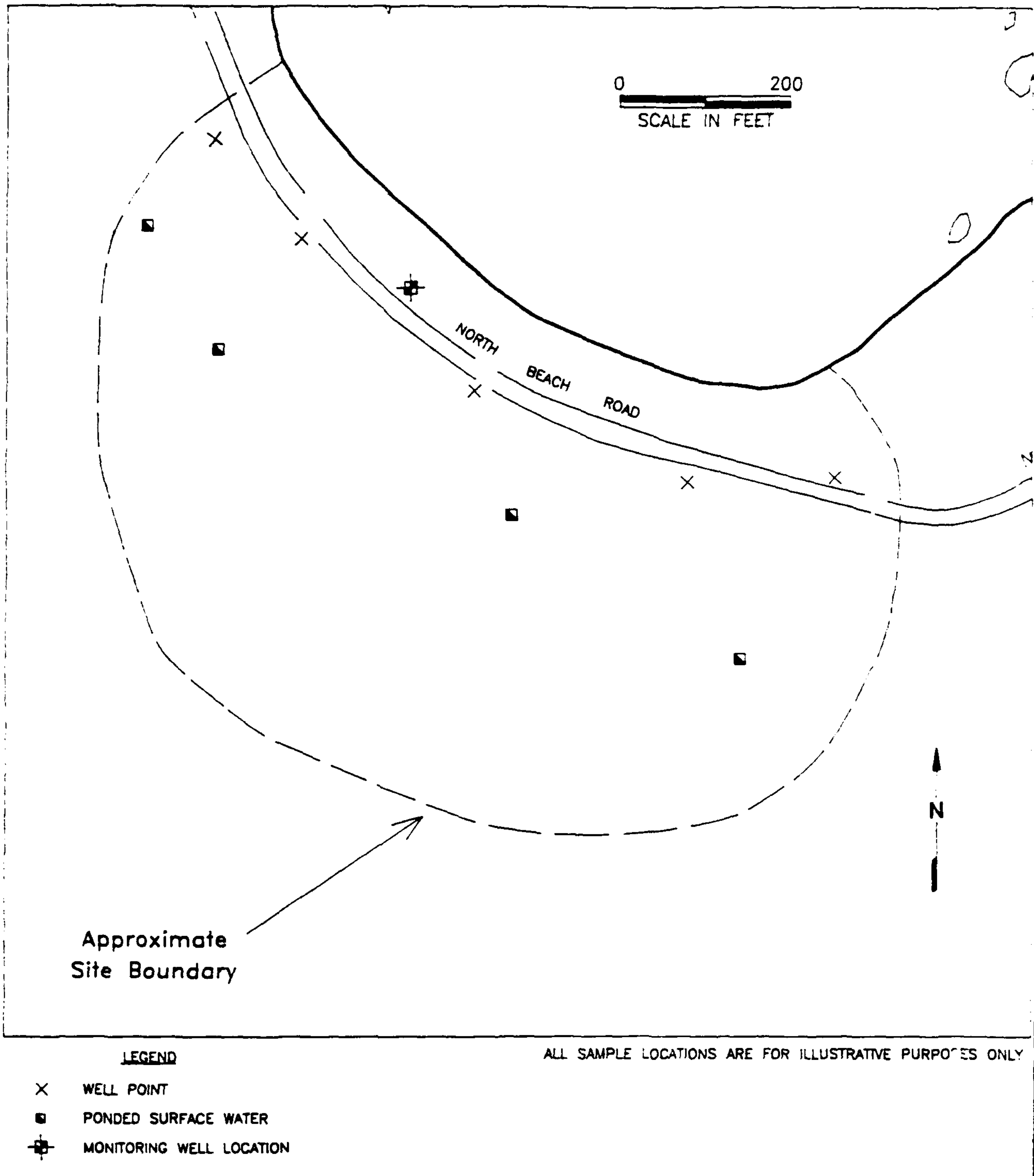

Figure 3.2.1-2
LF18 North Beach Landfill
Sample Locations
Eareckson Air Force Station, Alaska

Based on the results of the water level measurements and sample analysis from well points, one monitoring well will be installed and sampled for confirmation analysis. The groundwater sample will be analyzed for DRO and GRO (SW8100/8015), volatile organics, (SW8260), semivolatile organics (SW8270), metals (SW6020), PCBs/ pesticides (SW8080) and water quality (E300.0). The sample will also be analyzed by the onsite laboratory.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in soil and water samples.

SS20 - Retrograde Area

Site Description. This source area is located at the dock on the northwest point of the island. Potential contaminants consist of metal scrap, which are predominantly dock pilings. The area is currently covered with large diameter rock backfill.

Drilling and sampling were performed at the dock area by COE in December 1992. Soil samples were analyzed for TPH (SW8015 modified). Up to 130 mg/kg of heavy fuel was detected in four of the six soil samples analyzed.

The purpose of the LSI at SS20 is to collect data in support of a NFAD. Although existing TPH data appear to be adequate for support of a no further action decision, no analytical data exist for metals and volatiles. Because new sample locations will be targeted, TPH will be included in the analytical suite. Surface and subsurface soil samples will be collected, as well as a water sample, if water is encountered in the area during sampling.

Field Investigation. A site reconnaissance will be conducted to identify and map the boundaries of the retrograde area. This potential source unit may consist of two areas, separated by the road at the dock. No seeps or apparent runoff patterns were observed during site visits in October 1992 and June 1993.

Four surface soil samples will be collected and field screened for TPH and volatiles. Sample locations will be determined in the field and will be biased toward areas of stained soil or other potential indicators of contamination. Two of these surface soil samples will be sent offsite for fixed laboratory analysis. Analytical parameters for the two surface soil samples will be DRO and GRO (SW8100/8015), volatile organics (SW8240), and ICP metals (SW6020). The two samples sent offsite will be from the locations with the highest detections during the field screening. If all of the four samples are nondetections, the decision of which two samples to send offsite will be made in the field, based on field conditions and observations.

Two subsurface samples (depths of approximately 4 to 5 feet) will be collected from two test pits. A backhoe will be required to dig the test pits. These two subsurface samples will be analyzed onsite for TPH and volatiles, and sent offsite for the same analysis as the surface samples (DRO and GRO, ICP metals, and volatiles).

If water is encountered in either or both of the test pits, a water sample will be collected. The water sample(s) will be field screened for TPH and volatiles. One water sample will be sent offsite for analysis. If water is encountered in both test pits, the sample to be sent offsite will be based on the results of field screening. If both samples are nondetections, the decision as to which sample to send offsite will be made in the field and will be based on field conditions and observations. Water samples will be analyzed for the same parameters as the soil samples (DRO and GRO, ICP metals, and volatiles).

Potential sample locations are shown in Figure 3.2.1-3.

OT21 Old Grounded Barge

Site Description. The Old Grounded Barge is located on the beach in Alcan Cove, approximately 1,200 feet southeast of the dock on the northwest point of the island. The fuel barge was stranded on the beach after it ran aground in 1958. There is conflicting information regarding the amount of fuel on board when the barge was grounded. There are no visual signs of release.

No previous investigations have been conducted at the Old Grounded Barge. Samples will be collected to support preparation of an NFAD, if applicable.

Field Investigation. A site reconnaissance will be conducted to locate sample points around OT21. Subsurface soil samples will be located at the same depth as the base of the barge at six locations; three locations will be sampled on each side of the barge. The base of the barge is estimated to be 5 to 6 feet deep. Soil sample locations are shown in Figure 3.2.1-4. The six subsurface soil samples will be collected with hand augers and analyzed by the onsite laboratory for volatiles and TPH. Based on the results of the field screening, three subsurface soil samples will be sent to the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8240), and ICP metals (SW6020) analyses.

If field screening indicates that soil has been significantly affected, two well points will be installed adjacent to the barge. A groundwater sample will be collected from the well points to evaluate whether groundwater has been significantly affected. Well points will be located based on subsurface soil screening results. Well points shown in Figure 3.2.1-4 are for illustrative purposes only. The groundwater samples will be analyzed by the onsite laboratory for TPH and volatile organic compounds and by fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8260), and ICP metals (SW6020) analyses.

If soil samples indicate that well points are required, a monitoring well will also be located at OT21 for confirmation analysis. A groundwater sample will be collected for analysis by the onsite laboratory and by the fixed laboratory for DRO and GRO (SW8100/8015), volatile organics (SW8260), semivolatile organics (SW8270), metals (SW6020), PCBs/pesticides (SW8080), and water quality (E300.0). Well placement and analyses will be consistent with the objectives of the basewide investigation.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in soil and water samples.

LF28 Scrap Metal Landfill

Site Description. The Scrap Metal Landfill is located at the extreme southeast corner of the island. The Scrap Metal Landfill was used to dispose of scrap metal and is currently inactive.

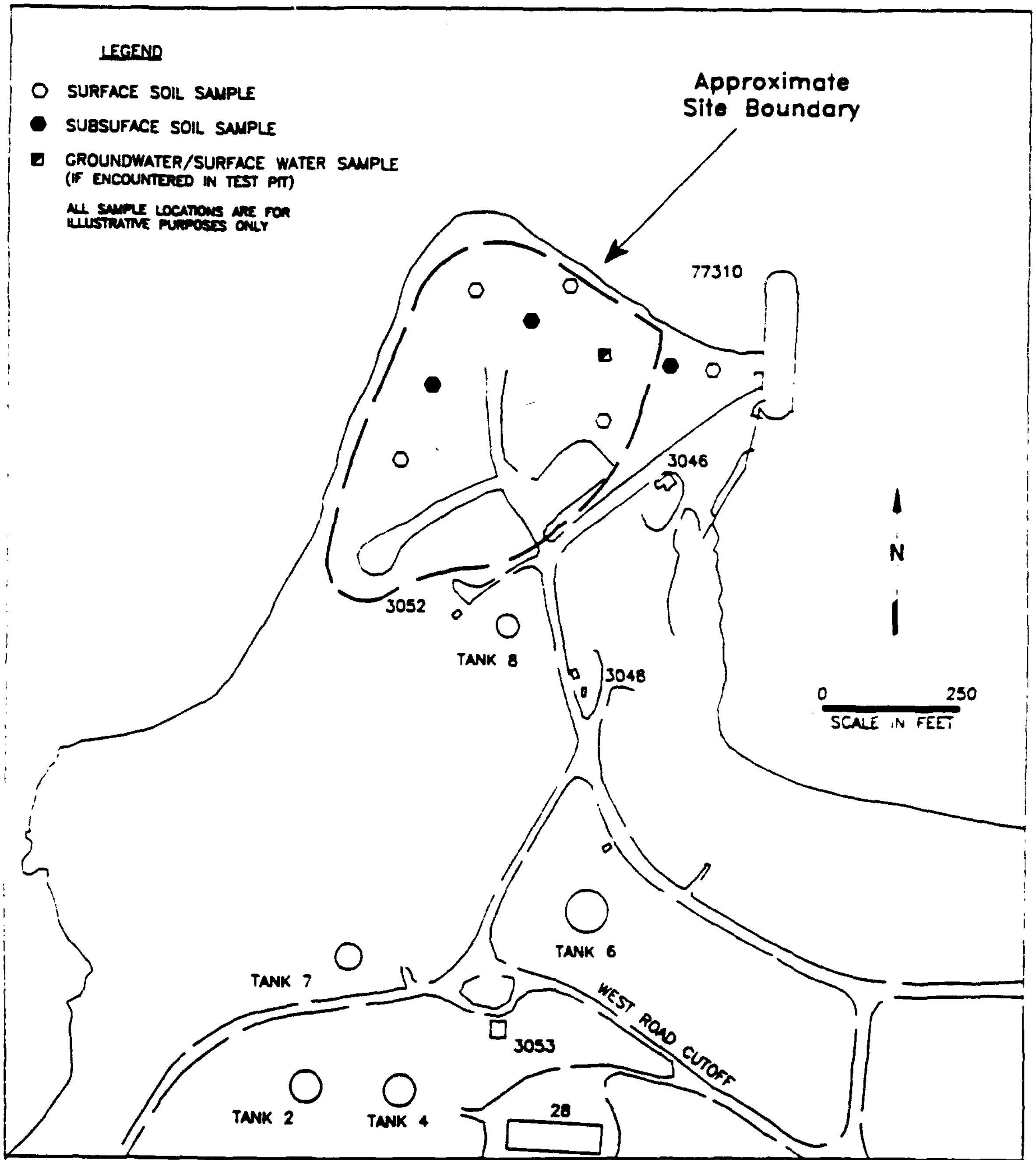

Figure 3.2.1-3

SS20 Retrograde Area (Dock)
Sample Location Map

Eareckson Air Force Station, Alaska

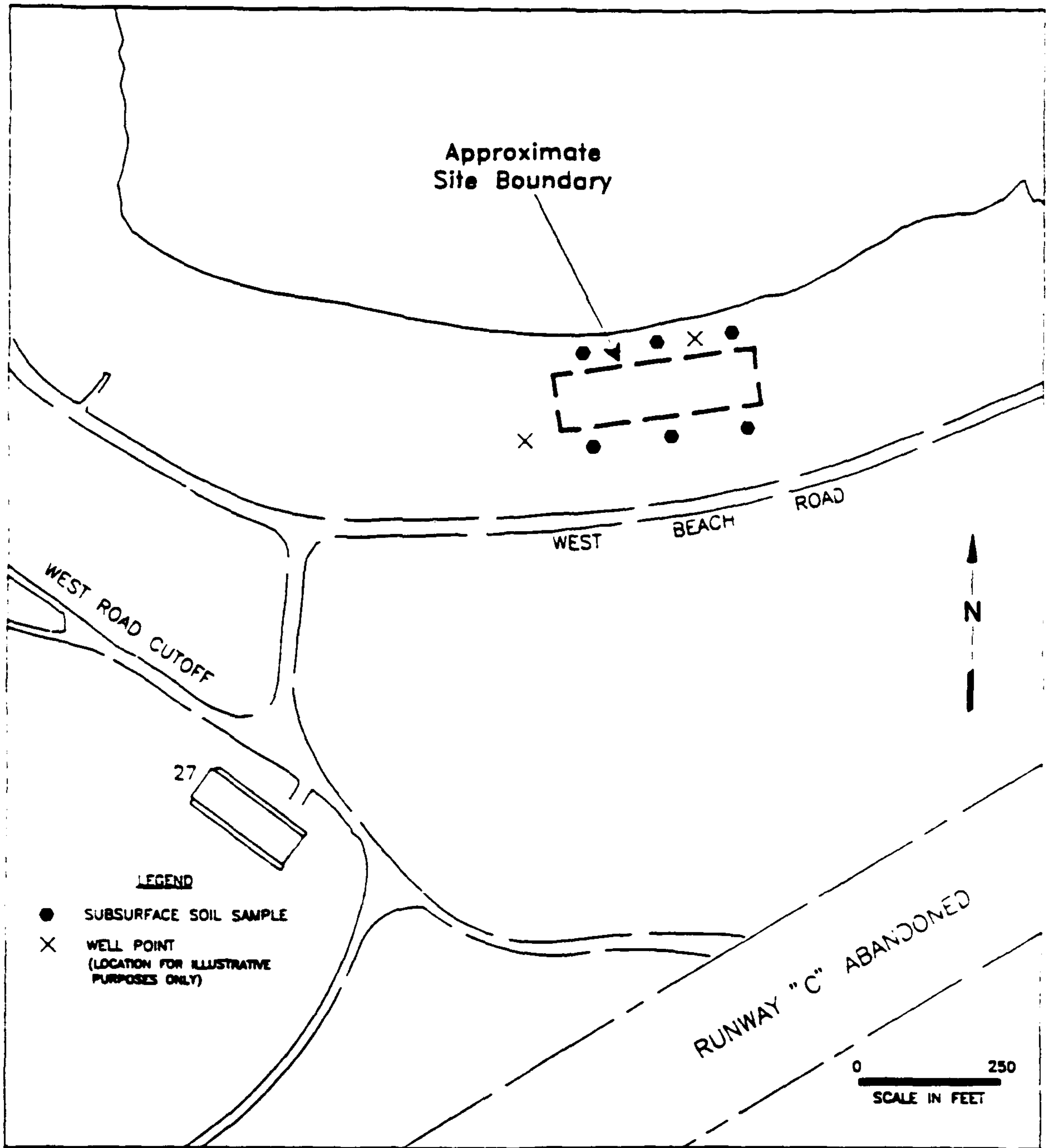

Figure 3.2.1-4

OT21 Old Grounded Barge
Sample Location Map

Eareckson Air Force Station, Alaska

CH2M Hill conducted a field investigation in 1988. TPH, volatile organic compounds, and elevated metals were detected in soil samples. Contaminant concentrations in soil samples were below human health and ecological risk criteria. The purpose of the LSI is to collect groundwater samples in the vicinity of LF28. Samples will be collected in support of NFAD preparation, if applicable.

Field Investigation. Based on site reconnaissance, two to three test pits will be excavated in the landfill. Test pits will be excavated using a backhoe. One subsurface soil sample will be collected from each test pit to evaluate whether hazardous materials were disposed of at the Scrap Metal Landfill. Test pit locations are shown in Figure 3.2.1-5; however, exact locations will be determined in the field based on site reconnaissance. Soil samples will be analyzed by the onsite laboratory for TPH and volatiles, and by the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8240), dioxins (SW8280), pesticides/PCBs (SW8080), and ICP metals (SW6020) analyses. The test pits will be logged to provide information about the depth of the landfill.

If surface or ponded water is present, two samples will be collected to determine whether the landfill is significantly affecting surface water and runoff in the area. The surface water samples will be analyzed by the onsite and fixed laboratories for the same parameters as the subsurface soil samples.

Six well points will be installed: four in the larger area and two in the smaller area. The approximate locations are shown in Figure 3.2.1-5, but may be refined based on field screening results from subsurface and ponded water samples. All six well points will be sampled for onsite screening of TPH and volatiles. Based on these results, three monitoring wells will be installed downgradient of the landfill. A groundwater sample will be collected from each well to evaluate whether the landfill is significantly affecting groundwater flowing beneath the landfill. The groundwater samples will be analyzed by the onsite and fixed laboratory for the same parameters as the subsurface soil samples and the ponded water samples, with the addition of semivolatile organics (SW8270). The proposed monitoring well locations are shown in Figure 3.2.1-5. Actual well locations will be determined during the investigation based on well point data.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in soil and water samples.

OT29 Ammunitions Dump

Site Description. The Ammunitions Dump is located near the southeast corner of the island. The area is a small portion of a rocky beach immediately below steep cliffs. The site was used to dispose ammunition following World War II. Various munitions, including 50 caliber, are present.

There have been no previous investigations at the Ammunitions Dump. Samples will be collected to support the preparation of an NFAD, if applicable.

Field Investigation. A site reconnaissance will be conducted at the Ammunitions Dump. Based on the site conditions and visible signs of release, four sediment/sand samples will be collected from the area to determine if the munitions have leached or are leaching any hazardous constituents. Proposed sample locations are shown in Figure 3.2.1-6. Samples will be collected as close as possible to the area without endangering worker safety. The samples will be analyzed by the onsite laboratory for TPH and

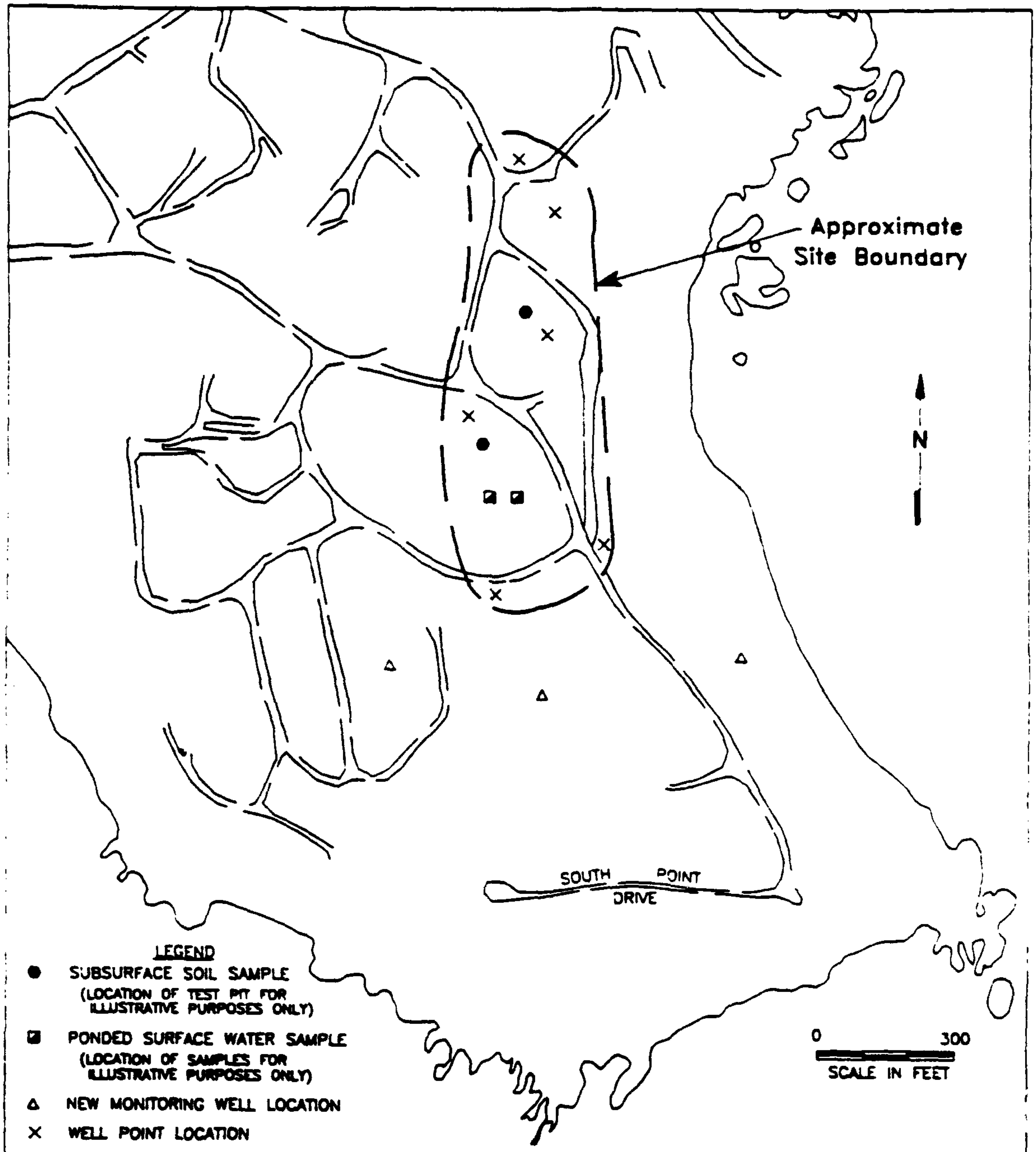

Figure 3.2.1-5

LF28 Scrap Metal Landfill
Sample Location Map

Eareckson Air Force Station, Alaska

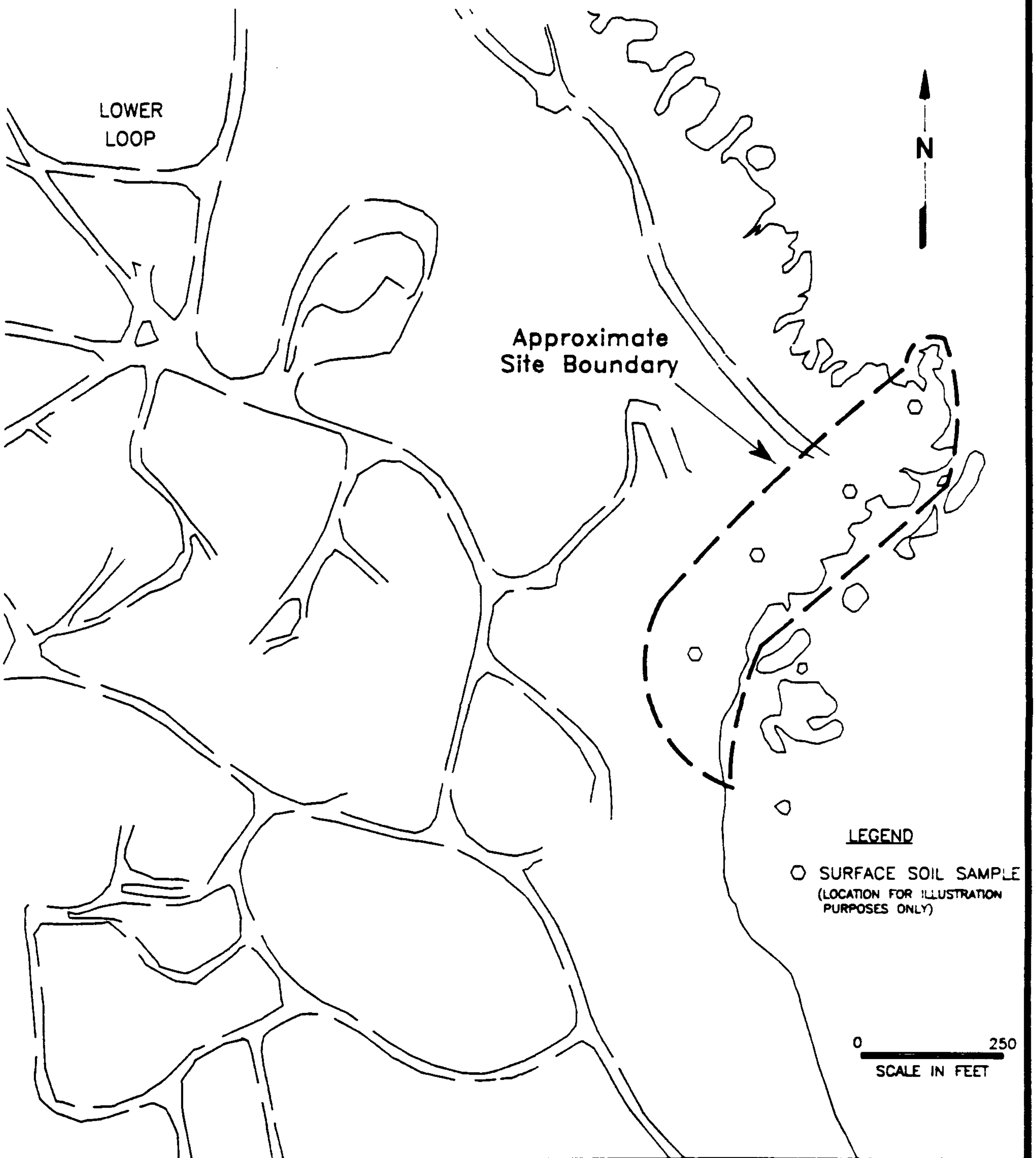

Figure 3.2.1-6

OT29 Ammunitions Dump
Sample Location Map

Eareckson Air Force Station, Alaska

volatile organic compounds and by the fixed laboratory for ICP metals (SW6020). Jacobs considered including nitroaromatics and nitroamines since they are components of some ordnance, and consulted with ordnance specialists and reviewed published sources of munition components. Based on this research, the munitions present on the beach and in the ocean at OT29 are primarily composed of black powder that does not include nitroaromatic compounds. Rather, the indicator parameters for black powder are heavy metals.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in sediment samples.

OT49 Upper Lake

Site Description. Upper Lake is located in the west-central part of the island at the edge of abandoned runway B. The lake was used to dispose of various munitions in the past by military personnel. Information regarding the types of ammunition is not available.

Water-quality samples have been collected. Trace levels of benzene, naphthalene, 1,2,3-trichlorobenzene, and TPH were detected in the samples. The pH has increased over time. An aquatic bioassay sample collected in 1988 indicated that the lake is not acutely toxic to Daphnia pulex in a 24-hour screening test.

Lake samples will be collected to evaluate water quality in support of NFAD preparation and to provide basewide and ecological water quality data.

Field Investigation. Three surface water and three sediment samples will be collected from the lake to determine whether the lake is a potential source of contamination and to evaluate water quality for ecological significance. The sample locations are shown in Figure 3.2.1-7. The samples will be located near the inlet and outlet, and on the east and west sides of the lake. The samples will be screened by the onsite laboratory for TPH and volatiles, and analyzed by the fixed laboratory for DRO and GRO (SW8100/8015), volatile organics (SW8260/8240), semivolatile organic compounds (SW8270), PCBs/pesticides (SW8080), ICP metals (SW6020), and mercury (SW7470/7471) analyses. Additionally, the three surface water samples will be analyzed for major ions (E300.0).

Samples collected from Upper Lake will also be collected to support the basewide investigation described in Section 3.1.1.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in water and sediment samples.

3.2.2 Early Action Source Units

FT02 Abandoned Drum Disposal Area

Site Description. The Abandoned Drum Disposal Area is one area of three comprising FT02. Fifty five-gallon drums were disposed of/buried approximately 150 feet northwest of the Aircraft Mockup on the west side of Runway C. The drums are located in a drainage that leads over the bluff above West Beach Road to the ocean.

There have been no previous field investigations conducted at the Abandoned Drum Disposal Area. Site reconnaissance conducted in 1992 by Jacobs indicated that a drainage runs under the abandoned runway.

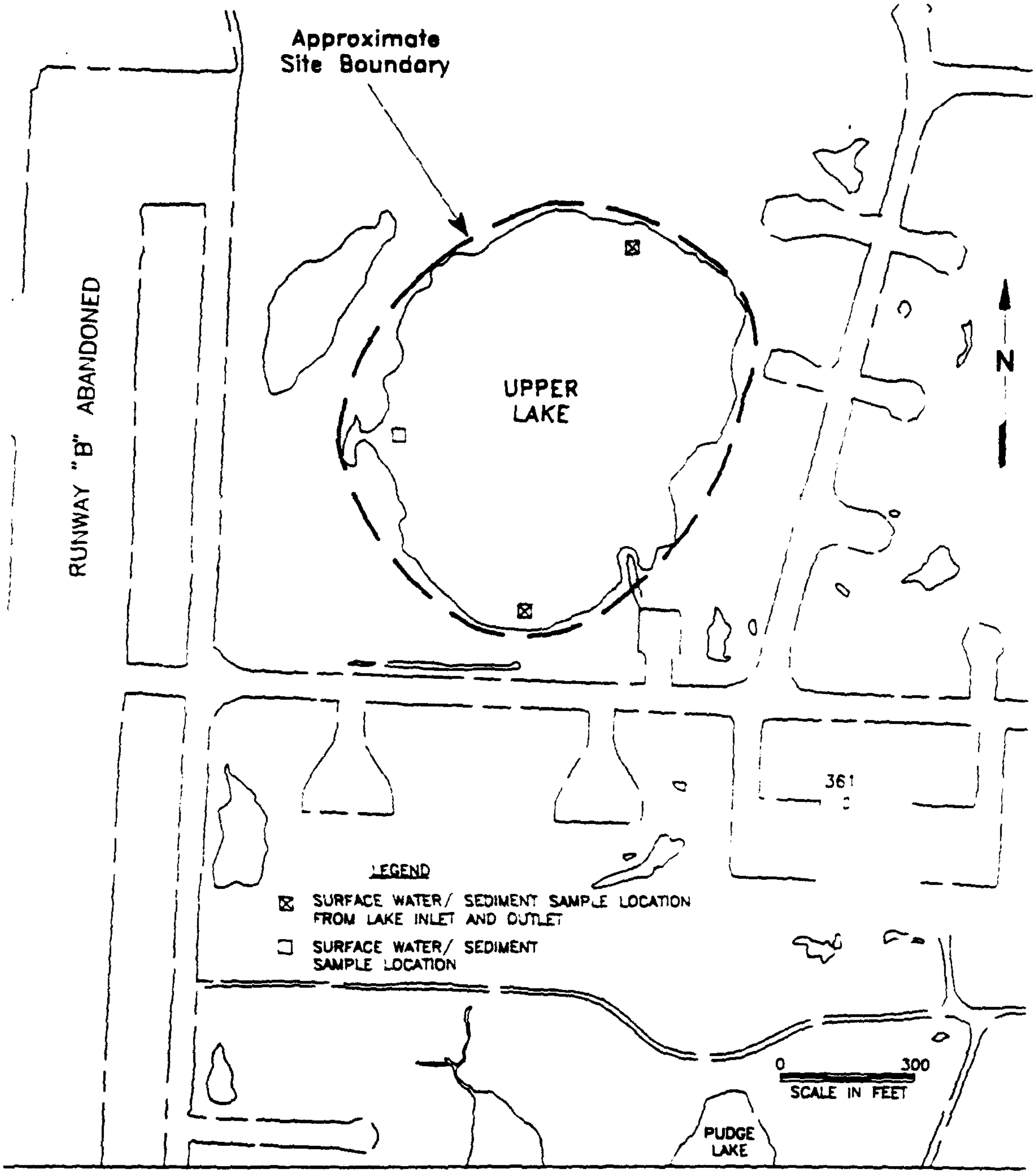

Figure 3.2.1-7

OT49 Upper Lake
Sample Location Map

Eareckson Air Force Station, Alaska

The purpose of the LSI at the Abandoned Drum Disposal Area is to collect samples from the drainage. Investigation activities are necessary to determine if surface water from the drainage contains contaminants that are discharging to the ocean.

Field Investigation. One sample of the surface water in the drainage will be collected at the area where the drums are located, one surface water sample will be collected at the point just before the waterfall, and one surface water sample will be collected at the point of discharge to the ocean. Surface water sample locations are shown in Figure 3.2.2-1. The samples will be collected to 1) provide data to determine whether any of the points in the drainage are contributing contamination that may be discharging to the ocean and 2) design an early action alternative, if necessary. A total of three surface water samples will be collected and analyzed by the onsite laboratory for TPH and volatile organic compounds, and by the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8260), semivolatile organic compounds (SW8270), and ICP metals (SW6020) analyses.

A total of three sediment samples will be collected at the drum disposal area, just above the waterfall and upstream from the conduit along the road. The sediment samples will be analyzed by the onsite laboratory for TPH and volatile organics and by the offsite laboratory for the same parameters as the water samples.

If precipitation conditions change during the field season, three additional surface water samples will be collected for screening-level analysis by the onsite laboratory. The surface water samples will be collected at the same sample locations as the samples collected for offsite analysis.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in water samples.

SS07/ST08 West End Oil/Water Separator and Diesel Tank 123

Site Description. The West End Oil/Water Separator consists of a series of five unlined, earthen ponds connected by shallow surface ditches. The ponds are designed to intercept a portion of the oil-contaminated surface waters draining from areas to the northeast before they reach the ocean. Diesel Tank 123 is a 490,000-gallon diesel fuel aboveground storage tank that is located approximately 500 feet south of the main part of the Fuel Tank Farm (ST46). Tank 123 is surrounded by an unlined earthen dike.

Previous investigations from the oil/water separator have shown a maximum TPH concentration of 141,000 ppm in the soil/sediment samples from Ponds 3 and 4 and a maximum lead concentration of 374 mg/kg in Pond 2 subsurface soil samples. CH2M Hill conducted a field investigation at Tank 123 in 1988. Volatile organic compounds and TPH were detected in subsurface soil samples collected from borings drilled around Tank 123. In addition, investigations by COE have documented floating product in several wells located within the vicinity of the oil/water separator drainage adjacent to Tank 123.

Three specific areas of known contamination have been identified for field investigation during 1993. These areas are shown in Figure 3.2.2-2. Areas A and B are located around monitoring wells where floating product has been measured. Area C is located around Ponds 1 and 2, where floating product was observed on Pond 1 during a site visit in October 1992.

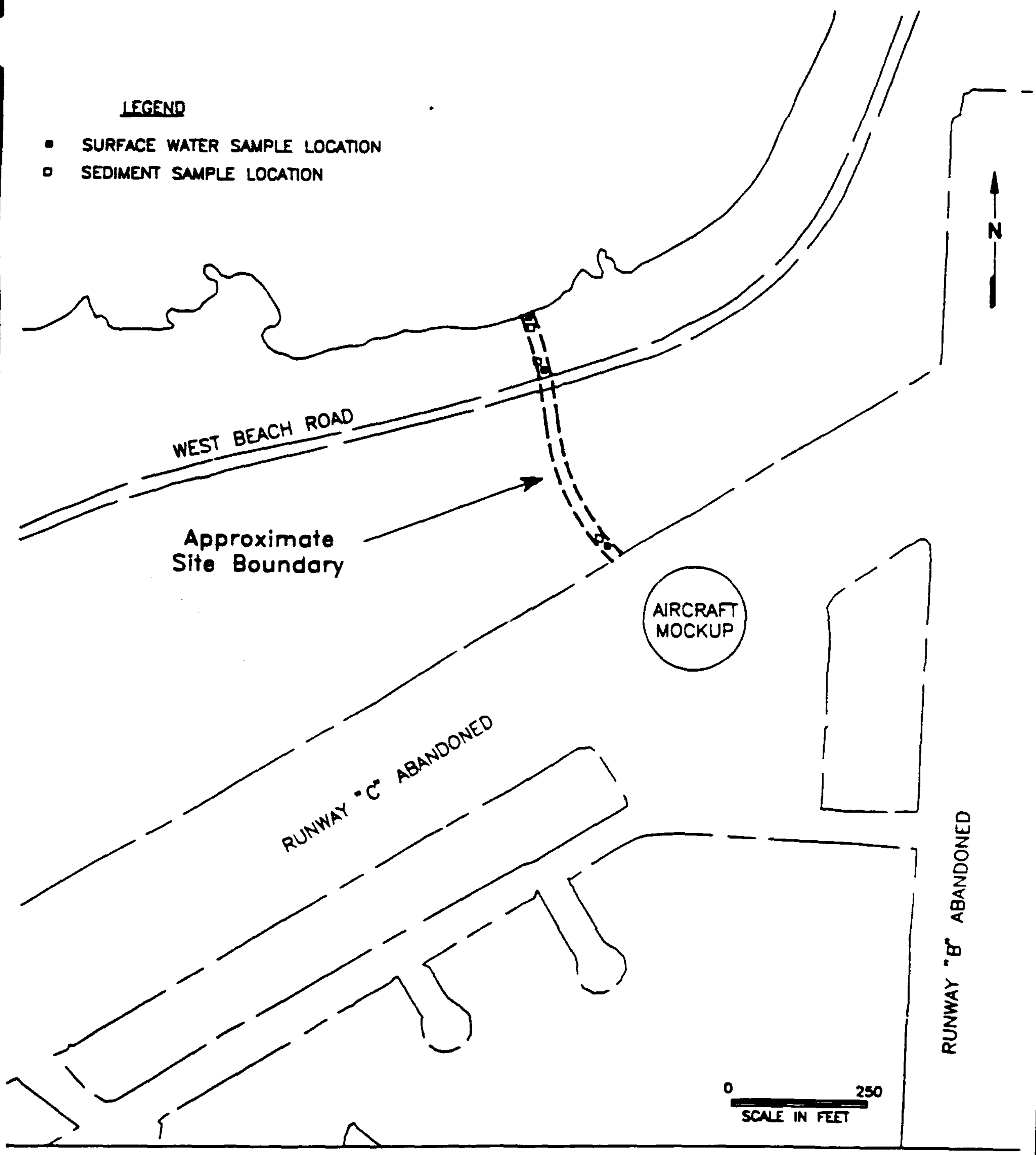

Figure 3.2.2-1

FT02 Abandoned Drum Disposal Area
Sample Location Map

Eareckson Air Force Station, Alaska

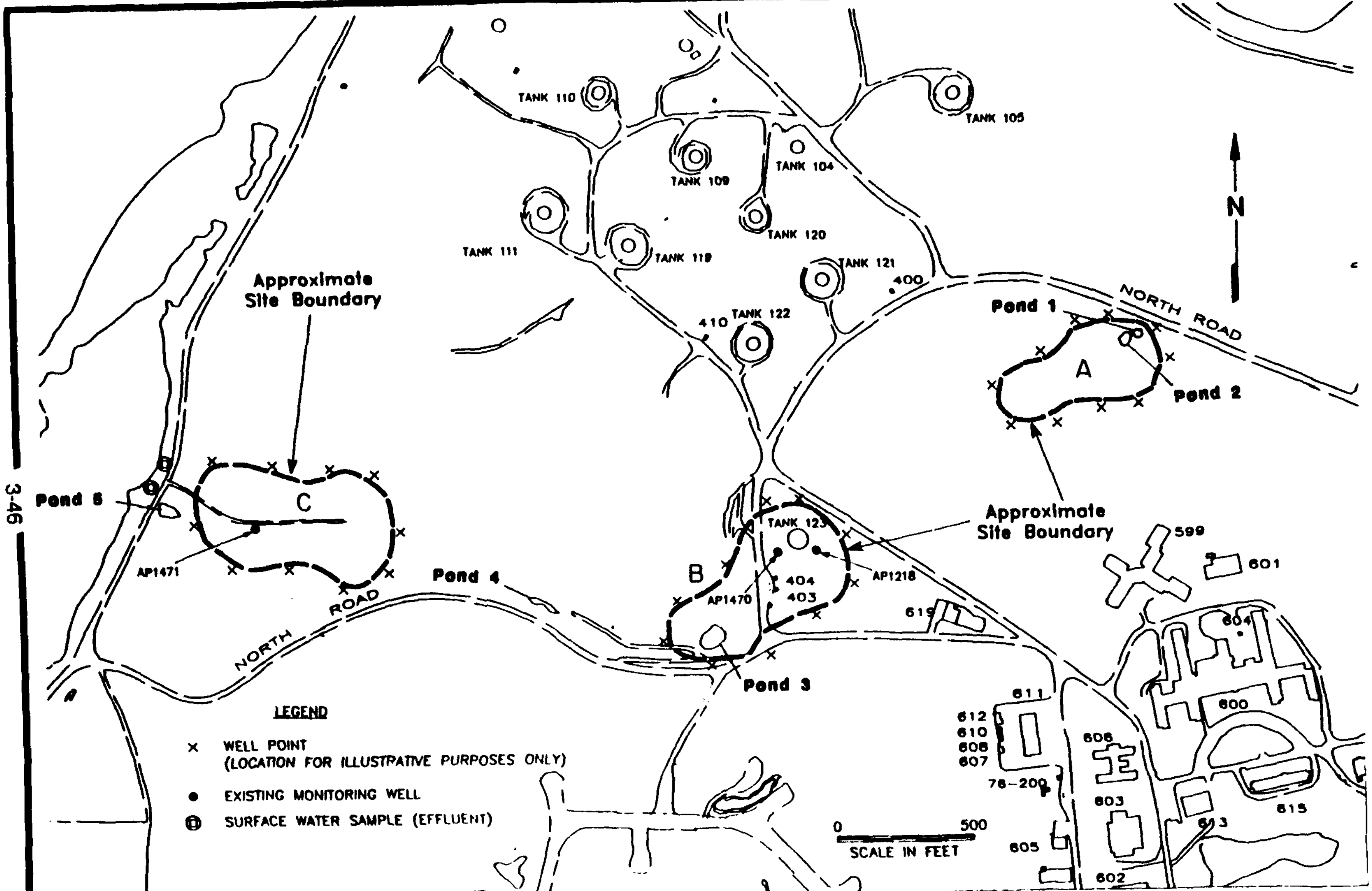

Figure 3.2.2-2

SS07/ST08 West End Oil/Water Separator and Diesel Tank 123
Sample Location Map

Eareckson Air Force Station, Alaska

Area A is located around Pond 5 and includes Monitoring Well AP-1471, located southeast of Pond 5. Floating fuel product was observed in Well No. AP-1471 (depth of product was not recorded).

Area B is located east of Area A and includes Pond 3; Diesel Tank 123; Monitoring Well No. AP-1218, located southeast of Tank 123; and Monitoring Well No. AP-1470, located southwest of Tank 123. Approximately 6 inches of product were measured in Well No. AP-1218. Measurements of product in Well No. AP-1470 have shown 0.5 to 1.5 feet of floating fuel product.

Area C is located northeast of Area B and includes Ponds 1 and 2, where 1 to 2 inches of floating product were observed on the pond surfaces during a site visit in October 1992.

An LSI will be conducted during 1993 to determine if early action(s) is warranted for the discharge from the oil/water separator to the tidal pool, or for floating product removal from any of the wells or ponds. In addition, information will be obtained to focus the 1994 RI at SS07/ST08 and to help determine the appropriate regulatory program for SS07 (e.g., POL vs. CERCLA). During the LSI, surface water samples will be collected of the effluent from the oil/water separator, in addition to groundwater samples collected from well points installed around each of the three areas.

Field Investigation. A site reconnaissance will be conducted to help identify and map the boundaries of each of the three areas discussed above. Ten well points will be installed around each of the three areas (Areas A, B, and C). Water-level measurements and a grab groundwater sample will be taken from each well point. Samples will be field screened for TPH and volatiles at the onsite laboratory.

Well points will also be used to measure for floating product. The well points will be capped and allowed to reach equilibrium with the shallow aquifer for at least one week before an attempt is made to measure product. Field screening data and product measurement information will be used to determine what locations will be used for groundwater samples for offsite analysis. Five samples from each area will be sent offsite for DRO and GRO (SW8100/8015), volatiles (SW8260), pesticides/PCBs (SW8080), ICP metals (SW6020), lead (SW7421), and semivolatile organics (SW8270).

If product is detected in any of the well points, 4-inch monitoring wells may be installed, during the basewide investigation to help identify early actions, such as free product removal.

In addition to the groundwater samples, two samples will be collected from the effluent at the discharge point into the tidal basin. One sample will be collected at the start of the field program (mid-August) and the second sample will be collected at the end of the field program (early October). These samples will be field screened in addition to being sent offsite for analysis. The parameters will be the same as for the groundwater samples described above. One surface water and one sediment sample will be collected from each of the five ponds and analyzed for the groundwater parameters as part of the basewide investigation.

The approximate locations of all well points and the effluent sample points are shown in Figure 3.2.2-2.

Because three USTs designated ST44 are located at the Power Plant (ST09), which contributes runoff to Pond 1 and other drainages comprising the oil/water separator

(SS07), the tanks will be measured to determine if they are empty. Two of the three USTS (3049-3 and 3049-6) contained No. 2 diesel fuel. The third tank (3051-1) contained waste oil.

ST10/SS11 Vehicle Refueling Shop and Vehicle Maintenance Shop

Site Description. During the POL investigation conducted by COE near the gas station in 1988, monitoring wells were installed. One monitoring well, AP-1529, located near Building 605 had floating fuel product measured at 2 to 3 inches in thickness. This area was investigated for the purpose of demolishing buildings for new construction in the area.

Because of the significance of the floating fuel product in the area, additional well points and monitoring wells will be installed to evaluate the ST10/SS11 area for potential early action.

Because floating product has been measured in wells at ST10/SS11, results of the LSI will be used to determine whether an early action is necessary and, if it is, to provide information necessary to design the appropriate early action remedial alternative. *Permanent monitoring wells may assist in evaluating the effectiveness of soils removal* conducted in 1993.

Field Investigation. A total of 15 well points will be installed in the vicinity of the Vehicle Refueling Shop and Vehicle Maintenance Shop to evaluate the groundwater quality, the extent of the floating fuel product contamination, and to provide information to design an early action remedial alternative, if necessary. The well points will be installed using the procedures described in Section 2.1.7 in the SAP. The well point locations are shown in Figure 3.2.2-3. Grab samples will be collected for onsite analysis for TPH and volatiles. After a minimum period of seven days, the fluid levels in the well points will be measured.

Based on the presence and depth of floating fuel product in the well points, up to five permanent monitoring wells will be installed. A groundwater sample from beneath any floating fuel product will be collected from each monitoring well. The groundwater samples will be analyzed by the onsite laboratory for TPH and volatiles, and the fixed laboratory for DRO and GRO (SW8100/8015) volatile organic compounds (SW8260), *and semivolatile organic compounds* (SW8270) analyses. If analytical results from samples collected during 1993 excavation activities in this area indicate that metals are present in significant concentrations, ICP metals (SW6020) will be included in the groundwater sample analyses. The monitoring wells may be sampled on a regular basis in coordination with the basewide monitoring network. A sample of the floating fuel product will also be collected to determine the properties of the fuel in the event that an early action is necessary. Monitoring well locations are shown in Figure 3.2.2-3; however, the exact locations will be determined based on the well point information.

Building 525

Site Description. During the POL investigation conducted by COE for the gas station in 1988, monitoring wells were installed. One monitoring well, AP-1525 located at the eastern edge of the active runway near Building 525, had floating fuel product measured at 6 to 7 inches. This area was investigated for the purpose of demolishing buildings for new construction in the area. Reportedly, a fuel-handling facility was located in the vicinity of well AP-1525, and the facility had a history of leaks.

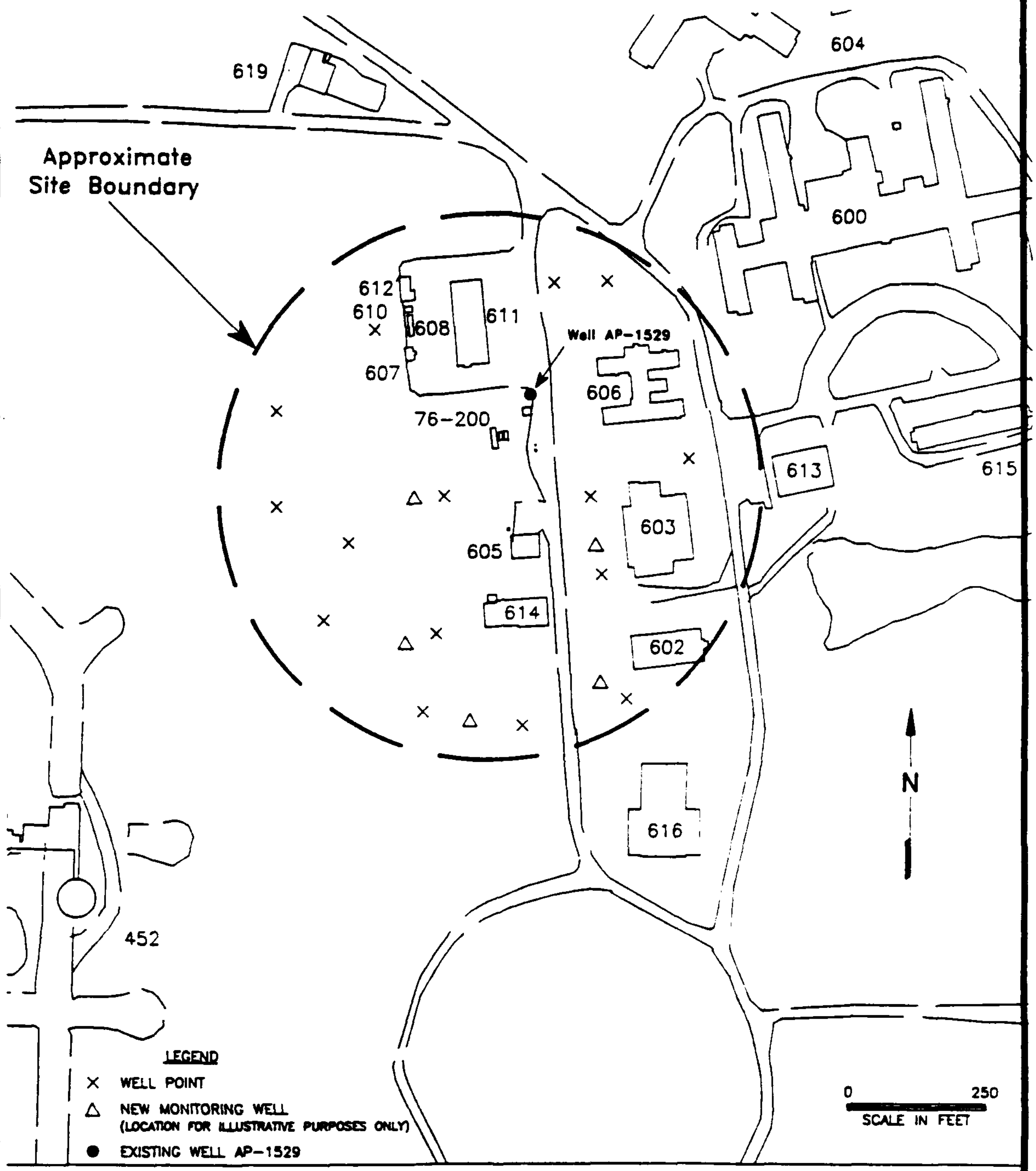

Figure 3.2.2-3

ST10/SS11 Vehicle Refueling Shop
and Vehicle Maintenance Shop
Sample Location Map

Eareckson Air Force Station, Alaska

Results of the LSI at Building 525 will be used to determine whether an early action is necessary and, if it is, to provide information necessary to design the appropriate early action remedial alternative.

Field Investigation. A total of 15 well points will be installed in the vicinity of Building 525 to evaluate the groundwater quality, the extent of the floating fuel product contamination, and to provide information to design an early action remedial alternative, if necessary. The well points will be installed using the procedures described in Section 2.1.7 in the SAP. The well point locations are shown in Figure 3.2.2-4. Grab samples will be collected for onsite analysis for TPH and volatiles. After a minimum period of seven days, the fluid levels in the well points will be measured as described in Section 2.3 in the SAP.

Based on the presence and depth of floating fuel product in the well points, five permanent monitoring wells will be installed using the procedures described in Section 2.1.6 in the SAP. A groundwater sample from beneath any floating fuel product will be collected from each monitoring well using the procedures described in Section 2.2.1 in the SAP. The groundwater samples will be analyzed by the onsite laboratory for TPH and volatiles, and the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8260), semivolatile organic compounds (SW8270), and ICP metals (SW6020) analyses. The monitoring wells may be sampled on a regular basis in coordination with the basewide monitoring network. A sample of the floating fuel product will also be collected to determine the properties of the fuel in the event that an early action is necessary. The fuel samples will be collected using the procedures described in the SAP. Monitoring well locations are shown in Figure 3.2.2-4; however, the exact locations will be determined based on the well point information.

3.2.3 Feasibility Study Source Units

FT02 Aircraft Mockup

Site Description. The Aircraft Mockup is one area of three comprising FT02. It is located at the northeast end of abandoned Runway C, approximately 600 feet southeast of West Beach Road. The area was used as a training area for firefighters. Cylindrical tanks were configured to resemble an aircraft fuselage and placed in two concentric berms. There is a catch basin located approximately 125 feet east of the bermed area.

CH2M Hill conducted field investigations in 1988 and 1992. TPH, volatile organic compounds, and semivolatile organic compounds were detected in subsurface soil samples and TPH, BTEX, semivolatile organic compounds, and elevated concentrations of zinc and chromium were detected in groundwater samples. The LSI will be conducted to provide additional information pertaining to groundwater contamination necessary to complete an FS at the Aircraft Mockup and to provide information for future remediation activities.

Field Investigation. A total of 10 well points will be installed at the Aircraft Mockup area to provide information on to the extent of groundwater contamination. The well points will be located to determine the extent of groundwater contamination, if possible, and provide information for screening of remedial alternatives. The well point locations are shown in Figure 3.2.3-1. The well points will be located to supplement the existing groundwater data. A groundwater sample will be collected from each well point to determine whether the soils contamination at the Aircraft Mockup is significantly affecting groundwater flowing beneath the site. The samples will be analyzed for

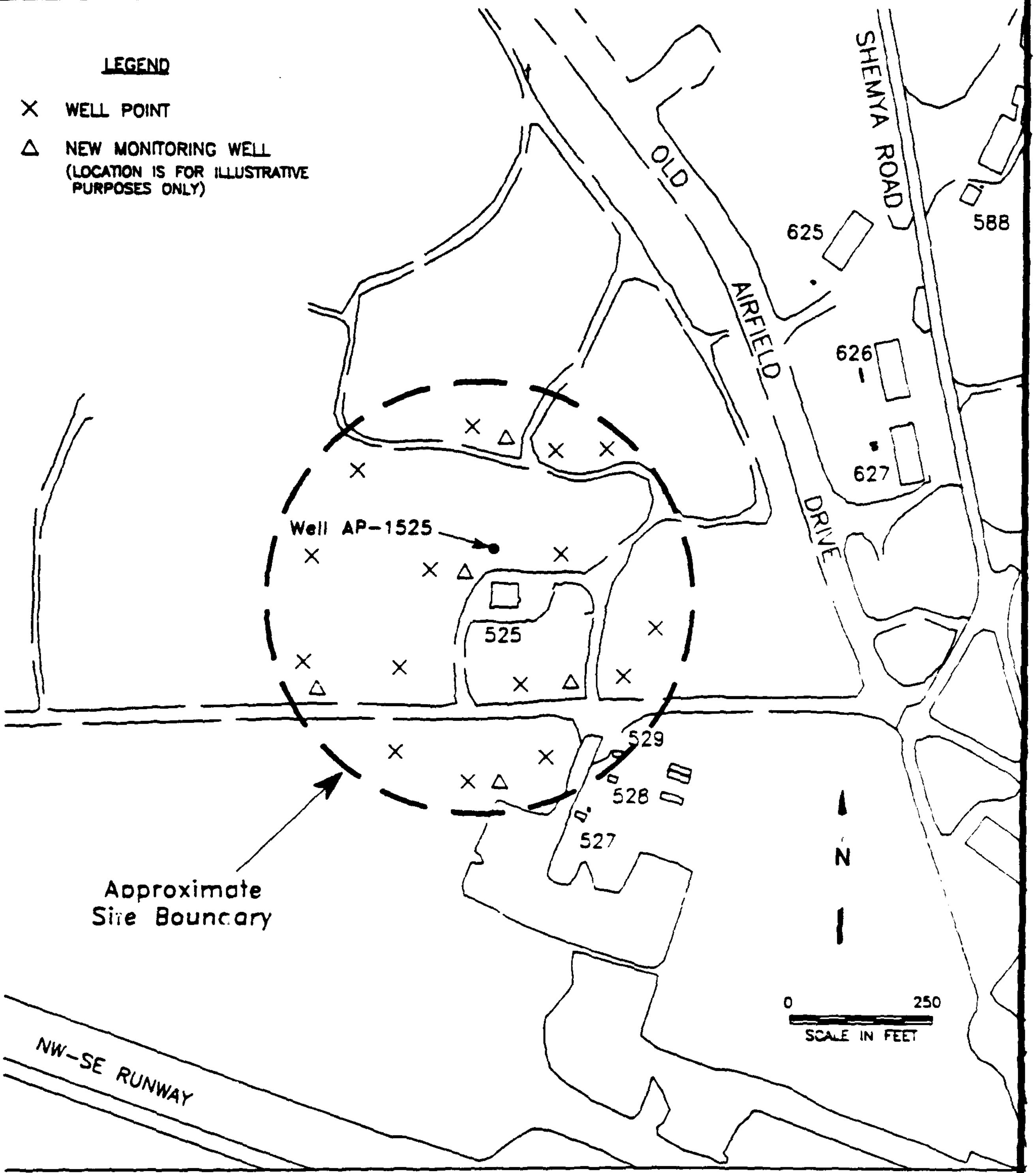

Figure 3.2.2-4
Building 525
Sample Location Map
Eareckson Air Force Station, Alaska

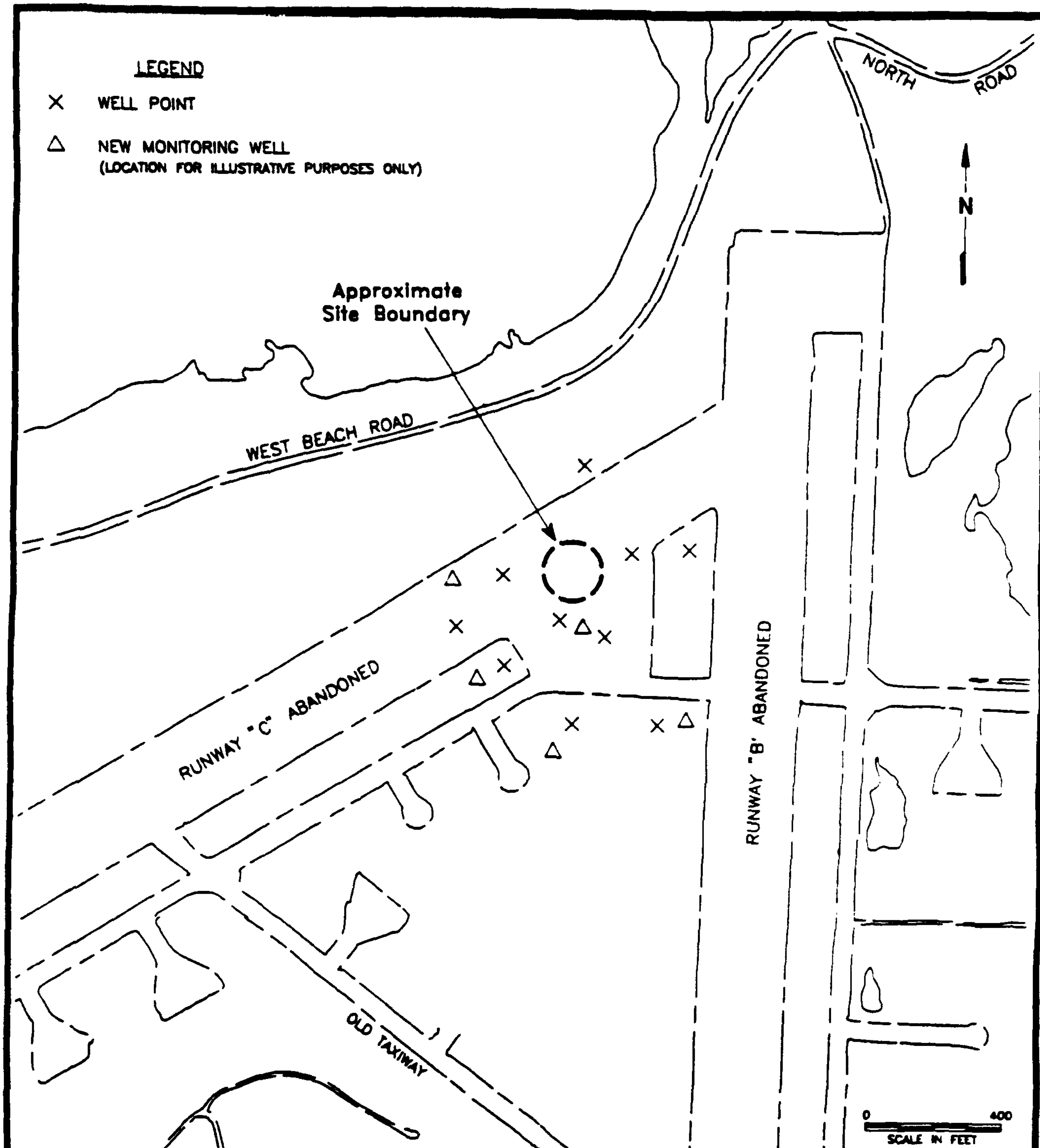

Figure 3.2.3-1

FT02 Aircraft Mockup
Sample Location Map

Eareckson Air Force Station, Alaska

volatiles and TPH by the onsite laboratory. The hydrogeologic and field analytical data will be used to locate up to five additional monitoring wells at the Aircraft Mockup. A groundwater sample will be collected from each of the monitoring wells. The samples will be sent to the onsite laboratory for TPH and volatile analyses, and the fixed laboratory for DRO and GRO (SW8100/8015), volatile organic compounds (SW8260), semivolatile organic compounds (SW8270), and ICP metals (SW6010) analyses. The monitoring wells may be sampled on a regular basis in coordination with the basewide monitoring network.

Analytical results will be compared with PRLs to determine the significance of any contaminant concentrations detected in water samples.

3.2.4 Other Source Units

FT02 Fire Training Area

Site Description. The Fire Training Area is located at the north end of Runway B and was previously used by firefighters as a training area. CH2M Hill (1988) indicates that this area was contaminated with JP-4, waste oil, and AFFF. Reportedly, all debris was removed as part of the ACE by the 5099 CEOS in 1985, soil was excavated to below discoloration, and the area was backfilled.

There have been no previous field investigations at the Fire Training Area. Samples will be collected to provide preliminary information pertaining to potential contamination resulting from past activities.

Field Investigation. Four surface soil samples will be collected to determine if there is residual contamination in the area. The surface soil samples will be sent to the onsite laboratory for TPH and volatile analyses. Based on the results of the field screening, two of the samples will be sent to the fixed laboratory for ICP metals (SW6020), lead (SW7421), and semivolatile organic compounds (SW8270) analyses.

Two soil borings will be drilled to a depth of approximately 10 feet to evaluate subsurface conditions at the Fire Training Area. Two subsurface soil samples will be collected from each boring to determine whether there is subsurface contamination associated with past activities. The four subsurface soil samples will be sent to the onsite laboratory for TPH and volatile analyses. Based on the field screening results, two of the samples will be sent to the fixed laboratory for semivolatile organic compounds (SW8270), ICP metals (SW6020), and lead (SW7421) analyses.

Five well points will be installed around the edge of the runway. Groundwater samples will be collected from each well point to evaluate groundwater quality in the vicinity of the Fire Training Area. The groundwater samples will be sent to the onsite laboratory for TPH and volatile analyses. Based on the field screening results, three of the samples will be sent to the fixed laboratory for semivolatile organic compounds (SW8270), and ICP metals (SW6020) analyses.

One monitoring well will be installed downgradient of the Fire Training Area. A groundwater sample will be collected and will be sent to the onsite fixed laboratories and analyzed for DRO and GRO (SW8100/8015 modified), volatile organic compounds (SW8260), semivolatile organic compounds (SW8270), ICP metals (SW6020) and water quality parameters (E300.0). The monitoring well may be sampled on a regular basis in coordination with the basewide monitoring network.

Sample locations are shown in Figure 3.2.4-1.

SS07 West End Oil/Water Separator

The LSI for SS07 has been described in Section 3.2.2. Information collected during the LSI at SS07/ST08 will be used to make a decision regarding the appropriate regulatory program for SS07 (POL vs. CERCLA). The oil/water separator is currently classified in the POL program. Samples collected during the 1993 LSI will be analyzed for a full suite of parameters (DRO and GRO, volatiles, semivolatiles, pesticides/PCBs, and ICP metals). If hazardous substances are detected, a decision will be made as to whether SS07 should be moved to either the RCRA or CERCLA program. See Section 3.2.2 for a full description of LSI activities for SS07.

3.2.5 Field Operations Summary

Table 3.2.5-1 summarizes the sampling and analysis program for the LSI. Each of the LSIs for potential source units described in Sections 3.2.1 through 3.2.4 is included in the table. Rationale for each LSI is included in Section 2.1.

3.3 COORDINATION OF BASEWIDE AND LIMITED SOURCE INVESTIGATION

For both technical and logistical reasons, both the basewide investigations (surface water/seep investigation, groundwater investigation, ecological survey, and background sampling program), and the LSI can be expedited by closely coordinating field data acquisition and interpretation. From a technical perspective, data obtained from the basewide investigations and the LSI, especially those within a given management zone, can directly complement each other. For example, basewide data will give an indication of the transport of contamination away from a given LSI site or sites, whereas LSI data will assist in identifying sources of contamination detected during basewide studies. From a logistical perspective, the limited support facilities available at Eareckson AFS dictate that tasks from each program be conducted concurrently to facilitate the use of transportation and communication facilities. This process may be taken one step further by combining the investigative tasks from both programs based on geography and not by program, thereby limiting mobilization time.

Integration of the basewide and LSI programs will also be aided by maximizing the use of dynamic or real-time data collection. Thus, the field studies will use collection of screening-level data such as well point groundwater samples, and an onsite laboratory for rapid screening of various media samples. The studies will also rely on considerable decision making in the field regarding sample locations, types of samples to be collected, and the degree of use of the onsite laboratory. This process will allow data from each investigation to be used to help guide its companion investigation while optimizing the use of limited field resources.

The 1993 field investigation consists of one field sampling program. The sampling program will be conducted to support the basewide surface water/seep investigation, the groundwater investigation, the background sampling, the ecological survey, and LSI activities. The following LSI activities will also be conducted in support of the basewide investigation:

- surface water and sediment sampling at Upper Lake (OT49);
- surface water and sediment sampling at the Abandoned Drum Disposal Area (FT02) and West End Oil/Water Separator (SS07); and

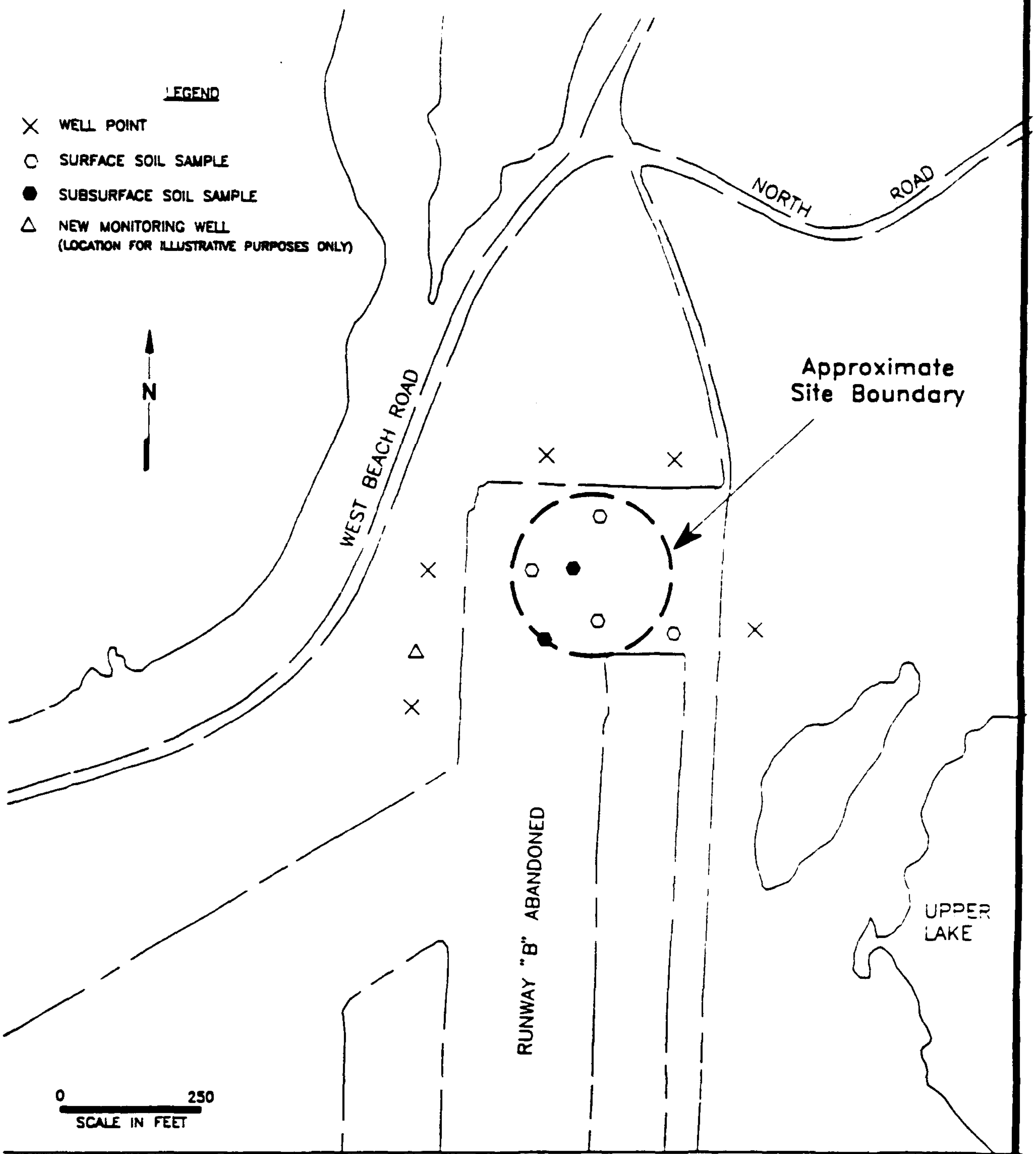

Figure 3.2.4-1

FT02 Fire Training Area
Sample Location Map

Eareckson Air Force Station, Alaska

TABLE 3.2.5-1
FIELD OPERATIONS SUMMARY FOR LIMITED SOURCE INVESTIGATION
E'RECKSON AIR FORCE STATION, ALASKA

Potential Source Unit	Number of Samples							Fixed Laboratory Analyses									QC Samples			
	Surface Soil	Sub-surface Soil	Surface Water	Sediment	Groundwater (Well Points)	Ground-water (Wells)	Product	DRO & GRO Mod. 8100/8015	Volatile Organics 8260/8240	Dioxins 8280	PCB/ Pesticides 8080	ICP Metals 6020	Semi-volatile Organics 8270	Water Quality E300.0	Data Level	Field (3) Screen	Trip (4) Blank	Equip.(5) Blank	Ambient (6) Blank	Duplicate (7)
FT02 (Aircraft Mockup)					10											10				
						5		5	5			5	5		II	5	1	2/2	1	1/1
FT02 (FTA)	4											2 (8)	2		II	4				
		4										2 (8)	2		II	4	2	2/2	1	1/1
					5							3 (8)	3		II	5				
						1		1	1			1 (8)	1			1				
FT02 (ADDA)			3					3	3			3	3		II	3	2	2/2	1	1/1
				3				3	3			3	3		II					
SS07/ ST08		5						5	5		5	5	5		II	5	4	4/4	1	2/2
				5				5	5		5	5	5			5				
			5					5	5		5	5	5			5				
					30			15	15		15	15	15		II	30	4	4/4	1	1/1
LF18					3			1	1			1	1		II	3				
	5							5	5	1	5	5	2		II	5	2	2/2	1	1/1
		5						5	5	1		5	2		II	5				
			2(1)					2	2			2	2		II	2				
LF19			4					1	1		1	1	1		II	4	1	2/2	1	1/1
					5			3	3		3	3	3		II	5				
OT21		6						3	3			3 (8)			II	6	1	2/2	1	1/1
					2(1)			2	2			2 (8)			II	2				
SS20	4							2	2			2			II	4	1	2/2	1	1/1
			2		1			1	1			1			II	2				
		2						2	2			2			II	2				
LF20		2						2	2	2	2	2	3		II	2				
			2					2	2	2	2	2	2		II	2	2	2/2	1	1/1
					6											6				
						3		3	3	3	3	3	3		II	3				

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Page 1 of 2

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TABLE 3.2.5-1 (continued)
FIELD OPERATIONS SUMMARY FOR LIMITED SOURCE INVESTIGATION
EARECKSON AIR FORCE STATION, ALASKA

Potential Source Unit	Number of Samples							FIXED LABORATORY ANALYSES									QC Samples			
	Surface Soil	Sub-surface Soil	Surface Water	Sediment	Groundwater (Well Points)	Ground-water (Wells)	Product	DRO & GRO Mod. 8100/8015	Volatile Organics 8260/8240	Dioxins 8280	PCB/ Pesticides 8080	ICP Metals 6020	Semi-volatile Organics 8270	Water Quality E300.0	Data Level	Field (3) Screen	Trip (4) Blank	Equip.(5) Blank	Ambient (6) Blank	Duplicate (7)
OT29				4								4			II	4	1	2/2	1	1/1
OT40			3	 3				3 3	3 3		3 3	3(8) 3(8)	3 3	3	II II	3 3	1	2/2	1	1/1
ST10/SS1*					15	5	1	5 1	5			5	5	5	II	15 5	1	2/2	1	1/1
Bldg. 525					15	5	1	5 1	5			5	5	5	II	15 5	1	2/2	1	1/1

NOTES:

(1) = Optional
(2) = Lead only (Method SW7421)
(3) = Analysis performed by the onsite field laboratory (8010/8020 and modified 8015)
(4) = Estimate based on 20 percent of samples collected for volatile organic analysis by the fixed laboratory
(5) = Estimate based on the estimated number of days to complete sample collection; 2/2 = onsite/fixed laboratory
(6) = Estimate based on one blank collected for analysis by the fixed laboratory per potential source unit included in the limited source investigation
(7) = Estimate based on 10 percent of samples collected; 1/1 = onsite/fixed laboratory
(8) = Surface water and sediment samples will also be analyzed for mercury (cold vapor methods 7470 and 7471) and lead (Method SW7421)

ADDA = Abandoned Drum Disposal Area
FTA = Fire Training Area
Equip. = equipment
ICP = inductively coupled plasma
LSI = limited source investigation
Mod. = modified
PCB = polychlorinated biphenyl
QC = quality control

- groundwater sampling and data collection from well points and monitoring wells installed at the Aircraft Mockup (FT02); the Fire Training Area (FT02), the West End Oil/Water Separator (SS07), Tank 123 (ST08), the Wood Dump (LF15), the Barrel Dump (LF18), the Old Grounded Barge (OT21), the Retrograde Area (SS20), and the Scrap Metal Landfill (LF28).

Groundwater, soils, surface water, and sediment data obtained during the basewide investigation will be evaluated, and where possible, used to focus the remedial investigations at potential source units not evaluated during the LSI and provide hydrogeologic information. Data from all investigation activities conducted in 1993 will be evaluated based on their impact to the program as well as to a specific investigation component.

4.0 REPORTING REQUIREMENTS

Several types of reports will be prepared both during and after the completion of the field effort. The following sections describe the data management requirements, NFADs, decision documents, proposed plans, letter reports, the SCS Technical Report, and weekly status reports.

4.1 DATA MANAGEMENT

Jacobs will enter all information obtained from the 1993 field effort into the Jacobs Environmental Management System (JEMS) data base system. This data base will allow preparation of Installation Restoration Program Information Management System (IRPIMS) data submittals to the Air Force as specified in the Statement of Work. All data will be entered as soon as possible after collection, or after analytical results are received and validated. Data entries will be checked for accuracy and completeness before the IRPIMS submittal is prepared.

The JEMS data management system will also allow for data manipulation, as well as interpretation. The data interpretation programs will generate summary tables, boring logs, cross sections, contour maps, etc., each of which will assist in preparation of the SCS Technical Report.

4.2 NO FURTHER ACTION DOCUMENTS

Jacobs will prepare NFADs for potential source units as they are identified. Currently, one potential source unit, SS12, has been selected for no further action based on previous investigations. Seven source units will be investigated for no further action during the field effort. These source units are described in Sections 2.2.1 and 3.2.1 of the Work Plan.

Preparation of NFADs will follow guidance from the State of Alaska (ADEC, 1992). The NFAD guidance prepared by ADEC is considered to contain the most conservative criteria for defining no further action. The NFAD guidance is the most stringent and has incorporated specific requirements for closure of both solid waste and UST sites with each applicable state program requirements. Each NFAD must serve as a public record to verify that no additional assessment and/or remediation will be required at each potential source unit. The NFAD will describe the location of the potential source unit, environmental setting, and historical release information, if applicable. Previous data will be evaluated and data summary tables will be provided. All potential exposure scenarios and both human and ecological receptors will be discussed. The exposure scenarios will include a description of the toxicity of any contaminants of concern, and a definition of current and probable future land uses. Exposure scenarios may include input that considers exposure duration more applicable to the Air Force Base scenario, which is currently a one-year unaccompanied tour. The format for the NFAD will follow the outline provided in the Air Force IRP Handbook (U.S. Air Force, 1991c) and specific guidance set forth by the State of Alaska.

The major sections of the NFAD may include the following:

- Executive Summary;
- Introduction;

- General Information:
  - Site Description and
  - Environmental Settings;
- Data Collection/Data Evaluation:
  - Background Data,
  - Data Collection/Evaluation, and
  - QA/QC;
- Exposure Routes;
- Receptors:
  - Human,
  - Animal,
  - Aquatic, and
  - Plant;
- Risk Assessment; and
- References.

All analytical data used to support the decisions, as well as background data and risk calculations, will be included as appendices to the NFAD.

4.3 DECISION DOCUMENTS

Decision documents will be prepared to present rationale for removing sites from the IRP. There are several reasons for removing sites form the IRP, as discussed below:

- Location of potential source unit is unknown (OT30, SS31, LF15, SS22, SS47);
- Regulated under State of Alaska solid waste regulations (LF27); or
- Regulated under State of Alaska UST regulations (ST33, ST34, ST35, ST37, ST38, ST40, ST41, ST42, ST43).

A decision document includes a description of the installation and site, source history, an analysis of the rationale for the decision, and a recommendation. Supporting information will include, at a minimum, a site location map and a list of references and interviews that provided information.

4.4 PROPOSED PLANS

Proposed plans will be prepared for two source units, LF24 and LF26 as described in Section 2.2.1.1. These plans will follow the outline specified in the Air Force IRP Handbook (U.S. Air Force, 1991c). Screening and detailed screening of alternatives will be included in the plans, as well as a FS for the selected alternatives.

Alternatives will be initially screened based on technical feasibility, regulatory compliance, brevity of project duration, and effectiveness in reducing risk to acceptable levels. Detailed screening of alternatives will be based on the following:

- overall protection of human health and the environment;
- compliance with ARARs;
- long-term effectiveness and permanence;
- reduction of toxicity, mobility, and volume through treatment;
- short-term effectiveness;
- implementability;
- cost;
- state acceptance; and
- community acceptance.

Results of the detailed screening of alternatives will provide the basis for the FS that will identify the preferred alternative(s). The proposed plan will describe the implementation of the preferred alternative(s).

4.5 INTERIM LETTER REPORTS

Interim letter reports will be submitted to the Air Force as project progress indicates. An interim letter report will be submitted immediately following completion of the field effort and before preparation of the SCS Technical Report is finalized to provide the Air Force with a timely summary of all field activity.

4.6 SITE CHARACTERIZATION SUMMARY TECHNICAL REPORT

The SCS Technical Report will be submitted to the Air Force following completion of the data collection, validation, and evaluation efforts. Items to be included in the SCS Technical Report are 1) site characterization summaries based on the results of the field effort, 2) revised conceptual site models, 3) ecological survey results, 4) preliminary discussion of risks, and 5) analytical data summaries. Appendices will include field records, field measurement data, laboratory analytical data, QA/QC of all data, and chain-of-custody forms.

4.7 WEEKLY STATUS REPORTS

During the basewide and LSI field activities, a weekly status report will be sent to AFCEE. This report will be prepared by the Jacobs site manager and will include the following:

- a summary of all activities;
- a list of personnel onsite;
- a description of types and numbers of samples collected;
- a list of samples analyzed by the field laboratory with analytical results;
- a list of samples sent to the fixed laboratory;
- copies of borehole lithologic logs, if applicable;

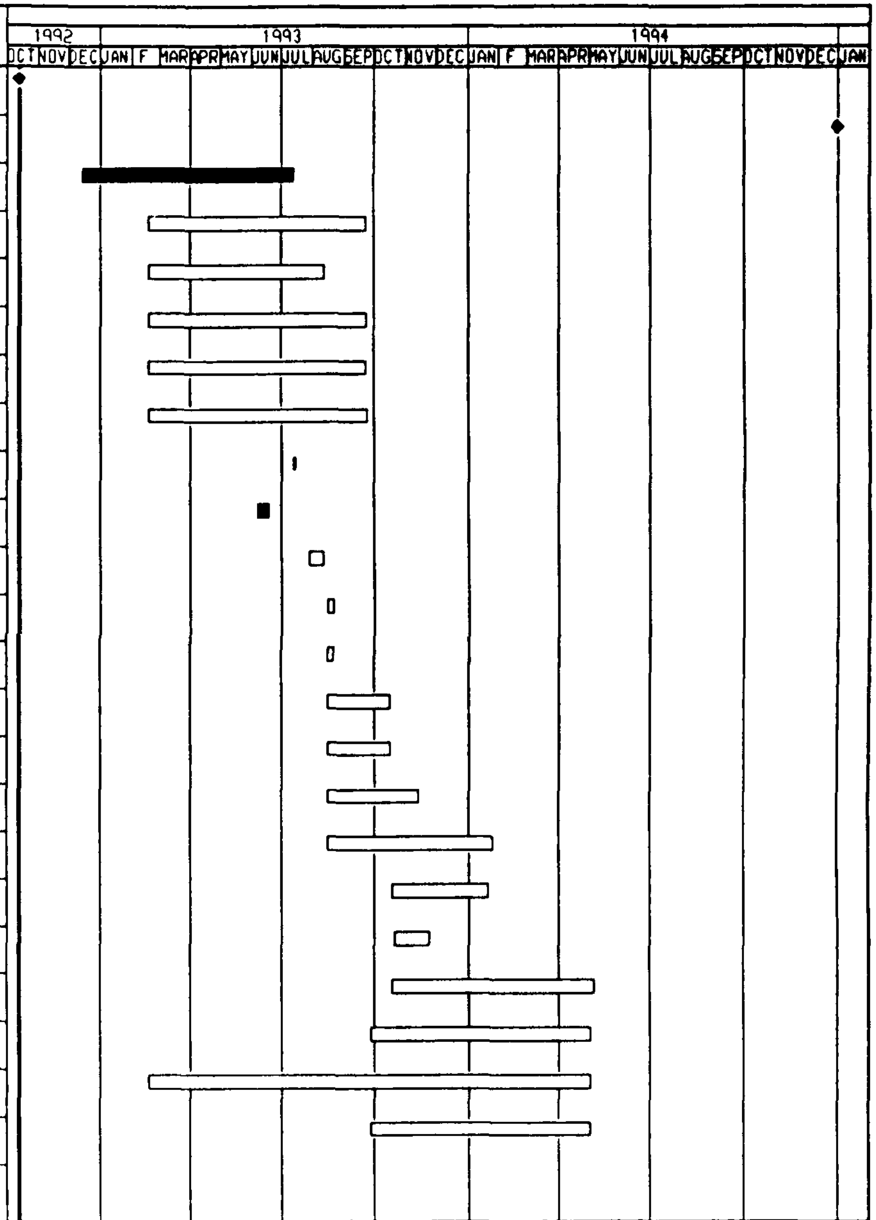
- a summary of plans for the following week; and
- a list of potential problems, proposed solutions, and outstanding issues requiring resolution.

5.0 PROJECT SCHEDULE

The proposed project schedule for all technical activities is shown in Figure 5.0-1. A site reconnaissance was conducted in June 1993. Information obtained during this activity has been used to finalize the Work Plan and SAP in preparation for the basewide and LSI field activities. Planning and coordination for the field activities will be conducted during finalization of the Work Plan and SAP. Fieldwork will begin in August 1993 and is expected to last approximately two months. As can be seen on the schedule, fieldwork will begin after comments have been received from regulatory agencies on the draft planning documents and before final versions of these documents are prepared.

Preparation of an NFAD and FS/interim action documents for potential source units identified from previous work will continue during all other activities. Additional potential source units will be identified for NFADs and other documents following completion of the LSI. After completion of all field activities, the SCS Technical Report will be prepared to summarize the results of the field investigations.

ACTIVITY ID	ACTIVITY DESCRIPTION	EARLY START	EARLY FINISH	ORIG DUR
1000-00	PROJECT START	13OCT92		0
1000-50	PROJECT FINISH		30DEC94	0
1121-00	PLANNING/SCOPING TASKS	14DEC92	12JUL93	151
1216-00	CONCEPTUAL MODEL DQO'S (PLANNING DOCUMENT)	18FEB93	22SEP93	156
1420-00	HEALTH & SAFETY PLAN (PLANNING DOCUMENT)	18FEB93	11AUG93	125
1430-00	QUALITY ASSUR PROJ PLAN (PLANNING DOCUMENT)	18FEB93	22SEP93	155
1460-00	FIELD SAMPLING & ANALYSIS PLAN (PLANNING DOCMNT)	18FEB93	22SEP93	155
14701-00	WORK PLAN (PLANNING DOCUMENT)	18FEB93	23SEP93	156
14703-35	MEET WITH AGENCIES (Elsendorf)	13JUL93	13JUL93	1
1210-05	SITE RECONNAISSANCE	7JUN93	17JUN93	4
1210-25	PERFORM DRILLING CLEAR/GEOPHYSICS/PERMITS	28JUL93	10AUG93	10
1210-20	SET UP FIELD SCREENING LAB	16AUG93	20AUG93	5
1210-30	MOBILIZE CREWS	16AUG93	20AUG93	5
1210-35	BASEWIDE FIELD PROGRAM	16AUG93	15OCT93	45
1210-40	LSI FIELD PROGRAM	16AUG93	15OCT93	45
1210-45	DATA ANALYSIS	16AUG93	12NOV93	65
1210-55	DATA MANAGEMENT	16AUG93	24JAN94	116
1210-60	IRPIMS INPUT	18OCT93	20JAN94	64
1210-50	DATA VALIDATION	21OCT93	22NOV93	23
14110-00	SCS TECHNICAL REPORT	18OCT93	5MAY94	144
1440-75	PREPARE NFA0's	27SEP93	2MAY94	156
1220-00	FEASIBILITY STUDIES/INTERIM ACTIONS	18FEB93	2MAY94	313
1221-05	FEASIBILITY STUDIES/SCREENING OF ALTERN REPORT	27SEP93	2MAY94	156



Plot Date 15SEP93
Data Date 13OCT92
Project Start 13OCT92
Project Finish 30DEC94

(c) Primavera Systems, Inc.

FIGURE 5.0-1-PROJECT SCHEDULE

EARECKSON AIR FORCE STATION, ALASKA

Date	Revision	Checked	Approved

EARECKSON AFS, ALASKA

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APPENDIX A

Preliminary ARARs
(from CH2M Hill, 1990)

INSTALLATION RESTORATION PROGRAM

STAGE 1

SHEMYA AIR FORCE BASE
SHEMYA, ALASKA

Prepared By

CH2M HILL

2550 DENALI ST. - 8TH FLOOR
ANCHORAGE, ALASKA 99503

AUGUST 10, 1990

FINAL TECHNICAL REPORT

Prepared for:

UNITED STATES AIR FORCE
ALASKAN AIR COMMAND
5099 CEOS/CC
ELMENDORF AIR FORCE BASE, ALASKA 99506

UNITED STATES AIR FORCE
HUMAN SYSTEMS DIVISION (AFSC)
IRP PROGRAM OFFICE (HSD/YAQ)
BROOKS AIR FORCE BASE, TEXAS 78235-5000

INSTALLATION RESTORATION PROGRAM

STAGE 1

FINAL TECHNICAL REPORT

FOR

SHEMYA AIR FORCE BASE
Shemya, Alaska 98736

United States Air Force
Alaskan Air Command
5099 CEOS/CC
Elmendorf Air Force Base, Alaska 99506

August 10, 1990

PREPARED BY

CH2M HILL
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Anchorage, Alaska 99503

CH2M HILL SOUTHEAST, INC.
Gainesville, Florida

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HUMAN SYSTEMS DIVISION (ARSC)
IRP PROGRAM OFFICE (HSD/YAQ)
BROOKS AIR FORCE BASE, TEXAS 78235-5000

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5. ALTERNATIVE REMEDIAL MEASURES

The selection of site remedial alternatives usually involves several steps. Initially, general classes or categories of response actions are considered. As more detailed information about the site and the contaminants becomes available, the selection process advances to the consideration of different technologies, and then to identification and evaluation of processes. Each step involves more detailed analyses and is more tailored to the site and the wastes to be managed.

More site investigation work will be required to delineate the nature and extent of contamination at Shemya AFB. The additional characterization will allow determination of which action-specific ARARs may be applicable or relevant to the site, and will influence the selection of remedial alternatives.

5.1 APPLICABLE OR RELEVANT AND APPROPRIATE REQUIREMENTS (ARAR)

The concept of ARARs was developed as part of the Comprehensive Environmental Response Compensation and Liability Act (CERCLA) program for site cleanups. Under CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), remedial actions on CERCLA sites must comply with all federal and state ARARs unless one of six conditions are met (waivers).

The Installation Restoration Program (IRP) is the United States Air Force (USAF) response to the requirements of CERCLA. All federal agencies must comply with the procedural and substantive requirements of the Superfund program. The IRP objective is derived from the overall objective of the National Contingency Plan (NCP).

5.1.1 Definitions

ARARs are federal and duly promulgated state environmental and public health laws, requirements, and regulations. In evaluating potential ARARs for a site, a determination is made as to whether a requirement is applicable or relevant and appropriate, or neither.

Applicable requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under federal or state law that specifically address the hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at the site.

For a requirement to be applicable, the remedial action or the circumstance at the site must satisfy all of the jurisdictional prerequisites of that requirement. For example, the minimum technology requirement for hazardous waste landfills under RCRA would apply only if a new hazardous waste landfill (or an expansion of an existing hazardous waste landfill) were to be built on the site.

Relevant and appropriate requirements are those cleanup standards, standards of control, and other substantive environmental protection requirements promulgated under federal or state law that, although not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at the site, address problems or situations sufficiently similar to those encountered, that their use is well suited to the site. In some circumstances, a requirement may be relevant but not appropriate to the specific situation.

The relevance and appropriateness of a requirement can be judged by comparing factors such as the characteristics of the remedial action, the hazardous substances in question, and the physical characteristics of the site with those characteristics addressed by the requirement. For example, RCRA hazardous waste management requirements would not be applicable to wastes that could not be strictly classified as hazardous wastes. However, if those wastes are similar to hazardous wastes, the RCRA requirements could be relevant and appropriate to their management.

ARARs are divided into three categories: chemical-specific, location-specific, and action-specific. Chemical-specific ARARs include those requirements that regulate the release to the environment of materials possessing certain chemical or physical characteristics or materials containing specific chemical compounds. These requirements generally set health or risk-based concentration limits or discharge limitations for specific hazardous substances. If, in a specific situation, a chemical is subject to more than one discharge or exposure limit, the more stringent of the two requirements is generally used.

Location-specific ARARs are those requirements that relate to the geographical or physical position of the site, rather than the nature of contamination or the proposed remedial actions. These requirements may limit the type of remedial actions that can be implemented, or may impose additional constraints on the cleanup action. Flood plain restrictions and protection of endangered species are among the potential location-specific ARARs.

Action-specific ARARs are requirements that define acceptable treatment and disposal procedures for hazardous substances. These ARARs generally set performance, design, or other similar action-specific controls or restrictions on particular kinds of activities related to management of hazardous substances or pollutants. These requirements are triggered by the particular remedial activities that are selected to accomplish a remedy. Since there are usually several alternative actions for any remedial site, very different requirements may be ARARs. The action-specific requirements do not in themselves determine the remedial alternative; rather, they indicate how or to what level cleanup will be achieved.

State standards and requirements must satisfy five criteria in order to be considered ARARs. The requirements must:

1. Be promulgated standards

2. Be more stringent than federal requirements

3. Be identified by the state in a timely manner

4 Not result in a statewide prohibition on land disposal

5. Be consistently applied statewide.

Under CERCLA, it is EPA's policy that state ARARs will be achieved to the greatest extent practicable.

5.1.2 Location-Specific ARARs

There are a number of location-specific ARARs that may affect the remedial actions at Shemya. Many of these requirements will be verified during the Stage 2 efforts. Table 5-1 lists the potential location-specific ARARs, along with their prerequisites and comments. The most significant of the potential requirements are the flood plain requirements under RCRA and Executive Order 11988, Protection of Floodplains, the wetlands requirements under Executive Order 11990 Protection of Wetlands, and the Fish and Wildlife Coordination Act.

Under RCRA, any of the sites at Shemya that are located in a 100-year flood plain and can be classified as hazardous waste disposal sites, will have to be closed in a manner that prevents washout of wastes during a 24-hour, 25-year flood event. Remedial actions at any of the sites that are located in a flood plain (100-year or otherwise) will be subject to Executive Order 11988, Protection of Floodplains. This order requires that actions in flood plains avoid

Table 5-1
POTENTIAL LOCATION-SPECIFIC ARARs

	Location	Requirement	Prerequisite(s)	Citation
1.	Within 61 meters (200 feet) of a fault displaced in Holocene time	New treatment, storage, or disposal of hazardous waste prohibited	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18(a)
2.	Within 100-year floodplain	Facility must be designed, constructed, operated, and maintained to avoid washout	RCRA hazardous waste; treatment, storage, or disposal	40 CFR 264.18(b)
3.	Within floodplain	Action to avoid adverse effects, minimize potential harm, restore and preserve natural and beneficial values	Action that will occur in a floodplain, i.e., lowlands, and relatively flat areas adjoining inland and coastal waters and other flood prone areas	Executive Order 11988, Protection of Floodplains, (40 CFR 6, Appendix A)
4.	Within salt dome formation, underground mine, or cave	Placement of noncontainerized or bulk liquid hazardous waste prohibited	RCRA hazardous waste; placement	40 CFR 264.18(c)
5.	Within area where action may cause irreparable harm, loss, or destruction of significant artifacts	Action to recover and preserve artifacts	Alteration of terrain that threatens significant scientific, prehistorical, historical, or archaeological data	National Archaeological and Historical Preservation Act (16 U.S.C. Section 469); 36 CFR Part 65
6.	Historic project owned or controlled by federal agency	Action to preserve historic properties; planning of action to minimize harm to National Historic Landmarks	Property included in or eligible for the National Register of Historic Places	National Historic Preservation Act Section 106 (16 USC 470 et seq.); 36 CFR Part 800
7.	Critical habitat upon which endangered species or threatened species depends	Action to conserve endangered species or threatened species, including consultation with the Department of the Interior	Determination of endangered species or threatened species	Endangered Species Act of 1973 (16 USC 1531 et seq.); 50 CFR Part 200, 50 CFR Part 402
8.	Wetland	Action to minimize the destruction, loss, or degradation of wetlands	Wetland as defined by Executive Order 11990 Section 7	Executive Order 11990, Protection of Wetlands, (40 CFR 6, Appendix A)
		Action to prohibit discharge of dredged or fill material into wetland without permit		Clean Water Act Section 404; 40 CFR Parts 230, 231
9.	Wilderness area	Area must be administered in such a manner as will leave it unimpaired as wilderness and to preserve its wilderness character	Federally owned area designated as wilderness area	Wilderness Act (16 USC 1131 et seq.); 50 CFR 35.1 et seq.

anlhn.. ol 5:1

Table 5-1 (Continued)

	Location	Requirement	Prerequisite(s)	Citation
10.	Wildlife refuge	Only actions allowed under the provisions of 16 USC Section 668 dd(c) may be undertaken in areas that are part of the National Wildlife Refuge System	Area designated as part of National Wildlife Refuge System	16 USC 668 dd et seq.; 50 CFR Part 27
11.	Area affecting stream or river	Action to protect fish or wildlife	Diversion, channeling, or other activity that modifies a stream or river and affects fish or wildlife	Fish and Wildlife Coordination Act (16 U.S.CC. 661 et seq.); 40 CFR 6.302
12.	Within area affecting national wild, scenic, or recreational river	Avoid taking or assisting in action that will have direct adverse effect on scenic river	Activities that affect or may affect any of the rivers specified in Section 1276(a)	Scenic Rivers Act (16 U.S.C. 1271 et seq. Section 7(a)); 40 CFR 6.302(e)
13.	Within coastal zone	Conduct activities in manner consistent with approved State management programs	Activities affecting the coastal zone including lands thereunder and adjacent shorelands	Coastal Zone Management Act (16 U.S.C. Section 1451 et seq.)
14.	Oceans or waters of the United States	Action to dispose of dredge and fill material into ocean waters is prohibited without a permit	Oceans and waters of the United States	Clean Water Act Section 404 40 CFR 125 Subpart M; Marine Protection Resources and Sanctuary Act Section 103

adverse effects, minimize potential harm, and restore and preserve natural and beneficial values.

If any remedial actions affect the wetlands located at Shemya, those actions will have to comply with Executive Order 11990, Protection of Wetlands. This order requires action to minimize the destruction, loss, or degradation of wetlands. No dredged or fill materials may be disposed of in a wetland without a Clean Water Act 404 Permit from the Army Corps of Engineers.

The Fish and Wildlife Coordination Act requires that the U.S. Department of Fish and Wildlife be consulted regarding any action that modifies a stream or river, or other water of the United States. The intent of this regulation is to protect fish and wildlife that may be adversely affected by changes in the quality or quantity of water in a river, stream, or other water body.

5.1.3 Chemical-Specific ARARs

The potential chemical-specific ARARs for Shemya include the Safe Drinking Water Act Maximum Contaminant Levels (MCLs), the RCRA Maximum Concentration Limits (RCRA MCLs), and the Clean Water Act Ambient Water Quality Criteria (AWQC). Evaluation of these potential ARARs cannot be completed with the currently available water quality data. Particular contaminants identified to date at Shemya are given in Table 5-2.

Some of the detection levels for inorganic constituents measured during the Stage 1 field investigation were above the corresponding MCL or AWQC. Confirmation sampling and priority pollutant metals analysis at lower detection levels will be required to verify compliance, or identify noncompliance, with ARARs. In addition to the inorganic parameters, there is a need for more specific data on petroleum hydrocarbons. Total petroleum hydrocarbons (TPH), the parameter used in this preliminary investigation, is useful as an indicator of potential contamination by POLs. ARAR evaluations, however, require quantification of the individual components of the waste. Confirmation sampling and analysis for volatile organics, base/ neutral and acids extractable, and polynuclear aromatic hydrocarbons (PAHs) will clarify the nature of the TPH contamination.

Table 5-2
CONTAMINANTS IDENTIFIED AT SHEMYA

Acetone
Butanone
Xylene
Toluene
Napthlene
Methylanapthalene
Benzopyrene
Nitrophenol
PCB
DDT
Methoxychlor
Arsenic
Barium
Cadmium
Chromium
Lead
Zinc
Petroleum Hydrocarbons

Ground water contamination, as evidenced by the results of the TPH analyses, needs to be evaluated in more detail. The potential ARARs for ground water include the MCLs, ground water that could potentially be a source of public drinking water, and the RCRA MCLs, which are standards for ground water at RCRA hazardous waste treatment, storage or disposal (TSD) sites. The RCRA MCLs are a subset of the drinking water MCLs, and include primarily inorganic constituents.

5.1.4 Action-Specific ARARs

The action-specific ARARs cannot be evaluated effectively until the wastes at the sites are more thoroughly delineated and classified. Action-specific requirements are derived primarily from RCRA, and therefore, are applicable to hazardous wastes. Some nonhazardous wastes may be sufficiently similar to hazardous wastes to cause the RCRA requirements to be relevant and appropriate to a site or situation.

Although Shemya AFB is not strictly classified as a licensed RCRA TSD facility, it would be held to the RCRA operating requirements if hazardous wastes were disposed on the station. Disposal is defined by RCRA to include unintentional spills or leaks. Therefore, if any of the material that is being detected at any of the investigation areas was derived from hazardous waste, RCRA cleanup standards may be applicable to the contaminated ground water and soil. An investigation into the source(s) of the contamination at these sites will be necessary to determine whether the RCRA standards are applicable.

The disposal of liquid or solid hazardous wastes is strictly regulated by RCRA. If any of the chemicals disposed of at the investigation areas contained hazardous wastes, the site could be classified as an unpermitted hazardous waste disposal facility, and may be subject to RCRA closure standards.

APPENDIX B

Letter from EPA Region X to the 11th CEOS Regarding NPL Listing for Shemya AFB

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 Sixth Avenue
Seattle, Washington 98101

May 20, 1993

Reply To
Attn Of: HW-124

Patrick M. Coullahan
Lieutenant Colonel, Commander
US Air Force, 11th CEOS
Elmendorf Air Force Base, AK 99506-4420

Re: Shemya Air Force Base

Dear Commander Coullahan:

Our Regional Environmental Protection Agency (EPA) staff have received the Air Force's Preliminary Assessment (PA) and Site Inspection (SI) for Shemya Air Force Base in the Aleutian Islands. We have subsequently evaluated the information provided on the Site in accordance with the Hazard Ranking System (HRS). Today's letter describes how EPA plans to proceed, based on the information provided.

The HRS is set forth in Appendix A to the National Oil and Hazardous Substances Pollution Contingency Plan (also known as the National Contingency Plan or the NCP). The HRS score is the primary criteria EPA uses to determine whether a site is eligible for the National Priorities List (NPL). The NPL, established under Section 105 of CERCLA, 42 U.S.C. § 9605(a), is the list of sites involving priority releases for long-term remedial evaluation and response. The HRS uses information provided in a PA/SI to make objective decisions on national priorities.

Based on the Air Force's PA/SI information for Shemya, and the HRS score, our review indicates that the Site is eligible for proposal to the NPL. Hazardous substances are being released into the environment, and in particular, groundwater levels of trichloroethylene (TCE) may pose an unacceptable risk to Base personnel.

Consequently, EPA recommends that the Air Force: a) voluntarily, but expeditiously, reduce levels of TCE in groundwater used by base personnel; and, b) continue your commitment to investigating (and undertaking response actions to minimize) other documented releases of hazardous substances at the Site. Specifically, we request an "action plan" for addressing a) and b) above, which includes:

- implementation schedules
- sufficient detail (design specs, risk calculations, etc.) to ensure reviewers that proposed actions will be appropriately protective
- long-term operation and maintenance plans (for any planned remedial/response actions that result in construction)
- suggested intervals for progress reports (Note: such reports should include progress summaries, identification of problems encountered during the interval, proposals for work during the next interval, and copies of field sampling reports and resulting data.)

Although the Agency hopes that the Air Force's voluntary cleanup activities, undertaken in a timely fashion, will obviate the need for imposed corrective action, we cannot rule out such imposed actions if human health and the environment on the island are not sufficiently protected. Consequently, in the future EPA may re-consider its approach to contamination on Shemya, if the Air Force's voluntary measures are either not protective of human health and the environment, or not implemented promptly.

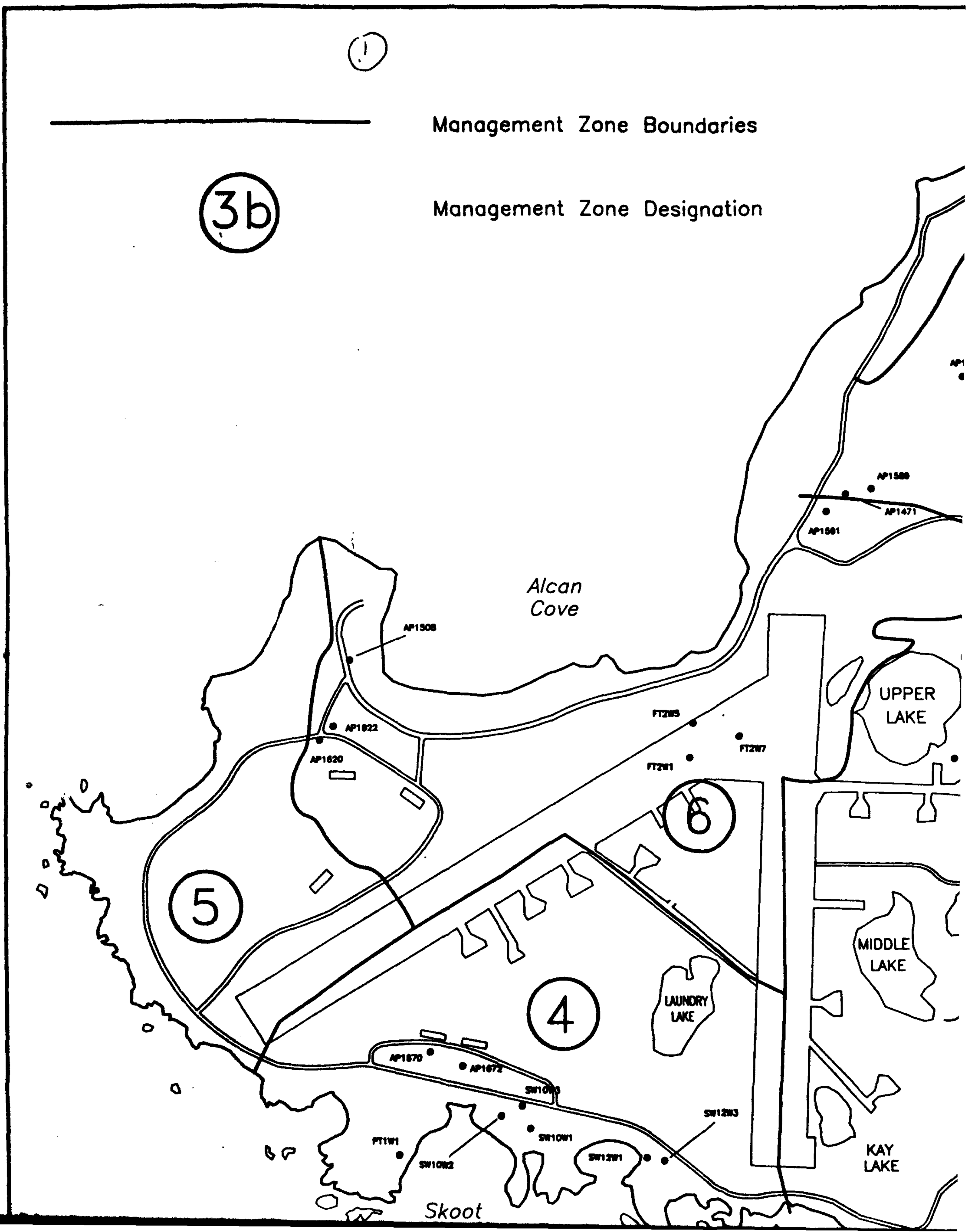
Thank you for your attention to this important matter. If you have any questions about this letter, I may be reached at (206) 553-2803. Please contact Mark Ader at (206) 533-1808 within the next thirty (30) days when you have decided what course of action the Air Force will propose for Shemya.

Sincerely, for

Wayne Pierre

George Hofer, Chief
Superfund Federal Facility Branch

cc: Marcia Combes, EPA-AOO
Dawn Teller, EPA
✓Michael Stanka, EAFB
Mary Siroky, ADEC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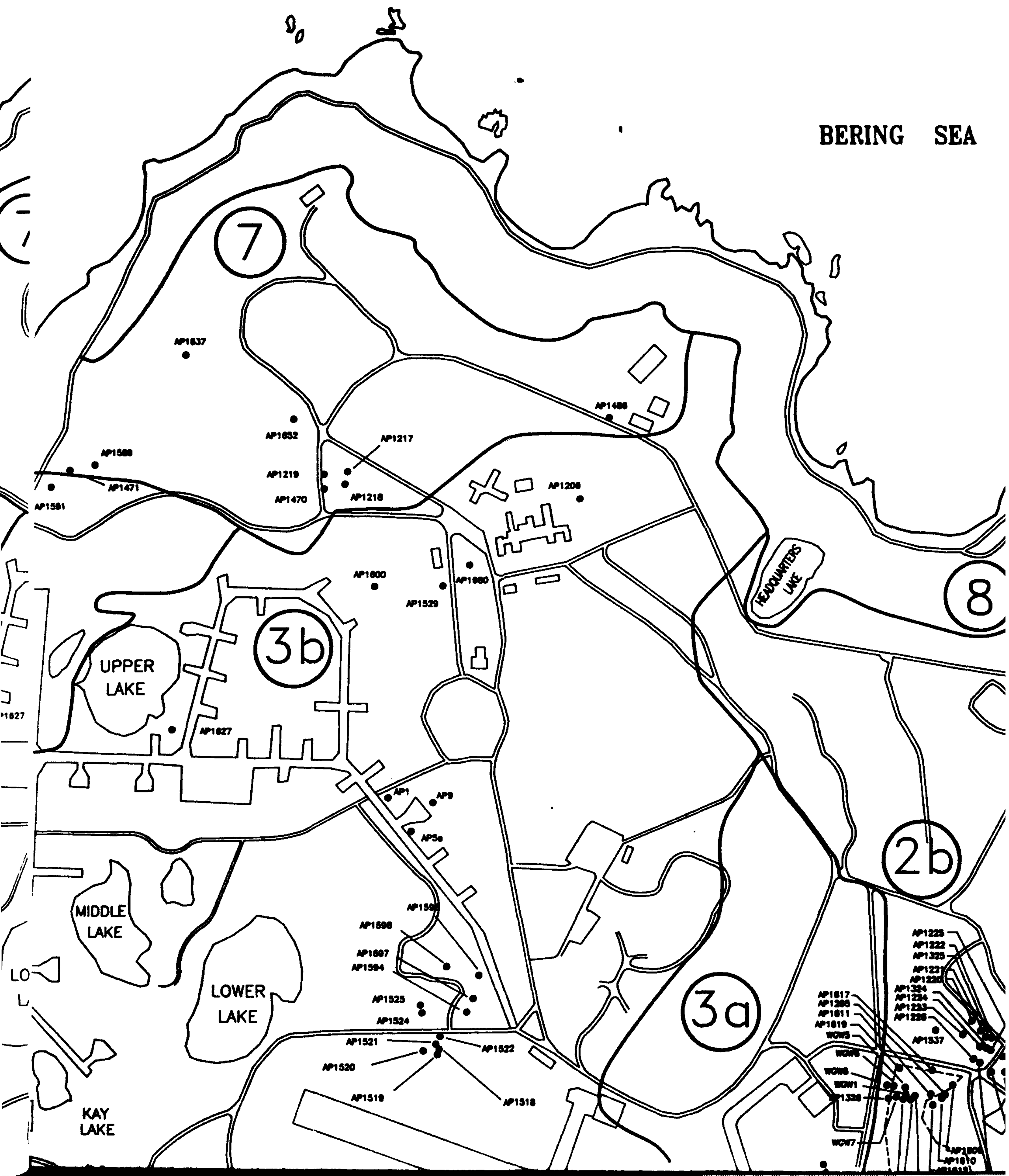
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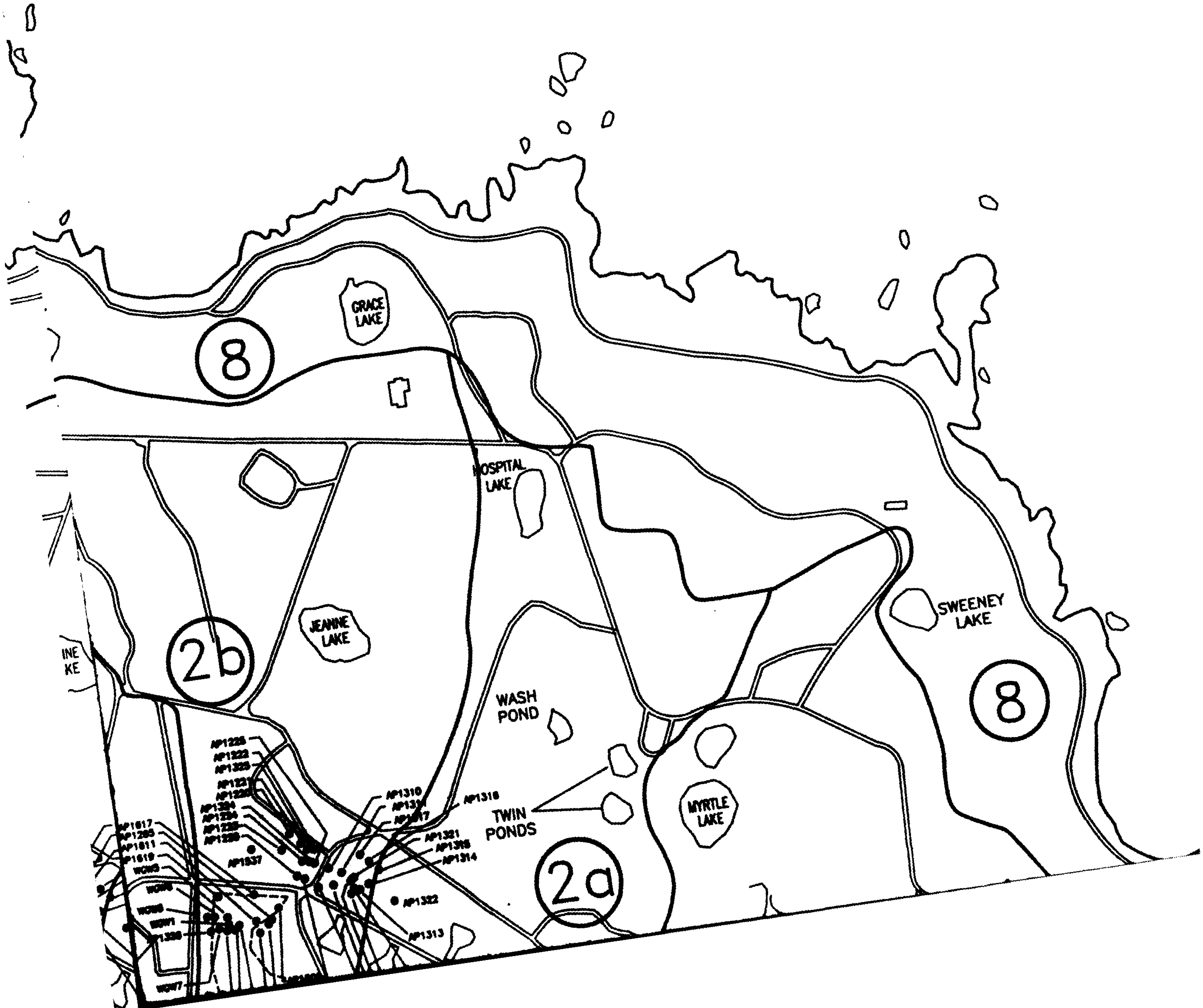
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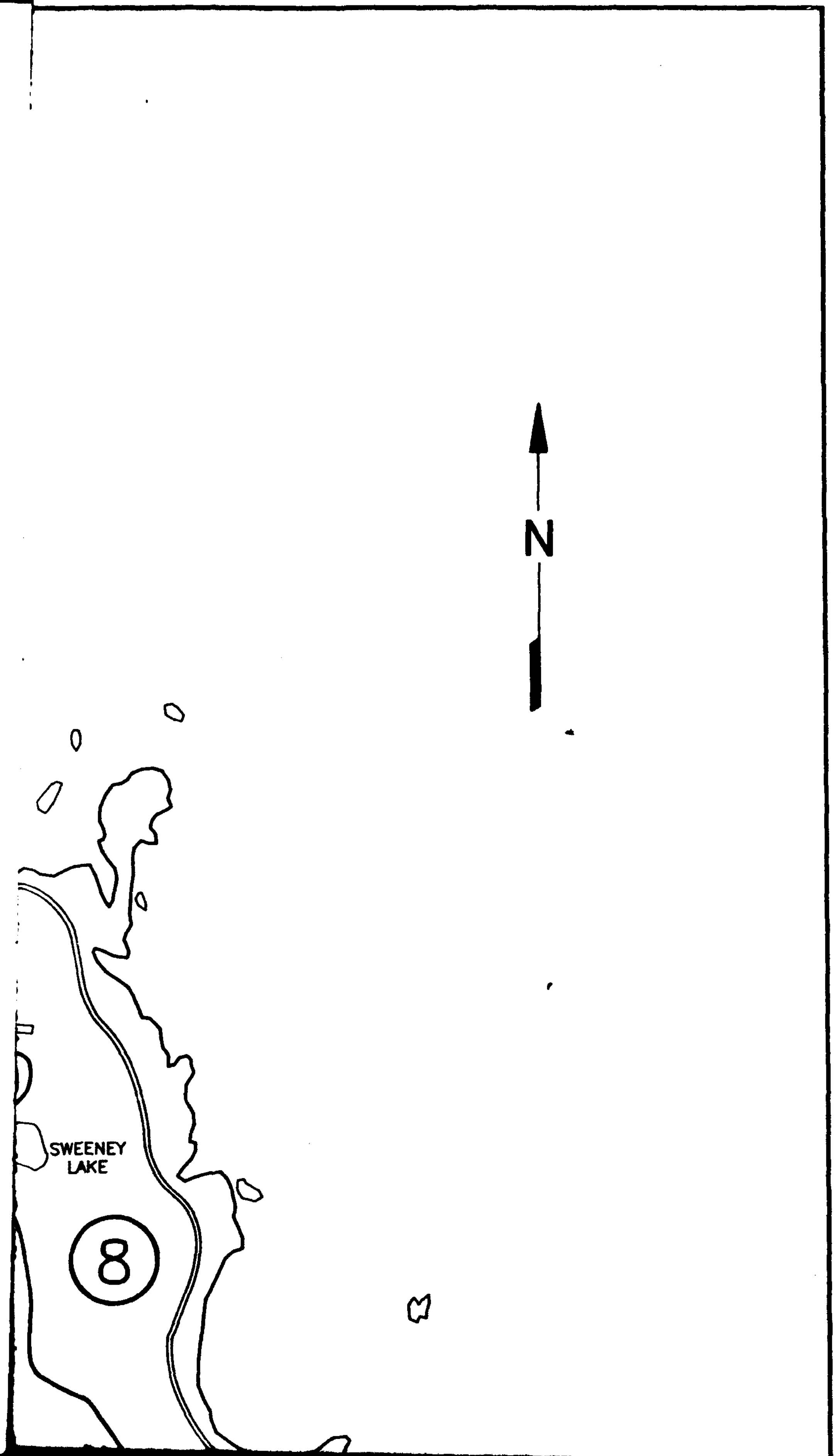

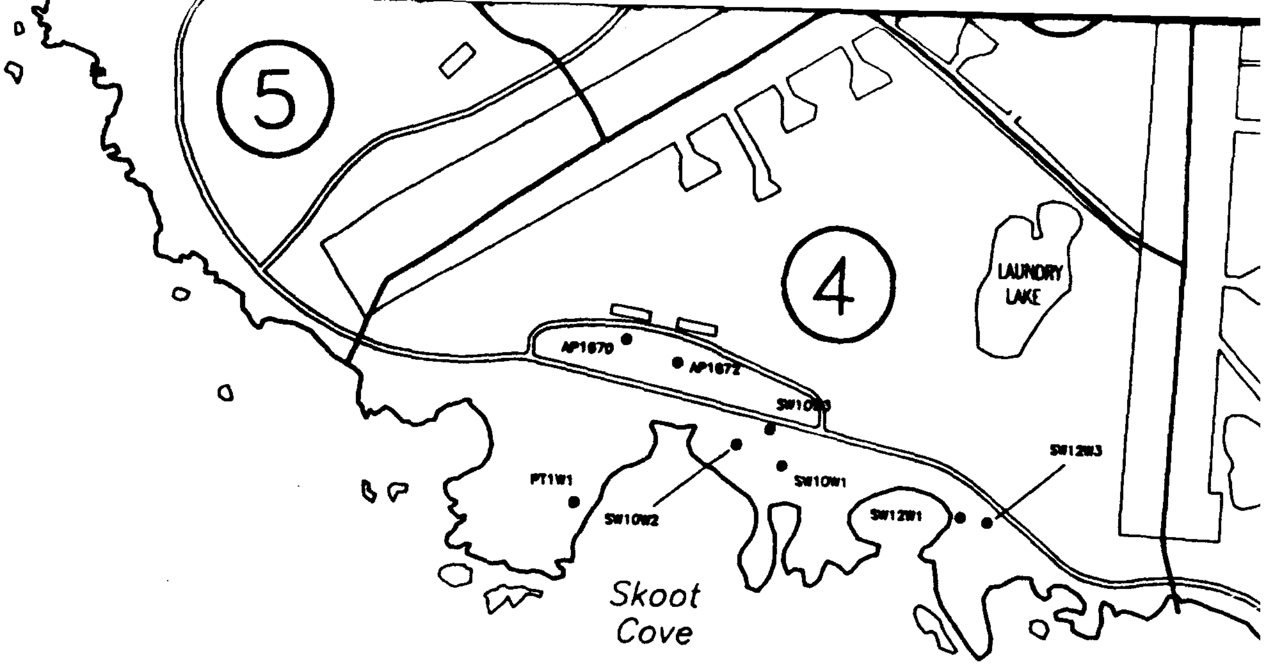

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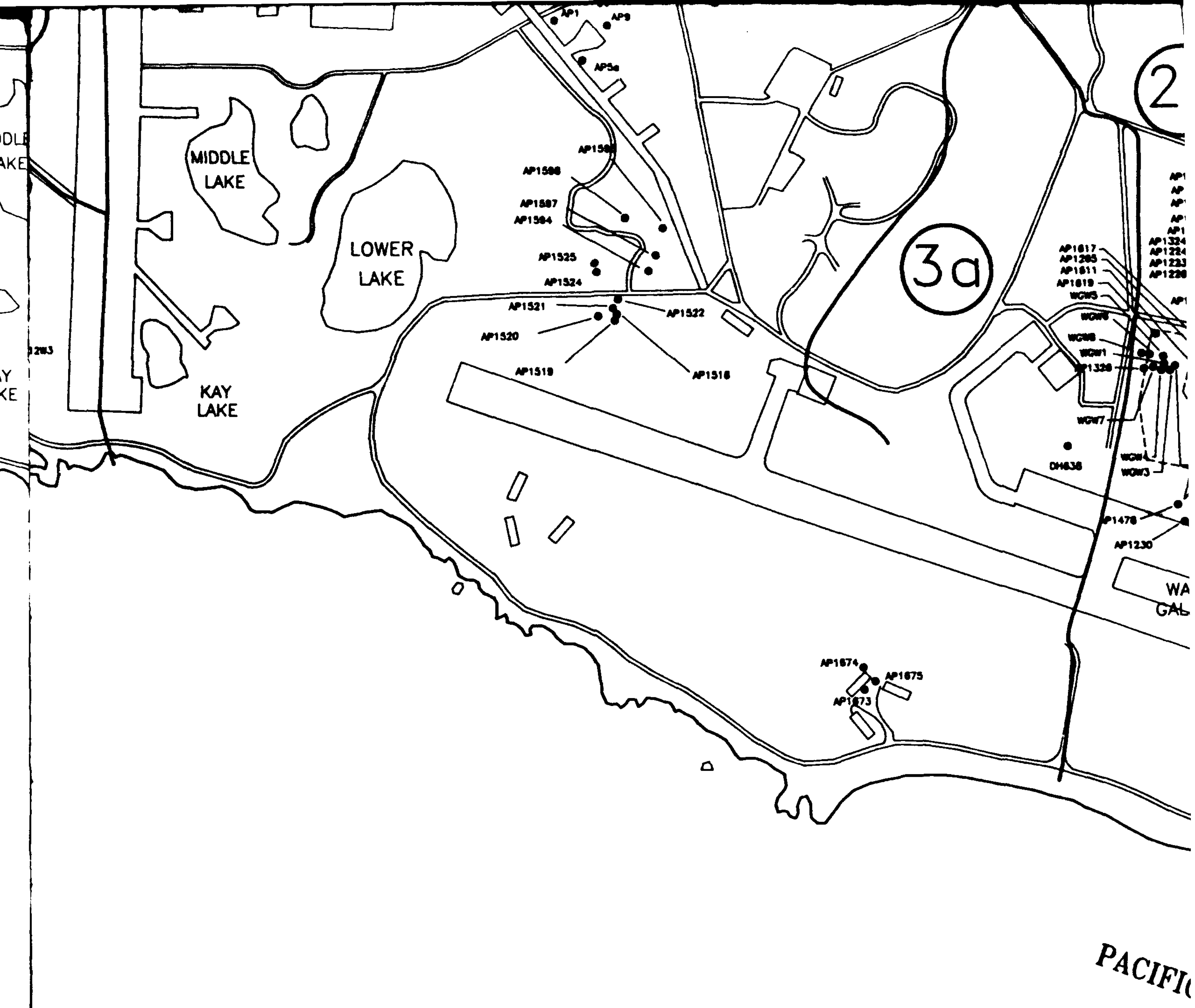

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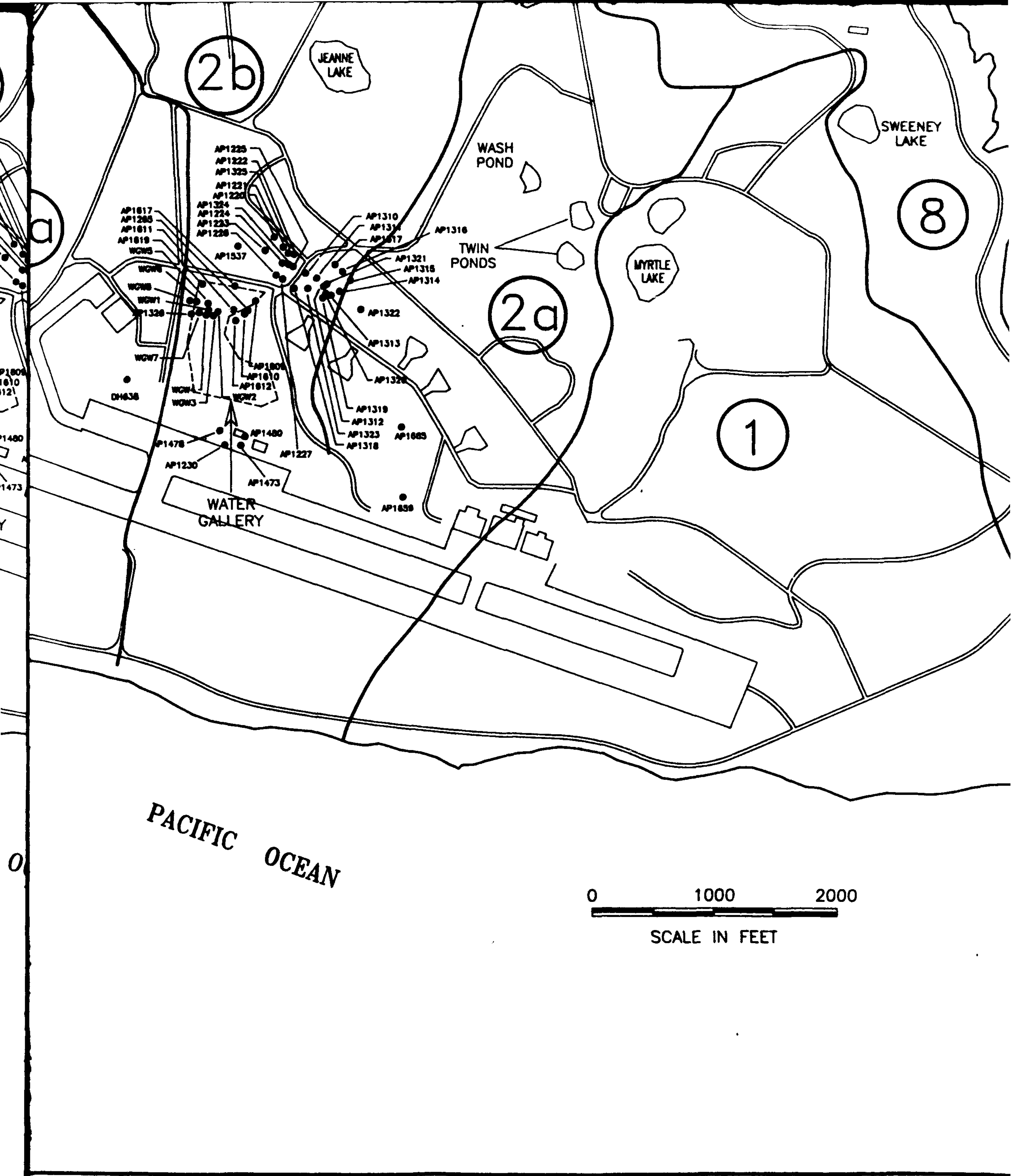
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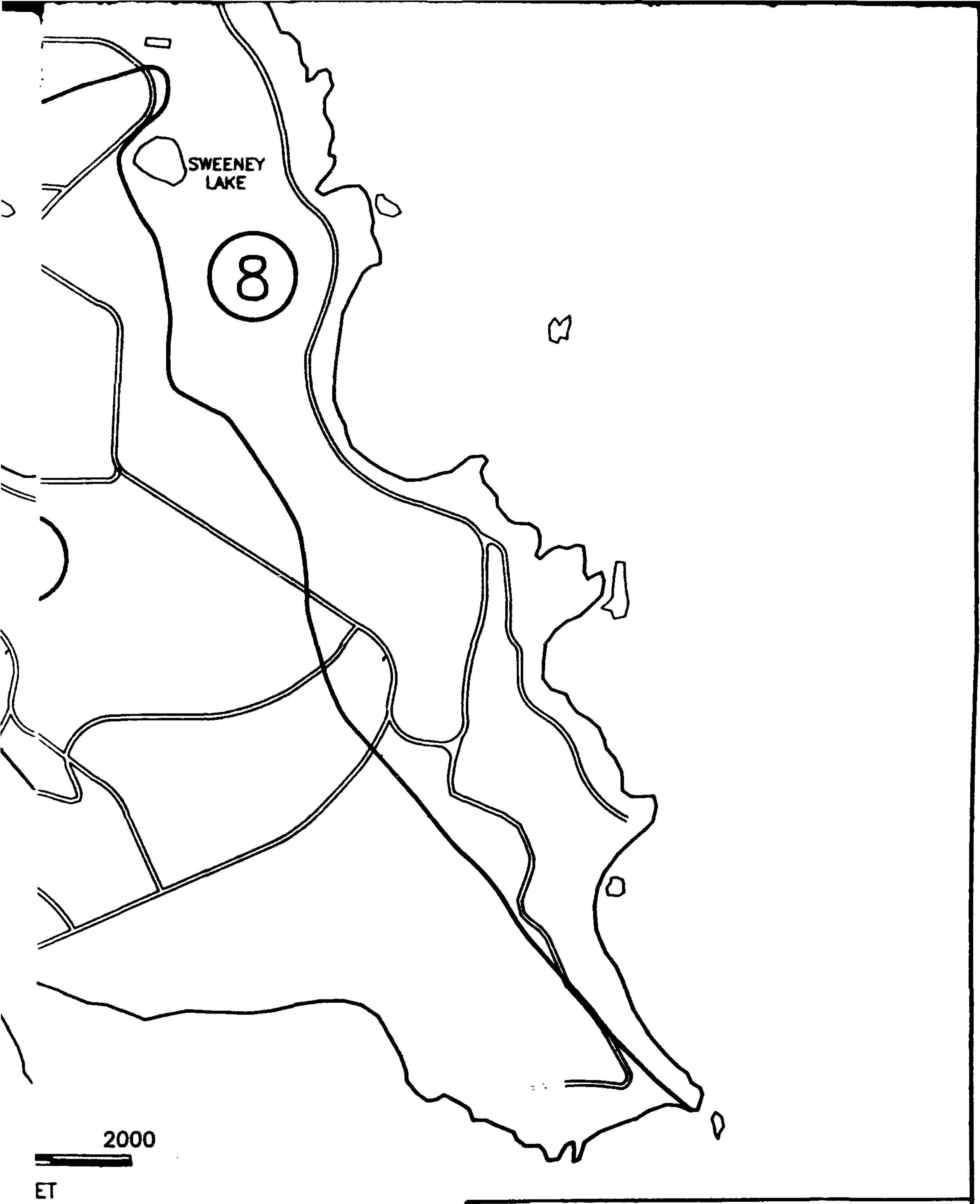
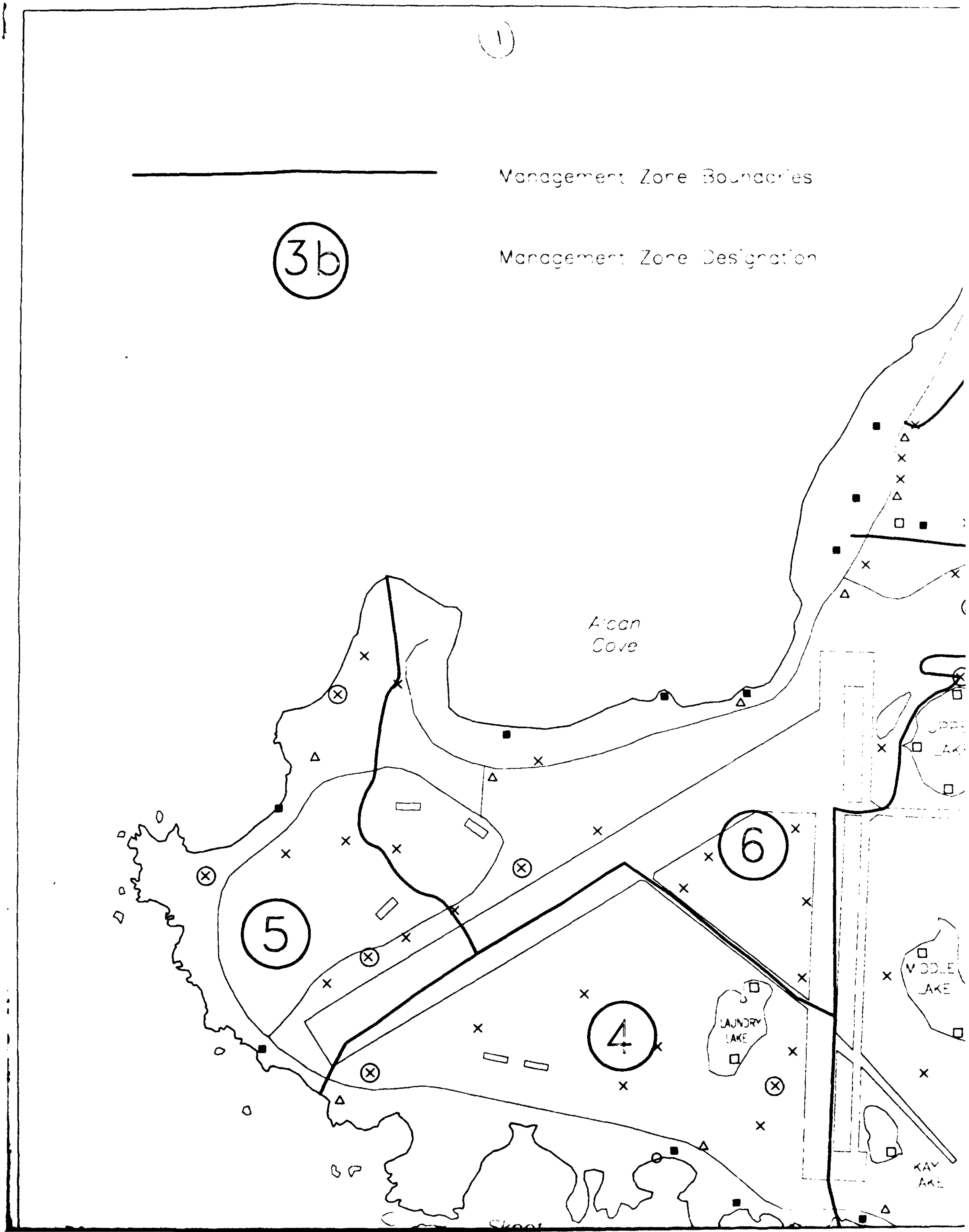


EARECKSON AIR FORCE STATION
ALASKA

Locations of Monitoring Wells and Piezometers in the Shallow Aquifer

AUG 1993	65G11600	PLATE 1	



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Management Zone Boundaries
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Management Zone Designation
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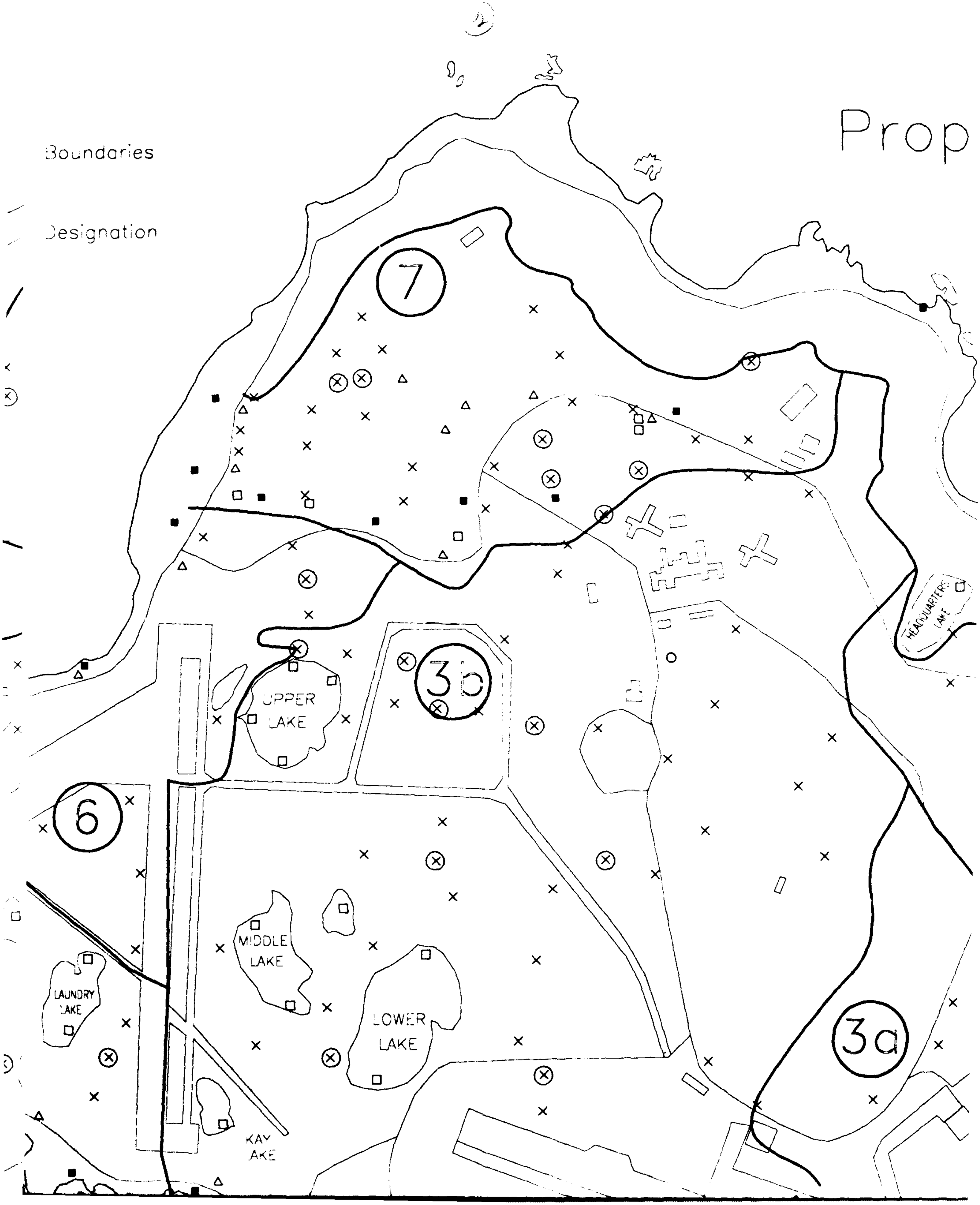

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Plate 2

Proposed Basewide Sample

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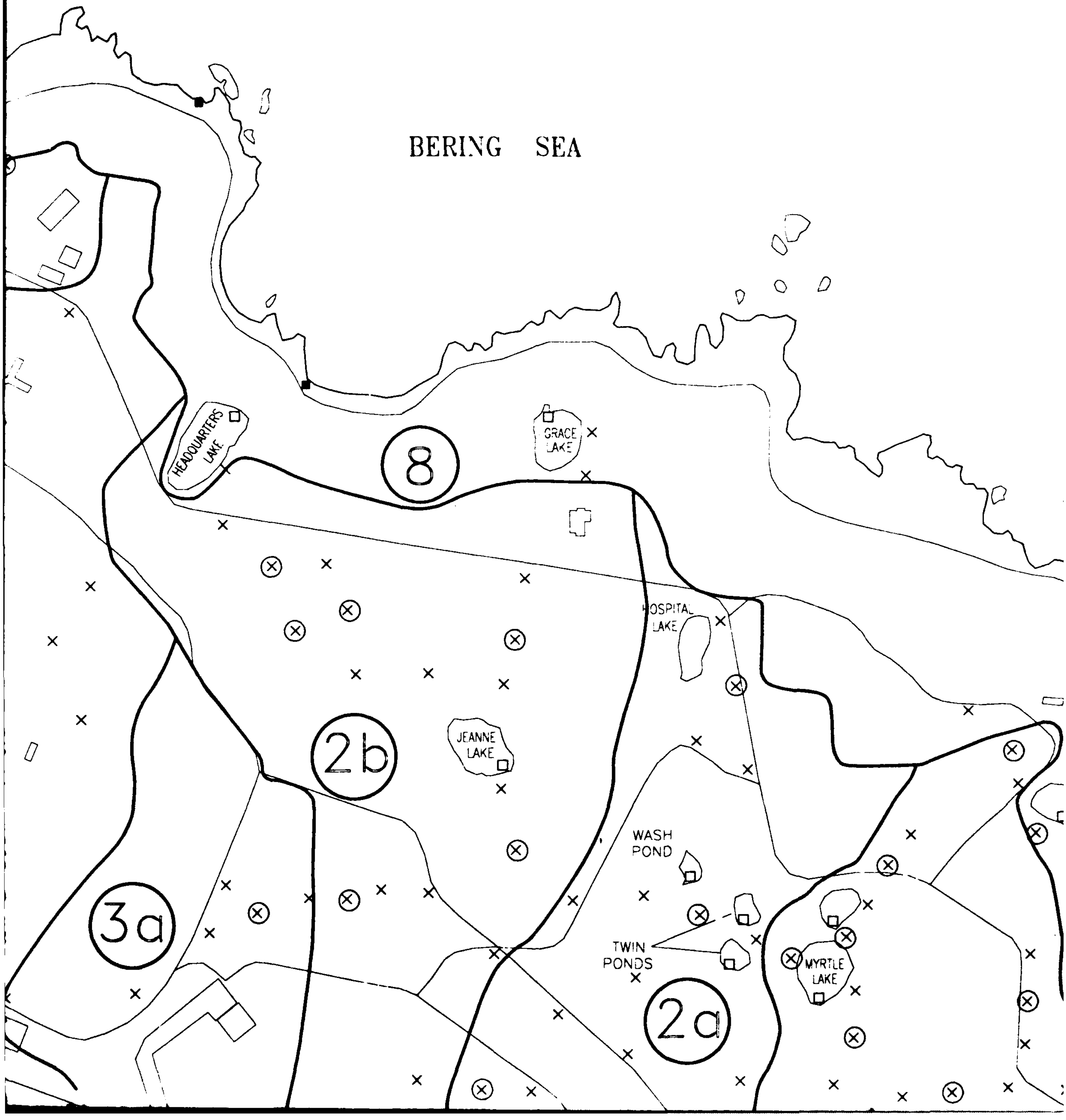

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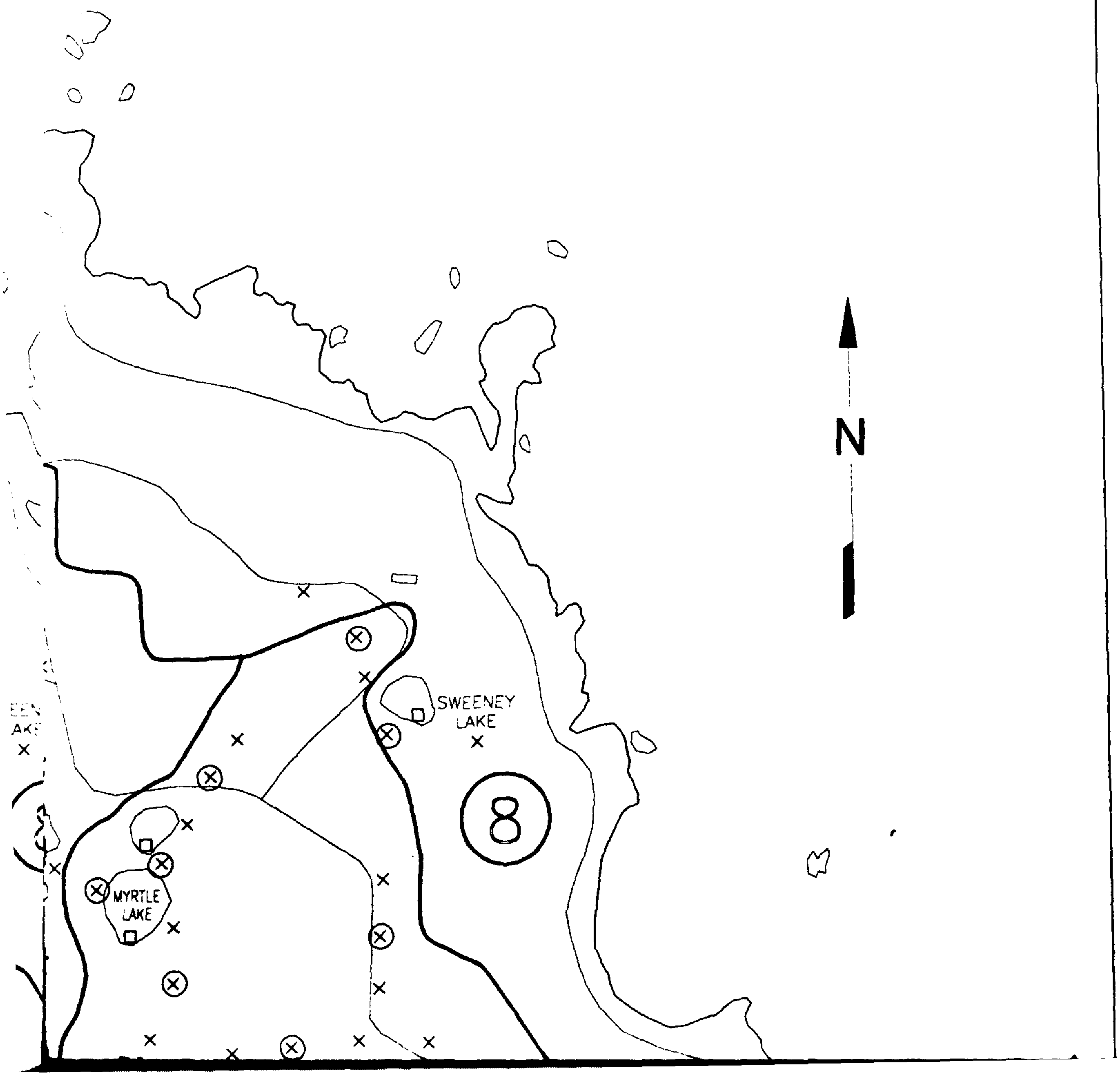
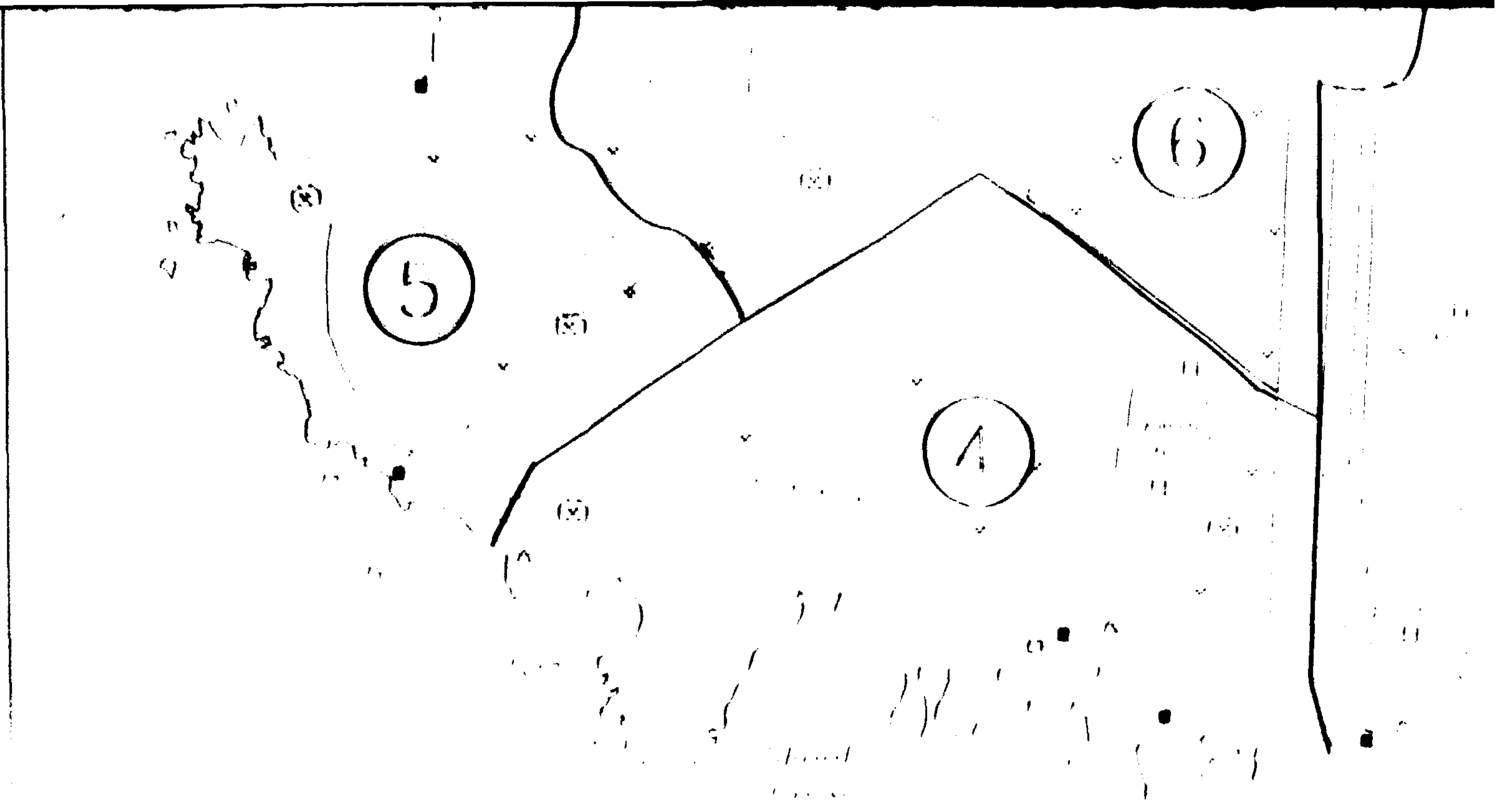
L Sample Location Map

a -ce Station, Shemya Island, Alaska





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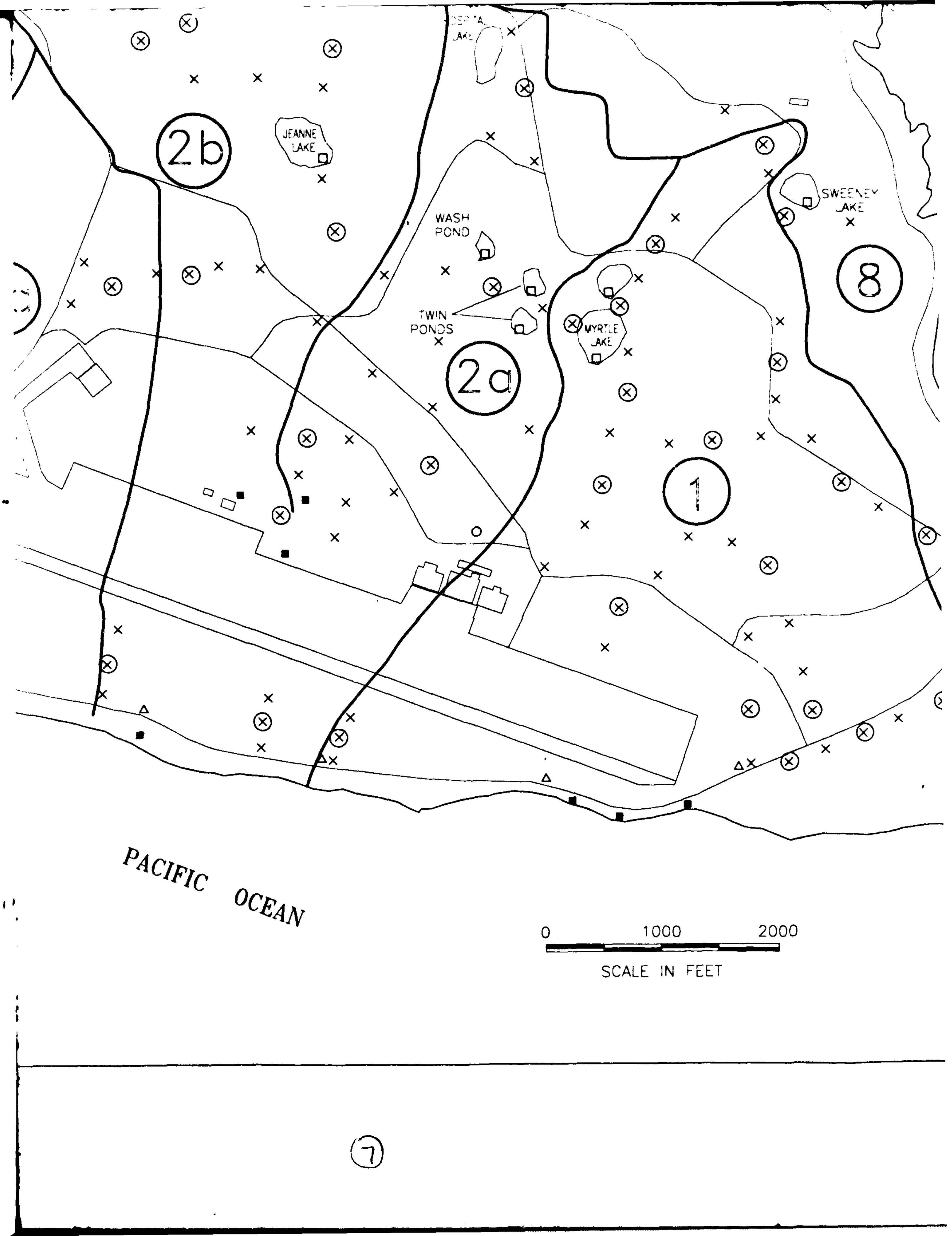

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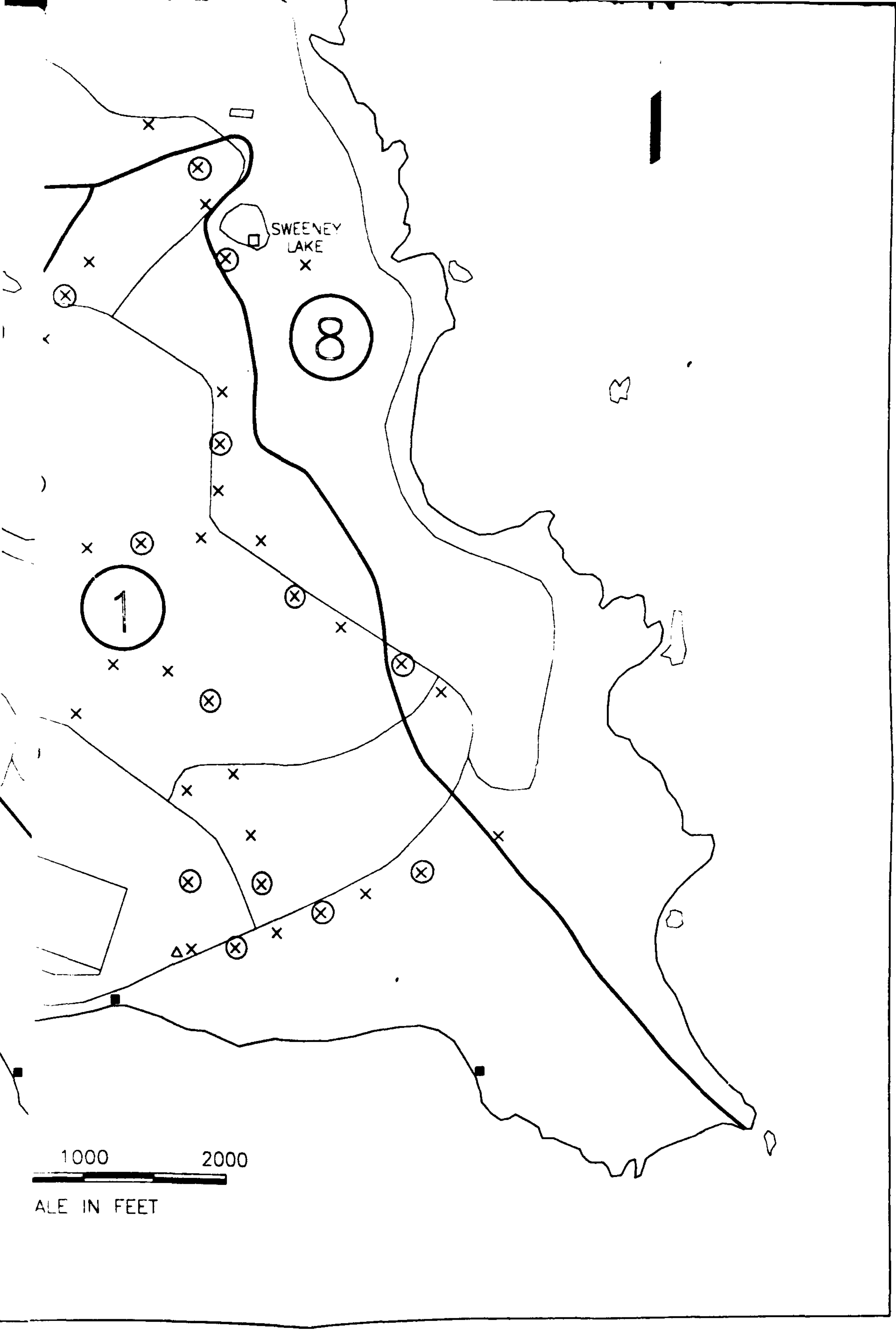

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