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Final
Record of Decision
Port Hadlock Detachment
Sites 10, 11, 12, 15, 18, 19, 20, 21, and 22

Naval Ordnance Center, Pacific Division
Port Hadlock Detachment
Indian Island, Washington
CTO 0114
September 15, 1995

NORTHWEST AREA

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

ENGINEERING FIELD ACTIVITY NORTHWEST, NAVAL FACILITIES ENGINEERING COMMAND
CONTRACT #N62474-89-D-9295

THE URS TEAM

URS Consultants

Science Applications International Corp.

Shannon & Wilson, Inc.

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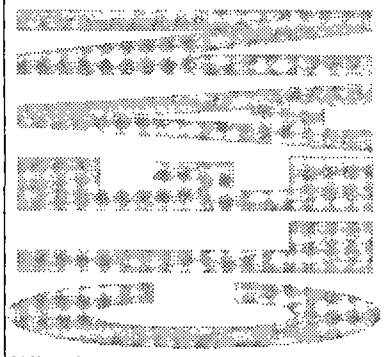

ENGINEERING FIELD ACTIVITY NORTHWEST, NAVAL FACILITIES ENGINEERING COMMAND
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FINAL

RECORD OF DECISION

COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY (CLEAN) NORTHWEST AREA

PORT HADLOCK DETACHMENT
SITES 10, 11, 12, 15, 18, 19, 20, 21, AND 22

CONTRACT TASK ORDER NO. 0114

PREPARED BY:

URS CONSULTANTS, INC.
SEATTLE, WASHINGTON

PREPARED FOR:

ENGINEERING FIELD ACTIVITY, NORTHWEST
SOUTHWEST DIVISION, NAVAL FACILITIES ENGINEERING COMMAND
POULSBO, WASHINGTON

SEPTEMBER 15, 1995

DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

Naval Ordnance Center, Pacific Division
Port Hadlock Detachment Sites 10, 11, 12, 15, 18, 19, 20, 21, and 22
Hadlock, Jefferson County, Washington

STATEMENT OF PURPOSE

This decision document presents the selected remedial action for Sites 10 and 21 and no further actions for Sites 11, 12, 15, 18, 19, 20, and 22 at Port Hadlock Detachment, developed in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practical, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the administrative record file for these sites.

The lead agency for this decision is the U.S. Navy (Navy). The Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) approve of this decision and have participated in the site investigation process and in the evaluation of alternatives for remedial actions.

ASSESSMENT OF THE SITE

Actual or threatened releases of hazardous substances from Sites 10 and 21, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present imminent and substantial danger to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDIES

The selected remedial actions at Site 10 at Port Hadlock Detachment address the potential chemical exposures and associated risks to human health and the environment by providing for capping, erosion protection, institutional controls, and monitoring of groundwater, marine sediment, and shellfish. This action will reduce the mobility of contamination and will limit human and biota exposure. The selected remedial action at Site 21 of groundwater monitoring is to determine whether the chemicals found during the RI are actually present in the groundwater or were merely artifacts of the sampling methods used. The following lists provide the major components of the remedial action for each site.

Site 10

- Place a landfill cap over approximately 3.7 acres.
- Install approximately 900 linear feet of erosion protection along the perimeter of the landfill.
- Implement institutional controls which include a temporary prohibition on shellfish harvesting on three beaches around Boggy Spit and land use restrictions for residential use and farming. Residential and farming restrictions and controls and requirements for the operation and maintenance of the landfill cap and erosion protection will be issued by the commanding officer and included in the Port Hadlock Detachment master plan upon completion of construction. Upon base closure, the Navy will attach deed restrictions to any

property transfer. The requirements for continued operation and maintenance of the landfill cap and erosion protection will be addressed by the Navy, Ecology, and EPA.

- Conduct a monitoring program that will involve sampling and analyzing groundwater, sediment, and shellfish. The results of the shellfish monitoring will be used to determine when the shellfish are safe to eat.

- The results of the monitoring will be reviewed in detail at the conclusion of the monitoring period in order to determine whether additional remedial action is necessary.

- Regular maintenance and inspection of the landfill cap and the erosion protection, particularly after seasonal storm events.

Site 21

- Sample and analyze the groundwater periodically for 2 years to determine whether or not the detections of certain chemicals in groundwater during the RI were anomalous. This alternative will require the construction of one additional monitoring well.

- At the conclusion of the monitoring period, the Navy, Ecology, and EPA would screen the analytical data against MTCA levels, State of Washington MCLs, and federal MCLs. If chemical levels present in the groundwater samples meet these standards, no further action will take place. If levels are not acceptable, the Navy, Ecology, and EPA will determine whether additional monitoring for establishment of background, well abandonment, or institutional controls are necessary. If remedial actions beyond those mentioned here are considered, this ROD will be reopened and the public will have the opportunity to comment on proposed actions.

No further action is expected for the remaining sites: Sites 11, 12, 15, 18, 19, 20, and 22. Soil was previously removed from Sites 11, 12, and 18. Confirmation monitoring for 1 year is under way for groundwater at Sites 11 and 12 and for sediment at Site 18 to assure that no more contamination exists at these sites.

STATUTORY DETERMINATIONS

The selected remedial actions are protective of human health and the environment and are in compliance with federal and state requirements that are legally applicable or relevant and appropriate to the remedial actions and are cost-effective. These remedies use permanent solutions and alternative treatment technologies to the maximum extent practicable. However, because treatment of the principal threat at each site was found to be impracticable, the remedies do not satisfy the statutory preference for treatment as a principal element.

Because these remedies will result in a hazardous substances remaining at Site 10 (and possibly at Site 21) above health-based levels, a review will be conducted no less frequently than every 5 years after commencement of remedial action to ensure that the remedies continue to provide adequate protection of human health and the environment.

Signature sheet for the Naval Ordnance Center, Port Hadlock Detachment, Sites 10, 11, 12, 15, 18, 19, 20, 21, and 22, Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

PGB

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Commander Philip G. Beierl
Commanding Officer, Port Hadlock Detachment
U.S. Navy

Signature sheet for the Naval Ordnance Center, Port Hadlock Detachment, Sites 10, 11, 12, 15, 18, 19, 20, 21, and 22, Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

for Charles Findley

Chuck Clarke
Regional Administrator, Region 10
U.S. Environmental Protection Agency

8-4-5
Date

Signature sheet for the Naval Ordnance Center, Port Hadlock Detachment, Sites 10, 11, 12, 15, 18, 19, 20, 21, and 22, Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

Mary E. Burg

Mary Burg
Program Manager, Toxics Cleanup Program
Washington State Department of Ecology

9 August 1995
Date

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ABBREVIATIONS AND ACRONYMS

ARAR	Applicable or Relevant and Appropriate Requirement
BEHP	bis(2-ethylhexyl) phthalate
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act of 1980
CFR	Code of Federal Regulations
COPC	chemicals of potential concern
DDD	dichlorodiphenyldichloroethane
DDT	dichlorodiphenyltrichloroethane
DoD	U.S. Department of Defense
DOH	Washington State Department of Health
EFA NW	Engineering Field Activity, Northwest
EPA	U.S. Environmental Protection Agency
FML	flexible membrane layer
GCL	geosynthetic clay liner
HEAST	Health Effects Assessment Summary Tables
HI	hazard index
HQ	hazard quotient
IR	Installation Restoration
IRIS	Integrated Risk Information System
LD_{50}	median lethal dose
LEL	lower explosive limit
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
MFS	State of Washington Minimum Functional Standards
MTCA	Model Toxics Control Act (Washington State)
NACIP	Navy Assessment and Control of Installation Pollutants
NAVFACENGCOM	Naval Facilities Engineering Command
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NOAEL	no observed adverse effects level
NPDES	National Pollutant Discharge Elimination System
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
RA	remedial action

ABBREVIATIONS AND ACRONYMS (Continued)

RAB	Restoration Advisory Board
RAO	remedial action objectives
RCRA	Resource Conservation and Recovery Act
RCW	Revised Codes of Washington
RfD	reference dose
RI/FS	remedial investigation/feasibility study
RME	reasonable maximum exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act of 1986
SDWA	Safe Drinking Water Act
SF	slope factor
SVOC	semivolatile organic compound
TBC	to be considered
TRC	Technical Review Committee
URS	URS Consultants, Inc.
VOC	volatile organic compound
WAC	Washington Administrative Code

DECISION SUMMARY

1.0 INTRODUCTION

In accordance with Executive Order 12580, the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan, the U.S. Navy (Navy) is addressing environmental contamination at Naval Ordnance Center Pacific Division, Port Hadlock Detachment, by undertaking remedial action. The selected remedial action has the approval of the Washington State Department of Ecology (Ecology) and the U.S. Environmental Protection Agency (EPA) and is responsive to the expressed concerns of the public. This Record of Decision (ROD) is intended to fulfill the state requirements for a cleanup action plan. The selected remedial actions will comply with applicable or relevant and appropriate requirements (ARARs) promulgated by Ecology, EPA, and other state and federal agencies.

2.0 SITE NAME, LOCATION, AND DESCRIPTION

Port Hadlock Detachment is on Indian Island in Jefferson County, Washington, southeast of Port Townsend and east of Hadlock (Figure 2-1). The island is bordered by Kilisut Harbor to the east, Port Townsend Bay to the west and north, and Oak Bay and Portage Canal to the south (Figure 2-1). Indian Island is approximately 5 miles long and covers approximately 2,700 acres. The island is wholly owned by the Navy and is primarily used for handling and storage of Naval ordnance.

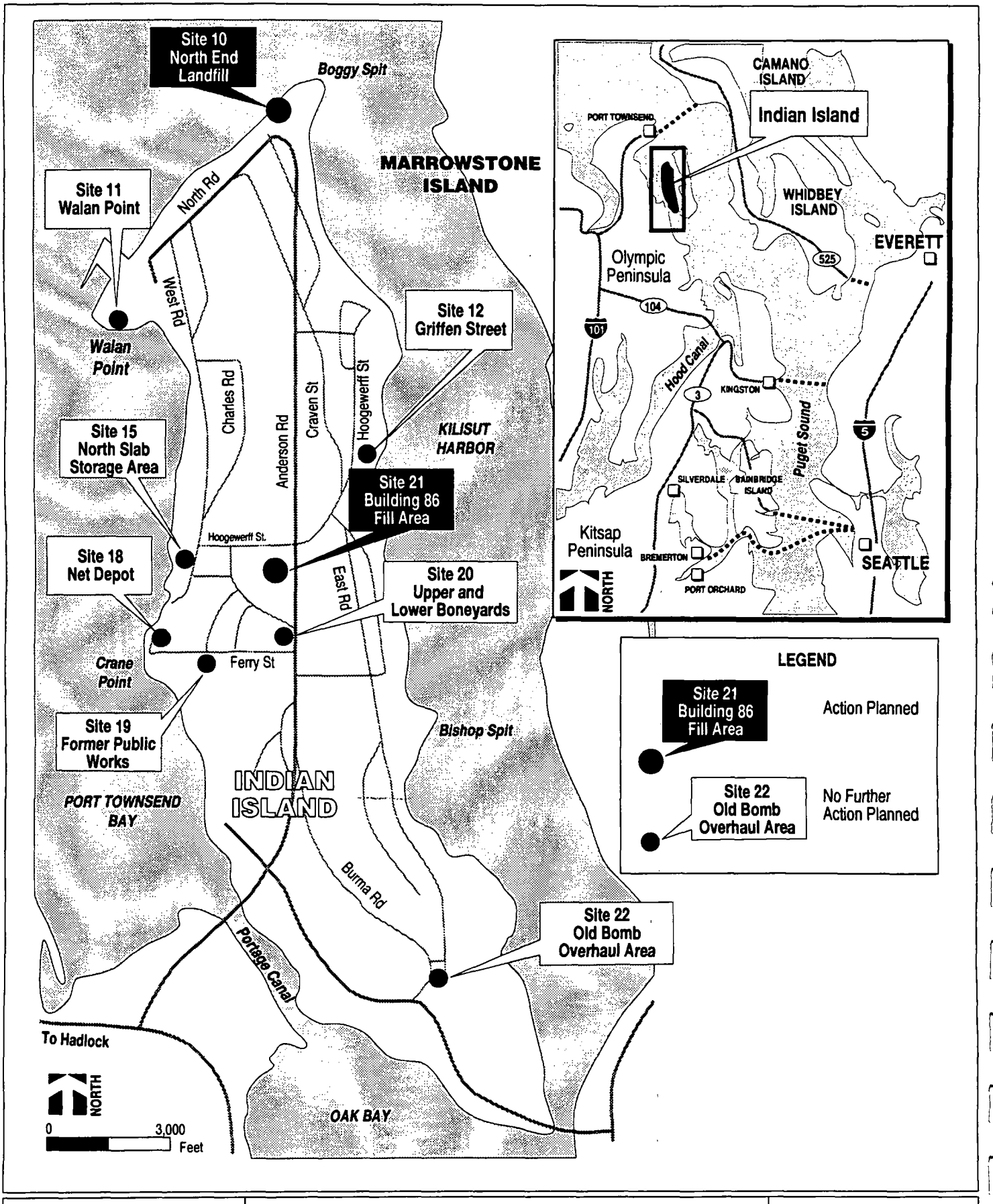
No private residences are present on Port Hadlock Detachment; however, there are 14 military residences. A public highway connects the Olympic Peninsula with Indian Island and Marrowstone Island, an island east of Port Hadlock Detachment that supports fewer than 250 private residences. The nearest Olympic Peninsula communities are Hadlock and Irondale, both less than 2 miles west of Indian Island across Port Townsend Bay.

This ROD addresses the nine sites shown on Figure 2-1 and documents decisions reached for no further action or remedial action for each site. These sites were originally identified as possible release areas and were studied under site hazard assessments according to state requirements to evaluate the presence of contamination. As a result, four of the sites (Sites 15, 19, 20, and 22) were determined to require no further action. Three of the sites (Sites 11, 12, and 18) require only compliance monitoring because areas of contamination were removed in mid-1994. The two remaining sites (Sites 10 and 21) were studied as part of a remedial investigation/ feasibility study (RI/FS) and require action.

A majority of this document is dedicated to Sites 10 and 21 because they are the only sites that require remedial action. The details of the seven other sites are given in Section 13.

2.1 SITE 10—NORTH END LANDFILL

Site 10 is an approximately 3.7-acre landfill on the north end of Port Hadlock Detachment (Figure 2-2). The site is relatively flat and is covered with grass. The landfill is located on Boggy Spit; it extends to the beach and has partially eroded onto the beach (SCS Engineers 1984). Landfill contents are exposed on the beach and in the



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 2-1** **Site Locations at Port Hadlock Detachment**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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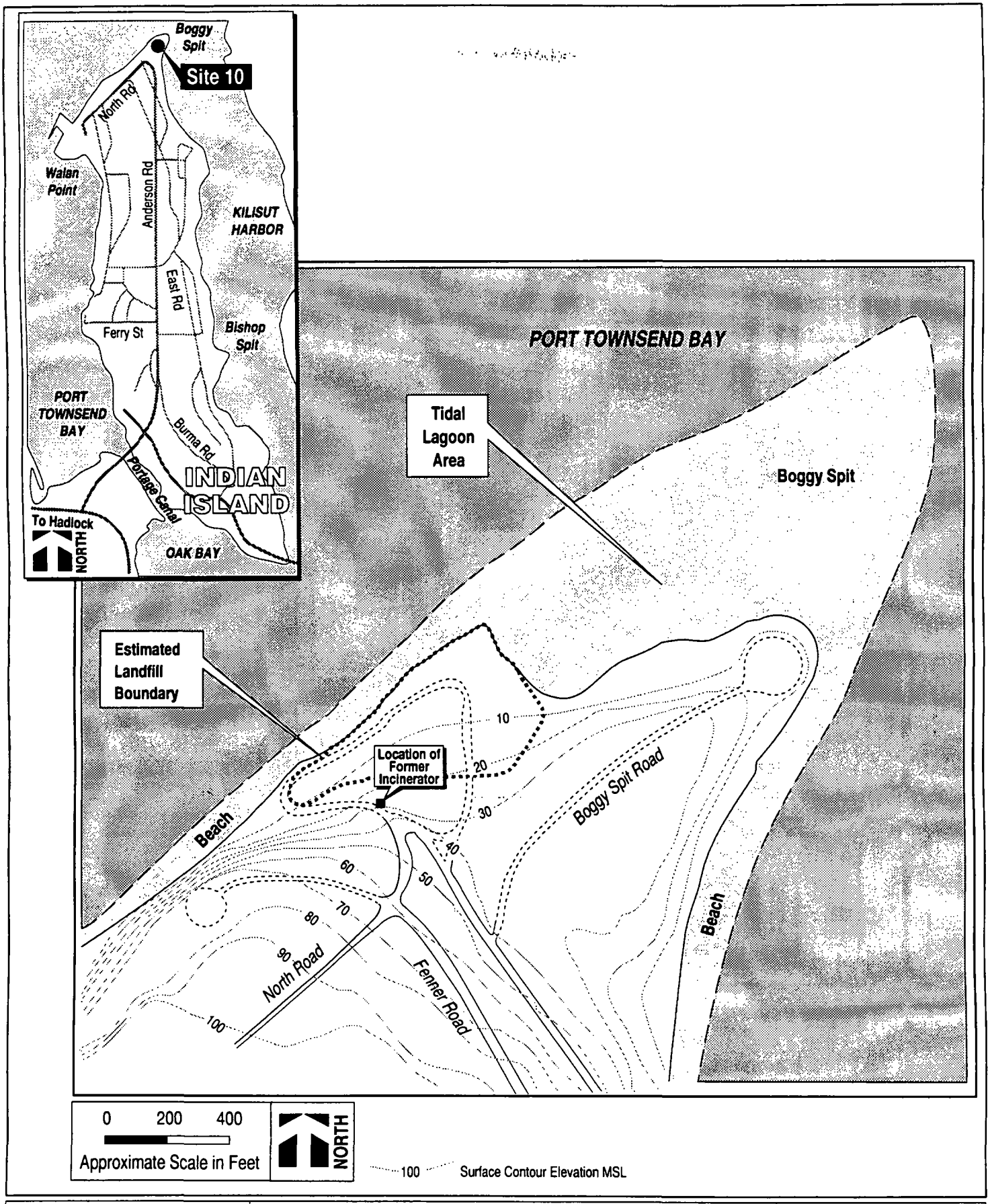

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 2-2 Site 10 Site Map	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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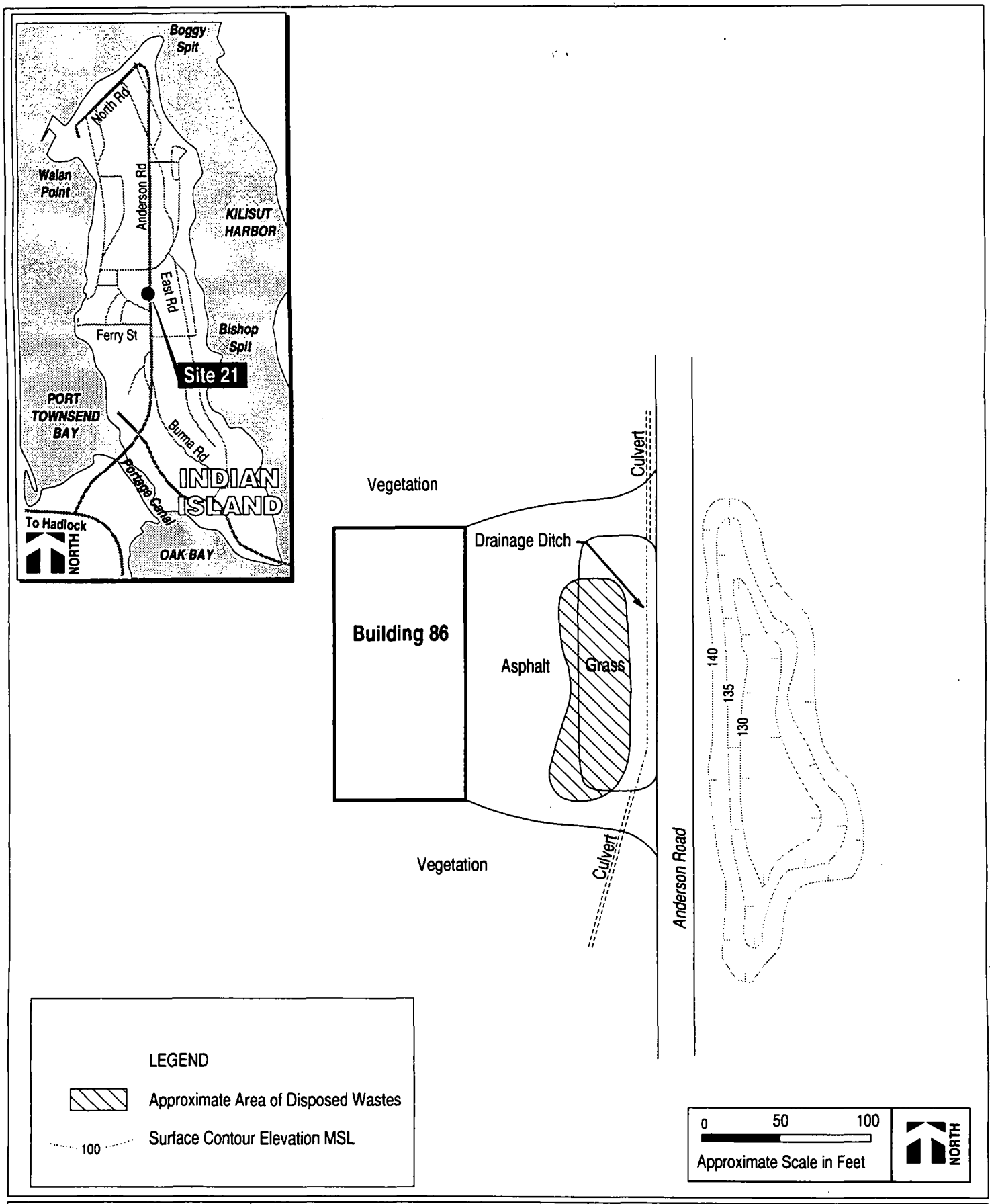
cutbank located between the uplands and the beach. This site was used as the primary landfill for the island from about 1945 until the mid-1970s. An incinerator burned materials at the site from the 1940s to 1953. According to the Current Situation Report (CSR) (SCS Engineers 1987), there was a trench located below the incinerator into which oil, paints, thinners, and other liquid wastes were dumped. Materials reportedly disposed of in the landfill include paint, thinners, strippers, oil, lead and zinc batteries, asbestos, submarine nets, metal parts, polyurethane resins, zinc-plating slag, residential trash, ash, and drums of unidentified liquid waste (SCS Engineers 1987). No data are available to indicate the contents of these drums. Despite Port Hadlock's history as an ordnance handling facility, no records or other information sources indicate that any explosive-related materials were disposed of at Site 10 during landfill operation.

A portion of the landfill along the shoreline has eroded into the marine environment. As long as the landfill is exposed, wave action and storm events may continue eroding the landfill onto the beach. This erosion releases contaminants into the marine environment.

Native American tribes have negotiated with the Navy to have year-round access to the majority of the beaches on the east side of Port Hadlock Detachment to harvest shellfish. As a result of environmental investigations of the landfill, the beaches immediately adjacent to the North End Landfill (Site 10) and Boggy Spit were closed to shellfish collection in 1988 by the Navy with the concurrence of the Washington Department of Health (DOH) because of the potential for the shellfish to be contaminated. Coastal waters surrounding the island are used for boating and recreational and commercial fishing and crabbing. Department of Defense personnel have access to several beaches on the east side of the island and Crane Point on the west side of the island for recreational use.

2.2 SITE 21

Site 21, an area of approximately 5,000 square feet immediately east of Building 86, is near the center of Port Hadlock Detachment (Figure 2-3). The area around the building, including a portion of Site 21, was paved in 1982. The site was reportedly used in the early 1940s as a disposal site for waste oils, solvents, electrical equipment, and paint (SCS Engineers 1984). One backup water-supply well is approximately 1,500 feet north, and another is 100 feet south of Site 21. Both wells were drilled in 1941. The



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 2-3** **Site 21** **Site Map**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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pumps were removed in the early 1980s (Kuehl 1994). According to facility records, Port Hadlock began purchasing water—provided via pipeline from Port Townsend—in 1945. Therefore, it is possible that the wells supplied water to the island for 4 years between their installation and the purchase of water from Port Townsend.

3.0 SITE HISTORY AND ENFORCEMENT ACTIVITIES

The Navy purchased Indian Island in 1939 to store explosives, seaplanes, and antisubmarine cable nets. Port Hadlock Detachment currently receives, stores, maintains, and issues naval ordnance. Prior to the establishment of regulations, some wastes were disposed of on the island using practices that were considered acceptable at that time.

In response to the requirements of CERCLA, the U.S. Department of Defense (DoD) established the Installation Restoration (IR) program. The Navy, in turn, established a Navy IR program to meet the requirements of CERCLA and the DoD IR program. From 1980 until early 1987, this program was called the Navy Assessment and Control of Installation Pollutants (NACIP) program. Under the NACIP program, a set of procedures and terminologies were developed that were different from those used by the EPA in administration of CERCLA. As a result of the implementation of SARA, the Navy has dropped NACIP and adopted the EPA CERCLA/SARA procedures and terminology. Responsibility for the implementation and administration of the IR program has been assigned to the Naval Facilities Engineering Command (NAVFACENGCOM). The Southwest Division of NAVFACENGCOM has responsibility for the western states. Engineering Field Activity, Northwest (EFA Northwest) has responsibility for investigations at Port Hadlock Detachment and other naval installations in the Pacific Northwest and Alaska.

The Navy conducted the initial assessment study in 1984 to investigate the possibility of contamination at sites on Indian Island (SCS Engineers 1984). Further study was done at two of the nine sites covered in this ROD (Site 10 and 21) in 1988 and were reported in the current situation report (SCS Engineers 1987). The current situation report recommended additional investigation at Sites 10 and 21; therefore, plans for an RI/FS were initiated in 1989.

As the RI/FS work progressed, Ecology and the Navy began working together in 1991 to investigate possible contamination from past practices. At the request of the Navy, Ecology issued Enforcement Order Number 91-153 to ensure that activities and standards meet the requirements of Washington State's Model Toxics Control Act (MTCA) passed in 1991. Site hazard assessments (described in Section 12) were completed at seven sites in 1992 to identify the potential presence of contamination.

EPA became involved in 1993 after Port Hadlock Detachment was proposed for the National Priorities List (NPL), a federal list of contaminated sites. In June 1994, Port Hadlock Detachment was placed on the NPL.

In January 1995, the final RI/FS report for Sites 10 and 21 was completed (URS 1995a). The purpose of the RI/FS was to characterize the site, determine the nature and extent of contamination, assess human and ecological risks, and evaluate remedial alternatives. A proposed plan addressing the Navy's preference for remedial actions was published for public comment in March 1995 (URS 1995b).

4.0 COMMUNITY RELATIONS

Federal and state requirements for public participation include providing the proposed plan to the public. The Navy also involved the community by having open houses, public meetings, and a Technical Review Committee (TRC). Fact sheets were distributed to the surrounding residents to keep them updated on the status of environmental projects on Indian Island. The proposed plan, which included proposed action or no further action for the nine sites in this ROD, and the RI/FS, which studied Sites 10 and 21, were provided to the public on March 6, 1995. An open house and public meeting were held at the Jefferson County Library in Port Hadlock on March 21, 1995, during which time representatives from the Navy, Ecology, and EPA answered questions about the sites and the remedial alternatives under consideration. The public comment period was from March 6 to April 7, 1995. Approximately 32 comments were received on the plan. The responsiveness summary, which includes responses to comments, is included in Appendix A.

This decision for remedial action described in this ROD is based on the administrative record file for these sites. The primary documents pertaining to this investigation can be reviewed at the following location:

Jefferson County Library
Ness Corner Road and Cedar Avenue
Port Hadlock, Washington 98339
(360) 385-6544

The official collection of all site-related documents is contained in the administrative record for this Port Hadlock Detachment. Related documents have been available since the Initial Assessment Report (SCS Engineers 1984) was produced in 1984. The public is welcome to review the Administrative Record by appointment at the following location:

Engineering Field Activity, Northwest
Naval Facility Command
19917 Seventh Avenue N.E.
Poulsbo, Washington 98370
(360) 396-0298

A dialogue has been established with the stakeholders, which included citizens living near the site, other interested organizations, the Navy, Ecology, and EPA. The actions taken to satisfy the statutory requirements also provided a forum for citizen involvement and input to the proposed plan and ROD, including the following:

- Creation of a community relations plan in 1989, and revisions in 1992 and 1995
- Fact sheets mailed to an established mailing list of interested individuals during the course of the cleanup process
- Technical Review Committee (TRC) meetings with representatives from the public and from other governmental entities including the Suquamish Tribe, the Northwest Indian Fisheries Commission, and the Washington State Department of Fish and Wildlife. The TRC was established in 1991.
- Public meetings and open houses held in May 1992 and August 1993 to inform citizens about the ongoing environmental investigations at Port Hadlock Detachment. An additional meeting and public comment period was held in 1991 when Enforcement Order 91-153 was issued by Ecology—at the Navy's request—requiring remedial action at Port Hadlock Detachment.
- Newspaper advertisements for the open houses and public meetings
- Public comment period on the proposed removal actions at Sites 11, 12, and 18 that began in 1993.
- Approximately 30 people attended a public meeting and open house on March 21, 1995, to present the preferred proposed actions and the findings of the investigations and to receive comments on the proposed plan. A public comment period on the proposed plan for Sites 10 and 21 ran from March 6 to April 7, 1995.

There is significant public and tribal interest in reopening the beaches in the vicinity of Site 10 for shellfish harvesting.

In the National Defense Authorization Act for Fiscal Year 1995 (Senate Bill 2182), Section 326(a), Assistance for Public Participation in Defense Environmental Restoration Activities, the Department of Defense was directed to establish Restoration Advisory Boards (RABs) in lieu of Technical Review Committees (TRCs). In mid-1995, Port Hadlock Detachment established a RAB.

The purposes of the RAB are to do the following:

- Act as a forum for discussion and exchange of information between the Navy, regulatory agencies, and the community on environmental restoration topics. The RAB is part of a process that addresses community concerns and issues during the cleanup process.

- Provide an opportunity for stakeholders to review progress and participate in the decisionmaking process by reviewing and commenting on actions and proposed actions involving releases or threatened releases at the installation. However, the RAB itself does not serve as a decisionmaking body.

- Serve as an outgrowth of the TRC concept by providing a more comprehensive forum for discussing environmental cleanup issues and serving as a mechanism for RAB members to give advice as individuals

The RAB members consist of representatives from the Navy and regulatory agencies as well as civic, private, tribal, local government, and environmental activities groups.

5.0 SCOPE AND ROLE OF RESPONSE ACTIONS WITHIN SITE STRATEGY

All potentially contaminated sites on Port Hadlock Detachment have been identified and investigated, with the exception of the Ordnance Burn and Ordnance Disposal Area (Site 34), which is presently undergoing a site investigation. This ROD addresses the sites that have been investigated as part of a site hazard assessment or RI/FS. As a result of removal actions that involved soil removals at Sites 11, 12, and 18, these sites are no-further-action sites. Compliance monitoring at these sites is being performed quarterly for one year. The cleanup action recommended for Site 10 will be the final cleanup action for that site. This action at Site 10 is being undertaken primarily to minimize the migration of contaminants from the landfill to the marine environment, which will reduce the risk from eating shellfish. Monitoring and evaluation will be conducted at Site 21 to determine whether there needs to be further action. This is anticipated to be the final cleanup action for the Port Hadlock Detachment unless action is required at Site 34 as a result of the current investigation.

6.0 SUMMARY OF SITE CHARACTERISTICS

This section summarizes regional characteristics and site conditions, including a discussion of the geologic, hydrologic, and environmental setting of Sites 10 and 21 and the nature and extent of contaminants of concern.

6.1 REGIONAL CHARACTERISTICS

The following subsections discuss the climate, geology, hydrogeology, surface water, and ecology of Indian Island.

6.1.1 Climate

The Port Hadlock/Port Townsend climate is classified as mid-latitude—west coast marine with cool, dry summers; mild, wet winters; moist air; and a relatively narrow temperature range. The total annual precipitation for the area is about 19 inches, with the least precipitation occurring in July (0.7-inch average), and the most precipitation in December (2.5-inch average). Average monthly temperatures range from 61.4°F in July to 39.5°F in January. Annual evapotranspiration is 14.4 inches; the water surplus to surface runoff and groundwater recharge is about 4.5 inches per year (Grimstad and Carson 1981).

6.1.2 Geology and Hydrogeology

Indian Island is within the Puget Sound Lowland, a geologically active area typified by earthquakes, volcanism, and mountain uplifts. Compressional mountain-building processes caused by partial subduction of the Juan de Fuca Plate beneath the North American Plate resulted in the uplift of the Olympic Mountains west of Indian Island. The Puget Sound Lowland originated as a down-dropped crustal block between the Olympic Mountains and the older Cascade Mountains to the east. Before Pleistocene continental and alpine glaciation, the Puget Sound Lowland was a fluvial lacustrine environment draining north and west into what is now the Strait of Juan de Fuca. Pleistocene glaciation of the Puget Sound Lowland produced the embayments of Puget Sound (SCS Engineers 1984).

Exposed bedrock in Puget Sound consists primarily of Tertiary basaltic volcanics and clastic sediments and Quaternary unconsolidated glacial, interglacial, and lacustrine sediments (SCS Engineers 1984). At least four separate glacial advances and accompanying interglacial periods have been proposed for the Puget Sound Lowland (Garling et al. 1963). Glacial sequences are generally coarse gravel, sand, lacustrine silt, and low-permeability till deposits. The interglacial sequences are generally fine-grained alluvial and lacustrine silts and sands, interbedded with lenses of sand and gravel.

Four geologic units occur on Indian Island (SCS Engineers 1984). From youngest to oldest, they are as follows:

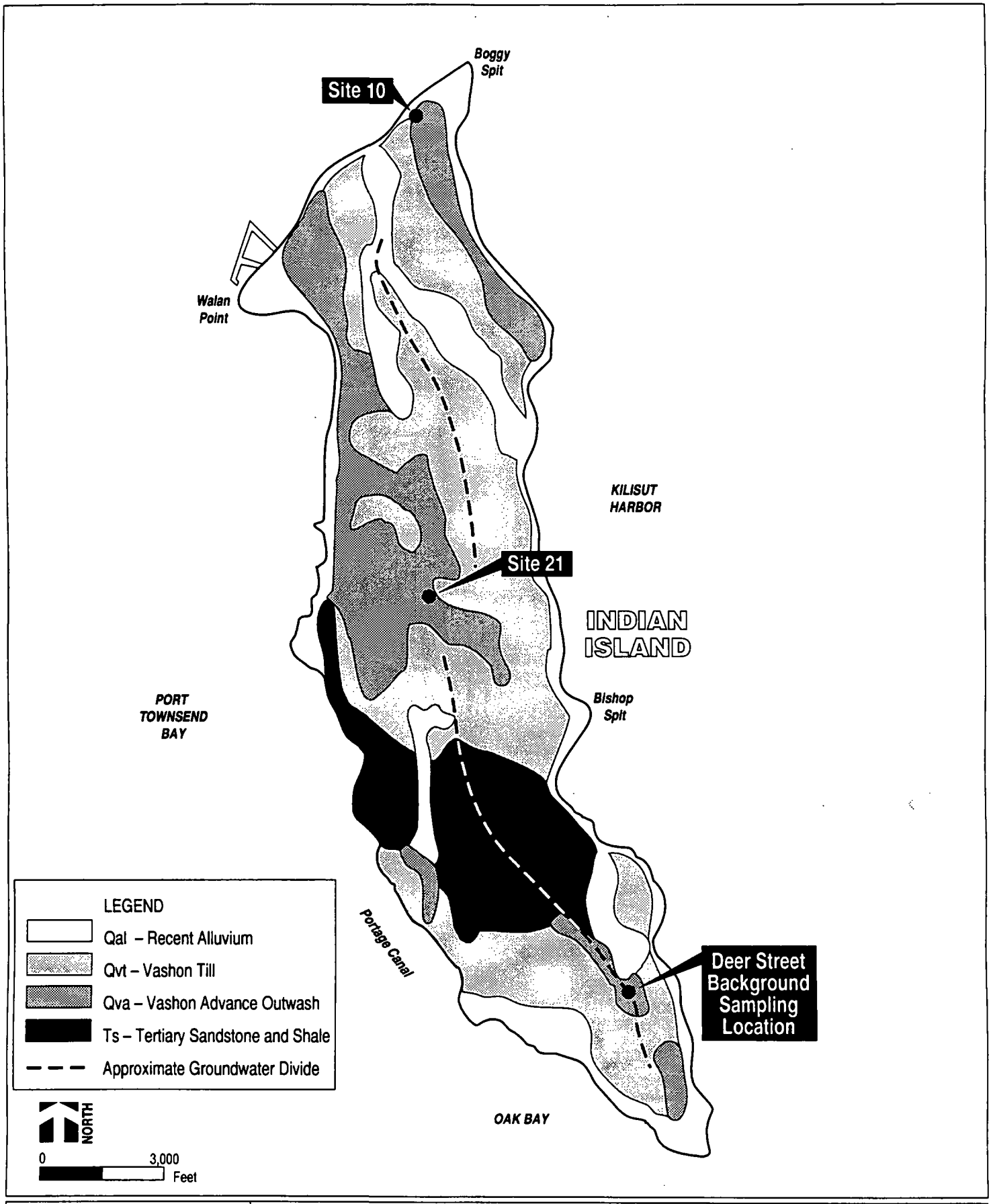
- Recent alluvium deposits: gravel, sand, and silt, with some clay
- Vashon Till: gravelly, sandy silt and clay
- Vashon Advanced Outwash: sand and gravel
- Tertiary Sandstone Shale: sandstone and shale that form the bedrock on Indian Island

Each of these geologic units can be observed in outcrops on the island (Figure 6-1).

Groundwater on Indian Island occurs at or near sea level beneath the island and, possibly, in limited perched aquifer zones in the topographically higher southern third of the island (SCS Engineers 1984). Field studies have confirmed that the sea-level aquifer occurs at Site 10 and Site 21. The aquifer is contained within the Vashon Advance Outwash. Groundwater likely flows away from areas of higher elevations in the center of the island toward Puget Sound, where groundwater is discharged (SCS Engineers 1984). The approximate groundwater divide, based on surface elevations, is shown in Figure 6-1.

6.1.3 Surface Water

Surface water runoff on Indian Island does not occur in well-defined channels, with the exception of a small intermittent stream on the sandstone bedrock on the eastern portion of the island. Elsewhere, the relatively permeable glacial materials allow for rapid infiltration, and soils derived from less permeable glacial till may produce perched water table conditions (SCS Engineers 1984).



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-1** **Surficial Geology of Indian Island**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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The only body of fresh water on Indian Island is Anderson Pond, adjacent to East Road in an undeveloped area in the southeastern corner of the island. The pond and associated wetland cover approximately 25 acres. Rainfall and groundwater discharge are the primary sources of water for Anderson Pond (Navy 1989).

6.1.4 Ecological Setting

Four major ecosystem types occur on the island and include mixed evergreen forest, saltwater wetland, freshwater wetland, and tidal shores. Most of the island is covered by a mixed evergreen forest of alder and Douglas fir that extends to the shores.

A major saltwater wetland area on Indian Island is Walan Point in the northwest portion of the island (Figure 2-1). The Walan Point area, which consists of approximately 11 acres, has been designated by the Navy as a bird sanctuary (Navy 1989). An approximately 1-acre saltwater wetland is near the intersection of Hoogewerff Street and North Fletcher Road on the northeast side of the island.

More than 30 species of waterbirds have been observed on or near Indian Island and in the vicinity of Kilisut Harbor and Port Townsend Bay (Buchanen 1988; Clambokidas et al. 1985; Fry et al. 1987; McAllister et al. 1986; Speich et al. 1988; Wahl and Speich 1983). Waterbirds that have been observed include cormorants, ducks, loons, murres, guillemots, eagles, herons, plovers, grebes, mergansers, scoters, and a variety of gulls. A small nesting colony of glaucous-winged gulls has historically been observed on Boggy Spit. Marbled murrelets could use the site for nesting; however, this is a very elusive species and has not been observed on the island to date. Bald eagles, a threatened species, have been observed in nests near Site 10.

The tidal shores surrounding Indian Island are characterized by sandy or gravelly beaches with sandy or soft mud in the intertidal and subtidal zones. Rocky shores occur on the southwest side of the island in areas of sandstone bedrock outcrops. The marine environment surrounding Indian Island is home to many species of flora and fauna that are typical of the islands in Puget Sound.

The benthic assemblages of Puget Sound consist of almost 200 species of macroalgae and seagrasses and more than 300 species of intertidal invertebrates over a range of substrates including mud, sand, gravel, cobble, and rock (Dexter et al. 1981). Offshore waters around Indian Island are characterized by diverse and abundant fish (Miller and Borton 1980; Miller et al. 1978) and shellfish. The north ends of Indian Island and

Kilisut Harbor are major spawning and nursery areas for herring, smelt, cod, tomcod, pollock, great sculpin, cabezon, and rock sole. Other species reported in this area and adjacent areas of Port Townsend Bay include salmon, trout, midshipman, eelpouts, tubesnouts, surfperch, pricklebacks, gunnels, rockfish, sablefish, greenlings, poachers, sanddab, and flounder. A seal rookery has been observed offshore from Site 10 in Port Townsend Bay.

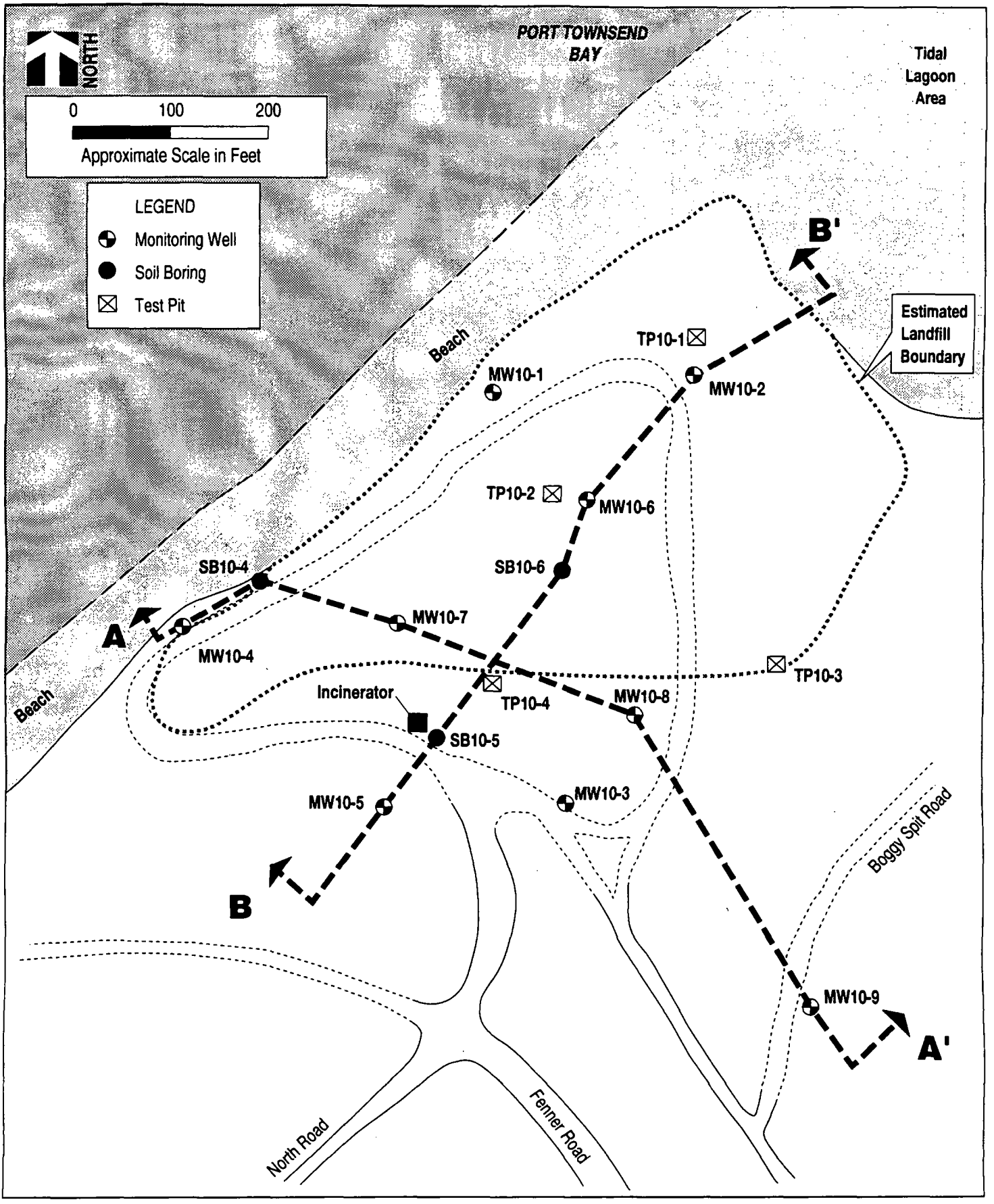
6.2 SITE CHARACTERISTICS—SITE 10

6.2.1 Geology and Hydrogeology

Site 10 is underlain by the Vashon Advance Outwash, consisting of sands and silty sands that contain the sea-level aquifer. The upper 3 to 5 feet of the site consists of clayey to silty sand. Debris—such as cinders, metal scraps and strapping, wood, cable, and 5-gallon buckets—is present at many locations in the landfill. The erosional cutbank, which is as high as 4 to 5 feet along the shoreline, exposes the contents of the landfill. The thickness of the debris varies from about 4 feet to a maximum thickness of 10 feet near soil boring 10-6 (SB10-6) and monitoring well 10-6 (MW10-6) (Figure 6-2). Beneath the landfill debris, fine- to coarse-grained sand and sand with traces of silt and gravel were observed. The soil south of the landfill consists of interbedded layers of sand and silty sand. Figure 6-2 is a geologic cross section location map; geologic cross sections A-A′ and B-B′ of Site 10 are shown in Figures 6-3 and 6-4, respectively.

All nine monitoring wells at Site 10 were used to obtain hydrogeologic information. A 24-hour tidal influence study was conducted at Site 10 on April 22 and 23, 1992, and the data from this study were used to evaluate the effects of tides on the groundwater flow at the site. These tidal effects are evident in contour maps of water-level elevations at the site. The mean water-level elevation contour map (Figure 6-5) shows the direction of net flow toward the bay, while contour maps of water-level elevations at high tide (Figure 6-6) and low tide (Figure 6-7) illustrate changes in flow direction throughout a single tidal cycle.

As depicted in Figures 6-3 through 6-7, the buried debris in the landfill is subjected to fluctuating groundwater saturation levels between tidal cycles. During a low tide, approximately 1.75 feet of the lower portion of debris is below the potentiometric surface and during a high tide, approximately 4.25 feet of the lower portion of the debris is below the potentiometric surface. The mean tidal averages show approximately 3 feet of submerged debris is in groundwater.



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 6-2 Site 10 Cross Section Location Map	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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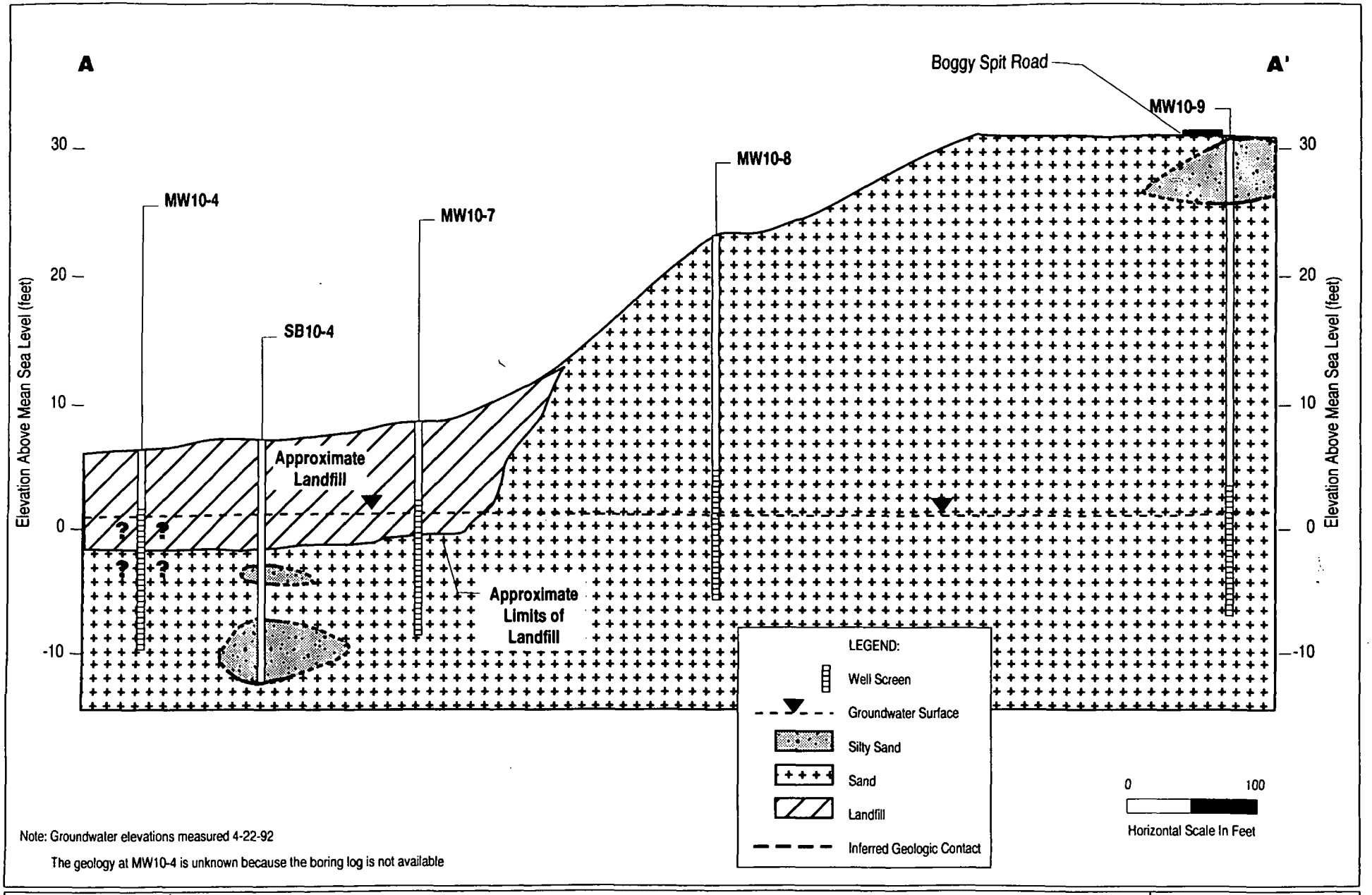

Note: Groundwater elevations measured 4-22-92

The geology at MW10-4 is unknown because the boring log is not available

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 6-3
Site 10
Cross Section A-A'

CTO 0114
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Port Hadlock Detachment
ROD

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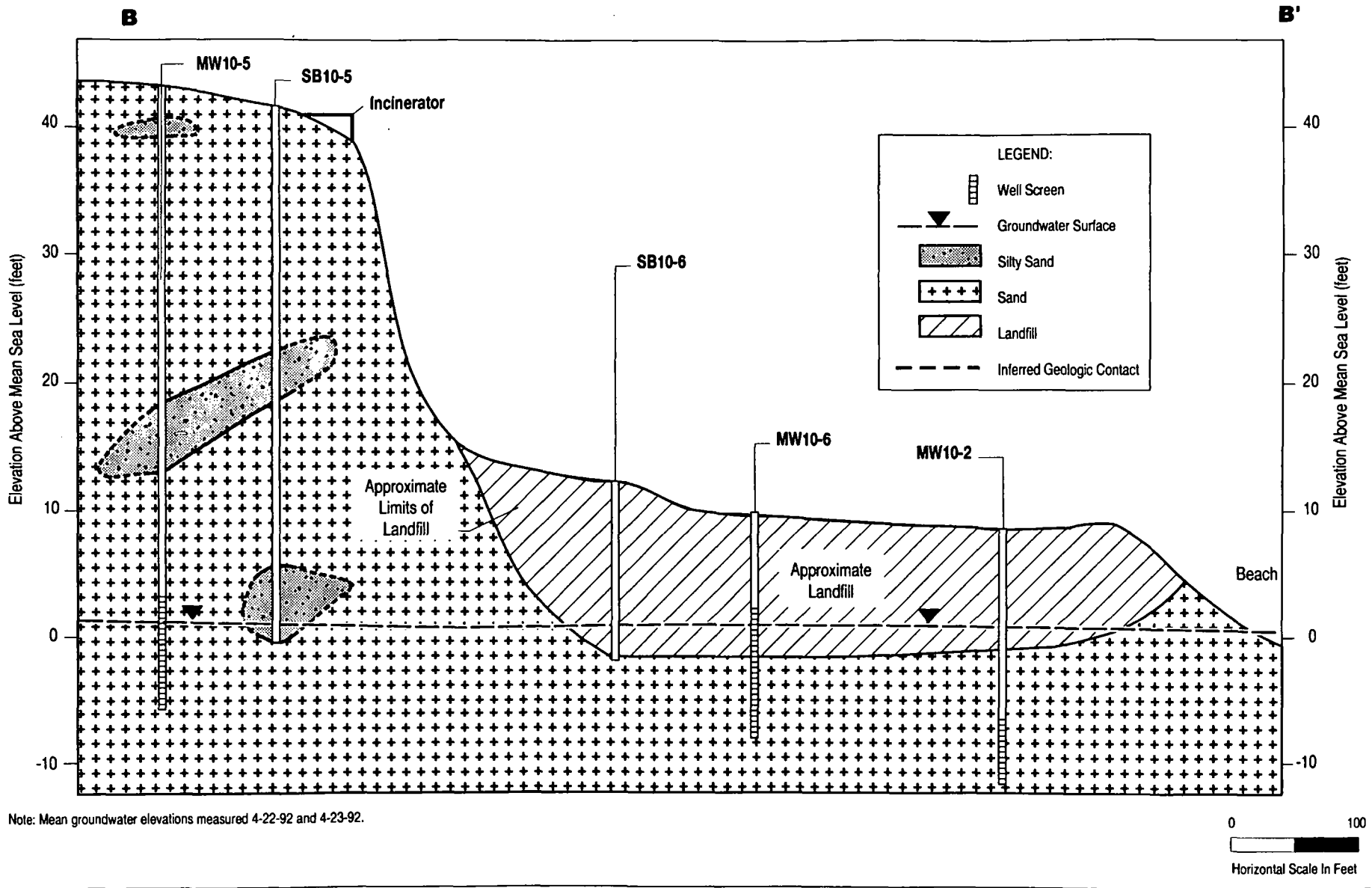

Note: Mean groundwater elevations measured 4-22-92 and 4-23-92.

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 6-4
Site 10
Cross Section B-B'

CTO 0114
NOC PACDIV
Port Hadlock Detachment
ROD

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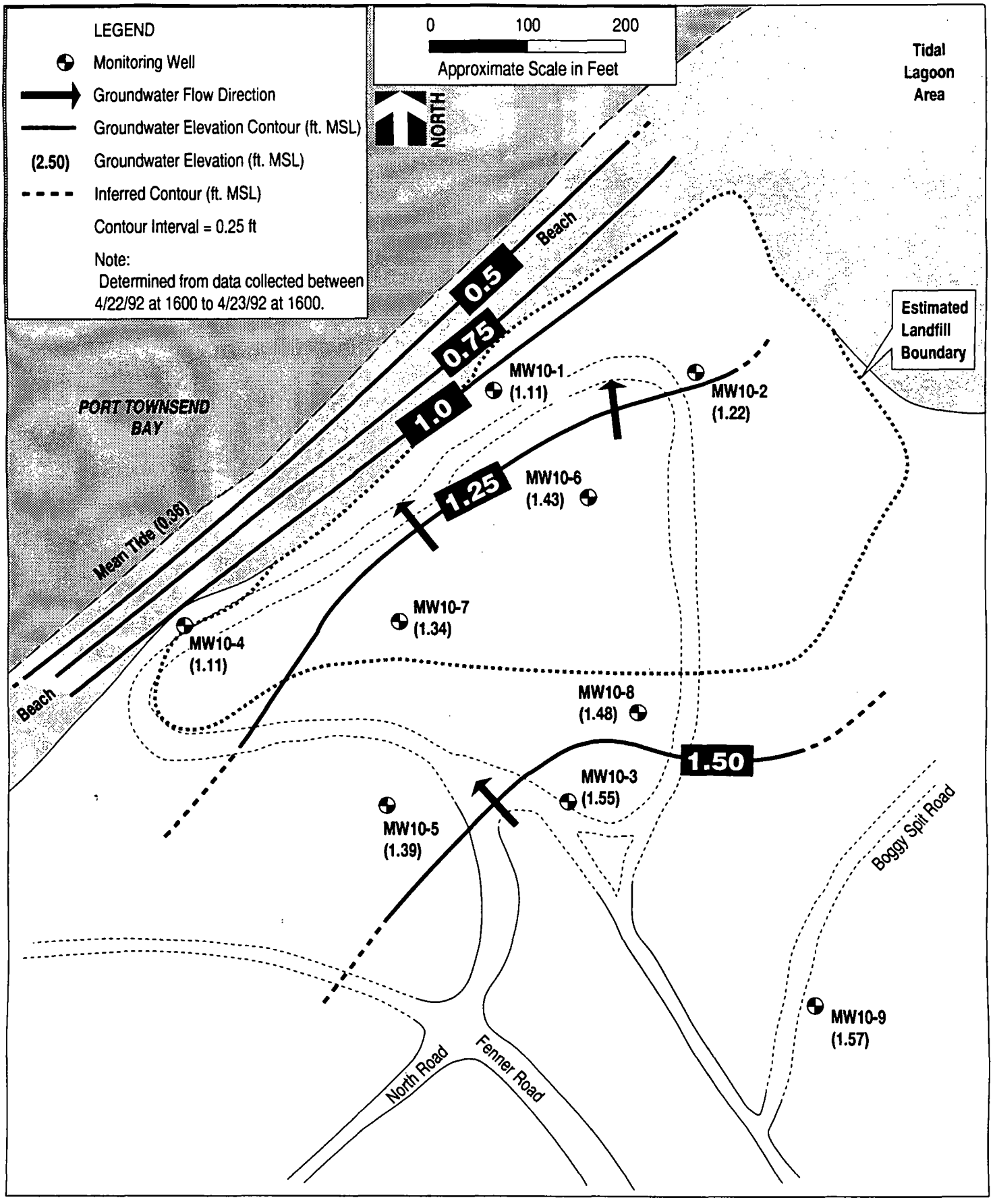

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 6-5 Site 10 Mean Water Levels	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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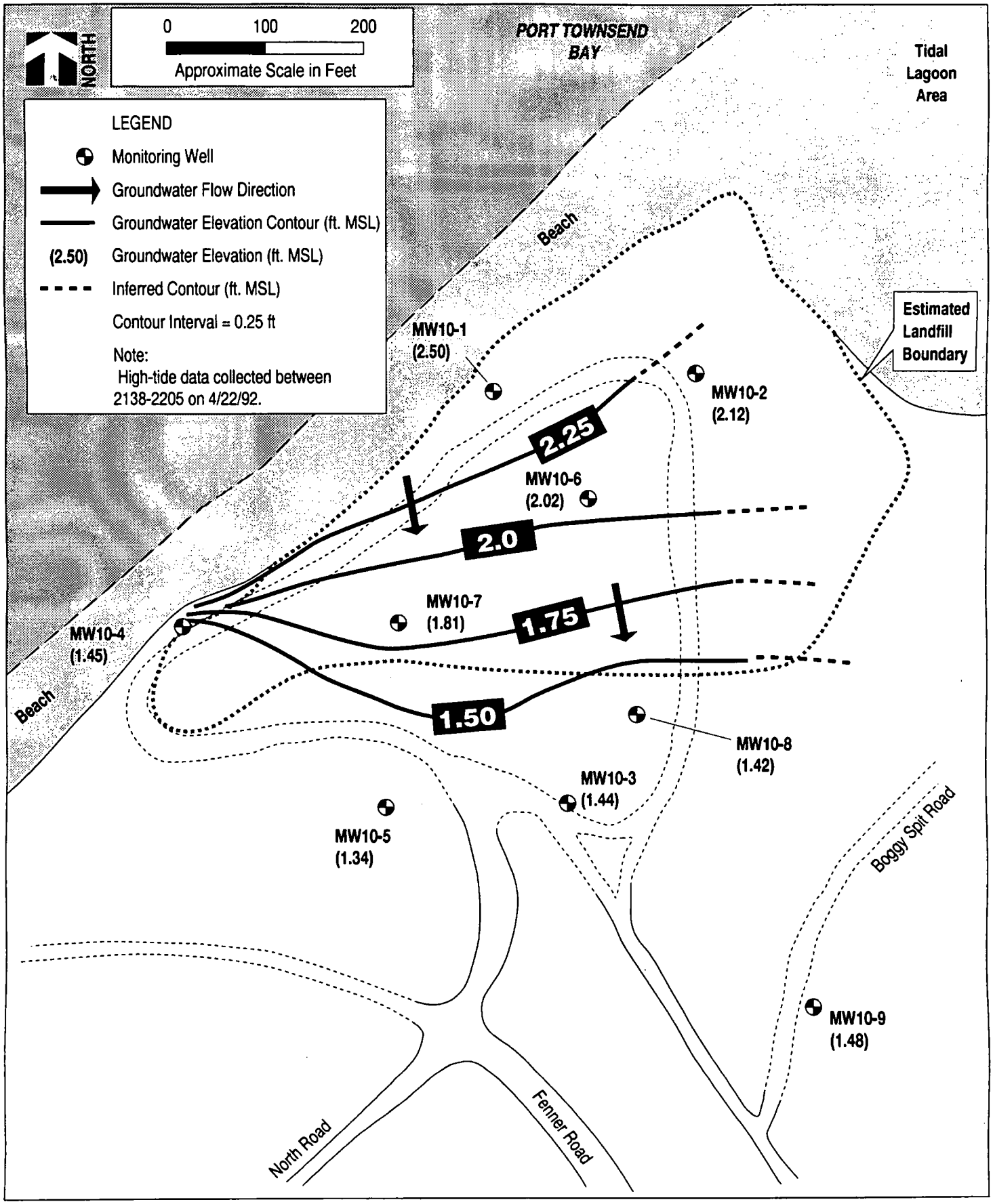

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-6** **Site 10** **High-Tide Groundwater Gradient Map**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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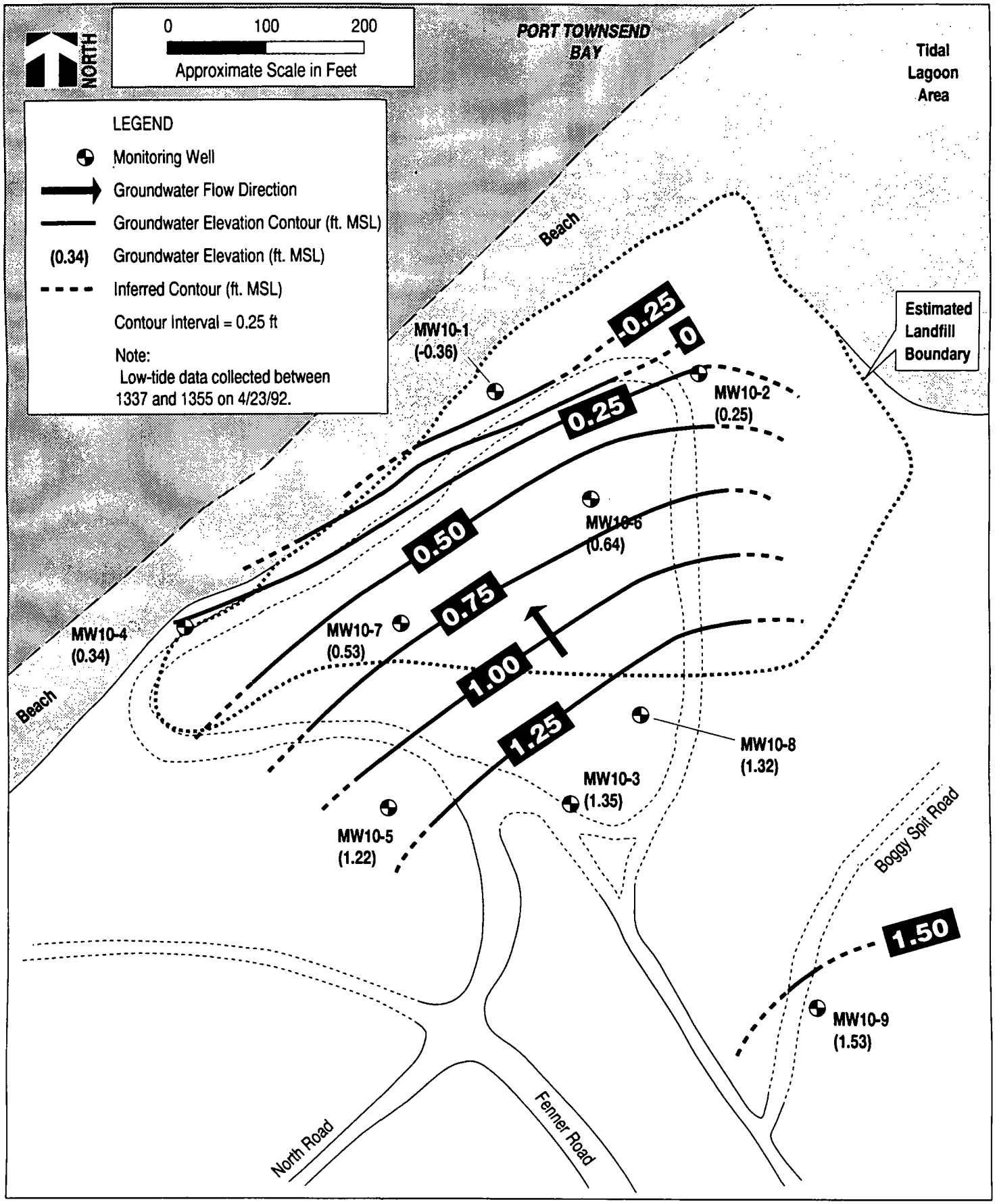

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	Figure 6-7 Site 10 Low-Tide Groundwater Gradient Map	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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The debris in the landfill averages 10 feet in thickness. Precipitation filtering through the landfill debris comes in contact with the upper approximately 6 feet of debris which is never submerged by tidal actions. This is equivalent to approximately 60 percent of the landfill debris coming into contact with infiltrating precipitation. Of the remaining 40 percent of the landfill debris, approximately 50 percent (20 percent of the total landfill mass) is situated at a level that is never above the potentiometric surface and the other 50 percent (20 percent of the total landfill mass) is situated in a zone directly affected by the raising and lowering of the water table through tidal actions.

The groundwater seepage velocity, based on mean water levels, is approximately 0.12 feet per day. Based on the maximum gradient at high tide, the maximum seepage velocity is 22 feet per day. A groundwater flow reversal from the bay to inland at a velocity of 22 feet per day causes a 12- to 15-foot wide dilution zone where salt water and fresh water mix. Chlorides and other solutes diffuse into the fresh water further inland until equilibrium is achieved. The width of this zone of diffusion (salinity above 10,000 mg/L) ranges from approximately 50 to 100 feet. Tides influence water levels as much as an estimated 650 feet inland.

Groundwater at Site 10 is not a source of drinking water under Washington state law. The groundwater near the shoreline contains salinity above the criterion of 10,000 mg/L for drinking water established in Washington Administrative Code (WAC) 173-340-720. In the absence of future drinking water potential, MTCA may approve groundwater cleanup levels that are based on protecting beneficial uses of adjacent surface water. MTCA requires that groundwater entering surface waters not exceed surface water cleanup levels at the point of entry or at any downstream location where it is reasonable to believe that hazardous substances may accumulate (WAC 173-340-720[c][iii]). For Site 10, a conditional point of compliance for groundwater (as defined under MTCA) is located at the edge of the waste management unit.

6.2.2 Marine Environment

Tidal shorelines around Indian Island typically consist of mostly sand or gravel substrates, with sandy or soft mud bottoms in the intertidal and subtidal zones (SCS Engineers 1984). Kilisut Harbor borders the east side of the island and is separated from Port Townsend Bay by a narrow sand spit projecting westward from Marrowstone Island. East of Site 10, the maximum water depth is about 20 feet, and the shallowest portion of the main navigational channel is about 10 feet.

Directly northeast of the landfill is a tidal lagoon (Figure 2-2). The substrate of the tidal lagoon consists of sandy silt, with some sand and cobbles at the northern side. West of Site 10, the subtidal substrate consists of sand, with some cobbles on the surface (SCS Engineers 1987). A shoal area extends north from the island's northernmost point for a distance of approximately 350 feet. The shoal is estimated to be approximately 1.5 feet below msl.

Deposits in the marine environment near Site 10 range from cobbles to silt and clay. Directly north of Site 10, cobbles cover the area, indicating a high-energy environment. Further to the east, between Boggy Spit and Marrowstone Island, medium sand covers the area. The grain size of the sediment progressively decreases to silt and clay further south in Kilisut Harbor, suggesting that this is a depositional and low-energy environment.

Marine flora and fauna around Site 10 are typical of that of Puget Sound, as previously described. A seal rookery is located in Port Townsend Bay adjacent to Site 10. According to the Department of Fish and Wildlife, the shellfish beds near Site 10 are some of the most productive in the state.

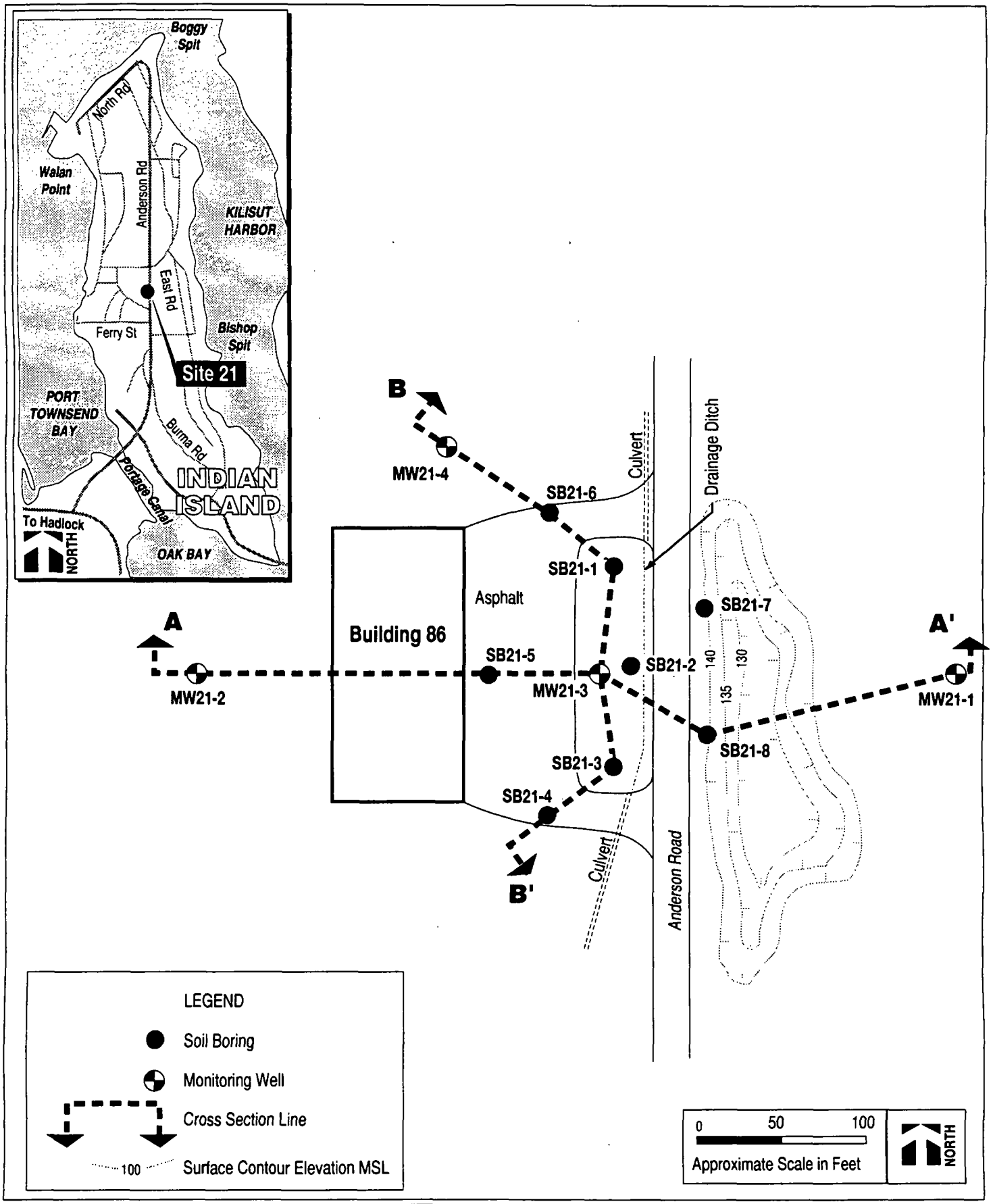
6.3 SITE CHARACTERISTICS—SITE 21

6.3.1 Geology

At this location, the material from 0 to approximately 20 feet below ground surface is fill material that was used to make a level area for the construction of Anderson Road and Building 86. The fill material is comprised of silt, sandy silt, silty sand, and sand. Below the fill material lies silt, silty sand, sand, and gravelly sand of the Vashon Advance Outwash. Cinder and metal fragments were encountered at several locations at depths varying from 1 to 20 feet below ground surface during the RI. Figure 6-8 is the Site 21 geologic cross section map showing the locations of cross sections A-A′ (Figure 6-9) and B-B′ (Figure 6-10).

6.3.2 Hydrogeology

Four monitoring wells were installed to evaluate the hydrogeologic conditions at Site 21. Groundwater in the sea level aquifer is present at approximately 135 to 137 feet below ground surface. Figure 6-11 shows groundwater contours that indicate groundwater flow



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-8** **Site 21** **Cross Section Location Map**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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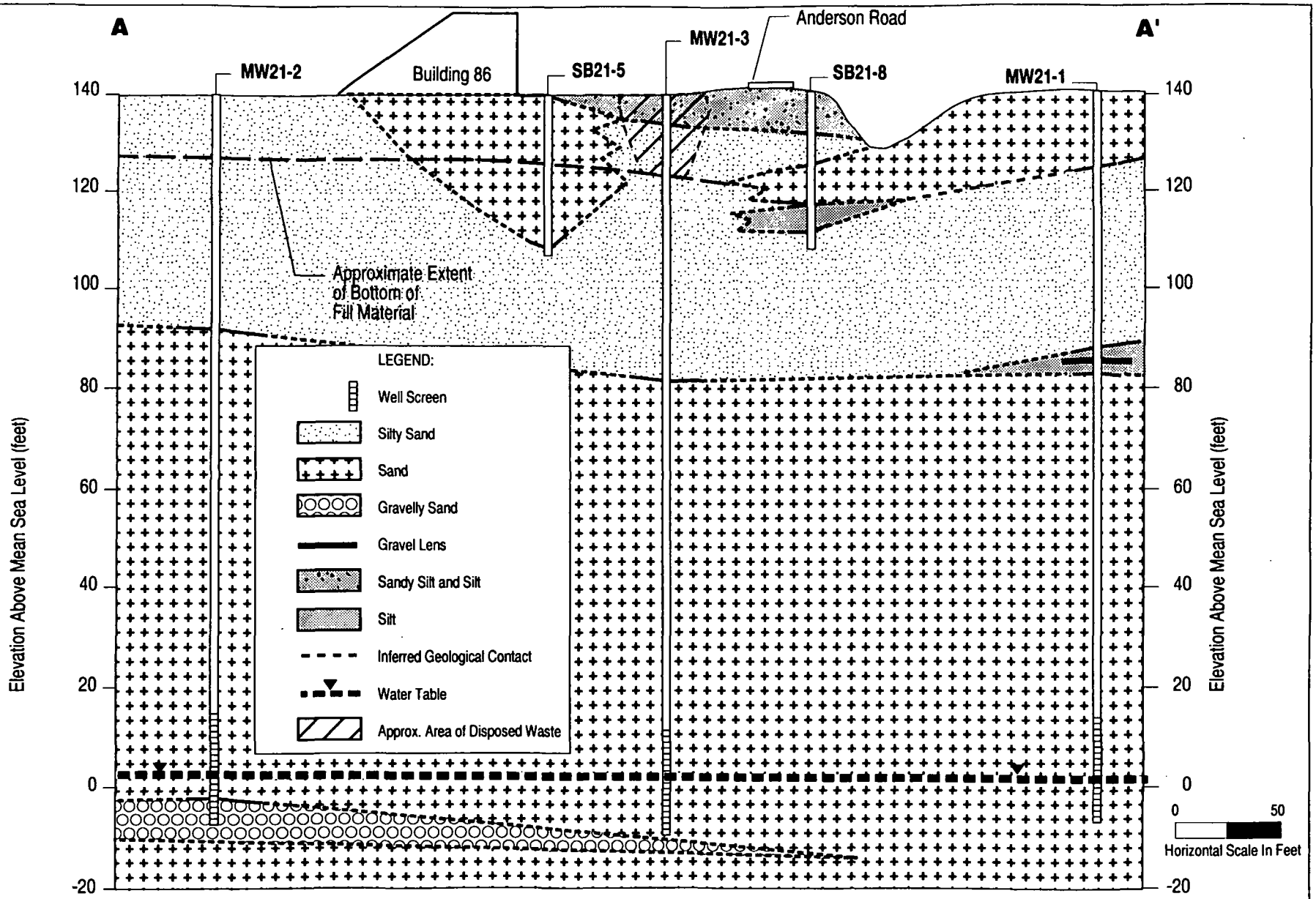

Note: Groundwater elevations measured 2-14-92 and 2-15-92

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 6-9
Site 21
Cross Section A-A'

CTO 0114
NOC PACDIV
Port Hadlock Detachment
ROD

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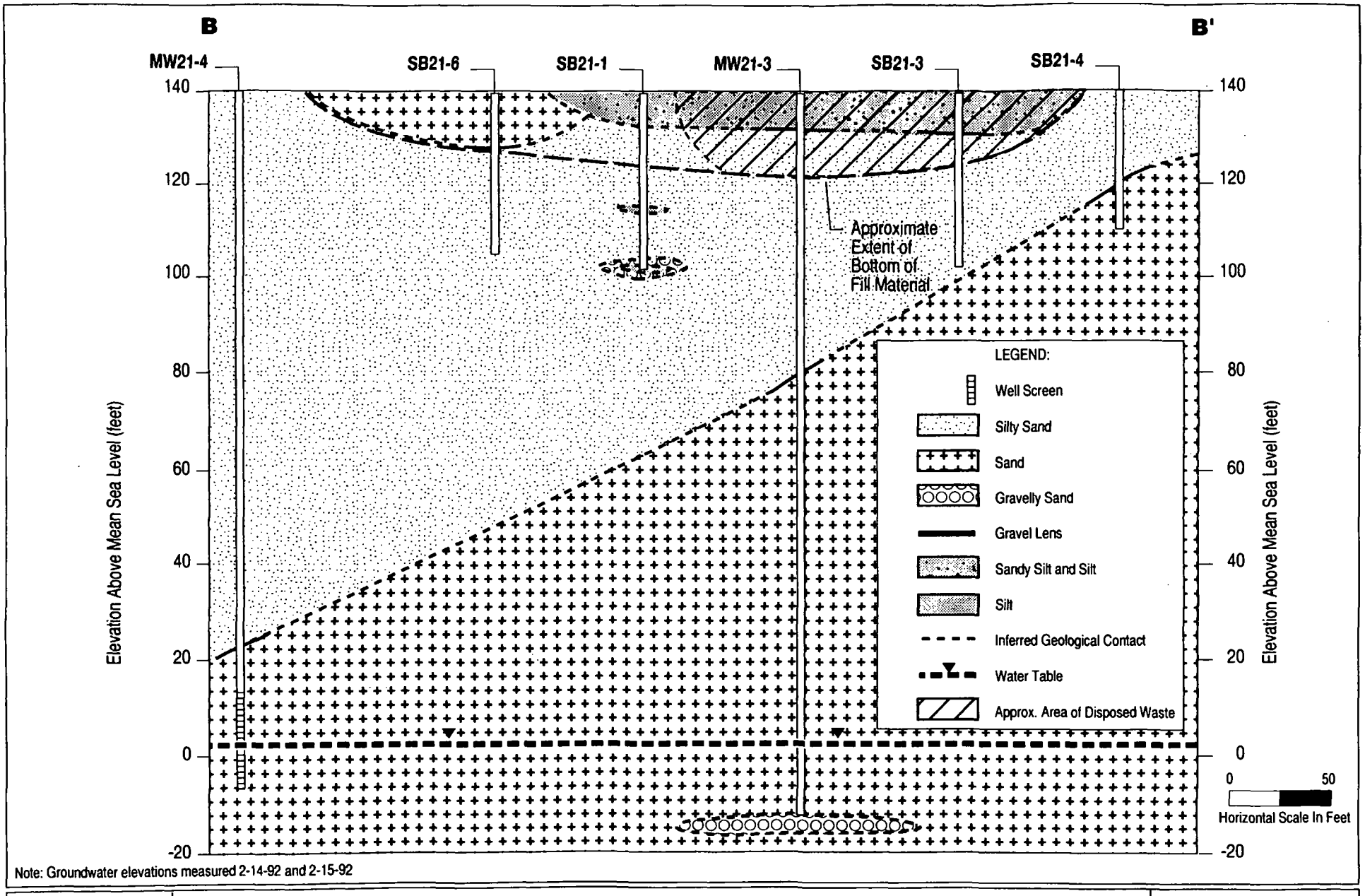

Note: Groundwater elevations measured 2-14-92 and 2-15-92

CLEAN
COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY

Figure 6-10
Site 21
Cross Section B-B'

CTO 0114
NOC PACDIV
Port Hadlock Detachment
ROD

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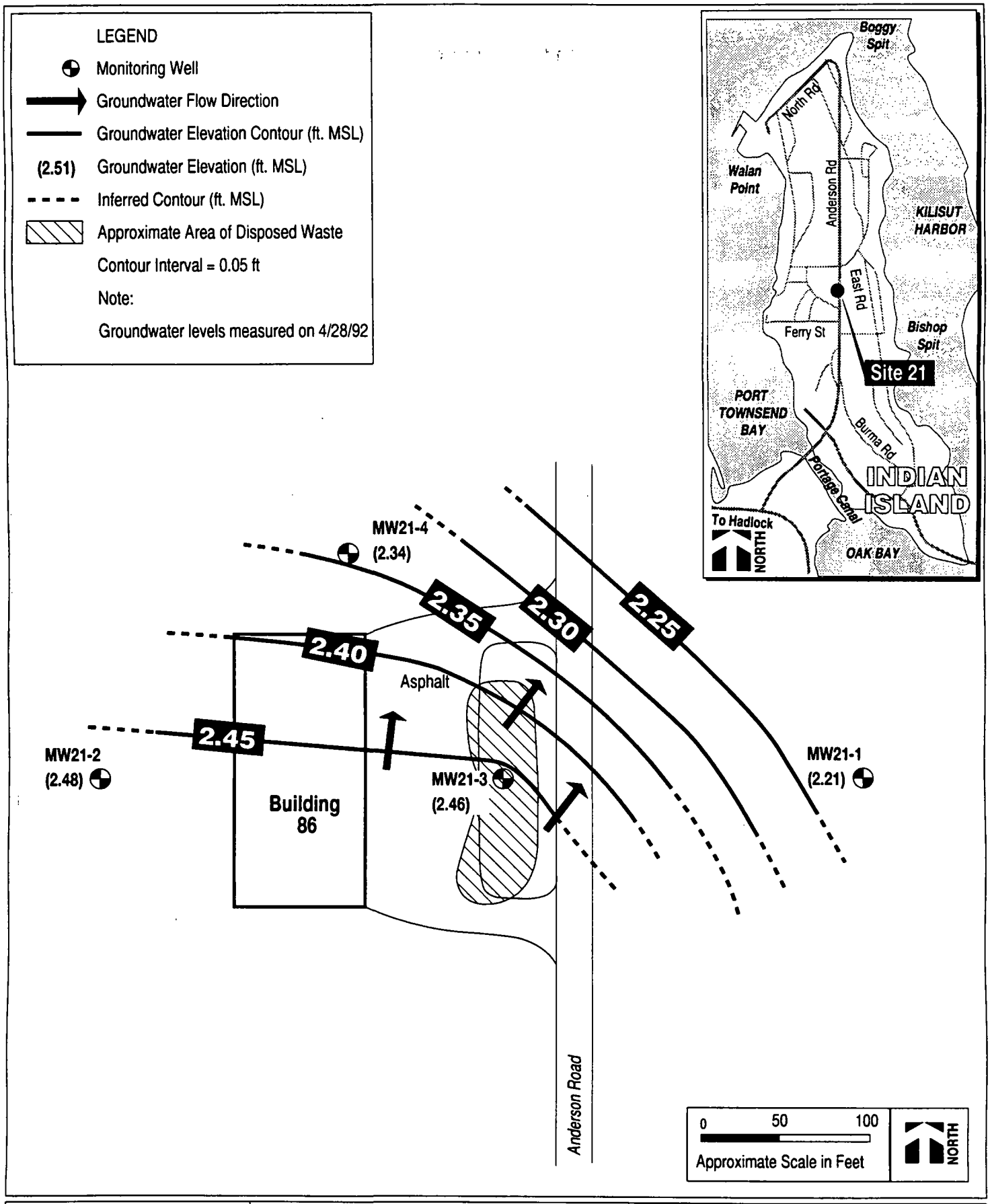

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-11** **Site 21** **Groundwater Gradient Map**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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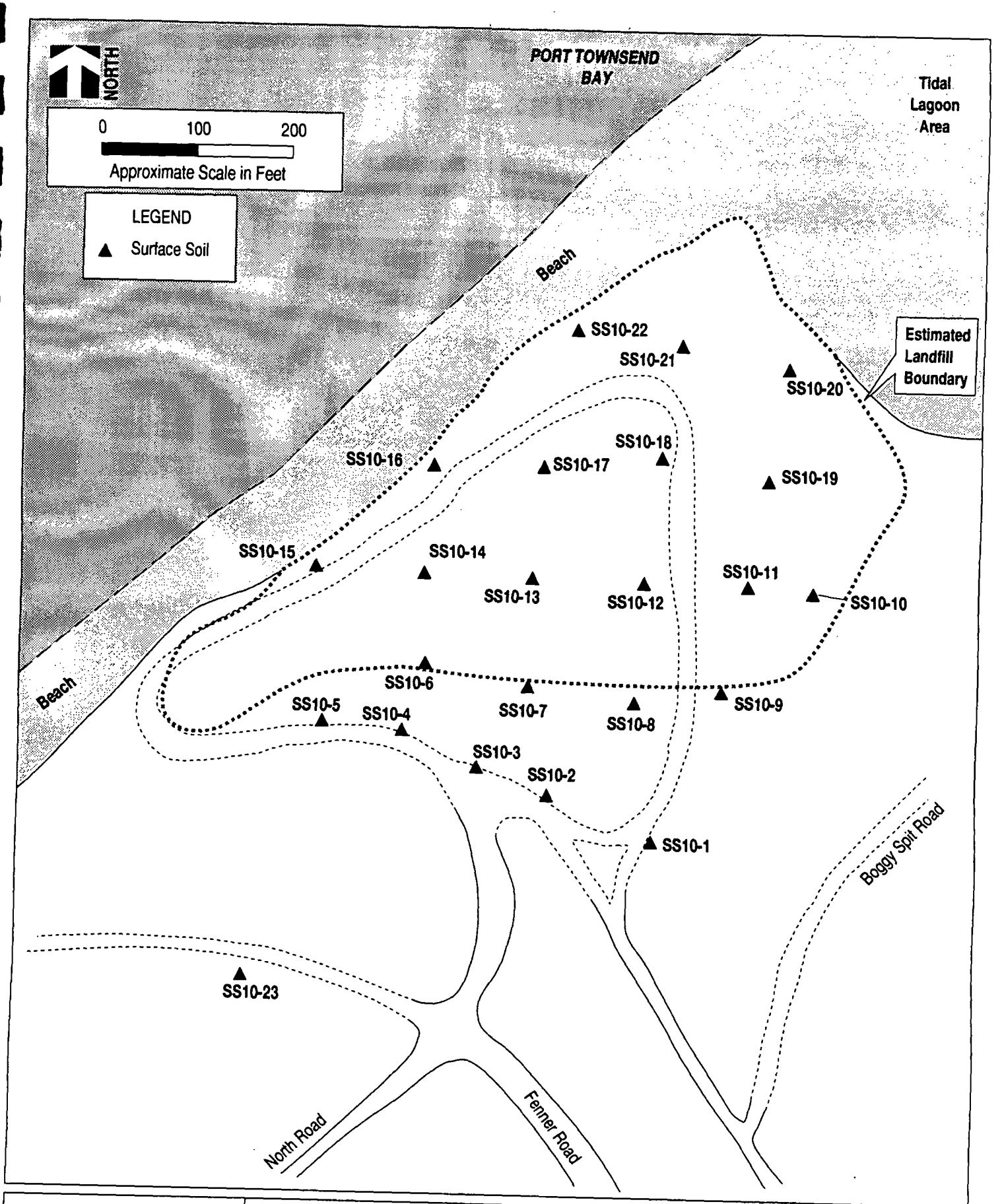
to the northeast during studies conducted in April 1992. However, the direction of flow has not been confirmed during other seasons because of the limited amount of data. When water levels were measured, the water table had a gentle gradient (0.0012 ft/ft) and a seepage velocity of 0.026 feet per day.

6.4 NATURE AND EXTENT OF CONTAMINANTS—SITE 10

Environmental media collected and sampled during the remedial investigation include surface and subsurface soil, groundwater, marine sediment, shellfish tissue, and air. Bioassays were also conducted on marine sediment. Locations of sampling points are shown in Figures 6-12 through 6-15. Samples were analyzed for volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), pesticides, polychlorinated biphenyls (PCBs), metals, and ordnance compounds. The toxicity characteristics leaching procedure (TCLP) was performed on soil samples from Site 10 which were then analyzed for VOCs, SVOCs, metals, herbicides, and pesticides. Air samples were analyzed for VOCs only. Analytical data from several sampling events occurring between 1989 and 1993 were obtained for analysis.

Results of the analyses were compared to regulatory screening levels and background concentrations (metals only) appropriate for the media of interest. The MTCA Method B residential cleanup levels were used as screening levels for surface and subsurface soil and air (Ecology 1994a). Due to the proximity of Site 10 to Port Townsend Bay, surface water screening levels were used to evaluate groundwater at Site 10. The surface water screening criteria included state and federal marine chronic ambient water quality criteria (AWQC), the National Toxics Rule for the 10^{-6} risk from the human consumption of organisms, and MTCA Method B for surface water. The Ecology sediment quality standards (SQS) found in the sediment management standards (SMS) were used to screen marine sediments (Ecology 1991). No screening levels were available for shellfish tissue. Those chemicals that were present in sampled media at concentrations higher than the screening levels and that were not related to background concentrations (metals only) using Ecology guidance were identified as contaminants of concern. Contaminants of concern for Site 10 are listed for each medium in Table 6-1. The following paragraphs describe the nature and extent of contaminants in each medium.



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-12** **Site 10** **Surface Soil/Root Zone Sampling Locations**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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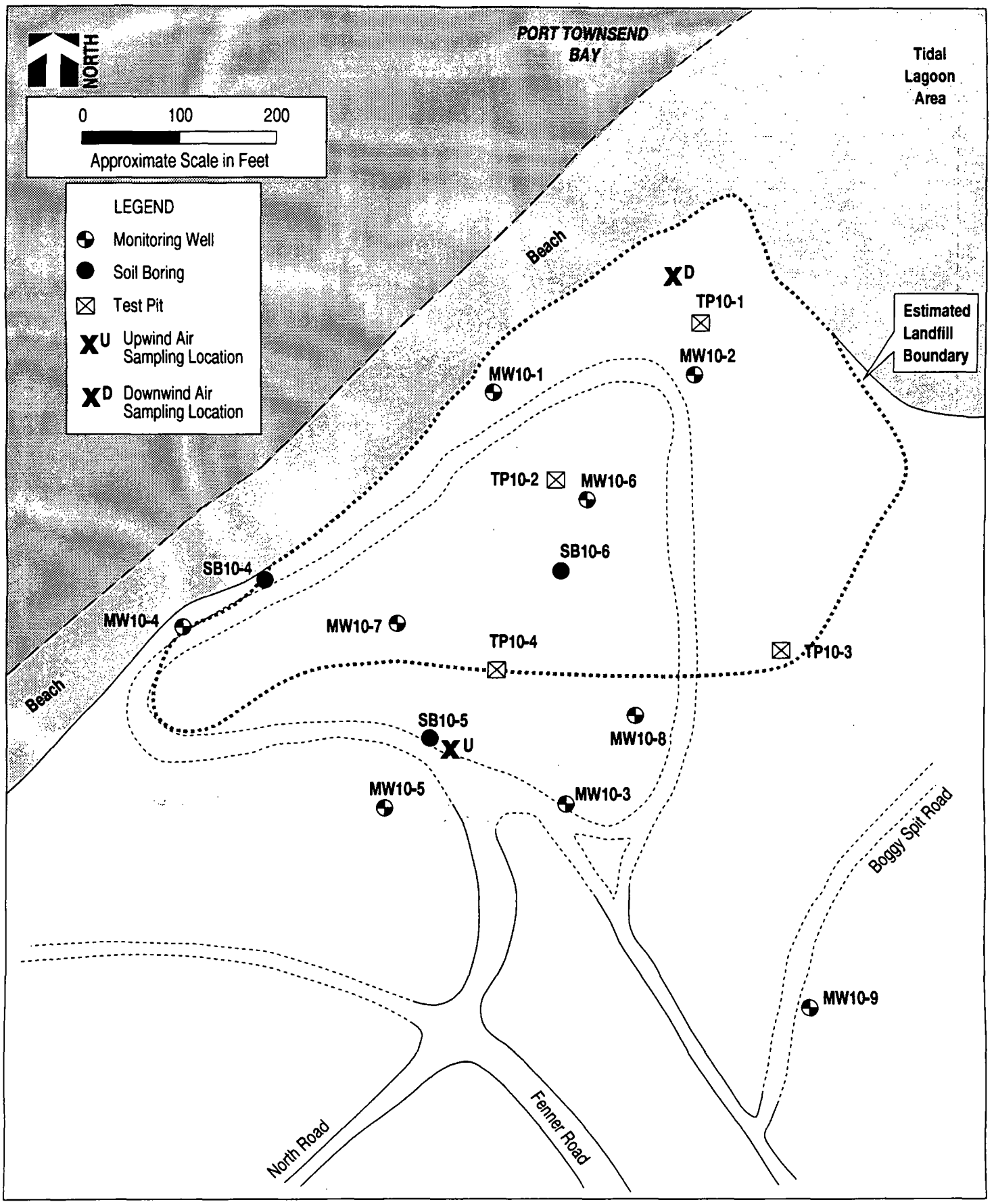

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-13** **Site 10** **Subsurface Soil and Air Sampling Locations**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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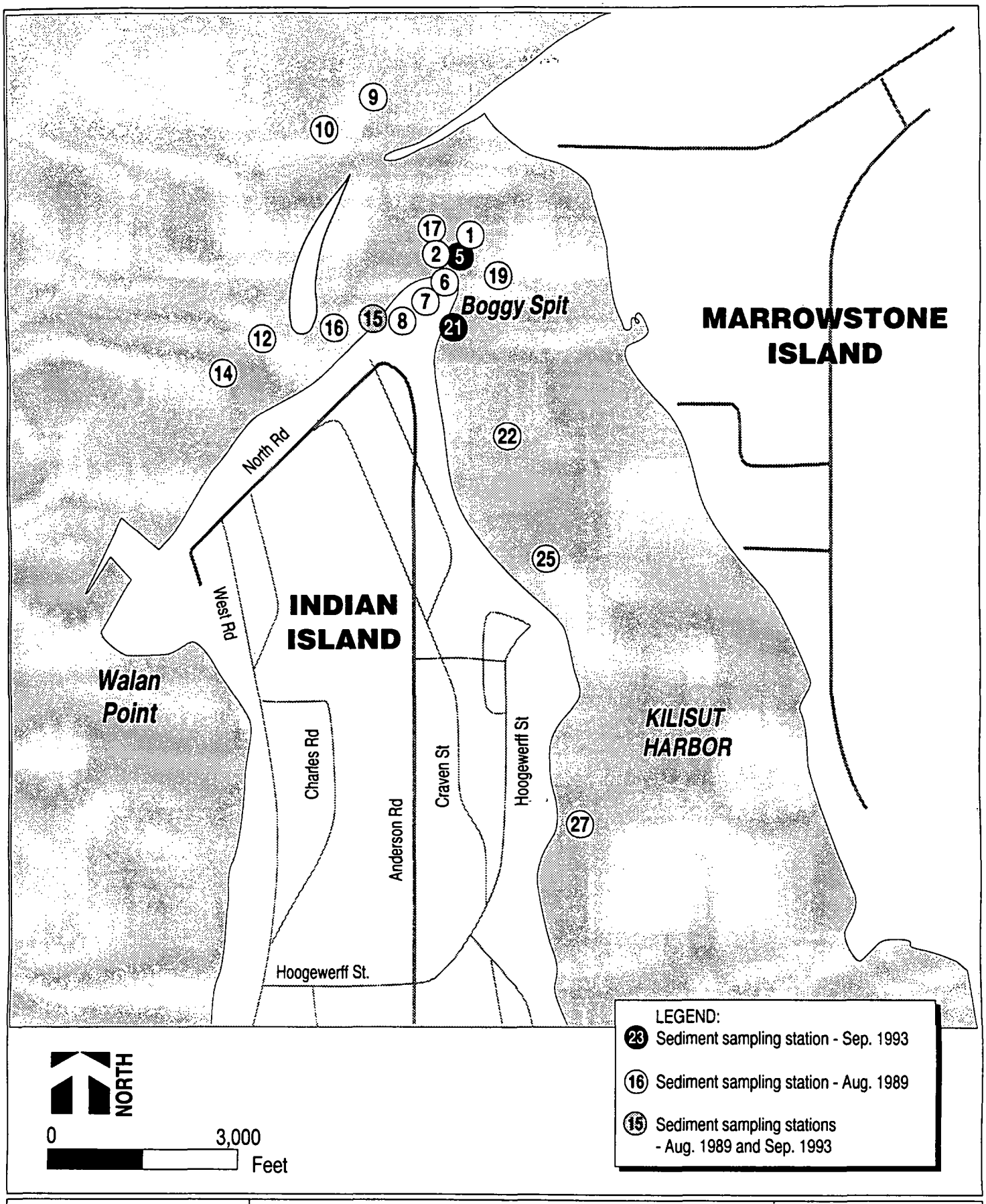

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-14** **Site 10** **Sediment Sampling Locations**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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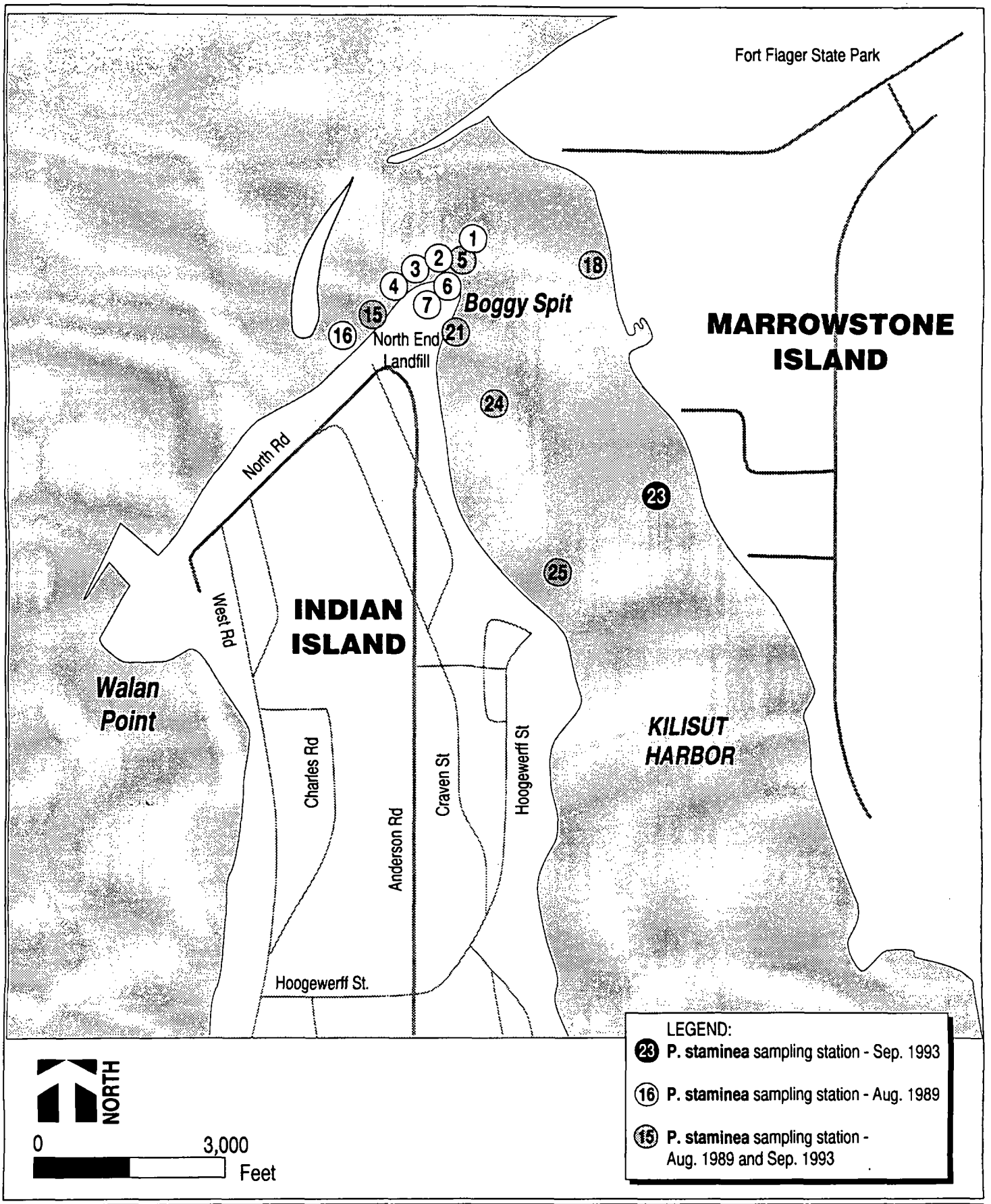

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-15** **Site 10** **Shellfish Sampling Stations**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

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Other chemicals that were detected in all media, such as DDT and its breakdown products, were not identified as contaminants of concern in all media, but suggest the possible migration of chemicals from the landfill to the marine environment.

6.4.1 Surface Soil

Surface soil was collected at 25 locations from 0 to 0.5 foot and 0.5 to 1.0 foot below ground surface. PCB, a contaminant of concern listed in Table 6-1, was detected only at SS10-20. The SVOCs identified as contaminants of concern were detected above MTCA Method B screening levels only at SS10-22 (see Figure 6-12). No exceedances of regulatory limits were observed for surface soil undergoing TCLP testing.

6.4.2 Subsurface Soil

Several SVOCs were identified as contaminants of concern. These SVOCs were present above their respective MTCA Method B screening levels in two locations: MW10-2 and TP10-2. Contaminants of concern in soil are limited to the northeast half of the landfill. No exceedances of regulatory limits were observed for subsurface soil undergoing TCLP testing.

6.4.3 Groundwater

The available data indicate that the landfill has caused groundwater contamination at Site 10. Due to saltwater intrusion from Port Townsend Bay and the past operational history of the site as a landfill, groundwater at Site 10 is not a source of potable water. Therefore, the chemical concentrations in groundwater were not compared to drinking water screening levels but instead to marine surface water criteria. Bis(2-ethylhexyl)phthalate (BEHP), chlordane, 4,4′-DDD, 4,4′-DDT, total arsenic, total beryllium, total and dissolved copper, total and dissolved lead, total and dissolved mercury, and total zinc were all detected above marine surface water criteria in Site 10 groundwater. However, concentrations of chemicals in groundwater found to be above surface water screening levels do not demonstrate a violation of surface water standards, but do indicate the potential for such violation and do indicate the potential for groundwater to exit the site and impact surface water and the marine environment. The contaminants of concern are listed in Table 6-1.

There is no apparent spatial pattern for the contaminants of concern in the groundwater, and it may be difficult to identify a pattern near the shoreline because of the dilution

Table 6-1
Contaminants of Concern at Site 10

Contaminant	Screening Value	Number of Analyses	Number of Detections Above Screening Value	Maximum Detection
Surface Soil (mg/kg)				
PCB 1254	0.13[a]	50	2	1.7
Benzo(a)anthracene	0.137[a]	50	1	1.3
Benzo(a)pyrene	0.137[a]	50	1	0.53
Indeno(1,2,3-cd)pyrene	0.137[a]	50	1	0.36
Benzo(b)fluoranthene	0.137[a]	50	1	1.7
Dibenzo(a,h)anthracene	0.137[a]	50	1	0.21
Chrysene	0.137[a]	50	1	1.9
Subsurface Soil (mg/kg)				
Benzo(a)anthracene	0.137[a]	37	1	0.79
Benzo(b)fluoranthene	0.137[a]	37	2	0.59
Benzo(k)fluoranthene	0.137[a]	37	2	0.81
Benzo(a)pyrene	0.137[a]	37	1	1.1
Dibenzo(a,h)anthracene	0.137[a]	37	1	0.18
Chrysene	0.137[a]	37	2	0.88
Indeno(1,2,3-cd)pyrene	0.137[a]	37	1	0.62
Groundwater (µg/L)				
Arsenic	0.0842[b]	30	8	126
Copper	2.9[c]	30	23	159
Beryllium	0.0793[b]	27	2	1.4
Lead	5.8[d]	30	12	213
Mercury	0.025[c,d]	30	4	0.49
Nickel	7.9[d]	30	14	316
Zinc	76.6[d]	30	9	427
4,4'-DDT	0.000356[b]	21	1	0.15
4,4'-DDD	0.000504[b]	21	2	0.036
gamma-Chlordane	0.000354[b]	21	1	0.033
Bis(2-ethylhexyl)phthalate	3.56[b]	21	10	49
Marine Sediment				
None	—	—	—	—
Air				
None	—	—	—	—

[a]Value reflects MTCA B criteria for soil
[b]Value reflects MTCA B criteria for surface water
[c]Value reflects Clean Water Act water quality criteria for surface water (marine chronic)
[d]Value reflects Washington water quality criteria for surface water (marine chronic)

Note:
Contaminants of concern for shellfish could not be identified because specific regulatory standards have not been developed. However, chemicals found in shellfish tissue were evaluated in the risk assessment.

caused by high tides. The background concentrations of metals in Port Hadlock groundwaters or surface waters have not been established. However, it is suspected that the landfill has impacted the metal concentrations in the groundwater.

BEHP was detected above its surface water comparison value in each well near the shoreline. Highest concentrations were detected in the northeast half of the landfill area. There is no historical record of the disposal of BEHP at the landfill or of exceedances of MTCA Method B soil cleanup levels during the RI. However, it appears that the landfill may be the source of this chemical.

Dichlorodiphenyldichloroethane (DDD) and dichlorodiphenyltrichloroethane (DDT) were detected only at MW10-6. They exceeded their surface water screening levels values. Gamma-chlordane was detected once at MW10-3, where its surface water screening level value was exceeded.

6.4.4 Marine Sediments

Two rounds of marine sediment sampling were conducted near Site 10. The data indicate that erosion from the landfill and dispersion of contaminated groundwater have impacted the marine sediments. Maximum concentrations for detected compounds in marine sediment were compared to the marine sediment quality standards (SQS) under the state sediment management standards (SMS) (Ecology 1991). The initial evaluation procedure for marine sediment is based on comparison of concentrations of chemicals to the corresponding SQS as defined by Ecology in the SMS. The state SQS for marine sediments address only protection of aquatic organisms and do not address bioaccumulation of toxics and subsequent ingestion by humans. If the chemical concentration in the marine sediment does not exceed the SQS, the compound in the marine sediment is designated as having no adverse effects on biological resources.

When chemical concentrations in sediments exceed the associated SQS as occurred for benzoic acid during Phase I, confirmatory tests with specified bioassays are used to provide a more direct characterization of the potential for adverse ecological effects. The results of the bioassays are particularly important for comparison with SMS criteria because failed or inconclusive assignments of adverse ecological effects from initial chemical analyses compounds are superseded by results of the bioassay tests. Therefore, the bioassay tests allowed for assignment of confirmatory designations of adverse ecological effects to tested sediments.

As a result of this evaluation, there are no contaminants of concern identified in the sediments surrounding Site 10. Phenol, the only compound in sediment near the site that exceeded the applicable SQS during Phase II, was detected at Station 15 near the northeast portion of the landfill. The phenol does not appear to be site related as the reference station in Samish Bay contained a higher concentration of this naturally occurring compound.

Several chemicals that were detected in the sediment suggest a link to contamination from the landfill. Aroclor 1260 was detected in sediment at Station 8, and Aroclor 1254 was detected twice at one soil sampling station. At Station 15, adjacent to the landfill, several SVOCs were detected at one or more orders of magnitude below the SQS. Five of these same SVOCs exceeded the MTCA Method B cleanup levels in soil samples taken from the landfill. Although other chemicals were detected, no other chemicals were above the SQS, other than phenol and benzoic acid, as mentioned above. 4,4-DDD and 4,4-DDT were detected at five sediment sampling stations in 1989, and in groundwater samples from one well. Other examples of analytes detected in the sediment include arsenic, BEHP, chromium, copper, lead, mercury, nickel, and zinc.

Under the evaluation criteria of the sediment management standards (Ecology 1991) for sediments and bioassays, the sediments would not require remediation. One of three replicate samples from Station 21 did not pass bioassay standards; however, because the other two replicate samples passed the same bioassay test, the one that did not pass was considered anomalous. Although Station 21 cannot be considered clean, active remediation or additional studies are not warranted.

6.4.5 Shellfish Tissue

No contaminants of concern were identified in shellfish tissue because no regulatory values have been developed for comparison. Instead, a risk assessment approach was used to evaluate risks posed by detected chemicals. Section 7 on risk assessment provides an evaluation of potential risks caused by detected chemicals. Table 6-2 shows the chemicals detected in shellfish tissue from Site 10 and from the reference station for the species tested (*P. staminea*).

As most of the toxic chemicals found in shellfish tissue on Site 10 beaches were also found in Site 10 soils, groundwater, or sediment, the landfill is believed to be the major source of contamination to the shellfish. The landfill is believed to be contaminating the

Table 6-2
Site 10 and Reference Station—Compounds Detected in Shellfish Tissue *(P. staminea)*

Compound	Phase I Maximum Detected Values	Phase II Maximum Detected Values	Detected Values From Reference Station	Units
Inorganics				
Aluminum	NA	26.5	33.6	mg/kg
Arsenic	3.4	3.3	0.19	mg/kg
Barium	NA	0.72	0.82	mg/kg
Cadmium	0.47	0.64	0.44	mg/kg
Calcium	NA	4630	582	mg/kg
Chromium	ND	0.36	0.48	mg/kg
Copper	1.1	1.2	1.1	mg/kg
Iron	ND	53.2	78.4	mg/kg
Lead	0.28	0.031	0.033	mg/kg
Magnesium	NA	696	648	mg/kg
Manganese	NA	1.5	1.6	mg/kg
Mercury	0.012	ND	ND	mg/kg
Nickel	NA	0.39	0.55	mg/kg
Potassium	NA	2740	2310	mg/kg
Selenium	0.61	0.54	0.35	mg/kg
Silver	0.16	0.16	0.17	mg/kg
Sodium	NA	4140	3350	mg/kg
Vanadium	NA	0.29	0.36	mg/kg
Zinc	17	14.5	11.3	mg/kg
Ordnance Compounds				
RDX	NA	0.57	ND	mg/kg
Picramic acid	NA	0.90	0.43	mg/kg
Picric acid	NA	0.037	ND	mg/kg
Pesticides/Aroclors				
4,4'-DDD	0.0015	ND	ND	mg/kg
4,4'-DDT	ND	0.005	ND	mg/kg
Aldrin	0.003	ND	ND	mg/kg
alpha-BHC	0.0009	ND	ND	mg/kg

Table 6-2 (Continued)
Site 10 and Reference Station—Compounds Detected in Shellfish Tissue *(P. staminea)*

Compound	Phase I Maximum Detected Values	Phase II Maximum Detected Values	Detected Values From Reference Station	Units
alpha-Chlordane	ND	0.0042	0.0064	mg/kg
beta-BHC	0.025	ND	ND	mg/kg
gamma-BHC (lindane)	0.0031	ND	ND	mg/kg
gamma-Chlordane	0.0021	ND	ND	mg/kg
Organophosphorus Pesticides				
Methyl parathion	0.037	ND	ND	mg/kg
Semivolatile Organics				
Benzoic acid	2.7	3.2	ND	mg/kg
Bis(2-ethylhexyl)phthalate	5.1	ND	ND	mg/kg
Di-n-butylphthalate	ND	6.0	ND	mg/kg
Pentachlorophenol	1.5	ND	NA	mg/kg
General Measurements				
Lipid	27	1.6	1.0	%

NA - Not analyzed
ND - Not detected; detection limits varied between samples

shellfish on adjacent beaches through direct erosion of landfill contents and through groundwater flow.

6.4.6 Air

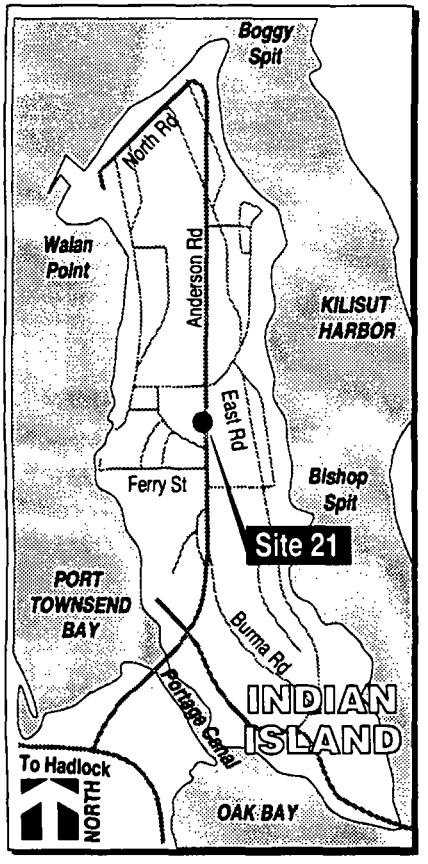
Because the volatiles (benzene, chloroform, chloromethane, 1,1-dichloroethane, and styrene) that were detected above the MTCA Method B screening level for air were not detected in other media at the site, it is believed that Site 10 is not the source of volatiles detected in air. Air emissions from industries near Port Townsend area and possibly from autos may be the source of the chemicals found in the air. Therefore, no contaminants of concern were identified for air at Site 10.

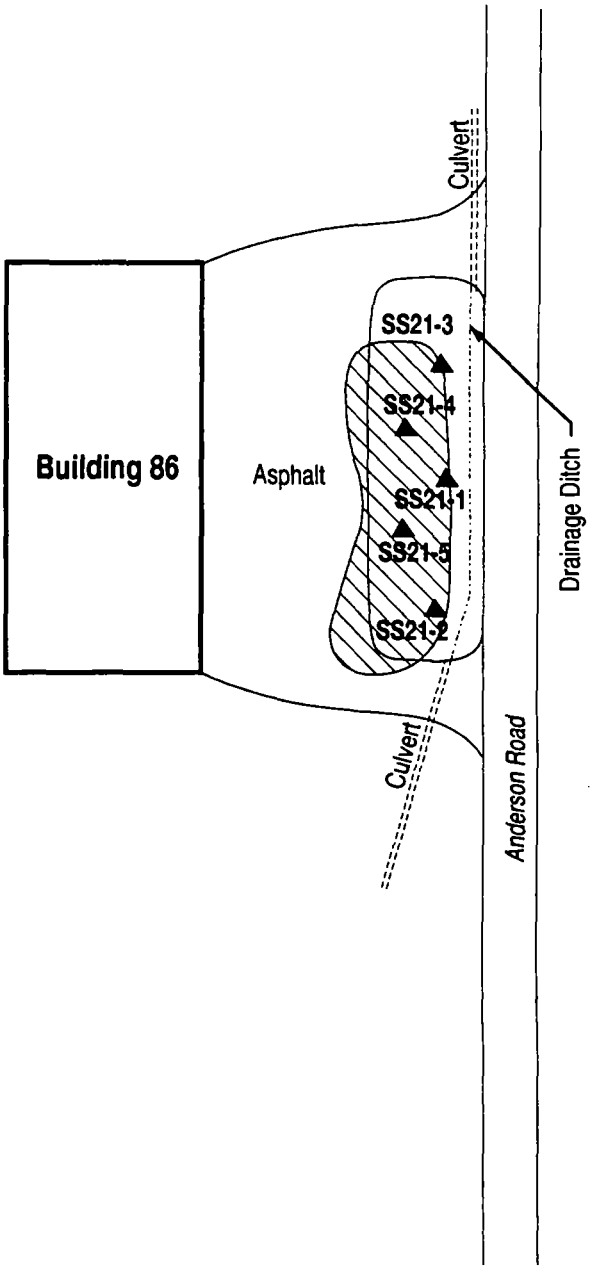
6.5 NATURE AND EXTENT OF CONTAMINANTS—SITE 21

Surface and subsurface soil, groundwater, and air samples from Site 21 were collected for analysis. Samples (except for air samples) were analyzed for metals, pesticides, PCBs, SVOCs, and VOCs. Air samples were analyzed for VOCs only. Sampling locations are shown on Figures 6-16 and 6-17. Contaminants of concern for Site 21 are listed in Table 6-3. These contaminants were identified by comparing the site analytical results to the MTCA Method B residential cleanup levels for surface and subsurface soil, groundwater, and air (Ecology 1994a). In addition to MTCA Method B, state specific ARARs and federal MCLs were also used for screening groundwater at Site 21. Site concentrations of metals in soil were also compared to background concentrations using Ecology guidance (Ecology 1992, 1993, 1994b). Those chemicals that were present in sampled media at higher concentrations than screening levels and were not related to background concentrations (metals only) using Ecology guidance became contaminants of concern.

6.5.1 Surface Soil

No contaminants of concern were detected in the surface soil. Although beryllium exceeded the published MTCA Method B cleanup levels (Ecology 1994a), the state natural background concentrations (Ecology 1994b) were used for screening. Beryllium was detected above state natural background concentrations (Ecology 1994b) in only two surface soil samples collected at Site 21 at concentrations less than twice the screening level.





SS21-6

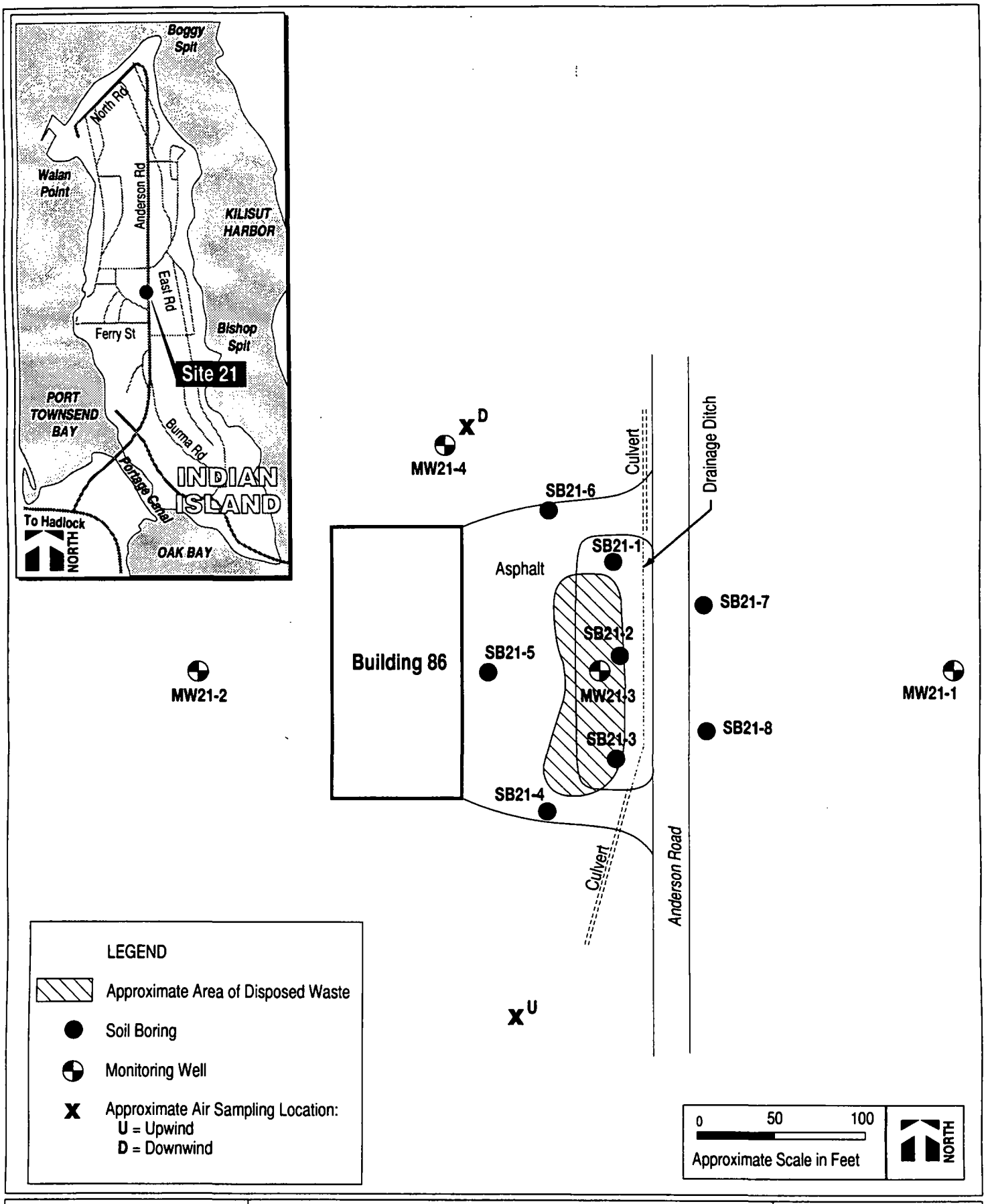
LEGEND

- Approximate Area of Disposed Wastes
- Surface Soil/Root Zone Sampling Location
- Background Surface Soil/Root Zone Sampling Location

0 50 100
Approximate Scale in Feet
NORTH

CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-16** **Site 21** **Surface Soil/Root Zone Sampling Locations**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

533011005-8-021695



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 6-17** **Site 21 – Subsurface Soil, Monitoring Well, and Air Sampling Locations**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

533011005-11-060195

Table 6-3
Contaminants of Concern at Site 21

Contaminant	Screening Level	Number of Analyses	Number of Detections Above Screening Level	Maximum Detection
Surface Soil (mg/kg)				
None	—	—	—	—
Subsurface Soil				
None	—	—	—	—
Groundwater (dissolved) (μg/L)				
Arsenic	5.0[a]	5	1	21
Manganese	80[e]	5	5	753
Nickel	100[c,d]	5	1	126
Groundwater (total) (μg/L)				
Antimony	6[c,d]	14	3	20.7
Arsenic	5.0[a]	17	10	32.5
Barium	1,120[e]	14	2	1,770
Beryllium	0.0203[e]	14	4	4.8
Lead	15[c]	17	4	61.1
Manganese	80[e]	14	14	11,200
Nickel	100[c,d]	17	10	1,340
Vanadium	112[e]	14	4	276
Bis(2-ethylhexyl)phthalate	6[c,d]	15	4	58
Hexachlorobutadiene	0.561[e]	15	1	18
Benzene	1.51[e]	17	1	2
Air				
None	—	—	—	—

[a]Value reflects MTCA A criteria for groundwater
[b]Value reflects Washington water quality standards for groundwater
[c]Value reflects federal maximum contaminant level (MCL)
[d]Value reflects Washington MCL
[e]Value reflects MTCA B criteria for groundwater
Note:— No contaminants of concern detected

6.5.2 Subsurface Soil

No contaminants of concern were detected in the subsurface soil. Beryllium exceeded state natural background concentrations (Ecology 1994b) but was within the Ecology background acceptance criteria as less than 10 percent of samples were found to exceed background. Lead was also found to exceed MTCA Method A in one sample at a depth of 8 to 10 feet in the subsurface where there is low potential for exposure.

6.5.3 Groundwater

As shown in Table 6-3, eight metals and three organic compounds detected in Site 21 groundwater were identified as contaminants of concern.Several of the metal concentrations may be from the waste reportedly disposed of at the site or may occur naturally; however, background concentrations in groundwater at Port Hadlock were not determined. Metal concentrations exceeding screening levels were detected primarily in unfiltered samples. The turbidity of groundwater collected for total metals analysis was very high (>200 nephelometric turbidity units) and may not represent actual groundwater conditions at the site. The turbidity in the samples was from suspended material in the water column during sampling. Purging of the Site 21 monitoring wells during sampling was also difficult due to their depth and relatively slow recovery. Concentrations of metals in filtered samples were lower than metal concentrations in unfiltered samples. It is possible that the high turbidity at Site 21 may have caused elevated unfiltered metals concentrations. Each compound exceeding screening levels was identified at least once in samples collected from MW21-2, which is west and upgradient of the reported area of waste disposal. This location also showed the highest concentrations of contaminants of concern. MW21-3, located in the reported disposal area and screened in the aquifer approximately 140 feet below land surface, contained the fewest number of contaminants of concern.

Bis(2-ethylhexyl)phthalate (BEHP) and hexachlorobutadiene in groundwater samples from MW21-2 were detected once above groundwater screening levels. The thermal degradation of the plastic portions of the monitoring well pump or a false positive detection could have caused this detection of hexachlorobutadiene exceedance. Hexachlorobutadiene was not detected in samples collected from MW21-2 6 days prior to its detection nor in a sampling event 2 months later. This compound was not detected in soil samples. BEHP, which was detected above its groundwater screening level once in samples from each well, may have been a field or laboratory contaminant; it is identified as a common laboratory contaminant in data validation guidance (EPA 1991d).

Both hexachlorobutadiene and BEHP could have originated from the material disposed of at the site or could have been detected for other reasons such as the result of inadvertent field or lab contamination of the particular water sample.

The only VOC detected above its screening level was benzene. It was detected once in well MW21-2 at 2 μg/L, which is near the detection limit, and was not detected in soil samples. Benzene may have originated from the reported disposed material, may have been detected as a false positive (it was not detected in the field duplicate collected), or may be related to field contamination. Sample containers and equipment were stored inside an enclosed area with a gasoline-powered air compressor to operate the sampling pumps.

6.5.4 Air

Volatile organic compounds found in air samples above MTCA Method B screening levels (benzene, chloroform, chloromethane, 1,1-dichloromethane, and styrene) were not found in soil or groundwater samples with the exception of benzene, which was detected once in one groundwater sample. Therefore, it is believed that Site 21 is not the source of contaminants detected in the air. Air emissions from industries near the Port Townsend area and possibly from autos may be the source of the chemicals found in the air. Therefore, no contaminants of concern were identified in air.

7.0 SUMMARY OF SITE RISKS

A baseline risk assessment (RA) was conducted to evaluate both current and potential future risks for Sites 10 and 21. It serves as a baseline to indicate what risks could exist if no action were taken, taking into consideration possible risks if existing land use patterns were to shift in the future to other uses, such as residential. The risk assessment results are used in evaluating whether remedial action is needed. The ecological risk assessment was qualitative and consisted of habitat characterization, hazard identification, exposure assessment, dose-response relationship, and risk characterization.

A baseline risk assessment is required by CERCLA. The human health and ecological risk assessments were prepared in accordance with EPA guidance documents. The Model Toxics Control Act (MTCA) has established cleanup goals for soil, water, and air based on human health risks. However, the CERCLA approach to human health risk assessment is different from the MTCA method used to determine cleanup levels. RAs based on EPA guidance evaluate dermal contact as an exposure pathway whereas MTCA does not. In addition, the MTCA method focuses on exposures to young children, while EPA guidance considers exposure over a 30-year period.

7.1 HUMAN HEALTH RISK ASSESSMENT—SITES 10 AND 21

The human health risk assessment in the remedial investigation evaluated potential risks associated with exposure to chemical contaminants detected at Sites 10 and 21. Risks were calculated for three exposure scenarios: current on-site worker, recreational visitor, and future on-site resident. These three scenarios were chosen to evaluate potential cases for human exposure. A current on-site resident was not used because no one lives at the site; however, the same assumptions that were used for the future on-site resident would apply. Additionally, the same assumptions that were used for the current on-site worker would apply to the future on-site worker. A "current" or "future" designation would not change the baseline risks for the same type of scenario. The primary components of the human health risk assessment are data evaluation, exposure assessment, toxicity assessment, and risk characterization.

Possible future recreational uses at Site 10 include activities such as picnicking and shellfishing. The goal of the proposed action is to reduce the potential risks to humans and the environment to acceptable levels, and to eventually reopen the shellfish beds at Site 10. For this reason, an additional exposure scenario for subsistence fishing was examined at Site 10.

7.1.1 Data Evaluation

The analytical results for each medium were evaluated to identify a list of chemicals, referred to as chemicals of potential concern (COPCs), to be carried through the remainder of the risk assessment. This list of COPCs was established by evaluating the following factors:

- **Data quality.** Data rejected for inadequate quality were eliminated from further consideration.

- **Essential nutrients.** Chemicals considered essential nutrients and generally nontoxic (aluminum, calcium, iron, etc.) were eliminated from further consideration.

- **Background concentrations.** Chemicals with site concentrations that were less than background concentrations were eliminated. The results of the 1993 marine sampling event were not compared to background because of limited background data.

- **Frequency of detection.** Chemicals detected in less than 5 percent of the total samples for a medium were eliminated from further consideration.

- **Laboratory contamination.** Chemicals identified as common laboratory contaminants were eliminated if concentrations were less than 10 times the laboratory blank value. Chemicals not identified as common laboratory contaminants were eliminated if concentrations were less than 5 times the laboratory blank value.

- **Upgradient chemicals.** Chemicals found only upgradient of the site were excluded.

The list of COPCs for depurated and undepurated shellfish tissue at Site 10 is shown in Table 7-1. (Undepurated shellfish represent shellfish that have not purged themselves of sediments in the digestive tract). A list of the COPCs used in the risk assessment for surface and subsurface soils and marine sediment at Site 10 and surface soils, subsurface soils, and groundwater for Site 21 can be found in the remedial investigation.

Table 7-1
Shellfish Contaminants of Potential Concern at Site 10

Depurated Shellfish Tissue	Undepurated Shellfish Tissue
4,4'-DDD	Arsenic
4,4'-DDE	Barium
4,4'-DDT	Cadmium
Alpha-BHC	Chlordane
Beta-BHC	Chromium
Delta-BHC	Copper
Methyl parathion	4,4'-DDT
Pentachlorophenol	Di-n-butyl phthalate
Bis(2-ethylhexyl)phthalate	Lead
Arsenic	Manganese
Chromium	Nickel
Copper	Picramic Acid
Mercury	Picric Acid
Silver	RDX
Zinc	Selenium
	Silver
	Vanadium
	Zinc

7.1.2 Toxicity Assessment

A toxicity assessment was conducted for the COPCs to measure the relationship between the magnitude of exposure and the likelihood or severity of adverse effect (i.e., dose-response assessment) on exposed populations. Toxicity values are used to express the

dose-response relationship, and are developed separately for carcinogenic (cancer) effects and noncarcinogenic (noncancer) health effects. Toxicity values are derived from either epidemiological or animal studies, to which uncertainty factors are applied. These factors account for variability among individuals, as well as for the use of animal data to predict effects on humans. The primary sources for toxicity values are EPA's Integrated Risk Information System (IRIS) database and Health Effects Assessment Summary Table (HEAST). Both IRIS and HEAST were used to identify the toxicity values used in the risk assessment.

Toxicity values for carcinogenic effects are referred to as cancer slope factors (SFs). SFs have been developed by EPA for estimating excess lifetime cancer risks associated with exposure to potential carcinogens (cancer-causing chemicals). SFs are expressed in units of $(mg/kg/day)^{-1}$ and are multiplied by the estimated daily intake rate of a potential carcinogen, to provide an upper bound estimate of the excess lifetime cancer risk associated with exposure at that intake level. The upper bound estimate reflects the conservative estimate of risks calculated from the SF. This approach makes underestimation of the actual cancer risk highly unlikely.

Toxicity values for noncancer effects are termed reference doses (RfDs). RfDs are expressed in units of kg/mg/day and are estimates of acceptable lifetime daily exposure levels for humans, including sensitive individuals. Estimated intakes of chemicals of potential concern (e.g., the amount of a chemical that might be ingested from contaminated drinking water) are compared with the RfD to assess risk.

7.1.3 Exposure Assessment

The objective of the exposure assessment is to estimate the types and magnitude of human exposure to COPCs at Sites 10 and 21. This exposure assessment is based on and is consistent with EPA's risk assessment guidance (EPA 1989, 1991b, 1991c). Exposure media, potentially exposed current and future populations, and exposure pathways were evaluated. A summary of exposure models appears in Table 7-2.

In order to calculate human intake of chemicals, exposure point concentrations must be estimated. Exposure point concentrations are those concentrations of each chemical to which an individual may potentially be exposed for each medium at the site. Exposure point concentrations were developed from analytical data obtained during the investigation.

Table 7-2
Human Exposure Models Selected to Evaluate Potential Risks from Chemicals at Sites 10 and 21

Site	Environmental Media	Current Worker			Current Visitor			Future Residential		
		INH	ING	DC	INH	ING	DC	INH	ING	DC
10	Surface soil (0-1′)		•	•		•	•		•	•
	Soil (0-10′)								•	•
	Marine sediment		•	•		•	•		•	•
	Shellfish					•			•	
21	Surface soil (0-1′)		•	•					•	•
	Soil (0-10′)								•	•
	Groundwater							•	•	•
Background (metals only)	Soil (0-10′)								•	•
	Shellfish								•	

Notes:
DC Dermal contact
ING Ingestion
INH Inhalation

Exposure point concentrations were calculated for both an average exposure and a reasonable maximum exposure (RME). The RME corresponds to the highest exposure that may be reasonably anticipated for a site. The RME concentration is designed to be higher than the concentration that will be experienced by most individuals in an exposed population. The RME concentration was calculated as the lesser of (1) the maximum detected concentration and (2) the 95 percent confidence limit on the arithmetic mean.

The average exposure scenario was evaluated to allow a comparison with RME. The average scenario is intended to be more representative of likely human exposure at the site. Each average exposure point concentration was calculated as an arithmetic average of the chemical results for a particular medium.

Estimates of potential human intake of chemicals for each exposure pathway were calculated by combining exposure point concentrations with pathway-specific exposure

assumptions (for parameters such as ingestion rate, body weight, exposure frequency, and exposure duration) for each medium of concern. Exposure parameters used in the risk assessment calculations were based on a combination of EPA Region 10 default values (EPA 1991d) and site-specific exposure assumptions. The only site-specific exposure assumption used in the Site 10 risk assessment was the consumption rate of shellfish. Native Americans are the most at-risk population due to subsistence use of shellfish. In consultation with Native Americans who have harvest rights to these beaches, a site-specific exposure assumption was developed assuming a person would eat 132 grams of shellfish per day, 350 days per year for 30 years—a very conservative scenario meant to reflect Native American dietary habits.

7.1.4 Risk Characterization

A risk characterization was performed to estimate the likelihood that adverse health effects would occur in exposed populations. The risk characterization combines the information developed in the exposure assessment and toxicity assessment to calculate risks for cancer and noncancer health effects. Because of fundamental differences in the mechanisms through which carcinogens and noncarcinogens act, risks were characterized separately for cancer and noncancer effects.

Noncancer Effects

The potential for adverse noncancer effects of a single contaminant in a single medium is expressed as a hazard quotient (HQ). A hazard quotient is calculated by dividing the average daily chemical intake derived from the contaminant concentration in the particular medium by the RfD for the contaminant. The RfD is a dose below which no adverse health effects are expected to occur.

By adding the HQs for all contaminants within a medium and across all media to which a given population may reasonably be exposed, a hazard index (HI) can be calculated. The HI represents the combined effects of all the potential exposures that may occur for the exposure scenario being evaluated. If the HI is less than 1, it indicates that noncancer health effects are unlikely. If the HI for a common endpoint is greater than 1, it indicates that adverse health effects are possible. Where the HI is less than 1, cleanup at a site generally is not warranted unless there are adverse environmental impacts.

Cancer Risks

The potential health risks associated with carcinogens is estimated by calculating the increased probability of an individual's developing cancer during his or her lifetime as a result of exposure to a carcinogenic compound. Excess lifetime cancer risks are calculated by multiplying the cancer slope factor by the daily chemical intake averaged over a lifetime of 70 years.

A cancer risk estimate is a probability that is expressed as a fraction less than 1. For example, an excess lifetime cancer risk of 0.000001 (or 10^{-6}) indicates that, as a plausible upper bound, an individual has a one-in-one-million chance of developing cancer as a result of site-related exposure to a carcinogen over a 70-year lifetime under the specific exposure conditions at the site. An excess lifetime cancer risk of 0.0001 (or 10^{-4}) represents a chance of one-in-ten-thousand. EPA recommends, in the National Contingency Plan (NCP), an acceptable target risk range for cancer of 0.000001 to 0.0001 (or 10^{-6} to 10^{-4}) for CERCLA sites.

Results

Tables 7-3 and 7-4 summarize the risk characterization results for each exposure scenario evaluated for Site 10 and 21, respectively.

Human Health Risks—Site 10. Except for shellfish ingestion at the RME level the human health risks were all below EPA's acceptable target levels (HI less than 1, excess lifetime cancer risk less than 10^{-4}).

An unacceptable noncancer risk (HI greater than 1) results from ingestion of both depurated and undepurated shellfish at a subsistence level from beaches adjacent to the landfill by visitors or future residents. The chemicals causing most of the risks are cadmium, copper, picramic acid, chromium, RDX, and BEHP. These chemicals were either found in soils from the landfill or are reasonably believed to be contained in the waste disposed in the landfill. An unacceptable noncancer risk also results from ingestion of undepurated shellfish at a subsistence level from the marine background location. This risk is associated primarily with cadmium. Although the HI for both Site 10 and background for undepurated shellfish consumption exceeded 1.0, the HI for Site 10 was greater (3.9 versus 2.3) and was caused by a wider range of chemicals.

Table 7-3
Summary of Human Health Risk Assessment at Site 10

Scenario	Medium	Noncancer		Cancer	
Current On-Site Worker	Surface Soil HI = 0.2 CR = 2×10^{-7}	Ingestion/Dermal Acceptable		Ingestion/Dermal Acceptable	
	Marine Sediment HI = 0.07 CR = 3×10^{-7}	Ingestion/Dermal Acceptable		Ingestion/Dermal Acceptable	
Recreational Visitor	Surface Soil HI = 0.02 CR = 3×10^{-8}	Ingestion/Dermal Acceptable		Ingestion/Dermal Acceptable	
	Marine Sediment HI = 0.0025 CR = 4×10^{-8}	Ingestion/Dermal Acceptable		Ingestion/Dermal Acceptable	
Background	Shellfish, Depurated	Shellfish Ingestion Acceptable		Shellfish Ingestion	
				Arsenic	2.0×10^{-5}
		Total (RME)	0.86	Total (RME)	2×10^{-5}
	Shellfish, Undepurated HI = 2.3 CR = 2.6×10^{-6}	Shellfish Ingestion		Shellfish Ingestion	
		Cadmium	1.59		
		Chromium	0.174	Acceptable	
		Selenium	0.127		
		Total (RME)	2.3		
Recreational Visitor/Future On-Site Resident (Subsistence Shellfishing)	Shellfish, Depurated	Shellfish Ingestion		Shellfish Ingestion	
		BEHP	0.197		
		Arsenic	0.180	BEHP	2.37×10^{-5}
		Chromium	0.347	Pentachlorophenol	7.94×10^{-5}
		Copper	0.905	Arsenic	4.04×10^{-5}
		Mercury	0.136	Total (RME)	2×10^{-4}
		Silver	0.105	Total (AVG)	8×10^{-6}
		Zinc	0.153		
		Total (RME)	2.1		
		Total (AVG)	0.23		
Recreational Visitor/Future On-Site Resident (Subsistence Shellfishing)	Shellfish, Undepurated	Shellfish Ingestion		Shellfish Ingestion	
		Arsenic	0.199	Arsenic	4.5×10^{-5}
		Cadmium	1.87	RDX	2.9×10^{-5}
		Chromium (VI)	0.13	Total (RME)	8×10^{-5}
		Selenium	0.166	Total (AVG)	3×10^{-6}
		Chlordane	0.106		
		Picramic Acid	0.814		
		RDX	0.202		
		Total (RME)	3.9		
		Total (AVG)	0.62		

Table 7-3 (Continued)
Summary of Human Health Risk Assessment at Site 10

Scenario	Medium	Noncancer	Cancer
Future Residential	Soil (0-10') HI = 0.3 CR = 1.0×10^{-6}	Ingestion/Dermal Acceptable	Ingestion/Dermal Acceptable
	Marine Sediment HI = 0.2 CR = $.7 \times 10^{-7}$	Ingestion/Dermal Acceptable	Ingestion/Dermal Acceptable

Notes:
Acceptable CERCLA risk: HI < 1.0 is acceptable; CR 10^{-4} to 10^{-6} is acceptable.
CR Cancer risk
HI Hazard index
RME Reasonable maximum exposure
RDX Royal demolition explosive

Table 7-4
Summary of Human Health Risk Assessment at Site 21

Scenario	Medium	Noncancer	Cancer
Current On-Site Worker	Surface Soil HI = 0.05 CR = 7×10^{-7}	Ingestion/Dermal Acceptable	Ingestion/Dermal Acceptable
Background	Soil (0-10') HI = 0.4 CR = 2×10^{-5}	Ingestion/Dermal Acceptable	Dermal/Acceptable Ingestion Arsenic 1.34×10^{-5} Beryllium 0.337×10^{-5} Total (RME) 1.7×10^{-5}
Future On-Site Resident	Soil (0-10') HI = 0.4 CR = 2×10^{-5}	Ingestion/Dermal Acceptable	Dermal/Acceptable Ingestion Arsenic 1.57×10^{-5} Beryllium 0.35×10^{-5} Total (RME) 1.9×10^{-5} Total (AVG) 1.3×10^{-6}
	Groundwater (filtered) HI = 0.6 CR = 4×10^{-6}	Ingestion/Dermal/Inhalation Acceptable	Ingestion/Dermal/Inhalation Acceptable
	Groundwater (unfiltered) HI = 5.0 CR = 4×10^{-6}	Dermal/Inhalation Acceptable Ingestion Cadmium 0.14 Chromium 2.78 Manganese 0.88 Nickel 0.76 Vanadium 0.47 Total (RME) 5.1 Total (AVG) 1.8	Ingestion/Dermal/Inhalation Acceptable

Notes:
Acceptable CERCLA risk: HI < 1.0 is acceptable; CR 10^{-4} to 10^{-6} is acceptable.
CR Cancer risk
HI Hazard index
RME Reasonable maximum exposure

Ingestion of shellfish from beaches adjacent to the landfill also resulted in a cancer risk that exceeds the acceptable target level of 1×10^{-4}. The chemicals causing most of this risk are pentachlorophenol, BEHP, and arsenic. BEHP and arsenic were found in soil at the landfill, and it is reasonable to believe that wastes containing pentachlorophenol were disposed in the landfill.

Human Health Risks—Site 21. At Site 21, the only risk exposure scenario that exceeded the acceptable HI target level was a result of the consumption of unfiltered groundwater by future residents (Table 7-4). The major risk contributors to unfiltered groundwater at Site 21 were total chromium, total manganese, total nickel, and total vanadium for a total HI RME of 5.1. The risk was calculated under the assumption that chromium was present as hexavalent chromium, although only total chromium was analyzed during the RI. In addition, no background groundwater results were available for total or dissolved metals at Site 10 or Site 21.

The fact that the risks posed to future residents by the filtered groundwater were acceptable under CERCLA (HI = 0.6) indicates that suspended matter in the water column (turbidity) during sampling may have influenced the analytical results. The uncertainty posed by the risks of unfiltered groundwater could be clarified through additional monitoring using low-flow sampling techniques.

Uncertainty. Considerable uncertainty is associated with the cancer and noncancer risks from the ingestion of depurated and undepurated shellfish. No comparisons can be made between these risks for the following reasons: (1) different shellfish species were collected during Phase I and Phase II sampling during the RI (Phase I sampling collected three species of shellfish and Phase II collected one species); (2) different sample locations were sampled during Phase I and Phase II sampling efforts; and (3) different background locations were used in Phase I and Phase II.

Conservative rates of 132 g/day for ingestion of shellfish in this risk assessment were based on a finfish ingestion rate. This rate was used instead of more typical ingestion rates of 1.1, 8.58, or 21.5 g/day, because a subsistence population was considered.

7.2 ECOLOGICAL RISK ASSESSMENT

A qualitative ecological risk assessment was performed for marine (sediment and shellfish tissue) and terrestrial (soil) habitats at Site 10 and for the terrestrial (soil) habitat at Site 21.

Analysis of the potential for toxic effects of inorganics at Site 10 and Site 21 did not indicate potential for phytotoxicity. Exposure concentrations identified for birds and mammals generally did not indicate potential for significant toxicity at these trophic levels. Individual organisms closely associated with the soil may receive doses in low-effect ranges; however, population-level effects were considered unlikely.

Estimated dose levels of DDT to birds were in the ranges of no observed adverse effects levels (NOAELs) to median lethal dose (LD_{50}) levels. Because DDT compounds were not widespread over the sites, population-level effects were determined to be unlikely. Similar determinations were made for small mammals that may be associated with soils at Site 10 and Site 21. Of the other chlorinated compounds (i.e., pesticides and Aroclor) reported for these sites, low soil concentrations coupled with minimal exposure potential also suggest that birds and mammals would not be exposed to toxic concentrations. Bald eagles, which are a threatened species near Site 10, forage mainly in the marine habitat, so exposure to site chemicals is believed unlikely.

Overall, the concentrations of the reported chemicals did not indicate the potential for significant adverse effects to terrestrial populations at Site 10 and Site 21. This finding results largely from the "spotty" manner of distribution (i.e., the non-uniform exposure potential) of the chemicals, and the limited size of the terrestrial habitat associated with the sites.

Detected levels of DDT compounds in some sediment samples exceed levels known to affect benthic organisms. However, the potential for effects of these compounds was thought to be localized because of their limited distribution. The levels identified in shellfish did not suggest significant biomagnification, although data pertaining to physiological effects on marine invertebrates at the identified tissue concentrations were not available.

The exposure data suggested that fish could be accumulating DDT compounds ranging from approximately 0.05 to 1.5 mg/kg wet weight (muscle tissue), indicating that piscivorous birds and mammals (terrestrial and marine) may also be accumulating these

compounds. However, the localized nature of the detected concentrations of DDT compounds relative to the large area over which these higher trophic level organisms forage suggests that exposure potential is limited and unlikely to result in significant bioaccumulation or toxic effects.

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this ROD, may represent an imminent and substantial endangerment to public health, welfare, or the environment. Remedial action is being considered for Site 10 primarily to minimize the migration of contaminants from the landfill to the marine environment to reduce the risk from eating shellfish.

8.0 DESCRIPTION OF ALTERNATIVES

In the feasibility study, technology types are screened to narrow the list of technologies that should be considered for more detailed evaluation. As specified by CERCLA guidance, technology types and process options were screened only on the basis of technical feasibility, with no other factors considered. Several remedial technologies, other than the four alternatives described in detail later in this section, were screened. Some examples for Site 10 included groundwater extraction and treatment and excavation of the landfill.

Groundwater extraction near the shoreline was considered to treat contaminants of concern in groundwater. Chemicals of concern in extracted groundwater/salt water cannot be treated to meet the established surface water cleanup levels in a practicable manner due to interferences from high concentrations of chemicals that are normally found in salt water and the very low concentrations required under the cleanup standards for some chemicals. Therefore, extraction and treatment of groundwater was rejected.

Excavation of the entire landfill contents was not considered practicable because of the large volumes of heterogeneous wastes, the relatively low human health and environmental risks posed by the landfill, and the adverse effects of a large-scale excavation adjacent to the marine environment. Therefore, removal and disposal was rejected as a possible technology.

The following is a discussion of the alternatives presented in the March 1995 proposed plan. The remedial alternatives presented in this ROD were developed from site-specific remedial action objectives (RAOs). RAOs are statements of remedial purpose designed to focus remedial actions to meet acceptable cleanup standards. It is the intent of the Navy, Ecology, and EPA to reduce the potential risk to humans and the environment to acceptable levels and to eventually reopen the shellfish beds by meeting RAOs in the design and implementation of remedial actions.

Under CERCLA, the no-action alternative must be considered at every site to establish a baseline for comparison. In addition to the no-action alternative, three remedial action alternatives were evaluated for Site 10, and two were evaluated for Site 21. These alternatives are based on the RAOs listed for each site.

The primary RAOs for Site 10 include the following:

- Reduce contaminants in shellfish to levels protective of human health. In the meantime, prevent human consumption of shellfish near Site 10.
- Reduce the transport of chemicals to groundwater or to the marine environment.
- Prevent people from coming in contact with soil containing contaminants that are above MTCA standards.
- Protect marine life and other animals that may prey on marine life from site contaminants.

The primary RAO for Site 21 is as follows:

- Prevent people from drinking groundwater that contains contaminants of concern at levels above federal MCLs, state specific ARARs, and MTCA levels.

8.1 SITE 10

The four alternatives evaluated for Site 10 were Alternative 1—no action; Alternative 2—monitoring and periodic reviews; Alternative 3—erosion protection; and Alternative 4—cap and erosion protection.

8.1.1 Alternative 1—No Action

This alternative includes no specific response actions to reduce concentrations or exposure to chemicals or to control their migration. It relies solely on natural attenuation mechanisms for migration control or the ultimate degradation of indicator chemicals. Erosion of the landfill would continue and shellfish harvesting would remain closed indefinitely at the beaches around Boggy Spit.

8.1.2 Alternative 2—Monitoring and Periodic Reviews

This alternative would control exposure to chemicals of concern present in the soils and shellfish by implementing institutional controls through restrictions on residential use, farming, shellfish harvesting, and public access, and include monitoring and periodic reviews.

Institutional Controls

Institutional controls would involve land-use restrictions for residential use, farming, shellfish harvesting on beaches around Boggy Spit, and public access and continuing existing security measures. Deed restrictions cannot be placed on the property until base closure. However, recreational use and farming restrictions and controls will be issued by the commanding officer and included in the base master plan. During periodic reviews, Ecology or EPA would ensure that the order is in place. Upon base closure, notification of the history of the site would be attached to any property transfer and the property transfer would have to meet the requirements of CERCLA Section 120(h) and WAC 173-340-440.

Permanent restrictions would be placed on the property by the Navy to limit or prevent development of the landfill area or to prevent use of the groundwater below the site and to prevent shellfish harvesting, except for monitoring purposes. If the site property is transferred to another owner, restrictive covenants would be written into the site property deed notifying potential owners that the land was used for waste disposal and that land use and water rights are restricted.

Existing security measures would be continued in order to control physical access to Site 10 by the general public and Navy personnel. Existing security measures include warning signs, periodic site inspections by base security, and a prohibition on shellfish harvesting. The prohibition on shellfishing would extend indefinitely, but shellfishing may be allowable in the future if chemical concentrations in shellfish reach cleanupgoals established in this ROD. When cleanupgoals are reached, the Navy will decide when to reopen shellfish beds with concurrence from EPA, Ecology, the Washington Department of Health (DOH), the tribes who have treaty rights to harvest shellfish in this area, and with input from the community.

Monitoring

Monitoring at Site 10 would include groundwater, sediment, and shellfish. Groundwater samples would be collected by using low-flow sampling techniques and would be analyzed for pesticides, semivolatile organic compounds, total and dissolved inorganics, ordnance compounds, picric/picramic acid, and standard groundwater constituents. Groundwater samples would be collected from five (four nearshore and one upgradient) monitoring wells and analyzed quarterly for 2 years. After reviewing the 2 years of data, the EPA, Ecology, and the Navy would decide on future monitoring requirements.

Measuring chemical concentrations in groundwater at the point of discharge to the marine environment is impracticable due to the low level of chemical concentrations and the dynamics of the marine environment. Groundwater monitoring results would be compared to surface water standards not as an attainment goal, but to evaluate trends in chemical concentrations. If trends in the four nearshore wells indicate that chemical concentrations are declining following the remedial action in a manner consistent with long-term attenuation, groundwater monitoring would be discontinued and the marine monitoring program would serve as the indicator of impacts of migration of groundwater to the marine environment.

Sediment and shellfish samples would be collected and analyzed for the following contaminants: inorganics, pesticides, semivolatile organic compounds, ordnance compounds, and picric/picramic acids. Other standard parameters would be analyzed for and specified in the sampling plan. Sediment and shellfish samples would be collected from sampling stations and analyzed and evaluated every other year. Four stations would be established at each of three beaches around Boggy Spit. Exact sampling locations and specific species would be determined during the development of the sampling plan. The scope of the monitoring program may be amended as the data are generated and evaluated. Any decision by the Navy to modify the monitoring program would be made with Ecology, EPA, and tribal concurrence.

Periodic Reviews

Because this alternative would result in unacceptable health risk from the consumption of shellfish and some exceedances of state cleanup levels from contaminants remaining in soil and groundwater, a review of the environmental data would be required no less frequently than every 5 years after initiation of the remedial action to assure that human health and the environment are being protected. The data would be used to evaluate

the effectiveness of the remedial action and determine if any additional remedial actions or monitoring is required in subsequent years.

8.1.3 Alternative 3—Erosion Protection

Alternative 3 would involve shoreline stabilization through the use of erosion protection and bioengineering, implementing institutional controls, monitoring, and conducting periodic reviews.

Erosion Protection

Erosion protection would reduce the potential for landfill debris to erode into the marine environment; this erosion is thought to be a significant source of contamination to adjacent beaches and surface waters. The erosion protection alternative was developed by the Navy with the Washington State Department of Fisheries and Wildlife and the Department of Ecology Shoreline Program. Erosion protection was selected because it is more aesthetically pleasing, provides more recreational opportunities than a typical vertical seawall, provides better fishery habitat, reduces maintenance costs, and provides better long-term effectiveness. Natural resource experts strongly encourage over hard-bank protection.

Erosion protection would be designed to meet the following performance criteria:

- Withstand a 25-year storm event (a very heavy storm that occurs infrequently)
- Minimize human and ecological exposure to landfill contents
- Provide for limited future site uses
- Protect the edge of the landfill
- Provide slope for surface drainage
- Support vegetation
- Provide access for operation and maintenance

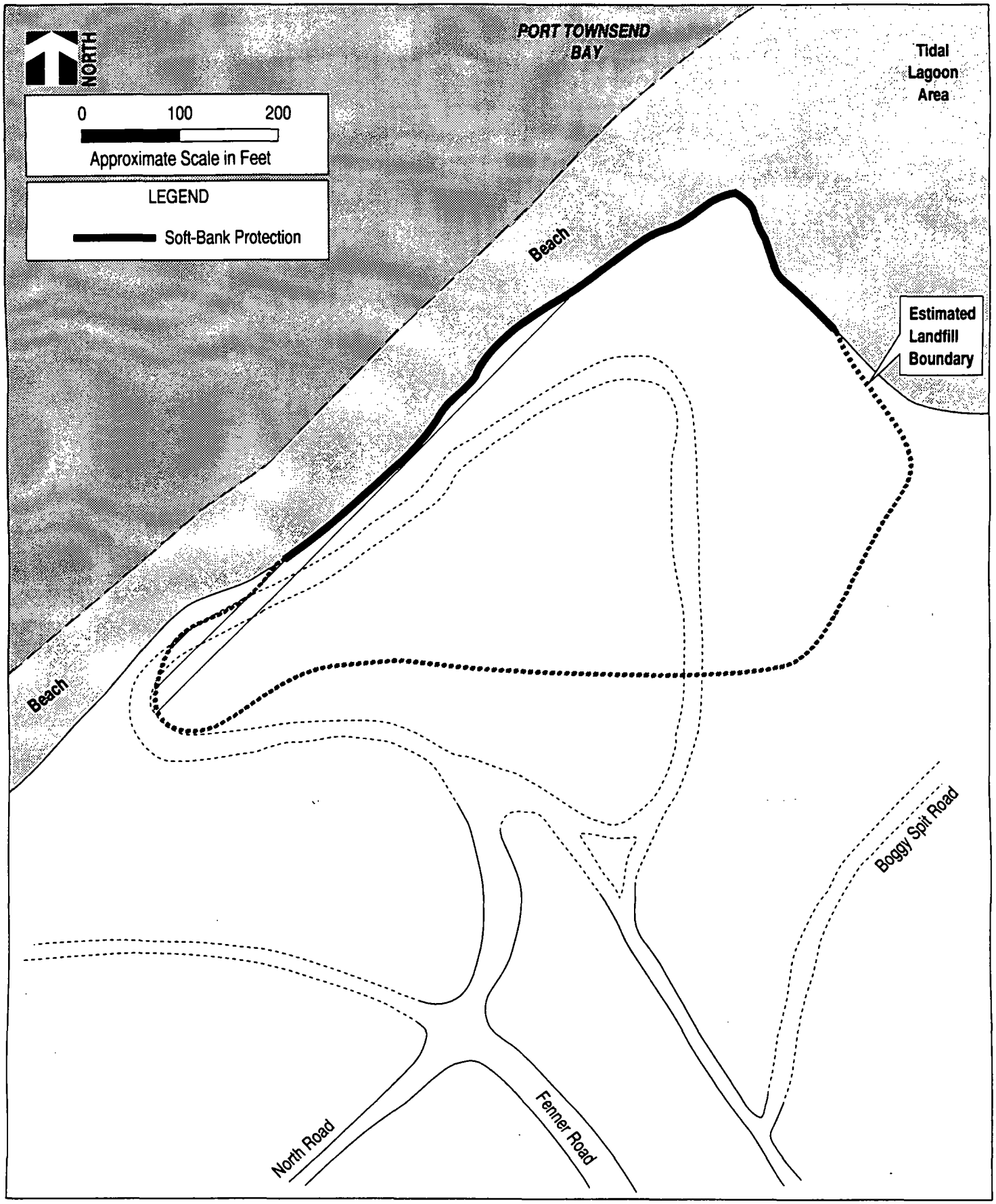
- Limit the amount of beach habitat encroachment
- Limit amount of landfill to be excavated

A supply of soil and rock (approximately 3,000 cubic yards) would be brought in and sloped from the intertidal area inland to ensure continuity with the existing beach habitat. The bank would be anchored with vegetation. The bank protection would extend approximately 900 feet along the perimeter of the landfill (Figure 8-1). This protection may require the removal of a portion of the existing bank and landfill contents, including submarine nets, up to 30 feet inland, in order to slope and revegetate adjacent uplands. Any excavated materials would be properly disposed of at an off-site landfill. This alternative would not affect any contamination of the beach caused by groundwater flow.

The degree of protection this technology would provide for the remaining landfill contents from erosion during storms is dependent upon proper installation and maintenance of the erosion protection. After installation of the erosion protection, the shoreline would be examined every spring and after storms to monitor the status of the erosion protection. The material provided for the erosion protection may require periodic replacement.

Institutional Controls

Under Alternative 3, institutional controls would be similar to those outlined for Alternative 2. In addition to the land-use restrictions for residential use, farming, shellfish harvesting at the beaches around Boggy Spit, and public access, and continuing existing security measures, there would be an additional condition placed on deeds in case of property transfer requiring monitoring and maintenance of the erosion protection. Deed restrictions cannot be placed on the property until base closure. However, orders concerning operation and maintenance requirements for the erosion protection and recreational use and farming restrictions and controls will be issued by the commanding officer and included in the base master plan. During periodic reviews, Ecology would ensure that the order is in place. Upon base closure, notification of the history of the site would be attached to any property transfer and the property transfer would have to meet the requirements of CERCLA Section 120(h) and WAC 173-340-440.



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 8-1** **Site 10** **Limits of Soft-Bank Protection**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

533011405-2-071795

It is anticipated that the shellfishing beaches around Boggy Spit would be opened sooner under this alternative than under Alternatives 1 or 2 because the erosion protection will keep contaminated landfill materials from further erosion onto the beach.

Monitoring

Although the purpose would differ, the monitoring for Alternative 3 would be similar to that described under Alternative 2. The only difference would be the monitoring and maintenance of the erosion protection. The monitoring data would be used to determine the effectiveness of the erosion protection, establish contaminant trends over time, and assess whether restriction on shellfish harvesting can be discontinued.

Periodic Reviews

Periodic reviews for Alternative 3 would be identical to that described under Alternative 2.

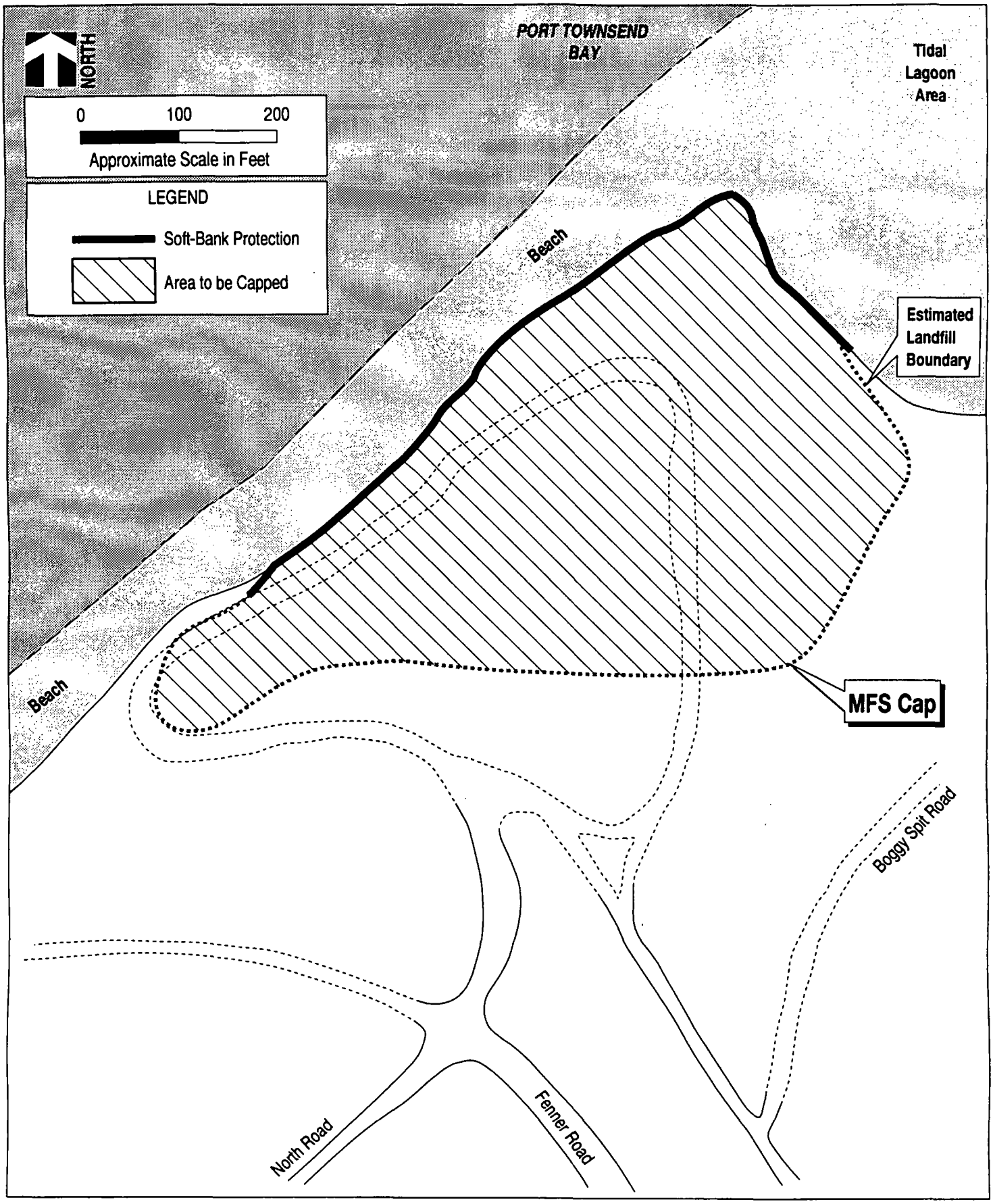
This is the selected remedy. Alternative 4 would involve constructing a landfill cap, stabilizing the shoreline by constructing erosion protection, implementing institutional controls, monitoring, and conducting periodic reviews.

8.1.4 Alternative 4—Cap and Erosion Protection

Landfill Cap

Alternative 4 would consist of a minimum functional standards (MFS) cap placed over the surface of the Site 10 landfill. The limits of the landfill are to be determined during preconstruction. An MFS cap is the standard cap required for the closure of solid waste landfills in the state of Washington under WAC 173-304-460. The MFS cap would be placed over the identified extent of the landfill (approximately 3.7 acres), as shown in Figure 8-2. In addition to MFS, the cap would be designed to meet the following performance criteria:

- Allow for drainage of a 25 year, 24 hour storm
- Minimize exposure to people from soil
- Provide for limited future site uses



CLEAN COMPREHENSIVE LONG-TERM ENVIRONMENTAL ACTION NAVY	**Figure 8-2** **Site 10** **MFS Cap With Soft-Bank Protection**	CTO 0114 NOC PACDIV Port Hadlock Detachment ROD

533011005-1-071795

- Protect against infiltration of water vertically through the landfill
- Allow for a setback of the cap from the shoreline to support the erosion control
- Provide slope for surface drainage
- Support a layer of vegetation
- Contain excavated soil under the cap, if required

The proposed design of the MFS cap is described below:

1. An aggregate leveling base to ensure proper drainage would be placed on top of the existing landfill surface.
2. A geosynthetic clay liner (GCL) would be installed on the top surface of the aggregate leveling base.
3. The second layer from the top would be a geocomposite drainage layer.
4. The top layer would consist of a soil layer that can sustain the growth of vegetation. The top soil layer would be seeded.

The MFS cap would reduce the infiltration and potential for transport of contaminants from soil to groundwater. The MFS cap would also eliminate the potential risk associated with PAHs and PCBs in surface soils by eliminating the exposure of human receptors to site soils.

The landfill would be inspected annually as part of the monitoring program, and repairs would be made to settlements that may rupture the cap. Some erosion may occur until vegetation is established. Repair efforts would be conducted if erosion degraded the performance of the cap.

Erosion Protection

The erosion protection for Alternative 4 would be identical to that described under Alternative 3, except for the disposal of the landfill contents removed during the construction of the bank protection. With the installation of the MFS cap, all or some of the excavated
landfill debris to be disposed of off site could be reconsolidated in the Site 10 landfill and included under the cap if it does not affect the cap integrity.

Institutional Controls

Under Alternative 4, institutional controls would be similar to those outlined for Alternatives 2 and 3. The differences would be that recreational use of the area would be allowed and conditions placed on deeds in case of property transfer requiring monitoring and maintenance of the erosion protection and cap. Deed restrictions cannot be placed on the property until base closure. However, orders concerning operation and maintenance requirements for the erosion protection and cap and farming restrictions and controls will be issued by the commanding officer and included in the base master plan upon completion of construction. During periodic reviews, Ecology would ensure that the order is in place. Upon base closure, notification of the history of the site would be attached to any property transfer and the property transfer would have to meet the requirements of CERCLA Section 120(h) and WAC 173-340-440. It is anticipated that the shellfishing beaches around Boggy Spit will be opened sooner under this alternative than the other alternatives because it offers the most protection for confining contaminated material within the landfill.

Monitoring

Although the purpose would differ, the monitoring for Alternative 4 would be similar to that described under Alternative 2. The only difference would be the monitoring and maintenance of the erosion protection and the MFS cap. The monitoring data would be used to determine the effectiveness of the erosion protection and cap, establish contaminant trends over time, and assess whether restrictions on shellfish harvesting can be discontinued.

Periodic Reviews

Periodic reviews for Alternative 4 would be identical to that described under Alternative 2.

8.2 SITE 21

The three alternatives evaluated for Site 21 were Alternative 1—no action; Alternative 2—institutional controls and periodic reviews; and Alternative 3—groundwater monitoring.

8.2.1 Alternative 1—No Action

This alternative includes no specific response actions to determine whether the chemicals found during the Remedial Investigation are actually present in the groundwater at concentrations above drinking water standards or were merely artifacts of the sampling methods used. As this alternative does not prohibit the use of groundwater, future users of groundwater in the vicinity of Site 21 may be exposed to chemicals above health-based standards.

8.2.2 Alternative 2—Institutional Controls and Periodic Reviews

This alternative would prohibit the use of groundwater in the vicinity of Site 21 by implementing institutional controls and periodic reviews.

Institutional Controls

Institutional controls would involve deed restrictions and security measures. If necessary, permanent restrictions would be placed on the property by the Navy to limit or prevent well installations or use of the groundwater below the site, except for monitoring purposes. If the site property is transferred to another owner, restrictive covenants would be written into the site property deed notifying potential owners that the water rights are restricted.

Deed restrictions cannot be placed on the property until base closure. However, groundwater use restrictions and controls may be issued by the commanding officer and included in the base master plan. During periodic reviews, Ecology would ensure that

the order is in place. Upon base closure, notification of the history of the site would be attached to any property transfer and the property transfer would have to meet the requirements of CERCLA Section 120(h) and WAC 173-340-440.

Periodic Reviews

Because there may be chemicals in the groundwater above health-based standards, a review of the deed restrictions and site conditions would be required no less frequently than every 5 years to assure that human health and the environment are being protected.

8.2.3 Alternative 3—Groundwater Monitoring

This alternative is the selected remedy. This alternative would monitor the groundwater for 2 years to verify the presence of contaminants at the site and evaluate seasonal groundwater flow. Groundwater monitoring would be conducted semiannually on three existing monitoring wells and one new monitoring well. Groundwater samples would be collected by using low-flow sampling techniques and would be analyzed for volatile and semivolatile organic compounds and total and dissolved inorganics. At the conclusion of the 2-year monitoring period, Ecology, EPA, and the Navy would screen the analytical data against MTCA levels, State of Washington MCLs, and federal MCLs found in Table 8-1. If chemical concentrations present in the groundwater samples meet cleanup standards, no further action would take place at Site 21. If concentrations were not acceptable, establishment of site-specific background concentrations for groundwater by installation of additional monitoring wells would be considered. If concentrations were still above cleanup levels in Table 8-1 and background, actions such as deed restrictions, well abandonment, and periodic reviews would be taken.

These actions would be taken to ensure that the groundwater would not be used for drinking water. If it is determined that there is a serious contamination problem at Site 21, the agencies may decide to investigate potential sources of the contamination and/or to treat contaminated groundwater. Such actions would be taken only after appropriate public involvement and reopeningthis Record of Decision.

Table 8-1
Groundwater Cleanup Standards at Site 21

Chemical of Concern		Remedial Goals (µg/L)	Source	Laboratory PQL Range[a] (µg/L)
Benzene		1.51	MTCA B	0.5 - 10
BEHP		6	Fed MCL, State MCL	1 - 10
Hexachlorobutadiene		0.561	MTCA B	2 - 10
Antimony-Total		6	Fed MCL, State MCL	10 - 60
Arsenic	Total	0.05	MTCA B	0.01 - 100
	Dissolved	0.05		
Beryllium-Total		0.0203	MTCA B	0.01 - 5
Lead-Total		5	MTCA A	5 - 50
Manganese	Total	80	MTCA B	Not Listed
	Dissolved	80		
Nickel	Total	100	Fed MCL, State MCL	10 - 150
	Dissolved	100		

[a]From a survey of laboratories reported in "Guidance on Sampling and Data Analysis Methods," Washington State Department of Ecology Toxics Cleanup Program, Publication No. 94-49, January 1995.

Notes:
µg/L micrograms per liter

9.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

EPA has established nine criteria for the evaluation of remedial alternatives:

- Overall protection of human health and the environment
- Compliance with ARARs
- Long-term effectiveness and permanence
- Reduction of toxicity, mobility, or volume through treatment
- Short-term effectiveness
- Implementability
- Cost
- State acceptance
- Community acceptance

The following sections summarize the detailed evaluation of alternatives presented in the proposed plan. Each remedial alternative is discussed relative to the evaluation criteria, to help identify a preferred alternative for Sites 10 and 21.

9.1 SITE 10

The following sections evaluate the four alternatives according to the nine EPA evaluation criteria. The no-action alternative (Alternative 1) was included as a baseline comparison.

9.1.1 Overall Protection of Human Health and the Environment

Under criteria established in federal guidance documents, the primary risk at Site 10 is the consumption of shellfish from the area. A portion of the risk may not be attributed to activities at Port Hadlock Detachment, since some of the chemicals contributing to the risk were found at the background location in Samish Bay. However, the majority of the risk from on-site shellfish can be attributed to contaminants also found in the landfill. Although risks to media other than shellfish at Site 10 are acceptable under federal guidance, state soil MTCA Method B cleanup standards were exceeded for PAHs and PCBs. Groundwater at Site 10 was found to exceed surface water cleanup standards for PAHs, pesticides, SVOCs, and inorganics. Groundwater is not a source of drinking

water, because the water is not potable. However, groundwater provides a contaminant pathway to the marine environment.

Alternative 1 (the no-action alternative) would not prevent exposures of concern and is not protective of the environment. Since portions of the Site 10 landfill would remain exposed to Port Townsend Bay, this alternative would not permit the reopening of shellfishing at the site. Because Alternative 1 would not provide adequate overall protection of the environment and does not meet this threshold criterion, it is eliminated from further consideration and is not included in the following sections that discuss the remaining evaluation criteria.

Alternative 2 (monitoring) would not reduce or eliminate contaminants in the soil, groundwater, or shellfish. Also, this alternative would not provide protection for the remaining landfill contents from erosion during storm events. This alternative would control exposure to contaminants in the soil and groundwater; control consumption of shellfish; and prevent exposure to landfill contents by implementing institutional controls (land-use restrictions for residential use, farming, shellfish harvesting, and public access and continuing existing security measures), monitoring, and periodic reviews.

With the installation of soft-bank erosion protection under Alternative 3, the potential for landfill erosion would be reduced, thereby reducing but not eliminating the migration of contaminants from soil.

Through institutional controls (land-use restrictions for residential use, farming, shellfish harvesting, and public access and continuing existing security measures), monitoring, and periodic reviews, this alternative would control exposures to soil and groundwater contaminants and control consumption of shellfish.

Through the installation of a landfill cap, Alternative 4 (cap and soft-bank erosion protection) would be effective in reducing contaminants in soil from migrating to the marine environment. Although the migration of groundwater contaminants to the marine environment would not be eliminated, this alternative would reduce the infiltration of precipitation and the potential for transport of contaminants from the soil above the water table to groundwater. The potential of landfill erosion would be reduced with the installation of soft-bank erosion protection. By implementing institutional controls, monitoring, and period reviews, this alternative would further control exposures to soil and groundwater contaminants and would control consumption of shellfish.

The cap would eliminate the infiltration of precipitation into the landfill and permit recreational use of the site. It is anticipated that the adjacent shellfishing beaches would be opened sooner under this alternative than under Alternatives 1, 2, or 3 because a significant source of contaminated material will be confined by the MFS cap and soft-bank erosion protection.

9.1.2 Compliance with ARARs

Contaminant concentrations detected in soils exceeded MTCA Method B cleanup levels and groundwater exceeded surface water screening levels. The shellfish contain chemicals believed to be dispersing from the landfill through erosion and groundwater flow. Exposure to the soil would be controlled through institutional controls (residential used restrictions) for Alternatives 2, 3, and 4. For Alternative 4, cleanup levels under MTCA would be attained through the combination of containment with a contingent point of compliance (the landfill cap) and measures to maintain the integrity of the cap.

It is anticipated that compliance with location-and-action-specific ARARs could be achieved for Alternatives 2, 3, and 4. Consultation with a number of regulatory agencies under Alternatives 3 and 4 would be necessary to assure that substantive elements of location-and-action-specific ARARs (fish and wildlife, flood plains, and historic and archaeological sites) are met. These ARARs are evaluated in Section 11.2 of the ROD.

9.1.3 Long-Term Effectiveness and Permanence

Under Alternative 2, the volume, toxicity, or mobility of contaminants remaining at Site 10 would not be reduced except by slow natural processes (dissolution and biodegradation). The mobility of exposed landfill contents during storm events would be reduced under Alternatives 3 and 4 with the installation of soft-bank erosion protection. Alternative 4 would reduce the mobility of contaminants in the soil with the placement of an MFS cap. All three action alternatives would rely on monitoring, periodic reviews, and institutional controls to ensure that unacceptable exposures attributed to the landfill are prevented over the long term and that appropriate additional actions are taken if warranted by the monitoring results.

The landfill cap and soft-bank erosion protection in Alternative 4 would provide the most long-term effectiveness and permanence. This alternative would be most effective in the goal of reopening the shellfish beds at Site 10 and permitting recreation use of the site. Alternative 3 (soft-bank erosion protection) would provide limited opportunity for

opening the shellfish resource and would not permit recreational use of the site due to the potential hazards in walking across the existing cap, which consists of uneven boulders and vegetation. Alternatives 3 and 4 would both require long-term operation and maintenance of the soft-bank erosion protection to maintain its effectiveness as would the MFS cap for Alternative 4.

9.1.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternative 2 would not reduce the toxicity, mobility, or volume of contaminants. Treatment is not a component of any of the alternatives. Although Alternative 4 does not include treatment, the mobility of contaminants would be reduced with the placement of an MFS cap over the landfill. The toxicity and volume of contaminants would remain the same under Alternative 4. In Alternatives 3 and 4, the soft-bank protection would provide slight reduction in the mobility of contaminants to the marine environment. The cost of reducing toxicity, mobility, or volume through treatment of a landfill like Site 10 is disproportionate to the amount of risk reduction achieved.

9.1.5 Short-Term Effectiveness

None of the alternatives would likely pose health risks during implementation. Workers and base personnel would be protected during construction by engineering and safety controls. Alternatives 1 and 2 could be implemented immediately after signing the ROD. Unavoidable short-term ecological impacts would occur under Alternatives 3 and 4 due to construction of the cap and soft-bank erosion protection. The impacts include temporary disruption of habitat and destruction of existing benthic organisms along the shoreline and shallow marine environment. It is expected that the benthic organisms would repopulate and establish a healthier community. Material will be used from commercial sources or from other on-island construction. Plants will be saved from on site, bought from commercial sources, or selectively harvested from the island. Alternative 3 is estimated to take 1 month for construction, and Alternative 4 is estimated to take 2 months actual construction.

Based on experience with other remedial actions at Port Hadlock, possible archaeological sites may be uncovered during excavations under Alternatives 3 and 4. An archaeologist would be present during excavations at the landfill under Alternatives 3 and 4.

9.1.6 Implementability

Alternatives 2, 3, and 4 are equally implementable. All three alternatives can be readily implemented using existing technology and readily available equipment. Materials and services needed to complete each alternative are available.

Alternatives 3 and 4 may require consultation with agencies concerning meeting the substantive requirements of ARARs for placement of the soft-bank erosion protection at the Site 10 landfill. Also, due to construction activities adjacent to and within the marine environment, Alternatives 3 and 4 would require an environmental protection plan.

9.1.7 Cost

The capital costs for Alternative 1 (no action) represent administrative costs as well as the cost of the five-year review of the alternative. The estimated present-worth cost of Alternatives 2, 3, and 4 is as follows: $317,000 for Alternative 2; $1,147,000 for Alternative 3; and $2,637,000 for Alternative 4. These cost estimates were prepared using costing techniques that typically achieve an accuracy of +50 percent to -30 percent for a specified scope of actions. Also, the cost estimates were based on 5 years of operations, at an annual discount rate of 5 percent (Table 9-1).

Table 9-1
Summary of Costs For Remedial Alternatives at Site 10

Alternative/Process Options	Capital Costs ($)	Annual O&M[a] ($)	Total Present Worth ($)
1—No Action	21,600	0	21,600
2—Institutional Controls	42,000	63,440	317,000
3—Soft-Bank Protection	832,000	72,800	1,147,000
4—MFS Type Cap With Soft-Bank Protection	2,285,000	81,200	2,637,000

[a]Assuming operation and maintenance for 5 years at 5% discount factor.

9.1.8 State Acceptance

Ecology concurs with the selection of the final remedial alternative for Site 10. Ecology has been involved with the development and review of the remedial investigation, feasibility study, proposed plan, and record of decision. Ecology participation has resulted in substantive changes to these documents.

9.1.9 Community Acceptance

Verbal comments received at the public meeting were mostly favorable to the proposed plan. Many of the written comments were also favorable, with many questions about the actual remedial action and how it would be accomplished. Even though one comment letter requested a new proposed plan, the Navy, EPA and Ecology feel that the community is generally supportive of the effort. A responsiveness summary of the comments is found in Appendix A of this document.

9.2 SITE 21

The following sections evaluate the three alternatives according to the nine EPA evaluation criteria. The no-action alternative (Alternative 1) was included as a baseline comparison.

9.2.1 Overall Protection of Human Health and the Environment

Chemicals were detected in the groundwater above state cleanup standards. According to federal guidance criteria, the primary risk at Site 21 is due to the consumption of unfiltered groundwater, whereas filtered groundwater provides acceptable risks.

Alternative 1 (the no-action alternative) would not include any specific response actions to determine whether the chemicals found during the RI are actually present or were merely artifacts of the sampling methods used. As Alternative 1 does not prohibit the use of groundwater, future users of groundwater in the vicinity of Site 21 may be exposed to chemicals above health-based standards. Because Alternative 1 would not provide adequate overall protection of the human health and does not meet this threshold criterion, it is eliminated from further consideration and is not included in the following sections that discuss the remaining evaluation criteria.

Alternative 2 would not reduce or eliminate contaminants in the groundwater. This alternative would control exposure to the groundwater contaminants by implementing institutional controls (groundwater use restrictions and security measures) and conducting periodic reviews.

The fact that the risks posed by filtered groundwater were acceptable indicates that suspended matter (turbidity) in the water during sampling may have influenced the analytical results and risks for unfiltered groundwater. The risk uncertainty posed by unfiltered groundwater would be clarified under Alternative 3 through additional monitoring by using low-flow sampling techniques. If additional monitoring indicates a risk posed by the groundwater, Alternative 3 would control exposure to groundwater by implementing institutional controls described under Alternative 2, abandoning wells, and conducting periodic reviews. If chemical concentrations present in the groundwater samples during monitoring were acceptable to the Navy, Ecology, EPA, no further action would take place at Site 21.

9.2.2 Compliance with ARARs

Under Alternative 2, chemical-specific ARARs for groundwater would be met by controlling exposure through groundwater use restrictions. Compliance with chemical-specific ARARs under Alternative 3 would be determined through groundwater monitoring. It is anticipated that compliance with action-specific ARARs could be achieved for both alternatives. No location-specific ARARs have been identified for Site 21.

9.2.3 Long-Term Effectiveness and Permanence

Under Alternative 2, permanent deed restrictions would be placed on the use of the groundwater. Also, periodic reviews would be conducted no less frequently than every 5 years to ensure the protection of human health and the environment.

The duration of the groundwater monitoring program under Alternative 3 would be dependent on the monitoring results. Additional remedial actions may be warranted based on the results of future groundwater monitoring. Additional actions may include deed restrictions, well abandonment, and periodic reviews. If it is determined after monitoring that there is a serious contamination problem at Site 21, the Navy and the agencies may decide to investigate potential sources of the contamination and/or to treat contaminated groundwater. However, the latter would only be done through reopening this ROD.

9.2.4 Reduction of Toxicity, Mobility, or Volume Through Treatment

Alternatives 2 and 3 would not reduce the toxicity, mobility, or volume of contaminants in the groundwater.

9.2.5 Short-Term Effectiveness

None of the alternatives would likely pose health risks during implementation. The remedial action objective would be met in Alternatives 2 and 3 through institutional controls, monitoring, and periodic reviews, although contaminants may remain at Site 21.

9.2.6 Implementability

Alternatives 2 and 3 can be readily implementable. Materials and services needed to complete each alternative are available. No construction or installation activities would be required under these alternatives.

9.2.7 Cost

The capital costs for Alternative 1 (no action) represent administrative costs as well as the cost of the five-year review of the alternative. The estimated present-worth cost of Alternatives 2 and 3 is $42,000 and $43,000, respectively. The cost estimates were prepared using costing techniques that typically achieve an accuracy of +50 percent to -30 percent for a specified scope of action. The cost estimate for Alternative 2 was based on 5 years of operations, at an annual discount rate of 5 percent. The cost estimate for Alternative 3 was based on 1 year of operation (Table 9-2).

Table 9-2
Summary of Costs For Remedial Alternatives at Site 21

Alternative/Process Options	Capital Costs ($)	O&M[a] ($)	Total Present Worth ($)
1—No Action	21,600	0	21,600
2—Institutional Controls	42,000	0	42,000
3—Groundwater Monitoring	43,000	0	43,000

[a]Assuming operation and maintenance for 5 years at 5% interest.

9.2.8 State Acceptance

Ecology concurs with the selection of the final remedial alternative for Site 21. Ecology has been involved with the development and review of the remedial investigation, feasibility study, proposed plan, and record of decision. Ecology's participation has resulted in substantive changes to these documents.

9.2.9 Community Acceptance

The one comment received during the comment period, which ended April 7, 1995, concerning Site 21 supported the selection of the preferred remedy of groundwater monitoring. The responsiveness summary of the comments is found in Appendix A.

10.0 THE SELECTED REMEDY

Based on consideration of CERCLA requirements, the analysis of alternatives using the nine evaluation criteria, and public comments, the Navy, Ecology, and EPA have determined that Alternative 4 (landfill cap and erosion protection) for Site 10 and Alternative 3 (groundwater monitoring) for Site 21 are the most appropriate remedies at Port Hadlock Detachment.

10.1 SITE 10

The combination of imposing institutional controls (land-use restrictions for residential use, farming, shellfish harvesting at three beaches around Boggy Spit, and continuing operation and maintenance requirements for the erosion protection and MFS cap), monitoring, landfill capping, and providing erosion protection along a portion of the landfill boundary and shoreline best achieves the RAOs established for Site 10. An MFS cap will be constructed over the landfill surface. The MFS cap meets regulatory requirements and is protective of human health and the environment. A Resource Conservation and Recovery Act (RCRA) cap is not necessary, because the landfill was closed prior to the Hazardous and Solid Waste Amendment of 1984 (amendment to RCRA), and no RCRA wastes are known to have been disposed of in the landfill. The selected remedy provides the highest potential for the goal of reducing the potential risks to humans and the environment to acceptable levels and opening up the shellfish beds.

The major components of the selected remedy for Site 10 include the following:

- Placing a landfill cap over approximately 3.7 acres
- Placing erosion protection along approximately 900 linear feet of the landfill perimeter and shoreline
- Possibly removing eroded landfill debris that is currently located in the intertidal area; excavating landfill contents from the water edge of the landfill in order to construct the erosion protection; and—based on the waste characterization to be conducted—disposing of debris at the Site 10

landfill, a Subtitle D (sanitary) landfill, and a Subtitle C (hazardous waste) landfill, if necessary, or, if possible, recycling material.

- Implementing institutional controls, which include a temporary prohibition on shellfish harvesting at beaches around Boggy Spit and land use restrictions for residential use and farming. Residential and farming restrictions and controls and requirements for the operation and maintenance of the landfill cap and erosion will be issued by the commanding officer and included in the base master plan upon completion of construction. Upon base closure, deed restrictions on activities destructive to the cap and erosion protection will be attached to any property transfer, and requirements for continued operation and maintenance of the landfill cap and erosion protection will be addressed.

- Conducting a monitoring program that will involve sampling and analyzing groundwater, sediment, and shellfish. The results of the shellfish monitoring will be used to determine when the shellfish are safe to eat.

- The results of the monitoring program will be reviewed in detail at the conclusion of the monitoring period to determine whether additional remedial action or monitoring is necessary.

- Conducting regular maintenance and inspection of the landfill cap and the erosion protection, particularly after storm events.

- Conducting periodic reviews

The data collected from the proposed Site 10 tissue monitoring program will be evaluated for human health risk using a methodology similar to that used in the baseline risk assessment. Exposure assumptions for the risk assessment will be developed in consultation with the Washington State DOH and the tribes. Monitoring will continue until human health risk reaches 10^{-5} for carcinogenic substances and the Hazard Index reaches 1 for non-carcinogenic substances, or background levels, whichever comes first. The Navy, with concurrence from EPA, Ecology, DOH, the tribes who have treaty rights to harvest shellfish in this area, and with input from the community, will decide when the shellfish on adjacent beaches can be harvested and the purpose of those harvests, i.e., subsistence, recreational, commercial, or ceremonial gathering. Ecological risks will be

evaluated by comparing sediment monitoring results with the Washington State SMS. The target for meeting these goals is 10 years.

Groundwater monitoring results will be compared to surface water standards not as an attainment goal, but to evaluate trends in chemical concentrations. If trends in the four nearshore wells indicate that chemical concentrations are declining following the remedial action in a manner consistent with long-term attenuation, groundwater monitoring would be discontinued and the marine monitoring program would serve as the indicator of impacts of migration of groundwater to the marine environment.

10.2 SITE 21

Groundwater monitoring best achieves the RAO established for Site 21. Groundwater monitoring will better define the human health risks posed by the contaminants in groundwater.

The major components of the selected remedy include the following:

- Conducting groundwater monitoring using low-flow extraction techniques or other techniques to reduce turbidity periodically for a 2-year period to determine whether the detections of certain chemicals in groundwater during the RI were anomalous. This alternative will require the construction of one additional monitoring well.

- At the conclusion of the monitoring period, the Navy, Ecology, and EPA would screen the analytical data against MTCA levels, State of Washington MCLs, and federal MCLs. If chemical levels present in the groundwater meet these standards, no further action will take place. If levels are not acceptable, the Navy, Ecology, and EPA will determine whether additional action or monitoring is necessary. Additional actions may include establishment of background deed restrictions, well abandonment, and periodic review.

If it is determined that there is a serious contamination problem at Site 21, the Navy and the agencies may decide to investigate potential sources of the contamination and/or to treat contaminated groundwater. However, such action will only be taken upon reopening of the ROD and public comment.

11.0 STATUTORY DETERMINATIONS

Under CERCLA, selected remedies must protect human health and the environment, comply with ARARs, be cost-effective, and use permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that use as their principal element treatment that significantly and permanently reduces the volume, toxicity, or mobility of hazardous wastes. The following sections discuss how the selected remedies for Sites 10 and 21 meet these statutory requirements.

11.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

11.1.1 Site 10

The selected remedial action for Site 10 will protect human health and the environment through landfill capping, erosion control, operation and maintenance activities, monitoring, and institutional controls. The landfill cap will protect humans and the environment from direct exposure to the contaminants in the landfill and will minimize migration of contaminants to the groundwater by eliminating precipitation flowing through the landfill. Long-term effectiveness of the cap will be provided through operation and maintenance activities. The erosion protection will prevent landfill contents from eroding into the marine environment during storms. Long-term effectiveness of the erosion protection will be provided through operation and maintenance activities. Monitoring will be initiated to detect any releases to the marine environment by sampling of groundwater, sediment, and shellfish. Implementing institutional controls will restrict future residential and farming land use at the landfill, temporarily prevent the public from harvesting nearby shellfish, and minimize the potential for activities at or near the surface of the site that could disturb the integrity of the landfill cap. Deed restrictions cannot be placed on the property until base closure. However, orders concerning operation and maintenance requirements for the erosion protection and recreational use and farming restrictions and controls will be issued by the commanding officer and included in the base master plan upon completion of construction. During periodic reviews, Ecology will ensure that the order is in place. Upon base closure, notification of the history of the site will be attached to any property

transfer and the property transfer will be required to meet the requirements of CERCLA Section 120(h) and WAC 173-340-440.

Implementation of the remedial action at Site 10 will not pose unacceptable short-term risks for site workers, residents, or the environment (including cross media impacts). Some mitigation may be required for marine/shoreline impacts during the implementation of this alternative. Activities at Site 10 will comply with the federal Occupational Safety and Health Act (OSHA) standards and the Washington Industrial Safety and Health Act and Occupational Health standards (WISHA), which are directly applicable to the cleanup action. There are currently no existing or planned residential dwellings in the vicinity of the site.

11.1.2 Site 21

The selected remedial action for Site 21 will protect human health and the environment through institutional controls, if groundwater contaminants are determined to be above drinking water standards. Groundwater monitoring will help to identify the human health risks posed by groundwater contaminants and to establish future remedial actions at the site, if required. If concentrations of any chemical exceed the applicable standards, background concentrations for groundwater will be established, which may require installation of additional monitoring wells. If concentrations are still not acceptable, actions such as deed restrictions, well abandonment, and periodic reviews will be taken. These actions will be taken to ensure that the groundwater is not used for drinking water.

If it is later determined that there is a serious contamination problem at Site 21, the agencies may decide to investigate potential sources of the contamination and/or to treat contaminated groundwater. Such actions will only be taken after appropriate public involvement and reopening this Record of Decision.

Implementation of the remedial action at Site 21 will not pose unacceptable short-term risks for site workers, residents, or the environment. Activities at Site 21 will comply with OSHA and WISHA standards, which are directly applicable to the cleanup action. There are currently no existing or planned residential dwellings in the vicinity of the site.

11.2 COMPLIANCE WITH ARARs

The selected remedy for Sites 10 and 21 will comply with federal and state ARARs that have been identified. No waiver of any ARAR is being sought or invoked for any component of the selected remedies. The chemical, action, and location-specific ARARs identified for the sites are discussed in the following sections.

11.2.1 Site 10 ARARs

- Regulations implementing the Washington Model Toxics Control Act (MTCA) (WAC 173-340), which establish cleanup standards for soil, groundwater, and surface water and require compliance monitoring where hazardous substances have been detected, are applicable.

- State of Washington Sediment Management Standards (WAC 173-204) are applicable because they establish standards for the quality of surface (marine) sediments, address the application of these standards as the basis for the management and reduction of pollution discharge.

- State of Washington Water Quality Standards for Surface Water (WAC 173-201A) and Washington Water Pollution Control (RCW 90.48) are applicable because they establish use classification and water quality standards for marine water for the protection of public health, fish, shellfish, and wildlife.

- Federal Water Quality Criteria (Federal Water Pollution Control Act (CWA), Section 303, and 40 CFR 131) are relevant and appropriate because they establish marine water criteria for the protection of aquatic life. The National Toxics Rule found in 40 CFR 131 addresses the risk to human health from the consumption of aquatic organisms and is considered an applicable requirement.

- RCRA Subtitle D (40 CFR 258) establishes relevant and appropriate federal requirements for the closure and postclosure care of solid waste landfills. This regulation is not applicable since it applies at municipal landfills operated after 1980. The wastes were placed in the Site 10 nonmunicipal landfill before 1980. However the closure and post-closure

requirements of 40 CFR 258.60 (a), (b)(1) and (2), 258.61 (a)(1), (b) are relevant and appropriate.

- RCRA Subtitle C (40 CFR 261, 262, 263, and 268), which specifies waste identification, storage, manifest, transport, treatment, and disposal requirements for solid waste that may contain hazardous substances, is applicable to the uncontained landfill debris that will be collected and transported off site during the remedial action. Relocated landfill debris will be placed within the landfill cover, unless recycled, it interferes with the cap, or is a RCRA/or Dangerous Waste.

- Federal requirements for the containerization and transportation of hazardous materials appear in 49 CFR 171-180. These regulations are applicable because uncontained landfill debris that will be collected may contain hazardous constituents and may require transport to an appropriate disposal facility.

- Washington Dangerous Waste Regulations (WAC 173-303) establish procedures for the designation of waste as dangerous and standards for the handling, transporting, storing, and treating of the designated waste. These regulations are applicable to the uncontained landfill debris that will be collected and transported off site during the remedial action.

- Washington Minimal Functional Standards for Solid Waste Handling (WAC 173-304) establish standards for solid waste handling. These regulations are not applicable because wastes were placed in the landfill before 1985. Because of the installation and maintenance of the landfill cap, these regulations (WAC 173-304-460 Sect 3 [e] and [f]) for the general design criteria of landfills under the Minimum Function Standards for Solid Waste Handling are relevant and appropriate.

- Washington Minimum Standards for construction and maintenance of wells (WAC 173-160) requires that measures be implemented to protect ground water from sources of contamination during well construction. This regulation is applicable at Site 10.

- Washington Transportation of Hazardous Waste Materials (WAC 446-50) concerns the transportation of hazardous materials and hazardous wastes

upon the public highways of Washington state. The regulation is designed to protect persons and property from unreasonable risk or harm or damage from incidents or accidents resulting from hazardous materials and hazardous wastes. The regulation is applicable if hazardous materials that require removal and disposal are discovered during the remedial action at Site 10.

- The Endangered Species Act (16 USC 1531, promulgated by 33 CFR 320-330) is relevant and appropriate to Site 10 in general because bald eagles are known to inhabit Indian Island. However, the actions of the selected remedy at Site 10 will not affect critical habitat of this species.

- The Marine Mammals Protection Act under Sections 101-103 is relevant and appropriate to Site 10 due to the seal rookery located off-shore from the landfill. However the actions of the selected remedy at Site 10 will not affect the seal rookery.

- The Washington Hydraulic Code (RCW 75.20.100-140 and WAC 220-110) specifies that a state permit is required for projects that will use, divert, obstruct, or change the natural flow or bed of state waters and that actions will be taken to protect fish and fish habitat from damage by construction activity. This regulation is relevant and appropriate; however, if it is determined that a fishery resource or habitat would be altered with the placement of the erosion protection into the marine environment, then this regulation would be applicable. With respect to the Washington Hydraulic Code, permits would not be required if the cleanup activities are conducted entirely on site but substantive requirements would be applicable if the marine environment is affected.

- The Shoreline Management Act of 1971 (RCW 90.58 and WAC 173-016) is applicable for the erosion protection to be used along the Site 10 shoreline. The shoreline of Site 10 at extreme low tide qualifies as a shoreline of statewide significance. Local master programs near Indian Island under the Shoreline Management Act are to actively promote aesthetic considerations during general enhancement of the shoreline area; protect the resources and ecology of the shorelines; and increase recreational opportunities for the public on the shorelines. The Shoreline Management Act also states that shoreline fill such as the erosion protection will be

designed and located so that significant damage to existing ecological values or natural resources not occur and that all fill material should be of such quality that it will not cause water quality problems.

- The Coastal Zone Management Act in Section 307(c)(1) requires that the lead agency (the Navy) determine whether the remedial alternative at Site 10 is consistent to the maximum extent practicable with the state coastal zone management program and must notify the state within 90 days of its determination. This regulation is considered applicable as erosion protection will be used along the shoreline at Site 10.

- The Archaeological and Historic Preservation Act of 1974 (16 USC 469) (Moss-Bennett Act) specifies that action must be taken to preserve historic properties or artifacts. The regulation is applicable since Indian artifacts have been discovered along the shoreline of Site 10.

- The Archaeological Resources Protection Act of 1979 (16 USC 470aa-11 and 43 CFR 7) specifies that actions must be taken to protect archaeological resources and to preserve data. This regulation is applicable since artifacts may be discovered during remedial activities at Site 10.

- Dredged and Fill Material Disposal Under Clean Water Act (CWA) Section 404 and Rivers and Harbors Act Section 10. Under the Section 404 CWA guidelines, no discharge of dredged or fill material shall be permitted which will cause or contribute to significant degradation of the waters of the United States if there is a practicable alternative to the discharge. The substantive requirements of Section 10 are required. This is considered applicable due to the erosion protection to be placed along the shoreline at Site 10.

- Washington Clean Air Act and Regulations per Olympic Air Pollution Control Agency (RCW 70.94 and WAC 173-400-040) for fugitive dust. Dust may be produced during soil disturbances in construction.

- Clean Water Act (CWA Section 402, 40 CFR Part 122). This regualtion applies to the storm water handling systems.

- Washington Water Well Construction (RCW 18.104) establishes authority for Ecology to require the licensing of water well contractors and operators and for the regulation of water well construction. This law is considered applicable at Site 21 as the construction of one additional monitoring well is planned.

11.2.2 Site 21 ARARs

- The federal Safe Drinking Water Act (SDWA) primary and secondary maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) (42 CFR 141) establish primary MCLs that are the maximum permissible level of a chemical in water delivered to any user of a public water system. Secondary MCLs are limits based on aesthetic considerations. MCLGs are chemical concentrations at which no known or anticipated adverse human health effects occur. Primary and secondary MCLs and nonzero MCLGs are considered to be relevant and appropriate for groundwater at Site 21 because of the potential for future residential development and associated groundwater usage.

- Washington State Board of Health Drinking Water Regulations (WAC 246-290-310) establish MCLs similar to federal MCLs. This regulation is considered relevant and appropriate for groundwater at Site 21 because of the potential for future residential development and associated groundwater usage.

- Washington Minimum Standards for construction and maintenance of wells (WAC 173-160) require that measures be implemented to protect ground water from sources of contamination during well construction. This regulation is applicable because one additional monitoring well will be constructed at Site 21.

- Regulations implementing the Washington Model Toxics Control Act (MTCA) (WAC 173-340) establish cleanup standards for soil, groundwater, and surface water and requires compliance monitoring where hazardous substances have been detected.

- Washington Water Well Construction (RCW 18.104) establishes authority for Ecology to require the licensing of water well contractors and operators

and for the regulation of water well construction. This law is considered applicable at Site 21 as the construction of one additional monitoring well is planned.

11.2.3 Other Criteria, Advisories, or Guidance

This section discusses other criteria, advisories, or guidance that are considered to be appropriate for the remedial actions of the selected remedy for Site 10 and Site 21.

If any of the uncontained landfill debris collected during remediation of Site 10 is determined to be hazardous waste that must be disposed in an off-site Subtitle C landfill, the NCP off-site disposal rule (40 CFR 300.440) must be followed. This will require that the Navy contact EPA prior to sending any waste off site to ensure that any off-site landfill is in compliance with the off-site disposal rule.

The State of Washington publication "Statistical Guidance for Ecology Program Managers," August 1992 (Ecology 1992) and Supplement 6 to the statistical guidance (Ecology 1993) are to be considered for sampling at Sites 10 and 21.

The State of Washington publication "Best Management Practices for Stormwater Control in Puget Sound Basin" should be considered for stormwater control systems.

11.3 COST-EFFECTIVENESS

The selected remedial actions for Sites 10 and 21 are cost-effective because they are protective of human health and the environment and attain ARARs, and their effectiveness in meeting the RAOs for Sites 10 and 21 is proportional to their cost as shown in cost Tables 9-1 and 9-2.

11.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES OR RESOURCE RECOVERY TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICAL

The selected remedy for Site 10 represents the maximum extent to which permanent solutions can be utilized in a cost-effective manner. It is protective of human health and the environment, complies with ARARs, and provides the best balance of tradeoffs in

terms of long-term effectiveness, permanence, short-term effectiveness, implementability, cost, and reductions in toxicity, mobility, or volume. The selected remedy meets the statutory requirements for using permanent solutions to the maximum extent practicable. Treatment is not part of the remedy for the landfill, and it is not anticipated that any resource recovery technologies (recycling) will be used at Site 10.

By placing a cap over the landfill, the selected remedy at Site 10 will provide a much longer lasting solution than the remaining alternatives. The landfill cap will provide more effective, long-term containment of any contaminants or contaminated material in the landfill than the existing landfill cover.

The selected alternative (groundwater monitoring) for Site 21 is a final remedy. During the remedial investigation, filtered and unfiltered groundwater sampling results presented conflicting degrees of risk. The selected alternative (Alternative 3) will better define the risk posed by groundwater contaminants and verify the presence of contaminants. Additional groundwater sampling will be conducted for 2 years. After a review of the groundwater data, Navy, Ecology, and EPA will select appropriate additional actions, if necessary. Additional actions will represent the maximum extent to which permanent solutions can be used in a cost-effective manner. Additional actions would include installation of additional monitoring wells to establish background concentrations for groundwater. Other possible actions may include deed restrictions and well abandonment if monitoring results indicate that groundwater contains chemicals above the drinking water standard.

If it is later determined that there is a serious contamination problem at Site 21, the agencies may decide to investigate potential sources of the contamination and/or to treat contaminated groundwater. Such actions will only be taken after appropriate public involvement and reopening this Record of Decision.

11.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedial action for Site 10 is being undertaken primarily to minimize the migration of contaminants from the landfill to the marine environment to reduce the risk from eating shellfish. Based on the nature of the site, the limited potential of the site for causing environmental damage in the future, and the technical impracticality of implementing a treatment alternative at a landfill containing low concentrations of contaminants, a treatment alternative was not selected for the remedial action.

Treatment is typically used at sites where wastes contain high concentrations of toxic compounds and are highly mobile such as liquid wastes. The Site 10 landfill contains a very large quantity of low concentrations of toxic compounds which represent a relatively low, long-term threat. The selection alternative will use engineering controls (erosion protection and the MFS cap) to contain landfill contents. Treatment is not practical as concentrations of toxics are low, compounds remaining are not very mobile, excavation and treatment of wastes at Site 10 may cause unacceptable short-term risks, and costs to excavate and treat such a large volume of waste is prohibitive.

The selected remedy of groundwater monitoring for Site 21 will better define the risk posed by the groundwater contaminants; therefore, a treatment alternative is not included. Based on the nature of the site, the potential of the site for environmental damage in the future, and the cost of implementing a treatment alternative, it is unlikely that a treatment action will be used if additional action is required at the conclusion of the 2-year monitoring action.

At the conclusion of the 2-year monitoring period, the Navy, Ecology, and EPA would screen the analytical data against MTCA levels, state of Washington MCLs, and federal MCLs. If chemical concentrations present in the groundwater samples meet these standards, no further action would take place at Site 21. If concentrations were not acceptable, background concentrations for groundwater will be established which may require installation of additional monitoring wells. If concentrations were still not acceptable, actions such as deed restrictions, well abandonment, and periodic reviews would be taken. These actions would be taken to ensure that the groundwater would not be used for drinking water.

If it is later determined that there is a serious contamination problem at Site 21, the agencies may decide to investigate potential sources of the contamination and/or to treat contaminated groundwater. Such actions will only be taken after appropriate public involvement and reopening this Record of Decision.

12.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The proposed plan released for public comment in March 1995 discussed remedial action alternatives for both Sites 10 and 21. The proposed plan identified Alternative 4 (landfill cap, erosion protection, and restrictions of land use and shellfishing [institutional controls]) as the preferred alternative for Site 10. The Navy reviewed all written and verbal comments submitted during the public comment period for Site 10. Upon review of these comments, it was determined that no significant changes to the remedy for Site 10, as it was originally identified in the proposed plan, were necessary to satisfy public concerns.

Although determined to be a non-significant change, the bank erosion control will have more bio-engineering components, i.e. more vegeatation, and less of the soft-bank components, i.e. sand and soils, than was anticipated in the proposed plan. The exact amount will be determined in the design phase, and will meet all listed RAOs. The technology being used for the erosion control is new to seawater systems, and will be a demonstration project. Therefore, the term "soft-bank" was dropped from the title of the erosion protection.

Also determined to be a non-significant change from the proposed plan is a slight change in the performance criteria for the erosion control system. It was originally stated in the proposed plan that the erosion control system would be designed to withstand a 100-year storm event. This has been changed to a 25-year storm event. Because the erosion control system is a demonstration project and the first of its kind, design issues such as this were still being worked through when the proposed plan was published. It is now known that a 25-year criterion is more appropriate and will be protective against a large storm event, which was the original intent. The seawall will be inspected after each winter season and after each major storm event, and repairs will be done to maintain seawall integrity.

At Site 21, the proposed plan identified Alternative 3 (groundwater monitoring) as the preferred alternative. The Navy reviewed all written and verbal comments submitted during the public comment period for Site 21. Upon review of these comments, it was determined that no significant changes to the remedy for Site 21, as it was originally identified in the proposed plan, were necessary to satisfy public concerns.

13.0 RESULTS OF THE SITE HAZARD ASSESSMENTS

Under an agreement between the Navy and Ecology, the Navy investigated seven other sites, in addition to the two already proposed for action, because of their historical use. These sites are listed in Table 13-1. In 1992, site hazard assessments were performed at these sites. The site hazard assessments determined whether there was sufficient contamination to need further investigation or some type of cleanup action at some or all of the sites. On the basis of that assessment, four of the seven sites required no further action because contamination was not found at levels above regulatory criteria. These sites (Site 15, 19, 20, 22) pose no current or potential threats to human health or the environment.

Based on the findings of the site hazard assessments, soil was removed at the other three sites: Sites 11, 12, and 18. (See Table 13-1 for details regarding the soil removals.) Soil confirmation samples were taken at each of the sites to determine that no soil contamination remained after the cleanup actions were taken. Groundwater at Site 11 (for total and dissolved inorganics and ordnance compounds) and Site 12 (for total and dissolved inorganics) will be monitored for 1 year. Storm drain sediments at Site 18 will be monitored when reaccumulation allows. The soil removals at Sites 11, 12, and 18 eliminate the need for additional remedial action, and monitoring will be conducted to assure no more contamination exists at the sites. If monitoring confirms that the sites are clean, no further action will be required. If contamination is detected, the Navy, EPA, and Ecology may consider additional actions. The original plan at Site 11 was to perform a detailed investigation after the soil was removed. Samples taken at the site after the soil was removed showed that no additional contaminants were present in the remaining soil, making the detailed investigation unnecessary. Before the soil was removed at the three sites, the Navy held a public meeting and a comment period for the removal action.

During the comment period on the proposed plan, no comments were received on the proposed no further action sites.

Table 13-1
Disposition of No Further Action Sites

Study Area	Description	Media Sampled/ Potential Contaminants	Results	Decisions/Status
Site 11 - Walan Point	A spit of land once used for disposing of ordnance in the late 1940s.	Soil: VOCs, metals, ordnance compounds Groundwater: VOCs, metals, ordnance compounds	2,4,6-Trinitrotoluene exceeded MTCA Method B soil cleanup levels in one sample location. Cadmium, trichloroethene, and tetrachloroethene exceeded MTCA cleanup levels for groundwater.	Soil and debris removed in August 1994; approximately 4,600 tons of metal slag, ordnance debris, ordnance in the form of bomblets, and soil from ordnance disposal areas were screened, and 1,500 tons were properly disposed off site.
Site 12- Griffin Street	An area near the beach used for ordnance disposal in the 1940s and 1950s.	Soil: Metals, ordnance compounds Groundwater: Metals, ordnance compounds	No exceedances of MTCA criteria by metals or ordnance compounds in soils. Arsenic and cadmium concentrations in groundwater did exceed MTCA cleanup levels.	Soil and debris removed in August 1994, approximately 1,800 tons of metal slag, ordnance debris, ordnance in the form of bomblets, and soil from ordnance disposal areas were screened, and 320 tons were properly disposed off site.
Site 15- North Slab Storage Area	A large concrete slab once used to store paints, solvents, and unknown wastes from the 1940s to the 1970s.	Soil gas: VOCs Soil: VOCs, SVOCs	No exceedances of MTCA criteria by either VOCs or SVOCs in the one soil sample taken.	No contamination found. No further action.

Table 13-1 (Continued)
Disposition of No Further Action Sites

Study Area	Description	Media Sampled/ Potential Contaminants	Results	Decisions/Status
Site 18 - Net Depot	An area on a concrete slab once used for building and repairing submarine nets in the 1940s and 1950s.	Soil gas: VOCs Storm sewer sediment: VOCs, SVOCs Soil: VOCs, SVOCs Groundwater: VOCs, SVOCs	Carcinogenic PAHs in the storm sewer sediment exceeded MTCA Method B for soil. Tetrachloroethene slightly exceeded MTCA Method B in the groundwater sample taken.	Soil removed August 1994; about 0.5 cubic foot of sediment was removed from a storm drain catch basin and properly disposed.
Site 19 - Former Public Works	An area used to facilitate public-works-related activities from the 1940s to the 1970s.	Soil gas: VOCs Soil: VOCs, SVOCs	No exceedances of MTCA criteria by either VOCs or SVOCs in soil.	No contamination found. No further action.
Site 20 - Upper and Lower Boneyards	Uncovered areas used for storing primarily inert materials. In one area, drums with oil and solvents were stored from the 1940s to the 1970s.	Soil gas: VOCs Soil: VOCs, SVOCs	No exceedances of MTCA criteria by either VOCs or SVOCs in soil.	No contamination found. No further action.
Site 22 - Old Bomb Overhaul Area	An area used from the 1940s to the 1970s to recondition bombs.	Soil: VOCs, SVOCs, PCBs, Metals, ordnance compounds	Arsenic in subsurface soils exceeded MTCA Method B carcinogenic standard but was comparable to Puget Sound natural background concentrations. No groundwater was encountered despite drilling to 79 feet.	No contamination found. No further action.

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APPENDIX A

Responsiveness Summary

RESPONSIVENESS SUMMARY
PORT HADLOCK DETACHMENT

This responsiveness summary addresses comments received on the proposed plan for remedial action at Port Hadlock Detachment. Public comments were submitted to the Navy during the public comment period that opened March 6, 1995, and closed April 7, 1995.

During the open house and public meeting held March 21, 1995, at the Jefferson County library in Port Hadlock, Washington, the proposed plan was explained, and public comments were solicited. This responsiveness summary addresses verbal and written comments from the public and government agencies that were submitted in four letters and three comment forms or at the public meeting. Comments were divided into three main categories: general, Site 10, and Site 21. Comments regarding Site 10 were subdivided into nine categories: general, contaminants of concern, erosion protection, landfill cap, monitoring, costs, effectiveness, risk assessment, and different alternatives.

Verbal comments received at the public meeting were mostly favorable to the proposed plan. Many of the written comments were also favorable, with many questions about the actual remedial action and how it would be accomplished. Even though one written comment requested a new proposed plan, the Navy feels that the community is generally supportive of the effort.

An information repository containing all the primary site documents is located at the Jefferson County Library in Port Hadlock.

GENERAL

Comment 1: Why is the military cleaning up Indian Island when the military can leave toxics in the environment?

Response: In 1980 the Department of Defense established a program to study and clean up its sites where substances were released by past disposal practices. If unhealthy amounts of substances are found, action is taken to ensure the safety of the environment and the public. For example, because unhealthy amounts of substances were detected at Sites 11 and 12 (former ammunition disposal areas), and Site 18 (old Net Depot) the

source of contamination was removed in 1994. At Site 10, unhealthy amounts of substances from the landfill have been found, and a landfill cap and erosion protection will be constructed to prevent exposure to humans and the environment.

Comment 2: As a new resident, I am pleased the Navy is taking responsibility for its actions.

Response: Thank you for the comment.

Comment 3: The proposed plan states that petroleum products may have been disposed at some of the sites. Because the investigations were conducted under Federal law, which does not address petroleum-contaminated sites, I wonder whether petroleum products were addressed.

Response: Petroleum products consist of many chemicals that were addressed as part of the investigation. Site samples were tested for petroleum chemicals such as benzene, ethylbenzene, toluene, and xylene. The State's program, the Model Toxics Control Act, does address petroleum products. The Navy cleans up petroleum only contaminated sites under the State program.

Comment 4: How is bilge water handled at Indian Island? Can the Navy also accept similar water from the public as a public service?

Response: Bilge water is collected from Navy ships and transported off the island for treatment. The Navy cannot accept bilge water from the public, as the treatment processes the Navy uses is specific to the Navy's bilge water contaminants.

Comment 5: I am not completely convinced that the groundwaters between Indian and Marrowstone Islands do not commingle.

Response: A study of the Marrowstone aquifer was recently conducted in response to a petition from the Marrowstone Island Community Association to designate Marrowstone Island as a Sole Source Aquifer. As part of proposing the Sole Source designation, EPA issued Support Document for Sole Source Aquifer Designation of Marrowstone Island and Aquifer System. That study determined that the Marrowstone Island aquifer system is confined to Marrowstone Island and is separate from other aquifers. Geological details used in determining the sole source designation can be found in the above

referenced document. A copy of this document will be placed in the information repository.

Comment 6: The proposed plan does not discuss the ultimate use of weapons stored on the island or the effect on people should a breach in the weapon storage area cause a catastrophe.

Response: That is correct. The proposed plan addresses the sites on the island that are or could be contaminated as a result of past practices at those sites. Port Hadlock stores conventional explosive material which are stored in bunkers designed to limit damage caused by an explosion to Indian Island. For more information on the mission of Port Hadlock Detachment, please call Gregg Conner, the Environmental Department Head, at (360) 396-5363.

Comment 7: The proposed plan does not discuss the archeological significance of artifacts or areas on the island.

Response: Archaeological information on Indian Island is included in a report entitled, *Archaeological Resource Assessment of Naval Warfare Engineering Station Properties*, and can be obtained by contacting Sandy Keinholz at (360) 396-0012. All attempts possible to preserve archaeological significant areas have been made. An archeologist has been and will be on site whenever any soils are disturbed in archeological areas. The archeological resources on the island are important and the protection of them could have been noted in the proposed plan. An archeological protection plan is being developed for the work at Site 10, with the States Historic Preservation Officer, and will be available in the repositories before any significant construction begins.

Comment 8: No sediment or surface water was sampled near the shore at Site 11 (Walan Point Ordnance Disposal Area), Site 12 (Griffin Street Ordnance Disposal Area), or Site 18 (Old Net Depot). Bioassays and sediment sampling should be conducted at the sites to determine whether contaminants migrated from the sites, potentially affecting aquatic resources.

Response: During the soil removal at Sites 11 and 12, soil samples were taken outside the areas removed, both to the sides and underneath. These soil sample results confirmed that no contaminants remain at the site. The lack of contaminants in the soil suggests that contamination has not moved farther off site and into the aquatic environment. Also, the Site Hazard Assessment originally performed on these sites

indicated very localized contamination. The removal actions were extended to remove the physical hazards posed by unexploded ordnance. Bioassays and sediment sampling do not seem to be required. Quarterly groundwater sampling is being accomplished to confirm that contaminants are not moving off site at Sites 11 and 12.

The Site Hazard Assessment for Site 18 also found very localized contamination in extremely low levels. The contaminate which we were concerned with, Benzo (a) pyrene, is a product of incomplete combustion of organic material, such as wood or charcoal. The Navy has no records of industrial burning being done at the site. The site was used for submarine net maintenance and preservation with a compound called cosmoline. Therefore, we suspect that the contaminate came from other sources and was contained in the spot removed. No other sampling in the area showed any compounds at levels of concern. The storm drain where soils were removed at Site 18 will be resampled when enough soils accumulate from runoff to confirm that the source was localized. Also, the beach area where the storm drain empties is an area with a tremendous amount of wave action and no significant shellfish beds, so concern is low for possible sediment or shellfish contamination.

SITE 10

General

Comment 9: The Department of Natural Resources (DNR) wants to protect state-owned aquatic lands from contamination. DNR supports efforts to cleanup the Site 10 landfill.

Response: Thank you for your comment.

Comment 10: The National Oceanic and Atmospheric Administration (NOAA) agrees that the information in the proposed plan and supporting documents does not demonstrate a severe degree of environmental risk at the Port Hadlock facility. However, because NOAA trust resources are so rich and diverse at this location, NOAA believes that a very protective approach to environmental protection is required at the site. NOAA supports the proposed action.

Response: Thank you for your comment.

Comment 11: What is the estimated schedule for cleanup activities?

Response: The start of cleanup activities is scheduled to begin in Spring of 1996 and end in Fall of 1996.

Contaminants of Concern

Comment 12: Concentrations of several metals in soil were above average concentrations in the earth's crust. These metals should be considered contaminants of concern.

Response: Above-average metal concentrations in the soil are not necessarily harmful. Many metals such as cadmium, iron, manganese, and zinc are naturally present in the soil in the Puget Sound Region at concentrations that are above the average found in the earth's crust. Metal concentrations in soil result from the parent material from which the soil originated and the weathering process that formed the soil. Parent material of the Puget Sound Region contained metals at above average concentrations in the earth's crust. Metal concentrations in soil were compared to the most stringent regulatory criteria for soil to identify contaminants of concern. When the regulatory level was lower than the natural background level, the natural background concentration was used. As part of a state-wide study by the Department of Ecology, natural background concentrations were established by collecting and analyzing samples that were not affected by human activity. Also, the Remedial Investigation at Sites 10 and 21 established island wide background soil levels using Washington State's statistical guidance to calculate the levels.

Comment 13: The proposed plan stated that no contaminants of concern were found in marine sediment, posing no risk to aquatic organisms. The Washington State Sediment Quality Standards (the value above which toxicity would always be predicted) were used to determine whether contaminants of concern were in the sediments. To be more protective of aquatic resources, sediment comparisons to ER-L screening guidelines show that arsenic, chromium, nickel, DDD, DDE, and DDT and are considered contaminants of concern by NOAA.

Response: Arsenic, cadmium, nickel, DDD, DDE, and DDT will be included on the list of chemical analyses used to monitor groundwater, sediment, and shellfish post construction, and will be evaluated to determine the effectiveness of the remedial effort. The Washington State Sediment Quality Standards are used consistently at clean-up sites

in Washington State. These levels were established to be protective of aquatic resources and were promulgated under Washington State Law.

Erosion Protection

Comment 14: How much soil and landfill debris will be excavated from the shoreline of Site 10 and deposited in the upland area of the landfill? It is our [Sierra Club] understanding that a wind and wave survey is under way to help determine how much needs to be excavated. Are there any drums in the landfill that may rupture during excavation?

Response: As estimated in the feasibility study, approximately 3,600 tons of excavated landfill debris may be placed on the upland area of the landfill before the landfill cap is constructed. A wind and wave survey report was completed in Spring 1995. Because landfills contain a variety of material, drums may be found during excavation. However, if a drum is found, precautions will be taken to keep the drum intact. Equipment will be on hand to contain and clean up a spill should a rupture occur. A copy of the Wind and Wave analyses will be available in the repository before significant construction begins.

Comment 15: DNR prefers removing landfill material to create a gradual beach slope rather than place clean fill in existing intertidal areas. However, care must be taken to ensure that removing landfill material does not spread contaminants. The softbank erosion control action should be carefully monitored to allow for corrective action in the event it fails to meet remedial action objectives.

Response: The Navy is currently working on the erosion protection design and intends to discuss the draft design with the Restoration Advisory Board. Care will be taken to prevent the spread of contamination during construction. An Environmental Protection Plan will be produced and followed, indicating the techniques to be used to prevent the release of substances during construction. A copy of these plans will be available in the repository before construction begins in 1996. An Operation and Maintenance Plan will also be produced and followed with contingency plans for possible wall failure, as well as a monitoring program for the walls integrity. This plan will also be available in the repository when it is complete. Also, a Sampling and Analyses Plan will be produced and followed outlining the Performance Sampling to be done on sediments, shellfish, and groundwater. This plan will also be available in the repository when complete.

Landfill Cap

Comment 16: How far will the landfill cap extend southeast toward the incinerator? Will the groundwater from under the incinerator still flow through the landfill?

Response: The landfill cap will extend to the base of the bluff below the incinerator. The horizontal distance from the incinerator to the base of the bluff is approximately 40 feet. It is true that the groundwater under the incinerator will flow through the landfill. However, there is no buried material under the incinerator that will add contaminants to groundwater. The main purpose of the cap is to cover buried material so that rainwater cannot wash contaminants from the material down to the groundwater.

Comment 17: The landfill cap design should meet Ecology's Minimal Functional Standards and prevent the leaching of contaminants into the marine environment by infiltration.

Response: The cap design will meet Ecology's Minimal Functional Standards.

Comment 18: The remedial action will only reduce rainwater seepage and erosion. If chemicals are below the water table, then a cap will have no effect. Also, a cap will not protect against the horizontal migration of contaminated groundwater.

Response: The Navy and regulatory agencies believe that the main pathways of contaminant movement to the marine environment are the discharge of contaminated groundwater from rainwater seeping through the buried landfill and erosion of the landfill along the shoreline. The amount of contamination that may come from material below the water table from the horizontal movement of groundwater should be very minor. It is assumed this material has been below the water table for at least 20 years.

Monitoring

Comment 19: Will shellfish testing be done along the entire west side of Marrowstone Island? If not, why not? How long will the shellfish near Site 10 be tested? What is the cost of testing one shellfish sample for the chemicals of concern?

Response: Shellfish monitoring is planned primarily near the Site 10 area and not along the entire west side of Marrowstone Island. The areas chosen are closest to the landfill,

so would be most effected by the migration of contaminates from the landfill. Contaminants from the landfill would become too diluted to detect in the marine environment near Marrowstone Island The Navy sampled along Marrowstone Island during the Remedial Investigation at Site 10. For information regarding the results, please see the Remedial Investigation in the information repository. The shellfish will be tested until it is determined that the shellfish are safe to eat. The Navy will work with the Department of Health, regulatory agencies and Tribal representatives to determine when the Shellfish are safe to eat. One shellfish sample costs about $2,000 for chemical analyses, plus cost of the sampling effort.

Comment 20: More testing needs to be done to determine how far and how quickly contaminants of concern migrate from the landfill. Groundwater and shellfish monitoring should occur after remedial action to evaluate the effectiveness of the cap and restoration of shellfish resources. The cap and shoreline protection should also be monitored.

Response: For further information of the testing already accomplished and the migration of contaminates from the landfill, please refer to the Remedial Investigation of Sites 10 and 21 available at the repository. Also, the Navy is performing groundwater monitoring for one year before construction begins to try and establish a better baseline of off site migration. Samples will be taken using state of the art techniques developed by Ecology. Two rounds of sampling have been taken and are being evaluated. A report of these findings can be found in the repository when the sampling is complete.

As part of the post construction monitoring program, shellfish and sediments will be sampled at 12 stations, four at each of three beaches adjacent to Site 10. Also, groundwater discharging off site will be sampled quarterly. Monitoring results will help confirm the effectiveness of the cleanup.

The cap and erosion protection will be inspected each year and after major storm events. Also, general maintenance will be performed on the cap and seawall.

Comment 21: NOAA recommends monitoring for offshore transport of contamination during the construction of the cap and erosion protection.

Response: Care will be taken to prevent the spread of contamination during construction. An Environmental Protection Plan will be produced and followed, indicating the techniques to be used to prevent the release of substances during

construction. A copy of this plan will be available in the repository before construction begins in 1996. Filter fabrics will be used along the shoreline to reduce the chance of offsite transport. The actual construction that may release contaminates will be done in a short period of time. It will be accomplished at low tide. Only small portions of the shore will be disturbed at any one time. No stockpiling will be done on the beach. Also, visual methods will be used to check for possible offsite erosion. The first monitoring event after the construction of the cap will be done soon after construction, and will confirm the effectiveness of measures used to prevent offshore transport during construction. (Others were concerned with similar issues. Please see Responses to Comments 15 and 20.)

Costs

Comment 22: In Table 4 of the proposed plan, Alternative 1 (no action) should be evaluated, and the costs for Alternative 3 (erosion protection) and Alternative 4 (cap and erosion protection) should be "poor" rather than "fair."

Response: Alternative 1 was not evaluated because it did not meet any cleanup objective for the site. In other words, it did not meet the criteria of protecting human health and the environment. Although the terminology is somewhat subjective, the Navy and the regulatory agencies believe the costs are fair when compared to the alternatives, and are fair based on the benefit that will be achieved. Additionally, these costs are comparable to the cost of cleanup actions at other Superfund sites with relatively the same human health risks.

Effectiveness

Comment 23: If contamination in groundwater or shellfish shows no improvement, then other actions (pumping and treating groundwater or underground containment wall) may be necessary. The Record of Decision should include contingencies for further actions, if cleanup objectives are not met.

Response: Construction of a landfill cap and erosion protection will protect the environment. It is unlikely that contaminant concentrations will increase. However, if they do increase, then the Navy and regulatory agencies will evaluate the need for further action. Pumping and treating groundwater and an underground containment wall were eliminated in the feasibility study because of technical problems. Seawater would be very difficult to treat and discharge if pumping and treating were conducted. A

horizontal geologic bed has not been identified at the site that would be sufficient to anchor a containment wall. It is required by law that the effectiveness of the remedial action be evaluated after 5 years. Additional remedial actions will require public comment and reopening of the Record of Decision. Please see a related response to Comment 15.

Risk Assessment

Comment 24: What does a hazard index of 3.9 mean?

Response: A hazard index measures noncancer health effects. It is expressed as a number. A hazard index of 1.0 or greater indicates a potential for an adverse effect and is generally considered an unacceptable risk according to EPA's Risk Assessment Guidance Manual.

Comment 25: The only (marginal) risk above EPA guidelines at Site 10 is ingesting shellfish. Yet the exposure assumption of eating over a quarter pound per day, 350 days per year, for 30 years is not very conservative; it is ridiculous. Consultation with the tribes on eating shellfish does not necessarily make these numbers valid. A conservative, yet realistic, ingestion assumption would probably yield no unacceptable risk, and no action would be appropriate for Site 10. Incremental risks from Site 10 do not justify action.

Response: The shellfish beds near Site 10 are a valuable resource, some of the most prolific beds in Puget Sound, according to the Department of Fish and Wildlife. It is important to give special consideration to this area. The Navy and regulatory agencies agreed to use the stated exposure assumption to account for the segment of the population that most depends on shellfishing in the area: Native American subsistence shellfishers. Although only eating shellfish poses a risk, cleanup actions will help satisfy the four cleanup objectives: (1) promote restoration of the shellfish beds, (2) reduce the potential for chemicals in soil to be carried into groundwater or to the marine environment, (3) prevent people from coming in contact with soil containing contaminants of concern, and (4) protect marine life and other animals that may prey on marine life by complying with water quality standards for marine surface waters. Also, similar numbers have been used as consumption rates of shellfish at other Naval installations in the Puget Sound area.

Comment 26: Some of the chemicals contributing to risk in shellfish were also found at a background location; therefore, Site 10 may not be the source of some of the chemicals in shellfish. The purpose of the risk assessment is to determine incremental risks caused by the site. More background samples should be collected to get a better idea of the true background. The Navy should demonstrate that the risk is a result of contamination from Site 10 before conducting remedial action.

Response: Substances found in the soils of the landfill were also found, albeit at low levels, in sediments and shellfish. For example, DDT was detected in soils, sediments, groundwater and tissue at Site 10, but it was not detected in the background sample. Although not conclusive, this indicates that substances are transporting off site, and that these substances contribute to the risk from eating the shellfish. The Navy and regulatory agencies agreed to collect a background sample (which consisted of about 30 shellfish) from one location. This location is representative of background for shellfish.

The chemicals causing the "most" risk are not the same in the landfill samples as they are in the background samples. An example is the substance copper. Copper is a naturally occurring element and was found in all media sampled. However, the levels found in the offsite shellfish were enough to add to the risk factor of eating the shellfish. The levels found in the reference station shellfish were not enough to add to the risk factor of eating the reference station shellfish. If background risk is subtracted from the site risk, then the remaining incremental risks are still unacceptable. The Hazard Index would be 1.7, and the cancer risk would be 1.8 in 10,000.

Comment 27: The cleanup objective of preventing people from contacting soil containing contaminants of concern does not make sense because no unacceptable risks were found for soil.

Response: The Navy must follow both federal and Washington State requirements. Federal requirements are based primarily on results of a site-specific risk assessment. State requirements are primarily based on specific numbers (called cleanup levels) developed for specific contaminates. There are times when the risk from substances found on site may be in a range that is acceptable under federal guidelines, but the concentration may not meet the state's cleanup level guidelines. That is what happened at this site for soils. If a contaminant is found above the state cleanup levels, then the state considers that there is a risk.

Different Alternatives

Comment 28: Alternative 3 (soft bank erosion protection) may provide enough protection, and it is less expensive. Also, the Navy has not shown that the money used for Alternative 4 (2.44 million) would provide any benefits.

Response: Alternative 3 does not address groundwater contamination. Alternative 4 (the landfill cap and erosion protection) is the chosen cleanup alternative because it provides more environmental protection and more rapidly restores the shellfish beds.

Comment 29: I do not understand why Alternative 1 (no action) is considered. It does not protect human health or the environment.

Response: Federal guidelines require consideration of the no-action alternative as a baseline in evaluating alternatives.

SITE 21

Comment 30: The Twanoh Group, Sierra Club agrees with the proposed plan for *Site 21.*

Response: Thank you for the comment.