DECLARATION OF THE RECORD OF DECISION

SITE NAME AND LOCATION

The Bremerton Naval Complex is located within Kitsap County, bordering the City of Bremerton, Washington, along the north shore of Sinclair Inlet, Puget Sound. Operable Unit B (OU B) Terrestrial is the subject of this Record of Decision (ROD). The Comprehensive Environmental Response, Compensation, and Liability Information System (CERCLIS) identification number for the Bremerton Naval Complex is WA2170023418. The site is identified as the Puget Sound Naval Shipyard Complex on the National Priorities List, but the nomenclature used in Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) documentation is the Bremerton Naval Complex (BNC), and that name is used herein.

STATEMENT OF BASIS AND PURPOSE

This decision document presents the Selected Remedy for Operable Unit B Terrestrial of the BNC, in Kitsap County, Washington, which was chosen in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act (SARA), and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record file for this site.

The remedy was selected by the U.S. Navy (Navy) and the U.S. Environmental Protection Agency (EPA). The Washington State Department of Ecology (Ecology) concurs with the Selected Remedy.

ASSESSMENT OF THE SITE

The response action selected in this ROD is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances into the environment. Such a release or threat of release may present an imminent and substantial endangerment to public health, welfare, or the environment.

DESCRIPTION OF THE SELECTED REMEDY

This ROD addresses OU B Terrestrial, which consists of most of the low-lying area along the Sinclair Inlet waterfront. OU B Terrestrial is one of six operable units at the BNC (five CERCLA units, OU A, OU B Marine, OU B Terrestrial, OU Naval Supply Center [NSC], and OU D, and OU C, a petroleum unit being managed under the state cleanup program). Decision documents for OU A, OU NSC, and OU B Marine have been completed. A steam sparging system has been used to recover subsurface petroleum at OU C. The Navy and Ecology are evaluating potential additional remedial actions for OU C, and a Cleanup Action Plan will be prepared for the site. A separate ROD will be prepared for OU D.

The Selected Remedy for OU B Terrestrial was developed to address all identified risks at the site, including risks to marine sediment quality posed by potential movement of contaminated stormwater, groundwater, and site soil into Sinclair Inlet. The major components of the Selected Remedy for OU B Terrestrial are the following:

- Stormwater facility restoration—includes sediment and debris removal, inspection of the integrity of the stormwater lines and catch basins, and repair or replacement of damaged stormdrain lines and catch basins where required and feasible
- Installing pavement or clean soil cover with vegetation in unpaved areas and repairing existing damaged pavement to limit potential infiltration of water into site soil
- Shoreline stabilization—repair of portions of existing shoreline protection with potential for erosion

- Institutional controls—development and implementation of excavation management and land use control plans and groundwater use restrictions

- Groundwater monitoring—installation and monitoring of compliance wells

STATUTORY DETERMINATIONS

The Selected Remedy is protective of human health and the environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost effective, and utilizes permanent solutions and alternative treatment (or resource recovery) technologies to the maximum extent practicable. The remedy in this OU does not include treatment as a principal element of the remedy for the following reasons:

- The site is effectively capped by pavement and buildings, so there is little potential for contact with contaminants and consequently little risk which could be addressed through treatment;

- The crowded active industrial site presents significant access problems, inflating the cost of treatment; and thus

- The high costs of treatment are disproportionate to the potential benefits to be achieved.

The contaminated soils and stormdrain sediments at OU B Terrestrial are not principal threat wastes as that term is defined by EPA. Principal threat wastes are source materials considered highly toxic or highly mobile that generally cannot be reliably contained or would present a significant risk to human health or the environment, should exposure occur.

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

DATA CERTIFICATION CHECKLIST

The following information is included in the Decision Summary section of this Record of Decision. Additional information can be found in the Administrative Record for this site.

- Chemicals of concern (COCs), addressed in this ROD as chemicals of interest and key chemicals, and their respective concentrations (see Section 6, Tables 6-1 through 6-4)

- Baseline risk represented by the COCs, addressed in this ROD as chemicals of potential concern (see Section 8)

- Cleanup levels for the chemicals of concern: as discussed in Section 9, no cleanup levels have been established for the site

- How source materials constituting principal threats are addressed (see Section 13)

- Current and reasonably anticipated future land and groundwater use assumptions used in the baseline risk assessment and ROD (see Section 8, Table 8-7)

- Potential land and groundwater use that will be available at the site as a result of the selected remedy (see Section 12.4)

- Estimated capital, annual operation and maintenance (O&M), and total present worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (see Section 12, Table 12-1)

- Key factor(s) that led to selecting the remedy (see Section 12.1)

Signature sheet for the foregoing BNC Operable Unit B Terrestrial Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

T.J. Dargan
Captain, U.S. Navy
Commanding Officer, Naval Station Bremerton

20NOV03
Date

Signature sheet for the foregoing BNC Operable Unit B Terrestrial Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

J.C. Orzalli Captain, U.S. Navy Commander, Puget Sound Naval Shipyard & Intermediate Maintenance Facility	11/13/03 Date

Signature sheet for the foregoing BNC Operable Unit B Terrestrial Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

James J. Pendowski
Manager, Toxics Cleanup Program
Washington State Department of Ecology

1/12/04
Date

Signature sheet for the foregoing BNC Operable Unit B Terrestrial Record of Decision between the U.S. Navy, the Washington State Department of Ecology, and the U.S. Environmental Protection Agency.

L. John Iani
Regional Administrator, Region 10
U.S. Environmental Protection Agency

3/8/04
Date

CONTENTS

CONTENTS (Continued)

CONTENTS (Continued)

CONTENTS (Continued)

FIGURES

TABLES

CONTENTS (Continued)

ABBREVIATIONS AND ACRONYMS

AOC	area of contamination
ARAR	applicable or relevant and appropriate requirement
BEHP	bis-2(ethylhexyl)phthalate
bgs	below ground surface
BNC	Bremerton Naval Complex
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERCLIS	Comprehensive Environmental Response, Compensation, and Liability Information System
CFR	Code of Federal Regulations
CIP	Community Involvement Plan
COI	chemical of interest
COPC	chemical of potential concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSF	cancer slope factor
Ecology	Washington State Department of Ecology
EFA NW	Engineering Field Activity, Northwest
EFH	Essential Fish Habitat
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FR	Federal Register
FS	feasibility study
HEAST	Health Effects Assessment Summary Tables
HHRA	human health risk assessment
HI	hazard index
HQ	hazard quotient
IRIS	Integrated Risk Information System
MLLW	mean lower low water
MTCA	Model Toxics Control Act
NAGPRA	Native American Graves Protection and Repatriation Act
Navy	U.S. Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
NPL	National Priorities List
NSB	Naval Station Bremerton

ABBREVIATIONS AND ACRONYMS (Continued)

NSC	Naval Supply Center
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene or perchloroethene
PSNS	Puget Sound Naval Shipyard
RAB	Restoration Advisory Board
RAO	remedial action objective
RBSC	risk-based screening concentration
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
RfD	reference dose
RI	remedial investigation
RME	reasonable maximum exposure
ROD	record of decision
SARA	Superfund Amendments and Reauthorization Act
SHPO	State Historic Preservation Officer
SQS	sediment quality standards
SVOC	semivolatile organic compound
TAPP	Technical Assistance for Public Participation
TCE	trichloroethene
TPH	total petroleum hydrocarbons
TRC	Technical Review Committee
UCL95	95 percent upper confidence limit
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington Department of Fish and Wildlife

DECISION SUMMARY

1.0 INTRODUCTION

The U.S. Navy (Navy), in cooperation with the U.S. Environmental Protection Agency (EPA) and the Washington State Department of Ecology (Ecology), is carrying out remedial actions at the Bremerton Naval Complex (BNC) in Bremerton, Washington (Figure 1-1). This record of decision (ROD) presents the remedial actions selected to address environmental contamination at Operable Unit (OU) B Terrestrial (OU B Terrestrial) at the BNC. The Navy is the lead agency for this decision document, and this ROD reflects EPA and Ecology concurrence with the selected remedial actions. The remedial actions are also considered responsive to public concerns expressed in the community participation process for this facility.

These actions are being performed by the Navy under the Installation Restoration Program in accordance with Executive Order 12580's delegation of responsibility and authority for implementation of the 1980 Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended by the Superfund Amendments and Reauthorization Act (SARA) of 1986. To the extent practicable, these remedial actions comply with the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 CFR 300. The Navy's actions are also guided by Washington State regulations, including the Washington State Model Toxics Control Act (MTCA, Revised Code of Washington [RCW] 70.105D), state cleanup regulations (Washington Administrative Code [WAC] Chapter 173-340), and the specific requirements of MTCA Enforcement Order DE92 TC-112, dated May 15, 1992.

The BNC was assigned Comprehensive Environmental Response, Compensation and Liability Information System (CERCLIS) number WA2170023418 and added to the National Priorities List (NPL) on May 31, 1994. The Navy is the lead agency for this work, and is performing the work under the Installation Restoration Program, established to address environmental contamination from past operations and waste disposal practices. The Navy's Engineering Field Activity, Northwest (EFA NW), is responsible for the programmatic activities related to cleanup from historical contamination at the BNC. On August 31, 1998, the Navy entered into an Interagency Agreement (IAG) with Ecology and EPA to establish a framework for completing the Navy's cleanup responsibilities under MTCA and CERCLA. The Navy is responsible for all aspects of the cleanup of historical contamination at the BNC.

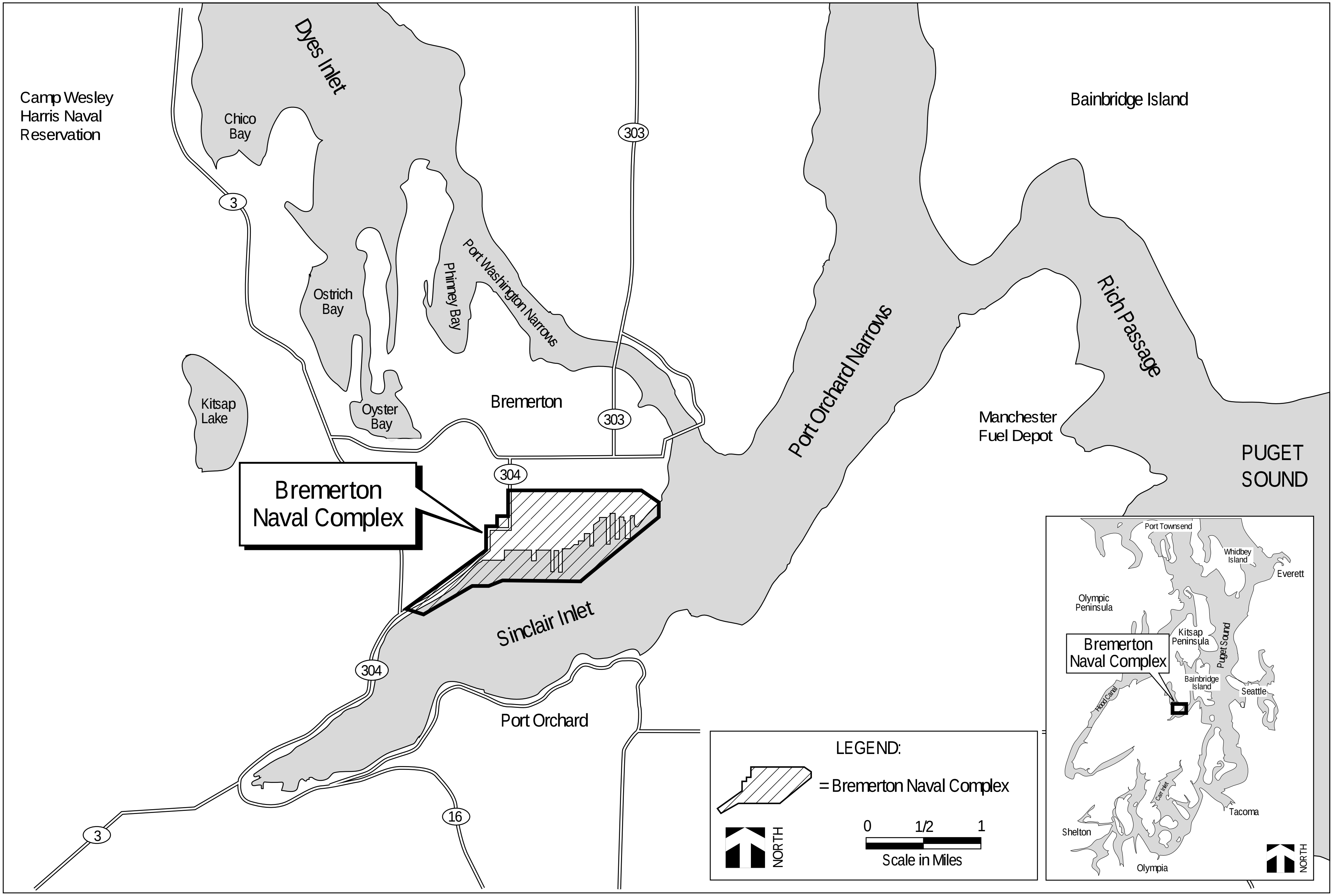
OU B Terrestrial is one of six operable units at the BNC, as shown in Figure 1-2. OU B Terrestrial encompasses a number of sites identified as potentially contaminated during pre-remedial investigations at the BNC: Sites 1, 2, 7, 8, 9, 10 Central, and 10 West (Figure 1-3). OU B Terrestrial also includes most of Site 10 East; the remainder of this site is included in OU D. Site 6 and the shoreline of Site 1 were addressed as part of the remedial action for OU B Marine.

The original division of the BNC into operable units in 1992 defined an OU B that included both terrestrial and marine areas. The OU B remedial investigation involved studies of both the terrestrial and marine components of the unit. Subsequent to this investigation, Navy plans for navigation dredging and pier replacement were announced, opening the possibility of economies of scale and reduced environmental impacts if this new work and the marine cleanup were combined. Consequently, OU B was divided in 1999 into OU B Marine and OU B Terrestrial to allow marine cleanup to be accelerated in order to coordinate with the navigation dredging and pier replacement.

The OU B Marine remedial action was described in a separate ROD. The remedy consisted of dredging of shallow marine sediments, disposal of these sediments in an excavated sea-floor disposal pit, placement of clean sediment and sand to cap the pit and limited nearshore areas, and shoreline stabilization. The remedy addressed Site 6 and the shoreline of Site 1 (Figure 1-3). The primary components of the remedial construction were carried out in 2000–2001.

While the marine and terrestrial components of the original OU B have been addressed in separate decision documents, the two operable units remain closely linked by physical transport pathways. For example, groundwater and surface water flow from OU B Terrestrial to OU B Marine. The potential for contaminants present within OU B Terrestrial to impact the recently remediated OU B Marine environment was a primary consideration in selecting the remedy for OU B Terrestrial.

Additional information regarding the other operable units at the BNC is provided in Section 5.

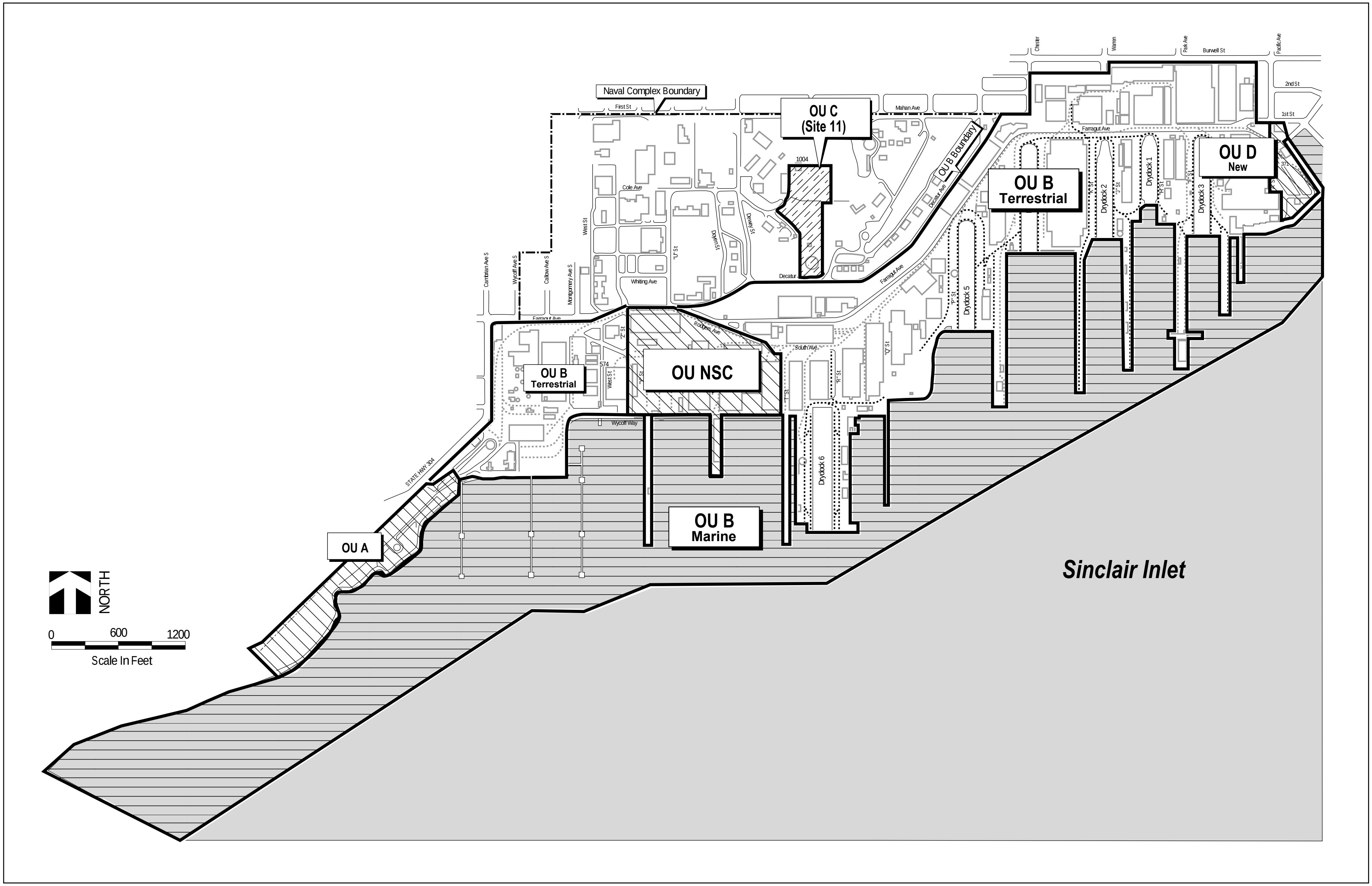


U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL

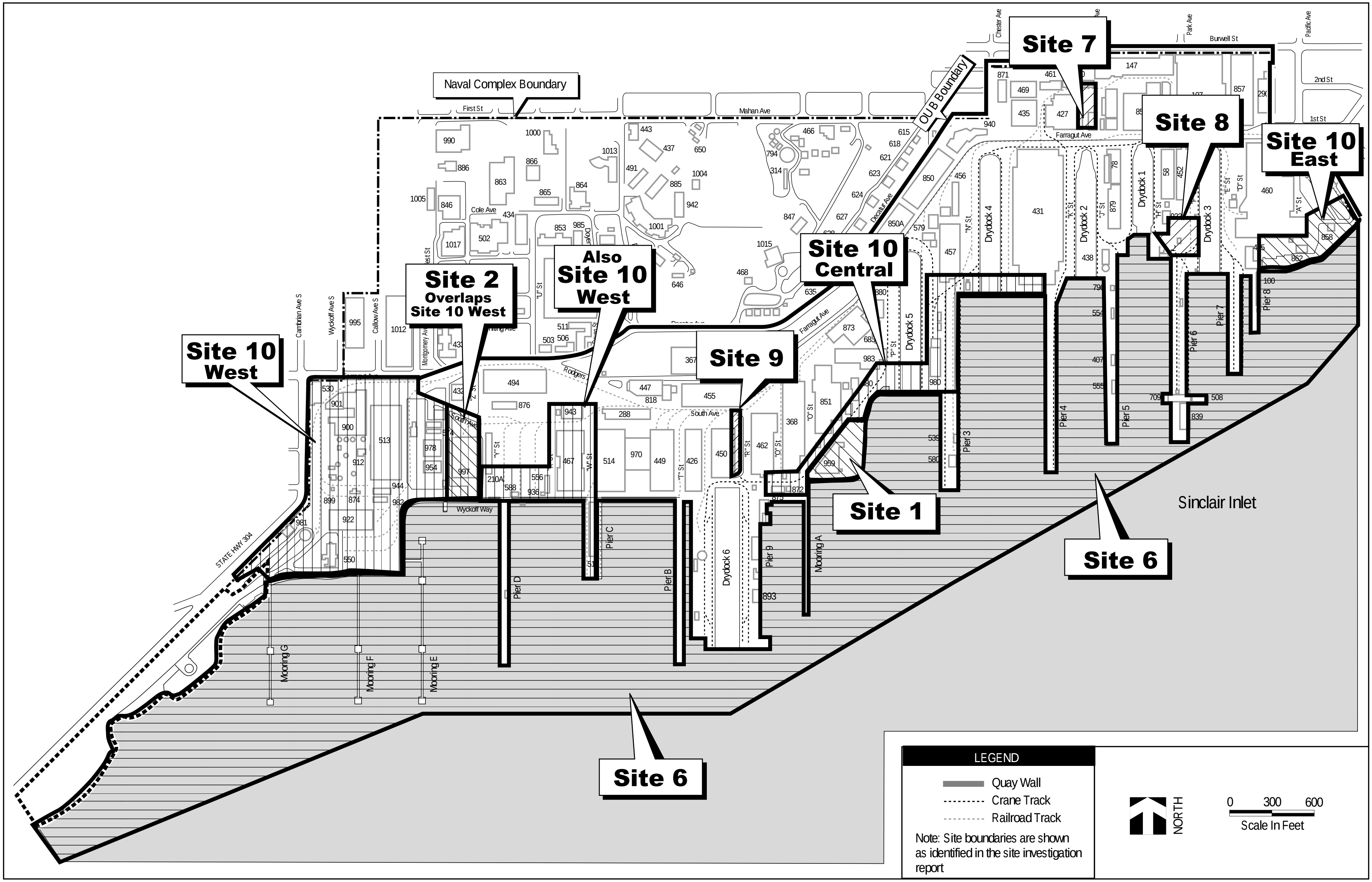
Figure 1-1
Bremerton Naval Complex Vicinity Map

33753009



U.S.NAVY	Delivery Order 0004 Bremerton Naval Complex ROD FOR OU B TERRESTRIAL	**Figure 1-2** **Bremerton Naval Complex Operable Units**

33753009



U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL

Figure 1-3
OU B Site locations

33753009

2.0 SITE NAME, LOCATION, AND DESCRIPTION

2.1 SITE NAME AND LOCATION

The BNC is located in the City of Bremerton, in Kitsap County, Washington (see Figure 1-1). The site is physically located at latitude 47º33'N and longitude 122º38'W. The Navy owns a total of 1,350 acres of property along the shoreline of Sinclair Inlet, an arm of Puget Sound. OU B Terrestrial makes up most of the shoreline area at the BNC, including all of the shoreline near the new OU D. Figure 2-1 is an aerial view of the BNC and the City of Bremerton, looking to the northeast.

2.2 SITE DESCRIPTION

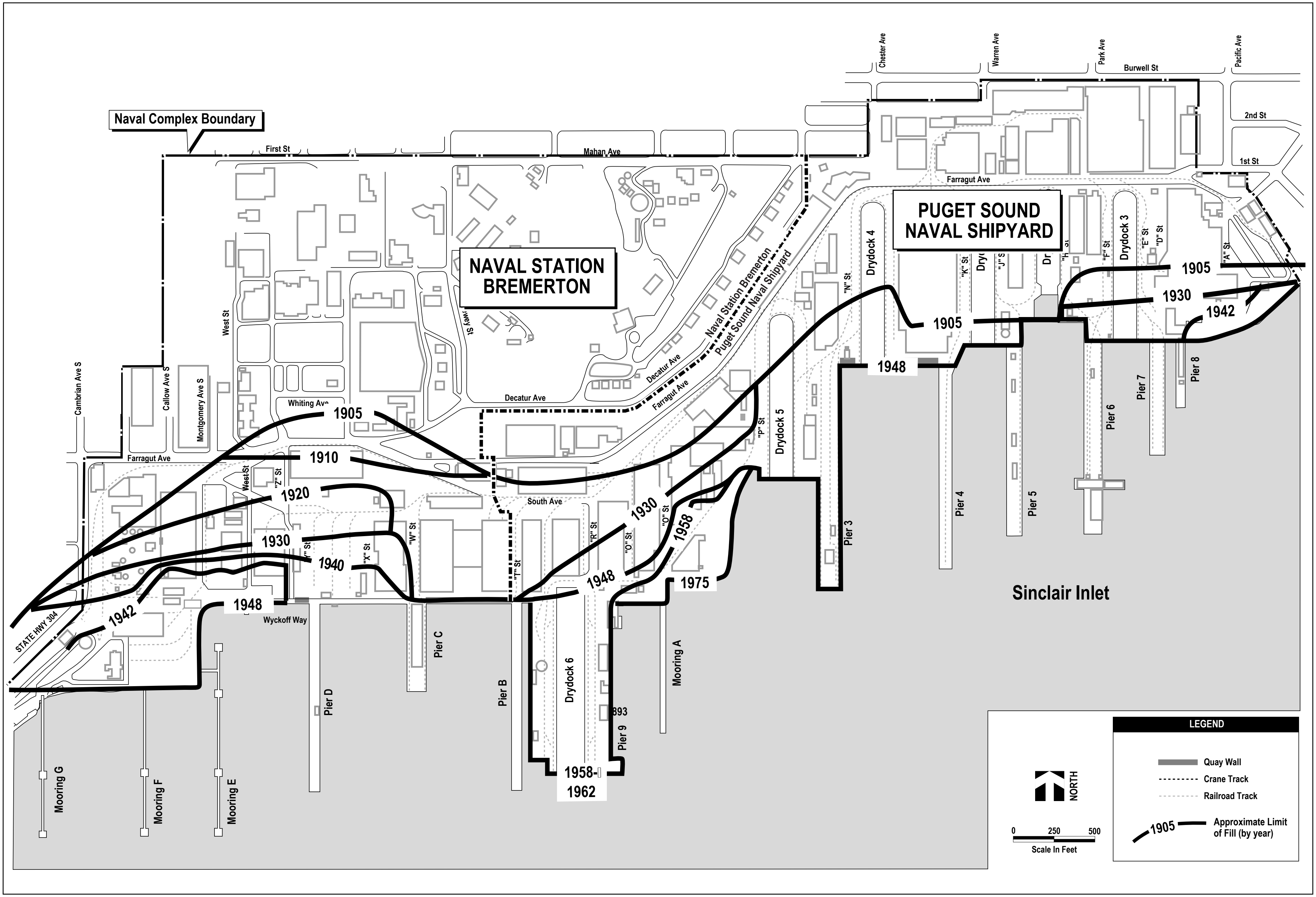
The OU B Terrestrial shoreline was created through a process of filling the tidelands and marshy areas, beginning in 1905 (Figure 2-2). OU B Terrestrial is less than 25 feet above mean sea level. OU B Terrestrial is used primarily for industrial activities at the BNC.

As shown in Figure 2-2, the BNC consists of two major commands: Naval Station Bremerton (NSB) and Puget Sound Naval Shipyard (PSNS). The primary role of NSB is to serve as a deep draft home port for aircraft carriers and supply ships. Currently, one aircraft carrier, four supply ships, and two Maritime Administration crane ships are home ported at NSB. Facilities on NSB property include six piers and moorings, a steam plant, parking, housing, and shopping, recreation, and dining facilities for military personnel and their families. NSB also serves as host to several tenant commands including the Naval Inactive Ships Maintenance Office, which has responsibility to provide for long-term care of inactive naval vessels, and the Fleet and Industrial Supply Center, which provides material acquisition and warehouse services to west coast Navy commands. NSB occupies the western portion of the BNC and is a fenced secure area.

The primary role of PSNS is to provide overhaul, maintenance, conversion, refueling, defueling, and repair services to the naval fleet. PSNS has the capability to drydock and work on all classes of Navy vessels and safely dispose of decommissioned nuclear powered ships. PSNS has six drydocks, eight piers and moorings, and numerous industrial shops to support the industrial operations. Like NSB, PSNS is host to many tenant commands. PSNS occupies the eastern portion of the BNC and access is strictly controlled.

U.S.NAVY	Delivery Order 0004 Bremerton Naval Complex ROD FOR OU B TERRESTRIAL	Figure 2-1 View to Northeast Over Bremerton Naval Complex

33753009



U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL

Figure 2-2
Functional Areas and Shoreline Development Within Bremerton Naval Complex

33753009

3.0 SITE HISTORY AND ENFORCEMENT ACTIONS

3.1 BREMERTON NAVAL COMPLEX

The BNC became the Pacific Northwest's first permanent naval installation in 1891. Table 3-1 shows a chronological listing of key events at the BNC from the time of the purchase of the original 190-acre site through expansion to its current size of approximately 1,350 acres and role as a home port for Navy vessels and the Navy's largest ship repair and overhaul facility on the West Coast. With six major piers, six drydocks, and almost 400 buildings and support facilities, the BNC remains a key naval facility in the forefront of repair, maintenance, and conversion of Navy surface ships and submarines.

Industrial activities at the BNC since it was established have produced waste and environmental contaminants. These waste streams have included metal plating wastes, filings and shavings associated with metal work, petroleum products, transformers containing polychlorinated biphenyls (PCBs), electrical components, batteries, acids, oxidizing materials, paints and paint chips, degreasing and cleaning solvents, and wood and miscellaneous materials from shipbuilding and ship dismantling. Waste disposal practices that were consistent with industry standards and widely accepted at the time—particularly the use of miscellaneous waste material as fill during expansion of the BNC—together with historic spills and leaks of industrial materials have led to elevated levels of various chemicals in BNC soil and groundwater. The types of fill encountered during subsurface sampling and the chemicals detected in the soil and groundwater are consistent with these types of contaminant sources. Portions of additional land acquired by the Navy to accommodate shipyard growth were likely also contaminated prior to Navy purchase. For example, land purchased west of the original shipyard area included waste disposal areas used by residents of the former community of Charleston.

Modern-day industrial operations and facilities at the BNC include metal machining, electrical, boilermaking, electronics, print, photo, and paint shops; pesticide operations; transportation operations; fuel storage facilities (aboveground and underground tanks and pipelines); firefighting operations; and medical facilities. Wastes generated by these operations are subject to current regulations.

The Washington State Department of Ecology issued Enforcement Order 92TC-112 regarding the site in May 1992. EPA placed the BNC on the NPL in May 1994.

3.2 PREVIOUS INVESTIGATIONS AND CLOSURE/REMOVAL ACTIONS

Various studies, investigations, and closure or removal actions have been undertaken at OU B Terrestrial. These studies have been grouped into three categories:

- Comprehensive environmental assessments
- Site investigations and closure/removal actions
- Other terrestrial studies

Table 3-2 provides a brief summary description of the primary historical investigations and closure/removal actions.

To expedite cleanup, under its removal authority and with approval from EPA and Ecology, the Navy initiated the remedial construction components, i.e., stormwater system restoration, paving, and shoreline stabilization as described in this ROD as removal actions prior to finalizing of the ROD.

Table 3-1
Key Events in Bremerton Naval Complex Site History

Date	Historical Activity or Event
1891	Navy purchases 190 acres of land on Sinclair Inlet for construction of a drydock and base for ship repair and overhaul.
September 1891	The base is designated the Puget Sound Naval Station; Lt. Ambrose B. Wyckoff assumes command of the region's first naval installation.
Spring 1896	Drydock 1 and miscellaneous support facilities are completed.
1901	The base is redesignated the Puget Sound Navy Yard (PSNY). Support facilities are under construction, including a second drydock (Drydock 2) designed for shipbuilding.
1914–1918	The construction of Drydock 3 occurs during World War I. PSNY has its first change in mission—new vessel construction begins in addition to overhauls. At this time, PSNY is the only shipyard on the West Coast capable of repairing armored battleships.
1919–1921	Upland filling and earthwork expand the industrial area of PSNY. A total of 25 submarine chasers, 6 submarines, 2 mine sweepers, 7 oceangoing tugs, 2 ammunition ships, and 1,700 small boats have been constructed at the yard.
1926	Pier 6, PSNY's largest pier, is constructed.
1930s	Upland expansion continues at PSNY.
1938–1945	World War II results in a major expansion of PSNY, including additional shore facilities, two new piers, and construction of Drydocks 4 and 5. A total of 394 fighting vessels are built, fitted out, repaired, or overhauled at PSNY during the 44 months of the war.
November 1945	PSNY is renamed the Puget Sound Naval Shipyard (PSNS). Decommissioning of the war fleet becomes a major activity.
1947	Mooring facilities are constructed to berth "mothballed" vessels.
1950–1953	The Korean War places new production demands on PSNS. Modernization of World War II carriers to accommodate modern jet aircraft begins.
mid-1950s	PSNS begins construction of guided-missile frigates.
1961	The BNC becomes part of the Navy's nuclear power program. Drydock 6 is completed in the early 1960s.
1964	PSNS provides logistical support for all Polaris submarines and support craft assigned to the Pacific Ocean. Ship and submarine overhauls become major activities, as well as construction of the first of the USS Sacramento class of fleet combat support ships.
1967	The Naval Supply Center (NSC) is commissioned at the BNC and assigned management responsibility for the Navy's increasing support needs in the Pacific Northwest.
1970s	After several ships are built in the early 1970s, PSNS ends its mission of new vessel construction and engages exclusively in repair, overhaul, and conversion work.
1973	Closure of naval shipyards in Boston, Massachusetts, and San Francisco, California (Hunter's Point) leads to increase in the BNC's role in ship repair and refueling for the Pacific fleet.
1975	Navy begins overhauling aircraft carriers at the BNC at a frequency of about one per year. Fill activities occur in the immediate area of Mooring A; the shoreline fill limits match those of the present-day BNC.
1980	Navy files Notice of Hazardous Waste Activity.

Table 3-1 (Continued)
Key Events in Bremerton Naval Complex Site History

Date	Historical Activity or Event
July 31, 1990	Preliminary Assessment of the Navy's properties is completed.
March 6, 1992	Washington State Department of Ecology Enforcement Order DE92 TC-006 is issued for NSC.
May 15, 1992	Site inspection (SI) report is issued.
May 15, 1992	Washington State Department of Ecology Enforcement Order DE92 TC-112 is issued for PSNS.
August 1992	Reorganization of operable units is proposed.
January 11, 1993	EPA completes evaluation of the BNC according to the Hazard Ranking System, a numeric estimate of relative severity of a hazardous substance release or potential release.
March 1, 1993	NSC is renamed the Fleet and Industrial Supply Center (FISC).
May 10, 1993	The BNC is proposed for inclusion on the National Priorities List (NPL).
May 31, 1994	The BNC is added to the NPL.
December 13, 1996	Record of Decision (ROD) is signed for OU NSC.
January 24, 1997	ROD is signed for OU A.
August 31, 1998	Navy, EPA, and State of Washington sign interagency agreement for the BNC.
October 1998	New Command Naval Station Bremerton is established.
June 13, 2000	ROD is signed for OU B Marine.
August 2002	Operable Unit D is established.

Notes:
EPA - U.S. Environmental Protection Agency
OU - operable unit
PSNS - Puget Sound Naval Shipyard

Table 3-2
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Comprehensive Environmental Assessments		
Initial Assessment Study of Naval Shipyard Puget Sound, Bremerton, Washington. Naval Energy and Environmental Support Activity (NEESA) 13-022. Port Hueneme, California. March 1983.	PSNS	The Navy conducted an IAS to identify, assess, and make recommendations for control of environmental contamination from past hazardous materials storage, transfer, processing, and disposal operations. Sites 1 through 6 were identified. No confirmation studies were recommended. Mitigating action or removal was recommended for two dark-stained soil spots sampled at Site 2 (former PCB storage site at Building 399). No environmental sampling of groundwater or surface water was conducted for the study.
Preliminary Assessment Supplemental Report, Puget Sound Naval Shipyard, Bremerton, Washington. NEESA 13-022A. Port Hueneme, California. June 1990.	PSNS	PA updated IAS report and identified Sites 7 through 11. Report recommended that Sites 1, 6, 7, 8, 9, 10, and 11 be included in the Site Inspection phase of Installation Restoration Program. No further action was planned at Sites 4 and 5, while Site 2 was to undergo a time-critical IAS to verify removal of PCBs near Building 399 in the early 1980s. No environmental sampling of groundwater, surface water, or soil was conducted for the report.
Puget Sound Naval Shipyard, Bremerton, Washington, Resource Conservation and Recovery Act Facility Assessment. Final Report. 3 vols. Prepared for U.S. EPA Office of Waste Programs Enforcement by PRC Environmental Management, Inc. 1992.	PSNS	EPA's RCRA Facility Assessment included a preliminary file review and visual site inspection. RFA designated 75 sites as solid waste management units (SWMUs) based on information previously presented in the IAS report and obtained from PSNS. RFA report also identified 14 SWMUs with high potential for release of hazardous wastes into the environment. Each pier, mooring, and drydock was listed as a separate SWMU. No environmental sampling of groundwater, surface water, or soil was conducted for the report.

Table 3-2 (Continued)
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Comprehensive Environmental Investigations		
Site Inspection Study, Puget Sound Naval Shipyard, Bremerton, Washington. 4 vols. Prepared for U.S. Navy CLEAN Contract N62474-89-D-9295 by URS Consultants, Inc. (URS). Seattle, Washington. May 15, 1992.	OU B Terrestrial Sites 1, 7, 8, 9, 10 East, 10 Central, 10 West, and OU B Marine Site 6. Site 3 (OU A), Site 11 (OU C), and Site 12 (OU NSC) were also studied.	Extensive environmental sampling of soil and groundwater at the SI terrestrial sites was conducted for HRS scoring. No analysis of TPH in soil or groundwater was conducted despite visual evidence at Site 8. Generally, carcinogenic PAHs and inorganics (especially arsenic, copper, and lead) were found at elevated levels in soil from SI sites throughout the BNC. In particular, copper and lead were found at high concentrations in Site 1 soil where spent sandblast grit was used as fill. Other chemicals detected above MTCA Method A criteria for residential soils and groundwater included: PCBs in Site 10 Central soil and groundwater; methylene chloride at Site 1 and 10 West; PAHs in groundwater at Sites 1, 8, 10 East, and 10 West; mercury in Site 10 Central and 10 West soil; and TCE in groundwater in Sites 7 and 9. TCE detection in Site 7 (Building 99 former plating facility) groundwater at concentrations as high as 17,000 µg/L was unexpected but was verified during three additional sampling events. Due to high turbidity from suspended matter in the water column, results for total inorganics were unusually high during SI groundwater sampling.
Site Investigations and Closure/Removal Actions		
Time Critical Removal Action at Initial Assessment Study Site 2, Remedial Action Report. Prepared for U.S. Navy by URS. Seattle, Washington. November 8, 1991.	Site 2	Results of historical cleanup at IAS Site 2 were evaluated in connection with a time-critical removal action. PCB concentrations in soil were below MTCA Method A industrial soil cleanup standards. However, lead was found in soil at a concentration of 16,000 mg/kg. Soil containing lead was removed during construction of Building 997 (hazardous/flammable material warehouse).
Final Report for Rapid Response at Mooring "G." Prepared for U.S. Navy by Ebasco Environmental, Inc. (Ebasco). 1994.	Site 10 West	Documented removal of 23 buried 5- to 8-gallon drums and 73 tons of associated contaminated soil at the foot of Mooring G. Three drums had a paint/solvent odor. Environmental sampling of excavated soil was conducted.

Table 3-2 (Continued)
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Final Closeout Report, Closure of Building 106 Tanks. Prepared for U.S. Navy by Ebasco. August 31, 1995; *Field Activities Summary Report: Building 106 Tanks, Interim Action Investigation.* Prepared for U.S. Navy under CLEAN Contract N62474-89-D-9295 by URS. Seattle, Washington. 1995; *Final Interim Action Report, Building 106 Tanks, Puget Sound Naval Shipyard, Bremerton, Washington.* Prepared for U.S. Navy under CLEAN Contract N62474-89-D-9295 by URS. Seattle, Washington. September 1996.	Site 8	Two 63,000-gallon USTs for former power plant at Building 106 were drained and filled with a grout slurry. Interim action investigation report of the closure was issued in 1996.
Closeout Report, Closure of Structure 614, Puget Sound Naval Shipyard, Bremerton, Washington. Prepared for U.S. Navy by Ebasco. 1995.	Structure 614 located in Site 10 West	Structure 614, a 24,000-gallon tank used as a hazardous waste bulk liquid accumulation tank between 1972 and 1983, was closed during the summer of 1994. Nearly 774 tons of soil and 172 tons of rubble were removed. Environmental sampling of the soil and groundwater was conducted.
Amended Final Report of Findings, Subsurface Soil Investigation Beneath Building 873, Puget Sound Naval Shipyard, Bremerton, Washington. Prepared for U.S. Navy CLEAN Contract N62474-89-D-9295 by URS. Seattle, Washington. 1995.	OU B Terrestrial north of Site 10 Central	Soil beneath plating, painting, and sandblasting shop in Building 873 was investigated. Environmental sampling of the soil for VOCs, cadmium, hexavalent chromium, silver, lead, and cyanide showed exceedances of MTCA Method A industrial soil criteria for lead and MTCA Method B residential soil criteria for cadmium and hexavalent chromium. Hexavalent chromium results may have been understated relative to total chromium based on soil extraction method used. One location may have exceeded the 2001 MTCA Method C industrial soil criterion for hexavalent chromium.

Table 3-2 (Continued)
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Geotechnical Report Abrasive Blast Facility, *P162, Puget Sound Naval Shipyard, Bremerton, Washington.* Prepared for the Navy by Shannon & Wilson. Seattle, WA. 1991; D*raft Geotechnical Report Abrasive Blast Facility*, *P192, Site B, Puget Sound Naval Shipyard, Bremerton, Washington.* Prepared for the Navy by Shannon & Wilson. Seattle, Washington. 1992; *Draft Remedial Characterization/ Feasibility Study Abrasive Blast Facility, Puget Sound Naval Shipyard, Bremerton, Washington.* Prepared for the Navy by Shannon & Wilson. Seattle, Washington. 1993; *Geotechnical Services, Environmental Sampling, and Testing, Mooring Buoy Electrical Duct Bank*, *Puget Sound Naval Shipyard, Bremerton, Washington*. Prepared for the Navy by GeoEngineers. 1992; *Geotechnical and Environmental Study P 283, Bachelors' Enlisted Quarters, Puget Sound Naval Shipyard, Bremerton, Washington.* Prepared for the Navy by Hart Crowser. 1991; *Results of Geotechnical Investigation (Fuel Tank Depot at Building 592) at Puget Sound Naval Shipyard, Bremerton, Washington.* Prepared for the Navy by Stan Palmer Construction. 1989; *Geotechnical Report, Oily Wastewater Collection System (P-240), Puget Sound Naval Shipyard, Bremerton, Washington*. Prepared for the Navy by Bouillon Christofferson & Schairer, Inc. September 1994.	Various locations within OU B Terrestrial	Geotechnical and environmental studies were conducted prior to construction of new facilities at PSNS. All studies included collection of soil boring samples where TPH was detected at least once above MTCA Method A soil cleanup levels. Several of the sites investigated are located in Site 10 West, which in addition to TPH contained soils with arsenic, cadmium, and mercury above MTCA Method A industrial soil cleanup levels. Characterization of TPH contamination during geotechnical and environmental studies was based on more stringent MTCA Method A soil cleanup levels in effect for TPH prior to the August 2001 revision to MTCA.

Table 3-2 (Continued)
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Closure Report, Site 1-C2, Operable Unit B, Puget Sound Naval Shipyard, Bremerton, Washington. Prepared for the Navy by Foster Wheeler Environmental. October 23, 1998; *Remedial Action Report, Paving Sites, Operable Unit B, Puget Sound Naval Shipyard, Bremerton, Washington*. Prepared for the Navy by Foster Wheeler Environmental. June 15, 2000.	Various locations within OU B Terrestrial	Paving installed at previously unpaved locations throughout OU B Terrestrial.
Final Closure Report, Treatability Study, OU B, PSNS, Bremerton, Washington. November 5, 2002.	Central OU B Terrestrial	Cleaning and inspection of a subset of stormwater system to refine basis for stormwater system restoration planning.
Other Terrestrial Studies		
Site Characterization Reports: Multiple UST Closures and Site Assessments at Former UST Sites, Puget Sound Naval Shipyard, Bremerton, Washington. Prepared for the Navy under Contract N44255-93-D-4050 by GTI Government Services, Inc. (GTI). February 1995; *UST Closure and Site Assessment Reports: Multiple UST Closures and Site Assessments at Former UST Sites, Puget Sound Naval Shipyard, Bremerton, Washington.* 2 vols. Prepared for the Navy under Contract N44255-93-D-4050 by GTI. February 1995.	Various locations within OU B Terrestrial and PSNS	Environmental site assessments for USTs removed or closed in place during 1992 through 1994. Environmental sampling of soil and groundwater was conducted. In some cases TPH contamination was found in soils left on site after tank removal. Conclusions regarding TPH contamination during the UST removals were based on more stringent MTCA Method A soil cleanup levels in effect for TPH prior to the August 2001 revision to MTCA.

Table 3-2 (Continued)
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Revised Final Storm Water Base Map Report, Puget Sound Naval Shipyard. Prepared for the Navy by EMCON Northwest, Inc. (EMCON). December 1992; *Final Submittal; Outfall, Drydock and Parking Lot Study, Puget Sound Naval Shipyard*. Prepared for Navy by EMCON. October 1993; *Revised Final Submittal; Storm Water Base Map Update, Puget Sound Naval Shipyard*. Prepared for the Navy by EMCON. October 1993; *Evaluation of Storm Sewer for NPDES Violations, Puget Sound Naval Shipyard Bremerton, Washington, Final Submittal*. Prepared for the Navy by Sitts & Hill Engineers, Inc. (Sitts & Hill). December 1993; *Final Submittal, Stormwater Base Map Update, Phase III*. Prepared for the Navy by Sitts & Hill. March 1994.	PSNS	Multiple-phase investigation of stormwater facilities at PSNS was conducted on behalf of the Navy to update stormwater base map and identify noncomplying inflows to the stormwater system. No environmental sampling was conducted. Noncomplying flows were subsequently addressed under the shipyard NPDES program.
Data on Quantity and Quality of Water Flowing in Drainage Systems of Dry Docks at Puget Sound Naval Shipyard, Bremerton, Washington, 1994. Open-File Report 95-361. Prepared for the Navy by E. Prych of U.S. Geological Survey.	Drydocks 1-6	USGS studied drydocks at PSNS to obtain information for use in investigations of the movement of chemicals in groundwater. Data on waste discharge rates were collected at various locations in the drainage systems of the drydocks. Environmental samples were collected from the drydocks and analyzed for copper, lead, VOCs and SVOCs. Environmental sampling results were similar to those obtained during OU B Phase I sampling.

Table 3-2 (Continued)
Summary of Historical Terrestrial Investigations and Closure/Removal Actions

Report	Location	Summary
Independent Remedial Action Report, Site 2, Puget Sound Naval Shipyard. Prepared for the Navy by Strand Hunt/AGRA. Kirkland, Washington. October 1996.	Site 2	Construction of Building 997 at Site 2 led to approximately 10,700 tons of excavated soil and 2,000 tons of construction debris being disposed of offsite in hazardous and nonhazardous landfills (Strand Hunt/AGRA 1996). In-place soil samples from excavation bottoms and side walls during construction contained high concentrations of arsenic, lead, total cPAHs, and total PCBs above MTCA Method C industrial soil criteria (MTCA Method A industrial soil criteria for lead). Building 997 covers the majority of Site 2. Those areas that were not directly covered by building were paved.

Notes:
CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act of 1980
EPA - U.S. Environmental Protection Agency
HRS - hazard ranking system
IAS - initial assessment study
MTCA - Model Toxics Control Act (Washington State)
OU - operable unit
OU NSC - Operable Unit Naval Supply Center
PA - preliminary assessment
PAH - polycyclic aromatic hydrocarbon
PCB - polychlorinated biphenyl
PCE - tetrachloroethene (from earlier name perchloroethylene)
PSNS - Puget Sound Naval Shipyard
RCRA - Resource Conservation and Recovery Act of 1976
RFA - Resource Conservation and Recovery Act Facility Assessment
SI - site inspection
SVOC - semivolatile organic compound
SWMU - solid waste management unit
TCE - trichloroethene
TPH - total petroleum hydrocarbons
USGS - United States Geological Survey
UST - underground storage tank
VOC - volatile organic compound

4.0 COMMUNITY PARTICIPATION

The Navy published a Community Relations/Public Participation Plan in October 1992. In conjunction with the publication of this plan, a Technical Review Committee (TRC) was established, consisting of representatives of the Navy and other governmental agencies and formal groups.

In 1994, the BNC began a transition from the regulatory agency-based TRC to a community-based Restoration Advisory Board (RAB). To ensure the community had sufficient opportunity to participate in the process, 26,000 brochures were mailed to the surrounding community. The address list included all residences and businesses within one mile of the BNC, as well as other stakeholders such as elected officials, religious groups, non-profit environmental organizations, news media, and Native American groups for whom the Sinclair Inlet area was ancestral land. Additionally, a series of open houses were held to provide information on cleanup and allow the community to ask questions about the RAB. About 20 individuals expressed interest in being on the RAB. By the spring of 1995, a community co-chair had been selected by the community members of the RAB, by-laws had been written, and the RAB was meeting on a regular basis.

Since the inception of the RAB, general attendance at the meetings has declined. Attendance is usually about 15 people with about 10 of the people representing the Navy or regulatory community. Meetings are held on an as-needed basis.

The Navy published a Community Involvement Plan (CIP) for the BNC in April 1996, replacing the Community Relations/Public Participation Plan. The new plan's goals are as follows:

- To encourage communication between the Navy and local community
- To encourage public participation in decisionmaking
- To focus on issues of interest to the community during the study and cleanup process
- To be open to change based on community involvement needs

Information on the Technical Assistance for Public Participation (TAPP) grants program was provided to community members at the April 1998 RAB meeting. There has been no interest expressed in obtaining a TAPP grant.

The Proposed Plan for OU B Terrestrial, formally presenting the preferred cleanup alternative, was issued for public comment on August 16, 2002, through a mailing to over 1,200 interested community members.

A public meeting to present the Proposed Plan was held in conjunction with an open house on August 28, 2002. A notice of availability was published in the *Bremerton Sun* on August 21 and 28, 2002, and in the *Northwest Navigator* on August 23, 2002. The public comment period extended through September 27, 2002. Fifteen Navy staff and 5 community members attended the open house, and 14 Navy staff and 1 community member attended the public meeting.

The final RI/FS for OU B Terrestrial and OU B Marine, together with other significant documents, have been made available for public review at the following branches of the Kitsap County Regional Library:

Central Branch
1301 Sylvan Way
Bremerton, Washington

Rev. Martin Luther King, Jr., Branch
612 Fifth Avenue
Bremerton, Washington

The Administrative Record for OU B, including the RI report, FS, and other documents forming the basis for this ROD, are available for public review by contacting:

Engineering Field Activity, Northwest
Naval Facilities Engineering Command
19917 Seventh Avenue Northeast
Poulsbo, Washington 98370-7570
(360) 396-0012

5.0 SCOPE AND ROLE OF OU B TERRESTRIAL

OU B Terrestrial is one of six operable units at the BNC. OU A, OU B Marine, OU B Terrestrial, OU NSC, and OU D are CERCLA units, managed under the federal Superfund program, and OU C is a petroleum unit managed under the state cleanup program. OUs A, B, C, and NSC were originally defined and established based on consideration of the Navy's command structure at the BNC, geography, site history, and suspected site contamination (see Figure 1-2). The original OU B was divided into two operable units, OU B Marine and OU B Terrestrial, in 1999 in order to allow cleanup of the marine area to be accelerated. A sixth operable unit, OU D, was established in August 2002 adjacent to the State ferry terminal at the eastern end of OU B Terrestrial in connection with the Navy's evaluation of a possible land transfer to the City of Bremerton.

Separate decision documents for OU A and OU NSC have been completed and the remedial actions specified in the RODs for those sites were implemented and completed in 1998 and 1999, respectively. The primary remedy component at OU A was containment of contaminated fill through upgrades to pavement and installation of riprap for shoreline erosion control. The primary remedy components at OU NSC were containment of contaminated fill through pavement upgrades, removal of contaminated sediments and debris from the stormwater system, and repair of damaged stormwater facilities.

Because petroleum, which is not a hazardous substance under CERCLA, was the primary contaminant found at OU C, this operable unit is not managed as a CERCLA site. A focused RI/FS for the site was prepared under MTCA and published in April 2002, and a steam sparging system has been used to recover subsurface petroleum. The Navy and Ecology are evaluating potential additional remedial actions for OU C, and a Cleanup Action Plan is planned for the site.

OU D was established in 2002 from a portion of the original OU B Terrestrial at the east end of the BNC. The Navy is evaluating possible transfer of a portion of OU D to the City of Bremerton for recreational use. A separate ROD will be prepared for OU D.

OU B Marine is composed of the entire marine area adjacent to the BNC, extending east and west along the shorelines of OUs A, B Terrestrial, and NSC and extending approximately 1,500 feet outward into Sinclair Inlet (Figure 1-2). This includes marine area adjacent to OU A that was originally considered part of OU A and studied during the early investigations of that site. OU B Marine and adjoining portions of Sinclair Inlet were addressed in a ROD issued in June of 2000. The remedy for OU B Marine involved dredging of contaminated marine sediments, confinement of these sediments in an excavated seafloor pit, capping of other contaminated sediments, and shoreline stabilization. The primary components of the remedial construction called for in the OU B Marine ROD were completed in 2001.

OU B Terrestrial includes most of the numbered sites identified during the original investigations of the BNC, as shown in Figure 1-3:

- Site 1—Industrial fill area created between 1960 and 1974 northeast of Mooring A
- Site 2—Former PCB storage site at demolished Building 399 and new Building 997 (Hazardous and Flammable Materials Warehouse)
- Site 7—Demolished Building 99, old metal plating shop
- Site 8—Two underground storage tanks beneath demolished Building 106 (old power plant)
- Site 9—Crane maintenance area east of Building 450
- Sites 10 East, Central, and West—Industrial fill additions to the shoreline

In addition to the individual sites listed above, OU B Terrestrial also includes other areas at the BNC, as shown in Figure 1-2. All six drydocks present at the BNC are located within OU B Terrestrial. In general, OU B Terrestrial was considered a single large unit for purposes of evaluating the nature and extent of contamination and assessing potential risks associated with the site. Because OU B Terrestrial is immediately adjacent to and discharges groundwater and surface water to OU B Marine, potential impacts to OU B Marine were a primary consideration in selecting a remedy for OU B Terrestrial.

6.0 SUMMARY OF SITE CHARACTERISTICS

The following sections summarize the primary pertinent characteristics of OU B Terrestrial. This material has been drawn primarily from the following documents:

- *Final Remedial Investigation Report, Operable Unit B, Bremerton Naval Complex, Bremerton, Washington.* Prepared by URS for the U.S. Navy. March 12, 2002.

- *Final Feasibility Study Report, Operable Unit B, Bremerton Naval Complex, Bremerton, Washington.* Prepared by URS for the U.S. Navy. May 24, 2002.

6.1 PHYSICAL SETTING

6.1.1 Location

OU B Terrestrial is a strip of land extending approximately 1,200 feet inland and stretching along the shoreline of the BNC from OU A in the southwest to OU D in the northeast, and does not include OU NSC. OU B Terrestrial is comparatively flat and has an elevation of less than 25 feet above mean sea level.

6.1.2 Physical Characteristics

The area occupied by the BNC has been greatly modified from its original condition. Historically the area consisted of tidelands, marshes, and forests. The area was cleared and filled in several stages beginning in the late 1800s to accommodate naval operations. The low-lying waterfront area where OU B Terrestrial is located is new land constructed of soil and various fill materials. The topography currently involves flat land along the waterfront connected by steep hillsides to a rolling upland area that includes the naval station. The industrial waterfront ranges in elevation from sea level to 25 feet above mean sea level and is almost completely paved. The hillsides adjacent to the waterfront reach a maximum elevation of 170 feet. There are no streams or wetlands at the BNC. The BNC does not lie within the 100-year floodplain. The BNC includes almost 400 buildings, 6 drydocks, and 14 piers and moorings.

Groundwater and surface water tend to flow from the higher areas of the BNC towards Sinclair Inlet (Figure 6-1). Continuous pumping of groundwater is required in the vicinity of the drydocks to relieve hydrostatic pressures that would otherwise tend to lift and potentially damage the drydocks. The water table throughout most of central and eastern OU B Terrestrial is significantly lowered by the operation of these drydock drainage relief systems (Figure 6-2). Operation of the drainage relief systems also increases the natural rate of intrusion of seawater into the soil along the shoreline in the vicinity of the drydocks. Most shallow groundwater and intruding seawater in central and eastern OU B Terrestrial pass through the drydock drainage relief systems before being discharged to the inlet.

Precipitation and resulting surface runoff at OU B Terrestrial are collected by an extensive stormwater system and discharged to the inlet. Much of the OU B shoreline consists of reinforced concrete bulkheads, steel sheetpile walls, and areas covered with riprap. Stormwater lines passing through the bulkheads and riprap discharge surface water runoff to the inlet. The BNC has been issued a stormwater permit.

Along bulkheads, water depths up to about –20 feet mean lower low water (MLLW) occur close to the shoreline. In some riprapped areas, the immediate nearshore areas are shallow, but the water depth increases rapidly farther offshore. Recent bathymetric survey data collected at the BNC reveal water depths generally between 40 and 45 feet, except in dredged areas near piers and vessel berthing areas, where depths increase to 45 to 50 feet. Offshore of the site, water depths are generally 40 to 45 feet. Depths increase to over 50 feet in two bathymetric depressions located south of the BNC in central Sinclair Inlet.

6.2 CULTURAL RESOURCES

The 1855 Treaty of Point Elliott promulgated articles of agreement between the United States and the Suquamish Tribe. An aboriginal right retained under the Treaty includes the immemorial custom and practice to hunt, fish, and gather within usual and accustomed grounds and stations, which was the basis of the Tribe’s source of food and culture. Sinclair Inlet is within the Suquamish Tribe’s usual and accustomed fishing area.

Suquamish ethnographic place names have been identified within Sinclair Inlet and the boundaries of BNC. Hunter-fisher-gatherer archaeological sites are also located within Sinclair Inlet and areas within the vicinity of BNC. Although no hunter-fisher-gatherer archaeological sites have been found at the facility, areas within BNC are identified as having a high probability for hunter-fisher-gatherer archaeological resources.

Puget Sound Naval Shipyard is a National Historic Landmark District. Four historic districts are located within Naval Station Bremerton; none of these districts are located within OU B Terrestrial.

6.3 BIOLOGICAL RESOURCES

As a heavily industrialized site, OU B Terrestrial includes little natural habitat area. However, the adjacent waters of Sinclair Inlet, including OU B Marine, support a wide variety of biological resources. For example, common invertebrates in the inlet include clams, mussels, and crabs. Among the marine finfish observed in the inlet, sole, flounder, perch, and herring are comparatively abundant. The inlet also acts as a migration corridor for species such as chinook, coho, and chum salmon and cutthroat and steelhead trout. Endangered and threatened species that are commonly observed in the vicinity include chinook and coho salmon and bald eagles.

6.4 NATURE AND EXTENT OF CONTAMINATION

The Navy has conducted extensive sampling of soil and groundwater throughout OU B Terrestrial, especially during the 1990-1991 site inspection and two phases of OU B remedial investigations in 1994 and 1995. In general, sampling locations were chosen to avoid roadways and other heavily traveled areas, and only in a few instances were samples collected from under existing buildings. Most sampling locations were in paved areas. Most soil borings were drilled to just below the fill/native material interface. Typically, soil samples were collected from the surface, from just above the water table, at the water table, at the fill/native material interface, and from the bottom of the boring. Many wells are screened across the water table, typically with an allowance of several feet above the water table to allow for changes due to tidal influence and drydock operations.

More limited sampling has been performed for surface water, drydock seeps and discharges, and stormwater catch basin sediments. The data set used to support the RI/FS process was the result of approximately 6,000 separate laboratory analyses.

The chemical data for OU B Terrestrial were subjected to a multi-step screening process to aid in organizing the RI discussion of nature and extent of contamination. This screening process served to identify chemicals that appeared to merit primary attention, for example due to degree of exceedance or frequency of exceedance of various regulatory criteria. These chemicals were identified as chemicals of interest (COIs). This COI screening process was devised solely to assist in the evaluation of chemical nature and extent. The data screening discussed in Section 8 in connection with the risk assessment process was a completely separate operation that was applied to the full set of site data.

For soil data, the nature and extent screening process used surface water and marine water criteria for ecological screening. MTCA Method C Industrial direct-contact criteria were used for human health screening.

As discussed in Section 7, groundwater at OU B Terrestrial is not currently a source of drinking water and is not expected to be a source of drinking water in the future. Consequently, marine water criteria rather than drinking water standards were used in the nature and extent screening of groundwater data. In the absence of marine water criteria, risk-based screening concentrations were used for the nature and extent screening.

The nature and extent screening used surface and marine water criteria in the screening of stormwater, drydock seep water, drydock drainage water, and drydock relief drainage water. Catch basin sediment data were screened using Washington State Sediment Quality Standards.

The following sections summarize by chemical categories the findings for the COIs identified as a result of this screening process for the primary sampled media.

6.4.1 Volatile Organic Compounds

Two volatile organic compounds (VOCs), tetrachloroethene or perchloroethene (PCE), and trichloroethene (TCE), exceeded screening levels and were identified as COIs in groundwater and drydock seep samples. In addition, PCE is considered a COI in soil and catch basin water samples, and TCE is considered a COI in drydock relief drainage samples. Exceedances for both compounds were limited to the eastern area of the shipyard, primarily in the area around Site 7 (see Figure 1-3). PCE exceedances of regulatory criteria occur in a plume-like configuration in eastern OU B Terrestrial. No sources of PCE have been identified within the eastern area of the shipyard; PCE found at the site is believed to be largely the result of contamination moving onto Navy property from one or more upgradient sources. TCE may also be attributable to historic shop practices at metal plating and treating facilities, vehicle maintenance operations, or the chemical breakdown of PCE.

6.4.2 Semivolatile Organic Compounds

Most of the individual carcinogenic polycyclic aromatic hydrocarbons (cPAHs), as well as total cPAHs, are considered COIs in all media except drydock water samples. Total cPAH exceedances of screening criteria were documented near oil pipelines, at the former shipbuilding ways burn pit near Site 1, near the closed underground storage tanks (USTs) at Site 8, and in the areas around Sites 7, 10 East, 10 Central, and 10 West (see Figure 1-3). Probable sources of cPAHs include leaks from oil pipelines and USTs, historic coal wharf remnants, former burn pit residuals, historic releases of waste oil during industrial activities, waste disposal areas associated with the former town of Charleston, and the oil distribution facility at Site 10 West.

In addition to cPAHs, the semivolatiles acenaphthene, fluoranthene, 4-methylphenol, butylbenzylphthalate, phenol, pentachlorophenol (PCP), and bis-2(ethylhexyl)phthalate (BEHP) are also considered COIs in at least one medium. Likely sources of most of these compounds include breakdown products from organic materials in industrial fill and former burn pits. Most exceedances were found near Site 10 Central. PCP is most likely attributable to preservative leaching from wood fragments reported in soil borings at Site 10 West. BEHP may be associated with plastic materials in fill as well as cross-contamination from plastic materials during sample collection and analysis.

6.4.3 Pesticides/PCBs

A total of 13 chlorinated pesticides and 4 PCBs are considered COIs in at least one medium. Soil and groundwater exceedances of screening criteria were located in the vicinity of the former burn pit north of Site 1 and near Sites 1, 8, and 10 West. Pesticides were detected in most drydock water samples, at two stormwater locations near Site 1 and Site 8, and in sediments from two catch basins in the eastern BNC. In general, the pesticide detections are distributed unevenly across the BNC. No specific sources of pesticides have been identified; pesticide detections at OU B Terrestrial are believed to be a result of historical pesticide usage for vermin control. However, pesticides may also have been disposed of in landfills reportedly incorporated into the BNC as the Complex expanded, and may have also been present in fill materials used to create additional waterfront area.

PCBs were occasionally detected in OU B Terrestrial soil samples, with a few of the results exceeding regulatory criteria. Detections of PCBs in groundwater and surface water were infrequent. PCBs were commonly detected in catch basin sediments, routinely above the stringent surface water-based criterion. The soil, groundwater, and surface water samples in which PCBs were detected were collected in several small isolated areas. PCBs were commonly used to increase the temperature stability of oils used to cool electrical transformers, so transformers historically used and stored at the BNC are a potential source of PCBs. Specific potential sources include spills reported at Site 2, where off-line transformers and waste PCBs were stored in the past, and at Site 10 Central. Other potential sources include industrial cutting and lubricating oils, some of which in the past also included PCBs to increase temperature stability, and PCBs used in sound-dampening felts in submarines.

6.4.4 Total Petroleum Hydrocarbons

Four total petroleum hydrocarbon (TPH) subsets are considered COIs: total petroleum, diesel, motor oil, and gasoline. Three were detected in soil and groundwater, and all four were detected in catch-basin sediments. TPH contamination is routinely found in areas of vehicle use, whether the land use is industrial, commercial, or municipal. For example, TPH is a very common stormwater system contaminant as a result of parking lot and street runoff. TPH detections and source areas within OU B Terrestrial generally coincide with areas where cPAHs were detected.

A portion of the observed TPH contamination may also be a result of sources such as leaks from pipelines and tanks, coal pier remnants, burn pit residuals, industrial releases, the Charleston landfill, and leaks associated with the oil distribution facility at Site 10 West.

Separate evaluations of the petroleum findings concluded that there are no significant potential associated human health risks given the current industrial usage of the site. However, in a few instances limited quantities of free-phase petroleum were observed floating on groundwater. To the extent that there is a possibility of release of free-phase petroleum this poses a potential threat to the marine environment. Petroleum contamination is not usually addressed as part of Superfund site cleanups. The Navy will address petroleum contamination through a separate BNC-wide petroleum management program. The Petroleum Management Plan, "Final Petroleum Management Plan, BNC, March, 2002," documents the Navy's intentions regarding petroleum management. Petroleum will be managed at the site in accordance with the plan and applicable revisions.

6.4.5 Inorganic Compounds

A variety of inorganic elements are considered COIs in one or more of the media sampled at OU B Terrestrial. Arsenic, copper, lead, mercury, nickel, and zinc tend to be particularly widely distributed and are considered COIs in most media sampled for inorganics analysis. The following summary will focus on these six common inorganics. Because of the tendency for inorganics to be widely distributed throughout OU B Terrestrial and for simplicity, the discussion of geographic distribution will be organized around a rough division of OU B Terrestrial into three subsections: western, central, and eastern. The western area can be approximated as the area west of Drydock 6 (see Figure 6-1), the central area as Drydock 6 and the area stretching east to Drydock 4, and the eastern area as Drydock 4 and the area to the east. Possible sources for these metals include the following:

- Spent abrasive grit and copper slag in fill
- Metal plating operations

- Foundry activities
- Equipment maintenance
- Use, maintenance, and stripping of lead-based paint on cranes
- Lead additives in petroleum products
- Materials storage at Site 2 and sheet metal work in several locations
- Batteries
- Electronic equipment
- Storage of metals on unpaved surfaces

All six of the comparatively common inorganics (arsenic, copper, lead, mercury, nickel, and zinc) are COIs in soil in all three subsections of OU B Terrestrial. As shown in the final remedial investigation report for OU B, elevated concentrations of all six of these inorganics were found in shoreline areas adjacent to Sinclair Inlet as well as in inland locations.

Analyses of water samples for OU B Terrestrial commonly included both total inorganics (unfiltered) analyses and dissolved inorganics (filtered) analyses.

In groundwater, the six common inorganic contaminants have been determined to be COIs based on total analysis in all three subsections of the site.

On the basis of dissolved inorganics results, five of the common inorganics are COIs in groundwater in one or more subsections of OU B Terrestrial. Dissolved arsenic, dissolved copper, and dissolved nickel are COIs in all three subsections of the site. Dissolved zinc is a COI in the central and eastern subsections of the site. Dissolved lead is a COI only in the central subsection of the site. Dissolved mercury is not a COI in groundwater.

The BNC drydocks are all located in the central and eastern subsections of OU B Terrestrial. Thus the following discussion of inorganics distribution in drydock seeps, drydock relief drainage water, and drydock discharges pertains only to the central and eastern subsections of the site.

The six common inorganics were less commonly found to be COIs based on drydock seep sampling than was the case for groundwater sampling. Total copper, total lead, total mercury, total nickel, and total zinc are COIs for seep water only in the eastern subsection of the site. Of the total inorganics, only total arsenic is a COI for seep samples in both the central and eastern subsections. Based on the dissolved results for drydock seep samples, dissolved arsenic and dissolved lead are COIs only in the central subsection of OU B Terrestrial. Dissolved copper and dissolved nickel are COIs only in the eastern subsection. Neither dissolved mercury nor dissolved zinc is a COI in drydock seep water.

Total arsenic, total copper, total lead, and total nickel are COIs for drainage relief water in both the central and eastern subsections of the site. Total mercury and total zinc are COIs for drainage relief water only in the eastern subsection. Total arsenic, total copper, total nickel, and total zinc are COIs in both the central and eastern subsections; total lead and total mercury are COIs only in the eastern subsection of the site.

Based on the results of drydock discharge sampling, total arsenic and total copper as well as dissolved arsenic and dissolved copper are COIs in both the central and eastern subsections of OU B Terrestrial. None of the other six common inorganics are COIs for drydock discharge water based on the results of the total or dissolved analyses.

The results of total inorganics analysis of stormwater sampling led to all six of the common inorganics being designated as COIs in all three subsections of OU B Terrestrial. Dissolved arsenic and dissolved zinc are also COIs in all three site subsections. Dissolved copper, dissolved lead, and dissolved nickel are COIs in the western and eastern subsections of the site. Dissolved mercury is a COI only in the western subsection of OU B Terrestrial.

Analysis of samples of catch basin sediment samples resulted in lead and zinc being designated as COIs in all three subsections of the site. Arsenic, copper, and mercury are COIs in the central and eastern subsections of the site. Nickel is not a COI for stormwater sediments.

6.4.6 Exceedance Factor Maps

The overall distribution of chemicals in soil and groundwater observed during the remedial investigations at OU B Terrestrial is summarized in three exceedance factor maps. The exceedance factors shown on these maps represent comparisons of the results of analyzing soil and groundwater samples to regulatory criteria. Figure 6-3 presents exceedance factors calculated by comparing the results of soil sampling to MTCA Method C Industrial criteria for direct soil contact. This figure shows that aside from Site 1 in central BNC and an isolated area of soils under a building north of Site 1, OU B Terrestrial soils tend not to exceed the industrial soil criteria. Figure 6-4 presents exceedance factors for soil compared to Washington State sediment quality standards. As this figure shows, site soils in many locations substantially exceed the marine sediment standards. Some of the locations with the highest exceedance factors based on comparisons with sediment standards were found in areas relatively close to the shoreline. Figure 6-5 presents exceedance factors for groundwater compared to surface water standards. Exceedances of surface water standards are relatively common.

6.4.7 Key Chemicals

Because a large number of chemicals have been detected within OU B Terrestrial, the Navy, EPA, and Ecology agreed to use representative key COIs to simplify and focus discussion of chemical distribution and fate and transport. The key COIs are arsenic, copper, lead, mercury, zinc, PAHs, and PCBs. Table 6-1 summarizes the distribution by medium of the key chemicals as well as the volatile organic compounds TCE and PCE. Table 6-2 summarizes the measured range of concentrations of the key COIs in soil, together with the screening criteria used for the COI analysis. Tables 6-3, 6-4, and 6-5 similarly summarize the results for the key chemicals in groundwater, stormwater, and catch basin sediments.

6.5 FATE AND TRANSPORT OF KEY CHEMICALS

Based on the presence within OU B Terrestrial of contaminants at levels exceeding regulatory criteria, potential chemical fate and transport mechanisms are of considerable interest. Potential transport mechanisms at the site include:

- Stormwater system
- Drydock discharges
- Groundwater discharges
- Direct erosion of soil along the shoreline

These mechanisms are discussed in the following subsections. Soil vapor transport was also evaluated as a potential pathway but was not found to be a threat.

6.5.1 Stormwater System

OU B Terrestrial includes extensive stormwater facilities for collecting surface water runoff and transporting it to Sinclair Inlet. Catch basins constructed at intervals within the stormwater lines trap soil particles and other solid materials that have entered the stormwater lines. Based on experience during cleanup of the stormwater facilities at OU NSC, many lines and catch basins may contain solid materials accumulated over many years of facility use. Chemical contamination is commonly found in samples of catch basin sediments collected within OU B Terrestrial. These sediments can act as a source of contamination since stormwater flowing through the sediment can pick up chemicals in dissolved or particulate form.

From experience during the OU NSC cleanup, it is also probable that at least some stormwater lines within OU B Terrestrial are damaged, for example due to heavy vehicle traffic or settling of soil. Damaged stormwater lines have increased potential to act as a transport pathway since gaps or openings in the lines open the possibility of contaminants in soil or groundwater entering the lines and eventually reaching the inlet. Therefore, contaminants that currently exist in the stormwater facilities are the primary threat posed to the marine environment by OU B Terrestrial. Contaminants in soil or groundwater entering the lines are also a potential threat to the marine environment.

6.5.2 Drydock Discharges

The second transport pathway at OU B Terrestrial is the discharge of water from the BNC drydocks. Historically, water discharged from the drydocks to Sinclair Inlet included a mixture of water originating from several different sources: drydock drainage relief water, water such as cooling water from work on vessels within the drydocks, and precipitation (surface water) falling within the drydocks. More recently, however, work methods within the drydocks have been modified to greatly reduce water releases, and process water collection systems have been installed to collect the “first flush” of precipitation falling within the drydocks at the onset of a rain incident. Consequently, current drydock discharges consist primarily of drainage relief water pumped out of the soil surrounding the drydocks in order to prevent strong uplifting forces from damaging the drydocks (see Figure 6-2). This drainage relief water is mostly seawater but also includes considerable groundwater. Because the drydock discharge involves comparatively high water flow rates, this pathway potentially represents a significant mass load to the inlet. However, based on the low chemical concentrations measured in the mixed discharge water this pathway is not considered a threat to the marine environment.

6.5.3 Groundwater Discharge

Direct discharge of groundwater to the inlet is the third transport pathway at OU B Terrestrial. Chemicals in site fill may become dissolved in site groundwater as it flows through the fill and as infiltrated surface water percolates through the fill to recharge groundwater. Such leaching mechanisms can be complex and variable, but it is through leaching that chemicals in the site fill can act as a source of chemicals to site groundwater. When the drydock relief drainage systems are operating, direct flows of groundwater to the inlet are comparatively limited because most groundwater at the site is drawn to the drydocks. Mathematical modeling and other analyses reported in the OU B RI report have predicted that even with the drainage relief systems out of operation, which is considered the most conservative scenario, direct groundwater discharges are not a threat to the marine environment.

6.5.4 Soil Erosion

Comparatively few soil samples have been collected within 100 feet of the BNC shoreline. However, the presence of contaminants in samples from locations closest to the shore suggests there is a strong likelihood that contaminants are also present in some areas immediately adjacent to Sinclair Inlet. For example, mercury and other inorganics have been detected in shallow soils from near-shore locations at concentrations well above the state sediment quality standards. For this reason, shoreline soil erosion is considered a fourth pathway by which contaminants can reach the inlet. In many parts of the BNC, bulkheads and retaining walls prevent erosion, but shoreline areas protected by riprap do present the possibility of erosion. In particular, riprap slopes throughout Site 10 East, along most of the shore at Site 10 West, and in a portion of Site 10 Central directly west of Site 1 are subject to potential erosion. Investigations in Sinclair Inlet in anticipation of the marine cleanup found evidence of historical slumping of fill material from Site 1 into the Inlet due to overly steep slopes, highlighting the importance of maintaining the stability of shoreline slopes.

6.5.5 Summary and Conclusions

The remedial investigation process included extensive evaluations of potential fate and transport mechanisms at OU B Terrestrial, using methods ranging from elaborate custom groundwater models to extrapolation of possible mass loads to the inlet based on measured chemical concentrations in stormwater. Analyses were also performed on specific chemical pathways such as the soil-to-groundwater pathway and the probable effects of direct groundwater discharges to the marine environment, including studies of measures of marine protectiveness.

Some of the primary predictions from the fate and transport evaluations included:

- Most site groundwater is drawn into the drydock drainage relief pumping systems when the drydocks are empty, together with substantial amounts of seawater;
- Modeling predicted that even with highly conservative assumptions exceedance of surface water criteria due to direct groundwater discharge into the inlet may extend at most a few inches offshore;
- Modeling with highly conservative assumptions predicted that direct groundwater discharge will not cause the marine sediments to exceed sediment quality standards;

- Soil chemical concentrations are typically many thousands of times higher than associated groundwater concentrations, and chemicals leached from soil do not result in groundwater concentrations predicted to adversely affect the adjacent marine environment;

- Drydock discharge concentrations are low and not considered a threat to the marine environment; and

- Mass loading of key chemicals to the inlet due to direct groundwater discharges is substantially less than from either stormwater discharges or drydock discharges.

The results of the evaluations were used to identify those OU B Terrestrial pathways with the greatest potential for transporting chemicals from OU B Terrestrial to OU B Marine, the adjacent marine environment.

Overall, the primary conclusions from the evaluations of potential fate and transport mechanisms at OU B Terrestrial were:

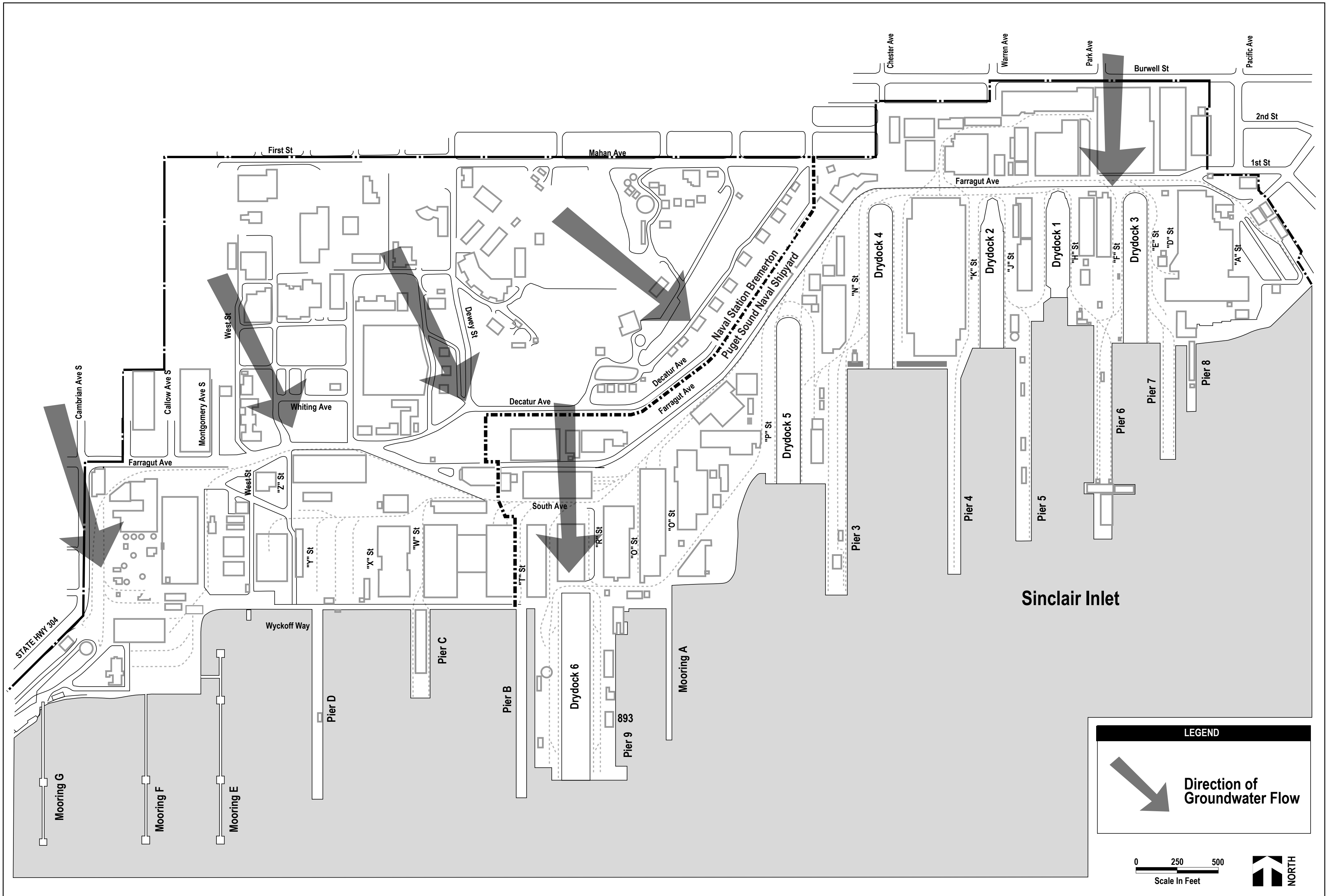
- The two primary pathways of concern at OU B Terrestrial are the stormwater system and erosion of soil along the shoreline, both of which have the potential to transport contaminants to OU B Marine;

- Potential impacts to marine water and marine sediments from direct groundwater discharges are very limited, and groundwater discharges are not likely to result in exceedances of surface water standards or sediment quality standards within Sinclair Inlet;

- Site groundwater is sufficiently protective of the marine environment and the recently implemented remedy for OU B Marine that active remediation of groundwater is not warranted;

- Mixed groundwater and seawater discharge from the drydock drainage relief pumping system is not considered a threat to the marine environment; and

- The soil-to-groundwater pathway does not pose a threat to the marine environment.

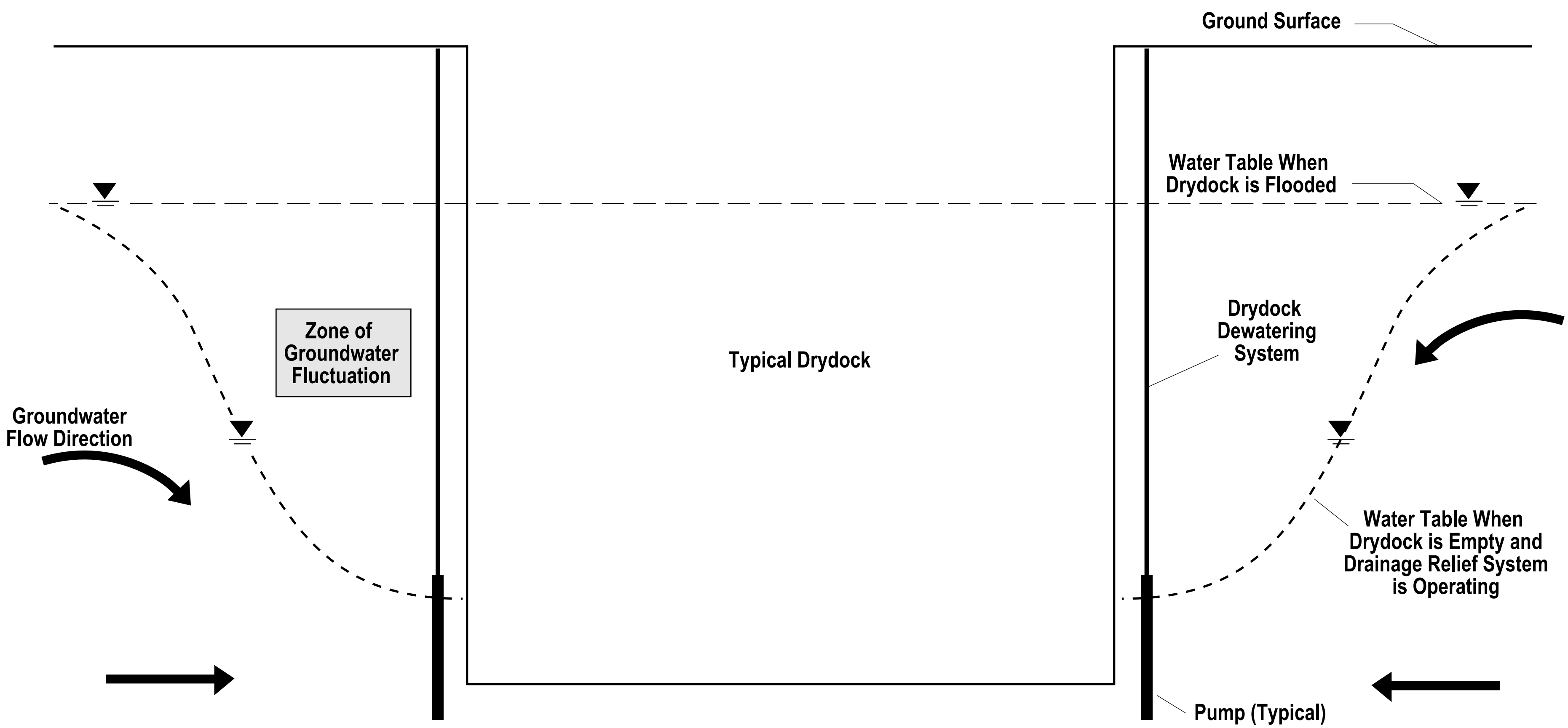


U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL

Figure 6-1
Projected Typical BNC Groundwater Flow Directions with Drydock Drainage Relief Pumping

33753009

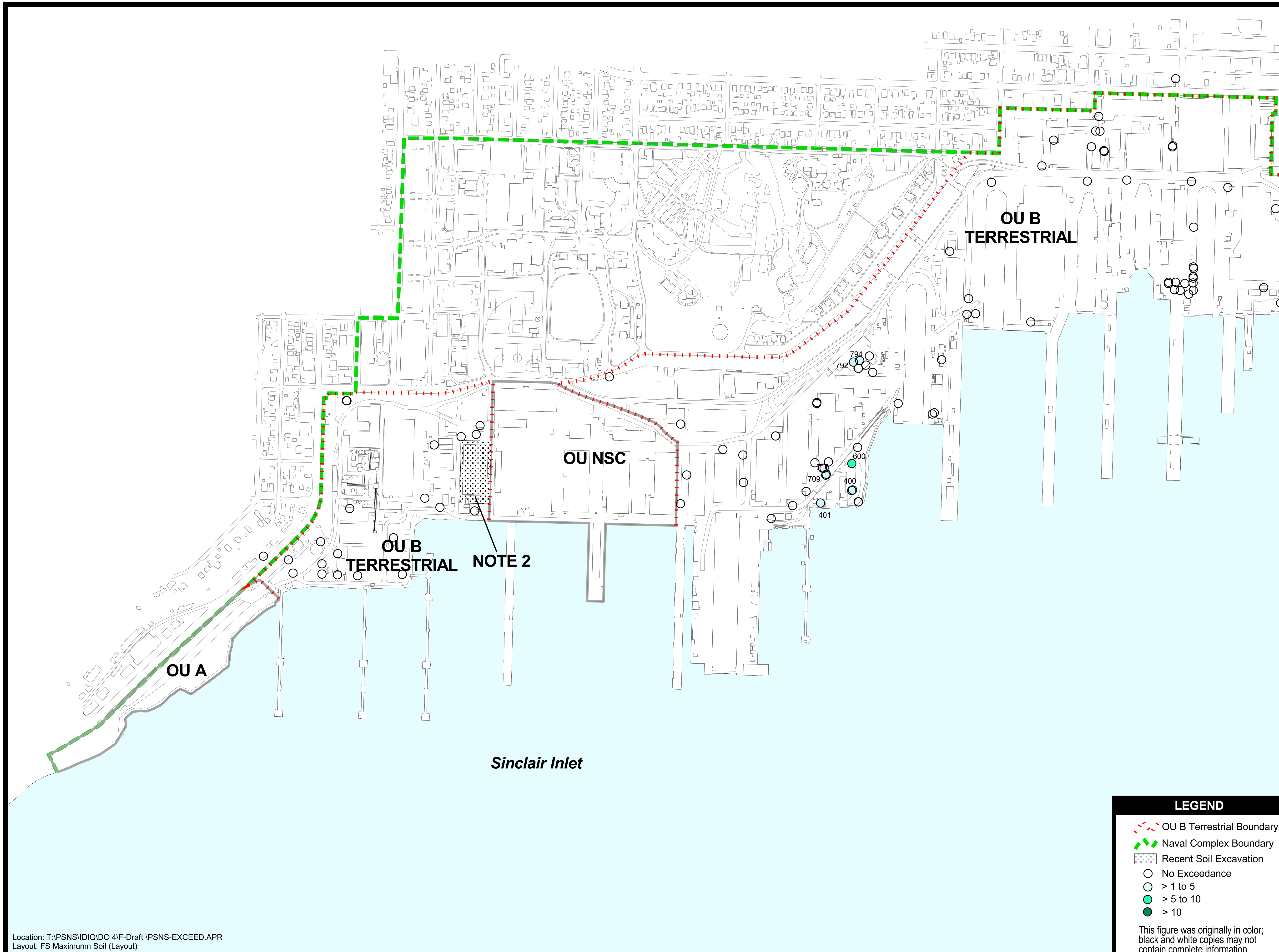


U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL

Figure 6-2
Conceptual Drydock Hydrology

33753009



NOTES

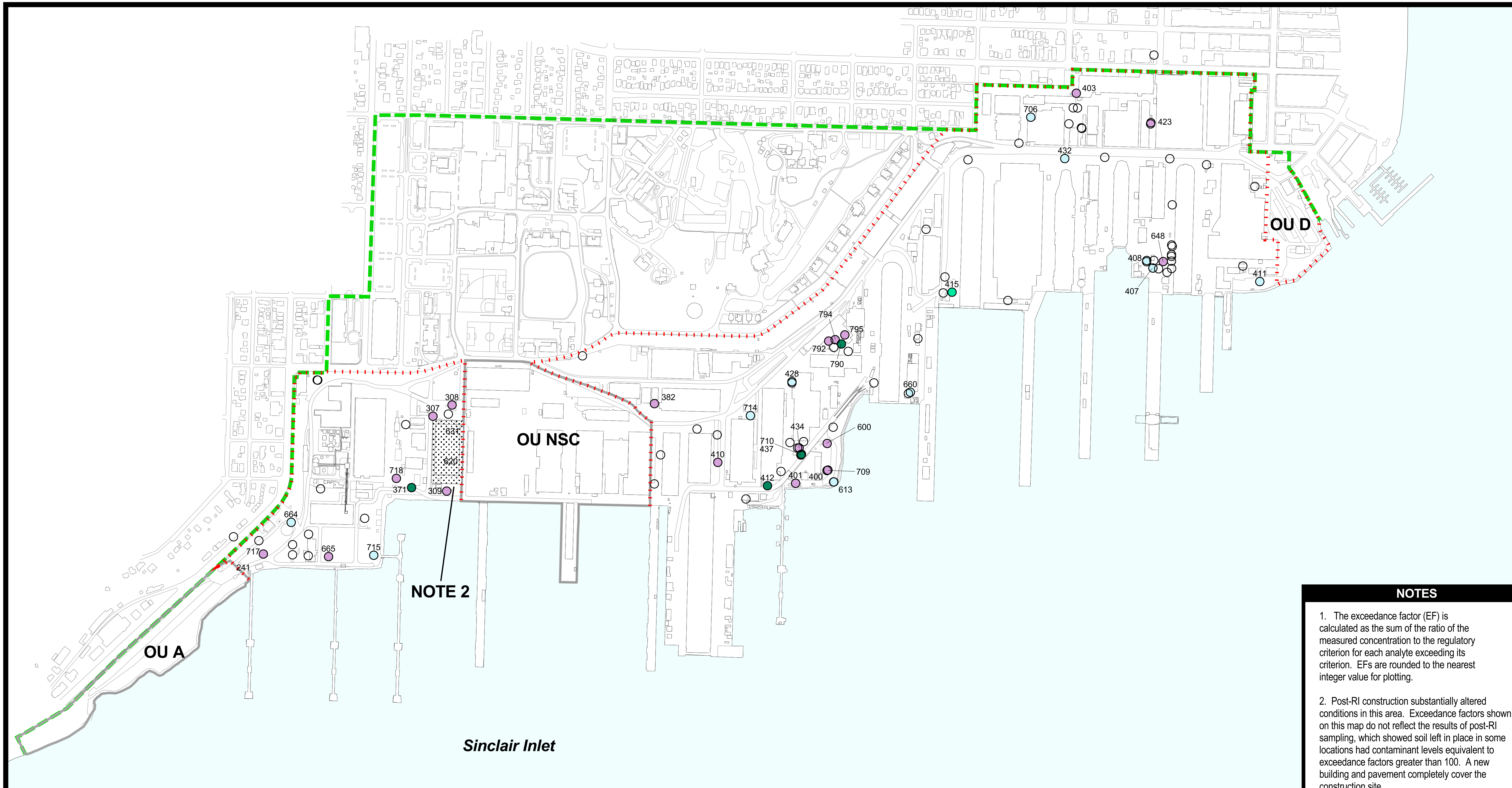
1. The exceedance factor (EF) is calculated as the sum of the ratio of the measured concentration to the regulatory criterion for each analyte exceeding its criterion. EFs are rounded to the nearest integer value for plotting.

2. Post-RI construction substantially altered conditions in this area. Exceedance factors shown on this map do not reflect the results of post-RI sampling, which showed soil left in place in some locations had contaminant levels equivalent to exceedance factors greater than 10. A new building and pavement completely cover the construction site.

Figure 6-3
Exceedance Factors for
Maximum Soil from 0 to 15 feet Below Ground
Surface versus MTCA C Industrial Standards

U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL



NOTES

1. The exceedance factor (EF) is calculated as the sum of the ratio of the measured concentration to the regulatory criterion for each analyte exceeding its criterion. EFs are rounded to the nearest integer value for plotting.

2. Post-RI construction substantially altered conditions in this area. Exceedance factors shown on this map do not reflect the results of post-RI sampling, which showed soil left in place in some locations had contaminant levels equivalent to exceedance factors greater than 100. A new building and pavement completely cover the construction site.

LEGEND

- OU B Terrestrial Boundary
- Naval Complex Boundary
- Recent Soil Excavation
- No Exceedance
- > 1 to 5
- > 5 to 10
- > 10 to 100
- > 100

This figure was originally in color; black and white copies may not contain complete information.

Figure 6-4
Exceedance Factors for
Average Soil from 0 to 15 feet Below Ground
Surface versus Sediment Quality Standards

N

300 0 300 Feet

U.S.NAVY

Delivery Order 0004
Bremerton Naval Complex
ROD FOR OU B TERRESTRIAL

Location: T:\PSNS\IDIQ\DO 4\F-Draft \PSNS-EXCEED.APR
Layout: FS Average Soil (Layout)
Date: 4-18-2003

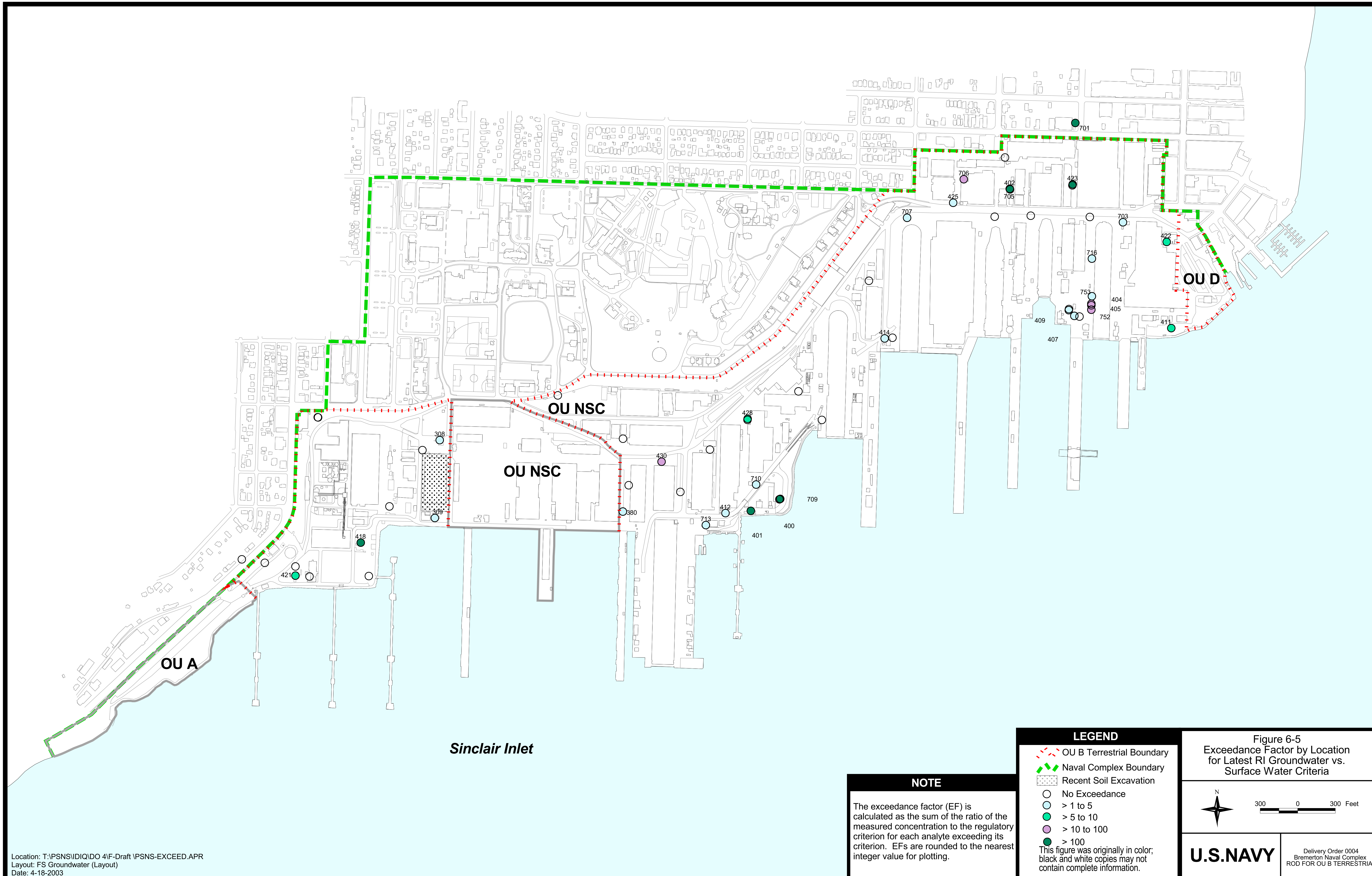


Figure 6-5
Exceedance Factor by Location for Latest RI Groundwater vs. Surface Water Criteria

NOTE

The exceedance factor (EF) is calculated as the sum of the ratio of the measured concentration to the regulatory criterion for each analyte exceeding its criterion. EFs are rounded to the nearest integer value for plotting.

Location: T:\PSNS\IDIQ\DO 4\F-Draft \PSNS-EXCEED.APR
Layout: FS Groundwater (Layout)
Date: 4-18-2003

Table 6-1
Distribution of Selected Chemicals Within OU B Terrestrial

Analyte	Groundwater/Surface Water	Soil	Catch Basin Sediment
Arsenic	●[a]	●[c,d]	●
Copper	●[a]		●
Lead	●[a]	●[c,d]	●
Mercury	●[a]		●
Zinc	●[a]		●
TCE	●[b]		
PCE	●[b]		
cPAHs	●[a]	●[d]	●
PCBs (total)	●[a]	●[d]	●

[a] Identified as key chemical for detailed analysis of fate and transport based on discussions with regulatory agency staff.
[b] Included based on localized elevated groundwater concentrations. No fate and transport modeling conducted.
[c] Based on scattered exceedances of MTCA Method C industrial soil (arsenic) and MTCA Method A industrial soil (lead) cleanup levels during site inspection and/or remedial investigation.
[d] Based on exceedances at Site 2 from in-place soil during the construction of Building 997. Total cPAHs using a total toxicity equivalent concentration and total PCBs did not exceed MTCA Method C industrial soil cleanup levels in soil collected from OU B Terrestrial during site inspection and remedial investigation.

Notes:
● – designated "chemical of concern" in final OU B feasibility study
MTCA – Model Toxics Control Act
cPAHs – carcinogenic polycyclic aromatic hydrocarbons
PCE - tetrachloroethene
TCE – trichloroethene

Source: Section 1, Final OU B FS

Table 6-2
Summary of Key Chemicals Detected in OU B Soil

Chemical	Number of Samples	Number of Detections	Range of Detections		MTCA Method C Industrial Soil Value[b]	Washington State Sediment Quality Value	Number of Samples Exceeding Industrial Soil Screening Criteria
			Minimum Detected Concentration[a]	Maximum Detected Concentration			
Inorganics							
Arsenic	384	350	0.3	229	87.5	57	6
Copper	338	333	3.1	12,400	130,000	390	0
Lead	400	383	0.98	8,650	1,000[c]	450	15[c]
Mercury	357	137	0.04	145	1,050	0.41	0
Zinc	373	362	17.2	23,600	1,050,000	410	0
PCBs							
Total PCBs	304	20	0.028	6.6	25[d]	12[e]	0
Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs)							
Acenaphthene	292	35	0.023	190	210,000	16[e]	0
Acenaphthylene	292	9	0.018	0.26	NA	66[e]	NA
Anthracene	292	40	0.013	70	1,050,000	220[e]	0
Fluorene	292	35	0.023	160	140,000	23[e]	0
Naphthalene	292	39	0.018	290	70,000	99[e]	0
Phenanthrene	292	87	0.015	360	NA	100[e]	NA
Total LPAH	292	90	0.019	1,070	NA	370[e]	NA
High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs)							
Benzo(a)anthracene	292	70	0.024	25	18	110[e]	1
Benzo(b)fluoranthene	292	76	0.009	13	18	230[e,f]	0
Benzo(k)fluoranthene	292	68	0.009	5.8	18	230[e,f]	0
Benzo(a)pyrene	292	70	0.015	8.7	18	99[e]	0
Benzo(g,h,i)perylene	292	44	0.005	1.6	NA	31[e]	NA
Chrysene	292	83	0.021	24	18	110[e]	1
Dibenz(a,h)anthracene	292	15	0.04	0.89	18	12[e]	0
Fluoranthene	292	93	0.009	140	140,000	160[e]	0
Indeno(1,2,3-cd)pyrene	292	43	0.019	1.4	18	34[e]	0
Pyrene	292	121	0.007	100	105,000	1,000[e]	0
Total HPAH	292	130	0.009	316.5	NA	960[e]	NA

[a] All units are mg/kg unless otherwise specified
[b] MTCA Method C formula values for soil for industrial land use, direct contact pathway (ingestion only). Note that since MTCA Method C does not take saturation limits into consideration, value can exceed 100%.
[c] MTCA Method A value for industrial land use
[d] Value of 25 mg/kg invoked under provisions of 40 CFR 761 for low-occupancy exposure scenario in lieu of MTCA Method C value of 66 mg/kg calculated for PCB mixtures for industrial site use (ingestion only)
[e] Washington State SQS value is specified in carbon-normalized form, i.e. as [mg per kg of organic carbon]
[f] SQS value is for Total Benzofluoranthenes

Notes:
MTCA - Model Toxics Control Act
NA - not available/applicable
PCB - polychlorinated biphenyl

Source: Table 4-21, Final OU B RI Report

Table 6-3
Summary of Key Chemicals Detected in OU B Groundwater

Chemical	Number of Samples	Number of Detections	Range of Detections		Screening Value	Source of Screening Value	Number of Samples Exceeding Screening Value
			Minimum Detected Concentration[a]	Maximum Detected Concentration			
Dissolved Inorganics							
Arsenic	110	41	0.63	10.9	5	WA BG	8
Copper	110	55	0.51	276	3.1	WA & US WQC	32
Lead	108	7	1.01	191	8.1	WA & US WQC	10
Zinc	110	32	6.8	750	81	WA & US WQC	11
PCBs							
Total PCBs	100	3	0.02	2	0.000104	MTCA B SW	3
Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs)							
Acenaphthene	105	14	1	300	643	MTCA B SW	0
Anthracene	105	6	0.6	13	25,900	MTCA B SW	0
Fluoranthene	105	13	0.9	31	90.2	MTCA B SW	0
Naphthalene	105	7	1	210	4,940	MTCA B SW	0
High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs)							
Benzo(a)anthracene	105	8	1	240	0.0296	MTCA B SW	8[b]
Benzo(a)pyrene	98	10	1	130	0.0296	MTCA B SW	10[b]
Benzo(b)fluoranthene	105	10	2	62	0.0296	MTCA B SW	10[b]
Benzo(k)fluoranthene	105	10	2	62	0.0296	MTCA B SW	10[b]
Chrysene	105	9	1	380	0.0296	MTCA B SW	9[b]
Dibenz(a,h)anthracene	105	1	2	2	0.0296	MTCA B SW	1[b]
Fluorene	105	9	1	470	3,460	MTCA B SW	0
Indeno(1,2,3-cd)pyrene	105	6	1	8	0.0296	MTCA B SW	6[b]
Pyrene	105	17	0.8	310	2,590	MTCA B SW	0

[a]All units are µg/L
[b]All PAH exceedances occurred during 1990-91 site inspection (SI). SI data not considered indicative of site conditions. No PAH exceedances reported during RI sampling, after adoption of low-flow sampling methods

Notes:
WA BG - Washington State natural background value
WA & US WQC - State and Federal water quality criteria
MTCA B SW - Standard MTCA Method B formula values for surface water
Data represent samples collected from approximately 55 monitoring wells

Source: Table 4-26, Final OU B RI Report

Table 6-4
Summary of Key Chemicals Detected in OU B Stormwater

Chemical	Number of Samples	Number of Detections	Range of Detections		Screening Value	Source of Screening Value	Number of Samples Exceeding Screening Value
			Minimum Detected Concentration[a]	Maximum Detected Concentration			
Dissolved Inorganics							
Arsenic	12	9	0.5	4.4	5	WA BG	0
Copper	12	12	2.1	66.4	3.1	WA & US WQC	9
Lead	12	6	1.1	20.8	8.1	WA & US WQC	1
Mercury	12	1	0.28	0.28	0.025	WA WQC	1
Zinc	12	12	15.5	396	81	WA & US WQC	3
Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs)							
Fluoranthene	12	1	2	2	90.2	MTCA B SW	0
Phenanthrene	12	1	2	2	---	NA	NA
High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs)							
Benzo(a)pyrene	12	1	0.8	0.8	0.0296	MTCA B SW	1
Chrysene	12	1	1	1	0.0296	MTCA B SW	1
Pyrene	12	1	2	2	2,590	MTCA B SW	0

[a]All units are µg/L

Notes:
WA BG - Washington State natural background value
WA & US WQC - State and Federal water quality criteria
WA WQC - State water quality criteria
MTCA B SW - State MTCA B value for surface water
NA - not available/applicable

Source: Appendix M, Final OU B RI Report

Table 6-5
Summary of Key Chemicals Detected in OU B Catch Basin Sediments

Chemical	Number of Samples	Number of Detections	Range of Detections: Minimum Detected Concentration[a]	Range of Detections: Maximum Detected Concentration	Washington State Sediment Quality Value	Number of Samples Exceeding SQS Screening Value
Inorganics						
Arsenic	10	10	20.7	74.6	57	4
Copper	10	10	219	6,480	390	8
Lead	10	10	191	2,010	450	7
Mercury	10	10	0.1	1.5	0.41	5
Zinc	10	10	336	3,680	410	9
PCBs[b]						
Total PCBs	10	10	4.4	311	12	8
Low Molecular Weight Polynuclear Aromatic Hydrocarbons (LPAHs)[b]						
Acenaphthene	10	1	12.6	12.6	16	0
Anthracene	10	2	10.4	52.2	220	0
Fluorene	10	6	10	19.1	23	0
Naphthalene	10	8	4.8	37.4	99	0
Phenanthrene	10	9	31.7	252	100	5
Total LPAH	10	9	49.6	301	370	0
High Molecular Weight Polynuclear Aromatic Hydrocarbons (HPAHs)[b]						
Benzo(a)anthracene	10	7	22.2	82.6	110	0
Benzo(b)fluoranthene	10	10	23.5	135	230[c]	0
Benzo(k)fluoranthene	10	10	23.5	135	230[c]	0
Benzo(a)pyrene	10	4	21.3	40.4	99	0
Benzo(g,h,i)perylene	10	1	19.1	19.1	31	0
Chrysene	10	10	26.5	126	110	1
Dibenz(a,h)anthracene	10	1	20.9	20.9	12	1
Fluoranthene	10	10	47.8	296	160	3
Indeno(1,2,3-cd)pyrene	10	3	16.5	23.5	34	0
Pyrene	10	10	32.2	222	1,000	0
Total HPAH	10	10	153	1,019	960	1

[a] All units are mg/kg unless otherwise specified
[b] Washington State SQS values for PCBs and PAHs are specified in carbon-normalized form, i.e. as mg per kg of organic carbon (OC); detected values were converted from bulk values to OC normalized form using a value of 2.3% OC
[c] SQS value is for total benzofluoranthenes

Notes:
PCB - polychlorinated biphenyl
SQS - sediment quality standard

Source: Tables 4-38 and 4-39, Final OU B RI Report

7.0 CURRENT AND POTENTIAL FUTURE LAND AND RESOURCE USES

7.1 LAND USE

The BNC, a federal facility including PSNS and NSB, is situated along the south edge of the City of Bremerton. The current and reasonably anticipated future land use for the OU B Terrestrial portion of the BNC is characterized as heavy industrial. The primary role of PSNS is to provide overhaul, maintenance, conversion, refueling, defueling, and repair services to the naval fleet. Six large drydocks are regularly used to service all classes of Navy vessels. Drydock 6, one of the largest in the world, is large enough to contain a nuclear-powered aircraft carrier. The drydocks are also central to PSNS' role as the nation's sole recycler of retired nuclear submarines and vessels. The primary role of NSB is to serve as a deep draft home port for several Navy vessels and provide long-term maintenance of inactive naval vessels. Related land uses include an assortment of industrial support functions such as a power plant, warehousing, a steel yard, public works shops, and parking and facilities to provide a wide range of services to military personnel.

Access to the BNC itself, including the shoreline, is strictly controlled and limited to authorized personnel. Current heavy industrial use of OU B Terrestrial is expected to remain relatively unchanged for the foreseeable future.

7.2 RESOURCE USES

7.2.1 Groundwater

There is no current beneficial use of groundwater at the BNC and no use is anticipated in the future. Data collected during the SI and RI indicate that the groundwater is not a potable water source. Throughout most of the low-lying shoreline area at the BNC, including OU B Terrestrial, intruding seawater combines with the groundwater, producing a brackish mixture. In addition, observations during sampling suggest that water cannot be withdrawn from site wells in sufficient quantity to maintain total dissolved solids at acceptable levels. Use of the water as a drinking water source, therefore, is not practicable. BNC obtains water from the City of Bremerton's municipal water system.

7.2.2 Surface Water

There are no natural surface water bodies within OU B Terrestrial. Precipitation and surface run off is captured in the stormwater system and discharged to Sinclair Inlet, the southern boundary of the OU.

7.2.3 Biological Resources in Sinclair Inlet

Sinclair Inlet, including OU B Marine immediately adjacent to OU B Terrestrial, supports a variety of biological resources, as noted in Section 6.

Outside of the BNC exclusion zone, Sinclair Inlet supports limited sport fishing for salmon, bottomfish, and forage fish. However, the Bremerton-Kitsap County Health District has issued a health advisory against the consumption of rockfish and bottomfish collected in the inlet due to chemical contamination. There is also a health advisory in effect against harvesting of shellfish from the inlet due to fecal coliform contamination.

The only current commercial fishing within the inlet is conducted by the Suquamish Tribe and primarily involves Chinook and chum salmon. Sea cucumbers have also been intermittently harvested on a commercial basis in the inlet, but the harvest has been suspended because of human health concerns relating to bioaccumulative chemicals including PCBs.

7.2.4 Other Natural Resources

Because of the highly industrialized nature of the site, there are no other natural resources such as forest or vegetation within OU B Terrestrial.

8.0 SUMMARY OF SITE RISKS

The baseline risk assessment for OU B estimated the risks that could exist based on taking no remedial actions, considering both current and potential future land use. The risk assessment included evaluations of both human and ecological risk and addressed both OU B Terrestrial and OU B Marine. The conclusions for OU B Marine were summarized in the June 2000 OU B Marine ROD. The conclusions of the detailed risk assessment presentation in the OU B RI report regarding OU B Terrestrial are summarized below. The risk assessment was used to evaluate the need for remedial action at both OU B Terrestrial and OU B Marine.

The risk assessment for OU B was conducted prior to the creation of OU D and was based on data collected throughout the original OU B, including OU D.

8.1 HUMAN HEALTH RISK ASSESSMENT

The baseline human health risk assessment (HHRA) for OU B provides a quantitative and qualitative evaluation of potential risk to humans from contact with chemicals identified at the site. Data collected throughout OU B Terrestrial were combined into a single database for use in this site-wide HHRA.

8.1.1 Identification of Chemicals of Potential Concern

In order to focus the risk assessment on those chemicals with the most significant potential to affect human health, the chemical results were screened to identify chemicals of potential concern (COPCs). This screening was performed specifically to evaluate risk to human health from contact with contaminants on site. The human health risk assessment process is separate from the screening discussed in Section 6.

Three criteria were used in the COPC screening process:

- The chemical must have been detected in at least 5 percent of the samples.
- For inorganic chemicals, the maximum detected concentration must have exceeded the concentration measured at a comparatively undisturbed background location.

- The maximum detected concentration must exceed an appropriate conservative risk-based screening concentration (RBSC), calculated in this case using default residential exposure parameters. The RBSCs were defined as the lower of the concentrations calculated to result in a hazard quotient (HQ) of 0.1 or an increased lifetime cancer risk 1 H 10^{-7}.

To be considered a COPC, a chemical had to meet all three criteria.

Those chemicals that contributed the majority of the risks for of the terrestrial human health scenarios are listed in Table 8-1, and are the focus of the remainder of this section.

8.1.2 Exposure Assessment

The purpose of the exposure assessment is to identify human receptors potentially at risk and estimate the type and magnitude of exposures to the COPCs identified at the site. The results of the exposure assessment are combined with chemical-specific toxicity information to characterize potential risks.

The exposure assessment process involves four steps: (1) characterizing the exposure setting, (2) identifying exposure pathways, (3) calculating exposure point concentrations, and (4) quantifying exposure in the form of chemical intakes.

The exposure setting for OU B Terrestrial is based on current and hypothetical future land uses at the site. The terrestrial human health exposure scenarios included an industrial worker, a construction worker, and a drydock worker. Although the site is expected to remain in industrial use for the foreseeable future, a hypothetical future resident scenario was also evaluated, consistent with common risk assessment practice. Table 8-2 summarizes the exposure pathways and site media included in these four scenarios.

Exposure point concentrations (EPCs) are concentrations of individual chemicals to which an individual may potentially be exposed for each medium. EPCs were developed based on EPA guidance using data collected at the site during the 1990–1991 site inspection and the 1994–1995 remedial investigation.

For the terrestrial scenarios, both reasonable maximum exposure (RME) point concentrations and average concentrations were used as EPCs. RMEs are intended to provide a conservative estimate of chemical exposure, well above the average potential exposure but within the range of possible exposures. RMEs represent the highest exposures reasonably expected to occur at a site.

In most cases, the 95 percent upper confidence limit (UCL95) on the arithmetic mean of the RI data is used as the RME. However, for a few chemicals only limited data were collected, and large variability in the reported results led to a computed UCL95 exceeding the maximum reported concentration. In these cases, the maximum reported concentration was used as the RME.

Tables 8-3 through 8-6 summarize the OU B data for the risk driver chemicals and the EPCs calculated from these data for use in assessing human health risk. The EPCs for soil from 0 to 8 feet below ground surface (bgs), used in the industrial worker scenario, are shown in Table 8-3. The EPCs for soil from 0 to 15 feet bgs used in the construction worker and future resident scenarios are shown in Table 8-4. EPCs for groundwater to a depth of 15 feet bgs, used with the construction worker scenario, are presented in Table 8-5. EPCs used for drydock worker exposure to groundwater, based on sampling of groundwater seeping into drydocks, are shown in Table 8-6.

Table 8-7 summarizes other exposure parameters used in performing the HHRA for OU B Terrestrial.

8.1.3 Toxicity Assessment

The toxicity assessment involves the following:

- Hazard identification, which weighs the available evidence of the potential adverse effects of chemicals on exposed individuals

- Dose-response assessment, which estimates the relationship between the magnitude of exposure to chemicals and the likelihood or severity of adverse effects

The primary component of hazard identification is the assembling of a toxicological summary consisting of toxicity profiles for the COPCs for the site. These profiles include chemical-specific information regarding the potential for exposure, pharmacokinetics, critical health effects, and the relationship of these effects to chemical exposures.

The dose-response assessment is intended to quantify the correlation between the magnitude of chemical exposure and potential resulting adverse health effects. This typically involves analyses of the severity or frequency of adverse effects and the exposure levels at which these effects occur using information from the toxicological literature. The objective of the analyses is to define dose-response relationships for oral ingestion, inhalation, and dermal contact.

The results of dose-response analyses take the form of toxicity values known as reference doses (RfDs) for noncarcinogenic (noncancer) effects and cancer slope factors (CSFs) for carcinogenic (cancer) effects. Some chemicals can produce both cancer and noncancer effects. Toxicity values are available for the ingestion pathway for many chemicals and are available for the inhalation pathway for some chemicals, but are not typically available for the dermal exposure pathway. Dermal toxicity values were derived from oral ingestion toxicity values based on EPA guidelines.

Noncancer effects are defined as all health effects other than cancer. For most noncancer effects, a mechanism is believed to exist that protects an exposed individual from adverse effects until a threshold level of exposure is reached. Laboratory studies are commonly used to gain insight on threshold values for specific chemicals. Although the ultimate objective of such studies is to establish the safe dose for a human, most such studies are carried out on laboratory animals. The results are commonly extrapolated to humans using conservative uncertainty factors to allow for influences such as individual variations in response to chemicals, together with modifying factors based on the perceived quality of the toxicological database for a given chemical.

RfDs were obtained in most cases from the EPA's Integrated Risk Information System (IRIS) database. In those cases where the IRIS database does not include RfDs for a particular chemical, values were obtained from the EPA's Health Effects Assessment Summary Tables (HEAST). Table 8-8 summarizes the toxicity data for noncancer effects.

The mechanisms leading to the development of cancer are believed to differ from the mechanisms of noncancer effects. No safe threshold level is believed to exist for exposure to cancer-causing chemicals, so a different form of toxicity value is associated with cancer effects. Cancer toxicity is generally expressed for risk assessment purposes with a combination of a weight-of-evidence classification and a CSF. The weight-of-evidence classification indicates the likelihood of a chemical to cause human cancer based on the strength of the supporting animal and human testing data. CSFs are developed for those chemicals perceived as likely to cause cancer in humans. Most CSFs for this risk assessment were obtained from the IRIS database. Where the IRIS database did not include CSFs for a chemical, values were obtained from the HEAST publication. Table 8-9 summarizes the cancer toxicity values.

8.1.4 Human Health Risk Characterization

Risk characterization integrates the results of the toxicity and exposure assessments into a quantitative description of potential noncancer and cancer risks. Because of fundamental differences in the handling of noncancer and cancer effects, the respective risks are characterized separately.

Noncancer Risks

The potential for noncancer risks is evaluated by comparing the estimated intake of a chemical over a specific time period with the reference dose for that chemical derived for a similar exposure period. This comparison yields an HQ, not a measure of potential incidence or severity of effect but an index as to whether a particular chemical exposure constitutes a potential health risk. Individual HQs calculated for each of the chemicals in cases of exposure to multiple chemicals are added to produce a hazard index (HI).

An HI less than or equal to 1 is interpreted to mean that no adverse noncancer health effects are likely. An HI above 1 suggests the possibility of noncancer health risk, and the degree of concern increases with increasing HI. In practice, HIs between 1 and 10 are often interpreted to suggest a comparatively minor risk of noncancer effects given the conservative nature of the risk assessment process.

Table 8-10 summarizes the results of the noncancer risk characterization for chemicals other than lead. All of the computed hazard indices are below 1. The highest HI, associated with the RME future resident scenario, had a value of 0.9. The most significant contributors to this HI are ingestion of arsenic in soil and dermal contact with soil containing PCBs.

Risks associated with exposure to lead were addressed separate from other chemicals through the process of blood-lead modeling, consistent with general risk assessment practice. In addition to site-wide conditions, this modeling examined the risks associated with those portions of the site where the highest lead concentrations in soil were observed. The modeling predicted that risks to site workers were below the established action level even at the highest measured soil lead levels. For the future resident scenario the predicted risks were below the action level when site-wide conditions were considered but above the action level for those sites with the highest soil lead concentrations.

Cancer Risks

Potential cancer risks are commonly presented as the increased probability of an individual developing cancer during their lifetime from exposure to cancer-causing chemicals. The resulting probabilities are expressed as the number of additional cancer cases likely for a specified population in addition to those cancers expected to occur because of existing exposures not connected with conditions at the site under investigation. For example, 1 additional cancer case expected in a population of 1,000,000 (i.e., one in a million) is expressed as an excess cancer risk of 1 H 10^{-6} or simply 10^{-6} (frequently shown as 1E-6 in tabular presentations).

Because of the conservatism inherent in cancer slope factors, predicted cancer risks typically represent upper bound values; the actual risk is not likely to exceed the estimated risk and may be substantially lower. The EPA has identified an upper limit of 10^{-4} for excess cancer risk, whereas Ecology uses a limit of 10^{-5} for industrial sites.

Table 8-11 summarizes the results of the cancer risk characterization. None of the calculated excess cancer risks exceeds the EPA allowable risk level. The cancer risk for the RME future resident scenario has a value of 6×10^{-5}, which exceeds the Ecology allowable risk level. This calculated cancer risk is almost entirely due to ingestion of chemicals in soil. Risk from consumption of arsenic in soil makes up more than half of the calculated risk. The calculated cancer risk for the average future resident scenario, considered generally more representative than RME values of typical exposures, is below the Ecology allowable risk level.

8.1.5 Uncertainty Analysis for Human Health Risk Assessment

Estimating and evaluating health risk from exposure to environmental chemicals is a complex process with inherent uncertainties. Uncertainty reflects limitations in knowledge, and simplifying assumptions must be made in order to quantify health risks.

Uncertainty in the risk assessment produces the potential for two kinds of errors. The first potential, or Type I, error is the identification of a specific chemical, area, or activity as a health concern when, in fact, it is not a concern (false positive conclusion). The second potential, or Type II, error is the elimination of a chemical, area, or activity from further consideration when, in fact, there should be a concern (false negative conclusion). In the risk assessment, uncertainties were handled conservatively (i.e., health protective choices were preferentially made). This strategy is more likely to produce more false positive errors than false negative errors.

In this assessment, uncertainties relate to (1) the development of media concentrations that people are exposed to, (2) the assumptions about exposure and toxicity, and (3) the characterization of health risks. Uncertainty in the development of media concentrations is due to the inability to sample every square inch of potentially impacted media at a site. Instead, a limited number of samples must be obtained to represent the contaminant characteristics of a larger medium. The sampling strategies for contaminants in this assessment were, in general, designed to prevent underestimation of media concentrations, thus avoiding an underestimation of the risks to public health.

There are uncertainties regarding the quantification of health risks in terms of a number of assumptions about both exposure and toxicity, including both site-specific and general uncertainties. Based on uncertainty in quantifying exposure and toxicity, the risk assessment is more likely to conclude that health risks and hazards exceed target risk goals when health risks are actually negligible than to conclude that chemicals are not a health risk when they actually are. This process is necessary to ensure the protection of public and ecological health.

Protective assumptions compensate for uncertainties in the calculations or simplifications that might potentially underestimate risk. Potential underestimation of risk is always possible because sampling every square inch of a site is technically infeasible, infrequently detected chemicals are typically screened out during the COPC identification process, toxicity data are often incomplete, simplifying assumptions must be made, and all hypothetically possible conditions and pathways cannot be assessed. Protective assumptions are intended to balance factors that tend to underestimate risk.

8.2 ECOLOGICAL RISK ASSESSMENT

Heavy industrial activity at OU B Terrestrial has led to a site that is almost entirely paved or built up, and congested with vehicular traffic. There is effectively no natural habitat area within OU B Terrestrial, and for this reason the ecological risk assessment conducted for OU B focused exclusively on the marine portion of the site. The ecological risk assessment conclusions, presented in the ROD for OU B Marine, were that there is a relatively minor threat to benthic invertebrates, minimal risk to bivalves, limited risks to bottom-dwelling fish and potentially some risk to marine birds. These conclusions were considered in selecting the remedy for OU B Marine as well as the remedy for OU B Terrestrial described in this ROD.

Table 8-1
Primary Chemicals Contributing to Human Health Risks

Chemical	Human Health Scenario			
	Industrial Worker	Construction Worker	Drydock Worker	Future Resident
Arsenic	●	●		●
Benzo(a)pyrene	●			●
Dibenz(a,h)anthracene				●
PCBs	●	●	●	●

Note:
PCB - polychlorinated biphenyl

Table 8-2
Terrestrial Human Health Exposure Scenarios and Pathways

Scenario	Ingestion of Chemicals in Soil	Inhalation of Chemicals With Soil Particles	Dermal Contact With Chemicals in Soil	Dermal Contact With Chemicals in Groundwater
Industrial Worker	●	●	●	
Construction Worker	●	●	●	●
Drydock Worker				●
Future Resident	●	●	●	

Table 8-3
Summary of Chemical Findings and Exposure-Point Concentrations for Soil From 0 to 8 Feet bgs (Industrial Worker Scenario)

Chemical	Concentration Detected (mg/kg)		Frequency of Detection	Average Exposure-Point Concentration (mg/kg)	RME Exposure-Point Concentration (mg/kg)	Statistical Measure for RME
	Minimum	Maximum				
Arsenic	0.8	152	109/118	12.2	16.4	UCL95
Benzo(a)pyrene	0.028	1.8	37/96	0.39	0.58	UCL95
PCBs (total)	0.059	6.6	16/117	0.21	0.32	UCL95

Notes:
Calculations of average exposure-point concentrations include non-detects at half the detection limit.
bgs - below ground surface
mg/kg - milligram per kilogram
PCB - polychlorinated biphenyl
RME - reasonable maximum exposure
UCL95 - 95 percent upper confidence limit

Table 8-4
Summary of Chemical Findings and Exposure-Point Concentrations for Soil From 0 to 15 Feet bgs (Construction Worker and Future Resident Scenarios)

Chemical	Concentration Detected (mg/kg)		Frequency of Detection	Average Exposure-Point Concentration (mg/kg)	RME Exposure-Point Concentration (mg/kg)	Statistical Measure for RME
	Minimum	Maximum				
Arsenic	0.3	229	172/194	11.6	15	UCL95
Benzo(a)pyrene	0.028	8.7	55/151	0.579	0.812	UCL95
Dibenz(a,h)anthracene	0.048	0.89	12/151	0.564	0.8	UCL95
PCBs (total)	0.028	6.6	21/170	0.185	0.269	UCL95

Notes:
Calculations of average exposure-point concentrations include non-detects at half the detection limit.
bgs - below ground surface
mg/kg - milligram per kilogram
PCB - polychlorinated biphenyl
RME - reasonable maximum exposure
UCL95 - 95 percent upper confidence limit

Table 8-5
Summary of Chemical Findings and Exposure-Point Concentrations for Groundwater From 0 to 15 Feet bgs (Construction Worker Scenario)

Chemical	Concentration Detected (µg/L)		Frequency of Detection	Average Exposure-Point Concentration (µg/L)	RME Exposure-Point Concentration (µg/L)	Statistical Measure for RME
	Minimum	Maximum				
Arsenic (total)	0.99	23.6	38/55	3.66	4.56	UCL95
PCBs (total)	0.02	0.04	2/56	0.04	0.04	Maximum

Notes:
Calculations of average exposure-point concentrations include non-detects at half the detection limit.
bgs - below ground surface
µg/L - microgram per liter
RME - reasonable maximum exposure
UCL95 - 95 percent upper confidence limit

Table 8-6
Summary of Chemical Findings and Exposure-Point Concentrations for Drydock Seeps (Drydock Worker Scenario)

Chemical	Concentration Detected (µg/L)		Frequency of Detection	Average Exposure-Point Concentration (µg/L)	RME Exposure-Point Concentration (µg/L)	Statistical Measure for RME
	Minimum	Maximum				
PCBs (total)	0.12	0.12	1/7	0.12	0.12	Maximum

Notes:
Calculations of average exposure-point concentrations include non-detects at half the detection limit.
bgs - below ground surface
µg/L - microgram per liter
RME - reasonable maximum exposure

Table 8-7
Human Health Exposure Parameters

Exposure Pathway	Parameter	Units	Industrial Worker		Construction Worker		Drydock Worker		Adu			
			Avg	RME	Avg	RME	Avg	RME	Avg			
Ingestion of chemicals in soil	Ingestion rate	mg/day	50	50	50	50	NA	NA	100			
	Exposure frequency	days/year	250	250	250	250	NA	NA	275			
	Exposure duration	years	10	25	2.5	5	NA	NA	9			
	Body weight	kg	70	70	70	70	NA	NA	70			
Inhalation of chemicals with soil particles	Inhalation rate	m^3/day	2.5	4.8	2.5	4.8	NA	NA	20			
	Exposure time	hrs/day	8	8	8	8	NA	NA	NA			
	Exposure frequency	days/year	250	250	250	250	NA	NA	275			
	Exposure duration	yrs	10	25	2.5	5	NA	NA	9			
	Body weight	kg	70	70	70	70	NA	NA	70			
Dermal contact with chemicals in soil	Skin surface area	cm^2	1,900	1,900	1,900	1,900	NA	NA	1,900			
	Exposure frequency	days/year	250	250	250	250	NA	NA	275			
	Exposure duration	years	10	25	2.5	5	NA	NA	9			
	Body weight	kg	70	70	70	70	NA	NA	70			
Dermal contact with chemicals in groundwater	Skin surface area	cm^2	NA	NA	1,900	1,900	1,900	1,900	NA			
	Exposure time	hrs/event	NA	NA	4	8	8	8	NA			
	Exposure frequency	events/yr	NA	NA	250	250	75	75	NA			
	Exposure duration	years	NA	NA	2.5	5	10	25	NA			
	Body weight	kg	NA	NA	70	70	70	70	NA			

[a] Average exposures were not estimated for children. The average residential scenario evaluated adults only as the best representation

Notes:
RME - reasonable maximum exposure
mg - milligram
cm - centimeter
cm^2 - square centimeter
kg - kilogram (1 kg = 2.2 pounds)
yr - year
NA - not applicable (exposure pathway not evaluated quantitatively because analysis found the pathway to be either incomplete or an i
exposure)

Table 8-8
Noncancer Toxicity Data Summary

Chemical of Concern	Length of Exposure[a]	Oral Reference Dose (mg/kg-day)	Oral Combined Uncertainty/ Modifying Factors	Primary Oral Target Organ	Inhalation Reference Dose (mg/kg-day)	Inhalation Combined Uncertainty/ Modifying Factors	Pr Inh T O	
Arsenic	chronic	0.0003	3	skin	NA	NA		
	subchronic	0.0003	3	NA	NA	NA		
Benzo(a)pyrene[b]	chronic	NA	NA	NA	NA	NA		
	subchronic	NA	NA	NA	NA	NA		
Dibenz(a,h)anthracene[b]	chronic	NA	NA	NA	NA	NA		
	subchronic	NA	NA	NA	NA	NA		
Total PCBs	chronic	0.00002	300	immune system	NA	NA		
	subchronic	0.00005	100	NA	NA	NA		

[a]Chronic exposure is longer than 7 years; subchronic is between 2 weeks and 7 years.
[b]No non-cancer toxicity data available

Notes:
mg/kg-day - milligram per kilogram per day
NA - not available or not applicable
PCB - polychlorinated biphenyl
USEPA - U.S. Environmental Protection Agency
USEPA 1998 - U.S. Environmental Protection Agency. 1998. Integrated Risk Information System (IRIS) On-Line Database. Office of Research anc Environmental Criteria and Assessment Office. Washington, D.C.
USEPA 1997 - U.S. Environmental Protection Agency. 1997. Health Effects Assessment Summary Tables (HEAST). FY-97 Update. EPA 540/R-9 for Environmental Assessment. August 8, 1997.

Table 8-9
Cancer Toxicity Data Summary

Chemical of Concern	Oral Cancer Slope Factor (mg/kg-day)	Inhalation Cancer Slope Factor (mg/kg-day)	Weight-of-Evidence Class	Source
Arsenic	1.5	15	A	USEPA 1998
Benzo(a)pyrene	7.3	NA	B2	USEPA 1998
Dibenz(a,h)anthracene	7.3	NA	B2	USEPA 1993
Total PCBs	2	2	B2	USEPA 1998

Notes:
A - human carcinogen
B2 - probable human carcinogen (sufficient evidence in animals, but inadequate evidence in humans)
C - possible human carcinogen
mg/kg-day - milligram per kilogram per day
NA - not available
PCB - polychlorinated biphenyl
USEPA - U.S. Environmental Protection Agency
USEPA 1998 - U.S. Environmental Protection Agency. 1998. Integrated Risk Information System (IRIS) On-Line Database. Office of Research and Development, Environmental Criteria and Assessment Office. Washington, D.C.
USEPA 1993 - .U.S. Environmental Protection Agency. 1993. Provisional Guidance for Quantitative Risk Assessment of Polycyclic Aromatic Hydrocarbons. EPA 600/R-93/089. Office of Research and Development. July 1993.

Table 8-10
Human Health Risk Characterization Summary—Noncarcinogens

Chemical	Hazard Quotient				Total Hazard Quotient [a]
	Ingestion of Chemicals in Soil	Inhalation of Airborne Chemicals	Dermal Contact with Chemicals in Soil	Dermal Contact with Chemicals in Groundwater or Seeps	
Industrial Worker – RME					
Arsenic	0.027	---	---	---	0.027
Total PCBs	0.0078	---	0.042	---	0.049
				Hazard Index	0.2
Industrial Worker – Average					
Arsenic	0.02	---	---	---	0.02
Total PCBs	0.0051	---	0.016	---	0.022
				Hazard Index	0.09
Construction Worker – RME					
Arsenic	0.024	---	---	---	0.024
Total PCBs	0.0026	---	0.014	0.084	0.1
				Hazard Index	0.2
Construction Worker – Average					
Arsenic	0.019	---	---	---	0.019
Total PCBs	0.0018	---	0.0058	0.042	0.05
				Hazard Index	0.1
Dry Dock Worker – RME					
Total PCBs	---	---	---	0.19	0.19
				Hazard Index	0.2
Dry Dock Worker – Average					
Total PCBs	---	---	---	0.19	0.19
				Hazard Index	0.2
Future Resident – RME					
Arsenic	0.18	---	---	---	0.18
Total PCBs	0.049	---	0.15	---	0.2
				Hazard Index	0.9
Future Resident – Average					
Arsenic	0.042	---	---	---	0.042
Total PCBs	0.01	---	0.016	---	0.026
				Hazard Index	0.2

[a] Only primary risk-causing chemicals shown, so individual values typically do not sum to total hazard index

Note:
PCB - polychlorinated biphenyl
RME - reasonable maximum exposure

Table 8-11
Human Health Risk Characterization Summary—Carcinogens

Chemical	Cancer Risk				Total Cancer Risk[a]
	Ingestion of Chemicals in Soil	Inhalation of Airborne Chemicals	Dermal Contact with Chemicals in Soil	Dermal Contact with Chemicals in Groundwater or Seeps	
Industrial Worker – RME					
Arsenic	4.3E-06	2.5E-08	---	---	4.3E-06
Benzo(a)pyrene	7.4E-07	---	---	---	7.4E-07
Total PCBs	1.1E-07	6.5E-11	5.9E-07	---	7.1E-07
Total Cancer Risk	6E-06	4E-07	7E-07	---	7E-06
Industrial Worker – Average					
Arsenic	1.3E-06	3.9E-09	---	---	1.3E-06
Benzo(a)pyrene	2.0E-07	---	---	---	2.0E-07
Total PCBs	2.9E-08	8.9E-12	9.4E-08	---	1.2E-07
Total Cancer Risk	2E-06	4E-08	1E-07	---	2E-06
Construction Worker – RME					
Arsenic	7.9E-07	4.6E-09	---	---	7.9E-07
Total PCBs	1.9E-08	1.1E-11	1.0E-07	6.0E-07	7.2E-07
Total Cancer Risk	1E-06	7E-08	1E-07	7E-07	2E-06
Construction Worker – Average					
Arsenic	3.0E-07	9.2E-10	---	---	3.0E-07
Total PCBs	6.5E-09	2.0E-12	2.1E-08	1.5E-07	1.8E-07
Total Cancer Risk	5E-07	1E-08	2E-08	2E-07	7E-07
Dry Dock Worker – RME					
Total PCBs	---	---	---	2.7E-06	2.7E-06
Total Cancer Risk	---	---	---	3E-06	3E-06
Dry Dock Worker – Average					
Total PCBs	---	---	---	1.1E-06	1.1E-06
Total Cancer Risk	---	---	---	1E-06	1E-06
Future Resident – RME					
Arsenic	3.5E-05	2.0E-08	---	---	3.5E-05
Benzo(a)pyrene	9.3E-06	---	---	---	9.3E-06
Dibenz(a,h)anthracene	9.1E-06	---	---	---	9.1E-06
Total PCBs	8.4E-07	4.8E-11	2.6E-06	---	3.4E-06
Total Cancer Risk	6E-05	3E-07	3E-06	---	6E-05

Table 8-11 (Continued)
Human Health Risk Characterization Summary—Carcinogens

Chemical	Cancer Risk				Total Cancer Risk[a]
	Ingestion of Chemicals in Soil	Inhalation of Airborne Chemicals	Dermal Contact with Chemicals in Soil	Dermal Contact with Chemicals in Groundwater or Seeps	
Future Resident – Average					
Arsenic	2.4E-06	3.6E-09	---	---	2.4E-06
Benzo(a)pyrene	5.8E-07	---	---	---	5.8E-07
Dibenz(a,h)anthracene	5.7E-07	---	---	---	5.7E-07
Total PCBs	5.1E-08	7.8E-12	8.2E-08	---	1.3E-07
Total Cancer Risk	4E-06	4E-08	9E-08	---	4E-06

[a]Only primary risk-causing chemicals shown, so individual values typically do not sum to total risk

Note:
PCB - polychlorinated biphenyls
RME - relative maximum exposure
4.3E-06: equivalent to 4.3 x 10^{-6}

9.0 REMEDIAL ACTION OBJECTIVES

9.1 NEED FOR REMEDIAL ACTION

The baseline human health risk assessment for OU B Terrestrial concluded that risks to site workers are acceptable under current land use conditions and controls. Levels of contaminants in soil and groundwater would require attention if a change to residential use was contemplated in the future.

Because of the industrial nature of OU B Terrestrial and its lack of natural habitat, no ecological risk assessment was performed for this upland area. There is no ecological basis within OU B Terrestrial for undertaking remedial action.

Although predicted risks within OU B Terrestrial under current conditions, namely with contaminated soil and groundwater contained in place, may not require any action other than institutional controls to ensure protectiveness, potential movement of contaminants off the site remains a matter of concern. EPA guidance (e.g., Role of the Baseline Risk Assessment in Superfund Remedy Selection, OSWER 9355.0-30, April 22, 1991) specifically notes that remedial action may be taken where there is a significant chance of a release occurring that could result in unacceptable risk. The stormwater facilities at the site have the potential to transport some contaminated material out of the terrestrial area. Catch basin sampling within OU B Terrestrial and a recent stormwater facility treatability study in central OU B Terrestrial have documented the presence of contaminated sediments within the stormwater system.

Erosion of contaminated soil in less protected areas of the shoreline is also a possible means of contaminants moving off site. Although the risks from potential stormwater system transport of contaminated material and erosion of soil have not been explicitly assessed, the human health risk assessment for OU B Marine identified potential long-term risks above acceptable levels to subsistence seafood harvesters consuming bottom-dwelling fish exposed to contaminated sediments. Marine sediment cleanup has been largely accomplished through the OU B Marine ROD and remedial action. However, to prevent recontamination, additional action is needed. Thus, the stormwater facilities and exposed soil with the potential to erode along the shoreline are appropriate targets for remedial action at OU B Terrestrial.

9.2 REMEDIAL ACTION OBJECTIVES

Based on the need for action summarized above, the remedial action objectives (RAOs) for OU B Terrestrial are:

- Continue to limit human exposure to site soils and groundwater
- Reduce the potential for chemical transport and control the threat of recontamination of the adjacent marine environment from:
  - Accumulation of sediment or debris in the stormwater system
  - Infiltration of soil and groundwater into the stormwater system
  - Infiltration of surface water into site soil
  - Erosion of shoreline soil

9.3 CLEANUP LEVELS

No cleanup levels have been established for this site. The RAOs are based on the need to contain contaminated terrestrial media (i.e., accumulated stormwater system sediment and debris, soil, and groundwater) and limit transport to the adjacent marine environment. The RAOs do not identify the need to remediate stormwater system sediment, soil, groundwater, or surface water based on risks due to direct exposure to those media.

10.0 DESCRIPTION OF ALTERNATIVES

The RAOs identified in Section 9 were used to identify a range of technologies for addressing contamination in soil, groundwater, stormwater, and catch basin sediment. These technologies were then screened for their applicability to actual site conditions, leading to a set of technologies suitable for use in a range of cleanup alternatives for OU B Terrestrial. As part of the screening process, the potential applicability of active methods of cleaning soil and groundwater was evaluated. For both soil and groundwater, the conclusion was that even for the highest contaminant levels found at OU B Terrestrial the costs of the most feasible permanent treatment technology were disproportionate to the limited potential benefits. Thus the four alternatives discussed below do not include active treatment of soil or groundwater. These alternatives are briefly summarized in Table 10-1.

10.1 ALTERNATIVE 1: NO ACTION

Alternative 1 is included as required under the NCP to provide a basis for comparing the cost effectiveness of other alternatives. Inclusion of this alternative helps ensure that the consequences of no action are fully evaluated and that instances in which no action may be appropriate are fully recognized so that needless remediation expenses can be avoided when only marginal benefits are expected.

Under this alternative, no proactive measures would be undertaken to remediate concentrations of chemicals and no institutional controls would be imposed to reduce or prevent human exposure. Concentrations of inorganic materials would remain comparatively constant across the site, but gradual reduction in concentration of organic compounds would occur through natural breakdown processes. This alternative would not include environmental monitoring to assess the effectiveness of natural attenuation or to verify protection of human health or the environment.

10.2 ALTERNATIVE 2: INSTITUTIONAL CONTROLS AND MONITORING

Institutional controls are non-engineered measures developed to restrict activities, access, and exposure to site contamination. The primary emphasis of Alternative 2 is to use institutional controls to limit human exposure to chemicals and to continue to track potential risks and impacts attributable to site conditions through environmental monitoring.

Because contaminants found to be widely distributed in site soil and groundwater will be left in place, these controls will apply throughout OU B Terrestrial and will be maintained until contaminant levels allow for unlimited use and unrestricted exposure.

Alternative 2 would include the following components:

- Institutional Control Components:
  - Limiting site access to official personnel
  - Current and future land use restrictions
  - Excavation management plan
  - Groundwater use restrictions
  - Institutional control monitoring
- Environmental Monitoring Components:
  - Groundwater monitoring
  - Storm water monitoring
  - Drydock outfall monitoring
- Periodic reviews

The Navy has implemented some of these components, for example access control through use of fencing and a security force, and restricts site use to industrial activities.

10.2.1 Institutional Control Components

Access Control

The BNC is fenced and access is limited to official personnel. The BNC is not accessible to the general public. Access control would be maintained under Alternative 2.

Land Use Restrictions

Cleanup decisions were based on the assumption that land use within OU B Terrestrial is strictly industrial in nature and will remain so until contaminant levels allow for unlimited use and unrestricted exposure.

Future Land Use Restrictions in Case of Transfer

The Navy would document any required land use restrictions in a Finding of Suitability to Transfer.

Excavation Management Plan

Future Navy industrial activities within OU B Terrestrial will include construction work involving soil excavation. The Navy will develop an Excavation Management Plan with which future excavation work must comply. The plan will require contractors to coordinate with BNC management prior to any excavation work and provide procedures to protect human health and the environment and maintain the remedy.

Groundwater Use Restrictions

Groundwater use would be restricted to monitoring purposes; there is no beneficial use of site groundwater.

Institutional Control Monitoring

As part of the remedial design process, the Navy would develop a site-wide IC Work Plan documenting the nature of the institutional controls applicable to the site and identifying measures to assess the effectiveness of these controls.

10.2.2 Environmental Monitoring Components

Groundwater Monitoring

The Navy would install new shoreline monitoring wells to measure chemical concentrations in groundwater effectively at the point of discharge to the marine environment. Existing monitoring wells directly upgradient of the drydocks, or new wells if necessary would also be sampled. For comparison with surface water criteria, methods would be developed to estimate the effects of attenuation, consistent with the use of a conditional point of compliance as provided for under MTCA.

Stormwater Monitoring

Periodic sampling of stormwater throughout OU B Terrestrial would be performed to identify trends in stormwater quality and assess potential risks to the marine environment associated with the stormwater system.

Drydock Outfall Monitoring

Drydock outfalls would be sampled on a periodic basis to evaluate the effectiveness of upland source control and compliance with applicable standards.

10.2.3 Periodic Reviews

Because contaminants would remain on site at concentrations that do not allow unlimited site use and unrestricted exposure, a review of the remedy would be required at least every 5 years.

10.3 ALTERNATIVE 3A: INSTITUTIONAL CONTROLS AND MONITORING, PAVING, SHORELINE PROTECTION, AND COMPREHENSIVE STORMWATER SYSTEM INSPECTION/REPAIR

10.3.1 Institutional Control Components

Alternative 3a would include the same institutional control components as Alternative 2.

10.3.2 Environmental Monitoring Components

Groundwater Monitoring

Alternative 3a would include the same groundwater monitoring as Alternative 2.

10.3.3 Remedial Construction

Alternative 3a would also include three remedial construction measures, described in more detail in the following paragraphs.

Site-Wide Capping

The majority of OU B Terrestrial is already paved with asphalt or concrete. Alternative 3a would include paving those remaining unpaved areas for which paving is feasible to further reduce the potential for human contact with soil as well as the potential for precipitation and surface runoff to pass through soil to the groundwater. In a few cases the Navy will likely use a clean soil cover with vegetation instead of paving where a landscaped approach is possible and appropriate. The alternative would also include repairs to any badly damaged existing pavement to limit the potential for precipitation to infiltrate site soils. As discussed in Section 12, paving of a number of previously unpaved sites was completed in 1998-2000 as part of a non-time critical removal action.

Shoreline Protection

Alternative 3a would include repairs or enhancement of OU B Terrestrial shoreline areas where there may be potential for fill material to erode into Sinclair Inlet. Most of the OU B shoreline is made up of comparatively solid structures such as concrete bulkheads, quay walls, or sheetpile, effectively precluding erosion. However, shoreline areas protected with armor rock are subject to potential erosion or slope failure due to insufficient armor rock or steep slopes, and therefore are potential candidates for remediation. These riprap areas are located in Sites 10 West, 10 Central, and 10 East.

Measures for shoreline protection would be evaluated based on three prioritized criteria, (1) effectiveness at achieving erosion control, (2) compatibility with site use at the BNC, and (3) the potential to avoid, minimize or mitigate impacts to marine habitat in compliance with the identified applicable or relevant and appropriate requirements (ARARs): Clean Water Act, Section 404 (33 CFR Parts 320-330, 40 CFR Part 230) and Hydraulics Project Approval (WAC 220-110).

Comprehensive Stormwater System Cleaning, Inspection, and Repair/Replacement

Alternative 3a would include an extensive program to upgrade the functionality of stormwater facilities throughout OU B Terrestrial. This program would involve three primary components: cleaning of stormwater lines and catch basins, inspection of the lines and catch basins, and repair of stormwater facilities with significant structural damage. It is estimated that more than 25 miles of stormwater piping, ranging from 4" to 54" in diameter, are in place within OU B Terrestrial. The system includes an estimated 2,300 catch basins, although a large number of these catch basins are likely associated with the comparatively small-diameter piping serving crane and rail track drains and roof drains and thus low-priority compared to basins in larger pipes. The stormwater system includes a total of approximately 92 outfalls discharging to Sinclair Inlet, although only 22 of these are major outfalls believed to serve substantial areas of the BNC.

The initial stage in the stormwater facility work would consist of cleaning sediments and other solid materials out of the pipelines and catch basins. Similar stormwater facility cleaning performed as part of the remedy for OU NSC as well as a recent stormwater system treatability study in central OU B Terrestrial demonstrated that cleaning is an effective means of removing a potential contaminant source from the site. These actions also demonstrated that existing utility records are unreliable, and this task would likely involve considerable preliminary on-site research regarding the stormwater system configuration. For example, fish tapes and video cameras would likely have to be routinely employed to establish line routing and connections. Care would be required to reduce the possibility of waste being discharged to Sinclair Inlet during the cleaning operation.

Once waste materials have been removed from the lines, the stormwater facilities will be visually inspected to verify the cleaning operation and identify facilities potentially in need of repair.

Repair of stormwater lines and catch basins with significant structural damage at this active, congested industrial site will require careful coordination. A variety of approaches will likely be required, possibly including installing new liner materials in existing lines, abandoning some line sections in place and running new lines nearby, and drilling and jacking new line sections into place under existing buildings. Given the complexity and potential risks associated with restoration of an extensive set of underground utilities at this crowded and active industrial site, latitude will be needed for on-site engineering judgment based on actual field conditions.

Waste collected during cleaning operations would be characterized for disposal. Depending on the results, solid materials may require landfill disposal, but it is possible that liquid wastes would be acceptable for discharge to the City of Bremerton sewage treatment facilities.

10.3.4 Periodic Reviews

Because contaminants would remain on site at concentrations that do not allow unlimited site use and unrestricted exposure, a formal review of the monitoring activities would be required at least every 5 years.

10.4 ALTERNATIVE 3B: INSTITUTIONAL CONTROLS AND MONITORING, PAVING, SHORELINE PROTECTION, AND SELECTED STORMWATER SYSTEM INSPECTION/REPAIR

Alternative 3b is identical to Alternative 3a except that the stormwater system work would be limited to a subset of the stormwater facilities, with priority assigned to lines that traverse the most contaminated soil found at OU B Terrestrial. An estimated 10 to 15 percent of the overall OU B Terrestrial stormwater facilities would be upgraded under this alternative. Because the majority of the stormwater facilities would not be cleaned, inspected, or upgraded, post-remedy stormwater sampling and analysis would be required.

10.5 RELATIVE FEASIBILITY AND COST OF ALTERNATIVES

Table 10-2 summarizes the primary concerns associated with each alternative as well as changes in the alternatives since the time of the feasibility study. For Alternatives 1 and 2 the primary concerns involve the risks posed by contaminants present in stormwater catch basins and lines and in shoreline soil subject to potential erosion. The primary concern associated with Alternative 3a is the cost and complexity of the stormwater system work. For Alternative 3b the primary concern is that the savings resulting from cleaning only a portion of the stormwater system will likely be offset by greater uncertainty regarding remedy effectiveness, potentially leading to a more complex decision-making process and possibly even higher long-term costs.

Table 10-3 summarizes the costs for each of the alternatives, with a discount rate of 7% used to calculate the present-worth cost over periods of 5 and 40 years.

Table 10-1
Summary of Alternatives for OU B Terrestrial

Alternative	Description
Alternative 1: No Action	• No active cleanup would occur • No significant change in levels of inorganic material would occur, but some reduction in levels of organic compounds is expected due to natural breakdown processes • Does not include any monitoring
Alternative 2: Institutional Controls and Monitoring	• Includes non-engineered measures (institutional controls) to control potential access to site and exposure to chemicals and restrict land and groundwater use • Includes monitoring of groundwater, stormwater, and drydock discharge water
Alternative 3a: Institutional Controls and Monitoring, Paving, Shoreline Protection, and Comprehensive Stormwater System Restoration	• Includes institutional controls to control potential access to site and exposure to chemicals and restrict land and groundwater use • Includes groundwater monitoring • Includes comprehensive program of stormwater system cleaning, inspection, repair/replacement, and post-remedy verification • Includes upgrading of pavement • Includes shoreline stabilization
Alternative 3b: Institutional Controls and Monitoring, Paving, Shoreline Protection, and Limited Stormwater System Restoration	• Includes all elements of Alternative 3a except that only a subset of the stormwater facilities would be cleaned, inspected, and repaired or replaced, prioritized on basis of level of contamination in soils traversed by stormwater lines • Includes stormwater monitoring

Table 10-2
Summary of Feasibility of Alternatives

Alternative	Major Concerns	Primary Modifications Since Feasibility Study
1: No Action	• Considerable contaminated material likely left in place in stormwater system, and damaged stormwater facilities have potential to transport contaminated soil and groundwater to Sinclair Inlet. No mechanism for detecting discharge of contaminants via stormwater system. • Shoreline erosion and release of contaminated soil to inlet can be anticipated.	• None
2: Institutional Controls (ICs)	• Considerable contaminated material likely left in place in stormwater system and damaged stormwater facilities have potential to transport contaminated groundwater and soil to Sinclair Inlet. Monitoring of stormwater system may trigger action on stormwater facilities. Need for future restoration of stormwater system almost inevitable. • Shoreline erosion and release of contaminated soil to inlet can be anticipated.	• Groundwater monitoring would include wells directly upgradient of drydocks, with allowance for attenuation.
3a: ICs, Paving, Shoreline Protection, and Comprehensive Stormwater System Restoration	• Although quite costly and complex, considered feasible.	• Revised groundwater monitoring as in Alternative 2. • Visual inspection to confirm success of stormwater system work, followed with regular catchbasin inspection and cleaning versus confirmation sampling
3b: ICs, Paving, Shoreline Protection, and Limited Stormwater System Restoration	• Costly, complex decision process during remedial action regarding priorities and when work in a given storm drainage basin can be considered complete. Substantial expenditures for sampling and analysis instead of cleanup.	• Revised groundwater monitoring as in Alternative 2.

Table 10-3
Summary of Alternative Costs

Alternative	Capital Cost	Annual O&M	Total Present Worth, 5 Years[a]	Total Present Worth, 40 Years[a]
1: No Action	$14,000	$0	$14,000	$14,000
2: Institutional Controls (ICs)	$323,000	$129,000	$853,000	$2,046,000
3a: ICs, Paving, Shoreline Protection, and Comprehensive Stormwater System Restoration	$11,940,000	$298,000	$13,160,000	$15,910,000
3b: ICs, Paving, Shoreline Protection, and Limited Stormwater System Restoration	$5,388,000	$318,000	$6,692,000	$9,628,000

[a]Present worth costs are in year 2002 dollars computed using a discount rate of 7%.

11.0 COMPARATIVE ANALYSIS OF ALTERNATIVES

Through promulgation of the National Contingency Plan, 40 CFR 300.430, the EPA has developed the following nine criteria for the detailed evaluation of remedial alternatives:

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

These criteria address CERCLA requirements as well as related technical and policy considerations important in selecting remedial procedures. The first two criteria serve as threshold criteria that must be met by an alternative prior to selection. In addition to serving as the basis for detailed analyses conducted during the FS process, the nine criteria provide the framework by which a remedial action alternative is selected.

Each of the evaluation criteria is described in detail in EPA guidance. An overview of each criterion is included in the following discussion of the comparative analysis. Table 11-1 briefly summarizes the conclusions of the comparative analysis.

11.1 OVERALL PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The criterion of overall protection of human health and the environment addresses whether an alternative would provide adequate protection of human health and the environment and how risks posed through each exposure pathway would be eliminated, reduced, or controlled, through treatment, engineered controls, or institutional controls.

Human health risks identified within OU B Terrestrial were within acceptable limits as long as current site conditions persist. However, as noted in Section 9, conditions within OU B Terrestrial also pose a threat to the marine environment from potential transport of contaminants present at the site. As documented in the ROD for OU B Marine, the human health risk assessment identified potential long-term risks above acceptable levels to subsistence seafood harvesters consuming bottom-dwelling fish exposed to contaminated sediments.

Alternative 1, the No Action alternative, does not include any actions to control potential transport of contaminants to the marine environment. Thus, Alternative 1 is not fully protective of human health and does not meet this threshold criterion; it is eliminated from further consideration and is not included in the following sections discussing the remaining evaluation criteria.

Alternative 2, Institutional Controls and Monitoring, would be effective at protecting human health within OU B Terrestrial. Institutional controls would continue to limit the potential for contact with chemicals present at the site and groundwater, stormwater, and drydock discharge water would be monitored. Although this alternative does not include any measures to control potential transport of contaminants to the marine environment, the results of stormwater monitoring could be taken into consideration in future operation, maintenance, and upgrading of the stormwater system.

Alternative 3a, Institutional Controls and Monitoring, Paving, Shoreline Protection, and Comprehensive Stormwater System Inspection/Repair, would be highly protective of human health and the marine environment. In addition to the measures included in Alternative 2 to control potential contact with chemicals present at the site, this alternative would include paving of limited areas not currently paved and upgrading currently damaged pavement. Enhanced shoreline protection measures would be installed in the limited areas where there is a potential for erosion to carry soil to the marine environment. Most significantly, extensive cleaning and restoration of the stormwater facilities would effectively address the primary mechanism for potentially transporting significant quantities of contaminants to the marine environment.

Alternative 3b, Institutional Controls and Monitoring, Paving, Shoreline Protection, and Selected Stormwater System Inspection/Repair, would be more effective than Alternative 2 but somewhat less effective than Alternative 3a at protecting human health and the environment. Because only a portion of the stormwater facilities would be cleaned and restored under this alternative, a potential for future release of contaminants to the marine environment would exist. Stormwater monitoring under this alternative would provide a means of identifying contaminant releases.

In summary, the alternatives rank as follows, from worst to best, on protection of human health and the environment:

- Alternative 1 – not protective;

- Alternative 2 – moderately protective;
- Alternative 3b – highly protective; and
- Alternative 3a – most protective

11.2 COMPLIANCE WITH ARARS

Section 121(d) of CERCLA and NCP 300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain legally applicable or relevant and appropriate Federal and State requirements, standards, criteria, and limitations, which are collectively referred to as "ARARs," unless such ARARs are waived under CERCLA section 121(d)(4).

Applicable requirements are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that specifically address a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance found at a CERCLA site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be applicable. *Relevant and appropriate requirements* are those cleanup standards, standards of control, or other substantive requirements, criteria, or limitations promulgated under Federal environmental or State environmental or facility siting laws that, while not "applicable" to a hazardous substance, pollutant, contaminant, remedial action, location, or other circumstance at a CERCLA site address problems or situations sufficiently similar to those encountered at the CERCLA site that their use is well-suited to the particular site. Only those State standards that are identified by a State in a timely manner and that are more stringent than Federal requirements may be relevant and appropriate.

Compliance with ARARs addresses whether the remedy will meet all of the applicable or relevant and appropriate requirements of other State and Federal environmental statutes or provides a basis for invoking a waiver.

Alternatives 2, 3a, and 3b would all be compliant with ARARs as long as the site use remains industrial in nature, measures to prevent exposure to contaminated media are maintained, and monitoring programs to track compliance are implemented. No ARARs waivers are being invoked.

In summary, the alternatives that comply with the ARARs are ranked from worst to best, demonstrating the ARARs preference for contaminant reduction and permanent solutions:

- Alternative 2 – complies with ARARs
- Alternative 3b – complies with ARARs and is preferable to Alternative 2 due to inclusion of active measures to control potential contact with contaminants and reduce amounts of on-site contamination
- Alternative 3a – complies with ARARs and is preferable to Alternatives 2 due to greater permanence and 3b due to increased degree of removal of contaminants from stormdrain system

11.3 LONG-TERM EFFECTIVENESS AND PERMANENCE

The criterion of long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time. This criterion includes the consideration of residual risk that will remain on site following remediation, and the adequacy and reliability of controls.

Provided that site paving continues to limit potential exposure to contaminants, Alternative 2 would be moderately compliant with this criterion. Monitoring actions included in this alternative would be effective in detecting off-site transport of contaminants. However, Alternatives 3a and 3b rank higher than Alternative 2 because they address stormdrain contaminants and include pavement restoration and shoreline restoration measures. Because of the greater extent of stormdrain remediation, Alternative 3a ranks highest of all.

In summary, the alternatives rank as follows from worst to best on long-term effectiveness and permanence:

- Alternative 2 – moderately compliant
- Alternative 3b – highly effective and permanent
- Alternative 3a – most effective and permanent due to greater degree of removal of contaminants from site

11.4 REDUCTION OF TOXICITY, MOBILITY, OR VOLUME THROUGH TREATMENT

The criterion of reduction of toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of a remedy.

None of the alternatives would include actual treatment as a component of the remedy. However, Alternatives 3a and 3b would include active measures to reduce potential contaminant mobility as well as the amount of on-site contaminated material potentially susceptible to off-site transport. Based on a comparison of the degree of potential remaining mobility of contaminants, Alternative 3a ranks highest, followed by Alternative 3b, since 3b addresses only a portion of the stormwater facilities.

The alternatives rank as follows from worst to best on reduction of toxicity, mobility, or volume through treatment:

- Alternative 2 – no reduction
- Alternative 3b – considerable reduction in quantity and mobility of on-site contaminants
- Alternative 3a – greatest reduction in quantity and mobility of on-site contaminants

11.5 SHORT-TERM EFFECTIVENESS

The criterion of short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community, and the environment during construction of the remedy. Alternatives involving more complex construction are inherently more risky to workers and the community.

Of the active alternatives, Alternative 2 is the least complex and thus ranks highest on short-term effectiveness. An implementation time of 1 to 2 years is projected for Alternative 2 for developing Land Use Control and Excavation Management Plans and initiating monitoring. Alternatives 3a and 3b are approximately equivalent on this criterion. Both of these alternatives would include shoreline stabilization work with inherent impacts to the environment and construction workers. Alternatives 3a and 3b each also would involve complex and time-consuming stormwater facility restoration work with attendant impacts and risk to construction workers and potential impact to the environment. In terms of the stormwater facility work, Alternative 3a would involve considerably more construction activity than 3b, but 3b would involve a more complex decision process related to setting priorities and adapting to findings in the field. Projected implementation times are 5 years for Alternative 3a and 3 years for Alternative 3b.

The alternatives rank as follows, from worst to best, on short-term effectiveness:

- Alternative 3b – significant potential impacts to construction workers and the environment
- Alternative 3a – potential impacts to construction workers and the environment approximately equal to those of 3b
- Alternative 2 – least potential impacts to the environment and workers

11.6 IMPLEMENTABILITY

The criterion of implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are also considered. Increased amounts of construction and greater complexity decrease the implementability of an alternative.

Alternative 2 is straightforward and easily implemented because it would consist of only institutional controls and monitoring. Alternative 3a would include more construction activity than Alternative 3b, but this is largely balanced by the expected increased decisionmaking complexity, related to cleaning and restoring only a portion of the stormwater facilities, and the stormwater facility monitoring that would be required. Alternatives 3a and 3b rank significantly below Alternative 2 on implementability but are considered approximately comparable.

The alternatives rank as follows from worst to best on implementability:

- Alternative 3b – implementation of alternative expected to be quite challenging

- Alternative 3a – implementation challenges expected to be approximately comparable to those of 3b

- Alternative 2 – most readily implemented

11.7 COST

Cost estimates were prepared using costing techniques that typically achieve an accuracy of +50 percent to –30 percent for a specified scope of actions. Because of contaminated soil and groundwater left in place, Alternatives 2, 3a, and 3b would all require maintenance and monitoring into the foreseeable future. Cost estimates were prepared for both 5 and 40 years of operation at an annual discount rate of 7 percent. The estimated costs of the alternatives are summarized in Table 11-1.

Table 11-1 shows that the cost of implementing Alternative 3a is estimated to be significantly higher than that of Alternative 3b, due to the greater extent of stormwater facility restoration included in 3a. However, Alternative 3b would be somewhat exploratory in nature, with the need for frequent decisions as to which stormwater lines to clean, inspect, and repair and where in a given section of the system to terminate active remediation. In some cases these decisions could require collection and analysis of environmental samples and/or additional investigation work, both likely resulting in delays in construction and increased management costs. For this reason the projected total costs for Alternative 3b are much less certain than those projected for Alternative 3a, and the fraction of the overall costs for 3b that would go directly towards cleanup of contaminated materials is less than for 3a.

In terms of cost, the alternatives rank as follows, from worst to best:

- Alternative 3a – greatest projected construction costs

- Alternative 3b – construction costs projected to be less than for 3b, but projections are inherently much less certain than those for 3a

- Alternative 2 – lowest cost

11.8 STATE ACCEPTANCE

The Washington State Department of Ecology has expressed support for Alternatives 3a and 3b with a preference for 3a due to the greater extent of contaminant removal.

11.9 COMMUNITY ACCEPTANCE

The RAB has been involved in the review and comment process for all project documents leading to this ROD. On August 28, 2002, the Navy held an open house and public meeting to discuss the proposed plan for final action for OU B Terrestrial. The public comment period extended from August 16, 2002, to September 27, 2002.

No objection to the proposed remedy was expressed in either the formal comments received from the community or during informal dialogue at RAB meetings. The community does not appear averse to the selected remedy.

The Suquamish Tribe supports the paving and stormwater system measures of the selected remedy but does not fully support the shoreline stabilization measures.

Public comments received at the public meeting and during the public comment period as well as Suquamish Tribe comments regarding the shoreline stabilization measures are summarized and addressed in the Responsiveness Summary of this ROD.

Table 11-1
Comparison of Cleanup Alternatives

Criterion	Alternative 1: No Action	Alternative 2: Institutional Controls and Monitoring	Alternative 3a: Institutional Controls and Monitoring, Paving, Shoreline Protection, and Comprehensive Stormwater System Restoration	I S
Overall protection of human health and the environment	Not protective of marine environment. However, adequate for protection of human health in terrestrial environment given industrial site use.	Fair	Very good	C
Compliance with ARARs	Would not meet State or Federal regulations	Fair	Very good	C
Reduction of toxicity, mobility, or volume through treatment	None	None	None: no treatment. However, would substantially reduce major potential source of contamination to marine environment through removal of contaminants accumulated in stormwater facilities as well as repairs to prevent soil and groundwater from entering stormwater lines.	N F n c e s c i r
Short-term effectiveness	Not applicable	Good	Fair	F
Long-term effectiveness and permanence	Not applicable	Fair	Very good	C
Implementability	Very good	Good	Fair	F
Cost [a]	$14,000/$14,000	$850,000/$2,000,000	$13,000,000/$16,000,000	$

[a] Present-worth costs are in year 2002 dollars for periods of 5 years and 40 years, based on a discount rate of 7%.
[b] Costs for Alternative 3b are considerably more uncertain than for other alternatives due to exploratory nature of selective stormwater

12.0 THE SELECTED REMEDY

12.1 SUMMARY OF THE RATIONALE FOR THE SELECTED REMEDY

Alternative 3a is the Selected Remedy for OU B Terrestrial. Alternative 3a is protective of human health and the environment and provides the best overall balance of risk reduction and cost effectiveness. As discussed in Section 9, there are no specific cleanup levels associated with the Selected Remedy. Some of the key factors in the selection of Alternative 3a include the following:

- Alternative 3a is more protective of human health and the environment than the other alternatives because it involves a comprehensive cleaning and restoration of stormwater facilities, effectively eliminating what appears to be the primary potential threat at the site.

- Alternative 3a complies with ARARs.

- Alternative 3a also gets the highest rating of all the alternatives on long-term effectiveness and permanence. The paving and shoreline stabilization measures included in both Alternatives 3a and 3b should be effective in controlling contamination left on site. The more comprehensive cleanup of the stormwater facilities included in Alternative 3a will have the effect of leaving less contamination on site than would Alternative 3b.

- Alternative 3a is projected to be more expensive than Alternative 3b, but significantly greater uncertainty in the cost of Alternative 3b complicates the comparison of costs for these two alternatives. Alternative 3b involves a more complex decisionmaking process than Alternative 3a and the likelihood of cost increases due to unforeseen conditions during construction is consequently greater. Much of the apparent cost savings in Alternative 3b could also be eliminated through the need for frequent environmental sampling and laboratory analysis to support decisions as to which stormwater lines are to be remediated. Sampling and analysis would lead to delays and additional costs. The Navy would rather target remedial resources directly towards cleanup and thus prefers Alternative 3a despite the apparent higher projected cost.

12.2 DESCRIPTION OF THE SELECTED REMEDY

The following subsections summarize the components of the Selected Remedy.

12.2.1 Stormwater System Restoration

This is the most complex, time-consuming, and costly of the measures included in Alternative 3a. Three primary steps are involved in stormwater system restoration: cleaning of the existing system, inspection of the system, and repair or replacement of those components of the system found to be damaged. Based on experience during similar work at OU NSC and during more recent investigations within OU B Terrestrial, portions of the stormwater system will be found to be inaccessible to cleaning and inspection equipment. Engineering judgment will be required in determining what repairs are necessary to restore the integrity of the system and what is feasible based on actual conditions encountered in the field. As explained in Section 9, there are no cleanup levels associated with this measure. Figure 12-1 depicts the primary stormwater lines at the BNC.

The removal of the historical sediment load within the system will meet the RAO "reduce the potential for chemical transport and control the threat of recontamination of the adjacent marine environment from accumulation of sediment or debris in the stormwater system," and address the primary risk associated with the site. The repair of the stormwater system will meet the RAO "reduce the potential for chemical transport and control the threat of recontamination of the adjacent marine environment from infiltration of soil and groundwater into the stormwater system."

Stormwater System Cleaning

Significant accumulations of sediment and debris are likely to be present in stormwater system catch basins, lines and manholes throughout OU B Terrestrial. Sediment and debris will be removed from the stormwater system. System cleaning will involve using high-pressure water jetting equipment to dislodge and flush sediment and debris to catch basins or manholes where it can be removed by vacuum truck. A variety of circumstances are likely to restrict the cleaning operation. For example, in each line, the section below the most downstream manhole or catch basin will not be cleaned because the dislodged material would be discharged to Sinclair Inlet. Similarly, lines that cannot be accessed because the planned cleaning technology is not capable of making tight turns, or lines where the end cannot be confidently identified will not be cleaned. Waste material from stormwater facility cleaning will be sampled, characterized, and properly disposed.

Stormwater System Inspection

From prior BNC stormwater system cleaning experience, existing as-built drawings of the stormwater system are unreliable, and significant effort will be required to establish the actual configurations. As cleaning is completed on subsections of the system, cameras will be run through the lines to confirm that the lines, catch basins, and manholes have been properly cleaned and identify damaged areas. Similar to the water jetting equipment used for cleaning, the cameras cannot make sharp bends and therefore inspection of all sections will not be feasible. The results and findings from the stormwater system cleaning and inspection, including any illegal connections that are identified, will be documented in an inspection report.

Stormwater System Repair/Replacement

From recent work with stormwater facilities at the BNC, damage to stormwater lines is expected to be common. Repair decisions will be made during remedial design and construction based on professional engineering judgment as to what approach will provide the most reduction of risk. The primary focus of the repair effort will be to repair stormwater system components (i.e., catch basins, manholes, drain lines, etc.) that have significant structural damage. Significant structural damage may include collapsed pipe, components with open holes and access to soil, and crushed pipe with a significant number of pieces missing. Hairline cracks in components will be permitted to remain as long as the structural integrity is not significantly impacted. In general, the type of defect, defect location, and number of defects per component will be considered in making the determination to repair a component.

12.2.2 Paving

Most of OU B Terrestrial is currently paved or covered by buildings. However, new asphalt or concrete pavement or a clean soil cover with vegetation will be installed where feasible and consistent with site use. Upgrades or repairs to damaged existing pavement will further limit potential contact with soil and fill and reduce the potential for surface water infiltration which could mobilize subsurface contaminants. Approximately 11,000 square yards of unpaved area within OU B Terrestrial was paved during 1998-2000 as part of a non-time critical removal action. Approximately 60 additional small areas are candidates for paving or pavement repair as part of the Selected Remedy. Only about seven of these areas exceed 500 square yards in area. The total area still subject to paving or pavement repair is approximately 12,000 square yards. This measure will not be used in the steep vegetated hillside area north of Farragut Avenue.

The paving measures will meet the following remedial action objectives:

- "Reduce the potential for chemical transport and control the threat of recontamination of the adjacent marine environment from infiltration of surface water into site soil"; and
- "Continue to limit human exposure to site soils and groundwater."

12.2.3 Shoreline Stabilization

The OU B Terrestrial shoreline is made up of a combination of sheetpile and bulkhead walls and armor rock (riprap). In June 2002 the Navy conducted an inspection of approximately 11,200 lineal feet of the shoreline from Mooring G in west BNC to the Washington State Ferry terminal at the east end of the BNC. Bulkhead/sheetpile areas were inspected from the water because of limited visibility from above, while riprap areas were inspected from the shore. Inspections were conducted during periods of low tide to maximize exposure of lower shoreline areas. For bulkhead/sheetpile areas, information recorded during the inspection included overall condition, evidence of damage to concrete and sheetpile, and evidence of exposure of soil or erosion. For riprap areas, recorded information included rock size and distribution, evidence of exposure of soil, slope, presence of debris, and evidence of sloughing, erosion, or erosion potential.

The inspection concluded that the bulkhead/sheetpile areas are in good condition. Only limited cracks, damage, and deterioration were observed, and these are not believed to contribute to soil erosion. Approximately 2,300 feet of the bulkhead/sheetpile shoreline were not accessible for inspection, but were inferred to be similar in nature to those areas that were inspected. The inspection concluded that riprap shoreline areas are in general steeper than is recommended for areas in the Puget Sound region, where there is a significant potential for seismic activity. Some riprap areas were also found to have insufficient riprap in place to properly protect against wave action and other threats of slope failure. Overall, approximately 3,000 linear feet of riprap areas is in need of upgrading.

Shoreline stabilization measures will be implemented in the areas highlighted in Figure 12-2. As noted in Section 10, the prioritized criteria for selecting the measures to be used for this shoreline stabilization are effectiveness at controlling erosion, compatibility with site use, and the potential to avoid, minimize or mitigate impacts to marine habitat in compliance with the identified ARARs: Clean Water Act, Section 404 (33 CFR Parts 320-330, 40 CFR Part 230) and Hydraulics Project Approval (WAC 220-110). The shoreline stabilization design will be developed based on site-specific conditions and the prioritized criteria presented above. The

Navy will work closely with resource agency representatives to identify opportunities and approaches for incorporating features and materials into the design that resemble natural conditions.

Construction of the shoreline stabilization measures will meet the remedial action objective "Reduce the potential for chemical transport and control the threat of recontamination of the adjacent marine environment from erosion of shoreline soil."

12.2.4 Institutional Controls

Institutional controls (ICs) are an important component of the Selected Remedy. The IC objectives for OU B Terrestrial are:

- Ensure that access to the site is controlled
- Ensure that the sole use of groundwater from the site is for monitoring purposes
- Ensure that excavations carried out at the site are managed appropriately given the contaminants left in place
- Ensure that the established industrial use of the site is maintained

The Navy will develop a BNC-wide IC Remedial Design to define the specific implementation actions necessary to achieve these IC objectives. The Navy will be responsible for implementing, monitoring, reporting on, and enforcing the ICs. Land use restrictions will be documented in the event of a future transfer of the property. The ICs will be applicable throughout the OU B Terrestrial site and, because contaminated soil and groundwater are being left on-site, will be maintained until contaminant levels allow for unlimited use and unrestricted exposure.

The institutional controls will meet the remedial action objective "Continue to limit human exposure to site soils and groundwater."

12.2.5 Groundwater Monitoring

There is no current or expected future beneficial use of groundwater at OU B Terrestrial. It has been concluded through analyses of primary fate and transport mechanisms that site groundwater is sufficiently protective of the marine environment and that no active groundwater remediation is warranted. It has been demonstrated in accordance with the requirements of WAC 173-340-350 through 173-340-390 that it is not practicable to meet cleanup levels throughout the site within a reasonable restoration timeframe. On this basis, a conditional point of compliance was selected for groundwater at OU B Terrestrial. Groundwater monitoring will be conducted at approximately ten new and existing monitoring wells within OU B Terrestrial. Four of these wells will be located in areas not influenced by drydock discharge pumping or quay walls and placed as close as feasible to the shoreline. The other six wells will be located immediately upgradient of each of the drydocks. Together these wells will serve as the conditional point of compliance for groundwater.

The Navy, EPA and Ecology, selected constituents for groundwater monitoring based on a review of the nature and extent of the COIs throughout OU B Terrestrial. For any given analyte the appropriate compliance criterion will be the more stringent of the State and Federal surface/marine water standards unless local background values already exceed these standards. In cases where the local background values exceed these levels/criteria, the appropriate standards will be based on the local background values. Table 12-1 lists the constituents to be monitored in groundwater and the conditional point of compliance groundwater criteria. Though PAHs were previously identified as a key chemical, PAHs have not been detected in recent groundwater monitoring and will not be monitored.

Because PCBs are only weakly soluble in water, the potential for detecting PCBs in groundwater samples is limited. PCBs therefore will not be monitored in groundwater. PCBs are, however, highly soluble in organic solvents, and if petroleum were present in groundwater, any PCBs that were present would tend to accumulate in the petroleum fraction. To evaluate the potential for PCB transport via the groundwater pathway, the Navy will collect and analyze a product or product/water sample for total PCB Aroclors in groundwater monitoring wells containing petroleum free product. If PCBs are not detected, sampling of product for PCB analysis will be discontinued. In the event PCBs are detected, the Navy, EPA, and Ecology will determine the appropriate follow-up measures.

Details regarding ground water monitoring locations, sampling requirements and sampling frequencies will be defined during the development of a long-term monitoring plan for OU B Terrestrial. As part of the preparation of this plan the Navy, EPA, and Ecology will identify a method for estimating the extent of attenuation between the drydock compliance monitoring wells and the ground water discharge points to the Sinclair Inlet. The ground water results from the wells will be adjusted based on the estimated attenuation and compared to the conditional point of compliance ground water criteria presented in Table 12-1 to determine whether compliance has been achieved.

After four rounds of monitoring, the Navy in conjunction with EPA and Ecology will evaluate the results of the groundwater monitoring and make appropriate revisions to the monitoring program. Such revision could include termination of groundwater monitoring if it is agreed that the monitoring is no longer providing useful information. Analysis will be discontinued for any analyte not detected in a given well after a minimum of four consecutive sampling events spanning a minimum two-year period.

The Navy in conjunction with EPA and Ecology may make additional revisions to the monitoring plan based on periodic reviews and optimization studies.

Groundwater monitoring will meet the RAO "reduce potential for chemical transport and control the threat of recontamination of the marine environment" by providing information to verify predictions that site groundwater is protective of the marine environment.

12.2.6 Remedy Maintenance

The physical condition of the paving restoration measures will be regularly inspected and maintenance performed as necessary to preserve the integrity of the remedy.

The shoreline restoration work, including measures to restore habitat, will be regularly inspected. Shoreline stabilization measures will be maintained as necessary to preserve the integrity of the remedy. Habitat features will not be routinely maintained. However, should the shoreline stabilization remedy fail, repair actions will include restoration of the established habitat.

The success of stormwater system cleaning, inspection, and repair/replacement will be verified and sustained through ongoing stormwater system monitoring. Monitoring will consist of periodic inspections of downstream catch basins, catch basin cleaning as needed, and stormwater line inspections if evidence is found of soil entering the stormwater system. Repairs would be conducted consistent with the remedy. The inspections and repairs will be documented and the results will be made available for the periodic reviews of the site.

The physical condition of monitoring wells will be regularly inspected and maintenance performed as necessary to support groundwater monitoring.

The persistence of the remedy, the effectiveness of the remedy in meeting the RAOs, and the effectiveness of the inspection and maintenance measures will be reviewed and evaluated as part of the periodic reviews.

12.3 SUMMARY OF EXPECTED REMEDY COST

The projected costs associated with the Selected Remedy are summarized in Table 12-2 in terms of year 2002 dollars. The information in this table is based on the best information available at the time of preparation of the final OU B feasibility study. Changes in cost components can be expected as a result of new information collected during remedial design. This is an order-of-magnitude engineering cost estimate, expected to be within +50 to –30 percent of the actual project cost.

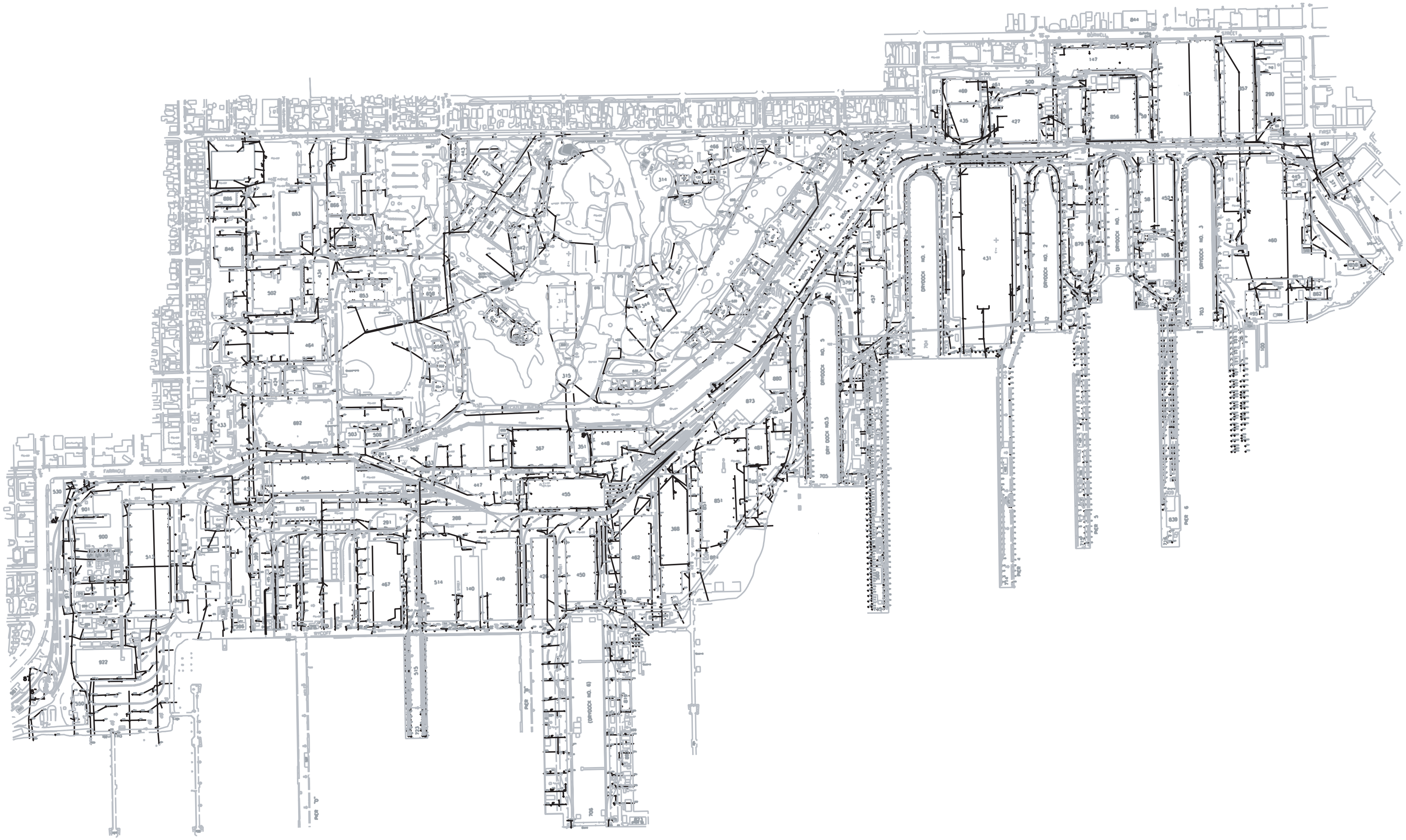
12.4 EXPECTED OUTCOMES OF THE SELECTED REMEDY

The Selected Remedy will not result in any changes in current land use at OU B Terrestrial. Contamination left in place at the site is generally compatible with industrial land use, but would not be compatible, for example, with residential use in the future. Institutional controls are expected to be sufficient to ensure the protectiveness of post-remedy conditions at the site since the remedy will address the primary sources of contamination with a significant chance of being mobilized. The contaminants that will be left in place at the site will be effectively contained by the combination of pavement and buildings.

The Selected Remedy will have no impact on current or potential future groundwater use at the BNC or in the vicinity. As noted in Section 7.2, groundwater within OU B Terrestrial is not a current source of drinking water and is expected to remain unsuitable for domestic uses for the foreseeable future.

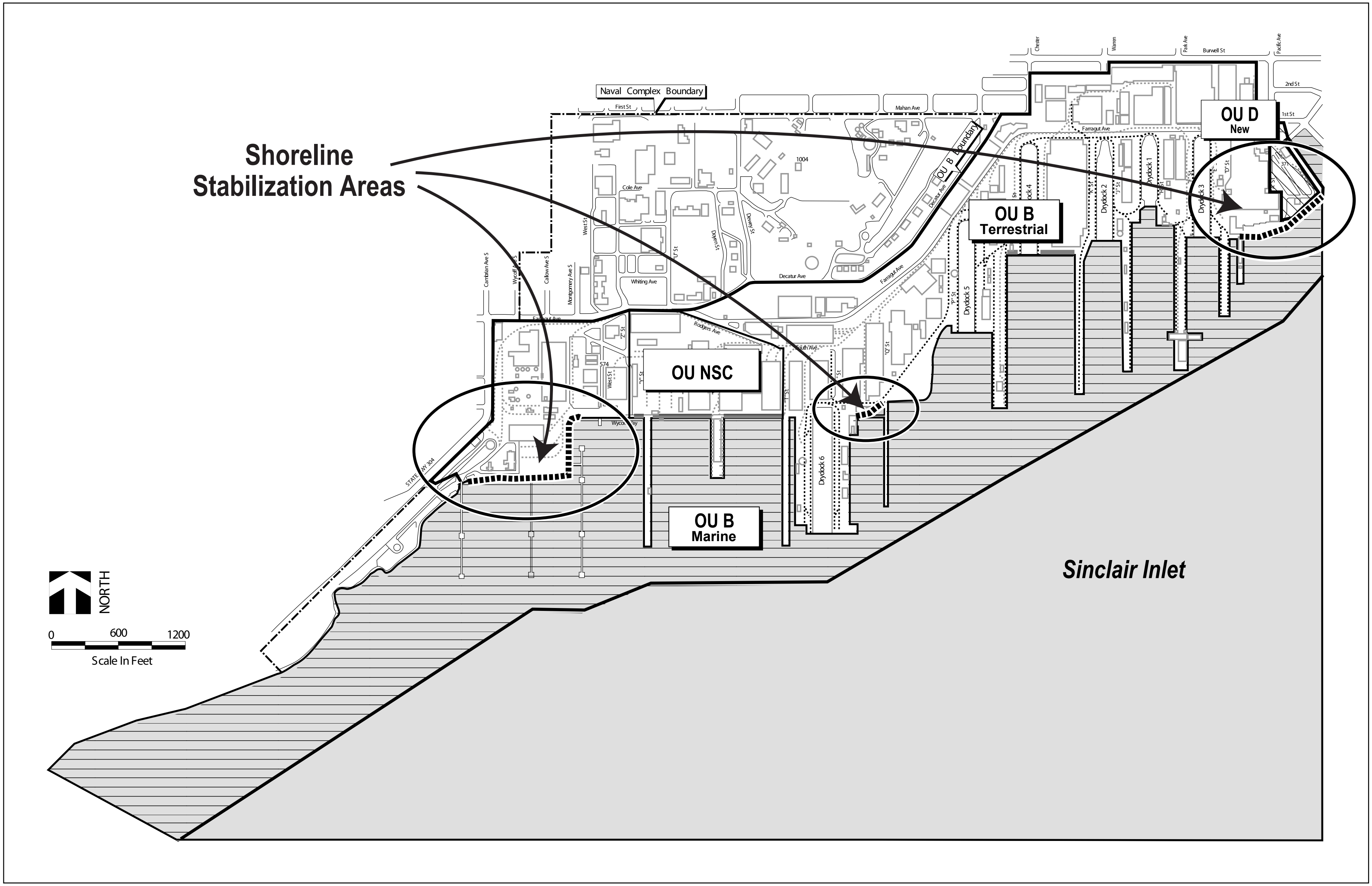
Because the Selected Remedy does not include any treatment of groundwater, improvements in groundwater quality at any given location within OU B Terrestrial in the future are expected to be comparatively limited. Levels of organic chemicals in groundwater will likely tend to gradually decline due to natural breakdown processes, but inorganic chemicals are not subject to natural breakdown. The fate and transport analyses summarized in Section 6 predicted that natural attenuation processes associated with passage of groundwater through the soil result in groundwater discharging from the site meeting surface water criteria and not presenting a threat of recontamination of marine sediments.

The Selected Remedy is expected to largely eliminate the primary threat posed by the site, namely the chance of contaminated sediments and debris being transported by the stormwater system to Sinclair Inlet. Paving measures will reduce the limited potential that presently exists for contact with contaminants and for contaminants to be transported by precipitation infiltrating the soil and leaching chemicals to the groundwater. Shoreline enhancement will significantly reduce the chance of direct erosion of site soils to Sinclair Inlet.



U.S.NAVY	Delivery Order 0004 Bremerton Naval Complex ROD FOR OU B TERRESTRIAL	**Figure 12-1** **Primary Stormwater Lines at the Bremerton Naval Complex**

33753009



U.S.NAVY	Delivery Order 0004 Bremerton Naval Complex ROD FOR OU B TERRESTRIAL	**Figure 12-2** **Location of Planned Shoreline Stabilization**

33753009

Table 12-1
Conditional Point of Compliance Groundwater Criteria

Analyte	Conditional Point of Compliance Ground Water Criterion (micrograms per liter)	Source of Criterion
Volatile Organics		
Trichloroethene	55.6	MTCA B- Carcinogen
Pesticides		
4, 4'-DDT	0.000356	MTCA B- Carcinogen
4, 4'-DDE	0.000356	MTCA B- Carcinogen
Aldrin	0.0000816	MTCA B- Carcinogen
Dieldrin	0.0000867	MTCA B- Carcinogen
Heptachlor Epoxide	0.0000636	MTCA B- Carcinogen
Inorganics		
Arsenic[a, b]	5.0	WA NAT BG
Copper[b]	3.1	WA MW-Chronic
Lead[b]	8.1	WA MW-Chronic
Mercury[c]	0.025	WA MW-Chronic
Nickel[b]	8.2	WA MW-Chronic
Zinc[b]	81	WA MW-Chronic

[a] The arsenic Standard Method B Surface Water Formula Value is 0.0982 µg/L. The Method B value is below the natural background concentration of 5.0 µg/l. The background level of 5.0 µg/l will be used for determining compliance.
[b] Criteria for arsenic, copper, lead, nickel, and zinc are based on dissolved analyses fraction.
[c] Criterion for mercury is based on total recoverable fraction of the metal.

Notes:
MTCA B- Carcinogen – MTCA Standard Method B Surface Water Formula Values - Carcinogen (*Cleanup Levels and Risk Calculations under the Model Toxics Control Act Cleanup Regulation, CLARC, Version 3.1*)

WA MW-Chronic – Washington Water Quality Standards-Marine Water - Protection of Aquatic Life-Chronic (WAC 173-201A-040)

WA NAT BG – Washington State natural background for arsenic as cited in WAC 173-340-900.

Table 12-2
Summary of Estimated Remedy Cost

Description	Quantity	Unit	Unit Cost ($)	Cost ($)	Source
DIRECT CAPITAL COSTS					
1. Well Installation and Development	1	LS	$80,000	$80,000	EE
2. Site-wide Paving/Vegetative Cover[a]					
- Remove and dispose of existing asphalt	4,100	SY	9.25	$38,000	FD
- Remove and dispose of existing base, subgrade, and unpaved material	2,800	CY	$11.32	$32,000	FD
- Placement and compaction of new subgrade material (controlled fill) to 6" depth	644	CY	$29.20	$19,000	FD
- Compaction Tests (areas 250 - 1,000 sf, 2 tests per lift; areas > 1,000 sf, 1 test per 1,000 sf per lift)	266	EA	$95.53	$25,000	FD
- Placement and finish of new asphalt	12,500	SY	$16.00	$200,000	FD
- Material and placement of tack coat	12,460	SY	$2.08	$26,000	FD
- Joint sealing edges of asphalt patch	10,520	LF	$1.79	$19,000	FD
- Saw cut asphalt	6,839	LF	$4.28	$29,000	FD
- Saw cut unreinforced concrete	1,024	LF	$14.00	$14,000	FD
- Remove and dispose of existing unreinforced concrete pavement	280	CY	$25.08	$7,000	FD
- Underground utility location	112,141	SF	$0.35	$39,000	FD
- Clearance of Building 959 area	1	LS	$5,000	$5,000	EE
3. Shoreline Protection Construction[b]	3,025	LF	$554.30	$1,677,000	FD
4. Stormwater Inspection and Repair[c]					
- Cleaning 3- to 15-inch diameter lines	133,000	LF	$3.58	$476,000	FD
- CCTV inspection 4-inch diameter lines	68,000	LF	$4.16	$283,000	FD
- CCTV inspection 5- to 6-inch diameter lines	55,000	LF	$3.60	$198,000	FD
- CCTV inspection 8- to 9-inch diameter lines	4,000	LF	$2.49	$10,000	FD
- CCTV inspection >10-inch diameter lines	7,000	LF	$0.83	$5,800	FD
- Repair broken pipe[d]	39,900	LF	$71	$2,833,000	FD
- Sampling of stormwater wastes	25	EA	$450	$11,000	FD
- Nonhaz. disposal of stormwater wastes	5,000	CY	$26.60	$133,000	FD
- Repair poorly accessible locations[e]	500	LF	$2,439	$1,220,000	FD

Table 12-2 (Continued)
Summary of Estimated Remedy Cost

Description	Quantity	Unit	Unit Cost ($)	Cost ($)	Source
TOTAL DIRECT CAPITAL COSTS (DCC)				$7,380,000	
INDIRECT CAPITAL COSTS					
1. Institutional Controls and Monitoring	1	LS	$69,000	$69,000	EE
2. Site-wide Paving/Vegetative Cover					
- Design plans and specifications	1	LS	$100,000	$100,000	FD
- Field engineering	14	WK	$2,000	$28,000	EE
- Office engineering	12	WK	$3,000	$36,000	EE
- Remedial action report	1	LS	$20,000	$20,000	EE
3. Shoreline Protection					
- Design plans and specifications	1	LS	$120,000	$120,000	EE
- Field data collection and analysis[h]	1	LS	$10,000	$10,000	EE
- Stakeholder meetings	1	LS	$25,000	$25,000	FD
- Coordination w. WSF at Site 10 East	1	LS	$10,000	$10,000	EE
- Remedial Action Report	1	LS	$20,000	$20,000	EE
4. Stormwater Inspection and Repair					
- Design plans and specifications	1	LS	$120,000	$120,000	EE
- Field data collection and analysis	1	LS	$25,000	$25,000	EE
- Design survey	1	LS	$15,000	$15,000	EE
- Remedial Action Report with as-builts	1	LS	$40,000	$40,000	EE
Five-Year Review	1	LS	$90,000	$90,000	FD
Project Management (5% of DCC)				$369,000	EE
Mobilization, bond, insurance (5% of DCC)				$369,000	
Engineering, construction management (15% of DCC)				$1,107,000	
TOTAL INDIRECT CAPITAL COSTS (ICC)				$2,570,000	
Capital/Indirect Contingency (20% DCC and ICC)				$1,990,000	
TOTAL CAPITAL COSTS				**$11,940,000**	
ANNUAL O&M					
1. Annual O&M Costs for Institutional Controls and Monitoring	1	LS	$107,715	$107,715	EE
2. Site-wide Paving/Vegetative Cover					
- Inspection and maintenance of ACP	100	Hour	$75	$7,500	EE
- Pavement repair (assume 5% per yr.)[f]	1	LS	$22,482	$22,482	EE
- Materials/Subcontracts for ACP repairs	1	LS	$20,000	$20,000	EE
3. Shoreline Protection					
- Inspection of shoreline protection	10	Hour	$75	$750	EE
- Boat rental - small	1	Day	$200	$200	FD
- Materials/Subcontracts for repairs[g]	180	LF	$500	$90,000	EE
Subtotal				$248,647	

Table 12-2 (Continued)
Summary of Estimated Remedy Cost

Description	Quantity	Unit	Unit Cost ($)	Cost ($)	Source
O&M Contingency (20%)				$49,729	
ANNUAL O&M					
Total Annual O&M				$298,000	
PRESENT WORTH ANNUAL O&M (year 2002 dollars, 5 years @ 7% discount)				**$1,220,000**	
PRESENT WORTH ANNUAL O&M (year 2002 dollars, 40 years @ 7% discount)				**$3,970,000**	
Total Present Worth Costs (5 Years)				**$13,160,000**	
Total Present Worth Costs (40 Years)				**$15,910,000**	

[a] Assumes design is 6-inch base with 4-inch asphalt concrete wearing course. Area to be paved in this estimate includes unpaved areas and damaged pavement noted during 2002 site walk performed in support of paving remedial design. Vegetative cover may be selected for certain areas. Limited to OU B Terrestrial and excludes damaged craneways, rail lines, OU A and OU NSC, and the Pier D construction site. Costs do not include installation of catchbasins and connection to stormwater system in larger unpaved areas such as Site 1. This estimate derived from FS estimate and subject to change. Final area to be paved is to be determined upon completion of remedial design and/or start of remedial action.
[b] Includes oversight, materials, and equipment costs to perform shoreline protection at Sites 10 East and 10 West and west of Mooring A and Drydock 5. Shoreline protection measures have been completed at Site 1.
[c] Capital costs calculated for initial cleaning and inspection of the stormwater system but not for operation and maintenance.
[d] Assumes repair would be required on 30% of the lines that are cleaned.
[e] Stainless steel sleeves would be used for repairs in poorly accessible areas (e.g., underneath buildings).
[f] Assumes pavement repairs performed "as needed" through existing base contracts, with no formal design required.
[g] Assumes replacement of 5% (180 ft) of new riprap at Sites 1, 10 West, and 10 East per year over 5-yr period.
[h] Includes initial investigation of stormwater configuration.

Notes:
Unit costs include contractor overhead and profit.
A/C - asphalt concrete
CY - cubic yard
EE - engineer's estimate
FD - former design
LF - linear foot
LS - lump sum
SF - square foot
SY - square yard
VQ - vendor quote
WK - week
WSF - Washington State Ferries

13.0 STATUTORY DETERMINATIONS

13.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The Selected Remedy will protect human health and the environment by substantially reducing the potential for contaminated groundwater and sediments to be transported to Sinclair Inlet from OU B Terrestrial, reducing the potential for contact with contaminated soil, leaching of contaminants from soil to groundwater, and potential direct erosion of soil to the inlet, and otherwise controlling site access and land use.

Data from groundwater monitoring are expected to demonstrate that groundwater discharging to the inlet does not exceed marine surface water criteria.

13.2 COMPLIANCE WITH ARARS

The Selected Remedy will comply with Federal and State applicable or relevant and appropriate requirements (ARARs). *Applicable requirements* address the specific circumstances existing at a CERCLA site. *Relevant and appropriate requirements* address circumstances similar enough to those existing at the site to be considered well-suited to the site. Background information on the ARARs can be found in the FS. No ARAR waivers are being invoked at this time. ARARs for the remedy are discussed below.

Clean Water Act Section 303 -- Federal Ambient Water Quality, 71 FR 18935-18936 (November 27, 2002). Section 304(a)(1) of the Clean Water Act requires EPA to develop, publish, and revise criteria for water quality accurately reflecting the latest scientific knowledge. These revised criteria are relevant and appropriate to discharges to surface water that may be established as part of the selected remedial action, i.e., during shoreline protection work and stormwater system cleaning, inspection, and repair/replacement, and these are relevant and appropriate to groundwater discharges to surface water. These values are relevant and appropriate for the selected remedy because they represent the latest scientific knowledge and because these criteria were developed to better protect aquatic organisms such as those that may be found within Sinclair Inlet [see CERCLA Section 121(d)(2)(B)(i)]. The Selected Remedy will satisfy this ARAR by ensuring that discharges established by the remedy do not cause exceedances of the water quality criteria in receiving surface waters.

Washington Water Quality Standards for Surface Waters (Ch. 173-201A WAC). Washington's toxics standards for protection of marine aquatic life (Section 070), as submitted to EPA by May 30, 2000, and any changes adopted by Washington and approved by EPA between May 30, 2000, and the date of this ROD are applicable to discharges to surface water in Washington state (with the exception of tribal lands). These regulations are applicable to the Selected Remedy to the extent the Selected Remedy results in a discharge to surface water in Washington state, i.e., during shoreline protection work and stormwater system cleaning, inspection, and repair/replacement. The Washington state regulations for human health protection incorporate the National Toxics Rule (40 CFR 131.36) by reference. The regulations also provide for short-term modifications of standards for specific water bodies during the performance of essential activities or to otherwise protect the public interest (Section 110). For example, the turbidity criteria established under Section 030 of the regulation can be modified to allow a temporary mixing zone during and immediately after in-water or shoreline construction activities that may result in the disturbance of in situ sediments.

Clean Water Act Storm Water Multi-Sector General Permit for Construction Activities (65 FR 64746-64880 and 40 CFR 122.26). These regulations provide that discharges of stormwater associated with "construction activities over 1 acre" require an NPDES permit. Although a permit would not be required for implementing the remedy on site, the substantive requirements of the Storm Water Multi-Sector General Permit for Construction Activities apply to elements of the Selected Remedy that result in discharges of storm water, including excavating and replacing stormwater lines and paving ground surfaces. The general permit provides for use of sediment and erosion controls, and stormwater management measures.

Clean Water Act, Section 404—Dredge or Fill regulations (33 CFR Parts 320-330, 40 CFR Part 230). These requirements are applicable to construction of the shoreline protection remedy, which will require work in or near navigable waters. They establish requirements that limit the discharge of dredged or fill material into navigable waters. EPA guidelines for discharge of dredged or fill materials in 40 CFR Part 230 specify consideration of alternatives that have less adverse impacts and prohibit discharges that would result in exceedance of surface water quality standards, exceedance of toxic effluent standards, or impacts to threatened or endangered species.

Hydraulics Project Approval regulations (Ch. 220-110 WAC). These regulations apply to construction of the shoreline protection remedy, which will require work within the shoreline that could change the natural flow or bed of the water body (and therefore has the potential to affect fish habitat). The requirements include bank protection (WAC 220-110-050), bed materials restrictions, siltation minimization, debris disposal (-270), and prohibited work times in saltwater areas, such as juvenile salmon outmigration periods (-271). Washington State Department of Fish and Wildlife (WDFW) concluded consultation with the Navy regarding the substantive requirements of these regulations for the proposed shoreline remedial action by letter dated June 12, 2003.

Coastal Zone Management Act (16 USC 1451 et seq.). Section 307(c)(1)(A) of the CZMA requires each Federal agency activity within the coastal zone to be consistent to the maximum extent practicable with the enforceable policies of approved state management programs. This requirement is applicable to construction of the shoreline protection remedy, which will take place within the coastal zone.

Shoreline Management Act regulations (Ch. 173-27 WAC). The shoreline management regulations are applicable to construction of the shoreline protection remedy, which requires work in the area extending landward 200 feet from the ordinary high water mark. Federal agency actions within a coastal county must be consistent to the maximum extent practicable with the approved Washington state coastal zone management program, and with the local master program.

Toxic Substances Control Act (15 USC 2601 et seq.). TSCA is applicable to the collection and disposal of materials containing PCBs and asbestos.

Washington Hazardous Waste Management Act regulations (Ch. 173-303 WAC) and Resource Conservation and Recovery Act (RCRA) Subtitle C regulations (40 CFR Parts 261 and 268). These regulations are applicable to the identification and disposal of wastes that designate as dangerous (including federally hazardous) wastes due to their exhibiting the toxicity characteristic.

Washington Solid Waste Management Act regulations (Ch. 173-350 WAC). These regulations are applicable to the management and disposal of waste materials that are not Washington dangerous wastes. They provide minimum functional standards for solid waste handling.

Washington State Model Toxics Control Act regulations—(WAC 173-340). Chapter 173-340-360(3)(e) of MTCA is applicable to the demonstration that treatment of groundwater or soil would be disproportionately costly given site conditions; 173-340-440 is applicable to the institutional controls included in the remedy; 173-340-720(8)(c) is applicable to making use of a conditional groundwater point of compliance; and 173-340-745 is applicable to the development of remedies for soil at an industrial site.

Endangered Species Act (ESA) (50 CFR Parts 17 and 402). The ESA makes it unlawful to "harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect" any federally designated threatened or endangered ("listed") species. The ESA is applicable to the construction of the shoreline protection remedy, which could affect Federal listed species that may be present in the area. Consistent with ESA Section 7, Navy consulted with the U.S. Fish and Wildlife Service (U.S. FWS) and the National Marine Fisheries Service (NMFS) to ensure that the proposed shoreline remedy avoids adverse habitat modification and impacts on such species. NMFS and U.S. FWS concluded ESA consultation with the Navy regarding the proposed shoreline remedial action by letters dated June 9, 2003, and July 25, 2003 respectively.

Magnuson-Stevens Fishery Conservation and Management Act regulations (50 CFR Part 600). These regulations are applicable to Navy actions in Sinclair Inlet that could affect essential fish habitat (EFH) for species such as salmon. Under 50 CFR 600.920(f), existing environmental review procedures for Federal actions may meet EFH consultation requirements if the existing process provides NMFS with timely notification of actions that may adversely affect EFH, including an assessment of the impacts of the proposed action on EFH. NMFS must also find that the existing process meets statutory requirements. NFMS concluded consultation regarding the proposed shoreline remedial action by letter dated June 29, 2003.

Fish and Wildlife Coordination Act (16 USC 661 et seq.). The Fish and Wildlife Coordination Act requires actions that will result in the control or structural modification of any natural body of water for any purpose, to protect the fish and wildlife resources that may be affected by the action. It is applicable to remedy activities that would impound, divert, deepen, control, or modify Sinclair Inlet. The Navy must consult with the U.S. Fish and Wildlife Service and WDFW regarding the potential effects of the project on fish and wildlife and identify measures that would mitigate those impacts. Also, the statute requires that adequate provision be made for the conservation, maintenance, and management of fish and wildlife resources and their habitats. U.S. FWS and WDFW concluded consultation regarding the proposed shoreline remedial action by letters dated July 25, 2003 and June 12, 2003, respectively.

Native American Graves Protection and Repatriation Act (NAGPRA) Regulations (43 CFR Part 10). NAGPRA regulations are intended to protect Native American graves from desecration through the removal and trafficking of human remains and "cultural items" including funerary and sacred objects. These regulations are applicable to ground disturbing activities such as stormwater system work and shoreline stabilization that could uncover Native American burials and cultural items. If such items were to be inadvertently discovered during excavation, the excavation would be required to cease and any affiliated tribes (the Suquamish) would be notified and consulted.

National Historic Preservation Act (NHPA) regulations (36 CFR Parts 60, 63, and 800). NHPA regulations require federal agencies to consider the possible effects of their activities on historic sites or structures (generally older than 50 years) that may be on or eligible for the National Register of Historic Places. These regulations are applicable to any activities conducted under the remedy that could affect the PSNS Historic District or yet to be discovered sites or features in other areas of OU B Terrestrial. If the Navy were to find a potential adverse effect on historic sites or structures, it would be required to evaluate alternatives to "avoid, minimize, or mitigate" the impact, in consultation with the State Historic Preservation Officer (SHPO). Unavoidable impacts on historic sites or structures may be mitigated through such means as taking photographs and collecting historical records.

13.3 COST-EFFECTIVENESS

Alternative 3a, the Selected Remedy, is cost-effective and represents a reasonable value for the money that will be spent. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness" (40 CFR 33.430(f)(1)(ii)(D)). This was accomplished by evaluating the overall effectiveness of the alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and were ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, or volume through treatment; and short term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

The estimated present worth cost of the Selected Remedy is approximately $16,000,000, projected over a 40-year period. The institutional controls and monitoring making up Alternative 2 would be substantially less costly at a projected cost of $2,000,000. However, while Alternative 2 is more effective than the Selected Remedy in the short term, it is substantially inferior in terms of long-term effectiveness and permanence. Alternative 3b has a projected cost of approximately $10,000,000, significantly less than the Selected Remedy. However, Alternative 3b is comparable to the Selected Remedy in terms of short-term effectiveness, and inferior in terms of long-term effectiveness and permanence.

None of the alternatives would include actions that would achieve reduction in toxicity, mobility, or volume through treatment. However, the Selected Remedy is the most effective of the alternatives in terms of reducing potential mobility of contaminants left in place. Overall, therefore, the Selected Remedy provides greater effectiveness than Alternatives 2 and 3b. The overall effectiveness of Alternative 3a was determined to be proportional to its costs and hence the Selected Remedy represents a reasonable value for the money that will be spent.

13.4 UTILIZATION OF PERMANENT SOLUTIONS AND ALTERNATIVE TREATMENT TECHNOLOGIES TO THE MAXIMUM EXTENT PRACTICABLE

The Selected Remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. Of those alternatives that are protective of human health and the environment and comply with ARARs, the Selected Remedy provides the best balance of tradeoffs in terms of long-term effectiveness and permanence, short-term effectiveness, implementability, cost, and reductions in toxicity, mobility, or volume achieved through treatment.

The Selected Remedy meets the statutory requirement to use permanent solutions to the maximum extent practicable. The cost of treatment of soil and groundwater at OU B Terrestrial was found to be substantial and disproportionate to the potential benefits. Long-term effectiveness is achieved by the Selected Remedy through removal and appropriate disposal of source materials from within the stormwater system, reduction of potential contaminant mobility, and containment of contaminants left on site.

13.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The selected remedy does not include treatment that reduces the toxicity, mobility, or volume of waste. As explained in the previous subsection, treatment was not found to be practicable for contaminated materials at OU B Terrestrial.

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (40 CFR 300.430(a)(1)(iii)(A)). Principal threat wastes are source materials considered highly toxic or highly mobile that generally cannot be reliably contained, or would present a significant risk to human health or the environment should exposure occur.

The contaminated materials present at OU B Terrestrial that are addressed by this ROD are not considered to be principal threat wastes. They are not highly toxic or highly mobile, and they can reliably be contained. Further, as explained in the previous subsection, treatment was not found to be practicable. Because no principal threat wastes are present at OU B Terrestrial, the Selected Remedy satisfies EPA's expectation that treatment should be used to address the principal threats posed by a site wherever practicable.

EPA has also established an expectation for use of engineering controls, such as containment, for waste that poses a relatively low, long-term threat or where treatment is impracticable (40 CFR 300.430(a)(1)(iii)(B)). The Selected Remedy is consistent with this expectation.

13.6 FIVE-YEAR REVIEW REQUIREMENTS

Because this remedy will result in hazardous substances, pollutants, or contaminants remaining on site above levels that allow for unlimited use and unrestricted exposure, a statutory review will be conducted within 5 years after initiation of remedial action to ensure that the remedy is protective of human health and the environment.

14.0 DOCUMENTATION OF SIGNIFICANT CHANGES

The Proposed Plan for OU B Terrestrial was published for public comment in August 2002. The plan identified Alternative 3a as the preferred alternative. The only significant change to Alternative 3a since the publication of the Proposed Plan and the public meeting is that visual inspection has been determined sufficient to confirm the cleaning of stormwater facilities.

As noted in Section 1, OU B Terrestrial and OU B Marine are now considered separate operable units, making a total of six OUs at the BNC, five being managed under CERCLA and one, OU C, being managed under the state cleanup program.

Subsequent to publication of the Proposed Plan, the Navy identified three remedial design criteria for selection of shoreline stabilization measures.

15.0 RESPONSIVENESS SUMMARY

The following questions were transmitted to the Navy by Mr. Craig Thompson of Ecology on August 20, 2002:

1. Comment: *The preferred alternative (3a) mentions a restoration time-frame of 5 years. Unfortunately, we were unable to find a schedule for implementation; that is, when does the Navy estimate the work will be started? Since much of the proposed work seems to be the kind of standard facility maintenance that the Navy would perform whether or not there was a clean-up in progress, is the work already in progress?*

Response: CERCLA 120(e)2 requires that "substantial continuous physical onsite remedial action" commence no later than 15 months after completion of the investigation and study. The preferred alternative (3a) restoration work is expected to start in early 2003, after the Record of Decision is signed. Some of the restoration work (e.g. pavement repairs and catch-basin cleaning) is similar to standard facility maintenance that is already in progress. However, the majority of the planned restoration work is beyond standard facility maintenance. As an example, the stormwater system work will include extensive cleaning of the interconnecting piping, video inspection, and repair. Details of the remedial design with a schedule for implementation will be established in work plans that are currently being developed.

2. Comment: *Page 9, bullet 3: The discussion of habitat friendly methods to control soil erosion does not give one a great feeling of confidence that these methods will be used. The Navy must allow the public, Trustees and resource agencies to have input into the determination of whether or not habitat friendly methods will be used - this can be accomplished by soliciting comments on the appropriate Draft Engineering Design Documents. Still – early involvement with interested parties would be constructive*

Response: The Navy agrees that the design of shoreline erosion control will involve input and review from the Agencies, Tribe, and other stakeholders. Soft bank approaches and materials that provide both habitat enhancement and erosion control will be considered. However, given the need to maintain the shoreline in a configuration that will best support the industrial needs of the Navy, measures such as engineered riprap, bulkheads, and sheetpile may be necessary to achieve reliable control of erosion. The prioritized criteria for selecting shoreline design will be: (1) reliable control of erosion, (2) compatability with BNC operation, and (3) avoiding, minimizing, or mitigating impacts to marine.

3. Comment: *Will 5-year reviews take place at which time EPA, Ecology, and the Navy will determine whether or not the selected remedy is sufficiently protective of human health and the environment?*

Response: A 5-year review will be conducted for OU B Terrestrial in accordance with CERCLA Section 121(c) and Navy and EPA guidance to ensure that remedial actions selected in the signed Record of Decision remain protective of human health and the environment.

The following questions were asked during the August 28, 2002 public meeting regarding the proposed remedy for OU B Terrestrial. The questions are paraphrased from the transcript of that meeting. Updated responses reflecting events subsequent to the public meeting are provided below.

4. Comment (unidentified audience member): *You mentioned earlier that from your sampling, soil and groundwater are not an issue as far as contaminant transport, and yet Alternative 3a has groundwater monitoring as a part of it. I was wondering why.*

Response: Section 12.2.5 of this ROD explains that groundwater monitoring will be included in the remedy to support the use of a conditional point of compliance under MTCA. Data from groundwater monitoring are expected to demonstrate that groundwater discharging to the inlet does not exceed marine water criteria.

5. Comment (Ms. Lisa Moss): *There's also going to be stormwater monitoring too, is that correct?*

Response: Following cleaning of the stormwater system, the system will be visually inspected to ensure sediment and debris have been removed. Stormwater sampling was under consideration as a verification method at the time of the public meeting, but it has since been concluded that visual inspection will provide a better indication of the successful completion of the remedy.

The following summarizes dialogue between the Navy and the Suquamish Tribe during the process of finalizing the remedy.

6. Comment: *Although the Navy, EPA, and Ecology are committed to shoreline stabilization to control potential erosion of contaminated shoreline soils, the Tribe does not feel that the risk to the marine environment from contaminated shoreline soils has been demonstrated to be significant enough to warrant the adverse impacts on the existing habitat. In order to ensure that the shoreline stabilization measures meet the goal of no net loss of habitat, the Tribe would* *prefer that the Navy also commit to monitoring, evaluating and, if necessary, modifying the habitat features included in the remedial design.*

Response: The Navy feels the shoreline stabilization measures are necessary to protect the public health and the environment from the threat of release of hazardous substances to Sinclair Inlet. The design and construction will be completed in compliance with the established ARARs.

The Navy will regularly inspect the shoreline stabilization measures of the remedy, including habitat features. Shoreline stabilization measures will be maintained as necessary to preserve the integrity of the remedy. Habitat features will not be routinely maintained. However, should the shoreline stabilization remedy fail, repair action will include restoration of the associated habitat features.