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JACKSON PARK COMPLEX
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OU 1 NEX GAS STATION LEAK AREA - DECLARATION OF RECORD OF DECISION (ROD) AMENDMENT 1

09/26/2013

Author Affiliation Unknown

DECLARATION OF THE RECORD OF DECISION
AMENDMENT NO. 1
OPERABLE UNIT 1, NEX GAS STATION LEAK AREA
JACKSON PARK HOUSING COMPLEX/NAVAL HOSPITAL BREMERTON

SITE NAME AND LOCATION

Jackson Park Housing Complex/Naval Hospital Bremerton
Operable Unit 1, NEX Gas Station Leak Area (formerly identified as Benzene Release Area)
Bremerton, Washington

STATEMENT OF PURPOSE

This decision document is an amendment to the Jackson Park Housing Complex/Naval Hospital Bremerton (JPHC/NHB) Operable Unit 1 Record of Decision (OU 1 ROD), executed in 2000. The purpose of this document is to amend the selected remedial actions for contaminated soil and groundwater at the Navy Exchange (NEX) Gas Station Leak Area (also referred to as "the site"), located within the JPHC/NHB Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site in Kitsap County, Washington. The site, formerly identified as the Benzene Release Area, is now identified as the NEX Gas Station Leak Area to reflect the current understanding of the source of the contaminants in soil and groundwater associated with this portion of JPHC. The presence of petroleum constituents, including benzene, and the results of additional investigations at the site have demonstrated that the source of contaminants is a fuel release from the NEX gas station.

This ROD Amendment documents a fundamental change to the selected remedy for the NEX Gas Station Leak Area. The original selected remedy in the OU 1 ROD, bioremediation through injection of oxygen-releasing chemicals into the subsurface, was completed in 2003 and did not achieve the ROD-specified cleanup objectives. Therefore, the primary treatment method will be changed to electrical resistive heating (ERH) with dual-phase extraction (DPE) and in situ chemical oxidation (ISCO). This amended remedy utilizes more aggressive treatment technologies with significantly higher cost than the original selected remedy. This modification to the scope, performance, and cost of the selected remedy represents a fundamental change and therefore requires a ROD Amendment.

This ROD Amendment has been developed in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the site. In accordance with the NCP, Section 300.825(a)(2), Section 300.435(c)(2)(ii), and CERCLA Section 117, this ROD Amendment will become part of the Administrative Record file, which is maintained at Naval Base Kitsap Bangor, 1101 Tautog Avenue (Building 1101, 2nd floor), Silverdale, Washington.

The U.S. Navy (Navy) is the lead agency for this decision. The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency. The EPA and the Navy jointly select the remedy for this site.

ASSESSMENT OF THE SITE

The response action selected in the OU 1 ROD, as modified by this ROD Amendment, is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substance 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 REMEDIES

The Navy, EPA, and Washington State Department of Ecology executed the OU 1 ROD in August 2000. OU 1 addresses human health risks at JPHC/NHB from terrestrial chemical sources in soil and groundwater and ingestion of shellfish from Ostrich Bay. OU 1 includes four upland sites (Sites 101, 101-A, 103, and 110). The NEX Gas Station Leak Area is located within Sites 101 and 110. The area is defined by benzene and petroleum contamination in soil and groundwater extending from the NEX gas station approximately 450 feet downgradient to the shoreline of Ostrich Bay. The area was historically identified by two seeps (Seep-L and Seep-R) exhibiting benzene concentrations that discharge through pipes along the shoreline of Ostrich Bay.

The OU 1 ROD presents selected remedies for soil, groundwater, and marine tissue at OU 1, as well as a specific remedy for the NEX Gas Station Leak Area (identified as the Benzene Release Area in the OU 1 ROD). This ROD Amendment modifies the previously selected remedy for the NEX Gas Station Leak Area, but does not affect the remedies selected in the OU 1 ROD for soil, groundwater, or marine tissue at all other areas of OU 1.

The original selected remedy for the NEX Gas Station Leak Area in the OU 1 ROD included in situ treatment of suspected source area soils and groundwater with Oxygen Release Compound (ORC®), a substance that releases oxygen when hydrated to enhance natural biodegradation of contaminated groundwater. The original selected remedy included an environmental monitoring program to verify effectiveness of the remedy. Institutional controls included as part of the selected groundwater remedy in the OU 1 ROD prevent construction of drinking water wells within the NEX Gas Station Leak Area and continue to be enforced.

In accordance with the OU 1 ROD, ORC® injection was performed at the NEX Gas Station Leak Area in 2001, and groundwater monitoring was conducted from 2001 to 2003 to assess the effectiveness of the ORC® injection. Groundwater monitoring indicated that a residual source of gasoline contamination was present at the site, and the contribution of dissolved petroleum constituents from the residual source and the site hydrogeology prevented the ORC® treatment from achieving cleanup objectives.

This ROD Amendment modifies the original selected remedy for the NEX Gas Station Leak Area. The remedy selected by this ROD Amendment (amended remedy) consists of active treatment of two areas of the site, the “source area” and the “near-shore area,” and flushing of contaminated groundwater between these two areas. Treatment at the source area will remove the ongoing source of contamination to groundwater that flows from the source area to the near-shore area. Treatment at the near-shore area will reduce contaminant concentrations in the groundwater prior to discharge to Ostrich Bay. The natural movement of groundwater

downgradient from the treated source area to the treatment system at the near-shore area (flushing) will result in remediation of the groundwater plume between these two areas. As provided in the original OU 1 ROD remedy, restrictions on construction of drinking water wells will remain in effect within the NEX Gas Station Leak Area.

The amended remedy for active treatment of the source area includes ERH with DPE to treat subsurface soil and groundwater. This technology involves heating the subsurface with electrodes to mobilize contaminants and removing contaminants mobilized as vapor and steam using a DPE system. The amended remedy for active treatment in the near-shore area includes ISCO to treat contaminated groundwater migrating toward Ostrich Bay. This technology involves injecting ozone, a natural oxidant, into the aquifer to chemically destroy chemicals of concern (COCs) exceeding cleanup levels. Increased dissolved oxygen concentrations in the treatment area will also enhance subsequent biodegradation of COCs in near-shore area groundwater. New monitoring wells will be installed to allow monitoring of the cleanup action process.

If ISCO is not as effective as expected after 2 years of active treatment, a pump and treat system will be implemented as the contingency remedy for the near-shore treatment area. Under the contingency remedy, groundwater would be pumped from extraction wells in the near-shore treatment area, treated above ground, and reinjected uphill from the source area.

STATUTORY DETERMINATIONS

The amended 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 actions, and is cost effective. The remedy utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable.

The amended remedy satisfies the statutory preference for treatment as a principal element of the remedy and reduces toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment.

The amended remedy will result in hazardous substances, pollutants, or contaminants remaining on site for approximately 12 years above levels that allow for unlimited use and unrestricted exposure. The OU 1 ROD predicted that the original selected remedy would clean up the site within 1 to 2 years. However, cleanup was not achieved. The amended remedy utilizes a longer, more significant field effort and longer estimated restoration time frame than the original selected remedy, because a more aggressive treatment approach is required to achieve remedial action objectives. Therefore, statutory reviews will be conducted at least once every 5 years after initiation of remedial actions under this ROD Amendment to ensure that the remedy is, or will be, protective of human health and the environment.

RECORD OF DECISION AMENDMENT DATA CERTIFICATION CHECKLIST

The information listed below is included in the Decision Summary section of this ROD Amendment or the OU 1 ROD. Section numbers in the list below refer to sections of this ROD

Amendment, unless specifically noted as referring to the OU 1 ROD. Additional information can be found in the Administrative Record file for the site.

- COCs and their respective concentrations (Section 3.3.2/pages 3-8 to 3-10)
- Baseline risk represented by the COCs (Section 3.4/pages 3-10 to 3-13)
- Cleanup levels established for COCs and the basis for these levels (Sections 4.1.3 and 4.1.4/pages 4-2 to 4-6/Tables 4-1 through 4-3)
- Current and reasonably anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and this ROD Amendment (Sections 1.2 and 3.4.1/pages 1-2 to 1-3 and 3-10 to 3-12 and the OU 1 ROD Section 6.4)
- Potential land and groundwater use that will be available at the site as a result of the amended remedy (Section 4.2.4/pages 4-12 to 4-14)
- Remedial actions in the original selected remedy that are modified by this ROD Amendment (Section 2.2/pages 2-2 to 2-3)
- Estimated capital, annual operation and maintenance, and total present-worth costs, discount rate, and the number of years over which the remedy cost estimates are projected (Section 5.2.7/pages 5-8 to 5-9)
- Key factors that led to selecting the remedy (Section 3/pages 3-1 to 3-13)

RECORD OF DECISION
AMENDMENT NO. 1
OPERABLE UNIT 1, NEX GAS STATION LEAK AREA
JACKSON PARK HOUSING COMPLEX/NAVAL HOSPITAL BREMERTON

Signature sheet for the foregoing Amendment No. 1 to the Record of Decision for Operable Unit 1 at Jackson Park Housing Complex/Naval Hospital Bremerton between the United States Navy and the United States Environmental Protection Agency.

T.A. ZWOLFER
Captain, U.S. Navy
Commanding Officer, Naval Base Kitsap

9/20/13
Date

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Dennis Faulk
Program Manager
U.S. Environmental Protection Agency, Region 10

Date 9/19/13

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TABLES

ABBREVIATIONS AND ACRONYMS

ARAR	applicable or relevant and appropriate requirement
BERA	baseline ecological risk assessment
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and total xylenes
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfm	cubic feet per minute
CFR	Code of Federal Regulations
COC	chemical of concern
COPC	chemical of potential concern
CSM	conceptual site model
CZMA	Coastal Zone Management Act
DPE	dual-phase extraction
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ERH	electrical resistive heating
FFS	focused feasibility study
gpm	gallons per minute
ISCO	in situ chemical oxidation
JPHC	Jackson Park Housing Complex
µg/kg	microgram per kilogram
µg/L	microgram per liter
$\mu g/m^3$	microgram per cubic meter
mg/kg	milligram per kilogram
mg/L	milligram per liter
MCL	maximum contaminant level
MCLG	maximum contaminant level goal
msl	mean sea level
MTBE	methyl tertiary-butyl ether
MTCA	Model Toxics Control Act (Washington State)
Navy	U.S. Navy
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEX	Navy Exchange
NHB	Naval Hospital Bremerton
NHPA	National Historic Preservation Act
NPDES	National Pollutant Discharge Elimination System
O&M	operation and maintenance

ABBREVIATIONS AND ACRONYMS (Continued)

ORC®	Oxygen Release Compound
OU	operable unit
OU 3M	Operable Unit 3-Marine
OU 3T	Operable Unit 3-Terrestrial
PSCAA	Puget Sound Clean Air Agency
RAO	remedial action objective
RBC	risk-based screening concentration
RCW	Revised Code of Washington
RD/RA	remedial design/remedial action
ROD	Record of Decision
SMA	Shoreline Management Act
SVE	soil vapor extraction
TPH-G	total petroleum hydrocarbons as gasoline
USC	United States Code
UST	underground storage tank
WAC	Washington Administrative Code

DECISION SUMMARY

1.0 INTRODUCTION

1.1 STATEMENT OF PURPOSE

This document amends the Jackson Park Housing Complex/Naval Hospital Bremerton (JPHC/NHB) Operable Unit 1 Record of Decision (OU 1 ROD), executed on August 9, 2000 (U.S. Navy, Ecology, and USEPA 2000). The OU 1 ROD selected a remedy for the Navy Exchange (NEX) Gas Station Leak Area (also referred to in this document as "the site"), located within the JPHC/NHB Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) site near the city of Bremerton, Kitsap County, Washington (Figure 1-1).

The site was formerly identified as the Benzene Release Area. Since issuance of the OU 1 ROD, the name has been changed to reflect the current understanding of the source of the contaminants in soil and groundwater beneath this portion of JPHC. The presence of petroleum constituents, including benzene, and the results of additional investigations at the site have demonstrated that the source of contaminants is a fuel release from the NEX gas station.

The original selected remedy for the NEX Gas Station Leak Area was completed in 2003. The selected actions, however, did not achieve the cleanup objectives. The purpose of this document is to amend the selected remedy for contaminated soil and groundwater at the NEX Gas Station Leak Area.

This ROD Amendment has been developed in accordance with CERCLA, as amended by the Superfund Amendments and Reauthorization Act, and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for the site. In accordance with the NCP, Section 300.825(a)(2), Section 300.435(c)(2)(ii), and CERCLA Section 117, this ROD Amendment will become part of the Administrative Record file, which is maintained at Naval Base Kitsap Bangor, 1101 Tautog Avenue (Building 1101, 2nd floor), Silverdale, Washington.

The U.S. Navy (Navy) is the lead agency for this decision. The U.S. Environmental Protection Agency (EPA) is the lead regulatory agency. EPA and the Navy jointly select the remedy for the site. The Washington State Department of Ecology (Ecology) has transferred lead regulatory agency status for JPHC/NHB to EPA and was therefore not involved in this ROD Amendment.

1.2 SITE NAME, LOCATION, AND DESCRIPTION

The NEX Gas Station Leak Area is located within the JPHC/NHB CERCLA site (Comprehensive Environmental Response, Compensation, and Liability Information System identification number WA3170090044). JPHC/NHB is on the site of the former Naval Ammunition Depot Puget Sound, which operated from 1904 to 1959. Operations included assembly, transportation, storage, and demilitarization of military weapons and ammunition. The EPA placed JPHC/NHB on the National Priorities List in 1994 for management of chemical contaminants and ordnance under CERCLA. The JPHC/NHB CERCLA site has been divided into three separate OUs:

- OU 1 consists of the terrestrial portion of the site and addresses human health risks from terrestrial chemical sources in soil and groundwater and ingestion of seafood from Ostrich Bay. OU 1 includes four upland sites (Sites 101, 101-A, 103, and 110). The NEX Gas Station Leak Area is located within Sites 101 and 110 of OU 1. The ROD for OU 1 was prepared in 2000 (U.S. Navy, Ecology, and USEPA 2000).

- OU 2 consists of the marine portion of the site and addresses the potential ecological risks to aquatic and aquatic-dependent animals exposed to marine sediments in Ostrich Bay. The ROD for OU 2 is pending.

- OU 3 addresses potential explosive hazards that may be present on former Naval Ammunition Depot Puget Sound property. The former Naval Ammunition Depot Puget Sound site has been further subdivided into OU 3-Terrestrial (OU 3T) JPHC, OU 3T NHB, and OU 3-Marine (OU 3M). The ROD for OU 3T JPHC was finalized in 2011 (U.S. Navy and USEPA 2011). RODs for OU 3T NHB and OU 3M are pending.

The NEX Gas Station Leak Area is located within Sites 101 and 110 of OU 1, as shown on Figure 1-2. The area is defined by benzene and petroleum contamination in soil and groundwater extending from the NEX gas station approximately 450 feet downgradient to the shoreline of Ostrich Bay. The area was historically identified by two seeps (Seep-L and Seep-R) exhibiting benzene concentrations that discharge through pipes along the shoreline of Ostrich Bay. The area includes the NEX gas station, Building 30 (maintenance building), a recreational pathway, and an area near the Ostrich Bay shoreline south of a sewage lift station located near the east terminus of Dowell road. Figure 1-3 shows a site plan.

The portion of the site immediately surrounding the NEX gas station is generally referred to as the source area. Residual sources in this area result in a dissolved-phase contaminant plume extending to Ostrich Bay. The portion of this plume between the recreational pathway and the shoreline is generally referred to as the near-shore area.

The land surface of the site slopes eastward from an elevation of approximately 64 feet above mean sea level (msl) at the NEX gas station to approximately 3 feet above msl at the shoreline seeps, which are located in the concrete seawall.

The site and surrounding area are developed for residential and recreational land use with paved and landscaped areas. The adjacent marine environment of Ostrich Bay is within the Suquamish Tribe's usual and accustomed fishing grounds and stations. Current and potential future land uses at the site are described in Section 6.4 of the OU 1 ROD. The Navy has no plan to modify existing land use at OU 1.

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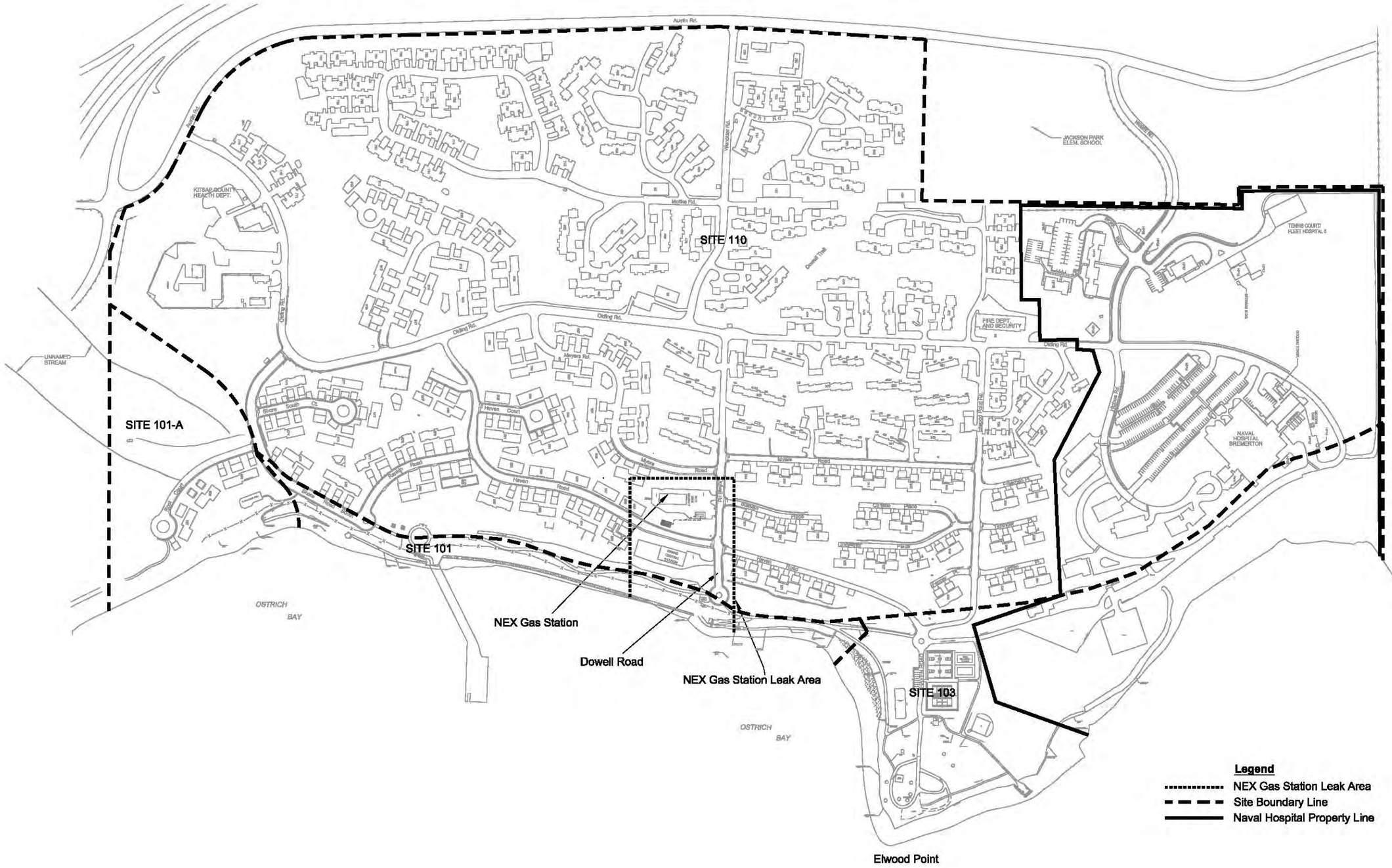
NORTH

0 1 2

Approximate Scale in Miles

U.S. NAVY	Figure 1-1 Vicinity Map	Delivery Order 0053 Jackson Park/Naval Hospital NEX GAS STATION LEAK AREA



U.S. NAVY	Delivery Order 0053 Jackson Park/Naval Hospital NEX GAS STATION LEAK AREA	0 200 400 SCALE IN FEET	**Figure 1-2** **NEX Gas Station Leak Area Location Map**

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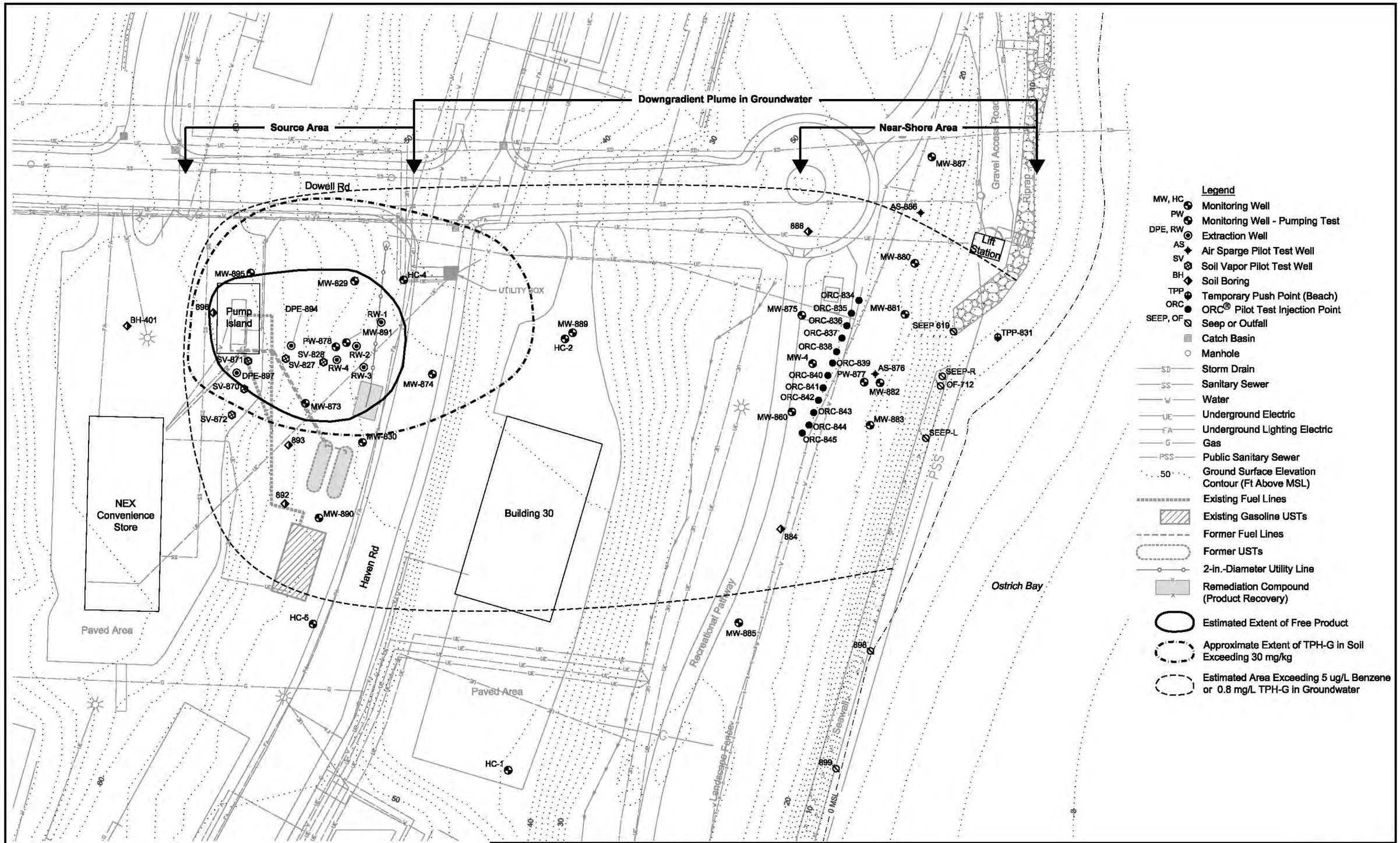

U.S. NAVY

Delivery Order 0053
Jackson Park/Naval Hospital
NEX GAS STATION
LEAK AREA

0 25 50
SCALE IN FEET

Figure 1-3
Site Plan

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2.0 SITE ENVIRONMENTAL HISTORY AND ORIGINAL SELECTED REMEDY

This section describes the history of the NEX Gas Station Leak Area and the original remedy selected for the site in the OU 1 ROD. The history of the JPHC/NHB CERLCA site and the selected remedies for the remainder of OU 1 are described in the OU 1 ROD.

2.1 SITE ENVIRONMENTAL HISTORY

In 1991, an unleaded gasoline release from a leaking pipe at the NEX gas station was discovered during tank pressure testing. In 1995, during an underground storage tank (UST) replacement project, leakage was noted in the pump island and associated tank piping systems (U.S. Navy 2000). The replacement project consisted of the excavation and removal of two 10,000-gallon gasoline USTs and installation of three new 10,000-gallon USTs southeast of the pump island (Figure 1-3). Benzene and total petroleum hydrocarbons as gasoline (TPH-G) were detected in soil samples collected from the excavation. No soil was reportedly transported from the site. The conclusion drawn from the data collected during the UST removal was that contamination was concentrated in the pump island area (Radix Northwest 1995). Groundwater was not assessed at the time of the UST removal.

In 1996 during seep sampling at Site 101, benzene was detected at one shoreline outfall, OF-712 (shown on Figure 1-3). Ecology conducted additional seep and groundwater sampling in the immediate area in 1996. In 1997 and 1998, the Navy conducted separate investigations to assess the source and extent of benzene and TPH-G in soil and groundwater at the site. The results of these investigations were reported in the benzene release investigation report (U.S. Navy 1998). In 1999, the Navy conducted additional field work. This third benzene release investigation identified a source of the benzene and petroleum contamination near the fuel dispenser island at the NEX gas station. Results of this sampling were reported in a data summary report (U.S. Navy 2000). Contaminated soil and groundwater were detected in the NEX Gas Station Leak Area at concentrations above the Washington State Model Toxics Control Act (MTCA) cleanup levels for unrestricted land use (MTCA Method A). A summary of the sampling results from 1996 through 1999 is provided in the OU 1 ROD.

Fuel line tightness testing was performed on the replacement UST system in June 2000. Visual inspection of the system components indicated that the system was properly designed, and no visual evidence of fuel leakage was found. The results of the inspection and testing led to the conclusion that the petroleum contamination resulted from leakage prior to 1995, when the piping system and tanks were replaced. The current USTs, piping system, and pump island are inspected periodically to evaluate system operation and maintenance (O&M).

The Navy and Ecology agreed that the cleanup of the NEX Gas Station Leak Area would be incorporated as part of the overall implementation of the selected remedy for OU 1 (U.S. Navy 2000). The OU 1 ROD identifies the original selected remedy for the site.

2.2 ORIGINAL SELECTED REMEDY

The OU 1 ROD describes the original selected remedy for soil and groundwater in the NEX Gas Station Leak Area (identified as the Benzene Release Area in the OU 1 ROD) as quoted below:

- *Oxygen-releasing chemicals will be placed in the subsurface using one or more of the following methods: injection of a slurry, backfllling of boreholes or open pits, or placement in monitoring wells. It is anticipated that on the order of 10,000 pounds of oxygen-releasing chemicals will be required. The specific quantities, locations, and application methods will be determined in the remedial design. The application will be designed to stimulate aerobic biodegradation of benzene and petroleum in soil and groundwater.*

- *Limited excavation and disposal of petroleum-contaminated soil may occur if significant petroleum contamination is found above the seasonal high-water table. The specific quantities and locations of any excavation will be determined in the remedial design. All waste material requiring off-site disposal, including excavated soil and debris that cannot be recycled, will be sampled to characterize for disposal. The material will be designated as nonhazardous solid waste, dangerous waste, or extremely hazardous waste using the criteria of the Washington State dangerous waste regulations (Chapter 173-303 WAC). All off-site treatment, storage, and disposal of CERCLA waste will occur at facilities that are acceptable under the Off-Site Disposal Rule (40 CFR 3 00.440).*

- *An environmental monitoring program will be conducted to verify effectiveness of the remedy. In the first 2 years, up to 10 groundwater and seep samples will be collected quarterly. Samples will be analyzed for petroleum hydrocarbons and benzene. Sampling requirements in following years will be based on the first 2 years' results. The specifics of the monitoring program (including sample numbers, sample locations, and chemicals analyzed) may be modified as requested by WDOE and/or the Navy and concurred with by Ecology and the Navy.*

The selected remedy for the Benzene Release Area does not include any institutional controls. The institutional controls that are included in the selected remedy for OU 1 groundwater will prevent construction of drinking water wells within the Benzene Release Area.

To clarify the intent of this last element of the original OU 1 ROD remedy description, the institutional controls applicable to Sites 101 and 110 prohibit the construction of drinking water wells, and this area includes the Benzene Release Area. The Navy has implemented this institutional control component of the remedy. A Land Use Control Plan (U.S. Navy 2005) is in place, and inspection and reporting of institutional controls is performed annually.

3.0 BASIS FOR AMENDMENT

The original selected remedy in the OU 1 ROD, described in Section 2.2, was completed in 2003 and did not achieve the ROD-specified cleanup objectives. Therefore, the primary treatment method will be changed to utilize more aggressive treatment technologies with significantly higher cost than the original selected remedy. The modification to the scope, performance, and cost of the selected remedy represents a fundamental change and therefore requires a ROD Amendment. This ROD Amendment documents the fundamental change to the selected remedy for the NEX Gas Station Leak Area.

This section summarizes the information that prompted and supports fundamentally changing the remedy selected in the OU 1 ROD.

3.1 MONITORING FOLLOWING REMEDY IMPLEMENTATION

The Navy implemented the remedial action selected in the OU 1 ROD from 2001 to 2003. Injection of Oxygen Release Compound (ORC®) into the subsurface, construction of four new monitoring wells (MW-880 through MW-883), and replacement of monitoring well MW-4 were completed in May 2001 (U.S. Navy 2001). Approximately 8,400 pounds of ORC® were placed in 35 injection locations in the source area, and 5,040 pounds were placed in 21 injection locations downgradient of the source area. The injection locations are shown on Figure 3-1. No excavation of petroleum soils was conducted during this remedial action. Quarterly groundwater monitoring was conducted from August 2001 through May 2003 of wells HC-2, HC-4, and HC-5 located near the NEX gas station and wells MW-4, MW-880, MW-881, MW-882, and MW-883 located downgradient of the gas station to assess the effectiveness of the ORC® injection. Seep-L and Seep-R, conditional points of compliance before groundwater enters Ostrich Bay, were also included in the monitoring program. Monitoring well and seep locations are shown on Figure 3-1.

As noted in the annual reports summarizing the monitoring (U.S. Navy 2003a and 2003b), the results suggested that a residual source of petroleum contamination was present at the site and that the contribution of dissolved petroleum constituents from the residual source and the site hydrogeology prevented the ORC® treatment from achieving the cleanup objectives. Routine monitoring of groundwater wells was discontinued after the initial 2-year period, because the results of the monitoring indicated that the monitoring network in place at that time was not adequate to define the distribution of TPH-G or benzene, toluene, ethylbenzene, and total xylenes (BTEX) in the groundwater beneath the site. The monitoring results indicated that more

information was needed to better understand the site conditions and assess the most effective remedial alternative.

3.2 ADDITIONAL INVESTIGATION AND PILOT TESTING

The Navy conducted additional investigation and pilot testing at the NEX Gas Station Leak Area between 2005 and 2010. This section summarizes the scope and conclusions of the investigations and pilot tests. A summary of soil and groundwater analytical results from site investigations between 1999 and 2010 are included in the focused feasibility study (FFS) report (U.S. Navy 2011a).

3.2.1 Soil and Groundwater Investigation – 2005

In 2005, the Navy conducted a subsurface investigation to further assess the extent of soil and groundwater contamination in the vicinity of the NEX pump island, as well as the lateral extent of contaminated groundwater beneath the site. Navy contractors completed soil borings throughout the site (locations 884, 888, 892, 893, 895, and 896). During this investigation, the Navy contractors also installed two dual-phase extraction (DPE) wells (DPE-894 and DPE-897) for potential pilot testing, one air-sparge well (AS-886) for potential future use, and five monitoring wells (MW-885, MW-887, MW-889, MW-890, and MW-891). Investigation locations are shown on Figure 1-3. The 2005 investigation generally established the boundaries of the groundwater contamination plume at the site and confirmed that soil beneath the NEX pump island was a residual source of contamination to groundwater (U.S. Navy 2006). This investigation also revealed the presence of free-phase petroleum hydrocarbons (free product) beneath the source area. The Navy revised the conceptual site model (CSM) based on the 2005 investigation and made recommendations in the field report to conduct a pilot test for the purpose of assessing DPE as a potential technology for interim removal of free product and a potential long-term remedy for the source area.

3.2.2 Dual-Phase Extraction Pilot Test – 2006

In 2006, Navy contractors conducted the recommended pilot test to assess DPE technology. The Navy presented the results of the pilot test in a technical memorandum (U.S. Navy 2007). This technical memorandum concluded that DPE is not the most feasible means to remove free product from the source area, because extraction and treatment of large volumes of water would be required to sufficiently suppress the groundwater surface and induce migration of free product to the DPE recovery wells. However, the pilot test did demonstrate that sufficient vapor-phase petroleum extraction rates could be achieved in the coarse-grained aquifer material beneath the source area. The results also indicated that a better understanding of the extent of free product

would be necessary to identify a long-term remedy for the source area, as well as for the downgradient portion of the site.

3.2.3 Free-Product Removal – 2009

A free-product skimming system, including downhole pneumatic skimmer pumps, was installed by Navy contractors in recovery wells RW-2, RW-3, and RW-4 in the summer of 2009 for the purpose of removing free product from the source area at the NEX gas station. Insignificant product removal (approximately 1 gallon) was achieved during the first year of skimming system operation (U.S. Navy 2011a). Skimming results indicate that passive removal of free product, without depressing the groundwater table, is not currently effective. The removal reports concluded that active removal using induced gradients may be more effective.

3.2.4 Focused Feasibility Study Investigation and Pilot Testing – 2010

The Navy conducted extensive additional subsurface investigation and pilot testing at the site in 2010 in support of an FFS. The purposes of the FFS investigation were the following:

- Estimate the lateral extent of free product at the site.
- Estimate the vertical extent of dissolved-phase petroleum hydrocarbons in groundwater across the site.
- Document the concentrations of petroleum hydrocarbons discharging to Ostrich Bay.
- Assess the aquifer characteristics (transmissivity, hydraulic conductivity, and storativity) in the source area and near-shore area.
- Assess the effect of the tide on groundwater elevations at the site.

The pilot testing conducted by the Navy in 2010 assessed four remedial technologies—soil vapor extraction (SVE), bioventing, ORC®, and air sparging.

Navy contractors installed several wells to meet the objectives of the subsurface investigation and allow pilot testing, including seven deep monitoring wells (MW-829, MW-830, MW-860, MW-873, MW-874, MW-875, and MW-895), two pumping wells (PW-877 and PW-878), five SVE wells (SV-827, SV-828, SV-870, SV-871, and SV-872), one air-sparge well (AS-876), and one intertidal temporary push point (TPP-831). Well locations are shown on Figure 1-3.

Investigation results are described in the FFS report (U.S. Navy 2011a), and the conclusions are summarized below:

- **Soil Sampling**: Analytical results for soil samples collected during the well installations generally indicate that BTEX and TPH-G are present in unsaturated soils above MTCA Method A cleanup levels in the immediate vicinity of the source area and in saturated soils above MTCA Method A cleanup levels downgradient of the source area.

- **Tidal Study**: Based on 6 days of measurements, the FFS concluded that tidally induced groundwater surface elevation fluctuation will be no greater than approximately 1.5 feet at any given location at the site. The tidal study showed that the entire site is in hydraulic communication with the surface water in Ostrich Bay. However, the groundwater response to tidal fluctuations varies by location, with the variations apparently controlled by the heterogeneous geology.

- **Baseline Groundwater Sampling**: The data collected as part of the baseline sampling at wells sampled prior to 2010 were generally comparable to concentrations of BTEX and TPH-G seen historically, with the exception of location MW-889, where concentrations were significantly lower in 2010 compared to 2006.

- **Free-Product Area Estimate**: The FFS estimated the area of free-product occurrence as depicted on Figure 1-3. Mobile, light nonaqueous-phase liquid (LNAPL) in quantities greater than residual saturation appears to exist over a limited area and has migrated laterally to the east, but appears to be stable (not migrating farther). The FFS noted minor fluctuations in the thickness of free product in response to tidal effects. During the tidal study and pumping test, field measurements documented free-product thickness increasing with decreasing groundwater levels.

- **Pumping Test – Groundwater Velocity Estimate**: The FFS estimated a maximum groundwater velocity at 2.7 feet/day across the site by considering the hydraulic gradient of 0.0220 foot/foot measured between well DPE-894 near the NEX gas station and well MW-883 in the near-shore area and using the average hydraulic conductivity.

- **Pumping Test – Capture Zone Analysis in the Source Area**: Assuming a flow rate of 28 gallons per minute (gpm), the FFS concluded that at least two wells would be required to capture the entire groundwater plume width in the NEX gas station area under high-gradient conditions. A flow rate of 28 gpm from two wells equates to an extraction and treatment volume of approximately 30 million gallons per year. This extraction rate is not expected to be sufficient to capture the entire vertical extent of dissolved contaminants.

- **Pumping Test – Capture Zone Analysis in the Near-Shore Area**: Assuming a flow rate of 0.5 gpm, the FFS estimated that approximately 12 wells would be required to capture the entire groundwater plume width in the shallow zone of the near-shore area. Pumping rates higher than 0.5 gpm are not considered to be achievable in this portion of the formation. A pumping rate of 0.5 gpm from 12 wells equates to an extraction and treatment volume of approximately 3.2 million gallons per year.

- **Saltwater Intrusion Potential**: The FFS concluded that there is very little potential for saltwater intrusion as a result of groundwater extraction in the NEX gas station area. However, the FFS also concluded that the potential is high for groundwater extraction in the shoreline area to induce saltwater intrusion. The freshwater-saltwater interface intersects the surface at the shoreline and slopes downward beneath land. If aggressive groundwater extraction is implemented near the shoreline, there is a potential for saltwater intrusion vertically if the pumping water surface is depressed to levels near sea level. There is also a very high potential for inducing lateral saltwater intrusion, depending on how much fresh water is extracted and how close to the shoreline the extraction system is constructed.

- **SVE/Bioventing Pilot Test**: During the SVE test, significant vapor-phase hydrocarbons were removed, demonstrating that SVE is a potentially feasible treatment technology for use in the unsaturated portions of the Vashon Till in the source area. Field measurements demonstrated that bioventing was effective at delivering air/helium in the shallow subsurface at the site (Vashon Till). However the field measurements also showed ambient oxygen concentrations to be high (greater than 20 percent) in the source area before, during, and after testing. This indicates that oxygen concentrations would not be expected to be limiting current rates of bioremediation, and bioventing would not be expected to be a useful treatment technology in the unsaturated portions of the Vashon Till.

- **ORC® Installation**: Biodegradation in the groundwater plume in the near-shore area does appear to be oxygen limited, and ORC® appears to be effective at increasing dissolved oxygen concentrations. ORC® would likely be effective at increasing rates of aerobic biodegradation and reducing benzene concentrations because of increased dissolved oxygen. However, the long-term effectiveness would be dependent upon the magnitude of benzene and TPH-G concentrations migrating into the treatment zone from the upgradient source area. Therefore, the ongoing effectiveness of ORC® in the near-shore area would be dependent on effective treatment at the source area.

- **Air-Sparge Pilot Test**: The FFS concluded that air can be effectively delivered to the subsurface in the near-shore area at low breakthrough pressures. Dissolved oxygen concentrations can be increased significantly (to saturation level) at the point of injection using air sparging within the Vashon Advance Outwash. Test results were inconclusive with regard to the dissolved oxygen radius of influence.

The Navy used the data collected for the FFS to develop a revised CSM, conduct a human health risk assessment, and evaluate potential remedial alternatives for the NEX Gas Station Leak Area.

3.3 REVISED CONCEPTUAL SITE MODEL

A revised CSM was developed by the Navy in the FFS that provides a summary interpretation of hydrogeologic and contaminant fate and transport conditions at the NEX Gas Station Leak Area and considered all data collected at the site through 2010. The CSM is presented in the FFS Report (U.S. Navy 2011a) and summarized in this section. Figure 3-2 illustrates the CSM for the site.

3.3.1 Geology and Hydrogeology

The geologic units underlying the NEX Gas Station Leak Area consist of, in descending order, fill, Vashon Till, and Vashon Advance Outwash. The fill layer is composed of reworked native till characterized by sandy silt and silty sand with some gravel and ranges in thickness from approximately 5 to 7 feet. The greatest thickness of fill is in the vicinity of the NEX gas station and along the near-shore in areas of cutting and filling done to level the surface grade during site development.

Vashon Till deposits underlie the fill layer and consist of dense to very dense silty, gravelly sands to sandy silts with gravel. The till layer is up to 22 feet thick in the vicinity of the NEX pump island and pinches out easterly toward the shoreline. Discontinuous lenses of perched

groundwater exist within the Vashon Till. Based on wells installed within the till in 2010, the perched groundwater is more continuous in the vicinity of the NEX gas station than previously thought during the development of the OU 1 ROD. The greatest saturated thickness within the till appears to be adjacent to the NEX pump island. Groundwater flow within the till is inferred to be easterly, with a 0.04 foot/foot gradient near the NEX gas station that steepens considerably in the central portion of the site. A significant vertical downward gradient is also evident between wells completed in the till and the underlying outwash deposits, and this vertical gradient is greatest near the NEX gas station. This downward vertical gradient has likely been the primary reason for downward vertical migration of dissolved-phase gasoline in the source area, as discussed further below.

The subsurface investigations identified Vashon Advance Outwash beneath the till across the entire site. The Vashon Advance Outwash generally consists of gravelly sands to sandy gravels. Groundwater is present in the outwash deposits as a continuous aquifer from the NEX gas station to the shoreline. Groundwater flow within the aquifer is inferred to be easterly, with an average hydraulic gradient of 0.008 foot/foot across the site. The gradient is significantly steeper in the eastern portion of the site (approximately 0.12 foot/foot), as compared to the vicinity of the NEX gas station.

At the time the OU 1 ROD was signed, it was thought that the outwash deposits thinned to the east toward the shoreline and that these deposits were underlain by lower permeability sandy silts with interbedded silt and clays that were not saturated. Based on deeper borings completed in 2010, the FFS concluded that the Vashon Advance Outwash deposits are greater than 80 feet in thickness beneath the site and do not thin easterly as previously thought. The full thickness of the outwash deposits is not known; the Vashon Advance Outwash can be up to 200 feet thick in the site vicinity (Kitsap PUD 1997). In the near-shore area, the upper portion of the outwash includes a zone of interbedded fine-grained material that varies in thickness from approximately 3 to 10 feet near the shoreline and appears to extend approximately 200 feet to the west, where it pinches out. It appears that all of the monitoring wells situated along the near-shore area have been completed within the upper portion of the outwash deposit, within a relatively thin sand layer above the finer grained material. Pumping tests conducted in 2005 and 2010 demonstrated hydraulic conductivities up to an order of magnitude lower in the near-shore wells screened in the upper portion of the outwash than in the wells screened in the deeper portions of the outwash in the NEX gas station area. The 2010 tidal study concluded that the entire site is in hydraulic communication with the surface water in Ostrich Bay. However, the groundwater response to tidal fluctuations varies by location, with the variations apparently controlled by the heterogeneous geology. The upper portion of the advance outwash deposits in the near-shore area is semiconfined to unconfined, depending on the presence and configuration of the interbedded fine-grained material. The lower portion of the advance outwash appears to be consistently under unconfined conditions.

3.3.2 Contaminants in Environmental Media

Contaminants in environmental media at the NEX Gas Station Leak Area consist of gasoline-range petroleum compounds in soil, groundwater, and groundwater discharging to surface water. Contaminants may also be present in sediment and seafood in the vicinity of the point of discharge. The source of these contaminants is a historical leak at the NEX gas station. Contamination in the source area consists of free product, as well as TPH-G and BTEX sorbed to soil, dissolved in shallow perched groundwater, and dissolved in deeper groundwater in the laterally continuous aquifer. The free product and contaminated soil in the source area act as an ongoing residual source of dissolved petroleum compounds in groundwater, which forms a plume of contaminated groundwater from the source area to the point of discharge to surface water in Ostrich Bay.

The maximum concentrations of TPH-G and BTEX reported in soil in the source area are as follows:

- TPH-G: 20,000 mg/kg
- Benzene: 53,000 µg/kg
- Toluene: 380,000 µg/kg
- Ethylbenzene: 110,000 µg/kg
- Total xylenes: 510,000 µg/kg

The maximum concentrations of TPH-G and BTEX reported in groundwater at the site are as follows:

- TPH-G: 280 mg/L
- Benzene: 24,000 µg/L
- Toluene: 79,000 µg/L
- Ethylbenzene: 6,910 µg/L
- Total xylenes: 30,000 µg/L

More details regarding the nature and extent of the petroleum contamination in environmental media at the site are provided in the sections below.

Free-Product Occurrence

The estimated lateral extent of free product was refined by the Navy based on the results of the FFS investigation. The FFS investigation showed that free product was present over an area of approximately 8,000 square feet (Figure 1-3), compared to the approximately 20,000 square feet previously estimated. The distribution of free product within this area is not uniform. The

quantity of free product above residual saturation, which is mobile and therefore directly recoverable, appears to be limited, relatively stable, and not migrating. Significant quantities of gasoline have not been recovered to date, which appears to confirm that only a limited quantity of mobile free product is present. In a much larger portion of the saturated zone within the outwash, petroleum appears to exist at concentrations at or below residual saturation within the smear zone (Figure 3-2). The extent of LNAPL saturation appears to extend approximately 20 feet below the top of the groundwater surface. The LNAPL smear zone is thought to be caused by a combination of factors, including seasonal and tidal fluctuations in groundwater levels, the downward vertical gradient observed between the perched groundwater and the underlying outwash aquifer, and variations in the hydraulic characteristics within the saturated zone.

Extent of Contamination

Contamination in the unsaturated zone appears to have migrated both vertically and laterally to the east, down slope from the NEX gas station. The lateral migration was likely affected by such factors as differences in the soil types and soil physical characteristics, perched groundwater flow, and perhaps by preferential flow pathways. No preferential pathways (such as utilities orientated along the axis of the plume) have been identified in the area.

The lateral dimensions of the dissolved-phase plume have been generally established and extend from the NEX gas station to the shoreline at Ostrich Bay. Monitoring wells MW-885 and MW-887 bound the south and north limits of the plume, respectively, at the near-shore. Based on hydraulic gradients across the site and groundwater flow path, the plume limits from the near-shore to the source area may be inferred, but no well is located in the plume perimeter to the north or south of the NEX gas station or midplume area. The highest concentrations of dissolved BTEX and TPH-G are situated beneath the source area and decline in concentration to the east.

At the time that the OU 1 ROD was signed, the Navy believed that only the perched groundwater in the Vashon Till had been impacted, not the deeper groundwater in the Vashon Advance Outwash. Vertical profile sampling at the source area has since indicated that elevated concentrations of BTEX and TPH-G appear to extend greater than 57 feet below ground surface (bgs; 4 feet below msl) and the vertical extent of the dissolved-phase plume has not been established. The Navy has extensively monitored the near-shore extent of dissolved-phase impacts within the upper portion of the outwash above the lower permeability finer grained soils, and these impacts are well defined laterally. Vertical profile sampling within the advance outwash beneath the finer grained material at the near-shore indicated that elevated concentrations of BTEX and TPH-G appear to extend to greater than 33 feet bgs (8 feet below msl), and the full vertical extent of the dissolved-phase impacts has not been established.

3.4 HUMAN HEALTH AND ECOLOGICAL RISK ASSESSMENT

The Navy did not perform human health or ecological risk assessments specific to the NEX Gas Station Leak Area as part of the CERCLA process prior to the OU 1 ROD, because the site was discovered in 1998 after the baseline remedial investigation/feasibility study (RI/FS) for OU 1 had been completed. The Navy conducted a human health risk assessment for the NEX Gas Station Leak Area as part of the FFS using data collected at the site from 2001 to 2010. The FFS did not include an ecological risk assessment specific to the NEX Gas Station Leak Area, but referred to the results of an extensive ecological risk assessment conducted for OU 2 of the JPHC/NHB CERCLA site in 2010 (U.S. Navy 2010). OU 2 of the JPHC/NHB CERCLA site addresses the ecological risks associated with marine sediments in Ostrich Bay, including the NEX Gas Station Leak Area. This section summarizes the results of the human health and ecological risk assessments presented in the FFS Report (U.S. Navy 2011a).

3.4.1 Human Health Risk Assessment

The human health risk assessment in the FFS report evaluated risks for commercial workers, utility workers, off-site residents, recreational visitors, recreational seafood harvesters, and tribal seafood harvesters (harvesting for ceremonial, commercial, and subsistence uses) that may be exposed to chemicals of potential concern (COPCs) at the NEX Gas Station Leak Area. COPCs identified at the site included TPH-G, BTEX, and methyl tertiary-butyl ether (MTBE; conservatively included based on detections in 2002). The following media were identified as potentially containing chemicals above regulatory levels: groundwater; subsurface soil; surface water in Ostrich Bay at the groundwater seeps; near-shore sediments in Ostrich Bay in the immediate vicinity of the seeps; seafood, including shellfish, from Ostrich Bay in the immediate vicinity of the seeps; and sediments and seafood from subtidal areas in Ostrich Bay.

Based on these affected media and potential receptors, the risk assessment identified the following as complete exposure pathways:

- Contact with subsurface soil and groundwater by utility workers
- Contact with surface water and sediment during recreational activities
- Future ingestion of seafood by recreational harvesters
- Future contact with surface water and sediment and ingestion of seafood by tribal harvesters (harvesting for ceremonial, commercial, and subsistence uses)
- Future ingestion of drinking water by residents and commercial workers

The risk assessment quantified only the pathway for utility workers. The risk assessment considered the drinking water pathway to be a health risk because Safe Drinking Water Act maximum contaminant levels (MCLs) were exceeded (i.e., the pathway is significant). The risk assessment did not evaluate the other complete pathways for significance because of a lack of sample data from the marine environment. Instead, the risk assessment discussed these pathways qualitatively.

The risk assessment concluded that two additional pathways may be complete, although the data were insufficient to quantify them:

- Inhalation of groundwater vapors by commercial workers
- Inhalation of groundwater vapors by residents

The risk assessment discussed these pathways qualitatively. Surface soil has not been found to be impacted and was not carried through the risk assessment as a medium or pathway of concern.

The risk evaluation identified utility maintenance worker risks above an acceptable level if utility workers were to be exposed to vapors from shallow groundwater flooding a trench (where groundwater is less than 15 feet bgs), because of exposures to benzene, ethylbenzene, xylenes, and C6-C8 aromatics. Risks from soil exposures and exposures to vapors from deep groundwater were acceptable. However, if residual LNAPL was present in soils (possibly beneath the pump islands), it was considered a potential worker hazard. No subsurface excavation should be conducted in the entire area without: proper worker protective equipment, worker training that addresses hazardous chemical exposures, and following all applicable worker health and safety regulations.

The risk assessment concluded that the future drinking water pathway is assumed to be a health risk because MCLs were exceeded. In addition, potentially significant and complete exposure pathways for which the risk assessment could not quantify risks because of a lack of data, but for which unacceptable risks may exist now or in the future include the following:

- Exposure to marine surface water and sediment during recreational activities, including future seafood harvesting—Worst-case assumptions and calculations based on the benzene concentrations in outfall OF-712 indicate recreational risks are likely very low. However, no sediment data related to the COCs are available in the vicinity of the seeps/outfalls to verify that these risks are acceptable.

- Future exposure to surface water and sediment and ingestion of aquatic organisms during tribal/subsistence harvesting—These exposures have not been quantified because of a lack of applicable sediment and tissue data. Any need to further

assess potential tribal/subsistence exposures will be done in consultation with the Suquamish Tribe and EPA.

- Possible vapor intrusion risks from groundwater near the NEX convenience store and residential housing units immediately north and south of the source area—The following indicate that the likelihood of indoor air risks is low: (1) Sample semiquantitative risk calculations for commercial and residential exposures below target health goals, (2) NEX convenience store located upgradient of the source and nearest homes located cross gradient, (3) the distance from the source area to residential homes, (4) the likely rapid plume attenuation cross gradient from the source area, and (5) the biodegradation of petroleum compounds as they move closer to the surface and are exposed to oxygen. However, potential vapor intrusion health risks above risk target goals for both the NEX convenience store and residential homes cannot be entirely ruled out without additional data collection and evaluation efforts.

3.4.2 Ecological Risk Assessment

As discussed above, the FFS referred to the results of an extensive ecological risk assessment conducted for JPHC/NHB CERCLA site OU 2 (U.S. Navy 2011b), which addresses the potential ecological risks associated with marine sediments in Ostrich Bay, including the NEX Gas Station Leak Area. This ecological risk assessment did not generate data considered representative of human health exposure in the small intertidal area within the NEX Gas Station Leak Area. The baseline ecological risk assessment (BERA) for OU 2 evaluated risks and calculated specific hazards for the benthic invertebrate community, crabs, fish, birds, and mammals that may be potentially exposed to COPCs in prey or sediments at OU 2. The data set used in the BERA consisted of data on sediment (52 samples from 43 locations) and aquatic biota chemical concentrations collected in 2009 from OU 2 (six composite samples from each: bent-nose clam, graceful crab whole body, graceful crab hepatopancreas, sea cucumber, and starry flounder whole body), sediment toxicity testing for benthic organisms (26 samples during Phase 1 and 9 samples during Phase 2), and risk calculations for aquatic and aquatic-dependent wildlife. BTEX was analyzed in all of the sediment samples, and TPH-G was analyzed in the two sediment samples closest to the Benzene Release Area. No tissue sample was analyzed for TPH-G, BTEX, or MTBE, because volatile organic compounds do not bioaccumulate. Of the COPCs identified at the NEX Gas Station Leak Area that were analyzed in sediment (e.g., TPH-G, BTEX, and MTBE), none was detected above conservative ecological screening levels. Therefore, it is unlikely that COCs from the NEX Gas Station Leak Area are contributing to an ecological hazard in OU 2. Furthermore, the BERA concluded that ecological risks at OU 2 are minimal. The preferred remedial action alternative for OU 2, which met the evaluation criteria,

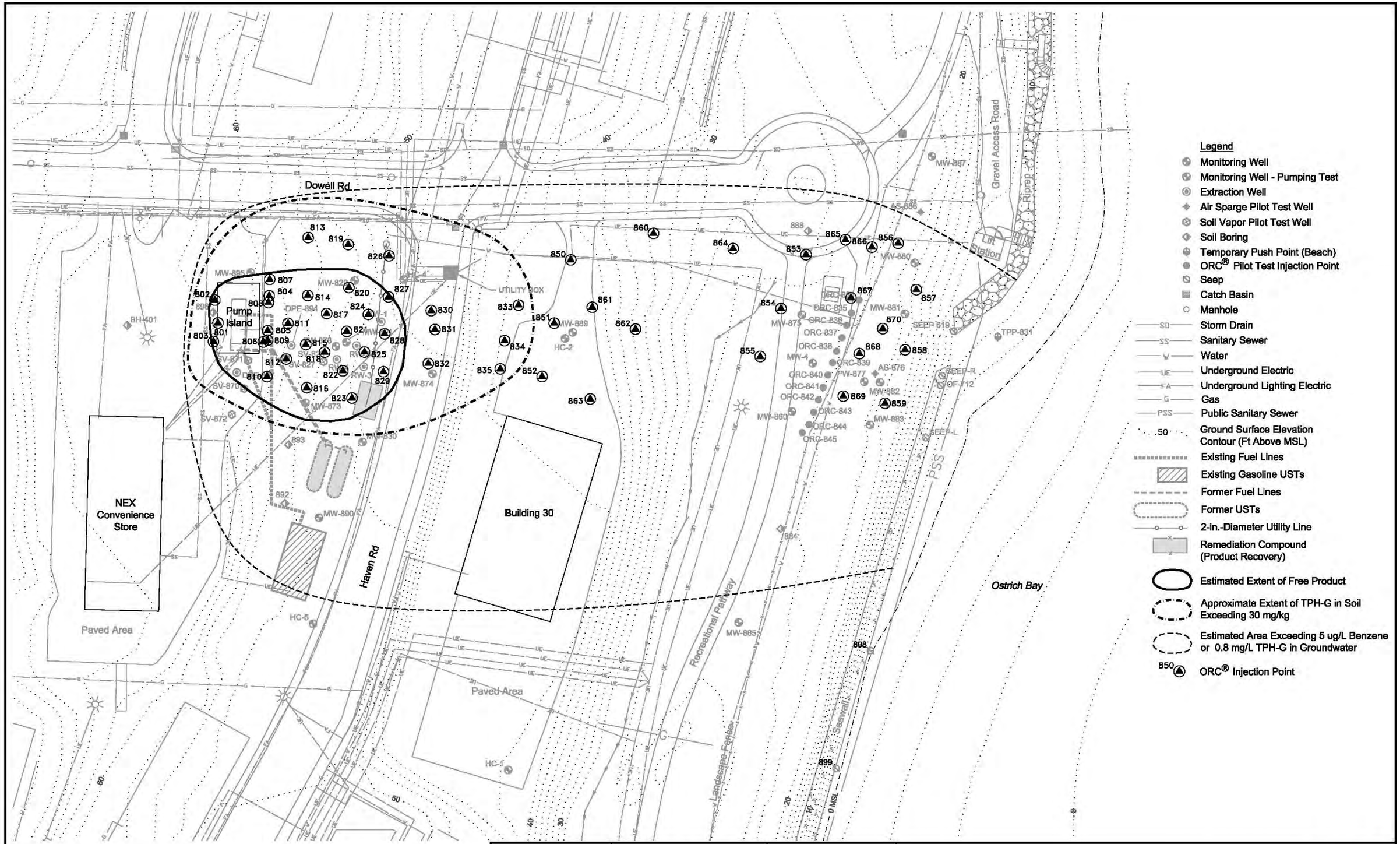
is monitored natural recovery. Neither of the two active remedial alternatives that involve capping of sediment met the evaluation criteria.

3.5 BASIS AND RATIONALE FOR THE AMENDMENT

The original selected remedy in the OU 1 ROD, described in Section 2.2, was completed in 2003 and did not achieve the ROD-specified cleanup objectives. Therefore, the primary treatment method will be changed to utilize more aggressive treatment technologies with significantly higher cost than the original selected remedy. The modification to the scope, performance, and cost of the selected remedy represents a fundamental change and therefore requires a ROD Amendment.

Groundwater and seep monitoring following ORC® injection in 2001 indicated that the selected remedy in the OU 1 ROD did not achieve the cleanup objectives, and more information was needed to better understand the site conditions and assess the most effective remedial alternative. The Navy performed additional field investigations at the site and developed a revised CSM to describe the site geology, hydrogeology, free-product occurrence, and extent of contamination. The revised CSM showed that dissolved-phase petroleum impacts extend deeper than previously understood, into the aquifer in the Vashon Advance Outwash. The human health risk assessment conducted during the FFS identified complete and potentially significant exposure pathways for utility workers, residents, recreational visitors, and seafood harvesters. Based on the revised CSM and human health risk assessment, revised preliminary remedial action objectives (RAOs) were identified, and remedial alternatives were developed and evaluated in the FFS.

The NCP Section 300.435(c)(2)(ii) requires that a fundamental change to the scope, performance, or cost of a remedy selected in a ROD be documented with a revised proposed plan and amended ROD. The original selected remedy at the NEX Gas Station Leak Area will be amended to utilize more aggressive and costly treatment technologies designed to treat the deeper groundwater now understood to be impacted, as well as the shallower perched groundwater. The preferred alternatives from the FFS were described in the *Proposed Plan for the Cleanup Action at the Benzene Release Area* dated October 2012 (U.S. Navy 2012). This ROD Amendment presents the remedial alternatives selected to amend the original selected remedy in the OU 1 ROD for the NEX Gas Station Leak Area.



U.S. NAVY

Delivery Order 0053
Jackson Park/Naval Hospital
NEX GAS STATION
LEAK AREA

Figure 3-1
Original Selected Remedy in OU 1 ROD - ORC® Injection

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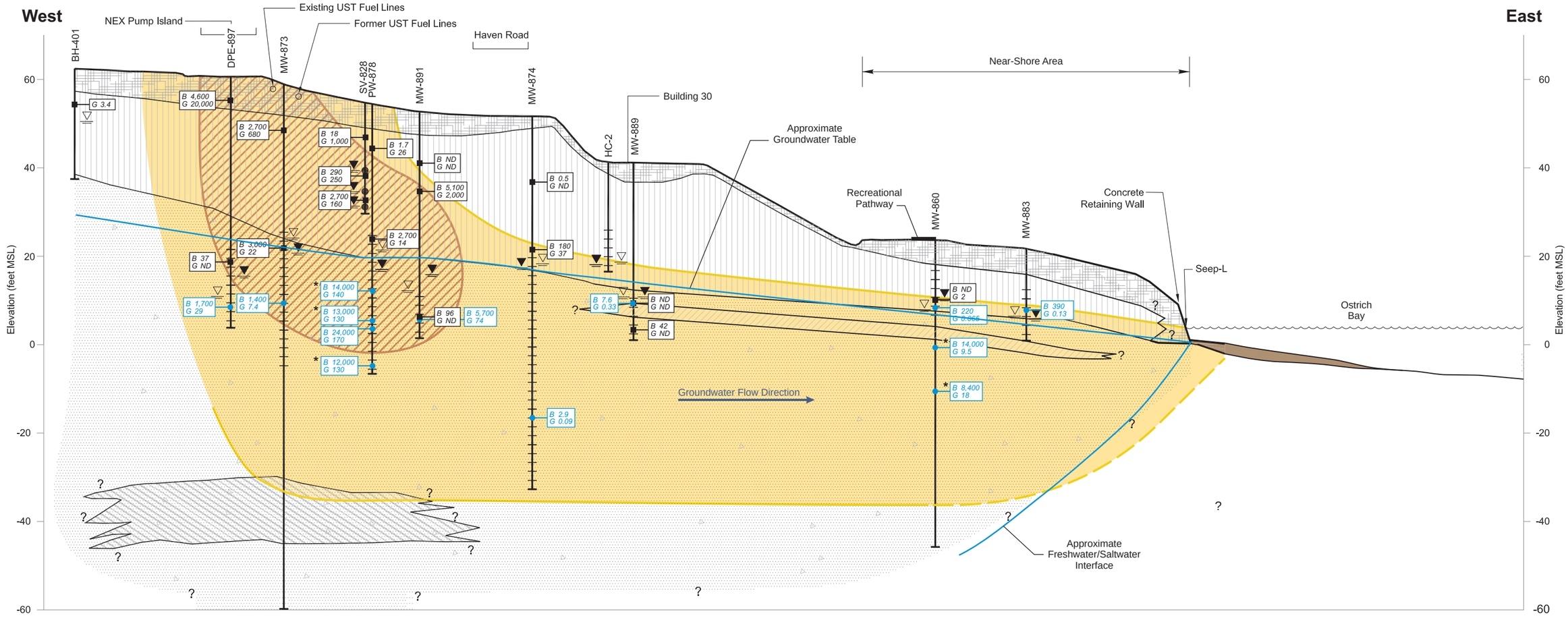
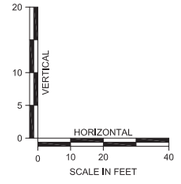


Legend

- Marine Beach Deposits
- Silty Sand With Gravels (Fill)
- Dense Silty Sand/Silty Sand With Gravel (Vashon Till)
- Sand and Gravelly Sand/Sandy Gravel (Vashon Advance Outwash)
- Sand and Gravelly Sand/Sandy Gravel/Sand With Silt (Vashon Advance Outwash)
- **Silty Sand/Silt/Sandy Clay (Vashon Advance Outwash)**
- Soil Vapor Well Screen
- Screen Interval
- Estimated Depth to Groundwater at Time of Drilling
- Static Depth to Groundwater (May 10, 2010)

- Approximate Area of Affected Soil and/or Groundwater Based on Field Screening and Analytical Data
- Approximate Area of Residual LNAPL
- B 2,700 / G 680 — Benzene Concentrations in Soil (µg/kg); TPH-Gasoline Concentrations in Soil (mg/kg)
- B 1,000 / G 3.8 — Benzene Concentrations in Groundwater, February 2010 (µg/L); TPH-Gasoline Concentrations in Groundwater, February 2010 (mg/L)
- ND Not Detected
- * Vertical Profile Samples Collected During Drilling (MW-860) or Post-Well Installation (PW-878)



Note: Reworked till in near-shore area referred to as fill.

U.S. NAVY	Delivery Order 0053 Jackson Park/Naval Hospital NEX GAS STATION LEAK AREA	**Figure 3-2** **Conceptual Site Model**

4.0 DESCRIPTION OF REMEDY MODIFICATION

This section summarizes the original RAOs from the OU 1 ROD and describes the revised RAOs and remedial actions selected to amend the original remedy. Key chemical-specific applicable or relevant and appropriate requirements (ARARs) that apply to the amended remedy are also discussed.

4.1 REMEDIAL ACTION OBJECTIVES

4.1.1 Remedial Action Objectives and Remediation Goals From OU 1 ROD

The OU 1 ROD identified two chemicals of concern (COCs) for the NEX Gas Station Leak Area, TPH-G and benzene, and established a surface water remediation goal (RG) for benzene with a conditional point of compliance located where impacted seeps enter Ostrich Bay. The RG for benzene was based on the MTCA Method B surface water cleanup level at the time (43 µg/L), which is a risk-based cleanup level designed for protection of humans consuming fish/shellfish from the water body. It was thought that deeper groundwater in the Vashon Advance Outwash was not impacted. Therefore, the basis for remedial action was protection of the marine environment. The ROD established a conditional point of compliance for groundwater at the NEX Gas Station Leak Area located as close as technically possible to the point or points where groundwater discharges to surface water (i.e., at the seeps and outfalls). The OU 1 ROD established a soil RG for TPH-G of 100 mg/kg at Site 110. The OU 1 ROD did not specify that this RG applied to the NEX Gas Station Leak Area.

To address potential human health and ecological risks associated with the COCs, the OU 1 ROD identified the following RAO for groundwater at the NEX Gas Station Leak Area: "Protect ecological receptors in the marine environment and human health by attaining compliance with water quality standards for marine surface water at the point of groundwater discharge." No RAO was established for soil or intertidal sediments at the NEX Gas Station Leak Area in the OU 1 ROD.

4.1.2 Revised Remedial Action Objectives

The FFS developed preliminary revised RAOs based on the revised CSM and human health risk assessment, summarized in Sections 3.3 and 3.4, respectively. These RAOs address the exposure pathways and chemicals for which risks to human health were identified, as well as potentially significant and complete exposure pathways for which the risk assessment could not quantify risks because of lack of data, but for which unacceptable risks may exist now or in the future.

The FFS developed the following RAOs to protect human health and the environment from risks related to current and future exposures to petroleum hydrocarbons at the site:

- Reduce petroleum hydrocarbons in groundwater to levels protective of human health at the point where groundwater discharges to Ostrich Bay.[1]
- Reduce petroleum hydrocarbons in groundwater to concentrations less than drinking water standards throughout the aquifer beneath the site.
- Reduce concentrations of petroleum hydrocarbons in soil beneath the site to concentrations protective of groundwater.
- Minimize exposure to free-phase product remaining in the vadose zone beneath the source area.

4.1.3 Chemical-Specific Applicable or Relevant and Appropriate Requirements

The FFS identified five COCs for the NEX Gas Station Leak Area, including TPH-G and BTEX compounds. Chemical-specific ARARs considered in developing revised cleanup levels for the site COCs are discussed in this section. Location-specific and action-specific ARARs that apply to the amended remedy at the NEX Gas Station Leak Area are discussed in Section 7.2.

Chemical-specific ARARs potentially applicable as soil and groundwater cleanup standards for the COCs at the site are listed below and shown in Tables 4-1, 4-2, and 4-3.

ARARs for Soil

MTCA Regulations, Washington Administrative Code (WAC) 173-340-740(2)(b)(i), (3)(b)(iii), (5), and (6) and 173-340-747. MTCA Method A soil cleanup levels for unrestricted land use (based on protection of drinking water) and MTCA Method B soil cleanup levels for direct contact and protection of groundwater used for drinking water are applicable chemical-specific ARARs at the site. These ARARs allow for adjustments in cleanup level values and establish the points of compliance where the soil cleanup levels will need to be achieved.

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[1]This RAO generally corresponds to the RAO listed in the OU 1 ROD (provided in Section 4.1.1). However, the RAO in the OU 1 ROD applied only to benzene and referred to the marine surface water quality standard, while the revised RAO applies to TPH-G and BTEX and involves achieving the more protective drinking water quality standards. Revised cleanup levels are discussed further in Section 4.1.4.

ARARs for Groundwater Used for Drinking Water

MTCA Regulations, WAC 173-340-720(3)(b)(i), (4)(b)(i), (7), and (8). MTCA Methods A and B cleanup levels for potable groundwater are potentially applicable chemical-specific ARARs at the site. These ARARs include MTCA Method A numerical concentrations identified in WAC 173-340-900, Table 720-1, and concentrations established under applicable state and federal law as further identified below. MTCA Method B calculated values for human health are not applicable because state and federal laws provide health-based standards that are sufficiently protective, following adjustment to comply with state risk standards as described in Section 4.1.4. These ARARs allow for adjustments in cleanup level values and establish the points of compliance where the groundwater cleanup levels will need to be achieved.

Federal Safe Drinking Water Act, 40 Code of Federal Regulations (CFR) 141.50 and 141.61; WAC 173-340-720(3)(b)(ii)(A) and (B) and -720(4)(b)(i). MTCA Methods A and B cleanup levels for potable groundwater include concentrations established under applicable state and federal laws. These chemical-specific ARARs include federal MCLs and maximum contaminant level goals (MCLGs) for noncarcinogens established under the Safe Drinking Water Act. Where the state standard is not more stringent than the federal standard, the state standard is not an ARAR. MCLs are not always risk-based values, but are values set as close as feasibly possible to the MCLGs, considering cost, benefits, and the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

Washington Department of Health Maximum Contaminant Levels, WAC 246-290-310(7)(b)(i); WAC 173-340-720(3)(b)(ii)(C). MTCA Methods A and B cleanup levels for potable groundwater include concentrations established under applicable state and federal laws. These chemical-specific ARARs include MCLs established by the Washington State Department of Health. The Washington State Department of Health has adopted by reference the concentrations presented for volatile organic compounds under the Safe Drinking Water Act (40 CFR 141.61[a]). Where the state standard is not more stringent than the federal standard, the state standard is not an ARAR.

ARARs for Groundwater Protective of Marine Surface Water

MTCA Regulations, WAC 173-340-720(3)(iv), (4)(b)(ii), (7), and (8) and 173-340-730(3), (5), and (6). MTCA regulations specify the requirements for cleanup levels and points of compliance for surface water, including cleanup levels based upon applicable state and federal laws, protection of surface water beneficial uses, and protection of human health. These regulations also specify requirements for adjustments in cleanup levels and standard and conditional points of compliance.

Washington State Water Quality Standards for Surface Waters, WAC 173-201A-240(3) and (5) and 173-201A-600. State water quality criteria for toxic substances developed in accordance with the Clean Water Act for the protection of human health and aquatic life are potential chemical-specific ARARs for groundwater discharging hazardous substances to surface water. Under WAC 173-201A-600, beneficial uses of Ostrich Bay include aquatic life uses, seafood harvesting, recreational uses, and miscellaneous uses, including wildlife habitat, commerce/navigation, boating, and aesthetic values. For the NEX Gas Station Leak Area COCs, no standard has been established for the protection of aquatic life. For COCs related to human-health-based water quality criteria, the State of Washington has adopted by reference the concentrations presented in 40 CFR 131.36, known as the National Toxics Rule. Where the state standard is not more stringent than the federal standard, the state standard is not an ARAR.

National Toxics Rule, 40 CFR 131.36(b)(1) and (d)(14); WAC 173-201A-240(5). The National Toxics Rule establishes water quality criteria for toxic substances for marine aquatic life and human health. The State of Washington has adopted by reference the human health-based-criteria as referenced in 40 CFR 131.36(d)(14) (WAC 173-201A-240[5]). The human-health-based standards for consumption of marine organisms are potentially relevant and appropriate to hazardous substances in groundwater that are likely to reach marine surface water. The State of Washington has not adopted the National Toxics Rule marine aquatic life criteria. Where the state standard is not more stringent than the federal standard, the state standard is not an ARAR.

Federal Clean Water Act, 33 USC 1251-1376, National Recommended Water Quality Criteria of 2009. The National Recommended Water Quality Criteria were established by EPA for evaluating toxic effects on human health and aquatic organisms. The human-health-based standards for consumption of marine organisms are potentially relevant and appropriate to hazardous substances in groundwater that are likely to reach marine surface water.

4.1.4 Revised Remediation Goals (Cleanup Levels)

This ROD Amendment establishes revised cleanup levels for the COCs (TPH-G and BTEX) in soil and groundwater at the NEX Gas Station Leak Area based on the revised RAOs (Section 4.1.2) and the potential chemical-specific ARARs (Section 4.1.3). These cleanup levels supersede and revise the remediation goals established for these COCs in the OU 1 ROD. This ROD Amendment also replaces the term “remediation goal” with “cleanup level” as the term used to refer to the numeric standards associated with the RAOs.

According to MTCA 173-340-720(7)(b), where cleanup levels are based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}), or a hazard index of 1, the cleanup level must be

adjusted downward so that the total excess cancer risk does not exceed 1×10^{-5} and the hazard index does not exceed 1 at the site. For benzene, the MCL of 5 µg/L was determined to be protective of both a cancer risk of 1×10^{-5} and hazard quotient of 1. Likewise for ethylbenzene, the MCL of 700 µg/L was determined to be protective of a hazard quotient of 1. Therefore, no adjustment to the benzene or ethylbenzene MCLs was necessary to comply with state and federal requirements. As a result of this conclusion, the MCLs for benzene and ethylbenzene of 5 and 700 µg/L, respectively, were selected as the cleanup levels for protection of groundwater for beneficial uses. However, for the xylene compounds, the MCL of 10,000 µg/L was found to exceed the MTCA Method B cleanup level, based on a hazard index of 1 and thus required downward adjustment to comply with state and federal requirements. The MTCA Method B cleanup level of 1,600 µg/L was selected as the cleanup level for the xylene compounds for protection of groundwater for beneficial uses. For TPH-G, the MTCA Method A cleanup level for potable groundwater was selected as the revised groundwater cleanup level.

These cleanup levels are protective of potable groundwater and are lower (and therefore more protective) than the potential chemical-specific ARARs for groundwater protective of marine surface water. Therefore, these cleanup levels are selected to be protective of all pathways. The cleanup levels for groundwater are shown in Tables 4-2 and 4-3. The remediation goal established in the OU 1 ROD for benzene at the NEX Gas Station Leak Area is provided in the tables for comparison.

This ROD Amendment also establishes revised numeric criteria for COCs in soil based on the protection of the groundwater pathway (i.e., leaching of contaminants from soil to groundwater). These criteria are provided for comparison and are not established as cleanup levels for soil. Achievement of the RAO for soil (protection of groundwater) will be demonstrated empirically using groundwater samples from monitoring wells located within the source area. The numeric criterion for TPH-G is the MTCA Method A soil cleanup level for unrestricted land use (based on protection of drinking water). The soil criteria for the BTEX compounds are based on MTCA Method B and were calculated using the MCLs and the three-phase partitioning model under WAC 173-340-747 (which results in cleanup levels protective of drinking water). Numeric criteria for soil are shown in Table 4-1. The RG established in the OU 1 ROD for TPH-G at Site 110 is provided in the table for comparison, although the OU 1 ROD did not specify that this RG applied to the NEX Gas Station Leak Area.

The FFS evaluated the need for RAOs to protect ecological receptors, although no ecological risk resulting from exposure to petroleum hydrocarbons was identified in the 2011 BERA (U.S. Navy 2011b). While minimal ecological risk may be present, drinking water standards for human health (revised downward where necessary) are also assumed by the Navy, EPA, and Suquamish Tribe to be protective of ecological receptors, based on comparison to potential chemical-specific ARARs for groundwater protective of marine surface water (Table 4-3).

4.1.5 Point of Compliance

The selected remedial actions for the NEX Gas Station Leak Area will reduce the concentrations of COCs in soil and groundwater throughout the site (the standard point of compliance) to at least the cleanup levels. Because several years will be required for the remedial actions to achieve this goal for groundwater throughout the site, a "conditional point of compliance" (WAC 173-340-720[8][c]) is also established at the "880 series wells" (the estimated 12 performance monitoring wells shown for the near-shore treatment zone on Figure 4-1). The remedial actions are intended to address the exposure at the point of discharge to surface water in the shortest reasonable time. MTCA addresses conditional points of compliance for properties abutting surface water (WAC 173-340-720[8][d][i]). The compliance sampling locations and frequency are discussed further in Section 4.2.4.

The selected near-shore remedy is expected to achieve the cleanup levels in groundwater at the conditional point of compliance in approximately 1 year. Although this is the expected outcome for this component of the remedy, the performance requirement is that the near-shore remedy must meet the performance standard established in Section 4.2.2 within 2 years of startup. The combination of active treatment at the source area, active treatment at the near-shore area, and flushing between these areas is expected to achieve the cleanup levels in groundwater at the standard point of compliance in approximately 12 years. The expected outcomes of the selected remedial actions are discussed further in Section 4.2.3.

4.2 DESCRIPTION OF THE ROD AMENDMENT

The FFS developed and evaluated remedial alternatives intended to meet the revised RAOs for soil and groundwater at the site. The FFS identified two portions of the site for active treatment, the source area and the near-shore area. Passive flushing of groundwater between these two areas was included as part of all of the alternatives evaluated. The institutional controls established in the OU 1 ROD, which prevent use of groundwater beneath the site for drinking water, remain in effect and will continue until the combination of active treatment and passive flushing result in meeting the groundwater cleanup level at the standard point of compliance.

Separate evaluations were performed to select a preferred remedial alternative for each active treatment area (the source area and the near-shore area). For the purpose of the FFS evaluations, the source area treatment zone was defined as the Vashon Till (35 feet bgs) and groundwater down through approximately the upper 30 feet of the Vashon Advance Outwash (total of 65 feet bgs) beneath the NEX pump island. Contaminated soil, LNAPL, and adjacent groundwater containing elevated dissolved concentrations of COCs are the targets of remedial actions in the source area. The near-shore area treatment zone was defined in the FFS as the upper 30 feet of

the groundwater aquifer (approximately 20 to 50 feet bgs) in the area between the recreational pathway and Ostrich Bay, from approximately Dowell Road to monitoring well MW-885. Groundwater containing dissolved concentrations of COCs is the target of remedial actions in the near-shore area.

The FFS acknowledged data gaps that have the potential to affect the size of the active treatment zones at both the source area and near-shore area. The FFS concluded that these data gaps could be reasonably filled during post-FFS sampling, and any resulting change in treatment zone size would not change the conclusions of the remedy evaluation in the FFS. The amended remedy for the source area and near-shore area and the expected outcomes of the amended remedy are described in this section.

4.2.1 Source Area Amended Remedy

The amended remedy for the source area is electrical resistive heating (ERH) with DPE, which consists of heating the subsurface with electrodes to mobilize contaminants for recovery by DPE. This in situ treatment technology will be performed in the upper 65 feet of the subsurface, throughout the region of Vashon Till soil and perched groundwater that exceeds cleanup levels and in the upper portion of the aquifer within the Vashon Advance Outwash with the highest dissolved concentrations. This remedy will entail complete removal or relocation of the NEX pump island to the west, outside of the treatment area, or shutdown of the NEX pump island for a period of 1 year, followed by reconstruction after the completion of treatment. The existing product recovery, groundwater monitoring, and soil vapor wells in the ERH treatment area will be properly decommissioned prior to ERH implementation, because they are not constructed to withstand the high temperatures that ERH will create in the soil and perched groundwater.

Soil and Groundwater Treatment

ERH technology will require installing an array of approximately 30 electrodes (Figure 4-1) throughout the treatment area and supplying electricity into that array. The resistance of the soil to the conduction of electricity between the electrodes results in heating of the soil and perched groundwater, causing transfer of soil contaminants with boiling points below that of the soil temperature into the vapor phase and boiling of the groundwater. For the saturated zone, deeper additional electrodes and energy demand will be needed to overcome the cooling effects of groundwater moving through the treatment zone. Following active heating of the treatment zone, the elevated temperatures support enhanced biodegradation activities as natural cooling occurs.

A DPE system with wells collocated with the electrodes will remove the contaminants mobilized as vapor and steam. The vapor phase will be treated prior to discharge to the air, and steam/liquids will be condensed and treated prior to discharge to Ostrich Bay. A large aboveground treatment compound with tanks, air stripper(s), and vapor-phase treatment equipment will be located at the site to process captured media. COCs will first be stripped from groundwater and condensate using air stripping. Vapors from the subsurface and the air stripper will be treated initially using an oxidizer and eventually with granular activated carbon as concentrations decrease. Treated groundwater will be discharged to surface water.

Source Area Performance Monitoring and Criteria for Termination of Active Treatment

The Navy will conduct performance monitoring to validate the effectiveness of the source area treatment, document changes in COC concentrations throughout the source area, and identify when the criteria for termination of active treatment in the source area have been met. Performance monitoring is different from compliance monitoring, in that performance monitoring is meant specifically to evaluate the operational effectiveness of a treatment process. Compliance monitoring is intended to document progress towards meeting RAOs. In some cases, data from a particular well may be used for both performance monitoring and compliance monitoring. Sitewide compliance monitoring is discussed in Section 4.2.5.

Approximately six new groundwater monitoring wells and six temperature monitoring points (Figure 4-1) will be installed as source area performance monitoring sampling locations. Some of the performance monitoring wells may also be included in the sitewide compliance monitoring well network and used to document meeting groundwater cleanup levels at the standard point of compliance, as defined in Section 4.1.5.

The source area active treatment system will be operated until the mean benzene concentration in groundwater samples collected from the source area performance monitoring wells is consistently at or below the cleanup level of 5 µg/L (unless otherwise agreed to by the Navy and EPA). The system is expected to achieve this goal following approximately 9 months of operation. However, the actual heating duration will depend on the results of performance monitoring. It is estimated that 9 months of active heating will reduce contaminant mass in the source area by 99 percent. Performance monitoring groundwater samples will be collected from the six new source area monitoring wells during the treatment time frame of approximately 9 months and for 1 year following completion of treatment.

Performance monitoring will also include collection of remedial system operational data as part of ongoing O&M procedures. The details of performance monitoring used to assess the functionality of the source area treatment system, and to optimize the system during operations, will be developed in the remedial design.

4.2.2 Near-Shore Area Amended Remedy

The amended remedy for the near-shore area is in situ chemical oxidation (ISCO) using ozone injection into the aquifer. This remedy will create a treatment zone in the near-shore area that will intercept and treat contaminated groundwater migrating toward Ostrich Bay. The injection of ISCO reagents such as ozone into the aquifer chemically destroys COCs. Increased dissolved oxygen concentrations in the treatment zone will also enhance subsequent biodegradation of COCs in near-shore area groundwater.

Groundwater Treatment

Ozone-sparging technology treats groundwater in situ by injecting ozone (a natural oxidant) at low pressures and flow rates. Two offset rows of approximately 25 vertical ozone-sparge wells will be constructed across the entire width of the dissolved plume, as shown on Figure 4-1. Each sparge well will be completed to an estimated depth of approximately 50 feet and have two injection depth intervals. Alternatively, two wells may be completed adjacent to each other at each location, with one well of each pair screened for injection near the top of the treatment zone and the other well in each pair screened to treat the bottom of the treatment zone. More than one injection depth zone is warranted to increase the distribution of ozone and focus injection to where it is needed. The completion depth is intended to be below the zone with dissolved COCs, the depth of which will be verified as part of remedial design/remedial action (RD/RA). Two or three small aboveground treatment sheds containing generation/distribution units will be used to deliver ozone through specialized tubing. The number of units required will be determined during remedial design, based on the specific performance characteristics of the equipment specified. The units will be able to inject in a pulsed mode and cycle through various sparge-point assemblies to maximize efficiency. Only low-voltage electricity is required to operate the generation/ distribution units, together with a small (less than 1 horsepower) compressor.

The ozone-sparge wells will treat COCs dissolved in groundwater by means of in situ chemical reactions that leave only water and beneficial oxygen as byproducts. The process uses nano- to micro-sized bubbles of air-encapsulated ozone for rapid destruction of the contaminants. The ozone bubbles are created by injecting an air-ozone mixture through invisible pores in specialized sparge points located inside the ozone wells. The bubbles are gently pushed through capillary pores in the soil, which eliminates channeling.

The primary treatment mechanism of ozone sparging is an in situ chemical reaction that oxidizes hydrocarbons to oxygen and carbon dioxide. Stripping of volatiles using this technology is avoided through the use of microporous oxidation points that allow flow rates to be kept very low (less than 7 cubic feet per minute [cfm]). In addition, the mass of COCs that could plausibly be stripped and discharged to the atmosphere using this technology at this site is unlikely to

exceed air discharge regulations and thereby require collection and treatment. However, the Navy will further evaluate the need for vapor collection and treatment in the near-shore area as part of the RD/RA. The Puget Sound Clean Air Agency (PSCAA) requires treatment of vapor discharge from groundwater treatment systems if the systems are expected to discharge more than 15 pounds of benzene per year. The vapor treatment required in this case would be the best available control technology, rather than meeting a specific numerical standard. Also, if vapor extraction is ultimately not included in the remedial design, the Navy will perform ambient air monitoring during initial operation of the system to demonstrate that risk-based discharge limits are not exceeded. Specifically, ambient air samples will be collected in the vicinity of the sparging system to measure the concentrations of COCs that could be emitted during the operations of the system. The concentrations of BTEX and TPH-G measured in the outdoor ambient air samples will be compared to risk-based screening concentrations (RBCs) calculated to be protective of recreational exposures to outdoor air. Table 4-4 presents the equations used to calculate the RBCs and the resulting RBCs. These RBCs are calculated to be protective of a recreational visitor frequenting the shoreline area for 2 hours twice per week for 50 weeks per year. This assumption likely overestimates the frequency of exposure a recreational visitor would experience on the shoreline area, because it is unlikely that any appreciable time would be spent at the shoreline area during the colder, inclement months of the year. Therefore, these RBCs are considered sufficiently conservative for use as benchmarks to evaluate potential exposure to COCs that might be emitted to outdoor air at the shoreline area through the operation of the sparging system.

Near-Shore Performance Monitoring and Contingency Remedy Triggers

The Navy will conduct performance monitoring to validate the effectiveness of the near-shore area treatment, document changes in COC concentrations throughout the near-shore area, and identify whether the criteria for trigging the contingency remedy in the near-shore area have been met. Eight new groundwater monitoring wells (Figure 4-1) will be installed in the treatment area as performance monitoring sampling locations. Some of the performance monitoring wells may also be included in the compliance monitoring well network and used to document meeting groundwater cleanup levels at the standard point of compliance, as defined in Section 4.1.5.

Performance monitoring will include collection of groundwater samples from 12 locations (unless otherwise agreed to by the Navy and EPA), including existing wells MW-880 through MW-883 and the eight new wells (Figure 4-1), at least quarterly during the first 2 years of ozone injection. The contingency remedy (described in Section 4.2.3) will be triggered if after 2 years of operation of the near-shore treatment system, the mean benzene concentration in these 12 wells is not consistently at or below the cleanup level of 5 µg/L, unless otherwise agreed to by the Navy and EPA. If the contingency remedy is triggered, the Navy shall issue a request for proposal for design of a pump and treat remedy as described in Section 4.2.3.

Monitoring will also include collection of remedial system operational data as part of ongoing O&M procedures. The details of performance monitoring used to assess the functionality of the near-shore area treatment system, and to optimize the system during operations, will be developed in the remedial design.

4.2.3 Description of Contingency Remedy

If ISCO is not as effective as expected after 2 years of active treatment, the Navy shall issue a request for proposal for design of a groundwater pump and treat system as the contingency remedy for the near-shore treatment zone. The Navy will document via a Memorandum to the Administrative Record that the contingent pump and treat remedy has been triggered. Construction of the contingent pump and treat remedy will initiate within 15 months, as required by statute. Under the contingency remedy, groundwater would be pumped from extraction wells in the near-shore treatment area, treated above ground, and reinjected uphill from the source area.

If triggered, the contingency groundwater remedy for the near-shore treatment area will consist of pump and treat, as described in the final FFS (Alternative N7 – Pump and Treat) and as summarized below. The precise parameters of the pump and treat contingency remedy (e.g., extraction well spacing and depth) would be adjusted as necessary during the contingency remedy remedial design.

The pump and treat contingency remedy would consist of a line of six extraction wells with a spacing of 40 feet installed across the dissolved plume immediately upgradient of Ostrich Bay. Each well would be completed to a depth of approximately 50 feet. Submersible pumps rated at 30 gpm are estimated to be necessary to create enough drawdown to capture the vertical extent of COCs in groundwater that discharges into Ostrich Bay.

Extracted groundwater would be routed to a treatment building for processing. Tray-style air strippers would be used to strip COCs from groundwater, because they are effective at removing TPH-G and benzene. The Navy will evaluate the need for treatment of air emissions at the design of the contingent pump and treat system in accordance with the PSCAA ARAR.

Treated groundwater from the treatment building would be routed to eight, 60-foot-deep injection wells located along a roughly north-south line immediately upgradient of the source area. The line of injection wells would be located between 20 and 80 feet west (upgradient) of the upgradient edge of the plume, with four of the eight wells located upgradient of the free-product limits (i.e., the central portion of the plume). The remaining four wells would be located near the outer (i.e., cross-gradient dissolved-phase) limits of the contaminated groundwater plume to allow the operator options regarding where to direct the treated water.

The reinjection system would have the capacity to operate without all of the wells being active. This would give the operator flexibility to rehabilitate wells without taking the treatment system off line. Alternatively, the operator may be able to direct water to specific areas to increase groundwater velocities in a way to support faster flushing of the contaminated groundwater plume. However, the benefits of mounding water around the infiltration wells will likely be highly localized and minor, because of the high hydraulic conductivity at the site. Overall the groundwater velocity across the entire site is not expected to increase enough to have a significant effect on the restoration time frame.

Design of a pump and treat system at this site would need to overcome certain complex engineering issues, including the following:

- Achieving continuous groundwater capture without drawing in salt water—Saltwater intrusion potential is discussed further in Section 3.2.4.

- Achieving comprehensive capture of the contaminated plume in the heterogeneous subsurface conditions in the near-shore area—Preferential pathways can develop within the subsurface, leading to more successful capture in some areas and less in others.

- Addressing loss of containment during power failures or other operational downtime—Temporary shutdown of the pumping system would result in immediate migration of contaminants beyond the capture zone.

4.2.4 Expected Outcome of Amended Remedy

The OU 1 ROD predicted that the original selected remedy could meet the cleanup objective (i.e., attaining water quality standards for marine surface water at the point of groundwater discharge) within about 1 to 3 months of remedy implementation, and "the site could be permanently cleaned up within 1 to 2 years." Groundwater monitoring following remedy implementation indicated that this outcome did not occur. The amended remedy includes a longer, more significant field effort and longer estimated restoration time frame than the original selected remedy, because a more aggressive treatment approach is required to achieve RAOs.

The amended remedy is expected to result in cleanup of soil and groundwater throughout the site to the cleanup levels. The approach to meeting these RAOs includes the following:

- Treatment of the ongoing residual source for the COC plume in groundwater that extends to Ostrich Bay (source area active treatment component of the remedy)

- Interception and treatment of the dissolved-phase COC plume in groundwater at the shoreline, prior to groundwater discharge to Ostrich Bay (near-shore active treatment component of the remedy)

- Continuation of the OU 1 ROD institutional controls that prevent exposure to groundwater as a drinking water source until passive flushing of the aquifer from the source area to the near-shore treatment zones results in meeting the groundwater RAOs

The Navy expects that active treatment of the source area will reduce the residual source COC concentrations to below the cleanup levels, with the resulting clean groundwater flushing through deeper and downhill portions of the aquifer. This flushing action is expected to move residual contaminants to the near-shore treatment zone and eventually result in meeting RAOs within all areas of the aquifer. The Navy expects that active treatment of the near-shore area will intercept the groundwater flushing from the source area treatment zone and the groundwater that discharges to the intertidal zone in Ostrich Bay.

The Navy estimates that the time to completely flush COC concentrations in groundwater exceeding cleanup levels between the source area and the near-shore area is approximately 11 years from the time of completion of source area remedial actions (U.S. Navy 2011a). Therefore, the Navy estimates that satisfaction of cleanup levels throughout the site will require a period of 12 years under the amended remedy (1 year of source area treatment followed by 11 years of flushing of the downgradient aquifer).

The Navy expects that ISCO in the near-shore area will achieve the cleanup levels at the conditional point of compliance, the 880 series wells (the 12 performance monitoring wells shown for the near-shore treatment zone on Figure 4-1), in approximately 1 year. Operation of the ozone-injection system will continue to be required following achieving the cleanup levels at the conditional point of compliance until COC concentrations in influent groundwater (i.e., groundwater flowing from the source area to the near-shore area) have decreased sufficiently. The ozone-injection system will operate on a continuous basis (with pulsed injections at each injection point) during the entire period of flushing, for an estimated 11 years following completion of the source area cleanup actions. If the cleanup levels for groundwater are met across the site in less than the estimated 11 years following completion of the source area cleanup, then active treatment at the near-shore area can be terminated earlier than expected.

Institutional controls are already in place and ongoing at the site, as required by the OU 1 ROD, prohibiting the use of groundwater as a drinking water source. Additional institutional controls requiring assessment of vapor intrusion risks for any new building constructed above the COC plume in groundwater will also be implemented until the cleanup levels for groundwater are met

across the site. Once the cleanup levels are met across the site, these institutional controls will be removed.

4.2.5 Compliance Monitoring and Periodic Reviews

Compliance sampling to document eventual attainment of the cleanup levels at the standard point of compliance will consist of groundwater samples collected from wells located throughout the dissolved-phase plume, including beneath the source area, in the near-shore area, and between these two areas.

A conditional point of compliance at the point of discharge of groundwater to surface water was originally established in the OU 1 ROD, with compliance samples collected at the shoreline seeps and outfalls. The revised CSM shows that groundwater discharge to surface water is likely to occur over a portion of the intertidal zone, as well as the seeps and outfalls. Therefore, the seeps and outfalls are not sufficient compliance sampling locations. The conditional point of compliance is revised by this ROD Amendment to be the 880 series wells (the 12 performance monitoring wells shown for the near-shore treatment zone on Figure 4-1).

The Navy will perform compliance sampling of the monitoring well network and seeps and outfalls in the intertidal zone semiannually during the first 2 years of active remediation and at least annually thereafter, until the cleanup levels have been achieved throughout the NEX Gas Station Leak Area.

Because the amended remedy will allow contaminants to remain in place for approximately 12 years at concentrations that do not allow unlimited site use and unrestricted exposure, periodic reviews of the amended remedy at the NEX Gas Station Leak Area will be required at least once every 5 years. The purpose of the 5-year review is to ensure that the remedial actions selected in this ROD Amendment are functioning properly and remain protective of human health and the environment. Five-year reviews are currently conducted at OU 1, including the NEX Gas Station Leak Area, for remedial actions selected in the OU 1 ROD. The last 5-year review for OU 1 considered site data from the period 2004 to 2009 (U.S. Navy 2011a). The amended remedy in this ROD Amendment will be evaluated in subsequent 5-year reviews of the remedial actions at OU 1.

4.2.6 Data Collection and Resolution of Data Gaps

Data collection and evaluation will be performed as part of the RD/RA to resolve the data gaps identified in the FFS and reiterated throughout this ROD Amendment. The data collected as part of the FFS were sufficient for evaluation and selection of a remedy. However, additional data are needed to refine the vertical and lateral dimensions of the treatment zones beneath the source

area and the near-shore area. These data will also allow resolution of the following uncertainties that result from data gaps identified in the FFS:

- Lateral extent of groundwater impacts to the north, south, and west of the NEX pump island
- Vertical extent of groundwater impacts in the source area and the near-shore area
- Potential vapor intrusion risk in the NEX convenience store and residential homes located upgradient and cross gradient of the source area
- Potential human health risks associated with exposure to impacted sediment, surface water, or seafood near the NEX Gas Station Leak Area seeps and outfalls during recreational activities, seafood harvesting, and seafood ingestion

The investigation will include soil and groundwater sampling to refine the lateral and vertical extent of COCs in groundwater and evaluate potential vapor intrusion risks. Because of the difficult drilling conditions experienced during previous investigations and the complex subsurface geology warrants logging of continuous soil cores, sonic drilling will likely be used to achieve the required sampling depths. Up to nine borings will be advanced upgradient and cross gradient of the NEX pump island (to the north, west, and south) to refine the lateral extent of the dissolved plume and free product. Up to six deep borings will be advanced within the source area and near-shore area to refine the vertical extent of groundwater impacts. The deep borings will extend deeper than the previously reported elevated concentrations of TPH-G and BTEX at 57 feet bgs in the source area and 33 feet bgs in the near-shore area. Continuous soil cores for lithological characterization and depth-discrete groundwater samples will be collected from all borings. Depth-specific groundwater samples and select soil samples will be analyzed for TPH-G and BTEX. The Navy will develop a work plan for EPA approval detailing the scope of the investigation and describing the use of the data in the remedial action.

The Navy will use the lithological data and lateral and vertical extent of elevated COC concentrations in groundwater to update the CSM for the site and refine the target treatment zones for ERH and DPE in the source area and ISCO in the near-shore area. Although the source area target treatment zone will consider the extent of COC concentrations exceeding the cleanup levels, active treatment will not be performed in all areas with elevated COC concentrations. As discussed above, flushing of the clean groundwater through deeper and downhill portions of the aquifer will be required to achieve cleanup levels throughout the site following active treatment of the source area. Potential vapor intrusion risks at the NEX convenience store and residential homes will be evaluated based upon the extent and concentrations of COCs in groundwater closest to the structures. This evaluation may include

the collection of soil gas, subslab vapor, indoor air, and ambient air (background) samples. If vapor intrusion poses an unacceptable risk, the amended remedy will be designed to be protective of human health for vapor intrusion.

The cleanup levels established for the amended remedy are protective of the marine environment, including human exposure to surface water and sediment and ingestion of aquatic organisms during recreational activities and tribal/substance harvesting. As discussed above, the amended remedy for the near-shore area is expected to achieve the cleanup levels at the near-shore area conditional point of compliance in approximately 1 year. Because the remedy will reduce COC concentrations to levels protective of the marine environment in groundwater discharging to surface water (as monitored at the conditional point of compliance wells), sediment and marine tissue sampling data are not critical to the design of the near-shore remedy. An ecological risk was not identified for the NEX Gas Station Leak Area COCs in the OU 2 BERA and supplemental RIs. Therefore, sediment and marine tissue sampling will not be conducted as part of the investigation.

Source Area Note:
NEX pump island will be shut down for 1 year followed by reconstruction after the completion of remediation using ERH or relocated outside of the ERH treatment area. Existing wells in the ERH treatment area will be properly decommissioned prior to ERH implementation.

Dowell Rd
Pump Island
UTILITY BOX
ERH Treatment Compound
NEX Convenience Store
Paved Area
Building 30
Haven Rd
Paved Area
Ozone Injection Shed #1
Ozone Injection Shed #2
Ozone Injection Shed #3
Gravel Access Road
Riprap
Lift Station
Recreational Pathway
Landscape Fence
Seawall
PSS
Ostrich Bay
0 MSL

Near-Shore Area Note:
Each shed would enclose equipment for 7 to 9 ozone injection points via below ground piping.

Legend

- Monitoring Well
- Monitoring Well - Pumping Test
- Extraction Well
- Air Sparge Pilot Test Well
- Soil Vapor Pilot Test Well
- Soil Boring
- Temporary Push Point (Beach)
- ORC® Pilot Test Injection Point
- Seep
- Catch Basin
- Manhole
- SD — Storm Drain
- SS — Sanitary Sewer
- W — Water
- UE — Underground Electric
- FA — Underground Lighting Electric
- G — Gas
- PSS — Public Sanitary Sewer
- 50 — Ground Surface Elevation Contour (Ft Above MSL)
- Existing Fuel Lines
- Existing Gasoline USTs
- Former Fuel Lines
- Former USTs
- 2-in.-Diameter Utility Line
- Remediation Compound (Product Recovery)
- Estimated Extent of Free Product
- Approximate Extent of TPH-G in Soil Exceeding 30 mg/kg
- Estimated Area Exceeding 5 ug/L Benzene or 0.8 mg/L TPH-G in Groundwater
- ERH Electrode and DPE Well (15-ft Spacing)
- Temperature Monitoring Point (6 Each)
- Existing Groundwater Monitoring Well Used for Performance Monitoring
- Proposed Groundwater Monitoring Well Used for Performance Monitoring
- Ozone Injection Point (2 Offset Rows With 20-ft Spacing)

U.S. NAVY	Delivery Order 0053 Jackson Park/Naval Hospital NEX GAS STATION LEAK AREA	0 25 50 SCALE IN FEET	**Figure 4-1** **Amended Remedy - Electrical Resistive Heating With Dual-Phase Extraction and In Situ Chemical Oxidation**

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Table 4-1
Chemical-Specific ARARs for Soil

Chemical	Typical PQL	Direct Contact: MTCA Method B[a] Carcinogenic	Direct Contact: MTCA Method B[a] Noncarcinogenic	Protection of Groundwater: MTCA Method A (Unrestricted Land Use)[b]	Protection of Groundwater: MTCA Method B[c]	ROD Amendment Numeric Criterion[d]	OU 1 ROD Remediation Goal[e]
Total Petroleum Hydrocarbons (mg/kg)							
Gasoline-range hydrocarbons (benzene not present)	10	NE	NE	100	NE	NA	NE
Gasoline-range hydrocarbons (benzene present)	10	NE	NE	30	NE	30	100
Volatile Organic Compounds (µg/kg)							
Benzene	5	18,200	320,000	30	28	28	NE
Toluene	5	NE	6,400,000	7,000	7,271	7,271	NE
Ethylbenzene	5	NE	8,000,000	6,000	6,048	6,048	NE
m,p-Xylene	5	NE	16,000,000	NE	91,440	91,440	NE
o-Xylene	5	NE	16,000,000	NE	91,440	91,440	NE
Total xylenes	5	NE	16,000,000	9,000	91,440	91,440	NE

[a]Chapter 173-340 WAC: MTCA Method B values are from Ecology website CLARC tables downloaded November 2012 (https://fortress.wa.gov/ecy/clarc/reporting/CLARCReporting.aspx), when available.
[b]MTCA Method A Soil Cleanup Levels for Unrestricted Land Uses, WAC 173-340-900, Table 740-1.
[c]Values calculated using the Safe Drinking Water Act maximum contaminant levels and the three-phase partitioning model under WAC 173-340-747.
[d]These numeric criteria are not established as cleanup levels for soil. Achievement of the remedial action objective for soil (protection of groundwater) will be demonstrated empirically using groundwater samples collected from monitoring wells within the source area.
[e]The OU 1 ROD established a soil remediation goal (RG) for TPH-G of 100 mg/kg at Site 110, but did not specify that this RG applied to the NEX Gas Station Leak Area. No remedial action objectives were developed for Site 110 soils in the OU 1 ROD.

Table 4-1 (Continued)
Chemical-Specific ARARs for Soil

Notes:
ARARs - applicable or relevant and appropriate requirements
µg/kg - microgram per kilogram
mg/kg - milligram per kilogram
MTCA - Model Toxics Control Act
NA - not applicable
NE - not established
PQL - practical quantitation limit
ROD - Record of Decision
WAC - Washington Administrative Code

Table 4-2
Chemical-Specific ARARs for Groundwater Protective of Drinking Water

Chemical	Typical PQL	MTCA[a]			Safe Drinking Water Act[c]		Washington State Department of Health[d]		ROD Amendment Cleanup Level	OU 1 ROD Remediation Goal[f]
		Method A Groundwater	Method B Groundwater (Carcinogen)[b]	Method B Groundwater (Noncarcinogen)[b]	MCL	MCLG	MCL	MCLG		
Total Petroleum Hydrocarbons (mg/L)										
Gasoline-range hydrocarbons (benzene not present)	0.25	1	NE	NE	NE	NE	NE	NE	NA	NE
Gasoline-range hydrocarbons (benzene present)	0.25	0.8	NE	NE	NE	NE	NE	NE	0.8	NE
Volatile Organic Compounds (µg/L)										
Benzene	0.5	5	0.795	32	5	0	5	0	5	43
Toluene	0.5	1,000	NE	640	1,000	1,000	1,000	1,000	640[b]	NE
Ethylbenzene	0.5	700	NE	800	700	700	700	700	700	NE
m,p-xylene	0.5	NE	NE	1,600	10,000[e]	10,000[e]	10,000[e]	10,000[e]	1,600[b,e]	NE
o-xylene	0.5	NE	NE	1,600	10,000[e]	10,000[e]	10,000[e]	10,000[e]	1,600[b,e]	NE
Total xylenes	0.5	1,000	NE	1,600	10,000	10,000	10,000	10,000	1,600[b]	NE

[a]Chapter 173-340 WAC: MTCA Method B values are from Ecology website CLARC tables downloaded November 2012 (https://fortress.wa.gov/ecy/clarc/reporting CLARCReporting.aspx), when available.
[b]MCLs for toluene and xylenes revised downward to the MTCA Method B Cleanup Levels to meet human health goals under MTCA, per WAC 173-340-720(7)(b). MCLs for benzene and ethylbenzene were found to meet MTCA human health goals and no revision downward was necessary (see also Section 4.1.4).
[c]Safe Drinking Water Act, 40 CFR 141.50 and 141.61
[d]Washington State Department of Health (WAC 246-290-310(7) has adopted by reference the concentrations for volatile organic compounds under the Safe Drinking Water Act, 40 CFR 141.61(a).
[e]MCL and MCLG for total xylenes
[f]The remediation goal (RG) for benzene in the OU 1 ROD was based on protection of surface water. The OU 1 ROD did not establish any RGs protective of drinking water.

Table 4-2 (Continued)
Chemical-Specific ARARs for Groundwater Protective of Drinking Water

Notes:
ARARs - applicable or relevant and appropriate requirements
CFR - Code of Federal Regulations
MCL - maximum contaminant level
MCLG - maximum contaminant level goal
µg/L - microgram per liter
mg/L - milligram per liter
MTCA - Model Toxics Control Act
NA - not applicable
NE - not established
PQL - practical quantitation limit
ROD - Record of Decision
WAC - Washington Administrative Code

Table 4-3
Chemical-Specific ARARs for Groundwater Protective of Surface Water

Chemical	Typical PQL	Protection of Aquatic Life				Protection of Human Health				ROD Amendment Cleanup Level[e]	OU 1 ROD Remediation Goal
		NRWQC[a]		Toxic Substances Criteria (WAC 173-201A-240[3])[b]		NRWQC[a]	NTR[c]	MTCA[d]			
		Marine		Marine Water		Human Health - Organisms Only	Human Health - Organisms Only	Method B Surface Water (Carcinogen)	Method B Surface Water (Noncarcinogen)		
		CMC	CCC	Acute	Chronic						
Total Petroleum Hydrocarbons (mg/L)											
Gasoline-range hydrocarbons (benzene not present)	0.25	NE	NE	NE	NE	NE	NE	NE	NE	NA	NE
Gasoline-range hydrocarbons (benzene present)	0.25	NE	NE	NE	NE	NE	NE	NE	NE	0.8	NE
Volatile Organic Compounds (µg/L)											
Benzene	0.5	NE	NE	NE	NE	51	71	22.7	1,990	5	43
Toluene	0.5	NE	NE	NE	NE	15,000	200,000	NE	19,400	1,000	NE
Ethylbenzene	0.5	NE	NE	NE	NE	2,100	29,000	NE	6,914	700	NE
m,p-xylene	0.5	NE	NE	NE	NE	NE	NE	NE	NE	10,000	NE
o-Xylene	0.5	NE	NE	NE	NE	NE	NE	NE	NE	10,000	NE
Total xylenes	0.5	NE	NE	NE	NE	NE	NE	NE	NE	10,000	NE

[a]National Recommended Water Quality Criteria (NRWQC) publication – Values when available are from the U.S. Environmental Protection Agency's website downloaded November 2012 and accessed at http://water.epa.gov/scitech/swguidance/standards/criteria/current/index.cfm.
[b]Water Quality Standards for Surface Waters of the State of Washington, Toxic Substances Criteria, WAC 173-201A-240(3); last update effective May 21, 2011. For human-health-based water quality criteria, the State of Washington has adopted by reference the concentrations presented in 40 CFR 131.36 (National Toxics Rule)(WAC 173-201A-240[5]).
[c]National Toxics Rule, 40 CFR 131.36 (July 1, 2012)

Table 4-3 (Continued)
Chemical-Specific ARARs for Groundwater Protective of Surface Water

[d]Chapter 173-340 WAC: MTCA Method B values are from Ecology website CLARC tables downloaded November 2011 (https://fortress.wa.gov/ecy/clarc/reporting/CLARCReporting.aspx), when available.
[e]Cleanup levels for groundwater protective of drinking water and surface water, whichever is more stringent. See Table 4-2 for cleanup levels for groundwater protective of drinking water.

Notes:
ARARs - applicable or relevant and appropriate requirements
CCC - criterion continuous concentration
CFR - Code of Federal Regulations
CMC - criterion maximum concentration
µg/L - microgram per liter
mg/L - milligram per liter
MTCA - Model Toxics Control Act
NA - not applicable
NE - not established
PQL - practical quantitation limit
ROD - Record of Decision
WAC - Washington Administrative Code

Table 4-4
Calculation of Risk-Based Screening Concentrations for Recreational Exposures to Outdoor Air

Exposure medium: outdoor air **Receptor population: recreational visitors** **Receptor age: child and adult** **Exposure point: outdoor air**		**MTCA equation 750-1: RBCair nc = (THQ x RfDi x BW x ATnc)/BR x EF x ED x ABS)** **MTCA equation 750-2: RBCair ca = (TCR x BW x ATca)/(SFi x BR x EF x ED x ABS)**		
		Recreational		
Parameter	**Unit**	**Noncancer**	**Cancer**	**Reference**
Risk-based screening concentration for outdoor air (RBCair)	mg/m^3	Chemical-specific	Chemical-specific	Calculated value using MTCA equations 750-1 and 750-2
Target cancer risk (TCR)	unitless	--	1.00E-06	MTCA default (WAC 173-340-750)
Target hazard quotient (THQ)	unitless	1.0E+00	--	
Inhalation reference dose (RfDi)	mg/kg-day	Chemical-specific	Chemical-specific	MTCA CLARC[a]
Inhalation slope factor (SFi)	$(mg/kg\text{-}day)^{-1}$	Chemical-specific	Chemical-specific	
Exposure frequency (EF)	unitless	0.023	0.023	Professional judgment: assumes 2 hours twice per week, 50 weeks per year (EF = 2h/24h x 2d/7d x 50w/52w = 0.023)
Exposure duration (ED)	year	6	30	MTCA default (WAC 173-340-750)
Breathing rate (BR)	m^3/day	10	20	
Body weight (BW)	kg	16	70	
Averaging time (AT)	year	6	75	
Inhalation absorption fraction (ABS)	unitless	1	1	
Chemical	**RfDi (mg/kg-day)**	**SFi $(mg/kg\text{-}day)^{-1}$**	**RBCair nc[b] (mg/m^3)**	**RBCair ca[b] (mg/m^3)**
Benzene	8.6E-03	2.7E-02	0.60	0.014
Toluene	1.4E+00	--	97	--
Ethylbenzene	2.9E-01	--	20	--
Xylenes	2.9E-02	--	2	--
TPH-G[c]	1.7	--	118	--

[a]MTCA CLARC database accessed on May 15, 2013 (https://fortress.wa.gov/ecy/clarc/Reporting/CLARCReporting.aspx)

Table 4-4 (Continued)
Calculation of Risk-Based Screening Concentrations for Recreational Exposures to Outdoor Air

[b]nc - noncancer; ca - cancer
[c]The RfDi for TPH-G is based on the aliphatic portion of the gasoline range (EC5 to EC8) from Washington State Department of Ecology's (Ecology) "Fact Sheet: Reference Doses for Petroleum Compounds" located at: https://fortress.wa.gov/ecy/clarc/FocusSheets/petroToxParameters.pdf. Ecology recommends evaluating the aromatic portion of the gasoline range using the toxicity criteria for the individual aromatic constituents benzene, toluene, ethybenzene, and xylenes.

Notes:
mg/kg - milligram per kilogram
mg/m^3 - milligram per cubic meter
MTCA - Model Toxics Control Act
TPH-G - total petroleum hydrocarbons as gasoline
WAC - Washington Administrative Code

5.0 EVALUATION OF ALTERNATIVES

CERCLA establishes nine criteria for the evaluation of remedial alternatives (USEPA 1988):

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

This section identifies the remedial alternatives evaluated in the FFS and presents an evaluation of the selected alternative, as well as the original selected remedy in the OU 1 ROD, against the nine CERCLA screening criteria.

5.1 ALTERNATIVES EVALUATED IN THE FFS

The FFS assessed a range of alternatives for active remediation of soil and groundwater in the source area and groundwater in the near-shore area of the site. Three active treatment alternatives (S1 through S3) were developed to address COCs in soil and adjacent groundwater at the source area. Seven active treatment alternatives (N1 through N7) were developed to address COCs in groundwater at the near-shore area. In addition, one no action alternative for each area of the site was included as a baseline for comparison to the other alternatives. Because the original remedy selected in the ROD has already been completed (although it did not meet the RAOs), the no action alternative in the FFS is equivalent to current conditions following implementation of the ROD-specified remedy.

The following alternatives were evaluated in the FFS for treatment of soil and adjacent groundwater in the source area:

- S0 – No Action
- S1 – DPE With Groundwater Circulation Wells
- S2 – ERH With DPE
- S3 – Comprehensive Excavation With ISCO

The following alternatives were evaluated in the FFS for treatment of groundwater in the near-shore area:

- N0 – No Action
- N1 – ORC®
- N2 – Biosparging
- N3 – ISCO
- N4 – Air Sparging
- N5 – DPE
- N6 – Groundwater Circulation Wells
- N7 – Pump and Treat

A comprehensive analysis of each source area and near-shore area alternative in relation to the CERCLA criteria was performed in the FFS. Based on the analysis, the proposed plan presented as the selected remedy Alternative S2, ERH with DPE, and Alternative N3, ISCO, because they provide the most cost-effective means of reliably protecting human health and the environment in the long term and have the shortest restoration time frame. The following sections present the evaluation of these selected alternatives, compared to the original selected remedy in the OU 1 ROD, against the nine CERCLA screening criteria. Selected Alternatives S2 and N3 are also referred to as the amended remedy.

5.2 EVALUATION OF ORIGINAL SELECTED AND REVISED REMEDIES

5.2.1 Overall Protection of Human Health and the Environment (Threshold)

Original Selected Remedy

The original selected remedy in the OU 1 ROD, in situ treatment of the source area and dissolved plume with ORC®, was expected to provide protection of human health and the environment by treating groundwater and source area soils to permanently remove the source of contamination. However, monitoring results following ORC® injection suggested that a residual source of petroleum contamination was present at the site and that the contribution of dissolved petroleum constituents from the residual source and the site hydrogeology prevented the ORC® treatment from achieving the cleanup objectives. Because the ORC® treatment did not achieve the cleanup objectives, the original selected remedy was not protective of human health and the environment. Monitoring results following ORC® injection indicated that more information was needed to better understand the site conditions and assess the most effective remedial alternative.

Amended Remedy

Following implementation of the ROD-specified remedy, additional investigation has improved the understanding of the CSM. The amended remedy includes implementation of more aggressive treatment technologies in the source area and near-shore area to achieve cleanup levels protective of human health exposure pathways for soil and groundwater across the site.

The amended remedy for the source area, ERH with DPE, will protect human health and the environment by reducing COC concentrations in the source area and reducing source area contributions to the groundwater plume that is migrating to Ostrich Bay. Therefore, this remedy will enhance long-term protection of both source area and downgradient receptors. After achieving RAOs beneath the source area, clean groundwater will flush through deeper and downhill portions of the aquifer. The degree of protection resulting from removing source area COCs will therefore continue to increase for several years after implementation of the active treatment components of this alternative. Concentrations of extracted COCs using DPE systems will be substantially lower after the initial months of operation and will continue to decrease over time until groundwater achieves the cleanup levels.

The amended remedy for the near-shore area will protect human health and the environment by reducing COC concentrations in the near-shore area groundwater prior to it discharging to Ostrich Bay. Therefore, this remedy will enhance long-term protection of receptors in the near-shore area and the marine environment. The ozone injection system in the near-shore area will be operated on a continuous basis until COC concentrations in influent groundwater achieves the cleanup levels.

During the time required for treated groundwater from the source area to flush through the remaining contaminated portions of the aquifer to the near-shore treatment zone, human health and the environment will be protected by the existing institutional controls established under the OU 1 ROD and enhanced by this ROD Amendment. These institutional controls currently prohibit the use of groundwater as a drinking water source and will be amended to require assessment of vapor intrusion risks for any new building constructed above the COC plume in groundwater until the cleanup levels for groundwater are met throughout the site.

5.2.2 Compliance With ARARs (Threshold)

Original Selected Remedy

The OU 1 ROD stated that the selected remedy would be implemented in compliance with all ARARs and would include treatment actions to comply with chemical-specific ARARs.

However, monitoring results following ORC® injection indicated that the ORC® treatment did not achieve the chemical-specific ARARs specified in the OU 1 ROD.

Amended Remedy

Potential chemical-specific ARARs for soil and groundwater were reevaluated following the OU 1 ROD, and revised cleanup levels were developed for the NEX Gas Station Leak Area. These cleanup levels are lower and therefore more protective than the remediation goals specified in the OU 1 ROD. The chemical-specific ARARs evaluation and revised cleanup levels are discussed in Sections 4.1.3 and 4.1.4, respectively. Action- and location-specific ARARs for the amended remedy at the NEX Gas Station Leak Area are discussed in Section 7.2.

The amended remedy is expected to satisfy all chemical-, action-, and location-specific ARARs for source area soil and groundwater throughout the site. Satisfaction of chemical-specific ARARs for groundwater is expected to be achieved in the source area and near-shore area within approximately 1 year of implementation of these active remedial actions. The time to flush COC concentrations sorbed to soil and dissolved in groundwater exceeding the cleanup levels between the source area and the near-shore area is estimated to be approximately 11 years from the time of completion of the source area remedial actions. Therefore, chemical-specific ARARs for soil and groundwater are expected to be achieved throughout the site within approximately 11 years after completion of the revised source area remedy (12 years of total remediation time).

5.2.3 Long-Term Effectiveness and Permanence (Balancing)

Original Selected Remedy

The OU 1 ROD stated that treatment of groundwater and source area soils using ORC® was expected to provide permanent destruction of the COCs. Monitoring results following ORC® injection suggested that a residual source of petroleum contamination was present at the site, and, therefore, the original OU 1 ROD remedy did not sufficiently destroy COCs as expected.

Amended Remedy

The amended remedy includes implementation of more aggressive treatment technologies in the source area and near-shore area to permanently remove or destroy COCs and achieve cleanup levels protective of all exposure pathways for soil and groundwater across the site.

The amended remedy will directly reduce COC concentrations in the source area using ERH and DPE, which will permanently remove and treat COCs from the subsurface. The source area treatment is also expected to subsequently reduce COC concentrations in the downgradient groundwater plume as treated groundwater flushes downgradient from the source area.

Concentrations of COCs in groundwater and concentrations of COCs sorbed onto soil will continue to stabilize as treated source area groundwater migrates downgradient towards the near-shore area where the groundwater will again be treated. COC reductions achieved at the source area, as well as incidental oxygenation (from the DPE component of the system) and warming of the aquifer as a result of the treatment technology, may also enhance biodegradation in the downgradient plume.

The amended remedy in the near-shore area will reduce COC concentrations in near-shore area groundwater using ISCO to permanently destroy COCs prior to discharge of groundwater to Ostrich Bay. The effectiveness of any injection or pumping technology can be decreased by heterogeneous subsurface conditions, and such conditions are known to be present in the near-shore area of the site. ISCO technology using ozone is expected to be more effective in these subsurface conditions than other technologies, because ozone vigorously penetrates soil pores.

5.2.4 Reduction of Toxicity, Mobility, and Volume Through Treatment (Balancing)

Original Selected Remedy

The OU 1 ROD stated that ORC® injection would provide reduction of toxicity, mobility, and volume of contaminants by treating the source area and the existing groundwater plume to permanently eliminate the toxicity of the COCs. Monitoring results following ORC® injection suggested that a residual source of petroleum contamination was present at the site and that the contribution of dissolved petroleum constituents from the residual source and the site hydrogeology prevented the ORC® treatment from achieving the cleanup objectives. Therefore, the original OU 1 ROD remedy did not sufficiently reduce the toxicity, mobility, and volume of COCs in the subsurface.

Amended Remedy

The amended remedy includes implementation of more aggressive treatment technologies in the source area and near-shore area to reduce the toxicity and volume of COCs in the subsurface throughout the site.

The amended remedy in the source area, ERH with DPE, will reduce the volume of COCs in source area media by heating the subsurface to mobilize contaminants for extraction by DPE. Removing COCs will directly reduce the volume of contaminants in the source area and subsequently reduce the volume of COCs available for contribution to the groundwater plume that is migrating toward the near-shore area. Treatment of the downgradient plume may also be enhanced by creating more favorable biodegradation conditions.

The amended remedy in the near-shore area, ISCO, will reduce the toxicity and volume of COCs in near-shore groundwater by first chemically destroying COCs and then enhancing bioremediation with increased concentrations of dissolved oxygen. Reduced concentrations of COCs will result in reduced toxicity and volume of COCs in groundwater prior to discharge to Ostrich Bay.

5.2.5 Short-Term Effectiveness (Balancing)

Original Selected Remedy

ORC® injection at the site, as specified in the OU 1 ROD, involved very limited construction activities and thus presented few short-term risks to workers and the community during remedial action. The OU 1 ROD estimated that the cleanup objectives could be met at the point of groundwater discharge within approximately 1 to 3 months, and the site could be permanently cleaned up within 1 to 2 years. Although the short-term risks to workers were minimal, the residual source of petroleum contamination present at the site and the site hydrogeology prevented the ORC® treatment from achieving the cleanup objectives or meeting the projected restoration time frame.

Amended Remedy

The amended remedy involves a longer, more significant field effort and longer estimated restoration time frame than the original selected remedy, because a more aggressive treatment approach is required to achieve RAOs. An investigation will also be required to close data gaps remaining following the FFS investigations and pilot testing and to complete the design of the amended remedy.

The amended remedy in the source area has an estimated restoration time frame of 1 year to achieve soil and groundwater cleanup levels beneath the source area, followed by 1 year of performance monitoring. The amended remedy in the near-shore area is expected to achieve the groundwater cleanup levels at the conditional point of compliance, 880 series wells (the 12 performance monitoring wells shown for the near-shore treatment zone on Figure 4-1), in approximately 1 year. Operation of the ozone injection system will continue after achieving the groundwater cleanup levels at the conditional point of compliance until COC concentrations in influent groundwater (i.e., groundwater flowing from the source area to the near-shore area) have decreased sufficiently. This process is expected to take approximately 11 years, following completion of the source area cleanup actions. Institutional controls that prohibit the use of groundwater as a drinking water source and require assessment of vapor intrusion risks for any new building constructed above the COC plume in groundwater will be required until the cleanup levels for groundwater are met across the site.

Risks to human health and the environment in the source area and near-shore area should be relatively low during implementation of the amended remedy, because treatment will be performed in situ and complete pathways between COCs and potential receptors will be addressed through sitewide institutional controls. Installation of the ERH and DPE system and injection and monitoring well construction will have low anticipated risks to human health and the environment. Removal and reconstruction or relocation of the NEX pump island and associated electrical and fuel supplies will be required, which will affect the community in the short term. O&M will have low expected health and safety risks to workers and the local community. Additional electrical safety precautions will be followed to mitigate any short-term risk. Ozone injection system pressures and flows will be maintained at low levels to prevent stripping of volatile COCs from the groundwater into the vapor phase. The Navy will evaluate the need for vapor collection and treatment in the near-shore area as part of the RD/RA. PSCAA requires treatment of vapor discharge from groundwater treatment systems if the systems are expected to discharge more than 15 pounds of benzene per year. If vapor extraction is ultimately not included in the remedial design, the Navy will perform ambient air monitoring during initial operation of the system to demonstrate that discharge limits are not exceeded.

5.2.6 Implementability (Balancing)

Original Selected Remedy

ORC® injection at the site was readily implementable. There was no significant concern over the administrative feasibility, technical feasibility, or availability of resources to implement the original selected remedy. The OU 1 ROD stated that characterization of the source area was critical to successfully determine the quantities and locations for ORC® injection, and additional applications of ORC®, if necessary, were readily implementable. The OU 1 ROD also stated that if existing structures, such as the pump island, prevented direct injection of ORC® in some contaminated areas, upgradient injection should allow oxygenated groundwater to flow through the inaccessible areas to remediate the soils. Although the original OU 1 ROD remedy was readily implementable and could be expanded or repeated if necessary, the remedy did not successfully meet the cleanup objectives.

Amended Remedy

Similar to the original OU 1 ROD remedy, the amended remedy is readily implementable. Components of the remedy in the source area include DPE wells, ERH electrodes, associated electrical supply, piping, and treatment equipment, and groundwater monitoring wells. Additional power will need to be supplied to the source area from an off-site source. Components of the remedy in the near-shore area include groundwater monitoring wells, ozone delivery wells, and ozone generation/delivery systems. ISCO should be very easy to implement,

and it would include moderate levels of ozone delivery equipment maintenance during implementation. Access and drilling success has been previously demonstrated at the site, although drilling conditions are challenging.

DPE pilot testing in the Vashon Till demonstrated that perched groundwater could be extracted at a manageable rate, allowing adequate contact of DPE well screens with soil vapors. Treatment equipment for extracted COCs is readily available and can be installed with standard construction techniques.

The amended remedy will require either the shutdown of the NEX pump island for a period of 1 year, followed by reconstruction after the completion of remediation using ERH, or the relocation of the NEX pump island outside the ERH treatment area.

The institutional control components of the amended remedy are readily implementable. The prohibition on the use of groundwater beneath the site as a drinking water source is already in place through the OU 1 ROD, is part of the Land Use Control Plan for the site, and is inspected annually. Institutional controls related to protection of the vapor intrusion pathway can be readily integrated into the existing Land Use Control Plan and inspection process.

5.2.7 Cost (Balancing)

Original Selected Remedy

The OU 1 ROD estimated the net present-worth cost of the original selected remedy to be $540,000, with an accuracy of +50 to −30 percent. The net present-worth costs were based on 5 years of operation. The actual cost of remedy implementation was approximately $1,000,000.

Amended Remedy

The total capital cost associated with implementation of ERH with DPE in the source area is estimated at $2,967,000. The estimated O&M cost through the restoration time frame of 1 year plus 1 year of compliance monitoring is $164,000. The total present-worth estimated cost of the revised source area remedy is $3,440,000 (assuming an interest rate of 3 percent and including taxes and oversight costs).

The total capital cost associated with implementation of ISCO in the near-shore area is estimated at $875,000. The active treatment alternatives in the source area and near-shore area are intended to reach the cleanup levels in groundwater throughout the site approximately 11 years following completion of the source area treatment. Therefore, O&M costs were estimated for ISCO for 11 years. Sitewide institutional controls preventing the use of groundwater as a drinking water source and requiring assessment of vapor intrusion risks for any new building

constructed above the COC plume would be required until groundwater throughout the aquifer meets the cleanup levels and are, therefore, included in the O&M costs. The estimated O&M cost for active near-shore treatment for 11 years is $632,000. The total present-worth estimated cost of the revised near-shore area remedy is $1,590,000 (assuming an interest rate of 3 percent and including taxes and oversight costs).

The combined present-worth estimated cost of the amended remedy in the source area and near-shore area is $5,030,000.

5.2.8 State Acceptance (Modifying)

Original Selected Remedy

The OU 1 ROD stated that Ecology was briefed on the remedial investigation, feasibility study and proposed plan and expressed its support for the original selected remedy for the NEX Gas Station Leak Area in the ROD. Both EPA and Ecology accepted the OU 1 ROD, as evidenced by their execution of the document.

Amended Remedy

Ecology has transferred lead regulatory agency status for JPHC/NHB to EPA and was therefore not involved in this ROD Amendment.

The EPA, as lead regulatory agency, participated in the development of the FFS and proposed plan to amend the OU 1 ROD. All comments and issues identified by the EPA on the FFS and proposed plan have been resolved, and the documents have been approved. Comments from the EPA on the draft final proposed plan are summarized and addressed in the Responsiveness Summary in Section 8.2. The EPA has expressed its support for the amended remedy, assuming that in the event the ISCO fails to meet the performance criteria defined in Section 4.2.2 at the end of 2 years from the date of installation, the Navy shall issue a request for proposal for design of a pump and treat remedy for the near-shore area.

5.2.9 Community Acceptance (Modifying)

Original Selected Remedy

The OU 1 ROD stated that the Restoration Advisory Board was involved in the review and comment process of all project documents leading to the ROD. Public comments on the proposed plan were summarized and addressed in the Responsiveness Summary of the ROD. Comments received from the public indicated no specific concern or preference associated with the various alternatives for the NEX Gas Station Leak Area.

Amended Remedy

Public participation activities related to ongoing investigations and cleanup activities at JPHC/NHB have been ongoing throughout the history of the project and guided by a community relations plan last updated in July 2008. The Suquamish Tribe, as a key stakeholder, participated in the development of the proposed plan to amend the OU 1 ROD. The Navy provided for a 30-day public review of the proposed plan from October 27 through November 26, 2012. Comments from the Suquamish Tribe are summarized and addressed in the Responsiveness Summary in Section 8.2. The Navy did not receive public comments on the proposed plan during the public comment period. The Navy and EPA are satisfied that the community is supportive of this ROD Amendment.

6.0 STATUTORY DETERMINATIONS

Under CERCLA Section 121 and the NCP, the lead agency must select remedies that are protective of human health and the environment, comply with ARARs, are cost effective, and utilize permanent solutions and alternative treatment technologies or resource recovery technologies to the maximum extent practicable. In addition, CERCLA includes a preference for remedies that employ treatment that permanently and significantly reduces the volume, toxicity, or mobility of hazardous wastes as a permanent element, with a bias against off-site disposal of untreated wastes. The following sections discuss how the amended remedy meets these statutory requirements.

6.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

The amended remedy for the source area, ERH with DPE, will protect human health and the environment by reducing COC concentrations in soil and groundwater beneath the source area and source area contributions to the groundwater plume that is migrating to Ostrich Bay. Therefore, this remedy will enhance long-term protection of both source area and downgradient receptors. After achieving RAOs beneath the source area, clean groundwater will flush through deeper and downhill portions of the aquifer. The degree of protection resulting from removing source area COCs will therefore continue to increase for several years after implementation of the active treatment components of this alternative.

The amended remedy for the near-shore area will protect human health and the environment by reducing COC concentrations in the near-shore area groundwater prior to it discharging to Ostrich Bay. Therefore, this remedy will enhance long-term protection of receptors in the near-shore area and marine environment. The ozone injection system in the near-shore area will be operated on a continuous basis (using a pulsed-injection approach at each well) until COC concentrations in influent groundwater achieve the cleanup levels.

During the time required for treated groundwater from the source area to flush through the remaining contaminated portions of the aquifer to the near-shore treatment zone (estimated to take 11 years), human health will be protected by the existing institutional controls established under the OU 1 ROD and enhanced by this ROD Amendment. These institutional controls currently prohibit the use of groundwater as a drinking water source and will be amended to require assessment of vapor intrusion risks for any new building constructed above the COC plume in groundwater until the cleanup levels for groundwater are met throughout the site.

6.2 COMPLIANCE WITH ARARS

The amended remedy for the NEX Gas Station Leak Area will comply with federal and state ARARs that have been identified. No ARAR waivers are being requested for the amended remedy. The ARARs identified for the amended remedy are discussed in this section.

6.2.1 Chemical-Specific ARARs

Chemical-specific ARARs potentially applicable as soil and groundwater cleanup standards for the NEX Gas Station Leak Area COCs are described in Section 4.1.3. Cleanup levels for soil and groundwater developed based on the potential chemical-specific ARARs are discussed in Section 4.1.4. Satisfaction of chemical-specific ARARs for soil and groundwater in the source area and groundwater in the near-shore area are expected to be achieved within approximately 1 year of remedy implementation. The time to flush COC concentrations in groundwater exceeding cleanup levels between the source area and the near-shore area is estimated to be approximately 11 years from the time of completion of source area remedial actions. Therefore, chemical-specific ARARs for groundwater are expected to be achieved throughout the site approximately 11 years after completion of the revised source area remedy.

In addition to soil and groundwater cleanup standards, MTCA Method B cleanup levels for air (WAC 173-340-750[3]) are potentially applicable if vapor intrusion health risks are determined to exceed risk target goals. MTCA specifies several criteria for establishing cleanup levels for air quality under WAC 173-340-750(3), which are to include consideration of (1) applicable state and federal laws and (2) protection of human health. MTCA Method B cleanup levels from the Ecology website CLARC tables (https://fortress.wa.gov/ecy/clarc/reporting/CLARCReporting.aspx) for BTEX compounds (noncarcinogen) are listed below. Note that the CLARC tables themselves are not ARARs—MTCA is the ARAR:

- Benzene: 14 µg/m^3
- Toluene: 2,300 µg/m^3
- Ethylbenzene: 460 µg/m^3
- Total xylenes: 46 µg/m^3

For benzene as a carcinogen, the MTCA Method B cleanup level for indoor air is 0.32 µg/m^3. Potential vapor intrusion risks at the NEX convenience store and residential homes will be evaluated during the RD/RA. If vapor intrusion risks above target risk goals are identified, the amended remedy will be designed to be protective of human health for vapor intrusion.

Also, if vapor extraction is ultimately not included in the remedial design for the near-shore treatment system, the Navy will perform ambient air monitoring during initial operation of the system to demonstrate that risk-based discharge limits are not exceeded. Specifically, ambient air samples will be collected in the vicinity of the sparging system to measure the concentrations of COCs that could be emitted during the operations of the system. The concentrations of BTEX and TPH-G measured in the outdoor ambient air samples will be compared to RBCs calculated to be protective of recreational exposures to outdoor air. Table 4-4 presents the equations used to calculate the RBCs and the resulting RBCs. These RBCs are calculated to be protective of a recreational visitor frequenting the shoreline area for 2 hours twice per week for 50 weeks per year. This assumption likely overestimates the frequency of exposure a recreational visitor would experience on the shoreline area, because it is unlikely that any appreciable time would be spent at the shoreline area during the colder, inclement months of the year. Therefore, these RBCs are considered sufficiently conservative for use as benchmarks to evaluate potential exposure to COCs that might be emitted to outdoor air at the shoreline area through the operation of the sparging system.

6.2.2 Location-Specific ARARs

Location-specific ARARs are restrictions placed on the concentration of hazardous substances or the conduct of activities solely because the substances occur or activities are conducted in specified locations. These requirements may limit the type of remedial action that can be implemented, or may impose additional constraints on remedial alternatives. Location-specific ARARs for the NEX Gas Station Leak Area are described below.

Endangered Species Act, 16 USC 1531-1540, 50 CFR 402 Subparts A and B, and 50 CFR 17. The Endangered Species Act protects fish, wildlife, and plants that are threatened or endangered with extinction. It also protects habitat designated as critical to the conservation of threatened or endangered species. The Endangered Species Act requires consultation with resource agencies for projects where federal permits, licenses, or other authorities that may affect threatened or endangered species and development of a biological assessment or biological opinion, as needed, to demonstrate compliance. The OU 1 ROD indicated that a bald eagle has been sighted several times and is known to nest at the JPHC/NHB. Prior to implementation of the amended remedy, the Navy will consult with U.S. Fish and Wildlife Service, National Oceanic and Atmospheric Administration Fisheries, and Ecology to evaluate whether threatened or endangered species will be impacted. Based upon the consultation, the Navy may need to conduct a biological assessment.

Federal Coastal Zone Management Act (CZMA), 16 USC 1451-1464, Chapter 90.58 Revised Code of Washington (RCW), WAC 173-27-060, and 15 CFR 923 and 930. The CZMA requires that federal agency action that is reasonably likely to affect use of shorelines be

consistent with the approved coastal zone management plan to the maximum extent practicable, subject to limitations set forth in the CZMA. Federal agencies are not required to obtain permits for shoreline development. Instead, a Coastal Zone Consistency Determination is prepared that includes a project description, a brief assessment of the impacts, and a statement that the project complies with the Coastal Zone Management Program. Ecology reviews the proposed project for consistency with state environmental requirements. If the project is consistent, Ecology concurs with the certification in writing. The Navy will prepare a Coastal Zone Consistency Determination for the amended remedy, and any remedial actions within the shoreline, such as installation of compliance monitoring points at the conditional point of compliance, will meet the Coastal Zone Consistency requirements.

Washington Shoreline Management Act (SMA), Chapter 90.58 RCW, Chapter 173-26 WAC, Chapter 173-22 WAC, and WAC 173-27-060. The SMA specifies the policies, standards, and limitations applicable to effects to coastal resources. The substantive requirements of this statute and implementing regulations are applicable to activities within 200 feet of the ordinary high-water mark. Proposed actions must be consistent with the policies and goals of the SMA and the locally approved CZMA program, including the City of Bremerton Shoreline Master Program and Kitsap County Shoreline Management Master Program. Proposed actions must also be consistent with the Kitsap County shoreline designation maps. The near-shore area is located within 200 feet of the ordinary high-water mark. The amended remedy for the near-shore area, as well as any other actions performed within the shoreline, will be designed to meet SMA requirements.

National Historic Preservation Act (NHPA), 16 USC 470 and 36 CFR Parts 800 60, and 65. Under Sections 106 and 110 of the NHPA, CERCLA remedial actions are required to take into account effects on any historic property included or eligible for inclusion on the National Register of Historic Places. The NHPA provides for consultation with the Tribe regarding the area of any potential effect and any additional action, such as cultural resource surveys that may be necessary to identify and protect cultural resources during remediation of the site. The Navy will consult with the Suquamish Tribe regarding the potential need for cultural resource surveys prior to amended remedy implementation.

6.2.3 Action-Specific ARARs

Potential action-specific ARARs are typically technology- or activity-based requirements or restrictions on actions taken with respect to hazardous substances. These potential requirements are triggered by the particular cleanup action alternative and set performance, design, or other standards that will be used to implement the proposed remedial action. Action-specific ARARs for the amended remedy are described below.

Minimum Standards for Construction and Maintenance of Water Wells, Chapter 18.104 RCW; WAC 173-160-101, -121, -161 to -241, -261 to -341, and -381. Well construction regulations establish minimum standards for water well construction. This regulation is potentially applicable to wells constructed for groundwater withdrawal and monitoring and for decommissioning of existing or future wells. The 13 new performance monitoring wells that will be installed in the source area and near-shore area and any additional groundwater wells installed or decommissioned at the site will comply with these water well standards.

Regulation and Licensing of Well Contractors and Operators, Chapter 18.104 RCW; WAC 173-162-020 and -030. These regulations apply to all water well contractors and operators who are providing well installation, maintenance, or abandonment services in Washington State. Only licensed water well contractors and operators will be permitted to install, maintain, or abandon wells at the NEX Gas Station Leak Area.

Groundwater Removal, RCW 90.03.250 and 90.44.050, .055, .060, and .100. These laws specify requirements for withdrawing groundwater at a rate greater than 5,000 gallons per day or any withdrawal or diversion of surface water. The amended remedy will involve groundwater extraction in the source area associated with the DPE system. If ISCO in the near-shore area is not as effective as expected after 2 years of active treatment, then the Navy will implement a groundwater pump and treat system as the contingency remedy. Groundwater removal requirements would apply to these remedial actions if groundwater is withdrawn above the threshold amount. Substantive requirements would be identified through consultation with Ecology.

General Regulations for Air Contaminant Source, Chapter 70.94 RCW; WAC 173-400-040(9); PSCAA Regulation 1, Section 6.0 and Section 9.15. Washington Clean Air and PSCAA regulations identify specific requirements related to the control of fugitive dust, including the requirement to employ reasonable precautions to minimize the emissions. Reasonable precautions include, but are not limited to, the following: (1) the use of control equipment, enclosures, and wet (or chemical) suppression techniques, as practical, and curtailment during high winds; (2) surfacing roadways and parking areas with asphalt, concrete, or gravel; (3) treating temporary, low-traffic areas (e.g., construction sites) with water or chemical stabilizers, reducing vehicle speeds, constructing pavement or riprap exit aprons, and cleaning vehicle undercarriages before they exit to prevent the track-out of mud or dirt onto paved public roadways; or (4) covering or wetting truck loads or allowing adequate freeboard to prevent the escape of dust-bearing materials. The Navy will take reasonable precautions to minimize dust emissions during remedial actions per the Washington State and PSCAA requirements.

PSCAA regulations also identify requirements for the exemption from and permitting of air pollution sources that exceed specific thresholds under Regulation 1, Section 6. The substantive requirements of this regulation are potentially applicable to groundwater and vapor extraction and treatment using DPE in the source area, ISCO in the near-shore area, and the pump and treat contingency remedy in the near-shore area. PSCAA includes treatment of vapor discharge from groundwater treatment systems if the systems are expected to discharge more than 15 pounds of benzene per year. The vapor treatment required in this case would be the best available control technology determined during the RD/RA through meeting the substantive requirements of the PSCAA ARAR, rather than meeting a specific numerical standard. The Navy will consult with the PSCAA to identify substantive requirements of this regulation.

Clean Water Act National Pollutant Discharge Elimination System (NPDES) Regulations, 40 CFR 122.29, 122.41, and 122.43 to 122.45. The Clean Water Act regulates the discharge of pollutants from point sources into waters of the United States. The EPA maintains responsibility for implementing the NPDES permit program at federal facilities, which provides conditions for authorizing direct point-source discharges to surface waters and specifies point-source standards for such discharges into waters of the state. CERCLA 121(e) requires that only the substantive provisions of a permit requirement be complied with for on-site discharges. Substantive requirements include technology-based effluent controls, effluent limitations, and compliance with surface water quality criteria, including establishment of a mixing zone.

The NPDES requirements are potentially applicable to the source area DPE system, which will involve groundwater extraction, treatment, and discharge to surface water. The Navy will consult with the EPA to establish discharge requirements for the DPE system, including establishing a mixing zone for any point-source discharge of treated effluent.

Washington State Underground Injection Control, RCW 43.21A.445 and Chapter 173-218 WAC. The underground injection control requirements are potentially applicable to the discharge of extracted and treated groundwater to infiltration or other ground surface systems. Under the contingency pump and treat remedy, groundwater would be pumped from extraction wells in the near-shore treatment area, treated above ground, and reinjected uphill from the source area. The contingency remedy would meet the substantive requirements of the underground injection control regulations.

Washington Solid Waste Management Act and Solid Waste Management Handling Standards Regulations, Chapter 70.95 RCW and WAC 173-350-300. The solid waste requirements are potentially applicable to the off-site disposal of solid nonhazardous wastes and contaminated media that may be generated as part of the cleanup action. The amended remedy implementation may generate solid waste during installation of DPE wells, groundwater monitoring wells, temperature monitoring points, and ozone injection points. In addition, the

pre-design investigation will generate investigation-derived waste. Solid waste from the pre-design investigation and remedy implementation will be stored, collected, and transported in accordance with this ARAR and sent to facilities licensed and permitted to accept the specific waste material.

Resource Conservation and Recovery Act, 42 USC 6901; Dangerous Waste Act and Regulation, Chapter 70.105 RCW; Chapter 173-303 WAC. Washington State is authorized to implement portions of the Hazardous and Solid Waste Amendment and Non-Hazardous and Solid Waste Amendment provisions of the Resource Conservation and Recovery Act. These regulations specify requirements for the identification, accumulation, manifesting, transport, treatment, storage, and disposal of dangerous waste. The dangerous waste regulations may apply to the active management, treatment, and disposition of soils or other waste materials. The potential applicability of these requirements is triggered only when the materials are actively managed.

The amended remedy does not include remedial excavation, treatment, or disposal of contaminated soil from the site. Contaminated soils may be generated during the investigation and installation of the ERH, DPE, and ozone injection systems and monitoring wells. Other waste materials will be generated during removal or relocation of the NEX pump island. The potentially applicable requirements for dangerous waste designation will be considered during the remedial design for the amended remedy, and dangerous waste regulations will be met for dangerous or hazardous waste transported off site for disposal.

6.3 COST EFFECTIVENESS

Based on the evaluation performed in the FFS, the amended remedy provides the most cost-effective means of reliably protecting human health and the environment in the long term. Remedial alternatives evaluated in the FFS for the source area and near-shore area are listed in Section 5.1. The estimated present-worth total costs for the source area alternatives are $2.2 million for Alternative S1 (DPE), $3.4 million for Alternative S2 (ERH with DPE), and $11.6 million for Alternative S3 (excavation). The selected alternative, ERH with DPE, would cost approximately 50 percent more than DPE alone, but is expected to have less residual risk, because heating of media using ERH is expected to more reliably remove the COCs throughout the impacted media. The excavation alternative would cost over three times as much as ERH with DPE and would not provide significantly greater protection for human health and the environment.

The estimated present-worth total costs for the near-shore area alternatives, N1 through N7, range from approximately $1.2 million to $3.0 million. The lowest cost alternative, N2 – Biosparging, has a relatively high potential for residual risk, because biosparging technologies rely primarily on advective transport and other low-energy mechanisms to move oxygen through the aquifer and enhance bioremediation rates of COCs. The selected alternative, N3 – ISCO, has an estimated present-worth total cost of approximately $1.6 million and is the lowest cost alternative that is expected to minimize residual risk using active technologies to ensure good contact between remedial agents and COCs. The remaining alternatives (N1 and N4 through N7) have higher estimated costs than the selected alternative and would be expected to have similar or higher potential for residual risk.

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

The amended remedy represents the maximum extent to which permanent solutions and treatment technologies can be used in a cost-effective manner for the NEX Gas Station Leak Area. It is protective of human health and the environment, complies with ARARs, and provides the best balance of trade-offs in terms of long-term effectiveness, permanence, short-term effectiveness, implementability, cost, and reductions in toxicity, mobility, or volume achieved through treatment. The amended remedy meets the statutory requirement to use permanent solutions to the maximum extent practicable. The soil and groundwater in the source area will be treated using ERH with DPE. The groundwater in the near-shore area will be treated using ISCO. A contingency pump-and-treat remedy for the near-shore area is included in this ROD Amendment for implementation in the event that the ISCO technology does not meet the RAOs. ERH with DPE and ISCO are innovative treatment technologies designed to permanently reduce concentrations of COCs in the subsurface.

6.5 PREFERENCE FOR TREATMENT AS A PRINCIPAL ELEMENT

The amended remedy will rely principally on active treatment technologies. The Navy will implement these active treatment technologies at two areas of the site: the source area and the near-shore area. Groundwater treated at the source area will flush downgradient through the aquifer to the near-shore active treatment system, which will intercept and treat the groundwater prior to groundwater discharge into Ostrich Bay. The active treatment selected for the source area is ERH with DPE. This technology heats both the soil and groundwater in the subsurface, using electrodes to mobilize contaminants for recovery by DPE and treatment above ground. The active treatment technology selected for the near-shore area is ISCO using ozone injection.

This technology will create a treatment zone in the near-shore area that will intercept and treat contaminated groundwater migrating toward Ostrich Bay. The injection of ISCO reagents such as ozone into the aquifer chemically destroys COCs exceeding cleanup levels. Increased dissolved oxygen concentrations in the treatment zone will also enhance subsequent biodegradation of COCs in near-shore area groundwater.

By utilizing these treatment technologies in the source area and near-shore area, the amended remedy satisfies the statutory preference for remedies that employ treatment as a principal element.

6.6 FIVE-YEAR REVIEW REQUIREMENTS

Because the amended remedy will allow contaminants to remain in place for approximately 12 years at concentrations that do not allow unlimited site use and unrestricted exposure, periodic reviews of the amended remedy at the NEX Gas Station Leak Area will be required at least once every 5 years. The purpose of the 5-year review is to ensure that the remedial actions selected in this ROD Amendment are functioning properly and remain protective of human health and the environment. Five-year reviews are currently conducted at OU 1, including the NEX Gas Station Leak Area, for remedial actions selected in the OU 1 ROD. The last 5-year review for OU 1 considered site data from the period from 2004 to 2009 (U.S. Navy 2011a). The amended remedy presented in this ROD Amendment will be evaluated as part of the subsequent 5-year reviews of the remedial actions at OU 1.

7.0 PUBLIC PARTICIPATION

Section 300.435(c)(2)(ii) of the NCP requires public participation in the process of approving a ROD Amendment. Specific requirements for public participation include releasing the proposed plan for public comment, providing responses to significant public comments in the ROD Amendment, and making the ROD Amendment and supporting information available to the public in the Administrative Record. This section documents public involvement in the amended remedy selection at the NEX Gas Station Leak Area and compliance with the public participation requirements set forth in Section 300.435(c)(2)(ii) of the NCP.

7.1 OPPORTUNITIES FOR PUBLIC PARTICIPATION

Public participation activities related to the selection of the Amended Remedy of the NEX Gas Station Leak Area at JPHC/NHB are part of the ongoing overall investigations and cleanup activities at JPHC/NHB and are guided by a community relations plan last updated in July 2008. The Navy has conducted Restoration Advisory Board meetings, town hall meetings hosted by the Commanding Officer, and other meetings to address specific issues of public interest. In addition, the Navy publishes information in project-specific notices concerning the progress of investigation and cleanup activities.

The EPA as lead regulatory agency and the Suquamish Tribe as a key stakeholder participated in the development of the proposed plan to amend the OU 1 ROD and this ROD Amendment. The Navy provided for a 30-day public review of the proposed plan from October 27 through November 26, 2012. No request was received for a public meeting, and, therefore, no public meeting was held. Comments on the proposed plan from the EPA and the Suquamish Tribe are summarized and addressed in the Responsiveness Summary in Section 8.2. The Navy did not receive public comments on the proposed plan during the public comment period.

The FFS and proposed plan are part of the Administrative Record for the site. This ROD Amendment is based on, and will become part of, the Administrative Record. The Administrative Record is maintained on file at the following location:

Naval Base Kitsap Bangor
1101 Tautog Avenue (Building 1101, 2nd floor)
Silverdale, Washington
(360) 396-6387

The FFS report, proposed plan, and ROD Amendment are also available for public review at the following information repositories:

- Sylvan Way Branch of the Kitsap Regional Library
  1301 Sylvan Way
  Bremerton, Washington
  (360) 377-7601

- Jackson Park Community Center
  90 Olding Road
  Bremerton, Washington

- Online at Naval Facilities Engineering Command Northwest public website:
  http://bit.ly/bvSkKB

7.2 RESPONSIVENESS SUMMARY

The Navy received written comments on the proposed plan and the draft ROD Amendment from the EPA and Suquamish Tribe. The comments on the proposed plan and the Navy's responses are presented in this section. Comments and responses on the draft ROD Amendment are presented in Appendix A.

7.2.1 EPA Comments on the Proposed Plan

The EPA invoked dispute on the draft final proposed plan based on four issues:

1. The lack of a specific period of time and criteria in which the pump and treat contingency remedy will be implemented

2. Remedial design exclusions that lead to no vapor-phase monitoring, no vapor-phase capture and treatment of COCs, and no injection of ozone at the bottom of the contaminated zone as part of the components of the ISCO preferred alternative

3. The lack of quantitative risk assessment information in the proposed plan that forms the basis for this response action

4. The lack of a comprehensive plume map in the proposed plan that shows contaminant concentrations throughout the plume from the source area to the downgradient extent of contamination

The Navy revised the draft final proposed plan to address the issues raised by the EPA. Based on a review of the materials and telephone discussions, the Navy and EPA agreed to the following resolutions:

1. In the event that the ISCO primary remedy fails to meet MCLs at the downgradient point of compliance (e.g., 880 series monitoring wells plus new proposed monitoring wells) at the end of 2 years from the date the ISCO remedy is installed, the Navy shall issue a request for proposal for design of a pump and treat remedy.

2. The draft final proposed plan was revised to delete the following two sentences from page 19 under the heading entitled "Near-Shore Area Alternative N3: In Situ Chemical Oxidation": "The ozone will move vertically and horizontally, and therefore it is not necessary to inject at the bottom of the contaminated zone. No vapor control is needed and no waste product is generated at the surface."

3. The proposed plan does not need to be revised to include quantitative risk information as the basis for action. Exceedances of MCLs establish a sufficient basis for this action to be implemented.

4. The draft final proposed plan shall be revised to include Figure 2-4 from the FFS, dated October 31, 2011. This figure, a cross-sectional diagram showing well locations and COC concentrations throughout the plume, will be modified to show the plume discharge to Ostrich Bay.

7.2.2 Suquamish Tribe Comments on the Proposed Plan

The Tribe submitted the following comments on the draft final proposed plan. The Navy's responses are provided following each comment. The Navy revised the draft final proposed plan as indicated in the comment responses to address the issues raised by the Tribe.

Comment 1: *Clarify the time-frame necessary to achieve compliance throughout the site.*

While there may be two remedy components that involve active treatment, the RG applies to the entire site. As presented in the PP, a two year time-frame is estimated for the source area component; a one year time-frame is estimated for the near-shore component. However, it will be necessary to continuously operate the near-shore ozone injection system for an estimated 12 years (not one year) to ensure that groundwater flushing from the upland area will meet the RG before discharging to Ostrich Bay. Although this is discussed in the PP, it is difficult to piece together the recovery time-frame for the site as a whole.

Response: The restoration time-frame is clearly described in several places in the proposed plan, including on pages 17 and 19 where the preferred alternatives are described, and on page 9 in the first paragraph under SUMMARY OF ALTERNATIVES. For further clarification, the Navy will add at the end of this paragraph, *"(a total restoration time of approximately 12 years under the preferred alternative)."* The Navy will also add a sentence to the first page, at the end of the paragraph below the bullet list describing the preferred cleanup action, *"Under the preferred cleanup action, the total site restoration time is estimated to be 12 years."*

Comment 2: *Provide an explanation of MCLs as cleanup levels assumed to be protective of human health.*

Specifically, the MCL for benzene reflects a technology-limited treatment standard rather than a risk-based threshold. As a known human carcinogen, it is assumed there is no safe threshold exposure for benzene.

Response: The proposed plan is probably not the place to include a detailed discussion of the basis for MCLs. EPA and the Tribe have accepted the MCL for benzene as an appropriate RG for this site. EPA has accepted that additional risk discussion need not be added to the proposed plan because an exceedance of an MCL establishes an unacceptable human health risk. The Navy believes adding a discussion of the basis for MCLs in this document would be a distraction to the public. If necessary, a discussion of the basis for MCLs can be added to the ROD amendment.

Comment 3: *Explain why a short-term point of compliance is necessary.*

The fact that the cleanup process may take 11–13 years does not adequately explain why a short-term point of compliance is needed or what would be measured. At this time, the Tribe does not agree that the point of compliance will be at the shoreline, where groundwater flows into surface water, if this refers to the intertidal seeps that have been historically sampled. The seeps measure the discharge of shallow groundwater and may not be completely representative of the groundwater plume at the site.

Response: The reason for a short-term point of compliance is explained in the second paragraph on page 9 under Point of Compliance**.** The short-term point of compliance is needed to establish compliance as soon as possible at the location where there is current exposure – groundwater discharging to surface water. The ultimate point of compliance is groundwater throughout the aquifer. However, this ultimate POC addresses a future exposure scenario. There is no current exposure to contaminated groundwater except at the shoreline. As documented in the FFS and the correspondence with EPA, compliance will not rely on the intertidal seep, but rather on groundwater wells. The Navy proposes no changes to the proposed plan based on this comment.

Comment 4: *Revise Figure 4 to reflect the benzene RG of 5 µg/L (remove the reference to the existing surface water criterion for benzene of 23 µg/L) and use the same units for the TPH-G in both Table 2 and Figure 4.*

Response: Figure 4 will be revised as requested.

Comment 5: *Explain why pump and treat has been identified as the contingent remedy for the near-shore area. It is not apparent from the PP text why a contingent action may be necessary, or why pump and treat was chosen.*

Response: The Navy does not concur that a contingent remedy is needed, or that pump and treat technology is the right choice for a contingent remedy. The text added to the proposed plan regarding the contingent pump and treat remedy was required by EPA. The Navy proposes no changes to the proposed plan based on this comment.

Comment 6: *Clarify the time-frame and performance measures that would be used to determine if it will be necessary to implement the contingent action.*

Response: As required by EPA, the time frame in the proposed plan will be changed to exactly 2 years. The specific performance measures will be established in the ROD Amendment. The Navy proposes no additional changes, beyond those required by EPA, in response to this comment.

Comment 7: *The Tribe was copied on a letter notifying the Navy that EPA Region 10 has invoked formal dispute over the draft final PP under the terms of the JPHC Federal Facilities Agreement (FFA). During other disputes between the Navy and the EPA, the Tribe has been excluded from participating in the dispute resolution process on the grounds that the Tribe is not a signatory party to the FFA. However, the 1998 Memorandum of Agreement between the Department of Defense and the Suquamish Tribe assures the Tribe of meaningful participation in site decision-making. The Tribe has actively participated on the JPHC project team and expects to continue to be involved in site management decisions, including the selection of a remedy for the Benzene Release Area.*

The Tribe may request consultation with the Navy to brief staff and/or tribal council regarding the status and outcome of the dispute resolution. It is also expected that tribal staff will be provided the opportunity to review and comment on any changes to the PP made as a result of the dispute.

Response: Comment noted. The Tribe will be informed of the outcome of the dispute resolution.

8.0 REFERENCES

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APPENDIX A

Comments and Responses on the Draft ROD Amendment

CONTENTS

RESPONSES TO EPA COMMENTS ON THE DRAFT RECORD OF DECISION AMENDMENT NO. 1, OPERABLE UNIT 1, NEX GAS STATION LEAK AREA, JACKSON PARK HOUSING COMPLEX/NAVAL HOSPITAL BREMERTON
Document Dated: 1/21/13
EPA Comments Dated: 3/14/13
Responses Dated: 3/27/13

POLICY COMMENTS

1. Several places in this document imply or state that vadose zone vapor phase monitoring, collection, and treatment of volatile organic compounds is not necessary for the Near Shore Treatment Area. EPA strongly disagrees with this conclusion. Based on the dissolved phase chemical concentration of benzene in the near shore area (~ 14,000 μg/L), and the inherent nature of air/ozone sparging into the saturated zone, any inefficiencies or channeling effects from these gasses may result in stripping both VOCs and unreacted ozone into the unsaturated zone and open air. As such, any design for an air/ozone ISCO sparging system must include a) vapor monitoring, b) vapor recovery, c) vapor treatment, and d) air discharge standards for the CoCs consistent with EPA's technical design guidance documents (EPA 1998, 2006) and ARARs. EPA has already initiated informal dispute on this issue on the draft final Proposed Plan for the Benzene Release Area, and EPA's position on this issue remains unchanged, vapor phase monitoring, collection, and treatment are required components of the preferred alternative for this OU.

   Response: The primary treatment mechanism of ozone sparging is an in-situ chemical reaction that oxidizes hydrocarbons to oxygen and carbon dioxide. Stripping of volatiles using this technology is avoided through the use of microporous oxidation points that allow flow rates to be kept very low (less than 7 cfm). In addition, with a maximum concentration of 14 ppm of benzene in groundwater, the mass of COCs that could plausibly be stripped and discharged to the atmosphere using this technology is very unlikely to exceed air discharge regulations and thereby require collection and treatment. However, the Navy will agree to further evaluate the need for vapor collection and treatment in the near-shore area as part of the remedial design. The Navy will also agree to perform ambient air monitoring during initial operation of the system to verify these conclusions. The Navy will add numerical values to the ROD amendment for comparison to air monitoring results. These numerical criteria will be based on COC discharge limits as promulgated by PSCAA, as well as human health exposure risks for users of the recreational pathway that passes through the near-shore treatment zone. This information will be added to the discussion of air ARARs under Section 7.2.3 and the description of the near-shore amended remedy in Section 4.2.2.

2. The Washington Department of Ecology MTCA Method B standards are ARARs for this site. Therefore any substantive requirements under MTCA Method B that are more stringent than federal standards become the applicable performance and cleanup standards. The preferred alternative either needs to meet this ARAR, or a legitimate basis for an ARAR waiver must be demonstrated, as compliance with ARARs is a CERCLA threshold criteria.

   Response: Section 4.1.4 will be revised to more fully explain the basis for the selected remediation goals. According to MTCA 173-240-720(7)(b), where cleanup levels are based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of 1, the cleanup level must be adjusted downward so that the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed 1 at the site. For benzene, the MCL of 5 µg/L was determined to be protective of both a cancer risk of 1×10^{-5} and a hazard quotient of 1. Likewise, for ethylbenzene, the MCL of 700 µg/L was determined to be protective of a hazard quotient of 1. Therefore, no adjustment to the benzene or ethylbenzene MCLs was necessary to comply with state and federal requirements. As a result of this conclusion, the MCLs for benzene and ethylbenzene of 5 and 700 µg/L, respectively, were selected as the remediation goals for protection of groundwater for beneficial uses. However, for the xylene compounds, the MCL of 10,000 µg/L was found to exceed the MTCA Method B cleanup level based on a hazard index of 1 and thus required downward adjustment to comply with state and federal requirements. The MTCA Method B cleanup level of 1,600 µg/L was selected as the remediation goal for the xylene compounds for protection of groundwater for beneficial uses.

3. In general, at the time the ROD Amendment is drafted, RI/FS cleanup "goals" become cleanup objectives (see EPA's "ROD Guidance" OSWER 9200.1-23P) and Remedial Action Objectives (RAOs) (see ROD Guidance, section 6.3.8 "Remedial Action Objectives"). The RAOs form the basis for the criteria that must be met for performance/compliance monitoring under the ROD Amendment.

   Response: As agreed during the comment resolution meeting on May 7, 2013, the Navy will replace the term "remediation goal" with "cleanup level" throughout the document where the revised numeric cleanup standards are discussed. Because the OU 1 ROD uses the term "remediation goals," this term will still be used when discussing the OU 1 ROD. The Navy will add an explanation of the change in terminology to Section 4.1.4.

4. Point of Compliance (POC) for groundwater remediation – Several locations in this document refer to "a majority of the" wells have to meet the RAOs at the POC after a two year time period. This statement is incorrect, *all* wells at the POC must meet the RAOs and cleanup levels at the end of the two year timeframe. In addition, the POC for the Near Shore

Treatment Area has already been determined in the Dispute Settlement Statement dated 6/28/12 for the OU-1 Benzene Release Area Proposed Plan. The POC for the Near Shore Treatment Area are the 880 series groundwater wells immediately downgradient of the treatment zone, not seeps or other areas downgradient in the intertidal zone that are not stratigraphically in the Vashon Advance Outwash formation.

Response: The Navy will agree to changing the conditional point of compliance to the 880 series wells (and additional wells to complete this alignment of wells) based on EPA's comment and the discussions during the informal dispute resolution. This change will affect text in Sections 4.1.5, 4.2.2, 4.2.3, and 4.2.4. As discussed in the comment resolution meeting of May 7, 2013, it is common for all treatment systems installed in real-world environments that treatment results are not uniform across the entire treatment zone. The Navy expects the ozone sparging system to be very effective over a short time frame. However, it would not be surprising to see the following hypothetical result:

- Steeply declining COC concentrations in all POC wells shortly after system startup
- Reaching RGs for most COCs at most POC wells after 1 year of operation
- System optimization followed by reaching RGs for more COCs at more POC wells
- At the 2-year mark, one or two wells that show occasional, inconsistent RG exceedances for some COCs during some monitoring events

If the trigger for implementing the contingency remedy after 2 years is too restrictive, this hypothetical scenario could result in abandoning a clearly effective treatment system and triggering the pump-and-treat contingency. To address this issue, and as discussed during the comment resolution meeting, the trigger for implementing the contingency remedy will be described under Section 4.2.2 and revised to state that the contingency remedy will be triggered if, after 2 years of operation of the near-shore treatment system, the mean benzene concentration in the POC wells at the near-shore treatment zone is not consistently at or below the cleanup level of 5 µg/L, unless otherwise agreed to by the Navy and EPA. To further clarify the trigger criteria, the discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4.2.2 of the ROD amendment and, instead, included in the remedial design.

The Navy's expectation is that the performance validation period that follows initial start-up of the near-shore treatment system will include frequent monitoring and regular status reports (perhaps on a monthly basis) shared with EPA. The Navy hopes to work cooperatively with EPA during this period to evaluate treatment system performance.

5. Contingency Remedy – It is unclear in this document what triggers the change to the contingency remedy.

   Response: Please see the response to Policy Comment No. 4, for the changes to be made to clarify what conditions trigger the contingency remedy. In addition to the changes discussed in response to Policy Comment No. 4, the Navy will remove the trigger criteria currently included under the heading "Contingency Remedy" on page 4-11 of the ROD amendment, in favor of a discussion under Section 4.2.2.

6. Principal Threat Wastes – The updated Conceptual Site Model (CSM) clearly demonstrates the basis for a determination of Principal Threat wastes, as the Source Area had provided a pathway for migration of contaminants into groundwater from the source all the way to Ostrich Bay. Both soil and groundwater concentrations of CoCs substantially exceed risk based RAOs by orders of magnitude. The draft final ROD Amendment should clearly establish that the Source Area is Principal Threat wastes consistent with EPA Guidance (ROD Guidance section 6.3.11; and OSWER 9380.3-06FS "A Guide to Principal Threat and Low Level Threat Wastes"), and serves as the basis for treatment of the source material. Numerical soil and groundwater RAOs are necessary to ascertain that the remedy is meeting the ROD Amendment performance standards.

   Response: As agreed during the comment resolution meeting on May 7, 2013, the ROD amendment will be silent with regard to principal threat wastes. The Navy will remove all references to the principal threat waste concept.

   RAOs and corresponding numerical RGs are established in the ROD amendment as written. The Navy proposes no changes to the ROD amendment based on this portion of the comment.

SPECIFIC COMMENTS

1. Page 7 – Signature – The signatory for this ROD will be D. Faulk not D. McLerran.

   Response: The Navy will change the signatory as indicated.

2. Page 1-1, 3rd paragraph – Recommend deleting the text in quotes: "memorialize a ROD" and amend "ment to". EPA recommends adding a statement up front explaining the lead regulator status of the ROD vs. the ROD Amendment. It is confusing as to why sometimes EPA was mentioned by not Ecology, and vice versa. See ROD Guidance for Decision Summary section 6.3.1 that recommends identification of the lead and support agencies.

   Response: The Navy will make the edits to the quoted text as requested, and will add a statement clarifying the regulator status. A statement similar to that at the beginning of Section 5.2.8, Amended Remedy, will be added to the beginning of the document.

3. Page 1-2, 1st bullet – This bullet does not match the 1st paragraph on page 1-1.

   Response: A statement will be added to this bullet, stating that the NEX Gas Station Leak Area is within Sites 101 and 110, as stated in the first sentence below the bulleted list.

4. Page 1-2, 2nd paragraph, "The area has been historically been defined by two seeps (Seep-L and Seep-R)" – This statement is confusing, the Benzene Release Area is defined as the extent of soil and groundwater contamination resulting from leaks at the NEX Gas Station, not by seeps on the shoreline.

   Response: This statement is describing the historical definition of the area, as stated in the OU 1 ROD and many other site documents. However, the Navy can agree to the following rewrite of this sentence: "The area is defined by benzene and petroleum contamination in soil and groundwater extending from the NEX gas station approximately 450 feet downgradient to the shoreline of Ostrich Bay. The area was historically identified by two seeps (Seep-L and Seep-R) exhibiting benzene concentrations that discharge through pipes along the shoreline of Ostrich Bay."

5. Figure 1-3 – Several of the acronyms are not defined on the figure including, BH, SV, MW, and TPP.

   Response: All of the symbols associated with these acronyms are defined in the legend. However, we will add the acronym next to each symbol for additional clarity.

6. Page 2-2, Section 2.2, 1st paragraph – Recommend adding the text in quotes: ….remedy for "soil and groundwater in" the NEX Gas Station Leak area….

   Response: The Navy will add the requested additional text.

7. Page 2-3, "The selected remedy for the Benzene Release Area does not include any institutional controls. The institutional controls that are included in the selected remedy for OU-1 groundwater will prevent construction of drinking water wells within the Benzene Release Area". – These two sentences are contradictory. The 1st sentence states there are no ICs, the 2nd sentence says ICs prevent construction of drinking water wells. What current ICs are in place to prevent exposure to contaminated groundwater?

   Response: This text is a quote from the OU 1 ROD. The ROD was attempting to convey that the remedy for the Benzene Release Area did not specifically include ICs as a component, because the Benzene Release Area was located within Sites 101 and 110, for which ICs were already a component of the groundwater remedy. As agreed during the comment resolution meeting of May 7, 2013, the Navy will add a statement following the quoted OU 1 ROD text to explain that the ICs applicable to Sites 101 and 110 prohibit the construction of drinking water wells, and this area includes the Benzene Release Area.

8. Page 3-3, Section 3.2.4, 1st paragraph – This paragraph only describes the purposes of an RI (i.e., nature and extent of contamination), and does not describe the purposes of a FFS (i.e., evaluate the range of remedial alternatives applicable to the site conditions and the preferred alternative based on that evaluation of the CERCLA Nine Criteria analysis).

   Response: This section is not intended to describe the purpose of the FFS. As titled, this section is intended to summarize the investigation and pilot testing results from the FFS as supporting information forming the basis for the amendment. The Navy proposes no change to the ROD Amendment based on this comment.

9. Page 3-5, 1st bullet, "This extraction rate is not expected to be sufficient to capture the entire vertical extent of dissolved contaminants." – What extraction rate would capture this? Is that rate necessary for the remedy to be protective?

   Response: This section summarizes the conclusions of the pumping test as presented in the FFS. Refinement of the pumping rate needed to achieve complete capture would be part of the remedial design for the contingency remedy, if triggered. The Navy proposes no changes to the ROD amendment based on this comment.

10. Page 3-5, 3rd bullet – What technical data supports these conclusions regarding salt water intrusion? If the near shore area has semi-confined groundwater conditions, how does this support the conclusion of salt water intrusion?

Response: The technical data supporting these conclusions consist of fundamental principles of shoreline hydrogeology and the tidal study, which showed that the entire site is in hydraulic communication with the surface water in Ostrich Bay (page 3-4 of the ROD Amendment). The Navy proposes no change to the ROD amendment based on this comment.

11. Page 3-6, 1st bullet, "However, the immediate long-term effectiveness appears to be dependent upon benzene and TPH-G concentrations present in the treatment area and will likely be variable." – This statement is unclear, does it mean that CoCs need to be at higher or lower concentrations for the technology to be effective?

    Response: This statement will be clarified.

12. Page 3-6, 2nd bullet , "Test results were inconclusive with regard to the dissolved oxygen radius of influence." – How do these results affect any technology (i.e., air sparging, ISCO w/ozone) that rely on sparging wells for in-situ delivery of air or oxidants? How will well spacing for sparge wells be determined for the full scale design if the radius of influence is unknown?

    Response: The FFS further noted that this test was conducted in relatively shallow wells, and a larger radius of influence is likely from deeper wells (as planned for the remedy). Further refinement of the radius of influence prediction will be included in the remedial design, partly based on additional data to be collected during design. The Navy proposes no change to the ROD Amendment based on this comment.

13. Page 3-8, 3rd paragraph, 2nd bullet – We assume the maximum concentration of benzene in groundwater should be 24,000 µg/L instead of 24 µg/L.

    Response: Thank you. We will correct this typographical error.

14. Page 3-9, 1st partial paragraph, "As explained in the OU 1 ROD, there is no principal threat wastes associated with the NEX Gas Station Leak Area." – EPA does not concur with this conclusion, see Policy Comment No. 6. The ROD Amendment needs to address PTW based on the current CSM, not the previous 2000 ROD that is being updated.

    Response: As agreed during the comment resolution meeting on May 7, 2013, the ROD Amendment will be silent with regard to principal threat wastes. The Navy will remove all references to the principal threat waste concept.

15. Pages 3-10 and 3-11, Section 3.4.1 Human Health Risk Assessment – This section contains numerous discrepancies with regard to the assessment of risks for which receptors and which CoCs. The 1st paragraph describes risk evaluation for multiple human receptors, but the 2nd paragraph only describes risks for utility workers. These exposure scenarios are not described with regard to the current and reasonable anticipated future land uses. The CoCs identified in the 1st and 3rd paragraphs do not match. This section needs to be completely re-written for consistency.

    Response: This section presents a summary of the risk assessment process followed in the FFS and is internally consistent. The risk assessment process begins with a broad list of contaminants of *potential* concern (COPCs) and *potential* receptors. Based on the assessment performed, the list of contaminants is narrowed to just the contaminants of concern (COCs) and the complete and significant exposure pathways. The bullet list on page 3-11 describes the complete exposure pathways identified for both current and reasonably anticipated future land uses. The risk assessment evaluated all of these pathways either quantitatively or qualitatively, depending on availability of data. The last paragraph on page 3-11 describes the results of the quantitative risk evaluation for utility workers. The remaining Section 3.4.1 on page 3-12 describes the results of the qualitative risk evaluation for all of the other complete exposure pathways listed in the bullets on page 3-11. These pathways were evaluated qualitatively due to lack of data for quantitative evaluation. The Navy proposes no change to the ROD Amendment based on this comment.

16. Page 3-12, remaining Section 3.4.1 – There are numerous inconsistencies in the section, and the lack of data regarding conclusions for risk assessment. No sediment data or tissue data are available for the specific NEX Gas Station Leak Area CoCs and there is no vapor intrusion data available for the entire groundwater plume. This entire section needs to be re-written for consistency with regards to what risk data is and is not available. In addition the remedy needs to include RAOs for vapor phase emissions for all CoCs throughout the plume.

    Response: This section presents a summary of the risk assessment conclusions from the FFS and is internally consistent. As stated on page 3-12, the bullet list describes potentially significant and complete exposure pathways for which the risk assessment could not quantify risks because of lack of data, but for which unacceptable risks may exist now or in the future. These risks were considered in the definition of RAOs and selection of the remedy, even though they could not be quantified. The EPA, Suquamish Tribe, and Navy concurred during the FFS and proposed plan stage that sediment and marine tissue data for benzene and the other petroleum COCs were not necessary for selecting a remedy at this site. As documented in the informal dispute resolution, exceedance of the MCLs is sufficient documentation of unacceptable risk warranting additional action. Also as agreed during the FFS, vapor intrusion risk will be evaluated following collection of additional data during

predesign. Vapor emissions from treatment systems will be addressed during design as part of compliance with air ARARs, as discussed under Section 7.2.3. The Navy proposes no change to the ROD Amendment based on this comment.

17. Page 3-12, Section 3.4.2 Ecological Risk Assessment, 1st sentence – These statements are inconsistent with Section 3.4.1. This section implies there is sediment and tissue sampling data for the NEX Gas Station Leak Area CoCs, Section 3.4.1 says there is not data.

    Response: This text will be edited to clarify that the ecological risk assessment addressed ecological risks to Ostrich Bay as a whole, but did not generate data considered representative of human health exposure in the small intertidal area within the NEX Gas Station Leak Area.

18. Page 3-13, 1st partial paragraph – How many sediment and tissue sampled were analyzed for TPH-G, BTEX and MTBE in the OU-2 investigation? That is not clear in this discussion.

    Response: The number of samples will be added to this paragraph.

19. Page 3-13, Section 3.5 Basis and Rationale for the Amendment – It is unclear from this section whether groundwater and/or the soil remedy did or did not meet the RAOs from the 2000 ROD. In addition, groundwater monitoring was not completed in 2003. This section needs to state what the revised remedy and the contingency remedy will be, and the basis for selection of those remedies. The ROD Amendment must be clear as to what part of the ROD is being amended, and what is not changed.

    Response: This section presents summary information that succinctly states the basis and rationale for the remedy. More detailed discussions regarding which remedy elements did and did not meet the RAOs are provided in Section 4. The 2 years of groundwater monitoring established in the OU 1 ROD as a component of the remedy were completed in 2003. The Navy proposes no change to the ROD Amendment based on this comment.

20. Page 4-2, Section 4.1.3 – This section needs to add ARARs for vapor phase air emissions, see Policy Comment No. 1.

    Response: These action-specific ARARs are discussed in Section 7.2.3 and do include ARARs for vapor phase air emissions. See also the response to Policy Comment No. 1.

21. Page 4-2, Section 4.1.3, ARARs for Soil - MTCA Method B is an ARAR for this action, not a “potential” ARAR in the ROD Amendment. See Policy Comment No. 2.

    Response: The word “potentially” will be deleted from this sentence.

22. Page 4-3, 1st paragraph, "MTCA Method B calculated values for human health are not applicable because state and federal laws provide health-based standards that are sufficiently protective." – EPA does not concur with this assessment of ARARs applicability. MTCA Method B is an ARAR. See Policy Comment No. 2.

    Response: This sentence will be revised to explain that MTCA was used to revised MCLs downward to meet state risk standards.

23. Page 4-3, 2nd and 3rd paragraphs – If these state MCLs are not more stringent than federal MCLs, then they are not ARARs.

    Response: To make it clear that these state standards were evaluated, the description of the standard will remain, but an explanation will be added stating that these standards are not more stringent than federal MCLs and, therefore, are not ARARs for the site.

24. Page 4-4, 1st and 2nd full paragraphs – If these state standards are not more stringent than federal standards, then they are not ARARs.

    Response: To make it clear that these state standards were evaluated, the description of the standards will remain, but an explanation will be added stating that these standards are not more stringent than federal MCLs and, therefore, are not ARARs for the site.

25. Page 4-4, Section 4.1.4 Revised Remediation Goals – This document is a ROD Amendment, therefore they are RAOs, cleanup levels, or ARARs, not "goals". See Policy Comment No. 3. This section needs a table that lists the CoCs and the various numbers resulting from MTCA Method B, MTCA Method A, MCLs, and ambient water quality criteria.

    Response: As agreed during the comment resolution meeting on May 7, 2013, the Navy will replace the term "remediation goal" with "cleanup level" throughout the document where the revised numeric cleanup standards are discussed. Because the OU 1 ROD uses the term "remediation goals," this term will still be used when discussing the OU 1 ROD. The Navy will add an explanation of the change in terminology to Section 4.1.4. The cleanup levels are presented in Tables 4-1 through 4-3.

26. Page 4-4, Section 4.1.4, 1st paragraph – MTCA Method B for groundwater applies to all CoCs, not just some.

    Response: Section 4.1.4 will be revised to more fully explain the basis for the selected remediation goals. According to MTCA 173-240-720(7)(b), where cleanup levels are based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of 1, the cleanup level

must be adjusted downward so that the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed 1 at the site. For benzene, the MCL of 5 µg/L was determined to be protective of both a cancer risk of 1×10^{-5} and a hazard quotient of 1. Likewise, for ethylbenzene, the MCL of 700 µg/L was determined to be protective of a hazard quotient of 1. Therefore, no adjustment to the benzene or ethylbenzene MCLs was necessary to comply with state and federal requirements. As a result of this conclusion, the MCLs for benzene and ethylbenzene of 5 and 700 µg/L, respectively, were selected as the remediation goals for protection of groundwater for beneficial uses. However, for the xylene compounds, the MCL of 10,000 µg/L was found to exceed the MTCA Method B cleanup level based on a hazard index of 1 and thus required downward adjustment to comply with state and federal requirements. The MTCA Method B cleanup level of 1,600 µg/L was selected as the remediation goal for the xylene compounds for protection of groundwater for beneficial uses.

27. Page 4-5, 1st partial paragraph – The contaminated soil in the NEX Gas Station Leak Area is in Site 110 (see figure 1-2) so why wouldn't the RG in the ROD apply? There are similar statements in the ROD Amendment elsewhere.

    Response: The OU 1 ROD was somewhat inconsistent in this regard. The OU 1 ROD specifically established RGs for groundwater in the Benzene Release Area, but did not explicitly include RGs for soil. Other CERCLA documents, such as the 5-year reviews and FFS, stated that the OU 1 ROD established an RG for benzene in groundwater discharging to surface water, but did not mention an RG for soil in the Benzene Release Area. We included the RG for TPH-G in Site 110 soils from the OU 1 ROD in the ROD Amendment for comparison, even though the OU 1 ROD, 5-year reviews, and FFS did not explicitly state that this RG applied to the Benzene Release Area. As discussed in the comment resolution meeting of May 7, 2013, the Navy will clarify in the ROD amendment that soil criteria are provided for comparison, but that the ROD amendment will not establish a cleanup level for soil. Achievement of the RAO for soil (protection of groundwater) will be demonstrated empirically using groundwater samples from monitoring wells located within the source area.

28. Page 4-5, 1st full paragraph, "While minimal ecological risk may be present, drinking water standards for human health will also be protective of ecological receptors." What is the data that is the basis for this statement?

    Response: The basis is the agreement among EPA, Suquamish Tribe, and Navy during the FFS process that drinking water standards would be sufficiently protective of ecological receptors (see letter from Suquamish Tribe dated February 13, 2012) and that collection of sediment and tissue data for volatile COCs was not warranted to support this conclusion. In response to the comment from the Suquamish Tribe on this same wording, the last sentence

of this section, on page 4-5, will be revised to read, "While minimal ecological risk may be present, drinking water standards for human health (revised downward where necessary) are assumed by the Navy, EPA, and Suquamish Tribe to also be protective of ecological receptors, based on current numerical criteria (see Table 4-3)."

29. Page 4-5, Section 4.1.5 Point of Compliance – Setting Points of Compliance is a part of remedy selection, this section needs to be moved to Section 4.2.

    Response: This introductory text provides an overview of the point of compliance framework for this amendment. Specific points of compliance details are discussed in Section 4.2.4, as cited by this text. The Navy proposes no change to the ROD Amendment based on this comment.

30. Page 4-5, Section 4.1.5, 2nd paragraph – This paragraph presents these as expectations and not requirements. The ROD Amendment needs to set forth the new replacement set of requirements.

    Response: This section summarizes the expected outcomes with regard to point of compliance, with the requirements detailed in Section 4.2.3, as cited by this text. As discussed during the comment resolution on May 7, 2013, the Navy will revise the discussion of "conditional point of compliance" to place the first occurrence of this phrase in quotes and add a citation of the WAC definition of this phrase.

31. Page 4-5, Section 4.2 – Section 4.2 should be a description of the new remedy, not a description of the FFS. Also, what is a "standard" POC as compared to any other type of POC? The POC for the Near Shore Treatment Area was already specified in the Dispute Settlement Statement for the OU-1 Benzene Release Area Proposed Plan.

    Response: The introductory text in Section 4.2 explains how the remedial alternatives were developed and evaluated under the FFS. The selected remedies are then described. A standard point of compliance differs from a conditional point of compliance as defined by MTCA, which is an ARAR for this site. These terms are introduced in Section 4.1.5. The Navy will accept moving the conditional point of compliance from the locations described in MTCA to the 880 series wells. As discussed during the comment resolution on May 7, 2013, the Navy will revise the discussion of "conditional point of compliance" in Section 4.1.5 to place the first occurrence of this phrase in quotes and add a citation of the WAC definition of this phrase.

32. Page 4-7, 1st partial paragraph, "Following active heating of the treatment zone, the elevated temperatures support enhanced biodegradation activities as natural cooling occurs." What microorganisms survive in boiling groundwater that would result in biodegradation?

    Response: Although perhaps counter-intuitive, the warm, oxygenated conditions established immediately following ERH have been shown to support enhanced biodegradation. Certain extreme thermophile microorganisms survive the high temperatures directly, and the warm, oxygenated conditions present as the treatment zone cools encourage the rapid recolonization of the area by other mircoorganims (DPRA 2009). The Navy proposes no change to the ROD Amendment based on this comment.

33. Page 4-7, 1st full paragraph, "Treated groundwater will be discharged to surface water." What is the location, POC, and RAOs for discharge to surface water. Is this treatment condensation water or groundwater that is being treated? Also, vapor phase air discharge standards for the oxidizer or GAC need to be established for all CoCs.

    Response: The requirements for these discharges will be established as part of the remedial design in compliance with the action-specific ARARs cited in Section 7.2.3. The Navy proposes no change to the ROD Amendment based on this comment.

34. Page 4-7, Performance Monitoring section, 1st paragraph – It is unclear why monitoring of the treatment system cannot be used for both performance and compliance monitoring, including documenting progress toward meeting RAOs.

    Response: This text is explaining the different goals of performance monitoring versus compliance monitoring, which is a typical distinction between monitoring types at CERCLA sites with active treatment systems. Certainly there is no reason that relevant data collected primarily for performance monitoring cannot also be used for compliance monitoring purposes. The details of the data to be collected and the use of the data are typically established in the O&M plan and Compliance Monitoring Plan. This explanation will be added to this paragraph.

35. Page 4-7, Performance Monitoring section, 3rd paragraph – This section needs to have soil and groundwater RAOs and cleanup levels for all CoCs.

    Response: As agreed during the comment resolution meeting on May 7, 2013, the Navy will retitle this section and revise the criteria in this section to focus on the conditions for termination of active treatment in the source area. This section will now state that the ERH system will be operated until the mean benzene concentration in groundwater samples collected from the source area performance monitoring wells is consistently less than the

cleanup level of 5 µg/L (unless otherwise agreed to by the Navy and EPA). To further clarify the trigger criteria, the discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4.2.1 of the ROD Amendment and instead included in the remedial design.

36. Page 4-8, 1st paragraph – It is unclear how energy consumption is a measure of the success of source area treatment.

Response: System operational data, such as energy consumption, are commonly used to assess whether an active treatment system is functioning as expected. Other data are needed, however, to show progress towards meeting RAOs and demonstrate ongoing protection of human health and the environment. The discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4.2.1 of the ROD Amendment and instead included in the remedial design.

37. Page 4-8, 5th paragraph – While this may be a good "first" response, if non-compliant wells do not meet groundwater RAOs, what is the next response? The ROD Amendment is a compliance document. Ultimately the entire groundwater plume needs to meet the groundwater RAOs for *all* wells, not just a "majority" of them. See Policy Comment No. 4.

Response: As agreed during the comment resolution meeting of May 7, 2013, the text cited in this comment will be removed from the ROD amendment and instead included in the remedial design.

38. Page 4-9, 2nd paragraph – Why would the ROD Amendment rely on the CSM from the original ROD since this ROD Amendment is required based on the data gaps and the failed treatment system from the original ROD? The original ROD was in error on exactly the issue of estimated mass in place.

Response: As agreed during the comment resolution meeting of May 7, 2013, the text cited in this comment will be removed from the ROD amendment and instead included in the remedial design.

39. Page 4-9, Section 4.2.2, Near-Shore Area Amended Remedy, "The injection of ISCO reagents such as ozone into the aquifer chemically destroys COCs exceeding RGs." – What technical data demonstrates that ozone destroys CoCs to below the ROD Amendment RAOs?

Response: The effectiveness of this technology was discussed during the comment resolution meeting on May 7, 2013. One outcome of that discussion was that it was agreed to leave the cited text in the ROD Amendment, but to delete the phrase "exceeding RGs."

40. Page 4-9, Section 4.2.2, Near-Shore Area Amended Remedy, "Increased dissolved oxygen concentration in the treatment zone will also enhance subsequent biodegradation of COCs in the near-shore area groundwater". – Ozone is an effective biocide. How does injection of ozone enhance biodegradation?

    Response: When it decomposes, ozone provides oxygen to the microbial community, which can aid in bioremediation. However, it is also a sterilizing agent in high concentrations or long residence times, so the ozone must be carefully controlled if bioremediation is to be encouraged (ITRC 2013). When ozone sparging is complete, the subsurface environment is oxygen-rich, encouraging microbial activity.

41. Page 4-9, Groundwater Treatment – Air/ozone sparged into the saturated zone moves upward, why would injection occur at the top of the treatment zone? This section needs to address ROD Amendment requirements, not recommendations.

    Response: Because of the heterogenous nature of the subsurface in the near-shore area, injecting at multiple depths is warranted to help ensure good ozone-COC contact and prevent channeling. In addition, the ozone is injected into the formation with very small bubbles that can travel in multiple directions and travel with the groundwater flow for short distances. The word "recommended" will be changed to "warranted."

42. Page 4-11, 1st paragraph, "The Navy will consider COC concentrations below the RGs in a majority of the performance monitoring wells following 2 years of operation to be one line of evidence of successful treatment. Unfavorable COC concentration trends at some individual wells, or COC concentrations that persist above the groundwater RGs will not automatically be construed by the Navy as a failure of the entire near-shore remedy. Instead, unfavorable results at individual performance monitoring wells will be used by the Navy to optimize the treatment system (e.g. adjustments to the ozone injection schedule, or addition of more ozone injection points in certain areas." – EPA strongly disagrees with these statements. Meeting ROD Amendment RAOs in a "majority" of the wells is not evidence of successful treatment. Based on the location of where the treatment system needs to be placed, both the performance and compliance monitoring wells will be at the immediately downgradient 880 series monitoring wells, which is the POC for groundwater. All POC monitoring wells will need to meet the ROD Amendment RAOs, or the contingency remedy will be triggered. The FFS estimated that groundwater RAOs could be met within one year, therefore if RAOs are not met in one year of system operation, the Navy should optimize the system at that time. If the RAOs in groundwater are not met at the groundwater POC within 2 years, the contingency remedy will be implemented.

Response: The Navy will agree to changing the conditional point of compliance to the 880 series wells (and additional wells to complete this alignment of wells), based on EPA's comment and the discussions during the informal dispute resolution. As discussed in the comment resolution meeting of May 7, 2013, it is common for all treatment systems installed in real-world environments that treatment results are not uniform across the entire treatment zone. The Navy expects the ozone sparging system to be very effective over a short time frame. However, it would not be surprising to see the following hypothetical result:

- Steeply declining COC concentrations in all POC wells shortly after system startup
- Reaching RGs for most COCs at most POC wells after 1 year of operation
- System optimization followed by reaching RGs for more COCs at more POC wells
- At the 2-year mark, one or two wells that show occasional, inconsistent RG exceedances for some COCs during some monitoring events

If the trigger for implementing the contingency remedy after 2 years is too restrictive, this hypothetical scenario could result in abandoning a clearly effective treatment system and triggering the pump-and-treat contingency. To address this issue and as discussed during the comment resolution meeting, the trigger for implementing the contingency remedy will be described under Section 4.2.2 and will be revised to state that the contingency remedy will be triggered if, after 2 years of operation of the near-shore treatment system, the mean benzene concentration in the POC wells at the near-shore treatment zone is not consistently at or below the cleanup level of 5 µg/L, unless otherwise agreed to by the Navy and EPA. To further clarify the trigger criteria, the discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4.2.2 of the ROD amendment and, instead, included in the remedial design.

43. Page 4-11, 2nd bullet – It is unclear how "up time" or volume of ozone delivered is evidence of successful treatment. The demonstrated in-situ destruction of CoCs to below ROD Amendment RAOs and cleanup levels is demonstration of successful treatment.

Response: As agreed during the comment resolution meeting on May 7, 2013, the Navy will retitle this section and revise the criteria in this section to focus on the conditions for triggering the contingency remedy. The discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4.2.2 of the ROD Amendment and instead be included in the remedial design.

44. Page 4-11, Contingency Remedy – This section does not follow EPA guidance for a contingency remedy, see Chapter 8 of the EPA ROD Guidance. This section contains no end-of-two-year criteria set forth. The ROD Amendment should specify under what circumstances the contingency remedy would be implemented, and be as specific as possible with criteria. The process by which a contingency would be invoked should be discussed. Generally an Explanation of Significant Differences (ESD) is required. However if the contingency remedy or the criteria for its selection are not well documented in the ROD Amendment, which is the case here, a 2nd ROD Amendment may be required.

    Response: Please see the response to Policy Comment No. 4 for the changes to be made to clarify what conditions trigger the contingency remedy. In addition to the changes discussed in response to Policy Comment No. 4, the Navy will remove the trigger criteria currently included under the heading "Contingency Remedy" on page 4-11 of the ROD Amendment in favor of a discussion under Section 4.2.2.The description of the contingency remedy meets EPA guidance and is well documented. To emphasize the contingency remedy, the fourth-level heading "*Contingency Remedy*" will be promoted to a third-level heading "4.2.3 Description of Contingency Remedy." If the contingency remedy is triggered, the Navy does not believe that a second ROD Amendment would be required.

45. Page 4-12, 1st and 2nd bullets – See Highlight 8-8 in the EPA ROD Guidance, of particular note is that the contingency remedy should have the same comparative analysis of alternatives as the selected remedy. It is unclear what "significant downward trends in COC concentrations in the near shore performance monitoring well network are not apparent…" means. Comparisons needs to be made based on achieving numerical RAOs. If there are 12 wells total, the "majority" is 7. If 5 wells do not meet groundwater RAOs, then the contingency remedy is not triggered. What is the remediation option based on that data?

    Response: The primary purpose of this document is to amend the original OU 1 ROD with a new, more aggressive remedy. Therefore, the outline for a ROD Amendment (Highlight 7-2 of the EPA ROD Guidance) is more applicable than the highlight regarding establishing a contingency remedy. Focusing the ROD amendment on the contingency remedy would distort the narrative away from the primary purpose of the document. All necessary information to establish the contingency remedy is provided in the ROD Amendment as written.

    The Navy has carefully developed the triggers for the contingency remedy to be quantitative and rigorous, but to allow the project team (including EPA) to critically evaluate the performance monitoring data and reach a consensus as to whether the contingent remedy should be triggered. Please see the response to Policy Comment No. 4, for the changes to be made to clarify what conditions trigger the contingency remedy.

46. Page 4-14, last paragraph – What current site ICs are in place for the Benzene Release Area? How are vapor emissions for the entire groundwater plume, including the Near Shore Area, being assessed? This paragraph does not follow the EPA ICs guidance, see: www.epa.gov/superfund/policy/ic/guidance/index.htm.

    Response: The first sentence of the last paragraph on page 4-14 states the IC that is in place, and the source of that IC. Vapor intrusion will be assessed following collection of predesign data, as agreed upon during the FFS process. ICs based on vapor intrusion risk will be included in a revision of the current site-wide IC plan. Vapor emissions from active treatment systems will be addressed during the remedial design as part of meeting the substantive requirements of the air emissions ARARs. The Navy proposes no change to the ROD Amendment based on this comment.

47. Page 4-15, Section 4.2.4 Compliance Monitoring and Periodic Reviews, 1st and 2nd paragraphs. – The terms "standard" and "conditional" qualifiers on POC should be deleted. No compliance requirement and monitoring in the LNAPL portion of the plume is apparent, Section 4.1.5 states "throughout the site". The entire discussion of POCs in the 2nd paragraph is inconsistent with the OU-1 BRA Draft Final Proposed Plan Dispute Settlement Statement, which lists the downgradient POC as the 880 series monitoring wells, not wells in the intertidal zone. See Policy Comment No. 4.

    Response: The discussion of standard and conditional POCs is consistent with MTCA and will be retained. The first sentence of this section clearly establishes the compliance groundwater samples will be collected from the source area as well as the other areas of the site. The Navy will agree to changing the conditional POC to the 880 series wells (and additional wells to complete this alignment of wells), based on EPA's comment and the discussions during the informal dispute resolution. As discussed during the comment resolution on May 7, 2013, the Navy will revise the discussion of "conditional point of compliance" in Section 4.1.5 to place the first occurrence of this phrase in quotes and add a citation of the WAC definition of this phrase.

48. Page 4-17, 1st paragraph, "target risk goals" – ROD Amendments have RAOs and cleanup levels, not "target risk goals."

    Response: As agreed during the FFS process, predesign data will be used to assess vapor intrusion risks against target risk goals. If unacceptable risks are present, then the amended remedy will be designed to be protective of human health for vapor intrusion. The Navy proposes no change to the ROD Amendment based on this comment.

49. Page 4-22, Table 4-2, MTCA Method B Groundwater (carcinogen) - Benzene is a known carcinogen, there is a state ARAR, but it is not included in the cleanup level. There is also no ARARs waiver. See Policy Comment No. 2.

    Response: Footnote b in this table will be revised to better explain the evaluation described in our response to Policy Comment No. 2.

50. Page 4-22, Table 4-2, footnote b – The explanation for this footnote makes no sense. The MCL is not revised downward to the 0.795 µg/L cleanup level for benzene.

    Response: Footnote b in this table will be revised to better explain the evaluation described in our response to Policy Comment No. 2.

51. Page 4-22, Table 4-2, footnote d – WA Department of Health are the same values as the federal, therefore are not an ARAR.

    Response: To make it clear that these state standards were evaluated, these values will remain in the table. The Navy proposes no change to the ROD Amendment based on this comment.

52. Page 5-1, Section 5.1, 1st paragraph, "Because the original remedy selected in the ROD has already been completed…." – This statement is misleading. The original remedy did not meet the RAOs identified, and included monitoring and ICs that were not completed and are ongoing.

    Response: This text simply explains why the "no action" alternative consists of the current conditions. Under current conditions, some action has been taken. Following the word "completed" in this sentence, the Navy will add "(although it did not meet RAOs)."

53. Page 5-2, 2nd paragraph, "the Navy recommended" – What does "recommend" mean in the CERCLA context? Does it mean that these were the preferred alternatives presented in the Proposed Plan? Pump and treat is also being selected as the contingency remedy so it needs an equivalent analysis in Section 5.2, see Highlight 8-8 in the ROD Guidance.

    Response: The phrase "the Navy recommended" will be changed to "the proposed plan presented as the preferred remedy." The primary purpose of this document is to amend the original OU 1 ROD with a new, more aggressive remedy. Therefore, the outline for a ROD Amendment (Highlight 7-2 of the EPA ROD guidance) is more applicable that the highlight regarding establishing a contingency remedy. Focusing the ROD Amendment on the

contingency remedy would distort the narrative away from the primary purpose of the document. All necessary information to establish the contingency remedy is provided in the ROD Amendment as written. To emphasize the contingency remedy, the fourth-level heading "*Contingency Remedy*" will be promoted to a third-level heading "4.2.3 Description of Contingency Remedy."

54. Page 5-4, Amended Remedy – This section does not mention ARARs compliance for air emissions. See Policy Comment No. 1.

Response: Compliance with this action-specific ARAR will be part of the remedial design, as stated in Section 7.2 and as cited in this text. The Navy proposes no changes to the ROD amendment based on this comment. Please see the response to Policy Comment No. 1.

55. Page 5-5, 1st paragraph – It is not intuitive what part of the remedy would cause incidental oxygenation of the aquifer. The last line on page 4-6 states that "boiling of the aquifer." Warm water holds less oxygen, boiling water contains essentially zero oxygen.

Response: A major element of the ERH technology is dual-phase extraction, which draws air through the soil, thus causing oxygenation. Text to this effect will be added.

56. Page 5-6, 1st partial paragraph – Again, pump and treat is missing from the Nine Criteria analysis.

Response: Again, the Navy believes that adding the contingency remedy to this analysis is unnecessary and would distort the narrative away from the primary purpose of the document.

57. Page 5-7, 1st paragraph, "Ozone injection system pressures and flows will be maintained at low levels to prevent stripping of volatile VOCs from the groundwater into vapor phase. Thus, atmospheric exposure risks to the community will not be associated with the remedy. The need for collection and treatment of soil vapor within the near-shore treatment zone will be further evaluated during remedial design. However, such collection and treatment is not expected to be necessary." – EPA strongly disagrees with these statements. What technical data supports that air/ozone sparging will not result in volatile emissions? The location of the ISCO w/ozone treatment system will need to be directly adjacent to the waterfront Recreation Pathway (see Figure 4-1), therefore there are potential community exposures due to volatile emissions at the Near Shore Area groundwater treatment system. Vapor monitoring, recovery, and treatment of volatile emissions are integral components of air/ozone sparging systems (EPA 2006, Figure 1), and EPA expects that these design components are present in the Remedial Design for the Near Shore Area groundwater treatment area. See Policy Comment No. 1.

Response: Please see our response to Policy Comment No. 1.

58. Page 5-7, 1st paragraph, last sentence – The action-specific and chemical-specific ARARs that would need to be met need to be identified.

Response: Action- and chemical-specific ARARs are presented in Section 7. The Navy proposes no change to the ROD Amendment based on this comment.

59. Page 5-7, Section 5.2.6, Implementability (Balancing) – There is no mention of implementability of the IC component of the amended remedy.

Response: A brief discussion regarding this topic will be added.

60. Page 5-9, Amended Remedy, 1st paragraph – Please tell the reader this information in the beginning of the ROD Amendment.

Response: This statement will be added to Section 1.0.

61. Page 5-9, Amended Remedy, 2nd paragraph – A major issue with this ROD Amendment is the lack of performance criteria that triggers the contingency remedy.

Response: Please see the response to Policy Comment No. 4 for the changes to be made to clarify what conditions trigger the contingency remedy.

62. Page 7-2, Section 7.2.1 Chemical-Specific ARARs, 4 bullets – The CLARC tables and numeric criteria need to be moved to the remedy section and out of the ARARs section. CLARC tables are not the ARAR, but they contain numbers that can be selected as clean up levels in the remedy.

Response: The chemical-specific ARARs for soil and groundwater were discussed in Section 4.1.3, *Chemical-Specific ARARs*, because they were used to establish the RGs, which were described in Section 4.1.4, *Revised RGs*. The MTCA Method B cleanup standards for air were not discussed in Section 4 because no RG for air has been established for the site. As agreed upon during the FFS process, predesign data will be used to assess vapor intrusion risks against target risk goals, which are based on the MTCA Method B cleanup levels identified in Section 7.2.1. Vapor emissions from treatment systems will be addressed during design as part of compliance with air ARARs, as discussed under Section 7.2.3. The Navy proposes no change to the ROD Amendment based on this comment. Text will be added in Section 7 to clarify that the CLARC tables themselves are not the ARAR.

63. Page 7-2, Section 7.2.1, last paragraph – The MTCA Method B benzene cleanup level of 0.32 µg/m^3 applied to the entire groundwater plume including the Near Shore Area.

Response: This is an indoor air ARAR, not applicable to the ambient outdoor air present over nearly all of the groundwater plume. The text will be edited to clarify that 0.32 µg/m^3 is an indoor air ARAR. This value will be part of the vapor intrusion assessment following collection of predesign data, as agreed upon during the FFS process.

64. Pages 7-3 through 7-7, Sections 7.2.2 and 7.2.3 – Many of the ARARs citations include entire chapters of statutes or regulations. Only the substantive requirements for this particular remedy should be identified as ARARs. *See* NCP definitions of "Applicable requirements" and "Relevant and appropriate requirements," both of which only are for substantive requirements. 40 CFR 300.5.

Response: The Navy believes that the ARARs citations are correct as is. 40 CFR 300.5 does not define "substantive" or provide details regarding what fraction of each statute or regulation must be cited in the ARARs section of a ROD or ROD amendment. A reader interested in the original content of the ARAR can find the information from the citations provided. The Navy proposes no change to the ROD Amendment based on this comment.

REFERENCES

U.S. Environmental Protection Agency (U.S. EPA). 1999. *A Guide to Preparing Superfund Proposed Plans, Records of Decisions, and Other Remedy Selection Decision Documents.* EPA 540-R-98-031. July 1999.

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DPRA. 2009. *In Situ Electrical Resistance Heating (ERH) for Treatment of Solvents, Greases, Fuels, Pesticides and Fumigants. Introduction and Conceptual Approach.* September 2009.

ITRC. 2013. www.itrcweb.org/Guidance/GetDocument?documentID=44

RESPONSES TO SUQUAMISH TRIBE COMMENTS ON THE DRAFT RECORD OF DECISION AMENDMENT NO. 1, OPERABLE UNIT 1, NEX GAS STATION LEAK AREA, JACKSON PARK HOUSING COMPLEX/NAVAL HOSPITAL BREMERTON
Document Dated: 1/21/13
Suquamish Tribe Comments Dated: 3/15/13
Responses Dated: 3/27/13

GENERAL COMMENTS

1. The draft ROD amendment does not accurately describe important elements of several ARARs, including the basis for the federal drinking water standards for benzene and the MTCA Method B adjustments for the protection of surface water. The Tribe is reiterating previously submitted comments and requests that the Navy revise this document to fully address this issue.

   Response: Section 4.1.3 will be revised to indicate that MCLs are not always risk-based values, but are values set as close as feasibly possible to the MCLGs, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies. Section 4.1.4 will be revised to more fully explain how MCLs were revised downward to meet the risk criteria of MTCA.

2. The draft ROD amendment should clearly establish how site cleanup levels will comply with ARARs and achieve protectiveness for all significant exposure pathways, including protection of human health and the environment for the groundwater to surface water pathway. During the FFS and development of the proposed plan, the project team discussed the use of drinking water standards, specifically the MCL for benzene, as RGs. This document, however, describes "protective" levels and does not adequately establish the basis for the proposed cleanup levels.

   Response: Section 4.1.4 will be revised to more fully explain the basis for the selected remediation goals. According to MTCA 173-240-720(7)(b), where cleanup levels are based on an applicable state or federal law and the level of risk upon which the standard is based exceeds an excess cancer risk of one in one hundred thousand (1×10^{-5}) or a hazard index of 1, the cleanup level must be adjusted downward so that the total excess cancer risk does not exceed one in one hundred thousand (1×10^{-5}) and the hazard index does not exceed 1 at the site. For benzene, the MCL of 5 µg/L was determined to be protective of both a cancer risk of 1×10^{-5} and a hazard quotient of 1. Likewise, for ethylbenzene, the MCL of 700 µg/L was determined to be protective of a hazard quotient of 1. Therefore, no adjustment to the benzene or ethylbenzene MCLs was necessary to comply with state and federal requirements. As a result of this

conclusion, the MCLs for benzene and ethylbenzene of 5 and 700 µg/L, respectively, were selected as the remediation goals for protection of groundwater for beneficial uses. However, for the xylene compounds, the MCL of 10,000 µg/L was found to exceed the MTCA Method B cleanup level based on a hazard index of 1 and thus required downward adjustment to comply with state and federal requirements. The MTCA Method B cleanup level of 1,600 µg/L was selected as the remediation goal for the xylene compounds for protection of groundwater for beneficial uses.

3. The draft ROD amendment specifies performance and compliance monitoring strategies which have not been vetted to the project team. The Tribe suggests that these sections be removed and that monitoring strategies be developed with input from the project team during the remedial design.

   Response: As discussed during the comment resolution meeting on May 7, 2013, the discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4 of the ROD Amendment and instead included in the remedial design.

SPECIFIC COMMENTS

1. Sections 3.4.2 and 4.1.4, Ecological Risks: Although the OU 2 ecological risk assessment did not conclude that there are significant ecological risks associated with Ostrich Bay sediments, it was not designed to fully evaluate or characterize the potential impacts of the discharge of contaminated groundwater from the NEX gas station area to Ostrich Bay. The FFS referenced the OU 2 ecological risk assessment; a specific evaluation was not done for the NEX gas station. The discussion does not establish how or if drinking water standards for human health will also be protective of ecological receptors.

   Revise the discussions regarding ecological risks to reflect the limitations and uncertainties of the NEX gas station evaluation and to clarify that it is assumed, but not known, if drinking water standards for human health will also be protective of ecological receptors.

   Response: The text of Section 3.4.2 will be edited to clarify that the ecological risk assessment addressed ecological risks to Ostrich Bay as a whole, but did not generate data considered representative of human health or ecological exposure in the small intertidal area within the NEX Gas Station Leak Area. The EPA, Suquamish Tribe, and Navy concurred during the FFS and proposed plan stage that sediment and marine tissue data for benzene and the other petroleum COCs were not necessary for selecting a remedy at this site. As

documented in the informal dispute resolution, exceedance of the MCLs is sufficient documentation of unacceptable risk warranting additional action.

The last sentence of this section, on page 4-5, will be revised to read, "While minimal ecological risk may be present, drinking water standards for human health (revised downward where necessary) are assumed by the Navy, EPA, and Suquamish Tribe to also be protective of ecological receptors."

2. Section 4.1.3, ARARs for Groundwater Used for Drinking Water: State and Federal laws do not provide standards that are sufficiently protective for human health for substances such as benzene. The MCL for benzene is a water treatment technology-based consideration, rather than a risk-based threshold. The MCLG for benzene is a risk-based threshold and is more appropriate for comparison with MTCA Method B calculated values.

   Revise the ARAR discussion to include MTCA Method B calculated values as ARARS for groundwater used as drinking water, where Method B values are more stringent than state or federal drinking water standards. Because benzene is a key risk driver at the site, discuss the basis of the MCL and MCLG for benzene.

   Response: Please see our response to General Comment No. 2. While the basis for the MCL for benzene might not be risk-based, the MCL of 5 µg/L corresponds to a cancer risk of less than 1×10^{-5} and a hazard index of 1. Therefore, the MCL complies with state and federal requirements, as per MTCA 173-240-720(7)(b). Section 4.1.4 will be revised as described in response to General Comment No. 2. Section 4.1.3 will be revised to indicate that MCLs are not always risk-based values, but are values set as close as feasibly possible to the MCLGs, considering cost, benefits and the ability of public water systems to detect and remove contaminants using suitable treatment technologies.

3. Section 4.1.3, ARARs for Groundwater Protective of Marine Surface Water: Current surface water quality standards reflect fish consumption rates that are no longer considered adequately protective of the general population of Washington State, let alone subsistence or tribal consumers. MTCA provides for beneficial unrestricted use of surface water resources and provides a default fish consumption rate of 54 g/day, based on a recreational angler exposure scenario developed by Ecology in the 1980s. The Washington water quality standards for surface water are based on an even lower fish consumption rate of 17.5 g/day, which is the default value in the National Toxics Rule. As acknowledged by both EPA and Ecology, current standards are not protective of consumers, such as tribal members, who eat fish and shellfish at rates above the regulatory default values.

Revise the discussion of MTCA to include the potential effects of adjusting fish consumption rates for tribal and subsistence consumers. While the cited regulations are ARARs, they cannot be construed to be protective for human health for subsistence and tribal harvesters.

Response: The Navy understands that currently promulgated surface water cleanup levels may not be protective of tribal fish consumption rates, but believes that it is premature to discuss potential changes in fish ingestion rates that are still being developed. This section of the ROD Amendment properly describes the ARARs as they are currently promulgated. The 5-year review process requires a reassessment of the ARARs used in decision making to assess the continued protectiveness of the RAOs and RGs memorialized in the ROD amendment. Any newly promulgated fish ingestion rates can be assessed through that process. Regardless of the ingestion rates used, volatile contaminants are not retained in fish tissue and are very unlikely to present an unacceptable human health risk at JPHC through the fish ingestion pathway.

4. Section 4.1.4 and Table 4-2, Revised Remediation Goals: MTCA Method B is used to establish risk-based cleanup levels. While the groundwater as drinking water cleanup levels for toluene and xylenes have been revised downward to the Method B levels, the cleanup levels for benzene and ethylbenzene are based on the federal MCLs. For benzene, in particular, the MCL is not a risk-based threshold.

   Revise the discussion and the table to establish the basis for using federal MCLs as cleanup levels, rather than MTCA Method B levels, if the federal MCLs do not represent risk-based, health-*protective levels.*

   Response: Section 4.1.4 will be revised as described in response to General Comment No. 2.

5. Section 4.1.4 and Table 4-3, Revised Remediation Goals: MTCA Method B allows for the downward revision of cleanup levels for sites that impact surface water within tribal fishing areas by adjusting default exposure parameters, including the fish consumption rate. The discussion and table do not present revised cleanup levels that can be considered protective of human health.

   Review the discussion and the table to present adjusted MTCA Method B cleanup levels that can be considered protective of human health for groundwater to surface water pathways. Establish what cleanup goals will be used at the site and supporting rationale.

Response: The MCL of 5 µg/L meets the risk standards established by MTCA. When revised fish consumption rates are promulgated in the future, the protectiveness of the MCL will be reassessed through the 5-year review process.

6. Section 4.1.5, Point of Compliance: MTCA allows conditional points of compliance for properties abutting surface water, but establishes a list of specific conditions that must be met, as well as providing for a formal notification and approval process that includes the natural resource trustees, the WA DNR and the US COE. It cannot be assumed that a conditional point (or points) of compliance will be used to monitor the near-shore remedial actions.

   Revise the discussion to include the conditions under MTCA for establishing a conditional point of compliance where groundwater discharges to surface water. Indicate that monitoring points for the near-shore remedy will comply with MTCA and will be determined by the project team.

   Response: The substantive requirements for establishing a conditional point of compliance under MTCA have been met through the FFS, proposed plan, and ROD Amendment process. These processes are formal and public and allow for input from all interested parties, including public agencies. The Navy believes that reiterating the specific elements of a conditional point of compliance from MTCA would not add clarity to the ROD Amendment. The use of a conditional point of compliance at the shoreline is a common approach for sites like JPHC. The purpose is to focus part of the remedial strategy on preventing contaminant discharge to surface water as soon as possible, while allowing a realistic time frame for cleanup of the entire site-wide contaminant plume in groundwater.

   In response to comments from EPA, the Navy has agreed to change the conditional point of compliance to the 880 series wells. We hope that this change will also satisfy any concerns that the Tribe has regarding the conditional point of compliance.

7. Section 4.2.1, Source Area Soil and Groundwater Treatment: During remediation of the source area, it is assumed that treated groundwater will be discharged to Ostrich Bay. Any discharge to Ostrich Bay must not degrade surface water quality or habitats.

   Include a discussion of provisions for evaluating process water disposal options, as well as impacts to Ostrich Bay if discharged to surface water. This may be incorporated in Section 4.2.5, Predesign Data Collection and Resolution of Data Gaps.

Response: The requirements for this discharge will be established as part of the Remedial design in compliance with the action-specific ARARs cited in Section 7.2.3. The Navy proposes no change to the ROD Amendment based on this comment.

8. Section 4.2.1, Source Area Performance Monitoring: The document describes performance monitoring to validate the effectiveness of the source area treatment and to document changes in COC concentrations throughout the source area. It is further stated that performance monitoring is specifically meant to evaluate the operational effectiveness of a treatment process. The monitoring and decision strategy outlined in this section has not been agreed to by the project team, and the Tribe does not support its inclusion in the ROD amendment.

   As an example, this section specifies that if significant rebound is observed, then the functionality of the remedy would come into question during the next 5-year review and the Navy would explore additional measures. There is no definition of what would constitute significant rebound; and the Tribe does not believe a decision regarding additional measures should necessarily be delayed to coincide with the 5-year review cycle.

   Indicate that monitoring will be performed, but remove the specific measures and objectives from the discussion. Monitoring and decision strategies will be determined with input from the project team.

   Response: As discussed during the comment resolution meeting on May 7, 2013, the discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4 of the ROD Amendment and instead included in the remedial design.

9. Sections 4.2.2 , Near-Shore Performance Monitoring and the Contingency Remedy: Similar to the preceding comment, this section describes a performance monitoring strategy for the near-shore remedy, and triggers for the contingency remedy, that has not be agreed to by the project team. The Tribe does not agree with its inclusion in the ROD amendment.

   Indicate that monitoring will be performed, but remove the specific measure and objectives from the discussion. Monitoring and decision strategies will be determined with input from the project team.

   Response: As discussed during the comment resolution meeting on May 7, 2013, the discussion of performance monitoring data other than COC concentrations (such as system operational data) will be removed from Section 4 of the ROD Amendment and instead included in the remedial design.

Navy Responses to EPA Comments on the Jackson Park OU-1 Rod Amendment, Redline Text Dated 6/11/13

Responses dated August 1, 2013

MAJOR COMMENTS

1. In regards to implementation of the contingent remedy, EPA needs a timeframe inserted for either delivery of a revised RD/RA document with an implementation schedule or a timeframe to have the pump and treat remedy implemented.

   Response: As written, the language regarding the schedule for design of the contingent pump and treat remedy matches the language agreed to in the dispute resolution, "…the Navy shall issue a request for proposal for design of a Pump and Treat remedy." Beyond this agreement, the following will be added to Section 4.2.3 of the ROD Amendment, "the Navy will document via a Memorandum to the Administrative Record that the contingent Pump and Treat remedy has been triggered. Construction of the contingent Pump and Treat remedy will initiate within 15 months as required by statute."

2. The ROD Amendment needs to include the rationale for why a contingency remedy is included. Based on EPA's analysis, the primary reason for why a contingency remedy is necessary is because a treatability study for the principal remedy, in-situ chemical oxidation (ISCO) using ozone, was not tested during the Focused Feasibility Study (FFS) phase to demonstrate that ISCO with ozone technology is capable of achieving the ROD Amendment Remedial Action Objectives (RAO) for benzene in groundwater under the site specific conditions.

   Response: The Navy has agreed to include the contingent pump and treat remedy and does not believe it is necessary to include additional rationale. This issue was discussed at length during the comment resolution meeting and changes were deemed unnecessary.

3. The vapor phase risk screening criteria needs to be based on residential exposure scenario, since it is the current and reasonable anticipated future land use (RAFLU) for the site, particularly under the Public Private Venture (PPV). The vapor risk screening levels need to be changed to a residential exposure scenario based on EPA risk assessment exposure parameters.

   Response: This comment will be addressed in two parts. Part (a) addresses the vapor discharge from the near shore treatment system. Part (b) addresses possible vapor intrusion into residences.

(a) The recreational scenario is most appropriate at the near shore treatment area because the current land use is recreational. The NEX Gas Station Leak Area is not part of the transfer to the PPV, therefore the RAFLU remains recreational. The existing Land Use Control (LUC) Management Plan remains in effect as part of the selected remedy. Should the land use change from recreational to residential use, the Navy will reevaluate the vapor phase screening criteria based on a residential exposure scenario and make appropriate modifications for vapor collection and treatment, if necessary, to meet the revised exposure limits.

(b) In regards to the vapor intrusion risk discussed in Section 3.4.1, page 4-16 in the redline version of the ROD Amendment (and reiterated on page 5-8 and 7-1) states that additional institutional controls requiring an assessment of vapor intrusion risks for any new building constructed above the COC plume will be implemented until the cleanup levels for groundwater are met across the site. Because of this remedy component, the Navy continues to believe that the correct exposure scenario is a recreational exposure. The land use will be limited to its current recreational use by the Land Use Controls Management Plan.

SPECIFIC COMMENTS

1. Page 1-1 last paragraph - Drop that sentence that EPA concurs. EPA approves, the State concurs.

   Response: The last sentence of the paragraph will be modified to, "EPA and the Navy jointly select the remedy for the site."

2. Page 4-6 section 4.1.5 -Remove the word proposed.

   Response: The word "proposed" will be removed as requested.

3. Page 6-1, Title – EPA is not the support agency. Suggest either dropping this section or restate that Ecology is no longer active on the project.

   Response: This section will be removed.

4. Page 3-4, 3rd bullet, Baseline Groundwater Sampling, "The data collected as part of the baseline sampling at wells sampled prior to 2010 were generally comparable to concentrations of BTEX and TPH-G seen historically, with the exception of location MW-889, where concentrations were significantly lower in 2010 compared to 2006." - This

conclusion is incorrect for downgradient well MW-4, which has significantly increased since 2000.

Response: This statement was excerpted from the final FFS approved by EPA. As described in Section 2.3.2 of the final FFS, well MW- 4 was re-installed in 2001. The replacement well was installed with a slightly deeper screened interval than the original MW-4. This deeper screened interval revealed much higher concentrations of benzene, and this result was a key piece of information that lead to the recharacterization of the site and revision of the conceptual site model. The relatively low benzene value from MW- 4 in 1999 is not directly comparable to the consistently much higher benzene concentrations measured at this location during the 13 monitoring events between August 2001 and February 2010. The 2010 benzene concentrations at MW-4 are slightly lower than, but consistent with, the 2001 benzene concentrations.

5. Page 3-12, Section 3.4.2, Ecological Risk Assessment, "The data set used in the BERA consisted of data on sediment (52 samples from 43 locations) and aquatic biota chemical concentrations collected in 2009 from OU 2 (six composite samples from each: bent-nose clam, graceful crab whole body, graceful crab hepatopancreas, sea cucumber, and starry flounder whole body), sediment toxicity testing for benthic organisms (26 samples during Phase 1 and 9 samples during Phase 2), and risk calculations for aquatic and aquatic-dependent wildlife. *None of the COPCs identified at the NEX Gas Station Leak Area (i.e., TPH-G, BTEX, and MTBE) was detected above conservative ecological screening levels in any of the media evaluated for the ecological risk assessment. Therefore, no chemical from the NEX Gas Station Leak Area is contributing to an ecological hazard in OU 2*." – This statement is very misleading, how many of the 52 sediment samples and 30 tissue samples in OU-2 were analyzed for TPH-G, BTEX, and MTBE? If TPH-G, BTEX, and MTBE were analyzed for as part the OU-2 Supplemental RI, then the sampling locations and results should be discussed. If however, TPH-G, BTEX, and MTBE were not analyzed for in sediment or tissue samples as part of the OU-2 Supplemental RI, this section shall not imply or state that these CoCs were "not detected" if in fact they were not analyzed for as part of that investigation. The primary CoCs for the OU-2 Supplemental RI were munitions compounds and metals, not TPH-G, BTEX and MTBE.

Response: The cited statement is paraphrased from the final FFS approved by EPA. BTEX was analyzed in all of the sediment samples, and TPH-G was analyzed in the two sediment samples closest to the Benzene Release Area. No tissue samples were analyzed for TPH-G, BTEX or MTBE, because VOCs do not bioaccumulate. This information will be added to the ROD amendment, and the quoted text will be revised to read, "*Of the COPCs identified at the NEX Gas Station Leak Area that were analyzed in sediment (e.g., TPH-G, BTEX, and MTBE) none were detected above conservative ecological screening levels. Therefore, it is*

unlikely that COCs from the NEX Gas Station Leak Area are contributing to an ecological hazard in OU 2."

6. Page 4-11, 2nd full paragraph, "The concentrations of BTEX and TPH-G measured in the outdoor ambient air samples will be compared to risk-based screening concentrations (RBCs) calculated to be protective of recreational exposures to outdoor air. Table 4-4 presents the equations used to calculate the RBCs and the resulting RBCs. These RBCs are calculated to be protective of a recreational visitor frequenting the shoreline area for 2 hours twice per week for 50 weeks per year. This assumption likely overestimates the frequency of exposure a recreational visitor would experience on the shoreline area, because it is unlikely that any appreciable time would be spent at the shoreline area during the colder, inclement months of the year. Therefore, these RBCs are considered sufficiently conservative for use as benchmarks to evaluate potential exposure to COCs that might be emitted to outdoor air at the shoreline area through the operation of the sparging system." The risk based screening concentration for vapor exposure needs to be based on a residential scenario, see General Comment No. 3.

   Response: Please see our response to Major Comment 3(a).

7. Page 4-12, 2nd paragraph, "Performance monitoring will include collection of groundwater samples from 12 locations (unless otherwise agreed to by the Navy and EPA), including existing wells MW-880 through MW-883 and the eight new wells (Figure 4-1), at least quarterly during the first 2 years of ozone injection. The contingency remedy (described in Section 4.2.3) will be triggered if after 2 years of operation of the near-shore treatment system, the mean benzene concentration in these 12 wells is not consistently at or below the cleanup level of 5 µg/L,unless otherwise agreed to by the Navy and EPA. If the contingency remedy is triggered, the Navy shall issue a request for proposal for design of a pump and treat remedy as described in Section 4.2.3." A specific time frame for contingency remedy implementation is needed, see General Comment No. 1.

   Response: Please see our response to Major Comment 1.

8. Page 4-14, 3rd paragraph , "Extracted groundwater would be routed to a treatment building for processing. Tray-style air strippers would be used to strip COCs from groundwater, because they are effective at removing TPH-G and benzene." This section needs to address air emissions from air strippers.

   Response: A sentence will be added to state, "The Navy will evaluate the need for treatment of air emissions at the design of the contingent pump and treat system in accordance with the PSCAA ARAR."

9. Page 4-19, 2nd paragraph, "An ecological risk was not identified for the NEX Gas Station Leak Area COCs in the OU 2 BERA and supplemental RIs." See Specific Comment No. 5.

   Response: Please see our response to Specific Comment 5.

10. Table 4-4 – See General Comment No. 3. It is unclear why breathing rates are presented. The toxicity criteria for inhalation exposures are presented in terms of an acceptable, continuous air concentration (or the inverse of one for cancer, not the inhalation reference dose and cancer slope factor presented). Additionally, the recommended averaging time of a 75 year lifespan give erroneous results. Cancer slope and unit risk factors (for inhalation exposures) are calculated based on the assumption of a 70 year lifespan. While we acknowledge that the actuarial tables indicate that on average people live longer nowadays, the cancer toxicity criteria haven't been adjusted to account for this fact. Thus, using them when averaging risk over a longer time span than 70 years is technically incorrect and will under-predict actual risks over that longer lifetime.

    Response: Please see our response to General Comment 3(a). As shown in Table 4-4, the calculations are based on MTCA (the state ARAR for the site), which is different from EPA's assumptions and process. The Navy proposes no change to the ROD amendment based on this comment.