Final

June 19, 2015

Fourth Five-Year Review

Naval Magazine Indian Island

Port Hadlock, Washington

Department of the Navy
Naval Facilities Engineering Command Northwest
1101 Tautog Circle
Silverdale, WA 98315

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EXECUTIVE SUMMARY

The U.S. Navy (Navy), the lead agency for Naval Magazine (NAVMAG) Indian Island, has prepared this five-year review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] Part 300). The purpose of this five-year review is to ensure that the remedial actions selected in the Record of Decision (ROD) issued in September 1995 for NAVMAG Indian Island remain protective of human health and the environment. A five-year review is required for this site because the remedies allow contaminants to remain in place at concentrations that do not allow unlimited site use and unrestricted exposure. This fourth five-year review was conducted in accordance with *Navy/Marine Corps Policy for Conducting Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Statutory Five-Year Reviews* (U.S. Navy, 2011a) and the U.S. Environmental Protection Agency's *Comprehensive Five-Year Review Guidance* (Environmental Protection Agency [EPA], 2001), as supplemented by a 2011 Memorandum *Clarifying the Use of Protectiveness Determinations for Comprehensive Environmental Response, Compensation, and Liability Act Five-Year Reviews* (EPA, 2012). This five-year review also provides information to the Washington State Department of Ecology for its periodic review pursuant to the Washington Administrative Code (WAC 173-340-420).

The remedies at the sites included in the ROD for NAVMAG Indian Island, as well as other Indian Island sites addressed under other programs (e.g., Resource Conservation and Recovery Act [RCRA] and the Model Toxics Control Act [MTCA]) herein referred to as post-ROD sites, have been implemented and are currently protective of human health and the environment, given the current land use. Ongoing monitoring and maintenance of Site 10 will continue to be required in the long term. Maintenance of institutional controls (ICs) at Site 10 is also required to ensure protectiveness of the remedy. Residual risks at Site 36 and the Hazardous Waste Storage Area (HWSA) are low, such that ICs are no longer required for these sites to be considered protective.

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FIVE-YEAR REVIEW SUMMARY FORM

SITE IDENTIFICATION		
Site Name: Port Hadlock Detachment		
EPA ID: WA4170090001		
Region: 10	**State:** WA	**City/County:** Indian Island/Jefferson County

SITE STATUS	
NPL Status: Deleted	
Multiple OUs? No	**Has the site achieved construction completion?** Yes

REVIEW STATUS
Lead agency: Other Federal Agency **If "Other Federal Agency" was selected above, enter Agency name:** U.S. Navy
Author name (Federal or State Project Manager): Carlotta Cellucci, R.G.
Author affiliation: Naval Facility Engineering Command Northwest, U.S. Navy
Review period: July 2009 – July 2014
Date of site inspection: January 15, 2015
Type of review: Statutory
Review number: 4
Triggering action date: July 20, 2010
Due date *(five years after triggering action date)*: July 20, 2015

FIVE-YEAR REVIEW SUMMARY FORM (CONTINUED)

Issues/Recommendations

Issues and Recommendations Identified in the Five-Year Review:

Site 10	**Issue Category: Operations and Maintenance**			
	Issue: The O&M Plan prescribes annual profiling across Transects 8 through 11, and every five years across all transects to support the five-year review process. Multiple rounds of shoreline improvements were conducted since the last five-year review, which altered the beach contours. Surveying was not conducted in accordance with the O&M Plan because results for Transects 8 through 11 would not have provided comparable data. As a result, only one quantitative beach profile was performed at Site 10 (in 2012) over the last five year period.			
	Recommendation: Perform quantitative beach profiling as outlined in the O&M Plan until the transitional area of high-to-low energy beach has stabilized. Following stabilization concurrence from stakeholders, the O&M Plan should be revised to document any changes to the profiling program. In the event that shoreline improvements are made in a given year, the survey transect for the corresponding year should be conducted after the improvements are completed to serve as new baseline for future comparison.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	U.S. Navy	EPA/State	June 31, 2016
Site 10	**Issue Category: Monitoring**			
	Issue: The approved groundwater monitoring regime has been limited to water quality parameters since 2002. However, this may not adequately identify critical changes indicating contaminant migration.			
	Recommendation: Reevaluate the groundwater monitoring program to determine if the use of water quality parameters alone is sufficient to monitor the protectiveness of the remedy.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	Yes	U.S. Navy	EPA/State	June 31, 2016
Site 10	**Issue Category: Site Access/Security**			
	Issue: The 2012 O&M Plan contains conflicting information regarding shellfish harvest restrictions associated with Site 10.			
	Recommendation: The O&M Plan should clarify that based on the results of shellfish tissue sampling, the related remedial action objective was achieved and the harvesting ban was lifted prior to the second five-year review. While the beaches surrounding the site remain within the explosive arc as mandated by NAVSEA OP-5 Volume 1(U.S. Navy, 2010a), this restriction is incidental and not related to the protectiveness of shellfish consumption.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	U.S. Navy	EPA/State	December 31, 2015

FIVE-YEAR REVIEW SUMMARY FORM (CONTINUED)

Site 36 and the HWSA	**Issue Category: Institutional Controls**			
	Issue: The third five-year review recommended ICs be placed on Site 36 and the HWSA based on residual cPAHs detected in soil.			
	Recommendation: Residual risks at Site 36 and the HWSA are low (between 1×10^{-5} and 1×10^{-6}) and the ICs should be removed.			
Affect Current Protectiveness	**Affect Future Protectiveness**	**Implementing Party**	**Oversight Party**	**Milestone Date**
No	No	U.S. Navy	EPA/State	December 31, 2015

Protectiveness Statement(s)
The remedies at the sites included in the ROD for NAVMAG Indian Island, as well as other Indian Island sites addressed under other cleanup programs (e.g., RCRA and the MTCA) referred to as post-ROD sites, have been implemented and are currently protective of human health and the environment, given the current land use. Ongoing monitoring and maintenance of Site 10 will continue to be required in the long term. Maintenance of ICs at Site 10 is also required to ensure protectiveness of the remedy. Residual risks at Site 36 and the HWSA are low, such that ICs are no longer required for these sites to be considered protective.

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SIGNATURE PAGE

Signature sheet for the Naval Magazine Indian Island fourth five-year review report.

N.A. Vande Griend, CDR USN
Commanding Officer
Naval Magazine Indian Island

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ACRONYMS AND ABBREVIATIONS

ARAR	applicable or relevant and appropriate requirement
BHC	alpha-benzene hexachloride
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
COC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CSR	current situation report
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESD	Explanation of Significant Difference
FS	feasibility study
HWSA	Hazardous Waste Storage Area
IAS	initial assessment study
IC	institutional control
ICMP	Institutional Controls Management Plan
LUC	land use control
MTCA	Model Toxics Control Act
NAD	Naval Ammunition Depot
NAVFAC NW	Naval Facilities Engineering Command Northwest
NAVMAG	Naval Magazine
Navy	U.S. Navy
NBK	Naval Base Kitsap
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NFA	no further action
NPL	National Priorities List
O&M	operation and maintenance
OM&M	operation, maintenance, and monitoring
OU	operable unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PID	photoionization detector
PVC	polyvinyl chloride
RAB	Restoration Advisory Board
RAO	remedial action objective

RCRA	Resource Conservation and Recovery Act
RDX	research demolition explosive
RI	remedial investigation
ROD	Record of Decision
SVOC	semivolatile organic compound
TPH	total petroleum hydrocarbon
TRC	Technical Review Committee
U&A	usual and accustomed
UST	underground storage tank
WAC	Washington Administrative Code

Section 1.0: INTRODUCTION

This report presents the results of the fourth five-year review performed for the Naval Magazine (NAVMAG) Indian Island. The purpose of five-year reviews is to determine whether the remedies selected in the Record of Decision (ROD) for implementation at a site are protective of human health and the environment. The methods, findings, and conclusions of five-year reviews are documented in five-year review reports which identify any issues found during the review and provide recommendations to address them.

The U.S. Navy (Navy), the lead agency for NAVMAG Indian Island, has prepared this five-year review report pursuant to Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Section 121 and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP; 40 Code of Federal Regulations [CFR] Part 300). CERCLA Section 121 states the following:

> If the President selects a remedial action that results in any hazardous substances, pollutants, or contaminants remaining at the site, the President shall review such remedial action no less often than each five years after the initiation of such remedial action to assure that human health and the environment are being protected by the remedial action being implemented. In addition, if upon such review it is the judgment of the President that action is appropriate at such site in accordance with section [104] or [106], the President shall take or require such action. The President shall report to the Congress a list of facilities for which such review is required, the results of all such reviews, and any actions taken as a result of such reviews.

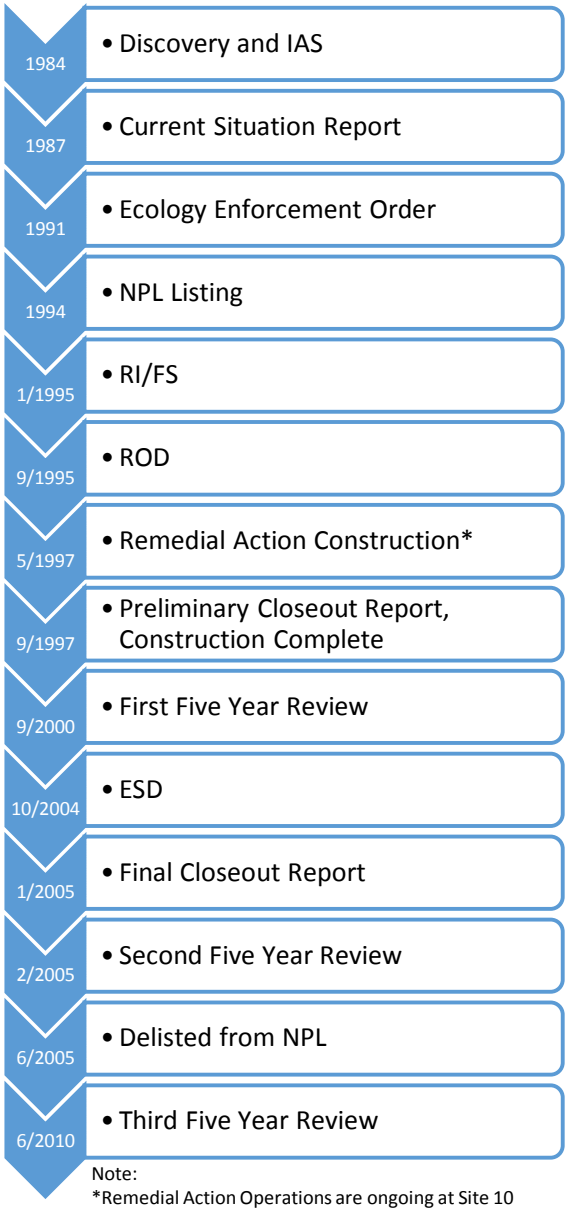
This five-year review has been prepared to also provide information to the Washington State Department of Ecology (Ecology) for its periodic review as required under the Model Toxics Control Act (MTCA) pursuant to Washington Administrative Code (WAC) Chapter 173-340-420. The information necessary for Ecology to perform the periodic review of CERCLA sites listed in the ROD, Site 10, and sites addressed under other programs (e.g., Resource Conservation and Recovery Act [RCRA] and the MTCA) after the ROD was signed, Site 36 and the Hazardous Waste Storage Area (HWSA), is provided in Appendix A.

Naval Facilities Engineering Command Northwest (NAVFAC NW) has conducted this five-year review of the remedial actions implemented at NAVMAG Indian Island (Figure 1-1). This review was conducted in January 2015 and included evaluation of data spanning the period from July 2009 through July 2014. This report documents the results of this review.

Figure 1-1. Map of NAVMAG Indian Island Showing the Locations and Status of Environmental Sites

Section 2.0: SITE CHRONOLOGY

This section provides a chronology of key environmental activities at NAVMAG Indian Island related to site discovery, investigation, and remediation.



The Navy purchased Indian Island in 1939 to store explosives, seaplanes, and antisubmarine cable nets. Prior to the establishment of environmental regulations, some wastes were disposed of on the island using practices that were considered acceptable at that time. Some of these practices are now known to be potentially detrimental to human health and the environment. In 1984, the Navy conducted an initial assessment study (IAS) to investigate the possibility of contamination at sites on Indian Island (U.S. Navy, 1984).

Thirteen sites (Sites 10 through 22; Figure 2-1) were identified at Indian Island in the IAS, which also addressed Naval Base Kitsap (NBK) Keyport (known at the time as Naval Undersea Warfare Engineering Station). Sites 1 through 9 and 23 through 32 are located at NBK Keyport and are thus not addressed in this document. The current situation report (CSR) included the results of additional investigation at Sites 10 and 21 (U.S. Navy, 1987). The CSR recommended additional investigation of Sites 10 and 21; planning for a remedial investigation and feasibility study (RI/FS) started in 1989. In 1991, Ecology issued the Navy Enforcement Order Number 91-153 under Washington State's MTCA (U.S. Navy, 1991).

Indian Island was included on the National Priorities List (NPL) in 1994. The final RI/FS report was completed in January 1995 (U.S. Navy, 1995). The Proposed Plan presenting the Navy's preferred remedial alternative was distributed for public comment in March 1995. The final ROD was issued in September 1995 and was signed by representatives of the U.S. Navy, EPA, and Ecology (U.S. Navy et al., 1995). The ROD specified remedial actions for Site 10 (Northend Landfill) and Site 21 (Building 86 Fill). Seven sites (Sites 11, 12, 15, 18, 19, 20, and 22) were declared in the ROD to merit NFA (assuming unrestricted site use). Sites 13, 14, 16, and 17 were determined to require no additional actions prior to the ROD and were not included in the ROD. Based on the final ROD, remedial action was implemented for Sites 10 and 21. The remedy for Site 10 is currently in place and will continue to be maintained in the future. The remedy for Site 21 was implemented from 1995 to 1997 and was approved for NFA by Ecology in November 2000. Site 10 is currently the only ROD-listed site with a remedy in place.

An Interagency Agreement specifying the roles and responsibilities of the signatories during the CERCLA action was signed by the U.S. Navy, EPA and Ecology in July 1996 (U.S. Navy et al., 1996). On September 26, 1997, the Navy issued the preliminary closeout report signifying construction completion (U.S. Navy, 1997a). The preliminary closeout report included the remedial action report, final inspection report, and operation and maintenance (O&M) manual as appendices. The final closeout report (U.S. Navy, 2005b) provided a consolidated summary of remedial activities completed for Site 10, as well as results of compliance monitoring completed at Sites 11, 12, 18, and 21 (as required by the ROD) and removal activities completed at sites identified after the ROD. The ROD has been amended by one Explanation of Significant Difference (ESD), which was completed in October 2004 (U.S. Navy et al., 2004). The ESD clarifies both the site-specific institutional control (IC) requirements and establishes procedures the Navy will follow to implement, maintain, and monitor these site-specific requirements. NAVMAG Indian Island was removed from the NPL (i.e., "delisted") on June 14, 2005.

Six additional sites were identified and addressed subsequent to the ROD (Sites 33, 34, 35, 36, EO101, and the HWSA). These sites were addressed under other programs (e.g., Resource Conservation and Recovery Act [RCRA] and the MTCA) after the ROD was signed and are herein referred to as post-ROD sites. Based on the post-ROD activities performed, all six sites were approved for NFA. However, during the third five-year review, Site 36 and the HWSA were recommended to have ICs in the form of land use controls (LUCs) established due to potential risk from residual soil contamination. ICs are currently in place at Site 36 and the HWSA to prevent residential and agricultural use.

This fourth five-year review addresses these three sites for which a remedy and/or ICs are currently in place (refer to Figure 2-1). Table 2-1 provides a summary of the three sites at NAVMAG Indian Island that currently have a remedy in place; Table 2-2 provides a summary of the 16 sites at NAVMAG Indian Island that have received regulatory approval for NFA. All 19 sites at Indian Island are located in controlled areas that are primarily used for military munitions storage and handling with occasional outdoor recreational use by station employees and their families.

Table 2-1. Summary of Sites with a Remedy in Place

Site No.	Site Name	Description	Remediation Activities	Current Status
Ongoing Maintenance and Monitoring with Land Use Controls				
10	Northend Landfill (ROD Site)	Landfill for residential and industrial wastes, 1940s to 1970s.	Removal of eroded landfill debris, landfill capping; landfill and shoreline erosion protection measures; ICs; periodic groundwater, sediment, and shellfish monitoring; regular landfill cap and the erosion protection maintenance and inspection and periodic reviews. Monitoring and maintenance activities have been ongoing since June 1997.	Remediation is complete (landfill cap, shoreline protection, and ICs restricting residential/farming land uses, water supply wells, and activities destructive to the cap or shoreline protection system). Monitoring and maintenance are ongoing.

Table 2-1. Summary of Sites with a Remedy in Place (Continued)

Site No.	Site Name	Description	Remediation Activities	Current Status
Institutional Controls				
36	New Boneyard (Post-ROD Site)	Since 1976, area used for dry storage of timbers, empty drums and tanks, transformers, large buoys, scrap wood, demolition debris, and miscellaneous equipment.	Removal of total petroleum hydrocarbon (TPH)- and polycyclic aromatic hydrocarbon (PAH)-contaminated soils completed in 2001 achieved cleanup criteria for unrestricted use. Site 36 initially received an NFA determination from Ecology in 2001.	Site 36 remained closed from 2001 to 2010. However, the third five-year review recommended restricting residential/farming land uses and installation of water supply wells due to residual carcinogenic PAH (cPAH) concentrations that exceeded the MTCA Method A cleanup level of 0.1 mg/kg for unrestricted land use.
HWSA	Hazardous Waste Storage Area (Post-ROD Site)	Between 1985 and 1997, used as less than 90-day storage facility for liquids and solids designated as dangerous and nondangerous wastes.	RCRA closure in 1998, including clean out of the secondary containment basin. Ecology concurred with RCRA closure in 1998.	The HWSA remained closed from 1998 to 2010. However, the third five-year review recommended restricting residential/farming land uses and installation of water supply wells due to residual cPAH concentrations that exceeded the MTCA Method A cleanup level of 0.1 mg/kg for unrestricted land use.

Table 2-2. Summary of No Further Action Sites

Site No.	Site Name	Site Description	Summary of Environmental Work
No Further Action - Site Work Complete			
11	Walan Point (ROD Site)	Spit of land used for ordnance disposal in late 1940s.	Debris removal was conducted in 1994. NFA in ROD, but confirmation groundwater monitoring was required. Confirmation groundwater monitoring was performed from 1994 to 1996. Because no further risks were identified, NFA determination by Ecology in 1996. The interior of Walan Point has been designated as a bird sanctuary by the Navy.
12	Griffin Street Ordnance Disposal Area (ROD Site)	Area near the beach used for ordnance disposal in 1940s and 1950s.	Debris removal was conducted in 1994. NFA in ROD, but confirmation groundwater monitoring was required. Confirmation groundwater monitoring performed from 1994 to 1997. Ecology determined NFA required in 1998.

Table 2-2. Summary of No Further Action Sites (Continued)

Site No.	Site Name	Site Description	Summary of Environmental Work
13	Gas Station Leak	Underground storage tank (UST) leak (gasoline) at gas station (Building 185) in 1979.	The UST was replaced with no residual soil concentrations exceeding cleanup criteria. Two additional USTs were removed in 1991. Not included in ROD.
14	Grit Blasting Area	Area adjacent to Building 190 used for cleaning of buoys and related equipment prior to repainting, 1940s to 1950s. Blasting grit, paint chips, and paint dust accumulated in piles.	Extraction procedure toxicity tests showed that the material in the piles was not a dangerous waste under RCRA. The piles were disposed of and no confirmation sampling was recommended. Not included in ROD.
15	North Slab Storage Area (ROD Site)	Equipment/supplies storage (including paints, solvents, liquid wastes, blasting grit), 1940s to 1970s. Drum storage was discontinued in the 1970s. In the early 1980s, area was reused for equipment and shipping container storage.	Results from soil gas survey (1991) and soil sampling (1992) showed chemicals of potential concern were below cleanup standards. NFA in ROD.
16	Unused Underground Tanks	19 unused USTs at Buildings 70, 84, 108 (2 tanks), 116 (2 tanks), 132, 150, 151, 161 (3 tanks), 162, 164, 165, 168, 169, 170, and 190.	USTs were decommissioned/removed prior to the ROD. Not included in ROD.
17	Buried Imhoff Tank	UST used for wastewater treatment.	Tank decommissioned by filling with sand and used as foundation for Building 835. Vent and blower system installed to maintain safe levels of combustible gases. Approved for NFA; not included in ROD.
18	Net Depot (ROD Site)	Area used to construct and repair submarine nets and associated equipment, 1940s to mid-1950s. The site included an aboveground tank of rust-preventing dip.	PAH-impacted sediment removed from storm drain in 1994. NFA in ROD. Confirmation sediment monitoring demonstrated no risks. Ecology provided NFA in 1996.
19	Public Works Area (ROD Site)	Public works shops, mostly active 1940s to early 1950s, with limited operations through 1979. Paints, thinners, and strippers were reportedly disposed of on the ground throughout this time period. The buildings were demolished.	No contamination detected. NFA in ROD.
20	Upper and Lower Boneyards (ROD Site)	Upper Boneyard used from the 1940s until 1979 to store surplus equipment and materials. Lower Boneyard used from the 1940s through the 1970s to store oil, solvents, waste oil, coal, poles, lumber, gravel, and scrap. Frequent small spills and leaks were reported from the drum rack.	No contamination detected. NFA in ROD.

Table 2-2. Summary of No Further Action Sites (Continued)

Site No.	Site Name	Site Description	Summary of Environmental Work
21	Building 86 Fill (ROD Site)	Disposal site for waste oils, solvents, electrical equipment, and paint, early 1940s.	ROD-selected remedy required groundwater monitoring for 2 years to determine whether previous detections were anomalous. Remedial action tasks at Site 21 were completed between 1995 and 1997. Detected concentrations (arsenic) were determined to be attributable to regional background. Ecology provided NFA in 2000.
22	Old Bomb Overhaul Area (ROD Site)	Area used to recondition bombs, 1940s to 1970s.	No contamination detected. NFA in ROD.
33	Small Arms Range (Post-ROD Site)	Small arms range, 1978 to 1992. Range expansion in early 1980s included excavating the original target area and placing the soil on the berm on the east side of the range.	Bullet lead fragments were observed in surface soils at this range, and, therefore, lead was a suspected chemical of concern (COC). 1997 soil sampling demonstrated that surface runoff has not contributed significant lead to the environment. A site inspection completed in July 2000 (U.S. Navy, 2000a) identified surficial soil at two locations with lead concentrations exceeding the MTCA Method A unrestricted soil cleanup level. Removal of lead-contaminated soil from impact area completed in 2001 achieved cleanup criteria for unrestricted use. NFA determination by Ecology in 2001.
34	Open Burn/Open Detonation Range (Post-ROD Site)	Active from the 1970s to 1990s.	Lead, petroleum hydrocarbons, and/or PAHs were detected in four areas of surface soil around a former burn pit (U.S. Navy, 1996). Removal of lead-, TPH-, and PAH-contaminated soil completed in 1997 achieved cleanup criteria for unrestricted use. Ecology determined NFA under MTCA in 1997. RCRA closure was completed in 2000.
35	Building 154 Floor Drain (Post-ROD Site)	Building 154 was a paint and solvent storage facility with a 6-inch floor drain.	During a 1997 investigation of a floor drain in a solvent and paint storage shed, no fluid, suspect chemical residue, or odor was observed in the drain or soils beneath the shed's concrete slab, and no volatile organic vapor was detected with a photoionization detector (PID). No contaminant concentrations were detected in the soil sample collected adjacent to the drain above MTCA soil cleanup levels for unrestricted use. The investigation findings collectively indicated no evidence of contaminant release through the floor drain (U.S. Navy, 1997b). No chemicals were detected above MTCA soil cleanup levels. Ecology provided NFA in 1997.
EO101	Crane Point Ammo Pier (Post-ROD Site)	Operated as an ammunition pier since before 1947. From 1978 to 1986, used for mooring Navy vessels. Demolition of the pier was completed in December 1997. Initial visual surveys of the pier area found no ordnance explosives or unexploded ordnance.	Navy review of historical photographs and limited site records in 2001 indicated the potential presence of MEC in the area of the former munitions loading and offloading pier at Crane Point. A Navy dive team conducted an ordnance survey which included side scan sonar in April and May 2004, and no MEC were found (U.S. Navy, 2004c). The site was recommended for NFA by the investigation team. The Navy explosives safety review board and Ecology concurred with the NFA determination in October 2004.

Section 3.0: BACKGROUND

NAVMAG Indian Island was named Port Hadlock Detachment at the time of the ROD. It is located on Indian Island in Jefferson County, Washington, on the northeast corner of Washington State's Olympic Peninsula. Indian Island is situated southeast of Port Townsend and east of Port Hadlock and is bordered by Kilisut Harbor to the east, Port Townsend Bay to the west and north, and Oak Bay and Portage Canal to the south. Indian Island is approximately 5 miles long by 1 mile wide, and 2,716 acres in size. The island is wholly owned by the Navy and is primarily used for the storage and handling of naval ordnance.

Several Native American archaeological sites are located on the island, as well as historically significant pioneer homestead sites and World War II era buildings. Four Native American tribes have treaty harvest rights for shell fishing on six NAVMAG Indian Island beaches. Each year a Shellfish Harvest Plan is updated to incorporate security requirements and harvest quotas.

The Navy has had a presence on Indian Island since 1939. In 1941, the Navy commissioned the Naval Magazine and Net Depot on Indian Island and used the facility for production of underwater mines, storage of antisubmarine nets, as a seaplane station, and as a minor Navy ammunition depot. The island was placed in a reduced activity status in 1959. The primary Navy ordnance depot in the northwest between World War II and 1970 was located at the Naval Ammunition Depot (NAD) Bangor, Washington. In 1973, the Navy announced the selection of Bangor as the homeport for the first squadron of Trident nuclear submarines. Based on the new mission for Bangor, munitions storage and handling associated with the NAD was moved to Indian Island. Construction of the new ordnance center took place from 1975 to 1979.

Indian Island is composed of four principal geologic units, which include:

(1) recent alluvium (mixture of relatively loose gravel, sand, and silt),
(2) Vashon Till (dense sandy silt with some gravel),
(3) Vashon Advance Outwash (dense sand with gravel), and
(4) tertiary bedrock (sandstone and shale).

Groundwater on Indian Island occurs at elevations near sea level and in localized shallower zones of perched water in the topographically higher southern portion of the island. In general, groundwater flows from a north-south groundwater divide running along the length of the island toward discharge locations in Kilisut Harbor on the east and Port Townsend Bay on the west. Glacial soils across much of Indian Island are generally permeable enough to infiltrate much of the precipitation falling on the island (average of about 19 inches per year). As a result, well-defined surface water channels are largely absent, with the exception of a small intermittent stream on the bedrock in the eastern portion of the island. The only freshwater body is Anderson Pond, located in the southeastern corner of the island.

Detailed descriptions for each site with a remedy in place are provided in the following sections.

3.1 Site 10 (Northend Landfill)

Site 10 (Northend Landfill) was used to dispose of residential and industrial wastes from approximately the 1940s to the 1970s. A conceptual site model for conditions at Site 10 prior to the implementation of the remedy is provided in Figure 3-1. Waste debris thickness at Site 10 ranges from 4 to 10 feet, and the landfill is underlain by Vashon Advance Outwash sand.

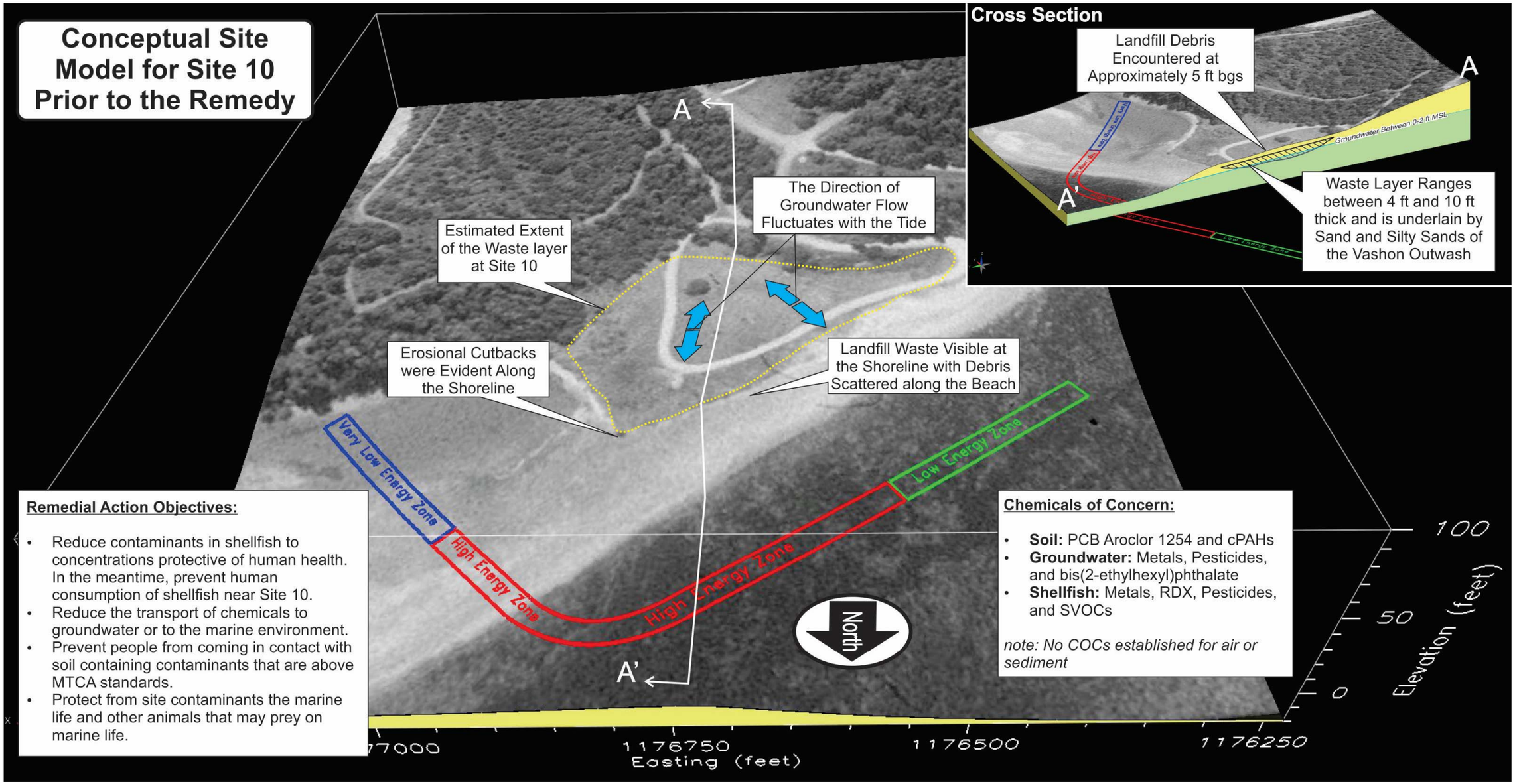


Figure 3-1. Conceptual Site Model for the Site 10 Northend Landfill Prior to the Implementation of the Selected Remedy

At Site 10, groundwater occurs at depths less than 10 feet below grade in the Vashon Advance Outwash sand. The lower portion of landfill debris is saturated. Because Site 10 is located adjacent to Port Townsend Bay, groundwater flow directions change in response to tidal fluctuations. However, the net groundwater flow direction is toward Port Townsend Bay. Site 10 groundwater is too saline to be a drinking water source.

Port Townsend Bay borders Site 10 to the west and is separated from Kilisut Harbor on the east side of Indian Island by Boggy Spit, which contains a tidal lagoon. Based on site and offshore conditions, three wave-energy regimes have been identified at the shoreline adjacent to Site 10. From east to west, they are the Very Low Energy Area (tidal lagoon northeast of the landfill), the High Energy Area (northernmost beach along the landfill), and the Low Energy Area (westernmost beach along the landfill) (U.S. Navy, 2005c).

The marine waters north of Site 10 and in Kilisut Harbor are major spawning and nursery areas for herring, smelt, cod, salmon, trout, and other fish. Shellfish (e.g., diverse species of clams) inhabit the beaches near Site 10, but the greatest abundance is farther to the east along Kilisut Harbor. A seal rookery has been observed offshore on the haul outs located on the beaches of Rat Island to the west of Site 10 in Port Townsend Bay. A variety of waterfowl (cormorants, ducks, gulls, etc.) have been observed around Site 10, and bald eagles nest near the site (U.S. Navy et al., 1995).

Media investigated during the RI/FS included air, soil, sediment, groundwater, and shellfish tissue. The ROD identified COCs for soil, groundwater, and shellfish tissue; no COCs were identified for sediment or air. COCs for soil included polychlorinated biphenyl (PCB) Aroclor-1254 and cPAHs (including benzo(a)anthracene, benzo(a)pyrene, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, and chrysene). COCs in groundwater included metals (arsenic, beryllium, copper, lead, mercury, nickel, and zinc), pesticides (4,4'-DDD, 4,4'-DDT, and gamma-chlordane), and one semivolatile organic compound (SVOC) (bis[2-ethylhexyl]phthalate). Although no screening levels were available for shellfish tissue, maximum detected concentrations of some chemicals in samples from Site 10 beaches were higher than those from a nearby reference location. These chemicals included metals (arsenic, cadmium, copper, lead, mercury, selenium, zinc, and some common ions), ordnance compounds (research demolition explosive [RDX], picramic acid, and picric acid), pesticides (4,4'-DDD, 4,4'-DDT, aldrin, alpha-benzene hexachloride [BHC], beta-BHC, lindane, gamma-chlordane, and methyl parathion), and SVOCs (benzoic acid, bis[2-ethylhexyl]phthalate, di-n-butylphthalate, and pentachlorophenol) (U.S. Navy et al., 1995).

3.2 Site 36 (New Boneyard)

Site 36 (see Figure 3-2) was remediated as a post-ROD CERCLA non-time critical removal action in January and May 2001. In January 2001, two petroleum-contaminated areas of the site were excavated to a depth of 2 feet. The verification sampling results confirmed that residual petroleum concentrations in the excavations were below MTCA Method A unrestricted soil cleanup levels. The excavations were backfilled with imported gravel. The petroleum-contaminated soil was disposed of at the Olympic View Sanitary Landfill in Bremerton, Washington.

Creosote-treated timbers and net pen blocks suspected of being a PAH source were also removed from the site at that time and either disposed of or beneficially reused offsite. Seven of the 19 blocks were disposed of at Columbia Ridge Landfill in Arlington, Oregon. The remaining 12 were taken offsite by the Navy for reuse at another facility. Verification sampling and analysis of the soils beneath the former creosote-treated timber and net pen blocks indicated residual cPAH concentrations below MTCA soil cleanup levels for industrial use, but above those for unrestricted use at two sampling locations.

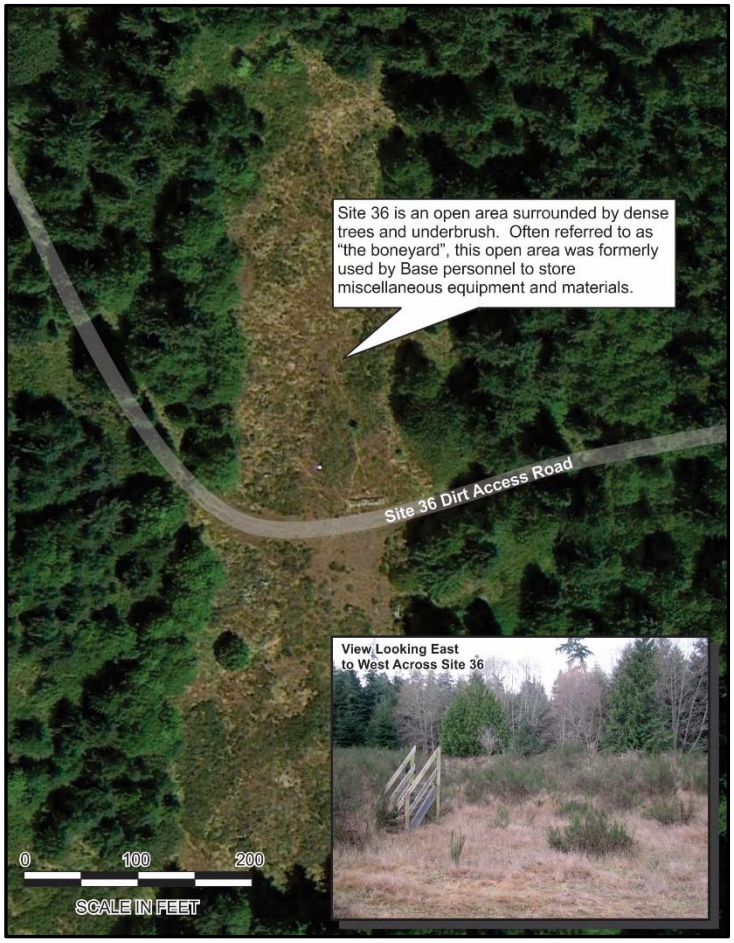


Figure 3-2. Map of Site 36 (New Boneyard)

Because the site investigation data indicated cPAH concentrations in soil above those acceptable for unrestricted use, ICs were established for Site 36 to restrict residential use, farming, and construction of water supply wells, as described in the 2000 IC Management Plan (ICMP) for Indian Island (U.S. Navy, 2000d).

However, the estimated volume of cPAH-contaminated soils was small and could be addressed cost-effectively as part of the Site 36 non-time critical removal action. Therefore, the Navy excavated these soils in May 2001, thereby eliminating the need for ICs at Site 36. With minor exceptions, the verification sampling results confirmed that residual cPAH concentrations in the excavations were below the 2001 MTCA unrestricted soil cleanup levels. The excavated soils were sampled and analyzed for waste designation and disposed of appropriately at a permitted landfill. The excavations were backfilled with imported gravel. As a result of the non-time critical removal action, ICs restricting use of Site 36 were no longer required for protection of human health and the environment. The second five-year review (U.S. Navy, 2005a) recommended that ICs be removed from Site 36, and the U.S. Environmental Protection Agency (EPA) concurred with this recommendation (EPA, 2005).

3.3 Hazardous Waste Storage Area

The detected COCs at the HWSA were primarily petroleum related (gasoline and PAHs), however, PCBs and methylene chloride were detected in one sample at low levels, in addition to various metals that were determined to be present at background levels. No soil was removed because only a few isolated occurrences of soil concentrations exceeded cleanup levels and groundwater was determined to be unaffected (U.S. Navy, 1998a and 1998b). For the TPH mixtures detected in soil, only the motor oil fraction exceeded the 1998 MTCA A unrestricted level. The maximum motor oil concentration at that time was 350 mg/kg, which is below the current MTCA Method A unrestricted land use cleanup level of 2,000 mg/kg. The HWSA was closed without restrictions under the RCRA program in 1998.

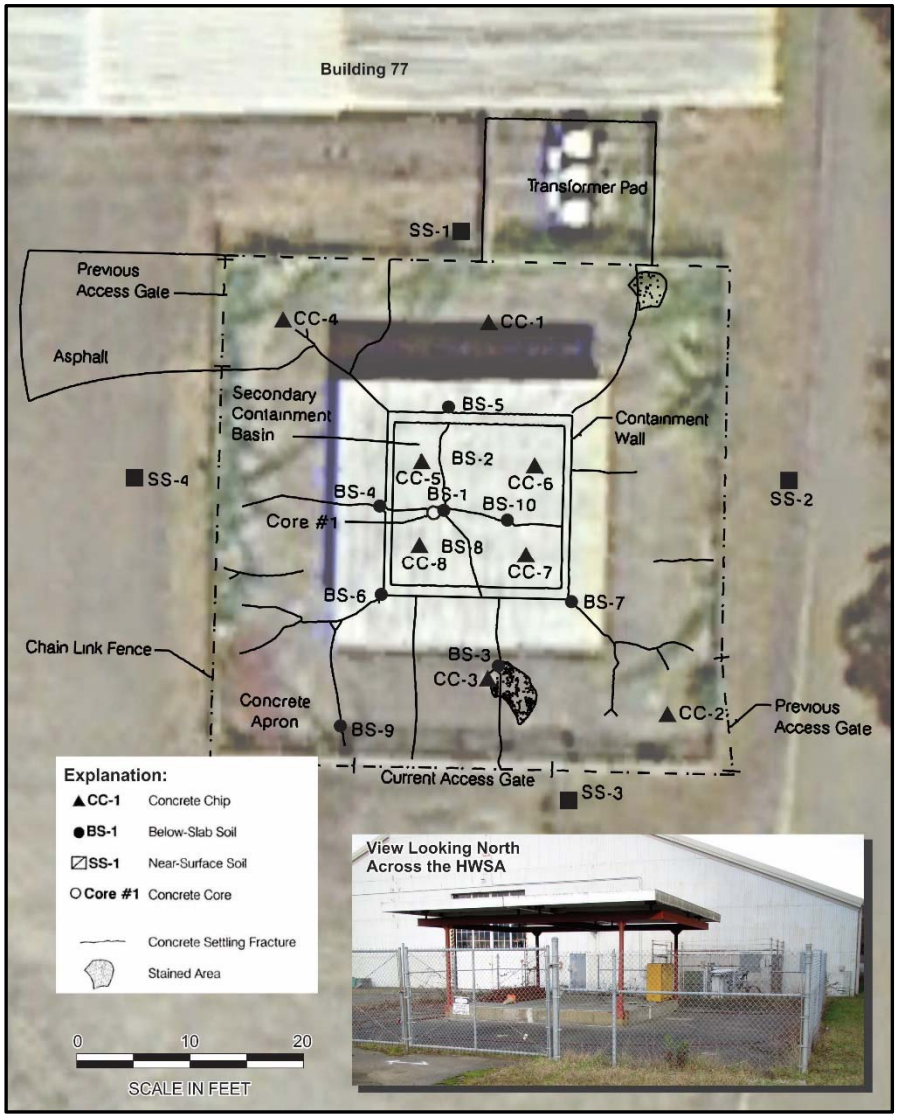


Figure 3-3. Map of HWSA

Section 4.0: REMEDIAL ACTIONS

This section provides a brief description of ongoing remedial action operation at Site 10 and monitoring of ICs at Site 36 and the HWSA.

4.1 Site 10 (Northend Landfill)

As discussed in Section 2.0, the Final ROD for NAVMAG Indian Island was issued in September 1995 (U.S. Navy et al., 1995) and defined site-specific remedial action objectives (RAOs) for Site 10, including:

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

Based on the RAOs described above, the selected remedy for Site 10 included multiple components to protect human health and the environment, including:

- Placing a landfill cap over approximately 3.7 acres of the site.
- Placing erosion protection along approximately 900 linear feet of the landfill perimeter and shoreline.
- Removing eroded landfill debris that was located in the intertidal area and excavating landfill waste from the water's edge to prepare the shoreline for the construction of the erosion protection measures.
- Implementing ICs, which include ICs for residential use and farming and a temporary prohibition on shellfish harvesting.
- Conducting a monitoring program for groundwater, sediment, and shellfish.
- Conducting regular maintenance and inspection of the landfill cap and the erosion protection, particularly after storm events.
- Conducting periodic reviews.

The ROD has been clarified by one ESD, dated October 2004, which defined the site-specific IC requirements and procedures for monitoring the requirements. The ESD clarified the IC requirements but did not substantively change the selected remedies (U.S. Navy et al., 2004).

4.1.1 Remedy Implementation. Mobilization and remedial construction of the physical components of the remedy began in July 1996 (see Figure 4-1). In August and September 1996, work progressed to the installation of the armor-rock section of the shoreline protection system in the High Energy Area and the quarry spall base and bench for the Low and Very Low Energy Areas.

Approximately 1,000 cubic yards of excavated material from the installation of the armor-rock section were regraded over the old landfill surface and then compacted. The approximately 10,000 cubic yards of import material were regraded and compacted over the site to establish a rough grade. Additional import material was placed to establish a final grade. After the final grade was established in October 1996, a gas-collection system was installed in the landfill area (see Figure 4-1). The purpose of the landfill gas system was to vent landfill gas (although none had been detected in studies done for the Olympic Air Pollution Control Authority) and, more importantly, to equalize air pressure under the cap from wave action. Various components of the landfill cap (covering approximately 3 acres), soil cover, and storm drains were installed between October 1996 and January 1997. In January, work on the shoreline protection system began again. A log revetment system was installed using duck-bill anchors at the top of the beach along the approximately 300-foot length of the Low Energy Area. After completion of the log revetment system, three layers of vegetative geogrids (approximately 2,700 linear feet) were constructed along the seaward side of the entire landfill cap (February to April 1997).

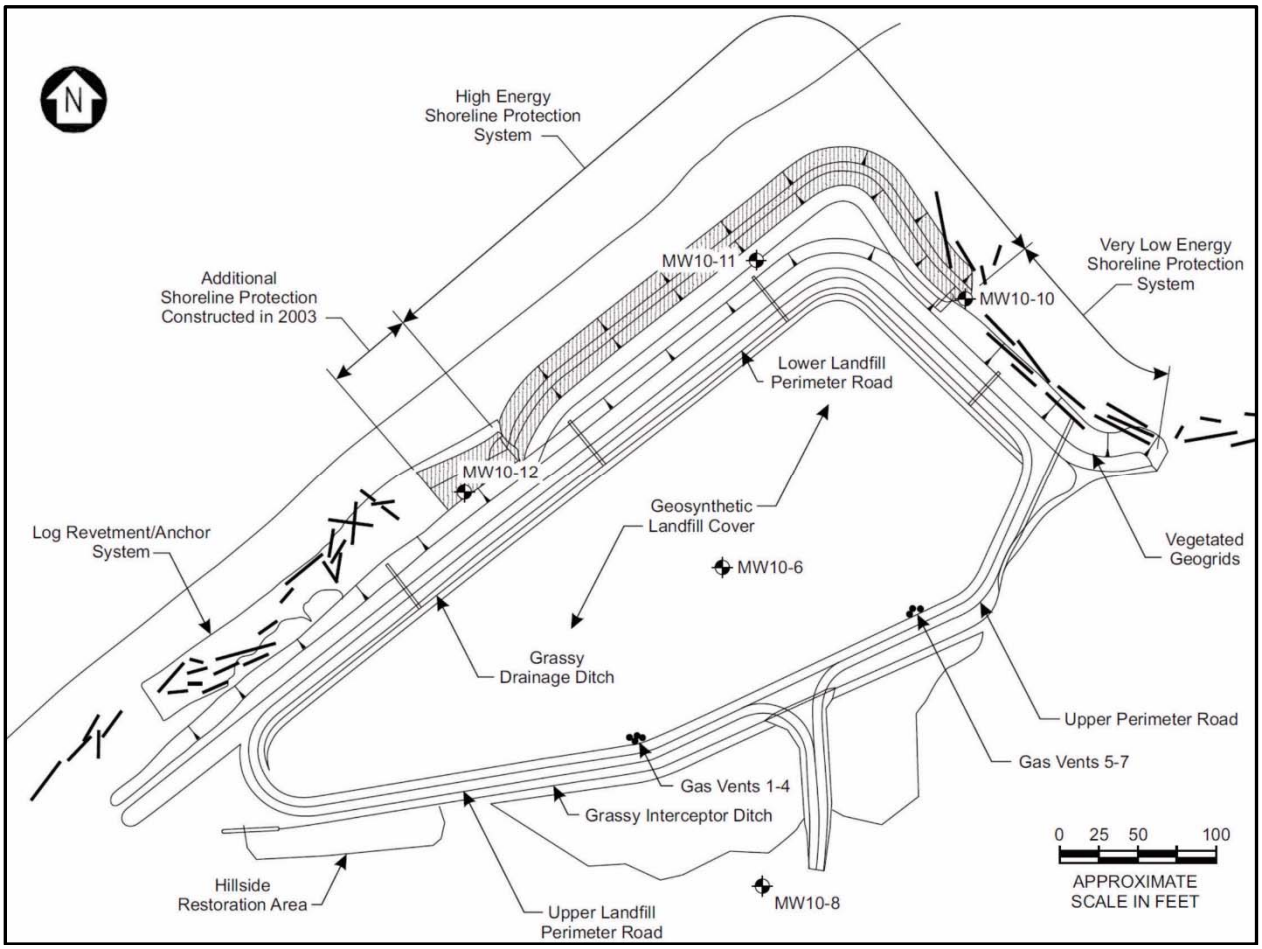


Figure 4-1. Map of Site 10 Showing Components of the Landfill Cap and Shoreline Protection System Associated with Remedial Construction Activities

In April 1997, a 2-foot soil cover (completed with topsoil as the top 6 inches of the cover) was placed over the landfill cap and hydroseeded with native grass and wildflowers. Planting on the geogrid and peripheral areas was completed in April 1997 and involved placing salt tolerant species of native willow shrubs to provide stability along the outer edges of the geogrid. The finishing ancillary cap features (e.g., gravel resurfacing, irrigation system, culverts, and surface gas vents) were installed in April 1997. The site was demobilized in May 1997 after the completion of construction activities. On September 26, 1997, the Navy issued the preliminary closeout report (U.S. Navy, 1997a) signifying successful completion of construction activities.

4.1.2 Operation, Maintenance and Monitoring. The monitoring program since remedy construction at Site 10 has included the following components:

- Groundwater monitoring
- Beach habitat monitoring
- Beach profile monitoring
- Marine (shellfish and sediment) monitoring
- Annual IC inspections.

Operation, maintenance, and monitoring (OM&M) activities began in June 1997, immediately following completion of the Site 10 remedial action in May 1997. The maintenance and monitoring plans for Site 10 have been updated periodically since 1997 to reflect changing conditions at the site and changing monitoring requirements. The most recent version of the plan, titled, Operation and Maintenance Plan Land Use Controls/ICMP, Revision 3, is dated May 16, 2012 (U.S. Navy, 2012a).

Inspections and Maintenance. Inspection and maintenance activities over this five-year review period have included IC inspections, visual inspections of site conditions, land surveys of beach-normal transects, routine maintenance such as weeding, and minor repair of the functional features of the landfill cap and shoreline protection system. These functional features include the landfill cap system, landfill gas collection system, landfill perimeter road, stormwater drainage system, hillside and site access road inspection, log revetment/anchor system, armor-rock shoreline protection system, and the vegetated geogrid.

Based on inspections and maintenance conducted since remedial construction, erosion at the shoreline has been the primary issue observed. Specifically, erosion became apparent at the transition between the High Energy Area (rock revetment) and Low Energy Area (log revetment), where several logs secured with anchor bolts broke away and needed to be re-anchored. Scouring and beach erosion were noted behind some logs in this transition zone. A more permanent repair was made in late 2003 and early 2004 when the rock revetment area was extended approximately 55 feet west along the shoreline (U.S. Navy, 2004a). In 2006, subsequent inspections revealed a small area of erosion at the transition of extended rock revetment and the Low Energy Area. Few changes in the shoreline were noted in 2007 and 2008, however, following major storms over the winter of 2008-2009, significant additional erosion was noted in this area. Additional description of the erosion in this area along with shoreline improvements made over the last five years is included in Table 5-1 presented in Section 5.0.

Groundwater Monitoring. The ROD required quarterly groundwater sampling and analysis of one upgradient and four nearshore monitoring wells for 2 years. The ROD states that the groundwater monitoring data will be used for the following:

- To determine the impact and effectiveness of the landfill cap and shoreline protection system on groundwater quality
- To establish trends of groundwater quality over time
- To help evaluate the need for shellfish harvesting restrictions at the beaches adjacent to the landfill.

Results of the first eight rounds of monitoring were included in the first five-year review (U.S. Navy, 2000c). These groundwater samples were analyzed for the groundwater COCs listed in the ROD (bis[2-ethylhexyl]phthalate, DDT, DDD, gamma-chlordane, and total and dissolved arsenic, beryllium, copper, lead, mercury, nickel, and zinc). Samples were also analyzed for diesel-range petroleum hydrocarbons, ordnance, and selected conventional parameters. Statistical analysis of the first eight rounds of compliance groundwater monitoring data indicated few significant changes in site groundwater quality (U.S. Navy, 2001a). Based on this analysis, the approach for evaluating remedy effectiveness and potential impacts to groundwater quality was reassessed by the Navy in the final Site 10 monitoring plan (U.S. Navy, 2000e). To date 36 rounds of monitoring have been conducted for Site 10. Monitoring requirements have been reduced over time and currently involve monitoring water levels and geochemical parameters using field instrumentation (i.e., pH, temperature, oxidation-reduction potential, salinity, dissolved oxygen, turbidity, specific conductivity, total dissolved solids, and color) as well as field titration testing to measure dissolved oxygen. Under the current monitoring plan, Tier 1 comparison criteria have been established for oxidation-reduction potential, dissolved oxygen, pH, and color; exceedances of these Tier 1criteria over two consecutive sampling events can trigger additional analyses, referred to as Tier 2 sampling, if required by Ecology. The groundwater monitoring program was conducted over the last five years and detailed information is provided in the technical assessment for Site 10 (Section 7.0).

Beach Habitat Monitoring. The purpose of the intertidal beach habitat survey was to evaluate the beach habitat and major organisms that inhabit the beach bordering Site 10 following implementation of the selected remedy. The preconstruction survey was completed in October 1995. Following construction, surveys were completed in October 1997 and November 1998 (U.S. Navy, 1999b). Because of the observed overall stability of the beach during the 1997 and 1998 surveys, detailed beach habitat surveying was discontinued after 1998 in favor of general visual inspections by Navy environmental staff. EPA and Ecology approved of these changes to the monitoring program (EPA, 2005).

Marine Monitoring and Harvest Restrictions. Because of potential human health concerns associated with site contaminants, the ROD imposed shellfish harvesting restrictions on three beaches (1, 2, and 19) around Boggy Spit (see Figure 4-2). The ROD required a marine monitoring program to determine when the shellfish would be safe to eat and restrictions could be terminated. Three rounds of sediment and shellfish monitoring were completed in May 1998, May 2000, and June 2004. The data from these sampling events were used to assess risks to human health and the environment, with the conclusion that the ROD criteria for the marine monitoring program had been met (U.S. Navy, 2004b and 2004d). The second five-year review recommended that the marine monitoring program and shellfish harvest restrictions be discontinued. EPA and Ecology concurred with this determination (EPA, 2005).

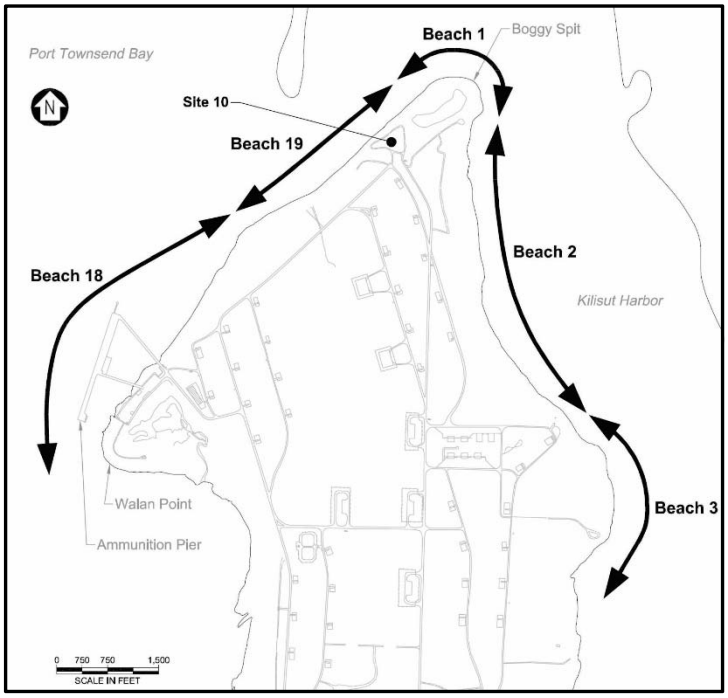


Figure 4-2. Beach Locations in Relation to Site 10

4.2 Site 36 (New Boneyard)

As described in Section 3.2, the post-ROD removal actions conducted at Site 36 were based on TPH and cPAH concentrations. The initial removal effort conducted in January 2001 left residual concentrations of cPAH at levels exceeding the criteria for unrestricted use. In response, a second removal effort was conducted in May 2001 to remove soil with residual cPAH concentrations above 1 mg/kg (U.S. Navy, 2001b). Based on the May 2001 removal efforts, Site 36 was approved for NFA. The third five-year review conducted an analysis of residual cPAH concentrations remaining at Site 36, which determined that several sampling locations exhibited cPAH concentrations above the MTCA Method A unrestricted screening level of 0.1 mg/kg (U.S. Navy, 2010d). As a result of this analysis, the third five-year review recommended that ICs be implemented to manage residual risk at Site 36. Since the third five-year review, residential use of the property (including the installation of potable wells) and farming has been restricted at Site 36. Additional details related to the monitoring of ICs at Site 36 are provided in Table 5-1, Section 5.0.

4.3 Hazardous Waste Storage Area

As described in Section 3.3, the HWSA was closed under the RCRA program without restrictions in 1998. The third five-year review conducted an analysis of residual cPAH concentrations remaining at HWSA, which determined that several sampling locations exhibited cPAH concentrations above the MTCA Method A unrestricted screening level of 0.1 mg/kg (U.S. Navy, 2010d). As a result of this analysis, the third five-year review recommended that ICs be implemented to manage residual risk at the HWSA. Since the third five-year review, residential use of the property (including the installation of potable wells) and farming has been restricted at the HWSA. Additional details related to the monitoring of the ICs at the HWSA are provided in Table 5-1 of Section 5.0.

Section 5.0: PROGRESS SINCE LAST FIVE-YEAR REVIEW

The third five-year review identified four recommendations and follow-up actions for NAVMAG Indian Island. No issues affecting the short-term protectiveness of remedies for sites at NAVMAG Indian Island were identified during the third five-year review (U.S. Navy, 2010d). The recommendations and follow-up actions were either intended to (1) maintain long-term protectiveness at a specific site, (2) ensure compliance with the ROD or subsequent remedy implementation requirements, and (3) discontinue aspects of the remedy because RAOs had been met. Table 5-1 presents the recommendations and follow-up actions identified in the third five-year review, which have all been completed within the last five years. A few instances require additional action to ensure the intent of the recommendations from the third five-year review are achieved.

Table 5-1. Summary of Progress since the Third Five-Year Review

Recommendation/Follow-Up Action #1: Perform engineering analysis of shoreline erosion at Site 10, and recommend a long-term repair.	
Completed: Yes	Completion Date: The initial design was finalized in April 2010, but was superseded by a revised design, which was finalized in December 2013. In addition, interim measures were taken in 2012 and in 2014 to provide immediate protection of the shoreline in the area between Transects 8 and 9, which is described below.
Summary of Activities Supporting Completion: Based on recommendations of the third five-year review, engineering evaluations were conducted in 2010 to develop a long-term solution to shoreline erosion at Site 10. A Shoreline Erosion Protection Alternatives Analysis Report evaluated alternatives for preventing future erosion of the shoreline adjacent to the Site 10 landfill (U.S. Navy, 2010b). On April 30, 2010, the final report was submitted to provide additional design details and technical considerations for implementing the recommended alternative, which involved the construction of a backshore rock berm parallel to the shoreline along the base of the geogrids between Transects 8 and 11 (U.S. Navy, 2010c). As shown in Figure 5-1, the berm recommended based on the 2010 evaluations was designed to be approximately 2 feet tall, 7 feet wide and underlain with a filter fabric. This design also included backfilling the area behind the rock berm with a sand and gravel mixture to serve as habitat for dune grass. The total cost of the recommended alternative was estimated to be $240,000; the 2010 shoreline design was not implemented. The 2010 design was replaced by a separate engineering evaluation and shoreline design document finalized in 2013, titled Final Shoreline Protection System Repair Design Recommendation Report (U.S. Navy, 2013c). The 2013 design was based on inspections of the shoreline, but also considered updated design wave conditions and expected sea level rise over the next 50 years. Based on the 2013 design report, no action was recommended in the Very Low Energy Zone and the placement of a new stone layer over the existing revetment was recommended in the High Energy Zone to account for increased wave energy. The 2013 design report concluded that more substantial shoreline improvements were required in the Low Energy Area. This updated design for the Low Energy Area of Site 10 would involve the installation of a three-layer system, including armor stone and filter fabric with a stone-filled marine mattress system approximately 7-feet wide (see Figure 5-1). Implementation of the 2013 design would require that additional armoring stone placed in 2012 and 2014 be removed as part of construction activities to provide long-term protection in the Low Energy Area of the Site 10 shoreline. The total cost of the recommended 2013 shoreline design was estimated to be $940,000.	

Table 5-1. Summary of Progress since the Third Five-Year Review (Continued)

Recommendation/Follow-Up Action #1: Perform engineering analysis of shoreline erosion at Site 10, and recommend a long-term repair. (Continued)	
Annual shoreline inspections from 2009 to 2012 showed that previously noted erosion below the geogrid between Transects 8 and 8.5 was becoming more significant. During an inspection conducted in the summer of 2010, the area around groundwater monitoring well MW10-12 was observed to have significantly eroded, such that most of the concrete seal was exposed (U.S. Navy, 2010f). Based on these observations, inspection personnel relocated several rocks from the beach and placed them around the well seal in July 2010 and again in December 2010 in an effort to stabilize and protect the wellhead and seal. However, evidence of further erosion in this area was observed during the inspection conducted in the summer of 2011, at which time the concrete well seal was entirely exposed along with a few inches of the polyvinyl chloride (PVC) casing below the concrete seal (U.S. Navy, 2011d). The inspections noted that while erosion around MW10-12 was significant, the adjacent geogrid had not been affected. In July 2011, groundwater monitoring well MW10-12 was abandoned due to the significant beach erosion in the area around the well. In November 2012, a replacement monitoring well (designated MW10-12R) was installed in the vicinity of former well MW10-12, but was placed further from the shoreline in between the geogrid and the road adjacent to the marker for Transect 8. In fall 2012, the Navy installed additional armor rock westward approximately 60 feet in the area between Transects 8 and 9 to stabilize the embankment below the geogrid around the former location of MW10-12R and prevent further erosion (U.S. Navy, 2013b). Subsequent repairs were conducted in 2014 once additional funding was available; these repairs augmented the 2012 repairs by rearranging existing large revetment stones and placing smaller armoring material within the revetment (U.S. Navy, 2014b). No shoreline erosion was noted after the 2012 interim measures, as documented in the 2013 Landfill and Shoreline Protection System Inspection Report (U.S. Navy, 2013b) and in the five-year review inspection presented in Appendix B. Both improvements in 2012 and 2014 were conducted as interim measures to provide immediate protection of the shoreline in the area between Transects 8 and 9.	
Recommendation/Follow-Up Action #2: Update the Operation and Maintenance Plan to clarify the intent and objectives of, and methodologies for completion of land surveys to be used for inspection of the landfill. Include in the update the new recommended groundwater sampling frequency and improved procedures for measuring dissolved oxygen.	
Completed: Yes	Completion Date: May 2012
Summary of Activities Supporting Completion: Revision 3 of the Operation and Maintenance Plan Land Use Controls/ICMP for Site 10, Site 36, and the HWSA was finalized in May 2012 (U.S. Navy, 2012a). This revised plan provided clarification for the implementation of land surveys, updated groundwater sampling frequencies (i.e., from semi-annual to annual), and improved procedures for measuring dissolved oxygen. The updated plan specified that quantitative beach profile surveys would be conducted annually beginning in 2012 for Transects 8 through 11 and every five years for all transects beginning in June/July 2014. The requirements of Recommendation/Follow-Up Action #2 only specified that the Operation and Maintenance Plan be updated for this action to be considered complete. It should be noted that while the updated plan was developed and finalized within the last five years, much of the specified surveying, specifically the annual survey for Transects 8 through 11 in 2013 and the comprehensive survey of all 11 transects in 2014, was not conducted, which is discussed further in Section 8.0.	
Recommendation/Follow-Up Action #3: Revise ICMP to include land use restrictions for Site 36 and the Hazardous Waste Storage Area.	
Completed: Yes	Completion Date: May 2012
Summary of Activities Supporting Completion: Revision 3 of the Operation and Maintenance Plan Land Use Controls/ICMP for Site 10, Site 36, and the HWSA was finalized in May 2012 (U.S. Navy, 2012a). This revised plan defines the required land use restrictions for Site 36 and the HWSA, describes the procedures for implementing and monitoring the restrictions, and provides forms for onsite inspection personnel to populate on an annual basis for documentation purposes.	
Recommendation/Follow-Up Action #4: Prepare and submit LUC monitoring reports to Ecology and EPA as required by the ICMP.	
Completed: Yes	Completion Date: October 2012, October 2013, and October 2014
Summary of Activities Supporting Completion: Beginning in 2012, inspection forms documenting LUC implementation and monitoring were provided to Ecology and EPA in the Annual Landfill and Shoreline Protection System Inspection Reports for 2012, 2013, and 2014 (U.S. Navy, 2012b, 2013b, 2014b).	

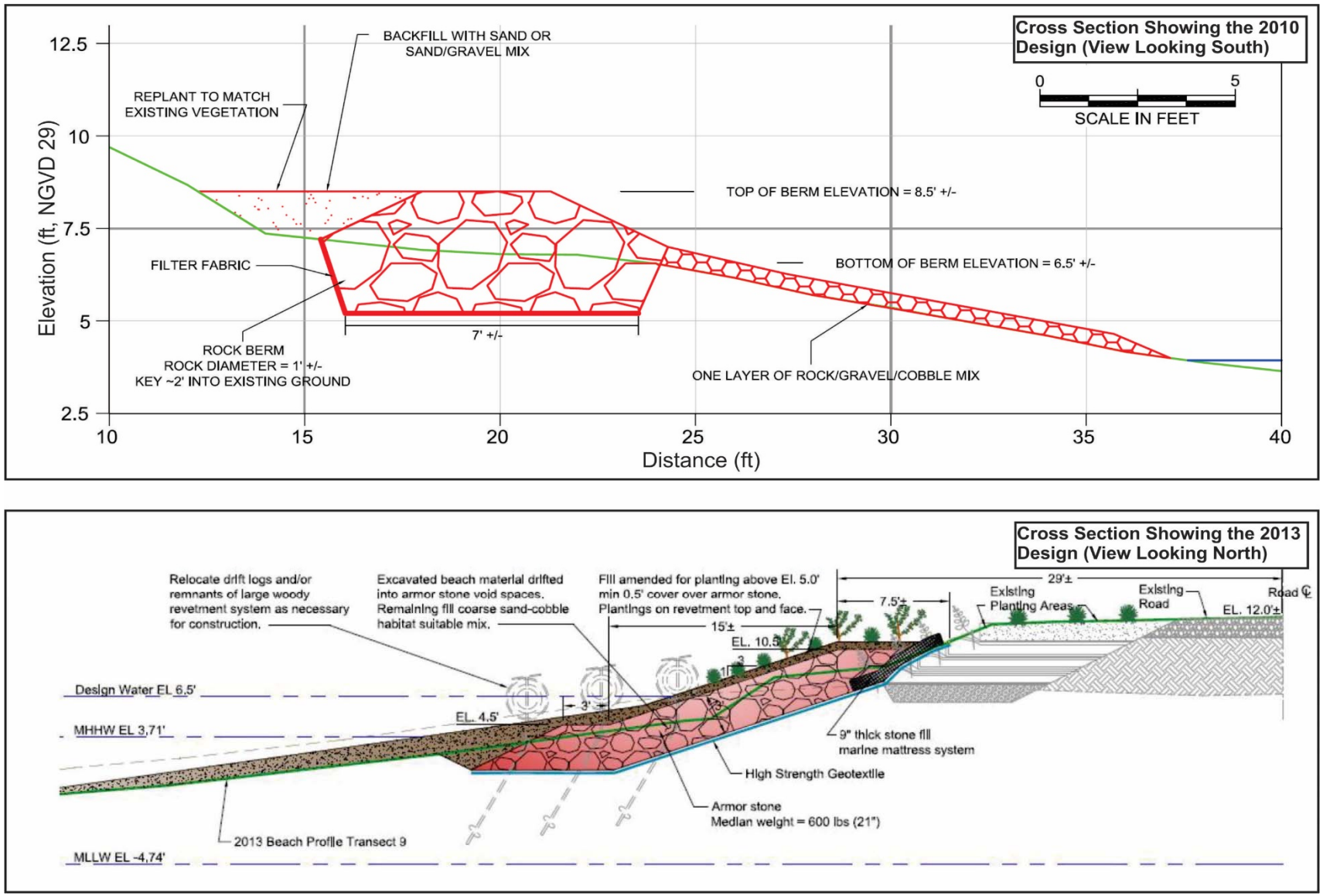


Figure 5-1. Conceptual Cross Sections Showing the 2010 and 2013 Shoreline Stabilization Designs for the Low Energy Area at Site 10

Section 6.0: FIVE-YEAR REVIEW PROCESS

6.1 Five-Year Review Team

The Navy is the lead agency for this five-year review. Personnel from NAVFAC NW and NAVMAG Indian Island represented the Navy in this five-year review. Project managers and staff from EPA and Ecology have also participated in the review process. Both EPA and Ecology are cosignatories of the ROD for NAVMAG Indian Island. All team members had the opportunity to provide input to this report.

6.2 Community Involvement

In support of this fourth five-year review, the Navy notified the public via a legal notice in the local newspaper on January 14, 2015 *(Port Townsend & Jefferson County Leader)* that this review was being conducted. The legal notice provided background information along with instructions for the public to comment on the protectiveness of the remedy. The completed fourth five-year review report will be made available to the public at the Jefferson County Library and a public notice to that effect will be published in the local newspaper.

Historically, the community has been informed of progress at Indian Island through fact sheets, public notices, open houses, and public meetings. The proposed plan was circulated for public comment prior to finalization of the ROD. Key documents have been made available for review at the Jefferson County Library in Port Hadlock, Washington. A community relations plan was prepared in 1989 and updated in July 2008.

In 1991, a Technical Review Committee (TRC) was established, with representatives from the public and governmental entities, including the Suquamish Tribe, the Northwest Indian Fisheries Commission, and the Washington State Department of Wildlife. The TRC was replaced with a Restoration Advisory Board (RAB) in mid-1995. The RAB members included representatives of the Navy, regulatory agencies, civic groups, private citizens, tribal governments, local governments, and environmental activist groups. The RAB was disbanded in September 2000.

6.3 Five-Year Review Schedule

The five-year review process involves: 1) performing an audit of all site activities that have been conducted over the last five years to support remedies in place at NAVMAG Indian Island, 2) performing a site inspection, 3) conducting interviews with key stakeholders and environmental managers, 4) performing a thorough evaluation of all environmental data collected over the last five years, and 5) developing a concise yet comprehensive five-year review report. The five-year review report is provided for review to representatives from the EPA, Ecology, and other key stakeholders. In addition, two public notices are provided in the local newspaper to encourage public participation in the five-year review process. A detailed schedule of this current five-year review process for NAVMAG Indian Island is provided in Figure 6-1.

Task Name	Start	Finish
Public Notice 1: Intent to Perform 5 Yr Review	Wed 1/14/15	Wed 1/14/15
Site Inspection	Thu 1/15/15	Thu 1/15/15
Interviews and Data Collection	Fri 1/16/15	Wed 2/11/15
Data Evaluation and Recommendations	Fri 1/16/15	Wed 2/11/15
Submit Internal Draft Five Year Review	Mon 2/23/15	Mon 2/23/15
Submit Draft Five Year Review	Wed 4/15/15	Wed 4/15/15
Navy, Stakeholder, and Agency Review	Wed 4/15/15	Fri 5/15/15
Responses to Navy, Stakeholder, and Agency Comments	Fri 5/15/15	Mon 6/1/15
Submit Final Five Year Review for Signature	Fri 6/19/15	Fri 6/19/15
Navy Publishes the Signed Final 5 Yr Review	Mon 7/20/15	Mon 7/20/15
Public Notice 2: Availability of Final 5 Yr Review	**Mon 8/10/15**	**Mon 8/10/15**

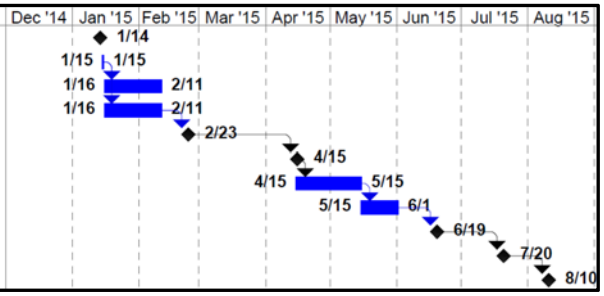


Figure 6-1. Schedule of the Five-Year Review Process for NAVMAG Indian Island

6.4 Document Review

Documents reviewed during this five-year review period were those that described the monitoring of the selected remedies over the last five years, the ROD in which the selected remedies were described, and the Operation and Maintenance Plan Land Use Controls/ICMP for NAVMAG Indian Island.

The primary documents reviewed include the following:

- The executed ROD (U.S. Navy et al., 1995)
- The ESD (U.S. Navy et al., 2004)
- The first, second, and third five-year review reports (U.S. Navy, 2000c, 2005a, 2010d)
- Plans and summary documentation addressing the decommissioning and replacement of MW10-12 (U.S. Navy, 2011b, 2012a, 2012b)
- Final reports from the 2010 engineering evaluations summarizing the analysis of alternatives and the recommended alternative for shoreline erosion protection at Site 10 (U.S. Navy, 2010b and 2010c)
- The 2013 design report for repairs to the shoreline protection system at Site 10 (U.S. Navy, 2013c)
- The work plan and technical memorandum summarizing temporary repair measures implemented in 2014 to address erosion in the Low Energy Area of Site 10 (U.S. Navy, 2014a, 2014b)
- The Final Revision 3 Operation and Maintenance Plan Land Use Controls/ICMP (U.S. Navy, 2012a)
- The long-term monitoring reports for groundwater at Site 10 (U.S. Navy, 2009a, 2010e, 2011c, 2012c, 2013a, and 2014c)
- The landfill and shoreline protection system inspection reports for Site 10 (U.S. Navy, 2009b, 2010f, 2011d, 2012b, 2013b, and 2014b)

6.5 Data Review and Evaluation

The data review and evaluation involved reviewing the results of activities conducted at NAVMAG Indian Island over the last five years for sites that have ongoing remedies either through the ROD or through post-ROD environmental activities. Three sites, Site 10, Site 36, and the HWSA, currently have remedies in place such that ongoing operation and maintenance, groundwater monitoring, and/or LUC/IC monitoring has produced both qualitative and quantitative data since the last five year review, as follows:

- **Site 10:** The evaluation for Site 10 included a review of site data related to ongoing efforts to (1) inspect and maintain the shoreline protection system at the site, (2) inspect and maintain the landfill cap, and (3) monitor beach erosion adjacent to the landfill boundary. The data produced from these activities are documented in annual landfill and shoreline protection system inspection reports (U.S. Navy, 2009b, 2010f, 2011d, 2012b, 2013b, and 2014b) and include photographs, observations made by field personnel and documented on inspection forms, and a 2012 elevation survey of beach Transects 8 through 11 (U.S. Navy, 2012b). The evaluation also included a review of all data associated with ongoing groundwater monitoring activities at Site 10, which is typically conducted semi-annually, with one event in the winter and one in the summer. The current groundwater monitoring network includes five wells (MW10-6, MW10-8, MW10-10, MW10-11, and MW10-12R), which are monitored for water levels and groundwater quality parameters (i.e., temperature, pH, oxidation-reduction potential, dissolved oxygen, specific conductivity, salinity, turbidity, and color). All data associated with ongoing groundwater monitoring activities at Site 10 are documented in annual groundwater monitoring reports (U.S. Navy, 2009a, 2010e, 2011c, 2012c, 2013a, and 2014c). The results of the data review for Site 10 are provided in the technical assessment presented in Section 7.0.
- **Site 36 and the Hazardous Waste Storage Area:** The third five-year review noted that there was no mechanism to monitor the ICs in place at Site 36 and the HWSA and that adequate documentation of ICs had not been provided to EPA and Ecology. Therefore, starting in 2012, inspection forms documenting LUC implementation and monitoring were populated and provided to Ecology and EPA in the Annual Landfill and Shoreline Protection System Inspection Reports for 2012, 2013, and 2014 (U.S. Navy, 2012b, 2013b, and 2014b). The qualitative findings associated with the 2012, 2013, and 2014 inspection forms were included in the data review conducted during this five-year review. The results of the data review for Site 36 and the HWSA are provided in the technical assessment presented in Section 7.0

6.6 Site Inspection

This section contains a summary of the findings of the site inspection. The site visit was performed on January 15, 2015, and was conducted by the following personnel:

- Carlotta Cellucci, NAVFAC NW
- Bill Kalina, NAVMAG Indian Island
- Ryan Wensink, Battelle
- Damon DeYoung, Battelle

The site visit consisted of inspecting all portions of the site covered by ICs or requiring ongoing remedy maintenance, including Site 10, Site 36, and the HWSA. The inspections of Site 36 and the

HWSA involved walking the site to ensure that ICs were being implemented properly and that the sites were not being used in a manner that would result in unacceptable exposure. The site inspection confirmed that Site 36 and the HWSA were being appropriately controlled by the Navy and no unauthorized uses of the sites were observed.

The inspection of Site 10 was intended to ensure that key components of the landfill remedy were being properly maintained and involved observations of the landfill cover, the access road, the stormwater collection and drainage system, the landfill gas collection system, groundwater monitoring wells, and the stabilized shoreline. The inspection confirmed that the Site 10 landfill was being adequately operated and maintained by the Navy, as noted through site conditions that were consistent with those reported in the annual Landfill and Shoreline Protection System Inspection Reports (U.S. Navy, 2009b, 2010f, 2011d, 2012b, 2013b, and 2014b).

During the survey, high tide prohibited access to the entire shoreline, however, the inspection team was able to access portions of the Low Energy Area where shoreline improvements were made in 2012 and 2014 as interim measures to provide immediate protection of the shoreline in the area between Transects 8 and 9. The larger armoring stones placed between Transects 8 and 9 were intact, however, when compared to photographs taken immediately following the 2014 improvements, it appears that some of the smaller aggregate had eroded away from the rock revetment and migrated to the beach face in the last seven months. Despite this limited erosion, the 2014 shoreline improvements in the Low Energy Area did appear to be providing interim protection of the shoreline between Transects 8 and 9.

Appendices B and C provide the completed site inspection checklist and representative photographs taken during the site inspection.

6.7 Site Interviews

Interviews were conducted with persons familiar with the environmental response actions at NAVMAG Indian Island. Interviewees were selected from the Navy, EPA, Ecology, and Native American Tribes with usual and accustomed (U&A) treaty harvest rights at the installation. Interview instructions and questions were sent to potential interviewees via U.S. mail and e-mail, and responses to questions were returned in the same manner. Not all of those contacted to provide comment responded to the request. Interview responses are documented in Appendix D. Highlights of the interview responses are summarized in the following subsections.

An invitation for community input was published in the first public notice; however, no community members have provided input.

6.7.1 Navy Personnel and Contractors. Personnel from NAVFAC NW and a Navy contractor were interviewed for this five-year review. The NAVFAC NW respondent had not been involved with the project for long but generally felt that, overall, the remedies were in good condition and that regular inspections and maintenance were being performed. The shoreline erosion was noted and shoreline protection action was taken in 2013. The Navy subcontractor respondent has been involved with the NAVMAG Indian Island sites since 2007 and noted no significant changes that impact the remedy. He indicated some localized shoreline erosion at and near the high-low energy transition zone had been repaired and confirmed that monitoring has been conducted regularly at Site 10 with annual IC inspections being added in 2012 for Site 36 and the HWSA to increase overall protectiveness of the remedy.

6.7.2 Agency Personnel. EPA and Ecology were invited to comment as part of the interview process. The EPA interviewee was not aware of any new information that would call into question the protectiveness of the remedies, or any changes to applicable or relevant and appropriate requirements (ARARs) that would impact the remedies at this site. EPA has had little involvement with any activities or issues at this site since the last five-year review but the respondent added that a project manager should be in place for the site to review the draft five-year review report.

The interviewee from Ecology has been involved in the implementation of the current O&M Plan and has visited/inspected the site when necessary since the last five-year review. The interviewee was not aware of any new information that would call into question the protectiveness of the remedies, or any changes to ARARs that would impact the remedies at this site. Results of long-term groundwater monitoring and landfill/shoreline protection system inspections to date indicate that all remedies are performing as expected.

6.7.3 Native American Tribes. Members of the native American Tribes with U&A treaty rights at the installation were invited to comment. Two representatives from tribal organizations responded. The Lower Elwha Klallam representative was unfamiliar with the ROD but has been involved in actively harvesting intertidal clams in the area and communicated that he has noticed increased security protocols but has no concerns regarding the site. The shellfish manager for the Jamestown S'Klallam Tribe raised concerns regarding the consumption rate used to evaluate shellfish ingestion and expressed an interest in having the U.S. Navy conduct additional evaluations of shellfish tissue in the future. However, based on the information provided by the Jamestown S'Klallam representative, it appears that the shellfish ingestion concerns may be related to a two-fold increase in the shellfish ingestion rate (based on ingestion rates reported for the Suquamish Tribe), which was evaluated in the third five-year review. The results of this evaluation demonstrated that there was no unacceptable risk and that the current remedy was protective, even when taking the increased consumption rate into consideration.

Section 7.0: TECHNICAL ASSESSMENT

One site at NAVMAG Indian Island, Site 10, has a ROD-selected remedy in place. To assess the continued protectiveness of the remedy for Site 10, each component is discussed in Section 7.1 below.

The remedies are complete for the remaining sites listed in the ROD and the post-ROD sites, including Sites 21, 33, 34, 35, and EO101, and have no further ongoing monitoring, evaluation, or IC requirements. As a result of the third five-year review, ICs were required for Site 36 and the HWSA due to changes in cleanup levels defined in the MTCA regulations. The following section provides the technical assessment for Site 10, Site 36 and the HWSA.

7.1 Site 10

The remedy for Site 10 involves many components, including a landfill cap, surface drainage, passive gas vents, a shoreline protection system, groundwater monitoring requirements, ICs, and reporting requirements. A conceptual site model for Site 10 with the current remedy in place is provided in Figure 7-1. Consistent with Navy and EPA guidance, the technical assessment evaluated the individual components to determine if the remedy remains protective of human health and the environment as specified in the ROD. The three questions of remedy protectiveness for Site 10 are provided in Sections 7.1.1 through 7.1.3.

7.1.1 Question A: Is the Remedy at Site 10 Functioning as Intended by the ROD?

Yes, the remedy established in the ROD[1] and amended in the ESD[1] is functioning as intended:

- ✓ Annual inspections[2] of all remedy components have been performed in accordance with O&M Plans[3].
- ✓ The landfill cap, surface drainage, passive gas vents, and perimeter road remain functional and have required little to no maintenance during the past five years.
- ✓ Vegetated geogrids along the perimeter of the landfill are functioning as intended with well-established vegetation.
- ✓ Shoreline protection has presented challenges to the remedy, however interim augmentations of the armor rock system in 2012 and 2014 have stabilized the shoreline.
- ✓ Groundwater monitoring results indicate stable conditions.
- ✓ Annual inspections and maintenance effectively support the functionality of the remedy.
- ✓ Appropriate O&M programs and funding are in place to meet inspection and maintenance requirements necessary for continued success of the remedy.

Table 7-1 provides a detailed summary of the technical assessment supporting the determination that the remedy at Site 10 is functioning as intended.

[1] The ROD (U.S. Navy et al., 1995) and ESD (U.S. Navy et al., 2004) were reviewed as part of the technical assessment.
[2] Inspection reports reviewed during this technical assessment include U.S. Navy, 2009b, 2010e, 2011c, 2012b, 2013b, and 2014b.
[3] O&M Plans reviewed during this technical assessment include U.S. Navy 2005c and 2012a.

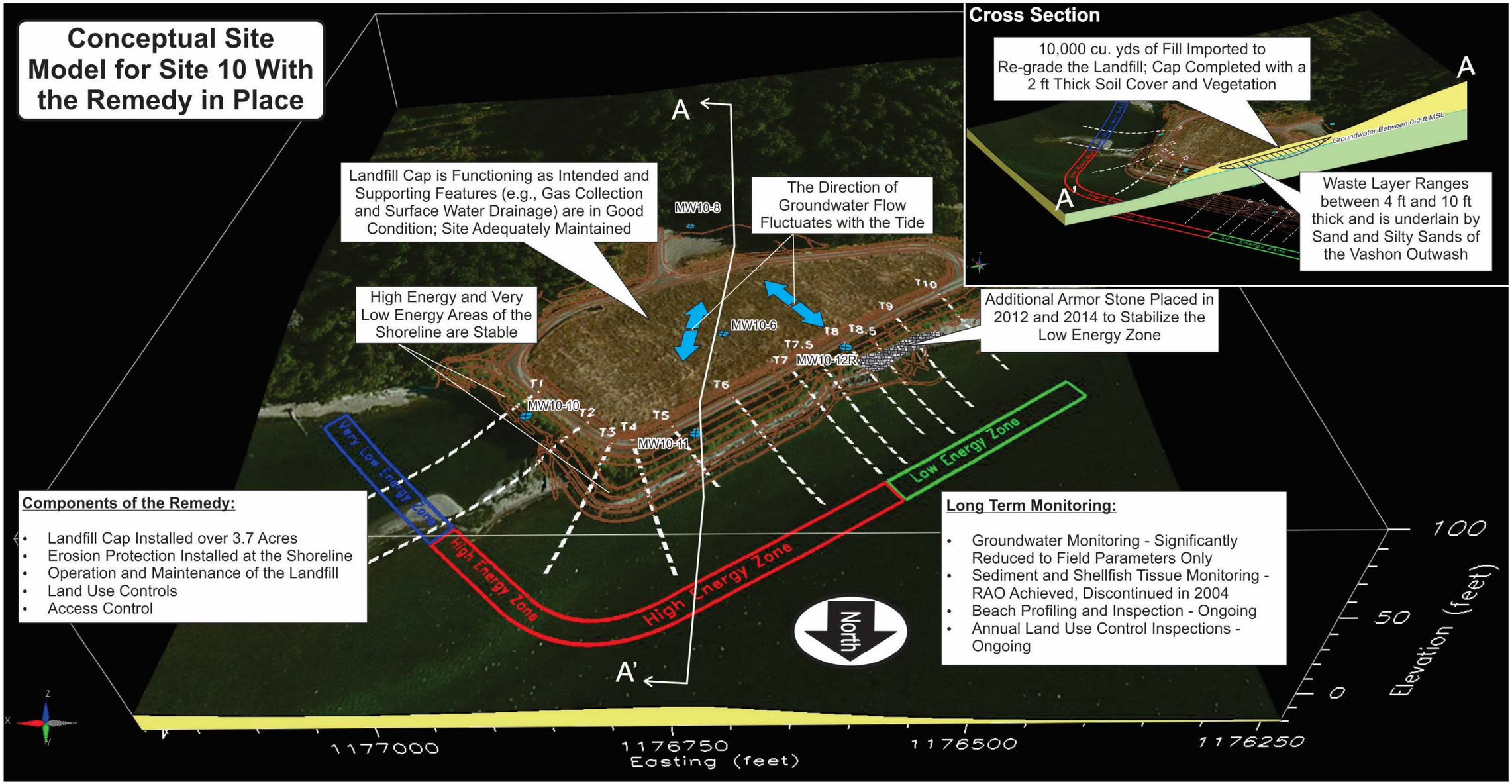


Figure 7-1. Conceptual Site Model for Site 10 with the Selected Remedy in Place

Table 7-1. Detailed Technical Review of the Remedy for Site 10

Landfill Cap
• The landfill cap is functioning as intended by the ROD. • Annual inspections indicate acceptable conditions (i.e., no settling, cracking, breach of the clay liner). • Maintenance activities including weed control have been performed annually.
Landfill Drainage System
• The drainage system is functioning as intended by the ROD. • The system has been inspected annually in accordance with the O&M Plans. • Minor sediment, grass and debris (<0.5 inches) was noted in a culvert in 2014. • No maintenance has been required or performed in the past five years.
Landfill Gas Collection System
• The passive gas collection/vent system is functioning as intended by the ROD. • Minor vegetation encroachment onto the concrete pads was noted in 2009 through 2011; no blockage of the vent pipes occurred; vegetation was removed during the inspections.
Landfill Perimeter Road
• The perimeter road is functioning as intended by the ROD. • Minor potholing has been identified during inspections; backfilled repairs were observed in 2009; size and location of current potholes does not affect the effectiveness of the remedy.
Vegetated Geogrids and Shoreline Protection Systems
• The vegetated geogrid system and shoreline protection systems, as modified, are functioning as intended by the ROD. • Annual inspections between 2009 and 2012 noted significantly more erosion near the geogrid between Transects 8 and 8.5 compared to previous inspections. Significant erosion surrounding groundwater monitoring well MW10-12 led to exposure of the concrete seal in 2010 and exposure of the PVC casing in 2011. Inspections noted that the adjacent geogrid had not been affected. Monitoring well MW10-12 was abandoned in 2011 and replaced with well MW10-12R in 2012. The new well was placed further from the shoreline in between the geogrid and the perimeter road adjacent to the marker for Transect 8. • Undercutting of the lower beach embankment west of Transect 8 was initially noted in 2012; a 60-foot segment of the armor rock shoreline was added in 2012 to mitigate erosion between Transects 8 and 9, around the former location of MW10-12R. Additional fortification occurred in 2014 when existing beach rocks were relocated and placed along the armor rock extension as an interim measure to provide immediate shoreline protection between Transects 8 and 9. • During the 2015 five-year review site inspection, no erosion was observed in the area between Transects 8 and 9 and no additional repairs are required (see photograph 7 of Appendix C), suggesting that the 2012 and 2014 improvements are functioning as intended. • Minor erosion (approximately 10 linear feet) was noted at the top of the armor rock revetment southwest of Transect 7.5 and east of Transect 5 in 2013, however, no repairs were warranted at the time as the erosion did not appear to affect the remedy. • The anchored log revetment system initially installed along the high- to low-energy beach transition has been consistently reported as ineffective. The third five-year review recommended an engineering analysis be performed to identify a long-term solution. Two iterations of shoreline protection design analyses have been performed[4], however no revisions to the current system have been made based on the recommended designs. • While the shoreline was subject to erosion and repaired over the last five years, the adjacent geogrids have remained intact and have functioned as intended. As a result, there has been no threat of landfill waste being released to the environment. • The current approach of placing additional armoring rock on an as-needed basis is cost effective and more favorable to stakeholders that have an interest in shellfish harvesting at NAVMAG Indian Island. Therefore, as long as shoreline inspections are conducted and additional armoring stone is placed as needed, the implementation of an engineered shoreline design (i.e., either the 2010 or 2013 design) is not necessary to maintain shoreline stability. • Annual shoreline inspections will continue to be implemented in accordance with the O&M Plan for Site 10. If future shoreline inspections find that erosion is threatening the stability of the shoreline and adjacent geogrids, measures will be taken to restore and armor the affected portion of the shoreline. • Similar to the approach used in 2014 (U.S. Navy, 2014a), an abbreviated work plan would be developed to clearly define the impacted portion of the shoreline and describe the measures to be taken to stabilize the affected area and ensure the protection of the geogrids.

[4] Shoreline protection designs reviewed included U.S. Navy 2010a, 2010b, and 2013c.

Table 7-1. Detailed Technical Review of the Remedy for Site 10 (Continued)

Groundwater Monitoring
• The groundwater monitoring component of the remedy is functioning as intended by the ROD. • Ten monitoring events[5] were performed since the third five-year review and monitored only geochemical parameters in the field in accordance with the O&M Plan. Fluctuations in dissolved oxygen and oxidation-reduction potential exceeded the Tier I criteria in consecutive semi-annual events in 2013-2014. However, escalation of the monitoring to perform Tier II sampling (laboratory based chemical analyses) was not warranted according to reports. • Dissolved oxygen measurements have been problematic in the field where correlation between results of water quality probes and field titration test kits have been poor. It is recommended to reevaluate the use of the titration test kits for future events. • Consistent with the findings of the third five-year review, under the physical conditions observed and documented over the past 17 years, leaching conditions remain stable across the site based on water quality parameters. • Based on discussions with stakeholders[6], the current groundwater monitoring program should represent an early detection system that can identify changes in site conditions prior to a significant breach of the landfill cap. Reevaluation of the groundwater monitoring program should be performed to determine more appropriate monitoring approaches to provide usable data that can more effectively monitor the protectiveness of the remedy.
Institutional Controls
• The ICs are functioning as intended by the ROD and the ESD. • IC inspections have been performed every year during the five-year review period. • Following finalization of the most recent O&M Plan, IC inspection checklists were provided in the site inspection reports. • ICs prohibiting residential use and farming are in place. • No intrusive activities potentially affecting the landfill cap integrity have been documented within the past five years. • Conflicting language is present in the O&M Plan regarding the shellfish harvesting restriction due to site contamination. The ban was lifted prior to the second five-year review, however the beaches surrounding the site remain within the explosive arc of the ammunition pier and therefore have a use restriction. The O&M Plan should be revised to specify the current use restrictions. There should be no expectation that ICs be maintained for shellfish harvesting based on site contamination.
Reporting
• The reporting component of the remedy is functioning as intended by the ROD and the ESD. • Annual reporting is provided as two separate documents, a "Landfill and Shoreline Protection System Inspection Report" and a "Groundwater Monitoring Report." Future reporting should be limited to one annual document capturing all aspects of the remedy evaluation. • Five-year reviews have been consistently performed in accordance with CERCLA.

7.1.2 Question B: Are the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives used at the Time of Remedy Still Valid?

Yes, the exposure assumptions, toxicity data, cleanup levels, and RAOs remain valid:

- ✓ All of the RAOs remain valid.
- ✓ The remedy for Site 10 has effectively met all RAOs established in the ROD.
- ✓ The cleanup levels provided via ARARs in the ROD remain valid.

Table 7-2 provides a detailed summary of the technical assessment supporting the determination that the exposure assumptions, toxicity data, cleanup levels, and RAOs used at the time of the remedy remain valid.

[5] Seven groundwater monitoring reports were reviewed during this technical assessment (U.S. Navy, 2009a, 2010d, 2011b, 2012c, 2013a, and 2014b).

[6] A kickoff meeting with the Navy, EPA, Ecology, and Navy contractors was held on February 18, 2015.

Table 7-2. Detailed Review of the Exposure Assumptions, Toxicity Data, Cleanup Levels, and Remedial Action Objectives for Site 10

Exposure Assumptions
• The third five-year review documented an elevated shellfish consumption rate for the Suquamish Tribe (Suquamish, 2000) that nearly doubled the consumption rate used in the baseline human health risk evaluation. However, an evaluation of the associated risk represented by the change in risk assessment assumptions did not affect the protectiveness of the Site 10 remedy. • The shellfish consumption rates provided in the third five-year review remain unchanged based on recent surveys from Ecology (Ecology, 2013). • All other exposure assumptions documented in the ROD remain valid.
Toxicity Data
• COCs that were above background include cadmium, chromium, copper, lead, mercury, selenium, silver, and zinc; EPA regional screening levels were reviewed to identify any changes in toxicity values for these metals that would affect the protectiveness of the remedy for Site 10. • No changes in toxicity values were found that would affect the protectiveness of the remedy for Site 10.
Cleanup Levels
• The ROD did not list specific numeric remedial goals for Site 10, but only stated that ARARs would be complied with. • No changes to ARARs were identified that affect the protectiveness of the remedy. • The Washington State Sediment Management Standard (Chapter 173-204 WAC) was revised in 2013, however no changes were made that affect the remedy. No sediment sample has exceeded the Sediment Management Standard and sediment monitoring was discontinued prior to the second five-year review. • The Water Quality Standards for Surface Waters of the State of Washington (Chapter 173-201A WAC) were revised in 2011, however no changes were made that affect the remedy. Groundwater concentrations of chemical compounds have historically been compared to, and met these surface water criteria. Evaluation of chemical compounds in groundwater was discontinued in 2002. • The Model Toxics Control Act Regulation and Statute (Chapter 173-340 WAC) was revised in 2013, however no changes were made that affect the remedy.
Remedial Action Objectives Established in the ROD

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

7.1.3 Question C: Has Any Other Information Come to Light that Could Call into Question the Protectiveness of the Remedy?

No. The remedy remains protective of human health and the environment.

7.2 Site 36

Based on removal excavations conducted in January and May of 2001, Site 36 was approved for NFA. The third five-year review included an analysis of residual cPAH concentrations remaining at Site 36, which determined that several sampling locations exhibited cPAH concentrations above the current MTCA Method A unrestricted screening level of 0.1 mg/kg. Since the third five-year review, residential use of the property (including the installation of potable wells) and farming have been restricted at Site 36 and IC inspection checklists have been completed on an annual basis. No additional changes to cleanup levels or toxicity values have been identified since the last five-year review. However, as part of this

fourth five-year review, residual cPAH data were reassessed to verify whether ICs are necessary for Site 36. As shown in Table 7-3, this risk evaluation estimates total cancer risk from cPAHs at Site 36 using maximum detected concentrations and MTCA Method B screening levels based on default assumptions for unrestricted site use. Based on this evaluation, benzo(a)pyrene and benzo(b)fluoranthene contribute an individual cancer risk in excess of 1×10^{-6}, however, total cancer risk (6.18×10^{-6}) is below 1×10^{-5} when all cPAHs are considered. This evaluation provides a conservative representation of conditions at Site 36 and supports that residual cancer risk is low. As a result, consideration should be given to removing the ICs that were implemented based on recommendations from the third five-year review.

Table 7-3. Cancer Risk from Maximum Detected cPAH Concentrations (mg/kg) at Site 36

cPAHs	MTCA Method B	Max Detected	Cancer Risk
Benzo(a)anthracene	1.37	0.55	4.02E-07
Chrysene	137	1.5	1.10E-08
Benzo(b)fluoranthene	1.37	2.2	1.61E-06
Benzo(k)fluoranthene	13.7	0.08 J	5.84E-09
Benzo(a)pyrene	0.137	0.52	3.80E-06
Indeno(1,2,3-cd)pyrene	1.37	0.36	2.63E-07
Dibenz(a,h)anthracene	0.137	0.013	9.49E-08
		Total Cancer Risk:	6.18E-06

7.3 HWSA

The HWSA was closed under the RCRA program without restrictions in 1998. The third five-year review included an analysis of residual cPAH concentrations remaining at HWSA, which determined that several sampling locations exhibited cPAH concentrations above the current MTCA Method A unrestricted screening level of 0.1 mg/kg. Since the third five-year review, residential use of the property (including the installation of potable wells) and farming have been restricted at the HWSA and IC inspection checklists have been completed on an annual basis. No additional changes to cleanup levels or toxicity values have been identified since the last five-year review. However, as part of this fourth five-year review, residual cPAH data were reassessed to verify whether ICs are necessary for the HWSA. As shown in Table 7-4, this risk evaluation estimates total cancer risk from cPAHs at the HWSA using maximum detected concentrations and MTCA Method B screening levels based on default assumptions for unrestricted site use. Based on this evaluation, benzo(a)pyrene contributes an individual cancer risk in excess of 1×10^{-6}, however, total cancer risk (1.79×10^{-6}) is below 1×10^{-5} when all cPAHs are considered. This evaluation provides a conservative representation of conditions at the HWSA and supports that residual cancer risk is low. As a result, consideration should be given to removing the ICs that were implemented based on recommendations from the third five-year review.

Table 7-4. Cancer Risk from Maximum Detected cPAH Concentrations (mg/kg) at the HWSA

cPAHs	MTCA Method B	Max Detected		Cancer Risk
Benzo(a)anthracene	1.37	0.14	J	1.02E-07
Chrysene	137	0.22	J	1.61E-09
Benzo(b)fluoranthene	1.37	0.22	J	1.61E-07
Benzo(k)fluoranthene	13.7	0.12	J	8.76E-09
Benzo(a)pyrene	0.137	0.16	J	1.17E-06
Indeno(1,2,3-cd)pyrene	1.37	0.072	J	5.26E-08
Dibenz(a,h)anthracene	0.137	0.04	J	2.92E-07
		Total Cancer Risk:		1.79E-06

Section 8.0: ISSUES, RECOMMENDATIONS AND FOLLOW-UP ACTIONS

This section identifies any issues and presents recommendations and follow-up actions identified as a result of the five-year review process. None of the issues identified affect the current protectiveness of the remedies associated with the ROD and post-ROD sites. The issues and recommended actions include (1) actions necessary to ensure long-term protectiveness of certain remedy components; (2) actions that do not affect protectiveness, but are necessary to achieve or maintain compliance with implementation plans; (3) actions resulting from RAOs having been met; and (4) other actions recommended as optimization measures to streamline the environmental program at NAVMAG Indian Island. A detailed summary of issues, recommendations, and follow-up actions is provided in Table 8-1.

Table 8-1. Summary of Issues, Recommendations and Follow-Up Actions

Issues	Affects Protectiveness		Recommendations/ Follow Up Actions	Party Responsible	Oversight Agency	Milestone Date
	Current	Future				
The O&M Plan prescribes annual profiling across Transects 8 through 11, and every five years across all transects to support the five-year review process. Multiple rounds of shoreline improvements were conducted since the last five-year review, which altered the beach contours. Surveying was not conducted in accordance with the O&M Plan because results for Transects 8 through 11 would not have provided comparable data. As a result, only one quantitative beach profile was performed at Site 10 (in 2012) over the last five-year period.	N	Y	Perform quantitative beach profiling as outlined in the O&M Plan until the transitional area of high-to-low energy beach has stabilized. Following stabilization concurrence from stakeholders, the O&M Plan should be revised to document any changes to the profiling program. In the event that shoreline improvements are made in a given year, the survey transect for the corresponding year should be conducted after the improvements are completed to serve as new baseline for future comparison.	Navy	Ecology	June 31, 2016
The approved groundwater monitoring regime has been limited to water quality parameters since 2002. However, this may not adequately identify critical changes indicating contaminant migration.	N	Y	Reevaluate the groundwater monitoring program to determine if the use of water quality parameters alone is sufficient to monitor the protectiveness of the remedy.	Navy	Ecology	June 31, 2016

Table 8-1. Summary of Issues, Recommendations and Follow-Up Actions (Continued)

Issues	Affects Protectiveness		Recommendations/ Follow Up Actions	Party Responsible	Oversight Agency	Milestone Date
	Current	Future				
The 2012 O&M Plan contains conflicting information regarding shellfish harvest restrictions associated with Site 10.	N	N	The O&M Plan should clarify that based on the results of shellfish tissue sampling, the related remedial action objective was achieved and the harvesting ban was lifted prior to the second five-year review. While the beaches surrounding the site remain within the explosive arc as mandated by NAVSEA OP-5 Volume 1(U.S. Navy, 2010a), this restriction is incidental and not related to the protectiveness of shellfish consumption.	Navy	Ecology	December 31, 2015
The third five-year review recommended ICs be placed on Site 36 and the HWSA based on residual cPAHs detected in soil.	N	N	Residual risks at Site 36 and the HWSA are low (between 1×10^{-5} and 1×10^{-6}) and these ICs should be removed.	Navy	Ecology	December 31, 2015

Section 9.0: PROTECTIVENESS STATEMENT

The remedies at the sites included in the ROD for NAVMAG Indian Island, as well as other Indian Island sites addressed under other cleanup programs (e.g., RCRA and the MTCA), referred to as post-ROD sites, have been implemented and are currently protective of human health and the environment, given the current land use. Ongoing monitoring and maintenance of Site 10 will continue to be required in the long term. Maintenance of ICs at Site 10 is also required to ensure protectiveness of the remedy. Residual risks at Site 36 and the HWSA are low, such that ICs are no longer required for these sites to be considered protective.

Section 10.0: NEXT REVIEW

The next five-year review is scheduled for 2020.

Section 11.0: REFERENCES

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Appendix A:
Crosswalk between CERCLA Five-Year Review and MTCA Periodic Review

Crosswalk between CERCLA Five-Year Review Elements and the MCTA Periodic Review Criteria

CERCLA Five-Year Review Element	MTCA Periodic Review Criteria	Site 10 Discussion[1]	Site 36 Discussion[2]	HWSA Discussion[2]
Is the remedy functioning as intended in the decision documents?		Yes. See Section 7.1.1.	Yes. See Section 7.2.	Yes. See Section 7.3.
Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives used at the time of the remedy still valid?		Yes. See Section 7.1.2.	Yes. See Section 7.2.	Yes. See Section 7.3.
Has other information come to light that could call into question the protectiveness of the remedy?		No. See Section 7.1.3.	No. See Section 7.2.	No. See Section 7.3.
	The effectiveness of ongoing or completed clean-up actions, including the effectiveness of engineering controls and institutional controls in limiting exposure to hazardous substances remaining at the site [WAC 173-340-420 (4) (a)]	Discussed in Sections 7.1.1 and 7.1.2.	Discussed in Section 7.2.	Discussed in Section 7.3.
	New scientific information for individual hazardous substances or mixtures	Discussed in Section 7.1.2.	Discussed in Section 7.2.	Discussed in Section 7.3.

[1] This is a CERCLA site.
[2] Site 36 and the Former Hazardous Waste Storage Area (HWSA) are not CERCLA sites but the Navy, as a matter of policy, follows the CERCLA five-year review process to the maximum extent practical at these sites.

Crosswalk between CERCLA Five-Year Review Elements and the MCTA Periodic Review Criteria

CERCLA Five-Year Review Element	MTCA Periodic Review Criteria	Site 10 Discussion[1]	Site 36 Discussion[2]	HWSA Discussion[2]
	present at the site [WAC 173-340-420 (4) (b)]			
	New applicable state and federal laws for hazardous substances present at the site [WAC 173-340-420 (4) (c)]	Discussed in Section 7.1.2.	The characterization and remedial actions at Site 36 were governed by Chapter 173-340 WAC. WAC 173-340-702 (12) (b) [2007 ed.] provides that, "In reviewing the adequacy of independent remedial actions, the department shall determine the cleanup level that applies to a release based on the rules in effect at the time of the final cleanup actions for that release began or in effect when the department reviews that cleanup action, whichever is less stringent." Soil samples collected in 2001 met MTCA criteria and the site was approved for NFA. During the third five year review, MTCA Method A screening levels were found to have changed from 1 mg/kg to 0.1 mg/kg for cPAHs [WAC 173-340-704 (2) (a)], and the report concluded that institutional controls were warranted	The characterization and remedial actions at the former HWSA were governed by Chapter 173-340 WAC. WAC 173-340-702 (12) (b) [2007 ed.] provides that, "In reviewing the adequacy of independent remedial actions, the department shall determine the cleanup level that applies to a release based on the rules in effect at the time of the final cleanup actions for that release began or in effect when the department reviews that cleanup action, whichever is less stringent." Soil samples collected in 1998 met MTCA criteria and the site was approved for NFA. During the third five year review, MTCA Method A screening levels were found to have changed from 1 mg/kg to 0.1 mg/kg for cPAHs [WAC 173-340-704 (2) (a)], and the report concluded that institutional

Crosswalk between CERCLA Five-Year Review Elements and the MCTA Periodic Review Criteria

CERCLA Five-Year Review Element	MTCA Periodic Review Criteria	Site 10 Discussion[1]	Site 36 Discussion[2]	HWSA Discussion[2]
			based on residual risk. However, based on assessment of MTCA Method B criteria [WAC 173-340-705 (4)], residual risk is below the 1×10^{-5} risk tolerance and therefore the Site meets the requirements for No Further Action. See Section 7.2.	controls were warranted based on residual risk. However, based on assessment of MTCA Method B criteria [WAC 173-340-705 (4)], residual risk is below the 1×10^{-5} risk tolerance and therefore the Site meets the requirements for No Further Action. See Section 7.3.
	Current and projected site and resource uses [WAC 173-340-420 (4) (d)]	Not applicable – not a MTCA site.	The Site is a vacant lot near military magazines and industrial buildings at an active Navy installation. There have been no changes in current or projected future Site or resource uses. Residual risk from site contaminants does not warrant the continuation of institutional controls. See Sections 3.2 and 7.2.	The Site is currently used for industrial purposes. There have been no changes in current or projected future Site or resource uses. Residual risk from site contaminants does not warrant the continuation of institutional controls. See Sections 3.3 and 7.3.
	The availability and practicality of more permanent remedies [WAC 173-340-420 (4) (e)]	Not applicable – not a MTCA site.	Institutional controls are not necessary at this Site to be protective of human health and the environment.	Institutional controls are not necessary at this Site to be protective of human health and the environment.
	The availability of improved analytical techniques to evaluate compliance with clean-up levels [WAC 173-	Not applicable – not a MTCA site.	The analytical methods used at the time of the removal actions and issuance of the No Further Action opinion	The analytical methods used at the time of the removal actions and issuance of the No Further Action opinion

Crosswalk between CERCLA Five-Year Review Elements and the MCTA Periodic Review Criteria

CERCLA Five-Year Review Element	MTCA Periodic Review Criteria	Site 10 Discussion[1]	Site 36 Discussion[2]	HWSA Discussion[2]
	340-420 (4) (f)]		were capable of detection below MTCA cleanup levels. The presence of improved analytical techniques would not affect decisions or recommendations made for the Site.	were capable of detection below MTCA cleanup levels. The presence of improved analytical techniques would not affect decisions or recommendations made for the Site.

Appendix B:
Site Inspection Checklist

I. SITE INFORMATION	
Site name: *Naval Magazine Indian Island*	**Date of inspection:** *01/15/2015*
Location and Region: *Port Hadlock, WA, Region 10*	**EPA ID:** *WA4170090001*
Agency, office, or company leading the five-year review: *US Navy NAVFAC NW*	**Weather/temperature:**

Remedy Includes: (Check all that apply)

☒ Landfill cover/containment
☒ Access controls
☒ Institutional controls
☐ Groundwater pump and treatment
☐ Surface water collection and treatment
☒ Other: *Shoreline erosion protection, monitoring of groundwater, sediment, and shellfish*
☐ Monitored natural attenuation
☐ Groundwater containment
☐ Vertical barrier walls

Attachments: ☐ Inspection team roster attached ☐ Site map attached

II. INTERVIEWS (Check all that apply)

1. **Navy Staff**

Contact: *Carlotta Cellucci*
Problems; suggestions; ☒ Report attached (Appendix C)

Contact: *Bill Kalina*
Problems; suggestions; ☒ Report attached (Appendix C)

Contact : *Jim Reuf (Sealaska)*
Problems; suggestions; ☒ Report attached (Appendix C)

2. **Regulatory and Tribal authorities and response agencies**

Agency: *Ecology*
Contact : *Ben Forson*
Problems; suggestions; ☒ Report attached (Appendix C)

Agency : *EPA*
Contact: *Dennis Falk*
Problems; suggestions; ☒ Report attached (Appendix C)

Agency : *Port Gamble S'Klallam Tribe*
Contact: *Paul McCollum*
Problems; suggestions; ☒ Report attached (Appendix C – Response Expected)

Agency : *Jamestown S'Klallam Tribe*
Contact: *Kelly Toy*
Problems; suggestions; ☒ Report attached (Appendix C)

Agency : *Lower Elwha Klallam Tribe*
Contact: *Doug Morrill*
Problems; suggestions; ☒ Report attached (Appendix C)

3. **Other interviews** (optional) ☐ Report attached.

III. ON-SITE DOCUMENTS & RECORDS VERIFIED (Check all that apply)

1. **O&M Records**

☒ O&M manual	☒ Readily available	☒ Up to date	☐ N/A
☒ As-built drawings	☒ Readily available	☒ Up to date	☐ N/A
☒ Maintenance logs	☒ Readily available	☒ Up to date	☐ N/A

Remarks: *Onsite files are maintained by Bill Kalina; files are also maintained by NAVFAC NW in electronic formats and in the Administrative Record.*

2. **Institutional Controls Inspection Records** ☒Readily available ☒ Up to date

Remarks: *For Site 36 and the Hazardous Waste Storage Area, IC inspections were initiated in 2012 and have been conducted annually. Inspection forms for all sites have been included in the annual inspection report for Site 10.*

IV. O&M COSTS

1. **O&M Organization**

☐ State in-house	☐ Contractor for State
☐ PRP in-house	☐ Contractor for PRP
☒ Federal Facility in-house	☒ Contractor for Federal Facility

☐ Other_____

Remarks: *A majority of the O&M is conducted by Sealaska under contract with NAVFAC NW. In 2012, the Navy Seabees self-performed a shoreline stabilization effort that involved the placement of armoring stone in the low energy zone of the Site 10 shoreline.*

2. **O&M Cost Records**

☒ Readily available ☒ Up to date
☒ Funding mechanism/agreement in place
Original O&M cost estimate: *$81,200 annually*

Total annual cost by year for review period if available: *Annual average has been $63,386 based on reported annual O&M task order award values (see below).*

- FY2009: *53,533.72*
- FY 2010: *53,533.72*
- FY2011: *66,358.39*
- FY2012: *62,748.00*
- FY2013: *56,810.41*
- FY2014: *100,265.00*
- FY2015: *52,952.79*

3. **Unanticipated or Unusually High O&M Costs During Review Period**

Describe costs and reasons: *Costs for Long-Term O&M are consistent and reasonable. Increased costs in 2014 included scope for revisions to the site management plan and shoreline stabilization efforts.*

V. ACCESS AND INSTITUTIONAL CONTROLS ☒ Applicable ☐ N/A	
A. General Facility	
1.	**Base security procedures still in force?** ☒ Yes ☐ No Remarks: *Controlled gate, badges required*
B. Site 10	
1.	**Any activities disruptive to landfill cap or shoreline protection?** ☐ Yes ☒ No Remarks: *The vegetation along the northern portion of the landfill cap shows evidence of trampling due to sea otters. However, the cover soil is undisturbed, and there is no evidence of a cap breach.*
2.	**Any residential or farming land use on landfill?** ☐ Yes ☒ No
3.	**Any digging or construction activities without dig permit?** ☐ Yes ☒ No Remarks*: Signage surrounding the landfill does not clearly state that digging/construction is not permitted without Base approval. The shellfish harvesting restrictions associated with Site 10 are no longer in place.*
4.	**Any shellfish harvesting apparent on Beaches 1, 2, or 19?** ☐ Yes ☒ No Remarks: *Signage stating that shellfish with potential toxic accumulations remains at Boggy Spit. The shellfish restriction due to contamination has been lifted. A site access restriction remains on the beaches as they are within the explosive arc of the ammunition pier.*
5.	**Shellfish harvest restriction signs intact and legible?** ☒ Yes ☐ No Remarks: *Only one sign was identified, at Boggy Spit, indicating that the surrounding beaches have a shellfish restriction. These signs are no longer necessary because shellfish harvesting restrictions were removed as a result of the third five-year review.*
C. Site 36	
1.	**Any water wells installed?** ☐ Yes ☒ No
2.	**Any residential or farming land use on the site?** ☐ Yes ☒ No
D. HWSA	
1.	**Any water wells installed?** ☐ Yes ☒ No
2.	**Any residential or farming land use on the site?** ☐ Yes ☒ No
E. Overall Institutional Controls	
1.	**Implementation and enforcement** Site conditions imply ICs properly implemented ☒ Yes ☐ No Site conditions imply ICs being fully enforced ☒ Yes ☐ No Type of monitoring (*e.g.*, self-reporting, drive by): *Self Reporting* Frequency: *Annual* Responsible party: *Navy* Contact: *Carlotta Cellucci, Remedial Project Manager, (360) 396-1518, carlotta.cellucci@navy.mil* Reporting is up-to-date ☒ Yes ☐ No Specific requirements in decision documents have been met ☒ Yes ☐ No Violations have been reported ☐ Yes ☒ No Other problems or suggestions: ☐ Report attached

2.	**Adequacy**	☒ ICs are adequate	☐ ICs are inadequate	☐ N/A
	Remarks: *Shellfish harvesting restrictions based on contamination are no longer required. Signage and language with the O&M Plan should be revised to identify current shellfish harvest restrictions are due to the explosive arc of the ammunition pier.*			
VI. REMEDY COMPONENTS (GENERAL VISUAL INSPECTION)				
A. Perimeter Road (Site 10)		☒ Applicable	☐ N/A	
1.	**Roads damaged**	☐ Location shown on site map	☒ Roads adequate	☐ N/A
	Remarks: *Minor potholing located along perimeter road, consistent with annual inspection reports. No potholes affect the integrity of the landfill remedy.*			
B. Landfill Cap and Shoreline Protection (Site 10)				
1.	**Settlement** (Low spots)	☐ Location shown on site map	☒ Settlement not evident	
2.	**Cracks**	☐ Location shown on site map	☒ Cracking not evident	
3.	**Erosion**	☐ Location shown on site map	☒ Erosion not evident	
4.	**Holes**	☐ Location shown on site map	☒ Holes not evident	
5.	**Vegetative Cover**	☒ Grass	☒ Cover properly established	☐ No signs of stress
	☒ Trees/Shrubs (indicate size and locations on a diagram)			
	Remarks: *Willow trees well established across vegetated geogrid system. Grasses stressed along the northern edge of the landfill cap due to sea otter encroachment. No trees or other vegetation observed penetrating the landfill cap.*			
6.	**Irrigation System**	☒ Not Functional	☐ Functional	☐ Damaged
	Remarks: *Irrigation system has been discontinued.*			
7.	**Bulges**	☐ Location shown on site map	☒ Bulges not evident	
8.	**Wet Areas/Water Damage**	☒ Wet areas/water damage not evident		
9.	**Slope Instability**	☐ Slides	☐ Location shown on site map	☒ No evidence of slope instability
10.	**Gas Vents**	☐ Active	☒ Passive	
	☐ Properly secured/locked	☒ Functioning	☐ Routinely sampled	☒ Good condition
	☐ Evidence of leakage at penetration		☐ Needs Maintenance	
	☐ N/A			
	Remarks: *Passive gas vents are functioning as intended and clear of debris.*			
11.	**Monitoring Wells** (within surface area of landfill)			
	☒ Properly secured/locked	☒ Functioning	☒ Routinely sampled	☐ Good condition
	☒ Evidence of leakage at penetration		☒ Needs Maintenance	☐ N/A
	Remarks: *Lids to flush mounted monitoring well vaults have loose/stripped bolts allowing water to penetrate into the vault. Repair of the vault lids is warranted.*			
C. Landfill Cover Drainage Layer (Site 10)		☒ Applicable	☐ N/A	
1.	**Outlet Pipes Inspected**	☒ Functioning	☐ N/A	
	Remarks: *Sea otter impacted grass areas along the northern edge of the landfill cover are proximal to drainage culverts and may represent the access route for sea otters to the landfill surface.*			
2.	**Outlet Rock Inspected**	☒ Functioning	☐ N/A	

D. Surface Water Structures at Landfill (Site 10)

1. **Siltation** ☐ Location shown on site map ☒ Siltation not evident

2. **Vegetative Growth** ☐ Location shown on site map ☐ N/A
☒ Vegetation does not impede flow

3. **Erosion** ☐ Location shown on site map ☒ Erosion not evident

4. **Discharge Structure** ☒ Functioning ☐ N/A

E. Log Revetment/Anchor System (Site 10)

1. **Overall Condition**

Condition of logs	☐ Good	☐ Some work needed	☒ Poor
Condition of anchor/chain assembly	☐ Good	☐ Some work needed	☒ Poor
Condition of beach	☒ Good	☐ Some work needed	☐ Poor

Remarks: *Repairs to the armor rock along the transitional zone between the high and low energy beaches appears to be functioning adequately. Unanchored logs remain on the low energy beach. It should be noted that while the condition of the logs and anchor/chain assembly were rated "poor", these features were considered to be a temporary measure to allow stabilizing vegetation to mature. The "poor" ratings do not represent a deficiency because the log revetment has served its purpose and is no longer considered a component of the remedy.*

F. Groundwater, Sediment, and Shellfish Monitoring

1. **Monitoring Wells**
☒ Properly secured/locked ☒ Functioning ☒ Routinely sampled ☐ Good condition
☒ All required wells located ☒ Needs Maintenance ☐ N/A
Remarks *Lids to flush mounted monitoring well vaults have loose/stripped bolts allowing water to penetrate into the vault. Repair of the vault lids is warranted.*

2. **Monitoring**
Types of monitoring being conducted: ☒ Groundwater ☐ Sediment ☐ Shellfish

Frequency: *Semiannual*

Remarks: *Monitoring is limited to water quality parameters including pH, temperature, oxidation-reduction potential (ORP), dissolved oxygen, color, specific conductance and salinity.*

3. **Data Trends**
Describe results and trends: *groundwater results have demonstrated stable conditions over the past 15 years. Temporal fluctuations in some parameters including dissolved oxygen and ORP have been observed to exceed the Tier I criteria established in the O&M Plan, however they are relatively short-lived with conditions returning to long-term values within two to three consecutive monitoring events.*

VII. OVERALL OBSERVATIONS

A. Implementation of the Remedy

Describe issues and observations relating to whether the remedy is effective and functioning as designed. Begin with a brief statement of what the remedy is to accomplish (i.e., to contain contaminant plume, minimize infiltration and gas emission, etc.): *See Technical Assessment (Section 7.0)*

B. Adequacy of O&M

Describe issues and observations related to the implementation and scope of O&M procedures. In particular, discuss their relationship to the current and long-term protectiveness of the remedy. *See Technical Assessment (Section 7.0)*

C. Early Indicators of Potential Remedy Problems

	Describe issues and observations such as unexpected changes in the cost or scope of O&M or a high frequency of unscheduled repairs, that suggest that the protectiveness of the remedy may be compromised in the future. *See Technical Assessment (Section 7.0)*
D.	**Opportunities for Optimization**
	Describe possible opportunities for optimization in monitoring tasks or the operation of the remedy. *See Recommendations (Section 8.0)*

Appendix C:
Annotated Photographs Documenting the Site Inspection

Photograph 1. HWSA fence line looking to the north. LUCs including prohibition of residential, school and farming remain in effect. Taken 01/15/2015.

Photograph 2. HWSA fence line looking to the east. Taken 01/15/2015.

Photograph 3. Site 36 looking to the southwest with broken concrete bollards and railroad tie in the foreground. LUCs including prohibition of residential, school and farming remain in effect. Taken 01/15/2015.

Photograph 4. Site 36 looking to the west with wooden staircase in the center of the photo. Taken 01/15/2015.

Photograph 5. Site 36 looking to the northwest with vehicle parked along access road. Taken 01/15/2015.

Photograph 6. Site 36 looking to the north with vehicle parked along access road. Concrete structure placed to deter vehicular access. Taken 01/15/2015.

Photograph 7. Site 10 looking to the east near Beach Transect 9. Armor rock in central portion of the photo placed in 2014 to bolster shoreline protection between Beach Transects 8 and 9. Loose log in foreground is a remnant of the log revetment system. Taken 01/15/2015.

Photograph 8. Site 10 looking to the east near Beach Transect 10. Foreground shows the low energy beach. Taken 01/15/2015.

Photograph 9. Site 10 looking to the east along the low energy beach near Beach Transect 11. Taken 01/15/2015.

Photograph 10. Site 10 restricted area sign near Beach Transect 11. Taken 01/15/2015.

Photograph 11. Site 10 looking to the southeast along very low energy beach near Beach Transect 2. Tidal lagoon located in the center of the photo is bordered by vegetated geogrids along the right, and log revetment in the background. Taken 01/15/2015.

Photograph 12. Site 10 looking to the west at the transition from the very low energy beach (left) to high energy beach (right) near Beach Transect 2. Taken 01/15/2015.

Photograph 13. Site 10 vegetated geogrid along very low energy beach near Beach Transect 2. Geogrid material is exposed, but vegetation is well established and continues to provide shoreline protection as designed. Taken 01/15/2015.

Photograph 14. Site 10 looking to the north from the perimeter road toward Beach Transect 5 marker post. All Beach Transect marker posts were located during site inspection. Taken 01/15/2015.

Photograph 15. Site 10 looking to the east toward Beach Transect 2 marker posts. Two marker posts (shown in foreground and background) are used during quantitative Beach Transect Profiling. Taken 01/15/2015.

Photograph 16. Site 10 Beach Transect 2 benchmark used as reference location during quantitative Beach Transect Profiling. Taken 01/15/2015.

Photograph 17. Site 10 looking to the east along perimeter road near Beach Transect 9. Surface water drainage ditch immediately to the right of the road with grass-vegetated landfill cap on the right side of the photo. LUCs including prohibition of residential, school and farming remain in effect. Taken 01/15/2015.

Photograph 18. Site 10 looking to the east near Beach Transect 7. Foreground shows trampled grass area impacted by river otter activity. Taken 01/15/2015.

Photograph 19. Site 10 looking to the southeast near Beach Transect 4. Foreground shows trampled grass area impacted by river otter activity. Concrete surface water culvert is located on the left. Taken 01/15/2015.

Photograph 20. Site 10 storm water 18-inch drainage pipe on right, and 24-inch overflow pipe with weir gate on left. Taken 01/15/2015.

Photograph 21. Site 10 passive gas vents 1 through 4. Vents are functional; openings are clear of vegetation and debris. Taken 01/15/2015.

Photograph 22. Site 10 passive gas vents 5 through 7. Vents are functional; openings are clear of vegetation and debris. Taken 01/15/2015.

Photograph 23. Site 10 benchmark for Beach Transect Profiling located within the passive gas vents 5-7 enclosure. Taken 01/15/2015.

Photograph 24. Site 10 monitoring well MW10-6 in the center of the landfill cap. One vault lid bolt is missing, and remaining bolts stripped. Well cap was secured with a pad lock. Taken 01/15/2015.

Photograph 25. Site 10 replacement monitoring well MW10-12R installed November 9, 2012 near marker post for Beach Transect 8. Taken 01/15/2015.

Photograph 26. Site 10 monitoring well MW10-10 near marker post for Beach Transect 2. Vault lid is secured by pad lock. Well is functional and in good condition. Taken 01/15/2015.

Photograph 27. Site 10 monitoring well MW10-11 near head marker for Beach Transect 5. Vault lid is secured by pad lock. Well is functional and in good condition. Taken 01/15/2015.

Photograph 28. Sign prohibiting shellfish harvesting; Boggy Spit in the left-center of the photo. No shellfish prohibition signs present near the landfill. Taken 01/15/2015.

Photograph 29. Close-up photo of sign prohibiting shellfish harvesting at Boggy Spit. Taken 01/15/2015.

Appendix D:
Interview Responses

Last Name	First Name	Affiliation	Status
Agency			
Forson	Ben	Washington State Department of Ecology, Toxics Cleanup Program	Form Received 2/2/2015
Faulk	Dennis	U.S. EPA Region 10	Form Received 2/10/2015
Tribe			
McCollum	Paul	Port Gamble S'Klallam Tribe, Director - Natural Resources Dept.	Reply received indicating the interview form would be provided by 2/19/2015; not yet received
Toy	Kelly	Jamestown S'Klallam Tribe, Environmental Program Manager	Form Received 2/19/2015
Morrill	Doug	Lower Elwha Klallam Tribe, Natural Resources Director	Form Received 2/10/2015
Todd	Steve	Suquamish Tribe, Dept. of Natural Resources	Received e-mail on 2/19/2015 declining participation due to staff demands
Navy (including Contractors)			
Cellucci	Carlotta	Naval Facilities Engineering Command NW, RPM	Form Received 2/4/2015
Kalina	Bill	Indian Island Installation Environmental Program Manager (IEPD)	Form Received 2/19/2015
Ruef	Jim	Navy Contractor working at Indian Island - Sealaska Environmental Services, LLC	Form Received 2/12/2015

Agency Personnel

INTERVIEW RECORD FOR FOURTH FIVE-YEAR REVIEW
August 2009 through August 2014
Type 2 Interview – Regulatory/Advisory Agency
Naval Magazine Indian Island
Washington

Individual Contacted:	**Ben Forson**
Organization:	**Washington State Department of Ecology, Toxics Cleanup Program**
Telephone:	**360-407-7227**
E-mail:	**bfor461@ecy.wa.gov**
Address:	**PO Box 47600** **Olympia, WA 98504-7600**

Contact made by:
Response type:
Date:

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response:
   I am familiar with the site in general and specifically, elements of the ROD that pertains to Site 10 Northend landfill. I have been involved with the implementation of the Long-Term Monitoring Plan which comprises of groundwater monitoring, and Landfill and shoreline protection system inspections and maintenance. My involvement since August 2009 has been site visit and inspection when necessary, and the review of Groundwater Monitoring and Landfill and Shoreline System inspection reports. I have also reviewed and commented on all revisions to the Long Term Monitoring Plan.

2. To the best of your knowledge, since August 2009 have there been any new scientific findings that relate to potential site risks and that might call into question the protectiveness of the remedies? Have there been any changes to the ARARs upon which the remedy decision was based?

   Response:

To the best of my knowledge, since August 2009 there has not been any new information that would call into question the protectiveness of the remedies and there has not been any change to the ARARs upon which remedy selection was based.

3. Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedy selected in the ROD?

   Response:

   No, I am not aware of any changes in site conditions that may impact the protectiveness of the remedy selected in the ROD

4. Since August 2009, have there been any complaints, violations, or other incidents related to Naval Magazine (NAVMAG) Indian Island that required a response by your office? If so, please provide details of the events and results of the responses.

   Response:

   No, I am not aware of any complaints, violations, or other incidents related to Naval Magazine (NAVMAG) Indian Island that required a response by Ecology since August 2009.

5. Are you aware of any community concerns regarding implementation of the remedies at NAVMAG Indian Island? If so, please give details.

   Response:

   No, I am not aware of any community concerns regarding implementation of the remedies at Naval Magazine (NAVMAG) Indian Island.

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the institutional controls implemented to protect human health and the environment at NAVMAG Indian Island?

   Response:

   No other comments, concerns or suggestions regarding the effectiveness of the institutional controls implemented to protect human health and the environment at NAVMAG Indian Island. Results of long-term groundwater monitoring and Landfill and shoreline protection system inspections to date indicate that all remedies are performing as expected.

7. Do you have any suggestions for changes to how the selected remedies (including institutional controls) are implemented?

   Response:

   None

8. Do you have any suggestions for changes to how monitoring of the remedy is conducted?

   Response:

   None

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NAVMAG Indian Island?

   Response:

   No other comments, concerns or suggestions regarding the effectiveness of the cleanup measures implemented so in protecting human health and the environment at NAVMAG Indian Island. Results of long-term groundwater monitoring and Landfill and shoreline protection system inspections so far indicate that all remedies are performing as expected

INTERVIEW RECORD FOR FOURTH FIVE-YEAR REVIEW
August 2009 through August 2014
Type 2 Interview – Regulatory/Advisory Agency
Naval Magazine Indian Island
Washington

Individual Contacted:	**Dennis Faulk**
Organization:	**U.S. EPA Region 10**
Telephone:	**509-376-8631**
E-mail:	**faulk.dennis@epamail.epa.gov**
Address:	**309 Bradley Blvd.** **Suite 115, Mail Code: HPO** **Richland, WA 99352**

Contact made by:
Response type:
Date: 2/15/2015

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response: I have little to no knowledge of the NAVMAG site. I am the EPA Program Manager for federal facility sites in Region 10 and work with the Navy on a number of sites in Western Washington. EPA currently does not have a Project Manager assigned to this Site but we do expect to have coverage by the time the 5 year review is sent for our comment.

2. To the best of your knowledge, since August 2009 have there been any new scientific findings that relate to potential site risks and that might call into question the protectiveness of the remedies? Have there been any changes to the ARARs upon which the remedy decision was based?

   Response: NO, unless there are PFO's that were used for fire training purposes.

3. Are you aware of any changes in site conditions that you feel may impact the protectiveness of the remedy selected in the ROD?

   Response: No

4. Since August 2009, have there been any complaints, violations, or other incidents related to Naval Magazine (NAVMAG) Indian Island that required a response by your office? If so, please provide details of the events and results of the responses.

   Response: No

5. Are you aware of any community concerns regarding implementation of the remedies at NAVMAG Indian Island? If so, please give details.

   Response:

   No

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the institutional controls implemented to protect human health and the environment at NAVMAG Indian Island?

   Response:

   No

7. Do you have any suggestions for changes to how the selected remedies (including institutional controls) are implemented?

   Response:

   No

8. Do you have any suggestions for changes to how monitoring of the remedy is conducted?

   Response:

   No

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NAVMAG Indian Island?

   Response:

   No

Native American Tribe

INTERVIEW RECORD FOR FOURTH FIVE-YEAR REVIEW
August 2009 through August 2014
Type 2 Interview – Regulatory/Advisory Agency
Naval Magazine Indian Island
Washington

Individual Contacted:	**Kelly Toy**
Title:	**Shellfish Program Manager**
Organization:	**Jamestown S'Klallam Tribe**
Telephone:	**360-681-4624**
E-mail:	**scott.chitwood@jamestowntribe.org**
Address:	**1033 Old Blyn Highway** **Sequim, WA 98382**

Contact made by:
Response type:
Date: 2/19/2015

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies and institutional controls at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response: I am familiar with the ROD remedies and site 10 monitoring because Jamestown conducts shellfish harvest on Indian Island and have reviewed previous 5 year review documents. The Tribe continues to harvest shellfish from Indian Island, except for the beaches at site 10. We have no involvement with the implementation of remedies, monitoring or maintenance.

2. To the best of your knowledge, since August 2009 have there been any new scientific findings that relate to potential site risks and that might call into question the protectiveness of the remedies? Have there been any changes to the ARARs upon which the remedy decision was based?

   Response: I am not aware of any new scientific findings.

3. What is your overall impression of the on-going effectiveness of implemented institutional controls at NAVMAG Indian Island?

   Response: The overall effectiveness appears to be protective of human health and the environment based on past monitoring results.

4. What effects have on-going remedy implementation had on the Tribe and the surrounding community?

   The restriction of shellfish harvest has an economic effect to our tribal harvesters. The Tribes do have a request to the Navy to conduct aquaculture on a site 10 beach. The shellfish risk assessment conducted in 2004 and the fish consumption rate used was based on 2 tribes that have no access to Indian Island. One of the 4 tribes who have access to Indian Island has a fish consumption rate significantly higher and is more appropriate for risk assessment. Shellfish tissue analysis should be conducted prior to lifting the current shellfish harvest restriction to ensure the effectiveness of the institutional controls.

5. Are you aware of any Tribal or other community concerns regarding implementation of the remedies? If so, please give details.

   We do have concerns about the shoreline protection system and whether the recommendation to perform engineering analysis of shoreline erosion and a long-term repair at Site 10 occurred since the last 5 year review.

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the institutional controls implemented to protect human health and the environment at NAVMAG Indian Island?

   Response: Not at this time.

7. Do you have any suggestions for changes to how the selected remedies (including institutional controls) are implemented?

   Response: No

8. Do you have any suggestions for changes to how monitoring of the remedy is conducted?

   Response: No

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NAVMAG Indian Island?

   Response: No

INTERVIEW RECORD FOR FOURTH FIVE-YEAR REVIEW
August 2009 through August 2014
Type 2 Interview – Regulatory/Advisory Agency
Naval Magazine Indian Island
Washington

Individual Contacted:	**Doug Morrill**
Title:	**Natural Resources Director**
Organization:	**Lower Elwha Klallam Tribe**
Telephone:	**360-452-4848 ext. 18**
E-mail:	**doug.morrill@elwha.org**
Address:	**2851 Lower Elwha Rd.** **Port Angeles, WA 98363**

Contact made by:
Response type:
Date: 2/10/2015

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies and institutional controls at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response: The Lower Elwha Klallam Tribe (LEKT) is one of four tribes with Usual and Accustomed Treaty Fishing Rights in the vicinity of NAVMAG Indian Island. We have been actively harvesting intertidal clams on the various beaches designated for tribal harvest on NAVMAG Indian Island since (and before) August 2009. I am not intimately familiar with the particulars of the ROD, and so I would consider my familiarity as very little.

2. To the best of your knowledge, since August 2009 have there been any new scientific findings that relate to potential site risks and that might call into question the protectiveness of the remedies? Have there been any changes to the ARARs upon which the remedy decision was based?

   Response: I am not aware of any new findings or information regarding the remedies. I am not familiar with the acronym ARAR, so cannot speak to that.

3. What is your overall impression of the on-going effectiveness of implemented institutional controls at NAVMAG Indian Island?

   Response: No impression.

4. What effects have on-going remedy implementation had on the Tribe and the surrounding community?

   Response: No change to where and how we harvest intertidal clams, aside from increased security measures that are likely not linked to the cleanup sites.

5. Are you aware of any Tribal or other community concerns regarding implementation of the remedies? If so, please give details.

   Response: Aside from security protocols, no concerns raised.

6. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the institutional controls implemented to protect human health and the environment at NAVMAG Indian Island?

   Response: No comments, concerns, or suggestions.

7. Do you have any suggestions for changes to how the selected remedies (including institutional controls) are implemented?

   Response: No suggestions.

8. Do you have any suggestions for changes to how monitoring of the remedy is conducted?

   Response: No suggestions.

9. Do you have any other comments, concerns, or suggestions regarding the effectiveness of the cleanup measures implemented so far in protecting human health and the environment at NAVMAG Indian Island?

   Response: No comments, concerns, or suggestions.

Navy Personnel
(including Contractors)

INTERVIEW RECORD FOR FOURTH FIVE-YEAR REVIEW
August 2009 through August 2014
Type 1 Interview – Navy Personnel
Naval Magazine Indian Island
Washington

Individual Contacted:	**Carlotta Cellucci**
Title:	**Remedial Project Manager**
Organization:	**Naval Facilities Engineering Command Northwest**
Telephone:	**360-396-1518**
E-mail:	**carlotta.cellucci@navy.mil**
Address:	**1101 Tautog Circle** **Building 1101, RM 110** **Silverdale, WA 98315**

Contact made by: Email by Kelly Quigley
Response type: Email
Date: February 3, 2015

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies and institutional controls at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response: I became the Navy RPM for Indian Island on October 21, 2014, so have only been involved in the project for the last 3 months. I have not yet become familiar with the ROD, but have reviewed the last 5-year review, it's recommendations and the progress made since the last 5-yr review.

2. Since performance of the third 5-year review of Naval Magazine (NAVMAG) Indian Island in Fall 2009, are you aware of any changes in land uses, access, or other site conditions that you feel may impact the protectiveness of the remedy selected in the ROD?

   Response: No.

3. Are you aware of concerns from the local community regarding implementation or overall environmental protectiveness of the selected remedy?

   Response: No.

4. Has there continued to be a regular on-site inspection and operation, maintenance, and monitoring (OMM) presence since August 2009?

   Response: Yes.

5. Have there been any unexpected OMM difficulties since August 2009?

   Response: Shoreline erosion was identified and a shoreline protection action was taken in 2014.

6. Have there been any substantial changes to inspection and OMM requirements or activities? If so, do you feel that these changes have impacted the protectiveness of the remedy selected in the ROD?

   Response: No substantial changes that have affected remedy protectiveness.

7. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedy (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: No.

8. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NAVMAG Indian Island?

   Response: No.

INTERVIEW RECORD FOR THIRD FIVE-YEAR REVIEW
August 2009 through August 2014
Type 1 Interview – Navy Personnel
Naval Magazine Indian Island
Washington

Individual Contacted:	**Bill Kalina**
Title:	**Indian Island Installation Environmental Program Manager**
Organization:	**IEPD**
Telephone:	**360-396-5353**
E-mail:	**william.kalina@navy.mil**
Address:	**100 Indian Island Rd.** **Bldg. 69, FL2, RM 230** **Port Hadlock, WA 98339**

Contact made by:
Response type:
Date:

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies and institutional controls at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response:

   I am very familiar with NAVMAG Indian Island and the ROD. I have been an employee in the Environmental Dept since 1994 and was involved with most of the NPL Site Cleanups.

2. Since performance of the third 5-year review of Naval Magazine (NAVMAG) Indian Island in Fall 2009, are you aware of any changes in land uses, access, or other site conditions that you feel may impact the protectiveness of the remedy selected in the ROD?

   Response:

   No. I am not aware of any changes other than some repair work on the rock groin protecting the Site 10 Landfill Cap shoreline.

3. Are you aware of concerns from the local community regarding implementation or overall environmental protectiveness of the selected remedy?

Response:

None.

4. Has there continued to be a regular on-site inspection and operation, maintenance, and monitoring (OMM) presence since August 2009?

Response:

Yes. I maintain copies of those in the NAVMAG I.I. Environmental Office.

5. Have there been any unexpected OMM difficulties since August 2009?

Response:

No. The shoreline erosion was the only issue at the Site 10 Landfill cap and this was repaired promptly.

6. Have there been any substantial changes to inspection and OMM requirements or activities? If so, do you feel that these changes have impacted the protectiveness of the remedy selected in the ROD?

Response:

No.

7. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedy (e.g., unauthorized excavation, unauthorized use of groundwater)?

Response:

No.

8. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NAVMAG Indian Island?

Response:

The remedies overall seem to be functioning effectively and the O&M is being conducted routinely.

INTERVIEW RECORD FOR FOURTH FIVE-YEAR REVIEW
August 2009 through August 2014
Type 1 Interview – Navy Contractor
Naval Magazine Indian Island
Washington

Individual Contacted:	**Jim Ruef**
Organization:	**Sealaska Environmental Services, LLC**
Telephone:	**206-930-9623**
E-mail:	**james.ruef@sealaska.com**
Address:	**Marine Science Center** **PO Box 869** **18743 Front Street NE, Suite 201** **Poulsbo, WA 98370**

Contact made by:
Response type:
Date: 2/12/2015

Summary of Communication

1. Please describe your degree of familiarity with Naval Magazine (NAVMAG) Indian Island, the Record of Decision (ROD), the implementation of the remedies and institutional controls at the site, and the monitoring and maintenance that has taken place since implementation of the remedies. Please also describe your involvement since August 2009.

   Response: *Navy Subcontractor, Task Order Manager and Project Quality Control Manager (PQCM) since 2007 for: (1) implementation of Long Term Monitoring (LTM)/Operation and Maintenance (O&M) remedy at Naval Magazine Indian Island, Site 10 Northend Landfill, and (2) Institutional Controls (IC) inspections at Site 10 Northend Landfill and, (since 2011) Area 36 and the Hazardous Waste Storage Area (HWSA).*

2. Since performance of the third 5-year review of Naval Magazine (NAVMAG) Indian Island in Fall 2009, are you aware of any changes in land uses, access, or other site conditions that you feel may impact the protectiveness of the remedy selected in the ROD?

   Response: *There have not been any significant changes that impact the remedy. Some localized shoreline erosion at and near the high-low energy transition zone was repaired at that location prior to any significant impacts to the Site 10 landfill geogrid and landfill.*

3. Are you aware of concerns from the local community regarding implementation or overall environmental protectiveness of the selected remedy?

   Response: *No, other than their input during the 5-year review process.*

4. Has there continued to be a regular on-site inspection and operation, maintenance, and monitoring (OMM) presence since August 2009?

   Response: *Yes; OMM has occurred each year since 2009 in accordance with the applicable version of the Operation and Maintenance Plan and per the directives of Naval Facilities Engineering Command Northwest.*

5. Have there been any unexpected OMM difficulties since August 2009?

   Response: *No OMM difficulties have occurred.*

6. Have there been any substantial changes to inspection and OMM requirements or activities? If so, do you feel that these changes have impacted the protectiveness of the remedy selected in the ROD?

   Response: *IC inspections (annual) were added to the scope of work in 2011 for Site 36 and the HWSA, increasing the overall protectiveness of the remedy.*

7. Are you aware of any violations of the institutional controls requirements at any of the OUs that could impact the protectiveness of this component of the remedy (e.g., unauthorized excavation, unauthorized use of groundwater)?

   Response: *No violations occurred that I am aware of, or that I have reported.*

8. Do you have any overall comments, concerns, or suggestions regarding the effectiveness of the remedies in protecting human health and the environment at NAVMAG Indian Island?

   Response: *No; the current OMM has been and, in my opinion, will continue to be adequate for protection of human health and the environment at NAVMAG Indian Island.*

Appendix E:
Recommended Modifications to the Groundwater Monitoring Program at Site 10

Recommended Monitoring Approach for Site 10

Groundwater monitoring at Site 10 has primarily consisted of measuring field parameters, such as pH, temperature, oxidation-reduction potential, salinity, dissolved oxygen, turbidity, specific conductivity, total dissolved solids, and color, and comparing the results to Tier 1 comparison criteria that were calculated using historical results for field parameters at Site 10. The intent of ongoing groundwater monitoring is to provide a mechanism for the Navy and agencies to understand possible changes in the landfill cap and other features of the remedy, such as drainage and the stabilized shoreline, which might increase contaminant mobility. The primary concern is that the deterioration of these engineered components of the remedy could allow increased hydraulic communication between the waste layer and adjacent surface water. While field measurements provide useful data during groundwater sampling, it is not necessarily appropriate to solely rely on these data to make determinations regarding changes in the effectiveness of the remedy. For example, during previous sampling events, key field parameters, such as dissolved oxygen, have shown wide fluctuations that have often been attributed to malfunctions in the multi-parameter water sensor used during field sampling. The third five-year review attempted to address these inconsistencies by recommending improvements to the manner in which field parameters were collected. These recent improvements have involved the use of redundant, but differing, field approaches for measuring dissolved oxygen, including a combination of a multi-parameter field sensor and a field titration kit. While this approach provides some degree of redundancy in the collection of dissolved oxygen measurements, the usefulness of these data is limited because these approaches are different and are not necessarily comparable.

In an effort to provide a more scientific approach for evaluation of landfill-component integrity through groundwater monitoring, consideration should be given to analyzing groundwater for key anions (Cl, SO_4, and HCO_3) and cations (i.e., Ca, Mg, Na, and K). These key indicator ions are useful for characterizing or fingerprinting source waters and then graphically presenting the results on geochemical diagrams, such as a Piper diagram (see Figure 1). At Site 10: (1) groundwater, (2) surface water from rain, and (3) saline water from Port Townsend Bay could be characterized through geochemical analysis of indicator ions to develop a "fingerprint" for each water source. Monitoring these parameters over time and plotting the results on geochemical diagrams would provide a more defensible approach for understanding geochemical changes that may be indicative of structural deficiencies in the landfill. Furthermore, the characterization of surface water from rain and saline water from Port Townsend Bay would allow site managers to evaluate whether changes in groundwater geochemistry are attributable to increased mixing with freshwater infiltrating through the cap or increased mixing with saline water intruding through the stabilized shoreline. Characterization of rain and surface water could be done during the first year of sampling only. Alternatively, a literature search could be conducted to identify existing data that characterizes regional rainfall and/or saline water from the Port Townsend Bay. This approach could be implemented by collecting water samples for laboratory analysis using EPA Method 200.8 (Ca, Mg, Na, and K), EPA Method 300 (Cl and SO_4), and EPA Method 2320B (HCO_3) and then plotting the results using commercially available geochemical modeling software.

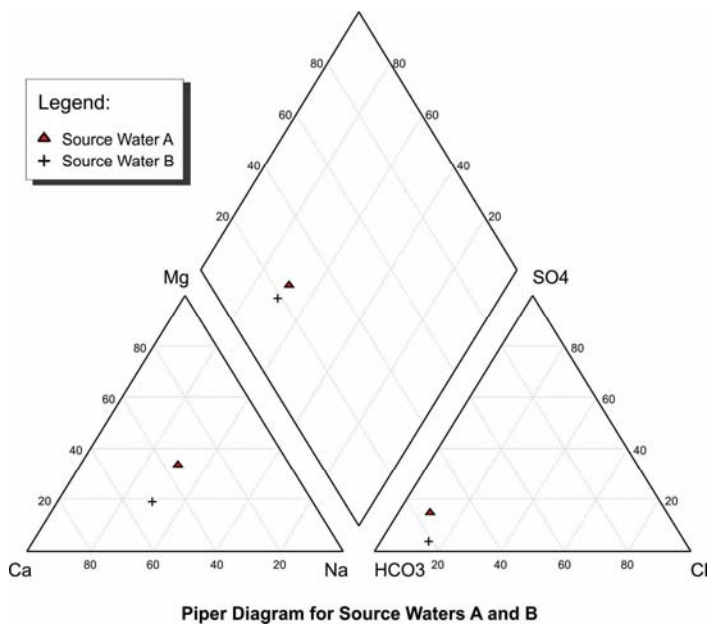

Figure 1. Example Piper Diagram