Five-Year Review Report

Second Five-Year Review Report

For

Manchester Annex Superfund Site

Manchester

Kitsap County, Washington

September 2009

PREPARED BY:
US Army Corps of Engineers
Technical Services Branch
Seattle, Washington

Approved by:

Scott E. Young
Chief, Environmental Programs Branch
Kansas City District

Date: 9-25-09

US Army Corps
of Engineers

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Concurrence by:

Linda Anderson-Carnahan for

Lori Cohen
Acting Chief, Environmental Cleanup Office
EPA Region 10

9/28/09
Date

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List of Acronyms and Abbreviations

AET	Apparent Effects Threshold
ARAR	Applicable or Relevant and Appropriate Requirement
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLARC	Cleanup Levels and Risk Calculations (Ecology Website for MTCA)
CMP	Compliance Monitoring Plan
CO	Cleanouts (for Pipes)
COC	Contaminant of Concern
COPC	Contaminant of Potential Concern
CT	Central Tendency
EPA	United States Environmental Protection Agency
FCS	Fish Consumption Survey
FFTA	Former Fire Training Area
HI	Hazard Index
IC	Institutional Control
ICP	Institutional Control Plan
I&M	Inspection and Maintenance
MG/KG	Milligrams per Kilogram (parts per million)
MTCA	Model Toxics Control Act
NCP	National Contingency Plan
NG/KG	Nannograms per Kilogram (parts per trillion)
NOAA	National Oceanographic and Atmospheric Administration
NPL	National Priorities List
O&M	Operation and Maintenance
PAH	Polynuclear Aromatic Hydrocarbons
PCB	Polychlorinated Biphenyl
PPB	Parts per Billion (ug/kg)
PPM	Parts per Million (mg/kg)
QAPP	Quality Assurance Project Plan
RAO	Remedial Action Objective
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation / Feasibility Study
ROD	Record of Decision
RME	Reasonable Maximum Exposure
RPM	Remedial Project Manager
Site	Manchester Annex Superfund Site
SQS	Sediment Quality Standards
SWAC	Surface-weighted Average Concentration
SPLP	Synthetic Precipitation Leaching Procedure
TBC	To Be Considered
TEQ	Toxicity Equivalent Concentration (for dioxins)
TPH	Total Petroleum Hydrocarbons
US	United States
USACE	United States Army Corps of Engineers
WHO	World Health Organization

Executive Summary

Purpose for the Five-year Review

The Seattle District, US Army Corps of Engineers (USACE) has conducted the second five-year review (FYR) of the Manchester Annex Superfund Site in Manchester, Washington, pursuant to an Interagency Agency Agreement (IAG) between the USACE and the US Environmental Protection Agency (EPA), Region 10. Under the Defense Environmental Restoration Act, the USACE is responsible for cleanup actions at Formerly Used Defense Sites (FUDS) on behalf of the Department of Defense. The purpose of this second five-year review is to determine whether the remedial actions implemented at the Manchester site (a former Navy complex) are protective of human health and the environment. This five-year review is required because hazardous substances remain on-site above the risk-based levels determined in the Record of Decision (ROD), thereby preventing unlimited use and unrestricted exposure. The methods, findings, and conclusions of the review are documented in this report. In addition, this report summarizes continuing issues identified during the review and includes recommendations and follow-up actions for them to be determined based on the availability of funds.

Triggering Action for the Review

According to EPA five-year review guidance (EPA 540-R-01-007), a five-year review should be completed within five years from the start date of remedial action (the "triggering action"), which is defined as the day the contractor mobilizes on-site to begin construction. The Superfund database ("CERCLIS") did not list a start date for construction for the Manchester Annex Site at the time this report was initially prepared. Consequently, the completion date for the remedial design phase, June 22, 1999, was identified by EPA Region 10 as the accepted trigger date for the first five-year review (completed in September 2004). The first five-year review was not completed in June, 2004 since USACE held a different understanding of the “triggering action” derived from Department of Army Guidance for FUDS sites (ER200-3-1). This second five-year review has been scheduled for completion in September, 2009.

Site Location and Contaminants

The site is located on the western shore of Clam Bay, about one mile north of Manchester, Washington. The Manchester site, also known as the Old Navy Dump/Manchester Laboratory (EPA/NOAA) Site, was historically owned by the US Navy and consists of a former fire training area (FFTA), a landfill, and a former submarine net and boat depot (the Net Depot). The activities in these areas resulted in various types of contamination. Firefighting training activities resulted in contamination of the soil with polychlorinated dioxins and furans (hereafter called dioxins) and petroleum hydrocarbons (TPH). Soils and sediments with dioxin and furan, polychlorinated biphenyls (PCBs), metals, vinyl chloride, and asbestos contamination resulted from landfill activities. Although activities at the Net Depot resulted in low-level metal contamination in the soil and seeps nearby, the potential health risks were determined to be minimal and consequently no cleanup measures were proposed for that facility.

Remedial Actions
The selected remedy to clean up the contamination included the following: a landfill cap and shoreline protection system; a sediment cap in the intertidal area; and removal of contaminated soil and structures in the FFTA. In addition, a restriction on subsistence-level shellfish harvesting was put into place until it can be determined that the shellfish are safe for resumption of harvesting. Harvest resumption cannot be determined at this time. A sufficient quantity of clam biomass (11 samples, 20 grams per sample) has not been identified over three separate clam survey events. Therefore, clam tissue sampling and analysis has not been performed. The presence of sea lettuce (Ulva spp.) is known to inhibit certain species of shellfish in the intertidal zone in this area. When data from clam sampling are available, a determination of harvest resumption may be made.

Neighboring Beaver Creek, though not contaminated, was also restored as part of the remedial actions to compensate for losses in wetland area caused by construction of the landfill cap and shoreline protection system. Biological monitoring at Beaver Creek has confirmed that a significant number of salmon were present in the restored stream soon after the construction was completed, indicating that the restoration has been successful at improving fish habitat.

Site Visit
In support of the second five-year review, site visits were conducted to interview site personnel, and conduct clam surveys and locate possible seeps. On April 17, 2009, USACE personnel conducted a site condition inspection and interviews with personnel from the EPA Manchester Laboratory, and National Oceanic and Atmospheric Administration (NOAA) Fisheries. USACE personnel also conducted telephone interviews with the EPA Region 10 RPM, and personnel from the Suquamish Tribe. The five-year review was also advertised in local papers to solicit public input. The newspaper advertisements were published on July 17 and July 19, 2009.

Remedy Protectiveness and Future Actions
A restriction on subsistence-level harvesting of intertidal bivalve organisms is in place, the landfill cap and shoreline protection systems are intact, and the cleanup requirements for the FFTA have been met. However, a determination of remedy protectiveness is deferred at this time due to lack of analytical data. Seep, sediment, and tissue sampling data are necessary to evaluate the current status and the long-term protectiveness of the actions implemented for the landfill and Clam Bay.

In both the previous and current five year review, the protectiveness of the remedy for the environment could only be partially determined, due to the lack of monitoring data. The landfill cap was determined to be sufficient to prevent wildlife contact with the landfill wastes, to provide adequate protection from upland exposure conditions, and to prevent infiltration of precipitation into the landfill. The protectiveness of the remedy regarding marine intertidal fauna, however, cannot be determined until seep, sediment, and tissue monitoring and sampling occur. However, clams were not available in sufficient quantity to support sampling; this is the second Five-year Review for which this determination has been made. The seep and sediment activities will be undertaken in August 2009. Once data are available, a protectiveness determination can be made.

Other issues found with respect to the requirements of the ROD were as follows: (1) a final institutional control plan (ICP) has not been implemented due to unresolved issues that EPA identified in the original 1998 draft; (2) the presence of landfill seeps has not been systematically verified during normal inspection and maintenance activities; and (3) maintenance on the landfill cap does not appear to be aggressive enough to prevent unwanted vegetation with roots that could potentially damage the liner from growing on the landfill cap.

To ensure that the remedy complies with the requirements of the ROD and provides long-term protection of human health and the environment, the following measures should be taken: (1) final institutional controls plan, including a compliance monitoring plan, be implemented; (2) landfill seeps be located, documented, and sampled for chemicals of concern; and (3) unwanted vegetation such as blackberries, alder, and scotch broom present on the landfill cap be removed to prevent possible future damage to the cap. In addition, sediment sampling conducted during the summer of 2009 will determine if site conditions meet the sediment clean up levels and goals established in the ROD. Clam tissue sample analysis will also be required to determine if contaminant levels present unacceptable health risks to subsistence harvesters.

In connection with the last action, coordination with the Suquamish Tribe, whose "Usual and Accustomed" clam harvesting area exists on the beach, should be conducted to evaluate the continued need for a shell fishing restriction.

It is expected that these actions will take approximately six months to complete (March 31, 2010), at which time a protectiveness determination will be made.

Five-Year Review Summary Form

SITE IDENTIFICATION		
Site name (from CERCLIS): OLD NAVY DUMP/MANCHESTER LABORATORY (USEPA/NOAA)		
EPA ID (from CERCLIS): WA8680030931		
Region: 10	State: WA	City/County: Manchester/Kitsap
SITE STATUS		
NPL status: ☒ Final ☐ Deleted ☐ Other (specify)		
Remediation status (choose all that apply): ☐ Under Construction ☐ Operating ☐ Complete		
Multiple OUs?* ☐ YES ☒ NO	Construction completion date: October 2001	
Has site been put into reuse? ☐ YES ☒ NO The landfill portion is excluded from active use. However, portions of the former fire training area are now covered with asphalt and used for parking. Also, recreational fishers are not permitted to access the beach for recreation or shellfish collection.		
REVIEW STATUS		
Lead agency: ☐ USEPA Region 10 ☐ State ☐ Tribe ☒ Other Federal Agency _____		
Author name: Joseph Marsh		
Author title: Environmental Protection Specialist	Author affiliation: US Army Corps of Engineers	
Review period: April 6, 2009 to September 15, 2009		
Date(s) of site inspection: April 17, 2009		
Type of review: ☒ Post-SARA ☐ Pre-SARA ☐ NPL-Removal only ☐ Non-NPL Remedial Action Site ☐ NPL State/Tribe-lead ☐ Regional Discretion		
Review number: ☐ 1 (first) ☒ 2 (second) ☐ 3 (third) ☐ Other (specify) _____		
Triggering action: ☐ Actual RA Onsite Construction Start ☐ Actual RA Start at OU#____ ☐ Construction Completion ☒ Previous Five-Year Review Report ☐ Other (specify)		
Triggering action date (from CERCLIS): September 29, 2004		
Due date (five years after triggering action date): September 30, 2009		

* ["OU" refers to operable unit.]

** [Review period should correspond to the actual start and end dates of the Five-Year Review in CERCLIS.]

Five-Year Review Summary Form, continued

Issues Affecting Protectiveness:

1. An institutional control plan should be finalized and implemented at the Manchester site to address contaminants left in-place, deed covenants, fishing restrictions, and maintaining the integrity of the landfill cap and shoreline protection system. Provision of technical documents to land managers and stakeholders is necessary to assure that the plan is implemented.
2. The Compliance Monitoring Plan needs to be revised/updated because monitoring of sediment and seeps at the toe of the landfill has not occurred at stated frequencies. Monitoring for clam tissue levels of contaminants of concern has not occurred due to the lack of sufficient biomass of clams on the beach. Thus, data are unavailable to support a protectiveness statement for seeps and shellfish; sediment has not reached the level that was anticipated to result in protection to human consumption of shellfish. The data from 2009 will be used to update the protectiveness statement; data from other events will be used to support the 2014 FYR for this Site.
3. Unwanted vegetation with roots that may be capable of damaging the landfill cap is growing on the landfill.
4. A subsistence-level fishing restriction for bivalves is in place for the Suquamish Tribe, though it was intended only to be a temporary measure.
5. The Suquamish Tribe has requested consultation regarding the consumption rate of shellfish as it relates to the clam tissue goal.
6. The shoreline protection system sustained wind and/or wave erosion of protective cover material on the north end of the system exposing the underlying filter fabric. The rock and sand cover material and filter fabric are critical components of the seawater intrusion protection system for the landfill.

Issues Not Affecting Protectiveness:

1. A weathered “Hazardous Area” sign still remains at the beach area.
2. The landfill cap needs to be reseeded/replanted with drought-resistant plants in accordance with the original plans for the landfill closure.
3. A final report summarizing the findings of cultural resources investigation during construction was not produced or provided to the Suquamish Tribe.

Recommendations and Follow-up Actions:

Issues Affecting Protectiveness:

1. Finalize and implement an institutional control plan.
2. Revise the Compliance Monitoring Plan with a monitoring schedule that complies with the ROD, and provides adequate information to monitor site conditions, progress toward RAOs and protectiveness. Monitor sediment, seeps, and clam tissue (if available) at the toe of the landfill on the stated schedule. Develop a supplemental report to this FYR with data presentation for the 2009 data gathered.
3. Remove unwanted vegetation from the landfill cap.
4. Consult with the Suquamish Tribe (and other state and federal agencies as appropriate) to evaluate the

continued need for a shell-fishing restriction.

5. Consult with the Suquamish Tribe.

6. Repair the damaged section of the shoreline protection system.

Issues Not Affecting Protectiveness:

1. Remove the weathered "Hazardous Area" sign, to be completed by March, 2010.
2. Reseed/replant drought-resistant plants on the landfill cap by September 2010.
3. Complete a report of findings from the archaeological investigation that occurred during remedial construction and provide to the Suquamish Tribe by March 2010.

Five-Year Review Summary Form, continued

Protectiveness Statement(s):

A protectiveness determination of the remedy at the Site cannot be made at this time pending data collection and review of seep water and sediment analysis, and (once there is sufficient biomass to sample it), clam tissue analysis. These data may be used to determine if the remedy is protective of human health and the environment in the long term. At the present time a restriction on subsistence-level harvesting of intertidal bivalve organisms is in place, the landfill cap and shoreline protection systems are intact, and the cleanup requirements for the Former Fire Training Area have been met. The shell-fishing restriction, however, was intended only as a temporary measure during the initial recovery period. Seep, sediment, and tissue sampling data are necessary to evaluate the current status and the long-term protectiveness of the actions implemented for the landfill and Clam Bay. The compliance monitoring plan, which will be completed and implemented during fiscal year 2009 (subject to the availability of funds), will address the status of PCBs and metals in sediment and seeps in Clam Bay. As sufficient biomass becomes available, clam tissue samples will be taken for the sake of documenting the removal of the shell-fishing restriction. Details of project completion dates are presented in Table 8.

Other Comments:

The ROD is not explicit as to which "shellfish" should be restricted from subsistence-level consumption. The RI/FS seems to suggest that only clams should be restricted. Table 15 of the ROD also indicates that the point of compliance is "intertidal clams" for achieving PCB cleanup goals. In the RI/FS, other edible shellfish such as sub-tidal crab, sea cucumbers, and geoducks did not appear to be sources of significant risk from site-related contamination; and thus are not deemed to be covered by the ROD restriction. Since the Suquamish Tribe currently maintains a restriction on subsistence-level harvesting of bivalves (clams, oysters, etc.) in the intertidal areas of Clam Bay, the requirements of the ROD are being met.

1. Introduction

This is the second Five-Year Review report of Remedial Actions for the Manchester Annex Superfund Site in Manchester, Washington. The first Five-Year Review report completed in 2004 was the triggering action for this review.

1.1. The Purpose of the Review

The purpose of a Five-Year Review (FYR) report is to determine whether remedial actions performed at a Superfund site continues to be protective of human health and the environment. The methods, findings, and conclusions of reviews are documented in FYR reports. In addition, FYR reports identify issues found during the review, if any, and identify recommendations to address them.

The United States Army Corps of Engineers (USACE), Seattle District, has conducted the second five-year review of the remedial actions implemented at the Manchester Annex Superfund Site in Manchester, Washington (EPA ID# WA8680030931). The Manchester site , also known as the Old Navy Dump/Manchester Laboratory (EPA/NOAA) Site, is considered one operable unit (OU) and consists of a former fire training area (FFTA), a landfill, and a former submarine net and boat depot (the Net Depot). This review was conducted from March 2009 through September 2009 by USACE, and the results are documented in this report.

1.2. Authority for Conducting the Five-Year Review

The United States Environmental Protection Agency (EPA) is overseeing this five-year review pursuant to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) § 121(c), 42 United States Code (IJSC) Section 9621(c), and the National Contingency Plan (NCP) . CERCLA § 121 states:

> *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 9604 (CERCLA X104) or Section 9606 (CERCLA X106) 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.*

The EPA interpreted this requirement further in the NCP, as stated in 40 CFR §300 .430(f)(4)(ii):

> *If a remedial action is selected that results in hazardous substances, pollutants, or contaminants remaining at the site above levels that allow for unlimited use and unrestricted exposure, the lead agency shall review such action no less often than every five years after the initiation of the selected remedial action.*

The purpose and focus of FYRs are further defined in EPA Office of Solid Waste and Emergency Response (OSWER) Directive 9355.7-03B-P (EPA 2001).

This second FYR report is a statutory review, following five years after the completion of the first FYR report signed September 29, 2004. The five-year review is required due to the fact that contaminants (landfill waste, petroleum-contaminated soil, PCBs in sediment) remain on-site above risk-based levels that allow for unlimited use and unrestricted exposure.

2. Site Chronology

Table 1 – Chronology of Site Events

Event	Date
US Army establishes ownership of site	1898
Ownership is transferred to US Navy	1919
State of Washington, EPA, and National Oceanic and Atmospheric Administration acquire parts of the property	1970s
Discovery of Site	March 1, 1987
Preliminary Assessment	March 25, 1988
Hazard Ranking Score (HRS) Package complete	Oct. 29, 1993
Final listing on National Priorities List	May 31, 1994
Interagency Agreement IAG negotiations and final agreement	July 6-30, 1997
Remedial Investigation (RI) Feasibility Study (FS)	Oct. 18, 1994 to Dec. 1996
Record of Decision (ROD) signed	Sept. 30, 1997
Non time-critical removal action (concrete simulator structures , underground piping, and petroleum-contaminated soil at the FFTA)	June 8, 1998 to Sept. 29, 1998
Remedial Design	Nov. 18, 1997 to June 22, 1999
Remedial Action -Construction dates (start and finish)	June 99-Oct. 01
Technical Specifications and Compliance Monitoring Plan for Phase II Construction	June, 2001
Inspection and Maintenance Manual	January, 2002
Preliminary close-out report	Sept. 30, 2002
Clam Survey conducted at the toe of the landfill	February 4, 2005
Remedial Action Report	March 8, 2005
Sediment sampling a the toe of the landfill	April 25-28, 2005
Clam Survey conducted at the toe of the landfill	May 25, 2006
Clam Survey conducted at the toe of the landfill	April 30, 2009

3. Background

3.1. Physical Characteristics

The Manchester site, located approximately one mile north of Manchester, Washington, is situated on the western shore of Clam Bay in Puget Sound (see Figure 1 -Site Map) . Clam Bay is a sensitive marine estuary, used primarily by recreational shell fishers and known to be used by bald eagles and Chinook salmon.

3.2. Land and Resource Use

The US Army established ownership of the site in 1898, and then transferred ownership to the US Navy in 1919. The Navy used the site for submarine net and boat construction and maintenance, fire fighting training, and waste disposal of on-site waste and waste generated from the Puget Sound Naval Shipyard in Bremerton, Washington. As shown on the map, the landfill area is bordered to the north by the former Net Depot, to the south by the FFTA, to the west by Manchester State Park, and to the east by Clam Bay.

In the 1970s, the EPA and NOAA acquired parts of the property and currently operate an analytical laboratory and a fisheries research laboratory, respectively. As of 2000, approximately 100 employees were employed at the laboratories. The EPA's property encompasses the northern 17.5 acres of the site. The EPA Manchester laboratory, an associated concrete parking pad, and other facilities occupy the northern-most fives acres of the EPA property, which is also the location of the former Net Depot. The landfill is located within the central 12.5 acres of the site and a small portion of the northwestern corner of the landfill area that extends onto Manchester State Park property. The former Navy Fire Training School was situated on the southern 22.5 acres of the site, and is currently occupied by the NOAA National Marine Fisheries Service (NMFS).

By virtue of the Treaty of Point Elliott, the Suquamish Tribe's right to fish and interests in their habitat were recognized to include the marine waters of Puget Sound. Tribal members engage in subsistence, ceremonial and commercial harvesting of a wide variety of marine resources throughout the federally adjudicated "usual and accustomed" fishing grounds and stations. The Manchester Annex site is within Suquamish exclusive usual and accustomed fishing grounds. Intertidal bivalves (specifically clams) have been identified as the resource of concern, as well as a point of compliance, at this site.

Future use of the site assumes continued operation of the laboratories, and subsistence-level shellfish harvesting by the Suquamish Indian Tribe once the PCB levels in shellfish tissue have been reduced to acceptable levels.

3.3. History of Contamination

When the Navy owned the site, the primary activities were submarine net construction and maintenance, fire fighting training, and waste disposal. The Net Depot operated from

approximately 1940 to the 1950s and included additional operations such as sand blasting, painting, and machining. The fire training area was used to train Navy personnel on procedures for extinguishing ship fires. Diesel, gasoline, and waste oil were used in fire training exercises and stored in underground storage tanks (USTs). The use and burning of fuel resulted in soil contaminated primarily with polychlorinated dioxins and furans (hereafter called dioxin) and total petroleum hydrocarbons (TPH).

From roughly 1946 to 1962 the Navy formed the landfill by using the tidal lagoon area between the Net Depot and the fire training area to dispose of approximately 70,000 cubic yards of demolition debris. The landfill occupies roughly six acres, has an average thickness of six feet, and was initially covered with one-foot layer of sand and gravel. The landfill soil is contaminated with dioxins, PCBs, metals, vinyl chloride, and asbestos. Over time, waste from the southeastern landfill edge eroded into Clam Bay and subsequently contaminated the water, sediment, and shellfish with PCBs, metals, and polycyclic aromatic hydrocarbons (PAHs) (a breakdown is provided in Section 3.5.).

3.4. Initial Response – Early Actions

As an initial response measure to minimize contact with landfill waste, the Navy placed one-foot thick soil cap over the landfill in the late 1950s/early 1960s. Further investigation into site contamination, however, was not formally conducted until 1987. Between 1987 and 1994, several investigations and a UST removal and closure action were undertaken by the USACE, EPA, and NOAA. Based on the findings, the Manchester site was listed on the CERCLA National Priorities List in 1994. The CERCLA remedial activities are being conducted under the Formerly Used Defense Site program. The RI/FS for the Manchester site, completed in 1996, was conducted by the USACE and overseen by the EPA in accordance with the IAG.

3.5. Basis for Taking Action

The chemicals of potential concern (COPCs) as identified by the RI/FS in site media that exceeded risk-based remediation goals are listed below. Although the italicized chemicals and compounds were detected in tissue and sediment samples, they were not included as part of the final COPCs. After risk assessment evaluation, it was determined that they posed minimal risk to human health and the environment, or that remedial actions to address the twelve COPCs would also manage risk associated with these additional constituents. Manganese concentrations, which were most significantly elevated in sub-tidal geoducks, were assumed to be the result of nearby commercial salmon net pen activities, rather than site -related activities.

Table 2: Contaminants of Potential Concern

Soil (Landfill)	**Soil and Simulator Debris (FFTA)**	**Sediment**	**Tissue (clams, geoducks, sea cucumbers)**
PCBs	Dioxins	PCBs	PCBs
Arsenic		Cadmium	Dioxins
Cadmium		Copper	Arsenic
Copper		Lead	PAHs
Lead		*Mercury*	Copper
Nickel		Zinc	*Manganese*
Silver		Dioxins/Furans	
Zinc		2,4-dimethylphenol	
Dioxins/Furans			
Asbestos			
Vinyl Chloride			

These chemicals were identified by screening validated sampling data from the site against the following risk-based criteria:

- Model Toxics Control Act (MTCA) cleanup levels for soil, groundwater, and surface water [WAC 173-340];
- State surface water quality standards [WAC 173-201A] and. federal Clean Water Act criteria [40 CFR 131, the National Toxics Rule]
- EPA Region 3 screening levels for soil, water, and fish/shellfish tissue [Smith, 1995]
- Plant and wildlife protection screening values for soils obtained from Will and Suter [1994] and Oak Ridge National Laboratory [1994]
- Washington State Department of Ecology Sediment Management Standards [WAC 173-204]

Human health and ecological risk assessments were performed to determine appropriate site cleanup requirements based on the current non-residential use of the site. The human health risk assessment evaluated three scenarios: risk to an on-site worker; risk to a subsistence consumer of shellfish; and risk to an occasional site visitor (including children). The assessment established that potential long-term risks to an on-site worker and occasional site visitor were associated primarily with potential skin contact and incidental ingestion of waste materials (soil and debris from the landfill and FFTA) containing elevated metals and dioxin concentrations. Long-term health risks to subsistence shellfish consumers were based on consumption of PCB-contaminated shellfish collected from the Clam Bay intertidal area.

The ecological risk assessment established that metals, PCBs, and furans in the landfill could negatively impact microbial and soil processes, plant growth, earthworms, and small rodents. Metals leaching from the landfill, as well as PCBs and 2,4-dimethylphenol detected in marine sediments, could result in acute and/or chronic toxicity to marine life and pose a risk to wildlife whose entire diet consisted of Clam Bay prey. The risk assessment concluded that there could be a current or potential threat to human health and the environment if actual or threatened releases

from the site were not addressed. Based on the RI/FS and the risk assessments, a set of remedial action objectives (RAOs) was developed for the site areas. The RAOs, as specified in the ROD, are listed below by area:

Landfill and Clam Bay Areas

- Prevent human and wildlife contact with solid wastes and soils/sediments in the landfill
- Prevent fugitive dust emissions containing asbestos
- Prevent shoreline erosion of landfill wastes
- Reduce solubilization and migration of landfill contaminants to Clam Bay by eliminating seeps or by improving the quality of the seeps so that they meet water quality criteria
- Reduce concentrations of metals, PCBs and 2,4-dimethylphenol to below cleanup levels for sediments in the biologically active zone (0 to 10 centimeter depth)
- Prevent subsistence-level harvesting of shellfish in the near-shore areas of Clam Bay until the shellfish are determined to be safe

Additional cleanup levels and goals were established in the ROD for aquatic exposure pathways in the marine environment, which included:

- A cumulative hazard index under 1, and a cumulative cancer risk goal under future reasonable maximum exposure (RME) conditions of 1 in 100,000 ($1x10^{-5}$, the MTCA Method C criterion), considering combined seafood ingestion, sediment contact, and incidental sediment ingestion pathways
- No identified risk to aquatic biota and other wildlife
- Compliance with applicable or relevant and appropriate requirements (ARARs), including State of Washington surface water quality standards [Washington Administrative Code (WAC) 173-201A] and sediment management standards [WAC 173-204].

Former Fire Training Area

- Prevent human and wildlife contact with simulator debris and soils containing dioxin concentrations greater than the cleanup level
- Minimize solubilization and migration of total petroleum hydrocarbons (TPH) into groundwater.

Additional cleanup levels and goals were established for the upland area containing the FFTA, which included:

- A cumulative hazard index under 1, and a cumulative cancer risk goal under future reasonable maximum exposure (RME) conditions of $1x10^{-5}$ (MTCA Method C),

considering cumulative soil contact, incidental soil ingestion, inhalation; and drinking water pathways

- No identified risk to aquatic biota and other wildlife
- Compliance with applicable or relevant and appropriate requirements (ARARs), including State of Washington MTCA Method C soil cleanup levels for non-industrial sites [WAC 173-340-740]

Groundwater in the area is used to supply local residents with drinking water. Shallow groundwater beneath the FFTA and the Outwash Aquifer near the FFTA was tested for contaminants. The risk assessment confirmed that the incremental lifetime cancer risk was less than 1 in 1,000,000 ($1x10^{-6}$) and that the hazard index was less than 0.3, indicating that risks from contaminants in the groundwater were below the thresholds of concern (HI <1 and cancer risk < $1x10^{-5}$). Consequently, no remedial action objectives were developed for the groundwater in this area.

Remaining Areas
The risk assessments performed during the RI/FS also allowed some of the Manchester site areas to be excluded from remedial actions:

- **Net Depot and Manchester State Park**. Although metals were detected at low concentrations in the soil and seeps in the Net Depot area, the potential health risks were determined to be minimal and consequently no additional actions were proposed for the Net Depot or Manchester State Park.
- **Former Fire Training Area - TPH-contaminated Soil**. A limited amount of TPH contaminated soil was excavated during the UST closure (described in Section 4.2 below). However, the bulk of the TPH-contaminated soil at the FFTA was left in place for the following reasons: the total petroleum hydrocarbons were tested using the Synthetic Precipitation Leaching Procedure (SPLP) and considered to be no longer leachable because they were highly weathered and consisted primarily of heavy petroleum constituents (very low aqueous solubility); and no petroleum constituents were detected during sampling of shallow groundwater beneath the TPH-impacted soil. Thus, the TPH-impacted soils were considered not to pose a risk to neighboring private and public water supply wells. In addition, the risk assessment concluded that the elevated levels of TPH in the soil would not pose a threat to human health.

4. Remedial Actions

4.1. Remedy Selection

The ROD for the Manchester Annex was signed September 30, 1997. The following section summarizes remedial actions selected based on the ROD, RI/FS and risk assessments.

4.1.1. Landfill Area and Clam Bay Sediments

The selected remedy for the landfill area and clam bay sediments in the ROD called for the following:

1. Excavation and relocation the debris in the intertidal zone of Clam Bay and establishment of a stable shoreline protection system, with a goal of no net loss of aquatic habitat;

2. The shoreline excavation backfill to be designed to achieve seep cleanup levels, provide the best possible habitat for marine organisms, and maximize long-term beach stability;

3. Placement of a thin clean sediment cap over intertidal Clam Bay sediment areas which exceed cleanup levels; and

4. The upland portion of the landfill to be capped in accordance with the State of Washington's Minimum Functional Standards (MFS) for solid waste landfill closures including installation of a hydraulic cutoff system up-gradient of the landfill area.

4.1.2. Former Fire Training Area

The selected remedy for the former fire training area in the ROD called for the following:

1. Removal of dioxin-contaminated debris from the main simulator complex in the former fire training area and disposal in a RCRA hazardous waste landfill;

2. Inspection of the simulators for cracks, and if leaks are identified, test soil for dioxins;

3. Demolition of simulator and excavation of soil beneath the simulators if is exceeds the dioxin cleanup levels;

4. Testing of the near-surface soils adjacent to the main simulator complex and soil/debris piles north of the main complex for dioxins and excavation if cleanup levels are exceeded; and

5. Closure in-place of concrete USTs remaining in the Fire Training Area.

4.1.3. General

1. **Implement the following institutional controls:**
    - Provide a written description of activities or prohibitions necessary to ensure long-term protection and maintenance of the selected remedy;
    - Prepare draft deed covenants prohibiting future residential use of the property;
    - Place a restriction on subsistence-level harvesting of shellfish (to be enforced by the Suquamish Tribe) until the Washington State Department of Health and the Suquamish Tribe determine that the shellfish are safe for subsistence-level harvesting; and
    - Develop an institutional control plan to address TPH-impacted soil left in-place at the FFTA (i.e., location of soil, depth of contamination, concentrations, and health and safety measures).

2. **Meet the following monitoring requirements post-construction**:[1]
   - **Monitor Seeps.** Monitor seeps at the seaward toe of the shoreline protection system, if observed, for compliance with cleanup levels and implement additional remedial measures if compliance has not been achieved. In the first year after cap placement, quarterly observations for seeps should occur. If no seeps are observed in the first year, then observations will continue once a year for five years. If seeps are observed, they should be tested for dissolved metals (As, Cd, Cr, Cu, Hg, Pb, Ni, and Zn) and total PCBs, and the samples should be collected from up to three locations. Thereafter, the sampling should occur semi-annually for two years, followed by annual monitoring for three years. The Compliance Monitoring Plan (CMP) [Hart-Crowser, 1999] also recommends analysis of total suspended solids (TSS), temperature, pH, salinity, turbidity, and dissolved oxygen to facilitate interpretation of the primary results.
   - **Monitor sediment and shellfish tissue.** Monitor sediment and shellfish tissue until compliance with PCB cleanup goals for sediment (40 ug/kg-dry) is achieved, or until the Washington State Department of Health and the Suquamish Tribe determine that the shellfish are safe for subsistence-level harvesting, whichever comes first.

     Sampling of sediments should occur initially immediately after cap placement. Thereafter, shellfish tissue and sediment should be sampled for compliance with PCB cleanup goals four, seven, and ten years after cap placement. In addition, the CMP recommends analysis of total lipids (in tissue) and total organic carbon (in sediment) to facilitate interpretation of the PCB results. The CMP recommends collecting the following clams (in order of decreasing preference): Manila, Littleneck, Butter, Horse, and Cockles.

Overall, the ROD states that the chosen remedial actions are protective of human health and the environment, and are compliant with applicable laws, but that they do not meet the statutory preference for treatment of the principal threat materials (the large volume of landfill waste and sediment) due to impracticability of treatment. As a result, hazardous substances may remain on-site above levels that are protective of human health and the environment. Therefore, reviews will be conducted every five years, at a minimum, to ensure that the remedial actions remain protective.

4.2. Remedy Implementation

The remedial design was finalized on June 22, 1999. The remedial design addressed the practical implementation of the remedial actions described above. The initial construction work (known as “Phase I construction”) was awarded in June of 1999 and terminated in early 2001 with the majority of the remedial work having been completed. In October of 2001, the remaining remedial work (known as “Phase II construction”) was completed. Other construction tasks that were not mentioned in the ROD but were performed during remedial construction included decommissioning of wells used during the RI, inspection for and closure of any drain

lines in the shoreline area that could have served as conduits of landfill leachate, and construction of a service road behind the EPA facility.

The status of the remedial actions is described below. Any design changes to original ROD construction elements are discussed below as well.

4.2.1. Landfill and Clam Bay Sediments

1. **Excavation and Relocation.** All debris, soil, and sediment was found suitable for placement on the upland landfill area and placed in accordance with the specifications. The final volume of material to be placed was much larger than originally estimated. As a result, the final finished slope of the landfill area (approximately 7%) was greater than the 5% specified by remedial design. This slightly steeper slope did not compromise compliance with the MFS for Washington State solid landfill closures.

2. **Shoreline Protection and Seeps.** The shoreline protection system abuts the landfill along its southern edge and extends nearly 1200 feet along the Clam Bay shoreline. It consists of layers of granular material that are designed to protect the shoreline from tidal erosion, allow landfill drainage yet prevent tidal flushing, and provide fish spawning habitat. Specifically, pit run/cobbles were placed along the slope of landfill that extended toward the Bay. A drainage filter fabric was placed next, followed by design fill, more drainage filter fabric, loose riprap, pit run/cobbles, and a fine-grained beach fill. The beach fill was intended to provide spawning substrate attractive to fish consumed by local salmon.
3. **Sediment Cap.** A six-inch minimum thickness cap of clean sediment was placed over the intertidal area identified as the "thin cap" area in the design plans. Similarly, another cap of clean sediment was placed in an intertidal depression area known as the "silt basin" to create an even transition to the main capped area. Capping materials were tested to verify compliance with Ecology's sediment quality standards for metals (cleanup standards are listed in **Table 4**) prior to application.
4. **Landfill Cap and Hydraulic Cutoff System**. The landfill cap and hydraulic cutoff system was completed in summer/fall of 2001.

   The final landfill cap system consisted of the following layers (from top to bottom):

   - grass and shrub vegetation
   - a 12-inch minimum topsoil layer to support the vegetation
   - an 18-inch minimum fill layer to protect the underlying geosynthetics
   - a geocomposite layer to drain water and filter out any soil particles in the draining water
   - a 50-mil PVC geomembrane

- A 12-inch minimum granular vent and bedding layer to route landfill gases to vents and protect the geomembrane from the landfill debris.

The landfill cap contains six passive gas vents that are constructed from three-inch diameter PVC pipe and facilitate equalization of gas pressure above and below the geomembrane. The landfill cap is also traversed by the EPA laboratory access road (902 linear feet) and a service road (less than 50 linear feet).

For the hydraulic cutoff system, a cutoff wall was constructed along the upland perimeter of the landfill using soil-bentonite slurry trench technology to prevent groundwater from seeping into the landfill. A perimeter drainage system was also installed immediately up-gradient of the cutoff wall to route water around the landfill perimeter and into Clam Bay. The system addresses both surface and subsurface drainage, and consists of ditches, drainpipes, drainpipe cleanouts, manholes, catch basins, culverts, and outfalls.

The ROD required that a post-closure plan be developed to address I&M, monitoring, and inspection requirements for the landfill cap, hydraulic system, and shoreline protection system. An Inspection and Maintenance Manual [Hart-Crowser, 2002a] and a Technical Specifications and Compliance Monitoring Plan for Phase II Construction [Hart-Crowser, 2001] were developed, which jointly satisfy the requirement for a post-closure plan.

4.2.2. Former Fire Training Area

1. **Simulator Debris Removal.** In 1998, a removal action took place at the FFTA, which included removal of the debris located within the main simulator complex; demolition of the simulators to below ground surface and in-place closure of the sub-grade foundations; closure of some concrete USTs and vaults; and removal of associated inactive underground piping, hydrocarbon-contaminated wastewater, and TPH-contaminated soil. The waste materials were characterized in accordance with local, state, and federal regulations prior to transportation off-site for recycling or disposal.

   The USACE, Ecology, and EPA determined that the remaining work to be completed as part of remedial construction would include off-site disposal of dioxin-contaminated debris piles within and near the northern simulator; six-inch excavation and off-site disposal of soil below the debris piles and soil around the northern simulator perimeter; and sampling and analysis of soil from eight locations within the FFTA to confirm that the dioxin cleanup level had been achieved.

2. **Soil Testing.** After construction was completed, eight samples were to be taken from the FFTA to confirm that the dioxin cleanup level had been achieved. However, at the end of the early removal action before the samples were taken, the landowner of the FFTA (NOAA) paved over the main simulator complex area to expand parking availability, which inadvertently reduced the available number of sampling locations to four. The USACE, Ecology, and EPA subsequently decided that sampling in the

paved area was not necessary because the asphalt provided a sufficient barrier to soil exposure, and institutional controls would prohibit future residential use and restrict subsurface excavations (discouraged due to TPH contamination left in-place). The final sampling set consisted of 18 pre-remedial action samples and four post-remedial action samples, which were analyzed for dioxin congeners and converted to 2,3,7,8-tetrachlorodibenzo-*p*-dioxin Toxicity Equivalent concentrations (TEQ).

Using Ecology guidelines, the calculated results were evaluated against the following criteria: (1) no results could be greater than two times the ROD cleanup level of 270 ng/kg, (2) the 95% upper confidence limit needed to be less than 270 ng/kg, and (3) no more than 10 percent of the sample results could be greater than 270 ng/kg.[2] These criteria were satisfied, and thus the remedy has performed as intended.

3. **UST Closure.** Several concrete USTs and vaults near the main simulator complex were closed and associated piping was removed. Approximately 100 linear feet of asbestos-clad piping were discovered during the removal and subsequently removed in accordance with applicable regulations. In addition, one vault contained approximately 300 gallons of sludge that had to be disposed of as Washington State Dangerous Waste because it failed the Toxicity Characteristic Leaching Procedure (TCLP) for lead (regulatory level is 5 mg/L). During FFTA work the monitoring wells used during the RI were also decommissioned (abandoned in-place).

4.2.3. General

1. **Implement the following institutional controls:**
   - A written description of activities or prohibitions necessary to ensure long-term protection and maintenance of the selected remedy has not been prepared. It is assumed that this information will be incorporated into the finalized ICP.
   - Deed covenants prohibiting future residential or childcare use of the property have not been developed. It is assumed that this information will be incorporated into the finalized ICP.
   - A restriction on subsistence-level harvesting of bivalves in intertidal areas is currently in place (Denice Taylor, Suquamish Tribe Representative, personal communication on 7/20/04 and 7/27/04).
   - Regarding the ICP, the EPA found the draft ICP submitted by Hart-Crowser in 1998 to contain a number of issues requiring resolution; consequently, the ICP was left to be finalized by the USACE. The ICP is scheduled to be complete in September 2009.

[2] The upper confidence limit is the upper limit of a confidence interval. If many data values (e.g., sampling results) are used and the confidence interval computed many times, in the case of a 95% confidence interval, for example, the true average (mean) of the values would be captured in the interval 95% of the time [NIST, 2004]. For the Manchester Site, the upper limit was set at 270 ng/kg.

2. **Meet the following monitoring requirements post-construction:**
   - **Monitor seeps.** Monitoring for seeps at the seaward toe of the landfill during inspections began in fall of 2004. No seeps have been noted by the I&M contractor during routine inspections. However, USACE observed two seeps at the seaward toe of the landfill during the 2009 clam survey. The USACE is planning to sample the seeps (if still present) and pore water on the beach in July, 2009.
   - **Sample sediment and shellfish tissue**. Surveys to determine the quantity of clams available for sampling were completed on 9 February 2005, on 25 May 2006, and the third event split between 30 April 2009 and 6 July 2009. All three surveys found that there were not enough clams to support the number of samples specified by the Compliance Monitoring Plan. Sediment samples were collected on the beach on 26 and 27 April 2005. The CMP for Manchester recommended sampling at four, seven, and ten year intervals after completion of remedial actions. The seven year monitoring event would have taken place in 2007, but no sediment sampling occurred that year. At this time, the USACE is planning to perform sediment sampling in August 2009.

4.3. Inspection and Maintenance

This section describes the general and specific I&M requirements for the remedy components, summarizes the I&M activities that have been conducted so far, and describes any problems that have been identified through I&M.

General inspection requirements for the landfill cap and shoreline protection system, as outlined in the Inspection and Maintenance Manual [Hart-Crowser 2002a], would consist of quarterly monitoring during the first two years of post-closure, and twice-yearly monitoring (with the possibility of two additional inspections) thereafter. Quarterly monitoring would continue indefinitely, however, if problems were identified and not resolved. Emergency inspections would be performed as needed (e.g., due to extremely heavy rains or powerful waves). Inspection requirements, associated maintenance requirements, and current status for each specific remedy component are described below.

4.3.1. Landfill Cap & Hydraulic Cutoff System (including vents, drainage, and roads)

The Inspection and Maintenance (I&M) Manual specified that the cap area should be inspected for localized depressions, wet or saturated areas, sloughing, cracks in the soil, bulging, erosion, exposure of geosynthetic materials, rodent holes, distressed vegetation, and plants with deep root systems (e.g., trees, large bushes) that could damage the geosynthetic layers. The gas vents and screens should be inspected for evidence of damage or clogging, and during the first year of inspections, the vents should be screened for explosive gas concentrations using a combustible gas indicator. If any concentration exceeds 10 percent of the lower explosive limit (LEL), the USACE point of contact, EPA Region 10, and the EPA Manchester laboratory must be notified to determine if increased monitoring or other measures are necessary to protect human health and the environment. After four quarterly monitoring events, screening for combustible gases can be discontinued if no measurements are recorded above the 10% LEL.

Roads traversing the cap should be inspected for depressions, cracking, potholes, and unwanted vegetation. Other cap features such as drainage ditches, culverts, outfalls, and catch basins should be inspected for problems such as erosion, significant odor, signs of burrowing animals, unwanted vegetation, and material clogging drains or otherwise impeding flow. The perimeter drainage pipes should be flushed with water on an annual basis with a minimum of 500 gallons injected into pipe cleanouts (CO) CO-1 through CO-4, and a minimum of 700 gallons into CO-5 through CO-8, at a rate of 370+ gallons per minute.[3] The injections should be logged onto a Drainpipe Water Injection Log.

Any problems that have occurred with the landfill cap or drainage system should be addressed promptly, and could include measures such as sediment, debris, and unwanted vegetation removal; erosion repair; reseeding; sealing of asphalt cracks; and control of burrowing animals. Significant erosion should be repaired to meet original design thicknesses and grades depicted on the as-built drawings. Any deficiencies should be photographed before and after repair, and the photos should be included in the Annual Maintenance Report.

4.3.2. Shoreline Protection System

The interface between the landfill cap and the shoreline protection system should be inspected to determine if sloughing of the vegetative landfill cover has occurred. The beach area should be inspected for signs of exposed riprap, exposed geosynthetics, or other exposed materials that would indicate that tidal erosion is occurring. During the first inspection event, eight to ten photo locations should be established on the beach from which subsequent photos can be taken to document the condition of the site. Any repairs to the shoreline protection system should conform to the original construction specifications, as-built drawings, and any subsequent modifications.

4.3.3. Inspection and Maintenance Activities during the Last Five Years

Current annual inspection and maintenance costs average $28,100 per year. These costs include, mowing, removal of unwanted vegetation (alders, blackberries, scotch broom) by hand and with herbicide, replanting of drought resistance shrubs on the landfill cap, inspection of the shoreline protection system and landfill cap, monitoring of gas vents, and maintenance of landfill drainage system.

Inspection and Maintenance of the Landfill is required on a semi-annual basis [Hart-Crowser, 2002a]. During the last five years the I&M contractor performed I&M activities at the site on six occasions in 2004, five in 2005, five in 2006, six in 2007, and three in 2008 thus meeting the requirement for inspection frequency. The annual inspection reports indicate that the contractor has routinely inspected the landfill cap for depressions, wet or saturated areas, sloughing, cracks in the soil, rodent holes, distressed vegetation, and plants with deep root systems; the drainage system; and the shoreline protection system as required by the I&M Manual. The perimeter drainage pipes are required to be flushed with water on an annual basis [Hart-Crowser, 2002a].

[3] Pipe cleanouts are used to remove debris that may accumulate in drain pipes.

The annual inspection reports indicate that this has only been performed in December, 2004 and July, 2006. The I&M Manual requires that eight to ten photograph locations of the beach be established for repeat photography to document beach dynamics over time. There is no indication that this has been done.

Based on the I&M activities performed to date, the primary problem appears to be persistent growth of scotch broom, blackberries, and alder on the landfill cap. Minor ponding along the swale drain alignment has been observed after heavy rainfall events and needs to be monitored to ensure that adequate drainage of landfill cap is occurring. Shrubs planted on the landfill cap are stressed during the dry summer months. During an inspection and monitoring event in July, 2005, the LEL in vent 6 was 15%, exceeded the action level which required notification of the USACE project manager and the EPA. It is unknown if this notification occurred. Monitoring of vent 6 was repeated one week later with a LEL of 0%.

At the time the ROD was written (1997), the estimated present worth of annual I&M costs over a maximum project life of 30 years were $260,000 for the landfill cap and Clam Bay area, and $0 for the FFTA, due to the use of institutional controls to handle the TPH-contaminated soil left in-place. In the Preliminary Closeout Report [EPA, 2002] prepared for the Manchester site, the I&M costs were estimated at $40,000 per year (including monitoring) for the landfill remediation, $0 for the FFTA, and $20,000 per year for the Beaver Creek restoration project.

The actual I&M costs for the period between April 2004 and September 2008 are summarized in Table 3 below.

Table 3. System Operations/I&M Costs

Dates		Area	Total Cost ($) – rounded to the nearest $500
From	To		
April 2004	October 2004	Landfill cap, hydraulic cutoff system, and shoreline protection system	27,500
		Beaver Creek	2,000
January, 2005	October, 2005	Landfill cap, hydraulic cutoff system, and shoreline protection system	27,500
January, 2006	October, 2006	Landfill cap, hydraulic cutoff system, and shoreline protection system	28,000
January, 2007	December, 2007	Landfill cap, hydraulic cutoff system, and shoreline protection system	34,500
February, 2008	September, 2008	Landfill cap, hydraulic cutoff system, and shoreline protection system	21,000
TOTAL:			$140,500

5. Progress Since the Last Five-Year Review

5.1. Protectiveness statements from last review

The protectiveness statement in the first Five Year Review (2004) reads as follows:

> *The remedy was determined to be protective of human health in the short-term because a restriction of subsistence-level harvesting of intertidal bivalve organisms is in place, the landfill cap and shoreline protection system are intact, and the cleanup requirements for the FFTA have been met. The shell fishing restriction, however, was intended only as a temporary measure during the initial recovery period. Seep, sediment, and tissue sampling data are necessary to evaluate the current status and the long-term protectiveness of the actions implemented for the landfill and Clam Bay…*
>
> *The protectiveness of the remedy for the environment (flora and fauna on land and in the marine environment) could only be partially determined during the five-year review, due to the lack of monitoring data. The landfill cap was determined to be sufficient to prevent wildlife contact with the landfill wastes, to provide adequate protection from upland exposure conditions, and to prevent infiltration of precipitation into the landfill. The protectiveness of the remedy regarding marine intertidal fauna, however, cannot be determined until seep, sediment, and tissue monitoring and sampling occur…Once data are available, a protectiveness determination can be made…*
>
> *Other issues found with respect to the requirements of the ROD were as follows: (1) a final institutional control plan has not been implemented; (2) the presence of landfill seeps has not been systematically sought during normal inspection and maintenance activities; and (3) maintenance on the landfill cap does not appear to be aggressive enough to prevent unwanted vegetation, with roots that could potentially damage the liner, from growing on the landfill cap.*
>
> *To ensure that the remedy complies with the requirements of the ROD and provides long-term protection of human health and the environment, the following measures should be taken: (1) a final institutional control plan should be implemented; (2) the presence of any landfill seeps should be actively sought and documented; and (3) unwanted vegetation such as blackberries, alders, and scotch broom present of the landfill cap should be aggressively removed to prevent possible future damage to the cap.*

5.2. Status of recommendations and follow-up actions from last review

Thirteen recommendations and follow-up actions were presented in the last Five Year Review (2004). The following section summarizes the recommendations and the status of the follow-up actions.

Recommendation 1:

> *Complete and implement final institutional control plan.*

Status:

> In progress. The final institutional control plan is set to be completed by 30 September, 2009.

Recommendation 2:

Coordinate with the Suquamish Tribe (and other state and federal agencies as appropriate) to evaluate the continued need for a shell fishing restriction.

Status:

On going. Clam surveys were performed in February, 2005, April, 2006 and April 2009. All three surveys concluded that the quantities of littleneck and manila clams found were not sufficient to support sampling. The Suquamish Tribe and USACE are also having discussions about possible alternative methods for sampling of clam tissue

Recommendation 3:

Update CMP and ensure that the monitoring in the CMP is implemented; provide CMP to the Suquamish Tribe.

Starting in 2005, collect and test sediment samples for PCBs to determine compliance with cleanup levels. Also test for silver to verify compliance with Ecology's sediment quality standards.

Starting in early 2005, collect and test clam tissue samples for PCBs to determine compliance with cleanup levels.

Status:

On-going. The CMP for Manchester recommended sampling at four, seven, and ten year intervals after completion of remedial actions. Sediment samples were collected in April 2005 and analyzed for PCBs and metals including silver. The seven year monitoring event would have taken place in 2007, but no sediment sampling occurred that year. A second round of soil sampling is planned for July, 2009. Clam surveys were performed in February 2005, April 2006 and April 2009. All three surveys concluded that there are quantities of littleneck and manila clams found were not sufficient to support sampling. Monitoring for seeps at the seaward toe of the landfill during inspections began in fall of 2004. No seeps have been noted by the I&M contractor during routine inspections. However, USACE observed two seeps at the seaward toe of the landfill during the 2009 clam survey. The USACE is planning to sample the seeps (if still present) and pore water on the beach in July 2009.The CMP has not been updated. USACE plans to revise/update the CMP during fiscal year 2010.

Recommendation 4:

Visually inspect shoreline area for presence of seeps and document the results (i.e., found/not found). If seeps are found, test seeps in accordance with the CMP and evaluate for further remedial action.

Status:

Ongoing. Starting in 2004 the USACE contractor began visually inspecting the shoreline for the presence of seeps during their quarterly inspections and maintenance. They reported in their annual reports than no seeps have been observed. It is possible that there was confusion on what constituted a seep, based upon contradictory statements in the Compliance Monitoring Plan. USACE observed two seeps on the shoreline down-

gradient of the landfill during the clam survey on 30 April 2009. USACE plans to collect pore water and seep samples (if more are observed) in July 2009.

Recommendation 5:

Pursue aggressive eradication of all unwanted vegetation on the landfill cap. Update I&M procedures accordingly.

Status:

Ongoing. The USACE I&M contractor has manually removed unwanted vegetation and will continue to remove it by hand as required during scheduled site inspection work.

Recommendation 6:

Produce and distribute annual reports of I&M activities to EPA (and other interested parties). Review I&M procedures to ensure adequacy and modify procedures if necessary.

Status:

On-going. USACE is compiling the reports and sending copies to EPA, NOAA, and the Suquamish Tribe.

Recommendation 7:

Complete a report of findings from the archeological investigation that occurred during remedial construction and provide to the Suquamish Tribe.

Status:

Not Complete.

Recommendation 8:

Replace soil from swale excavation on-site or dispose of it properly off-site. The I&M manual does not specify how to handle soil excavated for the landfill area – update I&M manual to correct this deficiency.

Status:

Complete. The soil was tested and found to be clean so it was spread at the site. The USACE does not anticipate the need to excavate soil from the landfill in the near future. If it becomes necessary, USACE will modify the I&M contract accordingly.

Recommendation 9:

Remove and appropriately dispose of miscellaneous items left on FFTA concrete pad.

Status:

Complete. The USACE I&M contractor removed a stack of wet hay, a 55 gallon drum, a wash bucket, and old stakes in 2004.

Recommendation 10:

Finalize draft remedial action report.

Status:

Complete: The remedial action report was finalized March 8, 2005.

Recommendation 11:

Provide final documents for NMFS personnel (RI/FS, RD, and as-builts) and to the Suquamish Tribe (RI/FS and final RAR).

Status:

On-going. Documents are currently being compiled and sent to the interested parties.

Recommendation 12:

Investigate current/past use of vault to determine the function of this vault.

Status:

Complete. Review of historic US Navy utility maps show the vault to be a component of the former storm water system.

Recommendation 13:

Remove the weathered "Hazardous Area" sign, as all hazardous material has been either removed from the site or contained under the landfill cap.

Status:

Not Complete. The "Hazardous Area" sign is still in place.

6. Five-Year Review Process

6.1. Administrative Components of the Five-Year Review Process

The Manchester Annex Superfund Site Five-Year Review team was led by Ed Louis, the USACE Kansas City District Project Manager. The following personnel from the USACE, Seattle District assisted with the review: May Carrell, Joseph Marsh, Amy Ebnet, Mandy Michalsen, Emile Pitre and John Wakeman.

6.2. Components of Review

By April 2009, the review team had been formed, and had established the review schedule and its major components including:

- Document Collection and Review;
- Data Assessment/Analysis;
- Site Inspection;
- Interviews and Community Notification and Involvement
- Five-Year Review Report Development and Review.

The FYR has a statutory completion date of September 30, 2009.

6.3. Community Involvement

Activities to involve the community in the FYR include a notice that will run in *The Kitsap Sun* and the *Port Orchard Independent* local newspapers in July 2009. The notice will state that a FYR will be conducted and ask for public comment.

6.4. Document Review

A review of reports pertinent to this five-year review was conducted by the review team. The types of documents reviewed included decision documents, risk assessment documents, and other supporting materials. Applicable cleanup standards, as listed in the 1997 ROD, were also reviewed. Attachment 1 is a complete list of documents reviewed during this Five-Year Review.

6.5. Data Review and Evaluation

Sediment samples were collected on the beach on 26 and 27 April, 2005. All sediment samples met the ROD-specified benthic protection standard of surface-weighted average concentration (SWAC) cleanup level of 130 µg/kg-dry for total PCBs. The SWAC of the samples and 11 individual samples did not meet the ROD's cleanup goal of 40 µg/kg-dry; however, this value was a conceptual target for PCBs and was intended to indicate the likelihood that shellfish would be below the 42 ug/kg-wet cleanup goal for human health. One sample for copper exceeded the benthic cleanup level, but the SWAC was below the cleanup level. Samples collected for 2,4-dimethyphenol met the cleanup level. The CMP for Manchester recommended sampling at four, seven, and ten year intervals after completion of remedial actions. The seven year monitoring event would have taken place in 2007 but no sediment sampling occurred that year. At this time, the USACE is planning to perform sediment sampling in July, 2009.

Monitoring for seeps at the seaward toe of the landfill during inspections began in fall of 2004. No seeps have been noted by the I&M contractor. At this time, the USACE is planning to sample the pore water on the beach in July, 2009.

Surveys to determine the quantity of clams available for sampling were completed on 9 February 2005, 25 May 2006 and 30 April 2009/6 July 2009. All three surveys found that there were not enough clams to support the number of samples specified by the QAPP. For sampling purposes, at least 20 grams of tissue are needed per sample which requires approximately five 1.5-inch Littleneck clams. The 2005 survey found only five Littleneck clams and one Manila clam greater than 1.5 inches in length. The 2006 survey found only 16 Littleneck clams and five Manila clams greater than one inch in length. Note that without clam tissue data there will not be sufficient basis for determining that compliance has been met.

6.6. Site Inspection

A site inspection was conducted on April 17, 2009 by Joe Marsh and Amy Ebnet, USACE technical staff (see Attachment 2, Site Inspection Checklist) in order to assess the integrity of the landfill cap and shoreline protection system, assess the condition of the FFTA, and document the

presence of institutional controls (signs, fencing, and any other access restrictions). Photos that document the site condition are included in Attachment 3 and referenced below.

The landfill cover is in very good condition with no obvious signs of settlement, sloughing, or erosion. Cover mowing appeared to be only partially completed with a very large patch on the northwest side overgrown with Oregon grape, wild rose, scotch broom and blackberry vines. The perimeter surface drainage ditch contained standing water in locations on the southeastern side of the landfill. Additional inspection revealed water to be flowing off the site on the southern end into a drainage ditch leading to the beach. Wetland vegetation including horse tails was observed growing along the interceptor drain along the western side of the landfill. The landfill cover strip on the east side of the access road appeared to be in very good condition.

Regarding the shoreline protection system, wind and/or wave damage exposed a section of black filter fabric, approximately three feet long, on the north end of the beach in front of the landfill adjacent to the rock embankment protection the southeast side of the EPA pier. No seeps were observed during the initial inspection. However, during the clam survey on 30 April 2009, two persistent seeps were observed in low areas along the beach.

The FFTA had been paved over or covered with gravel and appeared to be in good condition. We inspected monitoring wells MW-5 and MW-6 as the flush mount cover plates were still intact and NOAA was concerned that they were not abandoned. The monitoring wells had been filled with bentonite grout. Abandonment records for these wells were located on the Washington State Department of Ecology website.

6.7. Site Interviews

An interview with EPA Lab Director Barry Pepich and EPA Facilities Manager Robert Manos was conducted at the EPA laboratory during the site visit on 17 April 2009. James Hackett, NOAA Facilities Manager was interviewed at the NOAA Facility during the site visit on 17 April 2009. The EPA Remedial Project Manager, Kira Lynch, and Suquamish Tribe Environmental Scientist, Denise Taylor, were interviewed via telephone. Tom Flagg, NOAA Site Manager, and Desmond Maynard, NOAA Facilities Manager were also interviewed via telephone. See Attachment 4 for the interview questions and responses.

Generally concerns were raised about: the lack of communications between USACE and interested parties; the lack of follow through on site monitoring and sampling; the inability to determine if the remedy is sufficiently protective (through lack of data); and the lack of sufficient clams to sample the clam tissue at the site.

7. Technical Assessment

7.1. Question A: Is the remedy functioning as intended by the decision documents?

No. Institutional controls have not been implemented. A discussion by site area follows:

7.1.1. Landfill Area and Clam Bay Sediments

Remedial action objectives for these areas were outlined in Section 3.5. The landfill cap is preventing human and wildlife contact with landfill waste and dust, and is functioning as intended by the ROD. Inspection and maintenance of the cap is occurring, with the primary recurring issue continuing to be the persistent presence of scotch broom, alder, and blackberries on the cap. These plants/trees have roots that could damage the membrane if they are allowed to continue to grow; thus they need to be eradicated. Ongoing spraying and removal by hand occurred during the last five years. However, complete eradication of these unwanted plants has not occurred. In addition, a few trees were planted on the landfill cap by accident and will have to be moved. Minor ponding of water on the swale is a problem after heavy rainfall events.

At the time of this writing, an ICP has not been finalized. This would ensure that drilling, construction, or planting of plants that would affect the integrity of the cap do not take place. During the site interviews it was discovered that there are plantings on the cap that could affect the functioning through root intrusion.

Seep, shellfish and additional sediment monitoring data for Clam Bay are needed to determine whether the remedy is achieving the rest of the remedial action objectives listed in Section 3.5. . Monitoring for seeps began in 2004 during quarterly inspections with no observed seeps reported by the I&M contractor. However, two seeps were observed during the April 2009 clam survey. Seep samples and pore water samples need to be taken to determine whether they comply with remedial action goals. Sediment samples were collected in April 2005. The sediment cleanup level (to protect benthic organisms) for PCBs was achieved during this round of sampling; however the remedial action goal to protect shellfish consumption was not achieved. Additionally, one sediment sample significantly exceeded the copper cleanup level. Therefore, continued monitoring of sediment for PCBs and copper to evaluate recovery is recommended. Clam surveys were performed in February 2005, May 2006, and April 2009. The surveys revealed insufficient quantities of harvestable size clams to complete sampling.

Exposed filter fabric and erosion of the upper layers were observed along one portion of the shoreline protection system during the site inspection for this five year review. In the short term, it appears that a sufficient thickness of material remains in the shoreline protection system to function as a barrier between the landfill contaminants and the beach. If left unrepaired, the shoreline protection system may experience further erosion exposing the landfill contaminants to the environment. This portion of the shoreline protection system will require repair; subject to the availability of funds.

Regarding performance of the remedy related to ecological risks, the ROD indicated that potential unacceptable ecological risks were limited to the landfill area and Clam Bay. Thus, the remedy focused on achieving the remedial action goals for these areas. The landfill cap was determined to be sufficient to prevent wildlife contract with the landfill wastes and to provide adequate protection from upland exposure conditions. The landfill cap, hydraulic cutoff system, and shoreline protection system were designed to limit infiltration of precipitation into the landfill, thereby achieving seep cleanup levels immediately and providing protection to the marine environment. However, compliance with the ROD goals cannot be determined in this five-year review without seep/pore water samples, clam tissue samples and additional sediment samples.

7.1.2. Former Fire Training Area

Remedial action objectives for the FFTA were outlined in Section 3.5. Testing of the soils for dioxins indicated that compliance with the cleanup level of 270 ng/kg had been achieved. Therefore, the remedy has functioned as intended by the ROD to prevent human and wildlife contact with simulator debris and soils containing dioxin concentrations greater than the cleanup levels.

An ICP still needs to be finalized to address the TPH-impacted soil left in-place near the main simulator complex of the FFTA. Implementation of the ICP will help ensure compliance with the ROD.

7.2. Question B: Are the exposure assumptions, toxicity data, cleanup levels, and remedial action objectives (RAOs) used at the time of the remedy still valid? Yes.

The exposure assumptions, toxicity data, cleanup levels, and RAOs presented in the ROD were reviewed to determine their continuing validity and the results are discussed below.

7.2.1. Changes in Applicable and Relevant and Appropriate Requirements and To Be Considered Criteria

Applicable or relevant and appropriate requirements (ARARs) cited in the ROD were reviewed to evaluate changes in the ARARs since the last five-year review. Chemical specific ARARs are presented below.

Table 4: Cleanup Levels and Cleanup Goals for Site Contaminants of Concern Identified in the ROD Compared to Current Regulatory Standards.

Contaminant	Medium	Standard or Goal in ROD (CL/CG)[4]	Citation	Current Value in Regulations
Copper	Seeps	10.6 µg/L CL	Background	Unchanged
Nickel	Seeps	7.9 µg/L CL	WAC 173-201A marine chronic[5]	8.2 µg/L
Zinc	Seeps	77 µg/L CL	WAC 173-201A marine chronic	81 µg/L
Total Polychlorinated Biphenyls (PCBs)	Seeps	0.03 µg/L CL	WAC 173-201A marine chronic	Unchanged
Copper	Sediment	390 mg/kg-dry	WAC 173-204	Unchanged

[4] Cleanup Levels (CL) are enforceable standards in the ROD. The SQS value is intended to protect benthos; the "bioaccumulation correlation" is the basis for sediment cleanup based on a relationship of clam tissue to sediment concentration accomplished during the RI/FS. It is a Cleanup Goal (CG), intended as an advisory, and is not enforceable. Likewise, the clam tissue value is advisory.

[5] WAC 173-201A is an applicable standard.

Contaminant	Medium	Standard or Goal in ROD (CL/CG)[4]	Citation	Current Value in Regulations
		CL	[6]Sediment Management Standards (Sediment Quality Standard, SQS)	
Lead	Sediment	450 mg/kg-dry CL	SQS	Unchanged
Silver	Sediment	6.1 mg/kg-dry CL	SQS	Unchanged
Zinc	Sediment	410 mg/kg-dry CL	SQS	Unchanged
2,4-Dimethylphenol	Sediment	29 µg/kg-dry CL	SQS	Unchanged
Total PCBs	Sediment	130 µg/kg-dry CL 40 µg/kg-dry CG	SQS Bioaccumulation correlation[7]	Unchanged
Total PCBs	Tissue	42 µg/kg-wet CG	Subsistence fishing[8]	Unchanged
2,3,7,8-TCDD Equiv.	Soil	270 ng TEQ/kg-dry CL	WAC 173-340 Method C	1,500 ng/kg
TPH (as diesel)	Soil	200 mg/kg-dry CG	WAC 173-340 Method A	2,000 ppm

Chemical-specific values associated with ARARs cited in the ROD remained unchanged with the exception of the surface water discharge values for nickel, and zinc, and soil values for dioxin TEQ, and TPH (as diesel). The actions associated with surface water protection are ongoing. The cleanup level for seep discharges, which was initially based on the Washington State surface water quality standards (SWQS), would increase for nickel and zinc from the remedial action goals. Nickel SWQS increased from 7.9 to 8.2 µg /L, and zinc SWQS increased from 77 to 81 µg//L. These new values indicate a lower risk from exposure than previously considered, and the change has no impact on the remedy's protectiveness.

Under the Model Toxics Control Act (MTCA) Method A, the soil cleanup level for diesel was 200 mg/kg at the time the ROD was signed. This value increased to 2,000 mg/kg, effective in 2001. This new value indicates a lower risk from exposure than previously considered, and the change has no impact on the remedy's protectiveness.

[6] WAC 173-204 (SQS) are applicable standards.

[7] Bioaccumulation correlation is not an applicable or relevant and appropriate standard or to be considered guideline.

[8] This is a risk based value.

The soil cleanup level for dioxin TEQ at the time of the 1997 ROD was 270 ng/kg. This value was based on the MTCA Method C. In November 2007, the Washington State Department of Ecology (DOE) completed a rulemaking process to revise and update the policies and procedures for establishing cleanup levels for polychlorinated dioxin and furan mixtures. The rule amendments (Ecology, 2007) are outlined below.

- Amend WAC 173-340-708(8) to revise and update the risk policies for mixtures of dioxin to require that cleanup levels established for mixtures of dioxin and furans be based on a cancer risk of one-in-a-million (10^{-6})
- Amend the rule to require use of the most current Toxic Equivalent Factors (TEF) values to characterize mixtures, which at this time are those recommended by the World Health Organization (WHO) in 2005 (see Section 7.2.2 below)
- Modify the Gastrointestinal Absorption Fraction to 0.6 when establishing soil cleanup levels for dioxin and furan mixtures.
- Amending WAC 173-340-708(8) requiring cleanup proponents to consider the physical-chemical properties of individual dioxin-congeners when evaluating cross-media impacts.

Ecology concluded that the proposed rule provisions would result in changes to industrial soil cleanup levels based on human health risks. In general, cleanup levels established under the rule revision are 60-70% higher (less stringent) than those established under the rule at the time of the ROD. As a result, the Cleanup Levels and Risk Calculations (CLARC) under MTCA Method C for 2,3,7,8-TCDD in soil increased from 880 ng/kg to 1,500 ng/kg. These increased Method C value indicate that the ROD's soil cleanup value for dioxin would remain protective.

7.2.2. Changes in Exposure Pathways, Toxicity, and Other Contaminant Characteristics

No new pathways of exposure have been identified in this five-year review. No changes have been identified with respect to ecological protection. Since the ROD, the World Health Organization (WHO) has made minor changes to the methods by which toxicity equivalents are calculated. These changes are minor, and would not affect the efficacy of the clean up, but may slightly affect how summary toxicity is calculated during monitoring. Accordingly, the basis for toxicity and the determination of dioxin as chemicals of concern have not significantly changed. Table 5 shows differences of 2,3,7,8-tetrachlorodibenzo-*p*-dioxin (TCDD) Toxicity Equivalence Factors (TEF) for dioxin and furans; one compound has gone up, but four others have gone down.

Table 5 - Changes to 2,3,7,8-TCDD Toxicity Equivalence Factors Used in the Manchester Risk Assessment

Polychlorinated Dioxins and Furan Congeners	WHO (1998) I-TEF	WHO (2005) I-TEF
2,3,7,8-TCDD	1	1
1,2,3,7,8-PeCDD	0.5	**1**
1,2,3,4,7,8-HxCDD	0.1	0.1
1,2,3,6,7,8-HxCDD	0.1	0.1
1,2,3,7,8,9-HxCDD	0.1	0.1
1,2,3,4,6,7,8-HpCDD	0.01	0.01
OCDD	0.001	**0.0003**
2,3,7,8-TCDF	0.1	0.1
1,2,3,7,8-PeCDF	0.05	**0.03**
2,3,4,7,8-PeCDF	0.5	**0.3**
1,2,3,4,7,8-HxCDF	0.1	0.1
1,2,3,6,7,8-HxCDF	0.1	0.1
1,2,3,7,8,9-HxCDF	0.1	0.1
2,3,4,6,7,8-HxCDF	0.1	0.1
1,2,3,4,6,7,8-HpCDF	0.01	0.01
1,2,3,4,7,8,9-HpCDF	0.01	0.01
OCDF	0.001	**0.0001**

These changes would result in minor changes in calculated risks due to soil contact; these risks are remedied in any case, by the removal of contaminated soil in the FFTA. There have been no changes since the ROD for avian or fish TEQs.

Changes in Estimating Tribal Consumption of Seafood

In August, 2007, EPA Region 10 published a framework for tribal consumption of seafood[9] which states it "is intended to be applicable at EPA cleanup sites within Puget Sound and the Strait of Georgia," and "is intended to be applied to future decisions in the RCRA and CERCLA programs." Because of these qualifiers, it is apparent that this framework does not automatically drive past remedies to new action. The framework addresses this in the following way:

[9] EPA. 2007. Framework for Selecting and Using Tribal Fish and Shellfish Consumption Rates for Risk-Based Decision Making at CERCLA and RCRA Cleanup Sites in Puget Sound and the Strait of Georgia

> "After a remedy has been selected, CERCLA requires that five-year reviews be conducted at any remedial action site that does not allow for unlimited use or unrestricted exposure. The purpose of the five-year review is to assure that human health and the environment will be protected by the remedial action.
>
> "As part of the five-year review process, Tribes can provide new information to be considered or request that the lead federal agency evaluate particular aspects of a remedy relative to Tribal interests. Such requests are most helpful when provided to the lead federal agency early in the five-year review process. Such requests would be evaluated on a site-specific basis and consistent with EPA's five-year review guidance. EPA would generally discuss the appropriate means for addressing a Tribe's concern with the Tribe during the review process.
>
> "While a CERCLA five-year review includes considering new information, such as new information regarding exposure rates and assumptions, it is important to keep in mind that remedies and cleanup levels at CERCLA sites are determined by many factors. In determining whether a recalculation of site risks or any other detailed analysis is needed as part of the five-year review, EPA would review the basis of the selection of the remedial action and cleanup levels and other relevant information to determine whether further analysis of such updated information is appropriate, and focus our analysis on matters that would help assess the protectiveness of the selected remedy."

The Suquamish Tribe could utilize seafood from the Site vicinity, which is within the Tribe's sole Usual and Accustomed Area for harvesting shellfish. The risk assessment utilized consumption rates that considered subsistence utilization, but later-published research on Suquamish shellfish and finfish consumption rates[10] post-date the ROD, and are generally higher than those used in the assessment. By letter dated July 28, 2009, the Suquamish Tribe requested consultation regarding how to measure compliance of bivalve tissue with the ROD, and added that the Tribe should be consulted regarding establishment of consumption rates to determine appropriate exposure scenarios. The letter states, "It is likely that the use of Suquamish consumption data would indicate a lower tissue clean up goal is necessary to achieve the overall risk management goals for the site. Although it is agreed that a recalculation of risks is not needed as part of this Five Year Review, the Suquamish Tribe requests consultation in determining if recalculation of site risks or other detailed analysis is necessary as part of evaluating or monitoring protectiveness and compliance for future uses." It also states, "The clean up goal established in the ROD may not achieve the overall risk management goals established for the site using consumption rates based on the Suquamish seafood survey."

Table 6 shows a comparison of RI (Risk Assessment) and Framework approaches with respect to seafood consumption rates. The Framework values are not necessarily the values that would be used, however, and are presented for approximate comparison only. The Suquamish letter of July 28, 2009 further states, "the Framework specifies consultation with the Tribe in determining

[10] The Suquamish Tribe. 2000. Fish Consumption Survey of the Suquamish Indian Tribe of the Port Madison Indian Reservation, Puget Sound Region. (August)

appropriate exposure scenarios, including consumption rates, and does not establish what consumption rate will be used."

Table 6 - Comparison of the Tribal Framework and Risk Assessment in the RI

Risk Parameter	RI and ROD Value	Framework Value	
		Tulalip	Suquamish
Adult Exposure Duration (yr)	30,30 [a]	70	70
Adult Body Weight (kg)	81	81.8	79
Pelagic Fish Except Salmon (g/d)	128 g	8.1	56
Bottom Fish (g/d)		7.5	29.1
Shellfish (g/d)		96.4	183.5
Salmon (g/d) [b]		81.9	498.4

[a] Reasonable Maximum Exposure and Central Tendency Exposure, respectively
[b] Salmon are not anticipated to have Site-related contamination

As a result of recent clam abundance surveys it was confirmed that there are not presently sufficient intertidal clam resources to support the sampling and analysis as stated in the Compliance Monitoring Plan at the Manchester Site.

7.2.3. Changes in Land Use

There have been no changes in the physical conditions of the site that would affect the protectiveness of the remedy.

7.2.4. Institutional Controls

Vegetation with roots that may be capable of damaging the landfill cap is growing on the landfill. This could affect the protectiveness of the institutional controls if the conditions continue unchecked. It has been identified as an issue in this 5YR as well as the last 5YR.

7.3. Question C: Has any other information come to light that could call into question the protectiveness of the remedy?

There is no other information that calls into question the protectiveness of the remedy or changes to institutional controls.

8.0 Technical Assessment Summary

Changes to ARARs identified in the ROD for the Manchester Annex Superfund Site do not appear to negatively impact the protectiveness of the remedy. As of this writing, institutional controls have not been implemented. Institutional controls must be implemented to ensure the remedy functions as intended and remains protective. All of the clean-up goals listed in the

ROD remained unchanged or would increase if done in the current regulatory setting. The increased values indicate a lower risk from exposure than previously considered.

Changes to SWQS and cleanup values for dioxin in soil changes would result in minor changes in calculated risks due to seep water quality or to soil contact. The latter risks were mitigated by the removal of contaminated soil in the FFTA. The seep concentrations are currently unknown as there has not been a monitoring event for seeps.

Should higher levels of shellfish consumption be considered in the future (not as a part of the current 5YR) as suggested by the comment letter from the Suquamish, the associated tissue and sediment remedial goals would be lower, and approach Puget Sound reference area sediment and tissue concentrations. The EPA Tribal Framework states, "In determining whether a recalculation of site risks or any other detailed analysis is needed as part of the five-year review, EPA would review the basis of the selection of the remedial action and cleanup levels and other relevant information to determine whether further analysis of such updated information is appropriate, and focus our analysis on matters that would help assess the protectiveness of the selected remedy".

9.0 Issues

This section addresses issues that, either currently or in the future, prevent the remedial actions from being protective.

Table 7: Issues Associated with Protectiveness Statements in the 2009 Five-Year Review

Issue	Affects Protectiveness? (Y or N)	
	Current	**Future**
1. An institutional control plan should be finalized and implemented at the Manchester site to address contaminants left in-place, deed covenants, fishing restrictions, and maintaining the integrity of the landfill cap and shoreline protection system. Provision of technical documents to land managers and stakeholders is necessary to assure the plan is implemented.	N	Y

Issue	Affects Protectiveness? (Y or N)	
	Current	Future
2. The Compliance Monitoring Plan must be revised/updated because the monitoring of sediment and seeps at the toe of the landfill has not occurred at stated frequencies. Monitoring for clam tissue levels of contaminants of concern has not occurred due to the lack of sufficient biomass of clams on the beach. Thus data are not available to support a protectiveness statement for seeps and shellfish; sediment has not reached the level that was anticipated to result in protection to human consumption of shellfish. The data from 2009 will be used to update the protectiveness statement; the data from other events will be used to support the 2014 FYR.	N	Y
3. Unwanted vegetation with roots that may be capable of damaging the landfill cap is growing on the landfill	N	Y
4. A subsistence-level fishing restriction for bivalves is in place for the Suquamish Tribe, although it was only intended to be a temporary measure.	N	Y
5. The Suquamish Tribe has requested consultation regarding the consumption rate of shellfish as it relates to the clam tissue goal.	N	Y
6. The shoreline protection system sustained wind and/or wave erosion of protective cover material on the north end of the system exposing the underlying filter fabric. The fabric is part of the seawater intrusion protection system for the landfill.	N	Y

Administrative or operational issues that arose during the current review, but which are not associated with protectiveness issues are as follows:

- A weathered "Hazardous Area" sign still remains at the beach area.
- The landfill cap needs to be reseeded/replanted with drought-resistant plants in accordance with the original plans for landfill closure.
- A final report summarizing findings of the cultural resources investigation during construction was not produced or provided to the Suquamish Tribe.

10.0 Recommendations and Follow-Up Actions

Table 8 lists recommendations and follow-up actions for each issue identified in Table 7.

Table 8 – Recommended Follow-Up Actions

Issue	Recommendations/ Follow-Up Actions	Party Responsible	Oversight Agency	Planned Completion Date
1. An institutional control plan should be finalized and implemented at the Manchester site to address contaminants left in-place, deed covenants, fishing restrictions, and maintaining the integrity of the landfill cap and shoreline protection system. Provision of technical documents to land managers and stakeholders is also desirable.	Finalize and implement the ICP	USACE	EPA	March 2010
2. The Compliance Monitoring Plan must be revised/updated because monitoring of sediment and seeps at the toe of the landfill has not occurred at stated frequencies. Monitoring for clam tissue levels of contaminants of concern has not occurred due to the lack of sufficient biomass of clams on the beach. Thus data are not available to support a protectiveness statement for seeps and shellfish; sediment has not reached the level that was anticipated to result in protection to human consumption of shellfish.	Revise the Compliance Monitoring Plan with a monitoring schedule that complies with the ROD, and provides adequate information to monitor site conditions, progress toward RAOs and protectiveness. Monitor (and test if necessary) sediment, seeps, and clam tissue at the toe of the landfill on the stated schedule. Develop a supplement report to this FYR with data presentation for the 2009 data gathered.	USACE	EPA	January 2010
3. Unwanted vegetation with roots that may be capable of damaging the landfill cap is growing on the landfill	Remove unwanted vegetation from the landfill cap	USACE	EPA	August 2009
4. A subsistence-level fishing restriction for bivalves is in place for the Suquamish Tribe, though it was intended only to be a temporary measure.	Consult with the Suquamish Tribe (and other state and federal agencies as appropriate) to evaluate the continued	USACE	EPA	March 2010

Issue	Recommendations/ Follow-Up Actions	Party Responsible	Oversight Agency	Planned Completion Date
	need for a shell-fishing restriction.			
5. Adequacy of the ROD tissue-based compliance goal for shellfish.	Consult with the Suquamish Tribe.	EPA (Lead), USACE	EPA	March 2010
6. The shoreline protection system sustained wind and/or wave erosion of protective cover material on the north end of the system exposing the underlying filter fabric. The fabric is part of the seawater intrusion protection system for the landfill.	Repair the damaged section of the shoreline protection system	USACE	EPA	September 2010

Recommendations for issues not affecting protectiveness or it determination include:

- EPA will remove the weathered "Hazardous Area" sign to be completed by March 2010.
- USACE will reseed/replant drought-resistant plants on the landfill cap by September 2010.
- USACE will complete a report of findings from the archaeological investigation that occurred during remedial construction and provide to the Suquamish Tribe by March 2010.

11.0 Protectiveness Statement

A protectiveness determination of the remedy at the Site cannot be made at this time until further information is obtained. Further information will be obtained once review of seep water, sediment, and clam tissue sampling analysis has been performed. This data shall determine if the remedy is protective of human health while considering: a restriction on subsistence-level harvesting of intertidal bivalve organisms is in place; and the landfill cap and shoreline protection systems are intact, and the cleanup requirements for the Former Fire Training Area have been met. The shellfishing restriction, however, was intended only as a temporary measure during the initial recovery period. Seep, sediment, and tissue sampling data are necessary to evaluate the current status and the long-term protectiveness of the actions implemented for the landfill and Clam Bay. The compliance monitoring plan, which will be completed and implemented during fiscal year 2010 (subject to the availability of funds), will address the status

of PCBs and metals in sediment, seeps, and shellfish tissue in Clam Bay. As sufficient biomass for sampling becomes available, clam tissue samples will be taken for the sake of documenting the removal of the shell-fishing restriction.

It is expected that these actions will take approximately six months to complete (March 31, 2010). Details of project completion dates are presented in Table 8.

12.0 Next Review

The next five-year review for the Manchester Annex site is required by September 2014, five years from the date of this review.