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U.S. Environmental Protection Agency
Region 10
Seattle, Washington

Wyckoff/Eagle Harbor Superfund Site Soil and Groundwater Operable Units Bainbridge Island, Washington

RECORD OF DECISION

February 2000

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LIST OF ACRONYMS AND ABBREVIATIONS

ABC	Association of Bainbridge Communities
ACL	Alternate Concentration Limit
AET	Puget Sound Apparent Effects Threshold
AKART	All Known Available and Reasonable Methods of Treatment
ARAR	Applicable or Relevant and Appropriate Standard
ASILs	Acceptable Source Impact Levels
BA	Biological Assessment
bgs	below ground surface
BNA	base/neutral and acid extractable
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CLARC	Cleanup Levels and Risk Calculations
COC	Contaminant of Concern
RCRA	Resource Recovery and Conservation Act
cy	cubic yards
dB	decibels
DNAPL	Dense Non-Aqueous Phase Liquid
DNR	Washington State Department of Natural Resources
Ecology	Washington State Department of Ecology
EPA	U.S. Environmental Protection Agency
ESB	Ecological Screening Benchmark
FS	Feasibility Study
HEAST	Health Effects Assessment Summary Tables
HHRA	Human Health Risk Assessment
HPAH	High Molecular Weight Polynuclear Aromatic Hydrocarbon
HPO	Hydrous/Pyrolysis/Oxidation
HQ	Hazard Quotient
IRIS	Integrated Risk Information System
LNAPL	Light Non-Aqueous Phase Liquid

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

MCL	Maximum Contaminant Level
MCLG	Maximum Contaminant Level Goals
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MTCA	Model Toxics Control Act
NA	Not Applicable
NAAQS	National Ambient Air Quality Standards
NAPL	Non-Aqueous Phase Liquid
NCP	National Contingency Plan
NESHAP	National Emission Standards for Hazardous Air Pollutants
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollution Discharge Elimination System
NPL	National Priorities List
oc	organic carbon
O&M	Operation and Maintenance
OPA	Oil Pollution Act
OU	Operable Unit
PAH	Polynuclear Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCP	Pentachlorophenol
ppb	parts per billion
ppm	parts per million
PSEP	Puget Sound Estuary Program
PSR	Pacific Sound Resources
PW	Present Worth
RAO	Remedial Action Objective
RCW	Revised Code of Washington
RfD	Reference Dose
RI	Remedial Investigation
RME	Reasonable Maximum Exposure
ROD	Record of Decision
SARA	Superfund Amendments and Reauthorization Act
SMS	Sediment Management Standards
SVE	Soil Vapor Extraction
SW	surface water

LIST OF ACRONYMS AND ABBREVIATIONS
(Continued)

TAG	Technical Assistance Grant
TBC	To Be Considered
TCDD	tetrachlorodizenzo-*p*-dioxin
TDS	total dissolved solids
TEF	Toxicity Equivalency Factor
TOC	total organic carbon
TSDF	Treatment, Storage and Disposal Facility
WAC	Washington Administrative Code
WQS	Water Quality Standards
μg/kg	micrograms per kilogram
μg/L	micrograms per liter

PART 1: THE DECLARATION

SITE NAME AND LOCATION

Wyckoff/Eagle Harbor Superfund Site
Soil and Groundwater Operable Units (OU2 and OU4, respectively)
Bainbridge Island, Kitsap County, Washington
U.S. Environmental Protection Agency Identification Number WAD009248295

STATEMENT OF BASIS AND PURPOSE

This decision document presents the final remedial action selected by the U.S. Environmental Protection Agency (EPA) for the Soil and Groundwater Operable Unit of the Wyckoff/Eagle Harbor Superfund site, Bainbridge Island, Washington.

The remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and, to the extent practicable, the National Oil and Hazardous Substances Pollution Contingency Plan (NCP). This decision is based on the Administrative Record for this site.

The State of Washington Department of Ecology (Ecology) has participated in scoping the site investigations and in evaluating alternatives for remedial action. Ecology concurs with the selected remedy.

ASSESSMENT OF THE SITE

The response action selected in this Record of Decision is necessary to protect the public health and welfare, and the environment from imminent and substantial endangerment from actual or threatened releases of hazardous substances into the environment.

DESCRIPTION OF THE SELECTED REMEDY

The selected remedy described in this Record of Decision (ROD) addresses contaminated soil and groundwater in the upland portion of the site, two of four operable units at the Wyckoff/Eagle Harbor Superfund site. This is the final Record of Decision to be completed for the site.

The soil and groundwater at the Wyckoff facility is severely contaminated with polynuclear aromatic hydrocarbons, pentachorophenol, and dioxins/furans. The principal threat is defined as soil and groundwater containing free-phase oily contamination. The selected remedy will achieve substantial risk reduction by cutting off the migration pathway with a sheet pile wall and treating the principal threat at the site using thermal technologies.

The following are major components of the Selected Remedy - Thermal Remediation:

- Construct a sheet pile wall around the highly contaminated area of the Former Process Area to prevent potential flow of contaminants to Eagle Harbor during remediation;

- Conduct a pilot study to test the applicability and effectiveness of thermal remediation. The pilot study will be designed and implemented with the ability to expand to the full-scale system. The pilot study will test steam injection and electrical resistance heating (as a supplemental technology to steam injection).

  If the pilot study is successful (Scenario 1) at meeting performance expectations, then:

  -- Consolidate contaminated hot spots from the Former Log Storage/Peeler Area and the well CW01 area (approximately 60,000 cubic yards) within the Former Process Area.

  -- Remediate the soil and groundwater within the Former Process Area by full-scale thermal treatment.

  -- Construct a vapor cover over the treatment area (the Former Process Area) to enhance recovery of contaminated vapors, minimize emissions to the atmosphere, and reduce odors.

  -- Monitor biodegradation, oxidation, and other thermally-enhanced attenuation processes in soil and groundwater during and after active thermal treatment is completed to confirm whether further reductions in contaminant concentrations are being achieved.

- If the pilot is not successful (Scenario 2), then:

  -- Implement the contingency remedy, Containment with a Sheet Pile Wall (Alternative 2b).

- Common elements of Scenarios 1 and 2:

  -- Monitor the upper groundwater aquifer outside of the Former Process Area and the lower aquifer to ensure that contaminant levels are not increasing and for decreasing trends.

  -- Establish institutional controls to:

- ✓ Ensure that the upper aquifer groundwater outside the Former Process Area and the lower aquifer remain unused until protective levels are reached.

- ✓ Ensure that the upper aquifer groundwater within the Former Process Area remains unused due to contaminants that may remain after thermal treatment or will remain as part of the contingency remedy. This portion of the upper aquifer is also not potable due to high salinity levels.

- ✓ Restrict site use to reduce the risk of direct exposure to surface soil, if necessary.

If successful, Thermal Remediation could provide permanent protection to human health and the environment. This alternative could remove substantially all mobile non-aqueous phase liquids, the principle threat. If successful, this alternative would be a cost-effective and permanent solution to contamination at the Wyckoff Soil and Groundwater Operable Units (OUs).

EPA will be the lead agency for implementing soil and groundwater remediation at the Wyckoff site and will coordinate activities in the uplands with cleanup in the East Harbor.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and of the marine environment, complies with Federal and State requirements that are applicable or relevant and appropriate to the remedial action, is cost-effective, and utilizes permanent solutions and alternative treatment technologies to the maximum extent practicable. This remedy also uses permanent solutions and satisfies the statutory preference for treatment as a principal element for the two upland operable units (i.e., reduces the toxicity, mobility, or volume of hazardous substances, pollutants, or contaminants as a principal element through treatment).

Because this remedy may result in hazardous substances, pollutants, or contaminants remaining at the site, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

DATA CERTIFICATION CHECKLIST

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

- Chemicals of concern and their respective concentrations (see Tables 1 through 7)

- Baseline risk represented by the chemicals of concern (See Section 7, Summaries of Human Health and Ecological Risk Assessments)

- Cleanup levels established for chemicals of concern and basis for the levels (see Tables 13 through 15)

- Current and reasonable anticipated future land use assumptions and current and potential future beneficial uses of groundwater used in the baseline risk assessment and ROD (see Section 6, Current and Potential Future Site and Resource Uses)

- Potential land and groundwater use that will be available at the site as a result of the Selected Remedy (see Section 12, Selected Remedy)

- Estimated capital, annual operation and maintenance (O&M), and total present worth costs; discount rate; and the number of years over which the remedy cost estimates are projected (see Tables 16 through 24)

- Key factors that led to selecting the remedy (see Section 10, Comparative Analysis of Alternatives)

AUTHORIZING SIGNATURE

Chuck Clarke (signature) — 2-14-00

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

Date

PART 2: THE DECISION SUMMARY

This Decision Summary provides a description of the site-specific factors and analyses that led to selection of the remedy for the Soil and Groundwater operable units of the Wyckoff/Eagle Harbor Superfund site. It includes information about the site background, the nature and extent of contamination, the assessment of human health and the environmental risks, and the identification and evaluation of remedial alternatives.

The Decision Summary also describes the involvement of the public throughout the process, along with the environmental programs and regulations that may relate to or affect the alternatives. The Decision Summary concludes with a description of the remedy selected in this Record of Decision (ROD) and a discussion of how the selected remedy meets the requirements of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA), as amended by the Superfund Amendments and Reauthorization Act of 1986 (SARA), and to the extent practicable, the National Contingency Plan (NCP).

The Decision Summary is presented in the following sections:

Section 1	Site Name, Location, and Description
Section 2	Site History and Enforcement Activities
Section 3	Community Participation
Section 4	Scope and Role of Operable Units
Section 5	Site Characteristics
Section 6	Current and Potential Future Site and Resource Uses
Section 7	Summary of Site Risks
Section 8	Remediation Objectives and Cleanup Levels
Section 9	Description of Alternatives
Section 10	Comparative Analysis of Alternatives
Section 11	Principal Threat Waste
Section 12	Selected Remedy
Section 13	Statutory Determinations

Documents supporting this Decision Summary are included in the Adminstrative Record for the Soil and Groundwater operable units. Key documents include the following: the Eagle Harbor Risk Assessment (May 1991); the Remedial Investigation (June 1997); the Feasibility Study (October 1997); the Focused Feasibility Study Comparative Analysis of Containment and Thermal Technologies (April 1999); the Conceptual Design for the Soil and Groundwater Operable Units (September 1999); and the Soil and Groundwater Operable Units Proposed Plan (September 1999).

1. SITE NAME, LOCATION, AND DESCRIPTION

The Wyckoff/Eagle Harbor Superfund site is located on the east side of Bainbridge Island, in central Puget Sound, Washington (Figure 1). The site includes an inactive wood-treating facility, called the Wyckoff facility, contaminated sediments in adjacent Eagle Harbor, and other upland sources of contamination to the harbor, including a former shipyard. The site is currently divided into four operable units (Figure 1).

This Record of Decision (ROD) specifically addresses the contaminated soil and groundwater at the Wyckoff facility. The U.S. Environmental Protection Agency (EPA) is the lead agency for cleanup activities, and the Washington State Department of Ecology (Ecology) is the support agency. Cleanup monies for the Wyckoff facility will come from the Superfund trust fund.

2. SITE HISTORY AND ENFORCEMENT ACTIVITIES

2.1 Site History

From the early 1900s through 1988, a succession of companies treated wood at the Wyckoff property for use as railroad ties and trestles, telephone poles, pilings, docks, and piers. The wood-preserving plant was one of largest in the United States, and its products were sold throughout the nation and the rest of the world. Wood-preserving operations included: (1) the use and storage of creosote, pentachlorophenol, solvents, gasoline, antifreeze, fuel and waste oil, and lubricants; (2) management of process wastes; (3) wastewater treatment and discharge; and (4) storage of treated wood and wood products.

The main features of the wood-treating operation included: (1) a process area which included numerous storage tanks and process vessels such as retorts; (2) a log storage and log peeler area; and (3) a treated log storage area.

There is little historic information about the waste management practices at the Wyckoff facility. Prior to reconstruction of the Wyckoff facility in the 1920s, it is reported that logs were floated in and out of a lagoon that once existed at the site. The lagoon has since been filled. Treated logs were also transported to and from the facility at the former West Dock via a transfer table pit, and the chemical solution that drained from the retorts after a treating cycle went directly on the ground and seeped into the soil and groundwater below the surface. This practice began around the mid-1940s until operations ceased in 1988. Wastewater was also discharged into Eagle Harbor for many years, and the practice of storing treated pilings and timber in the water continued until the late 1940s. The log storage area was primarily used to store untreated wood.

2.2 Investigation and Enforcement History

Due to reports of oil observed on the beach, EPA began investigating the property in 1971. In 1984, EPA issued an order requiring the Wyckoff Company (renamed Pacific Sound Resources after operations ceased in 1988) to conduct environmental investigations. Data collected at the time revealed the presence of significant soil and groundwater contamination. Numerous other investigations were conducted at this site prior to initiation of the RI/FS. The Wyckoff Company, EPA, the Washington Department of Ecology (Ecology), and the National Oceanic and Atmospheric Administration (NOAA) all investigated other aspects of the site in the early to mid-1980s under regulatory authority other than Comprehensive Environmental Response Compensation and Liability Act (CERCLA) authority. While work was conducted under Resource Recovery and Conservation Act (RCRA) authority, the site was not considered a treatment, storage and disposal facility (TSDF).

The site, including Eagle Harbor, the wood-treating facility, and other sources of contamination to Eagle Harbor, was listed on the Superfund National Priorities List (NPL) in July 1987. In July 1988, the Wyckoff Company was ordered by EPA to install groundwater extraction wells and a groundwater treatment plant in an effort to halt continuing release of wood-treating contaminants to Eagle Harbor.

A settlement with the Wyckoff Company was embodied in a Consent Decree entered in Federal District Court in August 1994. The Decree creates the PSR Environmental Trust into which the heirs of the Wyckoff Company founders, owners and operators placed all ownership rights and shares in the Company to allow the Trust to maximize liquidation of all company assets, including nonwood-treating holdings, for the benefit of the environment. The beneficiaries of the Trust are the United States Department of Interior, National Oceanic and Atmospheric Administration (NOAA) of the Department of Commerce, and the Suquamish and Muckleshoot Tribes, as Natural Resource Trustees, as well as EPA (the Superfund trust fund) for reimbursement of CERCLA remedial costs. A memorandum of agreement was entered into by the beneficiaries of the Trust to ensure that settlement proceeds would be applied toward both environmental response and natural resource restoration goals.

The groundwater pump-and-treat systems were put online in 1990. In November 1993, based on an agreement with Wyckoff/PSR principals (see above), EPA assumed control of the site and operation of the systems and discovered that both the treatment plant and extraction systems were in a state of disrepair. Nine new extraction wells were then installed to replace the original seven and a variety of operational and process improvements were made to the treatment system.

The systems have been effective in recovering modest amounts of oily creosote in the form of non-aqueous phase liquid, or NAPL, and in helping to control the migration of contaminants from the groundwater to the Harbor. The extracted groundwater contaminated with elevated levels of polynuclear aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP) is treated at the plant so it can be safely discharged through an outfall to Puget Sound. As of January 2000, the groundwater extraction and treatment system has recovered approximately 88,700 gallons of NAPL (out of approximately 1 million gallons estimated to be present at the site), and treated over 316 million gallons of contaminated groundwater from the upper-aquifer underlying the Former Process Area. Currently, however, NAPL seeps are still moving out into the marine environment.

Other actions already taken to deal with the contamination include demolition and removal of the buildings, structures, above ground and underground storage tanks, underground foundations and piping, and the removal of asbestos, sludge, and some heavily contaminated soil.

2.3 History of Cleanup Actions at the Soil and Groundwater OUs

In September 1994, EPA issued an interim ROD for groundwater which included the following elements:

- Replacement of the existing treatment plant. The design of a new treatment plant began in late 1996 and was completed in July 1998, but the plant was not constructed pending a final decision regarding the Groundwater OU remedy.

- Evaluation, maintenance, and upgrade of the existing extraction system/hydraulic barrier operations. These activities have been completed.

- Evaluation of the performance of the existing extraction system and installation of a physical barrier, if needed. Because of continued releases to Eagle Harbor and Puget Sound despite ongoing pumping, a slurry wall was proposed as the most appropriate kind of barrier. The designs were put on hold, however, pending a final decision regarding the Groundwater OU remedy.

- Sealing of on-site water supply wells. These activities have been completed.

In November 1997, EPA issued a "final" Proposed Plan for cleanup of soil and groundwater. The components of this proposed plan included: (1) cap the contaminated soil in the "flat" area of the property, (2) excavate contaminated soil from a small area in the hillside portion of the property, and place it in the flat area of the soil cap, (3) implement institutional controls, and (4) monitor groundwater outside the slurry wall to confirm that contaminants will not cause risks and determine whether further action is needed.

At the time this containment strategy was proposed, no other technologies promised to provide a more effective remediation to sites containing dense non-aqueous phase liquids (DNAPL). Unfortunately, the containment strategy has no defined endpoint. The pump-and-treat system would have to be operated and maintained in perpetuity, and replaced every 30 years, in order to maintain the integrity of the containment option and prevent migration of contaminants into Eagle Harbor, or unless an effective and cost-effective treatment technology could be employed.

The projected long-term costs associated with the containment strategy could exceed a hundred millions dollars. These costs were of concern to the Department of Ecology.

Since the original proposal of the containment option, thermal remediation technologies have developed rapidly. Favorable results from thermal remediation of a former wood-treatment site similar to Wyckoff, located in Visalia, California, prompted EPA to delay selection of a final cleanup remedy to further evaluate thermal technologies for possible application at Wyckoff.

In late 1998, EPA Region 10 and the Technology Innovation Office at EPA Headquarters assembled a group of prominent researchers and industry experts in the field of thermal remediation of NAPL contamination, to provide oversight and consultation for the thermal technologies evaluation at the Wyckoff site. This group has become known as the In-Situ Thermal Technologies Advisory Panel, or ITTAP. EPA met with ITTAP members several times in 1999 to discuss and obtain expert feedback regarding the effectiveness, feasibility, and implementability of thermal remediation. Based on the results of various studies, site demonstrations, and the results of the Wyckoff laboratory studies, the ITTAP fully supports using thermal technologies at this site to remove the contamination.

In September 1999, EPA issued a second Proposed Plan for the Wyckoff Soil and Groundwater OUs. That Proposed Plan replaced the November 1997 Proposed Plan and presented a change in the cleanup strategy. In that plan, EPA's preferred remedy (now the selected cleanup remedy) focused on an innovative thermal technology, called steam injection (and if necessary, electrical resistance heating) to actively remove contaminants from the site's soil and groundwater. The pilot study that will be conducted at Wyckoff is of national interest and will provide valuable information that can be used at many other sites.

3. COMMUNITY PARTICIPATION

A 30-day public comment period was held for the November 1997 Proposed Plan (see above) from November 20 to December 20, 1997.

The RI/FS report for the Soil and Groundwater operable units of the Wyckoff/Eagle Harbor Superfund site was made available to the public in October 1997 and the Focused Feasibility Study and second Proposed Plan were made available for public review in September 1999. These documents can be found in the Administrative Record file and the information repository maintained at the EPA Records Center in Region 10 and at the Bainbridge Island Public Library. The notice of the availability of the Proposed Plan was published in the Daily Journal of Commerce, the Bremerton Sun, the Bainbridge Island Review, and the Seattle Times at the end of September 1999.

A public comment period for the Proposed Plan was held from October 4 to November 2, 1999. An extension to the public comment period was requested. As a result, it was extended to December 2, 1999. In addition, an Availability Session and Public Meeting were held on

October 21, 1999. The purpose of the Availability Session was to provide an informal opportunity for community members to meet with project representatives. The purpose of the Public Meeting was to present the Proposed Plan to a broader community audience than those that had already been involved at the site and to take formal public comments. At this meeting, representatives from EPA answered questions about problems at the site and the remedial alternatives. EPA's response to the comments received during this period is included in the Responsiveness Summary, which is part of this Record of Decision.

The Association of Bainbridge Communities (ABC) is a citizen's group representing residents from all parts of Bainbridge Island. During over fifteen years of its existence, ABC has continually stressed publicizing issues that deal with the environment on the island. ABC has published a quarterly newsletter called Scotch Broom since 1980. This newsletter contains articles informing Bainbridge citizens about land-use and environmental issues on Bainbridge Island. To promote local citizen involvement in decision-making at the Wyckoff/Eagle Harbor site, EPA awarded $50,000 to ABC under the Technical Assistance Grant (TAG) program in 1988. An additional $50,000 was awarded in 1993. Another $25,000 has been awarded recently. ABC members, as well as other Bainbridge Island citizens, remain active and informed about all aspects of site cleanup activities.

Local public interest in this site is very high. Community input is vital to the success of this project, and EPA seeks broad public involvement throughout the process. Other EPA community involvement initiatives include preparing fact sheets and press releases to keep the community informed, offering opportunities for direct public input at critical junctures, meeting with individuals and groups on a regular basis and/or as requested, and generally being responsive to questions, suggestions, and issues raised by members of the public.

4. SCOPE AND ROLE OF OPERABLE UNITS

As with many Superfund sites, the problems at the Wyckoff/Eagle Harbor site are complex. As a result, EPA has organized the work into four operable units (OUs) (Figure 1):

- Operable Unit 1: The East Harbor OU (PAH contaminated subtidal and intertidal sediments in Eagle Harbor)
- Operable Unit 2: The Wyckoff Soil OU (PAH, PCP, and dioxins/furans contaminated unsaturated soil)
- Operable Unit 3: The West Harbor OU (metals, primarily mercury, contaminated subtidal and intertidal sediments in Eagle Harbor, and upland sources)
- Operable Unit 4: The Wyckoff Groundwater OU (the saturated soil and groundwater beneath the Soil OU)

Remedies have already been selected for the West and East Harbor portions of the Wyckoff/Eagle Harbor Superfund Site in RODs dated September 1992 (amended in December 1995) and September 1994, respectively. These remedies are not included in this Record of Decision. Caps have been placed over contaminated marine sediments in both areas, heavily contaminated sediments were removed from the West Harbor, and monitoring mechanisms are in place. As stated in the September 1994 ROD, additional capping will be required in the East Harbor after source control at the Wyckoff site has been implemented. Source control, or control of ongoing migration of contaminants with groundwater at the Wyckoff site, is necessary to prevent recontamination of the East Harbor cap.

This Soil and Groundwater OU ROD contains the final cleanup actions for this site. This ROD does two things:

- Presents the final selected remedy for cleanup of both operable units.
- Explains how the selected cleanup remedy will protect human health and the environment by removing NAPL sources, reducing exposure, controlling contaminant releases, and protecting potential drinking water sources and aquatic resources in Eagle Harbor.

5. SITE CHARACTERISTICS

This section summarizes information obtained as part of the Remedial Investigation/Feasibility Study (RI/FS) activities at the Soil and Groundwater OUs. It includes a description of the conceptual site model on which all investigations, the risk assessment, and response actions are based. In addition, this section presents sources of contamination, sampling strategies, and documented types of contamination.

5.1 Site Geology

Figure 2 illustrates the relationship between the different components of the Soil OU and the Groundwater OU. The site geology can be characterized as:

- The vadose (or unsaturated) zone soil
- The unconfined upper aquifer
- The low-permeability confining layer, or aquitard
- The semi-confined lower aquifer
- The deep aquifers

The vadose (unsaturated) zone immediately below the surface of the Wyckoff Soil OU is 5 to 10 feet thick and consists of fill and native materials composed of discontinuous silt and fine sand layers.

The unconfined upper aquifer underlying the vadose zone soil is composed of fill and native materials from 5 to 10 feet in thickness, overlying marine sand containing small amounts of interbedded gravel, silt, and clay. This marine sand layer extends down another 5 to 70 feet below ground surface. The depth to water is strongly influenced by the tides. The maximum elevation of the water level within this aquifer defines the upper boundary of the Groundwater OU.

Separating the upper aquifer from the lower semi-confined aquifer is a relatively impermeable hard layer of marine silt and glacial till, also called the aquitard. The aquitard underlies all of the Former Process Area at the Wyckoff property. The top of this aquitard extends from near ground surface in the south-central part of the site to approximately 75 feet bgs along the northern portion of the site. Based on numerous field explorations during the RI and the Corps of Engineers exploratory drilling events in 1997 and 1999, it appears that the aquitard is continuous throughout the site. Its thickness ranges from 10 to 40 feet, with the thinnest area (10 feet) localized near the northeast corner of the site.

Underlying the aquitard is a semi-confined lower aquifer, which consists primarily of sand, with small amounts of silt, clay, and gravel. The lower boundary of this aquifer has not been completely determined, however, it is believed that this aquifer ends at approximately 200 feet bgs. Also, limited data from deeper well logs at the property indicate that there are at least two additional clay layers that may act as confining units between this semi-confined aquifer and even deeper aquifers.

The deep aquifers are located from approximately 200 to 1,500 feet bgs. These aquifers are potable and were used in the past by the Wyckoff Company to provide water for on-site operations with excess sent to nearby residents to be used for drinking water purposes. Due to environmental concerns that these water production wells may introduce contaminants to the deep aquifer systems, EPA sealed and abandoned them in 1995 as part of the Interim Groundwater action (see Section 2.3, above).

5.2 Conceptual Site Model

The conceptual site model depicting contaminant migration for the Soil and Groundwater Operable Units of the Wyckoff facility is presented in Figure 3. The primary source of contamination was the daily operation of the wood-treating facility including leaks, spills, and other releases of wood-treating contaminants into the ground, and storage of wood-treatment products.

As the spills and leaks occurred, the contaminants moved as a mobile NAPL phase in the vadose zone, adsorbing onto soil, volatilizing into soil gas, and dissolving into pore water. Except for the volatilization pathway, similar partitioning occurs below the water table. PAHs comprise a large portion of the NAPL and many of the PAHs exhibit very low aqueous solubilities and are strongly adsorbed to particulate surfaces. Volatilization is a dominant release mechanism for the lower-molecular-weigh PAHs with higher vapor pressures. Mobile NAPL migrates downward through the vadose zone until it reaches the water table. Phase separation occurs when NAPL encounters the water table, and light non-aqueous phase liquid (LNAPL) and dense non-aqueous phase liquid (DNAPL) continue to migrate along multiple pathways:

- LNAPL accumulates at the water-table surface and continues to migrate laterally, eventually emerging as intertidal seeps in Eagle Harbor and Puget Sound.

- DNAPL continues migrating downward. Lateral movement may occur through high-permeability gravel and cobble zones, or during temporary accumulation on fine-grained layers in the aquifer.

- In shoreline areas, downward migration of some DNAPL may be slowed or halted as it encounters brackish groundwater with approximately the same density.

- Along the northwest shoreline, DNAPL appears to be perched on clay and silt beds within the upper aquifer, and has been observed to move laterally through the bulkheads, discharging into the Log Rafting Area (Figure 4). This discharge appears to have been occurring for several decades, contemporaneously with sedimentation; the result is several feet of NAPL-saturated harbor-bottom sediments in the Log Rafting Area. The discharge has been reduced by the installation of a ninth extraction well in 1998 (PW09).

- DNAPL entered the lagoon which extended from the Log Rafting Area into the Tram Loading Area, either from the upper aquifer, from surface discharges, or from treated logs placed in the lagoon. This discharge was apparently contemporaneous with sedimentation and filling, resulting in as much as 10 feet of NAPL-saturated soil at the bottom of the old lagoon, now covered with clay fill.

- Most of the DNAPL migrates downward through the upper aquifer until it encounters the relatively low-permeability aquitard layer. The aquitard layer dips toward the north and east. The DNAPL builds up above the aquitard, forming large accumulations in depressions in the aquitard, and generally migrating down-dip toward Eagle Harbor.

- Small amounts of the DNAPL continue to migrate farther downward into fractures or sandy zones in the aquitard. Data from the current explorations indicate that continued downward migration of DNAPL occurs primarily in the central portion of the site (near the vicinity of well CW12, Figure 5), where the aquitard contains numerous sand beds and lenses.

- Based on the data collected to date, it appears that NAPL has not reached the lower aquifer.

NAPL undergoes dissolution as it encounters groundwater in the upper aquifer, resulting in dissolved contamination. The aqueous-phase contaminants are then transported with the groundwater flow, laterally toward Eagle Harbor. Downward advective transport of dissolved contaminants through the aquitard is unlikely under natural conditions, since the hydraulic head is higher in the lower aquifer than in the upper aquifer.

Transport of contaminants into the lower aquifer may occur through the following mechanisms:

- Small amounts of DNAPL seepage through fractures and sand zones in the aquitard.
- Transport by molecular diffusion from DNAPL-contaminated zones near the base of the aquitard.
- Leakage as a result of early drilling activities on the site, which may have provided conduits through the aquitard. In 1995, EPA properly sealed twelve old wells. These wells were industrial water supply wells, monitoring wells, groundwater/contaminant extraction wells, and two deep drinking water supply wells.

Dissolved contaminants in the lower aquifer are carried by groundwater flow toward discharge areas deep in Eagle Harbor and Puget Sound. However, due to the long transport distances involved, it is likely that any contamination in the lower aquifer will be removed by sorption and decay before discharge to the surface waters.

5.3 Soil Operable Unit

The overall Wyckoff property occupies approximately 57 acres. About 18 acres are in the Soil Operable Unit, including the 8 acres of the Former Process Area. Approximately 0.8 mile of shoreline has been extended and filled at least twice during past reconstructions of the property. The average ground surface elevation is approximately 10 feet above mean sea level. A tree-covered bluff defines the southern boundary of the Soil OU and extends toward the island's interior to an elevation exceeding 200 feet. The Soil OU includes near-surface (0 to 4 feet bgs) and subsurface vadose zone soil (5 to 7 feet bgs), consisting of fill and native materials, extending to the maximum elevation of the water table, which is approximately 5 to 10 feet below ground surface (bgs).

The Soil OU is divided into three components, the Log Storage/Peeler Area, the Former Process Area, and Well CW01 Area (Figure 2). There is widespread near-surface and subsurface soil contamination in these areas, with very elevated levels of contamination in the Former Process Area. The contaminants of concern (COCs) in soil are nine PAHs (benzo(a)anthracene, benzo(a)pyrene, benzo(b&k)fluoranthene, chrysene, dibenz(a,h)anthracene, indeno(1,2,3-cd)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, and naphthalene), pentachlorophenol, and dioxins/furans.

During the remedial investigation (RI), a total of 238 near-surface samples and 228 subsurface samples were collected from a grid across the Former Process Area and Log Storage/Peeler Area. Tables 1 and 2 summarize the chemicals detected in the near-surface and subsurface in these areas, respectively.

During the RI, one near-surface and one subsurface soil sample were collected in fill materials during drilling for installation of well CW01, which is located south of the Soil OU boundary (Figure 2). Seven additional near-surface samples were collected from 2-foot trenches excavated in the vicinity of CW01. Three of these samples were collected in fill materials and the other four were collected in native vadose zone soil beyond the fill. Table 3 summarizes the detected chemicals in the vicinity of Well CW01 Area.

5.4 Groundwater Operable Unit

The Groundwater Operable Unit includes the soil and groundwater in the saturated zone beneath the Soil Operable Unit (Figure 2). The Groundwater OU is composed of two water-bearing zones separated by a layer of low-permeability material, called the aquitard. These water-bearing zones (i.e., the upper and lower aquifers) consist of sand and gravel with variable amounts of silt. The aquitard is comprised of stiff marine silt and dense to hard glacial material. The aquitard is continuous throughout the site, but its thickness varies from 10 feet to 40 feet. The aquitard is generally very thick across the site with the thinnest area (10 feet) localized near the northeast corner of the site.

In the development of cleanup alternatives, the Groundwater OU was divided into three areas: the upper aquifer beneath the Former Process Area, the upper aquifer beneath the Former Log Storage Peeler Area, and the lower aquifer (Figure 2).

This remedy selection process and ROD specifically focus on the Soil OU and the upper aquifer beneath the Former Process Area (a portion of the Groundwater OU). EPA will monitor for decreasing trends in the other Groundwater OU components, which have only low levels or no contamination, to ensure that they do not pose a risk to human health or the environment.

In general, groundwater in the upper aquifer flows from the southern portion of the property north toward Eagle Harbor and Puget Sound where it discharges into the intertidal zone. Flow toward Eagle Harbor and Puget Sound increases during low tide because of greater elevation differences between the groundwater and the marine water. Groundwater and NAPL discharge is especially evident at low tide in the form of intertidal seeps (Figure 6). Subtidal discharge have also been observed in the Log Rafting Area (Figure 4).

The movement of upper aquifer groundwater is influenced and complicated by a number of factors including the complex and laterally discontinuous nature of the sediments and their widely varying hydraulic properties; surface water interactions such as the tidal influences that are experienced site-wide; seasonal and climatic influences; and the operation of the existing pump-and-treat system, which is operated 24 hours per day.

Light non-aqueous phase liquid (LNAPL) "pools" have been located in the upper aquifer beneath the Former Process Area at maximum thicknesses up to 13 feet. Dense non-aqueous phase liquid

(DNAPL) "pools" have been measured at maximum thicknesses up to 14 feet. Seeps of NAPL into the intertidal area have been observed along the eastern and northern shoreline. The seeps appear to coincide with observations of LNAPL in groundwater on-site. DNAPL pools have been observed (and periodically removed by divers) on the harbor floor in the Log Rafting Area west of the large dock (former West Dock). L- and DNAPL are present everywhere in the upper aquifer groundwater within the Former Process Area, as well as in the intertidal areas (Figure 7).

Data from the Remedial Investigation (June 1997) and subsequent investigations by the U.S. Army Corps of Engineers indicate that there are approximately 1 million gallons of NAPL in the upper aquifer of the Former Process Area. As Figure 6 indicates, NAPL is flowing horizontally beyond the property boundaries into Eagle Harbor. The low-permeability layer (aquitard) helps to minimize the downward vertical migration of DNAPL to the lower aquifer.

The contaminants of primary concern in the upper-aquifer groundwater are thirteen polynuclear aromatic hydrocarbons (PAHs), pentachlorophenol (PCP), and dioxins/furans[1], which are present in the groundwater in the form of mobile NAPL, dissolved constituents, and residual NAPL held in soil pore spaces. Volatile organics and base/neutral and acid extractables (BNAs) are also present in the groundwater, however, for purposes of cleanup, they are assumed to be co-located with the PAHs.

During the RI field investigation, samples of upper-aquifer groundwater were collected from 29 wells (Figure 5). During the 1995 Supplemental RI field investigation, samples of upper-aquifer groundwater were collected from 11 wells (6 of which were newly installed; also see Figure 5). Field efforts focused on collecting groundwater samples with minimal amounts of NAPL present in order to analyze dissolved-phase concentrations of contaminants. Table 4 summarizes the detected chemicals in the upper-aquifer groundwater.

During the 1994 field investigation, samples of lower-aquifer groundwater were collected from five wells (CW01, CW02, CW05, MWC20, and EWC1; Figure 5). During the 1995 field investigation, samples of lower-aquifer groundwater were collected from the same five wells plus three additional wells installed as part of the 1995 investigation (CW09, CW12, and CW15). Table 5 summarizes the detected chemicals in the lower-aquifer groundwater. It has recently been discovered that CW12 was mistakenly screened in a sandy zone within the aquitard instead of the lower aquifer. As a result, the data from this well is not representative of the lower aquifer.

The NAPL present at the Wyckoff OUs consists mostly of a mixture of creosote, pentachlorophenol, and/or aromatic carrier oils. Creosote was used by itself in the early years of wood-treatment production. Later, it was mixed with aromatic carrier oils to obtain deeper penetration of preservative in the wood. Beginning in 1957, pentachlorophenol became

[1] Dioxins/furans were detected in the NAPL samples, but not in the dissolved-phase groundwater.

commercially available for wood-preserving operations and was mixed with aromatic carrier oils.

Tables 6 and 7 summarize the LNAPL and DNAPL analytical data collected from eight wells, respectively. The compounds detected in NAPL are consistent with the products that were historically used during operations of the property. PAHs are present in both creosote and in aromatic carrier oils. The variations in contaminant concentrations in the NAPL may result from differences in the grade of raw material (i.e., creosote or pentachlorophenol) used in wood-preserving processes over the years, or from differences in sampling and analytical protocols.

6. CURRENT AND POTENTIAL FUTURE SITE AND RESOURCE USES

6.1 Current Land Use

Wood treating operations at the site ceased in 1988. By October 1997, EPA had removed all structures and buildings at the site. The only activity currently at the site is the existing pump-and-treat system.

The existing zoning of the Wyckoff property is Water-Dependent Industrial. Uses under the current zoning may include retail commercial, indoor entertainment, cultural and government facilities, associated parking, agriculture, boatyards, marine sales and repair.

6.2 Reasonably Anticipated Future Land Uses

For purposes of cleanup, the City of Bainbridge Island made recommendations regarding likely future land use designations. In June 1995, Mayor Janet West appointed the Wyckoff Zoning Advisory Committee to make zoning recommendations to the Bainbridge Island City Council. The Committee's mission was to conduct preliminary research for the city and create recommendations for zoning the area. The recommendations below were based on the assumptions that the contamination would be contained in-place, i.e., the contaminated groundwater would be contained using a slurry wall and the contaminated soil would be capped.

At this time, EPA is planning a more aggressive cleanup of the soil and groundwater. It is possible that there will be flexibility in future land uses based on the cleanup that may be achieved, including but not limited to, residential use for large portions of the Wyckoff property.

The Bainbridge Island Zoning Advisory Committee recommendations were:

<u>Residential Use in the Hillside Area</u> (Approximately 39 acres)
Single family and multi-family residential.

<u>Mixed-Use Water-Dependent/Water-Related Commercial in the Log Storage/Peeler Area</u> (Approximately 10 acres)
Water related commercial uses including marina, boatyard with haul-out facility, marine sales

and repair, marine related sales, and restaurants. Emphasis is on water-dependent uses.

Open Space Recreational Uses in the Former Process Area (Approximately 8 acres) Limited to public recreational uses including vegetated areas, pedestrian/bike trails, playgrounds, restroom facilities, recreational shelters, parking and potential museum structure.

6.3 Reasonably Anticipated Future Resource Uses

Much of the anticipated future resource uses will be determined by the mitigation plan for the site. Currently, the shoreline is supported by riprap and failing bulkhead. The condition of the shoreline is very important to Federal, State, and Tribal Agencies, as well as the City of Bainbridge Island and its community. EPA has been and will continue to coordinate closely with these entities to develop an acceptable mitigation plan for the sheet pile wall, and to address future land use and resource issues. Mitigation will be required because sections of the sheet pile wall will be constructed offshore, resulting in loss of habitat. The mitigation plan likely will modify large parts of the western shoreline to create a gently sloping beach that will significantly enhance the habitat and ecosystem at the Wyckoff site (see Section 12.3, below). As part of the mitigation effort, EPA will also develop protective measures to support and protect functions of nearshore habitat.

6.4 Groundwater Classification and Basis

Both Class II and Class III groundwater exist at Wyckoff (see Figure 8). Class III groundwater occurs where saltwater intrusion raises total dissolved solids (TDS) concentrations above 10,000 mg/L. Class II groundwater occurs above and upgradient of the 10,000 mg/L boundary.

6.4.1 Upper Aquifer

Groundwater in the upper aquifer underneath the Former Process Area is not currently extracted for potable, agricultural, or industrial purposes, due to saltwater intrusion caused by tidal flushing. High salinity levels are anticipated to remain in the future. The Washington State Department of Ecology has determined the upper aquifer groundwater in the Former Process Area to be non-potable because it is significantly affected by salinity and will not be used as a future source of drinking water. The assignment of Class III to the upper aquifer groundwater beneath the Former Process Area is consistent with EPA's definition of a potential source of drinking water.

The upper aquifer beneath the Former Log Storage Peeler Area does not serve as a current source of drinking water. However, this aquifer could potentially be potable (Class II B groundwater).

6.4.2 Lower and Deep Aquifers

The upper groundwater aquifer is separated from the lower aquifer by a low-permeability layer (aquitard). Data gathered during the remedial investigation and during exploratory drilling by the U.S. Army Corps of Engineers indicate that the low-permeability layer is continuous with thickness ranging from 10 to 40 feet in various locations. Groundwater in the lower aquifer (approximately 80 to 200 feet below ground surface) is considered potable (Class II B groundwater) although this aquifer has never been used for drinking water on this property.

Additionally, there are deep confined aquifers that are located from approximately 200 feet to 1,500 feet or more below ground surface. These aquifers are also potable (Class II A groundwater) and were used in the past by the Wyckoff Company to provide water for on-site operations with excess sent to nearby residents on Rockaway Beach to be used for drinking water purposes. EPA sealed and abandoned two deep drinking water wells (located at 500 feet and 800 feet bgs) in 1995 due to concerns that they could provide conduits for migration of contaminants to the deep aquifers.

6.5 Current Groundwater Use

Two community drinking-water supply systems are located in the immediate vicinity of the Wyckoff property: the Bill Point Wells and the South Eagle Harbor Supply Well. The Bill Point Wells are located upgradient on the hillside south of the Wyckoff property; drinking water is obtained from four wells that are each completed at depths of 150 to 160 feet below ground surface (bgs). Quarterly sampling was conducted from 1988 to 1994 at these wells to determine if they were impacted by the Wyckoff operations. An assessment of the analytical results indicated that some extremely low levels of organics existed in these wells, however, concentrations were extremely low, and in most cases several orders of magnitude below the most stringent drinking water levels. Several inorganic chemicals (metals) have also been detected. However, metals have not been used at the Wyckoff facility as part of wood-preserving operations. Furthermore, the Bill Point wells are also located upgradient of the contamination at Wyckoff, and there is no interconnection between the Bill Point aquifers and the aquifers beneath the Wyckoff site. Therefore, EPA ceased the sampling program in 1994. The South Eagle Harbor Supply Well is located about one-half mile west of the Wyckoff property and is completed at a depth of approximately 600 feet bgs. This well was constructed to provide a replacement water supply for the Rockaway Beach community.

7. SUMMARY OF SITE RISKS

7.1 Summary of Human Health Risk Assessment

A Human Health Risk Assessment (HHRA) was conducted to evaluate the potential human health risks that presented at the Soil and Groundwater OUs if no remedial action is performed. The risk assessment identified and characterized the toxicity of chemicals of potential concern, the possible exposure pathways, the potential human receptors, and the possible human health risks at Wyckoff. This section of the ROD summarizes results of the baseline risk assessment for both the Soil and Groundwater OUs and adjacent intertidal sediments.

The potential human health risks associated with the Soil and Groundwater OUs were characterized by estimating the risk on a sample-specific basis rather than an area-wide evaluation. This approach allowed for evaluation of both spatial variability and distribution of the risk associated with contaminants of primary concern throughout Wyckoff. The benefit of this approach is that it assists in delineating specific areas requiring remedial action based on potential human health risk. Contaminants of primary concern carried forward in the risk assessment included each chemical detected in at least one sample from each medium analyzed in the Soil and Groundwater OUs if an EPA-derived toxicity value was available. The classes of compounds representing chemicals of primary concern, along with minimum, maximum and average detected concentrations in each medium, are presented in Tables 1 through 7. Chemicals without an EPA derived toxicity value were evaluated qualitatively for overall risk contribution. Only sample results that met all validation requirements were used in the risk assessment.

Individuals who are potentially exposed by direct contact to contaminants include trespassers and health and safety trained workers. Potential exposure scenarios also include future residents. Only the residential exposure scenario was evaluated in the baseline HHRA; this scenario was selected because it is the most conservative and represents the highest potential future land use for large portions of the Wyckoff property. Under this conservative scenario, future residents could become exposed through the ingestion of near-surface, 0-3 inches below ground surface (bgs), and sub-surface (5-7 feet bgs) contaminated soil. The upper aquifer south and west of the Former Process Area (i.e., the upper aquifer underlying the Former Log Storage/Peeler Area) and the lower aquifer groundwater are assumed to be potential sources of drinking water. Consequently, future residential exposures through ingestion of contaminated groundwater and inhalation of volatile organic compounds released from groundwater were also evaluated. Samples collected from the upper aquifer groundwater beneath the Former Process have been classified as non-potable and were excluded from the risk assessment.

An evaluation of the potential human health risk associated with intertidal and subtidal sediments, surface water, and aquatic life next to the Wyckoff site is also summarized below.

For the exposure pathways considered, EPA's default exposure parameters were used. Both reasonable maximum and average exposure cases were calculated. Exposure point concentrations for soil and groundwater ingestion were based on the actual concentrations measured in each sample. For groundwater inhalation, a default volatilization factor was assumed. Exposure point concentrations and intake levels were assumed to be constant over the duration of exposure in order to calculate noncancer health impacts and cancer risk.

Risks were evaluated for cancer-causing and noncancer-causing (toxic) effects. The NCP defines the acceptable risk range for Superfund sites as excess lifetime cancer risks ranging from 1 in

10,000 (1×10^{-4}) to 1 in 1,000,000 (1×10^{-6}). This risk level means that an individual could face a 1 in 10,000 or 1 in 1 million chance of developing cancer because of exposure to contaminants beyond those cancers expected from other causes. Noncancer effects were evaluated by calculating the ratio between the estimated intake of a contaminant and its corresponding reference dose (the intake level at which no adverse health effects are expected to occur). If this ratio, called a hazard index, is less than 1, noncancer health effects are not expected at the site. A hazard index greater than 1 is an indication that toxic effects may occur, especially in sensitive subpopulations, but is not a mathematical prediction of the severity or incidence of the effects.

Based on Reasonable Maximum Exposure (RME) assumptions, the estimated excess cancer risk to future residents from the ingestion of surface or near-surface soil exceeded 10^{-4} at 35 of the 253 sample locations. These samples, collected from a systematic grid encompassing the entire 18 acres of the Soil OU, represent approximately 120,000 square feet (about 15%) of the Soil OU area. Most of the samples associated with a higher estimated excess cancer risk were limited to the Former Process Area. Exposure through ingestion of surface or near-surface soil was estimated to cause an excess cancer risk of 10^{-5} in approximately 300,000 square feet (about 37%)of the Soil OU. Samples with contaminant concentrations associated with this level of risk were collected in the Former Process Area and, from isolated areas along the southern boundary of the Soil OU, south of the Former Process Area and extending toward the western Soil OU boundary.

Contaminant concentrations in soil samples representing approximately 370,000 square feet (about 46%) of the Soil OU result in an excess cancer risk of 10^{-6}. This excess cancer risk is also associated with samples collected in the Former Process Area, with isolated areas throughout the southern and western portions of the Soil OU. All of the surface or near-surface soils with a Hazard Quotient greater than 1 are already associated with samples with a RME cancer risk greater than 10^{-6}.

The primary contributor to cancer risk through soil ingestion by future residents is benzo(a)pyrene, a carcinogenic PAH. The remaining carcinogenic high molecular weight PAHs, or HPAHs, PCP, and dioxins make up the rest. The primary contributor to non-cancer risk is naphthalene with a calculated HQ of 22.8. Table 8 summarizes the RME concentrations and estimated risk values for major risk drivers in the Soil OU.

In the upper-aquifer groundwater south and west of the Former Process Area, the excess cancer risk from ingestion of groundwater by future residents, based on RME from detected chemicals, ranges from 5×10^{-6} to 4×10^{-4}, with the higher values more closely associated near the Former Process Area. In general, the primary contributors to cancer risk in groundwater are benzo(a)pyrene, benzo(a)anthracene, benzo(b)fluoranthene, and benzo(b)anthracene. Similar to the soil ingestion exposure scenario, exceedances of the non-cancer hazard index of 1 are associated with locations of higher cancer risk. Contributors to non-cancer risk in upper aquifer groundwater include naphthalene (HQ=89), dibenzofuran (HQ=95.5), and Aroclor 1254 (HQ=5.75). Table 9 summarizes the RME concentrations and estimated risk values for major risk drivers in the Groundwater OU.

Below are tables with the different exposure assumptions used in the average and RME calculations that are responsible for the different risk characterization values in Tables 10 and 11.

Exposure Assumptions for Residential Soil Ingestion

Exposure ID	Body Weight (kg)	Average Time Carcinogenic (yr)	Average Time Noncancer (yr)	Exposure Frequency (day/yr)	Exposure Duration (yr)	Ingestion Rate (mg/day)
RME	a	70	30	350	a	a
Average	70	70	9	275	9	100

a The ingestion rate for RME exposure is actually an "ingestion factor", which combines exposure duration and ingestion rate using the following equation:

$$IF_{soil}/adj\ (mg\text{-}yr/kg\text{-}day) = \frac{I_{soil}/age\ 1\text{-}6 \times D_{age}\ 1\text{-}6}{W_{age}\ 1\text{-}6} + \frac{I_{soil}/age\ 7\text{-}31 \times D_{age}\ 7\text{-}31}{W_{age}\ 7\text{-}31}$$

where:

IF_{soil}-adj = age-adjusted soil ingestion factor (114 mg-yr/kg-day)
W_{age} 1-6 = average body weight from ages 1-6 (15 kg)
W_{age} 7-31 = average body weight from ages 7-31 (70 kg)
D_{age} 1-6 = exposure duration during ages 1-6 (6 yrs)
D_{age} 7-31 = exposure duration during ages 7-31 (24 yrs)
I_{soil}/age 1-6 = ingestion rate of soil age 1 to 6 (200 mg/day)
I_{soil}/age 7-31 = ingestion rate of soil all other ages (100 mg/day)

Note that the ingestion factor is in units of mg-yr/kg-day, and therefore is not directly comparable to daily soil intake rate in units of mg/kg-day.

Exposure Assumptions for Residential Groundwater Ingestion

Exposure ID	Body Weight (kg)	Average Time Carcinogenic (yr)	Average Time Noncancer (yr)	Exposure Frequency (day/yr)	Exposure Duration (yr)	Ingestion Rate (l/day)
RME	70	70	30	350	30	2
Average	70	70	9	275	9	1.4

In lower-aquifer groundwater, two of the four wells that were included in the risk assessment displayed an excess cancer risk of greater than 10^{-5} but lower than 10^{-4}. However, recent field investigations revealed that one of those two wells (CW12) was not screened in the lower aquifer. Consequently, data from this well may be representative of either the upper aquifer or contaminant levels penetrating high permeability zones of the aquitard, but not the lower aquifer.

The risk assessment completed in 1991 for the Eagle Harbor Operable Unit relied on data from a 1988 sampling of four transects (transect numbers 10, 11, 12, and 13) located in the intertidal environment adjacent to the Wyckoff property. Chemicals of concern used for the risk assessment included three semivolatile organic compounds, 12 polynuclear aromatic hydrocarbons (PAHs), two nitrogen-containing aromatic compounds, two volatile organic compounds, and 10 metals. Three exposure scenarios were used to complete the risk assessment using the 1988 data set: ingestion of clams, ingestion of intertidal sediments, and dermal contact with intertidal sediments.

The 1988 Puget Sound Estuary Program (PSEP) study of seafood consumption in Puget Sound (Tetra Tech, 1988) provided a high (95th percentile) Puget Sound consumption rate of 95.1 grams per day of fish. This rate corresponds to 230 servings of 1/3-lb of fish over the course of a year. The high rate for shellfish consumption was estimated to be 21.5 g/day, equivalent to a 1/3-lb serving a week. (The study estimated that an average consumer eats at most 30 such servings of fish and three such servings of shellfish per year).

Calculated hazard indices for dermal exposure using RME concentrations did not exceed unity. Cancer risk for dermal contact was not calculated because dermal toxicity values were not available to quantify risks. The noncancer hazards and cancer risk for ingestion of clams and intertidal sediments are summarized in Table 12.

Uncertainties associated with the Human Health Risk Assessment were identified and their potential effects evaluated. The major uncertainties that may result in an underestimation of risk include: (1) the limited characterization data for the presence of dioxins; (2) the assumption that chemicals were not detected in a sample are not present at that location; (3) and the fact that baseline exposures not associated with the Soil and Groundwater OUs are not included within the risk assessment. Cumulative intake, which includes the intertidal area adjacent to the Wyckoff facility, may be higher than estimated. The major uncertainties that may result in overestimation of risk include (1) that risk and doses are additive, and (2) the shallow groundwater from across the site is a potential future drinking water source. The major uncertainties that may result in either estimation or overestimation of risk is the assumption that chemical concentrations will be constant over the duration of exposure and the fact that we don't know how toxic all the chemicals present at the site are.

7.2 Summary of Ecological Risk Assessment

The Ecological Risk Assessment addresses the current and future impacts and the potential risks to upland ecological receptors posed by contaminants at the Soil OU if no cleanup action is taken. The sampling stations evaluated as part of the ecological risk assessment included those located south of the Former Process Area that did not have exceedances of a human health excess cancer risk of 10^{-5}. The other portions of the Soil OU were not evaluated in this baseline ecological risk assessment because (1) the near-surface and subsurface soil in these portions of the OU will be remediated based on human health concerns, so an extensive ecological risk assessment was not conducted; and (2) most of these portions are located in the Former Process Area, which has been heavily developed and has little or no suitable habitat for wildlife.

Ecological management goals for the Soil OU include attainment of soil conditions supportive of plants, invertebrates, mammals and birds that use the Soil OU and the reduction of potential toxicity at the Soil OU. Assessment endpoints used in the ecological risk assessment focused on species composition, abundance and productivity of plants, invertebrates, mammals and birds using the Soil OU. The measures of exposure and effect used to evaluate the assessment endpoints included concentrations of contaminants in near-surface soil and the responses of receptor species to those concentrations. Responses were quantitatively evaluated through comparisons of exposure point concentrations to ecological screening benchmarks (ESBs) and assessment of the potential bioaccumulation of selected chemicals to ecological receptors.

Potential ecological risk at the Wyckoff Soil OU was estimated through the calculation of hazard quotients. Hazard quotients are generated by taking the exposure point concentrations in near surface vadose soil for each chemical of potential ecological concern and dividing by the ESB for selected indicator species. In this assessment, indicator species included crop plants (oats, barley or lettuce), earthworms, deer mice and American robins. If the hazard quotient for any specific indicator species exceeds 1, it is recommended by the ecological risk assessment that the areas represented by these samples be included for remediation of near-surface soil, additional soil sampling or completion of soil bioassays.

The primary risk drivers for each receptor were slightly different and a function of the availability of toxilogical information for each receptor and the difference in sensitivity to chemicals among plants, invertebrates, mammals and birds. The primary risk drivers for plants included anthracene, benzo(a)pyrene, benzo(a)anthracene, benzo(g,h,i)perylene, pentachlorophenol and 2,3,4,5-tetrachlorophenol. Primary risk drivers for invertebrates were anthracene, acenaphthylene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, fluoranthene and phenanthrene. Benzo(a)pyrene was the only risk driver identified for mammals. Benzo(a)pyrene and dibenzo(a,h)anthracene were identified as the primary risk drivers for birds. Areas represented by samples with a hazard quotient of greater than 1 generally correspond to the discrete areas south of the former Process Area and the Log Storage/Peeler Area identified in the HHRA as exceeding the 10^{-5} RME cancer risk for human receptors.

Uncertainties associated with the baseline ecological risk assessment which may cause risk to be underestimated include: (1) lack of toxicological information for some chemicals and (2) exclusion of the inhalation and dermal contact exposure pathways for vertebrates. The major uncertainty factor that may cause overestimation of ecological risk is the inclusion of indicator species as potential receptors that may or may not actually use the Soil OU.

An ecological assessment of the marine area adjacent to the Soil OU was conducted previously as part of the Eagle Harbor risk assessment. The human health component of the Eagle Harbor risk assessment focused on the intertidal zone, where direct human contact was most likely and is summarized above. The ecological component focused on the subtidal zone because the Eagle Harbor sediment toxic effects were based almost entirely on subtidal sampling locations. The complete Eagle Harbor risk assessments can be found in the site's Administrative Record. These risk assessments concluded that unacceptable risks existed in the intertidal and subtidal areas for a wide variety of animals and that these problems were largely a result of releases from the Wyckoff site.

The assessment of ecological risks associated with subtidal sediments relied on a "triad approach" which links contamination to specific adverse ecological effects using a preponderance of field and laboratory evidence. Sediment chemical analysis, laboratory toxicity tests (bioassays) and the evaluation of the abundance of benthic organisms from specific locations are used in combination as the three elements of the triad approach. This approach was used to develop the Puget Sound Apparent Effects Threshold (AETs) used by the State of Washington to establish chemical standards for sediment quality. For specific chemicals, an AET is the chemical concentration in sediment above which particular adverse biological effects have consistently been observed in Puget Sound studies.

In samples from the eastern portion of Eagle Harbor, closest to the Wyckoff facility, sediments exceeded the benthic AET for at least two PAHs at numerous stations. At several locations, all sixteen PAH compounds exceeded their benthic AETs. Based on the comparison of the concentrations in Eagle Harbor samples with the 1988 benthic AETs for Puget Sound, EPA selected mercury and all sixteen PAHs as contaminants of concern in the East Harbor OU. As stated previously, the source of PAHs to the harbor is believed to primarily be releases from the Wyckoff facility. Releases of mercury likely resulted from the historic ship building activity in the western portion of the harbor.

The bioassays for acute toxicity indicated that sediments from many sampled locations in the East Harbor were toxic to amphipods, oyster larvae or both. The bioassay responses were most severe in the areas of high PAH contamination, such as areas of the East Harbor north of the Wyckoff facility. Bioassays of benthic infauna, in this case amphipods, are valuable indicators because the organisms live in direct contact with the sediments, are relatively stationary, and are important components of estuary ecosystems. Other studies conducted in the East Harbor tend to indicate that while sediment contamination is present above the benthic AET for large areas of the harbor, adverse effects on benthic communities at the level of major taxa (polycheata, molluscs and crustacea) may not be occurring except in more heavily PAH contaminated areas close to the Wyckoff facility.

Additional evidence of biological effects in Eagle Harbor includes the prevalence of liver legions and tumors in English sole, as documented by the National Oceanic and Atmospheric Administration (Malins, 1985). The high incidence of such effects in Eagle Harbor relative to other Puget Sound embayments was confirmed in the Puget Sound Ambient Monitoring Program 1991 sampling. This and laboratory research citing the effects of PAH and other sediment contaminants on marine organisms add to the preponderance of evidence indicating potential damage to Eagle Harbor marine life as a result of releases from the Wyckoff facility.

Actual or threatened releases of hazardous substances from the Soil and Groundwater OUs may represent imminent and substantial endangerment to public health or welfare, or the environment.

Based on the RIs for the Soil and Groundwater OUs, the East Harbor OU, the risk assessments and available information, remediation of the soil and groundwater at the Wyckoff facility is warranted. Exposure of future residents to soil and groundwater at the Wyckoff facility pose a human health risk above the acceptable range and may also affect people if other land uses are selected. Consumption of shellfish from adjacent intertidal areas also poses an unacceptable human health risk. Adverse biological effects were documented in much of the East Harbor. Most of the biological effects previously observed were associated with heavy sediment contamination near the Wyckoff facility where releases of contamination continue to occur.

The response action selected in this Record of Decision is necessary to protect the public health or welfare or the environment from actual or threatened releases of hazardous substances in the environment.

8. REMEDIATION OBJECTIVES AND CLEANUP LEVELS

The soil and groundwater investigations have identified contamination requiring remedial action at the Wyckoff site. The need for action was determined based on the results of the human health and ecological risk assessments. In addition, contaminant levels in the soil exceeded the Washington State Department of Ecology Model Toxics Control Act (MTCA) standards, and the contaminant levels in groundwater exceeded marine water quality and surface water standards and will contaminate sediment to levels above Sediment Management Standards. The objectives of the remedial action for Wyckoff Soil and Groundwater OUs are:

8.1 Soil Operable Unit

Future land use is unknown at this time. Although some areas of the site may be residential, others may include recreational uses. Because residential cleanup standards are the most stringent, they have been chosen as a goal for the soil at this site. Remedial action objectives for cleanup of the soil must address potential impacts to human residents who could be exposed to contaminants via ingestion, inhalation, or dermal contact.

Remedial action objectives (RAOs) for all three Soil OU areas are:

- Prevent human exposure through direct contact (ingestion, inhalation, or dermal contact) with contaminated soil.

- Prevent storm water runoff containing contaminated soil from reaching Eagle Harbor.

8.2 Groundwater Operable Unit

Remedial action objectives for cleanup of NAPL in the groundwater at Wyckoff must address impacts to marine water quality, surface water quality, and sediments in Eagle Harbor.

Humans have a negligible risk of direct contact on-site with groundwater at Wyckoff. Groundwater in the upper-aquifer underlying the Former Process Area is not extracted now for potable, agricultural, or industrial purposes due to the high salinity levels (see Section 6.3, above). Site specific groundwater contaminant concentration limits that are protective of the environment and human health have been developed and can be found in Table 13. These limits are to be met at the mudline (i.e., at the points where groundwater flows into surface water). The risks in the other two groundwater areas (the upper aquifer beneath the Former Log Storage/Peeler Area and the lower aquifer) are generally acceptable as most are below 10^{-5} risk. Where the risk exceeds 10^{-5}, the groundwater is in close proximity to the upper-aquifer groundwater beneath the Former Process Area.

The remedial action objectives for the Groundwater OU are:

- Reduce the NAPL source and the quantity of NAPL leaving the upper-aquifer beneath the Former Process Area sufficiently to protect marine water quality, surface water, and sediments (e.g., ensure the quantity of NAPL leaving the site will not adversely affect aquatic life and sediments). Site-specific groundwater contaminant concentration limits will be met at the mudline.

- Ensure contaminant concentrations in the upper-aquifer groundwater leaving the Former Process Area will not adversely affect marine water quality, and aquatic life in surface water and sediment.

- Protect humans from exposure to groundwater containing contaminant concentrations above MCLs.

- Protect the groundwater outside the Former Process Area and in the lower aquifers, which are potential drinking water sources.

The remedial action objectives for groundwater also support the objectives for sediments identified in the 1994 Record of Decision for the East Harbor Operable Unit.

8.3 Key Applicable or Relevant and Appropriate Requirements

The key Applicable or Relevant and Appropriate Requirements (ARARs) for the Wyckoff soil include the State of Washington Model Toxics Cleanup Act (MTCA) cleanup standards. For the groundwater, the key ARARs are State and Federal marine water quality standards/criteria, surface water standards for human consumption of organisms, and sediment management standards (although the sediments are not addressed under this ROD, sediment management standards were used to calculate groundwater cleanup numbers). Additional important standards for the groundwater are the Alternate Cleanup Levels (ACLs) for the upper aquifer groundwater beneath the Former Process Area that will ensure compliance with the key ARARs, as described in Section 8.3.2, below.

8.3.1 Soil Operable Unit

The Washington Model Toxics Control Act (MTCA) requirements have been identified as a key ARAR for the Soil Operable Unit actions. Specific cleanup levels are discussed in Section 8.4.1 and Table 14.

8.3.2 Groundwater Operable Unit

Alternate Concentration Limits for Groundwater

Usable groundwater should be returned to beneficial uses wherever practicable within a reasonable restoration time frame (40 CFR 300.430(a)(iii)(F)). If groundwater is a current or potential future source of drinking water, remedial actions must reduce contaminant concentrations to or below nonzero maximum contaminant level goals (MCLGs) or maximum contaminant levels (MCLs) established under Safe Drinking Water Act regulations (40 CFR 300.430(e)(2)(i)(B)). However, under the following circumstances, alternate concentration limits (ACLs) in accordance with CERCLA §121(d)(2)(B)(ii) may be used (40 CFR 300.430(e)(2)(i)(F)):

- The groundwater must have a known or projected point of entry to surface water.
- Measurements or projections must show that there is or will be no statistically significant increase of such constituents in the surface water at the point of entry or at any point where accumulation of constituents may occur downstream.
- The remedial action must include enforceable measures that will preclude human exposure to the contaminated groundwater at any point between the facility boundary and all known and projected points of groundwater entry into surface water.

As an EPA policy, technical impracticability to restore groundwater to drinking water levels should be considered and evaluated before ACLs are used.

MTCA (WAC 173-340-720(1)(c)) lists parallel requirements, and the Wyckoff facility groundwater meets the criteria as follows:

- Groundwater from the Wyckoff site discharges directly into Eagle Harbor and Puget Sound at known or projected points (see Figure 6).

- Laboratory treatability testing and groundwater modeling results indicate that there will be no statistically significant increase in contaminants in Eagle Harbor and Puget Sound, after thermal treatment is completed and groundwater contaminant concentrations are naturally attenuated between the shoreline wells and the marine water/sediment interface (i.e., the mudline). Under MTCA, wells can be placed onshore to monitor and predict the contaminant concentration at the mudline. The shoreline wells will be considered an alternate point of compliance under MTCA.

- Enforceable institutional controls outlined in this ROD will preclude human exposure to on-site groundwater and any groundwater between the site and Eagle Harbor or Puget Sound.

Restoration of Class III groundwater (see Section 6.4) to drinking water quality at Wyckoff is impracticable due to high TDS concentrations resulting from seawater intrusion, as well as widespread NAPL and its complex distribution due to the varying geologic formations. Thermal remediation is not expected to restore the upper aquifer beneath the Former Process Area to drinking water standards.

Based on the statutory language allowing ACLs (CERCLA §121(d)(2)(B)(ii)) as well as on the groundwater classification at Wyckoff and the impracticability of restoration, the use of ACLs at Wyckoff is appropriate. The ACLs for the Wyckoff site will be the maximum allowable source concentrations at shoreline monitoring wells that ensure protection of receptors at the mudline. ACLs will be determined by a fate and transport analysis, using a numerical groundwater model to simulate dispersion, sorption, diffusion and tidal dilution between the shoreline wells and the mudline. This ongoing modeling effort will include refinements based on laboratory thermal degradation studies, and data obtained during the thermal remediation pilot test. The goals of the ACLs are to meet State and Federal marine water quality standards/criteria for the protection of aquatic organisms, surface water standards for human consumption of organisms, and to protect marine sediments. Compliance with the ACLs will be confirmed by groundwater monitoring in shoreline wells after thermal remediation is completed.

Pending completion of the fate and transport analysis which will provide ACLs for site groundwater, the groundwater cleanup levels shown in Table 13 may be used as conservative indicators of aqueous contaminant concentrations that must be achieved within the uplands portion of the site.

It should be noted that many of the calculated cleanup levels shown in Table 13 exceed individual compound solubilities, which are the maximum dissolved concentrations possible at equilibrium with NAPL (i.e., the compound cannot dissolve at a sufficient rate to exceed the cleanup level).

8.4 Cleanup Levels

8.4.1 Soil Operable Unit

Media and Contaminants of Concern

The vadose soil (unsaturated soil found to a depth of 5-10 feet bgs)[2] is the medium of concern. The Soil OU is divided into three areas, the Former Process Area, the Former Log Storage/Peeler Area, and the Well CW01 Area (Figure 4). Former wood-treating operations at the Wyckoff property has resulted in widespread near-surface and subsurface contamination of soil, with elevated levels of contamination in the Former Process Area. The primary pathways of concern are human ingestion, inhalation, or dermal contact with contaminated soil. The primary contaminants of concern (COCs) in soil are (see Tables 1 through 3):

- Polycyclic aromatic hydrocarbons (PAHs)
- Pentachlorophenol (PCP)
- Dioxins/Furans

Cleanup Levels and Point of Compliance

As mentioned above, the State of Washington Model Toxics Control Act (MTCA) is the principal ARAR governing the establishment of cleanup levels for environmental cleanup actions. As set forth in WAC 173-340-700(2), MTCA requires that cleanup actions:

- Attain numeric cleanup levels for all COCs[3]
- Attain cleanup levels at defined locations termed the points of compliance

Numeric cleanup goals that define protectiveness for surface soil at this site are presented in Table 14. MTCA provides two methods that establish cleanup levels for soil. The method that applies to the soil at this site is Method B (WAC 173-340-740). For the carcinogenic PAHs, the overall risk sums to $9x10^{-6}$, which meets MTCA goals for risk not to exceed $1x10^{-5}$. The cleanup levels identified in Table 14 for non-carcinogens have not been adjusted downward in accordance with WAC 173-340-708(5)(c). These adjustments will be made based on the results of the thermal pilot study.

Under MTCA, for future unrestricted use, soil cleanup levels based on human exposure via soil ingestion, dermal contact, or inhalation, the point of compliance shall be established in the soils

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[2] Although the vadose zone is shallow at Wyckoff, in order to comply with MTCA regulations for unrestricted future use, the upper 15 feet of soil should be considered. (See Point of Compliance discussion).

[3] In certain cases, Ecology does allow the use of indicator chemicals.

throughout the site from the ground surface to 15 feet below the ground surface. This represents a reasonable estimate of the depth of soil that could be excavated and distributed at the soil surface as a result of site development activities.

If this point of compliance is not practicable[4], then a point of compliance will be established for direct contact at the ground surface and will require a placement of a soil cap with restricted future use (i.e., institutional controls).

8.4.2 Groundwater Operable Unit

Media and Contaminants of Concern

Groundwater quality at Wyckoff has been degraded through contact with wood-treating chemicals, which were used at this site from the early 1900s to 1988. The presence of free-phase and residual non-aqueous phase liquid (NAPL) in the subsurface (i.e., NAPL in the Soil and Groundwater OUs) acts as a continuing source of groundwater contamination. The primary pathways of concern are the NAPL moving through the groundwater to marine sediments and dissolved concentrations of contaminants moving through the groundwater to surface water and to the marine sediments. The primary contaminants of concern (COCs) in groundwater are polynuclear aromatic hydrocarbons (PAHs) and pentachlorophenol (PCP) (see Table 4). For purposes of cleanup, it is assumed that other contaminants are co-located with the PAHs and PCPs and will be remediated along with these primary contaminants of concern. This assumption is based on: (1) site characterization data show that the contaminants are co-located now, and (2) with the exception of Alternative 1, all the alternatives can address these other contaminants as well.

Cleanup Levels and Point of Compliance

Numeric cleanup goals that define protectiveness are the most stringent of State and Federal marine water quality standards/criteria, risk-based surface water standards for human consumption of organisms, and calculated pore-water maximums based on Sediment Management Standards for marine sediments. As discussed previously, marine water quality, surface water, and marine sediments in Eagle Harbor are the media of primary concern. Protection of the upper groundwater aquifer beneath the Former Process Area as a source of drinking water is not applicable at this site (see Section 8.3.2, above).

Federal and state surface water quality standards, MTCA surface water cleanup levels for human consumption of aquatic organisms, and calculated groundwater concentrations that protect sediments are presented in Table 13. Concentrations protective of sediments are calculated using the following equilibrium partition relationship, published partitioning coefficients (K_{oc}), and the

[4] "Practicable" is defined under MTCA as "capable of being designed, constructed, and implemented in a reliable and effective manner including consideration of cost..."

applicable marine sediment standards (Table 15):

$$C_w = C_s / K_{oc}$$

where:

C_w = pore-water concentration (mg/L)
C_s = sediment concentration (mg/kg$_{oc}$)
K_{oc} = organic carbon partition coefficient (L/kg$_{oc}$)

Where more than one standard exists for a COC, the lowest or most stringent concentration is reported as the appropriate cleanup level in Table 13.

For groundwater, the point of compliance is the location(s) where groundwater cleanup levels must be attained (WAC 173-340-720(6)(d)). The maximum beneficial use of the upper-aquifer groundwater at Wyckoff is recharge to surface water. Therefore, the appropriate point of compliance for the upper-aquifer groundwater at Wyckoff is a conditional point of compliance[5], which is located within the surface water as close as technically possible to the point or points where groundwater flows into the surface water. Compliance can be measured in the seeps in the intertidal area and/or in upland monitoring wells. MTCA allows for a conditional point of compliance when the following seven conditions are met:

- The contaminated groundwater is entering the surface water and will continue to enter the surface water even after implementation of the selected cleanup action;

- It is not practicable to meet the cleanup level at a point within the groundwater prior to entry into the surface water, within a reasonable restoration timeframe;

- Use of a mixing zone to demonstrate compliance with surface water cleanup levels shall not be allowed;

- Groundwater discharges shall be provided with all known available and reasonable methods of treatment (AKART) prior to release into surface waters. Selection of a cleanup action that is permanent to the maximum extent practicable and that uses at least groundwater containment measures to eliminate or minimize releases to the surface water shall be considered to have met this requirement;

- Groundwater discharges shall not result in violations of sediment quality values;

- Groundwater and surface water monitoring shall be conducted to assess the long-term performance of the selected cleanup action;

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[5] Can be measured in upland wells with back calculations. A modeling exercise is being conducted to determine admissible groundwater concentrations in upland wells.

- Prior to approval of the conditional point of compliance, a notice shall be mailed to the Washington State Department of Natural Resources and the United States Army Corps of Engineers for comments.

9. DESCRIPTION OF ALTERNATIVES

9.1 Description of Remedy Components

Four candidate alternatives were identified and evaluated for the Wyckoff Soil and Groundwater Operable Units:

Alt. No.	Cleanup Alternative Description
1	**No Further Action** • Maintain existing pump-and-treat system until it fails (in approximately 5 years)
2a	**Containment with a Slurry Wall** • Construct a slurry wall around the NAPL source within the Former Process Area • Construct a new pump-and-treat system to maintain the water level within the slurry wall • Remove the soil from Well CW01 Area and consolidate within the Former Process Area • Cap the contaminated soil in Former Process and Log Storage/Peeler Areas • Perform long-term O&M, monitoring, and institutional controls within the slurry wall and soil cap • Monitor the groundwater outside the contained area and implement institutional controls, if necessary • Replace the pump-and-treat system every 30 years and replace/repair the slurry wall, as needed
2b	**Containment with a Sheet Pile Wall** • Construct a sheet pile wall (with corrosion protection) around the NAPL source within Former Process Area • Construct a new pump-and-treat system to maintain the water level within the sheet pile wall • Remove the soil from Well CW01 Area and consolidate within the Former Process Area • Cap the contaminated soil in Former Process and Log Storage/Peeler Areas • Perform long-term O&M, monitoring, and institutional controls within the sheet pile wall and soil cap • Replace the corrosion protection system in the future, if necessary • Monitor the groundwater outside the contained area and implement institutional controls, if necessary • Replace the pump-and-treat system every 30 years and replace/repair the sheet pile wall, as needed

3	**In-Situ Thermal Remediation** (Steam Injection and, if necessary, Electrical Resistance Heating) ***Phase I*** • Construct a sheet pile wall (with corrosion protection) around the treatment zone (Former Process Area) • Perform an on-site pilot test of thermal remediation ***Phase II*** • Consolidate the contaminated soil from the Well CW01 and Former Log Storage/Peeler Area within the treatment zone of the Former Process Area • Construct a vapor cover over the treatment zone • Remediate the soil and groundwater using thermal remediation • Disposal of recovered NAPL off-site and treatment of contaminated groundwater and vapors on-site • Monitor biodegradation, oxidation, and other thermally-enhanced attenuation processes in soil and groundwater during and after thermal remediation • Monitor the groundwater outside the treatment zone for decreasing trends and implement institutional controls, if necessary • Implement institutional controls to ensure that the upper aquifer groundwater within the Former Process Area remains unused, and if necessary, to restrict site use to reduce the risk of direct exposure to surface soil
	In-Situ Thermal Remediation plus Contingency • Place a cap over the Former Process Area if thermal treatment does not remediate surface soil to MTCA cleanup standards • Perform ongoing pumping and treating if thermal treatment does not meet groundwater RAOs • Implement institutional controls to ensure that the upper aquifer groundwater within the Former Process Area remains unused, and if necessary, to restrict site use to reduce the risk of direct exposure to surface soil

9.2 Common Elements and Distinguishing Features of Each Alternative

Alternative 1: No Further Action

CERCLA requires evaluation of a no-action alternative to reflect future conditions without any cleanup effort. This alternative is used for comparison to other alternatives and does not include any type of institutional controls. Some cost would be associated with maintaining operation of the existing pump-and-treat system.

Under this alternative, no additional actions would be taken at the site with respect to soil and groundwater. The existing pump-and-treat system would be operated and maintained, but is expected to fail at the end of its design life, which is estimated to be within 5 years. Although the existing system removes some NAPL, due to the difficult nature of this contaminant, sufficient NAPL would not be removed to address the threats to human health and the environment at and from the site.

The purpose of maintaining the existing system would be to slow the migration of NAPL from the site to Eagle Harbor. However, NAPL seeps continue to be observed on the shoreline, both in the intertidal and subtidal areas. Another significant concern with a No Further Action alternative is that the clean sediment caps in the Harbor would be recontaminated. Further, NAPL, groundwater, and soil contamination would continue to pose an ongoing unacceptable threat to human health and the environment. The estimated present worth cost (5 years O&M cost) of maintaining the existing pump-and-treat system until it fails is $2,036,404. A detailed summary of present worth analysis for this alternative is presented in Table 16.

	Capital PW	O&M PW	Total Present Worth
Alternative 1		$2,036,404	$2,036,404

Alternative 2a: Containment with a Slurry Wall

This alternative was described in an interim ROD that EPA issued in September 1994 (see Section 2.3). Design of the slurry wall was shifted from installation entirely onshore around the Former Process Area to portions being installed offshore in the Harbor (see Figure 9) in order to effectively contain a greater percentage of subsurface NAPL, and to avoid buried construction obstacles and equipment limitations. The off-shore component of the slurry wall would require an offshore berm and backfill to provide a working surface and structural support for the wall. The berm and backfill would result in a permanent loss of approximately 2 to 3 acres of intertidal and subtidal habitat.

Slurry walls have been demonstrated to be effective at preventing migration of contaminants. Marine water quality standards would be attained beyond the barrier wall.

A new pump-and-treat system would be required under this alternative to prevent precipitation from accumulating inside the wall and causing downward leakage of contaminated groundwater into the lower aquifer. However, the system would not be capable of removing large amounts of NAPL from soil or groundwater. Long-term monitoring would need to be conducted to evaluate the effectiveness of the slurry wall to contain the contaminants. At some time in the future, a second wall (either sheet pile or slurry wall) may need to be installed behind the first slurry wall.

The new pump-and-treat system would need to be operated and maintained (and occasionally replaced) in perpetuity, unless a cost-effective treatment technology is employed, to preserve the integrity of this containment remedy. Groundwater throughout the site would be monitored to determine whether further actions would be necessary.

Under Alternative 2a, the contaminated soil in the Former Log/Storage Peeler Area and the Former Process Area would be capped. The Former Log/Storage Peeler Area would be capped with a multi-layer system which may include a topsoil layer, select fill material, a geotextile layer, a drain layer, and a barrier layer. Because the entire ground surface of the Former Log Storage/Peeler Area would be covered, this area could achieve residential cleanup levels. Several capping systems are possible for the Former Process Area, including variations on a multi-layer cover system or some form of an asphalt-concrete cover system. This would allow for a mix of commercial or recreational uses. Contaminated soil from a small area on the hillside in the southern portion of the property, the Well CW01 area, would be excavated and placed beneath the cap in the Former Process Area. The excavated area would be backfilled with clean soil.

Because soil and groundwater contamination would remain at the site under this option, ongoing long-term monitoring would be needed and institutional controls would be implemented in both the Log Storage/Peeler Area and Former Process Area. The estimated present worth cost (capital plus 30 years of O&M) of this alternative is $42,571,446. Detailed summaries of capital cost present worth and present worth analysis for this alternative are presented in Tables 17 and 18, respectively.

	Capital PW	O&M PW	Total Present Worth
Alternative 2a	$32,657,962	$9,913,484	$42,571,446

Alternative 2b: Containment with a Sheet Pile Wall

This alternative is a modification of Alternative 2a. Instead of a slurry wall, a sheet pile wall, from the surface down to the aquitard, would be constructed under this alternative.

A sheet pile wall is created by driving interlocking sections of structural materials together into the earth to create a continuous, jointed wall. Sheet piles are usually formed from steel due to its strength and availability. Due to the potential for leakage through the joints, sheet piles were not historically used for environmental remediation. However, in recent years, manufacturers have made significant advances in pile interlock design, sealing materials, installation techniques, and interlock leakage monitoring. The purpose of installing a sheet pile wall at Wyckoff is similar to the slurry wall, i.e., to prevent migration of contaminants to Eagle Harbor. A sheet pile wall could last more than 30 years with proper corrosion protection.

There are advantages in using sheet pile walls as vertical barriers in environmental projects. This is especially true at the Wyckoff site where the sheet pile wall can be constructed without a berm and backfill reducing offshore impacts. However, because buried bulkheads and debris exist near the north and east shoreline, the sheet pile wall would need to be placed slightly offshore to the toe of the riprap along the eastern and northeast shoreline and just outside of the existing bulkhead to the north (Figures 10 and 11). This would result in a loss of approximately 0.6 to 0.9 acres (1850 linear feet) of intertidal habitat along the shoreline.

Figure 10 shows the sheet pile wall in a "partial" alignment. This alignment will be adequate for the Thermal Remediation Alternative (Alternative 3, below). However, for long-term containment purposes associated with this alternative (Alternative 2b), a fully enclosed wall would be required.

A new pump-and-treat system would be required under this alternative to prevent precipitation from accumulating inside the wall and causing downward leakage of contaminated groundwater into the lower aquifer. Like the existing system and the one proposed in Alternative 2a, this system would not be capable of removing large amounts of NAPL from soil or groundwater. Long-term monitoring would be conducted to evaluate the effectiveness of the sheet pile wall to contain the contaminants. At some time in the future, a second wall (either sheet pile or slurry wall) may need to be installed behind the first sheet pile wall.

Similarly, like Alternative 2a, the new pump-and-treat system would need to be operated and maintained (and occasionally replaced) in perpetuity to preserve the integrity of this containment remedy unless some future cost-effective treatment technology is undertaken. Groundwater throughout the site would be monitored to determine whether further actions would be necessary.

Again, as with Alternative 2a, the contaminated soil in the Former Log/Storage Peeler Area and the Former Process Area would be capped. Contaminated soil from a small area on the hillside in the southern portion of the property, the Well CW01 area, would be excavated and placed beneath the cap in the Former Process Area. The excavated areas would be backfilled with clean soil.

Because soil and groundwater contamination would remain at the site under this option, ongoing long-term monitoring would be needed and institutional controls would be implemented in both the Log Storage/Peeler Area and Former Process Area. The estimated present worth cost (capital plus 30 years O&M) of this alternative is $28,530,174. Detailed summaries of capital cost present worth and present worth analysis for this alternative are presented in Tables 19 and 20, respectively.

	Capital PW	O&M PW	Total Present Worth
Alternative 2b	$18,311,851	$10,218,323	$28,530,174

Alternative 3: In-situ Thermal Remediation (Steam Injection and, if necessary, Electrical Resistance Heating) - EPA's Selected Remedy

Steam injection and electrical resistance heating (also known as six-phase soil heating) are innovative thermal technologies that deliver heat underground in order to mobilize and enhance the recovery of contaminants. A heat source is delivered via injection wells and/or electrodes. Heating the contaminated zone enhances the cleanup of difficult-to-remediate contaminants by:

- Reducing the viscosity of the contaminants to enhance extraction
- Increasing the contaminant vapor pressures to enhance volatilization
- Increasing contaminant solubilities to enhance dissolution
- Increasing microbial degradation and natural oxidation rates

Wells are placed within and surrounding the contaminated zone to collect the contaminants that are easier to extract. The extracted water, gas, and NAPL are either treated on-site or disposed of off-site.

If necessary, electrical resistance heating will be implemented in areas harder to heat, such as low-permeability soils, and/or in sensitive areas, such as the aquitard surface. Electrical resistance heating utilizes the same heat and recovery mechanisms as steam injection, except that the heat source is generated in the ground via electrical currents and the technology relies on conductive heating. Contaminants will be extracted and treated, or disposed of, in the same manner as steam injection.

Not all NAPL is expected to become mobilized by the delivery of heat. Heated areas of the site are expected, however, to remain at high temperatures for several months or years. These high temperatures will continue to enhance the volatilization and dissolution rates of the residual, relatively immobile NAPL. Ongoing extraction of contaminants would continue for an additional 2 to 5 years after "steaming" is stopped.

Thermal effects will also contribute to enhanced rates of microbial degradation and oxidation (contaminant breakdown) through hydrous/pyrolysis/oxidation (HPO, or oxidation) of contaminant constituents, resulting in non-toxic compounds.

Thermal remediation is capable of remediating contaminants that occur in both the unsaturated and saturated zones. Therefore, under this alternative, contaminated soil (approximately 60,000 cubic yards) from the Former Log Storage/Peeler Area and the Well CW01 area will be excavated and placed within the Former Process Area to be remediated by steam injection and, if necessary, electrical resistance heating. The excavated areas will be backfilled with clean soil.

Active steam injection would likely be applied at the Wyckoff site for approximately 2-3 years and ongoing pumping and treating of contaminated groundwater and vapors would be continued for an additional 2-5 years, plus 2 years of monitoring, resulting in approximately 10 years of full-scale remediation.

Steam injection is currently being utilized at the Southern California Edison Pole Yard site in Visalia, California. After two years of operation, steam injection has removed/destroyed over 141,000 gallons of creosote from the subsurface. Of the 141,000 gallons, approximately 55 percent were recovered as a NAPL, and the rest were evenly split between recovery in the water phase, recovery in the vapor phase, and destroyed in-situ via biodegradation and/or hydrous/pyrolysis/oxidation (HPO) process. In comparison, approximately 1,200 gallons were removed in 20 years by conventional pump-and-treat. The use of steam injection has accelerated the removal of creosote contamination by over 1,000 times.

An important component of the thermal remedy at the Wyckoff site will be construction of a temporary (approximately 10-15 years) sheet-pile barrier wall partially around the treatment zone (see Figures 10 and 11 and the sheet pile wall discussion under Alternative 2b, above)[6]. Under this alternative, the sheet pile wall will serve as a temporary barrier wall to eliminate the possibility of migration of contaminants, including those mobilized by the heat, to Eagle Harbor during the remediation process. If a sufficient amount of contamination were removed, i.e., depending on the degree of success of this alternative, the sheet pile barrier could be removed. However, if it is determined that success has not been achieved at the conclusion of thermal remediation, then the sheet pile wall may be cut off at the mudline, but will remain in the ground.

Another important component of the remedy would be a vapor cover over the heated areas to significantly reduce emissions of steam and contaminants into the atmosphere. As Figure 12 shows, the vapor cover will include a series of slotted horizontal pipes designed to extract steam and contaminated vapors, as well as to help minimize potential for leakage of vapors to the atmosphere. Additional layers, including gravel and an asphalt cap, may provide additional safety measures. The vapor cover will be removed after cleanup is completed.

The thermal remediation process includes extraction and off-site disposal and incineration of NAPL, the principal threat at the site. Treatment will be necessary for the large amounts of contaminated groundwater and vapors that are expected to be removed by the extraction system. Treated water that complied with water quality standards will be discharged to Puget Sound. The treated vapors will comply with air emission limitations. The process units for the groundwater treatment system will be similar (but larger than) the existing pump-and-treat system at the site. The vapor treatment system will be similar to that used at soil vapor extraction systems (SVE), a commonly used technology for soil contaminated with petroleum and volatile organics.

Under this alternative, if thermal treatment is successful, the remedial action objectives described in Section 8 could be met within a period of 10-15 years. Because thermal technologies, along with limited pump-and-treat, biodegradation, and oxidation (contaminant breakdown) may be capable of near complete removal/destruction of contaminants in the soil and groundwater, it is possible that unrestricted use of the site could be achieved (with the exception of human consumption of drinking water from the upper aquifer beneath the Former Process Area). Some short-term monitoring after site cleanup will be necessary to ensure ongoing protection of human health and the environment.

As part of the implementation of this alternative, EPA will conduct a pilot study first to assess the effectiveness and feasibility of full-scale thermal remediation in achieving cleanup goals at Wyckoff. The pilot study will test the steam injection technology as a primary remediation method and electrical resistance heating as a supplemental technology to steam. If the pilot study

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[6] Although the sheet pile wall is estimated to last more than 30 years with corrosion protection, under this alternative, the sheet pile wall would only be in-place during the period of thermal remediation, which is estimated to be approximately 10-15 years.

is determined to be effective and feasible, the results will aid in the design of the full-scale thermal remediation process. The pilot study will utilize the existing pump-and-treat system and will be operated for approximately 1 to 2 years.

To the extent practicable, the pilot will utilize all the components of the full-scale design and operational strategy and may provide important project information such as:

- Community impacts (e.g., noise, air emissions, and odors)
- Potential adverse effects to Eagle Harbor
- Vapor cap performance
- Dioxin cleanup in soil
- Total NAPL removal, expected steam movement, and aquitard heating (i.e., can NAPL be recovered from the aquitard surface?)
- Treatment plant performance
- Microbial population and contaminant oxidation before, during and after thermal treatment
- Operational approaches (e.g., fuel and water supply options, injection and extraction strategy, and monitoring)

In addition to evaluating the items listed above, EPA will evaluate the results of the pilot study to assess the likelihood that full-scale remediation will achieve the cleanup goals for the site. Achieving the cleanup goals is the long-term benefit that would justify the additional capital costs required to implement full-scale thermal remediation at the site. Accordingly, EPA has developed performance expectations for the pilot study that correspond to the final cleanup goals. If the pilot study reasonably achieves the following performance expectations, EPA believes that full-scale remediation is likely to be successful:

(1) Mobile NAPL is not detected within the pilot study area.

Thermal remediation is expected to remove a significant amount of NAPL from the site, thus, permanently ensuring future protection of human health and the environment. A suitably constructed and operated pilot study can be expected to remove substantially all the mobile free-product NAPL from the treatment area.

(2) Dissolved concentrations of NAPL constituents in groundwater within the perimeter of the pilot study area are sufficiently reduced such that - using site specific modeling - EPA can reasonably predict that the post-treatment dissolved concentrations that move from the site to Eagle Harbor and Puget Sound would not exceed marine water quality/criteria, surface water quality, and sediment standards at the mudline. (See Section 8.4, Cleanup Levels, above)

In addition to removing large quantities of the NAPL itself, EPA believes that thermal effects will contribute to significantly enhanced rates of biodegradation and hydrous/pyrolysis/oxidation (HPO) of NAPL constituents dissolved in groundwater before they can move to sensitive receptors or environments, thus potentially eliminating the need for a long-term remediation at this site.

Utilizing results of the pilot study, EPA will develop a model to predict the extent to which, and the timeframe within which, dissolved concentrations of NAPL constituents can be expected to decrease between the site and the mudline. This decrease may be due to many factors, including biodegradation and oxidation processes. This model will incorporate both field results and laboratory measurements.

(3) Surface soil (from 0 to 15 feet below ground surface) concentrations within the pilot study area attain MTCA cleanup levels. (See Section 8.4, Cleanup Levels, above)

As part of the pilot study, EPA will measure the active removal and the rate of attenuation of contaminants in surface soil through bioremediation and other oxidative processes. It is hoped that thermal remediation will cleanup the unsaturated soil to MTCA soil cleanup levels. If MTCA soil cleanup levels are not likely to be attained, however, EPA may still implement full-scale remediation but will consider a combination of actions for the soil which may include a soil cap, institutional controls, or other measures integrated into the future site use to ensure long-term human health and environmental protection.

If the pilot study reasonably attains these performance expectations, then full-scale remediation would be constructed and operated. However, if the pilot test does not reasonably achieve these performance expectations, EPA may conclude that full-scale remediation is not likely to achieve the cleanup goals for the site. If this determination is made, Alternative 2b (containment with a new pump-and-treat system) remedy will be implemented.

The estimated present-worth cost of Alternative 3 (capital plus 10 years O&M) is $41,479,143. Detailed summaries of capital cost present worth and present worth analysis for this alternative are presented in Tables 21 and 22, respectively.

The estimated cost of Alternative 3 plus the potential contingency of placing a soil cap over the Former Process Area if full-scale thermal treatment does not remediate the surface soil to MTCA cleanup standards, ongoing pumping and treating[7] if thermal treatment does not achieve groundwater RAOs, and institutional controls, is $46,389,251. Detailed summaries of capital cost present worth and present worth analysis for this alternative with contingency are presented in Tables 23 and 24, respectively.

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[7] For cost estimating purposes, EPA is assuming that the continued pumping and treating would occur for an additional 20 years. It is hoped that pumping and treating would be discontinued beyond this period and the residual contamination would naturally attenuate over time. Under this scenario, the sheet pile wall may be cut off at the mudline, but would remain in the ground.

	Capital PW	O&M PW	Total Present Worth
Alternative 3	$22,741,958	$18,737,185	$41,479,143
Alt. 3 plus Contingency	$24,571,236	$21,818,015	$46,389,251

10. COMPARATIVE ANALYSIS OF ALTERNATIVES

The remedy for the Wyckoff Soil and Groundwater OUs was selected on the basis of the remedial alternative evaluation criteria found in the NCP. The nine criteria are divided into three categories: threshold, balancing, and modifying criteria. To be eligible for selection, an alternative must meet the two threshold criteria. The five balancing criteria weigh trade-offs among alternatives; a low rating on one balancing criterion can be compensated by a high rating on another. The State and Suquamish Tribe support the selected remedy.

10.1 Overall Protection of Human Health and the Environment

Overall protection of human health and the environment addresses whether each alternative provides adequate protection of human health and the environment and describes how risks posed through each exposure pathway are eliminated, reduced, or controlled, through treatment, engineering controls, and/or institutional controls.

Alternative 1 (No Further Action) would not protect human health and the environment because the existing pump-and-treat system is not capable of removing or containing the risks presented by the site and is expected to fail within the next five years. As a result, NAPL and its contaminant constituents would continue to migrate to Eagle Harbor. Because this alternative does not meet threshold criteria, it will not be discussed further in this evaluation.

Alternatives 2a and 2b (Containment) will protect human health and the environment by: (1) constructing an impermeable wall barrier around the site that prevents flow of contaminants to Eagle Harbor, and (2) capping of the soils to prevent contact. Operating and maintaining a pump-and-treat system in perpetuity (unless a cost-effective future treatment technology is employed) would be necessary to maintain the integrity of the remedy within the slurry or sheet pile wall. Ongoing long-term monitoring and institutional controls would be necessary to ensure adequate containment, prevent damage to the soil cap, and to prevent potential future exposure.

Alternative 3 (Thermal Remediation) will, if successful, provide the greatest protection to human health and the environment by actively treating soil and groundwater and by removing mobile NAPL (the principal threat) from the site. Thermal technologies can further enhance distillation and biodegradation/oxidation of NAPL and its contaminant constituents such that residual and dissolved concentrations may not adversely impact the marine environment.

10.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

Section 121(d) of CERCLA and NCP §300.430(f)(1)(ii)(B) require that remedial actions at CERCLA sites at least attain Applicable or Relevant and Appropriate Federal and State Requirements (ARARs), unless they are waived under CERCLA section 121(d)(4).

Alternatives 2a, 2b, and 3 will comply with all ARARs. The key ARARs are the Washington Model Toxics Control Act (MTCA) soil cleanup levels, federal and state marine water quality standards, surface water standards for human consumption of organisms, and state sediment management standards (applicable for calculation of groundwater cleanup standards). Alternatives 2a and 2b (Containment) would comply with these standards on top of the soil cap and beyond the barrier wall. Alternative 3 (Thermal Remediation) could attain these standards at the mudline where groundwater flows into the surface water through the combination of removal and treatment/disposal of contaminants and biodegradation/oxidation processes.

Another key ARAR for Alternative 3 will be compliance with air emission limitations. For example, the boilers necessary to produce steam will require controls to comply with limitations on nitrogen oxide (NO_x) emissions. Also the treatment system of extracted groundwater and vapors for Alternative 3 will need to comply with requirements under the Puget Sound Air Pollution Control Agency, the federal Resource Conservation and Recovery Act, the state Dangerous Waste Act, and substantive requirements of the State's National Pollution Discharge Elimination System (NPDES).

Alternative 3 includes active soil and groundwater treatment and could achieve state and federal standards more permanently than Alternatives 2a or 2b.

10.3 Long-Term Effectiveness and Permanence

Long-term effectiveness and permanence refers to expected residual risk and the ability of a remedy to maintain reliable protection of human health and the environment over time, once cleanup levels have been met. This criterion includes the consideration of residual risk that will remain onsite following remediation and the adequacy and reliability of controls.

The long-term effectiveness of remediation measures is important at the Wyckoff site because of the large volume of NAPL in soil and groundwater. NAPL is expected to act as a source of contamination to the marine environment for a very long time unless effective measures are implemented.

Alternatives 2a and 2b (Containment) will be effective so long as the slurry or sheet pile wall remains intact around the site and the cap is adequately maintained. Under both alternatives, it is likely that a second wall would need to be constructed in the future behind the first wall to maintain ongoing containment over the long-term. Also, because water would continue to flow onto the site, a pump-and-treat system would also need to be operated and maintained (and occasionally replaced) so contaminated water does not flow over the wall or leak into the lower aquifer.

The long-term effectiveness of Alternative 3 (Thermal Remediation) is promising for the Wyckoff site. In early 1999, EPA began a series of laboratory tests to evaluate the effectiveness of steam injection to recover NAPL from the Wyckoff soil and groundwater. Steam was injected into soil cores from the Wyckoff site, to simulate the expected field conditions. Results indicated that approximately 99 percent of total PAHs were removed by steam injection. Although the Wyckoff lab samples did not contain any pentachlorophenol (PCP), lab tests using contaminated soil from the Visalia project (see page 38, above) indicated that 100 percent of PCP was removed by steam injection. Based on this information and the results from the Visalia project, it is expected that a significant amount of NAPL will be removed from the Wyckoff soil and groundwater by thermal remediation. EPA will be able to better quantify the total amount of NAPL to be removed during the on-site pilot test.

Factors that are likely to affect actual removal success include the volume of NAPL actually at the site, the ability to extend thermal effects to all NAPL areas and the ability to recover NAPL from heated areas. These uncertainties would be better assessed through an on-site pilot study (see pilot study discussion in Section 9.2, Alternative 3).

It has been demonstrated at Visalia that in-situ oxidation and biodegradation is occurring and results from EPA and UC Berkeley laboratory studies on Wyckoff soils indicate that the same phenomenon will likely occur at Wyckoff during and after steam injection. This could greatly reduce the amount of residual contamination and greatly increase the long-term effectiveness and permanence of Alternative 3.

Placement of a vapor cover over the area of thermal remediation is necessary to enhance unsaturated soil cleanup, and to ensure that harmful vapor and contaminants, as well as odors, from leaking into the atmosphere (Figure 12). The level of cleanup that can be achieved in the unsaturated zone is uncertain. After completion of the remediation, samples will be taken in the unsaturated soil to determine the actual concentrations in the soil. If the thermal remediation does not achieve soil cleanup goals in any part of the site, a permanent soil cap and/or institutional controls would be required in the Former Process Area.

10.4 Reduction in Toxicity, Mobility, and Volume Through Treatment

Reduction in toxicity, mobility, or volume through treatment refers to the anticipated performance of the treatment technologies that may be included as part of the remedy.

Alternatives 2a and 2b (Containment) include a pump-and-treat system in order to maintain the water level within the slurry and sheet pile wall, respectively. Treatment is necessary because the extracted groundwater will be contaminated and require treatment before it can be discharged to Puget Sound. But since the pump-and-treat system is not expected to remove large quantities of

NAPL, the pump-and-treat system is not effective at reducing the principal threat posed by NAPL at the site.

Alternative 3 (Thermal Remediation) will involve aggressive treatment technologies that will effectively reduce the toxicity, mobility, and volume of soil and groundwater contaminated with the principal threat NAPL. NAPL will be transported off-site for incineration and disposal. Contaminated vapors and groundwater that are extracted will be treated prior to discharge to the atmosphere and Puget Sound, respectively.

10.5 Short-Term Effectiveness

Short-term effectiveness addresses the period of time needed to implement the remedy and any adverse impacts that may be posed to workers, the community and the environment during construction and operation of the remedy until cleanup levels are achieved.

The most significant impact associated with Alternative 2a (Containment with Slurry Wall) is that it requires placement of a permanent berm and backfill over 2 to 3 acres of intertidal habitat in order to construct the slurry wall. The estimated cost of mitigating these impacts is $1.2 million.

Alternative 2b (Containment with Sheet Pile Wall) would result in a minimal loss of intertidal habitat, approximately 0.6 to 0.9 acres (1850 linear feet) of shoreline. This would result in a more modest mitigation effort with an approximate cost of $250,000. More details regarding the short-term effectiveness of sheet pile walls are described under Alternative 3, below.

Alternative 3 (Thermal Remediation) should cause accelerated migration of heated NAPL. Heated NAPL has the potential to migrate farther through the subsurface and marine environment than ambient-temperature NAPL. In order to eliminate this impact, EPA will construct a sheet pile wall around the treatment zone (around the Former Process Area) and will design and operate the injection of steam and extraction of contaminants at the site accordingly. For example, EPA might apply the steam process slower in areas closest to Eagle Harbor to ensure that the potential fugitive NAPL or thermal effects do not adversely affect the marine environment. Groundwater, temperature, and intertidal habitat monitoring will be performed in critical shoreline areas.

Driving of the sheet piles at Wyckoff will generate moderate to high noise levels. During EPA's sheet pile driving test conducted in September 1999, noise levels above 80 decibels (dB) were recorded in surrounding communities. EPA will be assessing noise abatement measures during the design phase of this project (see Section 12.3, below).

For Alternative 3, a sheet pile wall is preferred over a slurry wall because sheet pile walls can be installed in various configurations and possibly moved and reconfigured as conditions change during the remediation process. A sheet pile wall will not require an extensive berm and backfill like the slurry wall in Alternative 2a. A sheet pile wall can be removed when cleanup is achieved. However, the sheet pile wall may be cut off at the mudline if long-term containment is necessary to allow for microbial degradation, oxidation, and other thermally-enhanced attenuation processes in the groundwater to occur over time.

Steam injection would result in some amount of heat transfer through the sheet pile wall. However, based on conservative modeling, temperatures should be greatly reduced outside the sheet pile wall. Thermal effects would be greatest in the areas directly adjacent to the wall and the effects of temperature would diminish with distance. It is unknown at this time if the potential thermal impacts adjacent to the wall would result in any loss of habitat or the loss of the use of habitat. EPA is currently coordinating with the Natural Resource Agencies and Suquamish Tribe and is studying the potential effects of heat and adverse environmental impacts associated with the sheet pile wall. Potential thermal impacts may also be studied during the pilot test. If necessary, appropriate compensatory mitigation measures would be implemented.

Another short-term concern is protection of the lower aquifer from NAPL contamination. The upper aquifer is separated from the lower aquifer by a low permeability layer (aquitard). Groundwater in the lower aquifer is potable and samples indicate that it has very low levels of contamination. Based on numerous field explorations during the RI and the Corps of Engineers exploratory drilling events in 1997 and 1999, it appears that the aquitard is continuous throughout the site. Its thickness ranges from 10 to 40 feet. The aquitard is generally very thick across the site with the thinnest area (10 feet) localized near the vicinity of Well EWC4 (Figure 5). The aquitard would help prevent NAPL from moving downward to the lower aquifer during thermal remediation (See also discussion in Section 6.3 of the Responsiveness Summary.)

Thermal remediation might also produce noise due to operation of the process units and odor from the removal and treatment of large amounts of contamination. EPA will take measures to reduce noise levels by installing noise abatement equipment such as silencers and will reduce odors by constructing a tight vapor cover on the site as well as by installing filter systems to reduce odor emissions.

10.6 Implementability

Implementability addresses the technical and administrative feasibility of a remedy from design through construction and operation. Factors such as availability of services and materials, administrative feasibility, and coordination with other governmental entities are considered.

Alternative 2a (Containment with Slurry Wall) is implementable. The key element in constructing the slurry wall is to ensure that it is sealed into the aquitard so that it would serve as an impermeable barrier to contaminants.

Based on experiences at other sites, by going slightly offshore to avoid construction obstacles, and data from a summer 1999 installation test, sheet pile walls can be implemented successfully at Wyckoff. The test was conducted at the worst portion of the site, along the northeastern shoreline where the depth to aquitard is deepest (75 feet bgs) and where large cobbles are known to exist. The sheet piles were successfully driven to and seated into the aquitard. Information gathered from this test indicated that a heavy, robust, hot-rolled steel sheet pile will be required for this site. Sheet piles were monitored during installation to determine if the interlocks were intact, and were extracted after the test program for inspection. Evidence of the extracted piles showed that they can properly be installed and will be effective at containing the contamination.

One important factor associated with Alternative 3 is the water supply needed for steam and also for cooling extracted groundwater prior to treatment. EPA is currently evaluating a range of water supply options including an on-site production well in a deep aquifer, local sewage treatment plant effluent, and seawater desalinization (See also discussion in Section 12.3 of this ROD and Section 7 of the Responsiveness Summary.)

10.7 Cost

The estimated capital and operation and maintenance costs for each alternative are provided in Tables 7-15. The estimated total costs represent the first 30 years of capital and system operation only. They are based on the information available at the time the alternatives were developed. Cost estimates are expected to be accurate within a range of +50 or -30 percent.

Alternative 3, if successful, will provide a cost-effective solution and could be a permanent solution to the contamination at the Wyckoff site. Thermal remediation will reduce the toxicity, mobility, and volume of contaminants at this site.

10.8 State/Tribal Acceptance

The Washington State Department of Ecology has been involved with the development of remedial alternatives for the Wyckoff Soil and Groundwater OUs and agrees with EPA's Selected Remedy.

The Suquamish Tribe also supports the Selected Remedy.

10.9 Community Acceptance

The community supports the Selected Remedy but has concerns regarding noise levels, air emissions, odors, and visual impacts during construction and operation. Comments and EPA's responses on the Proposed Plan for the site are included as Part 3, the Responsiveness Summary of this ROD.

11. PRINCIPAL THREAT WASTE

The NCP establishes an expectation that EPA will use treatment to address the principal threats posed by a site wherever practicable (NCP §300.430(a)(1)(iii)(A)). Principal threat wastes include wastes with high concentrations of toxic compounds or are highly mobile which generally cannot be contained in a reliable manner or would present a significant risk to human health and the environment should exposure occur.

The free product light and dense non-aqueous phase liquids (L and DNAPL) at Wyckoff are the principal threat in the soil and groundwater. The NAPL contamination contains very high levels of PAHs and PCPs, and is highly mobile. NAPL is currently moving out into Eagle Harbor and Puget Sound and potentially into the lower aquifers over time.

The containment alternatives (2a and 2b) will not treat the principal threat wastes in soil and groundwater, but will keep them in-place at the site until a future treatment technology is employed. The containment alternatives present a risk of failure or need for replacement over the very long-term.

Thermal technologies, however, will utilize treatment to actively recover, remove, and/or treat the principal threat wastes. If successful, this technology could provide a permanent solution to the NAPL problem in the soil and groundwater at Wyckoff.

12. SELECTED REMEDY

12.1 Selected Remedy for the Soil and Groundwater Operable Units

Alternative 3, Thermal Remediation, is the Selected Remedy. This alternative is selected because it will achieve substantial risk reduction by treating the principle threat at the site. This alternative could permanently reduces risks and is cost-effective .

The following are major components of Thermal Remediation:

- Construct a sheet pile wall around the highly contaminated area of the Former Process Area to prevent potential flow of contaminants to Eagle Harbor during remediation;

- Implement thermal remediation of contaminated soil and groundwater in two phases, with an on-site pilot test being the first phase. The pilot system will be designed and implemented with the ability to expand to the full-scale system if the test reasonably achieves project performance expectations (see Pilot Study discussion in Section 9.2, Alternative 3, above) and if the thermal technology provides enough long-term benefits to be worth the additional capital costs. If the pilot study is successful at meeting these expectations, then the second phase, the full-scale system, will be constructed and operated. The pilot study will test both steam injection and electrical resistance heating (as a supplemental technology to steam injection). The full-scale thermal remediation system will be designed and constructed according to the results of the pilot;

- The pilot system will utilize the existing treatment plant to treat contaminated groundwater. The same substantive National Pollutant Discharge Elimination System (NPDES) standards developed for the existing treatment plant, with some modifications, will apply. Those standards, along with the modifications, are presented in Table 25. Substantive NPDES standards will be developed for the full-scale thermal remediation system (if implemented) based on the results of the pilot study;

- The pilot test data will be used to refine the alternate concentration limits (ACLs) for the Wyckoff groundwater (see Section 8.3.2). The goals of the ACLs are to meet ARARs (State and Federal marine water quality standards/criteria, surface water standards for human consumption of organisms, and to protect the marine sediments) at the mudline;

- Recovered NAPL will be disposed of off-site;

- If the pilot test does not reasonably achieve performance expectations, then Alternative 2b, Containment with a Sheet Pile Wall Remedy, will be implemented;

- If the pilot study is successful, consolidate contaminated hot spots from the Former Log Storage/Peeler Area and the Well CW01 area (approximately 60,000 cubic yards) within the Former Process Area to be remediated by the full-scale thermal treatment. Backfill the excavated areas with clean soil;

- Construct a vapor cover above the treatment area (the Former Process Area) to enhance recovery of contaminated vapors, to minimize emissions to the atmosphere, and to reduce odors. Air emissions associated with the vapor cover and thermal process units will comply with appropriate regulations;

- Monitor biodegradation, oxidation, and other thermally-enhanced attenuation processes in soil and groundwater during and after active thermal treatment is completed to confirm whether further reductions in contaminant concentrations are being achieved;

- Monitor the upper groundwater aquifer outside of the Former Process Area and the lower aquifer to ensure that contaminant levels are not increasing. If necessary, institutional controls will be established to ensure that these groundwater aquifer areas remain unused until protective levels are reached through natural attenuation[8];

- If full-scale thermal treatment does not remediate the surface soil in the Former Process Area to MTCA cleanup standards, then implement a combination of actions which may include a

[8] EPA will monitor for decreasing trends of contaminant levels in these aquifer areas.

soil cap, institutional controls, or other measures integrated into the future site use to ensure long-term human health and environmental protection.

- If full-scale thermal treatment does not remove substantially all mobile non-aqueous phase liquid (NAPL) and if thermal treatment does not reduce the concentrations of polynuclear aromatic hydrocarbons (PAHs) and pentachlorophenol (PCPs) in groundwater such that the need for a long-term remediation is eliminated, then the sheet pile wall may be cut off at the mudline, but will remain in the ground, and pumping and treating will be continued for additional years. The purpose of this action will be to contain the contaminants within the sheet pile wall area.

- Establish institutional controls for the upper aquifer groundwater within the Former Process Area to reduce the potential for human exposure to contaminants that may remain after thermal treatment. As described in Section 6.4.1, this portion of the upper aquifer will not be used as a potable water supply. The institutional controls will be necessary to assure that the upper aquifer beneath the Former Process Area remains unused;

The current estimated time for cleanup is approximately 1 to 2 years for the pilot study; 2-3 years of full-scale steaming plus 2-5 additional years of ongoing contaminant extraction plus 2 final years of monitoring[9]. However, since biodegradation and oxidation would continue to occur beyond this active remediation schedule, it is anticipated that the restoration timeframe for the site would continue for an additional 5 or more years.

The time line for the thermal remediation project is as follows:

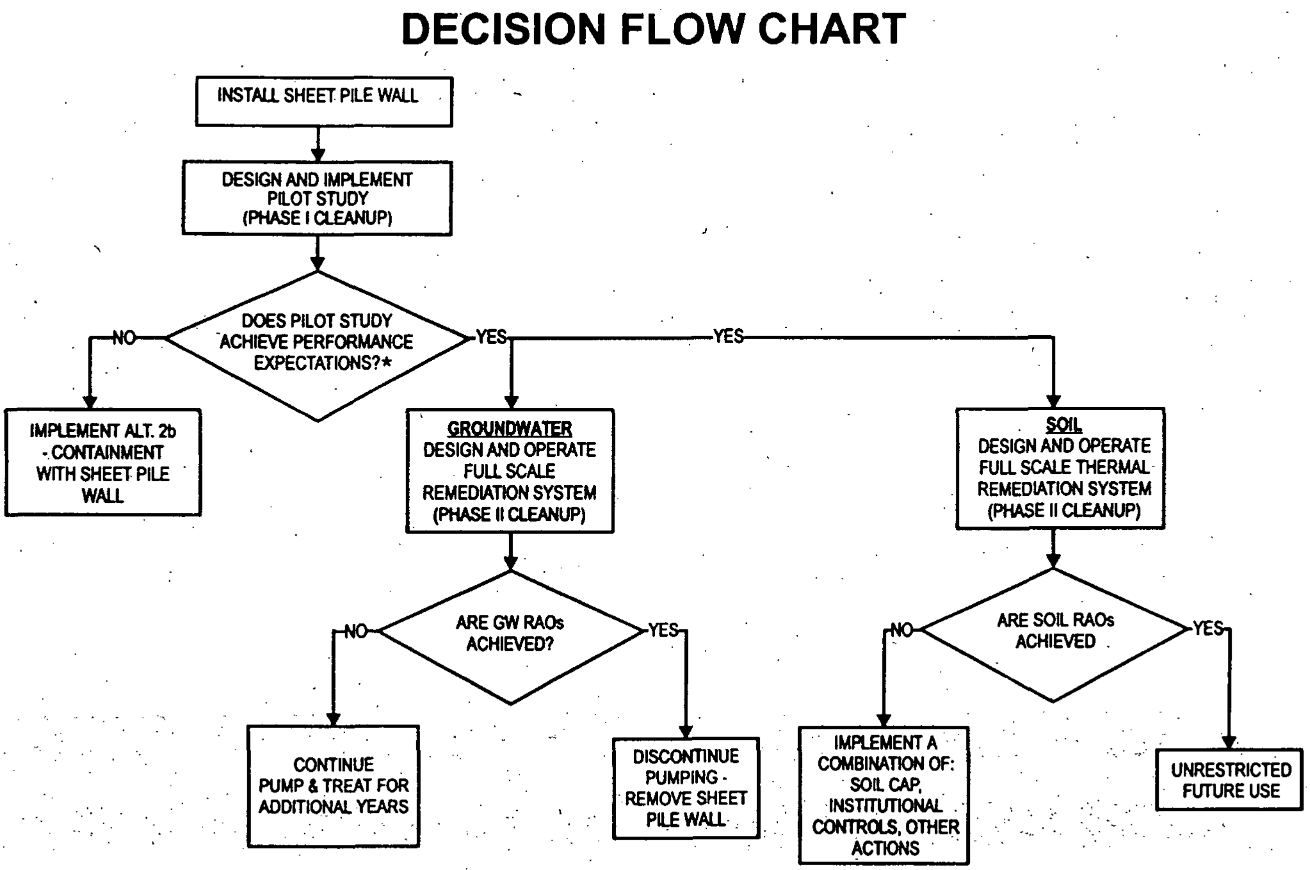
Phase	Time Frame	Years
Pilot Study[a]	1-2 years	2000 - 2002
Full-Scale Designs[b]	1 year	2002
Full-Scale System Construction	1 year	2003
Full-Scale System On-Line		2004
Steam Injection & Contaminant Recovery	3 years	2004 - 2007
Continued Contaminant Recovery	5 years	2007 - 2012
Full-Scale Cleanup Completed		2012
Post-Remedial Monitoring	2 years	2012 - 2014
Ongoing Natural Oxidation/Biodegradation	5 or more years	2014 and beyond

[a] Stake-holders and interested parties will have opportunities to provide input during the designs and operation of the pilot study, and will have access to the data generated during the pilot study.

[b] If results of the pilot are favorable after the 1st year of operation, then the designs for the full-scale remediation system can commence.

[9] The cleanup timeframe estimates are conservative, however, they do not include 1 year to design and construct the pilot system and 1½ years to design and construct the full-scale cleanup system. For cost estimating purposes, the larger time frame was used.

Below is a flow chart detailing the remedial steps and how EPA will be making cleanup decisions based upon the outcome of performance data.



*The decision of whether to proceed to full-scale thermal remediation or containment will be made by the Director of Region 10's Office of Environmental Cleanup.

12.2 Expected Outcomes of the Selected Remedy

If successful, thermal remediation could provide permanent protection to human health and the environment. This alternative could remove substantially all mobile NAPL, the principle threat, to achieve long-term protection of human health and the environment and compliance with ARARs. If successful, this alternative would be cost-effective.

The more aggressive cleanup of the property should permit greater subsequent land re-use flexibility. This may include, but not limited to, residential use for large portions of the Wyckoff property. The upper-aquifer groundwater within the Former Process Area may not have high reusability due to the saline levels, however, the other groundwater components (the Former Log Storage/Peeler Area groundwater and the lower aquifer) may have future re-use potential over time.

The containment alternatives, which require some kind of a barrier wall and permanent pump-and-treat system to prevent migration into Eagle Harbor, would not result in significant reductions in toxicity, mobility or volume of the principal threat at the site, would require an ongoing long-term remediation presence, and pose a higher risk of failure in the long-term.

12.3 Issues to be Addressed During the Design Phase of the Selected Remedy

Several elements of the remedy will be evaluated during design. These elements are:

Water Supply

EPA will evaluate the option of using water from the City of Bainbridge Island's sewage treatment plant effluent to generate steam. EPA currently anticipates that a maximum of 200 gallons per minute (gpm) of water would be needed during full-scale thermal remediation. Currently, only a handful of possible water sources have been identified for use at Wyckoff: (1) drilling a deep well at Wyckoff to supply clean groundwater, (2) City of Bainbridge Island sewage treatment plant effluent, (3) desalinated water from Puget Sound, and (4) demineralized and decontaminated groundwater from the contaminated aquifer at Wyckoff. There are potential drawbacks to each of these alternatives. A deep well may not have enough capacity to meet the anticipated 200 gpm need, and pumping this much water from the lower, potable aquifer could potentially have negative impacts to other water wells in the community. The city's treatment plant is on the opposite side of Eagle Harbor from the Wyckoff site. As a result, the water would need to be piped under or around the harbor. Ferry and other boat traffic may make installing an underwater pipeline impossible or cost-prohibitive. The total length, access, as well as right-of-way issues may make installing a pipeline around the harbor impossible or cost-prohibitive. Desalinating or demineralizing water from the sound or the brackish upper aquifer may be cost-prohibitive. EPA will further evaluate all of these alternatives during remedial design of the pilot study and after, as appropriate.

Sheet Pile Driving Noise Abatement

A preliminary review of noise abatement technology revealed that there are currently no standard methods or off-the-shelf equipment available for noise abatement of pile-driving activities. During remedial design, EPA will conduct a more thorough evaluation. EPA will explore the following avenues, which may have some effect in lowering noise levels in the site vicinity:

- Proper selection of sheet pile driving equipment
- Regular maintenance and repair of engine and vibrator enclosures, insulation, and mufflers
- Orientation and arrangement of equipment
- Management of work schedules
- Sound barriers such as work area enclosures or acoustic blankets
- Consulting with an industrial noise control expert

The sheet pile wall construction will take place during the winter months. EPA currently estimates that it will take up to four months to complete the sheet pile wall construction.

System Operation Noise and Air Emission Abatement

Noise related to a thermal remediation at Wyckoff is also of concern to EPA. There will be several sources of noise above current background levels at Wyckoff. These sources may include:

- Truck and barge traffic delivering construction and operations equipment and supplies
- Steam boiler noise
- Steam traveling through pipes
- Pumps moving extracted materials from the wells to the treatment plant

EPA will examine the noise issue during operation of the pilot study and during design of the full-scale remediation system. Both administrative and engineering controls will be evaluated to reduce noise levels at the site. Some controls may include:

- Limiting vehicle traffic to daylight hours and non-rush-hour times
- Delivering steam boiler fuel by barge
- Containing the steam boiler in a building
- Insulating steam pipes
- Enclosing pumps in buildings or vaults

Air emissions are another concern for EPA. While the purpose of any cleanup action at Wyckoff is to protect human health and the environment, the cleanup should not trade environmental damage in one media (e.g., sediments or groundwater) for another (e.g., air quality). As a result, EPA will further evaluate the air emissions issue operation of the pilot study and during design of the full-scale remediation system. Steam generation will be performed using the most appropriate fuel source and steam boilers available to meet project requirements as well as applicable air pollution regulations. Several methods that may prevent releases of vapors from creosote and other site contaminants will be evaluated during operation of the pilot study and during design of the full-scale remediation system. These methods include but are not limited to:

- Use of low-sulfur diesel fuel oil with efficiently running steam boilers.
- Installation of steam boiler off-gas treating equipment to further reduce nuisance odors.
- Use of an appropriate vapor cap with vapor collection pipes that would prevent heated vapors from escaping from the subsurface. The vapors would be collected in the pipes and routed to the treatment plant for remediation.
- Use of heat exchangers to cool contaminated liquids and vapors, reducing the amount of contamination that is likely to be released to the air .
- Use of covered process equipment and enclosed tanks so that contaminated liquids are not directly exposed to the ambient air.
- Control of contaminated vapors in the air to ensure levels are not harmful to people at or near the site.

Location of the Pilot Study

The location of the pilot study is important to gain both performance data on the use of thermal technologies at the Wyckoff site and to address specific engineering issues. An evaluation of site characteristics and discussions with thermal experts led to an examination of two potential pilot study locations.

The criteria for selecting these sites will focus on the following characteristics:

- The area should have ample quantities of both LNAPL and DNAPL.

- The area should be adjacent to the southern boundary of NAPL contamination to allow clean up-gradient groundwater to flow into the study location after heating. The flow of clean groundwater into the study area is important for the evaluation of post-heating oxidation and enhanced natural attenuation of contaminants.

- The area should be near the shoreline to allow EPA to monitor thermal effects in adjacent marine habitats.

The areas on the southwest and southeast corners of the former process area (Figure 13) fulfill these broad criteria. Each location presents both advantages and disadvantages as a final Pilot Study location that will need to be evaluated during design.

The southeast area (Area A), near the groundwater treatment plant contains soils highly saturated with both LNAPL and DNAPL. In addition, the geology of the area includes marine sands and gravel along with cobble zones, which will aid in the evaluation of engineering issues such as proper well screening intervals. This area is also adjacent to an intertidal zone, which will allow EPA to monitor the effects of thermal remediation on marine habitats. The major disadvantage of this location is that the southern extent of NAPL contamination near the treatment plant is not well defined and will need to be investigated before the specific location can be determined.

The southwestern corner of the site (Area B), near the asphalt pad, also meets the broad screening criteria. The advantage of this site is that the southern extent of NAPL contamination is fairly well determined. However, the geology of this area is dominated by non-marine clay fill material, which may make it difficult to evaluate the use of steam injection. Conversely, the presence of clayey fill is amenable to a more thorough evaluation of electrical heating. Disadvantages of the area include far less LNAPL than the area close to the treatment plant and no adjacent intertidal habitat in which to monitor thermal effects.

The thermal remediation experts on EPA's In-Situ Thermal Technologies Advisory Panel (ITTAP) tended to favor locating the Pilot Study in the area on the southeast corner (Area A) of the site with the recognition that the extent of NAPL under the treatment plant will be evaluated. However, it is possible that either potential pilot study locations may turn out not to be the optimal location. If this is the case, EPA will evaluate other options, including an area between the two locations, A and B.

Clean Water Act Section 404(b)(1) Analysis

EPA gave consideration to several technologies in the development of a suitable remedy. Prior to evaluating the selected remedy, EPA seriously considered the construction of a barrier wall (slurry wall) because it represented the most protective containment remedy at the time (Alternative 2a). Through the development of Alternative 2a, EPA reviewed design criteria and made all efforts to minimize impacts to the aquatic environment. However, because of site characteristics and construction constraints, Alternative 2a would require the loss of 2 to 3 acres of aquatic habitat.

When EPA re-evaluated the alternatives, it was determined that the selected remedy greatly minimized impacts to the aquatic environment. The current design of the sheet pile wall would impact approximately 0.6 to 0.9 acres of aquatic habitat around the immediate perimeter of the property. EPA will also evaluate the removal or partial removal of the protective sheet pile wall upon completion of thermal treatment. This will assist in restoring the perimeter shoreline to more natural conditions.

EPA and the Natural Resource Agencies (the Washington State Department of Ecology, Department of Natural Resources, Department of Fish and Wildlife, the National Marine Fisheries Service, the U.S. Fish and Wildlife Service) and the Suquamish Tribe have also developed a conceptual compensatory mitigation proposal to offset temporary and permanent losses. The proposal includes a re-shaping of a portion of the western shoreline to increase the area of intertidal slope and remove old failing bulkheads (see Sheet Pile Mitigation Requirements, below, for more information).

EPA's complete evaluation and findings regarding this project pursuant to Section 404 of the Clean Water Act will be completed post-ROD and will be placed in the site's Administrative Record.

Sheet Pile Mitigation Requirements

As stated above, the current estimate of impact from the sheet pile wall is between 0.6 and 0.9 acres of temporary and/or permanent loss of intertidal habitat. Pursuant to the Clean Water Act Section 404(b)(1), the purpose of mitigation is to offset adverse impacts to the aquatic environment from the sheet pile wall, including construction. The final impact of habitat loss from installation of the sheet pile wall will be fully evaluated during the design phase of the project. Remaining issues include assessing the total area impacted and a final determination of the type of permanent or temporary habitat loss to the marine environment. Once the extent of habitat impact is determined, a mitigation plan will be developed. The objective of this mitigation strategy will be to modify the western shoreline to increase and support habitat for baitfish spawning (surf smelt) and salmonids (juvenile chinook). This will include creating a gently sloping beach (no steeper than 1:6) with sand and pea gravel across potions of the western shore. The beach will be created through a combination of cutting back the existing shoreline and adding fill material to the existing intertidal/subtidal area to achieve the 1:6 slope. The grain sizes will be tiered so that finer grained material will be along the upper beach, coarser grained material in the mid-tidal ranges and finer grained materials in the subtidal.

EPA is also coordinating with the National Marine Fisheries Service (NMFS) to develop a Biological Assessment (BA) for the Wyckoff/Eagle Harbor site-wide remediation, as required by the Federal Endangered Species Act.

Thermal Remediation of Dioxins/Furans

A steam injection experiment was performed in a laboratory study to assess whether polychlorinated dioxins and furans can be recovered from the soil by steam injection. The results of this experiment show that significant reductions in the dioxin concentrations may not be possible by steam injection due to its low vapor pressures. Since vaporization is the main recovery mechanism in these laboratory experiments, significant recovery of these very low vapor pressure compounds would not be possible. However, optimal use of different recovery mechanisms in the field, such as mobilization/recovery in the liquid phase, may aid in removing more of the dioxins than were recovered in the lab.

EPA will further evaluate the remediation of dioxins and furans by thermal means during the on-site pilot study. Contingencies such as a surface soil cap or institutional controls will be developed to address this area of uncertainty.

13. STATUTORY DETERMINATIONS

Based on information currently available, EPA believes the Preferred Alternative provides the best balance of tradeoffs among the other alternatives with respect to the evaluation criteria. The preferred alternative best satisfies the following statutory requirements in CERCLA Section 121(b): (1) be protective of human health and the environment; (2) comply with ARARs; (3) be cost-effective; (4) utilize permanent solutions; and (5) satisfy the preference for treatment as a principal element.

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

13.1 Protection of Human Health and the Environment

The Selected Remedy, Alternative 3, will protect human health and the environment through the treatment of NAPL-contaminated soil and groundwater by in-situ thermal treatment, with a contingency of containment if RAOs are not met following remediation. The Selected Remedy actively treats the soil and groundwater by removing mobile NAPL (the principal threat) from the site. This remedy will reduce the threat of exposure to the most mobile chemicals of concern via direct contact or ingestion of soil, and exposure to groundwater and NAPL by marine organisms.

Once thermal treatment is completed, the vapor cap will be removed, and the sheet pile wall either removed, remain as is, or cut off at the mudline.

Because the principal threat will be removed, treated, and incinerated, the risks posed by the soil and groundwater at the Wyckoff site will be reduced. The combination of treatment, oxidation, and biodegradation may achieve ARAR levels within a reasonable timeframe.

If thermal treatment cannot achieve the cleanup levels for soil and groundwater, then the contingency of soil cap and containment with a sheet pile wall will be protective of human health and the environment because the exposure pathways will be removed.

Implementation of this remedy may create neighborhood disturbances such as noise levels, odors, increased traffic, and heat effects to Eagle Harbor, however, measures will be taken to minimize any short term impacts.

13.2 Compliance with Applicable or Relevant and Appropriate Requirements (ARARs)

The Selected Remedy will comply with all Federal and State applicable or relevant and appropriate requirements. EPA will develop alternate concentration limits (ACLs) for the Wyckoff groundwater (see Section 8.3.2). The goals of the ACLs are to meet State and Federal marine water quality standards/criteria, surface water standards for human consumption of organisms, and to protect marine sediments. The point of compliance for ACLs is at the mudline.

The ARARs are as follows:

State of Washington Model Toxics Control Act

(WAC 173-340-360(4)	This section is applicable for identifying the order of preference of cleanup technologies, including treatment as the highest preference.
(WAC 173-340-360(5)(d)	This section is applicable for identifying the state's preference for permanent solutions to the maximum extent practicable.
(WAC 173-340-360(6)	This section is applicable for selecting a cleanup that provides for a reasonable restoration time frame and identifying factors to be considered when establishing that time frame.
(WAC 173-340-440)	This section is applicable for requiring institutional controls where active cleanup measures (e.g., treatment) will not attain MTCA cleanup levels or where a cap is used to contain contaminants above MTCA cleanup levels.
(WAC 173-340-720)	This section is applicable for setting groundwater cleanup standards including points of compliance.
(WAC 173-340-730)	This section is applicable for setting surface water cleanup standards including points of compliance.
(WAC 173-340-740)	This section is applicable for setting soil cleanup standards including points of compliance.

State of Washington Dangerous Waste Regulations (WAC 173-303)

This is applicable to the treatment, storage or disposal of solid wastes which are dangerous or extremely hazardous to the public health and the environment. Sludges, NAPL, tank bottom sediments, and spent carbon will be disposed off-site.

Resource Conservation and Recovery Act (40 CFR 261, 264, and 268)

(40 CFR 261)	This applies to the identification of hazardous wastes. The NAPL and the treatment plant waste streams (sludges, tank bottom sediments, and spent carbon) are listed hazardous wastes.
(40 CFR 264 Subpart X)	Treatment of Hazardous Waste - This is applicable to treatment process units which must be located, designed, constructed, operated, and closed in a manner that will ensure protection of human health and the environment. These requirements are not applicable to the on-site treatment plant, which is excluded under the wastewater treatment unit exclusion (40 CFR 264.1(g)(6)).
(40 CFR 264 Subpart BB)	Air Emission Standards for Equipment Leaks - This is applicable to equipment to prevent organic emissions from leaking to the atmosphere.
(40 CFR 264.1080 and 265.1080 Subpart CC)	Air Emission Standards for Tanks, Surface Impoundments and Containers - This is relevant and appropriate to tanks, containers, surface impoundments, etc., that manage volatile hazardous waste.
(40 CFR 268)	Land Disposal Restrictions - This is applicable to the land disposal of listed or characteristic hazardous waste materials disposed off-site.

Off-site Disposal Rule (40 CFR § 300.440)

Wastes being treated or disposed off-site may only go to facilities that are in compliance with EPA's Off-site Rule.

Federal Water Pollution Control Act/Clean Water Act (33 USC 1251-1376; 40 CFR 100-149)

Acute marine criteria are applicable requirements for discharge to marine surface water via the groundwater treatment plant outfall. They are also relevant and appropriate for the discharge of groundwater to surface water at the mudline.

Federal Clean Water Act Dredge and Fill Requirements; Sections 401 and 404 (33 USC 401 et seq.; 33 USC 1413; 40 CFR 230, 231; 33 CFR 320-330)

These regulations are applicable to the discharge of dredged or fill material to waters of the U.S. The 404(b)(1) evaluation will be completed for the construction of the sheet pile wall and will comply with the requirements.

Rivers and Harbors Appropriations Act (33 USC 403; 33 CFR 322)

Section 10 of this act establishes permit requirements for activities that may obstruct or alter a navigable waterway; activities that could impede navigation and commerce are prohibited. These substantive permit requirements are anticipated to be applicable to remedial actions, such as construction of the sheet pile wall and shoreline reconstruction.

National Pollutant Discharge Elimination System (WAC 173-220)

The Washington State NPDES program provides conditions for authorizing direct discharges to surface waters and specifies point source standards for such discharges. The substantive NPDES standards are applicable to discharges to surface waters by the groundwater treatment plant. Substantive discharge standards have been developed for the existing treatment plant and, with some modifications, will also be applicable to the thermal pilot study treatment system. The modified NPDES standards are described in Table 25.

State of Washington Water Quality Standards for Surface Waters (WAC 173-201A)

Standards for the protection of surface water quality have been established in Washington state. The standards for marine waters will be applicable to discharges to surface water from the groundwater treatment plant and relevant and appropriate to the groundwater discharge to surface water.

State of Washington Sediment Management Standards (WAC 173-204)

Chemical concentration and biological effects criteria are established for Puget Sound sediments and are applicable such that discharges from the groundwater at Wyckoff should not cause exceedances of PAH and PCP standards in sediments (see Tables 13 and 15).

Safe Drinking Water Act/National Primary Drinking Water Regulations (40 CFR 141)

The federal primary drinking water standards, adopted by the State of Washington, set maximum contaminant levels (MCLs), which are the maximum permissible levels of contaminants in drinking water based on the prevention of adverse health effects. Large portions of the upper aquifer at Wyckoff is nonpotable due to high salinity levels, however, MCLs are relevant and appropriate to the lower aquifer, a potential future source of drinking water.

Clean Air Act

Prevention of Significant Deterioration (PSD) of Air Quality (40 CFR Part 52.21) provisions for prevention of significant deterioration of air quality in any portion of any State where the existing air quality is better than the national ambient air quality standards (NAAQS). This regulation is applicable if the potential to emit exceeds 250 tons per year or more of any air pollutant subject to regulation under the Act. If it is determined during remedial design that emissions will exceed the threshold levels for each pollutant, different fuel types will be evaluated.

The Standards of Performance for New Stationary Sources (40 CFR Part 60) provisions for Small Industrial-Commercial-Institutional Steam Generating Units (Subpart Dc) are applicable. This regulation provides limitations for particulate matter and sulfur dioxide emissions. An evaluation will be conducted during remedial design to determine if emissions will exceed the threshold levels for each pollutant.

The National Emission Standards for Hazardous Air Pollutants (NESHAP) (40 CFR Part 63) regulated specific categories of stationary sources that emit (or have the potential to emit) one or more hazardous air pollutants list in this part pursuant to section 112(b) of the Act. This regulation is applicable, however, an evaluation will be conducted during remedial design to determine if emissions will exceed the threshold levels for each pollutant.

Regulations I and III of the Puget Sound Air Pollution Control Agency (WAC 173-400 and 460)

Regulation I establishes technically feasible and reasonably attainable standards that are generally applicable to the control and/or prevention of the emission of air contaminants. Specific provisions will apply to the steam boiler and treatment system.

Regulation III is applicable to the steam boiler and treatment system if they emit a Class A or Class B toxic air pollutant into the ambient air (WAC 173-460-030(2)(b)). The regulation establishes acceptable source impact levels (ASILs) for toxic air pollutants emitted from new or modified sources to prevent air pollution, reduce emissions to the extent reasonably possible, and maintain such levels of air quality to protect human health and the environment.

Oil Pollution Control Act of 1990 (OPA)

(33 CFR Part 154)	Facilities Transferring Oil or Hazardous Materials in Bulk - This is applicable to Wyckoff, which is anticipated to be receiving bulk shipment of fuel from a vessel with a capacity of 250 barrels (10,500 gallons) or greater.
(WAC 173-180A, B, C, D)	Establishes minimum performance standards for oil transfer, storage and monitoring activities; Requires the preparation and implementation of a Facility Oil-Handling Operations Manual for onshore and offshore facilities (i.e., loading dock and pipeline); Requires the development, approval, and implementation of personnel oil-handling training and certification programs for onshore and offshore facilities; Requires development of an Oil Spill Prevention Plan. The substantive requirements are applicable to the delivery of fuel from barges to the site.

Federal Endangered Species Act of 1973 (16 USC 1531 et seq.; 50 CFR 200, 402)

This regulation is applicable to any remedial action performed at this site since this area is potential habitat for threatened and/or endangered species. The special species of concern for the Wyckoff site and surrounding marine habitats include Puget Sound Chinook, bull trout, Stellar sea lion, bald eagle, and marbled murrelet.

U.S. Fish and Wildlife Coordination Act (16 USC 661 et seq.)

Eagle Harbor provide potential habitat for the species identified above and used as a salmonid migratory route. This act prohibits water pollution with any substance deleterious to fish, plant life, or bird life, and requires consultation with the U.S. Fish and Wildlife Service and appropriate state agencies. Criteria are established regarding site selection, navigational impacts, and habitat remediation. These requirements are applicable for remedial activities on the site.

Construction in State Waters, Hydraulic Code Rules (RCW 75.20; WAC 220-110)

Hydraulic project approval and associated requirements for construction projects in state waters have been established for the protection of fish and shellfish. Substantive permit requirements are applicable to the construction of the sheet pile wall. The technical provisions and timing restrictions of the Hydraulic Code Rules are also applicable to construction of the sheet pile wall and shoreline modifications associated with habitat mitigation activities.

Shoreline Management Act (RCW 90.58, WAC 173-14); Coastal Zone Management Act (16 USC 1451 et seq., 15 CFR 923); Kitsap County Shoreline Management Program (WAC 173-19-2604); City of Bainbridge Shoreline Management Regulations

These statutes and regulations are applicable for construction of the sheet pile wall, which will be along the shoreline area of Wyckoff, and shoreline modifications associated with habitat mitigation activities.

Minimum Standards for Construction and Maintenance of Water Wells (WAC 173-160)

Well construction regulations establish minimum standards for water well construction. This regulation will be applicable to monitoring well construction, steam injection well construction/action, and if EPA decides to install a water well for steam generation. This regulation is also applicable to the decommissioning of wells.

Underground Injection Control Program (WAC 173-218)

This regulation is applicable to the steam injection wells necessary for thermal remediation.

Minimum Functional Standards for Solid Waste Handling (WAC 173-304)

As part of the selected remedy, if thermal remediation does not fully remediate the surface soil in the Former Process Area to MTCA cleanup levels, then a contingency will be employed which may include a soil cap. This regulation would then be relevant and appropriate.

General Regulations for Air Contaminant Sources (WAC 173-400)

This regulation requires Best Management Practices to be employed including covering stock piles, cleaning of trucks prior to leaving the site, and monitoring air emissions. This will be applicable during remedial action at Wyckoff.

TBCs (To Be Considered)

TBC items are state and local ordinances, advisories, guidance documents or other requirements that, although not ARARs, may be used in determining the appropriate extent and manner of cleanup. Generally, TBC requirements are used when no federal or state requirements exist for a particular situation.

A TBC for the Wyckoff Soil and Groundwater remediation is the City of Bainbridge Island's Title 16 Environment, Chapter 16.16 Noise Regulations. EPA intends to notify and coordinate with the Office of Planning and Community Development regarding the construction of the sheet pile wall and the thermal system operation.

13.3 Cost-Effectiveness

The Selected Remedy is cost effective. In making this determination, the following definition was used: "A remedy shall be cost-effective if its costs are proportional to its overall effectiveness." (NCP §300.430(f)(1)(ii)(D)). This was accomplished by evaluating the "overall effectiveness" of those alternatives that satisfied the threshold criteria (i.e., were both protective of human health and the environment and ARAR-compliant). Overall effectiveness was evaluated by assessing three of the five balancing criteria in combination (long-term effectiveness and permanence; reduction in toxicity, mobility, and volume through treatment; and short-term effectiveness). Overall effectiveness was then compared to costs to determine cost-effectiveness.

The pilot study (Phase I) creates an opportunity to proceed with Phase II (full-scale cleanup) only if reasonable cost-benefit can reasonably be predicted.

The estimated present worth cost for the Selected Remedy is $41,479,143. Although Alternative 2b, Containment with a Sheet Pile Wall, is estimated to be approximately $13 million dollars less expensive, treatment and removal of the principal threat contaminants are not addressed, and the containment cost estimates only represent a time frame of 30 years. As discussed above, containment has long-term operation and maintenance costs as well as future capital system replacement costs. The Selected Remedy may eliminate these costs.

EPA believes that the Selected Remedy's additional costs for treatment and removal of contaminants may provide a significant increase in long-term protection of human health and the environment and is protective.

13.4 Utilization of Permanent Solutions and Alternative Treatment (or Resource Recovery) Technologies to the Maximum Extent Practicable

EPA has determined that the Selected Remedy, an innovative treatment technology, represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at the site. The Selected Remedy treats the upland source materials constituting principal threats at the site, achieving significant reduction in NAPL volume in soil and groundwater. All NAPL recovered will be incinerated and the contaminated groundwater and vapors treated on-site. Approximately 1,000,000 gallons of NAPL still remain in the subsurface at this site. To date, approximately 88,700 gallons have been removed by pump-and-treat mechanisms and incinerated.

As discussed above, EPA will implement the Selected Remedy in two phases, with an on-site pilot study as the first phase. If the pilot study is successful at meeting performance expectations, then the full-scale cleanup will be employed. However, if the pilot is not successful, then the contingent remedy, Alternative 2b, will be implemented. The contingent remedy will then represent the maximum extent to which permanent solutions and treatment technologies can be utilized in a practicable manner at this site.

13.5 Preference for Treatment as a Principal Element

By utilizing treatment as a significant portion of the remedy, the statutory preference for remedies that employ treatment as a principal element is satisfied.

13.6 Five-Year Review Requirements

Because this remedy may result in hazardous substances, pollutants, or contaminants remaining at the site, a statutory review will be conducted within five years after initiation of remedial action to ensure that the remedy is, or will be, protective of human health and the environment.

13.7 Documentation of Significant Changes from Preferred Alternative of Proposed Plan

The Proposed Plan for the Wyckoff site was released for public comment in October 1999. The Proposed Plan identified Alternative 3, Thermal Remediation, as the Preferred Alternative for soil and groundwater remediation. EPA reviewed all written and verbal comments submitted during the comment period. It was determined that no significant changes to the remedy, as originally identified in the Proposed Plan, were necessary or appropriate.

TABLES

Table 1

Summary of Chemicals Detected in the Near-Surface (0-4 feet bgs) Former Process Area and Log Storage/Peeler Area Soil

Chemical Name	Number of Detections	Number of Samples	Minimum Detected Concentration (μg/kg)	Maximum Detected Concentration (μg/kg)	Average Detected Concentration (μg/kg)
PAHs:					
benzo(a)anthracene	34	238	720	220,000	25,239
benzo(a)pyrene	68	238	640	370,000	18,642
benzo(b&k)fluoranthene	64	188	1,150	550,000	26,320
benzo(b)fluoranthene	6	50	550	8,690	3,537
benzo(k)fluoranthene	4	50	510	3,100	1,728
chrysene	66	238	470	400,000	28,637
dibenz(a,h)anthracene	19	238	600	28,000	4,234
indeno(1,2,3-cd)pyrene	42	238	600	100,000	7,089
Phenols:					
pentachlorophenol	49	238	16.6	35,000	3,700
Dioxins/Furans:					
dioxin (2,3,7,8-TCDD)/tef	19	20	0.000295	1.1244	0.22

Table 2

Summary of Chemicals Detected in the Subsurface (5-7 feet bgs)
Former Process Area and Log Storage/Peeler Area Soil

Chemical Name	Number of Detections	Number of Samples	Minimum Detected Concentration (μg/kg)	Maximum Detected Concentration (μg/kg)	Average Detected Concentration (μg/kg)
PAHs:					
benzo(a)anthracene	38	228	410	310,000	30,676
benzo(a)pyrene	43	228	430	73,000	13,521
benzo(b&k)fluoranthene	31	182	340	140,000	28,911
benzo(b)fluoranthene	3	46	445	27,000	9,415
benzo(k)fluoranthene	1	46	9,600	9,600	9,600
chrysene	47	228	555	290,000	20,536
dibenz(a,h)anthracene	19	228	600	4,950	1,954
indeno(1,2,3-cd)pyrene	34	228	595	15,000	4,797
Phenols:					
pentachlorophenol	16	224	110	440,000	39,820
BNAs:					
carbazole	12	27	6.5	167,000	26,286
Dioxins/Furans:					
dioxin (2,3,7,8-TCDD)/tef	11	14	0.00002	3.226	0.47

Table 3

Summary of Chemicals Detected in the Near-Surface (0-4 feet bgs) Soil in the Vicinity of Well CW01 Area

Chemical Name	Number of Detections	Number of Samples	Minimum Detected Concentration (μg/kg)	Maximum Detected Concentration (μg/kg)	Average Detected Concentration (μg/kg)
Fill Materials					
benzo(a)anthracene	3	4	136.5	282	204.5
benzo(a)pyrene	4	4	93.8	290	208.575
benzo(b)fluoranthene	4	4	205	695	464.25
benzo(k)fluoranthene	4	4	77.8	216	162.45
chrysene	4	4	120	511	301.625
indeno(1,2,3-cd)pyrene	4	4	93.3	327	213.95
dioxin (2,3,7,8-TCDD)/tef	1	1	0.107663	0.107663	0.107663
Native Soil					
benzo(a)anthracene	1	4	330	330	330
benzo(a)pyrene	4	4	13.9	330	100.75
benzo(b)fluoranthene	4	4	43.6	850	264.9
benzo(k)fluoranthene	4	4	15.2	288	87.125
chrysene	3	4	24	621	246.9
indeno(1,2,3-cd)pyrene	4	4	11.9	345	100.3

Table 4

Summary of Dissolved-Phase Chemicals Detected in Upper-Aquifer Groundwater

Chemical Name	Number of Detections	Number of Samples	Minimum Detected Concentration (µg/L)	Maximum Detected Concentration (µg/L)	Average Detected Concentration (µg/L)
PAHs:					
acenaphthene	30	40	0.022	21,500	2,162.983
anthracene	32	40	0.083	5,350	607.950
benzo(a)anthracene	17	38	3	1,700	364.029
benzo(a)pyrene	19	37	0.058	240	72.066
benzo(b)fluoranthene	20	38	0.091	1,300	194.305
benzo(k)fluoranthene	17	37	0.033	520	78.044
chrysene	24	38	0.058	1,400	211.235
dibenz(a,h)anthracene	2	36	9.8	17.1	13.450
fluoranthene	32	40	0.046	17,000	1,402.447
fluorene	30	40	0.092	17,500	2,035.840
indeno(1,2,3-cd)pyrene	4	36	7	42.75	23.538
naphthalene	32	40	3.2	130,000	15,196.341
pyrene	32	40	0.037	5,000	609.450
Phenols:					
pentachlorophenol	14	38	12.4	16,000	2,096.993
trichlorophenol, 2,4,6-	2	36	22	37	29.500
Volatile Organics:					
benzene	11	40	3	57	15.164
carbon tetrachloride	1	40	2.3	2.3	2.300
dichloroethane, 1,2-	1	40	4	4	4.000
ethylbenzene	30	40	0.21	784.5	170.636
styrene	1	40	333	333	333.000
BNAs:					
bis(2-ethylhexyl)phthalate	10	38	1	12,000	1,249.630

carbazole	29	40	0.043	3,850	419.411
dimethylphenol, 2,4-	11	37	0.46	360	105.605
methylphenol, 4-	12	39	2	240	32.844

Table 5

Summary of Chemicals Detected in Lower-Aquifer Groundwater

Chemical Name	Number of Detections	Number of Samples	Minimum Detected Concentration (μg/L)	Maximum Detected Concentration (μg/L)	Average Detected Concentration (μg/L)
PAHs:					
benzo(a)anthracene	2	13	0.85	1.8	1.325
benzo(a)pyrene	6	13	0.15	0.38	0.272
benzo(b)fluoranthene	6	13	0.32	0.73	0.490
benzo(k)fluoranthene	6	13	0.11	0.33	0.200
chrysene	6	13	0.38	2	0.882
fluoranthene	5	13	0.34	29.7	13.188
naphthalene	8	13	0.25	1,403.95	328.439
Phenols:					
pentachlorophenol	4	13	1.5	18.5	8.125
Volatile Organics:					
carbon tetrachloride	2	13	1	1.3	1.150
BNAs:					
bis(2-ethylhexyl)phthalate	4	13	2.9	32	10.975
carbazole	5	13	0.057	37.4	12.106

Table 6

Summary of Chemicals Detected in LNAPL

Chemical Name	Number of Detections	Number of. Samples	Minimum Detected Concentration (μg/L)	Maximum Detected Concentration (μg/L)	Average Detected Concentration (μg/L)
PAHs:					
acenaphthene	5	5	9,000,000	36,000,000	24,400,000
acenaphthylene	4	5	190,000	540,000	365,000
anthracene	4	5	3,500,000	4,700,000	4,225,000
benzo(a)anthracene	5	5	1,200,000	5,800,000	2,420,000
benzo(a)pyrene	5	5	360,000	1,700,000	716,000
benzo(b)fluoranthene	5	5	600,000	3,200,000	1,316,000
benzo(g,h,i)perylene	3	5	140,000	450,000	246,667
chrysene	5	5	1,100,000	4,400,000	2,000,000
fluoranthene	5	5	6,200,000	23,000,000	13,160,000
fluorene	5	5	6,100,000	20,000,000	11,920,000
indeno(1,2,3-cd)pyrene	3	5	150,000	550,000	286,667
naphthalene	5	5	22,000,000	220,000,000	134,400,000
phenanthrene	5	5	14,000,000	64,000,000	35,200,000
pyrene	5	5	3,900,000	19,000,000	8,100,000
Phenols:					
pentachlorophenol	3	5	920,000	1,100,000	1,040,000
Volatile Organics:					
acetone	2	5	390,000	2,900,000	1,645,000
ethylbenzene	3	5	650,000	1,600,000	1,083,333
methylene chloride	5	5	99,000	20,000,000	4,553,800
toluene	3	5	310,000	1,000,000	666,667
xylene, mixture	3	5	1,000,000	6,000,000	3,066,667
BNAs:					
bis(2-ethylhexyl)phthalate	1	5	170,000	170,000	170,000

carbazole	4	4	820,000	4,364,000	2,371,000
dibenzofuran	5	5	6,000,000	25,000,000	14,400,000
methylnaphthalene, 2-	5	5	8,200,000	89,000,000	56,040,000
Dioxins/Furans:					
heptachlorinated dibenzo-p-dioxins, (total)	1	1	10	10	10
octachlorodibenzo-p-dioxin	1	1	26	26	26

Table 7

Summary of Chemicals Detected in DNAPL

Chemical Name	Number of Detections	Number of Samples	Minimum Detected Concentration (μg/L)	Maximum Detected Concentration (μg/L)	Average Detected Concentration (μg/L)
PAHs:					
acenaphthene	7	7	130,000	56,000,000	18,861,429
acenaphthylene	6	7	20,000	760,000	336,667
anthracene	5	7	700,000	4,600,000	2,740,000
benzo(a)anthracene	6	7	71,000	4,800,000	2,333,500
benzo(a)pyrene	6	7	20,000	1,300,000	650,000
benzo(b)fluoranthene	6	7	33,000	2,500,000	1,277,167
benzo(g,h,i)perylene	2	7	6,000	340,000	173,000
chrysene	6	7	62,000	3,600,000	1,875,333
fluoranthene	6	7	1,200,000	40,000,000	16,350,000
fluorene	7	7	150,000	50,000,000	13,721,429
indeno(1,2,3-cd)pyrene	1	7	6,000	6,000	6,000
naphthalene	7	7	480,000	210,000,000	74,368,571
phenanthrene	7	7	890,000	110,000,000	34,484,286
pyrene	7	7	230,000	15,000,000	7,072,857
Phenols:					
pentachlorophenol	1	7	750,000	750,000	750,000
Volatile Organics:					
chloroethylvinylether, 2-	1	4	400,000	400,000	400,000
ethylbenzene	2	4	420,000	810,000	615,000
methylene chloride	3	4	49,000	220,000	159,667
toluene	3	4	82,000	300,000	197,333
BNAs:					
bis(2-ethylhexyl)phthalate	1	7	200,000	200,000	200,000
carbazole	6	6	66,000	9,200,000	2,811,167

dibenzofuran	7	7	82,000	43,000,000	13,683,143
dimethylphenol, 3,5-	1	1	590,000	590,000	590,000
methylnaphthalene, 2-	7	7	2,400,000	84,000,000	28,400,000
naphthalene, 1-methyl-	6	6	650,000	100,000,000	45,008,333

Table 8

Reasonable Maximum Exposure Concentrations and Estimated Risk Values for Major Risk Drivers in Soil

Chemical of Concern	Concentration (mg/kg)	Cancer Risk	Contribution to Cancer Risk (%)	Source of Toxicity Information
Benzo(a)anthracene	310	$3.53x10^{-4}$	13.47	USEPA[a]
Chrysene	352	$4.01x10^{-6}$	0.15	USEPA[a]
Benzo(b)fluoranthene	214	$2.44x10^{-4}$	9.31	USEPA[a]
Benzo(k)fluoranthene	89.6	$1.02x10^{-5}$	0.39	USEPA[a]
Benzo(b&k)fluoranthene	550	$6.27x10^{-4}$	23.93	USEPA[a]
Benzo(a)pyrene	370	$4.21x10^{-4}$	16.07	IRIS
Indeno(1,2,3-cd)pyrene	100	$1.14x10^{-4}$	4.35	USEPA[a]
Dibenzo(a,h)anthracene	38.6	$4.40x10^{-5}$	1.68	USEPA[a]
Pentachlorophenol	108	$2.02x10^{-5}$	0.77	IRIS
2,3,7,8-TCDD/TEF	0.0001077	$2.52x10^{-5}$	0.96	HEAST
1,2,3,7,8-PeCDF/TEF	0.00075	$1.76x10^{-4}$	6.72	HEAST
1,2,3,4,6,7,8-HpCDD/TEF	0.0008	$1.87x10^{-4}$	7.14	HEAST
1,2,3,4,7,8-HxCDD/TEF	0.000098	$2.30x10^{-5}$	0.88	HEAST
2,3,4,6,7,8-HxCDF/TEF	0.000043	$1.01x10^{-5}$	0.39	HEAST
1,2,3.6,7,8-HpCDD/TEF	0.000067	$7.57x10^{-5}$	2.89	HEAST
1,2,3,7,8,9-HpCDD/TEF	0.0003	$7.03x10^{-5}$	2.68	HEAST
OCDD/TEF	0.00092	$2.15x10^{-4}$	8.21	HEAST

[a] Provisional Guidance for Quantitative Assessment of Polycyclic Aromatic Hydrocarbons, USEPA, July 1993
IRIS – Integrated Risk Information System, USEPA, 1995
HEAST – Health Effects Assessment Summary Tables, Annual Summary, USEPA, 1994.

Table 9

Reasonable Maximum Exposure Concentrations and Estimated Risk Values for Primary Risk Drivers in Groundwater

Chemical of Concern	Concentration (mg/L)	HQ	Cancer Risk	Contribution to Cancer Risk (%)	Source of Toxicity Information
Semi-volatile Organics:					
Bis(2-ethylhexl)phthalate	12.0	16.4	1.97×10^{-3}	2.67	IRIS
Carbazole	3.82		9.04×10^{-4}	1.22	HEAST
Naphthalene	130	89			ODEQ
Acenaphthene	21.5	9.82			IRIS
Fluorene	17.5	12.0			IRIS
Fluoranthene	17.0	11.6			IRIS
Pyrene	5.0	4.57			IRIS
Benzo(a)anthracene	1.7		1.45×10^{-2}	19.64	USEPA[a]
Benzo(b)fluoranthene	1.3		1.11×10^{-2}	15.04	USEPA[a]
Benzo(a)pyrene	0.24		2.04×10^{-2}	27.64	IRIS
Dibenzofuran	13.95	95.5			USEPA[b]
Phenols:					
Pentachlorophenol	16	14.6	2.23×10^{-2}	30.21	IRIS
4-methyphenol	0.24	1.32			HEAST
PCBs & Pesticides:					
Dieldrin	0.0062	3.40	1.16×10^{-3}	1.57	IRIS
Heptachlor epoxide	0.0007	1.48	7.48×10^{-5}		IRIS
PCB-1254	0.0042	5.75			IRIS

[a] Provisional Guidance for Quantitative Assessment of Polycyclic Aromatic Hydrocarbons, USEPA, July 1993
[b] Provisional RfD, USEPA Region 5, July 1994
IRIS – Integrated Risk Information System, USEPA, 1995
HEAST – Health Effects Assessment Summary Tables, Annual Summary, USEPA, 1994.
Oregon Department of Environmental Quality - Provisional RfD, January 1992

Table 10

Average Exposure, Maximum Exposure Concentration, and Associated Risk Values for Chemicals of Concern in Soil

Chemical of Concern	Average Conc. (mg/kg)	Average Conc. Cancer Risk	RME Concentration (mg/kg)	RME HQ	RME Cancer Risk
Naphthalene			250,000	22.8	
Benzo(a)anthracene	393	3.97×10^{-5}	310		3.53×10^{-4}
Chrysene			352		4.01×10^{-6}
Benzo(b)fluoranthene	214	2.16×10^{-5}	214		2.44×10^{-4}
Benzo(k)fluoranthene	26.5	2.68×10^{-5}	89.6		1.02×10^{-5}
Benzo(b&k)fluoranthene	550	5.56×10^{-5}	550		6.27×10^{-4}
Benzo(a)pyrene	370	3.74×10^{-4}	370		4.21×10^{-4}
Indeno(1,2,3-cd)pyrene	100	1.01×10^{-5}	100		1.14×10^{-4}
Dibenzo(a,h)anthracene	28	2.83×10^{-5}	38.6		4.40×10^{-5}
Dibenzofuran			1380	1.26	
Pentachlorophenol	108	1.79×10^{-6}	108		2.02×10^{-5}
2,3,7,8-TCDD/TEF	0.0001077	2.23×10^{-6}	0.0001077		2.52×10^{-5}
1,2,3,7,8-PeCDF/TEF	0.00075	1.56×10^{-5}	0.00075	2.73	1.76×10^{-4}
1,2,3,4,6,7,8-HpCDD/TEF	0.0008	1.66×10^{-5}	0.0008	2.92	1.87×10^{-4}
1,2,3,4,7,8-HxCDD/TEF			0.000098		2.30×10^{-5}
2,3,4,6,7,8-HxCDF/TEF			0.000043		1.01×10^{-5}
1,2,3,6,7,8-HpCDD/TEF	0.0003	6.23×10^{-6}	0.000067		7.57×10^{-5}
1,2,3,7,8,9-HpCDD/TEF	0.000069	1.43×10^{-6}	0.0003	1.09	7.03×10^{-5}
OCDD/TEF	0.00092	1.91×10^{-5}	0.00092	3.35	2.15×10^{-4}

Note: Different exposure assumptions were used for the Average Concentration Cancer Risk and the RME Cancer Risk calculations. The different assumptions used were: exposure duration, exposure frequency, ingestion rate, and average time exposed for non-carcinogens.

Table 11

Maximum Exposure Concentration and Associated Risk Values for Chemicals of Concern in Groundwater

Chemical of Concern	Average Concentration (mg/L)	Average HQ	Average Cancer Risk	RME Conc. (mg/L)	RME HQ	RME Cancer Risk
Volatile Organics:						
Benzene	0.057		$3.20x10^{-6}$	0.057		$1.94x10^{-5}$
1,2-dichloroethane				0.004		$4.27x10^{-6}$
Semi-volatile Organics:						
Bis(2-ethylhexl)phthalate	12	9.04	$3.25x10^{-4}$	12.0	16.4	$1.97x10^{-3}$
Carbazole	3.85		$1.49x10^{-4}$	3.82		$9.04x10^{-4}$
Naphthalene	130	89		130	89	
Acenaphthene	21.5	9.82		21.5	9.82	
Fluorene	17.5	12.0		17.5	12.0	
Anthracene	5.35	0.489		5.35	0.489	
Fluoranthene	17.0	6.4		17.0	11.6	
Pyrene	5.0	2.51		5.0	4.57	
Benzo(a)anthracene	1.7		$1.45x10^{-2}$	1.7		$1.45x10^{-2}$
Chrysene	1.4		$1.98x10^{-5}$	1.4		$1.20x10^{-4}$
Benzo(b)fluoranthene	1.3		$1.84x10^{-3}$	1.3		$1.11x10^{-2}$
Benzo(k)fluoranthene	0.52		$7.35x10^{-5}$	0.52		$4.46x10^{-4}$
Benzo(a)pyrene	0.24		$2.04x10^{-2}$	0.24		$2.04x10^{-2}$
Indeno(1,2,3-cd)pyrene	0.017		$2.40x10^{-5}$	0.007		$6.00x10^{-5}$
Dibenzofuran	13.95	95.5		13.95	95.5	
Phenols:						
Pentachlorophenol	16	8.04	$3.71x10^{-3}$	16	14.6	$2.23x10^{-2}$
4-methyphenol	0.24	1.32		0.24	1.32	
2,4,6-trichlorophenol				0.037		$4.78x10^{-6}$
PCBs & Pesticides[a]:						
Dieldrin	0.0062	1.87	$1.94x10^{-4}$	0.0062	3.40	$1.16x10^{-3}$
Heptachlor epoxide	0.0007	0.811	$1.23x10^{-5}$	0.0007	1.48	$7.48x10^{-5}$
PCB-1254	0.0042	5.75		0.0042	5.75	
Total PCBs	0.00745		$6.73x10^{-4}$	0.00745		$6.73x10^{-4}$

[a] Each compound detected in the RI samples was carried forward in the risk assessment as a potential contaminant of concern, but may not have contributed significantly to the overall estimated risk (see Table 9).

Table 12

Summary of Baseline Risk Adjacent to the Wyckoff Property From 1991 Risk Assessment			
	Ingestion of Clams		Ingestion of Sediments
Transect Number	Noncancer hazard[a]/major contaminant(s) contributing to noncancer hazard	Cancer risk[a]/major contaminant(s) contribution to cancer risk	Cancer risk[a]/ major contaminant(s) contribution to cancer risk
10	1 / methyl-mercury	2×10^{-3} / PAHs	6×10^{-6} / PAHs
11	NA	NA	1×10^{-5} / PAHs
12	20 / antimony	1×10^{-3} / PAHs	6×10^{-6} / PAHs
13	1 / methyl mercury, chromium	8×10^{-4} / PAHs	8×10^{-7} / beryllium

[a]Calculated using RME concentration
NA = Data not obtained at this transect to complete calculation

Table 13 Groundwater Cleanup Levels for Protection of Human Health and the Marine Environment (μg/L)

Contaminant of Concern	WA SW Quality Stds. (173-201A WAC)	MTCA Method B SW for Human Consumption of Organisms (173-340 WAC)[b]	Federal WQStandards/ NTR (40 CFR 131)		Federal WQ Criteria		Calculated Pore-Water Concentrations Based on SMS or HH (See Table 15)	Groundwater Cleanup Level[c]
			Marine Chron.c	Human Cons. of Orgs.	Marine Chronic	Human Cons.		
Naphthalene		9880					83	83
Acenaphthylene								
Acenaphthene		643				2,700	3	3
Fluorene		3,460		14,000		14,000	3	3
Phenanthrene								
Anthracene		25,900		110,000		110,000	9	9
Fluoranthene		90		370		370	3	3
Pyrene		2,590		11,000		11,000	15	15
Benzo(a)anthracene		.0296		.031		.049	.308	.0296
Chrysene		.0296		.031		.049	.262	.0296
Benzo(b)fluoranthene		.0296		.031		.049	.079	.0296
Benzo(k)fluoranthene		.0296		.031		.049	.079	.0296
Benzo(a)pyrene		.0296		.031		.049	.102	.0296
Dibenzo(a,h)anthracene		.0296		.031		.049	.007	.007
Benzo(g,h,i)perylene								
Indeno(1,2,3-cd)pyrene		.0296		.031		.049		.0296
HPAH							0.254	0.254
Pentachlorophenol	7.9[a]	4.9	143	8.2	7.9	8.2	880	4.9

[a] Chronic criteria
[b] Values obtained from MTCA Cleanup Levels and Risk Calculations (CLARC II) Update (February 1996)
[c] Where there is no cleanup level specified for a certain chemical, benzo(a)pyrene will be used as an indicator chemical during remediation. Groundwater cleanup levels will be measured at the point of compliance (see Section 8.4.2).

Table 14
Soil Cleanup Levels[a]

Contaminants of Concern	MTCA Method B Cleanup Standards[b] (μg/kg)
Naphthalene	3.20E+06
Acenaphthylene	NA
Acenaphthene	4.80E+06
Fluorene	3.20E+06
Phenanthrene	NA
Anthracene	2.40E+07
Fluoranthene	3.20E+06
Pyrene	2.40E+06
Benzo(a)anthracene	1.37E+02
Chrysene	1.37E+02
Benzo(b)fluoranthene	1.37E+02
Benzo(k)fluoranthene	1.37E+02
Benzo(a)pyrene	1.37E+02
Dibenzo(a,h)anthracene	1.37E+02
Benzo(g,h,i)perylene	NA
Indeno(1,2,3-cd)pyrene	1.37E+02
Dioxin (2,3,7,8-TCDD)/tef[c]	6.67E-03
Pentachlorophenol	8.33E+03

[a] For surface soil to 15 feet bgs, the most stringent of Method B levels will need to be met. If the levels cannot be practically met, then a point of compliance will be established in the soils for direct contact at the ground surface (see Section 8.4.1, above).

[b] Model Toxics Control Act (MTCA) Cleanup Levels and Risk Calculation (CLARCII) Update, February 1996. Where both cancer and non-cancer values are provided, the most stringent are used.

Concentrations of individual hazardous substances shall be adjusted downward to take into account exposure to multiple hazardous substances and/or exposure resulting from more than one pathway of exposure. In making these adjustments, the hazard index shall not exceed 1 and the total excess cancer risk shall not exceed one in one hundred thousand (MTCA Chapter 173-340 WAC).

[c] Chlorinated Dioxin/Furan TEFs (expressed as 2,3,7,8 TCDD TEQ)

NA = There were no values available for these chemicals in CLARCII. For purposes of cleanup, assume they are co-located with other PAH compounds.

Table 15 Estimate of Maximum Allowable Pore-Water Concentrations of COCs

Contaminant of Concern	Sediment Management Standards WAC 173-204 (mg/kg organic carbon[a]) Quality Standards	Screening Levels	Protection of HH for Intertidal Sediments (mg/kg oc)	Koc[b] (ml/g)	Calculated Pore-Water Maximums Based on Sediment Mgt. Stds. Quality Standards (µg/L)	Screening Levels (µg/L)	Calculated Pore-Water Based on HH	Most Stringent Pore-Water Concentration
Naphthalene	99	170		1,191	83	143		83
Acenaphthylene	66	66		NA				
Acenaphthene	16	57		4,898	3	12		3
Fluorene	23	79		7,961	3	10		3
Phenanthrene	100	480		NA				
Anthracene	220	1,200		23,493	9	51		9
Fluoranthene	160	1,200		49,096	3	24		3
Pyrene	1,000	1,400		67,992	15	21		15
Benzo(a)anthracene	110	270		356,938	.308	.756		.308
Chrysene	110	460		420,108	.262	1.095		.262
Total Benzofluoranthenes[c]	230	450		2,903,559	.079	.155		.079
Benzo(a)pyrene	99	210		968,774	.102	.217		.102
Dibenzo(a,h)anthracene	12	33		1,789,101	.007	.018		.007
Benzo(g,h,i)perylene	31	78		NA				
Indeno(1,2,3-cd)pyrene	34	88		NA				
HPAH[d]	960	5300	40[e]	157,213[f]	6.1	33.7	0.254	0.254
Pentachlorophenol	360	690		409	880	1687		880

[a] The listed chemical parameter criteria represent concentrations in parts per million "normalized", or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

[b] December 1998 Draft MTCA Rule Revision, Soil Organic Carbon-Water Partitioning Coefficient (Koc) Values, Table 747-4.

[c] The Total Benzofluoranthenes criterion represents the sum of the concentrations of the "B", "J", and "K" isomers.

[d] For the intertidal sediments, the cleanup goal established in the East Harbor Record of Decision (ROD), September 1994, is 1,200 μg/kg (dry weight), developed by EPA to address human health risks from consumption of contaminated shellfish in intertidal areas. This objective requires that intertidal sediment HPAH concentrations must not exceed 1,200 μg/kg (dry weight). Achievement of the HPAH objective in intertidal sediments is expected to result in corresponding reduction in clam tissue contamination.

The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benzo(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Dibenzo(a,h)anthracene, Benzo(g,h,i)perylene, and Indeno(1,2,3-cd)pyrene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

[e] 40 mg/kg organic carbon is 1,200 μg/kg (dry weight) normalized, i.e., (1200 μg/kg dw/3% TOC) x (1/1000)

[f] Average Koc for HPAH is derived from site-specific solubility-weighted NAPL composition data (Wyckoff NAPL Field Exploration Report, U.S. Army Corps of Engineers, 2000).

NA = There were no values available for these chemicals.

Table 16
Alternative 1 - No Action
Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$0	$0	$0	1.000	$0
1	$0	$500,000	$500,000	0.932	$466,197
2	$0	$500,000	$500,000	0.869	$434,679
3	$0	$500,000	$500,000	0.811	$405,292
4	$0	$500,000	$500,000	0.756	$377,892
5	$0	$500,000	$500,000	0.705	$352,344
6	$0	$0	$0	0.657	$0
7	$0	$0	$0	0.613	$0
8	$0	$0	$0	0.571	$0
9	$0	$0	$0	0.533	$0
10	$0	$0	$0	0.497	$0
11	$0	$0	$0	0.463	$0
12	$0	$0	$0	0.432	$0
13	$0	$0	$0	0.403	$0
14	$0	$0	$0	0.375	$0
15	$0	$0	$0	0.350	$0
16	$0	$0	$0	0.326	$0
17	$0	$0	$0	0.304	$0
18	$0	$0	$0	0.284	$0
19	$0	$0	$0	0.264	$0
20	$0	$0	$0	0.247	$0
21	$0	$0	$0	0.230	$0
22	$0	$0	$0	0.214	$0
23	$0	$0	$0	0.200	$0
24	$0	$0	$0	0.186	$0
25	$0	$0	$0	0.174	$0
26	$0	$0	$0	0.162	$0
27	$0	$0	$0	0.151	$0
28	$0	$0	$0	0.141	$0
29	$0	$0	$0	0.131	$0
30	$0	$0	$0	0.122	$0
TOTALS	**$0**	**$2,500,000**	**$2,500,000**		**$2,036,404**

Note: Discount factor calculated for continuous discounting; = e^(-i*t) where:

i = discount rate

t = time in years

Table 17

Alternative 2a - Containment with Slurry Wall
Summary of Capital Cost Present Worth

Element	Subelement	Present Worth Capital Cost
Barrier Wall	Slurry Wall (1997 alignment), habitat mitigation	$20,560,500
Fmr. Process Area	Injection/Extraction System	$34,848
	Treatment Plant Capital	$4,491,568
	Treatment Plant O&M	$0
	Treatment Plant (Old/New) Disposal	$182,757
	Disposal Cap	$3,083,426
Log Peeler Soil	Disposal Cap	$4,304,862
Monitoring	Groundwater Monitoring	$0
	Treatment Plant Influent/Effluent Monitoring	$0
	Treatment Plant Waste Characterization	$0
	Soil Excavation Air/Confirmation Monitoring	$0
TOTAL		**$32,657,962**

Table 18

Alternative 2a - Containment with Slurry Wall
Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$20,743,257	$730,000	$21,473,257	1.000	$21,473,257
1	$12,778,618	$772,545	$13,551,163	0.932	$12,635,021
2	$0	$754,845	$754,845	0.869	$656,231
3	$0	$800,670	$800,670	0.811	$649,010
4	$0	$767,481	$767,481	0.756	$580,050
5	$0	$767,481	$767,481	0.705	$540,835
6	$0	$767,481	$767,481	0.657	$504,271
7	$0	$767,481	$767,481	0.613	$470,179
8	$0	$767,481	$767,481	0.571	$438,392
9	$0	$767,481	$767,481	0.533	$408,754
10	$0	$754,761	$754,761	0.497	$374,803
11	$0	$737,481	$737,481	0.463	$341,463
12	$0	$737,481	$737,481	0.432	$318,378
13	$0	$737,481	$737,481	0.403	$296,854
14	$0	$737,481	$737,481	0.375	$276,785
15	$0	$737,481	$737,481	0.350	$258,072
16	$0	$737,481	$737,481	0.326	$240,625
17	$0	$737,481	$737,481	0.304	$224,357
18	$0	$737,481	$737,481	0.284	$209,189
19	$0	$737,481	$737,481	0.264	$195,047
20	$0	$761,369	$761,369	0.247	$187,751
21	$0	$737,481	$737,481	0.230	$169,566
22	$0	$737,481	$737,481	0.214	$158,102
23	$0	$737,481	$737,481	0.200	$147,413
24	$0	$737,481	$737,481	0.186	$137,447
25	$0	$737,481	$737,481	0.174	$128,155
26	$0	$737,481	$737,481	0.162	$119,491
27	$0	$737,481	$737,481	0.151	$111,413
28	$0	$737,481	$737,481	0.141	$103,880
29	$0	$737,481	$737,481	0.131	$96,857
30	$0	$978,267	$978,267	0.122	$119,795
TOTALS	**$33,521,875**	**$22,453,734**	**$56,953,876**		**$42,571,446**

Note: Discount factor calculated for continuous discounting; = e^(-i*t) where: **i = discount rate**
t = time in years

Table 19

Alternative 2b - Containment with Sheet Pile Wall

Summary of Capital Cost Present Worth

Element	Subelement	Present Worth Capital Cost
Barrier Wall	Sheet Pile Wall (Full Alignment, corrosion protection, and habitat mitigation)	$6,214,390
	Injection/Extraction System	$34,848
	Treatment Plant Capital	$4,491,568
	Treatment Plant O&M	$0
	Treatment Plant (Old/New) Disposal	$182,757
	Disposal Cap	$3,083,426
Log Peeler Soil	Disposal Cap	$4,304,862
Monitoring	Groundwater Monitoring	$0
	Treatment Plant Influent/Effluent Monitoring	$0
	Treatment Plant Waste Characterization	$0
	Soil Excavation Air/Confirmation Monitoring	$0
TOTAL		**$ 18,311,851**

Table 20

Alternative 2b - Containment with Sheet Pile Wall
Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$6,397,146	$730,000	$7,127,146	1.000	$7,127,146
1	$12,778,618	$787,545	$13,566,163	0.932	$12,649,007
2	$0	$769,845	$769,845	0.869	$669,271
3	$0	$815,670	$815,670	0.811	$661,169
4	$0	$782,481	$782,481	0.756	$591,386
5	$0	$782,481	$782,481	0.705	$551,405
6	$0	$782,481	$782,481	0.657	$514,127
7	$0	$782,481	$782,481	0.613	$479,369
8	$0	$782,481	$782,481	0.571	$446,960
9	$0	$782,481	$782,481	0.533	$416,743
10	$0	$769,761	$769,761	0.497	$382,252
11	$0	$752,481	$752,481	0.463	$348,409
12	$0	$752,481	$752,481	0.432	$324,854
13	$0	$752,481	$752,481	0.403	$302,892
14	$0	$752,481	$752,481	0.375	$282,414
15	$0	$752,481	$752,481	0.350	$263,322
16	$0	$752,481	$752,481	0.326	$245,519
17	$0	$752,481	$752,481	0.304	$228,921
18	$0	$752,481	$752,481	0.284	$213,444
19	$0	$752,481	$752,481	0.264	$199,014
20	$0	$1,276,369	$1,276,369	0.247	$314,749
21	$0	$752,481	$752,481	0.230	$173,015
22	$0	$752,481	$752,481	0.214	$161,318
23	$0	$752,481	$752,481	0.200	$150,412
24	$0	$752,481	$752,481	0.186	$140,243
25	$0	$752,481	$752,481	0.174	$130,762
26	$0	$752,481	$752,481	0.162	$121,921
27	$0	$752,481	$752,481	0.151	$113,679
28	$0	$752,481	$752,481	0.141	$105,993
29	$0	$752,481	$752,481	0.131	$98,827
30	$0	$993,267	$993,267	0.122	$121,632
TOTALS	**$19,175,765**	**$24,382,001**	**$43,557,766**		**$28,530,174**

NOTES: (1) Capital Cost Expended over 2 years since sheet pile wall would be installed during Year 0, rest of remedy during Year 1.

(2) Discount factor calculated for continuous discounting; = e^(-i*t) where:

i = discount rate

t = time in years

Table 21
Alternative 3 - Insitu Thermal Remediation
Summary of Capital Cost Present Worth

Element	Subelement	Present Worth Capital Cost
Barrier Wall	Sheet Pile Wall (Partial Alignment, corrosion protection, and habitat mitigation)	$4,877,110
Thermal	Steam Generation Capital	$1,793,952
	Fuel For Steam Generation	$0
	Steam O&M (not incl. fuel)	$0
	Steam Injection/Contaminant Extraction	$7,702,324
	Injection/Extraction System Removal	$0
	Treatment Plant Capital	$3,761,333
	Treatment Plant O&M	$0
	Treatment Plant (Old/New) Disposal	$158,881
	Vapor Cap Capital	$881,172
	Vapor Cap O&M	$0
	Containment Cap	$0
Log Peeler Soil	Soil Removal	$1,148,276
Monitoring	Thermal Monitoring	$2,418,911
	Groundwater Monitoring	$0
	Treatment Plant Influent/Effluent Monitoring	$0
	Treatment Plant Air Monitoring	$0
	Treatment Plant Waste Characterization	$0
	Soil Excavation Air/Confirmation Monitoring	$0
TOTAL		**$ 22,741,958**

Table 22

Alternative 3 - Insitu Thermal Remediation
Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$4,877,110	$0	$4,877,110	1.000	$4,877,110
1	0	$15,000	$15,000	0.932	$13,986
2	$20,549,467	$6,450,870	$27,000,337	0.869	$23,472,965
3	$0	$6,027,461	$6,027,461	0.811	$4,885,765
4	$0	$6,151,475	$6,151,475	0.756	$4,649,184
5	$0	$866,769	$866,769	0.705	$610,802
6	$0	$866,769	$866,769	0.657	$569,508
7	$0	$862,169	$862,169	0.613	$528,187
8	$0	$862,169	$862,169	0.571	$492,479
9	$0	$1,906,727	$1,906,727	0.533	$1,015,507
10	$0	$137,708	$137,708	0.497	$68,384
11	$0	$637,708	$637,708	0.463	$295,267
12	$0	$0	$0	0.432	$0
13	$0	$0	$0	0.403	$0
14	$0	$0	$0	0.375	$0
15	$0	$0	$0	0.200	$0
16	$0	$0	$0	0.326	$0
17	$0	$0	$0	0.304	$0
18	$0	$0	$0	0.284	$0
19	$0	$0	$0	0.264	$0
20	$0	$0	$0	0.247	$0
21	$0	$0	$0	0.230	$0
22	$0	$0	$0	0.214	$0
23	$0	$0	$0	0.200	$0
24	$0	$0	$0	0.186	$0
25	$0	$0	$0	0.174	$0
26	$0	$0	$0	0.162	$0
27	$0	$0	$0	0.151	$0
28	$0	$0	$0	0.141	$0
29	$0	$0	$0	0.131	$0
30	$0	$0	$0	0.122	$0
TOTALS	**$25,426,576**	**$24,784,823**	**$50,211,400**		**$41,479,143**

NOTES: (1) Capital Cost Expended in years 0 and 2 since sheet pile wall would be installed during Year 0, rest of remedy during Year 2 after Pilot Study.

(2) Discount factor calculated for continuous discounting; = e^(-i*t) where:

i = discount rate

t = time in years

Table 23

Alternative 3 With Contingency - Insitu Thermal Remediation and Limited Containment
Summary of Capital Cost Present Worth

Element	Subelement	Present Worth Capital Cost
Barrier Wall	Sheet Pile Wall (Partial/Full Alignment, corrosion protection, and habitat mitigation)	$5,281,743
Thermal	Steam Generation Capital	$1,793,952
	Fuel For Steam Generation	$0
	Steam O&M (not incl. fuel)	$0
	Steam Injection/Contaminant Extraction	$7,702,324
	Injection/Extraction System Removal	$0
	Treatment Plant Capital	$3,761,333
	Treatment Plant O&M	$0
	Treatment Plant (Old/New) Disposal	$158,881
	Vapor Cap Capital	$881,172
	Vapor Cap O&M	$0
	Containment Cap	$1,424,645
Log Peeler Soil	Soil Removal	$1,148,276
Monitoring	Thermal Monitoring	$2,418,911
	Groundwater Monitoring	$0
	Treatment Plant Influent/Effluent Monitoring	$0
	Treatment Plant Air Monitoring	$0
	Treatment Plant Waste Characterization	$0
	Soil Excavation Air/Confirmation Monitoring	$0
TOTAL		**$ 24,571,236**

Table 24

Alternative 3 With Contingency - Insitu Thermal Remediation and Limited Containment
Summary of Present Worth Analysis

Year	Capital Cost	Annual O&M Cost	Total Cost	Discount Factor (7%)	Present Worth
0	$4,877,110	$0	$4,877,110	1.000	$4,877,110
1	$0	$15,000	$15,000	0.932	$13,986
2	$20,549,467	$6,450,870	$27,000,337	0.869	$23,472,965
3	$0	$6,027,461	$6,027,461	0.811	$4,885,765
4	$0	$6,151,475	$6,151,475	0.756	$4,649,184
5	$0	$866,769	$866,769	0.705	$610,802
6	$0	$866,769	$866,769	0.657	$569,508
7	$0	$862,169	$862,169	0.613	$528,187
8	$0	$862,169	$862,169	0.571	$492,479
9	$0	$1,511,014	$1,511,014	0.533	$804,753
10	$0	$137,708	$137,708	0.497	$68,384
11	$0	$137,708	$137,708	0.463	$63,761
12	$4,237,280	$739,460	$4,976,740	0.432	$2,148,511
13	$0	$739,460	$739,460	0.403	$297,651
14	$0	$739,460	$739,460	0.375	$277,528
15	$0	$739,460	$739,460	0.200	$147,809
16	$0	$739,460	$739,460	0.326	$241,271
17	$0	$739,460	$739,460	0.304	$224,959
18	$0	$739,460	$739,460	0.284	$209,751
19	$0	$739,460	$739,460	0.264	$195,570
20	$0	$739,460	$739,460	0.247	$182,349
21	$0	$1,439,460	$1,439,460	0.230	$330,969
22	$0	$739,460	$739,460	0.214	$158,526
23	$0	$739,460	$739,460	0.200	$147,809
24	$0	$739,460	$739,460	0.186	$137,816
25	$0	$739,460	$739,460	0.174	$128,499
26	$0	$739,460	$739,460	0.162	$119,812
27	$0	$739,460	$739,460	0.151	$111,712
28	$0	$739,460	$739,460	0.141	$104,159
29	$0	$739,460	$739,460	0.131	$97,117
30	$0	$739,460	$739,460	0.122	$90,552
TOTALS	**$29,663,856**	**$38,638,850**	**$68,302,706**		**$46,389,251**

NOTES: (1) Capital Cost Expended in years 0 and 2 since sheet pile wall would be installed during Year 0, rest of remedy during Year 2 after Pilot Study.

(2) Containment surface soil cap installed at Year 11.

(3) Replace anode bed (sheet pile and well corrosion protection) at Year 20.

(4) Discount factor calculated for continuous discounting; = e^(-i*t) where:

i = discount rate

t = time in years

Table 25

Summary of Current Effluent Limitations and Monitoring Requirements (a)

CHEMICAL MONITORING

	Discharge Limitation		Monitoring Requirements		
Effluent Characteristic	Daily Maximum (ug/L)	Monthly Average (ug/L)	Measurement Frequency	Sample Type	Reported Value(s)
Total of 16 Polynuclear Aromatic Hydrocarbons (PAHs)	20	--	Once per week	24-hour composite (c)	Maximum daily
Individual PAHs (b)					
Naphthalene	4	–	Once per week	24-hour composite	Maximum daily
Acenaphthylene	4	–	Once per week	24-hour composite	Maximum daily
Acenaphthene	4	–	Once per week	24-hour composite	Maximum daily
Fluorene	2	–	Once per week	24-hour composite	Maximum daily
Phenanthrene	2	–	Once per week	24-hour composite	Maximum daily
Anthracene	2	–	Once per week	24-hour composite	Maximum daily
Fluoranthene	2	–	Once per week	24-hour composite	Maximum daily
Pyrene	2	–	Once per week	24-hour composite	Maximum daily
Benzo(a)anthracene	2	–	Once per week	24-hour composite	Maximum daily
Chrysene	2	–	Once per week	24-hour composite	Maximum daily
Benzo(b)fluoranthene	2	–	Once per week	24-hour composite	Maximum daily
Benzo(k)fluoranthene	2	–	Once per week	24-hour composite	Maximum daily
Benzo(a)pyrene	2	–	Once per week	24-hour composite	Maximum daily
Dibenzo(a,h)anthracene	2	–	Once per week	24-hour composite	Maximum daily
Benzo(g,h,i)perylene	2	–	Once per week	24-hour composite	Maximum daily
Indeno(1,2,3-cd)pyrene	2	–	Once per week	24-hour composite	Maximum daily
Pentachlorophenol (d)	6	–	Once per week	24-hour composite	Maximum daily
Discharge Flow (gpm) (e)	NA	–	Continuous	Recording	Maximum daily
Total Suspended Solids [TSS] (mg/L)	NA	–	Once per week	24-hour composite	Maximum daily
Total Dissolved Solids [TDS] (mg/L)	NA	–	Once per week	Grab	Maximum daily
Temperature [degrees C]	NA	–	Once per week	Grab	Maximum daily
Dissolved Oxygen [DO] (mg/L)	NA	–	Once per week	Grab	Maximum daily
pH	6.0 - 9.0	–	Once per week	Grab	Maximum daily
Metals (f)					
Zinc	95	47	Once per week	24-hour composite	Maximum daily
Lead	140	70	Once per week	24-hour composite	Maximum daily
Mercury	2.1	1	Once per week	24-hour composite	Maximum daily
Nickel	75	37	Once per week	24-hour composite	Maximum daily
Cadmium	43	21	Once per week	24-hour composite	Maximum daily
Chromium (Total)	1100	548	Once per week	24-hour composite	Maximum daily

BIOMONITORING (g)

		Monitoring Requirements		
Organism	Type of Toxicity Test	Measurement Frequency	Sample Type	Reported Value(s)
Inland Silversides (Menidia beryllina)	Acute survival test	Quarterly	24-hour composite	LC50
Purple sea urchin or sand dollar (h)	Chronic test	Quarterly	24-hour composite	IC25
Pacific oyster or mussel larvae (h)	Chronic test	Quarterly	24-hour composite	NOEC, LOEC, EC50/LC50

Notes:

(a) Modified from EPA's Administrative Order for Necessary Interim Response Actions No. 1091-06-03-106 dated June 17, 1991.

(b) Each of the 16 priority pollutants PAHs are quantified separately using EPA Method 8310 from Test Methods for Evaluating Solid Waste, Third Edition, SW-846. The 16 individual PAHs are summed to arrive at the total PAH value.

(c) A 24 hour composite sample is collected using an automatic sampler.

(d) Pentachlorophenol is quantified using EPA Method 8040 from Test Methods for Evaluating Solid W..ste, Third Edition, SW-846.

(e) Flow is measured by a continuous flow meter.

(f) Metals are quantified using EPA Contract Laboratory Program (CLP) analytical methods and QA/QC, however full documentation is not required. Documentation only includes calibration, blank, accuracy, and precision results.

(g) Specific requirements for analytical methods, QA/QC, and reporting are provided in the attached fact sheet.

(h) These organisms may be used interchangeably if required.

Reference: Interim ROD
Wyckoff Groundwater Operable Unit
Wyckoff/Eagle Harbor Superfund Site
September 30, 1994

Current Biomonitoring Requirements

I. Acute Toxicity Test Requirements:

1. For each test period (see also Paragraph I.8 below), acute survival toxicity tests are required for Inland Silversides (*Menidia beryllina*).

2. The test protocol is adapted from C.I. Weber, et al, *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*. EPA/600/4-90/027, 1991.

3. All quality assurance criteria used are in accordance with *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-90/027. Test results which are not valid (e.g., control mortality exceeds acceptable level) will not be accepted and must be repeated.

4. The test is performed with a series of dilutions (100, 50, 25, 12.5, and 6.25 percent effluent) plus a control (0 percent effluent) to determine (1) the LC_{50}, and (2) any statistically significant differences between the results for the control and each effluent concentration tested.

5. If the test demonstrates the presence of acute toxicity, EPA will undertake the following actions as needed to determine the source of toxicity:

   (a) Chemical analyses.

   (b) Evaluation of treatment processes and chemicals used.

   (c) Physical inspection of facility for proper operation of treatment units, spills, etc.

   (d) Examination of records.

   (e) Interviews with plant personnel to determine if toxicant releases occurred through spills, unusual operating conditions, etc.

   If any toxicity remains after conducting the above steps, additional monitoring or treatment may be required.

6. A written report of the toxicity test results and any related source investigation are prepared for EPA within 60 days after the initial sampling. The report of the toxicity test results and chemical analyses shall be prepared in accordance with the Reporting Sections in the documents specified above in Section I-3.

7. Chemical testing for the parameters for which effluent limitations exist shall be performed on a split of each sample collected for bioassay testing. To the extent that the timing of sample collection coincides with that of the sampling required for the effluent limitations, analysis of the split sample will fulfill the requirements of that monitoring as well.

8. Testing shall be conducted every three months (4 times per year), until EPA modifies this requirement in writing. Additional toxicity testing is also required at any time that spills or other unusual events result in different or substantially increased discharge of pollutants.

II. Chronic Toxicity Test Requirements:

1. For each test period (see also Paragraph II.11 below), chronic toxicity tests are required for the following organisms:

   (a) *Stronglyocentrotus purpuratus* (purple sea urchin), or *Dendraster excentricus* (sand dollar).

   (b) *Mytilus edulis* (mussel) or *Crassostrea gigas* (Pacific oyster) larvae.

   The purple sea urchin and sand dollar, and the mussel and Pacific oyster may be used interchangeably if necessary.

2. In each year, the bioassay tests shall be conducted four times with each organism during the organism's natural spawning period. To the extent that these seasons overlap, testing shall be conducted on splits of the same effluent samples. Any tests which fail the criteria for control mortality as specified in the respective protocols shall be repeated on a freshly collected sample.

3. Testing is conducted on 24-hour composite samples of effluent. Each composite sample collected shall be large enough to provide enough effluent to conduct toxicity tests, as well as chemical tests required in Part II.10. below.

4. The chronic toxicity tests are performed as follows:

(a) For the purple sea urchin/sand dollar, tests are performed on a series of dilutions, plus a control (0 percent effluent). The IC_{25} value (the incipient concentration of effluent causing a 25 percent reduction in biological measurement, e.g., fertilization, is calculated. EPA has indicated that the IC_{25} is the approximate analogue to the no observable effect concentration (NOEC) of the effluent in the control water. The NOEC is that concentration of effluent for which survival, reproduction, or growth of the test organisms is not significantly different (at the 95% confidence level) from that of the control organisms (see *Technical Support Document for Water Quality-based Toxics Control*, EPA/505/2-90-001, March 1991).

(b) For the mussel or Pacific oyster larvae, tests are performed on a series of dilutions, plus a control (0 percent effluent). The NOEC, LOEC (lowest observable effect concentration), and the EC50/LC50 (effective concentration [EC] at which 50 percent of the population shows sublethal effects such as reduction in growth and lethal concentration [LC] at which 50 percent of the population dies, respectively), are calculated.

5. The chronic bioassays are conducted in accordance with the following protocols:

(a) For purple sea urchin/sand dollar: *Short-term Methods for Estimating the Chronic Toxicity of Effluents and Receiving Waters to Marine and Estuarine Organisms*, EPA/600/4-87/028 and The Environmental Monitoring and Support Laboratory, Cincinnati, OH, 1988.

(b) For mussel/Pacific oyster larvae: *Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Saltwater Bivalve Molluscs*, ASTM E 724-89.

6. All quality assurance criteria used shall be in accordance with *Methods for Measuring the Acute Toxicity of Effluents to Freshwater and Marine Organisms*, EPA/600/4-85-013, *Quality Assurance Guidelines for Biological Testing*, EPA/600/4-78-043, and for oyster/mussel larvae test, *Standard Guide for Conducting Static Acute Toxicity Tests Starting with Embryos of Saltwater Bivalve Molluscs*, ASTM E 724-89. The control water shall be high quality natural seawater. No exceptions will be made for artificial sea salts or concentrated brine unless Wyckoff submits data to EPA which demonstrates that the lab has reliably conducted the specified test with one of these media.

7. The results of the bioassay tests are provided to EPA within 45 days after completion of each test in accordance with the Reporting Section in *Short Term Methods for Estimating Chronic Toxicity Effluents and Receiving Water to Marine and Estuarine Organisms*, EPA/600/4-87/028, May 1988, and include any other information required by the protocols.

8. EPA and Ecology will evaluate the results to determine whether they indicate the occurrence of chronic toxicity outside the mixing zone. If it appears that this may be occurring, a toxicity evaluation and reduction plan will be prepared within 90 days. The evaluation portion of the plan may include additional toxicity testing if needed to follow up on initial results or gather information for a possible toxicity limit in the future.

9. If the sea urchin/sand dollar or mussel/oyster larvae tests prove inadequate for evaluating Wyckoff's effluent, EPA may substitute alternative tests which will provide the required toxicity information.

10. Chemical testing for the parameters for which effluent limitations exist shall be performed on a split of each sample collected for bioassay testing. To the extent that the timing of sample collection coincides with that of the sampling required for the effluent limitations, analysis of split sample will fulfill the requirements of that monitoring as well.

11. After one year, EPA may reduce the monitoring requirements to once per year, using the more sensitive species. All modifications will be approved by EPA in writing.

Modifications to the Current Effluent Limitations
Wyckoff Thermal Remediation
Pilot Study Treatment System[1]

The following modifications will be made to the Chemical and/or Biomonitoring requirements:

1. Remove metals (zinc, lead, mercury, nickel, cadmium, and chromium) as a monitoring requirement. Metals was not used during wood-preserving operations at the Wyckoff/Eagle Harbor site. Additionally, years of sampling never detected metals in the treatment plant effluent.

2. Temperature will be monitored. Ecology believes an effluent temperature discharge of 20°C (68°F) to 25°C (77°F) would not cause a water quality violation in receiving waters of Puget Sound. A mixing zone has been established at the point of discharge. Grab samples for temperature monitoring will be taken once per week.

3. Dissolved oxygen (DO) and turbidity will also be monitored by grab samples once per week. The daily maximum discharge limitations are:

   DO: Shall exceed 6 mg/L
   (the receiving waters of Puget Sound off Wyckoff are considered to be Class A Marine Water)

   Turbidity: If background is < 50 ntu, discharge cannot exceed background plus 5 ntu
   If background is > 50 ntu, discharge cannot exceed a 10% increase

4. The following Measurement Frequency will be employed during the first three months of pilot study operation:

   - Daily effluent sampling for weeks 0 to 2
   - Twice a week for week 2 to month 3
   - Biomonitoring at month 3

   Based on the results of the sampling data, the Measurement Frequency will be adjusted as appropriate after month 3. Any sampling adjustments made shall be no less than once per week for effluent chemical monitoring and quarterly for biomonitoring, for the remainder of the pilot study.

The above modifications will be employed during the thermal pilot study. Effluent Limitations will be developed/adjusted for the full-scale treatment system based on the results of the pilot study, as appropriate.

---

[1] Per agreement by the EPA Project Manager, Hanh Gold, and the Ecology Project Managers, Guy Barrett and Marian Abbett on February 2, 2000, and during subsequent communications on February 8 and 10, 2000.

FIGURES

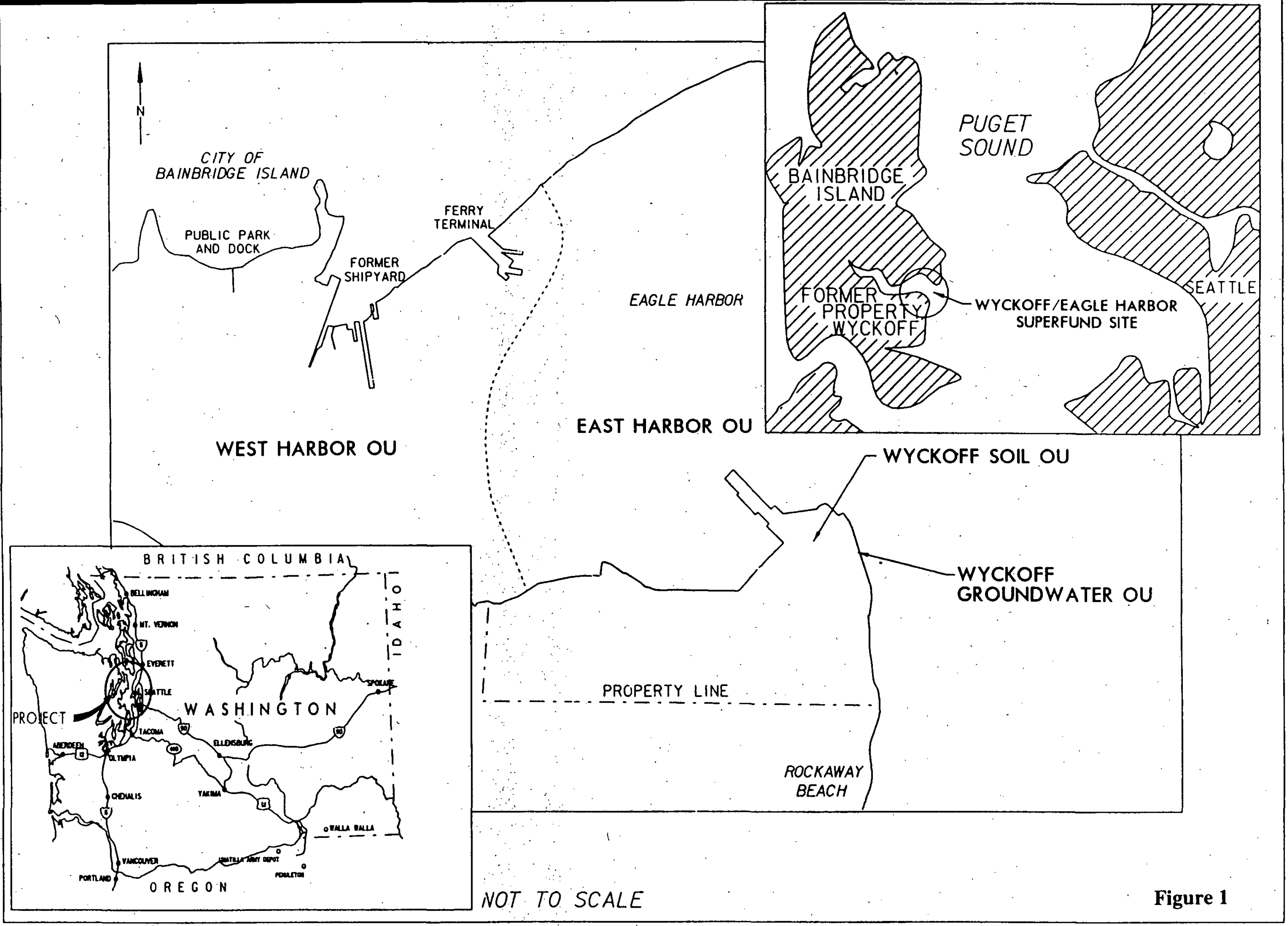


Figure 1

WYCKOFF/EAGLE HARBOR SUPERFUND SITE

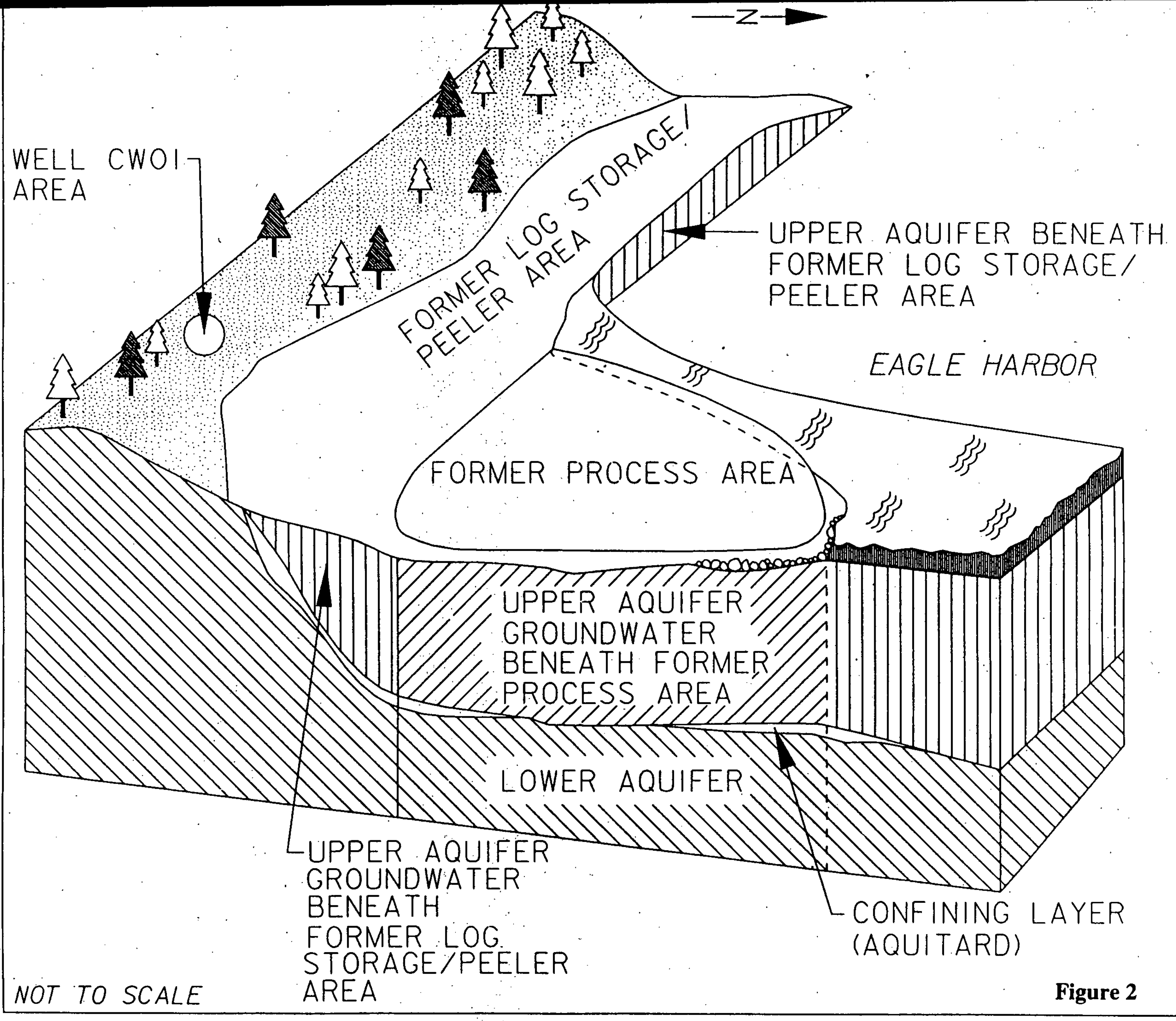
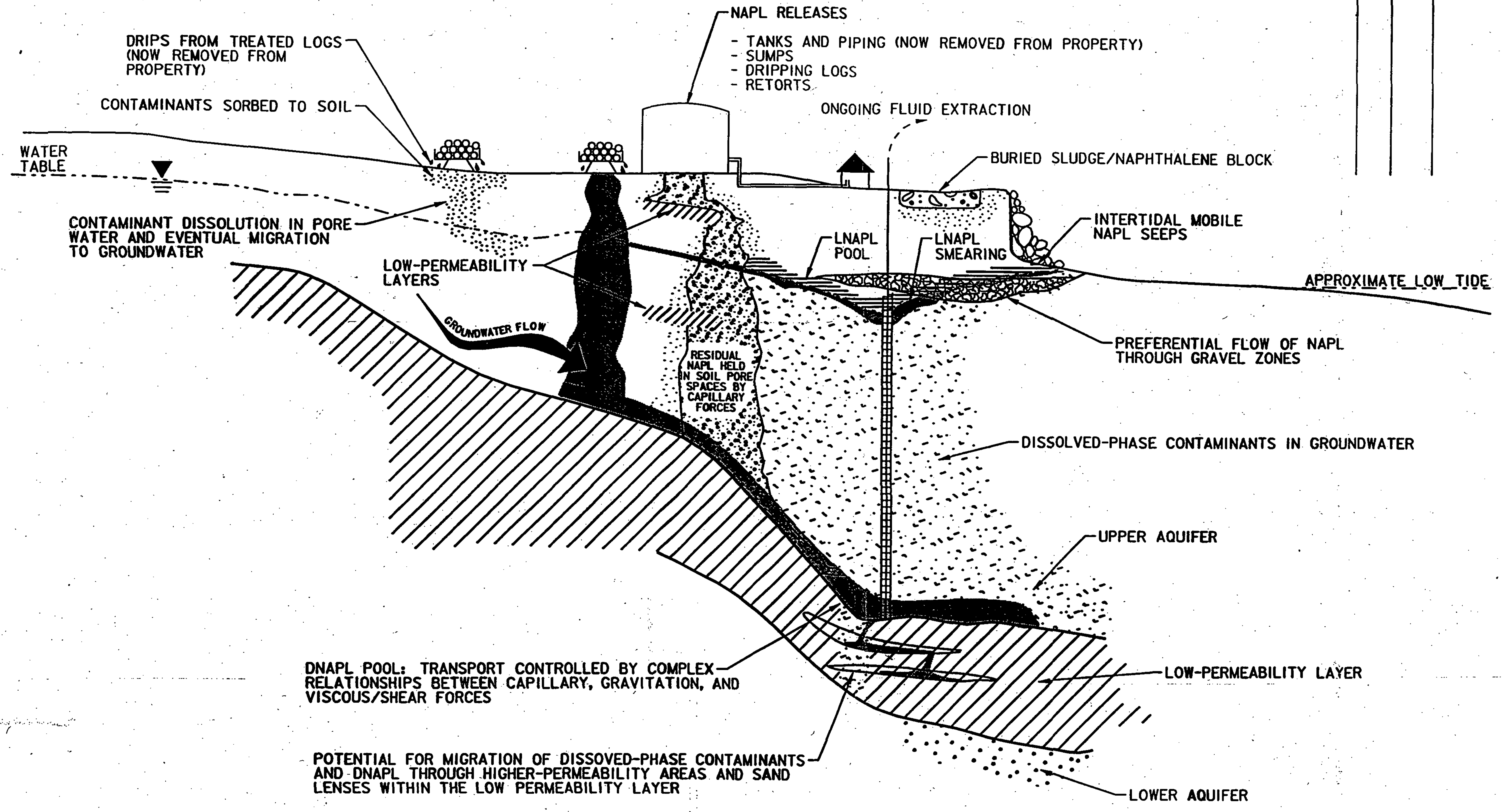


Figure 2

Soil and Groundwater Operable Units Components



REVISIONS

SYMBOL	ZONE	DESCRIPTION	DATE	BY

Figure 3

REDUCED TO 50% OF FULL SIZE

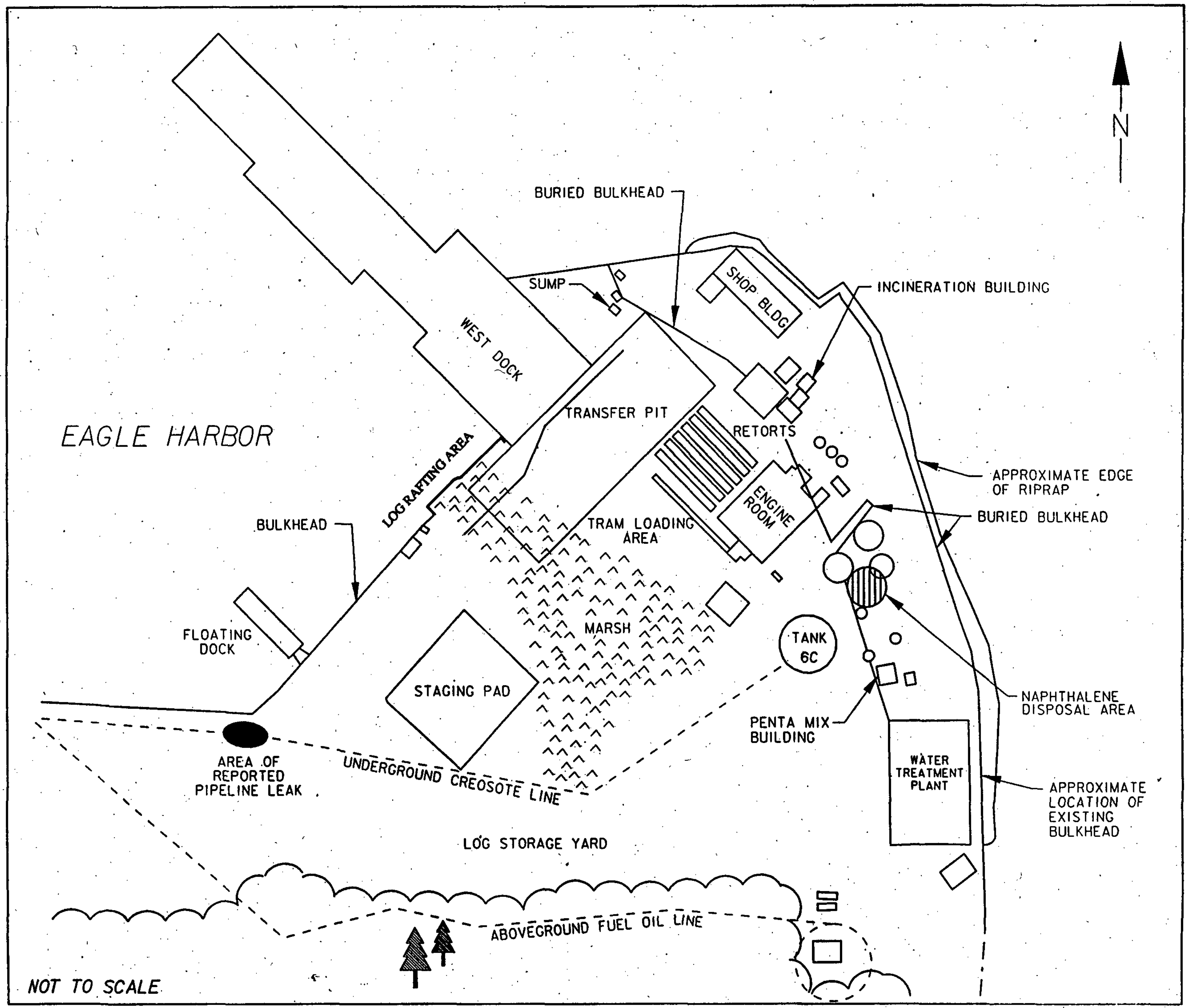
U.S. ARMY ENGINEER DISTRICT, SEATTLE
CORPS OF ENGINEERS
SEATTLE, WASHINGTON

WYCKOFF/EAGLE HARBOR SUPERFUND SITE

CONCEPTUAL MODEL OF CONTAMINANT FATE AND TRANSPORT

SIZE D | BROOKSHIER | EASTERLY

DATE AND TIME PLOTTED: 24-NOV-1999 11:01
DESIGN FILE: j:#nd#eh#geotech#fieldexpl#wyfeca0k.dgn



HISTORIC SITE MAP

Figure 4

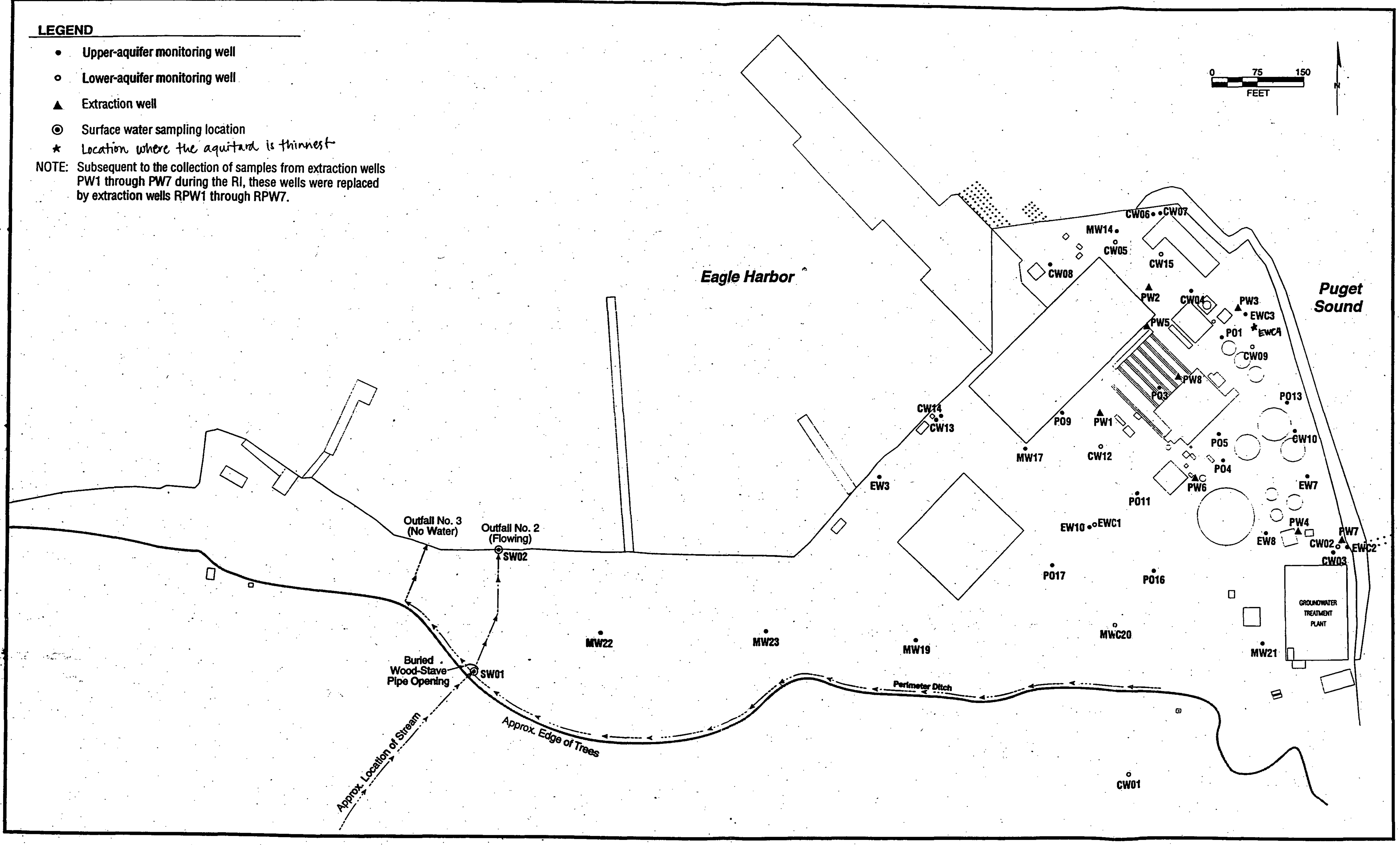


Figure 5

Groundwater Sampling Locations

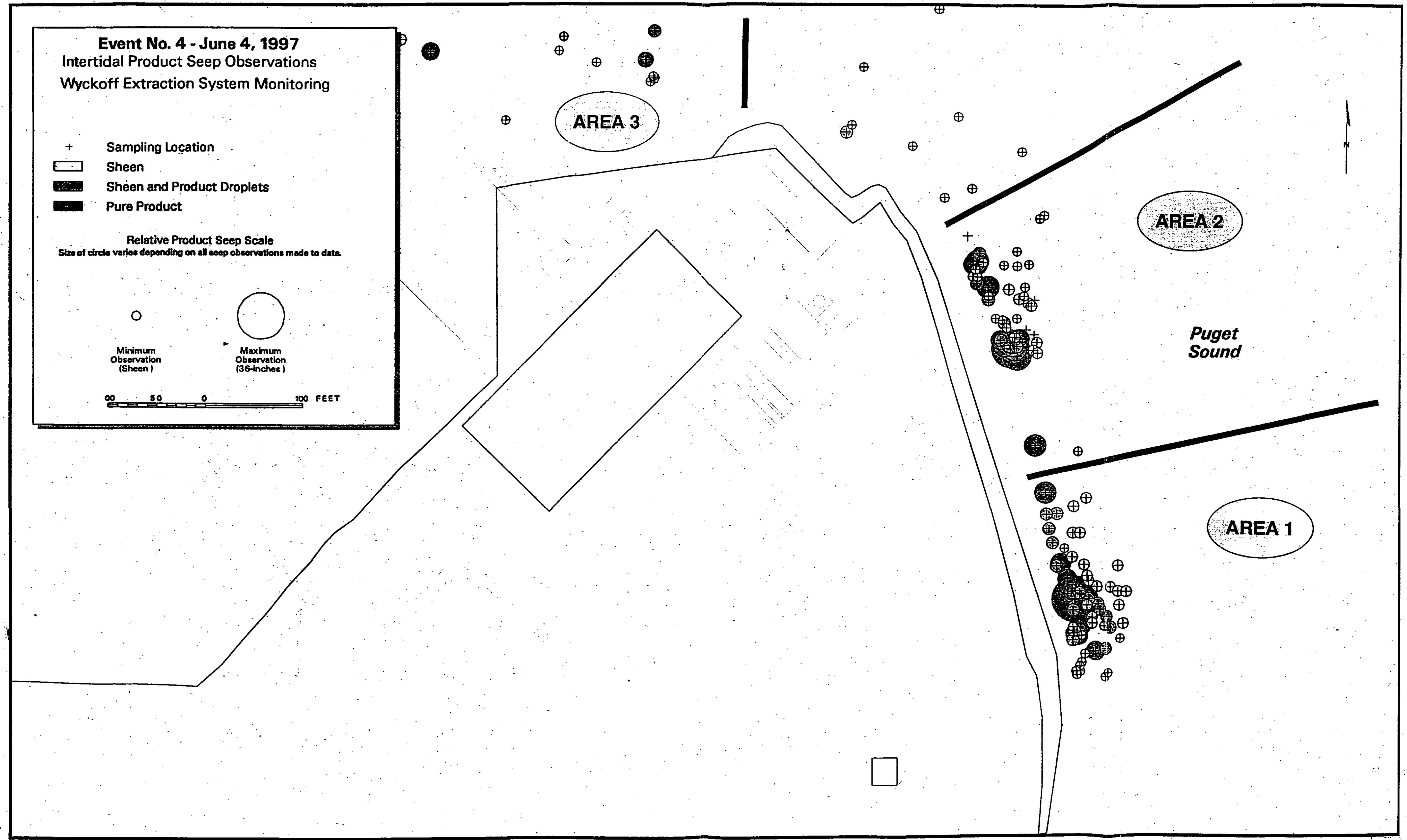


Figure 6
INTERTIDAL NAPL SEEP OBSERVATIONS
ON JUNE 4, 1997 (EVENT NO. 4)

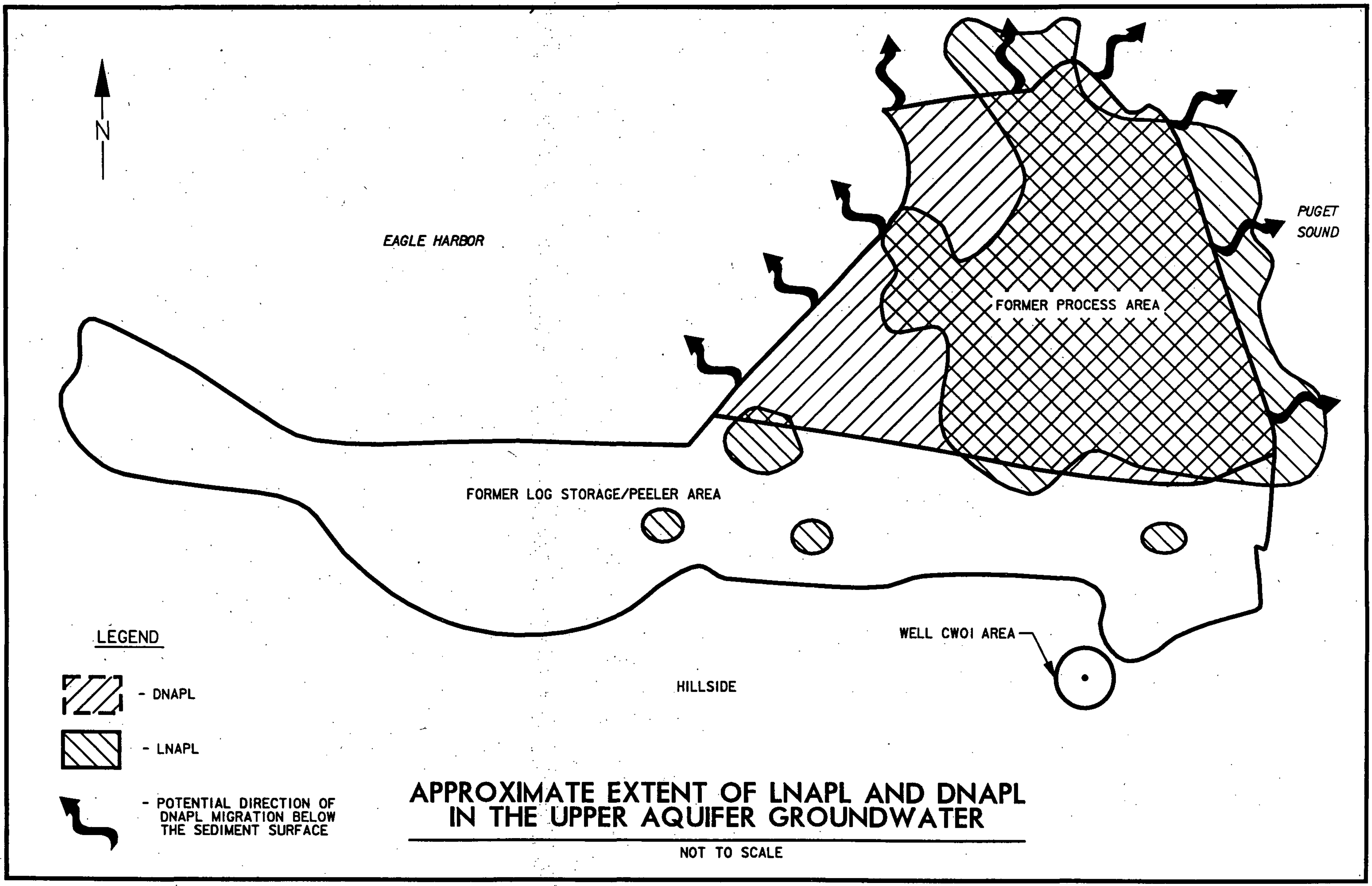

N
EAGLE HARBOR
PUGET SOUND
FORMER PROCESS AREA
FORMER LOG STORAGE/PEELER AREA
WELL CWO1 AREA
HILLSIDE
LEGEND
- DNAPL
- LNAPL
- POTENTIAL DIRECTION OF DNAPL MIGRATION BELOW THE SEDIMENT SURFACE
APPROXIMATE EXTENT OF LNAPL AND DNAPL IN THE UPPER AQUIFER GROUNDWATER
NOT TO SCALE

Figure 7

106341.04.03 • 6-3/NonPotable Upper Aquifer • 5/16/97 • JG

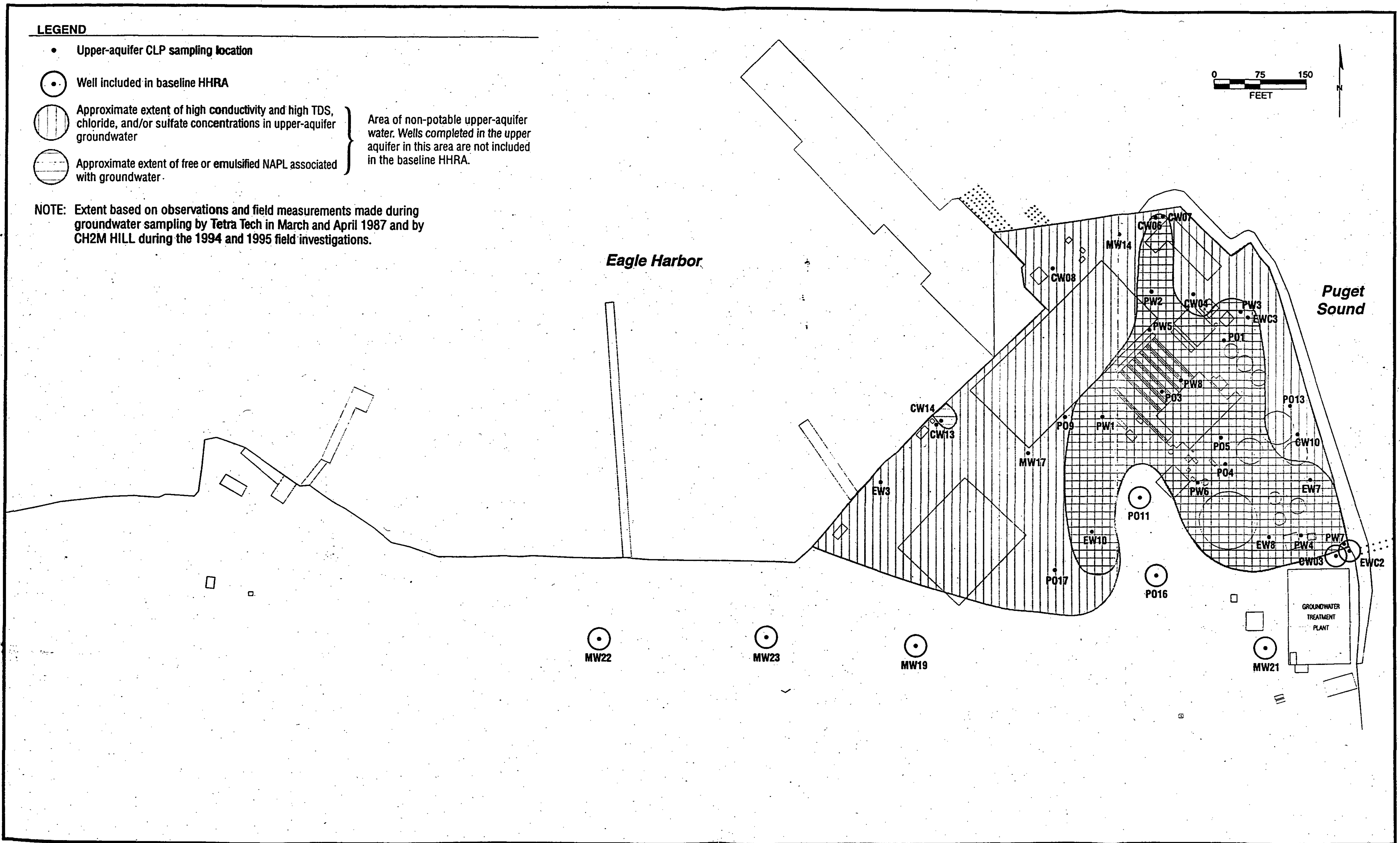
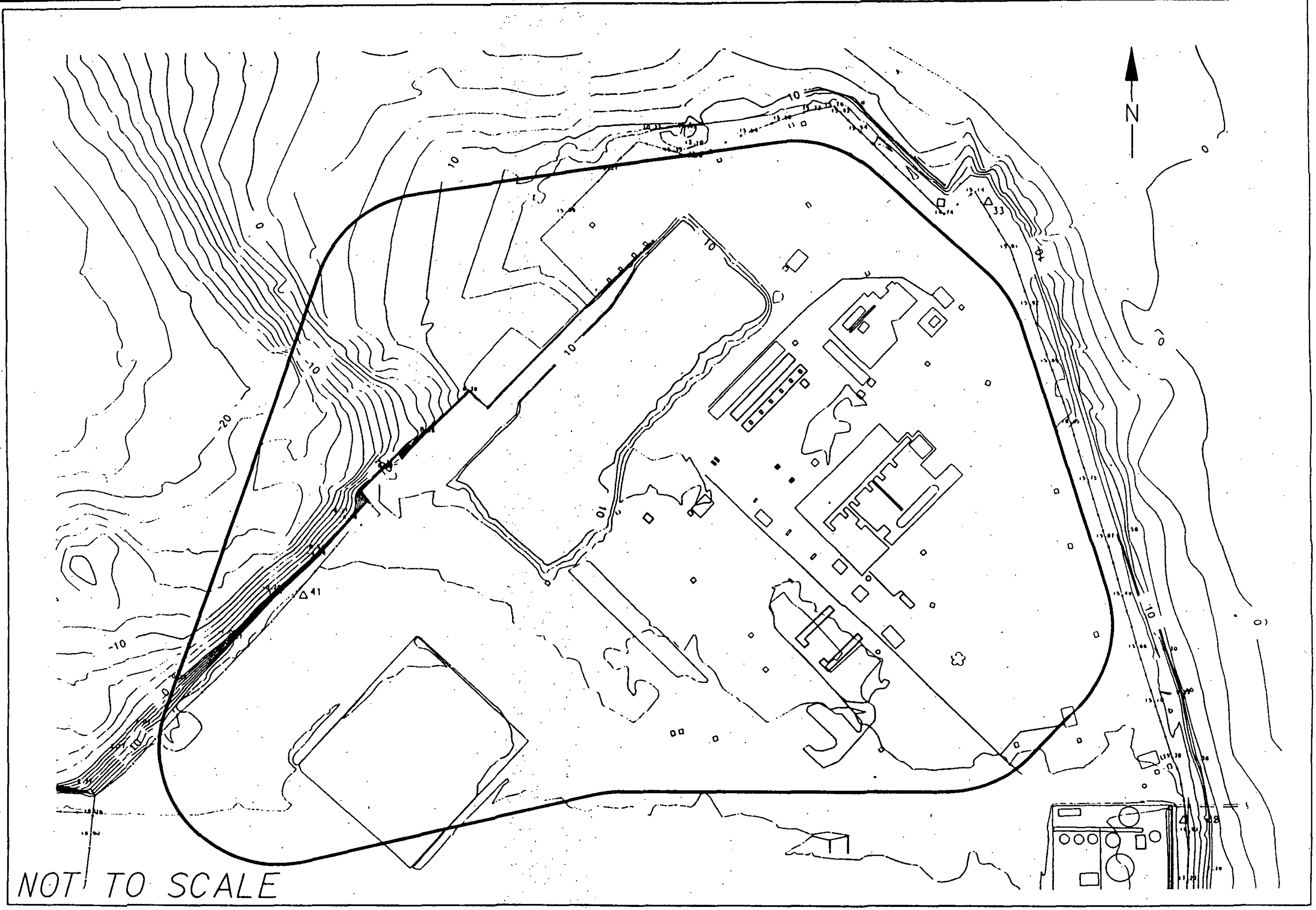
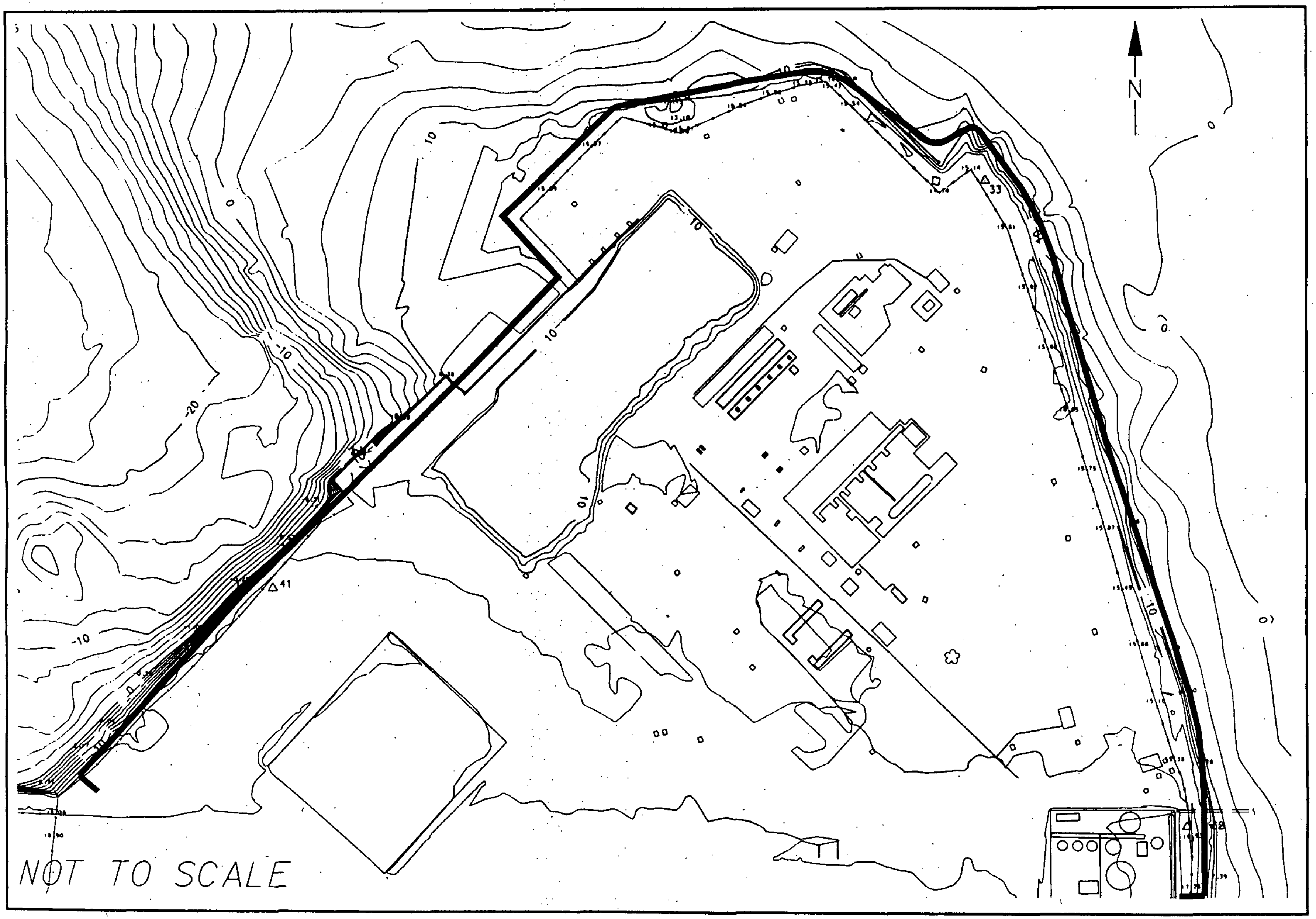


Figure 8
DELINEATION OF NON-POTABLE WATER IN UPPER AQUIFER



POTENTIAL SLURRY WALL ALIGNMENT

Figure 9



POTENTIAL SHEET PILE WALL ALIGNMENT (PARTIAL WALL)

Figure 10

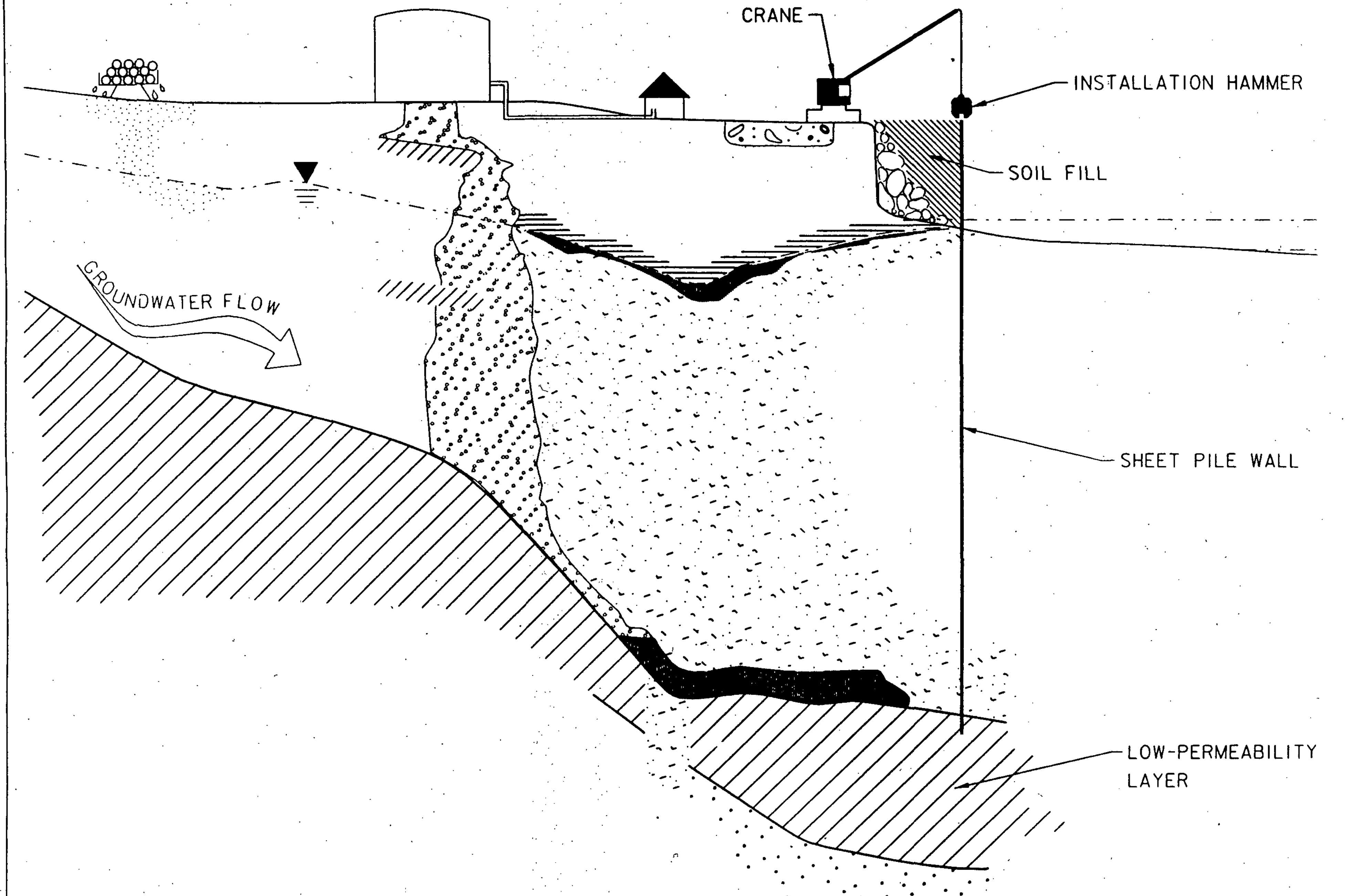


Figure 11

CROSS SECTION OF POTENTIAL SHEET PILE WALL

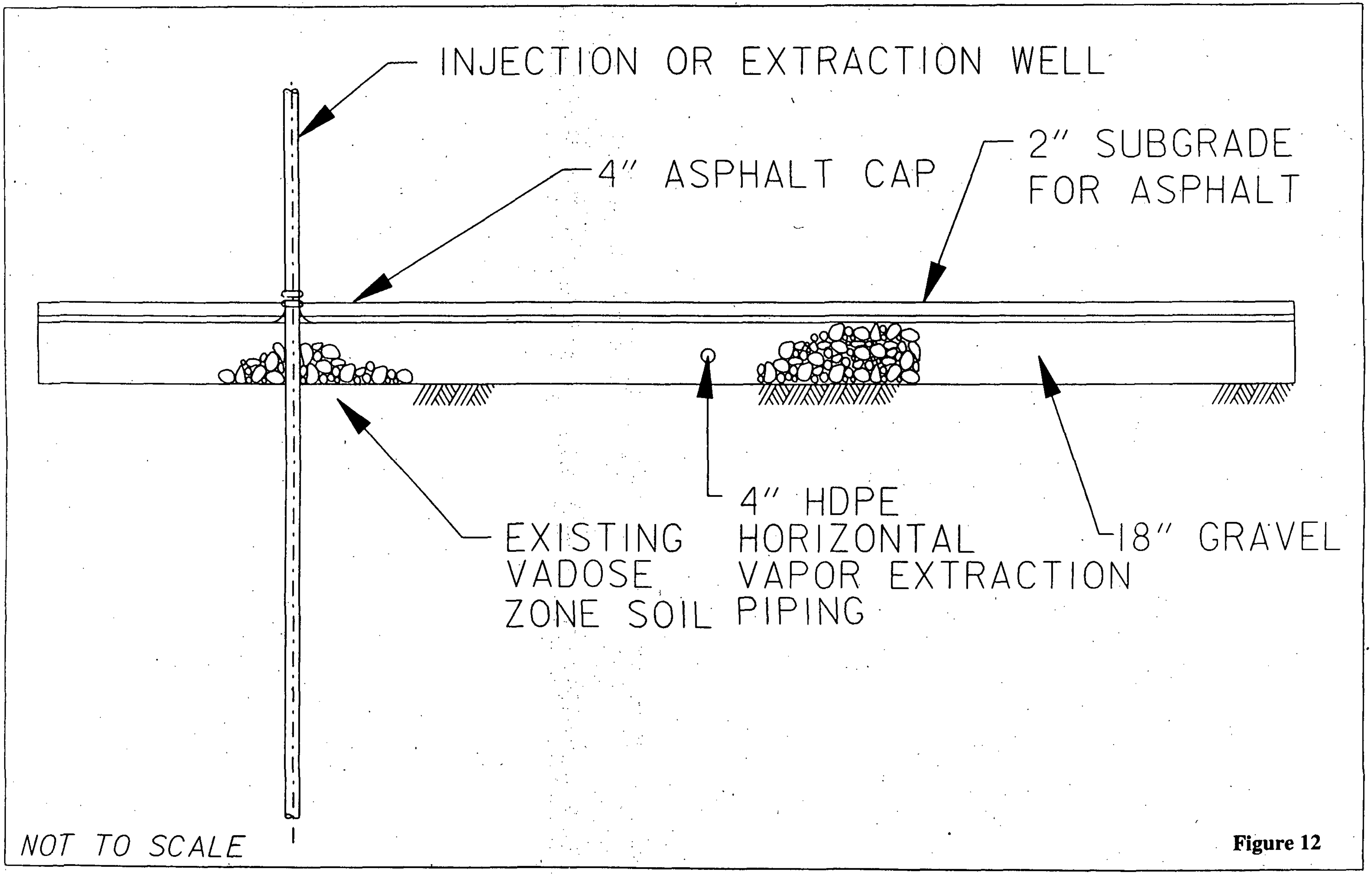


Figure 12

CONCEPTUAL STEAM INJECTION VAPOR COVER SYSTEM

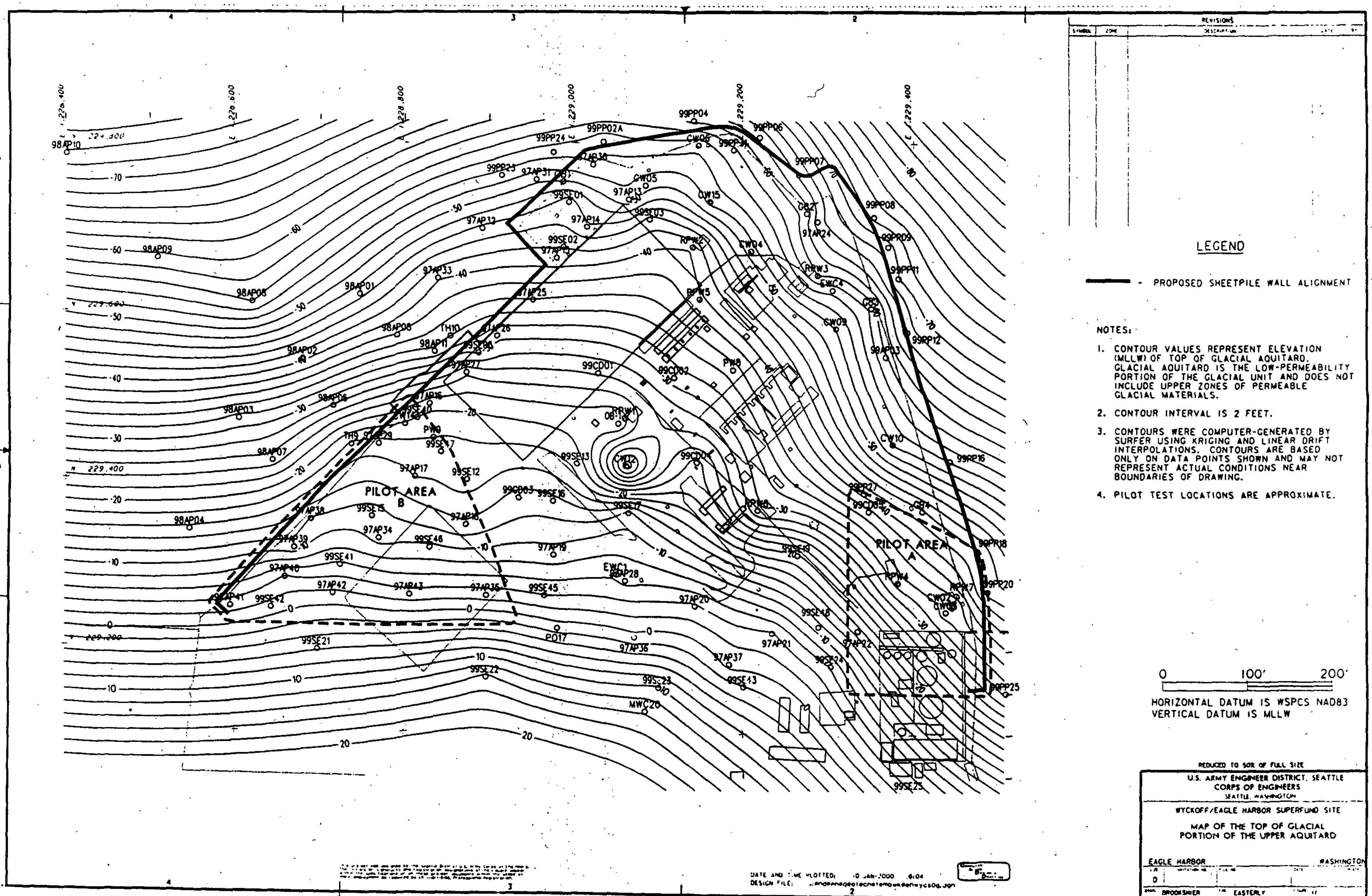


Figure 13

Potential Pilot Study Locations

WYCKOFF/EAGLE HARBOR
SUPERFUND SITE
BAINBRIDGE ISLAND, WASHINGTON

RECORD OF DECISION

PART 3: RESPONSIVENESS SUMMARY

February 2000

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WYCKOFF/EAGLE HARBOR
SUPERFUND SITE
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RECORD OF DECISION

RESPONSIVENESS SUMMARY

This document responds to comments received regarding the Proposed Plan for cleanup of the Wyckoff/Eagle Harbor Superfund Site, Soil and Groundwater Operable Units. Several of the reviewers provided similar comments on this document. Responses and discussions are organized by general topic. EPA's responses are presented in the first section of this Responsiveness Summary. Attachment 1 includes a copy of all original comments received on the Proposed Plan, and Attachment 2 summarizes the oral comments received during the Public Meeting held on October 21, 1999 at the Bainbridge Island Commons.

1. COST/RISK ANALYSIS OF NO ACTION AND CONTAINMENT

A group of reviewers requested EPA to estimate the damage, cleanup costs and operations that would be required if contaminants were not removed. They would like to know the risks and potential costs of leaving the contaminants in the ground.

The same group of reviewers also requested EPA to compare the level of continuing seepage of contaminants into Eagle Harbor that would result from selecting No Further Action (Alternative 1) with seepage levels anticipated with Alternatives 2 (Containment) and 3 (Thermal Remediation).

EPA Response: EPA conducted a human health and ecological risk assessment for Eagle Harbor in 1987 and also in 1997 for the Soil and Groundwater Operable Units. Environmental risk in Eagle Harbor is indicated by harm to marine life living on or in the contaminated sediments. Liver and reproductive damage in Eagle Harbor bottom fish is well documented. EPA tests also show that the contaminated sediments are toxic to organisms such as small crustaceans and oyster larvae, which are important indicators of marine environmental health. Contamination was also found in fish, crab, and clam tissues, indicating uptake through direct contact with contaminated sediment or bioaccumulation through the food chain.

The risk assessment found that if the contamination is not addressed at Wyckoff, human health and ecological effects would be unacceptable. Wyckoff groundwater and soil contain contamination that is carcinogenic to both humans and animals. If the contaminants are left alone, they would continue to seep out into Eagle Harbor, and would recontaminate the sediment cap that was put in place in 1993 and 1994. There is also a high risk of contaminants moving into the lower aquifer, a potential source of drinking water for the island. EPA recently observed pathways in the aquitard (the protective layer separating the upper and lower aquifer) that will eventually allow the creosote product to enter the lower aquifer. The possibility exists that contamination of the lower aquifer has already occurred in areas we have not yet detected during field investigation activities.

Regarding the issue of costs, as the September 1999 Proposed Plan indicated, the costs of No Further Action is minimal compared to other alternatives. However, the continued release and migration of contaminants from the site represents a current and future risk to human health and the environment, which is not acceptable to EPA.

EPA has not quantified the level of creosote seepage into Eagle Harbor. However, seeps are continuously observed during periodic mapping events. As stated above, ongoing seepage would continue if no action is taken. Seepage would be eliminated with both containment alternatives (2a and 2b) and Alternative 3. However, as discussed in the Proposed Plan and in response #2, below, the costs of containment as presented in the Proposed Plan are 30-year estimates. The actual costs of the containment remedies would be ongoing in perpetuity, with yearly operation and maintenance costs as well as periodic replacements of the containment components (i.e., pump-and-treat system and barrier wall replacement/repair) unless a cost-effective treatment technology is employed in the future. Some operation and maintenance costs may be required under the Selected Remedy (Alternative 3) after thermal treatment is completed, however, the duration would be much shorter due to large amounts of contaminants expected to be removed. Under the current Superfund law, all operation and maintenance costs starting 10 years after the remedy is operational and functional would need to be bourne by the State of Washington Department of Ecology.

2. CONTAINMENT vs. THERMAL REMEDIATION

One group of reviewers preferred Alternative 2b, Containment with a Sheet Pile Wall. They found this alternative to be the most cost effective, safest, and of least impact to the community.

EPA Response: While EPA recognizes that Alternative 2b poses lesser impacts from the community standpoint in the short-term, we do not believe that this alternative would provide the greatest long-term protection of human health and the environment. As discussed in the September 1999 Proposed Plan, the containment remedies pose a potential of failure in the future as well as perpetual operation and maintenance costs (unless a cost-effective treatment technology is undertaken). There would also be future land use restrictions placed on this site with the containment alternatives. However, as Section 12 of the ROD indicates, Alternative 2b is the contingent, or fall-back remedy, if thermal treatment is not successful.

3. STEAM INJECTION vs. ELECTRICAL RESISTANCE HEATING

The same group of reviewers suggested that EPA should consider testing electrical resistance heating as well as steam injection during the pilot study. They suggested that careful site-specific review of the technologies should be undertaken before the preferred method is selected. Another group of reviewers stated their preference for electrical resistance heating over steam injection.

EPA Response: EPA has conducted a thorough review of existing data from the use of these two technologies at other sites. Additionally, EPA has been working closely with experts in the field of electrical resistance heating. Based on our review and the recommendations of prominent thermal remediation professionals, it is clear that electrical heating alone would not accomplish the Wyckoff cleanup goals and would not be as cost effective as steam injection. However, it is firmly believed that electrical resistance heating would be a very useful technology to enhance the heating of this site and to aid steam injection in the recovery of contaminants. At this time, EPA plans to test the electrical resistance heating technology during the pilot study, as a supplement to steam injection.

4. MITIGATION COSTS

One reviewer noted that habitat mitigation costs are only included for Alternative 2a (Containment with a Slurry Wall). The reviewer requested an estimate of mitigation costs associated with Alternatives 2b (Containment with a Sheet Pile Wall), and Alternative 3 (Thermal Remediation).

EPA Response: It is estimated that mitigation for Alternative 2a would cost approximately $1.2 million due to permanent loss of 2-3 acres of intertidal habitat from the construction of an offshore berm and backfill for the slurry wall. As for the costs for habitat mitigation for Alternatives 2a and 3, because the sheet pile wall would not require significant offshore construction, the loss of intertidal habitat is estimated to be 0.6-0.9 acres. The costs to mitigate this loss would be approximately $250,000.

5. COMMUNITY IMPACTS/CONCERNS

Many reviewers raised concerns regarding the impacts to the community during the construction of the sheet pile wall and during operation of the thermal remediation system. These concerns and discussions are presented by subtopic below.

5.1 Sheet Pile Driving Noise Issues

Some reviewers are concerned about the level of noise that would be generated from the construction of the sheet pile wall at Wyckoff. When the Proposed Plan was published, it was anticipated that the sheet pile wall would be constructed during the months of August - December 2000. However, the reviewers suggested that the construction should be delayed until the winter months, from November 2000 - February 2001, when windows and doors would be closed, thus, minimizing noise disturbances to nearby communities. Also, it was suggested that the sheet piles be driven during the hours of 10:00 and 3:00, with a 45 minute break period, to minimize disturbances to residential activities. Finally, EPA was urged to engineer noise abatement measures to reduce offsite noise.

EPA Response: EPA understands the concerns of the community regarding noise levels. During our sheet pile driving test in September 1999, noise levels above 80 decibels (dB) were recorded in surrounding communities. For several reasons, the construction of the sheet pile wall is now anticipated to occur between November 2000 - February 2001. As noted by several reviewers, construction during winter months will help to minimize noise disturbance. EPA will continue to assess different noise abatement techniques and options during the design phase of this project (February - June 2000). To the maximum extent practicable, EPA will utilize different noise abatement measures to reduce impacts to nearby communities (see also Section 12.3 of the ROD). The Washington Administrative Code (WAC 173-60) specified a noise limit of 60 dB from an industrial noise source to a residential receiving property. However, noises generated by construction sites due to construction-related activities are exempt from limits specified in the WAC between the hours of 7:00 a.m. and 10:00 p.m.

However, it is EPA's intent to minimize noise to the residential areas as much as possible. Sheet pile driving will be restricted to between the hours of 8:00 a.m. and 5:00 p.m. Of the two types of hammers EPA tested and noise monitored, the vibratory hammer generated louder, more annoying sounds for sustained periods than did the diesel hammer. However, because the piles were driven much more quickly with the vibratory hammer, the use of this device will minimize the total duration of the noise.

Based on our noise level assessment, the Wing Point community will have the highest noise levels because of its location close to the water, with a clear line of sight to the pile driving location. Neighborhoods such as Bill Point, Rockaway Beach, and Eagledale will be less affected by construction noise.

The timing of the sheet pile wall installation is crucial. The Washington State Department of Fish and Wildlife and the National Marine Fisheries Service agencies have banned in-water construction during the fish window of February 15 - August 15. Therefore, any in-water activities must be completed prior to this period.

5.2 Noise Levels During Thermal Remediation/Boiler Operation

Several reviewers also raised the concern that the steam boiler would likely be noisy and requested noise mitigation measures during the period of thermal remediation.

EPA Response: While it is unclear at this time what the noise levels would be during thermal operation, EPA will assess this concern during remedial design and during the pilot study phase of this project. Exceedances of noise levels per the Washington Administrative Code discussed above will be evaluated. Some possible controls to reduce system operation noise may include:

- Limiting vehicle traffic to daylight hours and non-rush-hour times
- Limiting vehicle traffic on ferries
- Delivering steam boiler fuel by barge
- Containing the steam boiler in a building
- Insulating steam pipes
- Enclosing pumps in buildings or vaults

Mitigation measures will be implemented during full-scale operation, if necessary.

5.3 Diesel Fuel vs. Propane Fuel

Some reviewers also specified a preference for propane as a fuel choice for use in the steam boilers. They are concerned about potential air emissions and odors associated with diesel fuel.

> EPA Response: During our preliminary assessment, it was determined that liquid propane is not a viable boiler fuel. While propane has been employed as a backup fuel source for natural gas fired boilers in the anticipated size range (25,000 to 75,000 lbs. of steam generated per hour), we have not been able to identify any boiler plants in this size range that use propane as a primary fuel source. Bulk storage of propane would be more costly as the vessels must be pressure rated. Also, the quantity of propane necessary for any given thermal capacity would exceed the quantity of diesel fuel oil. At the full firing rate for one week, approximately 109,000 gallons of fuel oil would be required, while approximately 170,000 gallons of propane would be necessary. In addition, a vaporization station that could handle the required propane flow would cost an additional $110,000.
>
> EPA will assess potential air emissions and odors associated with diesel fuel during the pilot study. EPA is required, by law, to meet the standards of the Clean Air Act and the Puget Sound Air Pollution Control Agency (PSAPCA) standards for emissions. Odor mitigation measures would be implemented, if necessary.

5.4 Barge Delivery of Fuel vs. Truck Delivery

Some reviewers stated their preference for using barge to transport fuel to the site. Transfer of fuel by truck would have an impact on the island's streets and highways.

> EPA Response: Due to concerns over truck traffic, EPA has determined that fuel oil delivered to the site by barge would be more appropriate.

5.5 Odors During System Operation

Another concern raised is the possibility of odor problems during system operation.

> EPA Response: It is possible that some odors may be generated from the site as part of the cleanup process. At this time, EPA is unable to quantify this issue, however, the pilot study will provide valuable information and any problems will be addressed, as appropriate.

5.6 Light Glare During System Operation

One group of reviewers suggested the use of light reduction methods to reduce glare in adjacent residential neighborhoods, such as shades on exterior lighting.

> EPA Response: It is unclear at this time how much of a problem this may be. To the extent practicable, EPA will incorporate this concern into the designs of a full-scale thermal cleanup project. Care will be taken to require light shields and guards to reduce

the amount of direct or reflected light escaping from the property.

5.7 Site Landscape

One group of reviewers requested EPA to consider landscaping part of the spit area with vegetation to mask the thermal system equipment that could potentially be on-site for a period of 10 plus years of cleanup. Similarly, another group of reviewers suggested landscaping of the vapor cover.

EPA Response: These comments and suggestions are noted. EPA does not typically use cleanup funds to landscape sites. To the extent possible, EPA will place the structures away from the shoreline toward the hillside. Also, tanks and equipment necessary for thermal remediation will be on-site only during the period of steaming, estimated to be a maximum of 3 years. After steaming, a significant amount process equipment will be removed. Beyond those years, even though the pumping and treating of contaminants will continue, the visual nuisance is not anticipated to be as significant.

5.8 Community Outreach During System Operation

A group of reviewers requested a community monitoring system and complaint response program that will address impacts to the adjacent residential communities quickly and effectively.

EPA Response: EPA will identify the appropriate personnel. including on-site staff, for the community to contact should a problem arise.

5.9 Compare/Contrast Community Impacts Associated with Each Remedial Alternative

A group of reviewers requested further information comparing and contrasting the impacts of various cleanup alternatives to adjacent residential communities, and what specific steps will be taken to mitigate noise and air emissions in various alternatives. The reviewers also requested a comparison of time lines of each alternative with the estimate of time required for continuing operations.

EPA Response: EPA has completed an evaluation and compared/contrasted the "nuisance factors" of the local community associated with each remedial alternative, i.e., noise, traffic, visual, and odors. This evaluation can be found in a report entitled, *Focused Feasibility Study, Comparative Analysis of Containment and Thermal Technologies*, dated April 1999. This report is located in EPA's Administrative Record and can be viewed at the Bainbridge Island library or at EPA's Record Center in Seattle.

Please see the discussions above regarding EPA's responses to the noise and air emission mitigation questions, and response #10, below for a description of the thermal project time line.

6. DESIGN ISSUES

Reviewers raised a number of issues relative to the design of the remedy. Design issues and discussion are presented by subtopic below.

6.1 Proper Seating of Sheet Pile into Aquitard

A group of reviewers inquired about methods to assure that proper "seating" of the sheet pile wall into the aquitard and to avoid breaching of this confining layer.

> EPA Response: Strategies will be developed in the design phase to avoid damage to the aquitard by restricting the use of an impact hammer. As far as ensuring proper seating of the sheet pile wall into the aquitard, a geologist familiar with the Wyckoff subsurface strata will be at the site at all times during sheet pile driving to carefully monitor the event. The geologist will be comparing pile-tip depths, driving action, and penetration rates with data from corresponding well logs to determine the exact depths to which the piles should be driven in order to reach and be adequately seated into the aquitard material.

6.2 Heat Effects on Sheet Pile Joints

One reviewer expressed a concern of how heat will affect the malleability and inter-locking mechanisms of a sheet pile wall and ultimately the effectiveness of the wall to contain contaminants.

> EPA Response: Heat should not adversely affect the sheet pile joints since they do not need to be sealed or grouted. The type of piles that EPA has tested and selected for this site have close-fitting joints and are expected to perform as well as conventional piles without any need for joint sealants. Since all of the joint material will be of the same type, expansion and contraction with changing temperatures will be at similar rates, keeping the amount of contact between joint members at a high level throughout thermal operations. Thermal stresses along the wall should be accommodated by the flexibility inherent in the Z-shaped piling design.

6.3 NAPL Migration Thru the Aquitard into Lower Aquifers

One reviewer noted that the Proposed Plan included a figure which indicated potential migration of dissolved-phase contaminants and DNAPL through higher permeable areas of the aquitard into the lower aquifer. The reviewer requested more explanation of how the preferred alternative (Alternative 3) will affect migration of NAPLs into the lower aquifer and how EPA will address this concern.

> EPA Response: While it is true that there are areas around the site which DNAPL has found a pathway into the aquitard by means of higher permeability zones, EPA has not found an area where DNAPL has completely penetrated the aquitard. Based on the aquitard permeability data (hydraulic conductivity) and well logs collected to date, it is believed that the higher permeability zones primarily occur in a relatively small area in

the central portion of the site. In recognizing this concern and in evaluating the effectiveness of the steam injection remedy, EPA has conducted a series of NAPL density measurements as a function of temperature. Results indicate that DNAPL will become less dense than water (i.e., become LNAPL) with increasing temperatures. This is important because when NAPL becomes less dense than water, it will no longer have a tendency to move downward, and will be easier to recover as floating product.

An additional factor, which may have provided some protection for the lower aquifer, is the naturally occurring upward groundwater flow through the aquitard. Aggressive groundwater and NAPL pumping will be conducted during the thermal treatment of the upper aquifer, amplifying the existing upward gradient and providing further resistance to downward movement of contaminants.

6.4 NAPL Migration Through the Sheet Pile Wall

The same reviewer also requested additional information on how effective a sheet pile wall may be in stopping or reducing the migration of NAPLs currently seeping from the groundwater into the marine environment.

EPA Response: A sheet pile wall, if constructed properly and adequately seated into the aquitard, will substantially impede the migration of contaminants and possibly stop them altogether. EPA will be installing the thickest available sheet piles known with the tightest joints, similar or equal to the Frodingham Z-section steel piles. In addition, the thermal treatment strategy requires aggressive pumping inside the sheet pile wall, reducing groundwater levels below those outside the wall. This practice will induce an inward gradient which will act as further insurance against offsite transport of contaminants.

6.5 Thermal Remediation of Dioxins/Furans

A reviewer inquired about how EPA intends to remediate dioxins and furans from the site.

EPA Response: A steam injection experiment was performed in a laboratory study to assess whether polychlorinated dioxins and furans can be recovered from the soil by steam injection. The results of this experiment show that significant reductions in the dioxin concentrations may not be possible by steam injection due to its low vapor pressures. Since vaporization is the main recovery mechanism in these laboratory experiments, significant recovery of these very low vapor pressure compounds would not be possible. However, the importance of different recovery mechanisms in the field, such as recovery in the liquid phase, may aid in removing more of the dioxins than were recovered in the lab.

EPA will further evaluate the remediation of dioxins and furans by thermal means during the on-site pilot study. Contingencies such as a surface soil cap or institutional controls will be developed to address this area of uncertainty.

6.6 Thermal Remediation of High Molecular Weight PAHs

One reviewer noted that lab results show that steam injection is effective in removing total PAHs from soil; however, high molecular weight PAHs such as benzo(a)pyrene remain in high concentrations. The reviewer asked how EPA plans to remediate these remaining PAH constituents.

> EPA Response: The results from the initial steam injection experiment show that 99 percent of PAHs can be removed when the creosote is composed mainly of the more volatile components. When the soil contains greater amounts of the higher molecular weight PAHs, somewhat longer periods of steaming will be needed to achieve the same removal efficiency. The leaching test for this experiment showed that when the soil is cooled, very little of the remaining PAHs will dissolve into the aqueous phase, which means that the remaining contaminants will not move into the groundwater, and thus, into surface water and sediments. However, when the soil is still hot, significant amounts of the remaining PAHs will dissolve into the aqueous phase, even after steam injection has ended, which will help to increase recovery of the contaminants.
>
> Additionally, it has been demonstrated at the Visalia Steam Remediation Project that oxidation and biodegradation of residual contaminants will occur under the conditions that are likely to exist after the completion of steam injection. EPA is in the process of evaluating these processes and their ability to destroy the high molecular weight PAHs that remain after steam injection.

6.7 Vapor Cover Materials

One group of reviewers requested EPA to consider the use of plastic or other vapor barrier methods to find the best and most compatible method.

> EPA Response: EPA will evaluate the most technically sound and heat-compatible vapor cover during the project design. Various vapor cover types and materials may also be evaluated during the on-site pilot test. This vapor cover will be removed when thermal cleanup is complete.

7. WATER SUPPLY FOR STEAM GENERATORS

A number of reviewers objected to EPA's plan to drill a deep production well to the west of the Former Process Area. EPA would have used this well to evaluate sustainable aquifer yield and to assess potential impacts to existing water rights holders. It is EPA's preference to use the groundwater supply for steam generation if there is adequate yield and if pumping would not impair current users of the groundwater supply. However, concerns that have been expressed include: (1) preservation and conservation of the island's only source of domestic water supply; and (2) potential for introduction of contamination into the lower aquifer from the drilling of a production well.

These reviewers requested EPA to seriously consider using the City of Bainbridge Island's sewage treatment plant effluent, located across Eagle Harbor, as the source of water for steam generation.

Another group of reviewers requested EPA to retest and monitor the Bill Point water supply wells to ensure that EPA's pumping of the deep aquifer for water would not jeopardize this existing resource.

EPA Response: EPA would like to assess all possible water supply alternatives, including estimated costs, prior to making a final decision. EPA will be conducting these evaluations during the design phase of this project (see also Section 12.3 of the ROD). The City's proposed option of the sewage treatment plant effluent is an option that warrants attention. However, if the effluent option proves cost-prohibitive, then EPA would continue with plans to install a groundwater production well outside of the highly contaminated areas on the Wyckoff property. It is potentially difficult to transport the water across Eagle Harbor and laying a pipe on the sediment to Wyckoff may be unacceptable due to disturbances to the sediment cap. This issue requires additional research and discussion with State agencies before a decision can be made. A maximum of 200 gallons per minute (gpm) of water is anticipated for thermal remediation.

If it is ultimately decided that an on-site water well needs to be installed, every precaution will be taken to eliminate the potential of contaminants from entering the deep aquifers. EPA will also conduct a pumping test of this well and develop a monitoring program to ensure that existing nearby users would not be affected. If an effect is determined, EPA will consider other options to minimize the effect on neighboring water users.

8. FIRE SAFETY DURING OPERATIONS

A few reviewers raised a concern of potential fire incidents associated with the preferred cleanup alternative and requested a careful analysis of fire safety. They asked EPA to coordinate with the local fire department.

EPA Response: EPA is very concerned about the safety of on-site workers as well as nearby residents should a fire occur. EPA has always been very conscientious about development of a health and safety plan, as required by law, for every activity that occurs on-site. Because of a potentially higher risk of a fire due to fuel being stored on-site for thermal remediation, EPA will conduct a thorough review of fire safety and will develop a fire prevention plan. This plan will also include provisions on responding to potential fires. EPA will consult with local authorities, especially the fire department.

9. ASSESS IMPACTS TO WILDLIFE AND ECOSYSTEM DURING PILOT STUDY

One reviewer asked EPA to evaluate the possible negative impacts the pilot project may have to the surrounding ecosystem and habitats, particularly in the intertidal zone. Adverse impacts could include: temperature increases in water and sediment, increased migration of contaminants to offshore areas, and changes in sediment size and/or transport due to increased wave action from the sheet pile wall. EPA was requested to weigh any negative impacts to the ecological community against cleanup successes when making the final cleanup decision.

The reviewer also requested an explanation of the actions that will be taken to minimize effects to wildlife from the noise and odor of the remedial process or whether displacement of wildlife during remediation activities should be a concern.

EPA Response: EPA has been closely coordinating with the Federal and State Agencies (State of Washington Department of Ecology, Department of Natural Resources, Department of Fish and Wildlife, U.S. Fish and Wildlife Service, National Marine Fisheries Service, National Oceanic and Atmospheric Administration) and the Suquamish Tribe to develop a plan to monitor surrounding habitats and thermal effects in the intertidal zone during the pilot study and full-scale remediation. The pilot study, along with thermal effects monitoring, will provide valuable information to Trustee Agencies and EPA. EPA will incorporate the data gained during these studies into our final decision process.

In addition, EPA is in the process of completing an updated Biological Assessment pursuant to the Endangered Species Act, in coordination with the Natural Resource Agencies. Previous assessments failed to identify use of the site or nesting by species of concern. Construction of the sheet pile wall, likely to cause the most disturbance to wildlife, will occur outside Bald Eagle and Peregrine Falcon nesting periods and the State mandated fish window. Other wildlife in the area tend to be urban adapted species such as deer, Canadian geese and gulls.

10. PROJECT TIME LINE

One group of reviewers requested an overall description of the term of the preferred alternative with details of each phase that describes the potential impacts to the community for each phase.

EPA Response: The time line for the thermal remediation project is as follows:

Phase	Time Frame	Years
Pilot Study[a]	1-2 years	2000 - 2002
Full-Scale Designs[b]	1 year	2002
Full-Scale System Construction	1 year	2003
Full-Scale System On-Line		2004
Steam Injection & Contaminant Recovery	3 years	2004 - 2007
Continued Contaminant Recovery	5 years	2007 - 2012
Full-Scale Cleanup Completed		2012
Post-Remedial Monitoring	2 years	2012 - 2014
Ongoing Natural Oxidation/Biodegradation	5 or more years	2014 & beyond

[a] Stake-holders and interested parties will have opportunities to provide input during the designs and operation of the pilot study, and will have access to the data generated during the pilot study.

[b] If results of the pilot are favorable after the 1st year of operation, then the designs for the full-scale remediation system can commence.

The specific impacts to the community for each phase of the project are unclear at this time. One of the goals of the pilot study is to fully evaluate these issues and design for mitigation measures, as appropriate, during the full-scale cleanup of the project.

11. POST-REMEDIAL CONFIGURATION

One reviewer noted that the Proposed Plan did not discuss post-remedial configuration (what the site will look like when cleanup is complete). The commenter hoped that the same level of investigation and planning put forth to date is utilized to create a final post-remedial intertidal plan that truly enhances the aquatic ecosystem. EPA was also encouraged to work with the community to define a "vision" for the site.

> <u>EPA Response</u>: Much of the post-remedial configuration will be determined by the mitigation plan for the site. EPA has been and will continue to coordinate closely with the Natural Resource Agencies, the Suquamish Tribe, and the City of Bainbridge Island to develop an acceptable mitigation plan for the sheet pile wall, and to address future land use and resource issues. Mitigation will be required because sections of the sheet pile wall will be constructed offshore, resulting in loss of habitat. The mitigation plan likely will modify large parts of the western shoreline to create a gently sloping beach that will significantly enhance habitat and ecosystem at the Wyckoff site. As part of the mitigation effort, EPA will also develop protective measures to support and protect functions of nearshore habitat. EPA will include the community groups in design of the plan, as appropriate.

12. MISCELLANEOUS COMMENTS

12.1 Clarification Comment

One reviewer requested clarification of the statement in the Proposed Plan, "Site specific contaminant concentration limits that are protective of the environment are being developed for the Former Process Area groundwater."

> <u>EPA Response</u>: EPA, in conjunction with the Washington State Department of Ecology, has been developing alternate concentration limits (ACLs) for groundwater that must be achieved at the mudline in order to be protective of marine water quality standards, surface water standards, and sediment management standards. These numbers were necessary because, due to the non-potable quality of the upper aquifer groundwater, EPA will not be cleaning the groundwater to drinking water standards.
>
> Pending completion of the fate and transport analysis which will provide ACLs for site groundwater, the groundwater cleanup levels shown in Table 13 of the ROD may be used as conservative indicators of aqueous contaminant concentrations that must be achieved within the uplands portion of the site.

12.2 Why is a Sheet Pile Wall Less Expensive Than a Slurry Wall?

> <u>EPA Response</u>: In general, slurry walls are more expensive than sheet pile walls because of the high costs involved in excavating the wall "slot", mixing and transporting the slurry which keeps the excavation open, and preparing the specially designed contaminant-resistant backfill material, which forms the final wall structure. In contrast, sheet pile walls are formed simply by driving interlocking steel panels to the required

depth, using less equipment, time and materials than the equivalent slurry wall construction. In addition, site specific conditions at the Wyckoff property present major constructability issues associated with equipment limitations, buried debris, bulkheads, and tie-backs. Consequently, the slurry wall would have to be constructed off-shore, requiring a significant amount of fill in the intertidal/subtidal area. These construction issues double the typical slurry wall construction costs. Additional construction costs would be incurred to mitigate for the 2-3 acres of lost habitat caused by the off-shore fill.

12.3 Can a Pilot Study of One or Two Years be Done in Another Location, Rather Than in This Populated Community?

EPA Response: One key reason for conducting a pilot study at the Wyckoff site is to obtain site-specific data regarding the technology's ability to cleanup the soil and groundwater to protective standards. Pilot studies as well as full-scale cleanup projects using steam injection have been done at other sites. However, it is difficult to extrapolate the achievements at those sites to Wyckoff because every site is different (e.g., geologic and hydrologic conditions, site location and configuration, contaminant properties, etc.). In addition, a pilot study at the site is necessary to obtain engineering data for appropriate design of the cleanup process tailored to Wyckoff. Finally, EPA believes that it is necessary to have site-specific performance information in order to make a prudent and cost-effective decision regarding the most appropriate cleanup approach.

As discussed above, EPA will be taking measures to minimize community impacts as much as possible.

12.4 Will EPA Bring a Portable Generator to Provide Power if Electrical Resistance Heating is Used?

EPA Response: Based on our preliminary analysis and discussions with Puget Sound Energy, it appears that there will be enough electrical capacity in the current transformers located at Wyckoff to accommodate implementation of Electrical Resistance Heating process at this site. EPA's use of this electrical power should not impact the community supply.

12.5 Will Any Portions of the Site be Available for Use Before Cleanup is Completed?

EPA Response: The majority of the cleanup actions will take place within the Former Process Area. If the pilot test is successful, EPA will consolidate the Former Log Storage/Peeler Area soil within the Former Process Area for thermal treatment. As a result, the entire western portion of the Wyckoff property will be clean. However, the Wyckoff site is being managed by an Environmental Trust, which makes all the decisions associated with property management and sale of the property. Once EPA has certified that cleanup actions are complete, it is within the Trust's discretion to make cleaned areas of the site available as it sees fit.

12.6 Is Contamination Present on the Sediment Cap in Eagle Harbor?

EPA Response: The majority of the cap meets the cleanup goals established in the East Harbor September 1994 ROD for subtidal sediments. However, recent sampling of the sediment cap indicates contamination above cleanup goals exists at a few locations on the southern portion of the cap. One possible source of this contamination is the Wyckoff property. Creosote has been observed seeping through the bulkhead on the western side of the Wyckoff property onto the floor of the harbor. EPA has taken several actions to control the flow of creosote into the harbor along the bulkhead. Installation of a sheet pile wall along the shoreline will effectively eliminate the source of contamination to the harbor.

ATTACHMENT 1

October 26, 1999

RECEIVED
NOV 0 2 1999
Environmental Cleanup Office

Attn: Director EPA Seattle Region

From: Association of Bainbridge Communities (ABC) TAG Group
Box 10999, Bainbridge Island WA 98110

Re: **Comments** of Association of Bainbridge Communities (ABC) TAG Group **to Proposed Plan for Cleanup of Wyckoff Site/ Eagle Harbor**

Dear EPA:

We make the following comments to the Proposed Plan issued in September of 1999 for Public Comment.

1) **We support funding and development of a Pilot Project to use thermal technology at the Wyckoff Site as described in Alternative 3 of the Plan conditioned on (2) below.** Before addressing the conditions in (2) below, please note that we believe the Proposed Plan Report is deficient in the following areas and should provide the following:

- estimate the damage and responsive cleanup costs and kind of operations that would be required if contaminants are <u>not</u> removed (alternatives (1) and partial (2)) and eventually move into underlying and adjacent fresh water aquifers and continue to move into Eagle Harbor area. **The community needs to know the risks and potential costs of leaving the contaminants in the ground and the likelihood of eventual migration.**

- provide further information comparing and contrasting the impacts of various alternatives to adjacent residential communities. What specific steps will be taken to mitigate noise and air emmissions in various alternatives? Report should compare time lines of each alternative with best estimate of time required for continuing operations. For example, Report should state and compare noise and vapor levels and time periods of sheet pile installation and steam technology of Alterantive 3 with Alterntive 2 (continuing pump and treat) and with "no action" Alternative 1. Similarly Report should compare level of continuing seepage of contaminants into Eagle Harbor that would result by selecting "no action" Alternative 1 with seepage levels anticipated with Alternative 2 and 3.

2) **ABC TAG support is conditioned on EPA establiching certain limits for noise and vapor emissions and utilizing certain methods and designs to limit the adverse impact of the cleanup on the surrounding community.** (The following are not listed in any special priority).

- quantify the numbers (state hard numbers) that will be used to establish the "reasonable" levels for noise and vapor emission. The Proposed Plan does not establish noise and vapor emission levels. Such numbers not only must meet the standards of regulatory bodies but also should be stricter so as to meet the specific "close adjacent" residential conditions at the site. More funding should be used to make the cleanup process tolerable to adjacent residential areas. There should be an opportunity for review of these numbers once quantified by EPA.

- establish and describe methods that will assure that "seating" of the perimeter sheet pile does not cause a breach of the underlying aquitard. Breach of the aquitard might have extremely negative consequences.

- provide an overall description of the term of the project (preferred alternative) with details of each phase that describes the potential impacts to the community <u>for each phase</u>. The Proposed Plan, page 16, does not chart the time process sufficiently or correctly.

- consider use of electrical resistance as well as steam technology in the pilot project. Careful site specific review of the technologies should be undertaken before the preferred method is selected.

- use propane fuel to heat steam if steam technology is utilized, unless propane fuel is shown to cause more emissions or other environmental problems than another fuel choice. EPA should not use diesel fuel to heat steam rather than propane since diesel fuel has significantly higher toxic air emissions (even with "scrubbers"), even if use of diesel fuel is cheapest method.

- use barge method to transport fuel source. ABC opposes proposed cleanup process if EPA uses "trucked in" diesel fuel since this would likely result in injury to persons as result of heavy truck traffic over 5 year period. EPA should not jeopardize safety of BI residents and disrupt residential communities with heavy truck traffic when better alternative of barged fuel is available. Excuse of needing special Coast Guard or other "permits" to barge in fuel is not an acceptable reason for not using barge method.

- use effective noise reduction methods during the pile driving process with specific limits that must be achieved before the process is undertaken. This would include a design process using most current available techniques in sound reduction.

- schedule pile driving from November to February so as not to interfere with summer residential conditions where residents are likely to be outside and have open windows.

- schedule pile driving from between 10:00 and 3:00 so as to minimize the interference with residential activities. Schedule should also include a regular 12:00 PM 45 minute break period.

- consider the use of plastic or other vapor barrier methods to find best and most compatible method.

- use of light reduction methods to reduce glare in adjacent residential neighborhoods. This would inlcude shades on exterior lighting.

- consider landscaping of part of the spit area with vegetation so that community does not have to live with visual blight for the entire 10-15 year cleanup period. Such process might include placement of soil over the vapor barrier and planting of ground cover bushes in areas that are not required for regular cleanup operations.

- allow digging of new water well only if it will not compromise existing aquifers. If a vapor barrier can be used to collect water, this should be used to provide an additional water source.

- include a careful analysis of potential fire incidents conducted with the local fire department.

- include **an improved community monitoring system and complaint response program** that will address impacts to the adjacent residential communities quickly and effectively. Prior EPA responses to residential complaints (during an accelerated soil cleanup project) regarding dust emmissions from contaminated and inadeqately covered soil piles were not satisfactory or timely.

Thank you for the opportunity to comment. ABC TAG Group.

Dave Davison - Coordinator (206) 842-7003

Dave Davison

CITY OF
BAINBRIDGE ISLAND

November 22, 1999

Ms. Hanh Gold
EPA ECL-115
1200 Sixth Avenue
Seattle, WA 98101

RECEIVED
NOV 2 1999

Subject: Wyckoff Cleanup Plan

Dear Ms. Gold:

The City Council of Bainbridge Island has instructed me by resolution to express this community's concerns regarding the methodology for the proposed cleanup of the Wyckoff property. As we understand it this will utilize steam injection into the soil in order to mobilize entrapped contaminants. Please recognize the advantages of utilizing clean effluent water from the Bainbridge Island Sewage Treatment Plant as the source of water for the steam generator(s). Currently this water flows out into the Sound, but because it is quite clean and essentially free of pathogens and solids, it would be appropriate--and freely available.

Your choosing to use the sewer plant water would demonstrate your recognition of the importance of recycling, not to mention the environmental advantage associated with preserving resources. That is, it seems utterly wasteful to drill wells and draw fresh water from aquifers underlying the island surface. We who live here are mindful of the fact that fresh water aquifers constitute a limited resource. I hope you might share that concern.

Please give careful consideration both to the economics and to the environmental advantages of transmitting wastewater from our nearby sewage treatment plant to the Wyckoff site for use in the cleanup process.

We are anxious to assist you in any way possible with the cleanup process. Feel free to call if you have further questions or issues that we might discuss.

Sincerely,

Dwight Sutton
Mayor

DS:hsw

cc: Lynn Nordby (e-mail)
Lita Myers (e-mail)
Vault

I:\Dwight Sutton\11999 letter to Gold.doc

CITY OF BAINBRIDGE ISLAND

OFFICE OF THE MAYOR

RECEIVED
DEC 03 1999
Environmental Cleanup Office

November 24, 1999

Hanh Gold, Wyckoff Project Manager
Environmental Protection Agency, Region 10
1200 Sixth Avenue
Seattle, Washington 98101

RE: Public Comment on Wyckoff/Eagle Harbor Superfund Site Soil and Groundwater Operable Units Proposed Plan, September 1999

Dear Hanh Gold, Wyckoff Project Manager,

The City supports the proposed plan that involves the actual cleanup of the Wyckoff Superfund site rather than containment as was previously proposed. The ten-plus year time line proposed for the completion of the cleanup process is much improved from the previous 30+ years involved in the containment plan. EPA should be commended in pursuing the new thermal remediation technology (Alternative 3) for application at the Wyckoff Superfund site. The on-site pilot project appears to be the best method to gather necessary data to make further decision regarding the cleanup of the Wyckoff site.

As EPA develops the proposal further, please address the following community concerns:

Future Land Use of Wyckoff Site

Please review the resolution passed by the Bainbridge Island City Council (attached) which indicates the intention for the future land uses of the Wyckoff property. The City is in the midst of amending the Comprehensive Plan to change the designated land use of the property to reflect the intentions outlined in the attached resolution. In the spring of 1998, the Wyckoff Comprehensive Plan Amendment process was suspended when EPA delayed the issuance of the final Record of Decision (ROD) for the Wyckoff Superfund site. Once EPA's cleanup direction is known, the City will resume the comprehensive plan amendment process, probably in late 2000.

The future land use of the property includes residential and marine related commercial uses. The waterfront portions of the property are intended for marine uses, particularly to provide opportunity for a small-craft boat repair yard. Any proposals to reshape the shoreline as part of restoration of the property should recognize the intentions of the City to continue to provide opportunity for marine related commercial uses on this property.

625 Winslow Way East • Bainbridge Island, WA 98110
Phone 206-842-2545 • Fax 206-842-5741

Sheet Pile Wall

EPA should consider keeping the sheet pile wall in place after completion of the thermal cleanup. If future monitoring of the site determines that additional treatment is necessary to meet health standards, then the continued existence of the sheet pile wall will be beneficial for further cleanup.

Water Source for Steam Injection

The proposed plan does not outline the possible water sources for the steam injection, nor how water sources would be evaluated for final selection. The previous feasibility study (June 1998), discussed five possible means of supplying water to the site: (1) on-site well, (2) off-site community water supply, (3) truck, (4) barge, or (5) seawater desalinization. It is the City's understanding that EPA prefers the on-site well alternative. However, the on-site well alternative could have adverse impacts on our community. The City is concerned for several reasons. There is a potential that drilling a new well may open an avenue for contamination of the lower aquifer. In addition, pumping at a high volume level of 200 gpm for a period of ten years for the purpose of treating contaminated soil may not be in the best interest of Bainbridge Island. Groundwater is our city's primary source of domestic water. Conservation of groundwater is important to our community's future. The pilot project needs to include criteria which addresses these impacts and assess the best alternative source of water for steam injection water requirements.

As you may recall, the City has offered to provide treated effluent from our sewage treatment facility. I understand the EPA is still exploring this option as a potential alternative for water supply.

Noise and Odor

Noise levels from the cleanup process should meet the City's adopted noise standards for residential uses. The proposed vapor barrier needs to meet the adopted State of Washington standards for air quality. It may be difficult to meet the residential noise levels for the sheet pile wall driving. In this case, pile driving should occur during hours and months when the noise will be less disturbing to the nearby residential areas, such as during the winter months and during mid-day.

Vapor Barrier

Standards for the proposed vapor barrier should be developed during the pilot project which insure that volatile vapors are not released and that fire/life/safety measures are adequate to insure that there is no potential for combustion.. Emergency spill containment plans need to be incorporated also.

Material Transfer
The preferred alternative proposes transfer of materials by barge. This is preferred by the city also because truck transfer would have an adverse impact on the city streets and on Highway 305. measures to reduce the possibility of material spills should be included in any barge transfer program.

Visual Screening
The site is highly visible both from neighboring residences and water traffic. It is recommended that some type of landscaping should be provided to screen the equipment treatment facility areas during the ten-plus years the cleanup will be occurring.

Future Site Development
EPA should explore the possibility that once a portion of the site has been fully treated and cleaned, site development could occur on that portion of the site under specific conditions. Portions of the Wyckoff property are not contaminated and other portions have small areas of contamination that will be addressed early in the cleanup process. There is a possibility that the property could be purchased and the owner propose development for a portion of the site instead of waiting the ten-plus years for total cleanup of the site. The option to allow partial development should be considered during the pilot project and as EPA plans the future cleanup strategy for the site.

Public Interpretation
The thermal remediation technology proposed for this site is an innovative method for cleaning contaminated soils and is probably of national interest. EPA should provide some type of interpretive area for interested citizens and visitors that will likely be drawn to the Wyckoff Superfund site.

Thank you for the opportunity to comment of the proposed plan for the Wyckoff Superfund site.

Sincerely,

Mayor Dwight Sutton

attachments

RESOLUTION NO. 97 - 35

A RESOLUTION of the City of Bainbridge Island, Washington, relating to land use designations for clean up purposes only for the former Wyckoff property, an Environmental Protection Agency Superfund Site.

WHEREAS, the City of Bainbridge Island has been requested by the Environmental Protection Agency (EPA) to provide the land use designations that the City will likely apply on the former Wyckoff property in the future in order that the EPA may determine clean up levels necessary for the Wyckoff Superfund Site;

WHEREAS, the EPA has requested that the City provide the likely future land use designations by December, 1997, so that consideration of future land use for the Superfund site can be assessed as part of the EPA Record of Decision for the Wyckoff Superfund Site;

WHEREAS, the Planning Commission considered land use designations for clean up purposes and solicited public input at three public meetings held September 11, October 9 and October 23, 1997;

WHEREAS, the City recognizes that the Comprehensive Plan designation and Zoning district for the former Wyckoff property will not be changed with this resolution;

WHEREAS, the City recognizes that a Comprehensive Plan Amendment and Zoning Code Amendment will be required prior to any changes to the current Comprehensive Plan designation and Zoning Code designations of Water-dependent Industrial applying to the former Wyckoff property; now therefore

THE CITY COUNCIL OF THE CITY OF BAINBRIDGE ISLAND, WASHINGTON, DOES RESOLVE AS FOLLOWS:

Section 1. The following land use designations for the former Wyckoff property, a designated Environmental Protection Agency (EPA) Superfund site, are for clean up purposes only. These potential land use designations are provided to the EPA as a recommendation of likely land uses to be designated in the future for the Wyckoff Superfund site. Future land use designations for the site will likely be proposed as a master plan for the entire property. The City will complete a Comprehensive Plan Amendment, State Environmental Review (SEPA), and Zoning Amendment before any change in land use designations will occur for the Wyckoff property. The land use recommendations proposed in the August 7, 1996, report by the Wyckoff Zoning

Advisory Committee will be the starting point for consideration by the Planning Commission during the Comprehensive Plan and Zoning Amendment process.

The City Council for the City of Bainbridge Island recommends that the final clean up levels for the Wyckoff Superfund site accommodate future land uses as follows:

1. The area identified as the "Uplands" and "South Parcel" in the August 7, 1996, report by the Wyckoff Zoning Advisory (WZA) Committee, should allow **residential development** as proposed in the WZA Committee report, including single-family residential within the "South Parcel" and multi-family residential in the "Uplands" area.

2. The area of approximately 11 acres and identified as the "Point" in the August 7, 1996, report by the Wyckoff Zoning Advisory Committee and which generally coincides with the area identified by EPA as the "Former Process Area" should allow for **open space recreational uses**, to include vegetated areas, pedestrian/bike trails, playgrounds, restroom facilities, recreational shelters, parking and potential museum structure.

3. The area of approximately 6 acres and identified as the "Flatlands" in the August 7, 1996, report by the Wyckoff Zoning Advisory Committee and which generally coincides with the area identified by EPA as the "Former Log Storage/Peeler Area" should allow for **mixed-use water-dependent/water-related commercial**, to include marina, boatyard with haul-out facility, marine sales and repair, marine related sales, and restaurants. Emphasis is on water-dependent uses. Clean up methods need to accommodate adequate water access for these future water-dependent uses.

These areas are identified on the attached maps, Attachment A and B.

PASSED BY THE CITY COUNCIL this ___ day of ________, 1997.

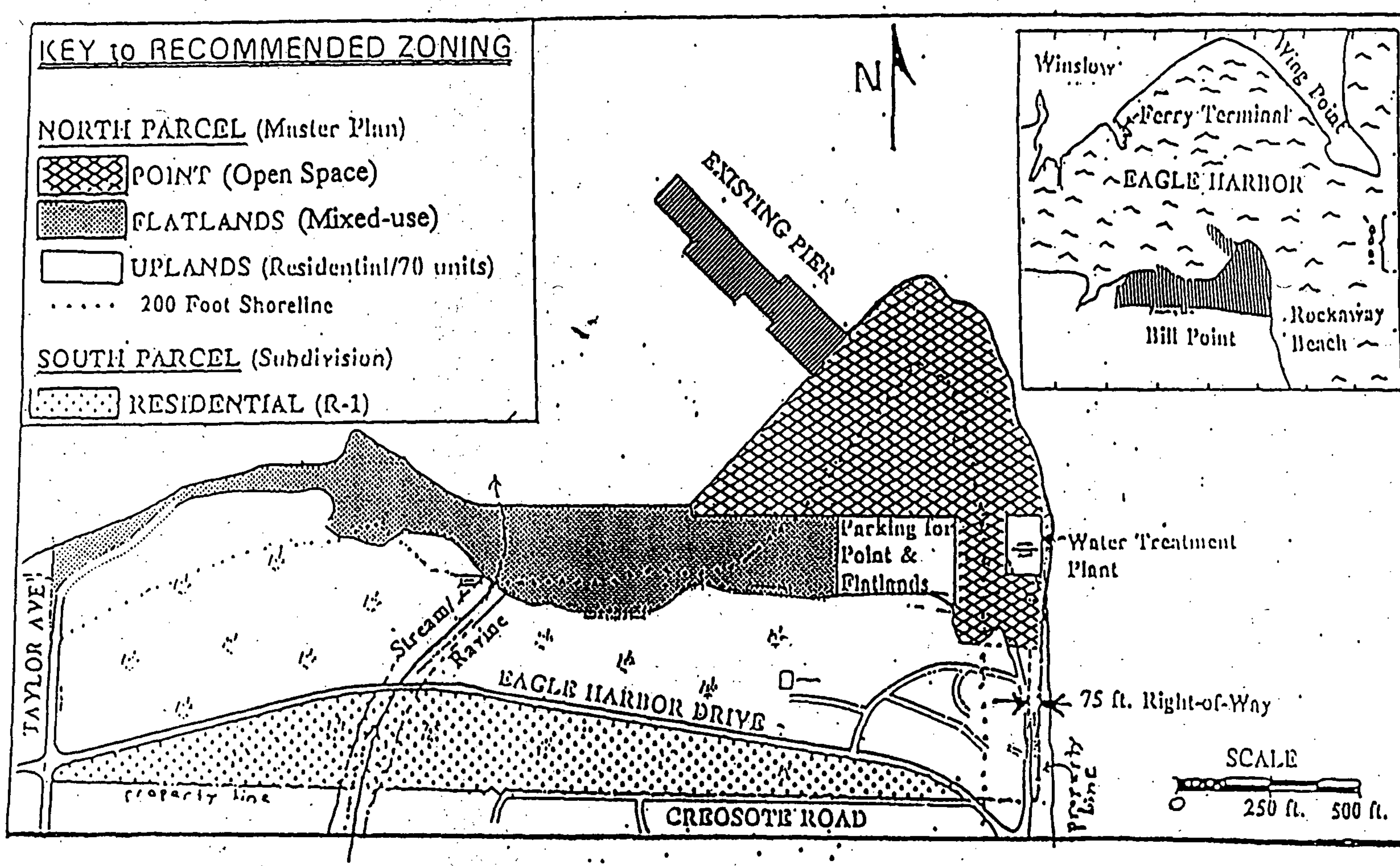
APPROVED BY THE MAYOR this ___ day of ________, 1997.

Dwight Sutton, Mayor

ATTEST/AUTHENTICATE:

Susan Kasper, City Clerk

FILED WITH THE CITY CLERK: 10/31/97
PASSED BY THE CITY COUNCIL: 12/18/97
RESOLUTION No.: 97-35


KEY to RECOMMENDED ZONING
NORTH PARCEL (Master Plan)
POINT (Open Space)
FLATLANDS (Mixed-use)
UPLANDS (Residential/70 units)
200 Foot Shoreline
SOUTH PARCEL (Subdivision)
RESIDENTIAL (R-1)
N
EXISTING PIER
Winslow
Wing Point
Ferry Terminal
EAGLE HARBOR
Rockaway Beach
Bill Point
Parking for Point & Flatlands
Water Treatment Plant
TAYLOR AVE
Stream/Ravine
EAGLE HARBOR DRIVE
75 ft. Right-of-Way
SCALE
0 250 ft. 500 ft.
Property line
CREOSOTE ROAD

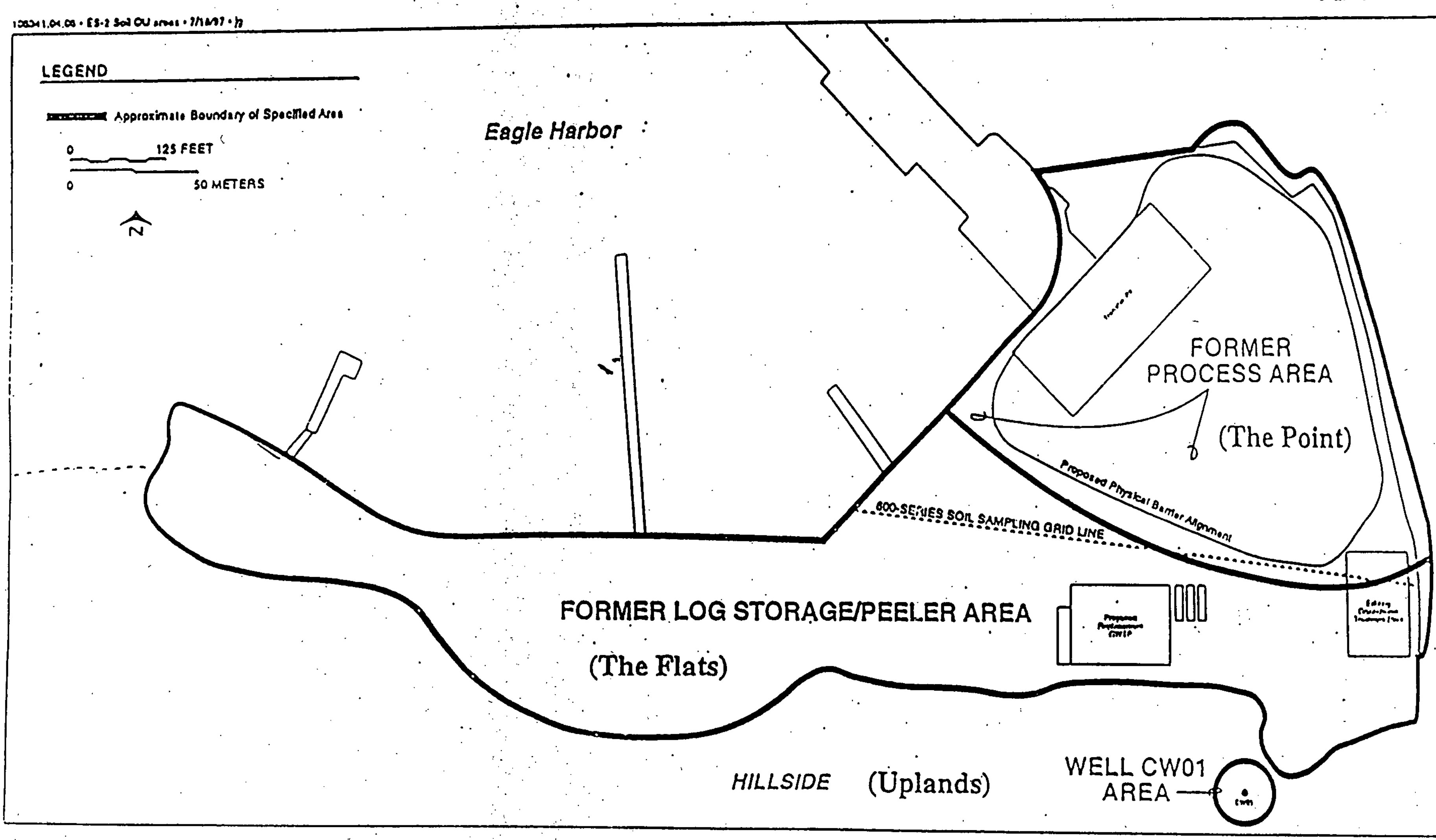


Figure ES-2
IDENTIFICATION OF AREAS AT THE WYCKOFF SOIL OU USED TO DEFINE REMEDIAL ALTERNATIVES

Note: Titles in ( ) are names used in the Wyckoff Zoning Advisory Committee's report.

Bill Point Homeowners' Association
10753 Bill Point Drive
Bainbridge Island, WA 98110

RECEIVED
DEC 03 1999
Environmental Cleanup Office

November 29, 1999

Hanh Gold, Project Manager
EPA Region 10, ECL-115
1200 Sixth Avenue
Seattle, WA 98101

Subject: Wyckoff / Eagle Harbor Superfund Site

I am submitting the following comments on the above subject as a member of the Bill Point Homeowners' Association, a non-profit organization incorporated in 1968 and consisting of 84 single family residences and 12 jointly owned Tracts located adjacent to the Wyckoff site on Old Creosote Road and Rockaway Beach Road.

Our development is zoned as a residential area and in accordance with the City Noise Ordinance (WA Dept of Ecology Title 173 WAC) the daytime maximum permissible noise level is 55 dBA. Sounds originating from temporary construction sites as a result of construction activity are exempt, however as thoroughly explained by Donald Le Clair in his October 29 letter to you, the anticipated pile driving noise level must be investigated and reduced to a reasonable level.

The noise originating from steam generation process during the anticipated three years of thermal remediation is also a serious concern. It is appreciated that the EPA recognizes that there may be a noise (and odor) problem and would suggest that the steam flooding process used in connection with crude oil production be reviewed. Steam is injected through wells into the ground around an oil well to increase oil recovery, and the noise (and odor) levels are well above that permitted in residential areas.

The wells supplying water to our Association are on our Tract K which borders on Old Creosote Road. Tests were conducted by CH2M HILL in 1998 for the EPA which indicated that the present pump-and-treat process did not affect the ground water levels in Bill Point water wells. However, they did recommend that , if in the future the extraction process was increased, the wells should be retested and monitored. Since the treatment process will be increased the tests should be run again and a more extensive test program be conducted before deciding on an on-site water source for steam generation.

In summary, with our Association directly adjacent to the Wyckoff site I am concerned about the noise (and odor) that will be generated and how our water supply will be affected by the proposed plan . Thank you for the opportunity to submit comments.

Sincerely yours,

Forest C. Monkman

Forest C. Monkman, Sc.D.
President
Bill Point Homeowners' Association

United States Department of the Interior

FISH AND WILDLIFE SERVICE
North Pacific Coast Ecoregion
Western Washington Office
510 Desmond Drive SE, Suite 102
Lacey, Washington 98503
Phone: (360) 753-9440 Fax: (360) 753-9008

RECEIVED
NOV 04 1999
Environmental Cleanup Office

NOV 1 1999

Hanh Gold, Project Manager
U.S. Environmental Protection Agency (EPA), Region 10
1200 Sixth Avenue, ECL-115
Seattle, WA 98101

Re: Proposed Plan for the Wyckoff/Eagle Harbor Superfund Site - Soil and Groundwater Operable Units

Dear Ms. Gold:

The U.S. Fish and Wildlife Service (FWS) would like to provide the following comments regarding the September 1999 Proposed Plan for the Wyckoff/Eagle Harbor Superfund Site - Soil and Groundwater Operable Units. We have provided both general and specific comments as well as our recommendation for which alternative we prefer. Several comments listed in the general portion of the letter will also be addressed specifically in the later section of this letter in order to clarify our concerns.

GENERAL COMMENTS

Overall, the document is well thought out and presented. The Proposed Plan seems to accomplish the goals set forth in the introduction of the document. However, there are instances in which the Proposed Plan is quite general. Although we understand many of these generalities will be addressed in the remedial and design phases of the project, several of those generalities will be mentioned in the specific comments section below. In a programmatic sense, we believe the Proposed Plan is a fine start to fulfilling the goals of the cleanup strategy but feel more detail needs to be provided to have sufficient information regarding the project.

A pilot study to explore the feasibility and efficacy of the thermal remediation alternative has been proposed. We urge the Environmental Protection Agency (EPA) to follow though and conduct this critical pilot project. If the site specific pilot study is designed and conducted properly, only then can an informed decision regarding remedial options be successfully determined. In general we support Alternative 3 (EPA's preferred alternative): In-situ Thermal Remediation. However, we would like to see the results of the pilot study prior to committing to a preferred remedial option. Alternative 3 appears to protect the environment to the maximum extent possible, is permanent, and has the least amount of direct habitat loss associated with it.

The FWS has concerns with ongoing sources of polycyclic aromatic hydrocarbons (PAHs) in the form of both dense and light non-aqueous phase liquids (NAPLs) from the site to the estuarine environment especially considering that risk assessments conducted at the site concluded that unacceptable risks existed for organisms inhabiting intertidal and sub-tidal areas around the site.

Seeps containing product NAPLs have been identified in the intertidal areas around the site and jeopardize the remedial activities (i.e. recontamination of the caps) that have already taken place in the harbor. These offshore areas may also be associated with federally listed and proposed threatened and endangered species under the Endangered Species Act and/or food items for endangered species. For example, bull trout (federally listed as threatened), have been found near surf melt spawning beaches, and the areas in and around Eagle Harbor have been documented as spawning grounds for surf smelt (Washington Department of Fish and Wildlife, Grandy Creek Trout Hatchery Biological Assessment, March 1997). The EPA is encouraged to address these issues in the biological assessment submitted to the FWS for this project and to consult with the National Marine Fisheries Service with regard to listed species under their purview.

SPECIFIC COMMENTS

Page 5, Summary of Site Contamination: We understand that thermal remediation in theory will effectively remove contaminants at the site such as PAHs and pentachlorophenol (PCP); however, dioxins and furans, which were also detected at the site, may not be addressed through thermal remediation. Please address how EPA plans to remediate dioxins and furans from the site.

Page 5, Figure 6: One concern listed in the figure is migration of dissolved phase contaminants and dense NAPLs through higher permeable areas of the aquitard into the lower aquifer. More clearly explain how the preferred alternative will address this concern.

Page 7, Groundwater OU: Add clarification and detail to the statement: "Site specific contaminant concentration limits that are protective of the environment are being developed for the Former Process Area groundwater."

Page 8, Clean Up Alternative Description 3: Include as a design/performance criteria to limit the access of wildlife, particularly birds, in and around the remedial site especially during the steam injection phase of the plan.

Page 10, Alternative 3: In-situ Thermal Remediation: Expand the discussion to include such concepts as how the heat will affect the aquitard layer and the properties of the NAPLs as well as how the increased mobility of the NAPLs may affect migration of these compounds into the lower groundwater table. Also, discuss further how effective a sheet pile wall may be in stopping or reducing the migration of NAPLs currently seeping in groundwater from upland into the marine environment.

Page 11, regarding the pilot project: A properly designed, conducted and evaluated pilot project is needed to fully determine the feasibility and efficacy of the thermal remediation alternative. Besides meeting the listed performance criteria, we would ask that the EPA evaluate the possible negative impacts the pilot project has to the surrounding ecosystem and habitats particularly in the intertidal zone. Adverse impacts could include: temperature increases in water and sediment some distance from the sheet pile wall, increased migration of NAPLs to offshore areas, and changes in sediment size and/or transport due to the increased wave action from the placement of the sheet pile wall. Finally, even if the pilot project is a "remedial success", we urge EPA to weigh these successes against the negative impacts to the surrounding ecological environment (if any occur) when making their final remedial decision for the groundwater and soil operable units.

Page 13, Steam Injection Laboratory Testing: Lab results show that thermal technology is effective in removing total PAHs from soil; however, high molecular weight PAHs such as benzo(a)pyrene remain in high concentrations. Since higher weight PAHs like benzo(a)pyrene are not only carcinogenic but also listed on the Dredge Material Management Program's list of bioaccumulative chemicals of concern, how does EPA plan to remediate these PAH constituents?

Page 13, In-situ Thermal Technologies Advisory Panel: How does the proposed plan deal with disturbances to wildlife from remedial activities?

Page 15, Short-Term Effectiveness: Mitigation costs are only included for Alternative 2a. If possible estimate mitigation costs associated with Alternatives 2b and 3. Also, the plan should address how heat will affect the malleability and inter-locking mechanisms of a sheet pile wall and ultimately the effectiveness of the wall to contain contaminants. Finally, in the last paragraph of this section explain the actions that will be taken to minimize effects to wildlife from the noise and odor of the remedial process. Is displacement of wildlife from the site during remedial activities a reason for concern?

We would like to applaud EPA for proposing the use of this innovative thermal technology as a means to achieve cleanup, protect human health and the environment, and prevent further discharge of contaminants, namely NAPLs, from the upland site into the marine environment. We hope these comments are both constructive and helpful in completing the final Proposed Plan for the Wyckoff/Eagle Harbor Superfund Site - Soil and Groundwater Operable Units. We appreciate the opportunity to review and provide comments on this matter and look forward to reviewing the biological assessment for this project. If you require more information or have questions concerning our comments, please contact Jay Davis at (360) 753-9568 or at his e-mail address: jay_davis@fws.gov.

Sincerely,

Alisa A Ralph

for Gerry A. Jackson, Manager
Western Washington Office

JD/vr

3

10881 Bill Point circle
Bainbridge Island, WA 98110
October 27, 1999

RECEIVED
NOV 01 1999
Environmental Cleanup Office

Hanh Gold
Project Manager
U. S. Environmental Protection Agency, Region 10
1200 6th Avenue, ECL-115
Seattle, WA 19101

Subject: EPA proposed plan dated September 1999 for cleanup of contaminated soils at the Wyckoff/Eagle Harbor Superfund Site.

Reference (a) EPA Wyckoff/Eagle Harbor Superfund Site, Soil and Groundwater Operable Units, Proposed Plan dated September, 1999.

1. Reference (a) set forth the EPA preferred cleanup alternative for cleanup of the contaminated soils and ground water at the Wyckoff/Eagle Harbor Superfund Site. The preferred alternative specifies driving interlocking sheet pile around the periphery of the contaminated area and injecting heat (steam or electricity) into the soil and removing the contaminated liquid and vapors in a controlled manner. I have no objection to the engineering approach to the cleanup process but am very concerned about the noise that will be generated by the sheet pile driving process and possibly the steam plant and other operations. As you know, my residence is located at the intersection of Eagle Harbor Drive and Old Creosote Hill Road and is one of the Bill Point Residences close to the Superfund Site.

2. At the EPA conducted meeting on October 21, 1999, it was made known that during the period approximately10-11 September, 1999, test driving of sheet pile was conducted at the Wyckoff Site using a vibrator hammer instead of the usual impact hammer and the resulting noise level measured at four different locations remote from the Wyckoff site. Wing Point had the highest sound level (80db). The sound level at Bill Point was reportedly not measured.

3. Although I wasn't aware that driving of sheet pile was taking place, I did hear an unusual and loud noise coming from the Wyckoff site at the time the test pile driving occurred. I wondered what was causing the noise as I had not previously heard such a noise and was thankful when the noise operation ceased. I discovered at the October 21 meeting what was causing the noise.

4. The level of noise created by the vibrator hammer method of driving sheet pile is unacceptable for the residential community surrounding Eagle Harbor considering that the pile driving operation will reportedly last three months. In addition, the pile driving is reportedly scheduled for the summer period which are the worst months for such an operation from a noise tolerance standpoint.

5. At the EPA meeting of October 21, 1999, it was stated by the project manager that reasonable efforts would be made to minimize the noise generated by the pile driving operation. Although it is comforting to know the noise problem is recognized by the EPA, a promise to make "reasonable efforts" to minimize the noise does not indicate the matter will receive a high priority in the overall scheme of the cleanup process. As a minimum, the EPA or it's contractors should develop a design for noise abatement equipment and test same under actual pile driving conditions on the site with the goal of achieving a maximum noise level not to exceed that specified in the City of Bainbridge Island Ordinances.

6. Noise blasted to the surrounding community is not an insignificant matter to the hundreds of people involved. With focused management and engineering attention, the noise problem can likely be solved. Production sheet pile driving should not commence until exhaustive efforts have been made to solve the problem, including testing same, and the community informed of the details of all efforts and test results.

Respectfully,

Donald LeClair

Donald LeClair

WASHINGTON STATE DEPARTMENT OF
Natural Resources

JENNIFER M. BELCHER
Commissioner of Public Lands

November. 2, 1999

RECEIVED
NOV 0? 1999
Environmental Cleanup Offic.

Hanh Gold
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, ECL-115
Seattle, WA 98101

Re: Wyckoff/Eagle Harbor Superfund Site - Soil and Groundwater Operable Units Proposed Plan, September 1999

The Washington State Department of Natural Resources (DNR) would like to communicate our concurrence with the conclusions of the above referenced report. As proprietary manager and natural resources trustee of State-owned aquatic lands (SOAL), DNR has an active interest in the Wyckoff/Eagle Harbor CERCLA site. As indicated in our more detailed June 19, 1998, comment letter, we strongly support the timely cleanup of Eagle Harbor and we acknowledge the efforts of the EPA and Washington State Department of Ecology.

DNR is in agreement with EPA's selection of the preferred alternative- Alternative 3: In-situ Thermal Remediation. We applaud your efforts to develop, test, and implement this technology. With the installation and careful monitoring of the sheet pile wall around the treatment zone, you have addressed our chief concern for fugitive contamination moving beyond the influence of the recovery system. DNR would also like to encourage you to carefully monitor transport mechanisms and impacts to the aquatic ecosystem during operation.

The brief plan that DNR received did not discuss post-remedial configuration. We hope that the same level of investigation and planning put forth to date is utilized to create a final post-remedial intertidal plan that truly enhances the aquatic ecosystem.

DNR looks forward to reviewing the findings of the first phase pilot test. Please feel free to call me at (360) 902-1057 if you have any questions.

Sincerely,

Tim Goodman, P.E.
Contaminated Sediments Manager
Aquatic Resources Division
1111 Washington St SE
PO Box 47027
Olympia, WA 98504-7027

c: Maria Peeler, DNR

bc: Mark Mauren
Bill Graeber
Christa Thompson, AGO

Comment Card

Wyckoff Public Meeting
Bainbridge Island, Washington
October 21, 1999

Please share your comments on the Wyckoff Proposed Plan for soil and groundwater cleanup. Simply print your thoughts on this card and drop it in the box before you leave. Feel free to use both sides. Thank you.

I have been part of the "clean up" effort since E.P.A. took over the Wyckoff site. In fact, I was one of the people who worked to make the site a Superfund issue. I appreciate all that E.P.A. has done to find the right method for extraction and also let the people have a voice in this effort. However, I feel now that many of the people in the area who will be impacted by the noise and the air emissions have not been alerted. The noise from the sheet pile installation will cause much consternation among the people on the north side of the harbor. Would it not be better to delay this installation until windows are closed and people are not enjoying the summer months outside?

I also would hope there will always be someone on the site night & day to monitor this process. If a fire is a potential of the cleanup method E.P.A. should alert the fire dept. so they can be prepared. In the past history of this clean up this has not been done.

Thanks for coming to the island to keep us informed.

Lucile Parker

Area Code (360)
598-3311
Fax 598-6295

THE SUQUAMISH TRIBE

P.O. Box 498 Suquamish, Washington 98392

November 1, 1999

RECEIVED
NOV 04 1999
Environmental Cleanup Office

Hahn Gold
U.S. Environmental Protection Agency
1200 Sixth Avenue, ECL-115
Seattle, WA 98101

Dear Ms. Gold:

The Suquamish Tribe has reviewed the Proposed Plan for the Wyckoff Soil and Groundwater Operable Units, and continues to support thermal remediation as the preferred alternative for the Wyckoff operable units.

It is important to the Tribe that a long-term, permanent solution to the release of contaminants from the Wyckoff site to Eagle Harbor and Puget Sound is conducted to address impacts to Tribal trust resources and aquatic habitat. Thermal remediation, if successful at the site, is the only alternative that will remove all mobile non-aqueous phase liquids (NAPL) from the site. Thermal remediation is also the only alternative available for permanent protection to human health and the environment. The containment alternatives will not significantly reduce the estimated 750,000 gallons of NAPL at the Wyckoff site, and will require long-term remediation.

Implementation concerns of thermal remediation such as noise during the installation of the sheet pile wall are understandable. However, it is believed that engineering controls and other measures will be conducted to address or reduce concerns associated with this alternative.

The Suquamish Tribe looks forward to our continued involvement on Eagle Harbor/Wyckoff issues. If you have any questions, please contact me at (360) 394-5240 or Richard Brooks at (360) 394-5250.

Sincerely,

Charlie Sigo
Eagle Harbor/Wyckoff Policy Representative

GLENN C WATERMAN
11205 NE Wing Pt.Drive
Bainbridge Is. WA 98110
Glennw6893@AOL.com

RECEIVED
OCT 22 1999
Environmental Cleanup Office

October 20, 1999

Ms. Hanh Gold, Project Manager
E.P.A. Region 10, ECL-115,
1200 Sixth Avenue,
Seattle WA. 98101

Re: Eagle Harbor EPA Project

Dear Ms Gold:

I have your October report "Fact Sheet" regarding progress and proposed future program at the Eagle Harbor project. I want to offer a few comments.

As a retired professional geologist I am familiar with erosion and sedimentation and the progress of nature in causing and curing problems. It seems to me that with the effort devoted to date in cleaning up after the periods of natural and man-made contamination that what conceivably remains on the surface under the water at Eagle Harbor is constantly being covered by erosional products from runoff, cannot harm man, beast or fish and needs no further attention. And what is buried under the sand and clay and a constantly increasing thickness of sediments deposited from run-off waters that there is no need for further expenditures to make sure that what is buried out of sight, beneath the water and under sediments need cause any further worry.

I would like to suggest that EPA has done a great cleanup job and sbould close down the project as finished. I see no need for a continuing project estimated to last a decade!

Sincerely,

Glenn C.Waterman

Glenn C.Waterman P.Eng

Wing Point Community, Inc.
P. O. Box 10627
Bainbridge Island, WA 98110

To: Hahn Gold, Project Manager
U.S. Environmental Protection Agency, Region 10
1200 Sixth Avenue, ECL-115
Seattle, Washington 98101
From: The Wing Point Community, Inc. (WPC)
Subject: Comments, Wyckoff Soil and Groundwater OUs.

Oct.25,1999

RECEIVED
OCT 2? 1999
Environmental ...

We have read and heard the plans for the Wyckoff facility. The WPC represents 76 homes on Wing Point, directly across Eagle Harbor from the facility. We have the following comments about the plans for further clean up of the site:

1. The driving of the sheet pile wall will produce a very loud and obnoxious sound that will degrade the quality of life of residents of the WPC during the period that the piles are to be driven. It will also lower property values during that time. We understand the plan is to drive the pilings during July, Aug., and Sept. of 2000. These are the months that people want to be outside and to have windows open. The noise is likely to be intolerable, if that is the time frame chosen. We strongly urge that the pile driving time be changed to start no sooner than November and occupy the following months until completed. We also urge that methods be developed to reduce the offsite noise level.

2.The steam injection system, if it uses diesel fuel, will create obnoxious and potentially hazardous odors that will affect the WPC during periods of quiet air and south winds. No plans have been specified for mitigating these odors to an acceptable level for the WPC. The WPC would strongly urge that propane fuel be used if the steam injection process is used. From our viewpoint, it would be preferable to use electric resistance heating instead of steam injection.

3. A boiler plant for producing steam is also likely to be noisy. Such noise, for the time and duration of the steam injection process, will significantly negatively affect the quality of life on Wing Point. Noise mitigation measures will have to be developed if this is the process chosen. For minimum impact of WPC, again we prefer the electric resistance heating instead of steam injection. The boiler plant also creates the possibility of a serious fire hazard on the site, and in delivering fuel to the site

4. We seriously believe that driving the sheet pile wall, followed by capping the contaminated area, would be the most cost effective, as well as safest and of least impact method to complete the facility cleanup. The Bainbridge Island committee that reviewed potential uses of the site, found satisfactory uses under a capping option.

Sincerely,

E. P. PAUP, President, WPC

W. E. Kreger, Past President, WPC

NORMAN S. WOOLDRIDGE
12625 MANZANITA ROAD NE
BAINBRIDGE ISLAND, WA 98110
Tele 206-842-7293

RECEIVED
NOV 09 1999
Environmental Cleanup Off

Hanh Gold
EPA. ECL-115
1200 Sixth Avenue
Seattle, WA 98101

November 8, 1999

RE: Wyckoff Cleanup Plan

Dear Ms. Gold,

The idea of utilizing a diminishing resource, potable water, to clean up a previous environmental problem seems ill advised in view of the alternative. I urge you to give careful consideration to substituting the treated effluent from the Bainbridge Island sewage treatment plant for this project. That wastewater is clean, free of solids and harmful pathogens. It is water which is otherwise dumped, unused, into Puget Sound.

The cost of running the line under Eagle Harbor to the Wyckoff site will not be too much different than the cost of digging a deep well. The residents of Bainbridge Island are very concerned about the quantity of water that is available for human consumption and are concerned about the seemingly wasteful and unnecessary approach you appear to be taking.

Sincerely,

Norman S. Wooldridge

ATTACHMENT 2

Summary of Comments
Received During the Wyckoff Public Meeting
Held October 21, 1999

Would a vapor cover be placed over the treatment zone and over contaminated soils?

There is concern about harmful or smelly vapors caused by the steam plant boiler system potentially run by diesel fuel.

What would potential vapors from the site consist of? There is concern about potentially harmful and/or smelly emissions from the site during treatment.

Will EPA guarantee that the asphalt cap will be removed after treatment is complete?

Why is a sheet pile wall less expensive than a slurry wall?

There is concern about the noise created by sheet pile driving.

Can sheet pile driving be scheduled during cooler months when there will be less noise impact to the community (closed windows, less outdoor activity)?

There is concern about potential ongoing noise from the operation of the steam plant.

Where would the steam plant be located?

Where will EPA get water for the boiler?

How many gallons per minute of water will be needed?

If EPA considers using effluent from the city's water treatment plant, would it be possible to put a pipeline under the water, potentially disturbing the sediment cap in the harbor?

There is concern about the potential for well drilling to introduce contaminants into the lower aquifer.

Does EPA have information which quantifies risk to human health from the site's contamination?

Has there been, or will there be, a risk-benefit analysis to decide whether the project is worth doing? Is the $40 million cost worth the health benefit? How much needs to be cleaned up?

Has the project been funded yet?

Can a pilot study of one to two years be done in another location, rather than in this populated community?

At one time, it was expected that the site would be fully useful with simply a cap over the contamination. Why is it necessary now to spend many millions more dollars and go beyond just capping the site? Why is capping not EPA's preferred alternative?

Is contamination present on the sediment cap in Eagle Harbor?

Will EPA bring in a portable generator to provide power if electrical resistance heating is used?

Will fuel be transported by truck or by barge? There is concern that trucking would not be welcomed by the community.

Will any portions of the site be available for use before cleanup is completed?

EPA is encouraged to work with the community to define a "vision" for the site.

EPA is encouraged to consider some sort of foliage at the site to improve its appearance.