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February 1995

EPA Superfund
Record of Decision:

Harbor Island (Lead)
(O.U. 3), Seattle, WA
6/28/1994

RECORD OF DECISION

DECLARATION, DECISION SUMMARY, AND RESPONSIVENESS SUMMARY

FOR

LOCKHEED SHIPYARD FACILITY, HARBOR ISLAND SEATTLE, WASHINGTON

JUNE 1994

UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
REGION 10
1200 SIXTH AVENUE
SEATTLE, WASHINGTON

DECLARATION

SITE NAME AND LOCATION

Lockheed S..ipyard Facility, Harbor I land

Seattle, King County, Washington

STATEMENT OF BASIS AND PURPOSE

This decision document presents the selected final remedial action, for soil and groundwater, for the Lockheed Shipyard facility operable unit on the Harbor Island site in Seattle, King County, Washington. This remedy was chosen in accordance with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 U.S.C. §§ 9601-96), as amended, and, to the extent practicable, the National Contingency Plan (NCP). This decision is based on the Administrative Record for the Lockheed facility which is available in EPA's Record Center, 7th Floor, 1200 Sixth Avenue, Seattle, Washington, 98101.

The Washington State Department of Ecology (Ecology) concurs with the selected remedy given the specifics found at the Lockheed facility.

The U.S. Environmental Protection Agency (EPA) has divided the Harbor Island site into four operable units: 1) the petroleum storage tank facilities (ARCO, Shell and Texaco) operable unit, 2) the marine sediment operable unit, 3) "soil and groundwater" operable unit, and 4) the Lockheed Shipyard facility operable unit. EPA is the lead agency for the Lockheed, marine sediments, and soil and groundwater units. A cleanup action was selected for the soil and groundwater operable unit in a Record of Decision issued in September 1993. EPA has designated the Washingtor Department of Ecology (Ecology) as the lead agency for the petroleum storage tank operable unit because the primary contaminant there is petroleum, which is excluded from the federal Superfund statute but is regulated under the State's Model Toxic Control Act (MTCA). A cleanup decision for the petroleum storage tank operable unit is expected to be made by Ecology in early 1995. The marine sediment operable unit will be addressed in a Record of Decision which EPA intends to issue in 1995. This decision document addresses only the Lockheed Shipyard facility.

ASSESSMENT OF THE FACILITY AND ADJACENT AREAS OF CONTAMINATION

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare or the environment.

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DESCRIPTION OF THE SELECTED REMEDY

The remedial action described in this Record of Decision represents a final remedy for treatment of the Lockheed Facility soil and groundwater operable unit. The remedial action presented in this ROD addresses the risks to human health and the environment by:

1) Excavate and treat soil containing the highest levels of petroleum contamination ("hot spots"). The petroleum hot spots are defined as those areas with concentrations of Total Petroleum Hydrocarbons (TPH) greater than 10,000 mg/kg. The TPH hot spot soil will be treated on-site by a thermal desorption system with an afterburner, instead of condensate collection as identified in the preferred alternative.

2) Contain exposed contaminated soil exceeding inorganic and organic cleanup goals. Containment would be achieved with a three inch asphalt cap designed to reduce infiltration of rainwater and reduce contaminant migration into the environment. Existing asphalt and concrete surfaces which are damaged in areas exceeding cleanup goals would either be replaced or repaired. Maintenance of new and existing caps would also be required under a Consent Decree for the settling PRPs as long they own the Lockheed facility.

3) Invoke institutional controls which would warn future property owners of remaining contamination contained under capped areas on this property, require future owners and operators to maintain these caps, and specify procedures for handling and disposal of excavated contaminated soil from beneath the capped areas if excavation is necessary in the future.

4) Monitor groundwater quality semi-annually for 30 years, or until it has been demonstrated that groundwater contaminants will not reach the shoreline in concentrations exceeding cleanup goals. The groundwater quality data will be reviewed at a minimum of every five years to assess the effectiveness of the selected remedy to meet water quality cleanup goals at the shoreline. This periodic data review will be conducted by EPA and Ecology and will coincide with the groundwater data review for the soil and groundwater operable unit. If groundwater data indicates that contaminants are likely to exceed cleanup goals at the shoreline, additional soil and/or groundwater remedial actions may be required in the future.

STATUTORY DETERMINATIONS

The selected remedy is protective of human health and the environment, complies with state and federal requirements that are legally applicable or relevant and appropriate to the remedial actions, and is cost effective. This remedy uses permanent solutions and treatment technologies to the maximum extent practicable for this site by treating the most highly contaminated areas and capping less contaminated areas. This remedy satisfies the statutory preference for remedial actions that employ treatment to reduce toxicity, mobility and volume.

Because this remedy will leave some hazardous substances on site above cleanup goals, a review of the site and its remedy will be conducted within five years after initiation of the remedial action to ensure the remedy continues to provide adequate protection of human health and the environment.

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

6/28/94
Date

CONCURRENCE

INITIAL	TR	CO	for		
NAME	ROSE	ORDINE	KRUEGER	RUSHIN	
DATE	6/23/94	6/23/94	6/24/94	6/24/94	

CONCURRENCE

INITIAL					
NAME	GEARHEARD	CLARKE			
DATE	6-24-94				

DECISION SUMMARY
LOCKHEED SHIPYARD, HARBOR ISLAND, SEATTLE, WASHINGTON

A. INTRODUCTION

The Lockheed Shipyard is an operable unit within the Harbor Island Superfund Site (Site), located in Seattle, King County, Washington. The Site was listed on the National Priorities List (NPL) in 1983 due to elevated lead concentrations in the soil from a lead smelter on the island, as well as elevated concentrations of other hazardous substances. A site assessment was performed by the United States Environmental Protection Agency (EPA) in 1985, pursuant to Section 105 of the Comprehensive Environmental Response, Compensation, and Liability Act of 1980, 42 U.S.C. § 9605, as amended, (CERCLA). The Lockheed Shipyard facility contains no wetlands, floodplains, rare or endangered species, historical sites or structures.

The Site has been divided into four operable units: 1) the petroleum storage tank facilities (ARCO, Shell and Texaco), 2) the marine sediments, 3) "soil and groundwater" unit, and 4) the Lockheed Shipyard facility. EPA is the lead agency for the Lockheed, marine sediments, and soil and groundwater units. A cleanup action was selected for the soil and groundwater unit in a Record of Decision issued in September 1993. EPA has designated the Washington Department of Ecology (Ecology) as the lead agency for the petroleum storage tank unit because the primary contaminant there is petroleum, which is excluded from the federal Superfund statute but is regulated under the State's Model Toxic Control Act (MTCA). A cleanup decision for the petroleum storage tank unit is expected to be made by Ecology in early 1995. The marine sediments unit will be addressed in a Record of Decision which EPA intends to issue in 1995.

Pursuant to Executive Order 12580 (Superfund Implementation) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP), 40 C.F.R. Part 300, Lockheed completed a Remedial Investigation/Feasibility Study (RI/FS) under a Consent Order issued by EPA. EPA issued a Proposed Plan for the Lockheed facility in April, 1994.

B. SITE NAME, LOCATION, AND DESCRIPTION

Harbor Island is located approximately one mile southwest of downtown Seattle, in King County, Washington, and lies at the mouth of the Duwamish River on the southern edge of Elliott Bay. The island is approximately 430 acres in size and is bordered by the east and west waterways of the Duwamish River (Figure 1).

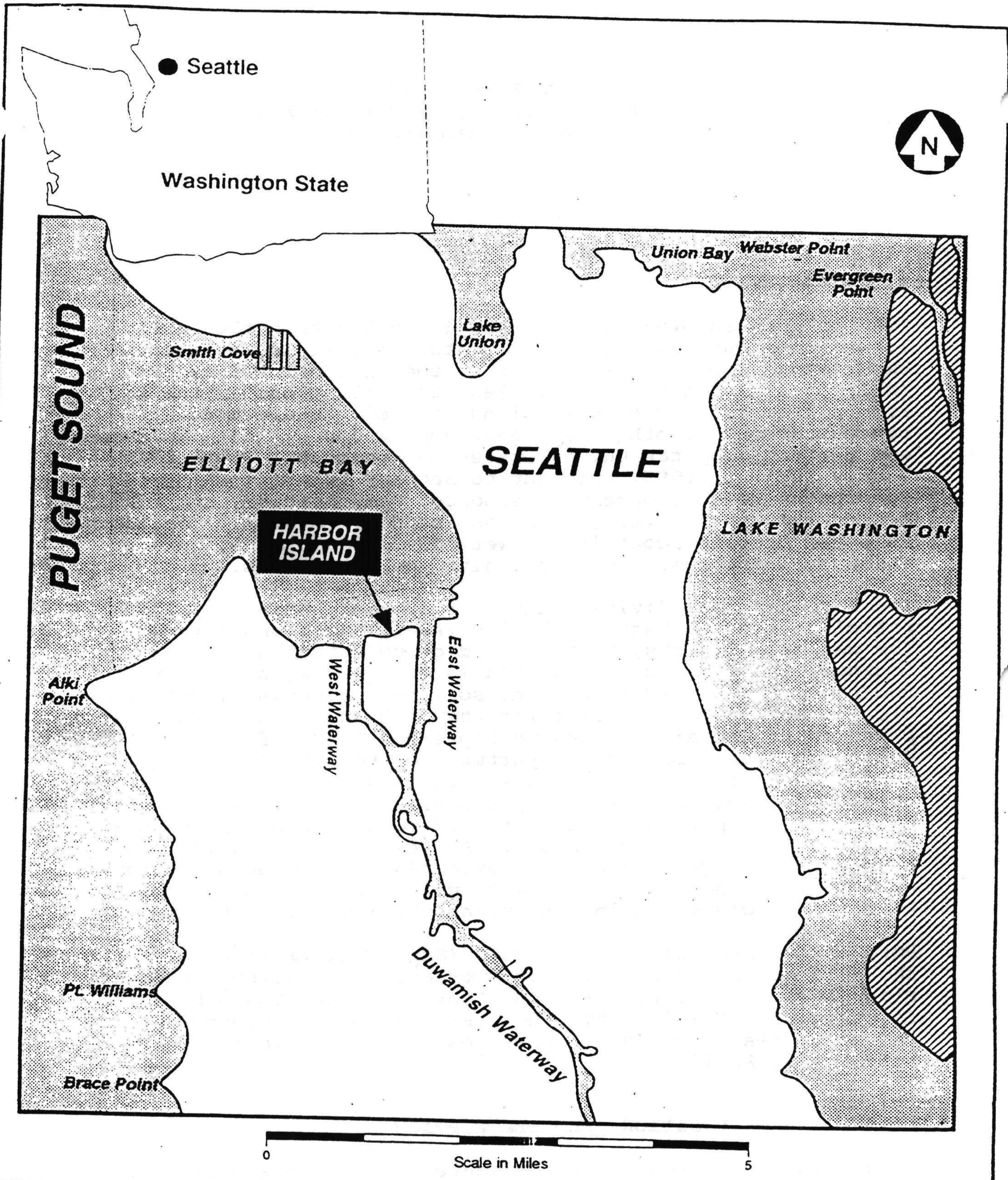


Figure 1
Harbor Island Location

From 1903 to 1905, Harbor Island was created from marine sediments dredged from the Duwamish River. Dredged sediment was placed across the Duwamish tidelands to form a fairly homogeneous sandy fill which is now Harbor Island. Since construction, Harbor Island has been used for commercial and industrial activities including shipping, railroad transportation, bulk fuel storage and transfer, secondary lead smelting, lead fabrication, shipbuilding, and metal plating. Warehouses, laboratories, and office buildings have also been located on the island.

The Lockheed Shipyard facility is located at 2929 16th Avenue S.W. on Harbor Island. The site occupies approximately 18.5 acres on the west side of Harbor Island and is adjacent to the West Waterway (Figure 2). Shipbuilding activities had been conducted on the site since the mid-1930s and the site was used by Lockheed to build and refurbish ships from 1959 to 1986. Shipbuilding activities included metal fabrication, pipefitting, electrical wiring, sandblasting and painting. The facility has been inactive since 1986, except for limited material storage. Approximately 35 buildings are located on the site and several buildings are constructed on wooden piers. Two shipways slope from above the ground surface into the west waterway. Over 90% of surface area of the shipyard is currently paved.

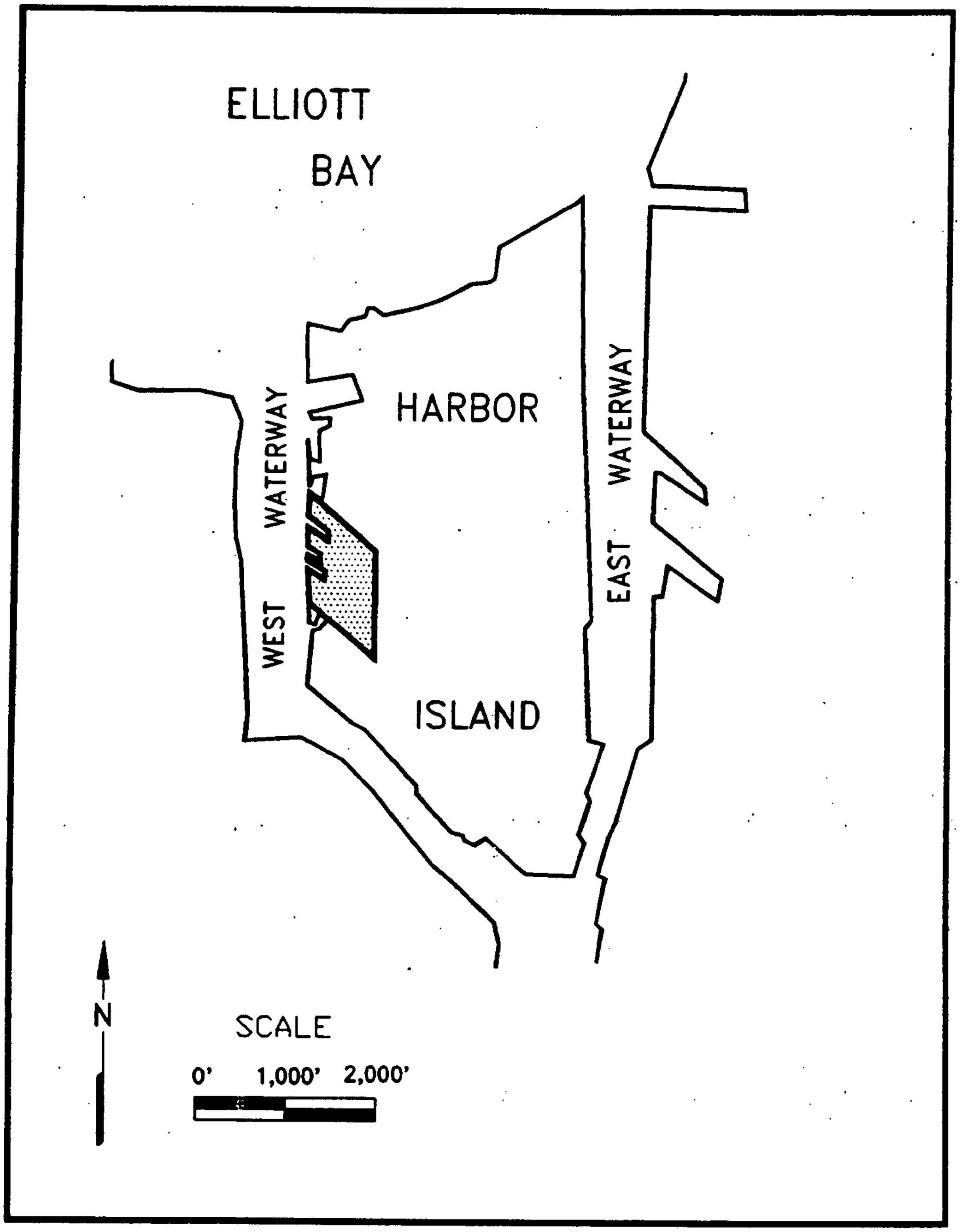
C. SITE HISTORY AND ENFORCEMENT ACTIVITIES

Prior to 1885, the area which is currently Harbor Island consisted of tideflats and a river mouth delta with some piling-supported structures. Initial construction of the island began between 1903 and 1905 when dredging of the East and West waterways and the main navigational channel of the Duwamish River occurred. Dredged sediment was spread across the present island area to form a fill 5 to 15 feet thick. This dredged sediment was later covered with soil and demolition debris from Seattle regrade projects. Since its construction, the island has been used for commercial and industrial activities. Major activities have included ocean and rail transport operations, bulk fuel storage and transfer, secondary lead smelting, lead fabrication, shipbuilding, and metal plating. Warehouses, laboratories, and office buildings also have been located on the island. The secondary lead smelter was originally constructed on Harbor Island in 1937 and was located near the center of the island.

Concern over the levels of lead in the air, due to the operation of the lead smelter, prompted several air monitoring studies during the 1970s. A study conducted in 1979 by the Puget Sound Air Pollution Control Agency (PSAPCA) showed that the quarterly average ambient air concentration of lead exceeded the federal standard for lead of 1.5 $\mu g/m^3$ 95% of the time. Subsequently, a site inspection conducted by EPA in 1982 identified a significant volume of lead contaminated soil at the lead smelter facility. As a result of this site inspection, the island was listed on the NPL in 1983.

Figure 2

Lockheed Shipyard Location on Harbor Island



The lead smelter ceased operation in 1984, but the facility later was subject to a RCRA enforcement action in conjunction with the closure of a surface impoundment. As part of this action, groundwater monitoring wells were installed and soil borings were taken to determine soil quality. In 1985, the Department of Ecology performed a preliminary investigation of the site to further define the nature and extent of contamination on the island. This investigation, and subsequent investigations, revealed numerous other types of contaminants in addition to lead, including: cadmium, chromium, arsenic, copper, zinc, mercury, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and petroleum products.

In 1986, approximately 220 parties associated with the Site were sent 104(e) information request letters by EPA. Based on the responses received, a Potentially Responsible Party (PRP) search was completed for Harbor Island in 1987. Since many of the facilities on the island had multiple owners and operators, the search identified approximately 150 PRPs. These PRPs were subsequently sent "general notice" letters. As a result of further evaluation of the information gathered on these PRPs, EPA removed 48 parties from the PRP list in 1989, and removed an additional 38 parties in 1994, bringing the current total of PRPs to 55. Evidence to be submitted by some of the remaining PRPs regarding their involvement at the Site may lead to a few more parties being removed from the PRP list.

In 1987, EPA planned a Phase I RI which included only areas on the island where there had been a release of hazardous substances from past operations. In an attempt to have this work performed by the PRPs, EPA sent "special notice" letters to 13 PRPs stating that EPA intended to conduct a remedial investigation unless the PRPs agreed to perform the work. EPA subsequently elected to perform the work with federal funds because EPA could not reach an agreement with these 13 PRPs. The Phase I investigation was initiated in 1988 and completed in 1990 at an approximate cost of $800,000.

During implementation of the Phase I RI, EPA negotiated a Consent Order with the City of Seattle. Under the terms of this Order, the City of Seattle cleaned contaminated sediments from its storm drain system on Harbor Island. These storm drains were considered a major pathway for contaminants entering the surrounding waters and marine sediments. The work under this Order was completed in the Spring of 1990 and the City is now periodically monitoring the discharge from these stormdrains to ensure that they meet water quality standards. In a separate enforcement action, EPA negotiated a Consent Order for a removal with the owner of the Value Metal Plating facility in January, 1991. This Order required the removal and off-site disposal of about 80 drums of spent electroplating solution. The work under this Order was completed in December, 1992.

Before proceeding with the next phase of the RI/FS, EPA noticed PRPs associated with several large facilities to allow them an opportunity to conduct an RI/FS on their facilities. Initially, four facilities were identified as potential PRP lead operable units: the petroleum storage tank facilities, Todd Shipyard, Lockheed Shipyard, and Terminal 18 (Port of Seattle). Todd Shipyard and Lockheed Shipyard were sent special notice letters requesting that they conduct an RI/FS on their facilities in June, 1990. In September, 1990, Lockheed agreed to conduct an RI/FS for the shipyard facility under a Consent Order to EPA. Negotiations were terminated with Todd due to submission of an inadequate good faith offer. An RI/FS special notice letter was sent to the Port of Seattle for Terminal 18 in January, 1991, but negotiations were terminated after the Port decided not to conduct the work. Both the Todd Shipyard and Terminal 18 facilities were then added to the soil and groundwater operable unit being conducted by EPA.

The petroleum tank storage unit consists of three storage tank facilities owned by Shell, ARCO, and Texaco. Since petroleum is excluded from the definition of "hazardous substance" under CERCLA, but is a hazardous substance under MTCA, EPA and Ecology signed a memorandum of agreement which gives Ecology the lead in undertaking enforcement action for these three tank farms. Agreements between Ecology and the tank farm owners to conduct RI/FSs were finalized in early 1993 and the selection of remedial actions is scheduled for early 1995. EPA elected to conduct the RI/FS on the marine sediment operable unit and the soil and groundwater operable unit.

The RI field work for the soil and groundwater unit began in May, 1991, and the field work for the marine sediment unit was initiated in September, 1991. The marine sediment operable unit RI/FS reports and Proposed Plan are scheduled to be completed at the end of 1994. The ROD for the marine sediment unit is scheduled for 1995.

D. HIGHLIGHTS OF COMMUNITY PARTICIPATION

CERCLA requirements for public participation include releasing the Remedial Investigation and Feasibility Study Reports and the Proposed Plan to the public and providing a public comment period on the Feasibility Study and Proposed Plan. EPA met these requirements in March 1994, by placing both Remedial Investigation and Feasibility Study Reports in the public information repositories for the site. EPA mailed copies of the Proposed Plan on April 22, 1994 to individuals on the mailing list. EPA published a notice of the release of the RI/FS and proposed plan in the Seattle Times in the morning edition on April 25, 1994. Notice of the 30 day public comment period and the public meeting discussing the proposed plan were included in the newspaper notice. The public meeting was held on May 11, 1994, at the EPA Region 10 Headquarters on Sixth Avenue in Seattle. Public comments received are located in the Responsiveness Summary section of the ROD.

To date, the following community relations activities have been conducted by EPA at the Harbor Island site:

March 1988- EPA updated the 1985 Community Relations Plan.

April 1988- EPA released a fact sheet explaining the environmental problems at the site.

December 1988- EPA released a fact sheet announcing the beginning of the Remedial Investigation.

June 1989- EPA mailed an update on the work at the site.

November 1989- A fact sheet is released explaining the work being conducted by the City of Seattle to clean and sample the storm drain system on the island.

June 1990- EPA releases an update of the activities at the site.

January 1991- EPA releases a fact sheet announcing plans to remove approximately 80 drums and some miscellaneous containers at the Value Metal Plating facility.

April 1991- EPA announces the availability of the Phase I report and the beginning of the Phase II investigation.

September 1992- EPA releases an update of the activities at the site.

June 23, 1993- Ad runs in the Seattle Times announcing the public comment period and the date and time of the soil & groundwater public meeting.

June 23, 1993- EPA releases the Proposed Plan for the cleanup of soil & groundwater.

July 9, 1993- EPA releases a notice of the extension to the public comment period.

August 23, 1993- The public comment period on soil & groundwater closes.

November 3, 1993- EPA announces cleanup decision for soil and groundwater.

April 22, 1994- EPA releases a Proposed Plan summary fact sheet and the Proposed Plan for cleanup of the Lockheed Shipyard facility.

April 25, 1994- Ad runs in the Seattle Times announcing the public comment period on the Lockheed Shipyard Facility.

May 11, 1994- Public Meeting on the Lockheed Shipyard Proposed Plan.

E. SCOPE AND ROLE OF RESPONSE ACTION WITHIN THE REMEDIAL STRATEGY

Contaminated media at Harbor Island consists of soil, groundwater and sediments. The overall remedial strategy for Harbor Island is to initiate cleanup of contaminated soil and groundwater first because they pose a risk to human health and act as sources of contamination to the marine sediments.

The remedial action selected in this Record of Decision addresses all contaminated soil and groundwater on the Lockheed facility property and is the second action selected for the Site. Remedial actions for the petroleum storage tank unit will selected by Ecology. It is intended that these actions will be compatible with the remedial actions selected for the Lockheed and soil and groundwater units.

Sediments at Harbor Island have been contaminated by direct runoff from contaminated surface soil, indirect runoff through storm sewer systems, and groundwater contaminant loading. Contamination by direct and indirect runoff will be controlled by the selected remedy for the Lockheed unit through: 1) excavating and treating petroleum "hot spots" soil, and 2) capping all areas where contaminants exceed cleanup goals.

F. SUMMARY OF SITE CHARACTERISTICS

General Characteristics

Harbor Island is situated in a geographic area known as the Puget Lowlands, a trough characterized by low relief, with glacially shaped bluffs and low rising hills, and a vast area of intertidal and tidal flats. Puget Sound, in which Harbor Island is located, is an inland marine waterway formed through continental glaciation. Harbor Island is located on the former delta of the Duwamish River, which flows into Elliott Bay and Puget Sound from the Duwamish-Green River valley.

The island, including the Lockheed facility, is composed largely of native fluvial sand dredged from the surrounding areas. Dredged sediment was placed across the Duwamish tidelands to form a fairly homogeneous sandy fill which is now Harbor Island. This fine-grained fill consists primarily of poorly graded, very dark gray, fine to medium, damp to wet, loose sand. The fine-grained fill thickness ranges from 3 to 15 feet. Alluvial deltaic deposits, consisting of unconsolidated, fine to coarse-grained sand, underlie the fill material. Overlying the fine-grained fill is a layer of coarse-grained fill which is from Seattle regrade projects conducted in the early 1900's. This coarse-grained fill consists of gravelly sand to coarse sand, dark grayish brown, poorly graded, loose, dry to moist. The thickness of the coarse-grained fill ranges from 0 to 7 feet.

Adjacent Land Use

Harbor Island is currently used for industrial and commercial purposes. Immediately north of the Lockheed Shipyard is the ARCO petroleum storage tank facility, to the east are several industrial/commercial businesses, to the south is the Fisher Mills facility, and to the west lies the West Waterway of the Duwamish River.

Use of Natural Resources

Surface water runoff is collected and drained from Harbor Island via a city owned storm drain system consisting of catch basins, outfalls, and drainage manholes throughout the island. This system discharges at 11 outfalls around the perimeter of Harbor Island and into the East and West waterways. The Lockheed facility has its own storm drain system which collects surface runoff and drains into the West Waterway. The West Waterway is used primarily for commercial shipping. There are no natural ponds on Harbor Island.

There are no drinking water wells in use on Harbor Island. Harbor Island groundwater is not currently used for drinking water and all water users on the island are serviced by the City of Seattle water system. Groundwater at a depth of approximately 40 feet is naturally brackish and not potable. Groundwater at Harbor Island is not considered to be a future drinking water source.

Groundwater Resources

Groundwater at Harbor Island, including the Lockheed facility, occurs as shallow, unconfined groundwater within the fill and deltaic sediment. The depth to the groundwater is shallow and ranges from 2.5 feet to 11 feet below ground surface (bgs). This groundwater occurs as freshwater and becomes brackish at depths of 45 feet near the shoreline, and deeper at inland locations. The water bearing stratigraphic column behaves as a single hydrostatigraphic unit.

Groundwater recharge occurs through infiltration of precipitation. The groundwater level is highest in the northern half of the island, where recharge is greatest. Groundwater elevation distribution indicates a radial flow condition with discharge to the adjacent waterways. Groundwater surface elevation decreases from the north central portion of the island to the southern portion because a greater percent of the southern portion is paved, preventing recharge through infiltration. The groundwater also responds to tidal forces within the adjacent marine estuary.

Known or Suspected Sources of Contamination

Since construction, the island has been used for commercial and industrial activities. Major activities include shipping, railroad transportation, bulk fuel storage and transfer, secondary lead smelting, lead fabrication, shipbuilding, and metal plating. Warehouses, laboratories, and office buildings have also been located on the island. The primary source of contamination at the Lockheed Shipyard is shipbuilding activities conducted at that facility since the mid-1930's. Some lead contamination at this facility may also be attributed to the lead smelter which operated nearby on the island.

Summary of the Remedial Investigation

In 1989, Lockheed conducted an Environmental Assessment of the shipyard, which identified a number of areas of potential environmental concern. The review identified features including above and below ground storage tanks, impoundments, oil stained areas, storm drain sediment and sandblasting grit. These areas were sampled as part of the Remedial Investigation (RI) to determine the nature and extent of contamination. Specific sampling included the following:

- Collection of soil samples from 44 soil borings drilled to a maximum depth of approximately 7 feet using a drill rig and collection of soil samples from eight shallow hand auger soil borings;

- Collection of 20 surface samples for metals analyses in a 200-foot grid pattern across the upland portion of the Lockheed facility;

- Construction of 25 shallow (maximum depth approximately 20 feet) monitoring wells and collection of soil samples and groundwater samples from each location; and

- Collection of 12 samples (4 during the RI and 8 after the RI) of sandblasting grit in the shipways.

Surface and Subsurface Soil Results

The results of analyses of surface soil samples collected during the remedial investigation are presented in this section. Results are presented according to classes of chemical compound. It was determined that none of the soil on the Lockheed facility is RCRA characteristic or listed hazardous waste.

A total of 17 different volatile organic compounds (VOCs) were detected in soil samples collected from the facility. The VOC concentration ranged from 1 to 810 ug/kg. The most frequently detected VOCs were tetrachloroethene, methylene chloride, toluene, xylenes, and acetone. The highest concentrations of tetrachloroethene were 500 and 810 ug/kg found at two locations in the surface soil. The highest concentrations of methylene chloride were 190 ug/kg at a 6.5 foot depth, and 590 ug/kg at a 5 foot depth. The highest concentrations of toluene were 88 ug/kg in the surface, and 210 ug/kg at a 7 foot depth. The highest concentrations of xylenes were 16 ug/kg in the surface, and 49 ug/kg at a 5 foot depth. The highest concentrations of acetone were 260 ug/kg in the surface, and 520 ug/kg at a 5 foot depth. The locations where elevated concentrations of VOCs were detected occur most frequently along the northern and southern portions of the facility.

A total of 27 different semi-volatile halogenated organic compounds, primarily polyaromatic hydrocarbons (PAHs), were detected in soil samples collected at the facility. In general, these PAHs were found in areas which had also been contaminated with petroleum products. Fluoranthene, pyrene, phenanthrene, and chrysene were the most frequently detected PAHs and the concentrations of total PAHs at the facility ranged from 7 to 39,000 ug/kg. The highest concentrations of fluoranthene were 26,000 ug/kg in the surface, and 16,000 ug/kg at a 7 foot depth. The highest concentrations of pyrene were 15,000 ug/kg at the surface, and 3,600 ug/kg at a 3 foot depth. The highest concentrations of phenanthrene were 39,000 ug/kg in the surface, and 17,000 ug/kg at a 5 foot depth. The highest concentrations of chysene were 3,800 ug/kg at the surface, and 2,100 ug/kg at a 3 foot depth.

Arsenic, cadmium, lead, and mercury were detected at levels high enough to be a potential risk to human health. Arsenic concentrations ranged from 1.1 to 236 mg/kg and was found at its highest concentration in the surface soil. Cadmium ranged from 0.35 to 12.7 mg/kg and was detected at its highest concentration at a 10 foot depth. Lead ranged from 0.84 to 3,520 mg/kg and was found at its highest concentrations at a 5 foot depth. Mercury ranged from 0.07 to 4.6 mg/kg and was found at its highest concentration in the surface soil.

Total petroleum hydrocarbons (TPH) were detected frequently in the soil across the facility. TPH concentration ranged from 5 to 51,000 mg/kg with the highest level occurring in the surface soil. Four samples at a 5 foot depth were in the range of 10,000 to 18,000 mg/kg. The most significant area of contamination occurs along the northern property boundary.

In the sandblasting grit samples, arsenic concentrations were in the range of 300 to 500 mg/kg and the lead concentrations ranged from 300 to 1,800 mg/kg.

Groundwater Results

In the groundwater, contaminants of concern and their maximum concentrations included: benzene in one well at 780 micrograms per liter (µg/L) in June 1991 and 180 µg/L in June 1992, tetrachloroethane (PCE) at 48 µg/L in two wells, copper at 74.1 µg/L, lead at 11.4 µg/L, and zinc at 329 µg/L. The highest levels of groundwater contaminants were found at the north and south ends of the facility in monitoring wells located 200 to 450 feet back from the shoreline. The investigation did not find any floating petroleum product on the groundwater associated with the petroleum contaminated soil areas.

Routes of Potential Migration

The fate of contaminants originating from the Site, including the Lockheed facility, depends on location-specific migration pathways and on the chemical and physical properties of each contaminant. This section focuses on the contaminants of concern and identifies their probable routes of migration in surface soil, subsurface soil, and groundwater.

Surface Soil

The principal transport mechanisms of the contaminants in surface soil are as suspended soil in surface water runoff. Surface water runoff is a significant current transport pathway for contaminants to reach the surrounding waterways and marine sediments. Surface water runoff can transport dissolved, suspended, and particulate-bound contaminants through storm drains into the surrounding estuary.

Subsurface Soil

The probable transport mechanism of the primary contaminants in subsurface soil is vertical transport of dissolved contaminants in rainwater which permeates through the soil. The primary factor which determines the rate which inorganic and organic contaminants leaches from the soil is the contaminant solubility. For inorganics, the pH of the water contacting the contaminated soil is also an important factor. Inorganics are relatively less mobile in the soil than organics because inorganics have relatively low solubility in water and they also strongly adsorb to soil particles, particularly silts and clay. Organics, on the other hand, are generally more soluble in water and primarily bind to naturally occurring soil organic matter, such as humic acid. Organic contaminants in high concentrations, such as petroleum, can also travel through pores in the soil as a Non-Aqueous Phase Liquid (NAPL). Organic contaminants in the NAPL state will not bind to soil organic matter and can flow through soil pores at a relatively fast rate. Residual NAPL can remain in the unsaturated (vadose) zone for long periods of time due to capillary attraction.

Groundwater

Contaminants in groundwater at the Lockheed facility are typically transported as dissolved constituents. A two-dimensional groundwater transport model (FLOWPATH) along with a Digital Elevation Model was used to determine both loading rates and concentrations of contaminants at the shoreline. The contaminant transport calculations performed by the model predict the concentration of contaminants at the shoreline and estimate the time for contaminant concentrations to exceed cleanup goals at the shoreline, which is the point of compliance. The results of this model predict none of the contaminants currently in the groundwater at the Lockheed facility will exceed cleanup goals, at the point where the groundwater reaches the shoreline, within the next 50 years.

G. SUMMARY OF SITE RISKS

An assessment of the human health risk for the Site, including the Lockheed facility, was completed as part of the soil and groundwater unit Remedial Investigation Report. This assessment involved several steps, including: identification of contaminants of concern, an exposure assessment, a toxicity assessment, and a risk characterization, all of which are described below.

The results of a habitat evaluation indicated that Harbor Island is unable to sustain a wildlife population or support a functioning wildlife habitat due to widespread industrial development Therefore, an ecological risk assessment was not performed due to the absence of wildlife habitat areas on Harbor Island. An ecological risk assessment will be conducted for the marine sediment operable unit of this island.

Contaminants of Concern

A multiple-step screening approach was used to identify the analytes of concern for the human health risk assessment. To be included in the risk assessment, contaminants had to occur in at least 5% of the samples and had to be at a concentration high enough to have a risk greater than 10^{-6} or hazard index of 0.1 Of all the contaminants identified as a potential health risk for Harbor Island, only three of them, lead, arsenic, and PAHs, are in concentrations high enough to be of concern at the Lockheed facility.

Exposure Assessment

Harbor Island has been used for industrial purposes for approximately the last 80 years. There are no homes, residential areas, schools, or commercial daycare facilities on Harbor Island, and these conditions are not likely to change in the foreseeable future. For that reason, an industrial exposure scenario is most appropriate for Harbor Island and the Lockheed facility and is the exposure scenario discussed below.

Industrial workers who may incidentally ingest soil through hand-to-mouth contact and absorb contaminants through dermal contact with contaminated soil were identified as the population most at risk of adverse health effects. Inhalation is not a significant pathway of exposure to contaminants on Harbor Island based on the results of air dispersion modeling conducted during the remedial investigation. The noncancer hazard from inhalation was not significant (hazard index of less than one), and the cancer risk was approximately two orders of magnitude less than that observed for the ingestion pathway for all scenarios evaluated.

Potential human exposure to contaminants in groundwater was not evaluated because there is no current or foreseeable use of groundwater for drinking water purposes, and the entire island is serviced by the city of Seattle water system. Further, the majority of groundwater beneath Harbor Island is naturally brackish and unsuitable for drinking.

Assuming an industrial scenario, risk was calculated for the reasonable maximum exposure (RME) and for an average exposure. The risks cited in this document are for RME only. The risks for the average exposure can be found in the Baseline Human Health Risk Assessment. RME is equal to the upper 95% confidence limit of the concentration distribution for each contaminant. For incidental soil ingestion and dermal contact exposures, measured soil concentrations were used to determine the RME values. RME values for inhalation exposures were estimated using the results of air dispersion modeling. The exposure assumptions used for all three pathways are based on EPA Region 10 risk assessment guidelines and are specified in the Baseline Human Health Risk Assessment.

In calculating risk for an industrial exposures it was assumed that risks from incidental soil ingestion, dermal absorption, and inhalation were additive and contributed to the total body burden. Combining all of the exposure assumptions, summary intake factors (rates of ingestion, absorption and inhalation) were derived for each exposure pathway. For the purpose of the risk assessment, the duration for an industrial exposure was set at 25 years.

Toxicity Assessment

In order of priority, the following EPA sources were consulted for toxicity criteria: Integrated Risk Information System (IRIS); Health Effects Assessment Summary Tables (HEAST); and EPA's Environmental Criteria and Assessment Office (ECAO). The basis for the noncarcinogenic and carcinogenic toxicity criteria used to calculate risk for the contaminants of concern is briefly discussed below.

The toxicity criteria used to evaluate noncancer risks are reference doses (RfDs). The term RfD refers to a daily intake of a contaminant to which an individual, including sensitive subpopulations, can be exposed without any expectation of noncarcinogenic adverse health effects (e.g., organ damage, biochemical alterations, birth defects). The contaminant of concern for noncancer health effects at the Lockheed facility was arsenic. This contaminant was only of concern through the oral route.

The toxicity criteria used to evaluate cancer risks are cancer slope factors. A cancer slope factor is a numerical estimate of the potency of a contaminant that, when multiplied by the average lifetime dose, gives the probability of an individual developing cancer over a lifetime. In developing cancer slope factors, it is assumed by the EPA that any dose of a carcinogen, no matter how small, is capable of causing cancer. Slope factors are derived by EPA using a linearized multistage model and reflect the upper-bound limit of a contaminant's cancer potency.

The contaminants of concern for cancer health effects at the Lockheed facility were arsenic and PAHs. Due to uncertainty on the appropriate toxicity criteria to use for evaluating lead, this metal was not included in cancer and noncancer risk calculations, but was evaluated using the uptake biokinetics model.

Arsenic is classified by EPA as a known human carcinogen. The oral slope factor for arsenic obtained from IRIS was 1.8 $(mg/kg\text{-}day)^{-1}$. Carcinogenic PAHs are classified by EPA as probable human carcinogens. The oral slope factor (also used as the dermal slope factor) obtained from the EPA ECAO was 5.8 $(mg/kg\text{-}day)^{-1}$. This is the slope factor for benzo(a)pyrene. In evaluating risk for other carcinogenic PAHs, this slope factor was used in conjunction with a toxic equivalency factor (TEF) approach. Using the TEF approach the slope factor for benzo(a)pyrene was multiplied by a numeric factor to adjust for the differing toxicities of the carcinogenic PAHs.

Risk Characterization

Noncarcinogenic risks were evaluated by comparing contaminant daily intakes to reference doses (RfDs). This was accomplished by calculating hazard quotients and hazard indices. A hazard quotient for a particular contaminant through a given exposure route is the ratio between the estimated daily intake and the applicable RfD. A hazard index is a sum of hazard quotients, which may be summed for all contaminants for a given exposure pathway, and across pathways. If a hazard quotient or hazard index exceeds 1.0, it indicates that potential noncarcinogenic health effects may occur under the defined exposure conditions.

Carcinogenic risk was calculated for each carcinogen by multiplying the estimated daily intake of carcinogen by the appropriate cancer slope factor. Carcinogenic risk was calculated for each carcinogen through each exposure pathway for each individual. The total carcinogenic risk for the industrial scenario was calculated by summing carcinogenic risk across exposure pathways, and across exposure pathways and age groups (infant and child) for the commercial scenario. According to the National Contingency Plan, the acceptable risk range for carcinogens at a Superfund site is between 1 in 1,000,000 (10^{-6}) and 1 in 10,000 (10^{-4}).

For the Lockheed facility the noncarcinogenic risks, calculated in the form of a hazard index, were found to range from 0.01 to 0.07. This range is well below a hazard index of 1.0, which is considered to be the threshold below which no adverse health effects are observed. The carcinogenic risk at the Lockheed facility was calculated to be in the range of 5 in 10 million (5×10^{-7}) to 7 in 100,000 (7×10^{-5}). Only two locations exceeded a risk of 1×10^{-5} due to arsenic contamination.

A risk assessment was not conducted for lead, which is considered to be a probable carcinogen, because a risk-based calculation method for lead has not yet been established by EPA. Concentrations of lead were found at three locations exceeding the state of Washington's cleanup standards of 1,000 mg/kg which is considered to be a protective level for industrial workers.

Because the groundwater on Harbor Island is not currently used for drinking water, and is not anticipated to be used for drinking water in the future, a human health risk assessment for ingestion of groundwater was not conducted. However, if contaminated groundwater was to enter the adjacent Duwamish River and Elliott Bay in significant concentrations, it could adversely effect marine organisms or pose a threat to individuals consuming these organisms. Contaminants in groundwater at the Lockheed shipyard which pose a potential risk to marine organisms or human health include benzene, PCE, copper, lead and zinc.

Uncertainty

The accuracy of the risk estimates depends in large part on the accuracy of the sampling data, exposure assumptions, and toxicity criteria. Most assumptions used in determining exposure to and toxicity of hazardous substances are intentionally conservative, resulting in a risk estimate which likely is greater than the actual risk present at the Site.

Uncertainties in sampling data directly influence the final risk calculations. A variability of minus 50 to plus 100% is typical for samples containing analytes at concentrations less than the contract-required quantitation limit. For samples containing higher concentrations of analytes, relative percent differences of 35% for soil are considered acceptable.

The estimated exposure dose for each exposure scenario and age class are standard values used in EPA risk assessment based on results of controlled studies conducted outside the scope of this risk assessment. The standard values are intended to be conservative because accurate site-specific data on exposure dose is not available.

The method for determining toxicity values is also intended to be conservative. Several conservative uncertainty factors are used in the development of toxicity criteria for carcinogens and noncarcinogens. For example, cancer slope factors for carcinogens and reference doses (RfDs) for noncarcinogens are often derived from animal studies with an additional safety factor added for extrapolating toxicity to humans.

Environmental Evaluation

As the first step in the environmental evaluation, a habitat and ecological community evaluation was performed. The results of the habitat evaluation showed that Harbor Island consists of an industrial matrix with a number of small and disconnected undeveloped patches of land. Due to the industrial development on the island, these patches do not appear sufficient in size or quality to sustain a wildlife population or support a functioning ecological community. The evaluation of potential ecological receptors indicated that only those species (i.e., rats, dogs, crows, and gulls) associated with urban areas would be expected to temporarily reside on Harbor Island. A field investigation as well as interviews were unable to verify the presence of any mammals on Harbor Island. The lack of suitable habitat and ecological receptors precluded the necessity for further environmental evaluation.

Petroleum in soil at the Lockheed shipyard is a potential risk to the marine environment since petroleum may leach from the soil into the groundwater and then migrate to the adjacent surface water. Based on the state of Washington's guidelines for petroleum contaminated soil, it was determined in the Harbor Island Record of Decision that petroleum concentrations below 600 mg/kg would be protective of the environment. Petroleum was found to exceed this protective level in seven areas at the Lockheed shipyard unit.

H. REMEDIAL ACTION OBJECTIVES

Actual or threatened releases of hazardous substances from this site, if not addressed by implementing the response action selected in this Record of Decision (ROD), may present an imminent and substantial endangerment to public health, welfare or the environment. The remedial action objectives (RAOs), and their associated numerical cleanup goals, are intended to protect human health and the environment by reducing risks to acceptable levels. RAOs are based on the results of the above risk assessment and on existing state and federal standards, which are applicable or relevant and appropriate requirements (ARARs).

For Harbor Island, including the Lockheed facility, the primary soil ARARs are the standards contained in MTCA and its implementing regulations. Compared to subsurface soil, surface soil presents a greater risk to human health because of the potential for more frequent exposure through direct contact or ingestion. Therefore, cleanup goals for the surface are more stringent and were based on a risk calculation specified by MTCA. The RAOs and cleanup goals for the Lockheed facility operable unit are shown in Table 1.

The cleanup goal for carcinogens in surface soil is to achieve a total cancer risk from all carcinogens of less than one in 100,000 (10^{-5}) for an industrial exposure. The cleanup goal for noncarcinogens in surface soil is to achieve contaminant concentrations with a hazard index of less than 1.0 (one). A hazard index of less than 1.0 means contaminant concentrations are not expected to pose an adverse health effect. The cleanup goal for lead, which is considered to be a probable carcinogen, is the MTCA numerical standard for an industrial exposure because a risk-based calculation method for lead has not yet been determined by EPA.

For subsurface soil, since human contact will be limited to infrequent excavations of limited duration, MTCA numerical standards for an industrial exposure were selected. The goal of these numerical standards is to achieve a risk from individual carcinogens of less than 1 in 100,000 (10^{-5}), and a hazard index from individual noncarcinogens of less that 1.0. The MTCA numerical standards selected for some of the contaminants in the subsurface are also designed to protect groundwater quality.

Table 1— Remedial Action Objectives and Cleanup Goals for Lockheed

Medium	Primary Receptors	Remedial Action Objective	Cleanup Goals[a]
Soil—Surface	Humans	Protect human health from exposure to contaminants in surface soil which pose a combined risk of greater than 1 x 10^{-5}.	Lead: 1,000 mg/kg[b] Arsenic: 3.60 to 32.6 mg/kg[c] Carcinogenic PAHs: 0.1 to 36.5 mg/kg[c]
Soil—Subsurface	Humans and Environment	Protect human health from infrequent exposure to contaminants in the subsurface which pose a risk greater than 10^{-5} for each contaminant. Prevent release of contaminants into the groundwater where they can be transported to the shoreline, where marine organisms could be exposed.	Lead: 1,000 mg/kg[b] TPH (diesel): 600 mg/kg[d] PAHs (carcinogenic): 20 mg/kg[b] Arsenic: 200 mg/kg[b] Benzene: 1.0 mg/kg[d] Ethylbenzene: 200 mg/kg[d] Toluene: 100 mg/kg[d] Xylenes: 150 mg/kg[d]
Groundwater	Environment	Prevent migration of contaminants to the shoreline where marine organisms could be exposed. Protect human health from consuming contaminated marine organisms which pose a risk greater than 1 x 10^{-6}	Benzene: 71 µg/L[e] Tetrachloroethylene: 8.8 µg/L Copper: 2.9 µg/L Lead: 5.8 µg/L Zinc: 76.6 µg/L

[a] Cleanup goals were determined at various locations over the island and vary based on the number and type of contaminants present.
[b] Goals are based on MTCA Method A for soil at industrial sites.
[c] Based upon achieving a 1 x 10^{-5} excess cancer risk or Hazard Index equal to 1.
[d] Based on the State of Washington Petroleum-Contaminated Soil Matrix Rating method.
[e] All groundwater levels are based on protection of marine organisms or human health from consumption of organisms.

The Lockheed RI data indicate that soil cleanup goals were exceeded in seven areas for one or more contaminants including arsenic, lead, and petroleum (Figure 3). The total volume of soil which exceeds cleanup goals, associated with these seven areas, is estimated to be 38,000 cubic yards. For sandblasting grit located on the facility, eight samples exceeded the cleanup goal for arsenic and two samples exceeded the cleanup goals for lead. The approximate volume of sandblasting grit on the facility is estimated to be about 1,120 cubic yards.

In addition to the cleanup goal for petroleum of 600 mg/kg, a petroleum "treatment level" of 10,000 mg/kg also applies to the Lockheed facility. This treatment level was identified in the Harbor Island soil and groundwater operable unit Record of Decision and was determined through a cost-benefit analysis (see Appendix B) which included the Lockheed soil data. This treatment level is considered to be the level above which treatment of petroleum is preferred because it would provide additional protection to the environment in a cost effective manner. Petroleum exceeded this treatment level in four areas (Figure 4), and the approximate volume of soil exceeding the treatment level is 4,800 cubic yards. Areas exceeding this treatment level are also referred to as "hot spots".

Groundwater

EPA and Ecology have determined that the federal and state drinking water standards do not apply to groundwater at Harbor Island. These drinking water standards are not relevant and appropriate to Harbor Island because: 1) there is no current or foreseeable use of groundwater for drinking water purposes, 2) the entire island is serviced by the city of Seattle water system, and 3) the surface water standards for the protection of marine organisms, and protection of human health from consumption of marine organisms, will be the cleanup goals for contaminants which reach the shoreline.

Several contaminants in the groundwater have the potential to eventually exceed the surface water standards including: copper, lead, zinc, benzene and PCE. However, none of these contaminants currently exceed the cleanup goals in the groundwater at the shoreline. Based on a computer model, which determines the transport of contaminants in groundwater, it is predicted that none of the groundwater contaminants are expected to reach the shoreline at concentrations exceeding cleanup goals in less than 50 years. In applying this computer model to the Lockheed facility, it was conservatively assumed that no remedial actions were taken.

Figure 3
Areas Exceeding Soil Cleanup Goals

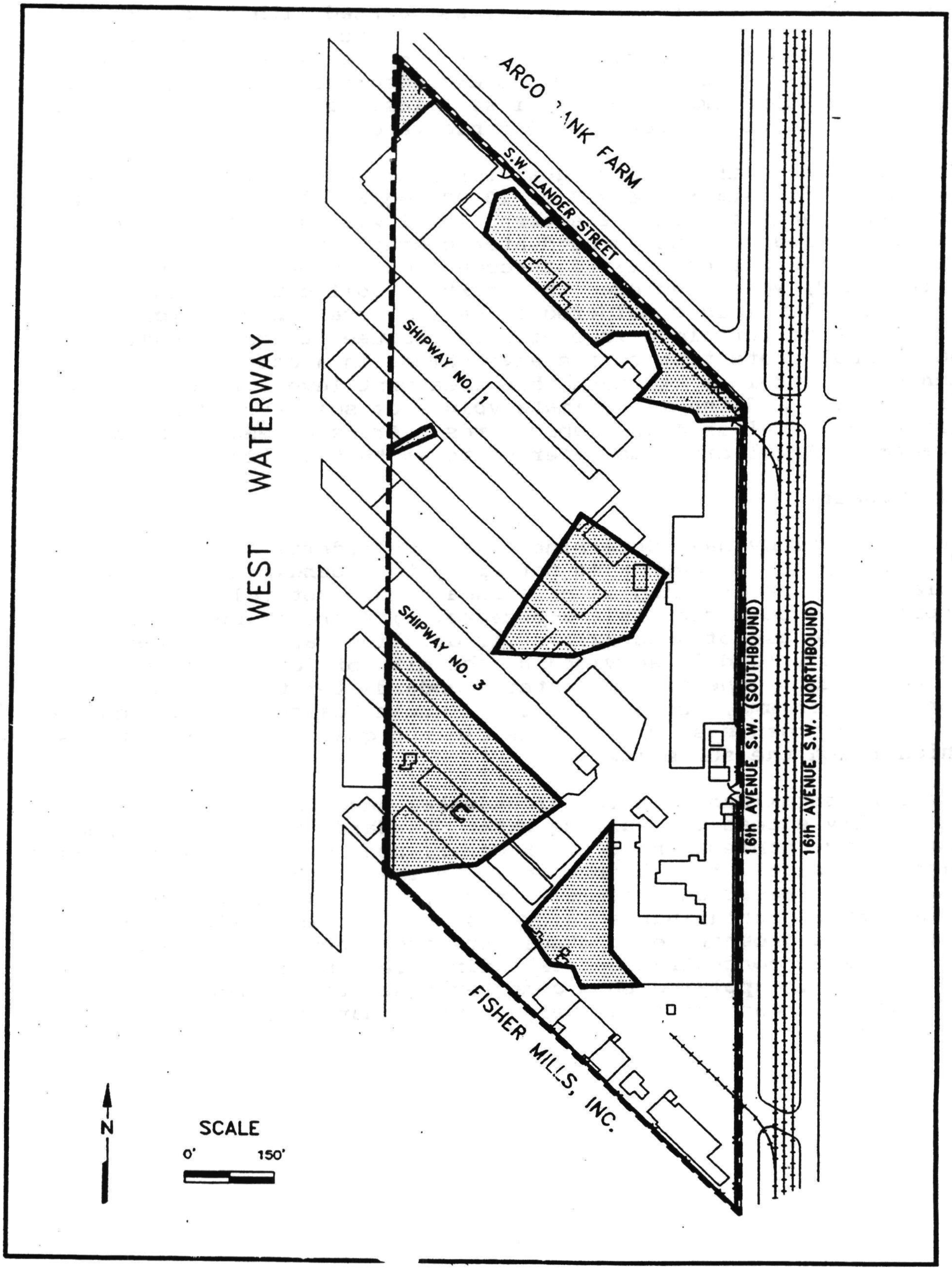
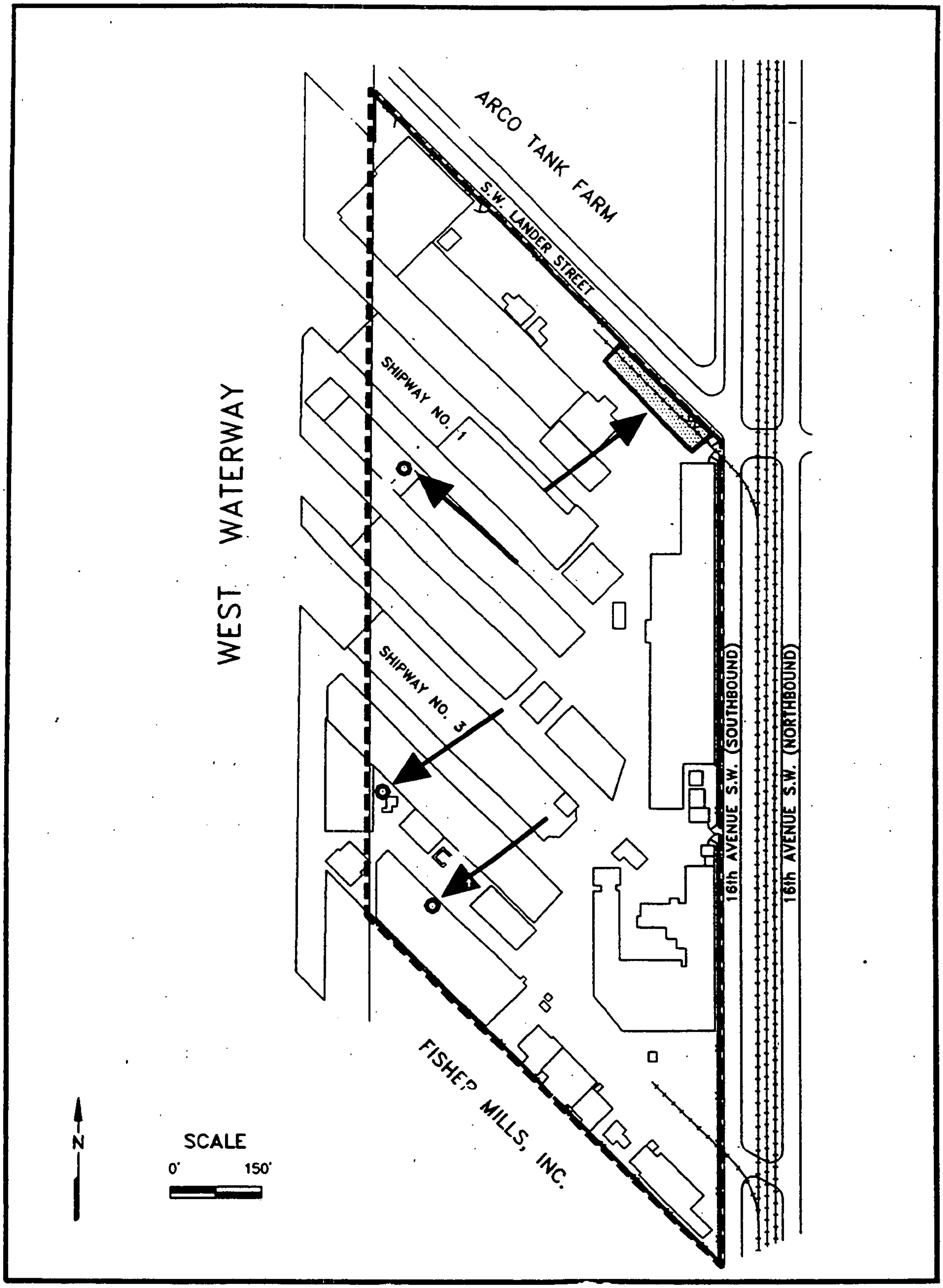


Figure 4
Soil Petroleum Hot Spots



I. DESCRIPTION OF REMEDIAL ALTERNATIVES

Soil Alternatives

Soil cleanup alternatives fall into five general categories:

- o No Action (Alternative 1)
- o Institutional Controls (Alternative 2)
- o Containment (Alternative 3)
- o Treatment of All Soil above Cleanup Goals (Alternatives 4-6)
- o Treatment of Hot Spot Soil/Containment (Alternatives 7-8)

The estimated time to complete the following alternatives includes activities from the beginning of the remedial design to completion of the remedial action. It does not include an additional 6-9 months typically required to finalize an agreement between EPA and the Potentially Responsible Parties to perform the work. Cost estimates for each alternative are given in present value (1994) dollars.

Alternative 1: No Action

The "No Action" alternative provides a baseline for comparative evaluation of other alternatives. Under Superfund, the "No Action" alternative is used to establish the risk levels and site conditions if no remedial actions are implemented. Site conditions and risk levels would remain as they currently exist. No changes or restrictions would be made that would affect activities at the site. This alternative has no treatment or containment components. Land development, site maintenance, and site improvement would continue in accordance with prevailing practices.

Since this alternative does not require any remedial action, there are no ARARs which apply to it.

Estimated Cost: None
Estimated Time to Complete: None

Alternative 2: Institutional Controls

Institutional controls may be used to control future uses of the property or limit access to the property. Employees working on the property would be instructed on how to minimize potential risks due to exposure to contaminated soil through informational meetings or health advisories issued by the State Department of Health. Institutional controls may also be used to establish maintenance and monitoring requirements for the Lockheed facility. Signs would be posted in key affected areas to warn workers of the potential for exposure associated with excavation or disturbance of the soils. Deed restrictions could also be recorded to advise potential buyers of the hazards and use limitations associated with the property. Periodic environmental monitoring and inspections would be required to verify the effectiveness of the institutional controls.

This alternative would not include treatment or containment, and existing potential exposure routes would remain. MTCA is an ARAR which would apply to this alternative (see Section L, "Compliance with ARARs"). MTCA allows institutional controls to meet cleanup goals, but it is not the preferred method.

Estimated Capital Cost: $30,000
Estimated Operating Cost: $50,000
Estimated Time to Complete: 2 months

Alternative 3: Containment (Capping)

Contaminated areas exceeding cleanup goals would be capped to prevent exposure of workers to contaminated soil. Capping would also minimize the transport of the contaminants by rain water runoff and infiltration. A cap would be installed in areas where soil contaminant levels exceed cleanup goals. Existing pavement would also be inspected and areas with cracks or heavily worn pavement would be repaired or replaced. Existing asphalt needing replacement, would be disposed at an off-Site facility. Approximately 2,000 square yards of area on the Lockheed facility would require capping under this alternative.

The cap design and the specific material used would be based upon the use of the capped area. Typically, this cap would consist of a 3-inch asphaltic wearing surface overlaying a base course of well-graded crushed rock, although in certain areas a reinforced concrete cap may be required to support heavy loads. A sealant would be applied to the asphalt surface following installation. Cap inspections and minor repairs based on those inspections would be made annually. It is anticipated that weather- and traffic-induced degradation of the asphalt surface would occur and the surface would need substantial surficial repair approximately every 10 years to maintain integrity of the seal. The cost estimate for this alternative is based on a 30 year maintenance period for the cap, and includes resurfacing 50 percent of the paved area every decade.

This alternative does not contain a treatment component. MTCA is the only regulation which is an ARAR for this alternative (see Section L, "Compliance with ARARs"). This alternative would meet this ARAR but would not satisfy the preference for treatment identified in MTCA.

Estimated Capital Cost: $400,000
Estimated Operating Cost: $300,000
Estimated Time to Complete: 2 months

Alternative 4: Off-Site Thermal Treatment and Disposal

All soil exceeding organic and inorganic cleanup goals, approximately 38,000 cubic yards, would be excavated and transported by truck to appropriate off-Site treatment facilities. Excavated areas would be backfilled with clean fill and capped with asphalt. Soil contaminated with organics (petroleum) would be treated at a permitted off-Site thermal desorption facility. Soil containing inorganic contaminant concentrations designated as dangerous waste, according to the Washington State Dangerous Waste Regulations, would be taken to a hazardous waste disposal facility for solidification and disposal.

Thermal desorption is a process by which soil is heated to a moderate temperature, typically 300 to 1,000 F, which vaporizes the organic contaminants and removes them from the soil. After the organics are vaporized, they can either be condensed and recovered in liquid form, or they can be oxidized in a secondary chamber, called an afterburner, at temperatures above 1400 F. For this alternative and alternative 7, which specify off-Site thermal treatment, the vaporized organics would be oxidized in an afterburner. The Puget Sound Air Pollution Control Agency (PSAPCA) has permitted several thermal desorption units in the Puget Sound area to treat petroleum contaminated soil in this manner. For alternatives 6 and 8, which specify on-Site thermal treatment, the vaporized organics would be recovered in liquid form and not oxidized.

Thermal desorption has been proven to be very effective in removing petroleum products from soil and it is believed that the cleanup goals for petroleum contaminated soil at this Site can easily be achieved. Treatment costs increase and efficiency of thermal desorption decreases as the moisture or clay content of soil increases. At the Lockheed shipyard, soil immediately above the water table will have elevated moisture content and may need to be set aside and allowed to drain prior to treatment. Clay content in the fill material at the Lockheed shipyard is low and is not anticipated to adversely impact thermal desorption operations.

Before starting excavation, a pre-remedial design investigation and survey would be conducted to verify the horizontal and vertical extent of contaminated soils. Several of the areas are located in buildings and these buildings would need to be modified or demolished to allow access for excavation equipment. Asphalt and concrete would be cut and removed as necessary to expose affected soils. Demolition debris including materials from buildings, asphalt, and concrete would be transported to an approved facility for disposal of those materials after removing loose soil.

This alternative does not contain a containment component. MTCA, and PSAPCA regulations are ARARs which apply to this alternative (see Section L, "Compliance with ARARs"). This alternative would comply with these ARARs and satisfy the CERCLA and MTCA preference for treatment.

Estimated Capital Cost: $6,200,000
Estimated Operating Cost: None
Estimated Time to Complete: 4 months

Alternative 5: On-Site Bioremediation and Solidification

All soil exceeding cleanup goals for organics and inorganics, approximately 38,000 cubic yards, would be excavated and treated. Soil contaminated with organics would be treated by on-Site bioremediation and soil contaminated with inorganics would be solidified by mixing with cement.

Bioremediation, under proper conditions, has the potential to degrade petroleum products to concentrations below the cleanup goals. Treatability studies would need to be performed prior to full-scale treatment to ensure that the proper operating conditions are achieved. Nutrients would be periodically added to stimulate biological activity and tilling equipment would be used to thoroughly mix the soil in each treatment cell and to introduce oxygen. Periodic sampling would be conducted to monitor progress and to adjust additives as necessary. When treatment goals had been reached, treated soils would be returned to the original excavation, backfilled, compacted, and paved.

Soils with both organic and inorganic contaminants would receive biotreatment for organic contaminants, and then solidified to decrease the mobility of the inorganics. Soils containing only inorganic contaminants above the cleanup goals would be solidified. An on-Site area would be established where contaminated soil would be solidified by mixing with cement and then backfilled into the original excavation, compacted, and paved. Because of the volume increase due to additives during solidification, it is possible that some of the treated soils would be disposed off-site for use as a structural backfill in construction projects.

This alternative does not contain a containment component. MTCA, the Clean Air Act, the State Clean Air Act, and PSAPCA regulations are ARARs which apply to this alternative (see Section L, "Compliance with ARARs"). This alternative would comply with these ARARs and satisfy the CERCLA and MTCA preference for treatment.

Estimated Capital Cost: $4,600,000
Estimated Operating Cost: None
Estimated Time to Complete: 24 months

Alternative 6: On-Site Thermal Treatment and Solidification

All soil above the organic and inorganic cleanup goals, approximately 38,000 cubic yards, would be excavated and treated. Petroleum contaminated soil would be treated by on-Site thermal desorption and soil contaminated with inorganics would be solidified by mixing with cement. The thermal desorption unit would heat the petroleum contaminated soil indirectly (no direct flame) at a moderate temperature and the organic vapors desorbed from the soil would be condensed and collected in liquid form. If not recyclable, this liquid would be sent off-Site to be incinerated. Following treatment, the clean soil would be returned to the original excavation and backfilled.

Soils with both organic and inorganic contaminants would first be treated by thermal desorption for organic contaminants, and then solidified to decrease the mobility of the inorganics. Soils containing only inorganic contaminants above the cleanup goals would be solidified. An on-Site area would be established where contaminated soil would be solidified by mixing with cement and then backfilled into the original excavation, compacted, and paved. Because of the volume increase due to additives during solidification, it is possible that some of the treated soils would be disposed off-Site for use as a structural backfill in construction projects.

This alternative does not contain a containment component. MTCA, the Clean Air Act, the State Clean Air Act, and PSAPCA regulations are ARARs which apply to this alternative (see Section L, "Compliance with ARARs"). This alternative would comply with MTCA but would not comply with the remaining ARARs unless the thermal desorption system is equipped with an afterburner (see section M, "Documentation of Significant Differences"). This alternative satisfies the CERCLA and MTCA preference for treatment.

Estimated Capital Cost: $15,600,000
Estimated Operating Cost: None
Estimated Time to Complete: 6 months

Alternative 7: Off-Site Thermal Treatment of TPH Hot Spots and Containment

Alternative 7 consists of excavating approximately 4,800 cubic yards of soil contaminated with petroleum concentrations exceeding the treatment level of 10,000 mg/kg. This soil would be treated in an off-Site thermal desorption unit with an afterburner similar to that described in Alternative 4. Excavations would be backfilled with compacted clean fill and paved with asphalt. All other soil areas which exceed the petroleum cleanup goal of 600 mg/kg and exceed cleanup goals for inorganics, would be capped in place to contain and reduce the mobility of these contaminants. The condition of the existing asphalt pavement would be inspected in areas exceeding cleanup goals and repairs would be made as required to reduce the potential for exposure to affected soils in these areas.

The asphalt cap would be inspected and repaired on an annual basis and extensive repairs to the pavement would be required every 10 years. The cost estimate for this alternative is based on a 30 year maintenance period for the cap, and includes resurfacing 50 percent of the paved area every decade.

MTCA and PSAPCA regulations are ARARs which apply to this alternative (see Section L, "Compliance with ARARs"). This alternative would comply with these ARARs and satisfy the CERCLA and MTCA preference for treatment.

Estimated Capital Cost: $1,000,000
Estimated Operating Cost: $300,000

Estimated Time to Complete: 4 months

Alternative 8: On-Site Thermal Treatment of TPH Hot Spots and Containment

Alternative 8 consists of excavating approximately 4,800 cubic yards of soil contaminated with petroleum concentrations exceeding the treatment level of 10,000 mg/kg. This soil would be treated in an on-Site thermal desorption unit with condensate collection similar to that described in Alternative 6. Contaminated soil would be excavated, treated by thermal desorption, backfilled into the original excavation, and paved. All other soil areas which exceed the petroleum cleanup goal of 600 mg/kg and exceed cleanup goals for inorganics, would be capped in place to contain and reduce the mobility of these remaining contaminants. The condition of the existing asphalt pavement would be inspected in areas exceeding cleanup goals and repairs would be made as required to reduce the potential for exposure to affected soils in these areas.

The asphalt cap would be inspected and repaired on an annual basis and extensive repairs to the pavement would be required every 10 years. The cost estimate for this alternative is based on a 30 year maintenance period for the cap, and includes resurfacing 50 percent of the paved area every decade.

MTCA, the Clean Air Act, the State Clean Air Act, and PSAPCA regulations are ARARs which apply to this alternative (see Section L, "Compliance with ARARs"). This alternative would comply with MTCA but would not comply with the remaining ARARs unless the thermal desorption system is equipped with an afterburner (see section M, "Documentation of Significant Differences"). This alternative satisfies the CERCLA and MTCA preference for treatment.

Estimated Capital Cost: $2,600,000
Estimated Operating Cost: $300,000
Estimated Time to Complete: 4 months

Groundwater Alternatives

Alternative 1: No Action

The "No Action" alternative provides a baseline for comparative evaluation of other alternatives. Under the "No Action" alternative, site conditions and risk levels would remain as they currently exist. No changes or restrictions would be made that would affect activities at the Site. This alternative contains no treatment or containment components.

Since this alternative does not require any remedial action, there are no ARARs which apply to it.

Estimated Cost: None
Estimated Time to Complete: None

Alternative 2: Extraction and Off-Site Treatment

This alternative consists of extracting groundwater from affected areas and discharging the water to METRO for off-Site treatment. Groundwater extraction would take place in three areas on the Lockheed facility and approximately three to five extraction wells would be used. The estimated total extraction rate is 50 gallons per minute (gpm). The extracted water would be routed to a central tank which would discharge to METRO. The discharge water would be sampled at regular intervals as required by METRO. The pretreatment standards required by METRO have been reviewed and it is anticipated that the extracted water would be acceptable without any pretreatment. Groundwater extraction and treatment would continue until the cleanup goals are met. Groundwater quality would be monitored in and downgradient of the contaminated areas to determine when the cleanup goals are achieved.

The groundwater ARARs which apply to this alternative are listed in Section L, "Compliance with ARARs". This alternative would comply with all of these ARARs.

Estimated Capital Cost: $270,000
Estimated Operating Cost: $1,600,000
Estimated Time to Complete: 10 years

Alternative 3: Extraction and On-Site Treatment

This alternative consists of extracting groundwater from affected areas, treating the water to permissible discharge levels in an on-Site treatment plant, and discharging the treated water to the storm drain system. Groundwater extraction would take place in three affected groundwater areas on the Lockheed facility. The estimated total extraction rate is 50 gallons per minute and the water would be extracted from approximately three to five extraction wells. The extracted water would be routed to a central storage tank at the on-Site treatment plant. The on-Site treatment plant would consist of a reverse osmosis unit to remove metals and an air stripper to remove volatile organics. Groundwater extraction and treatment would continue until the cleanup goals are met. Groundwater quality would be monitored in and downgradient of the contaminated areas to determine when the cleanup goals are achieved. Long-term requirements for reverse osmosis can be substantial, particularly if clogging of the membrane occurs. In these cases, frequent system downtime may be likely and operational expenses will rise proportionally.

The groundwater ARARs which apply to this alternative are listed in Section L, "Compliance with ARARs". This alternative would comply with all of these ARARs.

Estimated Capital Cost: $980,000
Estimated Operating Cost: $1,900,000
Estimated Time to Complete: 10 years

Alternative 4: Groundwater Monitoring

Groundwater modeling indicates that under current conditions, contaminants in the groundwater at the Lockheed facility will take more than 50 years to reach the shoreline, which is the point of compliance. This alternative would require groundwater monitoring at wells located downgradient of areas where groundwater contamination has been detected. The groundwater data would be used to verify that groundwater contaminant concentrations will not exceed cleanup goals at the shoreline in the future. Selected downgradient wells would be monitored semi-annually for 30 years or until it has been demonstrated that cleanup goals will be achieved at the shoreline in the long-term. Groundwater quality data from these wells would be reviewed at least every five years by EPA and Ecology to identify trends in contaminant concentrations and distribution. If contaminants are found to be migrating to the shoreline at concentrations exceeding the cleanup goals, additional source control actions or groundwater treatment may be required at that time. The cost estimate for this alternative is based on groundwater monitoring for a period of 30 years.

This alternative contains no treatment or containment components. The groundwater ARARs which apply to this alternative are listed in Section L, "Compliance with ARARs". This alternative currently comply with these ARARs, but additional remedial actions may be necessary in the future if groundwater monitoring demonstrates that contaminants in groundwater may reach the shoreline in concentrations exceeding the surface water standards.

Estimated Capital Cost: None
Estimated Operating Cost: $300,000
Estimated Time to Complete: 30 years

J. SUMMARY OF COMPARATIVE ANALYSIS OF ALTERNATIVES

This section discusses the comparison of alternatives with respect to the nine statutory CERCLA evaluation criteria. The first two criteria, "Protection of Human Health and the Environment" and "Compliance with ARARs", are threshold criteria.

Protection of Human Health and the Environment

Soil Alternatives
Alternatives 4, 5, and 6 have the highest overall protectiveness of human health and the environment because all soil with contaminant concentrations above the cleanup goals will receive treatment under these alternatives.

Alternatives 7 and 8 rank lower because only the petroleum hot spot soil would be treated and the remaining soil with concentrations above the cleanup goals would be capped. Alternative 3 ranks next because it prevents direct exposure to contaminated soil but may not prevent migration of petroleum from hot spot soil to the groundwater and to the adjacent surface water where marine organisms may be exposed.

Alternative 2 ranks lower because direct exposure to contaminated soil is controlled but not eliminated and migration of petroleum from hot spot soil to groundwater is not eliminated. Alternative 1 has the lowest overall protectiveness of the eight alternatives because this alternative has highest potential for human and environmental exposure to contaminants remaining on Site.

Groundwater Alternatives
Alternatives 2 and 3 provide the best protection to the environment because they require treatment of all groundwater which exceeds the cleanup goals. Alternative 4 ranks slightly lower because it does not provide for treatment of contaminated groundwater. However, groundwater monitoring would be used to verify modeling predictions that contaminated groundwater will not reach the shoreline. If modeling predictions prove to be inaccurate, the monitoring will enable the regulatory agencies to take the necessary protective measures before environmental damage occurs. Alternative 1 ranks lowest because it provides no protection to the environment.

Compliance with Applicable or Relevant and Appropriate Regulations (ARARs)

Soil Alternatives
Alternatives 2,3,4,5 and 7 comply with all soil and air ARARs listed in Section L, "Compliance with ARARs". Alternatives 6 and 8 meet soil ARARs but would not comply with air ARARs unless the thermal desorption system is equipped with an afterburner. This issue is addressed in the description of the selected remedy and in Section M, "Documentation of Significant Differences". Alternative 1 does not meet ARARs because it does not include any action to address soil contamination above the cleanup goals.

Groundwater Alternatives
All the groundwater alternatives currently comply with groundwater ARARs because contaminants are not currently at the shoreline above the cleanup goals. However, the groundwater alternatives can be ranked on the basis of their ability to continue to meet ARARs in the future. In this regard, alternatives 2 and 3 rank highest because they require immediate extraction and treatment of contaminated groundwater and would provide the greatest assurance that cleanup goals would not be exceeded at the shoreline in the future. Alternative 4 ranks slightly lower because it assures that ARARs will be achieved in the future by monitoring groundwater quality and allowing for additional remedial actions if necessary to meet ARARs. Alternative 1 ranks lowest because it would provide no assurance that ARARs would be achieved in the future.

Long-Term Effectiveness and Permanence

Soil Alternatives
Alternative 4 has the greatest long-term effectiveness because it permanently destroys or removes all contamination exceeding the cleanup goals and requires no long-term maintenance or controls. Alternatives 5 and 6 have slightly less long-term effectiveness than Alternative 4 because the long-term effectiveness of on-Site stabilization of inorganic contaminants is uncertain relative to off-Site treatment and disposal.

Alternatives 7 and 8 are next best for long-term effectiveness because the petroleum hot spot soil is removed and treated but long-term maintenance of capped areas will also be required. Because all contaminated soil remains in place, alternative 3 ranks lower because it requires long-term maintenance of capped areas to be effective. Alternatives 1 and 2 rank lowest because they do not provide permanent protection of human health or the environment.

Groundwater Alternatives
Alternatives 2 and 3 rank highest for this criterion because they require extraction and treatment of contaminated groundwater and have a greater potential for long-term effectiveness and permanence for groundwater contamination. Alternative 4 ranks next because even though it does not include treatment, it would include monitoring which could trigger additional soil or groundwater treatment if it appears that cleanup goals are not being achieved. Alternative 1 does not include any groundwater treatment or monitoring, and therefore, has the lowest potential for long-term effectiveness and permanence.

Reduction of Toxicity, Mobility, or Volume Through Treatment

Soil Alternatives
Alternatives 4, 5, and 6 perform better than the other alternatives under this criterion because they reduce toxicity, mobility or volume through treatment for all contaminated soil above the cleanup goals. Alternatives 7 and 8 rank slightly lower because only the volume and toxicity of petroleum hot spot soil would be reduced through treatment in these alternatives. Alternatives 1, 2, and 3 do not include a treatment component, and therefore do not offer any reduction in toxicity, volume, or mobility of contaminants through treatment.

Groundwater Alternatives
Alternatives 2 and 3 include treatment to reduce toxicity and volume of contaminated groundwater and are ranked higher under this criterion. Alternatives 1 and 4 rank lower because they do not include treatment.

Short-Term Effectiveness

Soil Alternatives
Alternative 3 ranks highest in short-term effectiveness because it addresses contaminants in the shortest period of time and

because capping causes minimal additional short term risk to workers and environment during remedial activities. Alternatives 7 and 8 rank next because they require excavation and handling of a relatively small volume of soil. Alternatives 4 and 6 rank lower under this criterion because they require excavation and handling of a larger volume or contaminated soil and allow human exposure to this excavated soil over a longer period of time. Alternative 5 ranks next because of potential exposure during excavation as well as potential for additional exposure during the landfarming activities. Alternatives 1 and 2 do not provide any protection to human health or the environment in the short-term.

Groundwater Alternatives
Alternatives 2, 3, and 4 have good short effectiveness because they present minimal exposure to humans during implementation and ensure good protection to the environment in the short-term. Alternative 1 ranks lowest because it does not include either groundwater treatment or monitoring, and therefore does not ensure protection to the environment in the short-term.

Implementability

Soil Alternatives
Alternative 1 ranks highest under this criterion because there is nothing to implement. Alternative 2 ranks second because this alternative involves specifying a set of procedures and does not involve any construction activities. Alternative 3 ranks next because, of all the alternatives involving construction activities, it is the only one that does not entail any excavation or treatment.

Alternatives 7 and 8 rank lower under this criterion because they require excavation of a relatively small volume of soil. Alternative 4 is next because it requires excavation of a larger volume of contaminated soil. Alternative 6 ranks lower because on-Site stabilization is a component of this alternative, which would require additional planning and oversight. Alternative 5 ranks lowest because both bioremediation and stabilization treatment techniques add to the planning and time required for implementation.

Groundwater Alternatives
Alternatives 1 and 4 rank highest under this criterion because there are no technical or administrative difficulties associated with implementing them. Alternative 2 ranks next because there may be difficulties in getting METRO to accept the contaminated groundwater water without pretreatment. Alternative 3 ranks lowest for this criterion because it may be technologically difficult to consistently treat groundwater to NPDES discharge requirements.

Cost

Soil Alternatives
Alternative 1 has the lowest estimated overall cost (zero), followed by Alternative 2 ($80,000) and Alternative 3 ($700,000). Alternatives 7 has the next lowest cost at $1.3 million and alternative 8 is next at $2.9 million; these alternatives are moderate in cost relative to alternatives 4-6 which involve excavating and treating all contaminated soil. Alternative 5 ($4.6 million) is the least costly alternative among this group of alternatives. Alternative 4 is next at an estimated cost of $6.2 million and alternative 6 ranks lowest with an estimated cost of $15.6 million.

Groundwater Alternatives
Alternative 1 has the lowest estimated overall cost (zero), followed by Alternative 4 ($300,000), Alternative 2 ($1.9 million), and Alternative 3 ($2.9 million). Alternative 3 has the largest operation and maintenance costs because it requires on-Site treatment over a 10-year duration.

State Acceptance

Ecology concurs with EPA's selected remedy, which is identified below.

Community Acceptance

The community generally supported the preferred alternative. The most significant comments received during the public comment period raised concern about the thermal desorption system which was identified as the treatment technology in the preferred alternative of the Proposed Plan. EPA has addressed this concern by selecting thermal desorption with an afterburner, instead of condensate collection, because an afterburner more efficiently controls the emissions of volatile gases. A complete summary of comments received and EPA's responses are provided in the attached Responsiveness Summary.

K. THE SELECTED REMEDY

Major Components of the Selected Remedy

Based on CERCLA, the NCP, the Administrative Record, the comparative analysis of the alternatives, and public comment, EPA has decided to select a remedy for the Lockheed facility operable unit which is a modified version of alternative 8 (On-Site Thermal Desorption and Containment) combined with groundwater alternative 4 (Monitoring). The modification to alternative 8 is that the thermal desorption system must be equipped with an afterburner instead of a condensate collector. This modification is preferable because, after further evaluating the performance of condensate collection technology, EPA has determined that condensate collection does not meet ARARs which establish air standards for emissions of volatile organic compounds (see

Section M, "Documentation of Significant Differences"). Specifically, the selected remedy includes the following components:

1) Excavate and treat soil containing the highest levels of petroleum contamination ("hot spots"). The petroleum hot spots are defined as those areas with concentrations of Total Petroleum Hydrocarbons (TPH) greater than 10,000 mg/kg. The TPH hot spot soil will be treated on-site by a thermal desorption system equipped with an afterburner, instead of a condensate collector as identified in the preferred alternative of the Proposed Plan.

2) Contain exposed contaminated soil exceeding inorganic and organic cleanup goals. Containment would be achieved with a three inch asphalt cap designed to reduce infiltration of rainwater and reduce contaminant migration into the environment. Existing asphalt and concrete surfaces which are damaged in areas exceeding cleanup goals would either be replaced or repaired. Maintenance of new and existing caps would also be required under a Consent Decree for the settling PRPs as long they own the Lockheed facility.

3) Invoke institutional controls which would warn future property owners of remaining contamination contained under capped areas on this property, require future owners and operators to maintain these caps, and specify procedures for handling and disposal of excavated contaminated soil from beneath the capped areas if excavation is necessary in the future.

4) Monitor groundwater quality semi-annually for 30 years, or until it has been demonstrated that groundwater contaminants will not reach the shoreline in concentrations exceeding cleanup goals. The groundwater quality data will be reviewed at a minimum of every five years to assess the effectiveness of the selected remedy to meet water quality cleanup goals at the shoreline. This periodic data review will be conducted by EPA and Ecology and will coincide with the groundwater data review for the soil and groundwater operable unit. If groundwater data indicates that contaminants are likely to exceed cleanup goals at the shoreline, additional soil and/or groundwater remedial actions may be required in the future.

The performance requirements for the thermal desorption system are: 1) greater than 99% destruction efficiency for volatiles, 2) particulate emissions from the exhaust stack cannot exceed 0.02 grains/dry standard cubic feet, 3) the afterburner must operate at a minimum temperature of 1400° F, and 4) opacity from the exhaust stack cannot exceed 5% for three minutes in any hour of operation. In addition to these performance requirements, EPA will require that dust collected in the baghouse be tested for TPH to determine if it meets cleanup goals before being mixed with treated soil and replaced in the ground.

The selected remedy will also require that all sandblasting grit in the shipways be consolidated and capped in place with a minimum three inch asphalt cap. Containment of this sandblasting grit is necessary because it exceeds cleanup goals for arsenic and lead and because it may act as a source of contamination to the nearby marine sediments.

EPA believes that the selected remedy best satisfies the nine evaluation criteria. It is protective of human health by preventing direct contact with contaminated soil, protective of the environment by preventing discharge of contaminants to surface water by runoff, and migration of contaminants to the groundwater. It has good short- and long-term effectiveness, is technically and administratively relatively easy to implement, and achieves the above objectives more cost effectively than any other alternative. The selected remedy is also consistent with the remedy selected in the Record of Decision for the Harbor Island soil and groundwater operable unit.

Basis for Remediation Goals

Soil

For Harbor Island, including the Lockheed facility, the primary soil ARARs are the standards contained in MTCA and its implementing regulations. Compared to subsurface soil, surface soil presents a greater risk to human health because of the potential for more frequent exposure through direct contact or ingestion. Therefore, cleanup goals for the surface are more stringent and were based on a risk calculation specified by MTCA (see Table 1).

The objective for surface cleanup goals for carcinogens is to achieve a total cancer risk from all carcinogens of less than one in 100,000 (10^{-5}). Principle carcinogens of concern at the Lockheed facility include PAHs and arsenic. Cleanup goals for noncarcinogens in the surface are also based upon the combined risk from all contaminants at each location. The cleanup goal for noncarcinogens was to achieve contaminant concentrations with a hazard index of less than 1.0 (one). A hazard index of less than 1.0 means contaminant concentrations will not pose an adverse health effect. The cleanup goal for lead, which is considered to be a probable carcinogen, is the MTCA numerical standard for an industrial exposure because a risk-based calculation method for lead has not yet been established by EPA.

For subsurface soil, since human contact will be limited to infrequent excavations of limited duration, MTCA numerical standards for an industrial exposure were selected. The goal of these numerical standards is to achieve a risk from individual carcinogens of less than 1 in 100,000 (10^{-5}). The MTCA numerical standards selected for some of the contaminants in the subsurface are also designed to protect groundwater quality.

Groundwater

EPA and Ecology have determined that the federal and state drinking water standards do not apply to groundwater at Harbor Island. These drinking water standards are not relevant and appropriate to Harbor Island because: 1) there is no current or foreseeable use of groundwater for drinking water purposes, and 2) the entire island is serviced by the city of Seattle water system. Instead the surface water quality standards for the protection of marine organisms, and protection of human health from consumption of marine organisms, will apply at the shoreline.

Groundwater contaminant transport modeling conducted indicates that none of the contaminants in the groundwater at the Lockheed facility will exceed surface water quality standards at the shoreline within the next 50 years.

Protection of the Environment During Remedial Action

Engineering controls will be implemented to mitigate the impact on the environment. During excavation, run-on/runoff controls will be installed to keep soil from being transported into the island storm sewer system and ultimately to Elliott Bay. Contaminated soil in excavation areas will be covered in inclement weather to minimize contaminated runoff. The treatment area will also be provided with run-on/runoff controls to minimize contaminant transport. Soil stockpiles in the treatment facility area will be covered with a rain shelter to prevent contaminated runoff.

Decontamination pads will be installed to clean equipment and minimize the spread of contamination to other areas of the Site. Transport trucks will be covered as needed to prevent loss during transport.

Contaminated liquid storage tanks and storage facilities will be provided with double containment to prevent leaks from entering the environment. Routine inspections of facilities will be performed to assure safety measures are in place and functioning properly. Discharges to the environment will meet applicable state and federal regulations.

Cost and Remediation Time Frame

The cost estimates prepared in the Feasibility Study for each alternative are intended to be within a range of -30% to +50% of actual costs. The net present value (cost in 1994 dollars) of the selected soil remedy (modified alternative 8) is approximately $1,300,000. The cost for the selected groundwater remedy (alternative 4) is approximately $300,000. Details of the cost estimates for modified soil alternative 8 and groundwater alternative 4 are shown in Tables 2, and 3, respectively. It is anticipated that the soil remedial design and remedial action component will take approximately 9-12 months to complete and the groundwater monitoring component will take 10-30 years to complete, depending on groundwater quality results. The cost estimate for groundwater monitoring is based on a 30 year monitoring period.

L. STATUTORY DETERMINATIONS

The selected remedy for the Lockheed facility will comply with CERCLA section 121 as follows:

Overall Protection of Human Health and the Environment

Long term protection of human health is obtained by removal and treatment of soil hot spots containing TPH and by capping of all the remaining soil above cleanup goals. These actions give a reduction in contaminant toxicity, mobility, and volume. Following implementation of the remedy, the overall risk to human health from potential exposure to contaminated soil will be less than the cleanup goal of 1×10^{-5}. Long term protection of the surface water quality will ultimately be achieved through the treatment of the petroleum hot spot soil, capping of the remaining contaminated areas, long-term maintenance of these caps, monitoring groundwater quality, and natural attenuation of remaining organics in the soil and groundwater.

Protection of human health during remediation will be obtained through compliance with OSHA and WISHE requirements, the use of personnel protective equipment, and other safety measures and engineering controls. Protection of the environment will be obtained during remediation by covering stockpiles and using berms and ditches around excavations to control contaminated runoff. In addition, the environment will be protected from air pollution through compliance with the substantive requirement of PSAPCA. Long term monitoring and maintenance will be required for the selected remedy. The asphalt caps will require annual inspection and repair as necessary. The groundwater quality will be monitored semi-annually until it has been demonstrated that groundwater contaminants will not reach the shoreline in concentrations exceeding cleanup goals. Periodic five-year reviews of the groundwater quality trends will be conducted to determine if additional source control or groundwater treatment actions are required to achieve surface water cleanup goals at the shoreline.

Compliance With ARARs

The selected alternative will meet all chemical-specific and action-specific applicable ARARs for the Lockheed facility, which are described below. No location-specific ARARs have been identified for the Lockheed facility.

ARARs for Air

Clean Air Act (42 U.S.C. §§ 7401 et seq.); Washington State Clean Air Act (RCW 70.94; WAC 173-400, -460)

TABLE 2 COST ESTIMATE FOR ALTERNATIVE GW4 (GROUNDWATER MONITORING)

TOTAL COSTS	Unit	Quantity	Unit Cost	Cost
1) GROUNDWATER MONITORING				
Sample Wells*	Annual	30	$3,500.00	$43,432
Laboratory Analyses*	Annual	30	$5,500.00	$68,250
Reporting*	Annual	30	$6,000.00	$74,454
Reviews**	5-Years	6	$20,000.00	$43,154
SUBTOTAL (DIRECT COSTS)				$229,289
Work Plan Development				$25,000
Contingency Allowance (25% of Direct Costs)				$57,322
TOTAL CAPITAL COSTS				$311,611
TOTAL PRESENT-WORTH COST				**$311,611**

* Present value calculated using P/A = 12.409 (i = 7%, N = 30 years)

** Present value calculated using P/F = 2.1577 (total) (i = 7%, reviews at 5,10,15,20,25 & 30 years)

TABLE 3 COST ESTIMATE FOR ALTERNATIVE S8 (ONSITE THERMAL DESORPTION OF HOT SPOTS)

CAPITAL COSTS	Unit	Quantity	Unit Cost	Cost
1) GENERAL				
Site Mobilization	LS	1	$10,000.00	$10,000
Temporary Fencing	LF	1,000	$12.00	$12,000
Site Survey/Layout	DAY	4	$800.00	$3,200
Deed Restriction	LS	1	$10,000.00	$10,000
Install Signs	LS	1	$1,500.00	$1,500
2) HEALTH & SAFETY				
Decon Equipment	LS	1	$5,000.00	$5,000
Health & Safety Expendibles (6 persons X $25/day)	DAY	90	$150.00	$13,500
Rinsate Disposal	GALLON	9,000	$0.77	$6,930
Laboratory Analyses	EACH	150	$350.00	$52,500
Photoionization Detector	MONTH	3	$600.00	$1,800
3) SOIL REMOVAL ACTIONS				
Remove Concrete/Asphalt	SQ YD	1,800	$6.40	$11,520
Dispose of Concrete/Asphalt	CU YD	300	$98.00	$29,400
Excavate Soil	CU YD	4,800	$5.00	$24,000
Shore Excavations	LF	300	$40.00	$12,000
Thermally Desorb TPH Soils	CU YD	4,800	$73.00	$350,400
Import Clean Gravel	CU YD	1,100	$12.00	$13,200
Backfill and Compact	CU YD	4,800	$4.00	$19,200
Install Asphalt (Excavations)	SQ YD	1,800	$15.00	$27,000
Install Asphalt (Other)	SQ YD	3,000	$15.00	$45,000
SUBTOTAL (DIRECT CAPITAL COSTS)				$648,150
Work Plan Development				$75,000
Engineering Design				$100,000
Construction Oversight				$40,000
Contingency Allowance (25% of Direct Capital Costs)				$162,038
TOTAL CAPITAL COSTS				**$1,025,188**

OPERATION & MAINTENANCE COSTS	Unit	Quantity	Unit Cost	Cost
Site Inspections*	Annual	30	$5,000.00	$62,045
Cap Maintenance*	Annual	30	$6,000.00	$74,454
Partial Cap Replacement**	10 Years	3	$96,800.00	$86,936
SUBTOTAL (DIRECT O&M COSTS)				$223,435
Administrative Costs (15% Direct O&M Costs)				$33,515
Contingency Allowance (25% Direct O&M Costs)				$55,859
TOTAL OPERATION & MAINTENANCE COSTS				**$312,809**

TOTAL PRESENT-WORTH COST	**$1,337,997**

* Present value calculated using P/A = 12.409 (i = 7%, N = 30 years)

** Present value calculated using i = 7% for replacements at 10, 20, and 30 years.

These acts require that remedial actions which would result in major sources of emissions, such as soil or groundwater treatment, will be designed to meet federal and state ambient air quality standards.

Puget Sound Air Pollution Control Authority (Regulations I, III)

These regulations require that remedial actions which could involve releases of contaminants to air will be performed in compliance with substantive requirements of a permit from PSAPCA. These regulations are applicable to all alternatives which require soil excavation and to all alternatives which specify on-site thermal desorption treatment of soil.

ARARs for Groundwater and Surface Water

Washington Water Pollution Control Act (RCW 90.48); Washington State Water Quality Standards for Surface Waters (WAC 173-201A)

These requires that surface water quality standards for protection of marine organisms will be achieved at the point of compliance, which is at the shoreline.

Model Toxics Control Act (RCW 70.105D; WAC 173-340)

MTCA (WAC 173-340-730) identifies cleanup standards for surface water and the point of compliance for these standards, both of which are applicable to the Lockheed operable unit.

Clean Water Act (33 U.S.C. §§ 1251 et seq.; 40 C.F.R. Part 131)

These identify federal marine and fresh surface water standards for protection of marine organisms and human health from ingestion of marine organisms. Only the marine water standards apply to Harbor Island and the Lockheed operable unit.

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

This includes standards for construction, testing, and abandonment of water and resource protection wells which may be used during groundwater monitoring or groundwater treatment.

ARARs for Soil

Model Toxics Control Act (RCW 70.105D; WAC 173-340)

MTCA specifies numerical cleanup goals for soil and risk based calculation methods for determining cleanup goals in soil. MTCA cleanup goals based on an industrial exposure scenario are applicable to Harbor Island and the Lockheed operable unit.

Cost Effectiveness

The selected remedy is cost effective because soil treatment by thermal desorption, which is the most expensive component of the remedy, is only required for petroleum hot spot soil, which has the greatest potential to migrate to the surrounding environment. The remaining contaminants in the soil above the cleanup goals are contained by an asphalt cap, which is an effective but relatively inexpensive method of containment.

Utilization of Permanent Solutions and Resource Recovery Technologies to the Maximum Extent Practical

The selected remedy represents the maximum extent to which permanent solutions and treatment technologies can be utilized in a cost effective manner for remediation of soil and groundwater at the Lockheed facility. The selected remedy provides the best balance in terms of long-term effectiveness and permanence, reduction of toxicity, mobility and volume achieved through treatment, short-term effectiveness, implementability and cost, while also considering the statutory preference for treatment as a principle element and considering state and community acceptance.

Treatment of the petroleum soil hot spots provides long-term effectiveness and permanence and provides a significant reduction of toxicity, mobility and volume while minimizing short-term risks. Containment of less contaminated areas of the Site also reduces the mobility and provides long-term effectiveness, while minimizing implementation difficulties and costs associated with removal of large quantities of soil which may be difficult to excavate.

Alternatives which treat all contaminated soil and groundwater provide greater reduction in toxicity, mobility and volume and better long-term effectiveness, but may cause short-term risks to workers associated with the cleanup, and have high costs. Alternatives which consist of little or no treatment are more easily and quickly implementable and have lower costs, but provide little reduction in toxicity, mobility, or volume.

The selected alternative satisfies the two mandatory threshold criteria, protection of human health and the environment, and compliance with ARARs. The selected remedy uses a combination of treatment, containment, and controls to achieve optimum compliance with the five balancing criteria: long-term effectiveness, short-term effectiveness, implementability, reduction in toxicity, mobility and volume, and cost. Reduction in toxicity and volume and cost effectiveness were the two balancing criteria which influenced the selection of the remedy.

Preference for Treatment as a Principal Element

The selected remedy requires treatment of petroleum hot spot soil by thermal desorption. The selected remedy meets the statutory preference for using treatment as a principal element of the remedial action at the Lockheed facility.

M. DOCUMENTATION OF SIGNIFICANT DIFFERENCES

The remedy selected in this Record of Decision is the preferred alternative in the Proposed Plan with one significant difference. This difference is that the on-Site thermal desorption system will be required to have an afterburner to destroy organic vapors instead of collecting these vapors by condensation. This modification is preferable because EPA has determined that condensate collection does not efficiently capture volatile organic compounds and will not meet ARARs which establish air standards for emissions of volatile organic compounds. The efficiency of collecting volatiles by condensate collection with carbon adsorption generally falls in the range of 95-99%. This range of collection efficiency would not meet PSAPCA's requirement that thermal desorption systems achieve greater than 99% destruction efficiency for volatile organic compounds. The destruction efficiency of thermal desorption with an afterburner is approximately 99.99%, which is two orders of magnitude higher than PSAPCA's requirement.

To verify that there would not be any risks to human health or the environment from direct and indirect exposure to the emissions from the operation of a thermal desorption system with an afterburner, EPA evaluated each potential exposure pathway. Since there are no wetlands or wildlife habitats on Harbor Island, there would be no direct or indirect ecological exposures on the island. Also, since the island is used exclusively for industrial purposes and groundwater is not a drinking water source, indirect human exposure through ingestion of milk, beef, vegetable, or water does not apply. The only significant exposure pathway is inhalation by workers operating the thermal desorption system. To address this pathway, EPA estimated the potential maximum worker exposure to petroleum constituents which pose the greatest health risks, benzene and PAHs (Appendix C). This exposure estimate identifies concentrations of benzene and PAHs at the stack exit, which is the point of maximum concentration before air dispersion occurs. Based on the assumptions used in the estimate, the concentrations of petroleum constituents in the stack air emissions would be about four order of magnitude below the industrial threshold value limits (TLVs) established for benzene and PAHs. Therefore, the operation of a thermal desorption system on Harbor Island will not present a health hazard to workers.

Thermal desorption with an afterburner will also be more cost-effective to implement than thermal desorption with condensate collection for type of soil contamination at the Lockheed facility. The approximate cost for implementing modified soil alternative 8 will be $1,300,000 instead of $2,900,000 as identified in the preferred alternative of the Proposed Plan. At this decreased cost, on-Site thermal desorption would now cost about the same as off-Site thermal desorption (alternative 7), eliminating the need for off-Site thermal desorption as a contingency. This option was identified in the Proposed Plan as a contingency if the Lockheed operable unit remedial action were to occur sooner than the remedial action for the Harbor Island soil and groundwater operable unit.

APPENDIX A

RESPONSIVENESS SUMMARY

Appendix A

RESPONSIVENESS SUMMARY
FOR THE LOCKHEED RECORD OF DECISION

Overview

From 1903 to 1905, Harbor Island was created from marine sediments dredged from the Duwamish River. Harbor Island has been used for commercial and industrial activities including shipping, railroad transportation, bulk fuel storage and transfer, secondary lead smelting, lead fabrication, shipbuilding and metal plating. Warehouses, laboratories and office buildings have been located on the island. Approximately 70% of Harbor Island is covered with buildings, roads or other impervious surfaces.

The site was placed on the National Priorities List in 1983, due to elevated lead concentrations in soil, as well as elevated levels of other hazardous substances. The lead concentrations were due to a lead smelter on the island, which ceased operations in 1984. The Lockheed property is an 18.5 acre shipyard facility located on the western side of Harbor Island adjacent to the West Waterway of the Duwamish River. This facility was identified as an operable unit of the Harbor Island site in 1990. Lockheed conducted a Remedial Investigation and Feasibility Study on this facility under Consent Order to EPA.

In addition to the Lockheed facility there are three other operable units on the Harbor Island site. These are: the marine sediments, the soil and groundwater unit, and the petroleum storage tank facilities. EPA has designated the Department of Ecology as the lead agency for the petroleum storage tank unit. The soil and groundwater operable unit has a Record of Decision, signed on September 30, 1993. The marine sediments Record of Decision will be issued in 1995.

On April 22, 1994, EPA began the public comment period on the cleanup alternatives for the Lockheed facility on Harbor Island. The proposed plan as well as the Remedial Investigation and Feasibility Study reports were released for public comment.

The proposed plan recommended Alternative 8 for soil which includes excavation of petroleum hot spot soil and treatment by on-site thermal desorption. The proposed plan also recommended Alternative 4 for groundwater which includes monitoring groundwater quality at the Lockheed facility for up to 30 years to ensure that cleanup goals are not exceeded at the shoreline.

Background on Community Involvement

As described above, the proposed plan for the cleanup of the Lockheed facility was released on April 22, 1994. The public comment period ran from April 22 until May 22, 1994. As part of the comment period, a public meeting was held on May 11, 1994. About 15 people attended the meeting, no one gave public comment. A copy of the transcript are available at the Region 10 Records office in the Park Place Building, 1200 West 6th Avenue.

Comments received in writing are included in the following summary.

Comment: EPA's Preferred Alternative, which includes off-Site treatment of petroleum hot spots, should allow the use of any permitted, off-site thermal treatment unit, including the use of a cement kiln which essentially recycles the TPH-impacted soil into a usable product (cement).

Response: Off-Site thermal desorption was considered as a contingency in the preferred alternative only if the Lockheed TPH contaminated soil could not be combined with other TPH contaminated soil on Harbor Island which will also be treated by thermal desorption. Because EPA has selected on-Site thermal desorption with an afterburner instead of condensate collection, the cost for off-Site and on-Site thermal desorption are now about the same for the Lockheed facility. Therefore, EPA has eliminated the contingency for off-Site thermal desorption as part of the selected remedy.

Comment: Lockheed believes that EPA's selection of alternative 8, which was modified to use the future Harbor Island thermal desorption unit with condensate recovery, is not based on the Yard 1 Feasibility Study and Technical Memorandum, nor has it been evaluated using the nine-criteria evaluation. The use of condensate recovery as a component of low temperature thermal desorption for treating TPH-impacted soil dramatically increases treatment costs without providing offsetting benefits.

Response: EPA believes that thermal desorption with condensate recovery is adequately described in the Technical Memorandum to the Feasibility Study and was the basis for alternative 8 in the Proposed Plan. However, after further evaluating the performance and cost of thermal desorption with condensate collection, EPA has selected thermal desorption with an afterburner, which more efficiently controls the emission of volatile organic compounds and is significantly lower in cost.

Comment: The Puget Sound Air Pollution Control Agency (PSAPCA) is concerned that the proposed preferred alternative (thermal desorption with condensate collection) may not be in compliance with PSAPCA regulations which specify that the best available control technology for thermal desorption units is an afterburner and a baghouse which obtains greater than 99% destruction efficiency for volatile organic compounds.

Response: EPA has selected thermal desorption with an afterburner and baghouse as the remedial technology for the Lockheed facility operable unit.

APPENDIX B

METHOD FOR DETERMINING HOT SPOT TREATMENT LEVELS

Appendix B

Method for Selecting Hot Spot Treatment Levels

I. Method Used in the Feasibility Study

The objective of selecting hot spot treatment levels in the Feasibility Study was to identify areas containing high concentrations of contaminants in relatively small volumes which could be excavated and treated, providing an optimal cost-benefit. The benefit, in this context, is the total mass of contaminant treated. The first step in the process was to identify the contaminants presenting the greatest risk to human health and the environment. This was accomplished by comparing contaminant concentrations to the cleanup goals to determine which had the highest exceedances. This process identified lead, mercury, arsenic, TPH, and PCBs. Arsenic was eliminated at this point because the distribution of its concentration showed that it was widely distributed across the island at levels not significantly above background, and was not highly concentrated in any particular areas. PCBs were also elimianted from further evaluation because EPA decided to set its treatment level at an existing regulatory limit, which is 50 mg/kg as defined by the federal Toxic Substance Control Act (TSCA).

For TPH, lead, and mercury, the concentrations and soil volumes associated with these concentrations were reviewed to identify the approximate point at which the mass of contaminant started rapidly decreasing as a function of increased soil volumes. The treatment levels were selected at the contaminant concentrations where the incremental amount of contaminant was disproportionate to the incremental soil volume. The cost to treat these contaminants was also analyzed semi-quantitatively to verify that the cleanup level selected was also at the point where the cost per mass of contaminant treated started rapidly increasing.

For example, treating all lead contaminated soil would result in treating 5.9×10^6 cubic yards of soil to remove 4.4×10^6 pounds of lead for an average of 0.75 pounds/cubic yard treated. Treating soil exceeding 2,000 mg/kg lead would result in an average lead treatment rate of 40 pounds/cubic yard. Treating soil exceeding 5,000 mg/kg, 10,000 mg/kg and 20,000 mg/kg would result in average rates of 57, 60, and 100 pounds/cubic yard, respectively. A noticeable increase in the amount of lead treated percubic yard of soil occurs at a lead concentration of greater than 10,000 mg/kg. Therefore, 10,000 mg/kg was selected as the treatment level for lead. This treatment level contains approximately 85% of the total mass of lead within 40% of the total volume of lead contaminated soil above the cleanup goal. The treatment level selected for TPH, 10,000 mg/kg, contains 66% of the total TPH mass within 14% of the TPH contaminated soil volume. The treatment level selected for mercury, 5 mg/kg, contains 27% of the mass of mercury within 8% of the contaminated soil volume. These results show that the objective of containing a majority of the contaminant mass in a minimum volume is achieved at the treatment levels for lead and TPH. The treatment level for mercury did not capture a majority of the mass of mercury, because mercury is more evenly distributed as a function of concentration than TPH or lead.

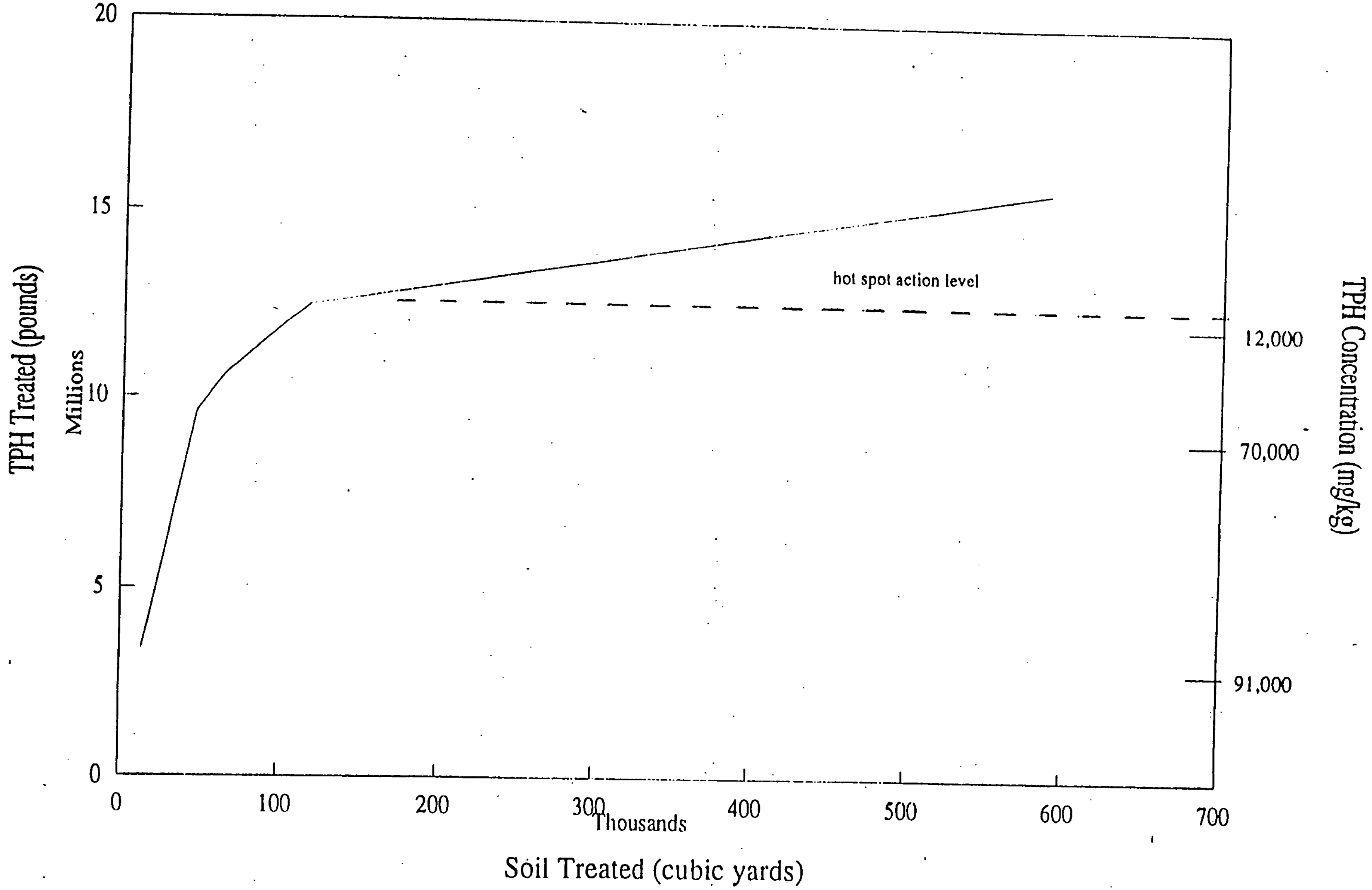
The corresponding cost analysis for lead, for example, also shows that as the pounds of contaminant per cubic yard decreases, the cost to treat each pound rapidly increases. Assuming it costs $100 to treat one cubic yard of soil, the average cost to treat a pound of lead at soil concentration exceeding 2,000 mg/kg, 5,000 mg/kg, 10,000 mg/kg, and 20,000 mg/kg is $2.50/lb, $1.75/lb, $1.66/lb, and $1.00/lb, respectively. The cost drops significantly at a lead concentration exceeding 10,000 mg/kg, indicating it is the cost effective breakpoint, and therefore, should be the treatment level. The cost effective breakpoint for TPH occurred at a concentration of about 10,000 mg/kg, and the breakpoint for mercury occurred at about 5 mg/kg.

II. Cost-Benefit Analysis of Treatment Levels

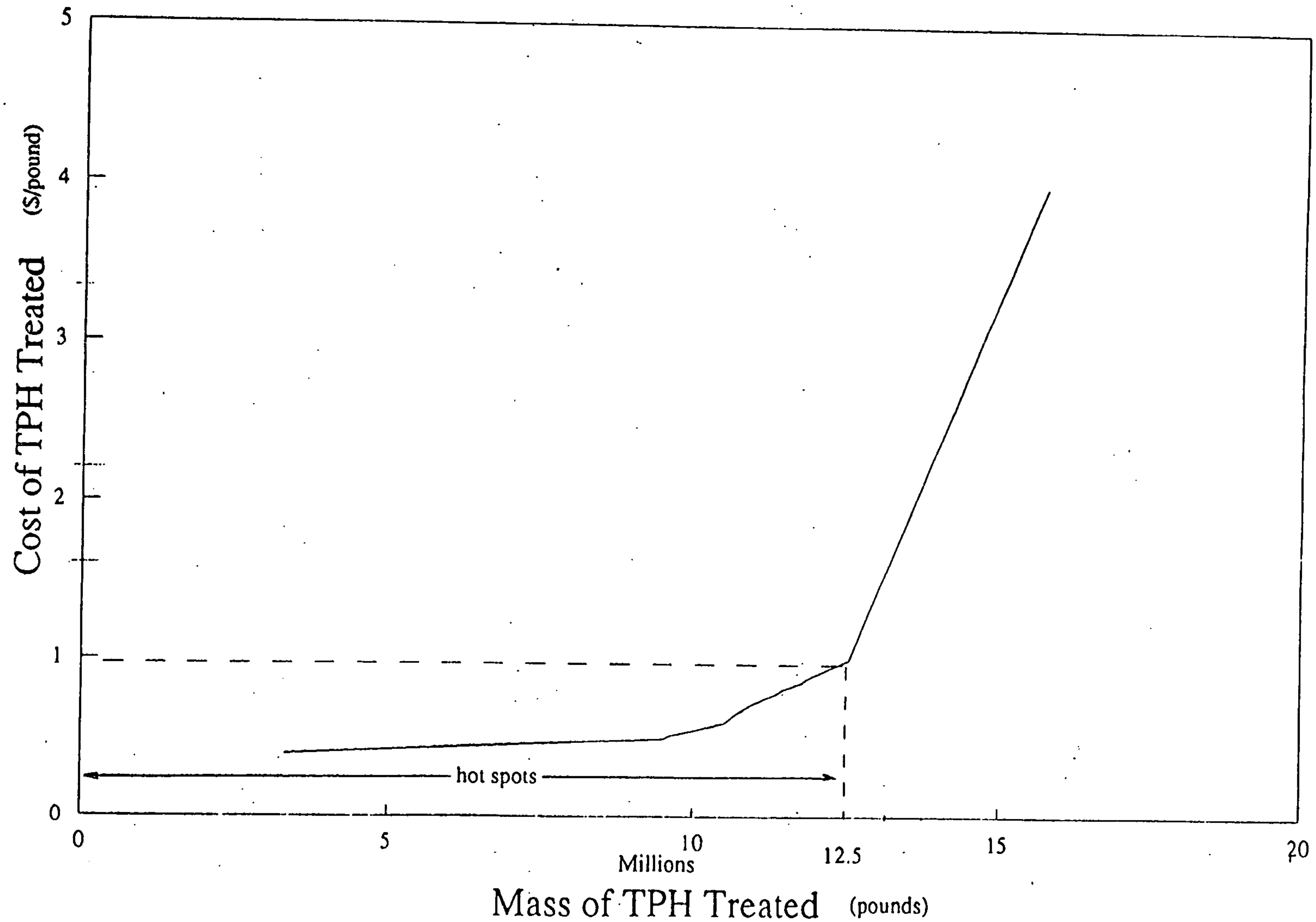
After selecting treatment levels in the Feasibility Study, a cost-benefit analysis was completed for lead, mercury and TPH to confirm these treatment levels. The analysis involved generating two types of functions (curves). The first type of curve, soil volume versus contaminant mass, was generated by ranking areas with the particular contaminant in order of highest to lowest concentration. The curve is based on the cumulative total contaminant mass and soil volume for each contaminant concentration. One assumption used in generating this curve was that the average contaminant concentration is an area is represented by the single sample taken from that location.

The second type of curve, mass of contaminant treated versus cost per pound of contaminant, was generated by calculating the excavation cost and treatment cost per cubic yard of soil, and dividing by the mass of contaminant treated. This process was also performed using cumulative totals as discussed above. It is important to note that this figure is semi-quantitative in nature since it used only excavation and treatment cost elements and did not include other costs required to implement the treatment alternative. Simplifying assumptions used to generate these curves include: 1) soil excavation costs are $2.00 per cubic yard, 2) excavation and handling costs are $6.00 per cubic yard, 3) lead and mercury are treated by solidification at a cost of $100 per cubic yard, 4) TPH is treated by thermal desorption at a cost of $100 per cubic yard, and 5) the contaminated soil associated with the Lockheed Shipyard operable unit was included in the calculation but the contaminated soil associated with the petroleum tank farm operable unit was not included.

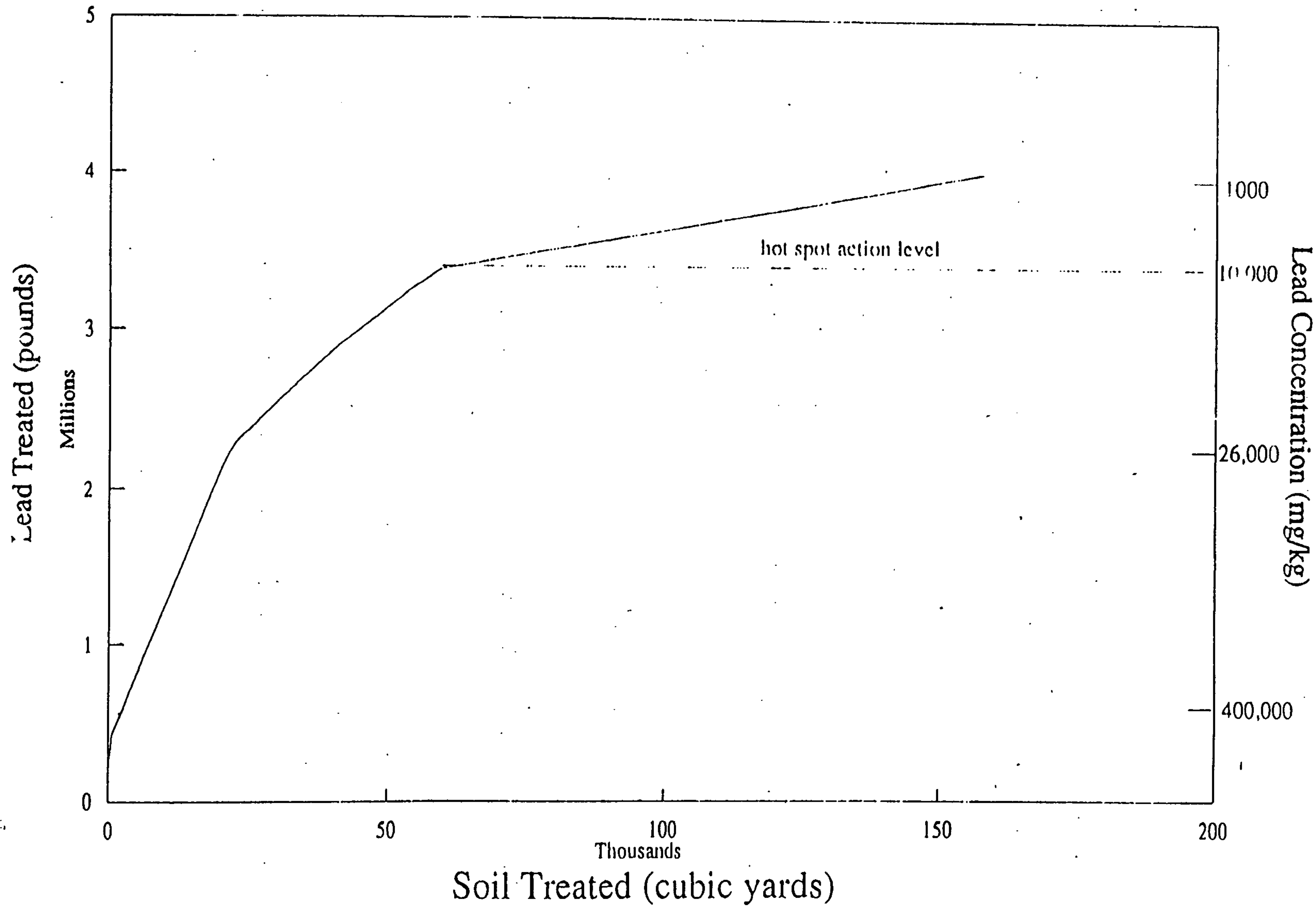
The volume versus mass curve was used to determine the point at which removing and treating additional soil volume does not provide a proportionate degree of benefit in term of mass treated. The mass versus cost per pound curve was used to determine the cost-benefit of treating an additional incremental volume of soil. As shown in each of the figures, the treatment levels generally mark the location at which signigicantly decreasing quantities of contaminant mass are treated with each incremental increase in soil volume removed. The treatment levels also generally locate the point at which the cost per pound of contaminant treated increases disproportionally with the soil mass removed.



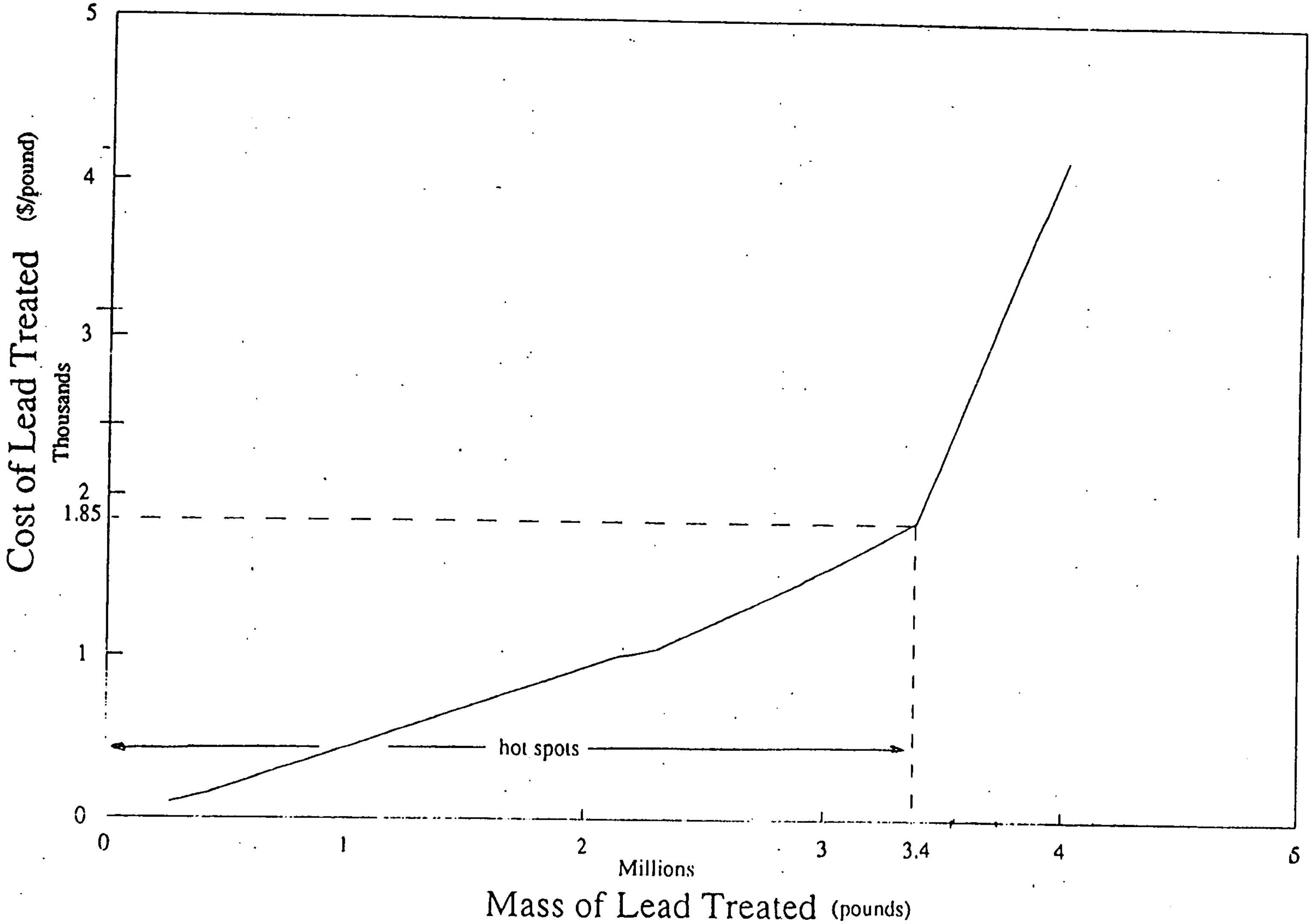
RFW564A - Graph 2A



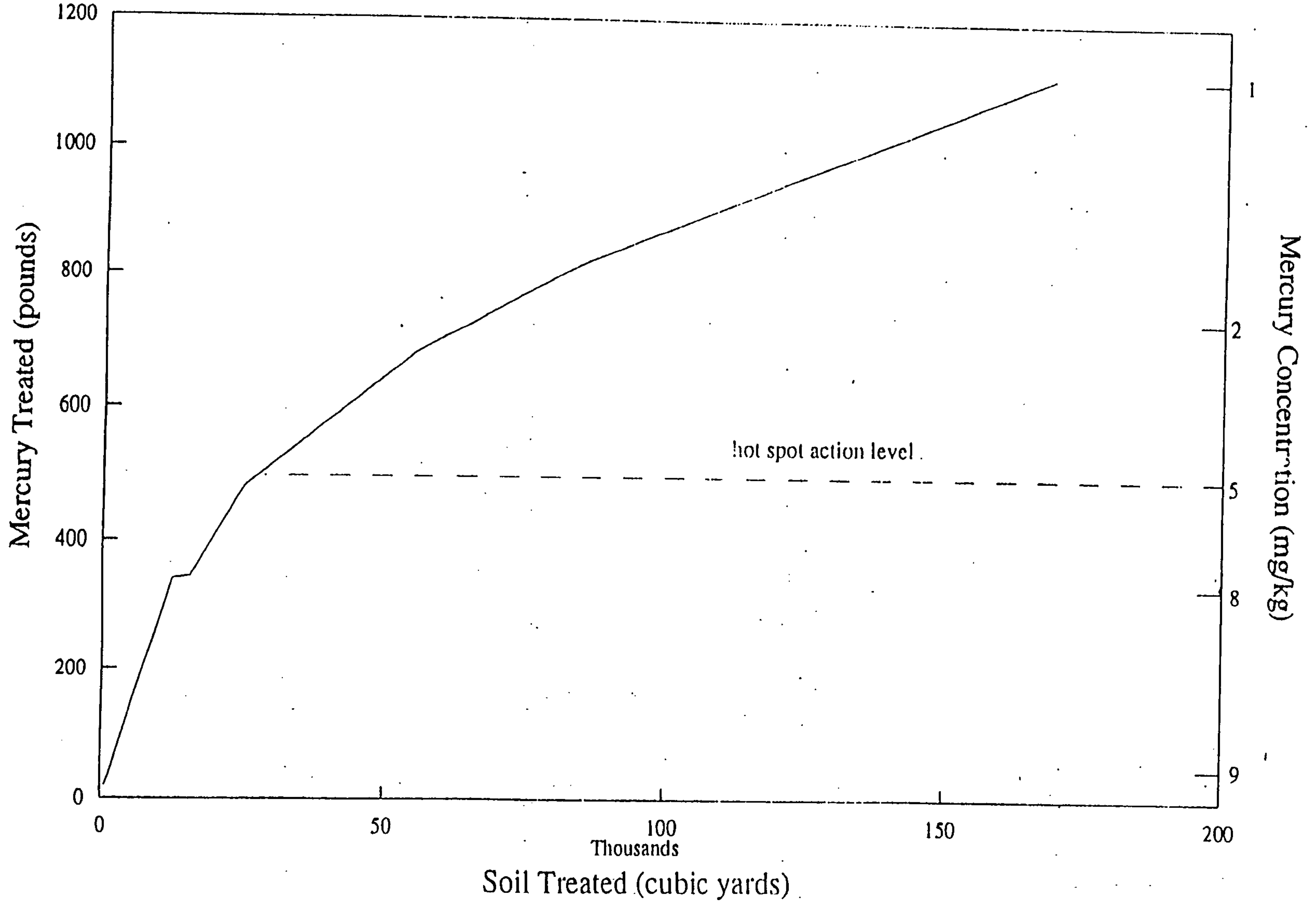
RFW564.WK3 - GRAPH 5



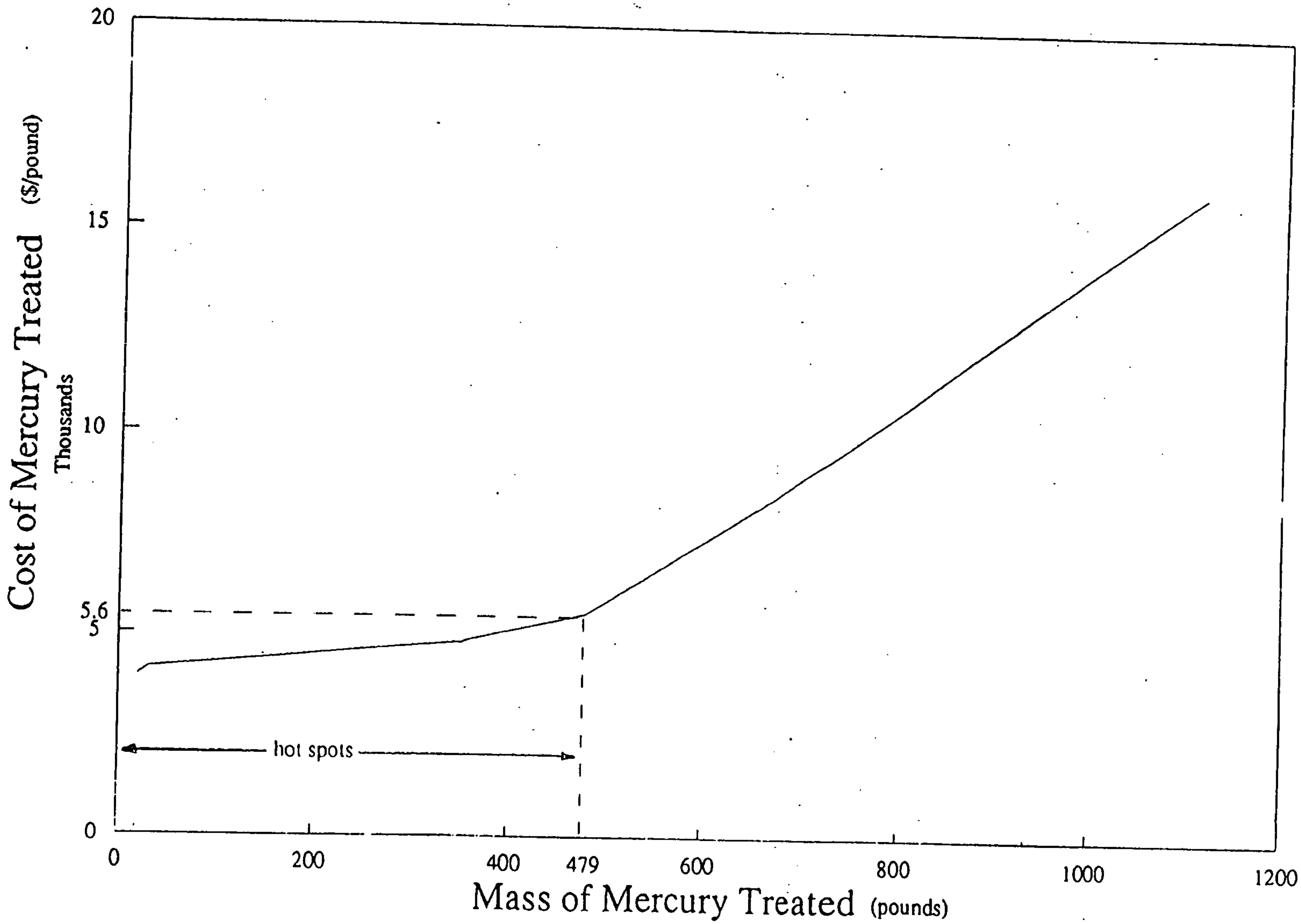
RFW564A.WK3 - GRAPH 3



Cost of Lead Treated ($/pound)
Thousands
5
4
3
2
1.85
1
0
0
1
2
3
3.4
4
5
hot spots
Millions
Mass of Lead Treated (pounds)



RFW564A.WK3 - GRAPH 4



RFW364A.WK3 GRAPH 7

APPENDIX C

EXPOSURE ESTIMATE FOR THERMAL DESORPTION

Appendix C

EXPOSURE ESTIMATE FOR THERMAL DESORPTION OF PETROLEUM CONTAMINATED SOIL AT HARBOR ISLAND

It is proposed that petroleum contaminated soil at Harbor Island be treated by thermal desorption with an afterburner. In order to determine if such a treatment system would produce air emissions which are safe for the system operators, who would be the individual with the greatest chance of exposure, the following calculations were performed. The petroleum constituents with the greatest potential for health effects were identified as benzene and PAHs. The air concentrations of these constituents are estimate at the point where the stack vents to the atmosphere, which would be the maximum possible concentration before mixing with ambient air. Finally, the industrial threshold values for these constituents are provided for comparison. These threshold values are based on an 8-hour work day and 40-hour work week, which are the assumed exposure durations for this case.

1. <u>Assumptions</u>

   a. Soil process rate: 100 tons/hr (22,500 kg/hr)
   b. Stack air flow rate: 600,000 ft^3/hr (22,222 m^3/hr)
   c. Afterburner Destruction Efficiency (DF): 99.99%
   d. Average concentration of benzene in soil: 2.0 mg/kg
   e. Average concentration of PAHs in soil: 30 mg/kg

2. <u>Calculated Air Concentrations at Stack</u>

a. Formula:

$$[C]_{air} = ([C]_{soil})(\text{process rate})(1\text{-DF})/\text{stack flow rate}$$

b. Benzene Concentration:

$$[\text{Benzene}]_{air} = (2\ mg/kg)(22{,}500\ kg/hr)(10^{-4})/(22{,}222\ m^3/hr) = 2\times10^{-4}\ mg/m^3$$

c. PAH Concentration:

$$[\text{PAH}]_{air} = (30\ mg/kg)(22{,}500\ kg/hr)(10^{-4})/(22{,}222\ m^3/hr) = 3\times10^{-3}\ mg/m^3$$

3. <u>Threshold Limit Values (TLVs)</u>

$$[\text{Benzene}]_{TLV} = 30\ mg/m^3$$

$$[\text{PAH (naphthalene)}]_{TLV} = 50\ mg/m^3$$

APPENDIX D

ADMINISTRATIVE RECORD

Operable Unit: Lockheed RI/FS Date: 09/11/90
Pages: 70

File Number : 1.1 - ENFORCEMENT
Doc. Number : 0001
Document Type: LEGAL DOCUMENT

Title/Subject: Administrative Order on Consent for Remedial Investigation/Feasibility Study, Lockheed Shipyard No. 1 Operable Unit

Author : FINDLEY, CHARLES
Organization : EPA-QA MANAGEMENT OFFICE (REGION 10)
Addressee : THOMPSON, JEFFERY M.
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/16/91
Pages: 1

File Number : 2.1.1 - FORMAL CORRESPONDENCE - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: Letter declaring as adequate McLaren's response to Westin's comments on the Work Plan, Field Sampling Plan and Quality Assurance Plan for Lockheed, dated 4/14/91.

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : REED, FRED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 04/01/92
Pages: 39

File Number : 2.1.1 - FORMAL CORRESPONDENCE - LOCKHEED RI/FS
Doc. Number : 0002
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: COVER LETTER AND COMMENTS ON THE LOCKHEED PHASE II RI/FS SAMPLING PLAN

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : AMORFINI, BUDDY
Organization : MCLAREN HART

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 04/01/91 (Est.)
Pages: 95

File Number : 2.2.1 - PHASE I LOCKHEED RI/FS WORK PLAN
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: REVISED PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY WORK PLAN FOR LOCKHEED SHIPBUILDING, SEATTLE, WASHINGTON YARD I

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 09/01/88
Pages: 39

File Number : 2.2.1 - PHASE I LOCKHEED RI/FS WORK PLAN
Doc. Number : 0002
Document Type: PHOTO(S)

Title/Subject: Aerial Photographic Property STudy : Lockheed Shipbuilding and Construction Company Seattle, Washington 1936-1985

Author : NOT INDICATED
Organization : LOCKHEED CORPORATION
Addressee : REED, FRED
Organization : LOCKHEED CORPORATION

Document Status: This Document is the Original and is Selected for Inclusion in the Administrative Record.

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HOWARD S. WHITNEY
MONO ROOFING CO.
PILGRIM PET SUPPLY, INC.

Operable Unit: Lockheed RI/FS Date: 06/01/92 (Est.)
Pages: 243

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: REVISED PHASE II REMEDIAL INVESTIGATION/FEASIBILITY STUDY PROGRAM FOR LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I WORK PLAN, FIELD SAMPLING PLAN, QUALITY ASSURANCE PROJECT PLAN

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 05/06/91
Pages: 4

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0002
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: COVER LETTER AND ENCLOSURES RE: FORM OF THE LETTER PROPOSED TO SUBMIT TO THE AGENCY TO SATISFY THE REQUIREMENTS OF PARAGRAPH 82 OF THE LOCKHEED ADMINISTRATIVE ORDER ON CONSENT

Author : BLUMENFELD, CHARLES R.
Organization : BOGLE & GATES
Addressee : KOWOLSKI, ED
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is the Original and is Selected for Inclusion in the Administrative Record.

....

Operable Unit: Lockheed RI/FS
Date: 06/27/91
Pages: 3

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0003
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: PROPOSED FINANCIAL ASSURANCES LANGUAGE RE: LOCKHEED ADMINISTRATIVE ORDER ON CONSENT

Author : KOWOLSKI, ED
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : BLUMENFELD, CHARLES R.
Organization : BOGLE & GATES

Document Status: This Document is Selected for Inclusion in the Administrative Record.

....

Operable Unit: Lockheed RI/FS Date: 08/26/91
Pages: 1

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0004
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: LETTER GRANTING LOCKHEED AND MCLAREN HART AN EXTENSION FOR DELIVERY OF THE PSCS TO EPA

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : AMORFINI, BUDDY
Organization : MCLAREN HART

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 11/18/91
Pages: 7

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0005
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: COMMENTS AND ENCLOSED SETS OF COMMENTS ON THE SITE CHARACTERIZATION REPORT PREPARED BY MCLAREN ON THE LOCKHEED SHIPYARD I

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : AMORFINI, BUDDY
Organization : MCLAREN HART

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 03/17/92
Pages: 1

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0006
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: LETTER RE: APPROVAL OF THE SITE CHARACTERIZATION SUMMARY

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : REED, FRED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 06/15/92
Pages: 1

File Number : 2.2.2 - PHASE II LOCKHEED RI/FS WORK PLAN
Doc. Number : 0007
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: APPROVAL OF THE REVISED RI/FS WORK PLAN DATED 6/92

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : ICF Kaiser Engineers, Inc
Organization : MCLAREN HART

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/01/91 (Est.)
Pages: 79

File Number : 2.3.1 - PHASE I LOCKHEED RI/FS SAMPLING AND ANALYSIS PLAN
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: REVISED PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY SAMPLING AND ANALYSIS PLAN FIELD SAMPLING PLAN FOR LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I VOLUME I

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/01/91 (Est.)
Pages: 65

File Number : 2.3.1 - PHASE I LOCKHEED RI/FS SAMPLING AND ANALYSIS PLAN
Doc. Number : 0002
Document Type: REPORT/STUDY

Title/Subject: REVISED PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY SAMPLING AND ANALYSIS PLAN VOLUME 2 QUALITY ASSURANCE PLAN FOR LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 12/05/91
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File Number : 2.3.1 - PHASE I LOCKHEED RI/FS SAMPLING AND ANALYSIS PLAN
Doc. Number : 0003
Document Type: REPORT/STUDY

Title/Subject: QUALITY ASSURANCE MANUAL - MCLAREN ANALYTICAL LABORATORY

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 04/16/92
Pages: 127

File Number : 2.3.1 - PHASE I LOCKHEED RI/FS SAMPLING AND ANALYSIS PLAN
Doc. Number : 0004
Document Type: REPORT/STUDY

Title/Subject: AMENDMENT TO THE QUALITY ASSURANCE MANUAL FULFILLING EPA REGION 10 ADDITIONAL REQUIREMENTS REVISION 1 MCLAREN ANALYTICAL LABORATORY

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 05/20/92
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File Number : 2.3.1 - PHASE I LOCKHEED RI/FS SAMPLING AND ANALYSIS PLAN
Doc. Number : 0005
Document Type: REPORT/STUDY

Title/Subject: AMENDMENT TO THE QUALITY ASSURANCE MANUAL FULFILLING EPA REGION 10 ADDITIONAL REQUIREMENTS REVISION 2.0 MCLAREN ANALYTICAL LABORATORY

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 11/13/92
Pages: 118

File Number : 2.4.1 - SITE CHARACTERIZATION SUMMARY REPORT - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: PHASE II SITE CHARACTERIZATION REPORT REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD 1 VOLUME 1 REPORT

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

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Date: 11/13/92
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File Number : 2.4.1 - SITE CHARACTERIZATION SUMMARY REPORT - LOCKHEED RI/FS
Doc. Number : 0002
Document Type: REPORT/STUDY

Title/Subject: PHASE II SITE CHARACTERIZATION REPORT REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I VOLUME II APPENDICES A-I

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 11/13/92
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File Number : 2.4.1 - SITE CHARACTERIZATION SUMMARY REPORT - LOCKHEED RI/FS
Doc. Number : 0003
Document Type: REPORT/STUDY

Title/Subject: PHASE II SITE CHARACTERIZATION REPORT REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I VOLUME III APPENDICES J-L

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

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PACIFIC MOLASSES CO.

Operable Unit: Lockheed RI/FS Date: 03/01/93 (Est.)
Pages: 124

File Number : 2.4.1 - SITE CHARACTERIZATION SUMMARY REPORT - LOCKHEED RI/FS
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Title/Subject: REVISED PHASE II SITE CHARACTERIZATION REPORT REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I VOLUME 1 REPORT

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

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Operable Unit: Lockheed RI/FS Date: 03/01/93 (Est.)
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File Number : 2.4.1 - SITE CHARACTERIZATION SUMMARY REPORT - LOCKHEED RI/FS
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Document Type: REPORT/STUDY

Title/Subject: REVISED PHASE II SITE CHARACTERIZATION REPORT REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I VOLUME II APPENDICES A-I

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

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Title/Subject: REVISED PHASE II SITE CHARACTERIZATION REPORT REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING SEATTLE, WASHINGTON YARD I VOLUME III APPENCIDES J-L

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 01/01/92 (Est.)
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Title/Subject: PRELIMINARY SITE CHARACTERIXATION SUMMARY PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING YARD I SEATTE, WASHINGTON REVISED JANUARY 1992 VOLUME 1 OF 3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
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Title/Subject: PRELIMINARY SITE CHARACTERIZATION SUMMARY PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING YARD I SEATTLE, WASHINGTON REVISED JANUARY 1992 APPENDICES VOLUME 2 OF 3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 01/01/92 (Est.)
Pages: 142

File Number : 2.4.1 - SITE CHARACTERIZATION SUMMARY REPORT - LOCKHEED RI/FS
Doc. Number : 0009
Document Type:

Title/Subject: PRELIMINARY SITE CHARACTERIZATION SUMMARY PHASE I REMEDIAL INVESTIGATION/FEASIBILITY STUDY LOCKHEED SHIPBUILDING YARD I SEATTLE, WASHINGTON REVISED JANUARY 1992 APPENDICES VOLUME 3 OF 3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/01/92
Pages: 254

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L5170 AND L5183

Comments : THIS DOCUMENT IS INCORPORATED INTO THE ADMINISTRATIVE RECORD BY REFERENCE ONLY - SEE SITE FILE OU3, 2.4.2 0001 FOR COPY

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 07/13/92
Pages: 236

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0002
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L5804

Comments : THIS DOCUMENT IS INCORPORATED INTO THE ADMINISTRATIVE RECORD BY REFERENCE ONLY SEE SITE FILE OU3, 2.4.2 0002 FOR COPY

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS

Date: 08/18/92
Pages: 138

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0003
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L6147

Comments : THIS DOCUMENT IS INCLUDED IN THE ADMINISTRATIVE RECORD BY REFERENCE ONLY SEE SITE FILE 2.4.2 0003, OU3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS

Date: 09/03/92
Pages: 87

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0004
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L6205

Comments : THIS DOCUMENT IS INCLUDED IN THE ADMINISTRATIVE RECORD BY REFERENCE ONLY, SEE SITE FILE 2.4.2 0004, OU3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

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Operable Unit: Lockheed RI/FS
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File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0005
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L6107

Comments : THIS DOCUMENT IS INCLUDED IN THE ADMINISTRATIVE RECORD BY REFERENCE ONLY, SEE SITE FILE 2.4.2 0005, OU3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

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Operable Unit: Lockheed RI/FS
Date: 08/20/92
Pages: 210

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0006
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L6129

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Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

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Operable Unit: Lockheed RI/FS
Date: 07/27/92
Pages: 241

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0007
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L6091

Comments : THIS DOCUMENT IS INCLUDED INTO THE ADMINISTRATIVE RECORD BY REFERENCE ONLY, SEE SITE FILE 2.4.2 0007, OU3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

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Operable Unit: Lockheed RI/FS
Date: 08/12/92
Pages: 213

File Number : 2.4.2 - QA/QC REVIEW REPORTS - LOCKHEED RI/FS
Doc. Number : 0008
Document Type: REPORT/STUDY

Title/Subject: QA/QC REVIEW REPORT OF LABORATORY PROJECT NUMBER L6121

Comments : THIS DOCUMENT IS INCLUDED INTO THE ADMINISTRATIVE RECORD BY REFERENCE ONLY, SEE SITE FILE 2.4.2 0008, OU3

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

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Operable Unit: Lockheed RI/FS
Date: NOT INDICATED
Pages: 305

File Number : 2.4.3 - FIELD DATA REPORTS - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: LOCKHEED YARD I PHASE I RI/FS FIELD DATA (VOLUME 1 OF 2)

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: NOT INDICATED
Pages: 236

File Number : 2.4.3 - FIELD DATA REPORTS - LOCKHEED RI/FS
Doc. Number : 0002
Document Type: REPORT/STUDY

Title/Subject: LOCKHEED YARD I PHASE I RI/FS FIELD DATA (VOLUME 2 OF 2)

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 10/01/90
Pages: 155

File Number : 2.5.1 - PHASE I HEALTH AND SAFETY PLANS - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: SITE SAFETY AND HEALTH PLAN FOR LOCKHEED SHIPBUILDING YARD I SEATTLE, WASHINGTON

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 02/02/92
Pages: 62

File Number : 2.5.2 - PHASE II HEALTH AND SAFETY PLAN - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: LOCKHEED SEATTLE YARD I SITE SAFETY AND HEALTH PLAN PHASE II RI/FS

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 05/01/93 (Est.)
Pages: 212

File Number : 2.7.1 - RI REPORT - LOCKHEED RI/FS
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: REMEDIAL INVESTIGATION REPORT LOCKHEED SHIPBUILDING YARD I, SEATTLE, WASHINGTON VOLUME I REPORT TEXT

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 05/01/93 (Est.)
Pages: 481

File Number : 2.7.1 - RI REPORT - LOCKHEED RI/FS
Doc. Number : 0002
Document Type: REPORT/STUDY

Title/Subject: REMEDIAL INVESTIGATION REPORT LOCKHEED SHIPBUILDING YARD I
SEATTLE, WASHINGTON
VOLUME II APPENDICES A THROUGH J

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 05/01/93 (Est.)
Pages: 259

File Number : 2.7.1 - RI REPORT - LOCKHEED RI/FS
Doc. Number : 0003
Document Type: REPORT/STUDY

Title/Subject: REMEDIAL INVESTIGATION REPORT LOCKHEED SHIPBUILDING YARD I, SEATTLE, WASHINGTON VOLUME III APPENDICES F THROUGH K

Author : NOT INDICATED
Organization : MCLAREN HART
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 12/21/93
Pages: 155

File Number : 2.7.2 - FS REPORT
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: Feasibility Study Report, Lockheed Shipyard No. 1, Operable Unit of the Harbor Island Superfund Site, Seattle, WA

Author : ICF Kaiser Engineers, Inc
Organization : NOT INDICATED
Addressee : NOT INDICATED
Organization : LOCKHEED CORPORATION

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 02/14/94
Pages: 13

File Number : 2.7.2 - FS REPORT
Doc. Number : 0002
Document Type: TECHNICAL MEMORANDUM

Title/Subject: Technical Memorandum summarizing thermal treatment alternatives for soils containing total petroleum hydrocarbons

Author : C. A. YUGE
Organization : LOCKHEED CORPORATION
Addressee : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 03/16/94
Pages: 8

File Number : 2.7.2 - FS REPORT
Doc. Number : 0003
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: Letter in response to request for Feasibility Study cost estimates to remove or cap sand blast grit located in the upland portion of the Lockheed Yard Shipway Nos. 2 and 3

Author : HELGERSON, R.N.
Organization : LOCKHEED CORPORATION
Addressee : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/22/94
Pages: 18

File Number : 3.1 -
Doc. Number : 0001
Document Type: PROPOSED PLAN

Title/Subject: THE PROPOSED PLAN HARBOR ISLAND SITE LOCKHEED SHIPYARD FACILITY SEATTLE, WASHINGTON

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/22/94
Pages: 2

File Number : 3.1 -
Doc. Number : 0002
Document Type: COMMUNITY RELATIONS/PUBLIC PARTICIPATION

Title/Subject: SUPERFUND FACT SHEET HARBOR ISLAND SITE LOCKHEED SHIPYARD FACILITY SEATTLE, WASHINGTON

Author : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 04/28/94
Pages: 2

File Number : 3.2 -
Doc. Number : 0001
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: COMMENTS ON THE PROPOSED CLEANUP ALTERNATI ES AT THE HARBOR ISLAND SITE REMEDIATION

Author : KIRCHER, DAVID S.
Organization : PUGET SOUND AIR POLLUTION CONTROL AGENCY
Addressee : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is the Original and is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 05/11/94
Pages: 9

File Number : 3.2 -
Doc. Number : 0002
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: LOCKHEED COMMENTS ON EPA'S PROPOSED PLAN FOR LOCKHEED SHIPYARD NO. 1, SEATTLE

Author : HELGERSON, R.N.
Organization : LOCKHEED CORPORATION
Addressee : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is the Original and is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS
Date: 06/23/94
Pages: 1

File Number : 3.2 -
Doc. Number : 0003
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: Comments on Lockheed's RI/FS Record of Decision

Author : MADAKOR, NNAMDI
Organization : WASHINGTON STATE DEPARTMENT OF ECOLOGY (WDOE)
Addressee : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 06/23/94
Pages: 1

File Number : 3.2 -
Doc. Number : 0003
Document Type: LETTER/FORMAL CORRESPONDENCE

Title/Subject: COMMENTS ON LOCKHEED'S RI/FS RECORD OF DECISION

Author : MADAKOR, NNAMDI
Organization : WASHINGTON STATE DEPARTMENT OF ECOLOGY (WDOE)
Addressee : ROSE, KEITH
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS Date: 05/11/94
Pages: 14

File Number : 3.3 - PUBLIC MEETING TRANSCRIPT
Doc. Number : 0001
Document Type: COMMUNITY RELATIONS/PUBLIC PARTICIPATION

Title/Subject: PROCEEDINGS : PUBLIC MEETING : LOCKHEED PROPOSED PLAN FOR HARBOR ISLAND

Author : HOLMES, KATHEY L.
Organization : BAYSIDE REPORTERS
Addressee : NOT INDICATED
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)

Document Status: This Document is the Original and is Selected for Inclusion in the Administrative Record.

Operable Unit: Lockheed RI/FS

Date: 06/28/94
Pages: 84

File Number : 4.1 - RECORD OF DECISION
Doc. Number : 0001
Document Type: REPORT/STUDY

Title/Subject: RECORD OF DECISION DELCARATION, DECISION SUMMARY, AND RESPONSIVENESS SUMMARY FOR LOCKHEED SHIPYARD FACILITY, HARBOR ISLAND SEATTLE, WASHINGTON

Author : CLARK, CHUCK
Organization : ENVIRONMENTAL PROTECTION AGENCY REGION 10 (EPA)
Addressee : NOT INDICATED
Organization : NOT INDICATED

Document Status: This Document is the Original and is Selected for Inclusion in the Administrative Record.

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