VOLUME I

REMEDIAL INVESTIGATION / FEASIBILITY STUDY
KENMORE INDUSTRIAL PARK
N.E. BOTHELL WAY AND JUANITA DRIVE N.E.
KENMORE, WASHINGTON

Submitted to:

Pioneer Towing Company, Inc.
P.O. Box 82298
Kenmore, Washington 98028-0298

Submitted by:

AMEC Earth & Environmental, Inc.
11335 N.E. 122nd Way, Suite 100
Kirkland, Washington 98034-6918

June 22, 2001

6-91M-10459-D

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1.0 INTRODUCTION

This report presents the results of AMEC Earth and Environmental, Inc.'s (AMEC) Remedial Investigation (RI) and Feasibility Study (FS) for the Kenmore Industrial Park. The RI portion addresses the current physical conditions of the site and evaluates the nature and extent of the environmental impacts identified at the site. The FS portion of this study evaluates remedial alternatives to address the environmental impacts identified in the RI portion. AMEC prepared this report in accordance with Washington Administrative Code (WAC) 173-340-350 Model Toxics Control Act (MTCA) requirements for RI/FS studies. The purpose of this RI/FS report is to collect, develop, and evaluate sufficient information regarding the site to enable the selection of a cleanup action. The RI/FS is focused consistent with WAC 173-340-130(5)-(7). Focused RI/FS reports are appropriate where, as in this case, the cleanup action is routine because it involves a limited choice among cleanup methods; the cleanup method is reliable and has proven capable of accomplishing cleanup levels; the cleanup levels are obvious and allow an adequate margin of safety; the Department of Ecology has experience with similar actions; and the action does not require an environmental impact statement. Section I of the report presents the results of the RI and Section II presents the FS.

SECTION 1 – REMEDIAL INVESTIGATION

2.0 REMEDIAL INVESTIGATION SUMMARY

The site is located north of and adjacent to the mouth of the Sammamish River on an approximately 45-acre property. The southwestern portion of this property forms a peninsula that extends into Lake Washington, south of the Kenmore Navigation Channel. The site is currently used as an industrial park predominantly occupied by a sand-and-gravel stockpile yard and several smaller storage and light industrial operations.

The site was formerly a deltaic peat deposit reclaimed through the placement of demolition fill material consisting predominantly of wood, with lesser quantities of concrete, metal and miscellaneous debris. The site was used as a demolition debris landfill prior to the current industrial activities. The Washington Department of Ecology gave the site a ranking of '1' on the Site Hazard Assessment (SHA) list in 1992. According to the SHA, the property was operated as a landfill between 1965 and 1981. In 1984, the EPA subcontracted the completion of a Potential Hazardous Waste Site Preliminary Assessment study on the site. The site was one of twenty landfills that received wastes from Bayside Disposal, potentially including hazardous materials such as medical wastes and transformers. The study determined that records existed for the disposal of stumps, demolition debris, and restaurant wastes. No physical evidence has been found that the site received hazardous waste. AMEC's subsurface explorations found that the composition of the landfill was consistent with demolition debris disposal.

The results of subsurface investigations performed at the site and summarized in this report indicate that petroleum hydrocarbons, lead, and barium in the soil are at concentrations above applicable MTCA cleanup levels. The results of groundwater investigations at the site indicate that concentrations of these contaminants of concern as well as groundwater concentrations of volatile organic compounds (VOCs) and semi-volatile organic compounds (SVOCs) currently meet MTCA groundwater cleanup levels at the proposed conditional point of compliance.

3.0 LOCATION AND FACILITY BACKGROUND

Kenmore Industrial Park is located southwest of the intersection of Bothell Way N.E. and 68th Avenue N.E. in Kenmore, King County, Washington, along the 6500 through 6800 blocks of N.E. 175th Street. The site comprises approximately 45 acres and its location is indicated on Figure 1, the Location Map. The project coordinator for the Remedial Investigation is:

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The current owner is Pioneer Towing Company, Inc. A list of known current and former owners and operators is provided in Table 3-1 and shown on Figure 2. A legal description of the parcels that comprise the site is provided in Appendix E.

3.1 Environmental Setting

Kenmore Industrial Park is located adjacent to and north of the mouth of the Sammamish River where the river flows into the northeast corner of Lake Washington. At the turn of the 20th century, the southern and western portions of the site were a shallow, submerged delta. After the U.S. Army Corps of Engineers lowered the lake level in 1916, and as development progressed at the site, the southern and western portions were subject to reclamation through landfilling of demolition debris, resulting in a landfilled peninsula elevated above the former deltaic environment.

Landfill records indicate that stumps, demolition debris, and restaurant wastes were disposed at the site. The site was one of twenty landfills that potentially received medical waste and transformers from one waste transporter, Bayside Disposal, but actual disposal of medical waste and transformers at the site has never been confirmed.

The demolition landfill areas were subsequently graded and covered with at least one foot of soil. Closure occurred in the mid-1970s, prior to the adoption of, but consistent with, the demolition waste landfill closure provisions in WAC 173-304-461. The site is currently used as an industrial park. The limits of the demolition landfill, including the site boundaries, site structures and exploration locations, are indicated on the Site and Exploration Plan, Figure 3. The approximate boundaries of the demolition landfill roughly correspond to the fill-peat boundary, are shown on Figure 3.

Several operations, including a sand and gravel staging area and assorted small storage and manufacturing industries, currently occupy the industrial park. Surface elevations across the site range from 21 to 34 feet above mean sea level. The majority of the property has been graded flatter than 5 percent. In addition, localized paved surfaces, at the north end of the site, slope up to 15 percent and peripheral roadway and shoreline embankments typically exceed a slope of 40 percent.

3.2 Facility Background

Historic activities that may have contributed to the placement of contaminants on the site occurred in two phases. The first phase consisted of demolition landfilling and grading activities that raised the elevation of the property above the level of Lake Washington. In the second phase, the developed property was put to use as an industrial park. The timing of these events is based on information obtained from Ecology's Site Hazard Assessment (SHA) report, dated 19 February 1992. This information is supplemented by AMEC's review of stereopairs of aerial photographs of the property provided by Walker & Associates of Tukwila, Washington.

3.2.1 Filling and Grading

Significant filling activities became evident at the north margin of the property by 1956. By 1969, the entire property appears to have been filled to its current elevation. Based upon the subsurface explorations performed by AMEC at the site, the fill consists of demolition debris, predominantly wood products with lesser amounts of concrete and asphalt rubble, and a minor soil matrix. A larger proportion of soil is encountered within the fill at the north end of the site between the east end of the navigation channel and the truck driving school. Components of the fill encountered less frequently included scrap metal, rubber tires, wire cables, stumps, carpeting, and plastic. The origin of the fill is reported to be housing demolition debris related to construction of the Interstate I-5. The debris encountered by AMEC during several phases of site exploration is consistent with this source. In total, an estimated 800,000 cubic yards of demolition debris underlie the southern two-thirds of the site. The demolition debris area is covered by an estimated 200,000 cubic yards (at least one foot in depth) of mineral soil cover. According to the Ecology SHA, "stumps, demolition debris and restaurant wastes had been disposed" at the site. The SHA also references the potential for hazardous materials (medical waste and transformers) to have been disposed on-site during land reclamation activities. AMEC's subsurface explorations performed between 1995 and 1997 did not encounter any evidence of significant sources of hazardous materials at the site; neither medical waste nor transformers were found.

3.2.2 Industrial Park Activities

Historic industrial developments at the site included support facilities for the concrete and asphalt plants adjacent and offsite to the northwest. A concrete truck fleet was fueled and maintained in a fenced compound occupying the north-central portion of the property. Fuels were stored in aboveground storage tanks (ASTs) inside the fenced compound. An impoundment was maintained in the west central portion of the property to contain washwater rinsed from the concrete trucks. Excess concrete was rinsed onto the ground surface surrounding the impoundment, or was recycled into ecology blocks. Aggregate was stockpiled in the southeastern quarter of the site. The site has been used for commercial fishing, marine towing, and construction contractor staging areas. Current and former business operations are discussed in greater detail in Section 3.4.

Ecology's 1992 Site Hazard Assessment (SHA) and the subsequent site ranking were based upon Ecology's knowledge of site history and site uses, and upon the results of previous site characterization studies performed by Geotech Consultants (January 1991). The final scoring of the site using the Washington Ranking Method (WARM), as outlined in Chapter 173-340, resulted in a ranking of 1 (highest rank) on the SHA list (File TCP ID: N-17-5127-0000). The ranking was based on a quantification of the potential exposure to humans or the environment along specific exposure routes including air, surface water, and groundwater. Ecology used the total metals concentrations in turbid groundwater samples from poorly constructed, undeveloped wells installed by Geotech Consultants for the calculation of risk, rather than dissolved groundwater concentrations documented by SEACOR (January 1992). Therefore, the risk calculations should be considered conservative.

Current and former business operations are summarized below in Section 3.4 and numerically cross-referenced (1 through 15) on Table 3-1 and Figure 2. Activities documented at the time of the SHA inspection (1992) included: painting and paint refurbishment activities at the southwest corner of the site (14); temporary storage of petroleum-contaminated soils (6) for recycling at an adjacent, offsite asphalt plant; and, storage of 55-gallon drums at various locations for containment of petroleum fuel, aviation fuel, motor oil, concrete form-release oil, and lubricating oil (6,8,9). Several tenants fueled and maintained loaders, excavators, cranes, and forklifts at the property (1,4,8,9). Spills and leaks associated with fueling, maintenance, and general traffic of heavy equipment were suspected to have contributed to localized, superficial petroleum hydrocarbon contamination at the site. A roofing contractor recycled waste roofing materials on the site (10). The majority of these site activities have been discontinued since Ecology's SHA report was prepared in 1992.

The potential for benzene, present in a temporary stockpile of petroleum-contaminated soil (Location 6 - no longer present on site), was interpreted to pose the greatest risk to the environment, and was the dominant factor in Ecology's site scoring calculations, resulting in the WARM bin rank of 1. Although the former stockpile was reportedly covered by tarps, located under partial shelter and bermed, no mechanism existed for the interception of runoff or leachate from the stockpile, constituting improper containment practices. The toxicity and mobility of benzene, along with the improper containment of the soil stockpile and the proximity of Lake Washington (a fishery resource) were listed as contributing factors to Ecology's priority ranking. Ecology's calculations determined that the soil stockpile posed the greatest threat to human health and to the environment via surface water, air, and groundwater routes.

The temporary stockpile, that served as the suspected source of benzene existed for less than three months; subsequent investigations detected no benzene in site soils, and benzene concentrations detected in the groundwater have all been below MTCA Method A residential cleanup levels. The temporary stockpile site was located in the approximate center of the property, near the northwest corner of the existing aggregate stockyard, between wells AW-2 and AW-7 shown on Figure 3. Other exposure pathways considered for site scoring were the former demolition landfill (assumed in 1992 to be situated within the southwest-central portion of the site) and the former concrete truck washout impoundment, but these pathways did not contribute to the WARM ranking. The location of the impoundment corresponds to the previously assumed location of the former demolition landfill.

AMEC's subsequent investigation indicated that the demolition landfill is not confined to the vicinity of the impoundment, but that the entire southern portion of the site is underlain consistently by demolition debris fill. As such, much of the entire filled portion of the site, encompassing approximately 30 acres, appears to comprise the landfill, as shown on Figure 3, Site and Exploration Plan. Ongoing activities documented through 1997 include: barges and fishing vessels docked against the existing bulkheads as well as the western shoreline; on-site storage, maintenance, loading and unloading of construction materials and aggregate; and unloading commercial fishing supplies and equipment.

3.3 Legal Description

The complete legal description of the site was obtained from the Lakepointe Master Plan General Information Sheet and is presented in Appendix E.

3.4 Current and Former Owners/Operators

The current property owner, Pioneer Towing Company, Inc., acquired the property in 1958 from Squire Investment. Current and former business operations have included assorted small storage and manufacturing industries, sand and gravel staging and support facilities, and associated offices. Table 3-1, presented below, summarizes information about the operations for all known current and former businesses on site; identifies the potential contaminants associated with each of the listed businesses; and provides a cross-reference key for locating each business on the site map shown in Figure 2.

3.5 Previous Investigations

Between 1990 and 1997, AMEC and other consulting firms conducted a number of investigations at the site. This section provides an overview of the scope, results and quality of these early investigations. At Ecology's request, and pursuant to an August 1997 amended scope of work, AMEC performed additional investigations to support preparation of this Remedial Investigation report between 1997 and 2001. These additional investigations are discussed in Section 3.6. The Site Hazard Assessment conducted by Ecology is discussed in Section 3.2. Information concerning the data obtained for specific parameters, analytical methodologies, and data quality are further detailed in Section 8.0.

Logs of all of AMEC's test pits, soil borings and cone penetrometer explorations are included in Appendix A. Logs of seven soil borings completed by others are also included in Appendix A. Except for B-102, wells installed in these seven borings have been lost or destroyed. Information obtained from these seven borings are qualified by uncertain well construction methods, apparent lack of well development prior to groundwater sampling, sample turbidity, and inadequate analytical method detection limits, as discussed in Section 3.5.1.

The Site and Exploration Plan (Figure 3) shows the locations of all of AMEC's test pits, soil borings and cone penetrometer explorations, along with the seven soil borings by others. Logs of AMEC's subsurface explorations are also incorporated in the Preliminary Geotechnical Engineering Evaluation, prepared by AMEC and dated 8 November 1996, and attached to this document as Appendix C. Field screening did not indicate the presence of volatile chemicals in soils sampled from any of AMEC's test pits and borings.

3.5.1 Previous Investigations by Others

Geotech Consultants, Inc. performed a Phase II Environmental Assessment of the site in November 1990. A copy of the report is included in Appendix D, Previous Investigation Reports. Geotech Consultants' revised study discussed the installation and sampling of seven groundwater monitoring wells, and a soil assessment in the vicinity of two underground storage tanks (USTs) at the parcel north of N.E. 175th Street. The results of the assessment were presented in a report entitled Revised: Phase II Environmental Study - Kenmore Pre-Mix Site, dated 24 January 1991. A copy of the report is included in Appendix D, Previous Investigation Reports and data are presented in Tables 3-2 through 3-6C. The results indicated total recoverable petroleum hydrocarbon (TRPH) concentrations above 5.0 parts per million (ppm) (5,000 μg/L); however, the analytical method in use at that time combined both petroleum and natural organic matter in the 1991 TRPH results, that are currently interpreted to overstate petroleum concentrations. The data quality of the results from the Geotech Consultant investigations is considered poor due to high sample turbidity, organic interference, high method detection limits, and improper well development (Table 3-2, Summary of Analytical Datasets and Qualifications (December 1990 Geotech Data)). Consequently, the Geotech Consultant data is not considered reliable for purposes of this RI/FS. Total metals concentrations were significantly elevated above their respective cleanup guidelines, and were evaluated subsequently by others.

A one-time PCB detection was further scrutinized and the results were presented in Geotech's report entitled Supplemental Sampling and Testing in the Proximity of Monitoring Well B-103, dated 22 July 1991 (collected June 1991, Table 3-2). A copy of the report is included in Appendix D, Previous Investigation Reports and the results are presented in Tables 3-2 through 3-6C. The groundwater data was deemed to be of poor quality because of high turbidity in the samples collected (Table 3-2). Consequently, the Geotech data is not considered reliable for purposes of this RI/FS.

Due to the elevated metals concentrations and alkaline conditions in the groundwater reported by Geotech Consultants in January and July 1991, SEACOR completed an investigation in January 1992, including collecting groundwater samples from three wells, B-1, B-2 and B-4, and analyzing the samples for pH and dissolved metals. A copy of the report is included in Appendix D and the results are presented in Tables 3-2 through 3-6C. The data quality of the results from the SEACOR investigation is considered poor due to improper well construction practices (Table 3-2). Consequently, the SEACOR data is not considered reliable for purposes of this RI/FS.

3.5.2 Previous Investigations by AMEC

AMEC initiated a Preliminary Geotechnical Engineering Evaluation for the site in September 1995. This report was finalized on 8 November 1996. A copy of this report is included as Appendix C and the results are presented in Tables 3-2 through 3-6C. A total of 27 soil borings ranging from 14 to 71.5 feet and eight cone penetrometer explorations ranging from 31 to 47 feet were advanced on the site, and along existing and proposed rights-of-way, between September 1995 and February 1996. Eleven of the soil borings were completed as groundwater monitoring wells to characterize subsurface soil and groundwater conditions. Wells were installed with screen depths ranging from 4 to 14 feet bgs. In March 1996, twenty test pits were excavated to depths of 1 to 11 feet below ground surface to view and explore the demolition debris fill and characterize the fill constituents for both geotechnical and environmental purposes. In November 1998, three additional monitoring wells were installed.

The results of soil sampling and analysis, and demolition debris fill characterization that took place in conjunction with the geotechnical evaluation are discussed in AMEC's Phase II Environmental Assessment, dated May 1996 (collected in October 1995 and February 1996). A copy of this report is included as Appendix D. The results are presented in Tables 3-2 through 3-6C and discussed in Section 8.0 of this report.

The results of initial groundwater sampling and analysis are discussed in AMEC's Phase II, and in Groundwater Analytical Results - August 1996 report dated 8 November 1996 (collected in August of 1996). Copies of these reports are included in Appendix D and presented on Tables 3-2 through 3-6C. Groundwater samples were obtained from eleven AMEC wells and one well (B-102) previously installed by Geotech Consultants. Different sampling methodologies were employed during different events. Furthermore, the final two sampling events focused on obtaining representative groundwater samples for TPH and metals analyses, that appeared to be affected to a greater degree by sample turbidity than gasoline and VOC analyses. Finally, the sampling program was further modified to include use of the draft silica gel cleanup methodology for TPH analysis, drafted by Mr. Bob Carrell at Ecology's Manchester laboratory. The draft silica gel cleanup was used for the data collected beginning in April 1996.

Groundwater data quality varied in these investigations. As a result of the variations in well construction, sampling and analytical test methodologies, limited comparisons may be drawn between analytical results from different sampling events. AMEC has rejected the metals results of the first two sampling events as unreliable (for the purposes of this RI/FS), due to unacceptably high sample turbidity. However, because turbidity is not a significant factor in the validity of gasoline or VOC data, these two sampling events are considered reliable for these analytes and are more fully discussed in Sections 8.2 and 8.5 of this report. Qualifications for all data obtained at the site by AMEC and other investigators are summarized on Table 3-2 Summary of Analytical Datasets and Qualifications.

3.6 AMEC Investigations for Support of Remedial Investigation Report

At Ecology's request, AMEC performed a number of investigations at the site specifically for the preparation of this Remedial Investigation Report; these are summarized below.

3.6.1 Additional Subsurface Investigation, November 1997

AMEC performed an additional subsurface investigation at the site, at the request of Ecology, in November 1997, consistent with the amended scope of work dated 24 July 1997. The investigation included advancing two additional soil borings (AW-12 and AW-13) near the southern boundary and northeast boundary or corner, respectively. The locations of the wells are indicated on the Site and Exploration Plan, Figure 2. Copies of the well boring logs are included with this report in Appendix A. The borings were advanced to depths of approximately 18 feet below site grade (bsg) and a monitoring well was installed in each of the borings. The monitoring wells were completed with aboveground monuments, and bollards were installed around the perimeter to protect the wells. The quality of the results from AMEC's subsurface investigation of November 1997 (collected November, 1997) is good (Table 3-2, Summary of Analytical Data Sets and Qualifications). The investigation results are presented in Tables 3-6A and 3-6B and discussed in Section 8.0 of this report.

3.6.2 Chemical Analyses of Fill Soils, November 1997

As part of the November 1997 investigation, soil samples were collected from each of the three additional borings. One soil sample was collected from each of the borings and submitted for gasoline, diesel- and oil-range petroleum hydrocarbons, PCBs and eight RCRA metals analyses. One native peat sample from each boring was submitted for laboratory analysis of eight RCRA metals (Section 3.6.3). The data quality of the results from AMEC's chemical analyses of fill soils is considered good (Table 3-2, Summary of Analytical Data Sets and Qualifications). The results of the fill soil analyses are presented in Tables 3-6A and 3-6B and discussed in Section 8.0. Laboratory analytical reports are included with this report in Appendix B.

3.6.3 Chemical Analyses of Native Peat Soils, November 1997

As part of the November 1997 investigation, AMEC submitted one native peat sample from each boring for laboratory analysis of eight RCRA metals. The data quality of the results from AMEC's chemical analyses of native peat soils is considered good (Table 3-2, Summary of Analytical Data Sets). The results of the native peat soil analyses are presented in Tables 3-6A and 3-6B and discussed in Section 8.0. Laboratory analytical reports are included with this report in Appendix B.

3.6.4 Additional Groundwater Assessments

In December 1997, after installation and elevation determination of the top of casing of the monitoring wells, hydraulic conductivity testing was performed on two of the wells, AW-12 and AW-13. The results of the conductivity tests are discussed in Section 4.5.5. A summary of the fluid level measurements is indicated on Table 3-4 and the inferred groundwater gradient is presented on the Groundwater Contour Map, Figure 7.

In September 1998, monitoring well AW-10 was resampled for dissolved lead content, and a surface water sample was collected from the Sammamish River for hardness testing. No lead was detected at 1.0 μg/L. Surface water hardness was 73.2 mg/L. The lead data is presented in Table 3-5B and discussed in Section 8.0 of this report. Laboratory test results are included in Appendix B.

In January 2001, shoreline compliance monitoring wells AW-6, AW-11, and AW-12 were sampled for diesel- and heavy oil-range petroleum hydrocarbons using the silica gel cleanup method, total RCRA metals, VOCs, and SVOCs. Compliance monitoring well AW-10 was discovered to be filled with solids to the water table, and therefore was not included in this sampling event. Diesel- and heavy oil-range petroleum hydrocarbons and SVOC compounds were undetected in all samples. Arsenic, barium, chromium, lead, and zinc in the groundwater were detected below the applicable MTCA cleanup levels. Only two VOC compounds were detected (carbon disulfide and chlorobenzene) and these two compounds were detected at concentrations well below the applicable MTCA cleanup levels. The January 2001 sampling results are presented in Tables 3-6A, 3-6B, and 3-6C and discussed in detail in Section 8.0 of this report. Laboratory test results are included in Appendix B.

In March 2001, shoreline compliance monitoring wells AW-6, AW-11, and AW-12 were sampled for diesel- and heavy oil-range petroleum hydrocarbons using the silica gel cleanup method, total and dissolved RCRA metals, VOCs, and SVOCs. Compliance monitoring well AW-10 was not included in this sampling event due to solids filling the well to the water table. Diesel- and heavy oil-range petroleum hydrocarbons and SVOC compounds were undetected in all samples. For the total metal samples, lead and barium were the only metals detected. For the dissolved metals samples, only arsenic, barium, and lead were detected. The detected metals concentrations were below the applicable MTCA cleanup levels. Only one VOC was detected (chlorobenzene); this concentration was well below the applicable MTCA cleanup level. The March 2001 sampling results are presented in Tables 3-5A, 3-5B, and 3-5D and discussed in detail in Section 8.0 of this report. Laboratory test results are included in Appendix B.

In May 2001, shoreline compliance monitoring wells AW-6, AW-11, and AW-12 were tested for hardness. Compliance monitoring well AW-10 was not included in this sampling event due to solids filling the well to the water table. Sampling showed hardness concentrations of 722 mg eq./L at well AW-6, 737 mg. eq./L at well AW-11, and 524 mg eq./L at well AW-12. The laboratory test results are included in Appendix B. The hardness results are presented in Table 3-5E and discussed in Section 8.0 of this report.

4.0 SITE GEOLOGIC CONDITIONS

The following section describes the site geologic conditions as indicated by AMEC's research and field investigations. Exploration locations are depicted on Figure 3 along with alignments for three cross-sections. The cross-sections show the relationship between different fill and soil materials encountered at the site are included as Figures 4,5 and 6.

4.1 Geomorphic Development

The property is located at the mouth of the Sammamish River, at the north end of Lake Washington, within the Puget Lowland basin. The Sammamish River flows west into Lake Washington off the southwest corner of the site. The large-scale geomorphic features of the vicinity are the result of Pleistocene Age glaciations, ending with the Vashon glaciation, which receded from the area approximately 13,000 years ago. The native soils underlying the site consist of alluvium deposited during the Holocene Age, following the recession of the Vashon glacier. Significant man-made modifications were performed this century to raise the property elevation above the level of Lake Washington. These modifications took place both onsite and offsite.

4.1.1 Drainage Basin Development

Recessional sands and gravels were deposited by glacial meltwaters and their proceeding river drainages on the upland plateaus, in valleys, and in lakes. A delta of recessional sand and gravel formed at the mouth of the Sammamish River and pro-graded into the Lake Washington trough. Recessional sands and gravels also blanket the flanks of the trough and river valleys. Once the glacial meltwaters receded, the Sammamish River was fed by local precipitation only, resulting in lower depositional energies, and deposition of finer sand and silt alluvium.

Following recession of the glaciers, the continual deposition of alluvium at the mouth of the Sammamish River resulted in surficial alluvium elevations near the surface elevation of the lake. The shallow water depth and alluvium likely provided a nutrient-rich environment. Organic materials originating in the ecosystem and some organic matter that eroded from upstream sources likely formed the peat layer encountered in the subsurface explorations. Although the majority of the ecosystem has been displaced, this sediment depositional process continues today; however, the rate is slower due to urbanization. Urbanization replaced the dense vegetation that previously contributed to the organic sediment load of the river; it also provided installation of sedimentation and erosion controls to protect surface water quality.

4.1.2 Modern Controls and Alterations

Following the lowering of Lake Washington in 1916, the Sammamish River was straightened in order to facilitate transportation and commercial uses. The current southern shoreline of the property was formed by the dredged alignment of the straightened river channel. The Kenmore Navigation Channel that angles across the site is also maintained by dredging, and originally served a timber mill located at the head of the channel. The dredging process consists of the selective removal of deltaic sediment accumulations from established navigational rights-of-way.

The north end of the site was graded early this century for construction of a railroad, Bothell Way, N.E. 175th Street, and for associated industrial developments such as an adjacent lumber mill. By 1960, the property was being filled towards the river shoreline and the navigation channel. By 1980, the property had been filled to an elevation approximately ten feet above the surrounding lake level, and bulkheads had been constructed along the navigation channel to protect the shorelines.

No flood controls are implemented along the Sammamish River, and the lake level is controlled further downstream at the U.S. Army Corps of Engineers Hiram Chittenden locks, where freshwater is discharged to Puget Sound. Upstream of the site, urban flooding risks are mitigated by civil engineering design as part of the urbanization process. The Corps maintains the lake level at approximately Elevation 16.5 between December and March, and at Elevation 18.4 between May and October.

4.1.3 Modern Sediment Deposition and Erosion Processes

Modern geomorphic processes continue to be dominated by human activities. Net deposition of alluvial sediments continues in the Sammamish River Navigation Channel, as well as in the Kenmore Navigation Channel. The continued sediment accumulation requires periodic dredging.

The majority of the site is protected from erosional forces by the relatively flat-lying grade maintained across the industrially developed upland area. The inner end of the Kenmore Navigation Channel is protected from erosion by bulkheads. Natural degradation and gradual settlement of the organic sediments underlying the site are expected to continue at a slow rate over time.

4.2 Surface Water and Sediments

There are two adjacent bodies of surface water: the Sammamish River and Lake Washington. The Kenmore Navigation Channel is a dredged extension of the lake that forms the northwest boundary of the site. Currently, there are no bodies of surface water on the site.

4.2.1 Sammamish River

According to Beak's Technical Report on Natural Resources, EPA's STORET database includes data from METRO sampling of Sammamish River waters near the eastern property boundary of the site beginning in 1963. Selected dissolved metals concentrations in water samples were measured quarterly to monthly between 1976 and 1986 at METRO Station No. 0405, near the 68th Avenue N.E. bridge and the upstream, eastern boundary of the site. Iron concentrations reportedly ranged from 428 μg/L to 878 μg/L, copper from below detection to 4 μg/L, lead from 2 to 9 μg/L, and zinc from below detection to 9 μg/L. Fecal coliform bacteria, dissolved oxygen and temperature parameters for the Sammamish River violate Class AA surface water standards, especially during the warmer summer months. Arsenic, hardness and pH were not evaluated at this sampling station by METRO.

4.2.2 Lake Washington

Beak's report also summarizes METRO water quality data from a water quality sampling station located at the north end of the lake (Station 0804), near the mouth of the Sammamish River. Temperature, turbidity, conductivity, dissolved oxygen, pH and nutrients are measured at this station. Turbidity ranged from 0.5 to 5 NTUs, and pH ranged from 6.8 to 8 between January 1990 and June 1995.

4.2.3 Surface Runoff

Surface runoff is collected in a series of catch basins that drain the central portion of the site and discharge to the Kenmore Navigation Channel. Erosion is not considered to be a significant site process due to the relatively flat-lying topography, and to the limited area of perimeter embankment slopes. As the contaminated medium is largely limited to the subsurface environment, it does not appear that this pathway represents a significant threat to nearby sensitive or human receptors. Surface water transport is discussed in greater detail in Section 10.2 of this report.

Ecology, Beak, and AMEC personnel noted oily sheens on surface runoff during or following wet weather. Puddles located within traffic areas are turbid. AMEC attributes the sheen and turbid conditions to on-site truck and heavy equipment traffic operations.

4.2.4 Sediments

Puget Sound Dredge Disposal Act (PSSDA) characterization was conducted by Science Applications International Corporation (SAIC) within the Kenmore Navigation Channel, beginning at the inner harbor and extending one-half nautical mile southwest of the site. The results of characterization are detailed in SAIC's report, dated May 1996. Three sediment samples (S1, S2 and S3) were collected within the inner harbor. SAIC reported a petroleum odor at depth in samples S1 and S2, as well as in S4 and S5, offshore of several marinas. SAIC noted abundant wood fibers and chips in the sediments of the inner harbor, consistent with historic timber mill development north of the channel. Analytical results indicated the following:

- Arsenic concentrations ranged from 4.6 to 11 mg/kg among all 15 samples.
- Lead concentrations ranged from 21 to 45 mg/kg among all 15 samples.
- Organo-tin compounds were detected above PSDDA screening levels in the only sample analyzed, S4, located outboard of the property boundaries, and offshore from several marinas.

- No volatile organics, chlorinated hydrocarbons, phenols, or PSDDA miscellaneous compounds were detected in any of the 15 samples.

- Low molecular weight polycyclic aromatic (LPAH) compounds exceeded PSDDA screening levels only in sample S1, but passed the subsequent bioassay. HPAH compounds did not exceed screening levels in sample S1.

- No pesticides were detected in samples S1, S2 and S3. The PCB Arochlor-1254 was detected at 0.017 mg/kg in sample S1, below the PSDDA screening level, and was detected between 0.015 and 0.027 mg/kg in six of the 15 samples.

- Bis- (ethylhexel) phthalate was detected between 0.087 and 1.0 mg/kg in all 15 samples, and between 0.087 and 0.240 mg/kg in samples S1, S2, and S3.

Three samples that exceeded screening levels were subjected to bioassays. Based upon the results of PSSDA characterization, the majority of the sediments slated for dredging qualified for open water disposal in Elliott Bay. One sample area outboard of the site failed the bioassay and required upland disposal.

Due to the occurrence of lead and arsenic on site, AMEC sampled river sediments on December 3, 1997 at two locations. The results of sampling were reported to Ecology in AMEC's letter dated 20 February 1998.The first sample, SED-1, was collected from the wetland upstream of the southeast corner of the site, and sample SED-2 was collected from the point on the river shoreline closest to AW-10, where elevated lead concentrations have been occasionally found in the groundwater. The upstream sampling location is sited beneath a bridge overpass, and is sited upstream and opposite from a public boat ramp. Both sediment samples were analyzed for total arsenic and lead content by EPA Method 6000/7000. No arsenic was detected in either sample above 10.0 mg/kg. Lead was detected in the upstream sample at a concentration of 83.4 mg/kg, and was undetected in the downstream sample at 10.0 mg/kg. The sediment quality standard for marine sediments is 57 mg/kg for arsenic and 450 mg/kg for lead, according to WAC 173-204-320; freshwater sediment standards have not been promulgated for Washington State at the time of this report.

4.3 Soils

Currently, the entire site and surrounding land surface consist of modified urban land. Site soil conditions were explored in several phases of geotechnical and environmental investigation that were summarized in Sections 3.5 and 3.6. Four principal soil layers underlie the site:

- Recent Fill and Demolition Fill

- Peat and Organic Silt

- Loose Alluvium

- Dense Sand and Gravel

The portion of the site south of N.E. 175th Street is underlain by significant thicknesses of very loose fill over soft, compressible peat, organic silt soils, and/or loose alluvium. Where fills or soft soil conditions occur, dense, bearing conditions are encountered within the underlying sands and gravels at depths of 25 to 45 feet below existing grades. The portion of the site north of N.E. 175th Street is underlain by loose to medium dense alluvial sands and gravels, historically re-graded into a series of cut and fill terraces for existing rights-of way.

The Site and Exploration Plan (Figure 3) delineates the area underlain at depth by peat soils, roughly equivalent to the area that was landfilled. Three generalized cross-sections are provided as Figures 4 through 6 to illustrate the general geologic conditions underlying the site. The purpose of the cross-sections is to illustrate the relationship between the demolition debris layer and the groundwater table.

4.3.1 Wood Debris Fills

The demolition fill material is composed predominantly of wood products with brick, wire, concrete, metal, and a silty sand matrix. The fill beneath the majority of the site contains an estimated average of 70 percent wood products by volume, with 10 to 15 percent each of concrete rubble and soil matrix. The fill layer averages 15 feet in thickness, with an estimated volume of 800,000 cubic yards of fill material. The texture of the demolition material is coarse, and includes logs, timber piling stubs, and large-diameter concrete slab fragments. The wood fragments were typically less than 8 inches in diameter. Fragments appeared to be several feet in length; one log approximately 8 feet long was removed from test pit TP-15. The matrix consists of silty fine sands, and occasionally includes the sandy, fine gravel of concrete washout products.

The demolition debris fill area is covered with approximately 200,000 cubic yards (at least one foot) of soil. The cover soils predominantly consist of a mineral soil with the texture of a silty, gravelly sand.

Waste roofing debris was stockpiled on the south central portion of the site between 1994 and 1996 for recycling purposes. The debris consisted of a mixture of wood shingles, asphaltic shingles, plastic, fabric, metal debris, fiberboard and styrofoam, as well as plastic sheeting. A total of 10,000 cubic yards of this material was removed and properly disposed between mid-1996 and early 1998; a total of 720 tons of roofing debris that may have contained non-friable asbestos were disposed at Oregon Waste Systems facility in Arlington, Oregon. An average of six inches of roofing debris remains spread across an approximate three-acre area at the south end of the site, predominantly mixed with site cover soils. This remaining layer is estimated to comprise just two-tenths of one percent (0.2%) of the volume of wood debris at the site. The county health department has requested that the remaining material be consolidated during the cleanup of the site.

4.3.2 Peat and Organic Silt

Native peat soils were encountered beneath the southern two-thirds of the site. These soils extended to depths of 15 to 35 feet below existing grades. The peat soils contain finer organic debris with increasing depth, grading from fibrous to amorphous in texture with depth.

4.3.3 Loose Alluvium

Soft or loose alluvial soils were encountered beneath the southern half of the site. These soils extended to depths of 25 to 45 feet below existing grades. These soils become increasingly coarse with increasing depth, with silts and clays grading into interbedded fine sands, and sandy fine gravels.

4.3.4 Dense Sands and Gravels

Beneath the loose alluvium, subsurface explorations encountered medium-dense to dense sands and gravels. Interbedded dense, silty sands and hard silts were occasionally encountered. These granular soils are interpreted to be glacial recessional outwash, but are not easily distinguished from overlying alluvial sands and gravels. The relative density, especially of the finer-textured interbeds, as well as the reduced potential for organic interbeds, provides the distinguishing characteristics for the purposes of this discussion. Medium-dense to dense sands and gravels, suitable for supporting foundation loads, were encountered beneath the filled portion of the site at depths of 25 to 50 feet.

4.4 Hydrogeologic Characteristics

Hydrogeologic characteristics of the site are presented in this section and include groundwater flow and gradient, groundwater recharge and discharge, groundwater quality, and hydraulic conductivity.

4.4.1 Groundwater Flow and Gradient

Groundwater levels beneath the southern, filled portion of the site closely correspond to adjacent surface water levels in both Lake Washington and the Sammamish River. Groundwater levels were measured seasonally between October 1995 and August 1996 in nine on-site wells (AW-1 through AW-9), and in December 1997 and March 2001. In addition to AMEC's original nine wells, groundwater levels and gradient information come from B-102 (installed by earlier investigators), wells AW-10 and AW-11 (added in February 1996), and wells AW-12 and AW-13 (added in November 1997). Surface water levels were measured on August 5, 1996, December 22, 1997 and March 26 and 27, 2001. The measured groundwater table and surface water elevations are situated within the debris fill layer and above the top of the native peat layer. The data indicates that the weight of the fill layer has submerged the former surface of the compressible peat deposits below the modern lake levels.

The seasonal low groundwater table develops beneath the filled portion of the site in late winter, contrary to local precipitation patterns, due to the influence of Lake Washington. The lake surface elevation is maintained by the Corps at approximately Elevation 18.4 feet (relative to King County Aerial Survey Datum, Benchmark KC-B-16) between May and October to accommodate fisheries and recreational needs. The surface elevation is maintained at approximately Elevation 16.5 annually between December and March to increase storage capacity, and minimize the potential for shoreline erosion. The seasonal high water table develops beneath the filled portion of the site between spring and autumn.

Well AW-9 was installed in native, granular soils at the north, up-gradient end of the property. Upgradient groundwater levels fluctuate seasonally, consistent with seasonal precipitation patterns.

Consistent with seasonally controlled lake levels, depth to water levels in the wells were observed to vary by less than two feet seasonally during the stated time interval, except in well AW-5, where levels varied by almost three feet. The variation observed in well AW-5 is attributed to concrete mixed into the demolition debris layer, in conjunction with a flow boundary behind the channel bulkhead and contribution of water from the former concrete washout impoundment. The former impoundment curved between AW-3 and AW-5, as shown on Figure 3. The locations of bulkheads that serve as flow boundaries are depicted on Figures 7 and 8.

Based upon AMEC's groundwater gradient contouring, it appears groundwater consistently flows south to southwest, beneath the north end of the site, at a gradient of up to 2 percent. The existing bulkhead appears to act as a barrier to flow, as evidenced by the compression of groundwater contours at the northwest corner of the site. Furthermore, wells in the vicinity of the bulkhead (AW-3, AW-4 and AW-8) exhibit greater variance with measured lake levels, than wells located remotely from the bulkhead (AW-2, AW-6, AW-7, AW-10, AW-11, AW-12, and AW-13). The groundwater gradient appears to be relatively flat beneath the southern two-thirds of the site, where the former lakebed was filled. Minor mounding of groundwater conditions is evident seasonally beneath the southwest portion of the site, where a higher proportion of concrete washout is encountered in the demolition fill.

Groundwater gradients inferred from measurements obtained on December 22, 1997 are presented on Figure 7 and correspond to seasonal low lake levels. Groundwater gradients inferred from measurements obtained on March 26 and 27, 2001 are presented on Figure 8 and correspond to seasonal high lake levels.

4.4.2 Sources of Groundwater Recharge

The principal sources of groundwater recharge at the site are the adjacent lake and river. Other than the bulkheads along the inner navigation channel, no geologic or hydrologic barriers to surface water or groundwater flow are evident along the shoreline of the site. Secondary sources of recharge include precipitation and infiltration.

Some precipitation at upgradient urbanized areas north of the site infiltrates the recessional sand and gravel soils, and migrates south beneath the north end of the site. Because of the granular and relatively pervious nature of site soils, groundwater that migrates onto the northwest end of the site quickly equilibrates with the adjacent lake levels. Along the east margin of the site, the gradient transition occurs much more slowly, and infiltration from up-gradient off-site sources appears to play a slight role in groundwater recharge on-site.

Under existing conditions, infiltration acts as a component of groundwater recharge. The exposed soil layer shows varying permeabilities through to the groundwater table. Visual observations of ponding areas before, during, and after rainfall events support the mechanisms of both overland flow and infiltration.

The overall contribution of infiltration from the site to Lake Washington and the Sammamish River is very small when compared to other sources. The contribution to the Sammamish River is not distinguished from the lake for the purposes of this discussion because the lower 2,000 feet of the river is virtually equilibrated with Lake Washington. Lake Washington occupies a drainage area of approximately 302,000 acres and receives 84% of its recharge from the Cedar River and Sammamish River drainage basins. The balance (16%) of recharge to Lake Washington originates within the 302,000-acre drainage area. (BEAK, 1996). The maximum theoretical contribution from combined overland flow (and infiltration from the site to Lake Washington) is fifteen-thousandths of one percent (0.00015%) of the Lake Washington drainage or area two-ten thousandths of one percent (0.000024%) of the recharge volume from the three drainage basins combined. Infiltration alone would constitute a divided proportion of the two-ten thousandths of one percent.

4.4.3 Areas of Groundwater Discharge

The shoreline is the discharge location for all groundwater flows. Shoreline discharge appears to be slightly inhibited behind the existing bulkheads of the inner navigation channel, based upon historic groundwater level measurements. Discharge to surface water is concentrated outside of the landfilled portion of the site at the north end of the Kenmore Navigation Channel, where groundwater elevations in the native sands and gravels drop rapidly to equilibrate with the adjacent lake level. Existing controls on the level of Lake Washington influence the rate of groundwater discharge from season to season. The net rate of discharge is expected to slow, between March 1 and May 1 annually as the lake level rises from Elevation 16.5 to 18.4 feet. Conversely, the rate of discharge is expected to increase annually between October 1 and December 1 as the lake level is dropped from Elevation 18.4 to 16.5 feet. No other variations in subsurface geology or fluctuations in seasonal groundwater were encountered that would suggest that groundwater discharge is concentrated along any particular stretch of the undeveloped lake or river shoreline.

4.4.4 Groundwater Quality and Hazardous Substances

The likely source of area groundwater contamination at the site appears to be the demolition fill that extends below the groundwater table. Detailed information about specific sources of groundwater contamination, the nature of contaminants in groundwater, and the quality of groundwater at the site are discussed in Section 8.0 of this report.

4.4.5 Hydraulic Conductivity

As part of this Remedial Investigation, hydraulic conductivity testing was performed on monitoring well AW-13 installed in November 1997 near the northeast corner of the site. The conductivity tests involved removing water in the monitoring well and monitoring the rate at which groundwater recharges the well. Based on recharge rate measurements, hydraulic conductivity values were calculated for the upper geologic formation by utilizing recharge rate and field measurements in Bouwer and Rice's modified version of the Thiem equation:

$K=Rc^2 \ln (Re/rw)/2Le \ \ (1/t \ln y_o/y_t)$

Where:		
	K = hydraulic conductivity (permeability)	Rc= radius of the well
	Re = equivalent radius	rw = radius of the boring
	Le = length of the saturated screen interval	t = time interval
	y_o = initial water level	y_t = water level at time (t)

For partially penetrating test wells:

$$\ln Re/rw =(1.1/\ln (Lw/rw) +A+B \ln ((H-Lw)/rw))/(Le/rw))^{-1}$$

Where:		
	H = depth of aquifer	A & B = dimension-less parameters
	Lw = water table	

Based upon the recharge rate and field measurements, Bower and Rice's equation indicates that the hydraulic conductivity (K) in the vicinity of AW-13 is approximately $6x10^{-3}$ cm/sec. However, this conductivity test is limited in scope and provides only a rough estimate of hydraulic conductivity rates at this location. This value should not be assumed to be a definitive measurement of hydraulic conductivity values at the site.

In addition to the hydraulic conductivity tests performed on AW-13, groundwater recharge measurements were also attempted in monitoring well AW-12. However, maximum groundwater removal rates of approximately 10 gallons per minute (gpm) were unsuccessful in drawing the groundwater level in the well more than one foot below static levels. This measurement indicates that hydraulic conductivity values in the vicinity of monitoring well AW-12 were relatively high compared to conductivity estimates obtained for AW-13.

Based on the results of the attempted drawdown test, a rough estimate of the hydraulic conductivity at AW-12 was calculated using the Thiem equation.

$Q=2BKLe \ y/\ln(Re/rw)$

Where:		
	Q = flow of water out of the well	K = hydraulic conductivity (permeability)
	Le = length of screened section of well	y = water level
	Re = equivalent radius	rw = radius of boring

Solving for K, this method indicated an approximate hydraulic conductivity value in the vicinity of monitoring well AW-12 of 1×10^{-2} cm/sec. This conductivity test is also limited in scope and provides only a rough estimate of hydraulic conductivity rates at this location. This value should not be assumed to be a definitive measurement of hydraulic conductivity values at the site. The elevated hydraulic conductivity value that was observed in well AW-12 is attributed to its installation in fill material, and to the proximity of the Sammamish River, approximately 60 feet away.

4.4.6 Public and Private Production Wells

AMEC reviewed the water well records at the Washington Department of Ecology Northwest Regional Office. The review found no public or private production wells in the vicinity of the site, using a search radius of one mile.

5.0 AIR AND LANDFILL GAS

No air quality sampling was performed as part of this Remedial Investigation. The results of air quality analysis performed in 1989 are presented in the Northshore Community Plan Update Draft Environmental Impact Statement, and form the basis for discussion in the Lakepointe Mixed Use Master Plan Draft Preliminary Supplemental Environmental Impact Statement (PDSEIS) dated August 1997. According to the referenced documents, the most significant air quality pollutants in the vicinity of the site are particulate matter and carbon monoxide from vehicular traffic on NE Bothell Way and 68th Avenue NE. Winter wood smoke emissions from residential sources posed the greatest particulate air quality concern in 1989. The PDSEIS report concluded that on-site truck traffic was considered to be an insignificant source of carbon monoxide, and that "some level of airborne particulate matter" is likely generated by light industrial operations on site.

Waste roofing debris was stockpiled by a former tenant in the south-central portion of the site between 1994 and 1996. The roofing waste potentially contains non-friable, asbestos-containing building materials. Approximately 10,000 cubic yards of the roofing waste was collected and disposed at a permitted disposal facility in Arlington, Oregon, after the former tenant quit business. Non-friable asbestos-containing building materials do not pose an air quality hazard in their existing form to the general public or to site employees. PSAPCA issued a final disposition letter on 26 February 1998, indicating that no further action was necessary regarding this material. A copy of PSAPCA's letter is included in Appendix F.

Landfill gas exists in the subsurface due to on-going decomposition of the underlying peat soils and demolition debris, as documented in AMEC's Preliminary Landfill Gas Survey report dated 5 December 1996. The preliminary survey was performed on two days in August 1996. The survey indicated that a typical landfill gas mixture existed in the vadose zone of interior site wells, and that oxygen mixing occurs within 100 to 200 feet of the shoreline, but not behind existing bulkheads. The landfill gas mixture consists principally of methane with some hydrogen sulfide, and characteristic high ratios of carbon dioxide to oxygen concentrations. No positive or negative pressures were measured in the twelve wells surveyed at the site, indicating that the gases were in equilibrium with ambient barometric pressures. To AMEC's knowledge, no landfill gas accumulations have been reported in any of the existing buildings on site, and none are suspected. However, a Landfill Gas Management Plan will be prepared as a requirement of cleanup action and development.

6.0 LAND USE AND HUMAN POPULATION EXPOSURE

Kenmore Industrial Park is located in the City of Kenmore. The current land use is industrial, with dense commercial development concentrated along the Bothell Way NE corridor adjacent to the north. The greater surrounding area is generally suburban residential. The proposed land use zoning is regional business with P-suffix conditions (RB-P) for the site. The proposed development and zoning are described in the Lakepointe Mixed Use Master Plan Preliminary Draft Supplemental Environmental Impact Statement, dated November 1997.

Human populations that are potentially exposed to hazardous substances at the site are operator employees, site visitors and trespassers; however, these people generally do not have access to the subsurface at the property. The operation of heavy equipment on site has generally resulted in the maintenance and compaction of the soil cover that overlies and separates the demolition debris from the surface. The highest risk of exposure to contaminants would be faced by an employee conducting excavation operations on the site. Slightly elevated levels of diesel- and oil-range total petroleum hydrocarbons (TPH) exist on the ground surface, attributed to heavy equipment operation and truck traffic on-site. The risks faced by employees working above the surface of the site, however, are no greater than at other sites with heavy equipment and truck traffic. Physical hazards posed by heavy equipment and truck traffic, and standard light industrial operations, likely pose a far greater hazard to site employees and visitors than exposure to hazardous substances.

The site is fenced, controlling access by the general public but trespassers may access the vegetated shoreline from Lake Washington or the Sammamish River. None of the ecological studies reviewed for this report identified any obvious hazardous substance exposure issues at the shoreline and vegetation growth appears vigorous.

The site is serviced by municipal drinking water supply, and no private or public drinking water wells are documented within a one-mile radius of the site. Therefore, the groundwater does not pose a hazard to the human population via ingestion of drinking water.

7.0 NATURAL RESOURCES AND ECOLOGY

The site is generally surrounded on the south by the Sammamish River and to the west by Lake Washington both of which constitute the most sensitive ecological receptor in the vicinity of the site. The Lakepointe Technical Report on Natural Resources by Beak Consultants Inc. (Beak, 1997) identified numerous species of birds and fish that are dependent on both the upland ecosystem (generally located within 45 feet of the shoreline) and the aquatic ecosystem (located offshore surrounding the site). Two wetland ecosystems (Class 2) were also identified by Beak Consultants in the southeast corner and west side of the site. Both wetlands were determined to be of overall low habitat value.

The near shore upland forest habitat, according to Beak Consultants, Inc. (Beak), may contain trees suitable for bald eagle nesting. The shoreline ecosystem appears to have conditions conducive to heron-feeding habitat. Herons have been observed feeding in the vicinity of the site and Canadian geese nest on the site. Although no bald eagle nesting has been observed on the site, Beak recommends that cottonwood trees greater in diameter than 20 inches, and conifers greater than 28-inches in diameter, within 250 feet of the Lake Washington and Sammamish River remain at the site (according to the Washington Department of Fish and Wildlife Bald Eagle Management Plan). Although numerous wildlife and plant populations were identified in the upland bank and offshore ecosystems, past development and use of the site interior has restricted wildlife habitat.

The offshore aquatic ecosystems adjacent to the south and west of the site provide spawning and rearing habitat for both anadromous and warm water fish species. Beak's technical report indicates the fisheries systems in the vicinity of the project site are currently stable. The inner harbor of the navigation channel is dominated by warm-water fish species, and provides poor salmonid habitat principally due to warmer temperatures, excess lighting and limited shading, and the presence of predatory fish species. Beak noted that the western lake shoreline appears to provide temporary staging habitat for rearing salmonids. Beak concluded that the Sammamish River principally serves as a salmonid migration route, but is otherwise too warm for permanent salmonid habitat.

The shoreline materials beneath the inner harbor of the navigation harbor are observed to consist of non-native materials (fill), with numerous timber-driven piles. Wood chips were identified by SAIC during PSSDA sediment characterization activities. Beak observed that the lake and river shorelines were underlain by root masses and wooden timbers, along with concrete rubble and tires. Beak's technical report indicates that the principal habitat limitations are posed by physical constraints, elevated surface water temperatures, and invasion of non-native plant species.

8.0 NATURE AND EXTENT OF HAZARDOUS SUBSTANCES

This chapter discusses the analytical and sampling methodologies used for purposes of the RI, the nature and extent of hazardous substances, and the likely sources of contaminants at the site. The information presented is a synthesis of data requested by Ecology and collected expressly for this remedial investigation and, to a lesser extent, data from earlier investigations. This discussion relies primarily on the data requested by Ecology and collected for this RI. However, prior investigation data is included where helpful to fill data gaps and where such data is acceptable for consideration based upon the data quality evaluation.

Potential sources of hazardous substances at the site include the subsurface demolition debris landfill and industrial activities at the surface. Based on the historic land use activities documented or suspected at the site, and on the contaminants of concern and management areas identified in Ecology's 1992 SHA, soil and groundwater at the site have been analyzed for five categories of hazardous substances:

- Total Petroleum Hydrocarbons (TPH)
- Metals
- Polychlorinated Biphenyls (PCBs)
- Volatile Organic Compounds (VOCs)
- Semi-Volatile Organic Compounds (SVOCs)

The following sections of this report discuss the results for each of these categories. Soil analytical test results for these hazardous substance categories are presented in Tables 3-6A, 3-6B, and 3-6C. Groundwater analytical test results are presented in Tables 3-5A, 3-5B, 3-5C, and 3-5D (with groundwater results subject to data qualifications as presented in those tables). Sampling and analytical method qualifications (e.g. method detection limits, data reliability, etc.) for all analytical data sets referenced in this report are summarized in Table 3-2.

8.1 Analytical and Sampling Methodologies and Dataset Qualifications for Groundwater Samples

Different analytical and sampling methodologies have been employed during different sampling events by different consultants to compare the effect of turbidity on TPH and metals concentrations, and to determine whether the organic matrix of the demolition debris fill or underlying peat soils interferes with and exaggerates the reported TPH concentrations. Table 3-2, Summary of Analytical Datasets and Qualifications, identifies acceptable (of general overall good quality) and unacceptable (poor quality) analytical data referenced in this RI report. The conclusions of this RI/FS report are based on acceptable data only. Gasoline and volatile compounds were not included in later sampling rounds due to the low concentrations at which they were originally detected and because they were presumed to be less influenced by sample turbidity than TPH and metals. Diesel, oil, and metals were included in later sampling rounds in part to study their variability in concentration, relative to sample turbidity.

With respect to metals data, in general, total (unfiltered) analyte concentrations from low-flow sampling techniques are considered to be representative of subsurface groundwater conditions and appropriate for comparison to state groundwater cleanup levels WAC 173-340-720(8)(a). In accordance with WAC 173-340-720(8) and WAC 173-340-730(7), however, dissolved-phase (filtered) concentrations are appropriate where a filtered sample provides a more representative measure of groundwater or surface water quality. WAC 173-340-720(8) states that Ecology expects that filtering will generally be acceptable for inorganic substances where low turbidity samples cannot be obtained or natural background concentrations in aquifer materials prevent representative samples of groundwater quality. WAC 173-340-730(7) further provides that when cleanup levels are based on requirements specified in applicable state and federal laws, the procedures for evaluating compliance that are specified in those requirements shall be utilized to evaluate compliance. Therefore, dissolved-phased concentrations are appropriate for comparison with high turbidity inorganic samples, non-representative samples impacted by natural background concentrations, and comparison of metal sampling results with applicable state and federal law surface water metals criteria with dissolved phase standards. For purposes of this RI/FS, dissolved-phase (filtered) concentrations are used where filtered samples provide a more representative measure of groundwater or surface water quality and where cleanup levels are based on dissolved-phase standards specified in applicable state and federal laws.

The varying methodologies and data quality are outlined below and summarized in Table 3-2:

- **December 1990** - Seven wells were installed and sampled by bailing without development or purging, resulting in significantly elevated total metals concentrations. At that time, the TPH detection limit was 5,000 μg/L, five times the MTCA Method A cleanup standard, and no TPH was detected. This data is of poor quality.

- **December 1991** - Three of the seven wells were sampled by bailing, and samples were field-filtered to determine dissolved metals concentrations. No elevated metals concentrations were detected. However, no total metals determinations were made for comparison. Although this data is only of fair quality, the dissolved metals concentrations are appropriate for comparison to MTCA surface water cleanup levels.

- **October 1995 and February 1996** - Eleven new wells were installed by February 1996. The eleven new wells and one of the original seven wells (twelve total) were sampled by bailing. The February 1996 event resulted in significantly elevated TPH concentrations and total metals concentrations, associated with elevated turbidity. Soil analytical test data is of generally overall good quality. Groundwater analytical test data is of poor quality.

- **April 1996** - The same twelve wells were micropurged to obtain non-turbid samples. Samples were submitted for standard WTPH methodology as well as Draft TPH Method silica gel cleanup, and for both total and dissolved metals. Groundwater analytical test data is of generally overall good quality.

- **August 1996** - The same twelve wells were micropurged and then bailed to obtain samples for turbid total, non-turbid total, and dissolved (field-filtered) WTPH and metals analyses. Groundwater analytical test data is of generally overall good quality.

- **September 1998** - Well AW-10 was micropurged and sampled for dissolved lead content on 29 September 1998. Groundwater analytical test data is of generally overall good quality.

- **January 2001** - Wells AW-3, AW-6, AW-11, and AW-12 were micropurged and sampled for total metals, VOCs, PAHs, TPH and SVOCs on January 19 and 22, 2001. Groundwater analytical test data is of generally overall good quality.

- **March 2001** - Wells AW-6, AW-11, and AW-12 were micropurged and sampled for total and dissolved metals, VOCs, PAHs, TPH and SVOCs on March 26 and 27, 2001. Groundwater analytical test data is of generally overall good quality.

  Additionally, on March 27, 2001, a single surface water sample was collected from 1 foot below the water surface at a near shore location adjacent to well AW-12. The sample was analyzed for dissolved arsenic. The surface water analytical data is of generally overall good quality.

- **May 2001** – Wells AW-6, AW-11, and AW-12 were micropurged and resampled for hardness on May 18, 2001. Groundwater analytical test data is of generally good quality.

8.2 Total Petroleum Hydrocarbons in Soil and Groundwater

8.2.1 Gasoline

No gasoline-range TPH and associated benzene, toluene, ethylbenzene, and/or total xylene (BTEX) compounds were detected in any groundwater samples above either the applicable residential or industrial MTCA regulatory cleanup levels for groundwater based on protection of surface water (Tables 3-5A, 3-5C, and 3-5D).

No gasoline-range TPH or BTEX compounds have been detected in the soil or demolition debris samples that have been collected from the site (Table 3-6A). Eight soil samples collected from established management areas and eight samples collected randomly across the site did not demonstrate detectable concentrations of gasoline or BTEX constituents. Furthermore, field-screening of an estimated 300 soil samples obtained from 58 exploration locations both within management areas as well as randomly across the site, including two test pits excavated at the site of former ASTs (TP-4 and TP-6), encountered no soil samples demonstrating detectable volatile emissions using a photo-ionization detector. Of three samples that demonstrated a petroleum odor, a greasy coating was visible on wood debris obtained from TP-2, TP-3, and TP-4, situated within the original, distributive haul road for the landfilled peninsula. However, wood products were not selected for TPH analyses except when soil samples were unrecoverable from drilled exploration locations. Based upon the results of field-screening, additional gasoline analyses were deemed unwarranted.

8.2.2 Diesel and Heavy Oil

Diesel-range TPH was not detected at the method reporting limit (250 μg/L) in any micropurged groundwater samples, except at wells B-102 and AW-3 where diesel-range TPH was detected at 390 µg/L and 1070 µg/L (without silica gel clean-up) (Tables 3-5A, 3-5C, and 3-5D). Heavy oil-range TPH was not detected at the method reporting limit (<750 μg/L) in any micropurged groundwater samples, except at well B-102 where heavy oil range TPH was detected at 360 μg/L (Tables 3-5A, 3-5C, and 3-5D). The MTCA residential and industrial cleanup level for diesel and heavy oil range TPH in groundwater is 1,000 μg/L. The use of the Draft TPH Method silica gel cleanup procedure (to eliminate natural hydrocarbons from groundwater samples) resulted in no petroleum hydrocarbon detections above the applicable MTCA cleanup level for groundwater.

Diesel-range TPH concentrations in soil samples ranged from non-detect (at 10.0 mg/kg) to 362 mg/kg (Table 3-6A). Heavy oil-range TPH concentrations in soil samples ranged from non-detect (at 25.0 mg/kg) to 2530 mg/kg (Table 3-6A). TPH was either undetected, or detected below the MTCA cleanup standard for soil in a sample collected by Ecology from a stockpile of soils dredged in 1992 from the Kenmore Navigation Channel by a site tenant, Waterfront Construction. The MTCA Method A residential and industrial cleanup level for both diesel and oil range TPH is 200 mg/kg in soil. Soil TPH at the site exceeds MTCA cleanup levels throughout the landfill area of the site.

8.3 Metals

Analyses were performed for the eight RCRA metals: arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver. Soil and groundwater samples collected from wells AW-3 AW-6, AW-11, AW-12 and AW-13 near the southwest corner of the property were also analyzed for tin and zinc. One surface water sample was analyzed for copper by Ecology in 1992. Due to groundwater turbidity, only micropurged samples from the groundwater investigations are considered good quality (Table 3-2).

Dissolved and total copper, lead, mercury, selenium, silver, tin and zinc concentrations were below applicable MTCA groundwater cleanup levels (based on protection of surface water) for representative groundwater samples (Tables 3-5B, 3-5C, 3-5D and Figure 10).

Arsenic, cadmium, chromium, mercury, silver, tin and zinc concentrations were below the applicable MTCA residential and industrial cleanup levels for soil (Table 3-6B and Figure 10).

8.3.1 Arsenic

Total arsenic concentrations in groundwater ranged from non-detect (at 4 μg/L) to 115 μg /L in upland interior groundwater well (AW-8). The most recent total arsenic data collected from all of the existing shoreline compliance wells (AW-6, AW-11, and AW-12) in January and March 2001 ranged from non-detect to 4.75 μg/L. The detection limit was 1.0 μg/L.

The natural background concentration for arsenic in groundwater in the State of Washington and the MTCA Method A cleanup level for groundwater arsenic are both 5 μg/L. The total arsenic data from the existing shoreline wells (January and March 2001) are below natural background and the MTCA Method A cleanup level.

Soil samples analyzed for arsenic had concentrations that ranged from 1.2 to 7.7 mg/kg (Table 3-6B). Arsenic was not detected using the Toxicity Characteristic Leaching Procedure (TCLP). The natural background soil value for arsenic in the Puget Sound region is 7 mg/kg (Ecology Publication 94-115). The MTCA Method A industrial cleanup level is 200 mg/kg and the residential cleanup level is 20 mg/kg. Soil arsenic data from the site is consistent with natural background levels and below MTCA Method A residential and industrial cleanup levels.

8.3.2 Barium

Total barium concentrations in groundwater ranged from non-detect (at 10 μg/L) to 1090 μg/L (Tables 3-5B, 3-5C, and 3-5D). The most recent total barium data collected from the existing shoreline compliance wells (AW-6, AW-11, and AW-12) in January and March 2001 ranged from 68.9 μg/L to 889 μg/L. The MTCA groundwater cleanup level (based on protection of surface water) for barium is 1,000 μg/L. Groundwater barium concentrations were below the applicable cleanup level for all site wells, except two samples collected in 1996. Based on the most recent data, barium concentrations at all of the existing shoreline compliance wells are below the applicable groundwater cleanup level.

Barium concentrations in the soil and wood samples collected from the borings range from 22 to 441 mg/kg (Table 3-6B). The MTCA residential and industrial soil cleanup levels for barium are 100 mg/kg in soil. Barium was detected above the applicable cleanup level in three soil samples.

8.3.3 Lead

Dissolved-phase lead concentrations in groundwater ranged from non-detect (at 1 μg/L) to 13 μg/L (Tables 3-5B, 3-5C, and 3-5D). The most recent lead data collected from the existing shoreline compliance wells (AW-6, AW-11, and AW-12) in March 2001 ranged from non- detect (at 1 μg/L) to 2.12 μg/L. The MTCA groundwater cleanup level for lead is based on protection of surface water and derived from a hardness dependent formula for dissolved phase lead in WAC 173-201A-040. Hardness data collected from site groundwater wells in May 2001 ranged from 524 to 737 mg. eq./L (Table 3-5E). Based on a hardness of 524 mg. eq./L (the most conservative value), the formula based cleanup level is 14.4 μg/L (dissolved-phase).

Groundwater lead concentrations are below the applicable cleanup level for all site interior and shoreline wells.

Lead values in site soil samples range from 10 to 1,510 mg/kg (Table 3-6B). Only two of the soil samples (from borings AW-3 and AW-5) and one wood sample (from boring AW-7) exceed the MTCA Method A residential cleanup level for soil of 250.0 mg/kg. Only one soil sample (from boring AW-5) exceeds the MTCA Method A industrial cleanup level for soil of 1,000.0 mg/kg.

8.3.4 Selenium

Dissolved-phase selenium concentrations in groundwater were found to be all non-detect (at 1 μg/L to 10 μg/L; Tables 3-5B, 3-5C, and 3-5D). The most recent dissolved and total selenium data collected from the existing shoreline compliance wells (AW-6, AW-11, and AW-12) in January and March 2001 was also non-detect at the ranges listed above. The MTCA groundwater cleanup level for selenium is based on protection of surface water (WAC 173-201A-040). Groundwater selenium concentrations are below the applicable cleanup level for all site interior and shoreline wells.

Selenium values in site soil samples range from non-detect <0.5 mg/kg to 0.6 mg/kg (Table 3-6B). Only two of the soil samples (from test pits TP-13 and TP 15) slightly exceed the MTCA Method B residential and the MTCA Method C industrial cleanup level for soil of 0.5 mg/kg.

8.4 Polychlorinated Biphenyls

Polychlorinated biphenyls (PCBs) have not been detected in any good quality data from groundwater at the site (Table 3-5A).

Soil sampling by Ecology in 1992 did not detect PCBs in soils at the site. Soil samples collected by AMEC in 1995 were well below the MTCA Method A residential cleanup level of 1.0 mg/kg for soil and the industrial cleanup level of 10.0 mg/kg for PCBs. A single wood sample collected by AMEC and representative of the demolition debris contained PCBs at 2.4 mg/kg, slightly above the MTCA Method A residential cleanup level, but below the MTCA Method A industrial cleanup level of 10 mg/kg.

The trace levels of PCBs encountered in site soils are not considered to constitute a threat of groundwater contamination due to the relative insolubility and high soil adsorption factor and binding capability to wood of PCB molecules. No evidence to date indicates that any sources of PCB contamination exist at the site that are likely to adversely affect the adjacent surface water. No PCBs have been detected in groundwater at the site in the vicinity of the locations where PCBs were detected in soil or wood, and no PCBs have been detected in groundwater at any other site locations.

8.5 Volatile Organic Compounds

At Ecology's request, volatile organic compound (VOC) analyses were performed on groundwater samples collected from the shoreline compliance monitoring wells AW-6, AW-11, and AW-12 in January and March 2001, additionally, samples were collected from wells AW-3 and AW-13. Based on the recent sampling, groundwater VOC concentrations at the shoreline compliance wells are all below the applicable reporting limits with the exception of the following compounds: carbon disulfide and chlorobenzene (Tables 3-5A, 3-5C, and 3-5D). Carbon disulfide was detected at 0.509 μg/L and 3.47 μg/L, well below the MTCA Method B cleanup level for groundwater of 800 μg/L (CLARK II February 1996). Chlorobenzene was detected at 0.768 μg/L I and 0.826 μg/L, well below the MTCA cleanup level of 680 μg/L based on protection of surface water. Ecology sampling in 1992 detected acetone at 8.7 μg/L in a surface water impoundment, well below the MTCA Method B groundwater level of 800 μg/L.

Various volatile organic compounds were detected at site interior well AW-3. All compounds were found to be below applicable MTCA cleanup levels (Tables 3-5C and 3-5D).

VOCs were not detected in any soil samples submitted for analysis (Table 3-6A).

8.6 Semi-Volatile Organic Compounds

At Ecology's request, semi-volatile organic compound (SVOC) concentrations were analyzed in groundwater samples collected in January and March 2001 from monitoring wells AW-3, AW-6, AW-11, AW-12, and AW-13 (Tables 3-5C and 3-5D). No SVOCs were detected in any groundwater samples submitted for analysis from the shoreline compliance wells.

Additional samples were collected for wells AW-3 and AW-13 in January and March 2001. Semi-volatile compounds were detected in groundwater from site interior well AW-3. However, these compounds were found to be at levels below applicable MTCA cleanup levels (Tables 3-5C and 3-5D).

SVOC's were not detected in any soil samples submitted for analysis.

8.7 Hazardous Substance Sources.

Hazardous substance source areas include the demolition debris, native and fill soils, and natural background conditions. Hazardous substance concentrations have been shown to vary across the site, but are typically found at concentrations below applicable cleanup levels. A comparison of the upgradient and potential source areas are discussed below.

Upgradient well AW-9 was installed in native granular soils upslope from the landfilled portion of the site. Groundwater quality in well AW-9 was characterized by the following conditions:

- No diesel- or heavy oil-range TPH was detected.

- Gasoline was undetected at 50 μg/L, and BTEX constituents were undetected at 0.5 μg/L.

- Total lead was undetected at 2 μg/L. Total arsenic and selenium were each undetected at 5 μg/L. Up to 10 μg/L total barium has been detected.

- No PCBs were detected.

Gasoline and Lead Sources

Low levels of gasoline, below MTCA cleanup levels, have been detected in groundwater beneath the southwest portion of the site. Review of gasoline chromatographs of groundwater samples indicated that detected gasoline was relatively fresh and estimated to be less than ten years old. This interpretation is based on the detection of BTEX compounds that weather more rapidly. It appears that the main source of the trace levels of gasoline in the groundwater originate from the area of the former impoundment, not the former stockpiles of petroleum-contaminated soils situated at the surface between the current sites of AW-2 and AW-7. No evidence of elevated volatile compounds in the soil or demolition debris were detected during field-screening of samples collected during excavation of 20 test pits and the advancement of 39 test borings at the site. No correlation is observed between lead detections and gasoline detections. Therefore, lead concentrations in the groundwater are attributed to the demolition debris.

Arsenic Sources

Arsenic concentrations in native and fill soils are consistent with Puget Sound natural background levels of 7 mg/kg (Ecology Publication 94-115). Arsenic concentrations in surface water are consistent with background levels (1-2 μg/L) documented by King County (personal communication with J. Frudge, King County Department of Natural Resources).

Barium Sources

The source of barium in the soil is not known. Barium in the soil is not interpreted to pose a source of groundwater contamination.

Selenium Sources

The source of selenium in the soil is not known. Selenium in the soil is not interpreted to pose a source of groundwater contamination.

PCB Sources

One wood sample (AW-7, 2.4 mg/kg) exceeded the MTCA residential cleanup level of 1.0 mg/kg. The sample concentration was below the industrial cleanup level of 10 mg/kg. The sample consisted of wood fragments from the demolition debris. The source of PCBs in the wood sample is not known. The hydrophobic properties of PCB compounds result in preferential partitioning to soil particles and other debris relative to water. Therefore, PCBs in wood or soil media are not interpreted to pose a source of groundwater contamination.

9.0 REGULATORY CLASSIFICATIONS

The federal Environmental Protection Agency issued No Further Action status to the site. However, the property currently remains a ranked, MTCA site under the state agency lead of the Washington State Department of Ecology. Ecology prepared a Site Hazard Assessment (SHA) report for the property dated 19 February 1992, as discussed previously in Section 3.2 of this report. The final site scoring, using the Washington Ranking Method (WARM), as outlined in Chapter 173-340, resulted in a ranking of 1 (highest rank) on the Site Hazard Assessment List (File TCP ID: N-17-5127-0000).

According to Beak Consultant's Final Technical Report on Natural Resources, the Sammamish River and Lake Washington are designated as Class AA or Lake Class waters under Chapter 173-201A WAC, and are also subject to the federal Clean Water Act. The shoreline wetlands mapped on the site are also subject to Class AA criteria. The land and shoreline uses are subject to regulation under Washington State's Growth Management Act (1990).

No regulatory classifications of air or groundwater at the site are known. According to information referenced in the EIS, the Kenmore Industrial Park is not situated within a designated Critical Aquifer Recharge Area, nor is the groundwater a drinking water source.

10.0 EXPOSURE PATHWAYS

This section of the Remedial Investigation discusses potential hazardous substance pathways to environmental receptors and human exposure routes. Based upon site characteristics, there are four potential hazardous substance migration paths at the site that could facilitate contaminant exposure to environmental and human receptors. The four potential exposure pathways or mechanisms include transport of contaminants by wind, surface water, groundwater, and direct or indirect contact. An Exposure Pathway Flow Chart is shown in Figure 12.

In consultation with Ecology, no formal risk assessment was performed as part of this Remedial Investigation given the focused nature of the RI and the routine nature of the cleanup (WAC 173-340-130(5)-(7)).

10.1 Wind Transport

Aeolian forces, or wind, may result in the mobilization of contaminants from the site. Environmental receptors exposed to the contaminants from the site via this pathway would be dependent on the wind direction, force and distance. Ultimately, wind forces require specific conditions to be considered as a pathway to receptors.

These conditions include the excavation and exposure of the contaminated soil media to the surface environment, dry or dusty soil conditions, strong surficial winds, and wind direction. The contaminants that are capable of evaporating and mobilizing under ambient weather conditions are limited to the subsurface environment and the very small area of exposed soil (less than 20% of the site area, see Figure 11). Therefore, this potential pathway does not represent a significant threat to environmental or human receptors in the vicinity of the site, except during excavation. A map showing the limits of exposed soil areas, vegetated, paved, and graveled surfaces is attached as Figure 11.

The generation of landfill gas emissions from the decomposition of organic peat soils and demolition debris underlying the site could also lead to wind transported natural methane and landfill gases. However, natural methane and landfill gas emissions appear to accumulate and disperse slowly by diffusion, as evidenced by the lack of measurable pressure accumulation in the site monitoring wells.

10.2 Surface Water Transport

Transport of contaminants by the movement of surface water or overland flow is another potential pathway. This pathway would require that the contaminated soil or media be present at the surface and that surface waters exhibit strong erosion forces capable of exposing, eroding and transporting the contaminated media to the nearest environmental receptor, such as the Sammamish River or Lake Washington.

Under existing industrial conditions, surface water runoff is conveyed to a single storm discharge point at the head of the navigation channel. With the exception of low levels of oil-range TPH in the cap soils (attributed to surface vehicular traffic) the contaminated medium is limited to the subsurface environment. The surface water pathway does not represent a significant threat to environmental or human receptors in the vicinity of the site.

10.3 Groundwater Transport

Another pathway with the potential to impact environmental or human receptors in the vicinity of the site is the subsurface migration of groundwater. Groundwater flows through the contaminated media and has the potential to mobilize contaminants originating at the site and transport them toward environmental and human receptors. The groundwater is not a drinking water source. Site groundwater flows to Lake Washington, which is also not a drinking water source.

Groundwater migration rates or groundwater velocities are a function of the hydraulic conductivity of the formation, soil porosity and the groundwater gradient. Hydraulic conductivity for the formation in the vicinity of AW-13 was calculated as approximately $6x10^{-3}$ cm/sec and the groundwater gradient on 22 December 1997 (low lake level) was measured as approximately 0.0043 ft/ft. Porosity of the subsurface media was conservatively estimated as 30 percent, based upon the observed wood content. Based upon these estimates and measurements, groundwater velocity in the vicinity of monitoring well AW-13 was calculated to be approximately $8x10^{-5}$ cm/sec or approximately 82.8 ft/yr, following the down-gradient direction between wells AW-13 and AW-10. This represents a high calculated groundwater flow at low lake level start. However, groundwater velocities at other areas on-site may be significantly different than those estimated at AW-13. Assuming this value is representative of average site conditions, it is estimated it would require approximately 3 years for a soluble, conservative contaminant originating in the vicinity of AW-13 to migrate to the Sammamish River, the nearest environmental receptor, via the southwesterly direction. During high lake levels, the groundwater velocity is reduced because the groundwater gradient between the upland portion of the site and the southern boundary (lake/river) is minimized.

10.4 Direct and Indirect Exposure

Direct exposure to hazardous materials at the site would be limited to human receptors that may come in close contact with the contaminated media. Potential routes of direct exposure would include inhalation of windborne particulates or landfill gases and dermal contact or ingestion of excavated fill materials or groundwater. An Exposure Pathway Flow Chart is shown in Figure 12.

Potential human receptors may include current and future workers and future residents. As the contaminated media present at the site are limited to the subsurface environment, except for surface TPH, the potential for exposure from direct contact would require excavation. The potential for direct human exposure is therefore considered low, except during earthwork activities, when a high potential would exist for inhalation and dermal contact.

Indirect contact occurs after a transport mechanism mobilizes contaminants to an environmental receptor where they are ingested or absorbed and human receptors consume the exposed receptors. For example, the bio-accumulation of contaminants in fish followed by fishery harvest may result in contaminated fish consumption by human receptors. As no commercial fishery exists in the vicinity of the site, the most likely human receptors risking indirect exposure would be recreational fishermen consuming fish caught in the vicinity of the site.

11.0 CONCLUSIONS

The conclusions of the Kenmore Industrial Park RI are summarized below:

- The southern two-thirds of the approximately 45-acre property consists of a peninsula reclaimed from Lake Washington in the late 1950s and early 1960s by landfilling with demolition debris. Fifty-eight exploration locations across the property encountered a relatively uniform, approximately fifteen-foot layer, of demolition debris in the reclaimed area. The main body of the peninsula is comprised of an estimated 800,000 to 1,000,000 cubic yards of the demolition debris fill capped with an estimated 200,000 cubic yards (over one foot) of soil cover.

- Groundwater is recharged by Lake Washington and the Sammamish River. A close correlation between groundwater and adjacent surface water elevations has been documented beneath the reclaimed portion of the property. Hydraulic conductivities in the demolition debris layer were calculated to range at two locations from $1x10^{-2}$ cm/sec near the river, to $6x10^{-3}$ cm/sec in the site interior. The groundwater flow rate beneath the site interior is estimated to be on the order of 80 feet per year.

- The use of the Draft TPH Method silica gel cleanup procedure that eliminates natural hydrocarbons from groundwater samples results in no petroleum hydrocarbon detections above the MTCA residential and industrial cleanup level for protection of surface water. Diesel and heavy-oil range TPH is present in the soil above residential and industrial cleanup levels at low levels throughout the landfilled areas of the site.

- All volatile organic compound (VOC) and semi-volatile organic compound (SVOC) concentrations are below applicable MTCA residential and industrial cleanup levels for protection of surface water at the existing shoreline monitoring wells and typically, not detected.

- Copper, mercury, selenium, silver, tin and zinc concentrations were below applicable MTCA groundwater cleanup levels for groundwater samples at the existing shoreline compliance wells.

- Arsenic, cadmium, chromium, mercury, silver, tin, and zinc concentrations were below the applicable MTCA residential and industrial cleanup levels for soil.

- Only two soil samples exceeded the MTCA Method A residential cleanup level for lead, and only one soil sample exceeded the MTCA industrial cleanup level. Lead concentrations from the existing shoreline compliance wells are below applicable MTCA cleanup levels.

- Barium in soil was detected above the applicable cleanup levels in three soil samples. Barium concentrations in groundwater from the existing shoreline compliance wells are below applicable cleanup levels.

- There are no exceedances of the MTCA Method A cleanup levels for arsenic in soils. Total arsenic concentrations in the groundwater are consistent with natural background concentrations and below applicable MTCA cleanup levels for protection of surface water at the existing shoreline monitoring wells.

- PCB detections in soil samples are below MTCA Method A residential and industrial cleanup levels with the exception of a single wood sample. PCBs are not present in the site groundwater. The potential is considered minimal for migration of trace levels of PCBs via the mobile media, groundwater, because of preferential partitions to soil particles and other debris relative to water. Therefore, PCBs are not considered to be a contaminant of concern at the site.

- Benzene, the compound for which the site was ranked highest priority for cleanup, is not a contaminant of concern at the site.

- The goal of a site Feasibility Study should focus on prevention of direct contact with fill soils, and the potential for groundwater contaminant impact on nearby surface waters.

SECTION II - FEASIBILITY STUDY

12.0 FEASIBILITY STUDY SUMMARY

The following section presents the results of the feasibility study (FS) performed for upland remedial action at the Kenmore Industrial Park in Kenmore, Washington. The purpose of the FS is to evaluate appropriate remedial actions that protect human health and the environment from hazardous substances present beneath the site. This evaluation is based upon contaminants of concern and potential exposure pathways and receptors identified in the RI (Section I), and includes development of cleanup levels and points of compliance for the affected media, evaluation of cleanup action technologies and actions, and thorough comparison between viable cleanup alternatives. The affected media are soil and groundwater (as a pathway to surface water). In accordance with the provisions of WAC 173-340-350(5), this FS focuses on four cleanup options.

Based upon the RI, the following contaminants of concern (COC) were selected for evaluation in this FS: oil- and diesel-range petroleum hydrocarbons (ORPH, DRPH), barium, arsenic, selenium, and lead in soil, and ORPH, DRPH, barium, arsenic, and lead in groundwater.

The approximately forty-five acre site is slated for mixed-use redevelopment, including residential use. Potential human exposure to the COCs in the landfilled portion of the site is limited to site workers performing excavation activities and landfill gasses. Groundwater in the vicinity of the site in not used for drinking water. Surrounding surface water bodies are not used as a drinking water resource. It is unlikely that groundwater at the site will ever be used as a drinking water source. The surrounding aquatic environment may potentially be exposed to COCs from the site conditions, should contaminants migrate off-site at chronic concentrations.

The surrounding freshwater surface waters are the closest environmental receptors to the site. Although groundwater at the site is not a drinking water source, groundwater can transport COCs leached from the soil to the adjacent surface waters. Therefore, to the extent established applicable levels exist, groundwater cleanup levels are based upon protection of surface water (with the exception of arsenic which is based on natural background levels).

In accordance with MTCA, compliance with the cleanup levels for the groundwater COCs will be determined at a conditional point of compliance. MTCA allows a conditional point of compliance "within the surface water as close as technically possible to the point or points where ground water flows into the surface water." WAC 173-340-720(6)(d). For this site, a conditional point of compliance is established at the shoreline. Groundwater COC concentrations will be monitored at the existing shoreline compliance monitoring wells AW-6, AW-11, and AW-12 and at a replacement well located at or near former well AW-10, (or similar replacements). These four shoreline wells are situated within the property boundary and within 100 feet of the lake and river shorelines. An estimate of attenuation between the monitoring wells and the shoreline may be considered in evaluating compliance with the TPH and lead cleanup levels, in accordance with a Compliance Monitoring Plan to be approved by Ecology, because the cleanup levels for these COCs are based on the protection of adjacent surface water. If the observed levels in these wells are below the cleanup levels, sampling at the point of entry into the surface water will not be necessary. Attenuation will not be considered for arsenic because the cleanup level is based on groundwater background concentrations.

The remedial action objectives (RAO) of proposed cleanup actions will be to:

1) Prevent human contact with COCs in the demolition debris, and

2) Reduce rainfall infiltration that might otherwise mobilize COCs above levels of concern to surrounding surface waters.

The six general remedial response actions reviewed are: no action, institutional controls, monitoring, various containment measures, disposal by excavation, and in situ treatment technologies. From these general actions, five process options were developed: no action, institutional controls, groundwater monitoring, containment by engineered containment cap, containment by permeable groundwater barrier. Various combinations of these process options were evaluated and developed into four viable cleanup action alternatives:

Alternative 1 - No Action
Alternative 2 - Institutional Controls and Monitoring
Alternative 3 - Engineered Low Permeability Cap across a Portion of the Site
Alternative 4 - Engineered Impermeable Cap with Permeable Groundwater Barrier

All alternatives, except no action, include institutional controls and compliance monitoring. In accordance with MTCA, each alternative was reviewed with respect to the following: protection of human health and the environment, compliance with cleanup levels, compliance with applicable state and federal laws, provision for compliance monitoring, short-term effectiveness, long-term effectiveness, permanent reduction of toxicity, mobility, and volume, ability to implement, cost, and provision for a reasonable restoration schedule.

Based upon the evaluation and comparison of the proposed cleanup alternatives, Alternative 3 is the recommended action. Major elements of Alternative 3 are listed below:

- Notices on the property deed to notify future owners of the presence of COCs under the property;
- A partial, engineered containment cap that limits human contact with the demolition debris and reduces infiltration through subsurface landfilled media , but that does not encroach on existing shoreline habitats;
- Consolidation of existing roofing debris away from the shoreline area to the site interior under the development footprint;
- Landfill gas management; and,
- Groundwater compliance monitoring.

The recommendation of Alternative 3 assumes that remediation will occur in conjunction with proposed redevelopment. However, if redevelopment is initiated, but is not completed to allow for commercial/residential use of the entire site, the recommended action would consist of implementation of Alternative 3 with respect to redeveloped areas and appropriate access restrictions and erosion controls for the portions of the site that remain industrial. If the entire site remains industrial, the recommended action is for institutional controls and monitoring appropriate for continued industrial use as provided for in Alternative 2. Alternative 2 provides for implementation of deed notices, access restrictions, erosion controls and groundwater monitoring appropriate for continued industrial use.

13.0 CLEANUP LEVELS AND REMEDIAL ACTION OBJECTIVES

This section presents the evaluation and selection of clean-up standards and remedial action objectives for the remedial action alternatives assessed for the property. In accordance with MTCA (WAC 173-340-700), this FS defines cleanup levels for each COC that was identified in the RI and determines locations where cleanup levels are to be attained (points of compliance).

Remedial action objectives (RAOs) define the end goal for site remediation and incorporate site-specific cleanup levels, points of compliance and other regulatory requirements which result in a successful site cleanup. The development of RAOs is accomplished by: 1) selecting COCs (Section 8); 2) defining potential current and future exposure pathways, receptors and reasonable maximum exposures (Section 10); 3) establishing cleanup levels and points of compliance (Section 13); 4) assessing additional regulatory requirements applicable to the site remedial action (Section 13.2) and; 5) presenting the RAOs based on evaluation of the above listed criteria (Section 14).

13.1 Development of Cleanup Levels and Points of Compliance

The development of cleanup levels and points of compliance depend upon the identification of potential exposure pathways, human and environmental receptors, and COCs for each medium affected, as described in WAC 173-340-700(2)(a). These factors were identified in the RI. The pathways and receptors at issue for this site consist of human exposure to COCs during excavation or construction activities and aquatic life exposure to COCs that may migrate into adjacent surface waters.

If development proceeds, COCs for the soil media are identified as oil- and diesel-range petroleum hydrocarbons (ORPH, DRPH), arsenic, barium, lead, and selenium. MTCA Method A residential cleanup levels are proposed for the soil media at the site, as explained in the following sections. COCs for the groundwater media are identified as ORPH, DRPH, arsenic, barium, and lead. MTCA cleanup levels for groundwater based on protecting surface water are proposed for the groundwater media.

If development does not proceed, COCs for the soil media are the same as under the redevelopment scenarios, however, MTCA Method A industrial cleanup levels are proposed for the soil media at the site, as explained in the following sections. COCs and cleanup levels for the groundwater media are the same as under the redevelopment scenarios.

13.1.1 MTCA.Cleanup levels

For assessing risk to human health, MTCA has established three methods used to determine compliance cleanup levels (CCLs) at sites undergoing remedial actions: Methods A, B and C:

- Method A is appropriate for sites undergoing routine cleanup actions that present a limited choice between a small number of reliable cleanup methods (i.e., a "routine action"), or that involve a relatively small number of hazardous substances are present. Method A incorporates numeric standards, derived from the Safe Drinking Water standards, water quality criteria, and conservative risk assessment calculations.

- Method B is the standard approach applicable to all sites and utilizes risk assessment to determine cleanup levels.

- Method C is the conditional method that may be employed where attainment of Methods A and B may be impossible to achieve, may cause greater environmental harm, or if the site can be classified as industrial. Method C levels are generally less conservative than the levels under the other two methods.

Sites may combine different methods for determining levels for different contaminants in accordance with method mixing guidelines. When using Method B, Method A cleanup levels may be used but not Method C cleanup levels (Ecology Publication #94-145). Moreover, MTCA regulation WAC 173-340-700(4)(d) provides that where natural background concentrations are greater than the cleanup level established by Methods A, B, or C, the cleanup level is set at the natural background concentration.

Cleanup of the site is proposed in conjunction with redevelopment for residential use. Method B is the standard method applicable to all sites and, therefore, is selected for the proposed cleanup at the site. In addition, where appropriate and available for specific contaminants, Method A standards and natural background concentrations are proposed as cleanup levels.

In addition to human health risks, environmental receptors require evaluation under MTCA. At the site, the closest receptor for groundwater is surface water. Under these circumstances, surface water criteria may be used as a basis to evaluate contaminant levels in groundwater. In addition, where groundwater cleanup levels are established to protect surface water, MTCA (WAC 173-340-720(6)(d)) allows a conditional point of compliance "within the surface water as close as technically possible to the point or points where ground water flows into the surface water." Wells located adjacent to the surface water may serve as surrogate conditional points of compliance for compliance monitoring.

13.1.2 Media Specific Cleanup Levels

Under WAC 173-340-705, the development of MTCA Method B cleanup levels for various media must comply with WAC 173-340-720 through -760 and the following general criteria:

- Applicable state and federal laws;

- No adverse affects to aquatic and terrestrial life; and,

- Protection of human health and the environment.

13.1.2.1 GROUNDWATER CLEANUP LEVELS

Groundwater at the site is characterized by the following:

- Groundwater is hydraulically connected to the adjacent lake and river waters.

- Site groundwater does not serve as a current source of drinking water.

- Groundwater in the vicinity of the site does not serve as a current or likely future source of drinking water.

- It is unlikely that hazardous substances will be transported from the present contaminated groundwater to groundwater that is a current or potential future source of drinking water.

- The surrounding surface water is recharged by an urbanized watershed and is not a suitable domestic water supply source.

The MTCA (WAC 173-340-720) rules allow Ecology to approve groundwater cleanup levels that are based on protecting beneficial uses of adjacent surface water where groundwater flows into surface water; the surface water is not classified as a suitable domestic water supply; groundwater flows into surface water will not result in cleanup level exceedances; the cleanup action includes institutional controls that prevent use of contaminated groundwater; and Ecology determines that it is unlikely that hazardous substances will be transported to groundwater that is a current or potential future source of drinking water. Therefore, groundwater cleanup levels may be based on protecting beneficial uses of adjacent surface water at this site, provided appropriate institutional controls are implemented.

Groundwater cleanup levels for protection of surface waters are established based on the most stringent cleanup levels for surface water under applicable state and federal laws. The relevant and appropriate regulations for surface water include the Method B calculations set forth in Model Toxics Control Act (WAC 173-340-730). MTCA Cleanup Levels and Risk Calculations (CLARC II) Update (Ecology Document 94-145, updated 1/96) provides risk-based data from which Method B cleanup levels may be calculated in the event that a chemical-specific cleanup standard has not been established under the following:

- National Water Quality Criteria (EPA 822-Z-99-001, April 1999);

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

- Section 304 of the Clean Water Act.

Natural background concentrations for contaminants are also a factor for determining cleanup levels. The organic contaminant standards of the Safe Drinking Water Act are not applicable at the site, because the standards address ground or surface waters that are current or potential sources of drinking water. However, the surface water quality standards should be used if no other standards are available for consideration. Table 13-1 lists the cleanup levels for protection of surface water that apply to the site for the COCs identified in the RI.

The rationale for individual cleanup levels presented in Table 13-1 is presented in the following paragraphs.

Lead, Arsenic, and Barium Cleanup Levels

The groundwater cleanup level for lead is based on protecting beneficial uses of adjacent surface water. The Water Quality Standards for Surface Waters of the State of Washington provide the relevant groundwater cleanup levels. The chronic aquatic life surface water lead standard is a dissolved standard based on a hardness dependent formula, rather than a single concentration. Therefore, the cleanup level concentration varies with hardness. The formulae is:

Lead Cleanup Level = (1.46203 - [(ln hardness)(0.145712)])(e(1.273[ln(hardness)]-4.705))

Based on the most conservative hardness measurement from the existing shoreline compliance monitoring wells (524 mg/L CaCO3 equivalents), the current cleanup level is 14.4 μg/L.

The groundwater cleanup level for arsenic is based on the natural background concentration of arsenic. Application of the human health surface water quality criteria for protection of beneficial uses of adjacent surface water establishes a cleanup level for arsenic of 0.018 μg/L based on consumption of organisms that live in the water. However, where the MTCA method establishes a concentration that is below natural background concentrations, the cleanup level is adjusted to equal the natural background concentration (WAC 173-340-700(4)(d)). Based on natural background concentrations for arsenic of 5 μg/L in groundwater in the state (that is also the MTCA Method A cleanup level), the groundwater cleanup level for arsenic at the site is 5 μg/L.

The groundwater cleanup level for barium is based on protecting beneficial use of adjacent surface water. Application of the surface water cleanup level from EPA's National Recommended Water Quality Criteria establishes a cleanup level for barium of 1,000 μg/L.

TPH

The MTCA Method A cleanup levels for groundwater TRPH, diesel-range TPH, and heavy oil-range TPH are all 1,000 μg/L. MTCA Method A groundwater cleanup levels are used because there are no applicable surface water cleanup levels under MTCA Methods A, B, or C and there are no MTCA Method B groundwater cleanup levels. Water Quality Standards for the State of Washington (WAC 173-201A) do not set cleanup limits for petroleum hydrocarbons and total petroleum hydrocarbons are not listed in Method B CLARC II tables (February 1996).

13.1.2.2 SOIL CLEANUP LEVELS

Organic and inorganic COC cleanup levels for soil are based on MTCA Method A and Method B residential soil values. Based on MTCA Method A, the applicable residential cleanup levels for arsenic and lead are 20.0 and 250 mg/kg, respectively (Table 3-6B). The applicable residential cleanup level for TPH (ORPH and DRPH) is 200.0 mg/kg. Where no Method A cleanup level exists for a soil COC, applicable residential cleanup levels are based on the most stringent MTCA Method B soil values.

In accordance with the provisions of WAC 173-340-740(3)(a)(ii)(A), soil concentrations established using Method B are equal to 100 times the groundwater cleanup level established at the site, unless it can be demonstrated that a higher soil concentration is protective of groundwater at the site. Soil cleanup levels equal to 100 times the groundwater levels proposed for protection of surface water at the site result in cleanup levels for barium and selenium of 100, and 0.5 mg/kg respectively.

Table 13-2 lists the soil cleanup levels for the COCs identified in the RI.

13.1.2.3 INDUSTRIAL CLEANUP LEVELS

If redevelopment does not occur and the site remains industrial, cleanup levels are based on continued industrial use of the site. Typically, industrial cleanup levels are equal to or less stringent than the cleanup levels for residential use. For the groundwater COCs at this site, the proposed industrial cleanup levels for TPH, arsenic, barium, and lead are the same as shown in Table 13-1. For soil COCs, the proposed industrial soil cleanup levels for continued industrial use are based on the MTCA Method A Industrial Soil Table and Method B calculations (based on 100 times the applied groundwater cleanup level) and are as shown in Table 13-3. The conditional point of compliance for monitoring during continued industrial use is discussed in Section 13.1.5 below.

13.1.3 Chemical-Specific Applicable Relevant and Appropriate Requirements

Chemical-specific Applicable Relevant and Appropriate Requirements (ARARs) either set protective cleanup levels for the COCs in the designated media or indicate an appropriate level of discharge.

Chemical-specific requirements are health or risk-based concentration limits that can include such requirements as ambient water quality criteria or drinking water maximum contaminant levels (MCLs). These ARARs are based on current, publicly available information and do not reflect administrative discretion.

The Safe Drinking Water Act and the Water Quality Standards for Groundwater of the State of Washington are not relevant or appropriate regulations for this site since no drinking water sources are impacted or potentially impacted. The Surface Water Quality Standards for the State of Washington are ARARs for the site.

13.1.4 Action and Location Specific ARARs

Action and location-specific ARARs are those requirements that define either acceptable treatment and disposal procedures for hazardous substances that are handled or created during the implementation of the remedial action, or restrict certain substances because they occur in special locations. Potential action and location-specific regulations that may be relevant and appropriate to the Kenmore Industrial Park include the federal Clean Air Act (40 CFR 60) and National Pollutant Discharge Elimination System (40 CFR 122, 125), the state Shoreline Management Act (RCW 90.58) and Minimum Functional Standards for Solid Waste Handling (WAC 173-304).

13.1.5 Conditional Points of Compliance

The point of compliance is the point or points on the site where the established cleanup levels are to be attained. Typically, MTCA establishes the point of compliance for groundwater and soils "throughout the site." However, conditional points of compliance for groundwater are allowed at sites where hazardous substances remain onsite as part of a cleanup action involving containment or where the affected groundwater flows into nearby surface water (WAC 173-340-720(6)(c) and (d)). Similarly, MTCA allows that a cleanup action may be determined to comply with soil cleanup levels at sites where hazardous substances remain onsite as part of the cleanup action where adequate monitoring and institutional controls are implemented (WAC 173-340-740(6)(d)).

At sites where groundwater flows into surface water, a conditional point of compliance is allowed where a dilution zone will not used to demonstrate compliance; groundwater discharges will be provided with known available and reasonable methods of treatment prior to release; groundwater discharges will not violate published sediment quality values; and groundwater monitoring is performed appropriately. In cases where these conditions exist, MTCA (WAC 173-340-720(6)(d)) allows a conditional point of compliance "within the surface water as close as technically possible to the point or points where ground water flows into the surface water."

The groundwater at this site flows to nearby surface water. Also, achieving groundwater cleanup levels throughout the site is not expected here because hazardous substances in groundwater are contained on site. Therefore, based on WAC 173-340-720(6)(c) and (d), Ecology has approved a conditional point of compliance at the shoreline of the site. Groundwater COC concentrations will be monitored at the existing shoreline compliance monitoring wells AW-6, AW-11, AW-12 and at a replacement well located at or near well AW-10, or similar replacements. These shoreline wells are situated within the property boundary and within 100 feet of the existing lake and river shorelines. The wells are also located outside the proposed development footprint and will be accessible for monitoring. An estimate of attenuation between the monitoring wells and the shoreline will be considered in evaluating compliance with the TPH and lead cleanup levels because the cleanup levels for these COCs are based on the protection of adjacent surface water. Attenuation will not be considered for arsenic because the cleanup level is based on groundwater background concentrations.

For soils, the Department of Ecology recognizes that for cleanup actions where hazardous substances remain onsite as part of the cleanup action the soil cleanup levels will typically not be met throughout the site (WAC 173-340-740(6)(d)). Therefore, the MTCA regulations provide that in cases where containment is a component of the cleanup action, the cleanup action may be determined to comply with cleanup levels where the compliance monitoring program ensures the long-term integrity of the containment system and other appropriate containment measures are implemented (WAC 173-340-360(8)).

13.1.6 Cleanup Levels and COC Concentrations

13.1.6.1 GROUNDWATER

COC concentrations in the groundwater meet groundwater cleanup levels for protection of surface waters at the conditional point of compliance. The measured concentration ranges at the existing conditional point of compliance monitoring wells are compared to the cleanup levels shown in Table 13-4. The comparison demonstrates that COC concentrations at the existing shoreline compliance wells (AW-6, AW-11, and AW-12) are currently below groundwater cleanup levels at the conditional point of compliance.

13.1.6.2 SOIL

As shown below on Tables 13-5 and 13-6, COC concentrations in the landfilled media exceed both residential and industrial soil cleanup levels for the TPH, barium, lead, and selenium COCs.

13.2 Regulatory Requirements

Under MTCA, remedial actions conducted at this site must comply with the substantive requirements of the following federal and state laws to the extent applicable (Table 13-7):

- Clean Water Act (40 CFR 100-149)
- Water Pollution Control (RCW 90.48, WAC 173-220, WAC 173-201A)
- Shoreline Protection Act (RCW 90.58)
- Sediment Management Standards (WAC 173-204)
- Minimum Functional Standards for Solid Waste Handling (WAC 173-304-461)
- Washington Clean Air Act (WAC 173-400)
- Puget Sound Clean Air Agency Regulations
- Hydraulic Code Regulations

14.0 REMEDIAL ACTION OBJECTIVES

Based upon characterization of the extent of contamination at the site, the identified COCs, the cleanup levels for the site, the points of compliance and other potential regulatory concerns, the Remedial Action Objectives (RAOs) for the site are as follows:

- Prevent human contact with COCs in the landfilled demolition debris, and;
- Reduce rainfall infiltration that might otherwise mobilize COCs above levels of concern to surrounding surface waters

These RAOs consider:

- The proposed use of the site as mixed residential;
- The hydraulic connection between the shallow groundwater table and adjacent surface waters;
- The lack of use of surface water as a current or future source of drinking water; and
- Protection of the surrounding surface waters.

15.0 EVALUATION OF GENERAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS

This section presents an evaluation of various general response actions, remedial technologies, and process options that could be used to achieve the RAOs for the site. Although concentrations of COCs in site soils exceed the site specific cleanup levels for TPH and lead a No Remedial Action alternative is evaluated because the cleanup levels for groundwater are currently met at the conditional point of compliance. Those actions or technologies that are evaluated as appropriate for the site will be used singularly or combined with other selected technologies to develop remedial action alternatives for the property.

The evaluation is structured as follows in this section: 1) Evaluating the potentially applicable general response actions, remedial technologies and process options for applicability, technical feasibility, effectiveness and cost based on site characteristics, COCs and RAOs; and 2) Summarizing the selected remedial technologies that may be used to develop remedial action alternatives based on the above evaluation.

15.1 Screening of General Response Actions, Technologies and Process Actions

This section presents an evaluation and assessment of various general response actions, remedial technologies and process options that would accomplish the RAOs identified above in Section 14.0. The screening process is summarized in Table 15-1, which includes: 1) brief descriptions of the general response actions, remedial technologies and process options that have the potential of achieving the site RAOs; 2) comments on the applicability of the remedial technology or process option based on site specific considerations and; 3) which technologies and options are carried through the screening process for further evaluation.

The initial screening of a particular technology or process option for this site is based on: 1) the documented ability of the process to address the site COC; 2) the technical feasibility of the process to be implemented at the site and; 3) the practicality of implementing the process based on the known physical and operational limitations of the property. After the initial screening evaluation, those technologies which are kept for further assessment are evaluated based on the goals of WAC 173-340-350, for the evaluation of cleanup alternatives. The various alternatives are then evaluated against specific MTCA threshold criteria presented in WAC 173-340-360, for the selection of cleanup actions.

15.2 Assumptions

Three important assumptions, based on site-specific characteristics, which were considered when developing the cleanup action alternatives, are presented below:

- Limitations of soil remediation - The achievement of proposed soil cleanup levels throughout the site is infeasible and some COCs in demolition debris would remain on site for all cleanup alternatives;

- Phasing of proposed development - Remedial activities will be coordinated with the phasing and construction of planned redevelopment or the site will remain industrial.

- Limitations of future site groundwater use - Shallow groundwater beneath the site is not a current or likely future drinking water source due its hydraulic connection with Lake Washington and the Sammamish River, two urbanized watersheds.

15.2.1 Limitations of Soil Remediation

Due to the large area (approximately 35 acres) and significant depth (average 14 feet) of demolition debris, and varying groundwater levels due to lake fluctuations, excavation of soil would be difficult and could not be accomplished without impairing existing shoreline, wetland, and aquatic habitats. Because depth to groundwater changes seasonally with the lake level, if soil removal is performed, soil cleanup levels will be attained only in soils above the winter low lake level (elevation 16.5, or approximately the upper 10 feet). Also, some areas of COC-containing soils impacted groundwater and thus do not impact the surrounding aquatic environment.

15.2.2 Phasing of Proposed Redevelopment

If redevelopment proceeds, construction of the remedial action would be phased with development over a period of seven to 15 years. During this time interval, the majority of the site would either be undergoing construction or remain industrial. Compliance with the RAOs would be met with provisions to protect site workers and the general public during and after the onset of site redevelopment. Under all but the No Action Alternative, appropriate institutional controls would be implemented prior to the time of initial site clearing and continue as phased development and remediation construction proceed.

If redevelopment does not proceed and the entire site remains industrial, institutional controls and monitoring appropriate for continued industrial use would be implemented for the entire site. If redevelopment was not completed to allow for commercial/residential use of the entire site, institutional controls and monitoring appropriate for continued industrial use would be implemented for the portions of the site that remain industrial (in to addition the institutional controls implemented for the redeveloped areas under all but the No Action Alternative).

15.2.3 Limitations on Future Groundwater Use

Shallow groundwater beneath the site occurs at depths of approximately 8 to 12 feet below ground surface, depending upon the lake stage and surface elevation. Due to the urbanization of the watershed, boat traffic, and the ready supply of a municipal water source, groundwater beneath the site is not considered a current or future potential source of drinking water.

15.3 General Response Actions

The general response actions considered in this preliminary screening process are: 1) no action; 2) institutional controls; 3) monitoring, 4) containment; 5) excavation; and, 6) in-situ soil and groundwater treatment. The following sections evaluate the technologies considered for each general response action.

15.3.1 No Remedial Action

Based on site-specific groundwater cleanup levels developed in Section 13 above for protection of surface water, cleanup levels for groundwater are currently met at the conditional point of compliance. This suggests that groundwater is not being significantly impacted by leaching of COCs from soil, that COCs are not migrating to surface water at concentrations of concern via groundwater, and that groundwater remedial action at the site is not necessary. The future risk of impairment by the release of COCs to the surface water is minimal. Furthermore, the likelihood of human exposure to the demolition debris, that are currently buried under more than one foot of soil cover, asphalt or concrete is low. As discussed in the RI, the most likely exposure scenario for soils is a worker performing excavation activities.

15.3.2 Institutional Controls and Restrictive Covenants

Notices could be added to the existing property deeds to prevent future property owners from unknowingly intruding on potential subsurface contamination. For instance, installation of future underground utilities could require proper and appropriate worker health and safety protections and proper handling of excavated soil.

Institutional controls in the form of deed notices and restrictive covenants will be needed as part of any cleanup action because some levels of COCs will remain in the subsurface regardless of the clean-up alternative selected. The purpose of the institutional controls is to:

- Prevent inadvertent contact with impacted soil and groundwater by notifying potential site users of the site conditions;
- Provide for the proper worker protection and handling of contaminated soil and/or groundwater generated by future site development or maintenance activities;
- Provide access to remediation equipment and wells for future monitoring and maintenance.

Given the proposed mixed-residential land use, it is likely that such institutional controls would suit future site development plans. The use of institutional controls is considered feasible at this site.

15.3.3 Monitoring

Monitoring could be performed to confirm that surface water is not impacted by the groundwater from the site. Periodic measurement of water levels and concentrations of COCs in groundwater is considered appropriate for monitoring the progress of remedial actions and compliance with groundwater cleanup levels established to protect surface water adjacent to the site. The existing shoreline compliance wells provide a readily accessible means of measuring groundwater elevations and collecting groundwater samples for quantitative analysis. As specified in Section 13.1.5, the existing shoreline compliance wells (AW6, AW-11, and AW-12) and a replacement well (at AW-10) are proposed to provide sampling data for monitoring purposes. If the observed levels in these wells are below the cleanup levels consideration of attenuation or sampling at the point of entry into the surface water will not be necessary.

15.3.4 Containment

Containment of COCs through the use of various types of barriers was evaluated for the site. General types of barriers are divided into (1) physical barriers, which provide some type of solid, engineered barrier to COC migration, and (2) treatment barriers, which require fluids to pass through a treatment process to remove COCs prior to reaching the proposed points of compliance.

Physical barriers evaluated for this site include vertical structures (such as slurry walls, sheet piling and injected cut-off walls) and horizontal structures (such as an engineered cap). While vertical barriers could be an effective physical barrier to COC migration, impermeable vertical barrier options are not considered feasible at the site due to the groundwater control necessary to prevent the build-up of vertical heads, or excess groundwater elevations, which could cause overtopping or under-flowing of the barrier. Permeable vertical barriers may be engineered to slow the rate of contaminant migration to surface water.

Treatment barriers were also evaluated for this site. A treatment barrier consists of an engineered arrangement of in-situ remedial technologies which do not physically limit the movement of groundwater but treat contaminants in groundwater to acceptable levels before they reach the groundwater point of compliance. Due to the low volatility of the principal COCs at the site, the high groundwater recharge capacity of the adjacent surface water bodies, and the absence of free product, in situ remedial technologies such as air sparging, vapor extraction, and pump and treat or liquid recovery systems are not considered feasible to remediate the site. Furthermore, these technologies are not appropriate for in situ remediation of the metals arsenic and lead, which do not biodegrade. In situ remedial technologies are discussed further in Section 15.3.6.

An engineered cap would prevent human contact with the demolition debris where the COCs are encountered. Furthermore, by intercepting and diverting surface runoff, an engineered cap would prevent or reduce further mobilization of COCs from the demolition debris in the vadose zone into the groundwater. A cap that covers the entire landfilled portion of the site and extends to or below the lake level, would adversely impact wetland and shoreline habitats, and conflicts with conditions for site redevelopment under the existing shoreline permit. In addition, an impermeable cap may increase the risk of landfill gas buildup and exacerbate the oxygen reducing conditions in groundwater under the site. Therefore, this option is not considered feasible at the site. Therefore, the two options carried forward for further consideration are a partial engineered cap and a vertical permeable barrier.

15.3.5 Excavation

Removal of impacted soils at the site by excavation could involve removal of all soils at the site that exceed the proposed CCLs, or selective removal of soil only from those areas containing the highest concentrations of COCs, or from those areas impacting both soil and groundwater. The estimated total volume of soil potentially requiring remediation is approximately 24,393,600 cubic feet (903,467 cubic yards) if all impacted areas were removed. Removal and subsequent replacement of the estimated total volume of potentially affected soil are infeasible because it would severely impact surface water quality and require relocation of existing utilities (including a major storm outfall). An estimated 35 acres of the site would require significant restoration efforts to return site grades above the lake level.

Selective excavation of landfilled media, consisting of soil and wood demolition debris, would involve physical removal of selected soil to an off-site facility for disposal. If active remediation is performed, soil cleanup levels will be attained only in areas of identified groundwater impact and soils could only be removed to an elevation at or above the winter low lake level (Elevation 16.5, or approximately the upper 10 feet).

Selective excavation would likely require excavation of the majority of the site and would result in excessive disposal costs in the course of searching for potential COC sources above the winter low water table. Furthermore, this option would provide no significant reduction in infiltration potential. Therefore, excavation is not carried forward for further evaluation.

15.3.6 In Situ Treatment of Soil and Groundwater

In situ treatment of soil and groundwater involves conducting remedial actions in-place without removing the impacted media from the subsurface. Soil and groundwater can be treated in-place by several technologies including vapor extraction, air sparging, and bioremediation. Site-specific conditions that dictate the effectiveness of in situ technologies include: soil porosity, permeability, moisture content, nature of contaminant, and depth to groundwater.

Due to the low volatility of the COCs at the site, the high groundwater recharge capacity of the adjacent surface water bodies, and the absence of free product, in situ technologies for the remediation of soil and groundwater are not considered feasible at the site, and are not carried further in this evaluation.

Potential accumulations of landfill gas and naturally occurring methane within the demolition debris may be actively or passively managed by in situ technologies. Implementation of gas management measures will be part of the engineering design for the redevelopment of the site and may complement the ventilation system design requirements for lower level parking areas.

Landfill gas management is carried further in this evaluation as an element of all alternatives proposed in conjunction with redevelopment.

15.4 Evaluation of Technologies and Process Options

Specific cleanup action alternatives that passed the initial screening evaluation are further assessed in this section. Information included in this section includes: 1) brief descriptions of each technology or process option as they would be applied to accomplish the RAOs at this site, 2) further evaluation of the successfully screened technologies based on effectiveness and relative cost and, 3) whether the technology or process option is considered appropriate for use in developing cleanup action alternatives for the property. Following this preliminary evaluation, each cleanup action alternative will be reevaluated in Section 17.0 by each MTCA threshold criteria specified in WAC 173-340-360.

The following process options passed the initial screening process and are further evaluated in this section:

- No Remedial Action
- Institutional Controls and Monitoring
- Engineered Cap over a Portion of the Site
- Impermeable Cap with a Permeable Vertical Barrier

In the preliminary evaluation of these process options it is assumed that the proposed remediation will occur in conjunction with site redevelopment for all but the institutional controls and monitoring option. The institutional controls and monitoring option covers both remediation in conjunction with redevelopment and remediation appropriate for continued industrial use.

15.4.1 No Remedial Action

This process option would involve no active remediation; under this option, the property would be developed without additional remediation. The proposed development would consist of a partial, non-engineered cap, consisting of new structures and pavement, and covering an estimated 30 acres of the site. Existing roofing debris would be consolidated as part of the development, and landfill gas management measures would be implemented in conjunction with redevelopment to mitigate potential accumulations beneath new structures. The approximate limits of the landfilled area, designated as af/Qp soil type (artificial fill over peat), are indicated on Figure 3.

New development would be engineered to meet standard code requirements. No additional capital expenses or maintenance costs are associated with this process. A potential for exposure to demolition debris would remain through excavation during construction and in the undeveloped buffer zones. Assuming that COC concentrations in the groundwater do not change groundwater would continue to meet proposed CCLs at the conditional point of compliance.

15.4.2 Institutional Controls and Monitoring

If remediation occurs in conjunction with redevelopment, this process option would involve no active remediation but would implement monitoring at the shoreline compliance wells. Deed notices and restrictive covenants would be recorded to protect workers during construction and prevent future owners from unknowingly intruding on potentially contaminated subsurface media. Landfill gas management and consolidation of roofing debris would occur in conjunction with redevelopment as part of this process option. The costs of this process option are relatively low, and would include the cost of preparing the restrictive covenants and preparing and implementing a monitoring plan. No long-term maintenance costs are anticipated by this action. Over the long-term, this process option would achieve the RAOs by preventing human contact with the demolition debris, reduce the potential risk of contaminant migration in groundwater beneath the site, and verifying that COCs are not migrating to surrounding surface waters.

If redevelopment does not proceed, this process option provides for implementation of the following institutional controls and monitoring as appropriate for continued industrial use: notice on the property deed to notify future owners of the presence of COCs under the property; a deed restriction with conditions to prevent extraction and use of groundwater at the site and prohibit soil excavation without proper health and safety procedures; access controls in the form of fencing and prominent signage at site access points; erosion controls; and groundwater (and surface water if necessary) monitoring. The costs of this option are relatively low. This option would achieve the primary RAO of preventing human contact with the demolition debris by controlling site access and prohibiting excavation without proper health and safety precautions. This option would also allow for verification that COCs are not migrating to surrounding surface waters at concentrations above the industrial cleanup levels.

15.4.3 Engineered Containment Cap Over a Portion of the Site

Under this option, installation of an engineered cap over a portion of the site would take place in conjunction with site development to prevent future human contact with the demolition debris and reduce the potential risk of contaminant migration in groundwater beneath the site. This alternative would include management of any landfill gases generated within the demolition debris layer below the cap and consolidation of roofing debris under the cap.

The engineered cap would be set back an average of 100 feet behind the shoreline along the river and the lake. The engineered cap would avoid impacts to existing wetland, riparian and aquatic habitats around the southern and western site margin. The engineered cap would be extended in areas around the site margin where stormwater ponds/swales are constructed. Institutional controls would be implemented to limit human interference within habitat areas and to require protection of workers performing any excavation activities. Notices and restrictions would be attached to the existing deeds to prevent future owners from unknowingly intruding on subsurface debris. Groundwater monitoring (and surface water monitoring, if necessary) would be performed to confirm long-term compliance.

The majority of the engineered cap will consist of new concrete or asphalt structures supported upon structural piling. The landfilled area outside the building footprints that is not covered with concrete or asphalt paving (the "soil cover area") will have a soil cover overlain with landscaping. For purposes of this alternative, "soil cover" means at least 2 feet of soil or equivalent media. Consistent with WAC 173-304-461 specifications for closure of demolition waste landfills, the site was previously closed with a cover of at least 1 foot of soil. Although not required, up to one additional foot of soil or equivalent media would be added on top of the existing cover in the soil cover area where needed to bring the total cover to at least 2 feet in thickness. Soil for the cover may come from areas on-site where the existing cover currently exceeds 2 feet. The additional soil (or equivalent media) above the existing cover would provide an extra measure of protection at the site consistent with the overall goal of protection of human health and the environment. The structures, paved areas, and soil cover would prevent human contact with the demolition debris and reduce the risk of contaminant migration in groundwater beneath the site but without increasing the risk of landfill gas buildup or exacerbating the oxygen reducing conditions in groundwater under the site.

The costs of this process option are relatively low and would consist of any additional cost of engineering and additional material and soil cover costs beyond those already planned for the development. Long-term maintenance costs would not be significantly increased by this design. This option would achieve the primary RAO by reducing the potential for human contact with landfilled demolition debris and would also reduce rainfall infiltration that might otherwise mobilize COCs above levels of concern to adjacent surface waters.

15.4.4 Impermeable Engineered Cap and Permeable Vertical Barriers

This process option would include an engineered impermeable cap that encompassed the upland portion of the site, a permeable groundwater barrier, management of any landfill gases generated within the demolition debris layer below the cap and consolidation of roofing debris under the cap. Installation of the impermeable cap would prevent infiltration through contaminated soils but potentially increase methane risk, exacerbate oxygen reducing conditions that could mobilize COCs in groundwater, and increase stormwater runoff to adjacent surface waters. Expansion of the cap to the shoreline would also displace existing habitat areas in an effort to maximize coverage of the upland area. In addition, a groundwater barrier would be constructed around the site perimeter, extending out as close to the shoreline as feasible, to slow the rate of exchange between groundwater and adjacent surface water. The barrier would be permeable, to prevent the groundwater table from rising underneath the upland area. However, installation of the barrier would displace existing wetland, riparian and aquatic habitats in the vicinity of the southern and western site margins. As a consequence, both the implementation of an impermeable cap and installation of a groundwater barrier conflict with existing shoreline management permit conditions for site development that require a buffer zone along the shoreline.

This option assumes that, over the course of phased development, impervious cover will be constructed across the entire landfilled portion of the site up to the perimeter established by the groundwater barrier wall. Approximately 30 acres of impervious structure would be in the form of parking areas and buildings and the balance of property, extending out to the shoreline, would be cleared of all existing trees and vegetation, graded, and resurfaced with a landscaped impermeable cover. The new structures and cover would be engineered to serve as an impervious cap and prevent human contact with the demolition debris and to intercept rainfall infiltration that might otherwise mobilize COCs into the groundwater table or surface waters. The impermeable cap could increase the risk of methane buildup, exacerbate the oxygen reducing conditions in groundwater under the site, and increase stormwater runoff.

The cost of this process option is high, including groundwater modeling, barrier design, and low-impact barrier installation and construction practices. This process option would destroy existing shoreline habitat at the expense of maximizing the containment of demolition debris.

15.4.5 Summary of Retained Process Options

The retained process options for the site are as follows:

- No Remedial Action
- Institutional Controls and Monitoring
- Engineered Cap over a Portion of the Site
- Impermeable Cap with a Permeable Vertical Barrier

Other process options were previously eliminated from further consideration.

16.0 DEVELOPMENT OF CLEANUP ACTION ALTERNATIVES

Four alternatives for cleanup of the site are developed below based on the process options retained from the evaluation completed in Section 14.2 above. The cleanup alternatives are summarized below:

- No Remedial Action (Partial, Non-Engineered Cap)
- Institutional Controls and Monitoring
- Containment by Engineered Cap over a Portion of the Site
- Containment by Impermeable Cap with a Permeable Vertical Barrier

The proposed cleanup alternatives provide a range of technical complexity, protectiveness and cost and are evaluated in detail in Section 17. Section 15 consists of a discussion of important assumptions that influenced the development of cleanup alternatives and a detailed presentation of the proposed cleanup alternatives for this site.

16.1 Descriptions of Cleanup Action Alternatives

This section presents descriptions of the four cleanup action alternatives developed for the site based on the available process technologies remaining after the screening process described above. These alternatives provide an appropriate range of potential remedial actions based on MTCA guidelines and the RAOs developed for the site. The proposed cleanup action alternatives take into account site-specific conditions and the important assumptions specified in Section 15. These alternatives are compared in detail in Section 17.0, and the recommended alternative is proposed in Section 18.0. All four alternatives where remediation occurs in conjunction with redevelopment include landfill gas management and consolidation of the roofing debris. All four alternatives except No Action include groundwater monitoring and institutional controls. The last two include an engineered containment cap.

16.1.1 Alternative 1 - No Remedial Action

Under the No Action alternative, site development would proceed without any required remedial action. Landfill gas management and consolidation of roofing debris would occur as part of the development design and construction. A partial cap would also be constructed, but it would not be engineered to maximize its effectiveness.

16.1.2 Alternative 2 - Institutional Controls and Monitoring

If development proceeds, this alternative provides for implementation of the following institutional controls and monitoring: notices would be attached to the existing deeds to prevent future owners from unknowingly intruding on potential subsurface contamination; monitoring would be performed to confirm compliance with cleanup levels; and landfill gas management and consolidation of roofing debris would occur as part of the development, design, and construction. The cost of Alternative 2 is the cost of preparing and implementing institutional controls at the site, and conducting groundwater compliance monitoring. A partial cap would also be constructed, but it would not be engineered to maximize its effectiveness.

If redevelopment does not proceed, this alternative provides for implementation of the following institutional controls and monitoring as appropriate for continued industrial use: notice on the property deed to notify future owners of the presence of COCs under the property; a deed restriction with conditions to prevent extraction and use of groundwater at the site and prohibit soil excavation without proper health and safety procedures; access controls in the form of fencing and prominent signage at site access points; erosion controls; and groundwater (and surface water if necessary) monitoring. The costs of this option are relatively low. This option would achieve the primary RAO of preventing human contact with the demolition debris by controlling access and by prohibiting excavation without proper safety precautions. This option would also allow for verification that COCs are not migrating to surrounding surface waters at concentrations above the industrial cleanup levels.

16.1.3 Alternative 3 - Containment by a Partial Engineered Cap

Under Alternative 3 site development would occur in conjunction with installation of an engineered cap over a portion of the site to prevent human contact with the demolition debris and reduce the potential risk of contaminant migration in groundwater beneath the site. This alternative would integrate landfill gas management with redevelopment design and operations. Consolidation of roofing debris under the cap would occur in conjunction with development construction.

The engineered cap would extend to the proposed fire lane and generally be set back an average of 100 feet behind the shoreline along the river and the lake. The engineered cap would avoid impacting existing wetland, riparian and aquatic habitats around the southern and western site margin. The engineered cap would be extended in areas around the site margin where stormwater ponds/swales are constructed. Potential contact with the demolition debris by humans and the environment might result if excavation occurred in habitat areas designated for protection. Institutional controls would be implemented to require protection of workers performing any excavation activities. Notices and restrictions would be attached to the existing deeds to prevent future owners from unknowingly intruding on subsurface debris. Groundwater monitoring would be performed to confirm long-term compliance with cleanup levels.

The cost estimate for this alternative assumes proposed land use redevelopment would ultimately create an estimated 35 acres of engineered cap. The majority of the engineered cap will consist of new concrete or asphalt structures supported upon structural piling. The landfilled area outside the building footprints that is not covered with concrete or asphalt paving (the "soil cover area") will have a soil cover overlain with landscaping. For purposes of this alternative, "soil cover" means at least 2 feet of soil or equivalent media. Consistent with WAC 173-304-461 specifications for closure of demolition waste landfills, the site was previously closed with a cover of at least 1 foot of soil. Although not required, up to one additional foot of soil or equivalent media would be added on top of the existing cover in the soil cover area where needed to bring the total cover to at least 2 feet in thickness. Soil for the cover may come from areas on-site where the existing cover currently exceeds 2 feet. The additional soil (or equivalent media) above the existing cover would provide an extra measure of protection at the site consistent with the overall goal of protection of human health and the environment. The structures, paved areas, and soil cover would prevent human contact with the demolition debris and reduce the risk of contaminant migration in groundwater beneath the site but without increasing the risk of landfill gas buildup or exacerbating the oxygen reducing conditions in groundwater under the site. The cost of the partial cap is approximately the cost of the additional engineering to design the development structures to serve as an effective cap and to the cost of the soil cover.

16.1.4 Alternative 4 - Containment by Engineered Cap and Permeable Groundwater Barrier

Alternative 4 would include an engineered impermeable cap that encompassed the entire upland portion of the site. In addition, a groundwater barrier would be constructed around the perimeter to slow the rate of exchange between groundwater and adjacent surface water. The barrier would be permeable, to prevent the groundwater table from rising underneath the upland area.

Alternative 4 would cap the entire upland and shoreline portions of the property. Installation of the barrier would displace existing wetland, riparian and aquatic habitats in the vicinity of the southern and western site margins. Installation of the impermeable cap would potentially increase methane risk, exacerbate oxygen-reducing conditions that could mobilize COCs in groundwater, and increase stormwater runoff. Expansion of the cap to the shoreline would also displace existing habitat areas in an effort to maximize coverage of the upland area. This alternative conflicts with existing shoreline management permit conditions for site development which require a buffer zone along the shoreline.

The cost estimate for this alternative assumes that proposed land use redevelopment would ultimately encompass a planned area of approximately 30 acres of impervious cover in the form of parking areas and buildings, constructed in several phases over the course of development. These structures will be engineered to serve as an impervious cap, prevent human contact with the demolition debris, and intercept rainfall infiltration. The cost of Alternative 4 includes the cost of engineering to design the proposed structures as a cap. Additional costs include design and installation of cap coverage in the proximity of the southern and western shorelines.

The cost estimate does not consider the value of habitat potentially lost due to barrier installation activities, or include the potential cost of design and reconstruction of riparian and aquatic habitats above the cap.

17.0 EVALUATION OF ALTERNATIVES

This section presents a detailed comparison of the four cleanup action alternatives described above in Section 16.0. As required by MTCA (WAC 173-340-360), the four alternatives must satisfy the following four threshold requirements:

- The action must protect human health and the environment;
- The action must comply with the appropriate cleanup standard established under MTCA;
- The action must comply with applicable state and federal laws;
- The action must provide for compliance monitoring.

In addition to these four threshold requirements, the action should also meet the following three requirements:

- The action should use permanent solutions to the maximum extent practicable;
- The action should provide a reasonable time frame for restoration;
- The action should consider public concerns raised during public comment on the proposed draft cleanup action plan.

The following sections present an evaluation of each alternative compared to the criteria presented previously and a comparison of the four alternatives to each other (Section 17.2). As required by MTCA, all proposed cleanup action plans are presented for public review and comment. Public concerns will be considered after the public comment period

17.1 Evaluation of Alternatives Relative to MTCA Criteria

This section presents a detailed evaluation of each alternative relative to the first six MTCA criteria listed above. The criteria of using permanent solutions to the maximum extent practicable is further assessed for short- and long-term effectiveness, reduction of mobility/toxicity, ability to be implemented and costs. Estimated present worth costs for capital construction, operation and maintenance and monitoring for a 25-year period based on an estimated seven to 15-year project duration and 10-year compliance period are presented in Appendix F. Proposed designs presented for each alternative are preliminary and conceptual in nature and may not represent the most efficient or cost-effective system layout. Comparison of each alternative to the criteria for evaluating the use of permanent solutions is presented in Table 17-1.

17.1.1 Alternative 1 - No Remedial Action

17.1.1.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 1 would not prevent contact with the demolition debris by a worker excavating on site. The completed development would prevent human contact with COCs in the demolition debris beneath the building and pavement development footprint. Groundwater currently meets established CCLs at the conditional point of compliance.

17.1.1.2 COMPLIANCE WITH CLEANUP LEVELS

Alternative 1 would result in soils with COC concentrations greater than the CCLs remaining on site within the landfill. Groundwater COC concentrations currently meet CCLs at the conditional point of compliance.

17.1.1.3 COMPLIANCE WITH APPLICABLE STATE AND FEDERAL LAWS

Alternative 1 would comply with applicable State and Federal laws (Table 13-7).

17.1.1.4 PROVISION FOR COMPLIANCE MONITORING

No provisions for compliance monitoring would be implemented under Alternative 1.

17.1.1.5 USE OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

Short Term Effectiveness - Groundwater COC concentrations currently meet the CCLs at the conditional point of compliance. Workers performing excavation for site development activities could be exposed to soil COCs over the short term until the development is completed.

Long Term Effectiveness - Groundwater CCLs are currently met on site at the conditional point of compliance. The completed development would prevent human contact with COCs in the landfilled media beneath the building and pavement development footprint.

Permanent Reduction of Toxicity/Mobility/Volume - Construction of the development would reduce mobility of COCs, but would not be designed as an engineered cap. This alternative would not reduce the volume or toxicity of the COCs in the demolition debris.

Ability to Implement- This alternative could be readily implemented under the proposed timeline for development.

Cost - Estimated costs for Alternatives 1, 2, 3 and 4 are itemized in Tables 17-2 through 17-5. No costs are associated with implementation of Alternative 1, as summarized below:

Total Capital Cost	$0
Annual Operations and Maintenance Cost	$0
Present Dollar 25 Year O&M Cost	$0

17.1.1.6 PROVISION FOR A REASONABLE RESTORATION SCHEDULE

Implementation of Alternative 1 could commence immediately. Completion of the entire development is estimated to be 7 to 15 years.

17.1.2 Alternative 2 - Institutional Controls and Monitoring

17.1.2.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 2 would protect human health by implementation of institutional controls which would control access, provide notification of site conditions to property users, and require implementation of appropriate worker health and safety procedures. Currently, groundwater meets CCLs at the conditional point of compliance. Compliance monitoring would continue after completion of development in accordance with provisions of an approved compliance monitoring plan. If the property remains industrial, compliance monitoring appropriate for continued industrial use would occur in accordance with provisions of an approved compliance monitoring plan.

17.1.2.2 COMPLIANCE WITH CLEANUP LEVELS

Alternative 2 would result in soils with COC concentrations greater than the CCLs remaining on site within the demolition debris landfill area. Groundwater COC concentrations on site currently meet CCLs at the conditional point of compliance and continued monitoring would document any changes in concentrations.

17.1.2.3 COMPLIANCE WITH APPLICABLE STATE AND FEDERAL LAWS

Alternative 2 would comply with applicable State and Federal laws (Table 13-7).

17.1.2.4 PROVISION FOR COMPLIANCE MONITORING

Monitoring would be performed to confirm that the proposed cleanup levels are being met at the conditional point of compliance and adequate protection of human health and the environment is being maintained in the future.

17.1.2.5 USE OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

Short Term Effectiveness - Groundwater COC concentrations currently meet the CCLs at the conditional point of compliance. Health and safety procedures would be implemented to protect workers over the duration of site construction activities.

Long Term Effectiveness - Groundwater CCLs are currently met at the conditional point of compliance. Over the long term, this alternative would effectively achieve the RAOs.

Permanent Reduction of Toxicity/Mobility/Volume - Construction of the development would reduce mobility of COCs, but would not be designed as an engineered cap. This alternative would not reduce the volume or toxicity of the COCs in the demolition debris.

Ability to Implement- This alternative could be readily implemented within the time-frame required to implement institutional controls.

Cost - The primary cost of Alternative 2 consists of fees to prepare notices and restrictive covenants and labor and laboratory fees to provide extended monitoring at the site. This cost estimate assumes 25 years to complete the planned redevelopment and monitoring. Estimated costs are itemized in Table 17-3 and are summarized below:

Total Capital Cost	$30,000
Annual Operations and Maintenance Cost	$23,520
Present-Dollar 25 Year O&M Cost	$401,584

If the site remains in industrial use, the estimated costs could be less based on a shorter timeframe for compliance monitoring.

17.1.2.6 PROVISION FOR A REASONABLE RESTORATION SCHEDULE

Implementation of Alternative 2 occurs in conjunction with redevelopment. Completion of the entire development is scheduled to require 7 to 15 years. Implementation of this alternative would begin upon issuance of the consent decree and only requires monitoring to continue.

17.1.3 Alternative 3 - Containment by Partial Engineered Cap

17.1.3.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 3 would limit human contact with the demolition debris and COCs within the upland portion of the site and reduce rainfall infiltration that might otherwise mobilize COCs above levels of concern to surrounding surface waters. By reducing but not completely eliminating infiltration, the cap would prevent contact the demolition debris without exacerbating oxygen reducing conditions in the groundwater. The permeable cap would also reduce the risk of landfill gas buildup and reduce stormwater runoff. Compliance monitoring and institutional controls would also be implemented to reduce human exposure, monitor the effectiveness of the cap, and confirm that COCs are not impacting the surrounding environment. Deed notices would provide notification of property conditions to site users and restrictive covenants would require proper health and safety procedures during proposed site redevelopment or future excavation activities.

17.1.3.2 COMPLIANCE WITH CLEANUP LEVELS

Alternative 3 would satisfy the RAOs by preventing human contact with COCs in the landfilled demolition debris and reducing rainfall infiltration that might otherwise mobilize COCs above levels of concern to surrounding surface waters. Soil with COC concentrations greater than the CCLs would remain, but would be contained under the partial, engineered cap. Groundwater COC concentrations currently meet CCLs at the conditional point of compliance. Continued monitoring would document any changes in concentrations.

17.1.3.3 COMPLIANCE WITH APPLICABLE STATE AND FEDERAL LAWS

Alternative 3 would comply with applicable State and Federal laws (Table 13-7).

17.1.3.4 PROVISION FOR COMPLIANCE MONITORING

Monitoring would be performed to confirm that the proposed groundwater cleanup levels are being met at the conditional point of compliance, and that protection of human health and the environment is being maintained in the future.

17.1.3.5 USE OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

Short Term Effectiveness - The implementation of Alternative 3 would require an estimated seven to 15 years to complete construction of the containment elements. Over the short-term, workers could be exposed to the demolition debris during phased site construction; however, health and safety procedures would be implemented to protect workers over the short-term duration of site construction activities. Groundwater CCLs are currently met at the conditional point of compliance.

Long Term Effectiveness - Groundwater CCLs are currently met at the conditional point of compliance. Over the long term, this alternative would achieve the RAOs.

Permanent Reduction of Toxicity/Mobility/Volume - Capping would reduce mobility of COCs, provided that oxygen reducing conditions are not exacerbated, but would not reduce the volume or toxicity of the COCs in the demolition debris.

Ability to Implement - This alternative would be implemented over a seven- to fifteen-year period during proposed site redevelopment activities. All construction techniques are considered feasible.

Cost - The primary capital cost for Alternative 3 consists of the additional engineering design of the development cap, and material costs to install the soil cover outside the limits of the proposed building and pavement development footprint. Operation and maintenance costs would consist of cap maintenance activities around the building perimeter, implementation of institutional controls, and monitoring costs. This cost estimate assumes 25 years to complete including seven to 15 years to complete the planned redevelopment, and ten years of additional monitoring. Estimated costs are itemized in Table 17-4 and are summarized below:

Total Capital Cost	$734,618
Annual Operations and Maintenance Cost	$26,592
Present Dollar 25 Year Cost (including O&M)	$1,128,144

17.1.3.6 PROVISION FOR A REASONABLE RESTORATION SCHEDULE

The restoration time frame for the site will reasonably achieve the remedial action objectives within the time frame for the applicable property use. Completion of the entire development is scheduled to take seven to 15 years. If the change in land use to mixed residential/commercial goes forward for any part of the site, an engineered cap and associated institutional controls will be in place prior to residential use of such areas. If the site remains industrial, institutional controls and monitoring appropriate for ongoing industrial uses will be implemented as soon as practical after entry of the consent decree.

17.1.4 Alternative 4 - Containment by Engineered Cap with Permeable Groundwater Barrier

17.1.4.1 PROTECTION OF HUMAN HEALTH AND THE ENVIRONMENT

Alternative 4 would involve installation of an impermeable cap to limit human contact with the demolition debris. The impermeable cap would prevent rainfall infiltration but increase landfill gas buildup, potentially exacerbates oxygen reducing conditions (mobilizing certain COCs into groundwater), and increase stormwater runoff. The permeable barrier would slow the potential migration of COCs in groundwater to surface water receptors but would displace existing wetlands, riparian, and aquatic habitat along the shoreline. Compliance monitoring and institutional controls would be implemented to reduce human exposure, monitor the effectiveness of the cap and document that COCs are not impacting the surrounding environment. Deed notices would provide notification of property conditions to site users and restrictive covenants would require proper health and safety procedures during proposed site redevelopment, or future excavation activities.

17.1.4.2 COMPLIANCE WITH CLEANUP LEVELS

Alternative 4 would satisfy the primary RAO by preventing human contact with the demolition debris. The alternative might actually increase the potential for migration of COCs from the demolition debris into surface waters by exacerbating oxygen reducing conditions in the landfill which may mobilize metals into solution in the groundwater. However, the permeable barrier would slow this potential migration. Soils with COC concentrations greater than the CCLs would remain but would be contained under the impermeable cap. Groundwater COC concentrations currently meet CCLs at the conditional point of compliance, but the potential for migration would be further controlled by the permeable barrier.

17.1.4.3 COMPLIANCE WITH APPLICABLE STATE AND FEDERAL LAWS

Alternative 4 would comply with applicable State and Federal laws (Table 13-7).

17.1.4.4 PROVISION FOR COMPLIANCE MONITORING

Monitoring would be performed to confirm that CCLs are being met at the conditional point of compliance and that protection of human health and the environment is being maintained in the future.

17.1.4.5 USE OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE

Short Term Effectiveness - The implementation of Alternative 4 would require an estimated seven to 15 years to complete construction of the containment elements. Over the short-term, workers could be exposed to the demolition debris during phased site construction; however, health and safety procedures would be implemented to protect workers over the short-term duration of site construction activities. Groundwater CCLs are already met at the conditional point of compliance.

Long Term Effectiveness - Groundwater CCLs are currently met at the conditional point of compliance. Over the long term, this alternative would achieve the RAOs.

Permanent Reduction of Toxicity/Mobility/Volume - Capping would reduce mobility of COCs, provided that oxygen reducing conditions are not exacerbated, but would not reduce the volume or toxicity of the COCs in the demolition debris. The permeable barrier would reduce potential migration of COCs in groundwater into adjacent surface waters, but would not reduce the volume of toxicity of COCs in the demolition debris.

Ability to Implement - This alternative would be implemented over a seven- to 15-year period during proposed site redevelopment activities. All construction techniques are considered feasible. It will be impossible however, to implement this alternative without impacting the shoreline habitat areas.

Cost - The primary capital cost for Alternative 4 consists of the additional engineering design of the development cap, barrier design and installation, construction of the cap within the shoreline area, and potential habitat reconstruction near the shoreline. High costs would be incurred to ensure that construction activities do not impact surface water quality. Operation and maintenance costs would consist of cap maintenance activities outside the building perimeter, implementation of institutional controls, and groundwater monitoring costs. This cost estimate assumes 25 years to complete cleanup, including 15 years to complete the planned development and ten years of additional monitoring. Estimated costs are itemized in Table 17-5 and are summarized below:

Total Capital Cost	$8,693,580
Annual Operations and Maintenance Cost	$26,592
Present Dollar 25 Year Cost (including O&M)	$9,087,105

17.1.4.6 PROVISION FOR A REASONABLE RESTORATION SCHEDULE

Completion of the entire development is scheduled to take seven to 15 years.

17.2 Comparison of Alternatives

This section presents a detailed comparison of each alternative relative to the MTCA evaluation criteria presented in Section 17.1 above. The detailed comparison includes relative strengths and weaknesses of each alternative compared to one another for each MTCA evaluation criteria. Table 13-7 presents a summary of the evaluation based on a qualitative ranking system. The qualitative ranking system and the detail presented below provide the basis for choosing the recommended alternative presented in Section 18.0.

17.2.1 Protection of Human Health and the Environment

All four alternatives protect human health and the environment by addressing the following RAOs:

- Prevent human contact with COCs in the landfilled demolition debris, and
- Reduce rainfall infiltration that might otherwise mobilize COCs above levels of concern to surrounding surface waters.

The primary objective is to prevent human contact with the contaminants of concern in the landfill debris. All of the alternatives contain various measures to achieve this goal. Alternative 1 allows for implementation of a partial cap, consolidation of roofing debris, and landfill gas management as part of the redevelopment of the site but does not include workers health and safety measures or other institutional controls. Alternatives 2, 3 and 4 have all the controls found in Alternative 1 with the addition of institutional controls designed to limit human access, prevent interference with contaminants, and protect worker health and safety. In addition, Alternatives 3 and 4 include an engineered cap. Alternative 3 includes an engineered cap without the loss of environmental habitats as in Alternative 4.

The secondary objective is to reduce rainfall infiltration that might otherwise mobilize COCs above levels of concern to surrounding surface waters. All the alternatives contain various measures to achieve this goal. All of the alternatives, except Alternative 1, provide for compliance monitoring to confirm that COCs are below cleanup levels. Alternatives 1, 2, and 3 would reduce infiltration to groundwater through the addition of impermeable buildings and paved areas, but not to the extent of the impermeable cap designed in Alternative 4.

Alternative 4 would further reduce mobility through construction of a permeable groundwater barrier but may increase the risk of landfill gas buildup, COC mobilization, and stormwater runoff with the implementation of an impermeable cap.

17.2.2 Compliance with Cleanup levels

COC concentrations in the demolition debris would remain above CCLs for soil under all of the alternatives. If development proceeds, alternatives 1 and 2 would cover soils under the development footprint. Alternative 3 would cover soils up to the shoreline buffer. Alternative 4 would cover soils over the entire site. Groundwater conditions currently meet CCLs at the conditional point of compliance. All of the alternatives that are proposed for implementation in conjunction with redevelopment would help ensure that groundwater CCLs continue to be met by reducing the mobility of COCs in the subsurface although the impermeable cap in Alternative 4 may exacerbate oxygen reducing conditions that could mobilize COCs into groundwater. If redevelopment proceeds, Alternatives 1, 2 and 3 would result in comparable reductions in COC mobility, with new development reducing infiltration of COCs to the groundwater. Alternative 4 further reduces COC mobility through construction of a permeable groundwater barrier that slows the rate of flow between groundwater and surface water.

17.2.3 Compliance with Applicable State and Federal Laws

All of the alternatives comply with legally applicable or relevant and appropriate requirements of state and Federal laws (Table 13-7).

17.2.4 Provision for Compliance Monitoring

Alternative 1 does not provide for compliance monitoring at the site. Alternatives 2, 3 and 4 each provide for appropriate compliance monitoring as set forth in WAC 173-340-410 including: 1) health and safety monitoring during construction activities; 2) performance monitoring to confirm the correct operation of the remedial system or action, compliance with operations requirements and attainment of the proposed cleanup levels; and, 3) compliance monitoring to document the long-term effectiveness of the cleanup action.

17.2.5 Use of Permanent Solutions

The use of permanent solutions to the maximum extent practicable is a requirement of MTCA that is evaluated according to the criteria listed in Section 15.0, and itemized in subsections 17.2.5.1 through 17.2.5.5 below.

17.2.5.1 SHORT-TERM EFFECTIVENESS

All of the alternatives present some short-term risks to human health if redevelopment proceeds because of the potential for human exposure during excavation activities in the demolition debris, although appropriate worker health and safety procedures would be employed. The extent of excavation activities for new development are comparable between Alternatives 1, 2 and 3. Alternative 4 presents the highest short-term risk to human health and the environment because of the logistics posed by shoreline construction and loss of habitat.

17.2.5.2 LONG-TERM EFFECTIVENESS

With respect to the secondary RAO of reducing rainfall infiltration that might otherwise mobilize COCs above levels of concern in adjacent surface waters, the effectiveness of the alternatives will increase with time as the rate of mobility stabilizes after construction. With respect to the primary objective of prevention of direct contact with demolition debris, the effectiveness of all of these alternatives will increase until final build-out is achieved.

17.2.5.3 PERMANENT REDUCTION OF TOXICITY, MOBILITY AND VOLUME

All of the alternatives carried out in conjunction with redevelopment would reduce the mobility of COCs in the subsurface reducing the rainfall infiltration through the demolition debris. Alternative 4 may exacerbate the potential for mobilization of COCs into groundwater but would reduce mobility into surface waters with the inclusion of the permeable groundwater barrier. None of the alternatives would result in a reduction in toxicity or volume of COCs at the site.

17.2.5.4 ABILITY TO IMPLEMENT

Alternatives 1 and 2 may be readily implemented as part of the proposed development. Alternative 2 also may be readily implemented if redevelopment does not proceed and the site continues in industrial use. Alternative 3 may be implemented as part of the proposed development after completion of engineering design of the cap. All of the alternatives share common design elements in terms of constructing above the demolition debris. Alternative 4 would be by far the most difficult to implement in terms of engineering design requirements and construction implementation in the vicinity of the shoreline.

17.2.5.5 CLEANUP COSTS

The costs for implementing the cleanup actions increase from Alternative 1 to Alternative 4. The cleanup costs are presented above, while detailed cost estimates are presented in Tables 17-2 through 17-5. The total estimated, present-dollar implementation costs are summarized below:

Alternative 1	$ 0
Alternative 2	$ 401,584
Alternative 3	$ 1,128,144
Alternative 4	$ 9,087,105

The cost estimates are presented in present dollar values and are based on engineering estimates and not actual subcontractor bids. These figures are intended to allow comparison between alternatives and, though compiled based on AMEC's experience and known subsurface site conditions, may not represent actual construction and operation and maintenance costs. The cost estimates include the capital construction costs and the cost for operation and maintenance and assume that the time to construct the development will span 25 years including an estimated seven to 15 years for development and 10 years of monitoring. The increasing complexities of the technologies used, or the difficulties in implementing each alternative, are reflected in the differences in cost between each alternative.

17.2.6 Provision for Reasonable Restoration Time Frame

Alternative 1 has an immediate implementation time frame since no monitoring, institutional controls, or engineering are proposed. All of the other restoration activities that involve redevelopment would be implemented over 7 to 15 year time frames. Alternative 2 has a short implementation time frame, consisting of the preparation of institutional controls. Alternative 3 requires engineering design and construction. Alternative 4 requires complex engineering design and a likely longer construction period.

18.0 RECOMMENDED CLEANUP ACTION

If redevelopment occurs, Alternative 3 is recommended because it is protective of human health and the environment, is readily implemented in conjunction with the proposed development, has a relatively low cost, will not exacerbate oxygen reducing conditions in groundwater at the site, is compatible with landfill gas management and surface water protection objectives, is compatible with proposed site redevelopment plans, and poses minimal impact to existing shoreline habitats.

If redevelopment does not occur and the site continues in industrial use, the institutional controls and monitoring elements of Alternative 2 appropriate for continued industrial use are recommended. This cleanup recommendation is protective of human health and the environment, readily implemented, relatively low cost, will not exacerbate oxygen reducing conditions in groundwater at the site or increase the risks of landfill gas build-up below the surface, and will not displace existing shoreline habitats.

18.1 Description of Proposed Cleanup Action

If redevelopment proceeds, the proposed cleanup action will include implementation of institutional controls to notify future owners and workers of subsurface conditions, compliance monitoring measures to protect worker health and safety and to document performance of the remedial action; consolidation of the surficial roofing debris at the site; and phased construction of an engineered cap in conjunction with new development that is planned to cover the majority of the site area. The building and pavement development footprint will be engineered to control stormwater runoff that would otherwise infiltrate through the demolition debris and the project design and construction will incorporate management of landfill gas.

If redevelopment does not proceed, the recommended cleanup provides for implementation of the following institutional controls and monitoring as appropriate for continued industrial use: notice on the property deed to notify future owners of the presence of COCs under the property; a deed restriction with conditions to prevent extraction and use of groundwater at the site and prohibit soil excavation without proper health and safety procedures; access controls in the form of fencing and prominent signage at site access points; erosion controls; and groundwater (and surface water if necessary) monitoring. This cleanup action would achieve the primary RAO by preventing future human contact with the demolition debris and would also provide monitoring to confirm that COCs are not migrating to surrounding surface waters at concentrations above industrial cleanup levels.

18.2 Implementation Schedule

The following elements of Alternative 3 may be implemented within weeks after issuance of a cleanup action plan:

- Preparation and filing of deed notices and restrictive covenants;

- Preparation of a health and safety plan in accordance with WAC 173-340-810, to address requirements for workers excavating in the demolition debris;

- Consolidation of roofing debris away from the southern shoreline to the site interior;

- Preparation of a sampling and analysis plan in accordance with WAC 173-340-820 for groundwater compliance monitoring;

- Engineering design of the landfill gas management system.

The elements listed above are not dependent upon other agency time lines. The following remedial tasks would begin in conjunction with the City of Kenmore development time lines, and be completed over the course of development:

- Phased construction of the development and cap.

- Phased construction of the landfill gas management system, which will be incorporated in the building and pavement development footprint to ensure that landfill gas does not accumulate beneath the development.

18.3 Justification for Selection of Recommended Cleanup Action

If redevelopment proceeds, Alternative 3 will result in short-term safeguards to groundwater quality at the conditional point of compliance, address health department concerns over roofing debris located near the shoreline, and attain the RAOs. Institutional controls will be implemented at the outset of the project to protect workers during construction, and groundwater monitoring will take place to verify effectiveness of remediation efforts through and after completion of each phase of redevelopment.

If the site remains industrial, implementation of the Alternative 2 elements appropriate for continued industrial use will provide immediate and long-term safeguards to achieve the primary objective of preventing human contact with landfilled demolition debris by controlling site access, notifying future owners of COCs, prohibiting soil excavation without proper health and safety procedures, and restricting extraction and use of site groundwater. Groundwater cleanup levels are currently met at the conditional point of compliance. However, continued monitoring will be used to achieve the secondary remedial objective by confirming that COCs in groundwater are not migrating to surrounding surface waters at concentrations above proposed industrial cleanup levels. Appropriate erosion controls will be used to achieve the secondary remedial objective by limiting stormwater flow to adjacent surface waters.

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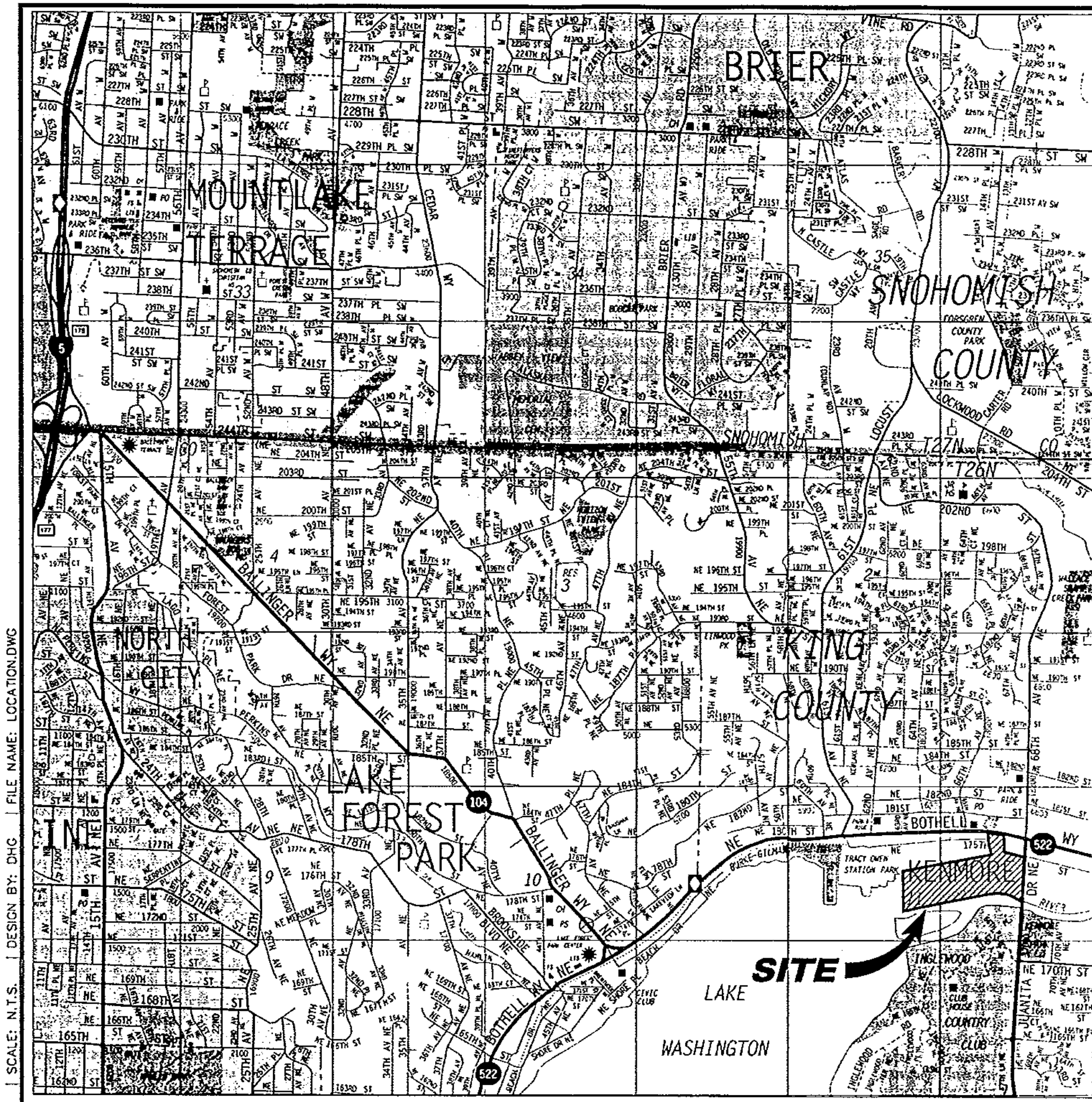
FIGURES



N.T.S.

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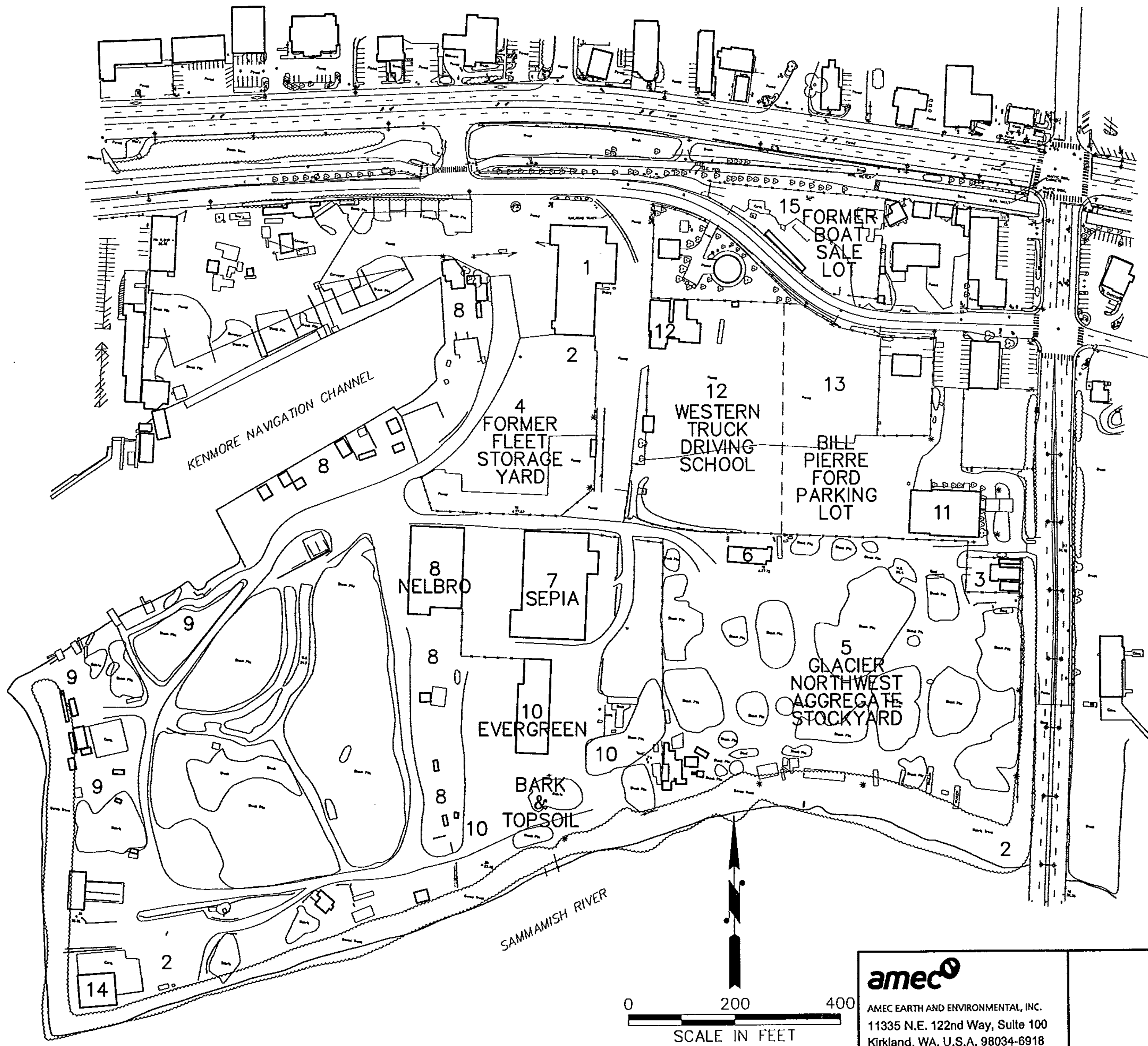
LOCATION MAP

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 1

JOB NO.: 7-91M-10459-D-RF | DWG DATE: 04-04-2001 | DESIGN BY: DHG | FILE NAME: LOCATION.DWG | SCALE: N.T.S.



KEY TO BUSINESSES

	CURRENT/FORMER OPERATORS	OPERATORS
1.	PIONEER TOWING CO., INC.	OFFICE
2.	PIONEER TOWING CO., INC.	DEMOLITION LANDFILL
3.	PIONEER TOWING CO., INC.	RV STORAGE
1.	GLACIER NORTHWEST	OFFICE
1.	GLACIER NORTHWEST	EQUIPMENT REPAIR SHOP
4.	GLACIER NORTHWEST	FLEET YARD
5.	GLACIER NORTHWEST	AGGREGATE STOCKYARD
6.	STERLING ASPHALT	FORMER PCS STOCKPILES
7.	SEPIA DESIGN	OFFICE INTERIOR DESIGN WAREHOUSE
8.	NELBRO PACKING	STAGING WAREHOUSE FOR COMMERCIAL FISHING OPERATIONS, WHARFS, OUTDOOR STORAGE
9.	WATERFRONT CONSTRUCTION	BULKHEAD, DOCK AND SHORELINE CONSTRUCTION CONTRACTOR'S STAGING YARD
10.	EVERGREEN TOPSOIL	LANDSCAPING MATERIALS
10.	FORMER STOUT ROOFING	ROOFING CONTRACTOR AND ROOFING WASTE RECYCLING
11.	CUSTOM INDUSTRIES	CHARITABLE DONATION, COLLECTION, REPAIR AND SALES
6.	ALBRECHT BIRKENBUEL CONTRACTOR	CONCRETE FINISHING CONTRACTOR
12.	WESTERN TRUCK DRIVING SCHOOL	COMMERCIAL TRUCK DRIVING SCHOOL
12.	FORMER OLYMPIC FOREST PRODUCTS	LUMBERYARD, WAREHOUSE AND OFFICE
2.	ALYESKA	STAGING OF EQUIPMENT AND STRUCTURES BOUND FOR ALASKA NORTHSLOPE
2.	OLYMPIC PREFAB	MANUFACTURER OF MODULAR OFFICE UNITS BOUND FOR ALASKA NORTHSLOPE
2.	SQUIRE DEVELOPMENT	NO KNOWN OPERATIONS
13.	BILL PIERRE FORD	NEW AUTOMOBILE STORAGE YARD
15.	WASHINGTON WATER SPORTS	RECREATIONAL BOAT SALES LOT
15.	SKIMASTERS WATER SPORTS	RECREATIONAL BOAT SALES LOT

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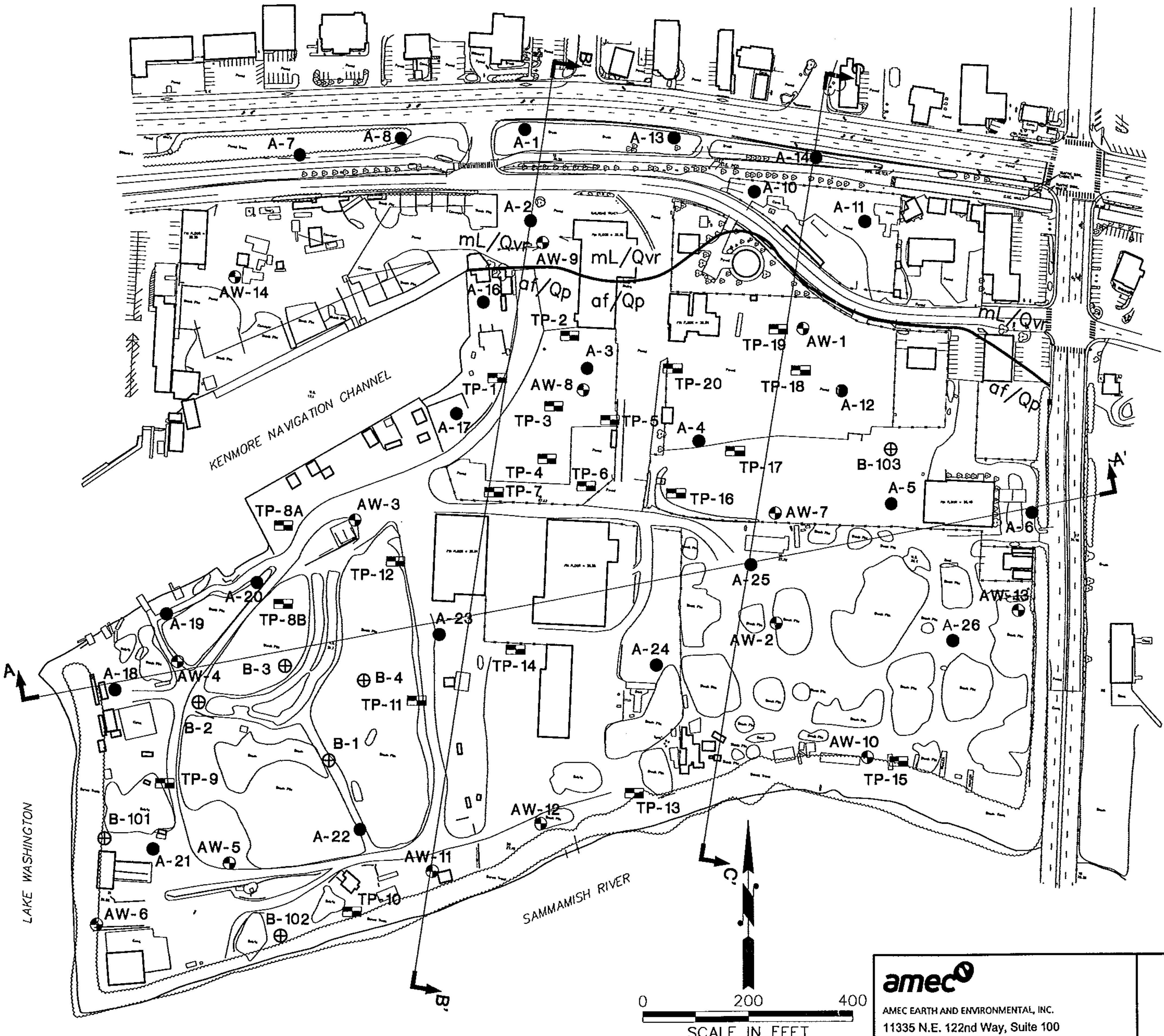
KEY TO CURRENT/FORMER BUSINESSES

KENMORE INDUSTRIAL PARK

KENMORE, WASHINGTON

FIGURE 2

JOB NO.: 6-91 0459-D-RF | DWG DATE: 04-26-2001 | SCALE: 1"=200' | DESIGN BY: DHG | F NAME: FIG-2.DWG



LEGEND

AW-14	GROUNDWATER MONITORING WELL NUMBER AND LOCATION
B-103	APPROXIMATE LOCATION OF FORMER WELLS INSTALLED BY OTHERS
A-26	GEOTECHNICAL BORING NUMBER AND LOCATION
TP-20	TEST PIT NUMBER AND LOCATION
A A'	ALIGNMENT OF GENERALIZED GEOLOGIC CROSS SECTION
mL/Qvr / af/Qp	GEOLOGIC CONTACT (DASHED WHERE INFERRED)

mL – MODIFIED LAND

ORIGINAL TOPOGRAPHY DISTURBED BY REMOVAL OF SOME PLEISTOCENE DEPOSITS, GRADING AND ARTIFICIAL FILL OF UNKNOWN QUALITY.

af – ARTIFICIAL FILL

ORIGINAL TOPOGRAPHY MODIFIED BY PLACEMENT OF SIGNIFICANT THICKNESS OF ARTIFICIAL FILL. COMPRISES THE DEMOLITION DEBRIS FILL DESCRIBED IN SUBSURFACE EXPLORATIONS.

af/Qp – PEAT

SIGNIFICANT THICKNESS OF ARTIFICIAL FILL OVER ACCUMULATIONS OF ORGANIC MATERIAL. MAY CONTAIN SMALL AMOUNTS OF SAND, SILT, CLAY AND VOLCANIC ASH DEPOSITED IN SWAMPS AND BAYS.

mL/Qvr – VASHON RECESSIONAL OUTWASH

ORIGINAL TOPOGRAPHY DISTURBED.
LIGHT BROWN, LOOSELY COMPACTED SAND AND GRAVEL, WELL-ROUNDED FROM STREAM TRANSPORTATION. SORTING VARIES; PARTICLE SIZE VARIES FROM MEDIUM SAND TO COBBLES.

NOTES: INFORMATION REGARDING THE EXTENT OF PEAT SOILS WAS SUPPLEMENTED BY PREVIOUS STUDIES PERFORMED FOR RIGHT-OF-WAYS AND FOR METRO SEWER STATION, AND BY REVIEW OF AERIAL PHOTOGRAPHS OF THE SITE AND VICINITY.

THE GEOLOGIC DEPOSITS SHOWN REPRESENT NATIVE SOIL CONDITIONS BELOW ARTIFICIAL FILLS.

* MONITORING WELLS INSTALLED BY OTHERS. REFER TO REVISED: PHASE II ENVIRONMENTAL STUDY – KENMORE PRE-MIX SITE, BY GEOTECH CONSULTANTS, INC., DATED 24 JANUARY 1991.

REFERENCE:
U.S. GEOLOGICAL SURVEY (USGS) GEOLOGICAL MAP OM-14, "PRELIMINARY SURFICAL GEOLOGIC MAP OF THE EDMONDS EAST AND EDMONDS WEST QUADRANGLES, SNOHOMISH AND KING COUNTIES, WASHINGTON (1975).

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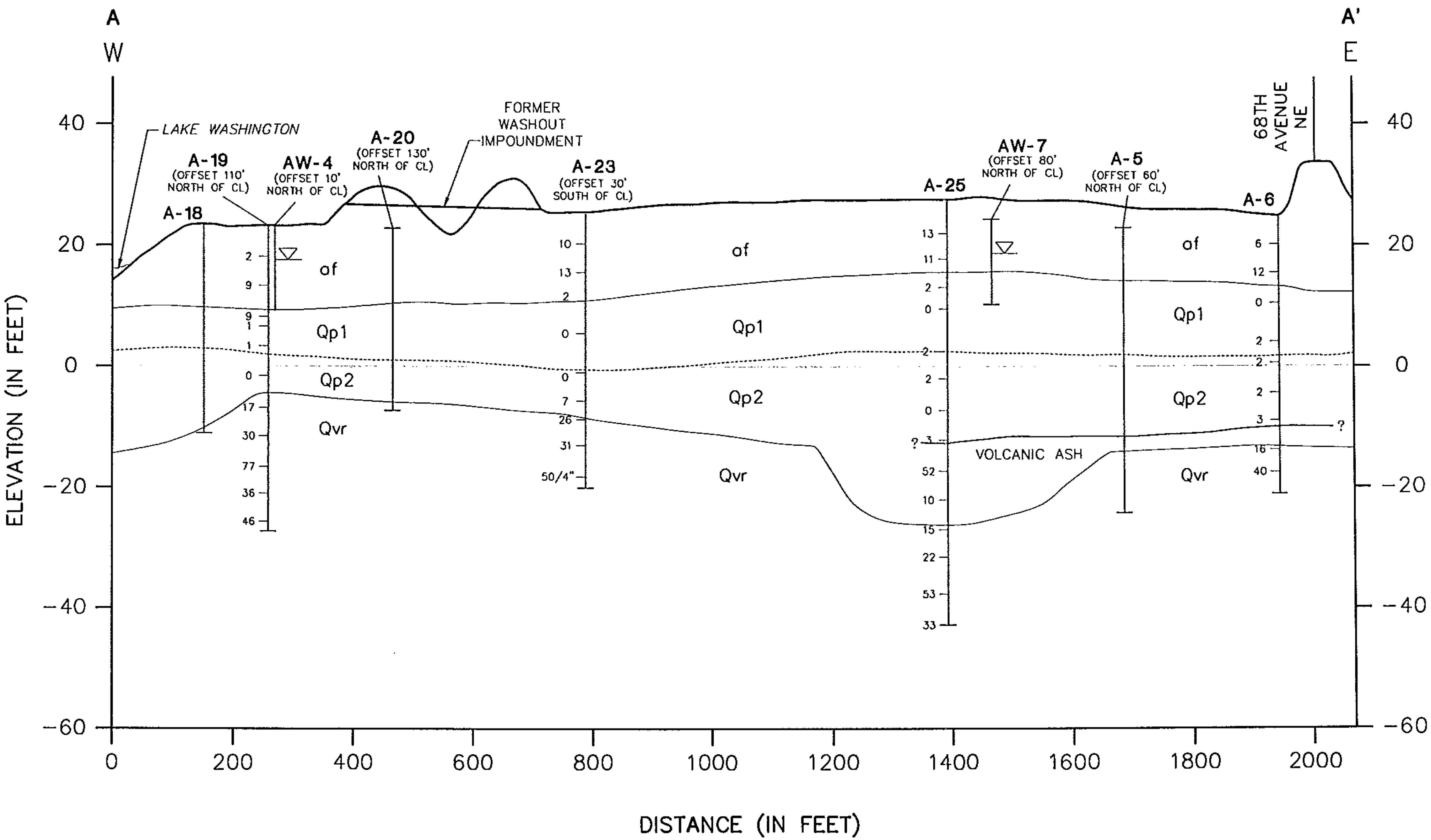
SITE & EXPLORATION PLAN

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 3

JOB NO.: 6-91M?159-D-RF | DWG DATE: 06-20-2001 | SCALE: 1"=200' | DESIGN BY: DHG | NAME: FIG-3.DWG



mL – MODIFIED LAND

ORIGINAL TOPOGRAPHY DISTURBED BY REMOVAL OF SOME PLEISTOCENE DEPOSITS, GRADING AND ARTIFICIAL FILL OF UNKNOWN QUALITY.

of – ARTIFICIAL FILL

ORIGINAL TOPOGRAPHY MODIFIED BY PLACEMENT OF SIGNIFICANT THICKNESS OF ARTIFICIAL FILL. COMPRISES THE DEMOLITION DEBRIS FILL DESCRIBED IN SUBSURFACE EXPLORATIONS.

Qp – PEAT

ACCUMULATION OF ORGANIC MATERIAL (Qp1)
LOOSE ALLUVIUM.
MAY CONTAIN SMALL AMOUNTS OF SAND, SILT, CLAY AND VOLCANIC ASH DEPOSITED IN SWAMPS AND BOGS (Qp2)

Qvr – VASHON RECESSIONAL OUTWASH

LIGHT BROWN, LOOSELY COMPACTED SAND AND GRAVEL, WELL-ROUNDED FROM STREAM TRANSPORTATION. SORTING VARIES; PARTICLE SIZE VARIES FROM MEDIUM SAND TO COBBLES. NOT DIFFERENTIATED FROM MORE RECENT ALLUVIUM, THAT MAY CONTAIN SILT, CLAY AND ORGANIC MATTER.

Qvt – VASHON TILL

POORLY SORTED, NONSTRATIFIED LODGMENT TILL DEPOSITED AS GROUND MORAINE. MIXTURE OF CLAY, SILT, SAND, PEBBLES AND COBBLES WITH OCCASIONAL LARGE BOULDERS. STONES ARE SUBANGULAR TO ROUNDED.

LEGEND

A-25 – SOIL BORING/MONITORING WELL NUMBER AND LOCATION

OBSERVED GROUNDWATER LEVEL

53 – BLOW COUNT (BLOWS/FOOT)

APPROXIMATE BOUNDARY OF GEOLOGIC UNIT

APPROXIMATE BOUNDARY BETWEEN ORGANIC PEATS (Qp1) AND ALLUVIUM (Qp2)

ELEVATION 0 (KING COUNTY BENCHMARK "KC-B-16")

BOTTOM OF HOLE

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

REFERENCE:
U.S. GEOLOGICAL SURVEY (USGS) GEOLOGICAL MAP OM-14, "PRELIMINARY SURFICAL GEOLOGIC MAP OF THE EDMONDS EAST AND EDMONDS WEST QUADRANGLES, SNOHOMISH AND KING COUNTIES, WASHINGTON (1975).

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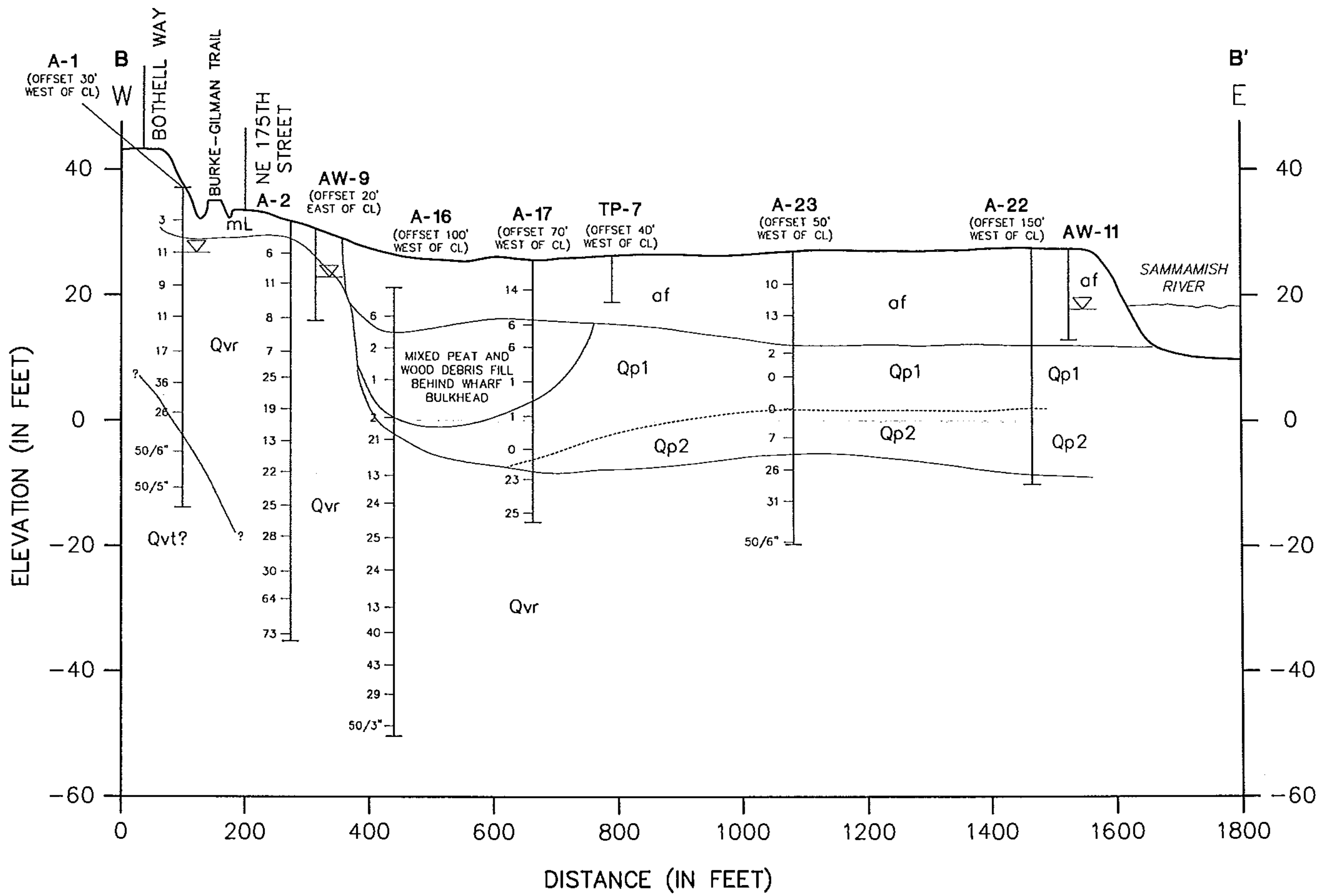
GENERALIZED GEOLOGIC CROSS-SECTON A-A'

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 4

JOB NO.: 7-91 459-0-RF | DWG DATE: 04-04-2001 | SCALE: 1"=200' | DESIGN BY: DHC | FILE NAME: FIG-4.DWG



LEGEND

A-25 SOIL BORING/MONITORING WELL NUMBER AND LOCATION

OBSERVED GROUNDWATER LEVEL

53 BLOW COUNT (BLOWS/FOOT)

APPROXIMATE BOUNDARY OF GEOLOGIC UNIT

APPROXIMATE BOUNDARY BETWEEN ORGANIC PEATS (Qp1) AND ALLUVIUM (Qp2)

ELEVATION 0 (KING COUNTY BENCHMARK "KC-B-16")

BOTTOM OF HOLE

mL – MODIFIED LAND

ORIGINAL TOPOGRAPHY DISTURBED BY REMOVAL OF SOME PLEISTOCENE DEPOSITS, GRADING AND ARTIFICIAL FILL OF UNKNOWN QUALITY.

af – ARTIFICIAL FILL

ORIGINAL TOPOGRAPHY MODIFIED BY PLACEMENT OF SIGNIFICANT THICKNESS OF ARTIFICIAL FILL. COMPRISES THE DEMOLITION DEBRIS FILL DESCRIBED IN SUBSURFACE EXPLORATIONS.

Qp – PEAT

ACCUMULATION OF ORGANIC MATERIAL (Qp1)
LOOSE ALLUVIUM.
MAY CONTAIN SMALL AMOUNTS OF SAND, SILT, CLAY AND VOLCANIC ASH DEPOSITED IN SWAMPS AND BOGS (Qp2)

Qvr – VASHON RECESSIONAL OUTWASH

LIGHT BROWN, LOOSELY COMPACTED SAND AND GRAVEL, WELL-ROUNDED FROM STREAM TRANSPORTATION. SORTING VARIES; PARTICLE SIZE VARIES FROM MEDIUM SAND TO COBBLES. NOT DIFFERENTIATED FROM MORE RECENT ALLUVIUM, THAT MAY CONTAIN SILT, CLAY AND ORGANIC MATTER.

Qvt – VASHON TILL

POORLY SORTED, NONSTRATIFIED LODGMENT TILL DEPOSITED AS GROUND MORAINE. MIXTURE OF CLAY, SILT, SAND, PEBBLES AND COBBLES WITH OCCASIONAL LARGE BOULDERS. STONES ARE SUBANGULAR TO ROUNDED.

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

REFERENCE:
U.S. GEOLOGICAL SURVEY (USGS) GEOLOGICAL MAP OM-14, "PRELIMINARY SURFICAL GEOLOGIC MAP OF THE EDMONDS EAST AND EDMONDS WEST QUADRANGLES, SNOHOMISH AND KING COUNTIES, WASHINGTON (1975).

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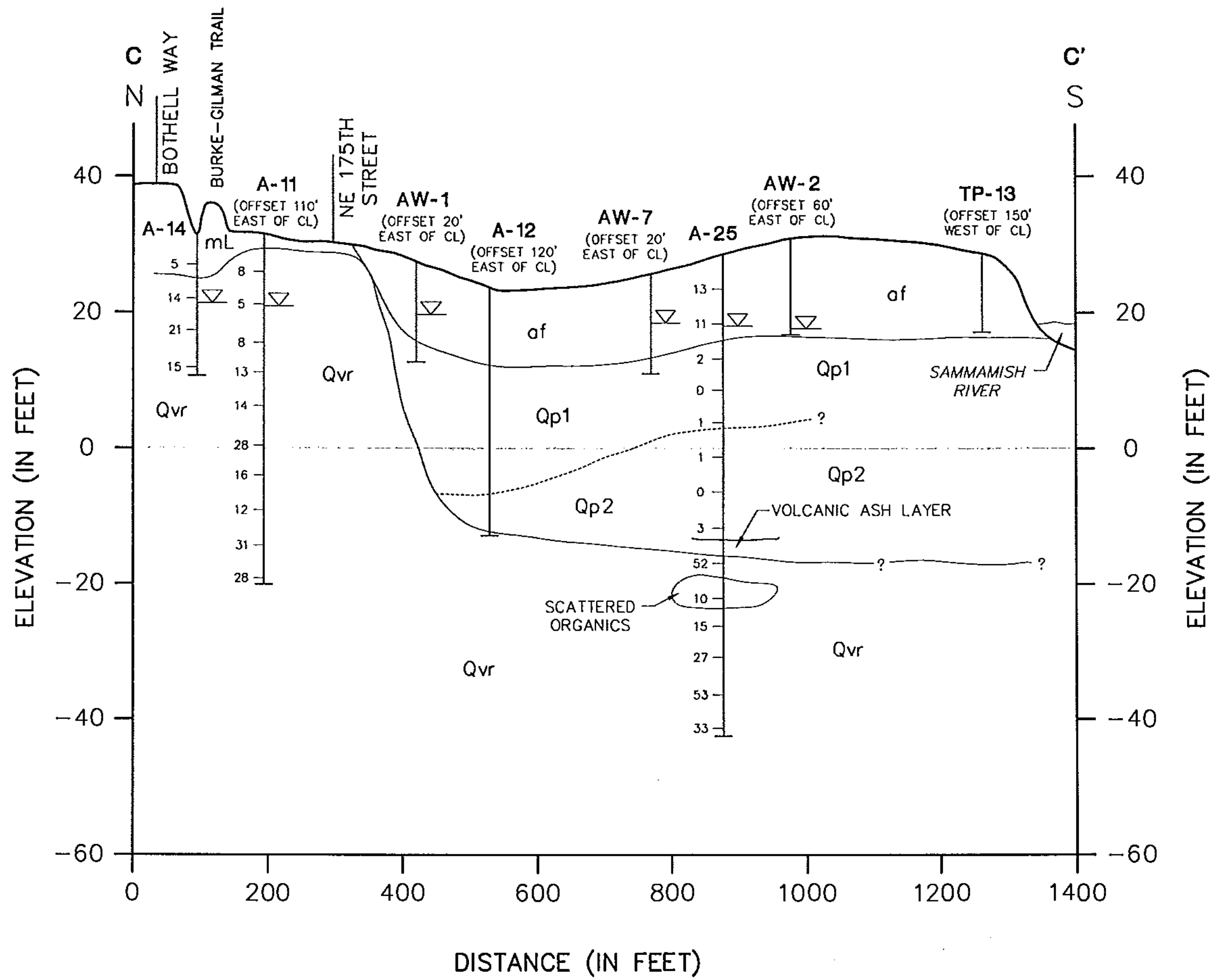
GENERALIZED GEOLOGIC CROSS-SECTION B-B'

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 5

JOB NO.: 7-91M-?0459-D-RF | DWG DATE: 04-04-2001 | SCALE: 1"=200' | DESIGN BY: DHG | FILE NAME: FIG-5.DWG



mL – MODIFIED LAND

ORIGINAL TOPOGRAPHY DISTURBED BY REMOVAL OF SOME PLEISTOCENE DEPOSITS, GRADING AND ARTIFICIAL FILL OF UNKNOWN QUALITY.

af – ARTIFICIAL FILL

ORIGINAL TOPOGRAPHY MODIFIED BY PLACEMENT OF SIGNIFICANT THICKNESS OF ARTIFICIAL FILL. COMPRISES THE DEMOLITION DEBRIS FILL DESCRIBED IN SUBSURFACE EXPLORATIONS.

Qp – PEAT

ACCUMULATION OF ORGANIC MATERIAL (Qp1)
LOOSE ALLUVIUM.
MAY CONTAIN SMALL AMOUNTS OF SAND, SILT, CLAY AND VOLCANIC ASH DEPOSITED IN SWAMPS AND BOGS (Qp2)

Qvr – VASHON RECESSIONAL OUTWASH

LIGHT BROWN, LOOSELY COMPACTED SAND AND GRAVEL, WELL-ROUNDED FROM STREAM TRANSPORTATION. SORTING VARIES; PARTICLE SIZE VARIES FROM MEDIUM SAND TO COBBLES. NOT DIFFERENTIATED FROM MORE RECENT ALLUVIUM, THAT MAY CONTAIN SILT, CLAY AND ORGANIC MATTER.

Qvt – VASHON TILL

POORLY SORTED, NONSTRATIFIED LODGMENT TILL DEPOSITED AS GROUND MORAINE. MIXTURE OF CLAY, SILT, SAND, PEBBLES AND COBBLES WITH OCCASIONAL LARGE BOULDERS. STONES ARE SUBANGULAR TO ROUNDED.

LEGEND

A-25 — SOIL BORING/MONITORING WELL NUMBER AND LOCATION
OBSERVED GROUNDWATER LEVEL
53 — BLOW COUNT (BLOWS/FOOT)
APPROXIMATE BOUNDARY OF GEOLOGIC UNIT
APPROXIMATE BOUNDARY BETWEEN ORGANIC PEATS (Qp1) AND ALLUVIUM (Qp2)
ELEVATION 0 (KING COUNTY BENCHMARK "KC-B-16")
BOTTOM OF HOLE

0 20 40
VERTICAL SCALE IN FEET

0 200 400
HORIZONTAL SCALE IN FEET

REFERENCE:
U.S. GEOLOGICAL SURVEY (USGS) GEOLOGICAL MAP OM-14, "PRELIMINARY SURFICAL GEOLOGIC MAP OF THE EDMONDS EAST AND EDMONDS WEST QUADRANGLES, SNOHOMISH AND KING COUNTIES, WASHINGTON (1975).

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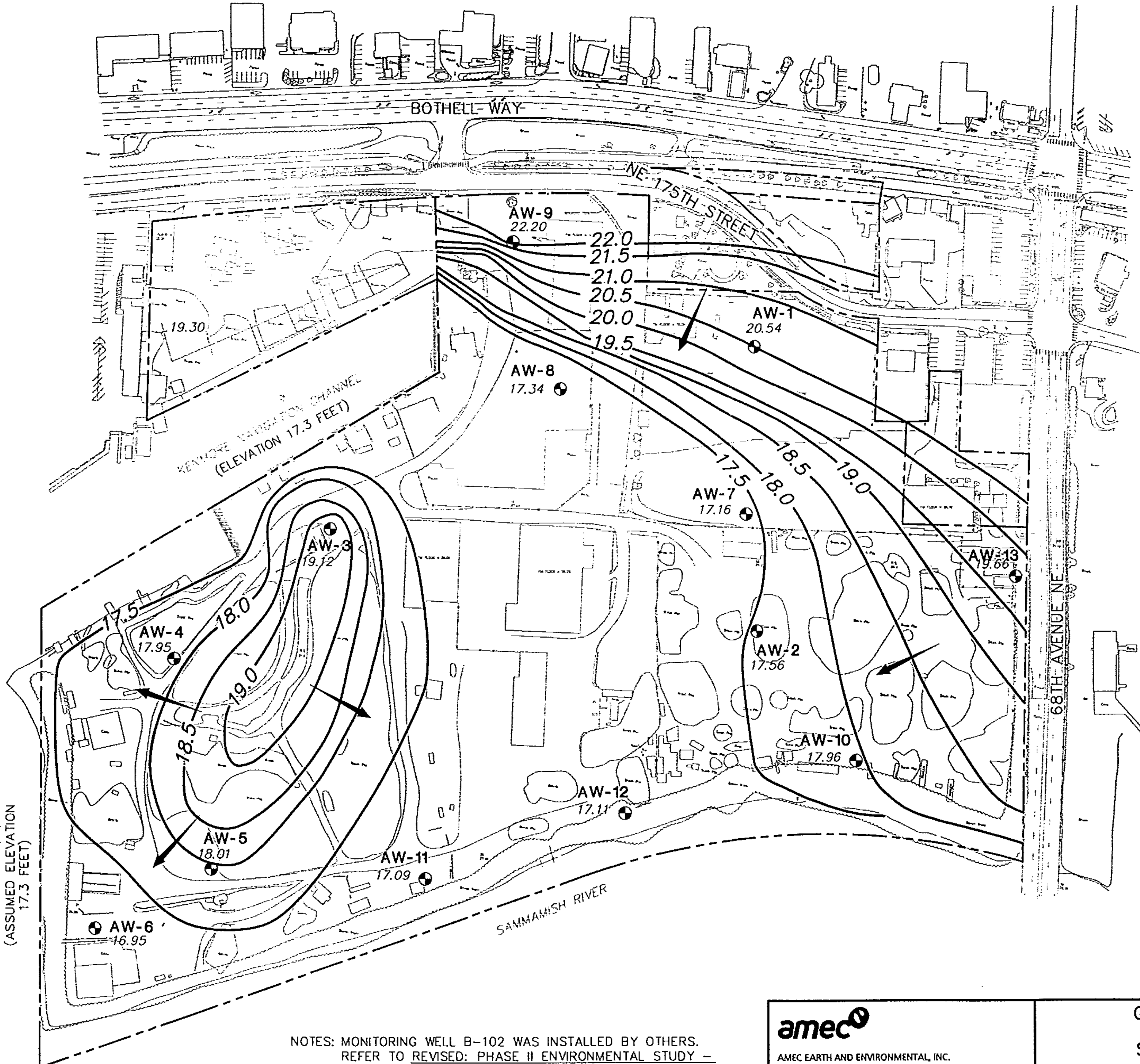
GENERALIZED GEOLOGIC CROSS-SECTION C–C'

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 6

JOB NO.: 7-91M-20459-D-RF | DWG DATE: 04-04-20018 | SCALE: 1"=200' | DESIGN BY: DHG | FILE NAME: FIG-6.DWG



LEGEND

AW-13 MONITORING WELL NUMBER AND LOCATION

—22.0— INFERRED GROUNDWATER SURFACE ELEVATION CONTOUR IN FEET

22.20 SPOT GROUNDWATER SURFACE ELEVATION IN FEET

INFERRED DIRECTION OF GROUNDWATER MIGRATION

BULKHEAD BARRIER

PROPERTY BOUNDARY

NOTES: MONITORING WELL B-102 WAS INSTALLED BY OTHERS. REFER TO REVISED: PHASE II ENVIRONMENTAL STUDY – KENMORE PRE-MIX SITE, BY GEOTECH CONSULTANTS, INC., DATED 24 JANUARY 1991.

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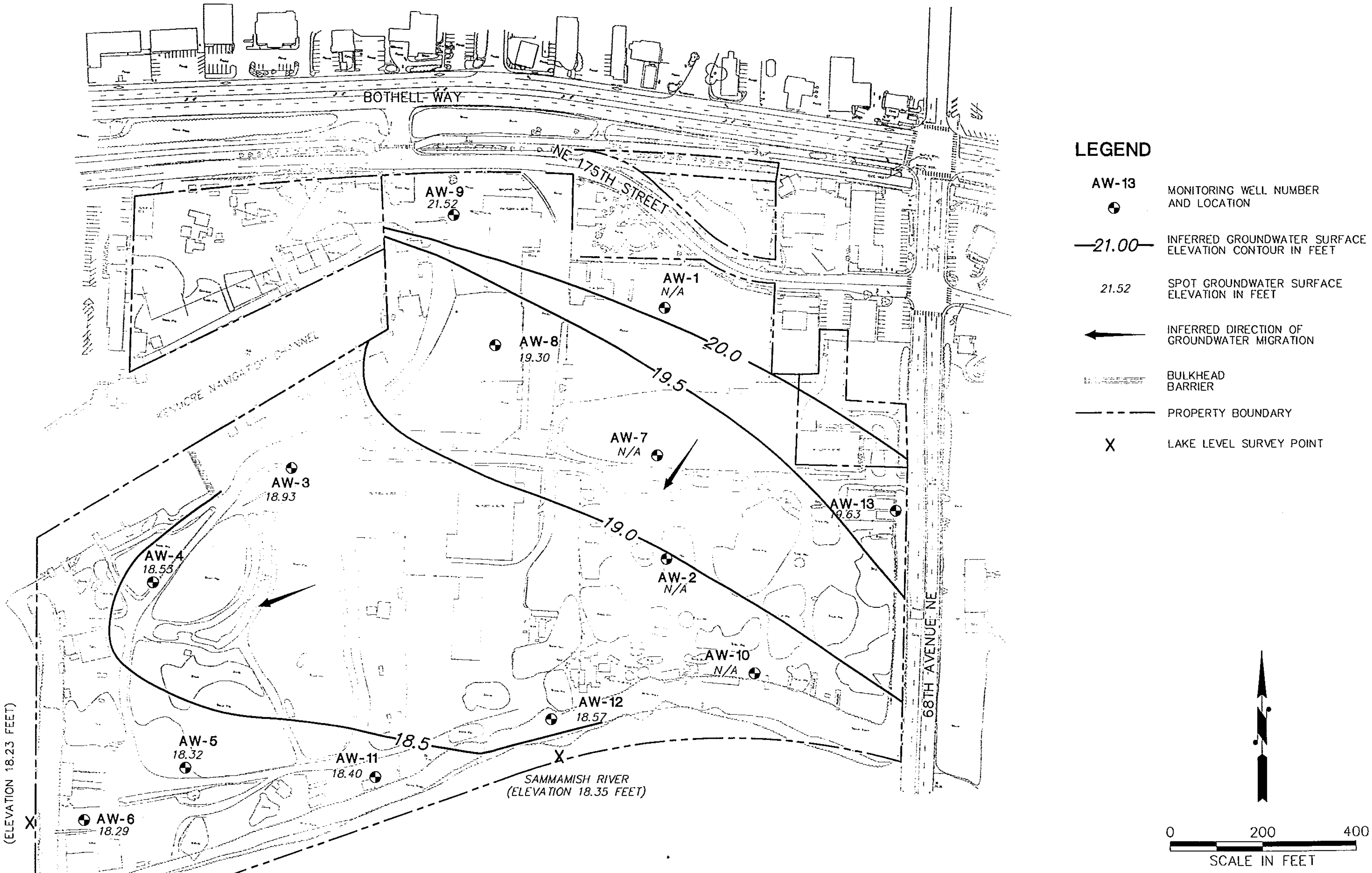
GROUNDWATER CONTOUR MAP FOR 22 DECEMBER 1997 SEASONAL LOW LAKE LEVELS

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 7

JOB NO.: 6-91M-10459-D-RF | DWG DATE: 04-04-2001 | SCALE: 1"=200' | DESIGN BY: DHG | FILE NAME: FIG-7.DWG



NOTES: MONITORING WELL B-102 WAS INSTALLED BY OTHERS. REFER TO REVISED: PHASE II ENVIRONMENTAL STUDY – KENMORE PRE-MIX SITE, BY GEOTECH CONSULTANTS, INC., DATED 24 JANUARY 1991.

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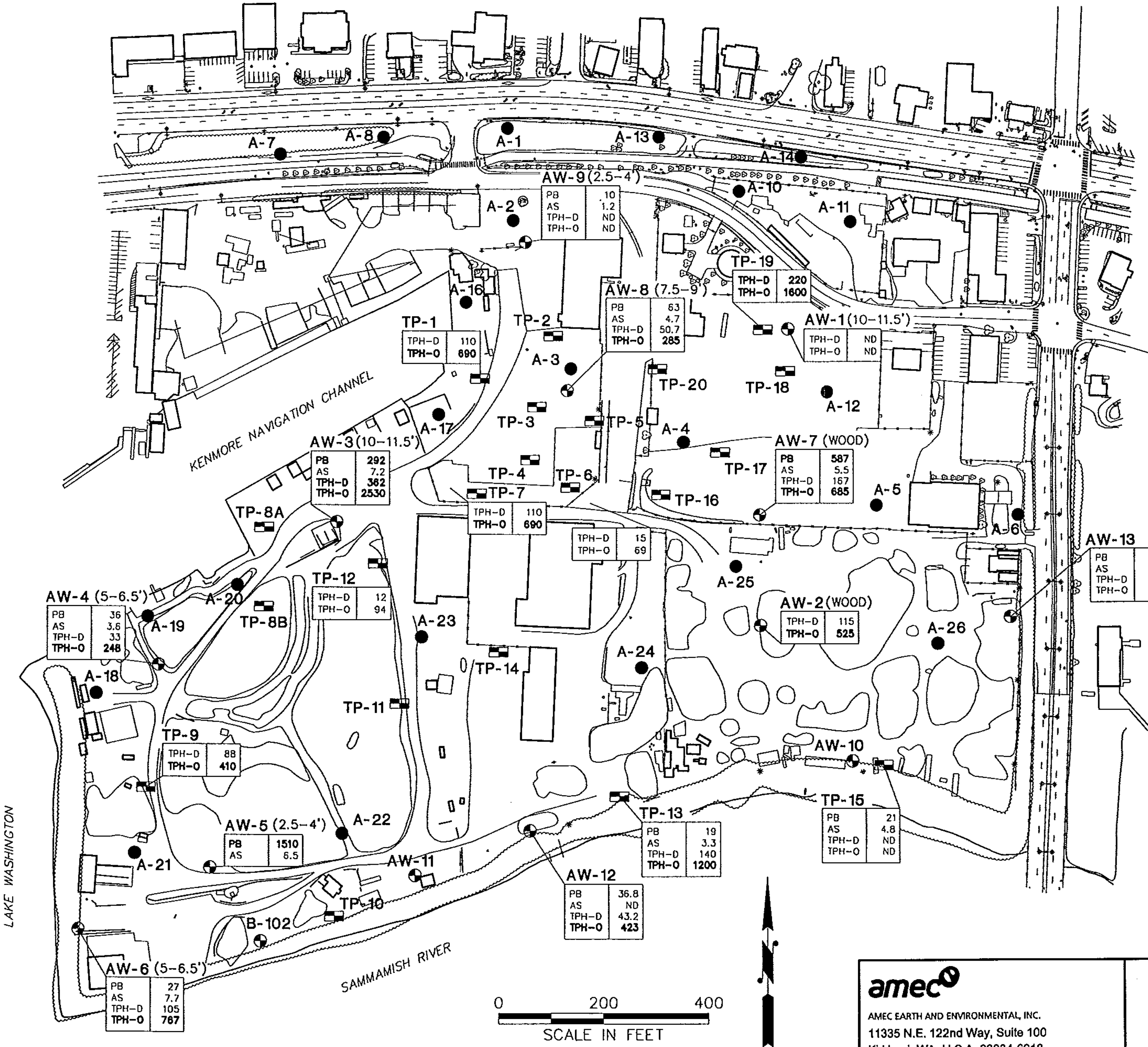
GROUNDWATER CONTOUR MAP
FOR 26 AND 27 MARCH 2001
SEASONAL HIGH LAKE LEVELS
KENMORE INDUSTRIAL PARK
KING COUNTY, WASHINGTON

FIGURE 8

JOB NO.: 6-91M?2459-0-RF | DWG DATE: 04-05-2001 | SCALE: 1"=200' | DESIGN BY: DHG | ... NAME: FIG-8.DWG



LEGEND

AW-14 — GROUNDWATER MONITORING WELL NUMBER AND LOCATION

A-26 — GEOTECHNICAL BORING NUMBER AND LOCATION

TP-20 — TEST PIT NUMBER AND LOCATION

(2.5-4') — SAMPLE DEPTH COLLECTED (IN FEET)

(WOOD) — NO SOIL SAMPLE OBTAINED DURING EXPLORATION. ANALYSES PERFORMED ON WOOD CUTTINGS.

SOIL TEST RESULTS

ALL CONCENTRATIONS ARE REPORTED IN PARTS PER MILLION (PPM)

ND — NOT DETECTED, BELOW METHOD DETECTION LIMIT

PB — TOTAL LEAD BY EPA METHOD 6010/7000

AS — TOTAL ARSENIC BY EPA METHOD 6010/7000

TPH-D — TOTAL PETROLEUM HYDROCARBONS - DIESEL RANGE BY ECOLOGY METHOD WTPH-D EXT.

TPH-O — TOTAL PETROLEUM HYDROCARBONS - HEAVY OIL RANGE BY ECOLOGY METHOD WTPH-D EXT.

PB	**587**
AS	ND
TPH-D	ND
TPH-O	ND

BOLD TEXT DENOTES CONCENTRATION IN EXCESS OF MTCA CLEANUP STANDARD

CONCENTRATIONS IN PPM

COMPOUNDS

NOTES: OTHER COMPOUNDS ARE PRESENT. PLEASE REFER TO THE REPORT TEXT FOR FURTHER DISCUSSION OF ANALYTICAL RESULTS.

MONITORING WELL B-102 WAS INSTALLED BY OTHERS. REFER TO REVISED: PHASE II ENVIRONMENTAL STUDY - KENMORE PRE-MIX SITE, BY GEOTECH CONSULTANTS, INC., DATED 24 JANUARY 1991.

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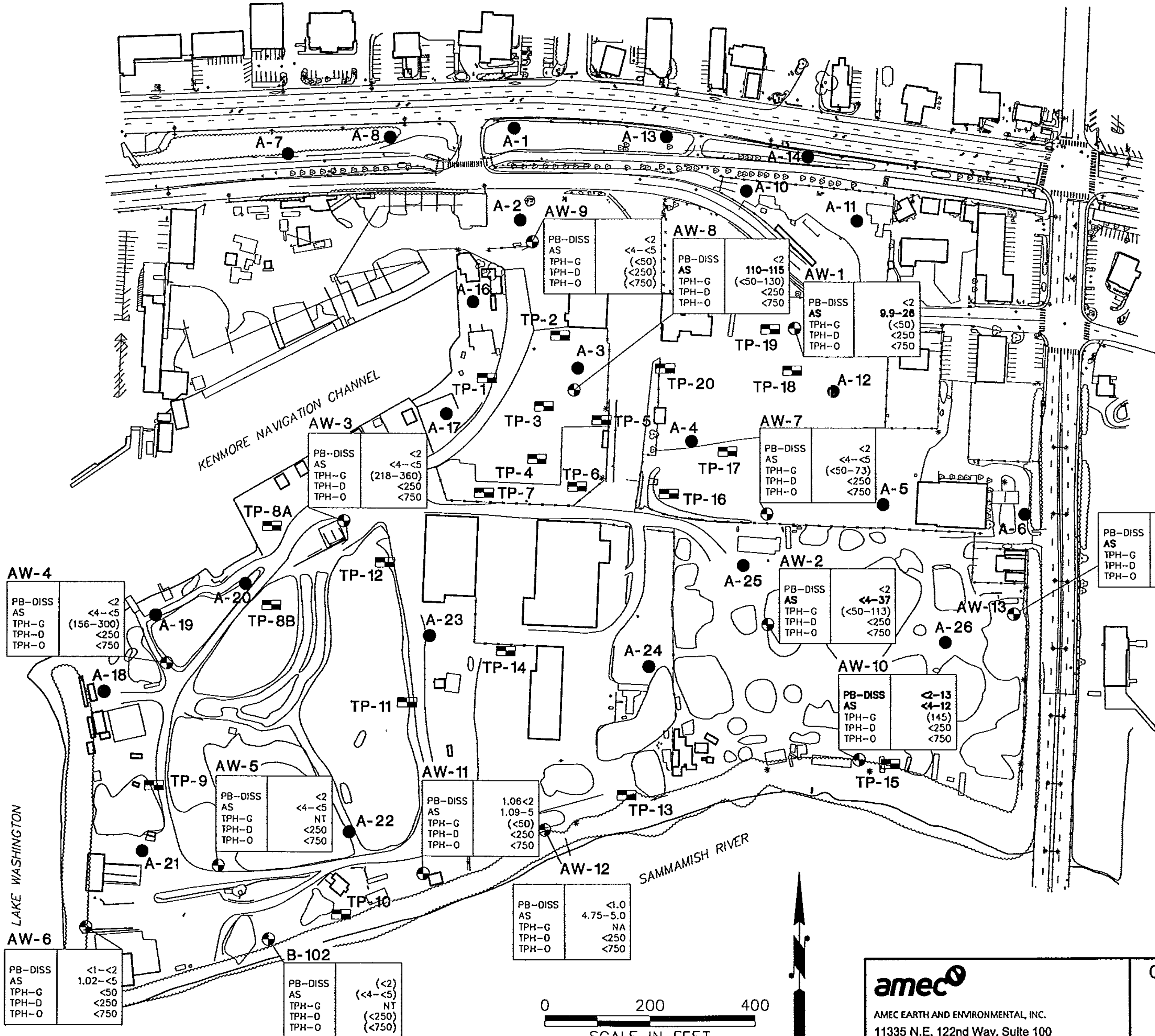
SOIL CONTAMINANT CONCENTRATIONS

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 9

JOB NO.: 6-91459-D-RF | DWG DATE: 04-05-2001 | SCALE: 1"=200' | DESIGN BY: DHG | NAME: FIG-9.DWG



LEGEND

AW-14 GROUNDWATER MONITORING WELL NUMBER AND LOCATION

A-26 GEOTECHNICAL BORING NUMBER AND LOCATION

TP-20 TEST PIT NUMBER AND LOCATION

GROUNDWATER TEST RESULTS

CONCENTRATIONS IN MICROGRAMS PER LITER (μg/L)

ND	NOT DETECTED, BELOW METHOD DETECTION LIMIT
NA	NOT APPLICABLE
PB-DISS	DISSOLVED LEAD BY EPA METHOD 6010/7000
AS	TOTAL ARSENIC BY EPA METHOD 6010/7000
TPH-G	TOTAL PETROLEUM HYDROCARBONS – GASOLINE RANGE BY ECOLOGY METHOD WTPH-G.
TPH-D	TOTAL PETROLEUM HYDROCARBONS – DIESEL RANGE BY ECOLOGY METHOD WTPH-D EXT. WITH SILICA GEL CLEANUP
TPH-O	TOTAL PETROLEUM HYDROCARBONS – HEAVY OIL RANGE BY ECOLOGY METHOD WTPH-D EXT. WITH SILICA GEL CLEANUP

PB-DISS	ND
AS	**9**
TPH-G	(ND)
TPH-D	ND
TPH-O	ND

BOLD TEXT SIGNIFIES CONCENTRATION(S) IN EXCESS OF CLEANUP STANDARD

QUALIFIED DATA (SEE TABLE 1)

CONCENTRATIONS IN PPB

COMPOUNDS

NOTES:
1. EXCEPT FOR COLLECTION OF TPH-G SAMPLES, MICROPURGE TECHNIQUES WERE USED TO MINIMIZE TURBIDITY WHILE SAMPLING THE WELLS. CONCENTRATIONS ARE REPORTED AS A RANGE FROM TWO SAMPLING EVENTS.
2. TOTAL ARSENIC IS COMPARABLE TO DISSOLVED ARSENIC CONCENTRATIONS.
3. OTHER COMPOUNDS MAY BE PRESENT. PLEASE REFER TO THE REPORT TEXT FOR FURTHER DISCUSSION OF SAMPLING METHODOLOGY AND ANALYTICAL RESULTS.

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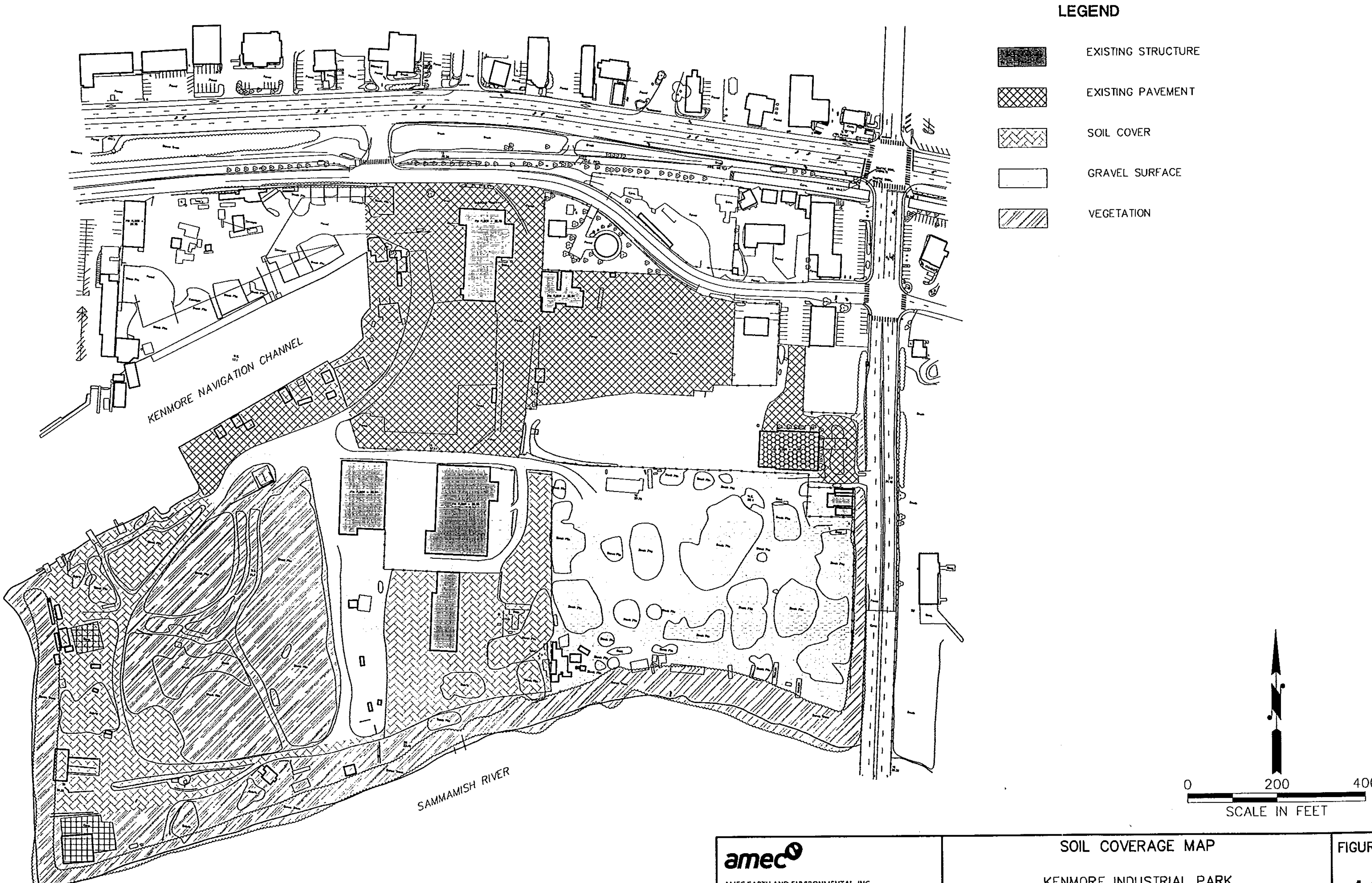
GROUNDWATER CONTAMINANT CONCENTRATIONS

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE 10

JOB NO.: 6-91M-459-D-RF | DWG DATE: 04-04-2001 | SCALE: 1"=200' | DESIGN BY: DHC | FILE NAME: FIG-10.DWG



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SOIL COVERAGE MAP

KENMORE INDUSTRIAL PARK

KING COUNTY, WASHINGTON

FIGURE

11

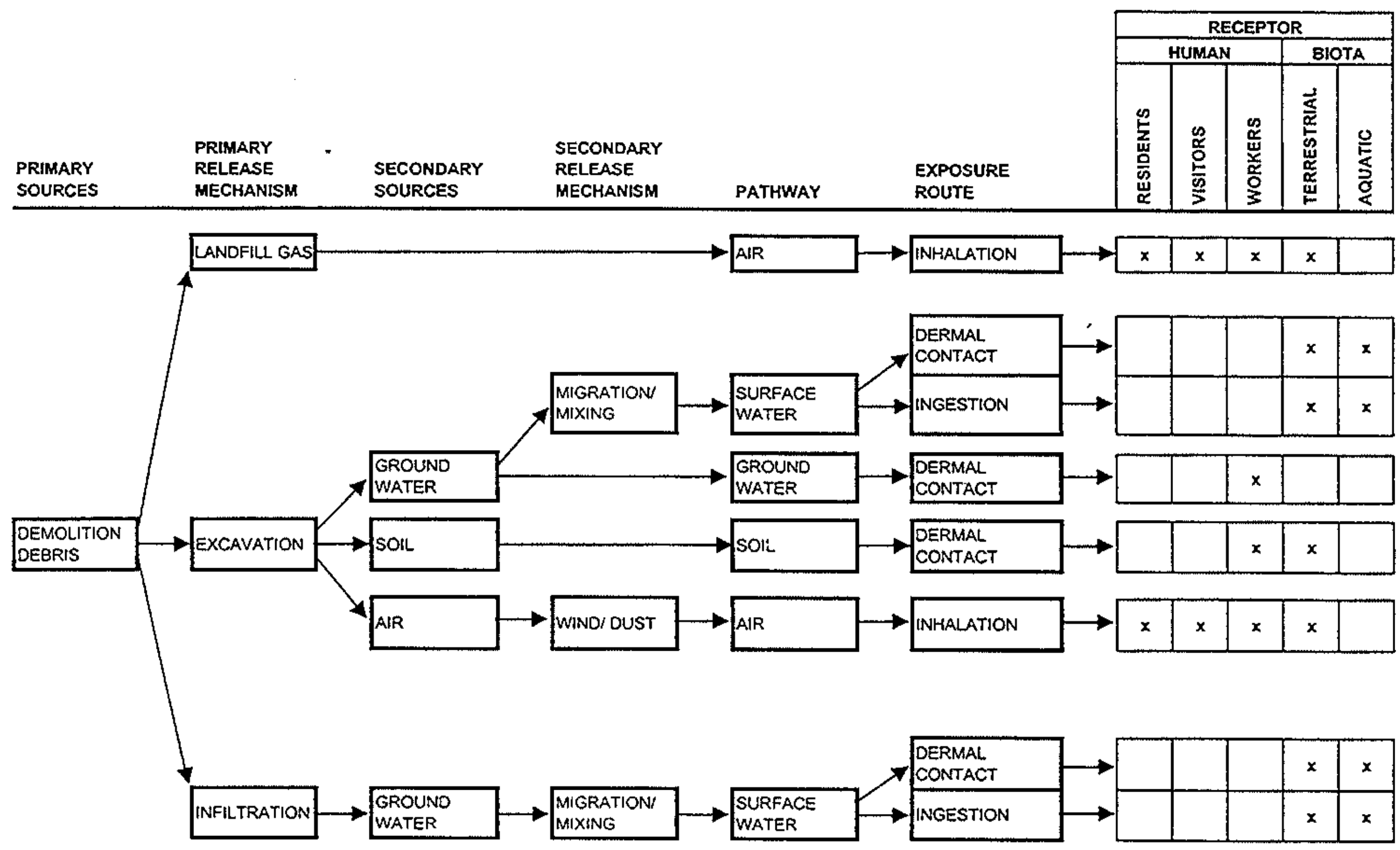
JOB NO.: 6-91K459-D-RF | DWG DATE: 04-05-2001 | SCALE: 1"=200' | DESIGN BY: DHG | NAME: SITE-11.DWG

Figure 12

EXPOSURE PATHWAY FLOW CHART

Lakepointe Development

Kenmore, Washington



TABLES

TABLE 3-1 CURRENT AND FORMER BUSINESS OPERATIONS ON SITE			
Key	**Business**	**Operations**	**Potential Contaminants**
Current Businesses			
1	Pioneer Towing Co. Inc.	Office	None known
1	Glacier Northwest	Office	None known
1	Pioneer Towing Co. Inc.	Equipment Repair Shop	Petroleum products
3	Pioneer Towing Co. Inc.	RV Storage	None known
5	Glacier Northwest	Aggregate Stockyard	None known
6	Albrecht Birkenbuel	Concrete finishing contractor	Concrete form release
7	Sepia Design	Office, interior design warehouse	None known
8	Nelbro Packing	Staging warehouse for commercial fishing operations, wharves, outdoor storage yard	Petroleum products
9	Waterfront Construction	Shoreline construction contractor's staging area	Petroleum products
10	Evergreen Topsoil	Landscaping materials	None known
11	Custom Industries	Charitable donation, collection, repair and sales store	None known
12	Western Truck Driving School	Office and training yard	None known
13	Bill Pierre Ford	New automobile storage lot	None known
Former Businesses			
2	Pioneer Towing Co. Inc.	Demolition landfill	Petroleum products and metals
2	Alyeska	Staging of equipment and structures bound for Alaskan northslope	None known
2	Olympic Prefab	Preparation of modular buildings bound for Alaskan northslope	None known
2	Squire Development	Former owner	None known
4	Glacier Northwest	Fleet storage yard	Petroleum products
6	Sterling Asphalt	Temporary PCS stockpiles	Petroleum products
10	Stout Roofing	Roofing contractor and roofing waste recycling	Non-friable ACM, wood leachate
12	Olympic Forest Products	Lumberyard, warehouse and office	None known
14	Pacific Ventures	Painting, sandblasting and refurbishment contractor	Petroleum products, metals, VOCs
15	Washington Water Sports	Recreational boat sales lot	None known
15	SkiMasters Water Sports	Recreational boat sales lot	None known

TABLE 3-2. SUMMARY OF ANALYTICAL DATASETS AND QUALIFICATIONS, KENMORE INDUSTRIAL PARK, KING COUNTY, WASHINGTON

Month/ Year Sampled	Firm/ Agency	Medium	Method	Data Quality	See Table
Various	AMEC	Water	Levels	Good	3-4
May-01	AMEC	Surface Water	Grab	Good	3-5E
Mar-01	AMEC	Surface Water	Grab	Good	SEE TEXT
Mar-01	AMEC	Groundwater	Micropurge	Good	3-5A,B,D
Jan-01	AMEC	Groundwater	Micropurge	Good - Lab noted anomalies due to low SVOC surrogate recoveries	3-5A,B,C
Oct-98	AMEC	Sediment	Grab	Good	3-6B
Sep-98	AMEC	Surface Water	Grab	Good	3-5E
Sep-98	AMEC	Groundwater	Micropurge	Good	3-5B
Dec-97	AMEC	Sediment	Grab	Good	3-6B
Nov-97	AMEC	Soil	Test Borings	Good	3-6A,B
Aug-96	AMEC	Groundwater	Bailer	Poor - Moderate sample turbidity	3-5A,B
Aug-96	AMEC	Groundwater	Micropurge	Good	3-5A,B
Aug-96	AMEC	Groundwater	Micropurge	Fair - Good sampling technique, poor well construction (B102)	3-5A-B
Apr-96	AMEC	Groundwater	Micropurge	Good	3-5A,B
Apr-96	AMEC	Groundwater	Micropurge	Fair - Good sampling technique, poor well construction (B102)	3-5A,B
Mar-96	AMEC	Groundwater	Bailer	Poor - Moderate sample turbidity	3-5A,B
Feb/Mar-96	AMEC	Soil	Grab	Good	3-6A,B,C
Feb-96	AMEC	Groundwater	Micropurge	Poor	3-5A,B
Oct-95	AMEC	Soil	Grab	Good	3-6A,B
Sep-95	AMEC	Groundwater	Bailer	Poor - Moderate sample turbidity Fair - Gasoline, VOC data	3-5A,B
Dec-91	SEACOR	Groundwater	Micropurge / Field Filter	Fair - Good sampling technique, poor well construction	3-5A,B
Nov-91	Ecology	Surface Water	Submersion	Fair - qualifications are stated in the SHA	3-5A,B
Nov-91	Ecology	Soil / Sediment	Grab	Fair - qualifications are stated in the SHA	3-6A
Jun-91	Geotech Consultants	Soil	Grab	Good	3-6A
Jun-91	Geotech Consultants	Water	Grab from Test Pits	Poor - High sample turbidity	3-5A
Dec-90	Geotech Consultants	Groundwater	Bailer	Poor - wells not purged or developed prior to sampling, high sample turbidity, organic interference, high method detection limits	3-5A,B

TABLE 3-3. SUMMARY OF MONITORING WELL CONDITIONS, KENMORE INDUSTRIAL PARK, KING COUNTY, WASHINGTON

Well No.	Installed by:	Year Installed	Last Sampled	Current Condition	Comments
B-1	Geotech Consultants	1990	1991	Destroyed	Requires closure under WAC 173-160-415
B-2	Geotech Consultants	1990	1991	Destroyed	Requires closure under WAC 173-160-415
B-3	Geotech Consultants	1990	1991	Destroyed	Requires closure under WAC 173-160-415
B-4	Geotech Consultants	1991	1991	Destroyed	Requires closure under WAC 173-160-415
B-101	Geotech Consultants	1991	1991	Destroyed	Requires closure under WAC 173-160-415
B-102	Geotech Consultants	1991	1997	Unknown	Constructed without monument - unable to locate.
B-103	Geotech Consultants	1991	1991	Destroyed	Requires closure under WAC 173-160-415
AW-1	AMEC	1995	1996	Poor	Monument rusted closed.
AW-2	AMEC	1995	1996	Unknown	Buried under gravel stockpile.
AW-3	AMEC	1995	2001	Good	
AW-4	AMEC	1995	1996	Poor	Bollards damaged.
AW-5	AMEC	1995	1996	Good	
AW-6	AMEC	1995	2001	Good	
AW-7	AMEC	1995	1996	Unknown	Unable to locate with metal detector.
AW-8	AMEC	1995	1996	Damaged	Broken monument.
AW-9	AMEC	1995	1996	Good	
AW-10	AMEC	1996	1998	Damaged	Filled with gravel or sand.
AW-11	AMEC	1996	2001	Good	
AW-12	AMEC	1997	2001	Good	
AW-13	AMEC	1997	2001	Good	Soil samples and water levels.

TABLE 3-4. SUMMARY OF WATER LEVEL MEASUREMENTS, KENMORE INDUSTRIAL PARK, KING COUNTY, WASHINGTON

Well Number / Top of Casing Elevation (feet)	Date Measured	Depth to Water (feet)	Groundwater Elevation (feet)
AW-1 / 26.76	02-Oct-95	6.22	20.54
	29-Feb-96	6.57	20.19
	16-Apr-96	6.90	19.86
	05-Aug-96	5.30	21.46
	22-Dec-97	6.22	20.54
	28-Mar-01	Not Available	Not Available
AW-2 / 31.32	02-Oct-95	13.48	17.84
	29-Feb-96	13.86	17.46
	16-Apr-96	12.80	18.52
	05-Aug-96	12.71	18.61
	22-Dec-97	13.76	17.56
	28-Mar-01	Not Available	Not Available
AW-3 / 28.23	02-Oct-95	9.42	18.81
	29-Feb-96	9.76	18.47
	16-Apr-96	9.30	18.93
	05-Aug-96	9.10	19.13
	22-Dec-97	9.11	19.12
	28-Mar-01	9.30	18.93
	18-Jan-01	10.43	17.80
AW-4 / 27.61	02-Oct-95	9.84	17.77
	29-Feb-96	10.26	17.35
	16-Apr-96	9.30	18.31
	05-Aug-96	9.17	18.44
	22-Dec-97	9.66	17.95
	28-Mar-01	9.08	18.53
AW-5 / 29.71	02-Oct-95	9.40	20.31
	29-Feb-96	12.27	17.44
	16-Apr-96	10.30	19.41
	05-Aug-96	11.15	18.56
	22-Dec-97	11.70	18.01
	28-Mar-01	11.39	18.32
AW-6 / 28.46	02-Oct-95	10.70	17.76
	29-Feb-96	11.08	17.38
	16-Apr-96	10.10	18.36
	05-Aug-96	9.96	18.50
	22-Dec-97	11.51	16.95
	28-Mar-01	10.17	18.29
AW-7 / 25.18	02-Oct-95	7.32	17.86
	29-Feb-96	7.66	17.52
	16-Apr-96	6.80	18.38
	05-Aug-96	6.57	18.61
	22-Dec-97	8.02	17.16
	28-Mar-01	Not Available	Not Available

TABLE 3-4. SUMMARY OF WATER LEVEL MEASUREMENTS, KENMORE INDUSTRIAL PARK, KING COUNTY, WASHINGTON			
Well Number / Top of Casing Elevation (feet)	**Date Measured**	**Depth to Water (feet)**	**Groundwater Elevation (feet)**
AW-8 / 26.16	02-Oct-95	8.06	18.10
	29-Feb-96	8.42	17.74
	16-Apr-96	7.50	18.66
	05-Aug-96	7.38	18.78
	22-Dec-97	8.82	17.34
	28-Mar-01	6.86	19.3
AW-9 / 30.22	02-Oct-95	8.18	22.04
	29-Feb-96	6.51	23.71
	16-Apr-96	7.00	23.22
	05-Aug-96	7.10	23.12
	22-Dec-97	8.02	22.20
	28-Mar-01	8.70	21.52
AW-10 / 30.12	02-Oct-95	Not Available	Not Available
	29-Feb-96	12.48	17.64
	16-Apr-96	11.90	18.22
	05-Aug-96	11.00	19.12
	22-Dec-97	12.16	17.96
	28-Mar-01	Not Available	Not Available
AW-11 / 29.59	02-Oct-95	Not Available	Not Available
	29-Feb-96	12.11	17.48
	16-Apr-96	11.10	18.49
	05-Aug-96	11.55	18.04
	22-Dec-97	12.50	17.09
	28-Mar-01	11.19	18.40
AW-12 / 29.82	22-Dec-97	12.71	17.11
	28-Mar-01	11.25	18.57
AW-13 / 30.91	22-Dec-97	11.25	19.66
	28-Mar-01	11.28	19.63
B-102 / 25.51	02-Oct-95	Not Available	Not Available
	29-Feb-96	Not Available	Not Available
	16-Apr-96	7.10	18.41
	05-Aug-96	6.92	18.59
	22-Dec-97	Not Available	Not Available
Surface Water in Lake Washington / 21.1	05-Aug-96	2.69	18.4
	22-Dec-97	3.80	17.3
	27-Mar-01	N/A	18.23
Surface Water in Lake Washington off Well AW-6	22-Jan-01	N/A	16.74
	27-Mar-01	N/A	18.29
Surface Water in Sammamish River off Well AW-12	22-Jan-01	N/A	16.78
	27-Mar-01	N/A	18.35

TABLE 3-5A. GROUNDWATER ANALYTICAL DATA, ORGANIC COMPOUNDS.

Agent	Well/ Sample Number	Date Collected	Data Quality*	TRPH (µg/L)	TPH: Diesel (µg/L)	TPH: Heavy Oil (µg/L)	WTPH-G (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	HVO's / VOCs: 1,1,1-TCA (µg/L)	HVO's / VOCs: TCE (µg/L)	HVO's / VOCs: c-1,2-DCE (µg/L)	HVO's / VOCs: 1,2-DCB (µg/L)	HVO's / VOCs: VC (µg/L)	PCBs (µg/L)
MTCA CLEANUP LEVELS				1,000	1,000	1,000	1,000	1.2	6,800	3,100	18,000	41,700	2.7	80	2700	2.92	0.000045
				MTCA Method A Groundwater[1]	MTCA Method A Ground water[1]	MTCA Method A Ground water[1]	MTCA Method A Groundwater[1]	MTCA Method B Surface Water[5]	MTCA Method B Surface Water[5]	MTCA Method B Surface Water[5]	MTCA Method B Groundwater[3]	MTCA Method B Surface Water[4]	MTCA Method B Surface Water[5]	MTCA Method B Groundwater[3]	MTCA Method B Surface Water[5]	MTCA Method B Surface Water[5]	MTCA Method B Surface Water[5]
Ecology	Pond	11/01/91	Fair	NT	NT	NT	NT	<1.0	<1.0	<1.0	<2.0	Acetone: 8.7					NT
Geotech	B-1	12/17/90	Poor	(<5000)	NT	NT	NT	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1.0)
Seacor	B-1	12/11/91	Fair	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-2	12/17/90	Poor	(<5000)	NT	NT	NT	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1.0)
Seacor	B-2	12/11/91	Fair	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-3	12/17/90	Poor	(<5000)	NT	NT	NT	(<1)	(<1)	(<1)	(4.0)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1.0)
Geotech	B-4	12/17/90	Poor	(<5000)	NT	NT	NT	(2.0)	(3.0)	(2.0)	(7.0)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1.0)
Seacor	B-4	12/11/91	Fair	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-101	12/17/90	Poor	NT	(<5000)	(<2000)	(<200)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1.0)
Geotech	B-102	12/17/90	Poor	NT	(<5000)	(<2000)	(<200)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1.0)
AMEC	B-102	04/12/96	Fair	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	B-102	08/13/96	Fair	NT	390	360	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-103	12/17/90	Poor	NT	(<5000)	(<2000)	(<200)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(<1)	(21000)
Geotech	TP-1	06/14/91	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	(<0.1)
Geotech	TP-2	06/15/91	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	(<0.1)
Geotech	TP-3	06/16/91	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	(<0.1)
Assumed Upgradient																	
AMEC	AW-1	10/02/95	Poor	NT	(840)	(630)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	(<1)	(<1)	(<1)	(<1)	(<1)	NT
AMEC	AW-1	02/22/96	Poor	NT	(550)	(420)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	(<1)	(<1)	(<1)	(<1)	(<1)	NT
AMEC	AW-1	04/17/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-1	08/12/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Sterling Asphalt Work Piles																	
AMEC	AW-2	10/02/95	Poor	NT	(14100)	(3360)	(<50)	(0.95)	(<0.5)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	NT
AMEC	AW-2	02/22/96	Poor	NT	(4300)	(2600)	(113)	(<0.5)	(2.27)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	NT
AMEC	AW-2	08/12/96	Poor	NT	(1500)	(1100)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-2	08/12/96	Poor	NT	(1,200 f)	(590 f)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-2	04/17/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-2	08/12/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Suspected Landfill																	
AMEC	AW-3	10/02/95	Poor	NT	(6910)	(8110)	(360)	(<0.5)	(38)	(4.4)	(26)	(9.1)	(3.7)	(<1)	(<1)	(<1)	ND
AMEC	AW-3	02/22/96	Poor	NT	(3700)	(2300)	(218)	(<0.5)	(35.8)	(3.39)	(16.7)	(<1)	(3.90)	(5.35)	(<1)	(<1)	ND
AMEC	AW-3	04/14/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-3	08/13/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-3	01/18/01	Good	NT	<250	<750	NT	1.19	0.575	0.404	2.567	<0.2	<0.2	0.236	3.84	<0.2	NT
AMEC	AW-4	10/02/95	Poor	NT	(19000)	(2430)	(300)	(<0.5)	(1.9)	(0.72)	(3.1)	(<1)	(<1)	(<1)	(1.3)	(<1)	ND
AMEC	AW-4	02/22/96	Poor	NT	(1700)	(2000)	(156)	(0.52)	(3.55)	(1.24)	(4.74)	(<1)	(<1)	(<1)	(2.05)	(<1)	ND
AMEC	AW-4	04/14/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-4	08/13/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Truck Wash Impoundment																	
AMEC	AW-5	10/02/95	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-5	02/22/96	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-5	04/15/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-5	08/13/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-5	08/13/96	Poor	NT	(1100)	(570)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-5	08/13/96	Poor	NT	(1200 f)	(980 f)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Pacific Ventures Area/Compliance Well																	
AMEC	AW-6	10/02/95	Poor	NT	(1880)	(2680)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	(<1)	(<1)	(<1)	(<1)	(<1)	NT
AMEC	AW-6	02/22/96	Poor	NT	(2000)	(3800)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	(<1)	(<1)	(<1)	(<1)	(2.00)	NT
AMEC	AW-6	04/14/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-6	08/13/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-6	01/18/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4C					NT

TABLE 3-5A. GROUNDWATER ANALYTICAL DATA, ORGANIC COMPOUNDS.

					TPH							HVO's / VOCs					
Agent	Well/ Sample Number	Date Collected	Data Quality*	TRPH (µg/L)	Diesel (µg/L)	Heavy Oil (µg/L)	WTPH-G (µg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	Total Xylenes (µg/L)	1,1,1-TCA (µg/L)	TCE (µg/L)	c-1,2-DCE (µg/L)	1,2-DCB (µg/L)	VC (µg/L)	PCBs (µg/L)
AMEC	AW-6	03/26/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4D					NT
KC R-O-W Alignment																	
AMEC	AW-7	10/02/95	Poor	NT	(1940)	(3400)	(73)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	ND
AMEC	AW-7	02/22/96	Poor	NT	(1500)	(5300)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	ND
AMEC	AW-7	04/16/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-7	08/12/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-8	10/02/95	Poor	NT	(5750)	(4480)	(130)	(<0.5)	(<0.5)	(<0.5)	(1.2)	NT	NT	NT	NT	NT	ND
AMEC	AW-8	02/22/96	Poor	NT	(2900)	(1600)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	ND
AMEC	AW-8	04/16/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-8	08/12/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-8	08/12/96	Poor	NT	(2400)	(1300)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-8	08/12/96	Poor	NT	(1,900 f)	(5,800 f)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-9	10/02/95	Poor	NT	(100)	(700)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	ND
AMEC	AW-9	02/22/96	Poor	NT	(<100)	(<200)	(<50)	(<0.5)	(<0.5)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	ND
AMEC	AW-9	04/16/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-9	08/12/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Southern Shoreline/Compliance Wells																	
AMEC	AW-10	03/07/96	Poor	NT	(4500)	(12000)	(145)	(<0.5)	(<0.5)	(1.37)	(6.92)	NT	NT	NT	NT	NT	NT
AMEC	AW-10	04/12/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-10	08/13/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-10	08/13/96	Poor	NT	(850)	(2700)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-10	08/13/96	Poor	NT	(620 f)	(330 f)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-11	03/07/96	Poor	NT	(2400)	(3900)	(<50)	(4.29)	(0.71)	(<0.5)	(<0.5)	NT	NT	NT	NT	NT	NT
AMEC	AW-11	04/12/96	Good	NT	<250	<750	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-11	08/13/96	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-11	01/18/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4C					NT
AMEC	AW-11	03/26/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4D					NT
AMEC	AW-12	01/18/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4C					NT
AMEC	AW-12	03/26/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4D					NT
Demolition Debris Landfill																	
AMEC	AW-13	01/18/01	Good	NT	<250	<750	NT	NT	NT	NT	NT	See Table 4C					NT

NOTES:

* The analysis, evaluation, and conclusions in this RI/FS are based only on good quality data. However, for completeness, all data (good, fair, and poor) are presented in this table. See Table 1 for explanation of dataset qualifications.

bold text indicates exceedances of specified cleanup levels for good quality data, see Table 1

(xxx) = indicates poor quality data, see Table 1 for explanation of dataset qualifications

[1] No applicable surface water cleanup level under MTCA Methods A, B, or C. No MTCA Method B groundwater cleanup level.

[2] CLARC II Tables February 1996

[3] No applicable surface water cleanup level under MTCA Methods A, B, or C.

[4] CLARC II Tables February 1996 for 1,1,1-trichlorethane

[5] Surface water cleanup level based on EPA National Toxics Rule (40 CFR 131.36)

All concentrations are expressed in micrograms per liter (µg/L)

< = Analyte was not detected above the stated Method Reporting Limit.

f=field-filtered sample

TRPH=Total Recoverable Petroleum Hydrocarbons by EPA Method 418.1

WTPH-D Ext. = Total petroleum hydrocarbons, diesel range (C12-C24) and heavy oil range (C>24), by Washington State Method WTPH-D Extended.

WTPH-G = Total petroleum hydrocarbons, gasoline range (C6-C12), by Washington State Method WTPH-G

Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX) by EPA Method 8020.

HVO's = Halogenated Volatile Organics by EPA Method 8010.

VOC's = Volatile Organic Compounds by EPA Method 8240/8260B

TCA = 1,1,1-Trichloroethane. TCE = Trichloroethene.

DCE = C-1,2-Dichloroethylene. DCB = 1,2-Dichlorobenzene

VC = Vinyl Chloride

PCB's = Polychlorinated Biphenyls by EPA Method 8080M.

NE = No cleanup level established.

ND = Analyte(s) not detected above laboratory method reporting limit. Refer to laboratory certificates for method reporting limit.

NT = Sample was not tested for indicated analyte(s).

MTCA = Washington State, Model Toxics Control Act.

TABLE 3-5B. GROUNDWATER ANALYTICAL DATA, INORGANIC COMPOUNDS.

Agent	Well/ Sample Number	Date Collected	Data Quality*	Ttl. As (µg/L)	Diss. As (µg/L)	Ttl. Ba (µg/L)	Diss. Ba (µg/L)	Ttl. Cd (µg/L)	Diss. Cd (µg/L)	Ttl. Cr (µg/L)	Diss. Cr (µg/L)	Ttl. Cu (µg/L)	Diss. Cu (µg/L)	Ttl. Pb (µg/L)	Diss. Pb (µg/L)	Ttl. Hg (µg/L)	Diss. Hg (µg/L)	Ttl. Se (µg/L)	Diss. Se (µg/L)	Ttl. Ag (µg/L)	Diss. Ag (µg/L)	Ttl. Sn (µg/L)	Diss. Sn (µg/L)	Ttl. Zn (µg/L)	Diss. Zn (µg/L)
				EPA Method 6010/7000																					
MTCA CLEANUP LEVELS				5	NA	1,000	NA	20.3	3.5	810	10	2,660	46.79	NA	14.4	NA	0.012	5	NA	25,900	59.57	9,600	NA	16,500	425
				MTCA Method A Ground-water[1]		MTCA Method B Surface water[2]		MTCA Method B Surface water[3]	MTCA Method B Surface water[4]	MTCA Method B Surface water[3]	MTCA Method B Surface water[5]	MTCA Method B Surface water[3]	MTCA Method B Surface water[4]		MTCA Method B Surface water[4]		MTCA Method B Surface water[6]	MTCA Method B Surface water[8]		MTCA Method B Surface water[3]	MTCA Method B Surface water[4]	MTCA Method B Groundwater[7]		MTCA Method B Surface water[3]	MTCA Method B Surface water[4]
Ecology	POND	11/1/91	Fair	NT	NT	NT	NT	(<2.0)	NT	(189)	NT	(16)	NT	(3.6)	NT	NT	NT	NT	NT	NT	NT	NT	NT	(36)	NT
Geotech	B-1	12/17/90	Poor	(<50.0)	NT	(830.0)	NT	(6.0)	NT	(180.0)	NT	NT	NT	(1930.0)	NT	(2.5)	NT	(<50.0)	NT	(<10.0)	NT	NT	NT	NT	NT
Seacor	B-1	12/11/91	Fair	NT	(2.7)	NT	(270)	NT	(1.7)	NT	(2.1)	NT	NT	NT	(1.4)	NT	(<0.50)	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-2	12/17/90	Poor	(1100)	NT	(10000.0)	NT	(49.0)	NT	(1720.0)	NT	NT	NT	(15500.0)	NT	(3.0)	NT	(<50.0)	NT	(<10.0)	NT	NT	NT	NT	NT
Seacor	B-2	12/11/91	Fair	NT	(2.7)	NT	(25)	NT	(4.5)	NT	(30.0)	NT	NT	NT	(2.6)	NT	(<0.50)	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-3	12/17/90	Poor	<50	NT	(700.0)	NT	(11.0)	NT	(150.0)	NT	NT	NT	(1810.0)	NT	(1.8)	NT	(<50.0)	NT	(<10.0)	NT	NT	NT	NT	NT
Geotech	B-4	12/17/90	Poor	(41.0)	NT	(3760.0)	NT	(54.0)	NT	(430.0)	NT	NT	NT	(12100.0)	NT	(8.3)	NT	(<50.0)	NT	(<10.0)	NT	NT	NT	NT	NT
Seacor	B-4	12/11/91	Fair	NT	(3.5)	NT	(740)	NT	(1.5)	NT	(1.4)	NT	NT	NT	(1.4)	NT	(<0.50)	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-101	12/17/90	Poor	(100.0)	NT	NT	NT	(14.0)	NT	(37.0)	NT	NT	NT	(170.0)	NT	(18.0)	NT	NT	NT	NT	NT	NT	NT	NT	NT
Geotech	B-102	12/17/90	Poor	(150.0)	NT	NT	NT	(6.0)	NT	(240.0)	NT	NT	NT	(67.0)	NT	(3.7)	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	B-102	4/12/96	Fair	(<4)	(<4)	(160)	(170)	(<5)	(<5)	(<10)	(<10)	NT	NT	(7.9)	(<2)	(<1)	(<1)	(<5)	(<5)	(<20)	(<20)	NT	NT	NT	NT
AMEC	B-102	8/13/96	Fair	(<5)	(<5)	(210)	(200)	(<5)	(<5)	(<10)	(<10)	NT	NT	(26)	(<2)	(<0.2)	(<0.2)	(<5)	(<5)	(<10)	(<10)	NT	NT	NT	NT
Geotech	B-103	12/17/90	Poor	(39.0)	NT	NT	NT	(2.3)	NT	(200.0)	NT	NT	NT	(72.0)	NT	(9.3)	NT	NT	NT	NT	NT	NT	NT	NT	NT
Assumed Upgradient																									
AMEC	AW-1	10/2/95	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-1	2/23/96	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-1	4/17/96	Good	9.9	12	520	460	<5	<5	<10	<10	NT	NT	2.9	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-1	8/12/96	Good	26	27	660	630	<5	<5	<10	<10	NT	NT	<2	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
Sterling Asphalt Work Piles																									
AMEC	AW-2	10/2/95	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	(77)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-2	2/23/96	Poor	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	(250)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-2	4/12/96	Good	<4	<4	590	670	<5	<5	<10	<10	NT	NT	<2	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-2	8/12/96	Good	37	36	450	440	<5	<5	<10	<10	NT	NT	<2	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-2	8/12/96	Poor	(68)	(51)	(600)	NT	(<5)	NT	(10)	NT	NT	NT	(400)	(4)	(0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
Suspected Landfill																									
AMEC	AW-3	10/2/95	Poor	(8)	NT	(200)	NT	(<5)	NT	(<10)	NT	NT	NT	(42)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-3	2/23/96	Poor	(25)	NT	(740)	NT	(5)	NT	(40)	NT	NT	NT	(380)	NT	(0.2)	NT	(5)	NT	(10)	NT	NT	NT	NT	NT
AMEC	AW-3	4/15/96	Good	<4	<4	480	530	<5	<5	<10	<10	NT	NT	3.2	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-3	8/13/96	Good	<5	<5	1030	1010	<5	<5	<10	<10	NT	NT	5	<2	<0.2	<0.2	<5	<5	40	<10	NT	NT	NT	NT
AMEC	AW-3	1/18/01	Good	2.24	NT	300	NT	<1	NT	1.87	NT	NT	NT	2.5	NT	<1	NT	<1	NT	<1	NT	<5	NT	<10	NT
AMEC	AW-4	10/2/95	Poor	(14)	NT	(350)	NT	(<5)	NT	(40)	NT	NT	NT	(400)	NT	(0.3)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-4	2/23/96	Poor	(32)	NT	(2680)	NT	(5)	NT	(230)	NT	NT	NT	(3930)	NT	(0.25)	NT	(5)	NT	(10)	NT	NT	NT	NT	NT
AMEC	AW-4	4/15/96	Good	<4	<4	140	170	<5	<5	<10	<10	NT	NT	<2	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-4	8/13/96	Good	<5	<5	270	210	<5	<5	10	<10	NT	NT	70	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
Truck Wash Impoundment																									
AMEC	AW-5	10/2/95	Poor	(<5)	NT	(570)	NT	(<5)	NT	(<10)	NT	NT	NT	(240)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-5	2/23/96	Poor	(120)	NT	(2230)	NT	(55)	NT	(280)	NT	NT	NT	(17200)	NT	(1.2)	NT	(6)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-5	4/15/96	Good	<4	<4	470	520	<5	<5	<10	<10	NT	NT	6.9	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-5	8/13/96	Good	<5	<5	610	570	<5	<5	<10	<10	NT	NT	140	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-5	8/13/96	Poor	(<5)	(<5)	610	NT	(<5)	NT	(<10)	NT	NT	NT	(170)	(<2)	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
Pacific Ventures Area/Compliance Well																									
AMEC	AW-6	10/2/95	Poor	(<5)	NT	(790)	NT	(<5)	NT	(20)	NT	NT	NT	(124)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	(10)	NT	(64)	NT
AMEC	AW-6	2/23/96	Poor	(33)	NT	(1150)	NT	(5)	NT	(90)	NT	NT	NT	(1080)	NT	(0.5)	NT	(5)	NT	(10)	NT	(50)	NT	(1870)	NT
AMEC	AW-6	4/15/96	Good	<4	<4	380	370	<5	<5	<10	<10	NT	NT	130	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-6	8/13/96	Good	<5	<5	210	890	<5	<5	<10	<10	NT	NT	7	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-6	1/18/01	Good	1.02	NT	689	NT	<1.0	NT	1.87	NT	NT	NT	1.5	NT	NT	<1.0	NT	<1.0	NT	NT	<500	NT	<10.0	NT
AMEC	AW-6	3/26/01	Good	<5.00	1.26	451	540	<5.00	<1.00	<5.00	<10.0	NT	NT	115	2.12	<1.00	<5.00	<5.00	<10.0	<1.00	NT	NT	NT	NT	NT
AMEC	AW-6	5/8/01	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT

TABLE 3-5B. GROUNDWATER ANALYTICAL DATA, INORGANIC COMPOUNDS.

Agent	Well/ Sample Number	Date Collected	Data Quality*	EPA Method 6010/7000 Ttl. As (µg/L)	Diss. As (µg/L)	Ttl. Ba (µg/L)	Diss. Ba (µg/L)	Ttl. Cd (µg/L)	Diss. Cd (µg/L)	Ttl. Cr (µg/L)	Diss. Cr (µg/L)	Ttl. Cu (µg/L)	Diss. Cu (µg/L)	Ttl. Pb (µg/L)	Diss. Pb (µg/L)	Ttl. Hg (µg/L)	Diss. Hg (µg/L)	Ttl. Se (µg/L)	Diss. Se (µg/L)	Ttl. Ag (µg/L)	Diss. Ag (µg/L)	Ttl. Sn (µg/L)	Diss. Sn (µg/L)	Ttl. Zn (µg/L)	Diss. Zn (µg/L)
MTCA CLEANUP LEVELS				5	NA	1,000	NA	20.3	3.5	810	10	2,660	46.79	NA	14.4	NA	0.012	5	NA	25,900	59.57	9,600	NA	16,500	425
				MTCA Method A Ground-water[1]		MTCA Method B Surface water[2]		MTCA Method B Surface water[3]	MTCA Method B Surface water[4]	MTCA Method B Surface water[3]	MTCA Method B Surface water[5]	MTCA Method B Surface water[3]	MTCA Method B Surface water[4]		MTCA Method B Surface water[4]		MTCA Method B Surface water[6]	MTCA Method B Surface water[6]		MTCA Method B Surface water[3]	MTCA Method B Surface water[4]	MTCA Method B Groundwater[7]		MTCA Method B Surface water[3]	MTCA Method B Surface water[4]
KC R-O-W Alignment																									
AMEC	AW-7	10/2/95	Poor	(6)	NT	(740)	NT	(<5)	NT	(<10)	NT	NT	NT	(98)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-7	2/23/96	Poor	(19)	NT	(880)	NT	(5)	NT	(40)	NT	NT	NT	(760)	NT	(0.4)	NT	(5)	NT	(10)	NT	NT	NT	NT	NT
AMEC	AW-7	4/16/96	Good	<4	<4	500	510	<5	<5	<10	<10	NT	NT	2.3	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-7	8/12/96	Good	<5	<5	760	780	<5	<5	<10	<10	NT	NT	<2	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-8	10/2/95	Poor	(99)	NT	(70)	NT	(<5)	NT	(<10)	NT	NT	NT	(87)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-8	2/23/96	Poor	(240)	NT	(110)	NT	(<5)	NT	(20)	NT	NT	NT	(90)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-8	4/16/96	Good	110	120	69	74	<5	<5	<10	<10	NT	NT	3.9	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-8	8/12/96	Good	115	118	120	110	<5	<5	<10	<10	NT	NT	<2	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-8	8/12/96	Poor	(150)	(112)	(200)	NT	(<5)	NT	(20)	NT	NT	NT	(120)	<2	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-9	10/2/95	Poor	(<5)	NT	(50)	NT	(<5)	NT	(10)	NT	NT	NT	(3)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-9	2/23/96	Poor	(<5)	NT	(<5)	NT	(<5)	NT	(<10)	NT	NT	NT	(<3)	NT	(<0.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-9	4/16/96	Good	<4	<4	<10	<10	<5	<5	<10	<10	NT	NT	<2	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-9	8/12/96	Good	<5	<5	10	10	<5	<5	<10	<10	NT	NT	<2	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
Southern Shoreline/Compliance Wells																									
AMEC	AW-10	3/7/96	Poor	(17)	NT	(350)	NT	(6)	NT	(40)	NT	NT	NT	(590)	NT	(0.6)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-10	4/12/96	Good	<4	<4	180	210	<5	<5	<10	<10	NT	NT	88	13	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-10	8/13/96	Good	**12**	9	660	420	<5	<5	30	10	NT	NT	300	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-10	8/13/96	Poor	(35)	(6)	(3840)	NT	(<5)	NT	(700)	NT	NT	NT	(4000)	<2	(2.2)	NT	(<5)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-10	9/29/98	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1.0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-11	3/7/96	Poor	(17)	NT	(830)	NT	(<5)	NT	(40)	NT	NT	NT	(490)	NT	(<0.2)	NT	(9)	NT	(<10)	NT	NT	NT	NT	NT
AMEC	AW-11	4/12/96	Good	<4	<4	830	590	<5	<5	<10	<10	NT	NT	<2	<2	<1	<1	<5	<5	<20	<20	NT	NT	NT	NT
AMEC	AW-11	8/13/96	Good	<5	<5	1090	1050	<5	<5	<10	<10	NT	NT	<2	<2	<0.2	<0.2	<5	<5	<10	<10	NT	NT	NT	NT
AMEC	AW-11	1/18/01	Good	1.09	NT	763	NT	<1.0	NT	2.34	NT	NT	NT	. 1.58	NT	NT	<1.0	NT	<1.0	NT	<5.0	<500	NT	11.2	NT
AMEC	AW-11	3/26/01	Good	<5.00	1.32	788	862	<5.00	<1.00	<5.00	<10.0	NT	NT	<1.00	<1.00	<1.00	<5.00	<10.0	<5.00	<1.00	NT	NT	NT	NT	NT
AMEC	AW-11	5/8/01	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	AW-12	1/18/01	Good	4.75	NT	68.9	NT	<1.0	NT	3.68	NT	NT	NT	6.68	NT	NT	<1.0	NT	<1.0	NT	<5.0	<500	NT	104	NT
AMEC	AW-12	3/26/01	Good	<5.00	1.65	133	188	<5.00	<1.00	<5.00	<10.0	NT	NT	6.22	<1.00	<1.00	<5.00	<10.0	<5.00	<1.00	NT	NT	NT	NT	NT
AMEC	AW-12	5/8/01	Good	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Demolition Debris Landfill																									
AMEC	AW-13	1/18/01	Good	**13.2**	NT	70.0	NT	<1.0	NT	1.21	NT	NT	NT	<1.00	NT	<1.00	NT	<1.00	NT	<1.00	NT	<500	NT	<10.0	NT

NOTES:

* The analysis, evaluation, and conclusions in this RI/FS are based only on good quality data. However, for completeness, all data (good, fair, and poor) are presented in this table. See Table 1 for explanation of dataset qualifications.
bold text indicates exceedances of specified cleanup levels for good quality data, see Table 1
(xxx) = indicates poor or fair quality data, see Table 1 for explanation of dataset qualifications.
[1] Cleanup level based on natural background concentrations for the State of Washington.
[2] Cleanup level based on EPA National Recommended Water Quality Criteria.
[3] Cleanup level based on CLARC II Method B formula values for surface water cleanup level.
[4] Cleanup level based on hardness dependent formula in WAC 173-201A-040. Calculation was based on lowest observed groundwater hardness of 524 mg. eq./l (Table 4E).
[5] Cleanup level of 10 µg/L is for hexavalent chromium. The standard for trivalent chromium is based on hardness dependent formula and equals 691(µg/l at groundwater hardness of 524 mg. eq./l (Table 4E, see WAC 173-201A-040).
[6] Cleanup level based on WAC 173-201A-040.
[7] Cleanup level based on MTCA Method B groundwater. No MTCA Method A or B surface water cleanup level.
All concentrations are expressed in micrograms per liter (µg/L).
< = Analyte was not detected above the stated Method Reporting Limit.
MTCA = Washington State, Model Toxics Control Act.
Ttl. = Total (unfiltered).
Diss. = Dissolved (field filter using 0.45 micron filter).
q = data qualifications apply. Refer to Ecology's SHA report.
NTU = Nephelometric Turbidity Units.
NA = not applicable
NE = not established
NT = Sample not tested for specified compound.

TABLE 3-5C. LAKEPOINTE GROUNDWATER SAMPLING RESULTS FOR THE JANUARY 2001 SAMPLING EVENT (LOW LAKE LEVEL[1])

Analyte	Method	Units	Reporting Limit	MTCA Cleanup Level	Notes	Shoreline Compliance Wells AW-6	Shoreline Compliance Wells AW-11	Shoreline Compliance Wells AW-12	Site Interior Wells AW-3	Site Interior Wells AW-13	Site Interior Wells AW-13 DUP
Hydrocarbons											
Diesel Range Hydrocarbons (C12-C24)	WTPH-D	µg/L	0.250	1000	Note 1				1070		
Heavy Oil Range Hydrocarbons (C24-C36)	WTPH-D	µg/L	0.750	1000	Note 1				ND[3]		
Diesel Range Hydrocarbons (C12-C24)	WTPH-D w/silica gel	µg/L	0.250	1000	Note 1	ND	ND	ND	ND	ND	ND
Heavy Oil Range Hydrocarbons (C24-C36)	WTPH-D w/silica gel	µg/L	0.750	1000	Note 1	ND	ND	ND	ND	ND	ND
Total Metals											
Arsenic	EPA 6020	µg/L	1.0	5	Note 2	1.02	1.09	4.75	2.24	13.2	12.5
Barium	EPA 6020	µg/L	10.0	1000	Note 3	889	763	68.9	300	70.0	68.8
Cadmium	EPA 6020	µg/L	1.0	20.3	Note 4	ND	ND	ND	ND	ND	ND
Chromium	EPA 6020	µg/L	1.0	810	Note 4	1.48	2.34	3.68	1.87	1.21	1.11
Lead	EPA 6020	µg/L	1.0	NA		1.50	1.58	6.68	2.5	ND	ND
Mercury	EPA 7470A	µg/L	1.0	NA		ND	1.06	ND	ND	ND	ND
Selenium	EPA 6020	µg/L	1.0	5	Note 4	ND	ND	ND	ND	ND	ND
Silver	EPA 6020	µg/L	1.0	25900	Note 4	ND	ND	ND	ND	ND	ND
Tin	EPA 6010B	µg/L	500	NA		ND	ND	ND	ND	ND	ND
Zinc	EPA 6020	µg/L	10.0	16500	Note 4	ND	11.2	104	ND	ND	ND
Volatile Organic Compounds by EPA Method 8260B											
Acetone	EPA 8260B	µg/L	5.00		Note 5	ND	ND	ND	ND	ND	ND
Benzene	EPA 8260B	µg/L	0.200	1.2	Note 7	ND	ND	ND	1.19	ND	ND
Bromobenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
Bromochloromethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Bromodichloromethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Bromoform	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Bromomethane	EPA 8260B	µg/L	1.00		Note 5	ND	ND	ND	ND	ND	ND
2-Butanone	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND	ND	ND
n-Butylbenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
sec-Butylbenzene	EPA 8260B	µg/L	0.200	NA	Note 9	ND	ND	ND	0.200	ND	ND
tert-Butylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
Carbon disulfide	EPA 8260B	µg/L	0.500	800	Note 6	3.47	0.509	ND	ND	ND	ND
Carbon tetrachloride	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Chlorobenzene	EPA 8260B	µg/L	0.200	680	Note 7	ND	0.768	ND	13.6	ND	ND
Chloroethane	EPA 8260B	µg/L	1.00		Note 5	ND	ND	ND	ND	ND	ND
Chloroform	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Chloromethane	EPA 8260B	µg/L	1.00		Note 5	ND	ND	ND	ND	ND	ND
2-Chlorotoluene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
4-Chlorotoluene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
Dibromochloromethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,2-Dibromo-3-chloropropane	EPA 8260B	µg/L	0.500		Note 8	ND	ND	ND	ND	ND	ND
1,2-Dibromoethane	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND	ND	ND
Dibromomethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	EPA 8260B	µg/L	0.200	2700	Note 7	ND	ND	ND	3.84	ND	ND
1,3-Dichlorobenzene	EPA 8260B	µg/L	0.200	400	Note 7	ND	ND	ND	0.208	ND	ND
1,4-Dichlorobenzene	EPA 8260B	µg/L	0.200	400	Note 7	ND	ND	ND	0.669	ND	ND
Dichlorodifluoromethane	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
1,1-Dichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,2-Dichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,1-Dichloroethene	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND	ND	ND
cis-1,2-Dichloroethene	EPA 8260B	µg/L	0.200	80	Note 6	ND	ND	ND	0.236	ND	ND
trans-1,2-Dichloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,2-Dichloropropane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,3-Dichloropropane	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND	ND	ND
2,2-Dichloropropane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,1-Dichloropropene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
cis-1,3-Dichloropropene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
trans-1,3-Dichloropropene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Ethylbenzene	EPA 8260B	µg/L	0.200	3100	Note 7	ND	ND	ND	0.404	ND	ND
Hexachlorobutadiene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
2-Hexanone	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND	ND	ND
Isopropylbenzene	EPA 8260B	µg/L	0.500	NA	Note 9	ND	ND	ND	0.720	ND	ND
p-Isopropyltoluene	EPA 8260B	µg/L	0.200	NA	Note 9	ND	ND	ND	0.315	ND	ND
Methylene chloride	EPA 8260B	µg/L	5.00		Note 8	ND	ND	ND	ND	ND	ND
4-Methyl-2-pentanone	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND	ND	ND
Naphthalene	EPA 8260B	µg/L	0.500	9880	Note 4	ND	ND	ND	57.1	ND	ND
n-Propylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
Styrene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
Tetrachloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Toluene	EPA 8260B	µg/L	0.200	6800	Note 7	ND	ND	ND	0.575	ND	ND
1,2,3-Trichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,1,1-Trichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
1,1,2-Trichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Trichloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
Trichlorofluoromethane	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
1,2,3-Trichloropropane	EPA 8260B	µg/L	0.500		Note 8	ND	ND	ND	ND	ND	ND
1,2,4-Trimethylbenzene	EPA 8260B	µg/L	0.200	NA	Note 9	ND	ND	ND	1.74	ND	ND
1,3,5-Trimethylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND	ND	ND
Vinyl chloride	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND	ND	ND
m,p-Xylene	EPA 8260B	µg/L	0.500	16000	Note 6	ND	ND	ND	1.77	ND	ND
o-Xylene	EPA 8260B	µg/L	0.250	16000	Note 6	ND	ND	ND	0.797	ND	ND
Total Xylenes		µg/L		16000	Note 6				2.567		

TABLE 3-5C. LAKEPOINTE GROUNDWATER SAMPLING RESULTS FOR THE JANUARY 2001 SAMPLING EVENT (LOW LAKE LEVEL[1])

Analyte	Method	Units	Reporting Limit	MTCA Cleanup Level	Notes	Shoreline Compliance Wells			Site Interior Wells		
						AW-6	AW-11	AW-12	AW-3	AW-13	AW-13 DUP
Semivolatile Organic Compounds by EPA Method 8270C											
Acenaphthene	EPA 8270C	µg/L	10.0	1200	Note 3	ND	ND	ND	16.9	ND	ND
Acenaphthylene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Aniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Anthracene	EPA 8270C	µg/L	10.0	1200	Note 3	ND	ND	ND	ND	ND	ND
Benzoic Acid	EPA 8270C	µg/L	20.0	64000	Note 6	ND	ND	ND	38.1	ND	ND
Benzo (a) anthracene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Benzo (ghi) perylene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Benzyl alcohol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Bis(2-chloroethoxy)methane	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Bis(2-chloroethyl)ether	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	EPA 8270C	µg/L	50.0		Note 8	ND	ND	ND	ND	ND	ND
4-Bromophenyl phenyl ether	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Butyl benzyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Carbazole	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
4-Chloroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2-Chloronaphthalene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
4-Chloro-3-methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2-Chlorophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Chrysene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Dibenz (a,h) anthracene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Dibenzofuran	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Di-n-butyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
1,3-Dichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
1,4-Dichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
1,2-Dichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
3,3'-Dichlorobenzidine	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
2,4-Dichlorophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Diethyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2,4-Dimethylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Dimethyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2,4-Dinitrophenol	EPA 8270C	µg/L	20.0		Note 5	ND	ND	ND	ND	ND	ND
2,4-Dinitrotoluene	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
2,6-Dinitrotoluene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Di-n-octyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Fluoranthene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Fluorene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Hexachlorobenzene	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Hexachlorobutadiene	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Hexachlorocyclopentadiene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Hexachloroethane	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene[4]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Isophorone	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2-Methylnaphthalene	EPA 8270C	µg/L	10.0	NA	Note 9	ND	ND	ND	13.4	ND	ND
2-Methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
3 & 4-Methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Naphthalene	EPA 8270C	µg/L	10.0	9.880	Note 6	ND	ND	ND	48.1	ND	ND
2-Nitroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
3-Nitroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
4-Nitroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Nitrobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2-Nitrophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
4-Nitrophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
N-Nitrosodiphenylamine	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
N-Nitrosodi-n-propylamine	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Pentachlorophenol	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND
Phenanthrene	EPA 8270C	µg/L	10.0	NA	Note 9	ND	ND	ND	12.0	ND	ND
Phenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
Pyrene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
1,2,4-Trichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2,4,5-Trichlorophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND	ND	ND
2,4,6-Trichlorophenol	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND	ND	ND

NOTES:

Note 1 - MTCA Method A groundwater cleanup level. No MTCA Method A, B, or C surface water cleanup levels or Method B or C groundwater cleanup levels.

Note 2 - MTCA Method A groundwater cleanup level based on Washington State natural background.

Note 3 - MTCA Method B surface water cleanup level using EPA's National Recommended Water Quality Criteria

Note 4 - MTCA Method B surface water cleanup level using CLARC II Tables February 1996.

Note 5 - All reported values were non-detect with detection levels lower than applicable cleanup levels under MTCA.

Note 6 - MTCA Method B groundwater cleanup level using CLARC II Tables February 1996

Note 7 - MTCA Method A and B surface water cleanup level using National Toxics Rule 40 CFR 131.36.

Note 8 - All reported values were non-detect with detection levels greater than applicable cleanup levels under MTCA.

Note 9 - No cleanup level available

All concentrations are expressed in micrograms per liter (µg/L).

bold text indicates exceedances of specified cleanup levels for good quality data, see Table 1

NA - not applicable

ND - Analyte(s) not detected above laboratory method reporting limit, refer to laboratory certificates for method reporting limit.

NT - not tested

[1] Samples AW-6 and AW-11 collected on January 19, 2001; and sample AW-12 collected on January 22, 2001. All samples collected unfiltered, using micropurge techniques.

TABLE 3-5D. LAKEPOINTE COMPLIANCE WELL GROUNDWATER SAMPLING RESULTS FOR THE MARCH 26, 2001 SAMPLING EVENT (TOTAL AND DISSOLVED, HIGH LAKE LEVEL)[1].

Analyte	Method	Units	Reporting Limit	MTCA Cleanup Level	Notes	Shoreline Compliance Wells AW-6	AW-11	AW-12	AW-12 DUP
Hydrocarbons									
Diesel Range Hydrocarbons (C12-C24)	WTPH-D	µg/L	250	1000	Note 1				
Heavy Oil Range Hydrocarbons (C24-C36)	WTPH-D	µg/L	750	1000	Note 1				
Diesel Range Hydrocarbons (C12-C24)	WTPH-D w/silica gel	µg/L	250	1000	Note 1	ND[2]	ND	ND	ND
Heavy Oil Range Hydrocarbons (C24-C36)	WTPH-D Heavy w/silica gel	µg/L	750	1000	Note 1	ND	ND	ND	ND
Total Metals									
Arsenic	EPA 6020	µg/L	5.00	5	Note 2	ND	ND	ND	ND
Barium	EPA 6020	µg/L	50.00	1000	Note 3	451	788	133	133
Cadmium	EPA 6020	µg/L	5.00	20.3	Note 4	ND	ND	ND	ND
Chromium	EPA 6020	µg/L	5.00	810	Note 4	ND	ND	ND	ND
Lead	EPA 6020	µg/L	5.00	NA		115	ND	6.22	5.82
Mercury	EPA 7470A	µg/L	1.00	NA		ND	ND	ND	ND
Selenium	EPA 6020	µg/L	5.00	5	Note 4	ND	ND	ND	ND
Silver	EPA 6020	µg/L	5.00	25900	Note 4	ND	ND	ND	ND
Tin	EPA 6010B	µg/L	500	NA		NT	NT	NT	NT
Zinc	EPA 6020	µg/L	10.0	16500	Note 4	NT	NT	NT	NT
Dissolved Metals (filtered[4])									
Arsenic	EPA 6020	µg/L	1.00	5	Note 2	1.26	1.32	1.65	1.84
Barium	EPA 6020	µg/L	10.00	NA		540	862	188	178
Cadmium	EPA 6020	µg/L	1.00	3.5	Note 9	ND	ND	ND	ND
Chromium	EPA 6020	µg/L	10.0	10	Note 10	ND	ND	ND	ND
Lead	EPA 6020	µg/L	1.00	14.4	Note 9	2.12	ND	ND	ND
Mercury	EPA 7470A	µg/L	1.00	0.012	Note 11	ND	ND	ND	ND
Selenium	EPA 6020	µg/L	10.0	NA	Note 11	ND	ND	ND	ND
Silver	EPA 6020	µg/L	1.00	59.57	Note 9	ND	ND	ND	ND
Tin	EPA 6010B	µg/L	500	NA		NT	NT	NT	NT
Zinc	EPA 6020	µg/L	10.0	425	Note 9	NT	NT	NT	NT
Volatile Organic Compounds by EPA Method 8260B									
Acetone	EPA 8260B	µg/L	5.00		Note 5	ND	ND	ND	ND
Benzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Bromobenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Bromochloromethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Bromodichloromethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Bromoform	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Bromomethane	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND
2-Butanone	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND
n-Butylbenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
sec-Butylbenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
tert-Butylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Carbon disulfide	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Carbon tetrachloride	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Chlorobenzene	EPA 8260B	µg/L	0.200	680	Note 7	ND	0.826	ND	ND
Chloroethane	EPA 8260B	µg/L	1.00		Note 5	ND	ND	ND	ND
Chloroform	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Chloromethane	EPA 8260B	µg/L	1.00		Note 5	ND	ND	ND	ND
2-Chlorotoluene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
4-Chlorotoluene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Dibromochloromethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,2-Dibromo-3-chloropropane	EPA 8260B	µg/L	0.500		Note 8	ND	ND	ND	ND
1,2-Dibromoethane	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND
Dibromomethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,2-Dichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,3-Dichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,4-Dichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Dichlorodifluoromethane	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
1,1-Dichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,2-Dichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,1-Dichloroethene	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND
cis-1,2-Dichloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
trans-1,2-Dichloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,2-Dichloropropane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,3-Dichloropropane	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND
2,2-Dichloropropane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,1-Dichloropropene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
cis-1,3-Dichloropropene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
trans-1,3-Dichloropropene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Ethylbenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Hexachlorobutadiene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
2-Hexanone	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND
Isopropylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
p-Isopropyltoluene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Methylene chloride	EPA 8260B	µg/L	5.00		Note 8	ND	ND	ND	ND
4-Methyl-2-pentanone	EPA 8260B	µg/L	2.00		Note 5	ND	ND	ND	ND
Naphthalene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
n-Propylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Styrene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
1,1,1,2-Tetrachloroethane	EPA 8260B	µg/L	0.200		Note 8	ND	ND	ND	ND
1,1,2,2-Tetrachloroethane	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Tetrachloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Toluene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,2,3-Trichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,2,4-Trichlorobenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,1,1-Trichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,1,2-Trichloroethane	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Trichloroethene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
Trichlorofluoromethane	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
1,2,3-Trichloropropane	EPA 8260B	µg/L	0.500		Note 8	ND	ND	ND	ND
1,2,4-Trimethylbenzene	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
1,3,5-Trimethylbenzene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
Vinyl chloride	EPA 8260B	µg/L	0.200		Note 5	ND	ND	ND	ND
m,p-Xylene	EPA 8260B	µg/L	0.500		Note 5	ND	ND	ND	ND
o-Xylene	EPA 8260B	µg/L	0.250		Note 5	ND	ND	ND	ND
Total Xylenes		µg/L							

TABLE 3-5D. LAKEPOINTE COMPLIANCE WELL GROUNDWATER SAMPLING RESULTS FOR THE MARCH 26, 2001 SAMPLING EVENT (TOTAL AND DISSOLVED, HIGH LAKE LEVEL)[1].

Analyte	Method	Units	Reporting Limit	MTCA Cleanup Level	Notes	Shoreline Compliance Wells			
						AW-6	AW-11	AW-12	AW-12 DUP
Semivolatile Organic Compounds by EPA Method 8270C									
Acenaphthene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Acenaphthylene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Aniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Anthracene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Benzoic Acid	EPA 8270C	µg/L	20.0		Note 5	ND	ND	ND	ND
Benzo (a) anthracene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Benzo (b) fluoranthene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Benzo (k) fluoranthene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Benzo (ghi) perylene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Benzo (a) pyrene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Benzyl alcohol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Bis(2-chloroethoxy)methane	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Bis(2-chloroethyl)ether	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Bis(2-chloroisopropyl)ether	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Bis(2-ethylhexyl)phthalate	EPA 8270C	µg/L	50.0		Note 8	ND	ND	ND	ND
4-Bromophenyl phenyl ether	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Butyl benzyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Carbazole	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
4-Chloroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2-Chloronaphthalene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
4-Chloro-3-methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2-Chlorophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
4-Chlorophenyl phenyl ether	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Chrysene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Dibenz (a,h) anthracene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Dibenzofuran	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Di-n-butyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
1,3-Dichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
1,4-Dichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
1,2-Dichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
3,3'-Dichlorobenzidine	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
2,4-Dichlorophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Diethyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2,4-Dimethylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Dimethyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
4,6-Dinitro-2-methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2,4-Dinitrophenol	EPA 8270C	µg/L	20.0		Note 5	ND	ND	ND	ND
2,4-Dinitrotoluene	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
2,6-Dinitrotoluene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Di-n-octyl phthalate	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Fluoranthene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Fluorene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Hexachlorobenzene	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Hexachlorobutadiene	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Hexachlorocyclopentadiene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Hexachloroethane	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene[3]	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Isophorone	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2-Methylnaphthalene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2-Methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
3 & 4-Methylphenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Naphthalene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2-Nitroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
3-Nitroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
4-Nitroaniline	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Nitrobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2-Nitrophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
4-Nitrophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
N-Nitrosodiphenylamine	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
N-Nitrosodi-n-propylamine	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Pentachlorophenol	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND
Phenanthrene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Phenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
Pyrene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
1,2,4-Trichlorobenzene	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2,4,5-Trichlorophenol	EPA 8270C	µg/L	10.0		Note 5	ND	ND	ND	ND
2,4,6-Trichlorophenol	EPA 8270C	µg/L	10.0		Note 8	ND	ND	ND	ND

NOTES:

Note 1 - MTCA Method A groundwater cleanup level. No MTCA Method A, B, or C surface water cleanup levels or Method B or C groundwater cleanup levels.

Note 2 - MTCA Method A groundwater cleanup level based on Washington State natural background.

Note 3 - MTCA Method B surface water cleanup level using EPA's National Recommended Water Quality Criteria

Note 4 - MTCA Method B surface water cleanup level using CLARC II Tables February 1996.

Note 5 - All reported values were non-detect with detection levels lower than applicable cleanup levels under MTCA.

Note 6 - MTCA Method B groundwater cleanup level using CLARC II Tables February 1996.

Note 7 - MTCA Method B surface water cleanup level using National Toxics Rule 40 CFR 131.36.

Note 8 - All reported values were non-detect with detection levels greater than applicable cleanup levels under MTCA.

Note 9 - MTCA Method B surface water cleanup level using hardness dependent formula from WAC 173-201A-040. Calculation was based on lowest observed groundwater hardness of 524 mg. eq./l (Table 4E).

Note 10 - MTCA Method B surface water cleanup level for hexavalent chromium. The standard for trivalent chromium is based on hardness dependent formula and equals 691(mg/l at groundwater hardness of 524 mg. eq./l (Table 4E, see WAC 173-201A-040).

Note 11 - MTCA Method B surface water cleanup level from WAC 173-201A-040.

All concentrations are expressed in micrograms per liter (µg/L).

bold text indicates exceedances of specified cleanup levels for good quality data, see Table 1

NA - not applicable

ND - Analyte(s) not detected above laboratory method reporting limit, refer to laboratory certificates for method reporting limit.

NT - not tested

[1] Samples AW-6 and AW-11 collected on January 19, 2001; and sample AW-12 collected on January 22, 2001. All samples collected unfiltered, using micropurge techniques

TABLE 3-5E. CONVENTIONAL PARAMETERS FOR GROUNDWATER AND SURFACE WATER.

Agent	Well/ Sample Number	Date Collected	Data Quality*	pH	Hardness (mg.eq/l)	Turbidity (NTUs)	Conductivity (µS)	ORP (mV)	TSS (µg/L)
Ecology	POND	11/1/91	Fair	NT	NT	NT	NT	NT	NT
Geotech	B-1	12/17/90	Poor	6.78	NT	NT	NT	NT	NT
Seacor	B-1	12/11/91	Fair	6.7	NT	NT	NT	NT	NT
Geotech	B-2	12/17/90	Poor	11.79	NT	NT	NT	NT	NT
Seacor	B-2	12/11/91	Fair	7.5	NT	NT	NT	NT	NT
Geotech	B-3	12/17/90	Poor	11.71	NT	NT	NT	NT	NT
Geotech	B-4	12/17/90	Poor	6.76	NT	NT	NT	NT	NT
Seacor	B-4	12/11/91	Fair	6.60	NT	NT	NT	NT	NT
Geotech	B-101	12/17/90	Poor	7.44	NT	NT	NT	NT	NT
Geotech	B-102	12/17/90	Poor	7.07	NT	NT	NT	NT	NT
AMEC	B-102	4/12/96	Fair	7.02	NT	NT	NT	NT	NT
AMEC	B-102	8/13/96	Fair	NT	NT	3.0	NT	NT	NT
Geotech	B-103	12/17/90	Poor	7.41	NT	NT	NT	NT	NT
Assumed Upgradient									
AMEC	AW-1	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-1	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-1	4/17/96	Good	6.14	NT	14.9	1810	NT	59000
AMEC	AW-1	8/12/96	Good	5.75	NT	0.1	1795	20	NT
Sterling Asphalt Work Piles									
AMEC	AW-2	10/2/95	Poor	NT	NT	NT			
AMEC	AW-2	2/23/96	Poor	NT	NT	NT			
AMEC	AW-2	4/12/96	Good	6.37	NT	21.1	1541	NT	53000
AMEC	AW-2	8/12/96	Good	6.64	NT	0.1	1377	NT	NT
AMEC	AW-2	8/12/96	Poor	NT	NT	>100			
Suspected Landfill									
AMEC	AW-3	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-3	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-3	4/15/96	Good	4.68	NT	3.5	1294	NT	6000
AMEC	AW-3	8/13/96	Good	6.61	NT	3.1	1313	-74	NT
AMEC	AW-4	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-4	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-4	4/15/96	Good	6.53	NT	1.1	823	NT	13000
AMEC	AW-4	8/13/96	Good	7.44	NT	4.5	552	NT	NT
Truck Wash Impoundment									
AMEC	AW-5	10/2/95	Poor	6.68	NT	NT	NT	NT	NT
AMEC	AW-5	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-5	4/15/96	Good	4.67	NT	4.6	837	NT	13000
AMEC	AW-5	8/13/96	Good	7.11	NT	3.1	835	-24	NT
AMEC	AW-5	8/13/96	Poor	NT	NT	<100	NT	NT	NT
Pacific Ventures Area									
AMEC	AW-6	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-6	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-6	4/15/96	Good	6.51	NT	3.1	1222	NT	25000
AMEC	AW-6	8/13/96	Good	6.68	NT	1.4	963	NT	NT
AMEC	AW-6	1/18/01	Good	NT	NT	NT	NT	NT	NT
AMEC	AW-6	3/26/01	Good	NT	NT	NT	NT	NT	NT
AMEC	AW-6	5/8/01	Good	NT	722	NT	NT	NT	NT
KC R-O-W Alignment									
AMEC	AW-7	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-7	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-7	4/16/96	Good	6.52	NT	4.3	1122	NT	14000
AMEC	AW-7	8/12/96	Good	6.7	NT	0.1	927	NT	NT
AMEC	AW-8	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-8	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-8	4/16/96	Good	7.27	NT	2.7	1475	NT	<5000
AMEC	AW-8	8/12/96	Good	6.97	NT	0.1	1344	NT	NT
AMEC	AW-8	8/12/96	Poor	NT	NT	<100	NT	NT	NT
AMEC	AW-9	10/2/95	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-9	2/23/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-9	4/16/96	Good	6.9	NT	0.6	194	NT	<5000
AMEC	AW-9	8/12/96	Good	6.27	NT	0	171	101	NT

TABLE 3-5E. CONVENTIONAL PARAMETERS FOR GROUNDWATER AND SURFACE WATER.

Agent	Well/ Sample Number	Date Collected	Data Quality*	pH	Hardness (mg.eq/l)	Turbidity (NTUs)	Conductivity (µS)	ORP (mV)	TSS (µg/L)
Southern Shoreline									
AMEC	AW-10	3/7/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-10	4/12/96	Good	7.88	NT	4.7	1290	NT	6000
AMEC	AW-10	8/13/96	Good	6.45	NT	1.4	1149	NT	NT
AMEC	AW-10	9/29/98	Good	NT	NT	NT	NT	NT	NT
AMEC	Sammamish River	9/29/98	Good	NT	73.2	NT	NT	NT	NT
AMEC	AW-11	3/7/96	Poor	NT	NT	NT	NT	NT	NT
AMEC	AW-11	8/13/96	Good	6.46	NT	1.4	1333	NT	57000
AMEC	AW-11	8/13/96	Good	6.80	NT	0.4	1005	NT	NT
AMEC	AW-11	1/18/01	Good	NT	NT	NT	NT	NT	NT
AMEC	AW-11	3/26/01	Good	NT	NT	NT	NT	NT	NT
AMEC	AW-11	5/8/01	Good	NT	737	NT	NT	NT	NT
AMEC	AW-12	1/18/01	Good	NT	NT	NT	NT	NT	NT
AMEC	AW-12	3/28/01	Good	NT	NT	NT	NT	NT	NT
AMEC	AW-12	5/8/01	Good	NT	524	NT	NT	NT	NT

NOTES:

* The analysis, evaluation, and conclusions in this RI/FS are based only on good quality data. However, for completeness, all data (good, fair, and poor) are presented in this table (see Table 1 for explanation of dataset qualifications.

NT = not tested for specified analyte

µg/L = Micrograms per liter.

µS = Microsiemens.

NTU = Nephelometric Turbidity Units.

ORP = Oxidation Reduction Potential.

TSS = Total Suspended Solids, by EPA Method 160.2.

Hardness by EPA Method SM 2340B

mV = Millivolts.

mg. eq./L= milligram equivalent of calcium carbonate per liter

TABLE 3-6A. SOIL ANALYTICAL RESULTS, ORGANIC COMPOUNDS.

Agent	Sample Number	Date Collected	Sample Depth (feet)	TRPH (mg/kg)	WTPH-D Ext. Diesel (mg/kg)	WTPH-D Ext. Heavy Oil (mg/kg)	WTPH-G (mg/kg)	Benzene (mk/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Total Xylenes (mg/kg)	HVOs/ VOCs (mg/kg)	PCBs 1254 (mg/kg)	PCBs 1260 (mg/kg)
MTCA Method A Residential Cleanup Levels[1]				**200.0**	**200.0**	**200.0**	**100.0**	**0.5**	**40.0**	**20.0**	**20.0**	Varies	**1.0**	
CLARC II Method B Table for Residential Soil				NE	NE	NE	NE	34.5	16,000	8,000	160,000	Varies	0.13	
MTCA Method B Residential Cleanup Levels (100 times groundwater cleanup level from Table 4B)				100	100	100	100	0.12	680	310	1,600	Varies	0.0000045	
				[1] Residential soil cleanup levels are shown in **bold** and are based on MTCA Method A.										
MTCA Method A Industrial Cleanup Levels[2]				**200.0**	**200.0**	**200.0**	**100.0**	**0.5**	**40.0**	**20.0**	**20.0**	Varies	**10.0**	
CLARC II Method C Table for Industrial Soil				NE	NE	NE	NE	4530	700,000	350,000	7,000,000	Varies	17	
MTCA Method C Industrial Cleanup Levels (100 times groundwater cleanup level from Table 4B)				100	100	100	100	0.12	680	310	1,600	Varies	0.0000045	
				[2] Industrial soil cleanup levels are shown in **bold** and are based on MTCA Method A.										
Geotech	**TP-1**	17-Jun-91	9	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	
Geotech	**TP-2**	18-Jun-91	6	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	
Geotech	**TP-3**	19-Jun-91	9	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	
Geotech	**TP-4**	20-Jun-91	9	NT	NT	NT	NT	NT	NT	NT	NT	NT	<1	
Ecology	**OLFORPRD**	01-Nov-91	0	114	NT	NT	NT	NT	NT	NT	NT	NT	NT	
Ecology	**PREMIX**	01-Nov-91	0	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	
Ecology	**WATERCON**	01-Nov-91	0	154	NT	NT	NT	NT	NT	NT	NT	NT	<72	
Ecology	**PACVENT**	01-Nov-91	0	**4800 ***	NT	NT	NT	NT	NT	NT	NT	NT	NT	
Soil Borings / *Former Management Areas*														
Assumed Upgradient														
AMEC	**AW-1**	22-Sep-95	10-11.5	NT	<25	<100	<50	<0.05	<0.05	<0.05	<0.05	ND	NT	NT
Sterling Asphalt Work Piles														
AMEC	**AW-2**	20-Sep-95	C (wood)	NT	115	**525 ***	<50	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
Suspected Landfill														
AMEC	**AW-3**	19-Sep-95	10-11.5	NT	**362 ***	**2530 ***	<50	<0.05	<0.05	<0.05	<0.05	ND	0.084	<0.046
AMEC	**AW-4**	19-Sep-95	5-6.5	NT	33	**248 ***	<50	<0.05	<0.05	<0.05	<0.05	ND	<0.046	<0.046
Truck Wash Impoundment														
AMEC	**AW-5**	19-Sep-95	2.5-4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Pacific Ventures Area														
AMEC	**AW-6**	19-Sep-95	5-6.5	NT	105	**767 ***	<50	<0.05	<0.05	<0.05	<0.05	ND	NT	NT

TABLE 3-6A. SOIL ANALYTICAL RESULTS, ORGANIC COMPOUNDS.

Agent	Sample Number	Date Collected	Sample Depth (feet)	TRPH (mg/kg)	WTPH-D Ext. Diesel (mg/kg)	WTPH-D Ext. Heavy Oil (mg/kg)	WTPH-G (mg/kg)	Benzene (mk/kg)	Toluene (mg/kg)	Ethyl-benzene (mg/kg)	Total Xylenes (mg/kg)	HVOs/ VOCs (mg/kg)	PCBs 1254 (mg/kg)	PCBs 1260 (mg/kg)
KC R-O-W Alignment														
AMEC	**AW-7**	20-Sep-95	C (wood)	NT	167	**685 ***	<50	<0.05	<0.05	<0.05	<0.05	NT	<0.046	**2.4**
AMEC	**AW-8**	20-Sep-95	7.5-9	NT	50.7	**285 ***	<50	<0.05	<0.05	<0.05	<0.05	NT	0.063	<0.046
AMEC	**AW-9**	20-Sep-95	2.5-4	NT	<25	<100	<50	<0.05	<0.05	<0.05	<0.05	NT	<0.046	<0.046
Southern Shoreline														
AMEC	**AW-12**	21-Nov-97	2.5 - 4	NT	43.2	**423 ***	<5.00	NT	NT	NT	NT	NT	<0.050	<0.050
AMEC	**AW-12**	21-Nov-97	12.5 - 14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
AMEC	**AW-13**	25-Nov-97	7.5 - 9	NT	<10.0	<25.0	<5.00	NT	NT	NT	NT	NT	<0.050	<0.050
AMEC	**AW-13**	25-Nov-97	12.5 - 14	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Test Pit Exporations / *Management Area*														
Demolition Debris Landfill														
AMEC	**TP-1/4'**	29-Feb-96	4	NT	110	**690 ***	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-6/6'**	29-Feb-96	6	NT	15	69	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-7/2'**	29-Feb-96	2	NT	110	**690 ***	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-9/6'**	29-Feb-96	6	NT	88	**410 ***	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-12/7'**	01-Mar-96	7	NT	21	94	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-13/6.5**	01-Mar-96	6.5	NT	140	**1200 ***	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-15/7'**	01-Mar-96	7	NT	<12	<25	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT
AMEC	**TP-19/2'**	01-Mar-96	2	NT	**220 ***	**1600 ***	<0.5	<0.05	<0.05	<0.05	<0.05	NT	NT	NT

NOTES:

Bold x,xxx concentrations exceed only Residential cleanup levels for PCBs.

Bold x,xxx* concentrations in table exceed Residential and Industrial cleanup levels.

WTPH-D Ext. = Total petroleum hydrocarbons, diesel range (C12-C24) and heavy oil range (C>24), by Washington State Method WTPH-D Extended.

WTPH-G = Total petroleum hydrocarbons, gasoline range (C6-C12), by Washington State Method WTPH-G.

Benzene, Toluene, Ethylbenzene and Total Xylenes (BTEX), by EPA Method 8020.

All concentrations are expressed in milligrams per kilogram (mg/kg).

< = Analyte was not detected above the stated Method Reporting Limit.

HVOs = Halogenated Volatile Organics by EPA Method 8010.

PCBs = Polychlorinated biphenyls by EPA Method 8081 M.

VOCs = Volatile Organic Compounds by EPA Method 8240.

NE = Not Established.

ND = Analyte(s) not detected above laboratory method reporting limit. Refer to laboratory certificates for method reporting limit.

NT = Sample not tested for specified analytes(s).

C = Composite sample collected from drill cuttings, due to no recovery from standard penetration test sampling.

MTCA = Model Toxics Control Act.

TABLE 3-6B. SOIL ANALYTICAL RESULTS, INORGANIC COMPOUNDS.

Agent	Sample Number	Date Collected	Sample Depth (feet)	pH	Total Metals by EPA Method 6010/7000 Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Tin (mg/kg)	Zinc (mg/kg)
MTCA Method A Residential Cleanup Levels[1]					**20.0**	NE	**2.0**	**100.0**	**250.0**	**1.0**	NE	NE	NE	NE
90% Natural Background for Puget Sound Region (Ecology Publication 94-115)					7	NE	1	48	24	0.07	NE	NE	NE	85
CLARC II Method B Table for Residential Soil					1.67	5,600	80	400	NE	24	400	**400**	**48,000**	24000
MTCA Method B Residential Cleanup Levels (100 times groundwater cleanup level from Table 4B)					0.5	**100**	2.03	81	1.44	0.0012	**0.5**	2,590	NE	**1,650**
					[1] Cleanup levels based on MTCA Method A Residential Soil. Where no Method A cleanup level exists the most stringent MTCA Method B applicable cleanup level applies. **Bold** level indicates applicable residential cleanup level.									
MTCA Method A Industrial Cleanup Levels[2]					**200.0**	NE	**10.0**	**500.0**	**1,000.0**	**1.0**	NE	NE	NE	NE
CLARC II Method C Table for Industrial Soil					219	245,000	3,500	17,500	NE	1050	17,500	17,500	**2,100,000**	1,050,000
MTCA Method C Industrial Cleanup Levels (100 times groundwater cleanup level from Table 4B)					0.5	**100**	2.03	81	1.44	0.0012	**0.5**	**2,590**	NE	**1,650**
					[2] Cleanup levels based on MTCA Method A Industrial Soil. Where no Method A industrial cleanup level exists the most stringent MTCA Method C applicable cleanup level applies. **Bold** level indicates applicable industrial cleanup level.									
Soil Borings / *SHA Management Areas*														
Assumed Upgradient														
AMEC	**AW-1**	22-Sep-95	10-11.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Sterling Asphalt Work Piles														
AMEC	**AW-2**	20-Sep-95	C (wood)	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Suspected Landfill														
AMEC	**AW-3**	19-Sep-95	10-11.5	NT	7.2	80	<0.6	28	**292**	<0.2	<0.6	<1	NT	NT
AMEC	**AW-4**	19-Sep-95	5-6.5	NT	3.6	65	<0.5	20	36	<0.2	<0.5	<1	NT	NT
Truck Wash Impoundment														
AMEC	**AW-5**	19-Sep-95	2.5-4	7.9	6.5	**441***	<0.5	29	**1510***	0.2	<0.5	<1	NT	NT
Pacific Ventures Area														
AMEC	**AW-6**	19-Sep-95	5-6.5	NT	7.7	93	<0.6	36	27	<0.2	<0.6	<1	10	64
KC R-O-W Alignment														
AMEC	**AW-7**	20-Sep-95	C (wood)	NT	5.5	**255***	<0.7	31	**587**	0.2	<0.7	<1	NT	NT
AMEC	**AW-8**	20-Sep-95	7.5-9	NT	4.7	77	<0.6	29	63	<0.2	<0.6	<1	NT	NT
AMEC	**AW-9**	20-Sep-95	2.5-4	NT	1.2	22	<0.5	15	10	<0.2	<0.5	<1	NT	NT

TABLE 3-6B. SOIL ANALYTICAL RESULTS, INORGANIC COMPOUNDS.

					Total Metals by EPA Method 6010/7000									
Agent	Sample Number	Date Collected	Sample Depth (feet)	pH	Arsenic (mg/kg)	Barium (mg/kg)	Cadmium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Selenium (mg/kg)	Silver (mg/kg)	Tin (mg/kg)	Zinc (mg/kg)
Southern Shoreline														
AMEC	**AW-12**	21-Nov-97	2.5 - 4	NT	<10.0	37.3	<0.250	18.7	36.8	<0.0500	<7.50	<2.50	NT	NT
AMEC	**AW-12**	21-Nov-97	12.5 - 14	NT	<10.0	53.4	<0.250	22.5	<10.0	<0.0500	<7.50	<2.50	NT	NT
Demolition Debris Landfill														
AMEC	**AW-13**	25-Nov-97	7.5 - 9	NT	<10.0	**139***	0.463	24.5	217	<0.0500	<7.50	<2.52	NT	NT
AMEC	**AW-13**	25-Nov-97	12.5 - 14	NT	<10.0	81.4	<0.250	23.5	<10.0	<0.0500	<7.50	<2.50	NT	NT
Test Pit Exporations / *Management Area*														
Demolition Debris Landfill														
AMEC	**TP-13/6.5**	01-Mar-96	6.5	NT	3.3	42	0.6	19	28	<0.2	**0.6***	<1	NT	NT
AMEC	**TP-15/7'**	01-Mar-96	7	NT	4.8	60	0.6	21	31	<0.2	**0.6***	<1	NT	NT
Surface Water Sediments														
Upstream														
AMEC	**SED-1**	03-Dec-97	0	NT	<10.0	NT	NT	NT	83.4	NT	NT	NT	NT	NT
Downstream														
AMEC	**SED-2**	03-Dec-97	0.0	NT	<10.0	NT	NT	NT	<10.0	NT	NT	NT	NT	NT

NOTES:

Bold x,xxx concentrations in table exceed Residential cleanup levels.

Bold x,xxx* concentrations exceed both Residential and Industrial cleanup levels.

All concentrations are expressed in parts per million (mg/kg), except for pH, which is unitless.

< = Analyte was not detected above the stated Method Reporting Limit.

C= Drill cuttings analyzed due to no soil sample recovery. Soil cleanup standards do not apply to this media.

MTCA = Model Toxics Control Act.

NE = Not Established.

NT = Sample not tested for specified analytes(s).

RCRA Eight Total Metals by EPA 6010 / 7471/ 7740 unless noted otherwise *.

TABLE 3-6C. SOIL ANALYTICAL RESULTS, TCLP METALS.

Agent	Sample Number	Date Collected	Sample Depth (feet)	Data Quality	TCLP Metals by EPA Method 6010/7000 Arsenic (mg/L)	Barium (mg/L)	Cadmium (mg/L)	Chromium (mg/L)	Lead (mg/L)	Mercury (mg/L)	Selenium (mg/L)	Silver (mg/L)
Dangerous Waste Criteria (WAC 173-303-100)					5.0	100.0	1.0	5.0	5.0	0.2	1.0	5.000
AMEC	**TP-1/4'**	29-Feb-96	4	Good	<0.1	<0.4	<0.01	<0.01	<0.05	<0.0002	<0.1	<0.01
AMEC	**TP-6/6'**	29-Feb-96	6	Good	<0.1	<0.4	<0.01	<0.01	<0.05	<0.0002	<0.1	<0.01
AMEC	**TP-7/2'**	29-Feb-96	2	Good	<0.1	<0.4	<0.01	<0.01	<0.05	<0.0002	<0.1	<0.01
AMEC	**TP-9/6'**	29-Feb-96	6	Good	<0.1	0.5	<0.01	<0.01	0.71	<0.0002	<0.1	<0.01
AMEC	**TP-12/7'**	01-Mar-96	7	Good	<0.1	<0.4	<0.01	<0.01	<0.05	<0.0002	<0.1	<0.01
AMEC	**TP-19/2'**	01-Mar-96	2	Good	<0.1	0.7	<0.01	<0.01	0.43	<0.0002	<0.1	<0.01

NOTES:

TCLP = Toxicity Characteristic Leaching Procedure

< = Analyte was not detected above the stated Method Reporting Limit.

mg/L = milligrams per liter of extract

TABLE 13-1 RECOMMENDED CLEANUP LEVELS FOR GROUNDWATER, KENMORE INDUSTRIAL PARK		
Contaminant	**Cleanup Level (μg/L)**	**Standard/Criteria**
TPH (ORPH and DRPH)	1,000	MTCA Method A (based on protection of groundwater because no applicable surface water cleanup level exists under MTCA Methods A, B, or, C, and there is no MTCA Method B groundwater cleanup level)
Arsenic	5	MTCA Method A (based on natural background concentrations for the State of Washington)
Lead (dissolved)	14.4	MTCA Method A and B (based on hardness dependent formula in WAC 173-201A-040. Calculation was based on lowest observed groundwater hardness of 524 mg. eq./L)
Barium	1,000	MTCA Method A and B (based on EPA National Recommended Water Quality Criteria)

TABLE 13-2 CLEANUP LEVELS FOR SOIL		
Contaminant	**Cleanup Level (mg/kg)**	**Standard/Criteria**
TPH (ORPH and DRPH)	200.0	Method A Residential
Arsenic	20.0	Method A Residential
Barium	100	Method B Residential
Lead	250	Method A Residential
Selenium	0.5	Method B Residential

TABLE 13-3 CLEANUP LEVELS FOR SOIL FOR CONTINUED INDUSTRIAL USE		
Contaminant	**Cleanup Level (mg/kg)**	**Standard/Criteria**
TPH (ORPH and DRPH)	200.0	Method A Industrial
Arsenic	200.0	Method A Industrial
Barium	100	Method C Industrial
Lead	1000	Method A Industrial
Selenium	0.5	Method C Industrial

TABLE 13-4 COMPARISON OF CURRENT COC CONCENTRATIONS TO GROUNDWATER CLEANUP LEVELS FOR PROTECTION OF SURFACE WATER AT CONDITIONAL POINT OF COMPLIANCE, KENMORE INDUSTRIAL PARK			
Contaminant	**2001 Measured Groundwater Concentration Range at Shoreline Compliance Wells (μg/L)**	**Cleanup Level (μg/L)**	**Exceedance of Cleanup Levels at the Conditional Point of Compliance**
TPH (ORPH and DRPH)	<250 to <750	1,000	None
Arsenic	1.02 to 4.75	5	None[1]
Barium	68.9 to 889	1,000	None[2]
Lead	<1 to 13	14.4	None

Notes: [1]A single anomalous exceedance of 12 μg/L occurred in 1996 in the no longer operable well AW-10.
[2]A single anomalous exceedance of 1,090 μg/L occurred in 1996 in the well AW-11.

TABLE 13-5
COMPARISON OF COC CONCENTRATIONS TO RESIDENTIAL SOIL MEDIA CCLs, KENMORE INDUSTRIAL PARK

Contaminant	Measured Soil Concentration Range (mg/kg)	Cleanup Level (mg/kg)	Exceedance Of CCL
TPH (ORPH and DRPH)	15 to 4,800	200	Throughout
Arsenic	<1.2 to 7.7	20	None
Barium	22 to 441	100	3 exceedances
Lead	<10 to 1,510	250	3 exceedances
Selenium	<0.5 to 0.6	0.5	2 exceedances

TABLE 13-6
COMPARISON OF COC CONCENTRATIONS TO INDUSTRIAL SOIL MEDIA CCLs, KENMORE INDUSTRIAL PARK

Contaminant	Measured Soil Concentration Range (mg/kg)	Cleanup Level (mg/kg)	Exceedance Of CCL
TPH (ORPH and DRPH)	15 to 4,800	200	Throughout
Arsenic	<1.2 to 7.7	200	None
Barium	22 to 441	100	3 exceedances
Lead	<10 to 1,510	1,000	1 exceedance
Selenium	<0.5 to 0.6	0.5	2 exceedances

TABLE 13-7
APPLICABLE STATE AND FEDERAL LAWS TABLE

Statute, Regulation, or Ordinance	Requirement	Comments
Federal Clean Water Act, 33 USC 1344, 33 CFR 325-330	Section 404 (Dredge and Fill) permit or Nationwide permit issued by Army Corps of Engineers for dredge or fill activities in navigable waters (including wetland areas).	Potentially applicable to bulkhead rehabilitation; and activity in/near site wetlands
Federal Clean Water Act, 33 USC 1341	State Water Quality Certification issued by State Department of Ecology for activities subject to Section 404 permit.	Potentially applicable if Section 404 (dredge and fill) permit required
Federal Rivers and Harbors Act, 33 USC 403	Section 10 Permit issued by Army Corps of Engineers for activities that obstruct navigational waterways.	Potentially applicable to bulkhead rehabilitation
Federal Endangered Species Act (ESA) 16 USC 1531 et. seq.	Consultation with NMFS required where there is a federal nexus and potential impact on endangered or threatened species.	Potentially applicable to bulkhead rehabilitation
Federal Occupational Safety and Health Act (OSHA), 29 CFR 1910.120	Site worker health and safety requirements.	Potentially applicable to remedial action construction activities.
Safe Drinking Water Act		Potentially applicable for drinking water supply (groundwater wells)
State Water Pollution Control Act, RCW 90.48, NPDES Permit Program, Ch. 173-220 WAC (implementing Federal Clean Water Act, 33 USC 1342)	National Pollutant Discharge Elimination System (NPDES) permit issued by the Department of Ecology for point source discharges to surface waters.[1]	Substantive requirements potentially applicable to point source discharges to adjacent surface waters
State Water Pollution Control Act, RCW 90.48, State General Permit Program, Ch. 173-226 WAC (implementing Federal Clean Water Act, 33 USC 1342)	Baseline General Stormwater Permit issued by Ecology for construction activities impacting more than 5 acres.[1]	Substantive requirements potentially applicable to remedial action construction activities
State Water Pollution Control Act, RCW 90.48, WAC 173-201A	Compliance with state surface water quality standards issued by the Department of Ecology.[1]	Substantive requirements potentially applicable for Lake Washington/Sammamish River

TABLE 13-7
APPLICABLE STATE AND FEDERAL LAWS TABLE

Statute, Regulation, or Ordinance	Requirement	Comments
		classifications
State Hydraulics Act, RCW 75.20, Ch. 220-110 WAC	Hydraulic Project Approval from the State Department of Fish and Wildlife for activities that affect the natural flow or bed of any water body.[1]	Substantive requirements potentially applicable to bulkhead rehabilitation, temporary bypass culverts, outfall structures, and stormwater pond facilities.
State Noise Control Act, RCW 70.107, Ch. 173-60 WAC	Establishes noise levels.	Potentially applicable to remedial action construction activities.
Washington Clean Air Act, RCW 70.94 RCW, WAC 173-400 through 492 (implementing the Federal Clean Air Act, 42 USC 7401 et.seq.) Puget Sound Clean Air Authority (PSCAA) Regulation I	Requirements applicable for control of fugitive dust emissions, Regulation I, Article 9.	Substantive requirements potentially applicable to construction of engineered cap.
State Environmental Policy Act (SEPA), 43.21 RCW, Ch. 197-11 WAC	Project environmental review.	Potentially applicable to the remedial action. Note: A SEPA checklist has been submitted to Ecology for the remedial action
State Shoreline Management Act, RCW 90.58; King County Code, Title 25 (as adopted by the City of Kenmore)	City of Kenmore shoreline management provisions for activities within 200 feet of State shorelines.	Potentially applicable to remedial actions within shoreline areas. Note: King County issued a Shoreline Substantial Development Permit (File No. L96SH107) for the site in August 1998.[2]
Washington Minimum Functional Standards for Solid Waste Handling, RCW 70.95, Ch. 173-304 WAC	Closure requirements for demolition waste landfills.	The standards of WAC 173-304-405 through 173-304-490 do not apply to this site because it was closed prior to the date of the regulations in accordance with WAC 173-304-400. However, the demolition waste landfilling facility closure requirements in WAC 173-304-461 are relevant and appropriate requirements.
Washington Industrial Safety and	Site worker health and safety requirements.	Potentially applicable to remedial action

TABLE 13-7
APPLICABLE STATE AND FEDERAL LAWS TABLE

Statute, Regulation, or Ordinance	Requirement	Comments
Health Act (WISHA), Ch. 296-62 WAC		construction activities.
King County Board of Health Code, Regulation 10.76.020	Construction standards for methane control.	Substantive requirements potentially applicable to methane control elements of remedial action.
City of Kenmore Provisions[3]	Local land use and development requirements.[1]	Substantive requirements potentially applicable to land use and construction elements of remedial action. Note: King County approved a Master Site Plan and issued a Commercial Site Development Permit (File No. B96CS005) for the site in August 1998.[2]

Notes:

1 . The substantive requirements of chapters 70.94, 70.95, 70.105, 75.20, 90.48, and 90.58 RCW and of any laws requiring or authorizing local government permits or approvals for the remedial action that are known to be potentially applicable and for which Pioneer Towing is exempt from the procedural requirements pursuant to RCW 70.105D.090(l) are set out in detail in Exhibit G to the Consent Decree.

2. The Commercial Site Development Permit (CSDP) and Shoreline Substantial Development Permit (SSDP) issued for the redevelopment may address and/or stand in lieu of certain listed requirements. However, the substantive requirements of the King County Code as adopted by the City of Kenmore supercede specific conditions in these permits. Therefore, implementation of the Cleanup Action Plan in conformance with applicable substantive code standards may not comply with all of the conditions identified in the CSDP and SSDP.

3. The City of Kenmore has adopted King County's Code provisions subject to certain modifications. The City plans to codify its own development provisions some time in 2001.

TABLE 15-1. SCREENING OF GENERAL RESPONSE ACTIONS, TECHNOLOGIES AND PROCESS OPTIONS KENMORE INDUSTRIAL PARK KENMORE, WASHINGTON

Remedial Action Objective	General Response Action	Remedial Technology	Process Option	Description	Comments
Prevent the migration of COCs above levels of concern to surrounding surface waters	No Remedial Action	**No Action**	**Non-Engineered Cap**	Cover the landfilled media with the proposed building footprint	Applicable
	Institutional Controls	Restrictive Covenants	Deed Notices	Amend site deeds to prevent future owners from unknowingly intruding on potential subsurface contamination	Not applicable, as groundwater already meets CCLs at the point of compliance
			Health and Safety Plan	Prepare health and safety plan to protect workers during excavation	Not applicable as groundwater already meets CCLs at the point of compliance
	Monitoring	**Groundwater Monitoring**	**Measurement of Fluid Levels**	Periodic measurement of fluid levels in compliance wells	Applicable
			Sampling at the Point of Compliance	Quarterly sampling of groundwater for diesel- and oil-range TPH, dissolved arsenic and dissolved lead	Applicable
	Containment	**Physical Barriers**	Full Engineered Cap	Construct engineered cap across upland portion of site and install groundwater barrier around site perimeter	Not feasible due to build-up of vertical head beneath and behind cap, and impact on shoreline habitats
			Partial Engineered Cap	Construct engineered cap across 68% of upland area slated for redevelopment	Applicable
			Permeable Vertical Barrier	Construct permeable groundwater barrier around site perimeter	Potentially applicable, but may damage shoreline and wetland habitats and be cost-prohibitive
	Off-site Disposal	Solid Recovery	Excavation	Removal of landfilled media and restoration of land surface	Not feasible due to damage of habitat, surface water quality and site utilization
			Selective Excavation	Selective excavation of landfilled media in areas where COCs exceed recommended CCLs for groundwater	Not applicable, as groundwater currently meets CCLs at the point of compliance
	In Situ Treatment	Liquid Recovery	Groundwater pumping, air sparging and/or bioremediation	Pumping and treatment of groundwater to remove inorganic COCs and remove or remediate organic COCs	Not applicable due to low COC concentrations, low volatility or inorganic nature of each COC, and high recharge capacity of adjacent surface waters
		Vapor Recovery	Landfill Gas Mitigation	Install passive or active landfill gas mitigation systems in conjunction with the proposed development	Not applicable

NOTE: Bolded options carried forward for further evaluation

TABLE 17-1. CRITERA FOR DETERMINING USE OF PERMANENT SOLUTIONS TO THE MAXIMUM EXTENT PRACTICABLE, KENMORE INDUSTRIAL PARK, KENMORE, WASHINGTON

PROPOSED CLEANUP ALTERNATIVE	Short-Term Effectiveness	Long-Term Effectiveness	Reduction in Toxicity, Mobility and Volume	Ability to be Implemented	Cost
Alternative 1					
No Action	Low	Moderate	Low	High	Low
Alternative 2					
Institutional Controls and Monitoring	Moderate	High	Low	High	Low
Alternative 3					
Partial Containment Cap	Moderate	High	Moderate Reduction in Mobility	High	Moderate
Alternative 4					
Partial Cap and Permeable Groundwater Barri	Moderate	High	Moderate Reduction in Mobility	Low	High

TABLE 17-2
ALTERNATIVE 1 COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	EXTENDED COST	TOTAL
CAPITAL COSTS					
Institutional Controls					$ -
Subtotal Capital Cost					$ -
Contingency (20%)					$ -
Total Capital Cost					**$ -**
ANNUAL OPERATION AND MAINTENANCE COSTS					
Institutional Controls					$ -
Subtotal Annual Operation and Maintenance Costs					$ -
Contingency (20%)					$ -
Total Annual Operation and Maintenance Costs					**$ -**
TOTAL FIRST YEAR COST FOR ALTERNATIVE 1					**$ -**
PRESENT DOLLAR 25-YEAR COST (5% discount rate)					$0.00

TABLE 17-3
ALTERNATIVE 2 COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	EXTENDED COST	TOTAL
CAPITAL COSTS					
Institutional Controls	1	ls	$ 25,000	$ 25,000	
Subtotal Capital Cost					$ 25,000
Contingency (20%)					$ 5,000
Total Capital Cost					**$ 30,000**
ANNUAL OPERATION AND MAINTENANCE COSTS					
Groundwater Monitoring, Quarterly					
Quarterly Costs:					
Sampling, 6 wells, 2 days/round	20	hrs	$ 80	$ 1,600	
Sampling Equipment	2	days	$ 250	$ 500	
Analytical (Pb, As, WTPH-D ext)	6	each	$ 200	$ 1,200	
Reporting	16	hrs	$ 100	$ 1,600	
Subtotal Groundwater Monitoring (1 year)					$ 19,600
Contingency (20%)					$ 3,920
Total Annual Operation and Maintenance Costs					**$ 23,520**
TOTAL FIRST YEAR COST FOR ALTERNATIVE 2					**$ 53,520**
PRESENT DOLLAR 25-YEAR COST (5% discount rate)					**$401,584.06**

TABLE 17-4
ALTERNATIVE 3 COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	EXTENDED COST	FIRST YEAR COST	TOTAL
CAPITAL COSTS (PHASED OVER 15 YEARS)						
Institutional Controls	1	ls	$ 25,000	$ 25,000	$ 25,000	
Cap Construction						
Topsoil, 3 feet thick, placed	14,556	cy	$ 10	$ 145,560	$ 50,946	
Gravel, 6-inch thick, clean pit run, placed	2,426	cy	$ 22	$ 53,372	$ 18,680	
Geo-Composite Fabrinet, installed	131,000	sf	$ 0.35	$ 45,850	$ 16,048	
Geo-Membrane 30-mil HDPE, installed	131,000	sf	$ 0.40	$ 52,400	$ 18,340	
Soil/Bentonite admixture, placed, compacted	3	acre-ft	$ 15,000	$ 45,000	$ 15,750	
Construction Oversight	15	yr	$ 15,000	$ 225,000	$ 78,750	
Engineering	1	ls	$ 20,000	$ 20,000	$ 20,000	
Phase I - First Year Capital Cost						
Subtotal Capital Cost					$ 243,514	
Contingency (20%)					$ 48,703	
Total Phase I Capital Cost					**$ 292,216**	
Total Capital Cost						
Subtotal Capital Cost						$ 612,182
Contingency (20%)						$ 122,436
Total Capital Cost						**$ 734,618**
ANNUAL OPERATION AND MAINTENANCE COSTS (25 YEARS)						
Cap Maintenance						
Quarterly Inspection	32	hrs	$ 80	$ 2,560		
Groundwater Monitoring, Quarterly						
<u>Quarterly Costs:</u>						
Sampling, 6 wells, 2 days/round	20	hrs	$ 80	$ 1,600		
Sampling Equipment	2	days	$ 250	$ 500		
Analytical (Pb, As, WTPH-D ext)	6	each	$ 200	$ 1,200		
Reporting	16	hrs	$ 100	$ 1,600		
Subtotal Groundwater Monitoring (1 year)					$ 19,600	
Subtotal Annual Operation and Maintenance Costs					$ 2,560	
Contingency (20%)					$ 4,432	
Total Annual Operation and Maintenance Costs					**$ 26,592**	
TOTAL FIRST YEAR COST FOR ALTERNATIVE 3					**$ 318,808**	
TOTAL CAPITAL COSTS FOR ALTERNATIVE 3						**$ 734,618**
PRESENT DOLLAR 25-YEAR COST (5% discount rate)						**$ 1,128,144**

NOTE: This cost estimate does not include overexcavation costs, if required to acheive planned finish grades within the cap areas.
This cost estimate assumes that Phase I development covers approximately 35 percent of the upland area slated for capping.

TABLE 17-5
ALTERNATIVE 4 COST ESTIMATE

ITEM	QUANTITY	UNIT	UNIT COST	EXTENDED COST	FIRST YEAR COST	TOTAL
CAPITAL COSTS (PHASED OVER 15 YEARS)						
Institutional Controls	1	ls	$ 25,000	$ 25,000	$ 25,000	
Cap Construction						
Topsoil, 3 feet thick, placed	30,000	cy	$ 10	$ 300,000	$ 105,000	
Gravel, 6-inch thick, clean pit run, placed	4,950	cy	$ 22	$ 108,900	$ 38,115	
Geo-Composite Fabrinet, installed	311,000	sf	$ 0.35	$ 108,850	$ 38,098	
Geo-Membrane 30-mil HDPE, installed	311,000	sf	$ 0.40	$ 124,400	$ 43,540	
Soil/Bentonite admixture, placed, compacted	4.5	acre-ft	$ 15,000	$ 67,500	$ 23,625	
Low Permeability Groundwater Cutoff						
Cutoff Wall to 40 feet: Sealed Sheet Piles, or Cement - Bentonite Trench with soil disposal	240,000	sf	$ 25.00	$ 6,000,000	$ 6,000,000	
Construction Oversight	15	yr	$ 30,000	$ 450,000	$ 157,500	
Engineering	1	ls	$ 40,000	$ 60,000	$ 60,000	
Phase I - First Year Capital Cost						
Subtotal Capital Cost					$ 6,490,878	
Contingency (20%)					$ 1,298,176	
Total Phase I Capital Cost					$ 7,789,053	
Total Capital Cost						
Subtotal Capital Cost						$ 7,244,650
Contingency (20%)						$ 1,448,930
Total Capital Cost						$ 8,693,580
ANNUAL OPERATION AND MAINTENANCE COSTS (25 YEARS)						
Cap Maintenance						
Quarterly Inspection	32	hrs	$ 80	$ 2,560		
Groundwater Monitoring, Quarterly						
<u>Quarterly Costs:</u>						
Sampling, 6 wells, 2 days/round	20	hrs	$ 80	$ 1,600		
Sampling Equipment	2	days	$ 250	$ 500		
Analytical (Pb, As, WTPH-D ext)	6	each	$ 200	$ 1,200		
Reporting	16	hrs	$ 100	$ 1,600		
Subtotal Groundwater Monitoring (1 year)					$ 19,600	
Subtotal Annual Operation and Maintenance Costs					$ 2,560	
Contingency (20%)					$ 4,432	
Total Annual Operation and Maintenance Costs					$ 26,592	
TOTAL FIRST YEAR COST FOR ALTERNATIVE 4					$ 7,815,645	
TOTAL CAPITAL COSTS FOR ALTERNATIVE 4						$ 8,693,580
PRESENT DOLLAR 25-YEAR COST (5% discount rate)						$ 9,087,105

NOTE: This cost estimate does not include overexcavation costs, if required to acheive planned finish grades within the cap areas.
This cost estimate assumes that Phase I development covers approximately 35 percent of the upland area slated for capping, and that the groundwater barrier would be completed during the first phase of construction