REPORT

Remedial Investigation / Feasibility Study Sea-Tac Development Site Seatac, Washington

Submitted To: Riddell Williams P.S.
1001 Fourth Avenue, Suite 4500
Seattle, Washington 98154

Submitted By: Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA 98052 USA

September 17, 2010 **Project No. 073-93368-05.03**

A world of capabilities delivered locally

Table of Contents

List of Tables

List of Figures

List of Appendices

List of Acronyms

amsl	above mean sea level
AO	Agreed Order
ARAR	applicable or relevant and appropriate requirements
AVC	Aviation Commercial
AVO	Aviation Operations
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylene
btoc	below top of casing
CAO	Cleanup Action Objectives
CAP	Cleanup Action Plan
CB-C	Community Business in Urban Center
CFR	Code of Federal Regulations
CMP	Compliance Monitoring Plan
COC	contaminants of concern
DBCP	1,2-dibromo-3-chloropropane
DCAP	Draft Compliance Monitoring Plan
Ecology	Washington Department of Ecology
EDB	ethylene dibromide or 1,2-dibromoethane
EDC	1,2-dichloroethane
EPA	U.S. Environmental Protection Agency
EPA-RAGS	EPA Risk Assessment Guildelines
ESA	Phase I Environmental Site Assessment
FWS	U.S. Fish and Wildlife Service
Golder	Golder Associates Inc.
HSA	hollow-stem auger
HASP	Health and Safety Plan
IAS	In-Situ Air Sparging
ISCO	In-Situ Chemical Oxidation
IRA	independent remedial action
MasterPark Facility	MasterPark Lot C
MCL	maximum contaminant level
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MNA	monitored natural attenuation
MTBE	methyl tert-butyl ether
MTCA	Model Toxics Control Act
µg/kg	micrograms per liter
µg/L	microgram per liter
NTU	nephelometric turbidity units
NWTPH-Gx	Northwest Total Petroleum Hydrocarbons-Gasoline
PID	photoionization detector
PQL	Practical Quantification Limit
QA	quality assurance
QP	quality procedures
QAPP	Quality Assurance Project Plan
Qva	Quaternary advance outwash
ROW	right-of-way
RI	remedial investigation
RI/FS	remedial investigation/feasibility study
Site	SeaTac Development Site as Defined in the Agreed Order
SAP	Field Sampling Analysis Plan
SIDS	Sample Integrity Data Sheets
SL	screening level
SVE	Soil Vapor Extraction
UST	underground storage tanks

VOC	volatile organic compounds
VCP	Voluntary Cleanup Program
WAC	Washington State Administrative Code
Work Plan	Remedial Investigation/Feasibility Study Work Plan
WDFW	Washington Department of Fish and Wildlife

1.0 INTRODUCTION

This document is the Remedial Investigation/Feasibility Study (RI/FS) Report prepared by Golder Associates Inc. (Golder) for SeaTac Investments LLC (SeaTac Investments), Scarsella Brothers Inc. and ANSCO Properties, LLC pursuant to the Agreed Order under the Model Toxics Control Act (MTCA). The PLP Group entered into an Agreed Order (No. DE 6844 with the Washington State Department of Ecology (Ecology) to complete a RI/FS and Draft Cleanup Action Plan (Draft CAP) for the SeaTac Development Site (Site). The scope and procedures used for this investigation were defined in the RI/FS work plan developed by Golder, dated August 31, 2009. Figure 1-1 shows the location of the Site.

1.1 Statement of Purpose

The purpose of the RI portion of the RI/FS, as defined in the work plan, was to collect, develop, and evaluate sufficient information regarding the Site to select a cleanup action and to evaluate Site risks. RI information was used to support the FS, which evaluates applicable cleanup alternatives and recommends a cleanup action in accordance with the MTCA rules; Sections WAC 173-340-350 through WAC 173-340-390 of the Washington State Administrative Code (WAC). Ecology will use the evaluation in this report to select a cleanup action. The cleanup action selected by Ecology will be proposed in the Draft CAP document that will be available for public review and comment. Following the public review period, a cleanup action will be formally selected in the Final CAP.

1.2 Objectives of RI/FS

The primary objective of this RI/FS was to assess the nature and extent of hazardous substance [gasoline range petroleum hydrocarbons (gasoline) and associated constituents] impacts to Site media. A release from an underground gasoline storage tank has impacted underlying soils and groundwater at the MasterPark Lot C facility (MasterPark Facility). The Site was previously investigated in the early 2000s and in 2007 and 2008. The RI collected data to eliminate data gaps that remained from the previous Site investigations. The RI included groundwater investigations in the regional (Qva) aquifer to define constituents, delineate groundwater impacts, and evaluate soil vapor resulting from impacted groundwater at selected Site locations. The extent of contamination in the soil was characterized in previous investigations at the MasterPark Facility. The RI evaluates the risk of exposure from releases at the Site to appropriate human and ecological receptors. Specific objectives of the remedial investigation included the following:

- A compilation of historical uses and operations at the MasterPark Facility and surrounding areas.
- A classification of the types of materials stored and used on the MasterPark Facility and surrounding area.
- An evaluation of previous investigations and cleanup actions conducted at the MasterPark Facility and surrounding area.

- A characterization of the nature, extent, and potential sources of hazardous substance releases at the MasterPark Facility and surrounding area that have impacted or have the potential to impact groundwater.
- A hydrogeologic investigation of the regional and MasterPark Facility-specific geologic and hydrogeologic characteristics affecting groundwater flow beneath the Facility.
- An assessment of the groundwater impacts from the Site releases, including the lateral and vertical extent of the dissolved contaminant plume.
- An assessment of volatile organic compounds in the soil vapor emanating from groundwater.
- An evaluation of the potential routes of exposure and risks to human and ecological receptors associated with releases or threatened releases of hazardous substances.

The objectives of the FS included the following:

- Define remedial action objectives (RAOs) specific to the MasterPark Facility.
- Identify and screen (initially) applicable treatment technologies.
- Develop potential remedial action alternatives (assemblage of applicable remedial technologies) for the Site.
- Estimate the cost of each potential cleanup alternative.
- Evaluate potential cleanup alternatives with respect to MTCA requirements.
- Recommend a preferred cleanup alternative for the MasterPark Facility.

The FS was conducted according to the MTCA regulations, specifically WAC 173-340-350 and WAC 173-340-360. The FS comprehensively evaluates likely cleanup alternatives, and proposes a recommended cleanup action that provides the most practical and achievable results for the MasterPark Facility. The remedy recommended from the FS is protective of human health and the environment; complies with cleanup standards; satisfies applicable, relevant, or appropriate requirements (ARARs); provides for compliance monitoring; is permanent to the maximum extent practicable; and is implementable within a reasonable time frame.

1.3 RI/FS Report Organization

This RI/FS Report is organized into 9 sections and 7 appendices. The contents of the sections are as follows:

- Section 1.0 provides general introductory information and identifies the objectives of the RI/FS.
- Section 2.0 provides general information regarding the Site including the location, type of former operations conducted at the Site, and a synopsis of the Site history.
- Section 3.0 provides results of the RI.
- Section 4.0 presents a description of contaminants of concern and the extent of contamination.
- Section 5.0 presents remedial action objectives
- Section 6.0 presents a screening of remedial action technologies

- Section 7.0 develops and describes the remedial alternatives that are appropriates for the Site.
- Section 8.0 presents a detailed evaluation of selected remedial alternatives.
- Section 9.0 lists the references cited in this RI/FS Report.

The following 7 appendices are included in this RI/FS Report.

- Appendix A Washington Fish and Wildlife Species Listing.
- Appendix B contains relevant data tables and figures from previous investigations.
- Appendix C contains laboratory analytical reports and data validation information. This appendix is on a CD.
- Appendix D contains copies of logs for groundwater monitoring wells installed during this RI/FS investigation.
- Appendix E contains geodetic data collected during this RI/FS investigation.
- Appendix F contains a summary of pertinent Federal and State laws and regulations that may be considered applicable or relevant and appropriate (ARAR) for the Site.
- Appendix G provides remedial cost information and details.

2.0 SITE BACKGROUND

The following sections provide general information regarding the Site including the location, type of historic operations conducted at the Site, and a synopsis of the Site history, including previous remedial actions. The geography and topography of the area are described along with descriptions of the regional geology and soils, adjacent land use, surface and groundwater, and meteorology.

2.1 Site Location and Description

The MasterPark Facility is approximately 7 acres, located at 16025 International Boulevard, SeaTac, Washington within Section 28, Township 23 North, Range 4 East (Figure 1-1) and is called the MasterPark Lot C. SeaTac Investments is currently operating the MasterPark Facility as a public valet parking lot, doing business as MasterPark Lot C (see Figure 2-1). SeaTac Investments leases the majority of the land from ANSCO Properties, LLC (current land owner of the north portion of the MasterPark Facility) under the terms of a long-term lease agreement.

Current data indicate the known soil contamination, the highest levels of groundwater contamination, and possible primary source of contamination (former underground storage tanks) are located on the MasterPark Facility property, but groundwater impacts extend beyond the MasterPark Facility property boundaries. The Site is defined, for purposes of this document, as the area where groundwater has been impacted above MTCA cleanup levels due to impact by the MasterPark Facility's contamination. The Site currently includes portions, or all of the following contiguous properties:

- MasterPark Lot C (the MasterPark Facility)
- Louden Property
- City of SeaTac (South 160th Street) right-of-way
- Washington Memorial Cemetery
- Port of Seattle Property (north of South 160th Street)

The Site extends beyond South 160th Street to the north onto Port of Seattle Property, is bound by International Boulevard to the east, and extends onto Washington Memorial Cemetery to the west. Presently the eastern majority of the Site, where the MasterPark Facility is operated, consists of relatively flat ground covered by asphalt. The western portion of the Site is owned and operated as a cemetery. The northern portion of the Site includes the Louden property and South 160th Street.

2.1.1 Adjacent Property Uses

The Site is in the City of SeaTac, Washington. To the north is the Louden property and South 160th Street. The Louden property contains an office building utilized by a real estate business and a warehouse building. The warehouse building has been utilized for the storage of goods and materials by various businesses. The Port of Seattle has major construction occurring north of South 160th Street for commercial buildings and infrastructure to support light rail transportation. To the east is Pacific Highway South (State Route 99) with numerous commercial businesses and buildings. Further east of the

MasterPark Facility (about 0.25 miles) a residential neighborhood exists. To the west and south of the MasterPark Facility is land owned by the Washington Memorial Cemetery. A single residence exists on the cemetery property just west of the northwest corner of the MasterPark Facility. Further west of the cemetery is Port of Seattle parking and commercial office buildings, followed by the airport access highway and SeaTac Airport.

The only municipal groundwater supply well system within a mile of the MasterPark Facility is located about 0.5 miles east of the MasterPark Facility, within a residential neighborhood. Washington Memorial Cemetery has groundwater well located south-southwest of the MasterPark Facility. The water pumped from this well is only used for cemetery irrigation and for use in a decorative fountain. Groundwater from this well has been sampled by Golder and Ecology in the past and analytical results indicate the groundwater is not impacted. The local groundwater supply wells are depicted on Figure 2-2.

2.1.2 Zoning

According to a City of SeaTac zoning map (February 2009, see Figure 2-3), the MasterPark Facility is zoned as CB-C or “Community Business in Urban Center”. Washington Park Cemetery and the associated cemetery residence are zoned as “Park.” To the north of Washington Park Cemetery the land is zoned AVO or “Aviation Operations.” The property immediately north of the MasterPark Facility on the north side of South 160th Street is zoned as AVC or “Aviation Commercial.” To the east of the MasterPark Facility, on the east side of International Boulevard, the land has mixed zoning including “Community Business in Urban Center,” followed by “Urban High Density Residential,” and “Urban Medium Density Residential.”

2.2 Site History

2.2.1 Historic Operations

It is suspected that portions of the Washington Park Cemetery may have been developed prior to 1936 as indicated by the presence of some of the current cemetery roads (to the south of the MasterPark Facility property) in a 1936 aerial photograph. The Site showed the first development in a 1946 aerial photograph with a single building. Major development of the MasterPark Facility property (uses prior to the current development) and surrounding properties was evident in a 1956 aerial photograph. Since the 1960s, the MasterPark Facility property was mainly a construction staging area that supported the construction of Interstate 5. The currently existing Louden property buildings were constructed at some point between 1960 and 1969 as indicated by aerial photographs of this vintage. More recently a number of small manufacturing and warehousing facilities operated at the MasterPark Facility property including public parking. Today, the entire MasterPark Facility is a paved parking lot with a single administrative building supporting the business.

2.3 Physical Setting

This section describes the regional geologic and hydrogeologic setting followed by Site-specific geology encountered during subsurface investigations at the Site.

2.3.1 Regional Geologic Setting

The Site is located in the Central Puget Lowland, where the geologic formation was significantly modified by the last glaciations of the Vashon Stade. Predominantly, the surficial geology of the Site is Quaternary recessional outwash (Qvr) deposits, characterized by stratified sand and gravel that is moderately well to well sorted (USGS 2004). These were deposited by channels carrying meltwater from the margin of the ice as it was retreating. A portion of the southeastern side of the Site consists of Quaternary advanced outwash (Qva) deposits, characterized by bedded sand and gravel that were deposited by fluvial processes in advance of the ice sheet. Because of the massive glaciation through the area, bedrock is only occasionally observed in outcrops northeast of the Site, such as portions of the hillsides adjacent to the Duwamish River. Bedrock in these areas includes volcanic, marine and continental sedimentary rocks of the Tertiary age. The depth to bedrock at the Site is unknown, but could range from 300 to 1,500 meters below ground surface (bgs).

The Site ground surface elevation generally declines from the southwest to the northeast with a maximum elevation near 400 feet above mean sea level (amsl) at the southwest corner of the Site and a minimum elevation of approximately 350 feet amsl near the northeast corner.

2.3.2 Soil

Near surface soils consist of a layer of fill that may be up to approximately 10 feet thick in places. Beneath the fill, till and/or layers of outwash sand are encountered. In general, the till occurs in the range of 10 to 30 feet bgs. Below the till is dense to very dense Qva stratum consisting of unstratified fine to coarse grained sandy deposits. Although the RI did not include boreholes deeper than the Qva stratum, regional geologic maps indicate the potential presence of lacustrine clayey silts and silty clay deposits beneath the Qva stratum at an unknown depth (USGS 2004).

2.3.3 Climate

2.3.3.1 General Climatic Conditions

A weather station is located at Seattle Tacoma International Airport, located east of the Site. Based on the data collected at this regional weather station, the area is characterized by mild temperatures, a defined rainy season, and considerable cloud cover (NOAA National Climatic Data Center, undated). The climate of the region is impacted by the presence of the Cascade and Olympic Mountains. The typical prevailing direction of weather fronts is southwesterly. Average temperatures in the summer reach 72º Fahrenheit, with the highest seasonal temperature occurring in August (University of Washington 2009). The lowest average temperatures typically occur in December and January and average lows reach approximately 36º Fahrenheit. Overall average annual minimum temperature is 45º Fahrenheit with average annual maximum temperature is 60º Fahrenheit annually.

2.3.3.2 Rainfall and Snowfall

Average precipitation values are highest during November where total precipitation reaches an average of approximately 5.9 inches. The lowest precipitation occurs during July with less than 1 inch of total precipitation on average. The annual average precipitation is 37.07 inches (University of Washington, 2009). The rainy season extends from October to March (NOAA National Climatic Data Center, undated). The occurrence of snow is variable, with most snow melting before there is measurable accumulation. Snow storms develop when cold air comes down from Canada.

2.3.3.3 Wind

Wind speeds in the summer average between 8 to 15 miles per hour (NOAA National Climatic Data Center, undated). Prevailing winds are from the southwest, although strong winter storms are characterized by northerly winds.

2.3.4 Groundwater Characteristics

A continuous zone of groundwater representing a regional aquifer occurs across the Site at a depth of approximately 50 feet bgs. This water-bearing unit is contained within outwash sand deposits present beneath till. The thickness of this saturated coarse-grained deposit is at least 40 feet based on the drilling of a monitoring well (MW-10) to a depth of 92 feet bgs. Above this regional aquifer, isolated pockets of perched groundwater occur at selected locations at depths less than about 20 feet bgs. These zones are limited in occurrence, not hydraulically continuous across the Site, and likely form over layers of till. Groundwater conditions are discussed further in Sections 3 and 4.

2.3.5 Ecological Resources

A request for a list of species within or in the vicinity of the Site was submitted to the Washington State Department of Fish and Wildlife (WDFW) on January 15, 2010. Golder received data from the WDFW on March 4, 2010, which included a habitats and species map and report. The WDFW map did not identify any priority habitat or species on or adjacent to the Site. The map indicated several urban natural open spaces and wetlands within five miles of the Site. Additionally, pileated woodpeckers, a state candidate species, were observed at a site 2 miles west of the Site in 1979. WDFW also identified several priority fish species that have been observed in streams within five miles of the Site. The priority fish include cutthroat trout, coho salmon, dolly varden/bull trout, chinook salmon, chum salmon, pink salmon, sockeye salmon, and steelhead. The WDFW map and report are included in Appendix A. The full lists of federal and state listed species for the State of Washington are provided in Appendix A.

The Western Washington U.S. Fish and Wildlife Office website (http://www.fws.gov/wafwo/speciesmap/KING.html), which includes King County, Washington, was queried for listed endangered and threatened species, and species of concern that are known to inhabit King County. As of November 1, 2007 the listed species include the following:

- Bull trout (Salvelinus confluentus)
- Canada lynx (Lynx Canadensis)
- Gray wolf (*Canis lupus)*
- Grizzly bear (*Usus arctos = U. a. horribilis)*
- Marbled murrelet (*Brachyramphus marmoratus)*
- Northern spotted owl (*Strix occidentalis caurina)*

The list of candidate species includes:

- Oregon spotted frog (*Rana pretiosa)*
- Yellow-billed cuckoo (*Coccyzus americanus)*

The list of species of concern includes:

- Bald eagle (*Haliaeetus leucocephalus)*
- Beller's ground beetle (*Agonum belleri)*
- California wolverine (*Gulo gulo luteus)*
- Cascades frog (*Rana cascadae)*
- Hatch's click beetle (*Eanus hatchi*)
- Larch Mountain salamander (*Plethodon larselli)*
- Long-eared myotis (*Myotis evotis)*
- Long-legged myotis (*Myotis volans)*
- Northern goshawk (*Accipiter gentilis)*
- Northern sea otter (*Enhydra lutris kenyoni)*
- Northwestern pond turtle (*Emys marmorata marmorata)*
- Olive-sided flycatcher (*Contopus cooperi)*
- Pacific lamprey (*Lampetra tridentata)*
- Pacific Townsend's big-eared bat (*Corynorhinus townsendii townsendii)*
- Peregrine falcon (*Falco peregrinus)*
- River lamprey (*Lampetra ayresi)*
- Tailed frog (*Ascaphus truei)*
- Valley silverspot (*Speyeria zerene bremeri)*
- Western toad (*Bufo boreas)*
- White-top aster *(Aster curtus)*
- Stalked moonwort (*Botrychium pedunculosum)*
- Tall bugbane (*Cimicifuga elata)*

Because of the Site's location within a historically urban area, it is not likely that the Site or surrounding adjacent properties provide necessary habitat for species other than infrequent transient visitors, such as birds and raptors. There is a forested section of the Site that is located on the Washington Memorial Park Cemetery, but the size of the forested area has increasingly diminished over time due to expansion of the cemetery. This forested land includes a potential wetland area (but not designated as a wetland by WDFW or King County [King County iMAP, 2010]) located adjacent south of the MasterPark Facility on the cemetery property. However, this potential wetland area is located more than 500 feet from the Site contamination and is not connected to the regional groundwater aquifer. Furthermore, the WDFW has not classified this as a wetland, according to their Habitats and Species Map (2010). The water in this wetland area was sampled as part of Golder's Phase II investigation in 2000, the results of which did not indicate any contamination above MTCA Method A. At this time, this area has not been delineated as a wetland nor has an ecological survey been conducted to identify the various resident or transient species that may use the wetland area. Therefore, this wetland area is not considered sensitive habitat. A man-made pond on the cemetery property that receives groundwater from a well located at the southern end of the pond is located approximately 1,500 feet south of the Site contamination. It is not anticipated to become impacted in the future by Site contamination because it is side gradient to the plume. Both the wetland and the pond may attract local waterfowl and may contain some aquatic species.

The nearest major surface water body is Bow Lake, located approximate 1.25 miles to the south of the Site.

Fencing surrounding the MasterPark Facility reduces access to this property (which comprises most of the Site) for most wildlife. There are no surface water impoundments, except for the wetland area and man-made pond described above, or streams on or adjacent to the Site, which precludes any listed aquatic species from being potentially impacted by the Site.

2.4 Previous Investigations

A series of investigations and remedial actions were conducted at MasterPark Lot C starting in September 2000 with a Phase I Environmental Site Assessment (ESA) followed by Phase II ESA investigations and culminating in September 2001 with an independent remedial action (IRA) conducted in coordination with property development. Ecology performed groundwater sampling at the Site in 2006, and remedial Site investigations resumed in 2007. The activities and results of these investigations are reported in documents that are briefly summarized in this Section. Pertinent tables and figures from each report are included in Appendix B. The first three reports were submitted to Ecology in April 2001 for review under the Voluntary Cleanup Program (VCP). The fourth report (2001c) was submitted to Ecology in October 2001. Additional reports addressing remedial actions conducted during redevelopment and construction at the MasterPark Facility were also submitted to Ecology under the VCP. All referenced documents are on file at Ecology's Northwest Regional Office in Bellevue, Washington.

2.4.1 *2001-2002 Investigations*

- **Golder Associates Inc. (Golder) 2000. *Phase I Environmental Site Assessment, SunReal Inc., SeaTac Airport Site, SeaTac, Washington*, October 12, 2000.**

  Golder conducted a Phase I Environmental Site Assessment (ESA) for the MasterPark Facility in October 2000 on behalf of SunReal Inc. The Phase I ESA identified a number of recognized potential environmental conditions and recommended further investigation. A Phase II ESA was authorized to further investigate and evaluate the recognized potential environmental conditions at the MasterPark Facility. The recognized environmental conditions included the potential for soil and groundwater contamination above regulatory levels at the MasterPark Facility resulting from prior and current Facility uses and activities. (See Appendix B-1 for tables and figures).

- **Golder 2001a. *Final Phase II Environmental Site Assessment Report, SeaTac Parking Garage Development Site, SeaTac, Washington*, April 5.**

  A limited field investigation involving drilling at 17 locations (four hollow stem auger locations, ten direct push locations and three hand auger locations) soil sampling, surface water sampling, sludge sampling from catch basins and an oil/water separator, and the installation of three groundwater monitoring wells. The initial Phase II ESA identified gasoline (and potentially diesel) range petroleum hydrocarbons, benzene, toluene, ethyl benzene and total xylenes (BTEX) contamination, accompanied by polycyclic aromatic hydrocarbons (PAHs) in MasterPark Facility groundwater at monitoring well MW-1. MW-1 is located in the northwest portion of the property near the former AirPro repair shop location. The concentrations of gasoline range petroleum hydrocarbons and BTEX reported in MW-1 were substantially above State Regulatory cleanup levels (tables in Appendix B-2). MW-1 was completed at an approximate depth of 52 feet bgs. At the time of installation it was not known if the well was completed in a deep perched water zone or in the regional water table aquifer. No soil associated with petroleum hydrocarbon contamination was encountered above 45 feet bgs. There was a no clear source for the groundwater contamination at MW-1 evident at the conclusion of this Phase II ESA.

  A perched water zone impacted by gasoline range petroleum hydrocarbons was also identified during the Phase II investigation. The source of the petroleum hydrocarbon contamination in the perched groundwater was the UST on the south side of the former Pacific Water Sports retail building. Monitoring wells MW-2 and MW-3 were completed in perched water zones for the purpose of collecting groundwater quality samples. A groundwater sample collected from MW-2 indicated concentrations of gasoline and xylene above the MTCA Method A cleanup level. The groundwater collected from MW-3 during the same investigation did not have detections of any compounds in excess of cleanup levels.

- **Golder 2001b.** ***Final Report for Extended Phase II Extended Environmental Site Assessment, SeaTac Parking Garage Development Site, SeaTac, Washington*****, April 5.**

  In conversations subsequent to the original Phase II ESA, Mr. Jerry Scarsella clarified that two underground storage tanks (USTs) were removed from the yard on the east side of the former AirPro repair shop in the early 1970s. In addition, Mr. Scarsella stated that it was his understanding that USTs had also been closed in-place on the adjacent north property (Louden Realty), but this has not been verified.

  As a result, the scope of work for the original Phase II ESA was amended to include additional investigations to determine whether either of the two reported UST closure locations on the MasterPark Facility could potentially be a source of the petroleum hydrocarbon contamination detected in the groundwater at MW-1. Six additional direct push drilling locations were investigated to assess soils in an area of two suspected former USTs believed to have been abandoned in the late 1970's. Conclusions drawn from the extended Phase II ESA investigation indicated that the subsurface soils near the suspected closed USTs had been impacted by gasoline range petroleum hydrocarbons and BTEX constituents. These soils exhibited concentrations of gasoline range petroleum hydrocarbons above the MTCA Method A cleanup levels to a depth of 24 feet bgs at GP11 sample location. However, benzene was not detected in any of the samples collected in this area. The extent of the gasoline range petroleum hydrocarbon impacted soils appeared at that time to be limited. See Appendix B-3 for tables and figures associated with this report.

- **Golder 2001c*. Final Report for the Phase III Environmental Site Assessment, SeaTac Parking Garage Development Site, SeaTac, Washington*, April 5.**

  The Phase III ESA investigation was conducted to determine if groundwater impacted with gasoline range hydrocarbons and BTEX constituents at MasterPark Facility monitoring well MW-1 were associated with a perched water zone or the regional aquifer. Seven additional monitoring wells were completed to more fully assess conditions of the aquifer beneath the MasterPark Facility. During the course of the Phase III ESA investigation, it was determined that MW-1 was in fact completed in the regional aquifer. The focus of the investigation subsequently shifted to identifying the direction of groundwater flow, attempting to identify the suspected source of the gasoline range petroleum hydrocarbons in the regional aquifer, and attempting to identify any other potential sources.

  Substantial gasoline range petroleum hydrocarbon contamination was identified in the regional aquifer below the north end of the MasterPark Facility. Groundwater from monitoring wells MW–1, MW-5, MW-7, MW-8a, MW-9, and MW-10 had concentrations of gasoline range petroleum hydrocarbons and often BTEX constituents above MCTA cleanup levels. Diesel range constituents were also detected in one groundwater sample collected from MW-1. However, the petroleum hydrocarbons identified as diesel constituents were likely the result of interference from the gasoline range petroleum hydrocarbons. There were no petroleum hydrocarbons in the gasoline, diesel, or oil ranges that were detected in any soil samples collected below 15 feet with the exception of those that were directly impacted by the contaminated groundwater or the samples collected at GP11. See Appendix B-4 for tables and figures associated with this report.

Impacted groundwater was encountered at the northern boundary of the MasterPark Facility and extended to the area between the former Pacific Water Sports finishing building on the east side of the property. At the completion of this investigation, the extent of the contamination was not known in the areas to the north or southwest of the MasterPark Facility.

- **Golder. 2001d. *Final Field Sampling Plan for Limited Remedial Actions at the Sea-Tac Parking Lot Development Site, 16000 Block International Boulevard, Sea-Tac, Washington (Rev.0)*. June 25, 2001.**

  This field sampling plan described the sampling activities to be implemented during the removal of the oil/water separator, USTs, and related drains and sumps as well as the limited soil remediation actions. These activities were to be conducted as part of the MasterPark Facility redevelopment.

- **Golder. 2001e. *Collection and Analytical Results of Groundwater Sample from Washington Memorial Park Cemetery, Private Well Letter Report Addressed to SeaTac Investments*, Attention Mr. Douglas Rigoni. September 27, 2001.**

  This letter reported results demonstrating that the groundwater at the cemetery’s supply well, which is cross-gradient to the impacted regional groundwater plume, had not been impacted by gasoline range hydrocarbons or BTEX constituents. See Appendix B-6 for tables and figures associated with this report.

- **Golder. 2001f. *Site Assessment Conducted for the Closure of a 3,000- and 10,000-Gallon Underground Storage Tank, Master Park Lot C, 16000 Block International Boulevard, SeaTac, Washington.* October 4, 2001.**

  This report summarized the assessment activities pertaining to the removal of two USTs from the MasterPark Facility. Field screening conducted during the closure by removal of a 3,000 gallon heating oil UST and a 10,000-gallon diesel UST did not indicate a release of petroleum products in association with the UST systems. However, a limited amount of soil around the 10,000-gallon diesel fill pipe was impacted. The analytical results for the soil samples demonstrated that petroleum hydrocarbons in the gasoline and heavy oil ranges were not present above MTCA Method A cleanup levels. Sample NT-SP3 (a sample from a stockpile with soil associated with the fill pipe) had a concentration of 280 mg/kg diesel range petroleum hydrocarbons, which was above the 200 mg/kg Method A clean up level for diesel at the time of the closure (the current limit is 2,000 mg/kg). The stockpile where the impacted soils were placed was transported off-site and disposed of at Waste Management's Olympic View Landfill in Port Orchard, Washington. Soils excavated in association with the UST removal that were not taken to the landfill were used as backfill in the excavation and compacted. The analytical results confirm that a release posing a risk to human health or the environmental did not occur in association with either of these two USTs. This assessment conducted for the closure of these two USTs confirms that these tanks did not contribute to impacts observed in the underlying regional groundwater aquifer. See Appendix B-7 for tables and figures associated with this report.

- **Golder 2001g.** ***Site Assessment Conducted for the Closure of a 1,000-Gallon Gasoline Underground Storage Tank, Master Park Lot C, 16000 Block International Boulevard, SeaTac, Washington*****. October 4, 2001.**

  The soil analytical results for this UST site assessment confirmed gasoline range petroleum hydrocarbons were released by this 1,000 gallon UST. Previous results from the Phase II ESA (2001b) investigation indicated the groundwater quality sample at MW-2 indicated a release had impacted a shallow perched water zone at approximately 12 feet bgs. A series of exploratory test pits were excavated during this UST assessment that indicated gasoline had migrated approximately 95 feet north. The gasoline migrated within a 1.5 to 2 foot wide zone within the perched water on top of a finer grained sandy silt layer within the till.

  Approximately 1,400 cubic yards (cy) of petroleum impacted soils associated with the UST release were excavated and disposed of at a landfill. During the process of soil and UST excavation, MW-2 was destroyed. Based on the results of the field screening activities and the analytical results of the confirmatory samples collected after the soil excavation, it was apparent that the sources of contamination in shallow soils and the perched water zone were effectively removed. Two cisterns and associated sludges encountered during remedial excavation activities were transported off-site for disposal with the petroleum impacted soils. Remaining soils did not exceed MTCA Method A cleanup levels. See Appendix B-8 for tables and figures associated with this report.

- **Golder 2001h.** ***Site Assessment Conduct For the Closure of a 1,000-Gallon Heating Oil Underground Storage Tank, Master Park Lot C 16000 Block International Boulevard, SeaTac, Washington*****. October 4, 2001.**

  The field screening conducted during the closure by removal of a 1,000-gallon heating oil UST indicated that a release of petroleum products had not occurred. The sample analytical results confirmed that petroleum hydrocarbons in the gasoline, diesel, or heavy oil ranges were not present in the soil above the MTCA Method A cleanup levels, and a product release did not occur as defined by Ecology's UST site assessment guidance document. Soils excavated in association with the UST removal were returned to the excavation and compacted. The site assessment conducted for this UST closure confirms that this tank did not contribute to impacts observed in the underlying regional groundwater aquifer. See Appendix B-9 for tables and figures associated with this report.

- **Golder 2001i. *Site Assessment for the Closure of a 300-Gallon Underground Storage Tank, Master Park Lot C 16000 Block International Boulevard, SeaTac, Washington.* October 24, 2001.**

  A 300-gallon heating oil UST was discovered at the MasterPark Facility during redevelopment grading activities. During removal of the UST, contaminated soil was observed to be present beneath and surrounding the UST. Approximately 60 cy of petroleum impacted soil were removed from beneath and around the UST during remediation activities. Confirmational sampling conducted following soil excavation activities confirmed that soils impacted above MTCA Method A cleanup levels had been removed. Groundwater was not encountered within the limits of the excavation. See Appendix B-10 for tables and figures associated with this report.

- **Golder 2002. Final Independent Remedial Action Report SeaTac Parking Garage Development Site SeaTac, Washington (MasterPark Lot C). Prepared for: SeaTac Investments LLC. January 24, 2002.**

  The independent remedial actions discussed in this report are summarized in Section 2.5 of this report. See Appendix B-11 for tables and figures associated with this report.

2.4.1.1 Summary of Investigations

The investigations and remedial actions listed above were reported to Ecology who issued a “no further action” letter for soils at the MasterPark Facility (Ecology 2003), but did not include groundwater. Groundwater in the underlying regional aquifer (identified as the Qva aquifer) contained elevated levels of petroleum contamination, including benzene, toluene, ethylbenzene, and xylenes (BTEX) under the northwestern portion of the MasterPark Facility. At that time, it was suspected that the probable source of the contamination in the aquifer was located off-site, hydraulically up-gradient of the MasterPark Facility.

2.4.2 2006-2007 Investigations

At the request of Ecology, EA Engineering, Science, and Technology, Inc. (EA) conducted groundwater sampling at the MasterPark Facility in June 2006. The results of EA’s sampling activities were presented in the following letter report:

- **EA Engineering, Science, and Technology Inc., 2006. *SeaTac Development Site, Summary of June 2006 Groundwater Monitoring Results – Work Order #17079, Contract Number: 30700 - Prepared for Washington Department of Ecology*. September 6, 2006.**

  EA collected groundwater level measurements and checked for free product in MW-1, MW-5, MW-6, MW-7, MW-8A, MW-9, MW-10, the cemetery well, and Bai Tong MW-1 through MW-3. Groundwater samples were collected from MW-5, MW-6, MW-7, MW-9, MW-10, and Bai Tong MW-3. At the time of sampling, there was less than 2.5 feet of water in all of the wells, except for MW-10. Groundwater samples were analyzed for gasoline range organics and BTEX. Additionally, the sample collected at MW-10 was analyzed for diesel range organics. One or more concentrations of gasoline and BTEX were detected at levels exceeding MTCA Method A cleanup standards in groundwater samples collected from MW-5, MW-7, MW-9, and MW-10.

In May 2007, Ecology required additional remedial investigations (Ecology, 2007) for the groundwater impacts under the MasterPark Facility because of the results gathered by EA in 2006. Several studies conducted during 2003 through 2006 on neighboring sites did not reveal a source for the groundwater impacts to the Qva aquifer. In June 2007 through January 2008, additional investigations were conducted at the Site and adjacent properties to determine the source and extent of groundwater impacts. These investigations were reported in the following documents:

- **Golder. 2008a. *On-Site Source and Groundwater Investigation Summary – June to November 2007*. Prepared for Riddell Williams P.S. January 14, 2008.**

  Golder conducted further investigations to determine if there were any on-site sources contributing to the impacts in the groundwater. Investigation activities consisted of four different phases (geophysical and subsurface investigation, soil vapor investigation, monitoring well installation, and soil boring subsurface investigation) spanning the months of June to November, 2007. See Section 3 for a discussion of the results of this investigation. The tables and figures from this report have been incorporated into the Tables and Figures sections of this RI/FS.

  As a result of both non-intrusive (geophysical) and intrusive (soil borings and test pits) subsurface investigations conducted in 2007, Golder did not find evidence of any remaining USTs or subsurface structures at the MasterPark Facility that may have been or are currently potential sources of gasoline. The soil investigations delineated the vertical and horizontal extent of gasoline in the vadose zone in the vicinity of historical soil boring GP-11 (installed during the extended Phase II in 2001). The installation of additional MasterPark Facility monitoring wells MW-11 through MW-14 (installed by ATC) and MW-15 through MW18 (installed by Golder) improved the understanding of both the local hydraulic gradient in the Qva aquifer and the associated gasoline plume. The series of 2007 investigations established that gasoline impacts identified in the area of GP-11 were continuous from approximately 8 feet bgs to the upper portion of the Qva aquifer and likely impacted the groundwater underlying the MasterPark Facility.

- **Golder 2008b. *Addendum to On-Site Source and Groundwater Investigation Summary – June to November 2007 Report (Dated January 14, 2008).* Prepared for Riddell Williams P.S. March 13, 2008.**

  This investigation further delineated the gasoline groundwater plume to determine if there were off-site sources contributing to the impacts to the groundwater east of the MasterPark Facility. These investigation activities were conducted between December 2007 and February 2008. The activities included rehabilitation of MW-8A and installation of MW-19. Both of these wells are located at the northeast boundary of the MasterPark Facility and have improved the understanding of the hydraulic gradient in the Qva aquifer and the associated gasoline plume underlying the MasterPark Facility. Water levels measurements collected for the monitoring wells indicated the general direction of groundwater flow is to the west with a southwesterly component towards the south end of the MasterPark Facility. Based on the results of the groundwater sampling conducted at MW-8A and MW-19 and from previous sampling efforts, the gasoline groundwater plume in the Qva aquifer has been adequately delineated to confirm that the MasterPark Facility is a contributing source to the gasoline impacts observed in the aquifer. See Section 3 for a discussion of the results of this investigation. The tables and figures from this report have been incorporated into the Tables and Figures sections of this RI/FS.

The additional investigation activities conducted by Golder in 2007 and 2008 are considered part of this RI and the results are incorporated throughout this report.

2.5 Previous Remedial Actions

The MasterPark Facility property was redeveloped (to its current condition) during the summer of 2001. An IRA and closure activities were conducted concurrently with the MasterPark Facility redevelopment to its current configuration and use. As indicated above, the remediation and closure activities were documented in Golder’s Final Independence Remedial Action Report (2002). The following is a brief discussion of the remedial actions that were implemented at the MasterPark Facility.

2.5.1 UST, Oil/Water Separator, and Sump Removal

As discussed above, five USTs were permanently closed (excavated) as part of the MasterPark Facility investigation and remediation. The USTs were closed in accordance with State guidance documents by a certified UST site assessor. Figure 2-1 depicts the location of the closed USTs and those identified off-site. One of the USTs, formerly containing gasoline was located near the former Pacific Water Sports building and was suspected of having impacted Site soils and shallow perched groundwater. Soils adjacent to the other four USTs suggested limited heating oil and diesel impacts to soil. An underground oil/water separator and a sump discovered on the MasterPark Facility property contained oily sludge. Polychlorinated biphenyls (below MTCA cleanup levels), polycyclic aromatic hydrocarbons (PAHs), and petroleum hydrocarbons were found to be associated with the oil residues and sludge. The oil/water separator and sump were removed and associated drain lines were plugged and sealed.

2.5.2 Soil Grading and Excavation

During the MasterPark Facility development to its current configuration and use, in excess of 4,500 yd^3 of near surface soil was either disturbed by utility excavation and/or grading. Of this amount approximately 250 yd^3 (370 tons) were determined to be impacted by petroleum hydrocarbons above the site-specific cleanup level. At the time of the remediation, MasterPark Facility excavation activities were conducted utilizing the interim TPH guidelines to determine a site-specific cleanup level (1,600 mg/kg) for diesel and oil range petroleum hydrocarbons in the near surface soils. Disturbed soils were subject to field testing and confirmation sampling of any soils identified over the site-specific cleanup level. These soils were removed from the Site and disposed of at the Waste Management Inc. Olympic View State permitted landfill. Soils that did not exceed the cleanup standard were considered useable as on-site fill and were either returned to the original excavations or used elsewhere on-site. Some soils that were not disturbed during the MasterPark Facility redevelopment appeared locally impacted by petroleum products but were not tested during remediation activities because they were left in place. To effectively remediate potentially impacted soils that were left in place, an asphalt cap remediation was incorporated.

2.5.3 Capping

Near surface soils covering approximately 5-15 percent of the MasterPark Facility were identified as being impacted with diesel and heavy oil range petroleum hydrocarbons (presumably from leaks from cars and trucks parked on barren ground) that are relatively non-hazardous. The selected soil remedial action was to leave undisturbed potentially impacted soils in place and construct a “cap” over the soils, thereby protecting human health and the environment. After demolishing all original MasterPark Facility buildings, removing potential subsurface sources, grading the MasterPark Facility, installing new underground utilities, and constructing the new building pad, the entire property was paved with asphalt in preparation for the construction of the new parking facility. The asphalt and footprint of the MasterPark Facility building serve as a cap for soils and prevent potential exposures to the public and the environment by direct contact. Diesel and heavy oil range hydrocarbons are not highly mobile in the subsurface. The asphalt cap prevents surface water from contacting and infiltrating through the impacted soils and mobilizing the petroleum hydrocarbons. Furthermore, the asphalt cap effectively cut-off the recharge of water to the shallow perched water zone, which is demonstrated by the fact that MW-3 has been dry since the independent remedial action. Without mobilization, the asphalt cap prevents residual petroleum hydrocarbons from migrating to perched water zones and the regional groundwater aquifer. Therefore, with the asphalt cap in place the petroleum hydrocarbons will not migrate downward in any appreciable manner or impact groundwater in the future. A Restrictive Covenant (dated 2002) was established for the asphalt cap with Ecology that requires Ecology notification prior to cap disturbance and excavation into the underlying Site soils.

2.5.4 Restrictive Covenant

A Restrictive Covenant was recorded in 2002 as the result of the IRA conducted at the MasterPark Facility because residual concentrations of diesel and oil range petroleum hydrocarbons in soil and gasoline range petroleum hydrocarbons remain in groundwater exceeding MTCA Method A cleanup levels. The restrictions and property use limitations specified by the Restrictive Covenant include the following:

- Groundwater at the MasterPark Facility cannot be used for any purpose other than remedial actions.
- Activities resulting in the release or exposure of capped contaminated materials are prohibited, without prior approval from Ecology.

- Activities interfering with the integrity of the remedial action are prohibited.
- Ecology must receive 30 day written notice of the owner’s intent to convey interest in the MasterPark Facility.
- Leases of the MasterPark Facility must be for uses and activities consistent with the Restrictive Covenant.
- Ecology must be notified prior to the use of the MasterPark Facility that is inconsistent with the Restrictive Covenant.
- Ecology is authorized by the property owner to enter the MasterPark Facility for the purpose of evaluating the remedial action.
- The owner of the MasterPark Facility property has the right to record an instrument that provides that the Restrictive Covenant no longer limits the use of the property.

3.0 RI/FS INVESTIGATION

This section describes the RI/FS field investigation tasks that were conducted from June 2007 to December 2009. Because previous investigations collected a significant amount of site data, the RI focused on data gaps that exist for completing the RI/FS Report. The data gaps were identified with respect to the major potential exposure pathways for the Site releases and groundwater, which included:

- Direct exposure to subsurface soils by humans or terrestrial ecology
- Vapor intrusion to buildings
- Site Soil to Groundwater Pathway
- Groundwater Pathway to Humans

The initial RI/FS investigations in 2007 and 2008 delineated much of the extent of the groundwater gasoline plume on the MasterPark Facility (Golder 2008a and 2008b). The delineation of the down-gradient extent of the gasoline plume for the entire Site (outside the Facility) was not complete prior to this RI/FS. The land west (and hydraulically down-gradient) of the MasterPark Facility includes the Washington Memorial Park Cemetery, Port of Seattle commercial buildings, the north entry drive freeway and SeaTac Airport.

The field RI/FS investigation was conducted in accordance with the RI/FS Work Plan and the Field Sampling and Analysis Plan (Golder 2009). The RI included a geophysical survey, subsurface soil investigation, two soil vapor sampling events, and a hydrogeologic investigation. As required by the Agreed Order for the Site, a Sampling and Analysis Plan (SAP), Quality Assurance Project Plan (QAPP), and Health and Safety Plan (HASP) were submitted along with the final RI/FS Work Plan. A summary of the major data generating activities are presented below.

3.1 Geophysical Survey

In order to identify if there were any on-site sources contributing to the impacts to the groundwater, namely undocumented USTs, a non-intrusive geophysical survey was conducted at the northeast portion of the MasterPark Facility in September 2007. Ground-penetrating radar, magnetometry, and time domain electromagnetic method (TDEM) were implemented for the survey. Detailed results of the geophysical investigation are included in Golder's report, *On-Site Source and Groundwater Investigation Summary – June to November 2007* (2008a). As depicted in Figure 3-1, three anomalies were detected that suggested the presence of massive or metallic objects buried within near-surface soils (<10 feet bgs). An intrusive investigation was conducted in October 2007 in order to positively identify these features. The results of this intrusive investigation are summarized in the next Section.

3.2 Soil Subsurface Investigations

Subsurface soil investigations occurred on several occasions in 2007, 2008, and 2009. Most of the subsurface investigations included the collection of soil samples. When soil samples were collected, they were given a unique identification number that typically included the MasterPark Facility name

(MasterPark Lot C), the sample location number (i.e., SB01), the sample collection date, and the sample depth. Documentation for soil samples included bottle labels and Chain of Custody Records. Samples were placed on ice in coolers for transport to the laboratory for analysis. The following sections briefly summarize the subsurface soil investigations conducted since 2007.

3.2.1 2007 Test Pits

The intrusive investigation in October 2007 to assess geophysical anomalies included excavating test pits at each of the three anomaly locations (Figure 3-1). No USTs or objects of significance were discovered in near-surface soils; however, strong petroleum-like odors and instrument readings suggested the presence of petroleum hydrocarbon impacted soil in Test Pit 3, which coincided with the historical location of soil boring GP-11. Analysis of soil samples was performed by Analytical Resources, Inc., Tukwila, Washington. Analytical results of soil collected from Test Pit 3 indicated the presence of diesel, motor oil, gasoline, toluene, ethylbenzene, and total xylenes. A summary of the soil samples results is included in Table 3-1a.

3.2.2 2007 Soil Borings

To delineate the horizontal and vertical extent of contamination in the vicinity of Test Pit 3 and GP-11, Golder advanced a series of five soil borings (labeled SB-01 through SB-05) to 45 feet below ground surface in the area where impacted soil was identified during previous investigations (Figure 3-2). A summary of soil sampling activities is included in Golder’s 2008a report. Analytical data reports are included in Appendix C. Soil boring diagrams and monitoring well completion logs are included in Appendix D.

Table 3-1 summarizes the soil sample analytical results. Soil samples were analyzed for motor oil, diesel, gasoline and BTEX. There were no detections above the laboratory PQLs of any constituents in soil collected from MW-15 (at 52 feet bgs), or the sample collected at 75 feet bgs in MW-17. All other soil samples had detections of at least one constituent above the laboratory PQL. Motor oil was only detected in MW-18 at 30 feet bgs and SB-05 at 25 feet bgs. Diesel was detected in MW-16 at 60 feet bgs, SB-01 at 25 feet bgs, SB-02 at 35 feet bgs, and SB-05 at 25-35 feet bgs. Gasoline was detected in all soil samples at concentrations above the laboratory PQL, except those identified above. Benzene was detected above the laboratory PQL in all samples from MW-18, SB-01, SB-02, SB-03 (except the 25 foot sample), SB-04 and SB-05. Toluene was detected in all soil samples at concentrations above laboratory PQLs, except for MW-15, MW-16 (at 60 feet bgs), and SB-03 (at 25 feet bgs). Ethylbenzene and total xylenes were detected in all soil samples at concentrations above laboratory PQLs, except for MW-15, and SB-03 (at 25 feet bgs).

The highest concentrations of gasoline and benzene in soil were collected from soil borings SB-01, SB-02 and SB-05. Relative concentrations of gasoline (and BTEX) were generally highest at depths between 10 feet and 30 feet bgs in each of the boreholes. For comparison of gasoline and benzene concentrations to depth, a cross-section is presented of analytical results in the source area, near the northwest corner of the MasterPark Facility (Figure 3-3).

3.2.3 2007 Monitoring Well Installation

To improve characterization of groundwater hydraulic gradient, direction of groundwater flow and delineation of gasoline within the Qva aquifer underlying the MasterPark Facility, four monitoring wells were installed in August 2007 by ATC Associates, Inc. (ATC) of Seattle, Washington. ATC installed monitoring wells MW-11 and MW-12 near the northeast and northwest corners of the MasterPark Facility boundary, respectively, and MW-13 and MW-14 near the western MasterPark Facility boundary (Figure 3-4). A summary of ATC's installation activities is included as Attachment D of Golder's 2008a report. No soil samples were collected during the installation of these wells.

Golder installed an additional three monitoring wells north and west of the MasterPark Facility (but likely within the Site boundary) to further characterize the groundwater hydraulic gradient and direction of groundwater flow in the Qva aquifer. In October 2007, monitoring well MW-15 was installed in the City of SeaTac right-of-way in South 160th Street. In November 2007, monitoring wells MW-16 and MW-17 were installed, on the adjoining property owned by Washington Memorial Park and Cemetery. MW-18 was installed at the MasterPark Facility in November 2007 by Golder to improve delineation of on-site soil contaminant concentrations and provide groundwater data in the immediate vicinity of Test Pit 3 and soil boring GP-11. Monitoring wells were installed using a hollow-stem auger. The lithology of the soil in each boring was logged. Soil samples were collected from boring split spoons and screened for volatile organics using a photoionization detector (PID). Soil samples exhibiting the greatest impact (as determined by field screening) were submitted for chemical analysis to Analytical Resources, Inc. and are summarized in Table 3-1. Monitoring well construction details are included in Table 3-2 and the well construction logs are included in Appendix D.

There were no detections above the laboratory PQLs of any constituents in soil collected from MW-15 (at 52 feet bgs), or the sample collected at 75 feet bgs in MW-17. Motor oil was only detected above the laboratory PQL in MW-18 at 30 feet bgs. Diesel was detected above the laboratory PQL in MW-16 at 60 feet bgs. Gasoline was detected in all soil samples at concentrations above the laboratory PQL, except MW-15, and MW-17 at 75 feet bgs. Benzene was detected above the laboratory PQL in all samples from MW-18. Toluene was detected in all soil samples at concentrations above laboratory PQLs, except for MW-15 and MW-16 (at 60 feet bgs). Ethylbenzene and total xylenes were detected in the same soil samples as toluene, in addition to MW-16 at 60 feet bgs. The highest detections of constituents were from MW-18 at 15 feet bgs.

3.2.4 2008 Monitoring Well Installation

One additional monitoring well was installed at the MasterPark Facility to further characterize the hydraulic gradient, direction of flow, and the potential for off-site contaminant migration. In January 2008, monitoring MW-19 was installed at the northeast corner of the MasterPark Facility. Monitoring wells were installed using a hollow-stem auger. The lithology of the soil in each boring was logged. Soil samples were collected from the each boring using a split spoon sampler and the soil was screened for volatile organics using a PID. A total of three soil samples that exhibited the greatest impact (as determined by field screening) were submitted for chemical analysis to Analytical Resources, Inc. and are summarized in Table 3-1. The results of the soil sampling are summarized in Table 3-1. Gasoline was detected in the soil samples collected from 10.5 and 25 feet bgs. O-xylene was detected in the sample collected from 25 feet bgs. Neither gasoline nor BTEX were detected above the laboratory PQL in the soil sample collected from 50 feet bgs. Monitoring well construction details are included on Table 3-2 and the well construction logs are included in Appendix D.

3.2.5 2009 Monitoring Well Installation

Monitoring well installation in 2009 was conducted in two phases. The first phase included the installation of one monitoring well (MW-20) on May 15, 2009 directly west of the center portion of the gasoline plume to identify the western extent of the plume. Using a hollow-stem auger (HAS) rig, soil samples were collected every five feet, the lithology logged, and soil was field screened for evidence of contamination. Screening techniques included sheen testing, PID reading, and olfactory senses. Pertinent results from the field screening and other observations were documented in the field logs. Wells were installed as outlined in Section 3.2 of the SAP and referenced Golder Technical Procedures. Copies of the boring logs and monitoring well construction details are provided in Appendix D and Table 3-2. Monitoring well construction details are summarized in Table 3-2. The results of groundwater analysis for MW-20 (discussed in a later section) were evaluated and Ecology determined that three additional wells were required to adequately delineate the northern and southwestern boundary of the plume. Soil samples were collected from a split spoon sampler at approximately 120 feet bgs and 128 feet bgs and submitted to Analytical Resources, Inc. for analysis of gasoline range petroleum hydrocarbons, BTEX, ethylene dibromide (EDB), naphthalene, methyl tert-butyl ether (MTBE), hexane, VPH, 1,2-dichloroethane, and lead. There were no detections of any of the constituents above laboratory PQLs in either of the samples, except for lead detected at 2 mg/kg in both samples. Sample results are summarized in Table 3-3.

The second phase of monitoring well installation began on November 30, 2009 and was completed on December 2, 2009 pursuant to detailed communication with Mr. Jerome Cruz of Ecology. MW-21 was installed on the Washington Memorial Park Cemetery property to characterize the southwestern boundary of the plume. MW-22 was installed in the center lane of South 160th Street, north of Washington Memorial Park Cemetery to characterize the northwestern boundary of the plume. MW-23 was installed in the center lane of South 160th Street, north of the MasterPark Facility, to characterize the northeastern boundary of the plume. No soil samples were submitted to a laboratory for analysis. The second phase monitoring wells were installed as per the SAP and referenced Golder Technical Procedures. Boring logs and well construction details are provided in Appendix D and Table 3-2. No soil samples were collected from these borings during monitoring well installation. However, a petroleum-like odor was observed in split spoons samples near the water table from MW-22.

Following installation, each well was developed by the driller. Well development was performed to produce representative formation water that was free of drilling fluids, cutting, or other materials potentially introduced during drilling and well construction. Development was performed through a combination of surging and groundwater purging (via submersible pump). A minimum of 55-gallons was pumped from each well and stored in labeled 55-gallon drums on the MasterPark Facility. Representative water was assumed to have been obtained when pH, temperature, and specific conductance readings have stabilized (pH within 0.1 standard pH units, temperature within 0.5 degrees C, and conductivity within 10 percent). A second groundwater sample was collected from MW-22 in February 2010 in order to confirm the results of the December 2009 groundwater sample. It was suspected that the December 2009 sample from MW-22 may have been turbid because of the recent installation of the well and potentially poor well development, thereby resulting in higher contaminant concentrations associated with the suspended material. On February 12, 2009 MW-22 was purged using a submersible bladder pump until the purge water obtained a turbidity reading less than 1 nephelometric turbidity units (NTU), after which time a groundwater sample was collected. The groundwater sample was analyzed for the same constituents as the December 2009 groundwater sampling event. Sample results confirmed the December 2009 detections of gasoline and BTEX. Table 3-12 includes a summary of the February 2010 detections in MW-22.

3.3 Soil Vapor Investigations

Two soil vapor investigations were conducted in 2007 and 2009. The 2007 program investigated the soil vapor in and around the source area. The 2009 program investigated the likelihood of vapor intrusion by conducting a soil vapor survey around the residence on the Washington Memorial Park Cemetery. Soil vapor samples were given a unique sample identification numbers. Documentation for soil vapor samples included canister labels and Chain of Custody Records. Samples were placed in boxes for transport to the laboratory. The following is a discussion of both soil vapor investigations and the results.

3.3.1 2007 Soil Vapor Investigation

To delineate the migration of volatilized petroleum hydrocarbons in soils at the MasterPark Facility and to help locate sources of gasoline in the vadose zone, Golder advanced a series of 14 soil probes in the northern portion of the MasterPark Facility and collected soil vapor samples from each of these locations (Figure 3-5). The 2007 soil vapor activities are summarized in more detail in Golder’s 2008a report. Soil vapor probe locations were labeled SG-1 through SG-14. The depth to which the soil vapor probes were advanced using a direct-push geoprobe drilling rig was consistent with the expected bottom depth of most USTs – approximately 8 to 10 feet bgs. One ambient air background sample was also collected.

TO-15 Modified analysis of the soil vapor samples was performed by Air Toxics, Ltd., and the results are summarized in Table 3-4. The analytical detection and quantification limits were standard, but not the lowest achievable. The objective of the 2007 soil gas investigation was to find sources of gasoline in the vadose zone, which were expected to be at relatively high concentrations. The analytical data show BTEX vapors were found at the highest concentration at SG-6, located in the vicinity of Test Pit 3 and historical soil boring GP-11. These analytical results suggest that this location may be part of the source of gasoline.

3.3.2 2009 Soil Vapor Investigation

The 2009 soil vapor investigation was conducted on September 9. To assess potential vapor intrusion into the residence at the cemetery, Golder advanced three temporary soil vapor survey probes into exterior soils directly adjacent to the north (SG-2), east (SG-3), and west (SG-1) sides of the residence building located on the Washington Memorial Park Cemetery property and one temporary soil vapor probe south-southeast of MW-12 (SG-4 and duplicate sample SG-5), as depicted in Figure 3-5. The probes extended into the ground using a direct-push geoprobe drilling rig to a depth of approximately 10 feet bgs. Soil vapor samples were collected into 6-liter SUMMA canisters, supplied by Air Toxics Ltd. The soil vapor samples were collected over a period of approximately 30-45 minutes.

The residential building has a crawl space. An ambient air sample of the crawl space was also collected (CS-01). The crawl space was inspected for possible storage of chemicals, paints, solvents and fuels prior to placement of the SUMMA canister. A capillary port to the SUMMA canister was used to control the sample collection period to obtain the sample during the same approximate period in which all of the soil vapor samples were collected (approximately 8 hours).

Background atmospheric air quality can influence the concentrations of volatile organic compounds in the soil vapor. As such, three background atmospheric air samples were obtained during the soil vapor sampling period in 6-liter SUMMA canisters. The background atmospheric air samples were collected outside. Two background samples were collected adjacent to South 160th Street, to the northeast and northwest of the Washington Memorial Park Cemetery residential building, at approximately 4 feet above ground level. The third background sample was collected on the MasterPark Facility, south of MW-12. A capillary port to the SUMMA canister was used to control the sample collection period to obtain the sample during the same approximate period in which all of the soil vapor samples were collected (approximately 8 hours). On the day of sample collection, the weather recorded at the nearby SeaTac Airport weather station indicated that the observed high temperature was 74°F while the observed high temperature was 55°F. Approximately 0.01 inch of precipitation was observed that day.

Isopropyl alcohol was used as a method for leak detection during the soil vapor sample collection. After the soil vapor probes were inserted in the ground, the hole around the probe was sealed with a bentonite slurry, and all sampling equipment was connected. Isopropyl alcohol was then sprayed on the ground around the probe. The principal behind this method is that if 2-propanol is detected in any of the soil vapor samples, then there likely is a leak. The detection may be from dissolution of the isopropyl alcohol through the soil that is then drawn into the sample, or because of a leak in the sampling equipment.

The Summa canisters were sent to and analyzed by Air Toxics Ltd. using EPA Method TO-15 Selective Ion Mode (SIM) and Modified Northwest Volatile Petroleum Hydrocarbons (VPH).

The sample results are summarized in Table 3-5 and the analytical data reports are provided in Appendix C. Neither the background ambient air samples nor the crawl space ambient air sample detected volatile petroleum hydrocarbons in the air. Volatile petroleum hydrocarbons were detected in all of the soil vapor samples. BTEX compounds were detected in the background ambient air and crawl space samples. BTEX compounds were also detected in all of the soil vapor samples, but at concentrations that were one to two orders of magnitude higher than the concentrations detected in the ambient air samples. Hexane was detected in two of the background ambient air and the crawl space samples. Hexane was also detected in all of the soil vapor samples, but at concentration that were two orders of magnitude higher than the concentrations detected in the ambient air samples. Naphthalene was not detected in any of the samples, except for SG-3. The concentration detected in SG-3 was slightly over the laboratory reporting limit. 1,2-dibromoethane was not detected in any of the samples collected at the site. 2-propanol was detected in all of the soil vapor samples, one background ambient air sample, and the crawl space sample. The detected concentrations of 2-propanol in the soil vapor samples varied between 2.4 µg/m^3 to 47 µg/m^3 (47 µg/m^3 was detected in a duplicate sample which contained 2-propanol at 3.8 µg/m^3). These detections are at trace concentrations and represent minor amounts of leakage. The trace levels of 2-propanol detections in the samples indicate that the tracer either leaked through the borehole seal or there was some leakage in the sampling train to the summa canister. The 2009 soil gas analytical results are considered valid, but may be at slightly higher concentrations due to minor leakage through the sampling system. Additionally, the time of the year that the samples were collected may also play a hand in the detected concentrations of COCs. For example, higher levels of COCs may be present in the crawlspace air (due to vapor intrusion) during periods of colder weather (winter months) when an upward migration of vapors is caused by a pressure gradient that may be present between the lower outdoor temperature and the higher indoor air temperatures.

Ecology recommended additional crawlspace samples be collected in the winter months. Currently, the cemetery house is not occupied and its parcel is under an application for a zoning change. If the zoning change is approved, the house will be demolished and the parcel will be used for parking or other commercial activities. The PLP Group will wait until the zoning change has been determined. If the zoning does change, then re-sampling will not occur. If zoning remains as it is now, then one additional round of soil gas samples will be collected from the crawlspace during the 2011 winter months.

3.4 Geodetic Survey

Several geodetic surveys were conducted to identify the X, Y, and Z coordinates of all of the monitoring wells associated with Site investigations. The geodetic surveys were conducted in July 2007, November 2007, February 2008, and December 2009 after each monitoring well installation event. For each survey event, all of the new wells were surveyed in addition to select old wells for confirmatory purposes. For those wells that have been surveyed multiple times, the average elevation of all of the surveys was used for determining groundwater contours and flow directions.

Monitoring wells were marked by Golder using a survey stake and flagging. Additionally, Golder marked the measuring point (typically the north side of the well casing) to be surveyed with a black marker to ensure the appropriate measuring point was surveyed. Core Design, Inc., of Bellevue, Washington, a certified professional land surveyor licensed in the State of Washington, was used to survey for the geodetic X, Y, and Z coordinates of monitoring wells. Monitoring wells were surveyed for elevation (Z-coordinate) to third order accuracy and precision. Elevation surveys have an accuracy and precision of at least 0.02 foot for water elevation measurement.

3.5 Groundwater Investigation

The RI/FS hydrogeologic investigations consisted of two field tasks: (1) Water Level Measurements and (2) Groundwater Quality Sampling. The hydrogeologic study focused on the groundwater quality directly beneath and down-gradient of the MasterPark Facility. The down-gradient extent of the gasoline plume in the Qva aquifer represented a data gap and was part of this RI/FS. As such, four new monitoring wells were installed by Golder in a phased approach, to address down-gradient impacts, as discussed in the proceeding sections. The ultimate goal for installing the additional monitoring wells was to delineate the outer extent of groundwater impact and to set the boundaries for the Site.

A total of five distinct groundwater monitoring events have been conducted (after each round of well installations) as part of this RI/FS investigation. These events occurred in the summer and fall of 2007, winter 2008, and the spring and fall of 2009. Historic groundwater sampling at the MasterPark Facility occurred during: the winter of 2001 and the summer of 2006. Because the monitoring wells were installed using a phased approach from 2001 to 2009, the groundwater monitoring periods prior to 2009 did not have analytical results for all of the wells. Furthermore, groundwater samples have never been collected during the spring season and have not been collected during the winter since 2001, which represent a data gap. The hydrogeologic study for this RI/FS intended to address these data gaps.

The locations of the monitoring wells that were included in the RI/FS groundwater investigation, including those installed by Golder, are depicted in Figure 3-4.

3.5.1 2007 Monitoring Well Rehabilitation

To better define the groundwater hydraulic gradient, direction of groundwater flow and improved delineation of gasoline within the aquifer, MW-8A was rehabilitated in December 2007 to make it a viable monitoring well. An obstruction in the well casing was cleared and the interior of the entire length of the casing was swabbed to remove any accreted material. The well was flushed with approximately 120 gallons of tap water. The well was developed in February 2008 and the well was sampled, the results of which are discussed later in this section.

3.5.2 Groundwater Hydraulic Gradient Investigations

To better understand the flow of groundwater at the Site, all new and existing monitoring wells were evaluated prior to each groundwater monitoring event. As such, groundwater hydraulic gradient data was collected on August 16, 2007; November 1, 13, and 28, 2007; February 4, 2008; May 22, 2009; December 7 and 10, 2009; and March 15 and 16, 2010 to measure groundwater level (elevation) changes. The order in which the monitoring well water levels were measured was based on historical well data. Water levels were measured beginning with the cleanest wells first, followed by the wells with a history of dissolved gasoline in the water phase. The order in which the new wells were evaluated was based on conditions (the suspected presence or absence of impacted groundwater) observed during the drilling as well as their relative location on the Site. Using an electronic water level tape, the groundwater level was measured in each well. Groundwater levels in 2009 and 2010 were obtained in triplicate for precision. The procedure for measuring the water level is discussed in the RI/FS SAP. The water level meter was decontaminated between each well using Alconox and distilled water. Groundwater level measurements are summarized in Tables 3-6 through 3-10. Based on the measured groundwater levels, groundwater contour maps were developed for each of the sets of measurements (Figures 3-6 through 3-10). The results of all of these hydraulic gradient events indicate that the groundwater flow direction is predominantly to the west (with some flow components to the northwest and southwest) and is not appreciably affected by seasons.

3.5.3 Groundwater Sampling Events

Groundwater sampling events occurred in August 2007, November 2007, February 2008, May 2009, December 2009, and March 2010. The SAP identified that groundwater samples would be collected from all of the existing and newly installed monitoring wells. Since monitoring wells were installed in a phased approach, the groundwater sampling activities were phased as well. Groundwater quality sampling activities were conducted in accordance with protocols and procedures specified in the relevant Golder Technical Procedures referenced in the SAP and QAPP.

3.5.3.1 Sample Collection

All wells were sampled using a GrunFos submersible impeller pump and new, dedicated, HDPE tubing during all of the groundwater sampling events, except for December 2009. During the December 2009 groundwater sampling event, a bladder pump with new, dedicated, HDPE tubing and bladders was used instead. The December 2009 and March 2010 sampling events used a different type of pump than the previous groundwater sampling events because it was determined that better quality samples could be obtained using a bladder pump. The groundwater monitoring wells were purged at a low-flow rate for sample acquisition.

During well purging, field parameters pH, conductivity, turbidity, dissolved oxygen, and temperature were measured approximately every 5 minutes and were recorded on Sample Integrity Data Sheets (SIDS). The instruments used in the field parameter measurements were field calibrated per the manufacturers’ specifications and as described in the QAPP at the beginning of the day. Purging continued until the water quality parameters stabilized, turbidity was less than 5 NTU, to ensure that the sample represented steady state conditions of the groundwater. Summaries of the field parameter measurements at the time of sample collection for the 2009 and 2010 sampling events are included in Table 3-12 through Table 3-14. After these conditions were met, an unfiltered groundwater sample was collected. A filtered groundwater sample was only collected from select wells during the May 2009 sampling event for potential lead analysis, after the collection of the unfiltered groundwater sample. The water was filtered using an inline 0.45 micron filter. Each sample was given a unique identification number that includes the MasterPark Facility name (MasterPark Lot C), the well number (i.e., MW11 for monitoring well MW-11), and the sample collection date (i.e. MasterParkLotC-MW11-121309). Documentation for groundwater samples included bottle labels, Sample Integrity Data Sheets and Chain of Custody Records. Samples were placed on ice in coolers for transport to the laboratory. The filtered samples were submitted to the laboratory, but were archived until unfiltered sample results are reviewed.

Groundwater samples were not collected from MW-1 during the 2009 and 2010 investigations because typically there is an insufficient volume of water in that well. Additionally, groundwater samples were not collected from MW-6 during the May 2009 investigation because previous analytical events did not detect constituents of concern above the laboratory PQL.

3.5.3.2 Groundwater Sample Analysis

During the 2007 and 2008 groundwater investigations, all groundwater samples were analyzed for gasoline range petroleum hydrocarbons and fuel additives associated with gasoline (BTEX). Groundwater samples collected from newly installed wells were also analyzed for motor oil and diesel range petroleum hydrocarbons. Samples were analyzed by Analytical Resources, Inc. in Tukwila, Washington.

Two groundwater sampling events were conducted in 2009 (May and December) and one sampling event was conducted in 2010 (March). During the May 2009 investigation, selected groundwater samples were obtained and analyzed for chemical constituents of concern per MTCA Table 830-1 “Required Testing for Petroleum Releases,” as specified by the RI/FS Work Plan. MTCA requires that gasoline releases be tested for the presence of potential additives and other constituents that influence the exposure risks to humans. Investigations in 2007 and 2008 analyzed for BTEX and lead in selected samples, but naphthalene and potential additives such as 1,2-dibromoethane (EDB), 1,2-dichloroethane (EDC), 1,2-dibromo-3-chloropropane (DBCP) and methyl tertiary-butyl ether (MTBE) have not been previously tested. Five wells were identified to be analyzed for the full list of potential additives in addition to VPH analysis, which included MW-12, MW-13, MW-16, MW-17, MW-18, and MW-20. These wells were chosen because they were either located within the high concentration portion of the groundwater plume, or they were located in the down-gradient, lower concentration portion of the plume. The remaining wells were only analyzed for gasoline and BTEX. As mentioned above, filtered samples were collected from MW-12, MW-13, MW-16, MW-17, MW-18, and MW-20 for the potential analysis for dissolved lead. The filtered samples were sent to the laboratory and archived until the results of the unfiltered samples were obtained.

Groundwater samples collected in December 2009 and March 2010 were only analyzed for those chemical constituents of concern that were positively detected during the May 2009 investigation, which included gasoline, BTEX, naphthalene, n-hexane, and EDB. All groundwater samples collected in December 2009 and March 2010 were analyzed for these constituents.

3.5.3.3 Sample Results

Groundwater sample results from the 2007 and 2008 investigations indicated that all wells, except MW-6 had detections of one or more constituents (gasoline and BTEX) above the laboratory PQL. Diesel was detected above the laboratory PQL in all wells analyzed for this constituent. Motor oil was not detected above the laboratory PQL in any of the samples that were analyzed for this constituent. The analytical results for groundwater samples collected in 2007 and 2008 are summarized on Table 3-11. A discussion of the comparison of results to screening levels is included in Section 4. Analytical laboratory reports are included in Appendix C.

May 2009 analytical results indicated gasoline and/or BTEX were detected in all wells, except for MW-20 at concentrations above the laboratory PQL. EDC and DBCP were not detected above the laboratory PQL in any of the wells that were analyzed for these constituents. EDB was detected above the laboratory PQL (using the EPA 8011 analysis) in samples collected from MW-12, MW-13, MW-16, and MW-18. MTBE was not detected above the laboratory PQL using EPA 8260 and WA-VPH analytical techniques. Naphthalene and hexane were detected in MW-12, MW-13, MW-16, and MW-18 above the laboratory PQL. Naphthalene was detected in MW-17 above the laboratory PQL, but hexane was below detection limits in this sample. MW-20 was also analyzed for these additional fuel additives, but there were no detections above the laboratory PQL. Lead was detected above the laboratory PQL in MW-12, MW-13, MW-17, and MW-18. One or more of the following volatile petroleum hydrocarbons were detected in MW-12, MW-16, MW-17, and MW-18 above the laboratory PQL: n-pentane, n-hexane, n-octane, n-decane, and n-dodecane. VPH analysis detected fuel fractions above the laboratory PQL in MW-12, MW-13, MW-16, MW-17, and MW-18. The fuel fractions included the C8-C10 aromatic range, C10-C12 aromatic range, C12-C13 aromatic range, C5-C6 aliphatic range, C6-C8 aliphatic range, C8-C10 aliphatic range, and C10-C12 aliphatic range. The highest concentrations were detected in the C8-C10 aromatic range. The May 2009 groundwater sample results are summarized in Table 3-12. Laboratory analytical data is included in Appendix C.

December 2009 results were similar to the detections in May 2009. For example, gasoline and/or BTEX were detected in all wells above the laboratory PQL except MW-6, MW-20, MW-21, and MW-23. Naphthalene was detected in MW-7, MW-9, MW-11 through MW-18, MW-22, and MW-23 above the laboratory PQL. N-Hexane was detected above the laboratory PQL in MW-7, MW-8A, MW-9, MW-11 through MW-16, MW-18, MW-19, and MW-22. EDB was detected above the laboratory PQL in

MW-7, MW-9, MW-12, MW-13, MW-14, MW-16, and MW-18. MW-6, MW-20 and MW-21 had no detections of any constituents above the laboratory PQL. The December 2009 groundwater sample results are summarized in Table 3-13.

March 2010 results were similar to the detections in May and December 2009. Gasoline and/or BTEX were detected in all wells above the laboratory PQL except MW-6, MW-20, MW-21, and MW-23. Naphthalene was detected in MW-7, MW-9, MW-11 through MW-18, and MW-22, above the laboratory PQL. N-Hexane was detected above the laboratory PQL in MW-5, MW-7 through MW-16, MW-18, MW-19, and MW-22. MW-6, MW-20, and MW-21 had no detections of any constituents above the laboratory PQL. The March 2010 groundwater sample results are summarized in Table 3-14.

3.6 Quality Assurance/Quality Control

Golder performed a variety of quality control measures during the sample collection and sample analysis process in order to have confidence in the results that were being provided and to achieve data quality objectives. The following is a summary of the results of the quality control program.

3.6.1 Field Quality Control

3.6.1.1 Field Duplicate Sample Results

Quality control duplicate samples were collected in the field and the results are summarized in Table 3-15. During the 2007 investigations, a total of three duplicate groundwater samples were collected (two in August and one in November). During the May 2009 investigation, a total of two duplicate groundwater samples and one duplicate soil gas samples were collected. The duplicate samples were collected from the same sampling location as the parent sample using the same equipment and sampling technique. Duplicate samples received a unique sample identification number and were analyzed independently as an indication of gross errors in sampling techniques. Duplicate samples in 2007 were analyzed by Analytical Resources Inc. Duplicate samples in 2009 and 2010 were analyzed by On-Site Environmental and Air Toxics. For the air and groundwater samples, the parent sample results and the duplicate sample results were fairly similar, and indicated good comparability, with the exception of the August 2007 groundwater sample collected from MW-5.

3.6.1.2 Field Split Sample Results

Eight split samples were collected in August 2007 by ATC. The split samples were collected from the same sampling location as the parent and duplicate sample using the same equipment and sampling technique. Split samples received a unique sample identification number and were analyzed independently by a second laboratory as an indication of gross errors in sampling and analytical techniques. Split samples were analyzed by Analytical Resources, Inc. of Tukwila, Washington and are summarized in Table 3-15. The results reported by On-Site Environmental Inc., the laboratory used by Golder for the parent samples, are consistently higher. Without embarking on a thorough data validation exercise including checking laboratory instrument calibration curves and reviewing internal laboratory notes the difference in the concentrations report by the respective laboratories cannot be legitimately determined.

3.6.1.3 Field And Equipment Blanks

Equipment blanks are used as a check on possible contamination originating from container preparation methods, sampling equipment, shipment, handling, storage, preservatives or site conditions. One water equipment blank was collected after sampling activities were completed on May 21, 2009 and a second equipment blank was collected on March 19, 2010. The equipment blanks were collected using laboratory-provided deionized water. The equipment blanks were given unique sample identification numbers and were analyzed by Analytical Resources Inc (2009 sample) or OnSite Environmental (2010 sample). There were trace level detections of toluene (0.53 µg/L) and total xylenes (1.6 µg/L) detected in the 2009 equipment blank. These are considered *de minimis* detections. There were no detections above the PQL in the 2010 equipment blank. The analytical results are summarized in Table 3-15.

4.0 NATURE & EXTENT OF CONTAMINANTS

All known and suspected sources of contamination identified in the previous investigations at the MasterPark Facility have been characterized and interim remedial actions were implemented in 2001-2002. The results of the RI/FS investigation and analytical results of sampled media were presented in Section 3 of this report. The following Section identifies the contaminants of concern (COC) as determined by results of the RI/FS investigations, the extent of those COCs, and discusses the nature of the COCs. All analytical results were compared to MTCA Method A or B (where applicable) cleanup levels for unrestricted land use (WAC 173-340-900). The result of this comparison to cleanup levels will determine the COCs for the Site.

4.1 Extent of Soil Impacts

4.1.1 Test Pit & Soil Boring Samples

Test pits were excavated to investigate the potential for existing USTs at the MasterPark Facility. Soil samples were collected and analyzed from each of the test pits. Analytical results of soil collected from Test Pit 3 indicated the presence of diesel, motor oil, gasoline, toluene, ethylbenzene, and total xylenes. A summary of the 2007 soil sample results is included on Table 3-1. Gasoline was detected at concentrations exceeding MTCA Method A cleanup levels in the soil samples collected at 6 feet and 8 feet bgs. No other detected constituents exceeded MTCA Method A levels.

Table 3-1 also summarizes the analytical results for soil samples collected from soil borings that were installed to further investigate and delineate the source area at the MasterPark Facility. The depths at which the samples were collected were from 25 to 45 feet bgs. The analytical results show detections of motor oil, diesel, gasoline, and BTEX. However, the detections of motor oil and diesel do not exceed MTCA Method A cleanup levels in any of the samples, while gasoline and BTEX do exceed these levels. The highest concentrations of gasoline and benzene were collected from soil borings SB-01, SB-02 and SB-05. Only one sample, SB-03 at 25 feet bgs did not have concentrations of gasoline or BTEX that exceeded MTCA Method A cleanup levels.

The detections above cleanup levels for soil samples collected from the test pits and borings are as follows:

Surface Soils (0-5 feet bgs)

- No samples collected

Near Surface Soils (5-15 feet bgs)

- Gasoline range petroleum products in excess of cleanup levels in Test Pit 3

Mid-depth and Aquifer Soils (15-50 feet bgs)

- Gasoline range petroleum products, benzene, and total xylene in excess of cleanup levels in SB-01, SB-02, SB-03, SB-04, and SB-05

- Toluene in excess of cleanup levels in SB-01, SB-02, and SB-04
- Ethylbenzene in excess of cleanup levels in SB-01, SB-02, and SB-05

Deep Soils (> 50 feet bgs)

- No samples collected

4.1.2 Monitoring Well Soil Samples

Soil samples were collected during monitoring well installation in 2007 and 2009. Table 3-1 summarizes the soil sample results from 2007 and identifies the results exceeding MTCA Method A cleanup levels. Table 3-3 summarizes the soil sample results from 2009 and also identifies the results exceeding MTCA Method A cleanup levels. The 2007 results show exceedances of gasoline, benzene, ethylbenzene and total xylenes. There were no exceedances of any constituents in soil samples collected in 2009. The following is a discussion of the depth profile of exceedances:

Shallow Soils (0-5 feet bgs)

- No samples collected

Near Surface Soil (5-15 feet bgs)

- Gasoline, benzene, ethylbenzene, and total xylene exceeding cleanup levels at MW-18

Aquifer Soils (15-50 feet bgs)

- Gasoline and benzene exceeding cleanup levels at MW-18
- Gasoline exceeding cleanup levels at MW-16 and MW-17

4.1.3 Determination of Soil COCs

As identified above, the following constituents have been identified in near-surface and aquifer soils exceeding cleanup levels and therefore are considered COCs for the Site:

- Petroleum Hydrocarbons - Gasoline
- Volatile Organic Compounds – Benzene; toluene, ethylbenzene, and xylenes

Although no surface soil samples were collected during the RI, it is assumed that there are localized areas of surface soil beneath the asphalt cap outside of the source area at the MasterPark Facility that exceed cleanup levels for petroleum hydrocarbons. The presence of these localized impacted areas was identified through observation of the surface soil prior to MasterPark Facility redevelopment, when vehicles were parked on top of bare soil. During MasterPark Facility remediation and redevelopment, the asphalt cap was placed over the entire property to prevent any potential direct contact with these surface soils that remained in place.

4.2 Extent of Groundwater Impact

4.2.1 RI/FS Investigation Groundwater Sample Results

The RI investigations from 2007 through 2010 included the installation of several monitoring wells to further delineate the extent of groundwater impact at the MasterPark Facility and on down-gradient portions of the Site. Groundwater sample results indicated detections of gasoline range petroleum hydrocarbons, diesel range petroleum hydrocarbons, BTEX, naphthalene, n-hexane, EDB, and lead above laboratory PQLs. Tables 3-11, 3-12, 3-13, and 3-14 summarize the detections in groundwater and identify the constituents that were detected at concentrations above MTCA Method A or B cleanup levels. Figures 4-1 and 4-2 depict the gasoline and benzene trends in select wells over time. Exceedances of cleanup levels included the following:

- Gasoline in MW-5, MW-7, MW-9, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-17, MW-18, MW-19, and MW-22
- Diesel in MW-16, MW-17, and MW-18
- Benzene in MW-5, MW-7, MW-9, MW-10, MW-11, MW-12, MW-13, MW-14, MW-15, MW-16, MW-18, MW-19, and MW-22
- Toluene in MW-7, MW-11, MW-12, MW-13, MW-14, and MW-18
- Ethylbenzene in MW-7, MW-9, MW-11, MW-12, MW-13, MW-14, MW-16, MW-18, and MW-22
- Total xylenes in MW-7, MW-9, MW-11, MW-12, MW-13, MW-14, MW-16, MW-18, and MW-22
- Naphthalene in MW-7, MW-9, MW-12, MW-13, MW-14, MW-16, MW-18, and MW-22
- EDB in MW-7, MW-9, MW-12, MW-13, MW-14, MW-16, and MW-18
- Lead in MW-13
- N-Hexane in MW-18

4.2.2 Determination of Groundwater COCs

The remainder of this section will discuss which of the above identified constituents will be considered COCs for groundwater at the Site.

4.2.2.1 Petroleum Hydrocarbons

Gasoline range petroleum hydrocarbons were detected in groundwater samples collected at the MasterPark Facility and on down-gradient portions of the Site at concentrations exceeding MTCA Method A cleanup levels. Diesel was also detected in groundwater at one well on the MasterPark Facility and two down-gradient wells on adjacent properties (however only a select number of wells were analyzed for diesel in 2007). It is likely that the gasoline is mobilizing the diesel and carrying it down-gradient. Both diesel and gasoline are recognized as COCs for the Site groundwater.

4.2.2.2 Volatile Organic Compounds

BTEX, naphthalene, and n-hexane were detected in groundwater samples collected at the MasterPark Facility and on down-gradient portions of the Site at concentrations exceeding MTCA Method A or B cleanup levels. BTEX detections occurred in twelve wells on and adjacent to the MasterPark Facility and were at concentrations well above cleanup levels. BTEX therefore is considered a COC for the Site groundwater.

Naphthalene was detected in eight wells on and adjacent to the MasterPark Facility and was detected at concentrations more than double the cleanup level. Naphthalene therefore is considered a COC for the Site groundwater.

EDB was detected in seven wells on and adjacent to the MasterPark Facility and was at concentrations well above the cleanup level. EDB therefore is considered a COC for the Site groundwater.

N-hexane was detected in only one well (MW-18) during one sampling event (May 2009) at a concentration that was just over the cleanup level. This sample was analyzed for n-hexane using two different analytical methods: EPA 8260B and WA-VPH. N-hexane was only detected above the cleanup level by the WA-VPH analysis. The EPA 8260B analysis detected n-hexane in the May 2009 sample from MW-18, but at a concentration below the cleanup level. N-hexane was analyzed again in the December 2009 samples using EPA 8260B, but this constituent was not detected in any of the samples above the cleanup level. The EPA 8260B analysis uses a gas chromatograph mass spectrometer (GC/MS) analyzer while the WA-VPH uses a gas chromatograph instrument. By itself, GS does not provide unique compound identification because two or more compounds can co-elute through the GC column. On the contrary, MS separates the compounds by their compound mass, so co-elution is not a problem. As such, the EPA 8260B analysis using a GC/MS is a far more precise analytical method than the WA-VPH. This is the reason why all guidance documents pertaining to site investigations require the use of a GC/MS at least initially, to positively identify site compounds. GS only analytical methods can be used for routine analysis once the site compounds have been identified. Although n-hexane was detected during one sampling event in one sample above the cleanup level, it was detected using an analytical instrument that is not as precise as the EPA 8260B method. Furthermore n-hexane was not detected in any samples above the cleanup level in December 2009. Because of this, n-hexane is not considered a COC for the Site groundwater.

4.2.2.3 Metals

Lead was detected in only one well (MW-13) during the May 2009 sampling event at a concentration slightly exceeding the cleanup level. Lead was detected in three other wells, but at concentrations less than half the cleanup level. The other detections of lead were also in wells that are in and/or adjacent to the source area. The calculated average lead concentration for wells located within the source area is 9.5 µg/L, which is less than the cleanup level. Because lead was only detected in one well above the cleanup level, and the average lead concentration within the source area was less than the cleanup level during a sampling event that exhibited the highest gasoline concentrations to date, it is suspected that lead is not a COC for Site groundwater. However, since lead has only been measured during one sampling event, the next round of analysis will include lead in select monitoring wells within the source area to confirm that lead is not a site COC. Because lead is relatively immobile in most groundwater aquifers, its presence locally in the aquifer (if applicable) will not affect the cleanup action recommended in this document, nor will it impact groundwater further down-gradient in the aquifer.

There is no evidence indicating arsenic as a contaminant at this site and therefore it will not be included as an analyte during the next sampling event.

4.3 Extent of Soil Vapor Impact

The COCs at the Site have high volatility and pose a potential risk of human inhalation by vapor intrusion into Site buildings. Vapor intrusion guidance document for evaluating potential unacceptable human exposures have been drafted by Ecology (2009). Ecology guidance recommends a tiered approach in evaluating the potential exposure from vapor intrusion from underground sources including vadose zone soils and groundwater containing volatile organic compounds.

4.3.1 RI/FS Investigation Soil Vapor Sample Results

Soil vapors at the Site were investigated twice: 1) in November of 2007 and 2) in September of 2009. During the 2007 soil vapor investigation 14 soil vapor samples were obtained from probes installed from eight to 10 feet bgs through sampling ports at the bottom of the probes. The analyses only included gasoline and BTEX compounds. The laboratory reporting limits were standard (not the lowest achievable) because the purpose at that time was to locate potential subsurface releases of gasoline. Table 3-4 presents the analytical results for the 2007 soil vapor sampling event and compares the results to MTCA Method B and C shallow soil vapor screening levels (SLs) (Ecology 2009).

During the September 2009 soil gas investigation, soil gas vapor were sampled and analyzed from four probes installed around the cemetery residence and adjacent to MW-12 on the MasterPark Facility. Since a soil vapor sample could not be obtained within the Louden property, the soil vapor sample adjacent to MW-12 was used as a surrogate for soil vapor under the Louden property. The source of soil vapor under the Louden property is by the emission of volatile organic compounds from the underlying groundwater. Since the concentration of gasoline and its volatile constituents are higher in groundwater from MW-12 than expected under the Louden property, the soil vapor concentration adjacent to MW-12 was considered to be a conservative surrogate for the Louden property buildings. The soil vapor samples were obtained from the probe port at its bottom. All soil gas probes were installed to 10 feet bgs. The atmosphere of the crawl space atmosphere of the cemetery residence was also sampled and analyzed. Three background ambient atmospheric air samples were obtained and analyzed for comparison with results from soil gas probes and the residence crawl space. The analysis of soil vapor samples from the 2009 event was for gasoline, BTEX, EDB, n-hexane and naphthalene. Table 3-5 presents the analytical results for the 2009 soil vapor sampling event and compares the results to MTCA Method B and C shallow soil vapor SLs (Ecology 2009). Note that sample SG-5 was a duplicate of SG-4 and not a discrete sample.

4.3.2 Determination of Soil Gas COCs

Benzene was detected only in soil gas samples from probes SG-3, SG-6, SG-13 during the 2007 sampling event. The other soil gas analytical results had a laboratory reporting limit of 22 to 24 µg/m^3, which is above the MTCA Method B shallow SL. Therefore, there is uncertainty whether the undetected benzene is above the MTCA Method B shallow SL. The only analyzed constituents (ethylbenzene, toluene, and xylenes) that were detected above the MTCA Method B shallow SLs were associated with sample SG-6, which was from the vadose zone source soils area near well MW-18. The only samples that had a soil vapor constituent above the MTCA Method C shallow SLs was SG-6 and SG-13. Again the SG-6 sample is from the vadose zone source soils. Sample SG-13 is from a probe near the western MasterPark Facility property boundary.

The 2009 soil gas sample analysis was conducted using the lowest achievable laboratory detection limits and expanded the analytes based on the results of groundwater analyses. Benzene was detected in all soil vapor samples obtained during the 2009 event at concentrations above the Method B shallow SL, but below the MTCA Method C shallow SL. No other analyzed constituent form soil vapor samples were detected above either MTCA Method B or C shallow SLs form the 2009 sampling event. EDB was not detected in any soil vapor sample with a reporting limit of 0.22 to 0.24 µg/m^3. Although the laboratory reporting limit (practical quantification limit) is above the MTCA Method B shallow SL, the actual analytical method detection limit (MDL) is much lower than the laboratory reporting limit.

MTCA Methods B and C cleanup levels for soil gas are based on risk and are calculated using standard risk calculation equations using default parameters specified in MTCA and Ecology's *Draft Guidance For Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action* (2009), which also specify certain land-uses (residential and industrial) that are considered in the cleanup levels. The Site is not considered industrial as defined in WAC 173-340-200. However, the exposure intake parameters for indoor air intrusion exposure for a commercial worker are very similar to that of an industrial worker, except that most risk assessment guidance has the breathing rates as being different due to the assumption that industrial workers are breathing harder due to more exhaustive work. However, that is really the only dissimilarity between commercial and industrial workers because both consider exposure to adults and the work duration is the same (8 hours for 5 days rather than 24 hours every day for residential exposure scenarios). Using the above mentioned risk calculations for industrial workers, one can substitute the breathing rate for commercial workers in order to calculate cleanup levels pertaining to a commercial scenario. We assumed that the worker exposure inputs are the same or similar for a commercial worker as to an industrial worker and simply used the Method C cleanup level for indoor inhalation by commercial workers.

4.4 Summary of Site Impacts & COCs

4.4.1 Summary of Impacted Soil Extent

A source of gasoline impacted soils exists within the MasterPark Facility near the location of the former gasoline USTs. Available data or information do not suggest near surface soils are impacted off the MasterPark Facility property, except for allegations that there were petroleum UST(s) on the Louden property in the past. Soil analytical data indicates the source of impacted soil is located near the northwest corner of the MasterPark Facility, as depicted by the cross-section presented in Figure 3-3. Comparing the data from SB-01, SB-02, and SB-05 with those from GP-11, Test Pit 3, and monitoring well MW-18, concentrations of gasoline and BTEX constituents above MTCA cleanup levels are continuous within this area from approximately 8 feet bgs to the top of the Qva aquifer. Relative concentrations of gasoline (and BTEX) in the source area are highest at depths between 10 feet and 40 feet bgs and decrease in concentration with increasing depth to the top of the Qva aquifer.

4.4.2 Summary of Impacted Groundwater Extent

4.4.2.1 Gasoline

Groundwater analytical results confirm that the source of impact is bounded by MW-12 to the north, MW-14 to the south, MW-18 to the east, and MW-13 to the west. This is demonstrated by gasoline isoconcentration contour maps that were developed for the 2007-2008 (Figure 4-3) and May 2009 (Figure 4-4) groundwater sampling events. These figures show that the highest concentrations of gasoline were detected in MW-12, MW-13, MW-14, and MW-18. With distance from these wells, the concentration of gasoline in groundwater steadily decreases. However, prior to the installation of MW-21, MW-22, and MW-23 in December 2009, the northwest, northeast, and southern extent of gasoline impacted groundwater could not be delineated with high confidence. The groundwater analytical results from the December 2009 and March 2010 groundwater sampling events further characterized the gasoline plume such that MW-20, MW-21, and MW-23 did not have detections of gasoline and thus have not been impacted by the plume. The groundwater samples collected from MW-22 in December 2009, February 2010, and March 2010 were impacted by gasoline. The gasoline plume can therefore be described as ending between MW-5 and MW-21 to the south; between MW-17 and MW-20 to the west; east of MW-19; between MW-15 and MW-23 to the northeast; and beyond MW-22 to the northwest. The March 2010 sampling event was the first time that gasoline was detected above screening levels in MW-19. Figures 4-5 and 4-6 depict the groundwater isoconcentration contours for the December 2009 and March 2010 groundwater sampling events. Figures 4-5 and 4-6 may indicate that in addition to migration along the approximated groundwater flow direction to the west, the gasoline plume is migrating to the northwest. This is exemplified by the gradient of gasoline contours in the west and northwest direction.

The extent of groundwater gasoline impacts toward the northwest was estimated for the March 2010 monitoring period. Well MW-22 was installed in December 2009 and was initially sampled the following week. Because the December 2009 groundwater sample from MW-22 contained 8,000 µg/L gasoline, a confirmational groundwater sample was obtained on February 12, 2010, which contained 12,000 µg/L gasoline. During the March groundwater sampling event, the groundwater sample from MW-22 had a gasoline concentration of 15,000 µg/L. These rapidly increasing concentrations of gasoline indicate that the front edge of the gasoline plume is currently arriving at this monitoring location and is increasing at about a rate of 2,000 µg/L per month. If the gasoline concentration has been steadily increasing at this rate, the groundwater during the summer of 2009 may have been below MTCA levels of 800 µg/L at MW-22. The groundwater velocity has been estimated to flow at an average linear velocity of about 20 feet per month, using an average hydraulic gradient of 0.0013, a porosity of 0.3 and a hydraulic conductivity of 0.05 cm/second. The hydraulic conductivity was estimated in the Phase III Environmental Site Assessment (Golder 2001) from a 24-hour pump test of the Highline groundwater supply well for the well log. Therefore the groundwater gasoline plume is estimated to have migrated about 140 feet beyond MW-22, which is depicted in Figure 4-6. Since the Port of Seattle has the entire area north of South 160th Street under heavy construction, it is not possible to confirm the extent of the gasoline plume to the northwest. However, the gasoline plume will eventually be further delineated northwest of MW-22 through the installation of an additional well(s). This cannot occur until either construction on that property is completed and/or the Port of Seattle provides authorized access for well installation.

Groundwater sample results over the course of the RI investigation from MW-10 (the “deep well”), indicate that gasoline has not migrated vertically to deeper reaches of the Qva aquifer.

4.4.2.2 Benzene

Benzene groundwater sample results indicate that the highest concentrations are located at MW-18, thereby confirming that the source area is in this vicinity. This is demonstrated by benzene isoconcentration contour maps that were developed for the 2007-2008 (Figure 4-7) and May 2009 (Figure 4-8) groundwater sampling events. With distance from MW-18, the concentration of benzene steadily decreases. The benzene concentration gradient to the east is much steeper than that to the west and north, likely because of the general groundwater flow direction. Prior to the installation of MW-21, MW-22, and MW-23 in December 2009, the northwest and northeast extent of benzene impacted groundwater could not be delineated with high confidence. The groundwater analytical results from the December 2009 sampling event further characterized the benzene plume such that MW-20, MW-21, and MW-23 did not have detections of benzene and thus have not been impacted by the plume. The groundwater sample collected from MW-22 was impacted by benzene above cleanup levels. The benzene plume can therefore be described as ending between MW-5 and MW-21 to the south; between MW-13 and MW-17 to the west; east of MW-19; between MW-15 and MW-23 to the northeast; and beyond MW-22 to the northwest. Figures 4-9 and 4-10 depict the benzene groundwater isoconcentration contours for the December 2009 and March 2010 groundwater sampling events and tend to indicate that in addition to migration along the approximated groundwater flow direction to the west and southwest, the benzene plume is migrating to the northwest. This is exemplified by the lower gradient of benzene contours in the west and northwest direction.

When comparing Figures 4-5 and 4-6 (gasoline isoconcentration contours from December 2009 and March 2010) with Figures 4-9 and 4-10 (benzene isoconcentration contours from December 2009 and March 2010), they depict similar source area contours, but the benzene plume appears smaller than the gasoline plume, indicating that some condition is preventing the benzene from migrating as far as gasoline.

The benzene detections in MW-10 slightly exceeding cleanup levels indicate that benzene has vertically migrated deeper into the Qva aquifer, since MW-10 is monitoring groundwater about 20 feet below the water table. Other gasoline constituents (toluene, ethylbenzene, and xylenes) have also been detected in MW-10, but at concentrations well below cleanup levels. Gasoline has not been detected in MW-10.

4.4.2.3 EDB

EDB groundwater sample results also indicate that the highest concentrations are centered on MW-18, thereby confirming that the source area is in this vicinity. Figure 4-11 depicts the EDB isoconcentration contours for the December 2009 sampling event and Figure 4-12 depicts EDB for the March 2010 sampling event. Isoconcentration contours were not drawn for the May 2009 data because only select wells were analyzed for EDB at that time, whereas all wells were analyzed for EDB during the December 2009 and March 2010 events and thus better represent the condition of EDB in the groundwater. Figures 4-11 and 4-12 delineate the EDB plume, which has not impacted as wide of an area as the benzene and gasoline plumes. The EDB plume is bound by MW-22 to the northwest, MW-15 to the north, MW-23 to the northeast, MW-11 along the east side, MW-17 to the west, and MW-5 to the south. The EDB isoconcentration contours are steep on the east side and are elongated to the south. The gradient to the west and north is lower than the gradient on the east indicating wider transport in those directions, likely through down-gradient and cross-gradient groundwater migration.

4.4.3 Site Plume Delineation & Site COCs

Table 4-1 summarizes the COCs that have been determined for each of the impacted media for the Site and provides the maximum concentration detected for each COC (citing both the 2007 and 2009 data). A wide gasoline-range petroleum hydrocarbon (and related fuel additive) groundwater plume exists on the Site. The plume is believed to originate on the MasterPark Facility and is associated with historic UST petroleum release(s). The plume extends at least 345 feet to the northwest, passing underneath the Louden property and South 160th Street; at least 275 feet to the west passing underneath a portion of the Washington Park Cemetery; 365 feet to the south; and 185 feet to the east (based on the distance of known impacted wells from the MW-18 source). It has not been confirmed that the plume extends onto the Port of Seattle property north of South 160th Street, but it is assumed that at least of the portion may impact groundwater on the Port of Seattle property based on concentrations of COCs detected in MW-22. As such, a portion of the Port of Seattle property north of South 160th Street is also considered part of the

Site. Based on the known extent of COCs in soil and groundwater, the Site is hereby defined as including the MasterPark Facility, the eastern portion of the Washington Park Cemetery, the Louden property, South 160th Street owned by the City of SeaTac, and the southern end of the Port of Seattle property north of South 160th Street.

Delineation of the down-gradient portion of the plume (northwest of MW-22) will eventually be conducted through the installation of an additional well(s) to the northwest of MW-22. However, this will not occur until either construction on the Port of Seattle property is completed and/or the Port provides authorized access for well installation.

4.5 Physical Nature of the Site

4.5.1 Groundwater

The results of the hydraulic gradient events conducted from 2007 to 2009 indicate that the groundwater flow direction is predominantly to the west, with some flow components to the northwest and southwest. The northwesterly and southwesterly groundwater flow components are exemplified by the gasoline, benzene, and EDB isoconcentration contour figures that depict the COC plumes trending in the west, northwest, and southwest directions. Additionally, groundwater is not appreciably affected by seasons, as indicated by relatively similar groundwater elevations collected during the summer, spring, and winter months. The gradient of the aquifer at the Site is relatively flat, with less than one foot of elevation change in the groundwater level. The hydraulic gradient between MW-11 and MW-20 ranges from 0.0099 foot/foot (May 2009) to 0.0011 foot/foot (December 2009).

Groundwater has been contaminated by petroleum hydrocarbons and related COCs being released from the soil smear zone. The presence of COCs in the aquifer soils actively contributes dissolved fractions of COCs to the groundwater phase. The groundwater analytical results indicate a primarily horizontal migration of COCs through the aquifer (as depicted by the COC isoconcentration contour maps), but low level detections of gasoline constituents at MW-10 (deeper well) indicate there is some vertical movement in the aquifer.

4.5.2 Soil

The Site is underlain by a layer of fill up to approximately 10 feet thick in places followed by till and/or layers of outwash sand occurring in the range of 10 to 30 feet bgs. Till was not encountered in the area near the source soils near well MW-18, either because it was absence geologically or the till was removed during gasoline UST installation and removal. Below the till is dense to very dense advanced outwash consisting of unstratified fine to coarse grained sandy deposits. It is because of the absence of till and the sandy nature of the soil beneath the Site UST source area that COCs have been able to migrate vertically through the soil profile to the aquifer. The presence of COCs in vadose zone soils above the smear zone have the potential to continue contributing dissolved phase COCs to the water table into the future.

4.6 Nature of Contamination

The Site COCs are petroleum products and related fuel additives. By nature, gasoline is comprised of a mixture of aliphatic hydrocarbons and a number of volatile compounds. The aliphatic and aromatic hydrocarbons in gasoline are C-4 to C-12 straight-chained and ringed hydrocarbons, where as diesel typically consists of C-10 to C-18 straight-chained and ringed hydrocarbons. The heavier petroleum hydrocarbons (those with more carbon) are not readily dissolved in water. However, gasoline is volatile and highly mobile in the subsurface and when mixed can mobilize other contaminants including heavier petroleum hydrocarbons. Heavier hydrocarbons are typically not very mobile in soils and have high adsorption onto soils because of their high organic carbon to water partition coefficients (Koc). Gasoline being lighter than water could be present as free phase product on the water table from releases of gasoline. As a pure phase liquid, gasoline releases can exceed the soil absorption capacity and migrate as a liquid vertically through the water column and result in a floating (light) non aqueous phase liquid (LNAPL) on the water table. With sufficient time, a gasoline floating product will dissipate by constituent volatilization, biodegradation and dissolution into groundwater. However, no free product has been observed on Qva groundwater at this Site. Table 4-2 shows the physical and chemical properties for Site COCs. In general, constituents with lower Koc and/or higher aqueous solubility are more mobile. Gasoline and its constituents biodegrade more readily under aerobic subsurface conditions than anaerobic conditions. The lighter and more mobile/volatile gasoline constituents typically degrade at faster rates.

4.7 Physical Processes

The COCs are subjected to several physical processes as they migrate through the subsurface environment including advection, dispersion, and molecular diffusion. Advection is the migration of a substance due to the bulk movement of water. Advection tends to move chemicals in the direction of flow. Hydrodynamic dispersion, which consists of both mechanical dispersion and molecular diffusion, dilutes concentrations primarily in the direction of flow. Mechanical dispersion of ground water plumes is caused primarily by the movement of ground water around the soil particles that are in the flow path. These particles divert the forward motion of ground water and tend to disperse substances. Molecular diffusion, caused by Brownian motion and concentration gradients also causes chemicals to disperse and dilute in ground water. Therefore, as COCs migrate, these physical processes, in combination with the chemical and biological processes, retard and dilute COC concentrations in water along the infiltration and ground water pathways.

Infiltrating rainwater typically does not currently come into contact with soil containing COCs at the MasterPark Facility because of the asphalt cap. For pathways activated by contact of water with soil containing COCs (e.g., overland runoff and infiltration), the migration rate is controlled by the availability of water, the time of contact between the water and the constituents, the rate of evaporation, the permeability and wetting characteristics of soil and the vadose zone, and the solubility of the COCs. The relative partitioning of COCs between the dissolved and particulate phases are controlled by a complex combination of precipitation, dissolution, and sorption reactions.

Sorption is an important process affecting metals migration for infiltrating rainwater and ground water. Sorption can be thought of as an equilibrium-partitioning process between the soil and water.

4.8 Risk Evaluation

This section presents a summary of the Human Health Risk Evaluation (HHRE) and the Ecological Risk Evaluation (ERE) for exposures to Site media impacted by COCs. The Site COCs by media were determined in Section 4.3. The purpose of the HHRE and ERE is to determine if the Site COCs pose unacceptable risks to receptors at the Site in its current state and in the future. The risk evaluation defines the constituents and media that need to be addressed to eliminate unacceptable risks. The results of this section will be used to develop Cleanup Action Objectives (CAOs) in Section 5.

4.8.1 Receptor and Exposure Evaluation

Information concerning potential receptors and exposure pathways, including chemical sources and chemical constituent release mechanisms, are integrated into the conceptual site model (CSM). The CSM provides a framework for problem definition, defines the framework for the risk evaluation, and assists in identifying response actions for the Site, if necessary. A CSM is typically based on current information available, but is dynamic and can change as new information becomes available for a site.

The CSM for the Site reflects current and reasonable future land uses of the Site. The potential sources, affected media, release mechanisms, and routes of exposure presented in the CSM represent the suspected sources of hazardous substance releases at the Site and are identified on the basis of historical information, previous Site investigations, and the results of the RI conducted for this Report. Site RI investigation activities and previous investigations are presented in Sections 2 and 3 of this Report.

4.8.1.1 Potential Receptors

The following current and future receptors may be exposed to Site COCs and were included as potential receptors in the CSM:

- **Current residences and potential future on-Site and off-Site residents.** The only current residence at the Site is the Washington Memorial Park Cemetery residence. This residence is located on land that is zoned as Park. Typically Park land cannot be developed with residential property, but it is likely that this residence was grandfathered in. Nevertheless, the existence of this residence presents the potential for future on-Site residential receptors. There are no current residences on the MasterPark Facility, so there are no current residential receptors at the MasterPark Facility. Since the MasterPark Facility is zoned commercial, has been commercial in the past and will remain so for the foreseeable future, in addition to the deed restrictions already in place, residential land uses are not considered a potential future receptor for the MasterPark Facility. The portion of the Site that is zoned "Park" cannot be developed as residential without changing the zoning, and therefore there is low potential for future additional residences on the cemetery. The northern portion of the Site (south of South 160th Street) is zoned Community Business in Urban Center (Louden property), has been commercial in the past and is expected to remain so for the foreseeable future. Therefore, it is not reasonably likely in the near future that the property will be used for residential purposes. The northern and northeastern portion of the Site includes the South 160th Street right-of–way and Port of Seattle owned-land that is zoned Aviation Commercial (Port of Seattle property). All of the Site land north of South 160th Street is currently under major construction for transportation infrastructure for the airport and light rail system. It is not reasonably likely in the foreseeable future (next 20 to 30 years) that this portion of the Site would be redeveloped for residential purposes.

- **Current and future commercial workers in all Site properties and surrounding areas**. The surrounding area is expected to remain commercial for the MasterPark Facility and land to the north and northeast. Current and future commercial workers are potential receptors.
- **Current and future visitors or trespassers at the Site.** Current and Future visitors or trespassers will be potential receptors at the Site, but will not be exposed to Site contaminated soils because of the MasterPark Facility asphalt cap with recorded deed restrictive covenants, and lack of an exposure route to Site contaminated groundwater. Therefore, the current and future visitor of trespasser is not included as a potential receptor for the Site.
- **Current and future construction workers are present in the area of the Site.** These workers could only be exposed to near surface soils (<15 feet) on the MasterPark Facility property, if excavating through the asphalt cap. Construction workers cannot be exposed off the MasterPark Facility because near-surface soils elsewhere on the Site are not contaminated. Since current or future construction excavations or trenches would be conducted in the open ambient atmosphere for a short duration on the Site, construction workers on the Site, but off the MasterPark Facility are not considered a potential receptor for the Site. Future construction workers involved with excavations on the MasterPark Facility are retained as potential receptors.

The current and future ecological receptors that may be exposed to Site COCs:

- Terrestrial wildlife is currently only a receptor on the Washington Memorial Park Cemetery property, including the wetland area adjacent south of the MasterPark Facility. The MasterPark Facility property is fenced and source soils are completely capped with asphalt pavement. Because of the presence of this cap and because of the urban, commercial and light industrial nature of the MasterPark Facility and surrounding land for the foreseeable future, the Site does not present an unacceptable risk to terrestrial wildlife. The expansion of the cemetery and Port of Seattle transportation infrastructure facilities will decrease the available open and wooded space in the area that is expected to result in a general decrease in the presence of wildlife at the Site. Visiting avian are present and will be present in the future, but cannot be exposed to Site contamination.
- Because there are no perennial surface water bodies in the area within 500 feet of the Site contamination, there are no aquatic organisms and associated aquatic wildlife receptors at the Site. There is a man-made pond on the cemetery property that may attract waterfowl and may contain some aquatic species; however, it is approximately 1,500 feet south and side-gradient to the Site contamination.

4.8.1.2 Potential Receptor Exposure Pathways

A complete exposure pathway is defined by the following four elements (EPA 1989):

- A source of chemical release into the environment
- An environmental medium for transport of the chemical (e.g., air, ground water, or soil)

- A point of potential exposure for a receptor
- A route of exposure for the receptor (e.g., ingestion inhalation or dermal contact)

An exposure pathway is considered complete or potentially complete when all four of these elements are present. All potential human health exposure pathways for the media of concern depict primary and secondary release mechanisms, retention-exposure mechanisms, and potential exposure routes.

A discussion of the main potential exposure pathways are presented in the following sections.

4.8.1.2.1 Soil Exposure Pathway

The source of gasoline releases at the Site includes former gasoline USTs one the MasterPark Facility property. Currently, the vadose zone soils immediately surrounding and beneath the former gasoline USTs are limited to an area of approximately 50 to 60 foot diameter surrounding MW-18 on the MasterPark Facility. The upper 15 feet of soil in this source area have residual gasoline constituents (including benzene) remaining at concentrations above MTCA levels for unrestricted land use and industrial or commercial land uses. As part of the remediation and redevelopment of the MasterPark Facility property in the early 2000s, under Ecology's oversight, the property was capped with asphalt pavement and deed restrictions pertaining to the maintenance of the integrity of the asphalt cap were recorded to prevent direct contact exposure of humans and wildlife to impacted soil. Near surface soils (upper 15 feet) in all Site properties surrounding the MasterPark Facility are not impacted by the source and therefore there is no potential for exposure of any receptor group to soil on-Site (but off of the MasterPark Facility).

Future MasterPark Facility construction workers could become exposed by direct contact and incidental ingestion to Site near surface soils during construction excavation or impacted soil removal activities in the vicinity of MW-18 source area. The MasterPark Facility will remain Community Business in Urban Center for the foreseeable future and it is reasonably unlikely that the property will be developed for residential purposes, therefore the potential for unacceptable exposure via direct contact to MW-18 source area soils by future residents is not a complete exposure pathway.

4.8.1.2.2 Groundwater Exposure Pathway

Groundwater at the Site exists in the advance outwash deposits (Qva) beneath the Site. This aquifer is impacted with gasoline constituents including EDB as a gasoline additive. Groundwater is between 45 and 115 feet below land surface at the Site. There is no known discharge of Site groundwater to surface water in the area, including the wetland area and man-made pond on the cemetery property south of the Site. Therefore, terrestrial and aquatic wildlife are not exposed to Site groundwater. Currently, as shown in Figure 2-2, there are no potable groundwater supply wells within a mile of the Site in the general down-gradient direction (west, southwest or northwest) from the Site. The closest groundwater supply well is in the Washington Memorial Park Cemetery, south of the Site, and is used from watering. However, this cemetery well has not been impacted by Site releases (as per results from Ecology's 2006 and Golder's 2001 sampling events). Therefore, there are no current groundwater exposure pathways to off-Site humans from drinking water impacted by Site releases.

The only manner in which future humans can become exposed to Site groundwater is by extracting groundwater from on-Site wells for ingestion (drinking or cooking) and bathing (dermal contact). The Restrictive Covenant on record (dated 2002) for the MasterPark Facility states that groundwater at the MasterPark Facility may not be used for any purpose other than for remedial actions. As long as the Restrictive Covenant remains in place, the current and future risk of human exposure through ingestion of groundwater on the MasterPark Facility does not exist. Depending on the location of a theoretical future groundwater supply well, the potential exists for groundwater used for drinking water to contain unacceptable concentrations of gasoline (and constituents), benzene, and EDB. According to a representative from Ecology's water resources division, a groundwater well for private drinking water purposes can be installed by a private party without a water right as long as the well would be for one home or group of homes using less than 5,000 gallons per day, the well is located at least 100 feet from any source of contamination, and the well meets other set-back requirements. However, King County has additional regulations that must be met. In order to install a domestic water well in King County, several criteria must be met, as follows: the property is 5 acres or greater in size or the lot was created prior to 1972, and the well meets county set-back requirements. Additionally, the Highline Water District, which governs water service in the vicinity of the Site, indicated that it is unlikely that Ecology would grant a permit to install a well for all other purposes (other than domestic) in an area where there is an established water service provider and existing water service infrastructure. Given this information, there is no reasonably likely potential to install a domestic water well on portions of the Site that could be developed for potable use in the future.

4.8.1.3 Surface Water Exposure Pathway

Perennial surface water bodies do not exist within 500 feet of the Site contamination. The man-made pond on the cemetery property that receives groundwater from a well is located to the south by approximately 1,500 feet of the Site contamination. It is not anticipated to become impacted in the future by Site contamination because it is side gradient to the plume. The cemetery pond well has been sampled by Golder and Ecology in the past and has been free of contamination. Therefore, exposures to surface water by releases from the Site are not an operable pathway for human or ecological receptors.

4.8.1.4 Air (Vapor Intrusion Exposure Pathway)

The COCs at the Site have high volatility and potentially pose a risk through human inhalation of vapors intruding into Site buildings. A vapor intrusion guidance document for evaluating potential unacceptable human exposures has been drafted by Ecology (2009). Ecology guidance recommends a tiered approach to evaluating the potential exposure to vapor intrusion from underground sources including vadose zone soils and groundwater containing volatile organic compounds. Soil vapor intrusion into buildings poses a greater risk than the same soil vapor emission to the open ambient atmosphere. Therefore, this exposure evaluation is focused on potential soil vapor intrusion into buildings located over areas of impacted vadose zone soils and groundwater. The impacted vadose zone source soils are localized near the MW-18 source area on the MasterPark Facility.

The current potential exposure from soil vapor intrusion is associated with buildings that are over or near impacted groundwater. There are currently no buildings located over the impacted vadose zone source soils in the northwest portion of the MasterPark Facility. Buildings located over impacted groundwater include the Washington Memorial Park Cemetery residence to the northwest of the MasterPark Facility, the Port of Seattle commercial buildings at the north and northwest portions of the Site and the Louden property buildings to the north of the MasterPark Facility. The MasterPark Facility office building is located south of the area of impacted groundwater (the closest impacted groundwater has low COC concentrations) and based upon the use of Ecology's "Preliminary Assessment" approach presented in their draft guidance document (2009), the MasterPark Facility building is not considered to be potentially impacted by soil vapor intrusion (Figures 4-4 and 4-8). The cemetery residence has a passively vented crawl space separating the ground surface with the first floor of the home which aids in the diffusion of soil vapors and mixing with the ambient air as evidenced by the results of the residence crawl space air sample with surrounding atmospheric air. The Louden property buildings are commercial in nature and are located over impacted groundwater. The foundation and floor details of the buildings on the Louden property are not known. Access to the Louden property for investigation purposes has been denied to Golder and Ecology.

Tables 3-4 and 3-5 also provide the "Tier I Assessment Screening Levels (SL)" per Ecology draft guidance (2009) for comparison with the analytical results of the soil vapor investigations. Since the Site has both residential and commercial buildings, both MTCA Method B and C Tier I SLs are applicable. The SLs used for comparison in this evaluation were for shallow soil vapor concentrations or below floor slab depths. The soil vapor samples were all obtained at the Site from depths of ten (10) feet bgs. Therefore, the "Tier I Assessment" should be conservative using shallow soil vapor SLs. As shown in Tables 3-4 and 3-5, Site soil vapor concentrations for benzene exceed the MTCA Method B shallow soil vapor SLs (for unrestricted land use) under the cemetery residence, and potentially in most of the MasterPark Facility area that is above the impacted groundwater. The only locations that exceeded the Method C shallow soil vapor SLs are associated with the vadose soils in the source area around MW-18 and adjacent to MW-13 along the MasterPark Facility's west property boundary (only one compound exceeded SLs in this sample). The Louden property surrogate soil vapor sample obtained adjacent to MW-12 did not contain COCs above Method C shallow soil vapor SLs. Therefore, shallow soil vapor COC concentrations under buildings on the Louden property are also not anticipated to be above MTCA Method C Tier I SLs.

The cemetery residence crawl space air sample had the same general concentrations of COCs that were analyzed in the background ambient atmospheric air samples; however the reporting limit for naphthalene exceeded the MTCA Method B indoor air screening levels (SL) of 1.4 µg/m^3 in the crawl space sample, but given the fact that naphthalene in soil gas was below SLs, it likely is not a problem in indoor air.

Although the soil vapor concentrations exceed the MTCA Method B shallow soil gas SLs for unrestricted land use, the crawl space air indicates that the ambient air is adequately venting the residence crawl space, resulting in no increased risk.

The results of the soil vapor sampling events and Tier I preliminary assessment indicated that there is not an unacceptable risk to the current resident at the Site or current commercial workers at the MasterPark Facility. Since the Tier I soil vapor sampling results also indicate that soil vapors are below shallow soil screening levels at the property boundary, there is no unacceptable risk from vapor intrusion into current commercial buildings to workers on the Site (but off of the MasterPark Facility). However, future commercial workers, if the MasterPark Facility is ever redeveloped and buildings are built over the source area near well MW-18 may be exposed to unacceptable vapor intrusion from soil gases if proper precautions are not incorporated into the building installation to abate vapor intrusion.

4.8.2 Summary of Receptors and Exposure Pathways

The following is a summary of operable potential receptors and exposure pathways to Site contamination:

- Future MasterPark Facility commercial workers
    - Exposure to MasterPark Facility soil vapors, if a commercial building were built over impacted groundwater at the source area near MW-18
- Future MasterPark Facility construction workers
    - Exposure to MasterPark Facility soils through direct contact and ingestion

5.0 CLEANUP ACTION OBJECTIVES

This Section presents the initial components of the RI/FS cleanup action evaluation for the Site by establishing cleanup action objectives (CAOs). CAOs provide the basis for developing and evaluating alternatives for the selected removal action at the Site.

These components are presented in the following Sections. Cleanup alternatives are assembled in Section 6, and developed from the retained technologies in Section 7, and evaluated in Section 8.

5.1 Development of Cleanup Action Objectives

CAOs are Site-specific goals based on acceptable exposure levels that are protective of human health and the environment and consider applicable or relevant and appropriate requirements (ARARs). CAOs combine the consideration of ARARs and the specific constituents, affected media, and potential exposure pathways of a Site as determined through a preliminary risk assessment. CAOs identify risk pathways that removal actions should address. The major Site ARAR is MTCA, which requires compliance with other ARARs including, but not limited to:

- Washington State Drinking Water Standards (WAC 246-290-310)
- Washington State Groundwater Standards (WAC 173-200)
- Federal Primary Drinking Water Standards (29 CFR 141 and 143)
- Washington State Dangerous Waste Regulations (WAC 173-303)
- Federal Resource Conservation and Recovery Act (29 CFR 262)

Appendix F contains a comprehensive list of ARARs applicable to the Site as well as a brief summary description of each ARAR.

5.1.1 Human and Ecological Risk Pathways

5.1.1.1 Potential Human Risks

As part of the remediation and redevelopment of the MasterPark Facility property in the early 2000s, under Ecology's oversight, the property was capped with asphalt pavement to prevent direct contact exposure of humans. A Restrictive Covenant (dated 2002) was recorded requiring Ecology notification prior to any removal of pavement and excavation of soils at the MasterPark Facility. This Covenant currently protects humans from direct exposure to impacted source soils at the MasterPark Facility (see Section 2 for a summary of the Restrictive Covenant). The human risk evaluation presented in Section 4.8 identified a potential unacceptable risk to future construction workers at the MasterPark Facility by exposure (ingestion and direct contact pathways) to near-surface soils. The risk evaluation also identified that there is a potential unacceptable risk from intrusion of soil vapors into a new commercial building to future commercial workers on the MasterPark Facility, if constructed on top of the vadose zone source soils (near MW-18 or MW-13). The likelihood of future residents at the Site is not reasonably likely because of the current commercial and light industrial nature of the Site; the current construction projects on the north-northeast end of the Site (Port of Seattle and Louden properties) and no reasonably likely change in the future of the land use.

Using the Tier I suggested approach in Ecology's draft soil vapor intrusion guidance document (2009), there is no identified unacceptable risk to the current cemetery resident or current commercial buildings on the Louden property. If in the future, a commercial building is placed over the vadose zone source soils near MW-18 or MW-13 on the MasterPark Facility, there is the potential for unacceptable risk from indoor soil vapor intrusion if no precautions are included in the building design and construction. Future construction (excavation/trench) workers have the potential for unacceptable exposures from the MasterPark Facility vadose zone source soils near well MW-18. Again, the required prior notification to Ecology for any excavation of MasterPark Facility soils should assure proper health and safety precautions during construction and excavation activities.

Site groundwater poses a risk to humans only if future groundwater potable supplies are developed using Site groundwater impacted above MTCA Method A or B cleanup levels. The potential for this to occur in the future is not reasonably likely, because there are ample public water supplies servicing the area from sources that are not or will not be impacted by Site groundwater and it is not reasonably likely that additional residences will be developed on the Site in the foreseeable future.

5.1.1.2 Potential Ecological Risks

As part of the remediation and redevelopment of the MasterPark Facility, under Ecology's oversight, the property was capped with asphalt to prevent direct contact exposure of humans and terrestrial wildlife to impacted soil. The asphalt cap remains in good condition at the present time. Because of the presence of this cap and because of the urban, commercial and light industrial nature of the MasterPark Facility and surrounding land, the Site does not present an unacceptable risk to terrestrial wildlife.

There are no perennial surface water bodies in the area within 500 feet of Site contamination. The closest perennial surface water body is the man-made pond on the cemetery property located approximately 1,500 feet south of the Site contamination. It is not anticipated to become impacted in the future by Site contamination because it is side gradient to the plume. The cemetery pond well has been sampled by Golder and Ecology in the past and has been free of contamination. Therefore, exposures to surface water by releases from the Site are not an operable pathway for ecological receptors.

5.2 Cleanup Action Objectives

The objective of the cleanup action is to eliminate or sufficiently reduce exposure pathways that represent a potential unacceptable risk to receptors. The CAOs specific for the Site include:

- Eliminate potential exposure to potential future human residents to contaminated near-surface source soils at the MasterPark Facility via direct contact exposure pathways.
- Eliminate potential exposure to humans from vapor intrusion into future commercial buildings from vadose zone source soils at the MasterPark Facility near well MW-18 and MW-13.

- Eliminate potential Site-impacted groundwater to migrate and impact additional Qva aquifer in the future.

6.0 IDENTIFICATION AND SCREENING OF REMEDIATION TECHNOLOGIES

This section identifies and screens remediation technologies for use in assembling remediation alternatives. Technologies are grouped by general response actions, as discussed below.

6.1 General Response Actions

General response actions are broad categories of remedial actions that can be combined to meet CAOs at a site. The following general response actions are generally applicable to most sites, including the Sea-Tac Development Site:

- No action
- Institutional controls (including monitoring)
- Monitored Natural Attenuation (MNA)
- Containment
- Removal
- Ex-Situ Treatment (including reuse and recycling)
- In-Situ Treatment
- On-Site Disposal
- Off-Site Disposal

Except for "no action," each of these response actions represents a category of technologies. The applicable technologies will vary depending on the media and COCs.

6.2 Identification and Screening of Technologies

This section identifies and screens technologies that may be included as part of remediation alternatives. A comprehensive list of technologies and process options to address the affected media and COCs is developed to cover all the applicable general response actions. The list of technologies is then screened to develop a refined list of potentially feasible technologies that are used to develop alternatives.

The remediation technologies are screened using the following criteria:

> **Effectiveness –** The potential effectiveness of the technology to (1) address site-specific conditions, including applicability to the media and COCs for this Site, (2) achieve CAOs, (3) minimize human health and environmental impacts during implementation, and (4) provide proven and reliable remediation under Site conditions.
>
> **Implementability –** The technical and administrative feasibility of implementing a technology. Technical considerations cover site-specific factors that could prevent successful use of a technology, such as physical interferences or constraints, practical limitations of a technology, and soil and aquifer properties. Administrative considerations include the ability to obtain permits and the availability of qualified contractors, equipment, and disposal services.

> **Cost –** The capital and operation and maintenance costs associated with the technology. Costs that are excessive, compared to the overall effectiveness of the technology, may be considered as one of several factors used to eliminate technologies. Technologies providing effectiveness and implementability similar to that of another technology by employing a similar method of treatment or engineering control, but at greater cost, may be eliminated. At the screening level, the cost evaluation is based on engineering judgment of relative costs.

The technologies and process options are screened against the criteria in the priority order listed above using the "fatal flaw" approach. This approach ranks the criteria in order of importance, as listed above. Once a technology is rejected based on effectiveness, it is not evaluated further (i.e., based on implementability or cost). Similarly, if a technology is effective, but not implementable, the technology is rejected and evaluation of cost is not undertaken. This approach streamlines the evaluation of technologies while maintaining the MTCA screening methodology.

Evaluation and screening of technologies are performed in a single step. The key criterion in selecting the screening level (technology class, individual technology, or process option) is whether there is a significant difference between the technologies or process options when evaluated against the screening criteria (effectiveness, implementability, and cost). Technologies and process options that are judged to have significant differences are screened separately, and the retained technologies or process options will be developed into separate remediation alternatives to allow full evaluation and comparison.

Process options retained for any given technology that are screened together (i.e., not evaluated separately) are considered equally suitable (at the screening level of evaluation). Selection of representative process options is performed during the development of alternatives, so that best engineering judgment may be used to select and combine appropriate technologies and process options into cohesive, integrated remediation alternatives.

The potentially applicable technologies considered for the Site are presented in Table 6-1. The technology screening is also presented in this table. Retained technologies are assembled into alternatives in the next section.

7.0 DESCRIPTION OF REMEDIATION ALTERNATIVES

In order to meet the CAOs for the Site, the following remediation alternatives have been assembled using the technologies retained in Section 6:

- Alternative A – Focused In-Situ Air Sparging and Soil Vapor Extraction (IAS-SVE) with Source Area Cap
- Alternative B – Focused In-Situ Chemical Oxidation (ISCO) with Source Area Cap
- Alternative C – Focused Groundwater Pump-and-Treat with Cap and SVE for the Source Area
- Alternative D – In-Situ Air Sparging and Soil Vapor Extraction (IAS-SVE) for Entire Plume with Cap and SVE for the Source Area
- Alternative E – Groundwater Pump-and-Treat for Entire Plume with Cap and SVE for the Source Area

It is necessary to make a number of design assumptions to develop and evaluate the alternatives. These design assumptions are suitable for the comparative evaluation in this FS. However, the design assumptions used here are not necessarily the same as the design basis that would be used for the final, detailed design. A pilot study of the selected treatment would be necessary to provide information needed for final design.

Components used in the alternatives are described first, followed by descriptions of each alternative.

7.1 Components of the Alternatives

Remediation components used in the alternatives are described in this section.

7.1.1 Institutional Controls

Institutional controls would include land use restrictions and prohibition of use of Site groundwater as a source of potable water. Land use restrictions would prohibit land use inconsistent with maintaining the integrity of the MasterPark Facility asphalt cap so long as COCs remain above cleanup levels under the cap (see Section 7.1.5 for a discussion of cap protectiveness). Land use restrictions are expected to continue indefinitely.

Groundwater use restrictions would prohibit drinking water wells at the Site, preventing contact with or ingestion of contaminated groundwater. Restrictions on groundwater use beyond the MasterPark Facility (on-Site but off-property) would require negotiations with the affected landowners. Groundwater use restrictions would remain in force until COC concentrations decrease to below groundwater cleanup levels. Whether by active treatment, enhanced biodegradation, or monitored natural attenuation, all Site groundwater is expected to eventually meet cleanup levels.

7.1.2 Monitoring

Monitoring is included as part of all alternatives. Separate monitoring programs will be used for the short term (during installation of the cleanup action), the operational period, and the long term (following completion of the operational period). Monitoring plans will be prepared for the selected remedy during final design. An Operations and Maintenance Plan will be prepared for treatment processes included in the selected remedy.

Under MTCA (WAC 173-340-410), monitoring includes:

1. "Protection monitoring" to confirm that human health and the environment are adequately protected during implementation/installation. A Site-specific Health and Safety Plan will be prepared
2. "Performance monitoring" to confirm that cleanup standards or other performance standards have been attained during the operational period. Performance monitoring includes regular monitoring of treatment discharges and treatment system performance. Inspections of the treatment system are conducted to allow timely maintenance of any permanent physical components of the remedy (e.g., cap). Groundwater level and monitoring would provide information for evaluating the plume containment efficiency for a pump-and treat system.
3. "Confirmational monitoring" to monitor the long-term effectiveness of the remedy after completion of remedial action. This includes monitoring final cleanup conditions or monitoring enhanced biodegradation and natural attenuation for achieving cleanup objectives.

MNA will be included as part of all alternatives for areas of the plume that are not actively remediated. Details of the MNA program will be discussed in the DCAP.

7.1.3 Long-Term Maintenance (Asphalt Cap)

All alternatives assume some soil contamination left in place under the MasterPark Facility asphalt cap. Regular inspection and maintenance is included to ensure that the cap remains effective. Long-term maintenance of the cap would continue so long as COCs remain above cleanup levels under the cap.

7.1.4 Capping

Near-surface soils covering approximately 5-15% of the MasterPark Facility were identified as being impacted with diesel and heavy oil petroleum hydrocarbons that are relatively non-hazardous. These impacted soils were left in place in anticipation of capping with asphalt.

After demolishing all original MasterPark Facility buildings, removing potential subsurface sources, grading the property, installing new underground utilities, and constructing the new building pad, the entire property was paved with asphalt in preparation for the construction of the new parking lot. The asphalt surface and footprint of the building at the MasterPark Facility provide a cap for the contaminated near-surface soils and prevent potential exposure to the public and the environment. Diesel and heavy oil hydrocarbons are not highly mobile in the subsurface. The asphalt cover prevents surface water from contacting and infiltrating through the impacted soils and mobilizing the petroleum hydrocarbons. Thus, the asphalt cap minimizes the potential for migration of petroleum hydrocarbons to groundwater.

7.1.5 In-Situ Air Sparging (IAS)

In-situ air sparging (IAS) is a treatment process whereby air is injected into the groundwater below the contamination. A schematic of IAS is shown in Figure 7-1. As the air moves up through the contamination, the air strips VOCs from the groundwater based on the partitioning of the VOCs between air and water or soil. In addition, the oxygen introduced with the air typically stimulates aerobic microbial activity, resulting in increased microbial degradation of petroleum compounds within the groundwater and the vadose zone soil.

IAS for this Site will be targeted for groundwater treatment. However, the injected air will continue to strip VOCs from vadose zone soils as it works towards the surface. In addition, IAS will be used in conjunction with SVE (see Section 7.1.6).

Microbial degradation occurs as the VOC-laden air works its way towards the surface. The microbial degradation reduces introduction of VOCs into ambient air. However, at the Site it has been assumed that SVE will be necessary to collect vapor from IAS to ensure that VOC-laden air does not reach the surface.

The spacing of IAS wells is determined by the radius of influence (ROI) of the injected air. For this FS, a ROI of 25 feet (50 feet between wells) has been assumed. The injection of air is assumed to be introduced 30 feet below the water table and allowed to disperse upward. The agitation of the aquifer by IAS creates turbulence that increases the mixing and effectiveness of contact laterally within the aquifer. Anisotropy, that exists in most aquifers where the hydraulic conductivity is greater horizontally than vertically, also promotes lateral spreading of the sparged air while migrating vertically toward the surface of the water table. A pilot test to determine the actual ROI would be necessary prior to design of a full-scale system.

Another advantage of IAS is oxygenation of the groundwater, thereby stimulating biodegradation by naturally occurring microbes. Because groundwater is migrating in a down-gradient direction faster than the petroleum plume (due to retardation), the oxygenated groundwater will flow into the petroleum plume beyond the zone of IAS direct injection. In addition, oxygen will diffuse in groundwater beyond the injection zone. With time, the biodegradation of the down-gradient Site plume is enhanced over existing natural attenuation processes.

Two options are considered in the alternatives: treatment of groundwater within the MasterPark Facility boundary (Alternative A), and treatment of the entire groundwater plume (Alternative D).

7.1.6 Soil Vapor Extraction (SVE)

SVE is a treatment process whereby a vacuum is induced in subsurface trenches or wells using a vacuum blower. A schematic of SVE is shown in Figure 7-2. VOCs from the soil are thereby extracted for treatment at the surface. VOCs in the vadose soil vapor are extracted directly. The vacuum induces VOCs in the vadose soil to volatilize into the vapor phase. While some VOCs in groundwater will be extracted by the vacuum, SVE is primarily for treatment of unsaturated soils (vadose zone). SVE is typically used in conjunction with IAS, because as VOCs are stripped from the water table by IAS, the volatilized VOCs can be extracted by the SVE system.

SVE increases circulation of air in the subsurface, bringing additional oxygen to the treatment area. This additional oxygen typically stimulates microbial activity, resulting in increased microbial degradation of petroleum compounds.

The spacing of SVE trenches or wells is determined by their radius of influence (ROI) and the extent of a surface seal. Where there is asphalt over the treatment area, SVE trenches can be limited to the center of the area and around the edges. For areas without a surface seal, a ROI of 50 feet has been assumed. The depth of SVE wells is assumed to be five (5) feet above the high groundwater table level.

The soil vapors extracted by the SVE system will contain Site COCs and will need to be treated before discharge to the atmosphere. Various processes are available to treat COCs in the SVE off-gas. Two common systems are catalytic oxidation and vapor-phase carbon absorption. Because of COC concentrations in the off-gas are expected to be relatively low, this FS assumes vapor-phase carbon adsorption would be used. Treated SVE vapors would be discharged under and air permit to the atmosphere.

Two options are considered in the alternatives for combined IAS and SVE: treatment of groundwater within the MasterPark Facility boundary (Alternative A), and treatment of the entire groundwater plume (Alternative D). Because the treatment processes in the other alternatives will not treat vadose zone source soils, SVE in just the source area (near MW-18) is included for these alternatives.

7.1.7 In-Situ Chemical Oxidation (ISCO)

ISCO is a treatment process whereby a strong chemical oxidant is injected into the groundwater in the contaminated zone. A schematic of ISCO process is shown in Figure 7-3. For petroleum hydrocarbons, Fenton’s reagent is commonly used. Fenton’s reagent is produced on site by adding an iron catalyst to a hydrogen peroxide solution. A 50 percent solution of peroxide is common for this application. Acid is typically included in the injection mixture, as Fenton’s reagent is more effective at acidic pH. Another process option for ISCO is ozone sparging. In this process, ozone is generated on-site from air and then injected as a gas (2 percent ozone in air) into the subsurface.

ISCO destroys petroleum hydrocarbons by oxidation, with an endpoint of carbon dioxide (CO_2) for complete treatment. Destruction of lighter petroleum hydrocarbons is typically rapid upon contact, but multiple applications (typically 3) are usually required over a period of time. ISCO is not limited to only volatile petroleum hydrocarbons, but will also destroy the less volatile petroleum fractions. Oxidation cannot be restricted to target compounds. Natural organic carbon and some reduced soil minerals will be oxidized. Therefore, the quantity of oxidant required is much higher than that calculated based just on the COC concentrations. Analysis of Soil Oxygen Demand is necessary to determine injection quantities.

Where the oxidant is liquid (e.g., Fenton's reagent), ISCO is limited to groundwater and will not remove COCs in vadose zone soils. Therefore, SVE has been included with the ISCO alternative using liquid oxidant to remove VOCs from the vadose zone in the source area. Ozone sparging can work in the vadose zone as well as groundwater, and would not need SVE.

Another advantage of ISCO is oxygenating the groundwater, thereby stimulating biodegradation by naturally occurring microbes. Because groundwater is migrating in a down-gradient direction faster than the petroleum plume (due to retardation), the oxygenated groundwater will flow into the petroleum plume beyond the zone of ISCO treatment. In addition, oxygen will diffuse in groundwater beyond the injection zone. With time, the biodegradation of the down-gradient Site plume is enhanced over existing natural attenuation processes.

The spacing of ISCO wells is determined by the ROI. For this FS, a ROI of 12.5 feet (25-foot well spacing) has been assumed for liquid oxidant. For ozone, the air turbulence should result in somewhat greater spreading, and a ROI of 15 feet (30-foot well spacing). A pilot test to determine the actual ROI would be necessary prior to design of a full-scale system.

One option is considered for ISCO treatment of groundwater within the MasterPark Facility boundary (Alternative B), which is focused for the destruction of the highest concentrations of COCs. Treatment of the entire plume is not considered, because it would be very expensive and would not provide any significant advantage over the other alternatives that treat the entire plume.

7.1.8 Groundwater Extraction and Treatment (Pump-and-Treat)

Contaminated groundwater may be pumped from the aquifer, treated, and the resulting clean water discharged. A schematic of pump-and-treat is shown in Figure 7-4. Extraction wells would be installed within the groundwater plume area, equipped with submersible pumps. The extraction wells would be placed along a line perpendicular to the groundwater/contaminant flow direction. The extraction wells are assumed to be spaced every 25 feet along the extraction line to reduce the overall amount of groundwater extracted for complete capture and containment of the plume, while minimizing the capture of deeper clean groundwater.

Various processes are available to treat groundwater containing Site COCs. This FS assumes liquid-phase carbon adsorption would be used. Treated groundwater would be discharged under permit to a local Metro sanitary sewer system for improved treatment.

Groundwater pump-and-treat does not enhance biodegradation of petroleum hydrocarbons as the technology does not significantly change the redox condition of the aquifer. Therefore, COC impacted groundwater not contained or extracted by the pump-and-treat system will have to rely on natural attenuation processes existing in the aquifer. The time frame for natural attenuation is expected to be longer than the enhanced biodegradation provided by IAS and ISCO.

Two options are considered in the alternatives: extraction only from the MasterPark Facility (Alternative C), and extraction from the entire Site groundwater plume (Alternative E).

7.2 Description of the Alternatives

7.2.1 Alternative A – Focused IAS-SVE with Source Area Cap

This alternative would have the following components:

- Institutional controls as described in Section 7.1.1
- Monitoring as described in Section 7.1.2
- Asphalt cap over the source area as described in Section 7.1.4
- Cap maintenance as described in Section 7.1.3
- IAS-SVE for the MasterPark Facility as described in Sections 7.1.5 and 7.1.6
- Operation and maintenance of the system (assumed to take 5 years)
- Enhanced biodegradation and attenuation for Site groundwater, down-gradient of the MasterPark Facility (assumed to take 15 years).

Alternative A focuses on VOC removal from the area of highest concentrations within the MasterPark Facility. It would remove VOCs from the groundwater by IAS and capture them by SVE. The layout of this alternative is shown in Figure 7-5. The SVE would also remove VOCs from soil in the vadose zone. Among other benefits, by removing contaminated subsurface vapors, this SVE would alleviate potential vapor intrusion concerns. SVE off-gas would be treated by carbon adsorption before discharge to the atmosphere.

The oxygenation of the groundwater would stimulate natural microbial degradation, providing enhanced biodegradation for the down-gradient Site plume. In order to quantify the MNA occurring in the down-gradient portion of the plume, additional wells will need to be installed to the northwest of MW-22. These wells may be installed once the Port of Seattle construction is complete or when the Port of Seattle authorizes the well installation on their property. After the wells are installed they will be routinely monitored as part of the Compliance Monitoring Program to evaluate the natural attenuation occurring down-gradient of the remediation system. The installation of additional wells northwest of MW-22 is discussed further in the DCAP.

7.2.2 Alternative B – Focused ISCO with Cap and SVE for the Source Area

This alternative would have the following components:

- Institutional controls as described in Section 7.1.1
- Monitoring as described in Section 7.1.2
- Asphalt cap over the source area as described in Section 7.1.5
- Cap maintenance as describe in Section 7.1.3
- ISCO for the MasterPark Facility groundwater plume as described in Section 7.1.7 (completed in 1 to 2 years)

- SVE for the vadose source area as described in Section 7.1.6 (assumed to take 5 years) if liquid oxidant is used (not needed for ozone sparging)
- Enhanced biodegradation and attenuation for Site groundwater down-gradient of the MasterPark Facility (assumed to take between 15 years for ozone sparging and 20 years for liquid oxidant).

Alternative B would destroy the COCs in place by chemical oxidation. A total of about 46 ISCO wells are anticipated for ozone sparging, and 66 ISCO wells for liquid oxidant (Fenton's reagent). The layout of this alternative is shown in Figure 7-6a for ozone and 7-6b for liquid oxidant.

The oxygenation of the groundwater would stimulate natural microbial degradation, providing enhanced biodegradation for the down-gradient Site plume. Similar to Alternative A, additional wells in the northwest portion of the plume will be required in order to conduct MNA in the down-gradient portion of the plume.

7.2.3 Alternative C – Focused Groundwater Pump-and-Treat with Cap and SVE for the Source Area

This alternative would have the following components:

- Institutional controls as described in Section 7.1.1
- Monitoring as described in Section 7.1.2,
- Asphalt cap over the source area as described in Section 7.1.4
- Cap maintenance as describe in Section 7.1.3
- Pump-and-treat for the MasterPark Facility portion of the groundwater plume as described in Section 7.1.8 (assumed to take 30 years)
- SVE for the vadose source area as described in Section 7.1.6 (assumed to take 5 years)
- Monitored natural attenuation for Site groundwater, down-gradient of the MasterPark Facility (assumed to take 30 years)

Alternative C (Focused Groundwater Pump-and-Treat) contains and removes contaminated groundwater within the MasterPark Facility. Extracted groundwater is treated by liquid-phase carbon absorption and discharged to the local Metro sanitary sewer system. The extraction wells will have dedicated submersible pumps and will be placed along the MasterPark Facility's western property boundary with a spacing of 25 feet. The layout of this alternative is shown in Figure 7-7.

The average depth of the extraction wells will be 55 feet. The close spacing for the extraction wells will minimize the pumping rate for plume containment by not drawing non-impacted and deeper groundwater to the extraction wells. The extraction rate for Alternative C is estimated at approximately 10 to 20 gpm. For costing, the extraction rate was assumed to be 15 gpm. If this alternative is selected, the actual extraction well spacing and pumping rate will be refined through an aquifer pump test.

The restoration time frame is anticipated to be long. The operation of Alternative C at the MasterPark Facility would be expected for about 30 years, with natural attenuation for the remaining down-gradient Site plume assumed to take about 30 years also. Similar to Alternative A, additional wells in the northwest portion of the plume will be required in order to conduct MNA in the down-gradient portion of the plume.

7.2.4 Alternative D – IAS-SVE for Entire Plume with Cap and SVE for the Source Area

This alternative would have the following components:

- Institutional controls as described in Section 7.1.1
- Monitoring as described in Section 7.1.2
- Asphalt cap over the source area as described in Section 7.1.4
- Cap maintenance as describe in Section 7.1.3
- IAS-SVE for the entire Site groundwater plume as described in Sections 7.1.5 and 7.1.6
- Enhanced biodegradation of the down-gradient plume in addition to IAS-SVE
- Operation and maintenance of the system (assumed to take 5 years on the MasterPark Facility and 10 years for the down-gradient Site plume).

Alternative D would use IAS and SVE, the same system as Alternative A at the MasterPark Facility, but would also use combined IAS and SVE at a second location near the down-gradient limit of the groundwater plume. The layout of this alternative is shown in Figure 7-8. This alternative would remove VOCs from the groundwater by IAS and capture them by SVE. The SVE would also remove VOCs from soil in the vadose zone. Among other benefits, by removing contaminated subsurface vapors, this SVE would alleviate potential vapor intrusion concerns. SVE off-gas would be treated by carbon adsorption before discharge to the atmosphere. In order to design a IAS-SVE system for the down-gradient portion of the plume, additional well installation will be required in order to characterize the plume northwest of MW-22. However, these wells cannot be installed until after the Port of Seattle completes construction on this property or until the Port of Seattle provides the necessary access to their property. The additional characterization and well installation is discussed further in the DCAP.

The down-gradient IAS-SVE system would be independent and have the same components as the system on the MasterPark Facility. The array of IAS and SVE wells would be spaced at 50-foot centers, but arranged in two lines creating a treatment zone approximately 100 feet wide near the down-gradient limit of the plume. The second combined IAS and SVE location would not be operated continuously, but will be used intermittently to remove contaminants from the groundwater as the plume passes over the second combined IAS and SVE location. In this manner, the area of highest groundwater concentrations within the MasterPark Facility is removed in a relatively short time period, but the cleanup of the remaining down-gradient Site plume would take more time. The down-gradient Site plume would be subjected to enhanced biodegradation of the petroleum hydrocarbons as oxygenated groundwater flows into the plume at the same time the second IAS-SVE system would capture or degrade any plume constituents before they pass. The intermittent operation of the down-gradient IAS-SVE system is assumed to be operational for one year, followed by two to three years of monitoring as the plume migrates into the IAS-SVE zone.

7.2.5 Alternative E – Groundwater Pump-and-Treat for Entire Plume with Cap and SVE for the Source Area

This alternative would have the following components:

- Institutional controls as described in Section 7.1.1
- Monitoring as described in Section 7.1.2
- Asphalt cap over the source area as described in Section 7.1.5
- Cap maintenance as describe in Section 7.1.3
- Pump-and-treat for the entire Site groundwater plume as described in Section 7.1.8 (estimated to take 30 years)
- SVE for the vadose source area as described in Section 7.1.6 (assumed to take 5 years).

Alternative E would use the same system as Alternative C on the MasterPark Facility, but would also use a separate pump-and-treat system at a second location on the Site near the down-gradient limit of the groundwater plume. The pump-and-treat system for the down-gradient portion of the plume would only be designed and installed after additional characterization of the down-gradient Site plume occurs, similar to what was discussed for Alternative D, in the above section. The layout of this alternative is shown in Figure 7-9. The groundwater extraction wells at both locations would be spaced about 25 feet along a perpendicular line to the groundwater flow direction. Site groundwater extraction wells (those located down-gradient of the MasterPark Facility) are expected to average be about 130 feet deep, because of the increased elevation of land surface compared to the MasterPark Facility. The purpose of the second extraction location is to contain the existing plume, with eventual removal of the existing plume that is not captured (down-gradient) by the MasterPark Facility pump-and-treat system. The total operational extraction rate from both Alternative E extraction locations is estimated between 20 and 50 gpm. For costing, an extraction rate of 40 gpm was assumed. The restoration time required for complete cleanup of the entire plume in Alternative E is long and estimated to be 30 years.

8.0 EVALUATION OF REMEDIATION ALTERNATIVES

This section evaluates the remediation alternatives developed and described in the previous section. The evaluation concludes with a discussion of the overall evaluation and recommends the preferred alternative. The evaluation of remedial alternatives is consistent with the MTCA regulation process (WAC 173-340-360). As required by MTCA, a three-step evaluation process is conducted. The first step in the remedial alternative evaluation process is a "threshold" evaluation (Section 8.1), the second step is an evaluation of reasonable restoration time frame (Section 8.2), and the third step is a "permanence" evaluation (Sections 8.4 and 8.5).

8.1 Threshold Evaluation [WAC 173-340-360 (2)(a)]

The threshold evaluation determines whether each alternative meets the minimum requirements for consideration. Only alternatives that meet the minimum threshold criteria can be considered for selection. Under MTCA, remediation alternatives must meet the following threshold requirements per WAC 173-340-360(2)(a):

- Protection of human health and the environment
- Compliance with cleanup standards
- Compliance with ARARs
- Provision for compliance monitoring

Each alternative is evaluated individually against the threshold criteria in the following sections.

8.1.1 Protection of Human Health and the Environment [WAC 173-340-360 (2)(a)(i)]

As a threshold criterion, protection of human health and the environment addresses whether a remediation alternative would result in sufficiently low residual risk to current and potential future receptors after completion of the alternative. Potential risks were the basis for developing the CAOs for the Site. Therefore, protection of human health and the environment is evaluated by determining whether an alternative adequately addresses the CAOs.

All alternatives include components or provisions to address all of the Site-specific CAOs. The differences in how these alternatives would achieve CAOs are considered in the comparative "permanence" evaluation (Section 8.1.3).

8.1.2 Compliance with Remediation or Cleanup Standards [WAC 173-340-360 (2)(a)(ii)]

All of the alternatives are intended to meet groundwater cleanup levels throughout the Site (either through active treatment or monitored natural attenuation). All alternatives also include SVE in the source area, which will reduce concentrations of volatile organics in the vadose zone (unsaturated soil), but may or may not be sufficient to meet TPH soil cleanup levels.

Compliance with MTCA cleanup standards does not require removing all contaminated media from a site; these regulations include provisions for meeting cleanup requirements through containment. All of the alternatives include an asphalt cap, institutional controls, and long-term maintenance and monitoring to address residual soil contamination. Thus, all of these alternatives meet the requirements of WAC 173-340-740(6)(f):

1. Permanence
2. Protective of human health
3. Protective of ecological receptors
4. Provides institutional controls
5. Provides compliance monitoring
6. Prevents migration of contained wastes

8.1.3 Compliance with ARARs [WAC 173-340-360 (2)(a)(iii)]

Potential ARARs other than MTCA for the Site are presented in Appendix F. All alternatives would comply with applicable ARARs.

8.1.4 Compliance Monitoring [WAC 173-340-360 (2)(a)(iv)]

Compliance monitoring requirements are specified in MTCA regulations at WAC 173-340-410. Compliance monitoring includes:

1. "Protection monitoring" to confirm that human health and the environment are adequately protected during implementation.
2. "Performance monitoring" to confirm that cleanup standards or other performance standards have been attained.
3. "Confirmational monitoring" to monitor the long-term effectiveness of the remedy after completion of remedial action.

All alternatives include provision for compliance monitoring meeting this threshold requirement.

8.1.5 Summary of Threshold Evaluation

Based on the foregoing evaluation, all of the remediation alternatives developed for the Site meet the threshold criteria.

8.2 Reasonable Restoration Time Frame [WAC 173-340-360 (4)]

Remedial actions under MTCA are required to provide a “reasonable restoration time frame”. All of the alternatives developed for the Site would provide a reasonable restoration time frame considering the factors specified in WAC 173-340-360(4)(b). There are two sets of Site alternatives: one set provides active treatment for the entire groundwater plume, whereas the other set provides active treatment only for the MasterPark Facility and monitored natural attenuation to address lower concentrations in the down-gradient Site groundwater plume. The estimated time frames for the alternatives are as follows:

- Alternative A – The installation and operational period is estimated to be 5 years, with enhanced biodegradation on the Site for approximately 15 years (10 years past active treatment). Naturally occurring biodegradation will be accelerated by the addition of oxygen to the aquifer through the MasterPark Facility IAS-SVE.

- Alternative B – The installation and operational period is estimated to be approximately 5 years, with enhanced biodegradation on the Site for approximately 15 to 20 years (10 to15 years past active treatment). Naturally occurring biodegradation will be enhanced by the oxidation provided by ISCO using liquid oxidant, but to a lesser extent than the longer introduction of oxygen in air provided by IAS. For ozone sparging, which also introduces oxygen into the groundwater, biodegradation after ISCO would take about as long as after IAS.
- Alternative C – The installation and operational period is estimated to be 30 years with monitored natural attenuation for approximately 30 years (the same time period as active treatment. Pump-and-treat does not introduce oxygen into the groundwater to enhance biodegradation.
- Alternative D – The installation and operational period is estimated to be 10 years, which is the total restoration time frame because the entire plume receives active treatment.
- Alternative E – The installation and operational period is estimated to be 30 years, which is the total restoration time frame because the entire plume receives active treatment.

On this basis, the alternatives rank as follows for restoration time frame (shortest to longest):

1. Alternative D
2. Alternative A
3. Alternative B
4. Alternative C
5. Alternative E

8.3 Permanence Evaluation

The Site remedy is selected from alternatives meeting the threshold criteria (Section 8.1) and providing a reasonable restoration time frame (Section 8.2). The remedy must use permanent solutions to the “maximum extent practicable”, which is determined by comparative evaluation of the alternatives using the criteria specified in WAC 173-340-360(3):

- Overall protectiveness
- Reduction in toxicity, mobility, and volume of hazardous substances
- Long-term effectiveness and reliability
- Short-term risks
- Implementability
- Cost
- Community acceptance

These criteria and the basis for evaluating the alternatives against them are defined and discussed below. These definitions are consistent with MTCA regulations, but have been refined to minimize the overlap of considerations in the criteria.

Community acceptance is determined based on public comments on the proposed Draft Cleanup Action Plan (DCAP), and is therefore not included in this FS evaluation.

8.3.1 *Overall Protectiveness [WAC 173-340-360 (3)(f)(i)]*

This criterion is one of the threshold criteria that were discussed in Section 8.1. Overall protectiveness addresses the degree to which each alternative attains cleanup standards and minimizes potential risks (both long-term and short-term). All cleanup alternatives are protective of humans and the environment. All alternatives keep humans from using Site groundwater for potable use and remediate impacted Site groundwater, but at different time frames. Although all alternatives use vadose source SVE extraction that will reduce the potential for potential vapor intrusion into nearby residences and commercial buildings, Alternatives A and D virtually eliminate the possibility for vapor intrusion. This is because SVE is used not only in the vadose source area, but also within the in the entire area where the highest concentrations of COCs are present in the groundwater. Alternative B aggressively destroys the COCs in groundwater at the MasterPark Facility and, therefore, also offers somewhat additional protection from vapor intrusion over Alternatives C and E by removing a source of VOCs.

On this basis, the alternatives are ranked as follows for this criterion (most to least protective):

1. Alternative D
2. Alternative A
3. Alternative B
4. Alternative E
5. Alternative C

8.3.2 *Reduction of Toxicity, Mobility, and Volume of Hazardous Substances [WAC 173-340-260 (3) (f) (ii)]*

This criterion addresses the degree to which a remediation alternative reduces the inherent toxicity, the mobility (ability of constituents to migrate from the Site to the environment), and/or the quantity of material (volume or mass).

All of the alternatives provide some form of treatment for the entire groundwater plume, whether through active treatment, enhanced biodegradation, or natural attenuation. The differences are primarily not in the extent of treatment, but rather the reliability of the treatment and the time to complete treatment (which are evaluated under other criteria). The majority of contaminant mass is within the MasterPark Facility boundary and, therefore, all alternatives would destroy the majority of contaminant mass. ISCO would destroy more of the heavier, less volatile and less mobile, hydrocarbons not removed by IAS-SVE or pump-and-treat. Therefore, it would provide more removal of TPH mass in the MasterPark Facility area than the other alternatives, but the additional removal would be of limited additional benefit in terms of toxicity and mobility reduction.

Although all alternatives would remove VOCs in the source area, Alternatives A and D provide more extensive VOC removal in vadose zone soils by directly removing VOCs with subsequent treatment and destruction.

On this basis, the alternatives are ranked as follows for this criterion (most to least reduction in toxicity, mobility, and volume):

1. Alternative B
2. Alternative D
3. Alternative A
4. Alternative C
5. Alternative E

8.3.3 Long-Term Effectiveness and Reliability [WAC 173-340-360 (3)(f)(iv)]

This criterion addresses the long-term effectiveness and reliability of the alternatives at reducing risks after completion of remedial action. Risks during the implementation period are addressed under short-term risks. Evaluation for this criterion considers the following:

- **Long-Term Effectiveness –** how well the alternative is expected to protect human health and the environment after completion of remedial action.
- **Reliability –** The confidence in the alternative achieving the expected effectiveness under site conditions. Uncertainties in site conditions and the extent to which the component technologies are proven (established) are reliability considerations.

All of the alternatives have the intent of achieving cleanup levels in the entire groundwater plume. Therefore, to the extent that they would achieve this objective, they would have the same long-term effectiveness. Thus, reliability is the primary differentiator for this criterion.

Alternative D (IAS-SVE for the entire plume) would be the most reliable, because it uses technology proven effective for Site COCs to actively treat the entire plume. Alternative B is considered the next most reliable, because ISCO would aggressively degrade the hydrocarbons in place, and would thereby remove more of the hydrocarbons from the saturated soil and groundwater than IAS-SVE (which would just remove the more volatile and biodegradable hydrocarbons). However, the mobility of these additional, higher-molecular-weight hydrocarbons is low, so that the benefit of this additional removal is marginal. Alternative A is considered the next most reliable because, like Alternative D, it uses technology proven for the key contaminants, but only on the MasterPark Facility. Alternative A would enhance natural biodegradation for the remainder of the plume; while this should be effective, it is generally considered less reliable than active treatment (as in Alternative D).

Alternatives C and E rely on groundwater extraction and treatment ("pump-and-treat"), which has proven less reliable and slower at achieving cleanup levels than IAS-SVE or ISCO. These technologies rely on the dissolution of the contaminants, which would be very slow for the heavier hydrocarbons in the groundwater. These two alternatives are therefore ranked below the other alternatives for long-term effectiveness and reliability. Alternative E is ranked higher than Alternative C because Alternative E would actively treat the entire plume, whereas Alternative C would use the somewhat less reliable monitored natural attenuation.

On this basis, the alternatives are ranked as follows for long-term effectiveness and reliability (most to least effective and reliable):

1. Alternative D
2. Alternative B
3. Alternative A
4. Alternative E
5. Alternative C

8.3.4 Short-Term Risks [WAC 173-340-360 (3)(f)(v)]

This criterion addresses short-term effects on human health and the environment while the alternative is being implemented. The evaluation includes consideration of the following factors:

- Risk to Site workers
- Risk to the community
- Risk to the environment (wildlife)

Because the Site is in a congested commercial area, existing development has had far greater impacts on the local ecology than any differences between alternatives. Therefore, evaluation of short-term risk is based on potential risks to Site workers and the surrounding community.

Alternative B has the greatest short-term risk because of the health and safety risks of hydrogen peroxide, a strong oxidant, along with the acid also used to make Fenton's reagent. Mixing these chemicals on-site requires careful controls and attention to worker health and safety. In addition, the subsurface chemical reaction is exothermic (generates heat), and must be carefully controlled to avoid adverse effects (such as melting buried plastic pipe or ejecting boiling water from wells). ISCO with ozone sparging would have less short-term risk than with Fenton's reagent, because transporting and storing hazardous liquid chemicals would not be required, but ozone is also a strong oxidant that requires careful controls.

The alternatives that involve construction of a treatment system on the Site, down-gradient of the MasterPark Facility, Alternatives D and E, generally have greater short-term risks to the community as well as Site workers than alternatives with treatment restricted to the MasterPark Facility (Alternatives A, B, and C) because of the more limited ability to control public access to the Site remediation equipment.

Pump-and-treat has less construction and less complexity than IAS-SVE, and would not have above-ground rotating equipment (i.e., blowers). However, pump and treat alternatives would have connections made to the Metro sewer system within South 160th Street and would have buried active electrical wiring throughout the remediation area. Therefore, Alternative C has somewhat more short-term risk to workers than Alternative A, and Alternative D has somewhat less short-term risk to workers than Alternative E.

On this basis, the alternatives are ranked as follows for short-term risk (least to most potential risks):

1. Alternative A
2. Alternative C
3. Alternative D
4. Alternative E
5. Alternative B

8.3.5 Implementability [WAC 173-340-360 (3)(f)(vi)]

This criterion addresses the degree of difficulty in implementing each alternative. Implementability issues become more significant as the complexity of the alternative increases and as the reliance on innovative technology increases. Implementability issues are important because they address the potential for delays, cost overruns, and remedy failure.

For this evaluation, implementability has been evaluated using the following considerations:

> **Technical Feasibility** – The potential for problems during implementation of the alternative and related uncertainties. The evaluation includes the likelihood of delays due to technical problems and the ease of modifying the alternative, if required.
>
> **Administrative Feasibility** – The degree of difficulty anticipated due to regulatory constraints, permitting, and the degree of coordination required between various agencies.
>
> **Availability of Services and Materials** – The availability of experienced contractors and personnel, equipment, and materials needed to implement the alternative. Availability of disposal capacity can also be a consideration. The required services and materials are readily available for all of the alternatives, and therefore this consideration is not a distinguishing factor.

All of the alternatives would require air permitting for discharge of treated SVE off-gas (except ISCO using ozone), but Alternative D has the highest SVE flow, followed by Alternative A, with relatively more difficulty in air permitting (although such permitting is not expected to be particularly difficult).

Alternatives C and E would require permission from Metro to discharge treated groundwater to its sewer system. This permitting could be more difficult than permitting SVE off-gas, due to reluctance to accept groundwater flows and thus decrease their available capacity.

The alternatives that involve construction of treatment system on-Site, down-gradient of the MasterPark Facility, Alternatives D and E, have more construction and greater complexity, and are therefore more difficult to implement than alternatives with treatment restricted to the MasterPark Facility (Alternatives A, B, and C). Because Alternatives D and E require installation and operation of the cleanup action on-Site, down-gradient of the MasterPark Facility, permission from the other Site property owners would be required and could be very difficult to implement. One adjacent property owner has refused such access to in the past during investigation activities.

Alternative B using ozone is considered the easiest to implement because there is the least treatment equipment to install and an air discharge permit is not required. Alternative B (using either ozone or Fenton’s reagent) would require permission from Ecology for injecting either a gaseous or liquid oxidant into the groundwater. Alternative B using Fenton’s reagent would be more difficult because of the difficulty in mixing the reagents properly, and specialized contractors are typically required.

On this basis, the alternatives are ranked as follows for implementability (easiest to hardest to implement):

1. Alternative B (using ozone)
2. Alternative A
3. Alternative B (using Fenton’s reagent)
4. Alternative C
5. Alternative D
6. Alternative E

8.3.6 Cost [WAC 173-340-360 (3)(f)(iii)]

Cost estimates have been prepared based on the descriptions of the alternatives and associated assumptions presented in Section 7. Summary cost estimates for comparison are presented in Table 8-1. Cost estimates for the alternatives are presented in Tables 8-2 through 8-6. These costs include capital, operations, maintenance, and monitoring costs on a net present value basis.

The estimates were prepared to allow comparative evaluation of alternatives, not for budgeting purposes. The design basis is subject to change during final, detailed design of the selected alternative, and these changes would affect the cost of the remedy. The uncertainties in the FS designs and associated cost estimates are such that actual costs could vary significantly from these estimates. However, the uncertainty in the *relative* cost of the alternatives is much less than the uncertainty in the magnitude of the costs, and these cost estimates are suitable for comparative evaluation of the alternatives.

On the basis of these cost estimates, the alternatives are ranked as follows for cost (lowest to highest cost):

1. Alternative A
2. Alternative B
3. Alternative C
4. Alternative D
5. Alternative E

8.4 Net Benefit (Overall Non-Cost Evaluation)

The net benefit of the alternatives is determined by combining criteria evaluations, considering the relative importance of the criteria. In Table 8-7, comparative criteria evaluations discussed in the preceding sections are scored expressed in numeric terms (scored), on a scale of 1 to 10.

The criteria have been weighted as shown in the table. Criteria weightings are inherently subjective measures of the relative importance of the criteria. Different stakeholder can have different values, resulting in different criteria weightings that reflect these values. The benefit of using criteria weightings is that the relative values are explicit and can be compared for discussion between stakeholders.

The net benefit is the sum of the evaluation scores multiplied by the criteria weights. On this basis, the alternatives rank in the following order (most beneficial to least beneficial):

1. Alternative D
2. Alternative A
3. Alternative B
4. Alternative C
5. Alternative E

8.5 Disproportionate Cost Analysis and Overall Evaluation

Under WAC 173-340-360(3)(e), a cleanup action shall not be considered practicable “if the incremental cost of the alternative over that of a lower cost alternative exceeds the incremental degree of benefits achieved by the alternative over that of the other lower cost alternative”. The disproportionate cost analysis is only used for the alternatives that meet the minimum threshold criteria (Section 8.1) and provide an appropriate level of protection for Site risks.

The determination of practicability is made using an analysis of benefit versus cost. The disproportionate benefit/cost analysis can be performed quantitatively using the overall judged scoring of the non-cost criteria as the net benefit. The ratio of net benefit to estimated cost, which is a measure of cost-effectiveness, is given in Table 8-7.

As can be seen in this table, Alternative A has the best cost-effectiveness of the alternatives, as well as the second-best net benefit. Alternative D, which has the best net benefit, uses the same treatment as Alternative A (IAS-SVE), but Alternative D uses this treatment for would treat the entire plume. However, Alternative D only provides a slight benefit over Alternative A. Although Alternative B using ozone has a slightly less overall benefit than Alternative A, Alternative B using ozone has nearly the same cost-effectiveness as Alternative A because its overall cost is anticipated to be less. Alternative A achieves cleanup levels in the entire groundwater plume by using IAS-SVE at the MasterPark Facility to also enhance natural biodegradation in the remainder of the groundwater plume. Alternative A also virtually eliminates the potential for vapor intrusion into nearby residences and commercial buildings with extensive SVE within the MasterPark Facility where the contaminant soil vapors are the highest. The mass in the down-gradient portion of the Site plume is many times less than at the mass on the MasterPark Facility, but it more than doubles the cost to add active treatment for the down-gradient Site area. The comparison of the evaluation of these two alternatives shows clearly that the marginal extra benefit from active treatment of the plume has a disproportionate cost. Alternative A also meets the threshold criteria (see Section 8.1), and has an acceptable restoration time frame (estimated 15 years compared to 10 years for Alternative D). Therefore, Alternative A (Focused IAS-SVE with Source Area Cap) is the preferred alternative.

9.0 REFERENCES

City of SeaTac, 2009. *City of SeaTac Zoning Map.* City of SeaTac Geographic Information System. February 2009. http://www.ci.seatac.wa.us/Modules/ShowDocument.aspx?documentid=108

Golder Associates Inc. (Golder). 2000. Phase I Environmental Site Assessment, SunReal Inc., SeaTac Airport Site, SeaTac, Washington, October 12, 2000.

Golder Associates Inc. 2001a. Final Phase II Environmental Site Assessment Report, SeaTac Parking Garage Development Site, SeaTac, Washington, April 5, 2001.

Golder Associates Inc. 2001b. Final Report for Extended Phase II Extended Environmental Site Assessment, SeaTac Parking Garage Development Site, SeaTac, Washington, April 5, 2001.

Golder Associates Inc. 2001c. Final Report for the Phase III Environmental Site Assessment, SeaTac Parking Garage Development Site, SeaTac, Washington, April 5, 2001.

Golder Associates Inc. 2001d. Final Field Sampling Plan for Limited Remedial Actions at the Sea-Tac Parking Lot Development Site, 16000 Block International Boulevard, Sea-Tac, Washington (Rev.0), June 25, 2001.

Golder Associates Inc. 2001e. Collection and Analytical Results of Groundwater Sample from Washington Memorial Park Cemetery, Private Well Letter Report Addressed to SeaTac Investments, Attention Mr. Douglas Rigoni, September 27, 2001.

Golder Associates Inc. 2001f. Site Assessment Conducted for the Closure of a 3,000- and 10,000-Gallon Underground Storage Tank, Master Park Lot C, 16000 Block International Boulevard, SeaTac, Washington, October 4, 2001.

Golder Associates Inc. 2001g. Site Assessment Conducted for the Closure of a 1,000-Gallon Gasoline Underground Storage Tank, Master Park Lot C, 16000 Block International Boulevard, SeaTac, Washington, October 4, 2001.

Golder Associates Inc. 2001h. Site Assessment Conduct for the Closure of a 1,000-Gallon Heating Oil Underground Storage Tank, Master Park Lot C, 16000 Block International Boulevard, SeaTac, Washington, October 4, 2001.

Golder Associates Inc. 2001i. Site Assessment for the Closure of a 300-Gallon Underground Storage Tank, Master Park Lot C 16000 Block International Boulevard, SeaTac, Washington, October 24, 2001.

Golder Associates Inc. 2002. Final Independent Remedial Action Report SeaTac Parking Garage Development Site SeaTac, Washington (MasterPark Lot C). Prepared for: SeaTac Investments LLC. January 24, 2002.

Golder Associates Inc. 2008a. On-Site Source and Groundwater Investigation Summary – June to November 2007. Prepared for Riddell Williams P.S. January 14, 2008.

Golder Associates Inc. 2008b. Addendum to On-Site Source and Groundwater Investigation Summary – June to November 2007 Report (Dated January 14, 2008). Prepared for Riddell Williams P.S. March13, 2008.

Golder Associates Inc. 2009. Remedial Investigation / Feasibility Study (RI/FS) Work Plan For Sea-Tac Development Site, SeaTac, Washington. Prepared for Riddell Williams P.S. April 21, 2009.

King County iMAP, 2010. Interactive Mapping Tool. http://www.kingcounty.gov/operations/GIS/Maps/iMAP.aspx. Accessed March 2010.

National Oceanic and Atmospheric Administration (NOAA) National Climatic Data Center. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwDI~StnSrch~StnID~20027732, undated.

United States Geological Survey (USGS). 2004. Geologic Map of the Des Moines 7.5' Quadrangle, King County, Washington. By Derek B. Booth and Howard H. Waldron.

University of Washington. 2009. Washington Observed Climate Normals 1971-2000. Seattle Tacoma Airport. http://www.atmos.washington.edu/marka/wa.normals.html

United States Environmental Protection Agency (EPA). 1989. Risk Assessment Guidance for Superfund (RAGS), Volume I, Human Health Evaluation Manual (Part A), Interim Final: EPA/540/1-89/002.

Washington State Department of Ecology. 1997. Washington State Department of Ecology Analytical Methods for Petroleum Hydrocarbons, Pub.No. ECY 97-602, June, 1997.

Washington State Department of Ecology. 2002. (Revised November 2007). Model Toxics Control Act Regulations (WAC 173-340). Olympia, Washington. WAC 173-340.

Washington State Department of Ecology. 2003. Letter from Roger Nye of Ecology to Douglas Rigoni of SeaTac Investments LLC. Independent Remedial Action. September 17, 2003.

Washington State Department of Ecology 2009. Guidance for Evaluating Soil Vapor Intrusion in Washington State: Investigation and Remedial Action – Review Draft. Publication No. 09-09-047. Olympia, Washington.

TABLES

TABLE 3-1
2007-2008 Subsurface Soil Analytical Results

Sample Location	Depth (ft bgs)	Date	Motor Oil	Diesel	Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes	m,p-Xylene	o-Xylene
Test Pit 3	6	10/26/2007	**580,000**	**180,000**	**130,000**	<16	**32**	**170**	**760**	---	---
	8	10/26/2007	**23,000**	**72,000**	**2,700,000**	<14	**220**	**2,500**	**4,560**	---	---
MW-15	52	10/30/2007	<11,000	<5,300	<5,500	<14	<14	<14	<42	---	---
MW-16	60	11/8/2007	<11,000	**10,000**	**320,000**	<13	<13	**35**	**159**	---	---
	65	11/8/2007	<11,000	<5,400	**26,000**	<13	**130**	**76**	**450**	---	---
MW-17	75	11/9/2007	<11,000	<5,400	<5,400	<13	<13	<13	<40	---	---
	80	11/9/2007	<12,000	<5,800	**38,000**	<11	**13**	**31**	**288**	---	---
MW-18	15	11/26/2007	<11,000	<5,400	**1,400,000**	**290**	**1,100**	**8,600**	**53,000**	---	---
	30	11/26/2007	**29,000**	<5,600	**6,600**	**64**	**33**	**24**	**136**	---	---
	35	11/26/2007	<11,000	<5,500	**10,000**	**140**	**290**	**74**	**420**	---	---
	40	11/26/2007	<11,000	<5,300	**150,000**	**360**	**1,800**	**770**	**4,400**	---	---
	45	11/26/2007	<11,000	<5,500	**18,000**	**71**	**330**	**95**	**610**	---	---
MW-19	10.5	1/31/2008	---	---	**8,800**	< 12	< 12	< 12	---	< 24	< 12
	25.0	1/31/2008	---	---	**8,000**	< 15	< 15	< 15	---	< 29	**18**
	50.0	1/31/2008	---	---	< 5,400	< 13	< 13	< 13	---	< 27	< 13
SB-01	25	11/27/2007	<11,000	**14,000**	**1,600,000**	**2,100**	**40,000**	**12,000**	**72,000**	---	---
	40	11/27/2007	<11,000	<5,400	**360,000**	**68**	**660**	**740**	**5,200**	---	---
	45	11/27/2007	<12,000	<5,800	**35,000**	**690**	**1,900**	**270**	**1,680**	---	---
SB-02	25	11/27/2007	<11,000	**17,000**	**3,800,000**	**2,900**	**74,000**	**35,000**	**215,000**	---	---
	35	11/27/2007	<11,000	**6,000**	**150,000**	**26**	**110**	**150**	**960**	---	---
	45	11/27/2007	<11,000	<5,400	**64,000**	**36**	**280**	**160**	**930**	---	---
SB-03	25	11/27/2007	<11,000	<5,400	**3,600**	<15	<15	<15	<45	---	---
	45	11/27/2007	<11,000	<5,400	**380,000**	**530**	**4,900**	**2,400**	**13,600**	---	---
SB-04	25	11/27/2007	--	--	**41,000**	**2,600**	**3,500**	**310**	**1,970**	---	---
	40	11/27/2007	--	--	**550,000**	**730**	**9,300**	**4,100**	**14,800**	---	---
	45	11/27/2007	--	--	**32,000**	**67**	**360**	**84**	**560**	---	---
SB-05	25	11/28/2007	**22,000**	**18,000**	**860,000**	**1,800**	**24,000**	**6,400**	**40,000**	---	---
	35	11/28/2007	<11,000	**18,000**	**1,800,000**	**2,300**	**13,000**	**9,000**	**50,000**	---	---
	45	11/28/2007	<10,000	<5,300	**49,000**	**53**	**330**	**150**	**1,100**	---	---
MTCA Method A Cleanup Values			2,000,000	2,000,000	30,000	30	7,000	6,000	9,000	9,000	9,000

All concentrations indicated in µg/Kg (parts per billion)

ft bgs = feet below ground surface

Bold - Indicates concentration above laboratory practical quantitation limits

Shading indicates detected concentration exceeds MTCA Method A cleanup level for unrestricted landuse.

TABLE 3-2
Well Construction Details

Well ID	Well Status	Well Type	Casing Diameter	Casing Construction	Measuring Point	Measuring Point Elevation (Feet amsl)	Depth to Bottom of Well (Feet BMP)	Top of Screen Interval (Feet BGS)	Top of Screen Elevation (Feet amsl)	Bottom of Screen Interval (Feet BGS)	Bottom of Screen Elevation (Feet amsl)
MW-01	Active	Flush-mounted	2-inch	PVC	Top of casing.	361.37	52	41	320.37	51	310.37
MW-02	Abandoned	Flush-mounted	2-inch	PVC	Top of casing.	362.96	20	14.5	348.46	19.5	343.46
MW-03	Abandoned	Flush-mounted	2-inch	PVC	Top of casing.	363.97	28	17	346.97	27	336.97
MW-04	No Well Installed	---	---	---	---	---	---	---	---	---	---
MW-05	Active	Flush-mounted	2-inch	PVC	Top of casing.	364.26	58	48	316.26	58	306.26
MW-06	Active	Flush-mounted	2-inch	PVC	Top of casing.	369.68	60	50	319.68	60	309.68
MW-07	Active	Flush-mounted	2-inch	PVC	Top of casing.	358.70	53.5	43.5	315.20	53.5	305.2
MW-08A	Active	Flush-mounted	2-inch	PVC	Top of casing.	359.16	54	44	315.16	54	305.16
MW-09	Active	Flush-mounted	2-inch	PVC	Top of casing.	362.14	58	47.5	314.64	57	305.14
MW-10	Active	Flush-mounted	2-inch	PVC	Top of casing.	360.18	92	80	280.18	90	270.18
MW-11	Active	Flush-mounted	2-inch	PVC	Top of casing.	357.53	58	42	315.53	57	300.53
MW-12	Active	Flush-mounted	2-inch	PVC	Top of casing.	364.88	68	52	312.88	67	297.88
MW-13	Active	Flush-mounted	2-inch	PVC	Top of casing.	365.42	65	50	315.42	65	300.42
MW-14	Active	Flush-mounted	2-inch	PVC	Top of casing.	363.76	65	50	313.76	65	298.76
MW-15	Active	Flush-mounted	2-inch	PVC	Top of casing.	364.64	65	50	314.64	65	299.64
MW-16	Active	Flush-mounted	2-inch	PVC	Top of casing.	376.36	73	63	313.36	73	303.36
MW-17	Active	Flush-mounted	2-inch	PVC	Top of casing.	385.81	83	73	312.81	83	302.81
MW-18	Active	Flush-mounted	2-inch	PVC	Top of casing.	360.45	62	47	313.45	62	298.45
MW-19	Active	Flush-mounted	2-inch	PVC	Top of casing.	356.61	59	43	313.61	58	298.61
MW-20	Active	Stick-up	2-inch	PVC	Top of casing.	430.98	128	117	313.98	127	303.98
MW-21	Active	Stick-up	2-inch	PVC	Top of casing.	390.79	92	42.5	348.29	57.5	333.29
MW-22	Active	Flush-mounted	2-inch	PVC	Top of casing.	393.31	97	80	313.31	95	298.31
MW-23	Active	Flush-mounted	2-inch	PVC	Top of casing.	354.94	60	42.5	312.44	57.5	297.44

TABLE 3-3
2009 Soil Sample Analytical Results

ANALYTE	Analytical Method	MTCA Method A or B Cleanup Level - Unrestricted	MTCA Method A Cleanup Level - Industrial	Units	Well ID	MW-20	MW-20
					Sample Depth	120	128
					Sample Date	5/15/2009	5/15/2009
Hydrocarbon Identification							
Gasoline	NWTPH-Gx	30,000	30,000	µg/kg		< 5400 U	< 7300 U
Benzene	NWTPH-Gx	30	30	µg/kg		< 14 U	< 18 U
Toluene	NWTPH-Gx	7,000	7,000	µg/kg		<14 U	< 18 U
Ethylbenzene	NWTPH-Gx	6,000	6,000	µg/kg		<14 U	< 18 U
m,p-Xylenes	NWTPH-Gx	9,000	9,000	µg/kg		< 27 U	< 36 U
o-Xylene	NWTPH-Gx	9,000	9,000	µg/kg		< 14 U	< 18 U
MTBE	NWTPH-Gx	100	100	µg/kg		< 27 U	< 36 U
Volatile Organic Compounds							
1,2-Dichloroethane	8260B	11,000	---	µg/kg		<1.1 U	< 1.2 U
Benzene	8260B	30	30	µg/kg		< 1.1 U	< 1.2 U
Toluene	8260B	7,000	7,000	µg/kg		< 1.1 U	< 1.2 U
Ethylbenzene	8260B	6,000	6,000	µg/kg		< 1.1 U	< 1.2 U
Total Xylenes	8260B	9,000	9,000	µg/kg		< 2.3 U	< 2.4 U
m,p-Xylenes	8260B	9,000	9,000	µg/kg		<1.1 U	< 1.2 U
o-Xylene	8260B	9,000	9,000	µg/kg		< 1.1 U	< 1.2 U
Ethylene Dibromide	8260B	5	5	µg/kg		< 1.1 U	< 1.2 U
Naphthalene	8260B	5000	5,000	µg/kg		< 5.7 U	< 6.1 U
Methyl tert-Butyl Ether	8260B	100	100	µg/kg		< 1.1 U	< 1.2 U
Hexane	8260B	4,800,000	---	µg/kg		< 5.8 U	< 6.1 U
Volatile Petroleum Hydrocarbons							
Benzene	WA-VPH	30	30	µg/kg		< 1,000 U	< 1,200 U
Toluene	WA-VPH	7,000	7,000	µg/kg		< 1,000 U	< 1,200 U
Ethylbenzene	WA-VPH	6,000	6,000	µg/kg		< 1,000 U	< 1,200 U
m,p-Xylenes	WA-VPH	900	9,000	µg/kg		< 2,000 U	< 2,400 U
o-Xylene	WA-VPH	900	9,000	µg/kg		< 1,000 U	< 1,200 U
Methyl tert-butyl ether	WA-VPH	100	100	µg/kg		< 1,000 U	< 1,200 U
n-Pentane	WA-VPH	---	---	µg/kg		< 1,000 U	< 1,200 U
n-Hexane	WA-VPH	---	---	µg/kg		< 1,000 U	< 1,200 U
n-Octane	WA-VPH	---	---	µg/kg		< 1,000 U	< 1,200 U
n-Decane	WA-VPH	---	---	µg/kg		< 1,000 U	< 1,200 U
n-Dodecane	WA-VPH	---	---	µg/kg		< 1,000 U	< 1,200 U
C8 - C10 Aromatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
C10 - C12 Aromatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
C12 - C13 Aromatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
C5- C6 Aliphatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
C6 - C8 Aliphatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
C8 - C10 Aliphatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
C10 - C12 Aliphatics	WA-VPH	---	---	µg/kg		< 10,000 U	< 12,000 U
Metals							
Lead	200.8	250,000	1,000,000	µg/kg		**2000**	**2000**

Bold indicates a detection above the laboratory practical quantification limit.

All concentrations indicated in µg/Kg (parts per billion)

ft bgs = feet below ground surface

< U - Analyte undetected at given practical quanititation limit.

MTCA Method A or B Cleanup Levels for unrestricted land-use. WAC 173-340-900.

MTCA Method A Cleanup Levels for industrial properties. WAC 173-340-900.

TABLE 3-4
2007 Soil Vapor Sample Analytical Results

Sample Location	Depth (ft bgs)	Sample Date	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
SG-00*	NA	11/15/2007	4.6	150	14	52	22
SG-1	10	11/15/2007	<22	470	<31	84	<31
SG-2	10	11/15/2007	<24	380	<32	66	<32
SG-3	10	11/15/2007	31	250	<34	64	<34
SG-4	10	11/15/2007	<23	300	<31	80	<31
SG-5	10	11/15/2007	<23	200	<31	76	<31
SG-6	10	11/15/2007	21,000	4,400	64,000	110,000	22,000
SG-7	10	11/15/2007	<22	180	<30	69	<30
SG-8	10	11/15/2007	<22	330	<30	66	<30
SG-9	10	11/15/2007	<23	300	75	200	47
SG-10	10	11/16/2007	<24	92	<32	49	<32
SG-11	10	11/16/2007	<22	150	<30	56	<30
SG-12	10	11/16/2007	<22	130	<30	51	<30
SG-13	10	11/16/2007	41	130	<32	62	<32
SG-14	10	11/16/2007	<23	210	<32	50	<32
MTCA Method B Soil Gas SL (Shallow Probe)			3.2	22,000	4,600	310	440
MTCA Method C Soil Gas SL (Shallow Probe)			32	49,000	10,000	1,000	1,000

All concentrations indicated in µg/m^3 (micrograms per cubic meter)

ft bgs = feet below ground surface

SG-00* Ambient air sample, represents background concentrations in ambient air.

NA not applicable

Soil Gas Concentrations Exceeding the Method B Screening Levels for Shallow Soil Gas are Shaded

Soil Gas Concentrations Exceeding the Method C Screening Levels for Shallow Soil Gas are Shaded

TABLE 3-5
2009 Soil Vapor Sample Analytical Results

			Risk Driver	MTCA Method B Soil Vapor SL	MTCA Method C Soil Vapor SL	Soil Vapor Samples					Ambient Air Samples			Crawl Space Sample
ANALYTE	Analytical Method	UNITS	C= Carcin. NC=Non Carcin.	Shallow Probe	Shallow Probe	GAI-SG-1	GAI-SG-2	GAI-SG-3	GAI-SG-4	GAI-SG-5**	GAI-AMB-1	GAI-AMB-2	GAI-AMB-3	GAI-CS-01
						9/9/2009	9/9/2009	9/9/2009	9/9/2009	9/9/2009	9/9/2009	9/9/2009	9/9/2009	9/9/2009
Volatile Petroleum Hydrocarbons														
C5-C6 Aliphatics	Northwest VPH (Mod.)	$\mu g/m^3$	NC	NSA	NSA	< 50	110 NJ	270 NJ	180 NJ	250 NJ	< 51	< 52	< 52	< 51
C6-C8 Aliphatics	Northwest VPH (Mod.)	$\mu g/m^3$	NC	NSA	NSA	< 63	< 65	200 NJ	< 60	74 NJ	< 65	< 66	< 66	< 64
C8-C10 Aliphatics	Northwest VPH (Mod.)	$\mu g/m^3$	NC	NSA	NSA	410 NJ	1000 NJ	700 NJ	370 NJ	450 NJ	< 92	< 94	< 94	< 91
C10-C12 Aliphatics	Northwest VPH (Mod.)	$\mu g/m^3$	NC	NSA	NSA	5800 NJUJ	5900 NJUJ	5600 NJUJ	4000 NJUJ	5000 NJUJ	< 110	< 110	< 110	< 110
C8-C10 Aromatics	Northwest VPH (Mod.)	$\mu g/m^3$	NC	NSA	NSA	220 NJ	280 NJ	190 NJ	140 NJ	190 NJ	< 78	< 79	< 79	< 77
C10-C12 Aromatics	Northwest VPH (Mod.)	$\mu g/m^3$	NC	NSA	NSA	270 NJ	< 83	< 82	470 NJ	290 NJ	< 83	< 84	< 84	< 82
Volatile Compounds														
Benzene	TO-15 SIM	$\mu g/m^3$	C	3.2	32	9.2	12	16	10	12	1.7	0.57	0.77	0.46
Toluene	TO-15 SIM	$\mu g/m^3$	NC	22000	49000	43	37	39	29	27	4.8	1.9	1.8	7.2
1,2-Dibromoethane (EDB)	EPA 8011	$\mu g/m^3$	C	0.11	1.1	< 0.24	< 0.24	< 0.24	< 0.22	< 0.24	< 0.24	< 0.25	< 0.25	< 0.24
Ethylbenzene	TO-15 SIM	$\mu g/m^3$	NC	4600	10000	17	16	16	11	11	1.3	0.34	0.21	3.0
m,p-Xylene	TO-15 SIM	$\mu g/m^3$	NC	460	1000	49	45	46	32	34	4.5	0.88	0.51	9.7
o-Xylene	TO-15 SIM	$\mu g/m^3$	NC	440	1000	18	17	18	12	13	1.5	0.29	0.18	1.9
Hexane; n-	TO-15 SIM	$\mu g/m^3$	NC	3200	7000	22	31	54	36	42	0.81	0.66	< 0.57	13
Naphthalene	TO-15 SIM	$\mu g/m^3$	NC	14	30	< 4.0	< 4.1	4.3	< 3.8	< 4.1	< 4.1	< 4.2	< 4.2	< 4.1
2-Propanol*	TO-15 SIM	$\mu g/m^3$	---	---	---	6.1	2.4	5.3	47	3.8	< 1.9	5.2	< 2.0	18

> - indicates a no detection above the laboratory practical quantification limit.

NJ - The identification is based on presumptive evidence; estimated value.

UJ - Non-detected compound associated with low bias in the CCV.

Soil Gas Concentrations Exceeding the Method B Screening Levels for Shallow Soil Gas are Shaded

Soil Gas Concentrations Exceeding the Method C Screening Levels for Shallow Soil Gas are Shaded

* Tracer used for leak detection.

** Duplicate of SG-4.

TABLE 3-6
Groundwater Level Measurements - November 2007

Well ID	Date Measured	Depth to Water (ft bmp)	Elevations (ft above mean sea level)	
			Groundwater Elevation (ft amsl)	Top of Casing (ft amsl)
MW-5	11/14/2007	53.82	310.44	364.26
MW-6	11/14/2007	59.13	310.55	369.68
MW-7	11/14/2007	48.00	310.69	358.69
MW-9	11/14/2007	51.66	310.48	362.14
MW-11	11/14/2007	46.67	310.86	357.53
MW-12	11/14/2007	54.39	310.49	364.88
MW-13	11/14/2007	54.97	310.45	365.42
MW-14	11/14/2007	53.32	310.44	363.76
MW-15	11/14/2007	54.12	310.48	364.60
MW-16	11/14/2007	65.95	310.41	376.36
MW-17	11/14/2007	75.60	310.21	385.81
MW-18	11/28/2007	52.50	307.95	360.45

ft amsl = feet above mean sea level

ft bmp = feet below measuring point

Top of casing elevations are from the original survey.

TABLE 3-7
Groundwater Level Measurements - February 2008

Well ID	Date Measured	Depth to Water (ft bmp)	Elevations (ft above mean sea level)	
			Groundwater Elevation (ft amsl)	Top of Casing (ft amsl)
MW-1	--	--	--	361.38
MW-5	2/4/2008	53.99	310.27	364.26
MW-6	2/4/2008	59.23	310.45	369.68
MW-7	2/4/2008	48.00	310.69	358.69
MW-8A	2/4/2008	48.54	310.62	359.16
MW-9	2/4/2008	51.74	310.4	362.14
MW-10	2/4/2008	50.04	310.14	360.18
MW-11	2/4/2008	46.84	310.69	357.53
MW-12	2/4/2008	54.45	310.41	364.86
MW-13	2/4/2008	55.05	310.37	365.42
MW-14	2/4/2008	53.43	310.33	363.76
MW-15	--	--	--	364.60
MW-16	2/4/2008	66.08	310.28	376.36
MW-17	2/4/2008	75.70	310.11	385.81
MW-18	2/4/2008	50.03	310.42	360.45
MW-19	2/4/2008	45.90	310.71	356.61

All elevations correspond to NAVD 88

-- = Depth or Elevation not measured

TABLE 3-8
Groundwater Level Measurements - May 2009

Well ID	Date Measured	Depth to Water (ft below measuring point)				Elevations (ft above mean sea level)	
		1	2	3	Average	Groundwater Elevation	Top of Casing
MW-01*	5/22/2009	*48.61*	*48.61*	*48.61*	48.61	312.75	361.36
MW-05	5/22/2009	*54.51*	*54.51*	*54.51*	54.51	309.75	364.26
MW-06	5/22/2009	*59.91*	*59.90*	*59.90*	59.90	309.78	369.68
MW-07	5/22/2009	*48.68*	*48.67*	*48.67*	48.67	310.02	358.69
MW-08A	5/22/2009	*49.20*	*49.20*	*49.20*	49.20	309.96	359.16
MW-09	5/22/2009	*52.25*	*52.25*	*52.25*	52.25	309.89	362.14
MW-10	5/22/2009	*50.59*	*50.60*	*50.60*	50.60	309.58	360.18
MW-11	5/22/2009	*47.39*	*47.38*	*47.38*	47.38	310.15	357.53
MW-12	5/22/2009	*54.99*	*54.99*	*54.99*	54.99	309.87	364.86
MW-13	5/22/2009	*55.51*	*55.51*	*55.51*	55.51	309.91	365.42
MW-14	5/22/2009	*53.90*	*53.91*	*53.91*	53.91	309.85	363.76
MW-15	5/22/2009	*54.76*	*54.75*	*54.76*	54.76	309.84	364.60
MW-16	5/22/2009	*66.57*	*66.56*	*66.56*	66.56	309.80	376.36
MW-17	5/22/2009	*76.17*	*76.17*	*76.17*	76.17	309.64	385.81
MW-18	5/22/2009	*54.52*	*54.53*	*54.53*	54.53	305.92	360.45
MW-19	5/22/2009	*46.52*	*46.50*	*46.52*	46.51	310.10	356.61
MW-20	5/22/2009	*121.65*	*121.65*	*121.65*	121.65	309.33	430.98

* According to notes dated July 2007, the monument on this well has been repaired and should be resurveyed.

Elevations correspond to NAVD 88

Elevation measurements provided for groundwater, top and bottom of screen are based on surveyed data from the top of casing.

Top of casing elevations include re-surveyed elevations and may differ slightly from elevations presented in earlier tables.

TABLE 3-9
Groundwater Level Measurements - December 2009

Well ID	Date Measured	Depth to Water (ft below measuring point)				Elevations (ft above mean sea level)	
		1	*2*	*3*	Average	Groundwater Elevation	Top of Casing
MW-01*	12/7/2009	*48.78*	*48.78*	*48.78*	48.78	312.59	361.37
MW-05	12/7/2009	*54.88*	*54.88*	*54.88*	54.88	309.38	364.26
MW-06	12/7/2009	*60.31*	*60.31*	*60.31*	60.31	309.37	369.68
MW-07	12/7/2009	*49.02*	*49.02*	*49.02*	49.02	309.68	358.70
MW-08A	12/7/2009	*49.58*	*49.58*	*49.58*	49.58	309.58	359.16
MW-09	12/7/2009	*52.68*	*52.66*	*52.66*	52.67	309.47	362.14
MW-10	12/7/2009	*50.91*	*50.91*	*50.91*	50.91	309.27	360.18
MW-11	12/7/2009	*47.79*	*47.78*	*47.78*	47.78	309.75	357.53
MW-12	12/7/2009	*55.29*	*55.29*	*55.29*	55.29	309.59	364.88
MW-13	12/7/2009	*55.83*	*55.83*	*55.83*	55.83	309.59	365.42
MW-14	12/7/2009	*54.29*	*54.28*	*54.28*	54.28	309.48	363.76
MW-15	12/7/2009	*55.05*	*55.05*	*55.05*	55.05	309.59	364.64
MW-16	12/7/2009	*66.82*	*66.82*	*66.82*	66.82	309.54	376.36
MW-17	12/7/2009	*76.49*	*76.49*	*76.48*	76.49	309.32	385.81
MW-18	12/7/2009	*50.85*	*50.86*	*50.85*	50.85	309.60	360.45
MW-19	12/7/2009	*46.89*	*46.89*	*46.89*	46.89	309.72	356.61
MW-20	12/7/2009	*121.97*	*121.97*	*121.97*	121.97	309.01	430.98
MW-21	12/7/2009	*81.45*	*81.44*	*81.44*	81.44	309.35	390.79
MW-22	12/10/2009	*83.80*	*83.80*	*83.80*	83.80	309.51	393.31
MW-23	12/10/2009	*45.22*	*45.22*	*45.22*	45.22	309.72	354.94

* According to notes dated July 2007, the monument on this well has been repaired and should be resurveyed. Resurveyed August 2007 and elevation was corrected.

Elevations correspond to NAVD 88

Elevation measurements provided for groundwater, top and bottom of screen are based on surveyed data from the top of casing.

Top of casing elevations include re-surveyed elevations and may differ slightly from elevations presented in earlier tables.

TABLE 3-10
Groundwater Level Measurements - March 2010

Well ID	Date Measured	Depth to Water (ft below measuring point)				Elevations (ft above mean sea level)	
		1	*2*	*3*	Average	Groundwater Elevation	Top of Casing
MW-01*	3/15/2010	*48.72*	*48.72*	*48.72*	48.72	312.65	361.37
MW-05	3/15/2010	*54.59*	*54.58*	*54.59*	54.59	309.67	364.26
MW-06	3/15/2010	*60.03*	*60.03*	*60.03*	60.03	309.65	369.68
MW-07	3/15/2010	*48.70*	*48.69*	*48.69*	48.69	310.01	358.70
MW-08A	3/15/2010	*49.29*	*49.28*	*49.29*	49.29	309.87	359.16
MW-09	3/15/2010	*52.30*	*52.30*	*52.30*	52.30	309.84	362.14
MW-10	3/15/2010	*50.65*	*50.65*	*50.66*	50.65	309.53	360.18
MW-11	3/15/2010	*47.49*	*47.49*	*47.49*	47.49	310.04	357.53
MW-12	3/15/2010	*54.96*	*55.01*	*55.01*	54.99	309.89	364.88
MW-13	3/15/2010	*55.66*	*55.66*	*55.66*	55.66	309.76	365.42
MW-14	3/15/2010	*53.98*	*53.98*	*53.98*	53.98	309.78	363.76
MW-15	3/16/2010	*54.83*	*54.83*	*54.83*	54.83	309.81	364.64
MW-16	3/15/2010	*66.63*	*66.61*	*66.62*	66.62	309.74	376.36
MW-17	3/15/2010	*76.30*	*76.28*	*76.28*	76.29	309.52	385.81
MW-18	3/15/2010	*50.58*	*50.58*	*50.59*	50.58	309.87	360.45
MW-19	3/15/2010	*46.60*	*46.60*	*46.60*	46.60	310.01	356.61
MW-20	3/15/2010	*121.79*	*121.79*	*121.79*	121.79	309.19	430.98
MW-21	3/15/2010	*81.25*	*81.26*	*81.26*	81.26	309.53	390.79
MW-22	3/16/2010	*83.62*	*83.63*	*83.63*	83.63	309.68	393.31
MW-23	3/16/2010	*45.00*	*45.00*	*45.01*	45.00	309.94	354.94

* According to notes dated July 2007, the monument on this well has been repaired and should be resurveyed. Resurveyed August 2007 and elevation was corrected.

Elevations correspond to NAVD 88

Elevation measurements provided for groundwater, top and bottom of screen are based on surveyed data from the top of casing.

Top of casing elevations include re-surveyed elevations and may differ slightly from elevations presented in earlier tables.

TABLE 3-11
2007 - 2008 Groundwater Analytical Results

Sample Location	Sample Date	Motor Oil	Diesel	Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes
MW-5	8/16/2007	--	--	**1,600**	**7**	**5.9**	**37**	**3.2**
MW-5	8/16/2007	--	--	**270**	**3.3**	**6.9**	**7.1**	**4.5**
MW-5 DUP	8/16/2007	--	--	**340**	**5.2**	**8**	**6.5**	**6.6**
MW-6	8/16/2007	--	--	<250	<1.0	<1.0	<1.0	<2.0
MW-6	8/16/2007	--	--	ND	ND	ND	ND	ND
MW-7	8/16/2007	--	--	**68,000**	**500**	**3,200**	**1,600**	**8,690**
MW-7	8/16/2007	--	--	**45,000**	**600**	**2,800**	**1,300**	**8,200**
MW-8A[1]	2/4/2008	--	--	<250	<1.0	**1.0**	<1.0	<2.0
MW-8A[2]	2/4/2008	--	--	**290**	<1.0	**2.7**	<1.0	**1.4**
MW-9	8/16/2007	--	--	**34,000**	**280**	**230**	**750**	**3,270**
MW-9	8/16/2007	--	--	**28,000**	**350**	**300**	**740**	**3,900**
MW-11	8/16/2007	--	--	**31,000**	**48**	**1,400**	**650**	**3,400**
MW-11	8/16/2007	--	--	**26,000**	**140**	**1,700**	**860**	**4,400**
MW-12	8/16/2007	--	--	**92,000**	**710**	**7,600**	**1,800**	**11,000**
MW-12	8/16/2007	--	--	**57,000**	**590**	**6,400**	**1,700**	**10,000**
MW-13	8/16/2007	--	--	**92,000**	**180**	**5,600**	**2,100**	**12,600**
MW-13	8/16/2007	--	--	**77,000**	**330**	**6,100**	**2,600**	**16,000**
MW-14	8/16/2007	--	--	**96,000**	**150**	**6,300**	**2,100**	**12,700**
MW-14	8/16/2007	--	--	**56,000**	**93**	**5,600**	**1,800**	**12,000**
MW-14 DUP	8/16/2007	--	--	**41,000**	**160**	**4,100**	**1,200**	**8,500**
MW-15	11/1/2007	<500	**440**	**10,000**	**18**	**16**	**350**	**418**
MW-16	11/13/2007	<500	**1,700**	**26,000**	**160**	**320**	**830**	**1,733**
MW-17	11/13/2007	<500	**7,300**	**17,000**	**1.0**	**5.2**	**45**	**507**
MW-18	11/28/2007	<500	**660**	**79,000**	**2,900**	**7,500**	**1,600**	**6,290**
MW-18 DUP	11/28/2007	<500	**690**	**100,000**	**3,000**	**7,500**	**1,600**	**6,340**
MW-19	2/4/2008	--	**--**	<250	<1.0	**1.6**	<1.0	**1.1**
MTCA Method A Cleanup Values		500	500	800	5.0	1,000	700	1,000

ft bgs = feet below ground surface

All concentrations indicated in µg/L (parts per billion)

-- = Not Analyzed, No Value

ND- Not Detected

Shading indicates detected concentration exceeds MTCA Method A cleanup level for unrestricted landuse.

Bold - Indicates detection above laboratory practical quantitation limit.

[1] Sample collected prior to purging well.

[2] Sample collected following complete purging of well.

TABLE 3-12
May 2009 Groundwater Analytical Results

May 2009 Groundwater Analytical Results	Analytical Method	MTCA Method A or B Cleanup Levels	UNITS	MW-1	MW-5	MW-6	MW-8A	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16	MW-17	MW-18	MW-19	MW-20
					5/19/2009	5/19/2009	5/19/2009	5/19/2009	5/20/2009	5/20/2009	5/21/2009	5/20/2009	5/20/2009	5/19/2009	5/22/2009	5/28/2009	5/21/2009	5/21/2009	5/27/2009
Field Parameter																			
pH	---	---	stnd	--	6.5	--	6.58	6.17	6.73	6.73	*6.43*	6.29	6.45	6.34	6.33	6.23	6.71	6.99	6.58
Conductivity	---	---	uS/cm	--	347	--	194	290	492	268	*416*	474	435	552	440	183.9	494	271	391
Dissolved Oxygen	---	---	mg/L	--	0.75	--	1.11	1.86	0.49	0.5	*0.19*	1.13	2.37	1.58	0.35	0.37	0.11	0.17	3.88
Temperature	---	---	°C	--	15.7	--	14.6	15.6	15.6	16	*17.8*	18.8	17	15.2	15.4	18.2	17.4	15.3	17.2
Turbidity	---	---	NTU	--	1.54	--	1.48	2.86	4.51	4.18	*33.7*	4.8	4.91	>1000	3.97	4.9	4.58	3.14	3.95
Total Gallons Purged	---	---	gallon	--	6	--	9	8	32	32	58	30	38	< 0.5	63	37	40	25	31
	---	---																	
Metals (Total)																			
Lead	200.8	15	µg/L	NS	NS	NS	NS	NS	NS	NS	**3**	**27**	NS	NS	< 1 U	**1**	**7**	NS	< 1 U
Volatile Organic Compounds																			
1,2-Dichloroethane	8260B	0.48	µg/L	NS	NS	NS	NS	NS	NS	NS	<10 U	<10 U	NS	NS	<1.0 U	<0.2 U	<10 U	NS	<0.2 U
Benzene	8260B	5	µg/L	NS	NS	NS	NS	NS	NS	NS	**1,600**	**51**	NS	NS	**180**	**0.7**	**3,100**	NS	<0.2 U
Toluene	8260B	1000	µg/L	NS	NS	NS	NS	NS	NS	NS	**1,400**	**1,400**	NS	NS	**67**	**0.6**	**7,600**	NS	<0.2 U
Ethylbenzene	8260B	700	µg/L	NS	NS	NS	NS	NS	NS	NS	**2,400**	**2,100**	NS	NS	**1,200**	**13**	**2,200**	NS	<0.2 U
Total Xylenes	8260B	1000	µg/L	NS	NS	NS	NS	NS	NS	NS	**10,000**	**11,000**	NS	NS	**1,800**	**96**	**9,600**	NS	<0.6 U
m,p-Xylene	8260B	1000	µg/L	NS	NS	NS	NS	NS	NS	NS	**9,400**	**9,700**	NS	NS	**1,800**	**94**	**8,800**	NS	<0.4 U
o-Xylene	8260B	1000	µg/L	NS	NS	NS	NS	NS	NS	NS	**1,600**	**2,000**	NS	NS	<10 U	**2.6**	**820**	NS	<0.2 U
1,2-Dibromoethane	8260B	0.01	µg/L	NS	NS	NS	NS	NS	NS	NS	<10 U	<10 U	NS	NS	<10 U	<0.2 U	<10 U	NS	<0.2 U
Naphthalene	8260B	160	µg/L	NS	NS	NS	NS	NS	NS	NS	**580**	**640**	NS	NS	**350**	**150**	**460**	NS	<0.5 U
Methyl tert-butyl ether	8260B	20	µg/L	NS	NS	NS	NS	NS	NS	NS	<10 U	<10 U	NS	NS	< 10 U	<0.5 U	< 10 U	NS	<0.5 U
Hexane	8260B	480	µg/L	NS	NS	NS	NS	NS	NS	NS	**200**	**130**	NS	NS	**190**	<0.5 U	**370**	NS	<0.5 U
EDB & DBCP Analysis																			
1,2-Dibromoethane	8011	0.01		NS	NS	NS	NS	NS	NS	NS	**0.7**	**0.067**	NS	NS	**0.23**	<0.010 U	**1.4**	NS	<0.010 U
1,2-Dibromo-3-chloropropane	8011	0.031		NS	NS	NS	NS	NS	NS	NS	<0.033 Y (< 0.11U)	<0.016 U	NS	NS	<0.011 U	<0.010 U	<0.011 U	NS	<0.010 U
Hydrocarbon Identification																			
Total Gasoline Range	NWTPH-Gasoline	800	µg/L	NS	**1,900**	NS	**460**	**37,000**	< 100 U	**36,000**	**110,000**	**76,000**	**98,000**	**7,800**	**28,000**	**6,300**	**78,000**	**460**	< 100 U
Benzene	NWTPH-Gasoline	5	µg/L	NS	**6.6**	NS	**15**	**240**	**8.7**	**52**	**1,200**	**43**	**210**	**9.9**	**170**	**0.58**	**2,600**	**16**	<0.25 U
Toluene	NWTPH-Gasoline	1000	µg/L	NS	**5.4**	NS	**3.9**	**220**	**0.78**	**880**	**11,000**	**1,100**	**6,200**	**3.4**	**55**	**0.93**	**6,400**	**3.6**	<0.25 U
Ethylbenzene	NWTPH-Gasoline	700	µg/L	NS	**34**	NS	**1**	**810**	**0.65**	**890**	**1,900**	**1,800**	**2,000**	**200**	**1,000**	**13**	**1,800**	**3.3**	<0.25 U
m,p-Xylene	NWTPH-Gasoline	1000	µg/L	NS	**1.6**	NS	**1.7**	**2,700**	**2.5**	**3,200**	**7,300**	**7,700**	**8,400**	**69**	**1,600**	**79**	**7,200**	**4.3**	<0.50 U
o-Xylene	NWTPH-Gasoline	1000	µg/L	NS	**0.99**	NS	<0.25 U	**210**	**0.52**	**150**	**1,400**	**1,700**	**1,700**	**4.7**	<5.0 U	**2.8**	**660**	**1**	<0.25 U
Volatile Petroleum Hydrocarbons																			
n-Pentane	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	**870**	<250 U	NS	NS	**330**	<5.0 U	**1,500**	NS	<5.0 U
n-Hexane	WA-VPH	480	µg/L	NS	NS	NS	NS	NS	NS	NS	<500 U	<250 U	NS	NS	**240**	<5.0 U	**500**	NS	<5.0 U
n-Octane	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	<500 U	<250 U	NS	NS	<50 U	**6.6**	<250 U	NS	<5.0 U
n-Decane	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	<500 U	<250 U	NS	NS	<50 U	**6.2**	<250 U	NS	<5.0 U
n-Dodecane	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	<500 U	<250 U	NS	NS	**190**	**120**	<250 U	NS	<5.0 U
C8 - C10 Aromatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	**18,000**	**19,000**	NS	NS	**5,800**	**1,100**	**16,000**	NS	<50 U
C10 - C12 Aromatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	<5,000 U	**2,900**	NS	NS	**2,600**	**1,300**	<2,500 U	NS	<50 U
C12 - C13 Aromatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	<5,000 U	<2,500 U	NS	NS	<500 U	**160**	<2,500 U	NS	<50 U
C5- C6 Aliphatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	<5,000 U	<2,500 U	NS	NS	**1,300**	<50 U	**5,300**	NS	<50 U
C6 - C8 Aliphatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	**6,600**	**2,700**	NS	NS	**4,200**	**57**	**7,300**	NS	<50 U
C8 - C10 Aliphatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	**16,000**	<2,500 U	NS	NS	<500 U	<50 U	**8,800**	NS	<50 U
C10 - C12 Aliphatics	WA-VPH	---	µg/L	NS	NS	NS	NS	NS	NS	NS	**6,500**	**6,900**	NS	NS	**2,600**	**650**	**4,200**	NS	<50 U

MTCA Method A or B Cleanup Levels for unrestricted land-use. WAC 173-340-900.
Bold indicates a detection above the laboratory practical quantification limit.
NS - Not sampled due to insufficient water.
NA - Not Analyzed
Y - There was a chemical interference during analysis. Concentration in paranthesis is result of dilution analysis.
< U - Analyte undetected at given practical quanititation limit.
Shading indicates detection exceeding MTCA Method A or B Cleanup Levels for Unrestricted Landuse. WAC 173-340-900

TABLE 3-13
December 2009* Groundwater Analytical Results

ANALYTE	Analytical Method	MTCA Method A or B Cleanup Level	UNITS	MW-1	MW-5	MW-6	MW-7	MW-8A	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16	MW-17	MW-18	MW-19	MW-20	MW-21	MW-22	MW-22	MW-23
				12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/7/2009	12/10/2009	2/12/2010*	12/10/2009
Field Parameter																								
pH	---	---	stnd	---	6.82	6.23	6.89	6.81	6.52	6.85	6.83	7.58	6.44	6.78	6.61	6.5	6.46	6.8	7.31	6.85	6.53	6.96	---	6.78
Conductivity	---	---	uS/cm	---	372	400	347	245	306	163.3	284	452	429	552	484	473	166	587	246	361	264	5.66	---	182.8
Dissolved Oxygen	---	---	mg/L	---	0.22	0.63	2.83	0.3	0.43	1.94	0.25	0.06	0.18	0.61	0.26	0.25	0.13	0.28	0.26	5.84	4.16	0.27	---	0.13
Temperature	---	---	°C	---	11.1	12.6	10.9	10.4	10.7	12.2	12.1	12	12.3	10.6	13.6	12.7	10	12.4	12.8	10.6	11.2	11.7	---	13.1
Turbidity	---	---	NTU	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	---	0.97	---
Total Gallons Purged	---	---	gallons	---	2	2	2	2	2	2.5	2	1.5	2	2	2	2	2.5	2	2	2.5	2	2	3.2	2
Hydrocarbon Identification																								
Total Gasoline Range	NWTPH-Gasoline	800	µg/L	NS	**790**	<100	**46,000**	**200 z**	**19,000**	<100	**9,500**	**38,000**	**31,000**	**68,000**	**5,900**	**10,000**	**4,500**	**44,000**	**130 z**	<100	<100	**8,000**	**12,000**	<100
Benzene	NWTPH-Gasoline	5	µg/L	NS	**7.5**	<1.0	**520**	**6.1**	**190**	**2.9**	**26**	**390**	**20**	**520**	**21**	**69**	<4.0	**2,200**	**2**	<1.0	<1.0	**17**	**22**	<1.0
Toluene	NWTPH-Gasoline	1000	µg/L	NS	**2.5**	<1.0	**5,600**	<1.0	**33**	**3.6**	**300**	**2,600**	**310**	**8,600**	<4.0	**67**	**7.0**	**5,400**	**1.3**	<1.0	<1.0	**26.0**	**51.0**	<1.0
Ethylbenzene	NWTPH-Gasoline	700	µg/L	NS	**29**	<1.0	**1,300**	**1.3**	**730**	**1**	**400**	**1,200**	**870**	**2,300**	**420**	**580**	**8.8**	**1,600**	**3.1**	<1.0	<1.0	**770**	**850**	<1.0
m,p-Xylene	NWTPH-Gasoline	1000	µg/L	NS	**2.8**	<1.0	**5,600**	**2.4**	**1,900**	**2.9**	**1,200**	**4,400**	**3,700**	**8,300**	**45**	**480**	**54**	**6,100**	**6.7**	<1.0	<1.0	**1,100**	**1,700**	<1.0
o-Xylene	NWTPH-Gasoline	1000	µg/L	NS	<1.0	<1.0	**1,200**	<1.0	**27**	<1.0	**26**	**590**	**870**	**1,700**	**4.3**	**9.5**	<4.0	**590**	**1.3**	<1.0	<1.0	**12**	**19**	<1.0
Naphthalene	NWTPH-Gasoline	160	µg/L	NS	<3.0	<3.0	**420**	<3.0	**260**	<3.0	**150**	**540**	**500**	**570**	**150**	**230**	**140**	**380**	<3.0	<3.0	<3.0	**270**	**280**	**4**
n-Hexane	NWTPH-Gasoline	480	µg/L	NS	<5.0 U1	<1.0	**220**	**23**	**83**	<1.0	**91**	**110**	**100**	**180**	**6.3**	**66**	<4.0	**180**	**51**	<1.0	<1.0	**4.9**	**11**	<1.0
EDB																								
1,2-Dibromoethane (EDB)	EPA 8011	0.01	µg/L	NS	<0.0095	<0.0096	**0.028**	<0.0096	**0.013**	<0.0095	<0.0095	**0.21**	**0.054**	**0.46**	<0.0096	**0.053**	<0.0095	**1.9**	<0.0096	<0.0095	<0.0096	<0.0095	< 0.0096	<0.0094

MTCA Method A or B Cleanup Levels for unrestricted land-use. WAC 173-340-900.
Bold indicates a detection above the laboratory practical quantification limit.
NS - Not sampled due to insufficient water.
NA - Not Analyzed

Z = Sample contains early eluting compounds not quantified in the gas range.

U1 = The practical quantitation limit is elevated due to interferences present in the sample.

< U - Analyte undetected at given practical quanititation limit.

Shading indicates detection exceeding MTCA Method A or B Cleanup Levels for Unrestricted Landuse. WAC 173-340-900

* MW-22 was resampled on February 12, 2010 in order to confirm the December 2009 detections.

TABLE 3-14
March 2010 Groundwater Analytical Results

ANALYTE	Analytical Method	MTCA Method A or B Cleanup Level	UNITS	MW-1	MW-5	MW-6	MW-7	MW-8A	MW-9	MW-10	MW-11	MW-12	MW-13	MW-14	MW-15	MW-16	MW-17	MW-18	MW-19	MW-20	MW-21	MW-22	MW-23
				---	3/19/2010	3/19/2010	3/18/2010	3/18/2010	3/19/2010	3/19/2010	3/18/2010	3/15/2010	3/19/2010	3/19/2010	3/16/2010	3/17/2010	3/17/2010	3/18/2010	3/18/2010	3/17/2010	3/17/2010	3/16/2010	3/16/2010
Field Parameter																							
pH	---	---	stnd	---	6.49	5.96	6.61	6.67	6.19	6.66	6.59	6.38	6.28	6.49	6.44	6.40	6.51	6.69	7.04	6.63	5.97	6.65	6.54
Conductivity	---	---	uS/cm	---	361	409	354	336	294	169.1	291	472	271	378	565	446	145.3	586	275	359	257	586	217
Dissolved Oxygen	---	---	mg/L	---	0.14	0.87	1.41	0.29	0.13	0.34	0.16	0.03	0.16	0.21	0.18	0.22	0.52	0.11	0.07	4.82	3.21	0.25	0.15
Temperature	---	---	^{o}C	---	14	13.5	13.3	9.9	14.2	11.8	13.1	14.5	12.8	14.1	12.9	11.7	9.3	14.2	12.5	10.8	11.5	12.5	13.1
Turbidity	---	---	NTU	---	3.65	3.75	5.18	2.16	7.18	3.69	20	40.8	72.1	20.8	21	5.14	142	5.39	84	4.37	5.13	82	8
Total Gallons Purged	---	---	gallons	---	2	2	1.5	1.5	2	1.5	2	5.5	2	2	6.5	4.5	3.5	2.5	7	4.5	3	8	5
Hydrocarbon Identification																							
Total Gasoline Range	NWTPH-Gasoline	800	µg/L	NS	**370**	< 100	**26,000**	**190**	**16,000**	< 100	**11,000**	**36,000**	**33,000**	**64,000**	**5,400**	**6,600**	**1,700**	**52,000**	**1,300**	< 100	< 100	**15,000**	< 100
Benzene	NWTPH-Gasoline	5	µg/L	NS	**3.3**	< 1.0	**230**	**2.9**	**170**	**1.1**	**21**	**230**	**14**	**250**	**17**	**51**	< 1.0	**2,600**	**8.9**	< 1.0	< 1.0	**23**	< 1.0
Toluene	NWTPH-Gasoline	1,000	µg/L	NS	< 1.0	< 1.0	**1,100**	< 1.0	**65**	**4.4**	**300**	**2,400**	**230**	**6,200**	**2**	**15**	< 1.0	**6,000**	**1.8**	< 1.0	< 1.0	**74**	< 1.0
Ethylbenzene	NWTPH-Gasoline	700	µg/L	NS	**2.7**	< 1.0	**360**	< 1.0	**400**	< 1.0	**390**	**1,300**	**890**	**1,200**	**310**	**430**	**4**	**1,700**	**43**	< 1.0	< 1.0	**1,400**	< 1.0
m,p-Xylene	NWTPH-Gasoline	1,000	µg/L	NS	**4.5**	< 1.0	**4,000**	**1.7**	**1,400**	**4.4**	**1,200**	**4,800**	**3,400**	**6,500**	**56**	**290**	**26**	**6,200**	**4.7**	< 1.0	< 1.0	**2,400**	< 1.0
o-Xylene	NWTPH-Gasoline	1,000	µg/L	NS	< 1.0	< 1.0	**630**	< 1.0	**34**	**1.2**	**24**	**340**	**1,100**	**2,000**	**3.2**	< 4.0	**1.4**	**490**	**1.7**	< 1.0	< 1.0	**20**	< 1.0
Naphthalene	NWTPH-Gasoline	160	µg/L	NS	< 5.0	< 5.0	**210**	< 5.0	**160**	< 5.0	**130**	**520**	**410**	**700**	**120**	**170**	**63**	**420**	< 5.0	< 5.0	< 5.0	**380**	< 5.0
n-Hexane	NWTPH-Gasoline	480	µg/L	NS	**52**	< 1.0	**160**	**8**	**100**	**1.2**	**140**	**210**	**130**	**85**	**28**	**38**	< 1.0	**350**	**2.8**	< 1.0	< 1.0	**15**	< 1.0
EDB																							
1,2-Dibromoethane (EDB)	EPA 8011	0.01	µg/L	NS	< 0.0096	< 0.0096	**0.010**	< 0.0096	**0.016**	< 0.0095	< 0.0095	**0.16**	**0.029**	**0.29**	< 0.0096	**0.044**	< 0.0095	**2.5**	< 0.0096	< 0.0095	< 0.0096	< 0.0095	< 0.0096

MTCA Method A or B Cleanup Levels for unrestricted land-use. WAC 173-340-900.

Bold indicates a detection above the laboratory practical quantification limit.

NS - Not sampled due to insufficient water.

NA - Not Analyzed

Z = Sample contains early eluting compounds not quantified in the gas range.

U1 = The practical quantitation limit is elevated due to interferences present in the sample.

< U - Analyte undetected at given practical quanititation limit.

Shading indicates detection exceeding MTCA Method A or B Cleanup Levels for Unrestricted Landuse. WAC 173-340-900

TABLE 3-15
Field Quality Assurance / Quality Control Sample Results

Groundwater QA/QC Results

	August 2007 QA/QC Results																	November 2007 QA/QC Results	
Sample Type	Parent	Duplicate	Split	Parent	Split	Parent	Split	Parent	Split	Parent	Split	Parent	Split	Parent	Split	Parent	Duplicate	Split	Parent	Duplicate
Sample Location	**MW-5**	**MW-5**	**MW-5 DUP**	**MW-6**	**MW-6**	**MW-7**	**MW-7**	**MW-9**	**MW-9**	**MW-11**	**MW-11**	**MW-12**	**MW-12**	**MW-13**	**MW-13**	**MW-14**	**MW-14**	**MW-14 DUP**	**MW-18**	**MW-18 DUP**
Sample Date	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	8/16/2007	11/28/2007	11/28/2007
Motor Oil	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	<500	<500
Diesel	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	--	660	690
Gasoline	1,600	270	340	<250	ND	68,000	45,000	34,000	28,000	31,000	26,000	92,000	57,000	92,000	77,000	96,000	56,000	41,000	79,000	100,000
Benzene	7	3.3	5.2	<1.0	ND	500	600	280	350	48	140	710	590	180	330	150	93	160	2,900	3,000
Toluene	5.9	6.9	8	<1.0	ND	3,200	2,800	230	300	1,400	1,700	7,600	6,400	5,600	6,100	6,300	5,600	4,100	7,500	7,500
Ethylbenzene	37	7.1	6.5	<1.0	ND	1,600	1,300	750	740	650	860	1,800	1,700	2,100	2,600	2,100	1,800	1,200	1,600	1,600
Total Xylenes	3.2	4.5	6.6	<2.0	ND	8,690	8,200	3,270	3,900	3,400	4,400	11,000	10,000	12,600	16,000	12,700	12,000	8,500	6,290	6,340

	May 2009 QA/QC Results					March 2010 QA/QC Results		
Sample Type	Parent	Duplicate	Parent	Duplicate	Field Blank	Parent	Duplicate	Equipment Blank
Sample Location	**MW-9**	**MW-9**	**MW-14**	**MW-14**	**MW-7**	**MW-22**	**MW-22**	**MW-5**
Sample Date	5/19/2009	5/19/2009	5/20/2009	5/20/2009	5/21/2009	3/16/2010	3/16/2010	3/19/2010
Gasoline	---	---	---	---	---	15,000	15,000	<100
Benzene	---	---	---	---	---	23	23	<1.0
Toluene	37,000	41,000	98,000	100,000	<100 U	74	72	<1.0
Ethylbenzene	240	240	210	210	<0.25 U	1,400	1,300	<1.0
Total Xylenes	220	210	6,200	6,300	0.53	2,420	2,420	<1.0
Hexane	810	810	2,000	2,100	<0.25 U	15	15	<1.0
Naphthalene	2,910	2,910	10,100	10,300	1.6	380	420	<5.0
EDB	NS	NS	NS	NS	NS	<0.0095	<0.0095	<0.0096

Notes:

All concentrations indicated in µg/L (parts per billion)

-- = Not Analyzed, No Value

ND- Not Detected

Bold - Indicates concentration above regulatory cleanup values

Shading - Indicates split sample collected by ATC at the same time as parent and duplicate sample but was sent to a differ

Duplicate - A second sample collected from the same location at the same time using the same equipment as the parent sample, but labeled as a new sample.

Soil Vapor QA/QC Results

			Sample Type:	Parent	Duplicate
ANALYTE	**Analytical Method**	**UNITS**	**Sample ID:**	GAI-SG-4	GAI-SG-5
			Sample Date:	9/9/2009	9/9/2009
Volatile Petroleum Hydrocarbons					
C5-C6 Aliphatics	Northwest VPH (Mod.)	µg/m^3		180 NJ	250 NJ
C6-C8 Aliphatics	Northwest VPH (Mod.)	µg/m^3		< 60	74 NJ
C8-C10 Aliphatics	Northwest VPH (Mod.)	µg/m^3		370 NJ	450 NJ
C10-C12 Aliphatics	Northwest VPH (Mod.)	µg/m^3		4000 NJUJ	5000 NJUJ
C8-C10 Aromatics	Northwest VPH (Mod.)	µg/m^3		140 NJ	190 NJ
C10-C12 Aromatics	Northwest VPH (Mod.)	µg/m^3		470 NJ	290 NJ
Volatile Compounds					
Benzene	TO-15 SIM	µg/m^3		10	12
Toluene	TO-15 SIM	µg/m^3		29	27
1,2-Dibromoethane (EDB)	EPA 8011	µg/L		< 0.22	< 0.24
Ethylbenzene	TO-15 SIM	µg/m^3		11	11
m,p-Xylene	TO-15 SIM	µg/m^3		32	34
o-Xylene	TO-15 SIM	µg/m^3		12	13
Hexane	TO-15 SIM	µg/m^3		36	42
Naphthalene	TO-15 SIM	µg/m^3		< 3.8	< 4.1
2-Propanol	TO-15 SIM	µg/m^3		47	3.8

Notes:

> **-** indicates a no detection above the laboratory practical quantification limit.

NJ - The identification is based on presumptive evidence; estimated value.

UJ - Non-detected compound associated with low bias in the CCV.

Duplicate - A second sample collected from the same location at the same time using the same equipment as the parent sample, but labeled as a new sample.

TABLE 4-1
Site COCs

Soil		Soil Vapor		Groundwater	
COPC	Maximum Detected Concentration (µg/kg)	COPC	Maximum Detected Concentration (µg/m3)	COPC	Maximum Detected Concentration (µg/L)
Gasoline	3,800,000	At Source		Diesel	7,300
Benzene	2,900	Benzene	21,000	Gasoline	110,000
Toluene	74,000	Ethylbenzene	64,000	Benzene	3,000
Ethylbenzene	35,000	Total Xylene	132,000	Toluene	11,000
Total Xylene	215,000	At Washington Park Cemetery Residence		Ethylbenzene	2,600
		Benzene	16	Total Xylenes	16,000
				Naphthalene	640
				EDB	1.9

TABLE 4-2
Physical and Chemical Properties of COCs

Constituent or Fuel Fraction	Aqueous Solubility (mg/L)	Soil Organic Carbon-Water Partitioning Coefficient	Henry's Law Constant	Persistence
Aliphatics				
EC > 4 - 8 (Gasoline)	NA	NA	NA	Low
EC > 8 - 10 (Gasoline)	NA	NA	NA	Low
EC > 10 - 12 (Diesel)	0.034	2.34E+05	120.0	Medium
EC > 12 - 16 (Diesel)	0.00076	5.37E+06	520.0	Medium
Aromatics				
EC > 4 - 8 (Gasoline)	NA	NA	NA	Low
EC > 8 - 10 (Gasoline)	NA	NA	NA	Low
EC > 10 - 12 (Diesel)	25.0	2.51E+03	0.14	Medium
EC > 12 - 16 (Diesel)	5.8	5.01E+03	0.053	Medium
Volatile Organic Compounds				
Benzene	1750	6.61E+01	2.28E-01	Low
Toluene	526	1.35E+02	2.72E-01	Low
Ethylbenzene	169	6.76E+02	3.23E-01	Low
Xylenes	198	6.92E+02	2.93E-01	Medium
EDB	4320	5.37E+01	2.93E-02	Medium
Naphthalene	31	1.29E+03	1.98E-02	Medium

Sources: Idaho DEQ Risk Evaluation Manual, "Physical-Chemical Properties For Developing IDTLs and RATLs", July 2004.
Washington State Department of Ecology, CLARC Database
N/R = not researched
NA = not available

TABLE 6-1
Identification and Screening of Remediation Technologies
Sea-Tac Development Site

General Response Actions	Options	Process Description	Effectiveness	Implementability	Relative Cost	Retain for Further Consideration	Reasons for Screening Decision
Institutional Controls and Monitoring	Site Access Restrictions	Prevention of access to affected area by fencing and warning signs.	Effective at limiting exposure by warning potential intruders of hazards.	Implementable, but requires negotiations with land owners for off-property activities.	Low	Yes	Necessary during remedial action. Not required after completion of treatment.
	Land Use Restrictions	Controls, including deed restrictions, to limit or prevent activity that would lead to exposure, or damage to remedy, i.e., restrictions on use of site groundwater for drinking water or activities that would damage a cap.	Effective at eliminating risk due to exposure to constituents of concern.				
	Groundwater Use Restrictions						
	Alternate Water Supply	Supply of an alternate source of drinking water in cases where existing or future supply is impacted by site constituents of concern.	Effective at eliminating risk from exposure to constituents of concern in drinking water.	Implementable.	Med	No	Contaminated groundwater not in use.
	Monitoring	Environmental monitoring (i.e., groundwater) to measure the effectiveness of the remedy.	Effective	Implementable.	Med	Yes	Required by MTCA.
Monitored Natural Attenuation	Monitored Natural Attenuation	Allow natural physical and biological processes to gradually remove site contamination.	Proven effective on petroleum hydrocarbons in groundwater where natural conditions are conducive to microbial activity. Typically slow.	Implementable.	Low	Yes	Cost-effective remediation of groundwater plume outside of the Facility.
Containment	Capping	Soil Cover	Effective at preventing direct contact with contaminated soil.	Implementable.	Low	No	Inconsistent with site use; limited reduction in infiltration.
		Asphalt Cap	Effective at preventing direct contact with contaminated soil. Reduces infiltration through contaminated soil into groundwater.	Implementable.	Existing	Yes	Decreases potential risks due to direct contact and groundwater contamination.
		Low-Permeability Soil Cap	Effective at preventing direct contact with contaminated soil. Reduces infiltration through contaminated soil into groundwater.	Implementable.	High	No	Asphalt cap provides sufficient reduction in infiltration and is more consistent with site use.
	Surface Water Controls	Stormwater drainage controls	Effective at minimizing erosion of cap and minimizing infiltration.	Implementable.	Existing	Yes	Ancillary to capping.
	Vertical Barriers for Groundwater Containment	Slurry wall or similar impermeable wall around all contaminated site areas.	Not effective at this site because unable to key into bottom low-permeability layer.	Not implementable due to depth to groundwater and lack of lower confining layer.	High	No	Not effective.
	Hydraulic Containment	Groundwater pumping	Potentially effective	Difficult to implement because of permeable soil (high extraction flows).	Med to High	Yes	Consider as a groundwater treatment option.
Removal	Excavation	Standard excavating equipment such as backhoes, trenchers, and bulldozers.	Ineffective on groundwater	Not practical due to depth to contamination	High	No	In-situ treatment more cost-effective for soil.
	Groundwater pumping	Groundwater pumping	Potentially effective	Difficult to implement because of permeable soil (high extraction flows).	Med to High	Yes	Consider as a groundwater treatment option.
Ex-Situ Treatment - Soil	Various	Varies	Effective	Implementable	High	No	In-situ treatment more cost-effective for soil.
Ex-Situ Treatment - Groundwater	Various	Varies; liquid-phase carbon adsorption assumed for pump-and-treat	Effective	Implementable	Mod to High	Yes	Compare to other retained treatment options for cost-effectiveness.
In-Situ Treatment	In-situ air sparging (IAS)	Inject air into subsurface to strip VOCs from soil and groundwater	Effective	Implementable	Med	Yes	Proven, cost-effective treatment for petroleum hydrocarbons

TABLE 6-1
Identification and Screening of Remediation Technologies
Sea-Tac Development Site

General Response Actions	Options	Process Description	Effectiveness	Implementability	Relative Cost	Retain for Further Consideration	Reasons for Screening Decision
	Soil vapor extraction (SVE)	Extract VOCs in soil vapors under vacuum. Treat offgas before discharge to atmosphere.	Effective	Implementable	Med	Yes	Proven, cost-effective treatment for petroleum hydrocarbons
	In-situ biodegradation	Use natural biological processes to degrade hydrocarbons on soil.	Potentially effective	Implementable	Low	Yes	See Monitored Natural Attenuation. In addition, some enhancement provided by IAS and SVE.
	In-situ chemical oxidation (ISCO)	Inject chemical oxidants (e.g., Fenton's reagent or ozone) to degrade hydrocarbons.	Effective with sufficient chemical oxidant.	Implementable	Med to High	Yes	Proven treatment for petroleum hydrocarbons; treatment completed faster than IAS-SVE.
	In-situ thermal desorption	Heat soil in place electrically to volatilize hydrocarbons. Recover hydrocarbons by LNAPL recovery and soil vapor extraction.	Poor effectiveness at this site. Not practical to get in-situ temperatures high enough to volatilize high-molecular-weight compounds.	Potentially implementable but difficult (large electrical demand)	Very High	No	More costly and potentially less effective than other retained treatment technologies.
Disposal	On-site	On-site landfill	Effective containment	Inconsistent with Site use	Med	No	Inconsistent with Site use
	Off-site	Permitted landfill	Effective containment	Implementable	High	No	Could be appropriate for treatment residuals.

TABLE 8-1
Summary of Cost Estimates for Remediation Alternatives

Alternative		Estimated Costs (millions) [a]		
		Capital	O&M [b]	Total
A	Focused IAS-SVE with Source Area Cap	$1.1	$0.9	$1.9
B1	Focused ISCO with Source Area Cap - Ozone Sparging	$1.0	$0.8	$1.8
B2	Focused ISCO with Source Area Cap - Fenton's Reagent	$1.8	$0.5	$2.3
B	Average ISCO cost	$1.4	$0.6	$2.0
C	Focused Groundwater Pump-and-Treat with Cap and SVE for the Source Area	$0.6	$2.8	$3.4
D	IAS-SVE for Entire Plume with Cap and SVE for the Source Area	$2.3	$1.9	$4.2
E	Groundwater Pump-and-Treat for Entire Plume with Cap and SVE for the Source Area	$1.3	$4.8	$6.1

[a] Costs are for early 2010.

[b] Net present value of both operating and maintenance costs during remedial action and post-remediation maintenance and monitoring.

TABLE 8-2
Estimated Cost for Alternative A: Focused IAS-SVE with Source Area Cap

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Facility					
Asphalt cap				Existing	
Contractor mob/demob				$ 10,000	
IAS wells	20	ea	$ 6,300	$ 126,000	
SVE wells	7	ea	$ 3,300	$ 23,100	Includes SVE well in source area
SVE trenches	620	lf	$ 54	$ 33,480	
Well/riser connection & traffic boxes	39	ea	$ 750	$ 29,250	
Header trenching	1,620	lf	$ 12.00	$ 19,440	
PVC pipe, 6"	300	lf	$ 16.00	$ 4,800	IAS & SVE Headers
PVC pipe, 4"	1,620	lf	$ 10.00	$ 16,200	IAS & SVE Headers
Pipe manifold	1	ea	$ 2,000	$ 2,000	
Fencing around above-ground equipment	200	lf	$ 20	$ 4,000	
Electrical installation				$ 50,000	Including new transformer
IAS blowers and controls		LS		$ 100,000	Installed on skid or trailer
SVE blowers and controls		LS		$ 80,000	Installed on skid or trailer
Carbon vessels for offgas treatment	4	ea	$ 20,000	$ 80,000	Includes carbon
Treatment equipment installation & startup		LS		$ 100,000	
Subtotal				$ 678,000	Rounded
Institutional controls and permits				$ 35,000	
Off-property access cost				$ -	
Engineering				$ 110,000	Design & bid package
Construction oversight				$ 60,000	
Reports				$ 50,000	Monitoring plan, O&M manual, completion report
Contingency			20%	$ 136,000	
TOTAL CAPITAL COSTS				**$ 1,069,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
Treatment operation	5	yr	$ 94,000	$ 430,000	Labor & electrical (carbon replacement not needed)
SVE offgas monitoring	5	yr	$ 11,000	$ 50,000	
Groundwater monitoring	15	yr	$ 18,000	$ 215,000	Includes reporting
Asphalt cap inspection & maintenance	5	yr	$ 5,000	$ 23,000	
Subtotal			$128,000	$ 718,000	
Contingency			20%	$ 144,000	
NET PRESENT VALUE O&M [b]				**$ 862,000**	
TOTAL ALTERNATIVE COST				**$ 1,931,000**	Net present value [b]

[a] Costs are for early 2010, including contractor overhead & profit.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 8-3a
Estimated Cost for Alternative B1: Focused ISCO with Source Area Cap - Ozone Sparging

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Facility					
Asphalt cap				Existing	
Contractor mob/demob				$ 10,000	
Ozone sparge wells	46	ea	$ 5,500	$ 253,000	Including source area
Well & traffic boxes	46	ea	$ 750	$ 34,500	
Header trenching	1,500	lf	$ 12.00	$ 18,000	
Tubing for ozone distribution	1,500	lf	$ 5.00	$ 7,500	
PVC conduit for ozone tubing, 4"	1,500	lf	$ 10.00	$ 15,000	
Fencing around above-ground equipment	80	lf	$ 20	$ 1,600	
Electrical installation				$ 50,000	Including new transformer
Ozone generation units	2	ea	$ 60,000	$ 120,000	
Treatment equipment installation & startup		LS		$ 100,000	
Subtotal				$ 610,000	Rounded
Institutional controls and permits				$ 35,000	
Off-property access cost				$ -	
Engineering and Pilot Test				$ 130,000	Design & bid package
Construction oversight				$ 60,000	
Reports				$ 50,000	Monitoring plan, O&M manual, completion report
Contingency			20%	$ 122,000	
TOTAL CAPITAL COSTS				**$ 1,007,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
Treatment operation	5	yr	$ 69,000	$ 345,000	Labor & electrical
Groundwater monitoring	20	yr	$ 18,000	$ 268,000	Includes reporting
Asphalt cap inspection & maintenance	5	yr	$ 5,000	$ 23,000	
Subtotal			$ 92,000	$ 636,000	
Contingency			20%	$ 127,000	
NET PRESENT VALUE O&M [b]				**$ 763,000**	
TOTAL ALTERNATIVE COST				**$ 1,770,000**	Net present value [b]

[a] Costs are for early 2010, including contractor overhead & profit.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 8-3b
Estimated Cost for Alternative B2: Focused ISCO with Source Area Cap - Fenton's Reagent

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Facility					
Asphalt cap				Existing	
Contractor mob/demob				$ 10,000	
SVE for source area				$ 77,600	
Injection equipment rental & labor	3	inject	$100,000	$ 300,000	Including mob/demob for injection
ISCO injection wells	66	ea	$ 6,300	$ 415,800	
Wellheads in traffic boxes	66	ea	$ 500	$ 33,000	
Chemical cost	216,000	lb	$ 2.00	$ 432,000	
Subtotal				$ 1,268,000	Rounded
Institutional controls and permits				$ 35,000	
Off-property access cost				$ -	
Engineering and Pilot Test				$ 130,000	Design & bid package
Construction oversight				$ 60,000	
Reports				$ 50,000	Monitoring plan, O&M manual, completion report
Contingency			20%	$ 254,000	
TOTAL CAPITAL COSTS				**$ 1,797,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
ISCO treatment operation					Included in capital costs
SVE treatment operation	5	yr	$ 21,000	$ 96,000	Labor & electrical (carbon replacement not needed)
SVE offgas monitoring	5	yr	$ 11,000	$ 50,000	
Groundwater monitoring	20	yr	$ 18,000	$ 268,000	Includes reporting
Asphalt cap inspection & maintenance	5	yr	$ 5,000	$ 23,000	
Subtotal			$ 55,000	$ 437,000	
Contingency			20%	$ 87,000	
NET PRESENT VALUE O&M [b]				**$ 524,000**	
TOTAL ALTERNATIVE COST				**$ 2,321,000**	Net present value [b]

[a] Costs are for early 2010, including contractor overhead & profit.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

Golder Associates

TABLE 8-4
Estimated Cost for Alternative C: Focused Groundwater Pump-and-Treat with Cap and SVE for the Source Area

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Facility					
Asphalt cap				Existing	
Contractor mob/demob				$ 10,000	
SVE for source area				$ 77,600	
Pump-and-Treat					
Groundwater extraction wells & pumps	13	ea	$ 12,000	$ 156,000	
Well/riser connection & traffic boxes	13	ea	$ 750	$ 9,750	
Header trenching	300	lf	$ 12.00	$ 3,600	
PVC pipe, 3"	300	lf	$ 8.00	$ 2,400	Header
Fencing around above-ground equipment	200	lf	$ 20	$ 4,000	
Electrical installation				$ 20,000	
Carbon vessels for groundwater treatment	4	ea	$ 5,000	$ 20,000	Includes carbon
Treatment equipment installation & startup		LS		$ 50,000	
Subtotal				$ 353,000	Rounded
Institutional controls and permits				$ 35,000	
Off-property access cost				$ -	
Engineering				$ 100,000	Design & bid package
Construction oversight				$ 40,000	
Reports				$ 50,000	Monitoring plan, O&M manual, completion report
Contingency			20%	$ 71,000	
TOTAL CAPITAL COSTS				**$ 649,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
Groundwater treatment operation	30	yr	$ 67,000	$ 1,313,000	Labor, electrical, and carbon
POTW discharge costs	30	yr	$ 20,000	$ 392,000	User fees and monitoring
SVE treatment operation	5	yr	$ 21,000	$ 96,000	Labor & electrical (carbon replacement not needed)
SVE offgas monitoring	5	yr	$ 11,000	$ 50,000	
Groundwater monitoring	30	yr	$ 18,000	$ 353,000	Includes reporting
Asphalt cap inspection & maintenance	30	yr	$ 5,000	$ 98,000	
Subtotal			$ 142,000	$ 2,302,000	
Contingency			20%	$ 460,000	
NET PRESENT VALUE O&M [b]				**$ 2,762,000**	
TOTAL ALTERNATIVE COST				**$ 3,411,000**	Net present value [b]

[a] Costs are for early 2010, including contractor overhead & profit.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 8-5

Estimated Cost for Alternative D: IAS-SVE for Entire Plume with Cap and SVE for the Source Area

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Facility				$ 678,000	See Table 8-2
Off-Property					
IAS wells	17	ea	$ 18,000	$ 306,000	
SVE wells	15	ea	$ 10,000	$ 150,000	
Well/riser connection & traffic boxes	32	ea	$ 750	$ 24,000	
Header trenching	800	lf	$ 12.00	$ 9,600	
PVC pipe, 6"	100	lf	$ 16.00	$ 1,600	IAS & SVE Headers
PVC pipe, 4"	800	lf	$ 10.00	$ 8,000	IAS & SVE Headers
Pipe manifold	1	ea	$ 2,000	$ 2,000	
Fencing around above-ground equipment	200	lf	$ 20	$ 4,000	
Electrical installation				$ 50,000	Including new transformer
IAS blowers and controls		LS		$ 100,000	Installed on skid or trailer
SVE blowers and controls		LS		$ 80,000	Installed on skid or trailer
Carbon vessels for offgas treatment	4	ea	$ 20,000	$ 80,000	Includes carbon
Treatment equipment installation & startup		LS		$ 50,000	
Subtotal				$ 1,543,000	Rounded
Institutional controls and permits				$ 35,000	
Off-property access cost				$ 50,000	
Engineering				$ 160,000	Design & bid package
Construction oversight				$ 120,000	
Reports				$ 75,000	Monitoring plan, O&M manual, completion report
Contingency			20%	$ 309,000	
TOTAL CAPITAL COSTS				**$ 2,292,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
Treatment operation - Facility	5	yr	$ 94,000	$ 430,000	Labor & electrical (carbon replacement not needed)
SVE offgas monitoring - Facility	5	yr	$ 11,000	$ 50,000	
Treatment operation - off-property	10	yr	$ 94,000	$ 802,000	Labor & electrical (carbon replacement not needed)
SVE offgas monitoring - off-property	10	yr	$ 11,000	$ 94,000	
Groundwater monitoring	10	yr	$ 18,000	$ 154,000	Includes reporting
Asphalt cap inspection & maintenance	5	yr	$ 5,000	$ 23,000	
Subtotal			$233,000	$ 1,553,000	
Contingency			20%	$ 311,000	
NET PRESENT VALUE O&M [b]				**$ 1,864,000**	
TOTAL ALTERNATIVE COST				**$ 4,156,000**	Net present value [b]

[a] Costs are for early 2010, including contractor overhead & profit.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 8-6
Estimated Cost for Alternative E: Groundwater Pump-and-Treat for Entire Plume with Cap and SVE for the Source Area

Item	Quantity	Units	Unit Cost	Cost [a]	Notes
CAPITAL COSTS					
Facility				$ 353,000	See Table 8-4
Off-Property					
Groundwater extraction wells & pumps	16	ea	$ 20,000	$ 320,000	
Well/riser connection & traffic boxes	16	ea	$ 750	$ 12,000	
Header trenching	400	lf	$ 12.00	$ 4,800	
PVC pipe, 3"	400	lf	$ 10.00	$ 4,000	Header
Fencing around above-ground equipment	200	lf	$ 20	$ 4,000	
Electrical installation				$ 20,000	
Carbon vessels for groundwater treatment	4	ea	$ 5,000	$ 20,000	Includes carbon
Treatment equipment installation & startup		LS		$ 20,000	
Subtotal				$ 758,000	Rounded
Institutional controls and permits				$ 35,000	
Off-property access cost				$ 50,000	
Engineering				$ 160,000	Design & bid package
Construction oversight				$ 80,000	
Reports				$ 50,000	Monitoring plan, O&M manual, completion report
Contingency			20%	$ 152,000	
TOTAL CAPITAL COSTS				**$ 1,285,000**	
Operations, Maintenance, & Monitoring (O&M)					Present value calculation, 3% net interest.
Groundwater treatment operation - Facility	30	yr	$ 67,000	$ 1,313,000	Labor, electrical, and carbon
POTW discharge costs	30	yr	$ 20,000	$ 392,000	User fees and monitoring
Groundwater treatment operation - off-property	30	yr	$ 67,000	$ 1,313,000	
POTW discharge costs	30	yr	$ 20,000	$ 392,000	
SVE treatment operation	5	yr	$ 21,000	$ 96,000	Labor & electrical (carbon replacement not needed)
SVE offgas monitoring	5	yr	$ 11,000	$ 50,000	
Groundwater monitoring	30	yr	$ 18,000	$ 353,000	Includes reporting
Asphalt cap inspection & maintenance	30	yr	$ 5,000	$ 98,000	
Subtotal			$229,000	$ 4,007,000	
Contingency			20%	$ 801,000	
NET PRESENT VALUE O&M [b]				**$ 4,808,000**	
TOTAL ALTERNATIVE COST				**$ 6,093,000**	Net present value [b]

[a] Costs are for early 2010, including contractor overhead & profit.

[b] The sum of capital and operating costs and the net present value of the post-closure care costs.

TABLE 8-7
Summary of the Comparative Evaluation of the Alternatives

Criteria	Criteria Weights	Alternative Scores						
		A	B1	B2	B	C	D	E
		Focused IAS-SVE	Focused ISCO using Ozone	Focused ISCO using Fenton's	Average of B1 & B2	Focused Groundwater Pump-and-Treat	IAS-SVE for Entire Plume	Groundwater Pump-and-Treat for Entire Plume
Overall Protectiveness	20%	7	5	5	5	1	10	3
Long-Term Effectiveness and Reliability	20%	6	4	7	5.5	1	10	3
Restoration Time Frame (years)		15	15	20	17.5	30	10	30
score	20%	8	8	6	7	1	10	1
Short-Term Risk	10%	10	4	3	3.5	8	5	1
Reduction in Toxicity, Mobility, and Volume	10%	6	10	9	9.5	1	7	2
Implementability	20%	9	10	8	9	7	3	1
Net Benefit	100%	7.6	6.8	6.4	6.6	2.9	7.8	1.9
Cost (present value, millions)		$1.9	$1.8	$2.3	$2.0	$3.4	$4.2	$6.1
Benefit : cost (i.e., cost-effectiveness)		3.9	3.8	2.8	3.2	0.9	1.9	0.3

APPENDIX A

ECOLOGICAL RESOURCE DATA

LISTED AND PROPOSED ENDANGERED AND THREATENED SPECIES AND CRITICAL HABITAT; CANDIDATE SPECIES; AND SPECIES OF CONCERN

IN **KING COUNTY**

AS PREPARED BY

THE U.S. FISH AND WILDLIFE SERVICE

WESTERN WASHINGTON FISH AND WILDLIFE OFFICE

(Revised November 1, 2007)

LISTED

Bull trout (Salvelinus confluentus)

Canada lynx (Lynx canadensis)

Gray wolf (Canis lupus)

Grizzly bear (Ursus arctos = U. a. horribilis)

Marbled murrelet (Brachyramphus marmoratus)

Northern spotted owl (Strix occidentalis caurina)

Major concerns that should be addressed in your Biological Assessment of project impacts to listed species include:

1. Level of use of the project area by listed species.

2. Effect of the project on listed species' primary food stocks, prey species, and foraging areas in all areas influenced by the project.

3. Impacts from project activities and implementation (e.g., increased noise levels, increased human activity and/or access, loss or degradation of habitat) that may result in disturbance to listed species and/or their avoidance of the project area.

Castilleja levisecta (golden paintbrush) [historic]

Major concerns that should be addressed in your Biological Assessment of project impacts to listed plant species include:

1. Distribution of taxon in project vicinity.

2. Disturbance (trampling, uprooting, collecting, etc.) of individual plants and loss of habitat.

3. Changes in hydrology where taxon is found.

DESIGNATED

Critical habitat for bull trout

Critical habitat for the marbled murrelet

Critical habitat for the northern spotted owl

PROPOSED

None

CANDIDATE

Oregon spotted frog (Rana pretiosa)

Yellow-billed cuckoo (Coccyzus americanus)

SPECIES OF CONCERN

Bald eagle (Haliaeetus leucocephalus)

Beller's ground beetle (Agonum belleri)

California wolverine (Gulo gulo luteus)

Cascades frog (Rana cascadae)

Hatch's click beetle (Eanus hatchi)

Larch Mountain salamander (Plethodon larselli)

Long-eared myotis (Myotis evotis)

Long-legged myotis (Myotis volans)

Northern goshawk (Accipiter gentilis)

Northern sea otter (Enhydra lutris kenyoni)

Northwestern pond turtle (Emys (= Clemmys) marmorata marmorata)

Olive-sided flycatcher (Contopus cooperi)

Pacific lamprey (Lampetra tridentata)

Pacific Townsend=s big-eared bat (Corynorhinus townsendii townsendii)

Peregrine falcon (Falco peregrinus)

River lamprey (Lampetra ayresi)

Tailed frog (Ascaphus truei)

Valley silverspot (Speyeria zerene bremeri)

Western toad (Bufo boreas)

Aster curtus (white-top aster)

Botrychium pedunculosum (stalked moonwort)

Cimicifuga elata (tall bugbane)

Species of Concern In Washington State

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS	STATE STATUS	MAPPING CRITERIA
Cascade torrent salamander	*Rhyacotriton cascadae*	Amphibian	none	SC	IO
Columbia spotted frog	*Rana luteiventris*	Amphibian	none	SC	IO
Dunn's salamander	*Plethodon dunni*	Amphibian	none	SC	IO
Larch Mountain salamander	*Plethodon larselli*	Amphibian	FCo	SS	IO
Northern leopard frog	*Rana pipiens*	Amphibian	FCo	SE	IO
Oregon spotted frog	*Rana pretiosa*	Amphibian	FC	SE	IO
Rocky Mountain tailed frog	*Ascaphus montanus*	Amphibian	FCo	SC	IO
Van Dyke's salamander	*Plethodon vandykei*	Amphibian	FCo	SC	IO
Western toad	*Bufo boreas*	Amphibian	FCo	SC	IO
Giant Palouse earthworm	*Driloleirus americanus*	Annelid	none	SC	IO
Leschi's millipede	*Leschius mcallisteri*	Arthropod	none	SC	IO
American white pelican	*Pelecanus erythrorhynchos*	Bird	none	SE	B
Bald eagle	*Haliaeetus leucocephalus*	Bird	FCo	SS	B
Black-backed woodpecker	*Picoides arcticus*	Bird	none	SC	B
Brandt's cormorant	*Phalacrocorax penicillatus*	Bird	none	SC	B
Brown pelican	*Pelecanus occidentalis*	Bird	FE	SE	RSC
Burrowing owl	*Athene cunicularia*	Bird	FCo	SC	B
Cassin's auklet	*Ptychoramphus aleuticus*	Bird	FCo	SC	B
Common murre	*Uria aalge*	Bird	none	SC	B
Common loon	*Gavia immer*	Bird	none	SS	B
Ferruginous hawk	*Buteo regalis*	Bird	FCo	ST	B
Flammulated owl	*Otus flammeolus*	Bird	none	SC	B
Golden eagle	*Aquila chrysaetos*	Bird	none	SC	B
Lewis' woodpecker	*Melanerpes lewis*	Bird	none	SC	B
Loggerhead shrike	*Lanius ludovicianus*	Bird	FCo	SC	B
Marbled murrelet	*Brachyramphus marmoratus*	Bird	FT	ST	B
Merlin	*Falco columbarius*	Bird	none	SC	B
Northern goshawk	*Accipiter gentilis*	Bird	FCo	SC	B
Oregon vesper sparrow	*Pooecetes gramineus affinis*	Bird	FCo	SC	B
Peregrine falcon	*Falco peregrinus*	Bird	FCo	SS	B
Pileated woodpecker	*Dryocopus pileatus*	Bird	none	SC	B
Purple martin	*Progne subis*	Bird	none	SC	B
Sage thrasher	*Oreoscoptes montanus*	Bird	none	SC	B
Sage grouse	*Centrocercus urophasianus*	Bird	FC	ST	B
Sage sparrow	*Amphispiza belli*	Bird	none	SC	B
Sandhill crane	*Grus canadensis*	Bird	none	SE	B
Sharp-tailed grouse	*Tympanuchus phasianellus*	Bird	FCo	ST	B
Short-tailed albatross	*Diomedea albatrus*	Bird	FE	SC	none
Slender-billed white-breasted	*Sitta carolinensis aculeata*	Bird	FCo	SC	IO
Snowy plover	*Charadrius alexandrinus*	Bird	FT	SE	B
Spotted owl	*Strix occidentalis*	Bird	FT	SE	IO
Streaked horned lark	*Eremophila alpestris strigata*	Bird	FC	SE	B
Tufted puffin	*Fratercula cirrhata*	Bird	FCo	SC	RLC
Upland sandpiper	*Bartramia longicauda*	Bird	none	SE	B
Vaux's swift	*Chaetura vauxi*	Bird	none	SC	B
Western grebe	*Aechmophorus occidentalis*	Bird	none	SC	B
White-headed woodpecker	*Picoides albolarvatus*	Bird	none	SC	B
Yellow-billed cuckoo	*Coccyzus americanus*	Bird	FC	SC	B
Chinquapin hairstreak	*Habrodais grunus herri*	Butterfly/Mot	none	SC	IO
Great arctic	*Oeneis nevadensis gigas*	Butterfly/Mot	none	SC	IO
Island marble	*Euchloe ausonides*	Butterfly/Mot	FCo	SC	IO
Johnson's hairstreak	*Mitoura johnsoni*	Butterfly/Mot	none	SC	IO
Juniper hairstreak	*Mitoura grynea barryi*	Butterfly/Mot	none	SC	IO
Makah (Queen Charlotte)	*Lycaena mariposa*	Butterfly/Mot	FCo	SC	IO
Mardon skipper	*Polites mardon*	Butterfly/Mot	FC	SE	IO
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	Butterfly/Mot	FT	SE	IO
Puget blue	*Plebejus icarioides*	Butterfly/Mot	none	SC	IO
Sand-verbena moth	*Copablepharon fuscum*	Butterfly/Moth	none	SC	IO
Shepard's parnassian	*Parnassius clodius shepardi*	Butterfly/Moth	none	SC	IO
Silver-bordered fritillary	*Boloria selene atrocostalis*	Butterfly/Moth	none	SC	IO
Taylor's checkerspot	*Euphydryas editha taylori*	Butterfly/Moth	FC	SE	IO
Valley silverspot	*Speyeria zerene bremnerii*	Butterfly/Moth	FCo	SC	IO
Yuma skipper	*Ochlodes yuma*	Butterfly/Moth	none	SC	IO
Black rockfish	*Sebastes melanops*	Fish	none	SC	IO
Bocaccio rockfish	*Sebastes paucispinis*	Fish	none	SC	IO
Brown rockfish	*Sebastes auriculatus*	Fish	FCo	SC	IO
Bull trout	*Salvelinus confluentus*	Fish	FT	SC	none
Canary rockfish	*Sebastes pinniger*	Fish	none	SC	IO
China rockfish	*Sebastes nebulosus*	Fish	none	SC	IO
Chinook salmon (Upper Columbia Sp)	*Oncorhynchus tshawytscha*	Fish	FE	SC	none
Chinook salmon (Snake R. Sp/Su)	*Oncorhynchus tshawytscha*	Fish	FT	SC	none
Chinook salmon (Puget Sound)	*Oncorhynchus tshawytscha*	Fish	FT	SC	none
Chinook salmon (Snake R. Fall)	*Oncorhynchus tshawytscha*	Fish	FT	SC	none
Chinook salmon (Lower Columbia)	*Oncorhynchus tshawytscha*	Fish	FT	SC	none
Chum salmon (Lower Columbia)	*Oncorhynchus keta*	Fish	FT	SC	none
Chum salmon (Hood Canal Su)	*Oncorhynchus keta*	Fish	FT	SC	none
Coastal cutthroat	*Oncorhynchus clarki clarki*	Fish	FCo	none	none
Coho salmon (Puget Sound)	*Oncorhynchus kisutch*	Fish	FCo	none	none
Coho salmon (Lower Columbia/SW WA)	*Oncorhynchus kisutch*	Fish	FT	none	none
Copper rockfish	*Sebastes caurinus*	Fish	FCo	SC	IO
Eulachon	*Thaleichthys pacificus*	Fish	none	SC	RC
Greenstriped rockfish	*Sebastes elongatus*	Fish	none	SC	IO
Lake chub	*Couesius plumbeus*	Fish	none	SC	IO
Leopard dace	*Rhinichthys falcatus*	Fish	none	SC	IO
Margined sculpin	*Cottus marginatus*	Fish	FCo	SS	IO
Mountain sucker	*Catostomus platyrhynchus*	Fish	none	SC	IO
Olympic mudminnow	*Novumbra hubbsi*	Fish	none	SS	IO
Pacific cod	*Gadus macrocephalus*	Fish	FCo	SC	IO
Pacific hake	*Merluccius productus*	Fish	FCo	SC	IO
Pacific herring	*Clupea pallasi*	Fish	FCo	SC	none
Pygmy whitefish	*Prosopium coulteri*	Fish	FCo	SS	IO
Quillback rockfish	*Sebastes maliger*	Fish	FCo	SC	IO
Redstripe rockfish	*Sebastes proriger*	Fish	none	SC	IO
River lamprey	*Lampetra ayresi*	Fish	FCo	SC	IO
Sockeye salmon (Snake R.)	*Oncorhynchus nerka*	Fish	FE	SC	none
Sockeye salmon (Ozette Lake)	*Onchorhynchus nerka*	Fish	FT	SC	none
Steelhead (Puget Sound)	*Oncorhynchus mykiss*	Fish	FT	none	none
Steelhead (Upper Columbia)	*Oncorhynchus mykiss*	Fish	FT	SC	none
Steelhead (Snake River)	*Oncorhynchus mykiss*	Fish	FT	SC	none
Steelhead (Middle Columbia)	*Oncorhynchus mykiss*	Fish	FT	SC	none
Steelhead (Lower Columbia)	*Oncorhynchus mykiss*	Fish	FT	SC	none
Tiger rockfish	*Sebastes nigrocinctus*	Fish	none	SC	IO
Umatilla dace	*Rhinichthys umatilla*	Fish	none	SC	IO
Walleye pollock	*Theragra chalcogramma*	Fish	FCo	SC	IO
Widow rockfish	*Sebastes entomelas*	Fish	none	SC	IO
Yellowtail rockfish	*Sebastes flavidus*	Fish	none	SC	IO
Yelloweye rockfish	*Sebastes ruberrimus*	Fish	none	SC	IO
Black right whale	*Balaena glacialis*	Mammal	FE	SE	IO
Black-tailed jackrabbit	*Lepus californicus*	Mammal	none	SC	IO
Blue whale	*Baleonoptera musculus*	Mammal	FE	SE	IO
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	Mammal	FE	SE	IO
Fin whale	*Baleonoptera physalus*	Mammal	FE	SE	IO
Fisher	*Martes pennanti*	Mammal	FC	SE	IO
Gray wolf	*Canis lupus*	Mammal	FE	SE	IO
Gray whale	*Eschrichtius robustus*	Mammal	none	SS	IO
Gray-tailed vole	*Microtus canicaudus*	Mammal	none	SC	IO
Grizzly bear	*Ursus arctos*	Mammal	FT	SE	IO
Humpback whale	*Megaptera novaeangliae*	Mammal	FE	SE	IO
Keen's myotis	*Myotis keenii*	Mammal	none	SC	B
Killer whale	*Orcinus orca*	Mammal	FE	SE	IO
Lynx	*Lynx canadensis*	Mammal	FT	ST	IO
Mazama (Western) pocket gopher	*Thomomys mazama*	Mammal	FC	ST	IO
Merriam's shrew	*Sorex merriami*	Mammal	none	SC	IO
Olympic marmot	*Marmota olympus*	Mammal	none	SC	IO
Pacific harbor porpoise	*Phocoena phocoena*	Mammal	none	SC	RSC
Preble's shrew	*Sorex preblei*	Mammal	FCo	SC	IO
Pygmy rabbit	*Brachylagus idahoensis*	Mammal	FE	SE	IO
Sea otter	*Enhydra lutris*	Mammal	FCo	SE	B
Sei whale	*Baleonoptera borealis*	Mammal	FE	SE	IO
Sperm whale	*Physeter macrocephalus*	Mammal	FE	SE	IO
Steller sea lion	*Eumetopias jubatus*	Mammal	FT	ST	RSC
Townsend's ground squirrel	*Spermophilus townsendii*	Mammal	FCo	SC	IO
Townsend's big-eared bat	*Corynorhinus townsendii*	Mammal	FCo	SC	B
Washington ground squirrel	*Spermophilus washingtoni*	Mammal	FC	SC	IO
Western gray squirrel	*Sciurus griseus*	Mammal	FCo	ST	IO
White-tailed jackrabbit	*Lepus townsendii*	Mammal	none	SC	IO
Wolverine	*Gulo gulo*	Mammal	FCo	SC	IO
Woodland caribou	*Rangifer tarandus*	Mammal	FE	SE	IO
Blue-gray taildropper	*Prophysaon coeruleum*	Mollusk	none	SC	IO
California floater	*Anodonta californiensis*	Mollusk	FCo	SC	IO
Columbia oregonian	*Cryptomastix hendersoni*	Mollusk	none	SC	IO
Columbia pebblesnail	*Fluminicola columbiana*	Mollusk	FCo	SC	IO
Dalles sideband (snail)	*Monadenia fidelis*	Mollusk	none	SC	none
Giant Columbia River limpet	*Fisherola nuttalli*	Mollusk	none	SC	IO
Newcomb's littorine snail	*Algamorda subrotundata*	Mollusk	FCo	SC	IO
Northern abalone	*Haliotis kamtschatkana*	Mollusk	FCo	SC	IO
Olympia oyster	*Ostrea conchaphila*	Mollusk	none	SC	none
Poplar oregonian	*Cryptomastix populi*	Mollusk	none	SC	IO
Beller's ground beetle	*Agonum belleri*	Other Insect	FCo	SC	IO
Columbia clubtail (dragonfly)	*Gomphus lynnae*	Other Insect	FCo	SC	IO
Columbia River tiger beetle	*Cicindela columbica*	Other Insect	none	SC	IO
Hatch's click beetle	*Eanus hatchi*	Other Insect	FCo	SC	IO
Long-horned leaf beetle	*Donacia idola*	Other Insect	none	SC	IO
Mann's mollusk-eating ground beetle	*Scaphinotus manni*	Other Insect	none	SC	IO
Pacific clubtail	*Gomphus kurilis*	Other Insect	none	SC	IO
California mountain kingsnake	*Lampropeltis zonata*	Reptile	none	SC	IO
Green sea turtle	*Chelonia mydas*	Reptile	FT	ST	IO
Leatherback sea turtle	*Dermochelys coriacea*	Reptile	FE	SE	IO
Loggerhead sea turtle	*Caretta caretta*	Reptile	FT	ST	IO
Sagebrush lizard	*Sceloporus graciosus*	Reptile	FCo	SC	IO
Sharptail snake	*Contia tenuis*	Reptile	FCo	SC	IO
Striped whipsnake	*Masticophis taeniatus*	Reptile	none	SC	IO
Western pond turtle	*Actinemys marmorata*	Reptile	FCo	SE	IO

Source: Washington Department of Fish & Wildlife http://wdfw.wa.gov/wlm/diversty/soc/soc.htm

Status Codes:

FE: Federal Endangered
FT: Federal Threatened
FC: Federal Candidate
FCo: Federal Species of Concern
SE: State Endangered
ST: State Threatened
SC: State Candidate
SS: State Sensitive

Mapping Criteria Codes:

B: Breeding Location (Nest or Den)
CR: Communal Roost
RC,RLC,RSC: Regular (Large or Small) Concentration
RI: Regular Individual
IO: Individual Occurrence

State Condidate Species

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Cascade torrent salamander	*Rhyacotriton cascadae*	Amphibian	none
Columbia spotted frog	*Rana luteiventris*	Amphibian	none
Dunn's salamander	*Plethodon dunni*	Amphibian	none
Rocky Mountain tailed frog	*Ascaphus montanus*	Amphibian	FCo
Van Dyke's salamander	*Plethodon vandykei*	Amphibian	FCo
Western toad	*Bufo boreas*	Amphibian	FCo
Giant Palouse earthworm	*Driloleirus americanus*	Annelid	none
Leschi's millipede	*Leschius mcallisteri*	Arthropod	none
Black-backed woodpecker	*Picoides arcticus*	Bird	none
Brandt's cormorant	*Phalacrocorax penicillatus*	Bird	none
Burrowing owl	*Athene cunicularia*	Bird	FCo
Cassin's auklet	*Ptychoramphus aleuticus*	Bird	FCo
Common murre	*Uria aalge*	Bird	none
Flammulated owl	*Otus flammeolus*	Bird	none
Golden eagle	*Aquila chrysaetos*	Bird	none
Lewis' woodpecker	*Melanerpes lewis*	Bird	none
Loggerhead shrike	*Lanius ludovicianus*	Bird	FCo
Merlin	*Falco columbarius*	Bird	none
Northern goshawk	*Accipiter gentilis*	Bird	FCo
Oregon vesper sparrow	*Pooecetes gramineus*	Bird	FCo
Pileated woodpecker	*Dryocopus pileatus*	Bird	none
Purple martin	*Progne subis*	Bird	none
Sage thrasher	*Oreoscoptes montanus*	Bird	none
Sage sparrow	*Amphispiza belli*	Bird	none
Short-tailed albatross	*Diomedea albatrus*	Bird	FE
Slender-billed white-breasted	*Sitta carolinensis aculeata*	Bird	FCo
Tufted puffin	*Fratercula cirrhata*	Bird	FCo
Vaux's swift	*Chaetura vauxi*	Bird	none
Western grebe	*Aechmophorus*	Bird	none
White-headed woodpecker	*Picoides albolarvatus*	Bird	none
Yellow-billed cuckoo	*Coccyzus americanus*	Bird	FC
Chinquapin hairstreak	*Habrodais grunus herri*	Butterfly/Moth	none
Great arctic	*Oeneis nevadensis gigas*	Butterfly/Moth	none
Island marble	*Euchloe ausonides*	Butterfly/Moth	FCo
Johnson's hairstreak	*Mitoura johnsoni*	Butterfly/Moth	none
Juniper hairstreak	*Mitoura grynea barryi*	Butterfly/Moth	none
Makah (Queen Charlotte)	*Lycaena mariposa*	Butterfly/Moth	FCo
Puget blue	*Plebejus icarioides*	Butterfly/Moth	none
Sand-verbena moth	*Copablepharon fuscum*	Butterfly/Moth	none
Shepard's parnassian	*Parnassius clodius*	Butterfly/Moth	none
Silver-bordered fritillary	*Boloria selene atrocostalis*	Butterfly/Moth	none
Valley silverspot	*Speyeria zerene bremnerii*	Butterfly/Moth	FCo
Yuma skipper	*Ochlodes yuma*	Butterfly/Moth	none
Black rockfish	*Sebastes melanops*	Fish	none
Bocaccio rockfish	*Sebastes paucispinis*	Fish	none
Brown rockfish	*Sebastes auriculatus*	Fish	FCo
Blue-gray taildropper	*Prophysaon coeruleum*	Mollusk	none
California floater	*Anodonta californiensis*	Mollusk	FCo
Columbia oregonian	*Cryptomastix hendersoni*	Mollusk	none
Columbia pebblesnail	*Fluminicola columbiana*	Mollusk	FCo
Dalles sideband (snail)	*Monadenia fidelis*	Mollusk	none
Giant Columbia River limpet	*Fisherola nuttalli*	Mollusk	none
Newcomb's littorine snail	*Algamorda subrotundata*	Mollusk	FCo
Northern abalone	*Haliotis kamtschatkana*	Mollusk	FCo
Olympia oyster	*Ostrea conchaphila*	Mollusk	none
Poplar oregonian	*Cryptomastix populi*	Mollusk	none
Beller's ground beetle	*Agonum belleri*	Other Insect	FCo
Bull trout	*Salvelinus confluentus*	Fish	FT
Canary rockfish	*Sebastes pinniger*	Fish	none
China rockfish	*Sebastes nebulosus*	Fish	none
Chinook salmon (Upper Columbia Sp)	*Oncorhynchus tshawytscha*	Fish	FE
Chinook salmon (Snake R. Sp/Su)	*Oncorhynchus tshawytscha*	Fish	FT
Chinook salmon (Puget Sound)	*Oncorhynchus tshawytscha*	Fish	FT
Chinook salmon (Snake R. Fall)	*Oncorhynchus tshawytscha*	Fish	FT
Chinook salmon (Lower Columbia)	*Oncorhynchus tshawytscha*	Fish	FT
Chum salmon (Lower Columbia)	*Oncorhynchus keta*	Fish	FT
Chum salmon (Hood Canal Su)	*Oncorhynchus keta*	Fish	FT
Copper rockfish	*Sebastes caurinus*	Fish	FCo
Eulachon	*Thaleichthys pacificus*	Fish	none
Greenstriped rockfish	*Sebastes elongatus*	Fish	none
Lake chub	*Couesius plumbeus*	Fish	none
Leopard dace	*Rhinichthys falcatus*	Fish	none
Mountain sucker	*Catostomus platyrhynchus*	Fish	none
Pacific cod	*Gadus macrocephalus*	Fish	FCo
Pacific hake	*Merluccius productus*	Fish	FCo
Pacific herring	*Clupea pallasi*	Fish	FCo
Quillback rockfish	*Sebastes maliger*	Fish	FCo
Redstripe rockfish	*Sebastes proriger*	Fish	none
River lamprey	*Lampetra ayresi*	Fish	FCo
Sockeye salmon (Snake R.)	*Oncorhynchus nerka*	Fish	FE
Sockeye salmon (Ozette Lake)	*Onchorhynchus nerka*	Fish	FT
Steelhead (Upper Columbia)	*Oncorhynchus mykiss*	Fish	FT
Steelhead (Snake River)	*Oncorhynchus mykiss*	Fish	FT
Steelhead (Middle Columbia)	*Oncorhynchus mykiss*	Fish	FT
Steelhead (Lower Columbia)	*Oncorhynchus mykiss*	Fish	FT
Tiger rockfish	*Sebastes nigrocinctus*	Fish	none
Umatilla dace	*Rhinichthys umatilla*	Fish	none
Walleye pollock	*Theragra chalcogramma*	Fish	FCo
Widow rockfish	*Sebastes entomelas*	Fish	none
Yellowtail rockfish	*Sebastes flavidus*	Fish	none
Yelloweye rockfish	*Sebastes ruberrimus*	Fish	none
Black-tailed jackrabbit	*Lepus californicus*	Mammal	none
Gray-tailed vole	*Microtus canicaudus*	Mammal	none
Keen's myotis	*Myotis keenii*	Mammal	none
Merriam's shrew	*Sorex merriami*	Mammal	none
Olympic marmot	*Marmota olympus*	Mammal	none
Pacific harbor porpoise	*Phocoena phocoena*	Mammal	none
Preble's shrew	*Sorex preblei*	Mammal	FCo
Townsend's ground squirrel	*Spermophilus townsendii*	Mammal	FCo
Townsend's big-eared bat	*Corynorhinus townsendii*	Mammal	FCo
Washington ground squirrel	*Spermophilus washingtoni*	Mammal	FC
White-tailed jackrabbit	*Lepus townsendii*	Mammal	none
Wolverine	*Gulo gulo*	Mammal	FCo
Columbia clubtail (dragonfly)	*Gomphus lynnae*	Other	FCo
Columbia River tiger beetle	*Cicindela columbica*	Other	none
Hatch's click beetle	*Eanus hatchi*	Other	FCo
Long-horned leaf beetle	*Donacia idola*	Other	none
Mann's mollusk-eating ground beetle	*Scaphinotus manni*	Other	none
Pacific clubtail	*Gomphus kurilis*	Other	none
California mountain kingsnake	*Lampropeltis zonata*	Reptile	none
Sagebrush lizard	*Sceloporus graciosus*	Reptile	FCo
Sharptail snake	*Contia tenuis*	Reptile	FCo
Striped whipsnake	*Masticophis taeniatus*	Reptile	none

Source: Washington Department of Fish & Wildlife

Status Codes:

FE: Federal Endangered
FT: Federal Threatened
FC: Federal Candidate
FCo: Federal Species of Concern

SE: State Endangered
ST: State Threatened
SC: State Candidate
SS: State Sensitive

State Endangered Species

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Northern leopard frog	*Rana pipiens*	Amphibian	FCo
Oregon spotted frog	*Rana pretiosa*	Amphibian	FC
American white pelican	*Pelecanus erythrorhynchos*	Bird	none
Brown pelican	*Pelecanus occidentalis*	Bird	FE
Sandhill crane	*Grus canadensis*	Bird	none
Snowy plover	*Charadrius alexandrinus*	Bird	FT
Spotted owl	*Strix occidentalis*	Bird	FT
Streaked horned lark	*Eremophila alpestris strigata*	Bird	FC
Upland sandpiper	*Bartramia longicauda*	Bird	none
Mardon skipper	*Polites mardon*	Butterfly/Moth	FC
Oregon silverspot butterfly	*Speyeria zerene hippolyta*	Butterfly/Moth	FT
Taylor's checkerspot	*Euphydryas editha taylori*	Butterfly/Moth	FC
Black right whale	*Balaena glacialis*	Mammal	FE
Blue whale	*Baleonoptera musculus*	Mammal	FE
Columbian white-tailed deer	*Odocoileus virginianus leucurus*	Mammal	FE
Fin whale	*Baleonoptera physalus*	Mammal	FE
Fisher	*Martes pennanti*	Mammal	FC
Gray wolf	*Canis lupus*	Mammal	FE
Grizzly bear	*Ursus arctos*	Mammal	FT
Humpback whale	*Megaptera novaeangliae*	Mammal	FE
Killer whale	*Orcinus orca*	Mammal	FE
Pygmy rabbit	*Brachylagus idahoensis*	Mammal	FE
Sea otter	*Enhydra lutris*	Mammal	FCo
Sei whale	*Baleonoptera borealis*	Mammal	FE
Sperm whale	*Physeter macrocephalus*	Mammal	FE
Woodland caribou	*Rangifer tarandus*	Mammal	FE
Leatherback sea turtle	*Dermochelys coriacea*	Reptile	FE
Western pond turtle	*Actinemys marmorata*	Reptile	FCo

Source: Washington Department of Fish & Wildlife
http://wdfw.wa.gov/wlm/diversty/soc/endanger.htm

Status Codes:

FE: Federal Endangered	SE: State Endangered
FT: Federal Threatened	ST: State Threatened
FC: Federal Candidate	SC: State Candidate
FCo: Federal Species of Concern	SS: State Sensitive

Threatened Species

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Ferruginous hawk	*Buteo regalis*	Bird	FCo
Marbled murrelet	*Brachyramphus marmoratus*	Bird	FT
Sage grouse	*Centrocercus urophasianus*	Bird	FC
Sharp-tailed grouse	*Tympanuchus phasianellus*	Bird	FCo
Lynx	*Lynx canadensis*	Mammal	FT
Mazama (Western) pocket gopher	*Thomomys mazama*	Mammal	FC
Steller sea lion	*Eumetopias jubatus*	Mammal	FT
Western gray squirrel	*Sciurus griseus*	Mammal	FCo
Green sea turtle	*Chelonia mydas*	Reptile	FT
Loggerhead sea turtle	*Caretta caretta*	Reptile	FT

Source: Washington Department of Fish & Wildlife
http://wdfw.wa.gov/wlm/diversty/soc/threaten.htm

Status Codes:

FE: Federal Endangered

FT: Federal Threatened

FC: Federal Candidate

FCo: Federal Species of Concern

SE: State Endangered

ST: State Threatened

SC: State Candidate

SS: State Sensitive

Washington Sensitive Species

COMMON NAME	SCIENTIFIC NAME	ANIMAL TYPE	FEDERAL STATUS
Larch Mountain salamander	*Plethodon larselli*	Amphibian	FCo
Bald eagle	*Haliaeetus leucocephalus*	Bird	FCo
Common loon	*Gavia immer*	Bird	none
Peregrine falcon	*Falco peregrinus*	Bird	FCo
Margined sculpin	*Cottus marginatus*	Fish	FCo
Olympic mudminnow	*Novumbra hubbsi*	Fish	none
Pygmy whitefish	*Prosopium coulteri*	Fish	FCo
Gray whale	*Eschrichtius robustus*	Mammal	none

Source: Washington Department of Fish & Wildlife
http://wdfw.wa.gov/wlm/diversty/soc/sensitiv.htm

Status Codes:

FE: Federal Endangered

FT: Federal Threatened

FC: Federal Candidate

FCo: Federal Species of Concern

SE: State Endangered

ST: State Threatened

SC: State Candidate

SS: State Sensitive

Federally Listed Species in Washington State

STATUS	SPECIES/LISTING NAME
E	Albatross, short-tailed (Phoebastria (=Diomedea) albatrus)
T	Bear, grizzly lower 48 States, except where listed as an experimental population or delisted (Ursus arctos horribilis)
T	Butterfly, Oregon silverspot (Speyeria zerene hippolyta)
E	Caribou, woodland Selkirk Mountain population (Rangifer tarandus caribou)
E	Deer, Columbian white-tailed Columbia River DPS (Odocoileus virginianus leucurus)
T	Lynx, Canada (Contiguous U.S. DPS) (Lynx canadensis)
T	Murrelet, marbled CA, OR, WA (Brachyramphus marmoratus)
T	Owl, northern spotted (Strix occidentalis caurina)
T	Plover, western snowy Pacific coastal pop. (Charadrius alexandrinus nivosus)
E	Rabbit, pygmy Columbia Basin DPS (Brachylagus idahoensis)
T	Salmon, chinook Puget Sound (Oncorhynchus (=Salmo) tshawytscha)
T	Salmon, chinook fall Snake R. (Oncorhynchus (=Salmo) tshawytscha)
T	Salmon, chinook lower Columbia R. (Oncorhynchus (=Salmo) tshawytscha)
E	Salmon, chinook spring upper Columbia R. (Oncorhynchus (=Salmo) tshawytscha)
T	Salmon, chinook spring/summer Snake R. (Oncorhynchus (=Salmo) tshawytscha)
T	Salmon, chum Columbia R. (Oncorhynchus (=Salmo) keta)
T	Salmon, chum summer-run Hood Canal (Oncorhynchus (=Salmo) keta)
T	Salmon, sockeye U.S.A. (Ozette Lake, WA) (Oncorhynchus (=Salmo) nerka)
E	Salmon, sockeye U.S.A. (Snake River, ID stock wherever found.) (Oncorhynchus (=Salmo) nerka)
T	Sea turtle, green except where endangered (Chelonia mydas)
E	Sea turtle, leatherback (Dermochelys coriacea)
T	Sea-lion, Steller eastern pop. (Eumetopias jubatus)
T	Steelhead Puget Sound DPS (Oncorhynchus (=Salmo) mykiss)
T	Steelhead Snake R. Basin (Oncorhynchus (=Salmo) mykiss)
T	Steelhead lower Columbia R. (Oncorhynchus (=Salmo) mykiss)
T	Steelhead upper Columbia R. Basin (Oncorhynchus (=Salmo) mykiss)
T	Steelhead upper Willamette R. (Oncorhynchus (=Salmo) mykiss)
T	Sturgeon, North American green U.S.A. (CA) Southern Distinct Population Segment (Acipenser medirostris)
T	Trout, bull U.S.A., conterminous, lower 48 states (Salvelinus confluentus)
E	Whale, humpback (Megaptera novaeangliae)
E	Whale, killer Southern Resident DPS (Orcinus orca)
E	Wolf, gray Lower 48 States, except where delisted and where EXPN. Mexico. (Canis lupus)

Plants -- 9 listings

STATUS	SPECIES/LISTING NAME
T	Catchfly, Spalding's (Silene spaldingii)
T	Checker-mallow, Nelson's (Sidalcea nelsoniana)
E	Checkermallow, Wenatchee Mountains (Sidalcea oregana var. calva)
E	Desert-parsley, Bradshaw's (Lomatium bradshawii)
T	Howellia, water (Howellia aquatilis)
T	Ladies'-tresses, Ute (Spiranthes diluvialis)
T	Lupine, Kincaid's (Lupinus sulphureus (=oreganus) ssp. kincaidii (=var. kincaidii))
T	Paintbrush, golden (Castilleja levisecta)
E	Stickseed, showy (Hackelia venusta)

Source: U.S. Fish & Wildlife Service
http://ecos.fws.gov/tess_public/pub/stateListingIndividual.jsp?state=WA&status=listed

APPENDIX B

HISTORICAL REPORTS

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

PHASE I ENVIRONMENTAL SITE ASSESSMENT
SUNREALSEATAC AIRPORT SITE
SEATAC, WASHINGTON

Prepared for:

David Schroedl
President
SunReal

Submitted by:

Golder Associates Inc.
Seattle, Washington

William J. Beck
Senior Environmental Scientist

for

Douglas J. Morrell, Ph.D.
Principal

Lisa C. Vaughn
Biologist

October 12, 2000

003-1133.1000
1012lcv1.doc

FIGURES

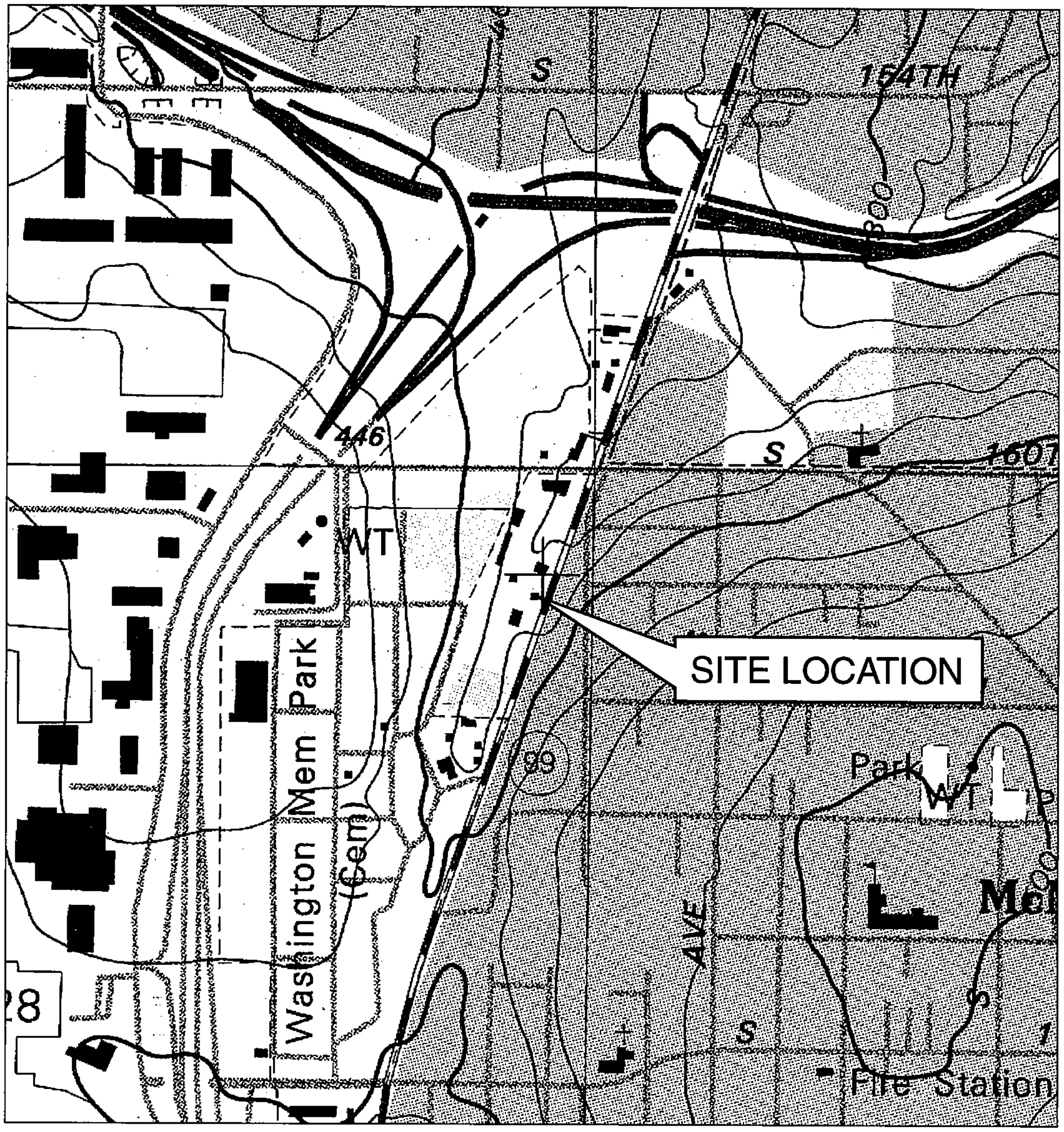


FIGURE 1

SITE VICINITY MAP

SUNREAL/SEATAC GARAGE ESA/WA

PROJECT NO. 003 1133.1000 DRAWING NO. 94540 DATE 9/11/00 DRAWN BY PWF

Golder Associates

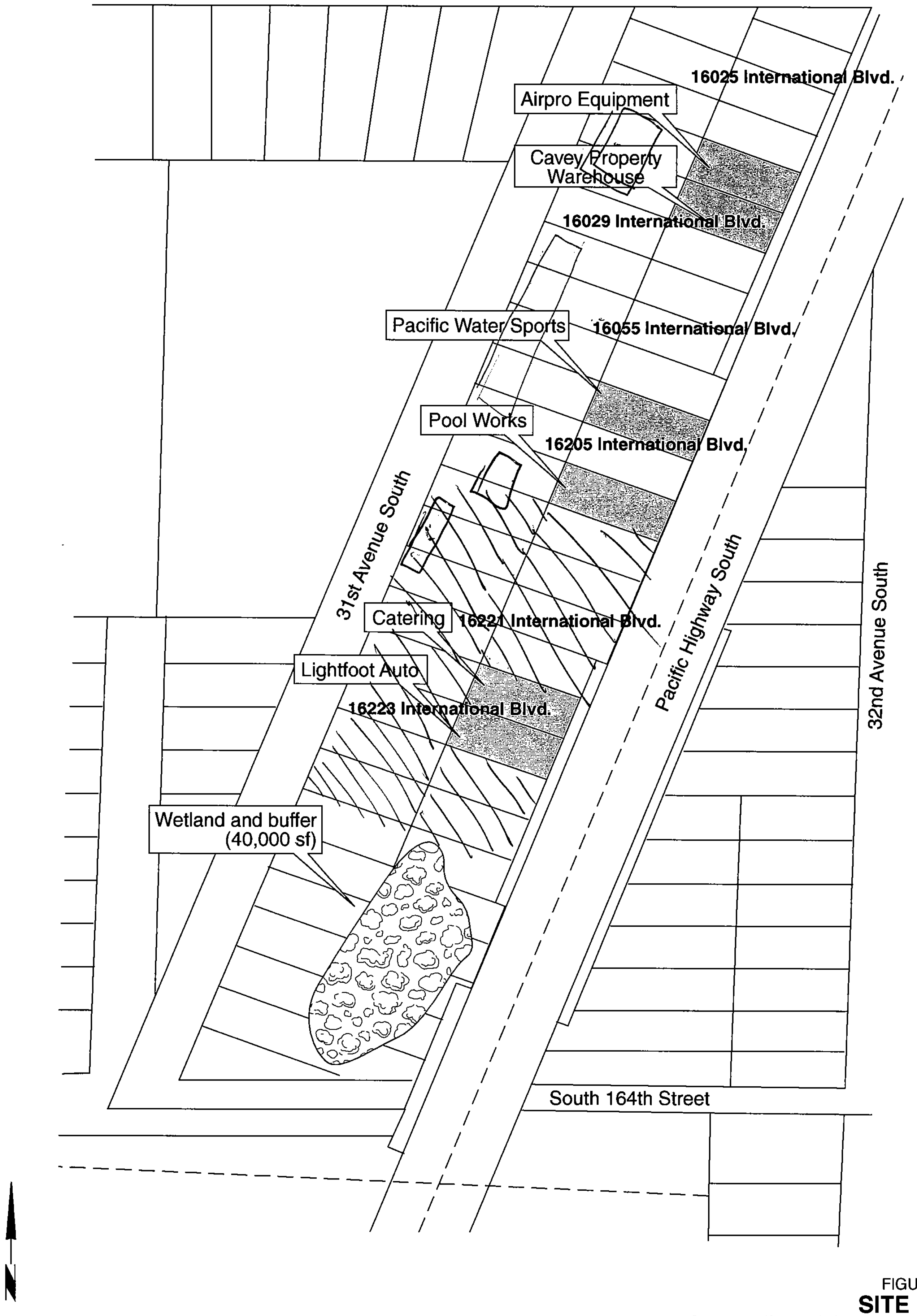


FIGURE **2**

SITE MAP

SUNREAL/SEATAC GARAGE ESA I/WA

PROJECT NO. 003 1133.1000 DRAWING NO. 10630 DATE 8/28/2000 DRAWN BY EA

Golder Associates

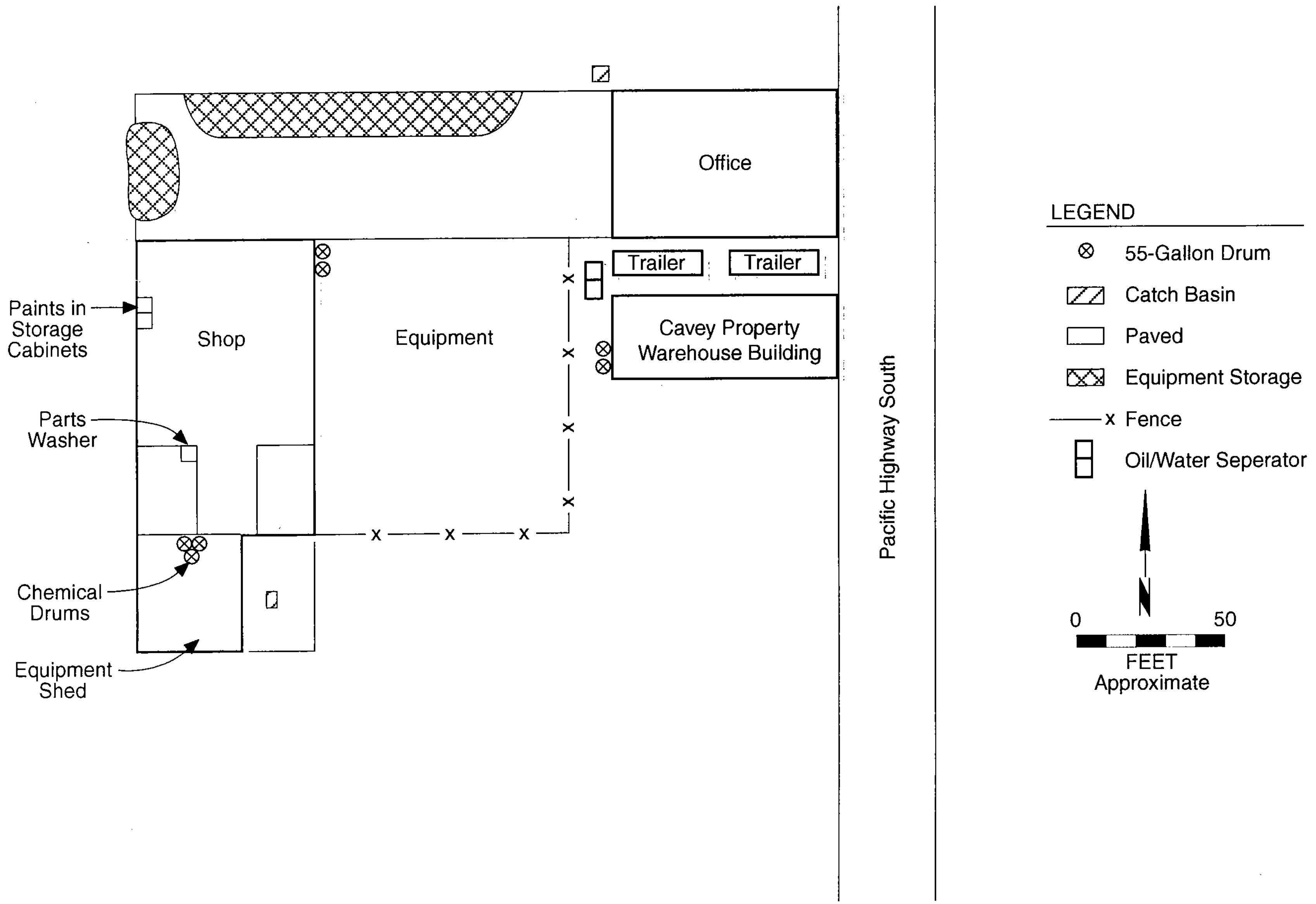


FIGURE **3**

AIRPRO EQUIPMENT &
CAVEY PROPERTY SITE MAP
SUNREAL/SEATAC GARAGE ESA I/WA

PROJECT NO. 003 1133.1000 DRAWING NO. 10634 DATE 10/12/2000 DRAWN BY EA

Golder Associates

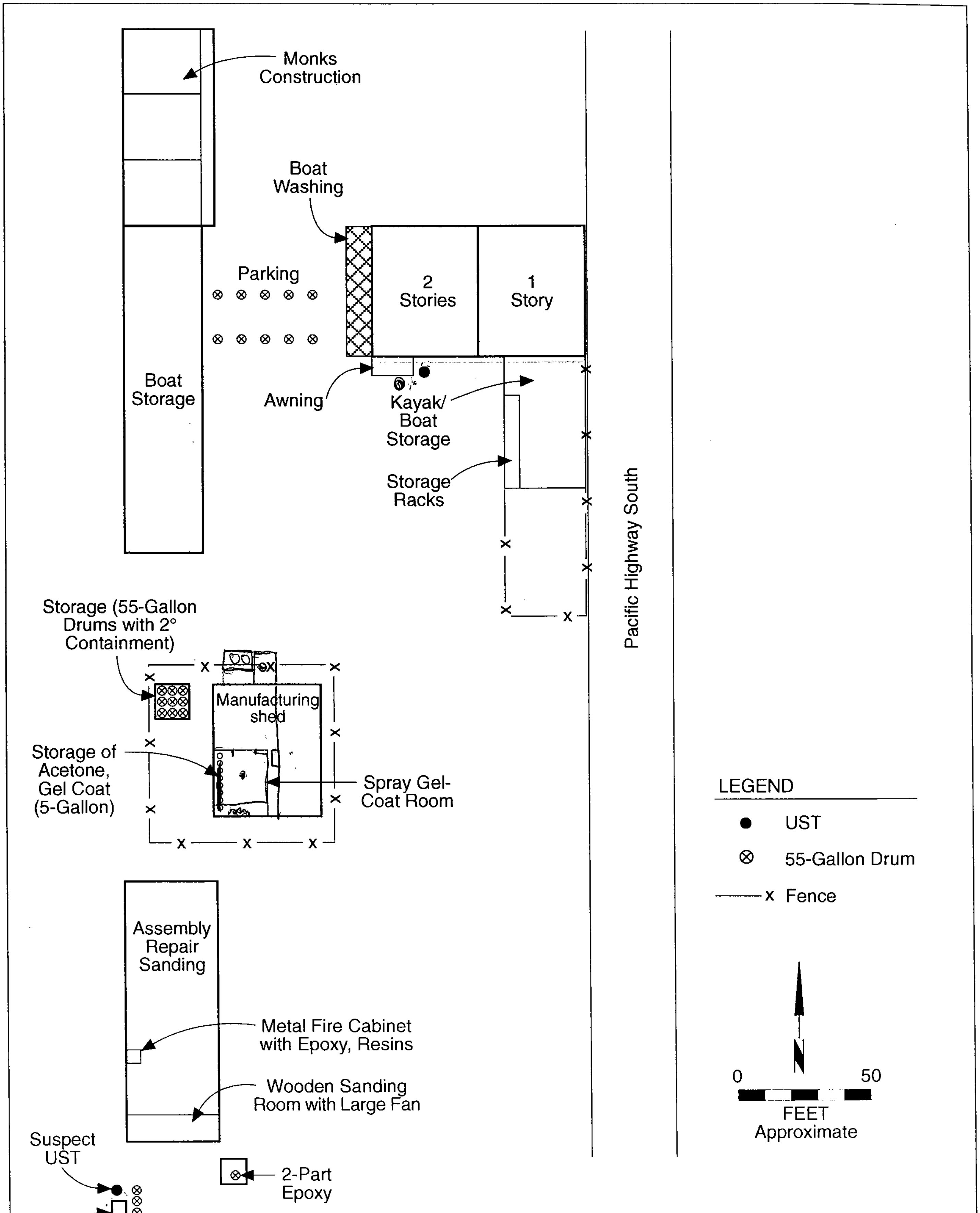


FIGURE **4**

PACIFIC WATER SPORTS SITE MAP

SUNREAL/SEATAC GARAGE ESA I/WA

PROJECT NO. 003 1133.1000 DRAWING NO. 10632 DATE 10/12/2000 DRAWN BY PWF

Golder Associates

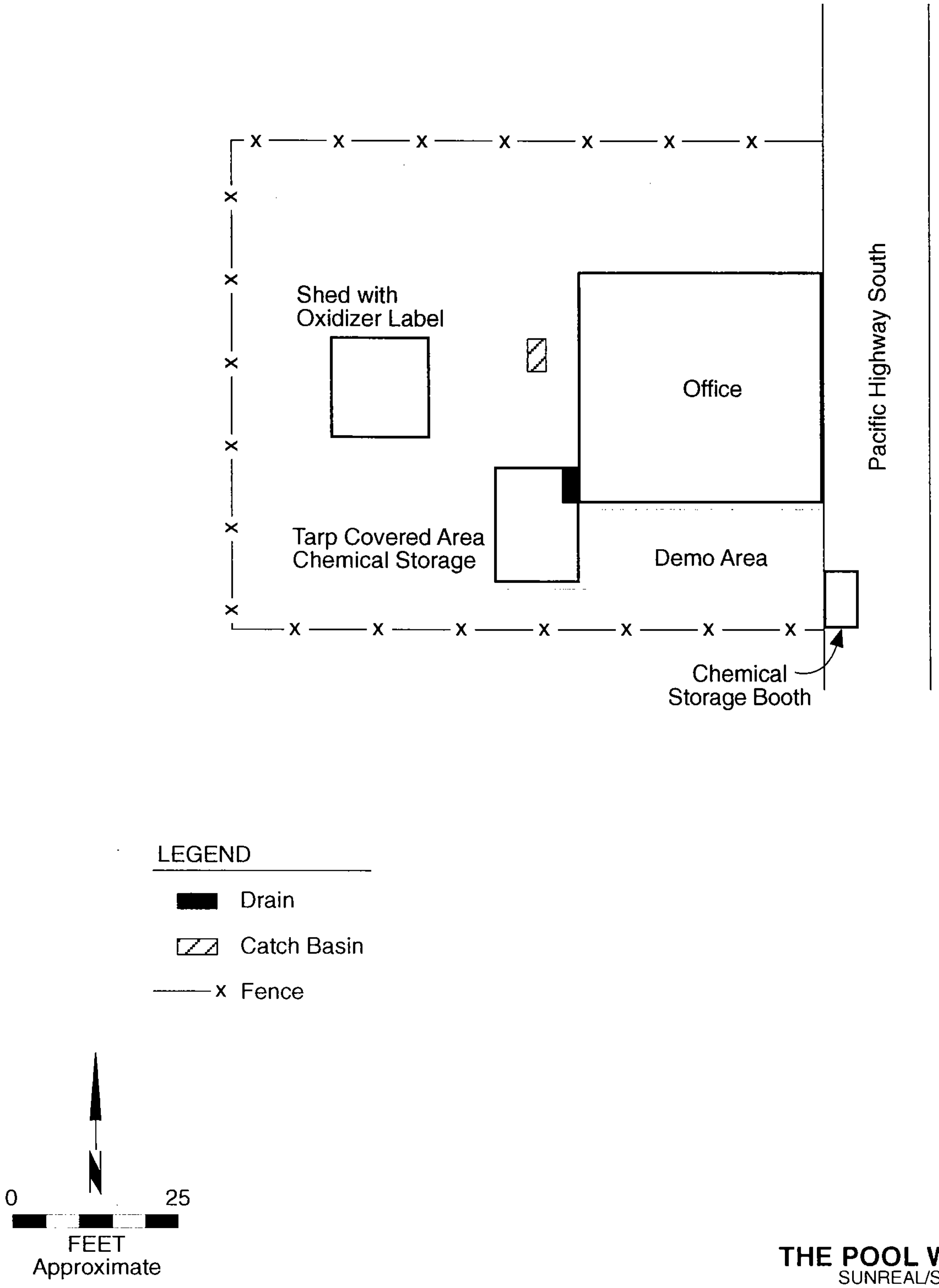


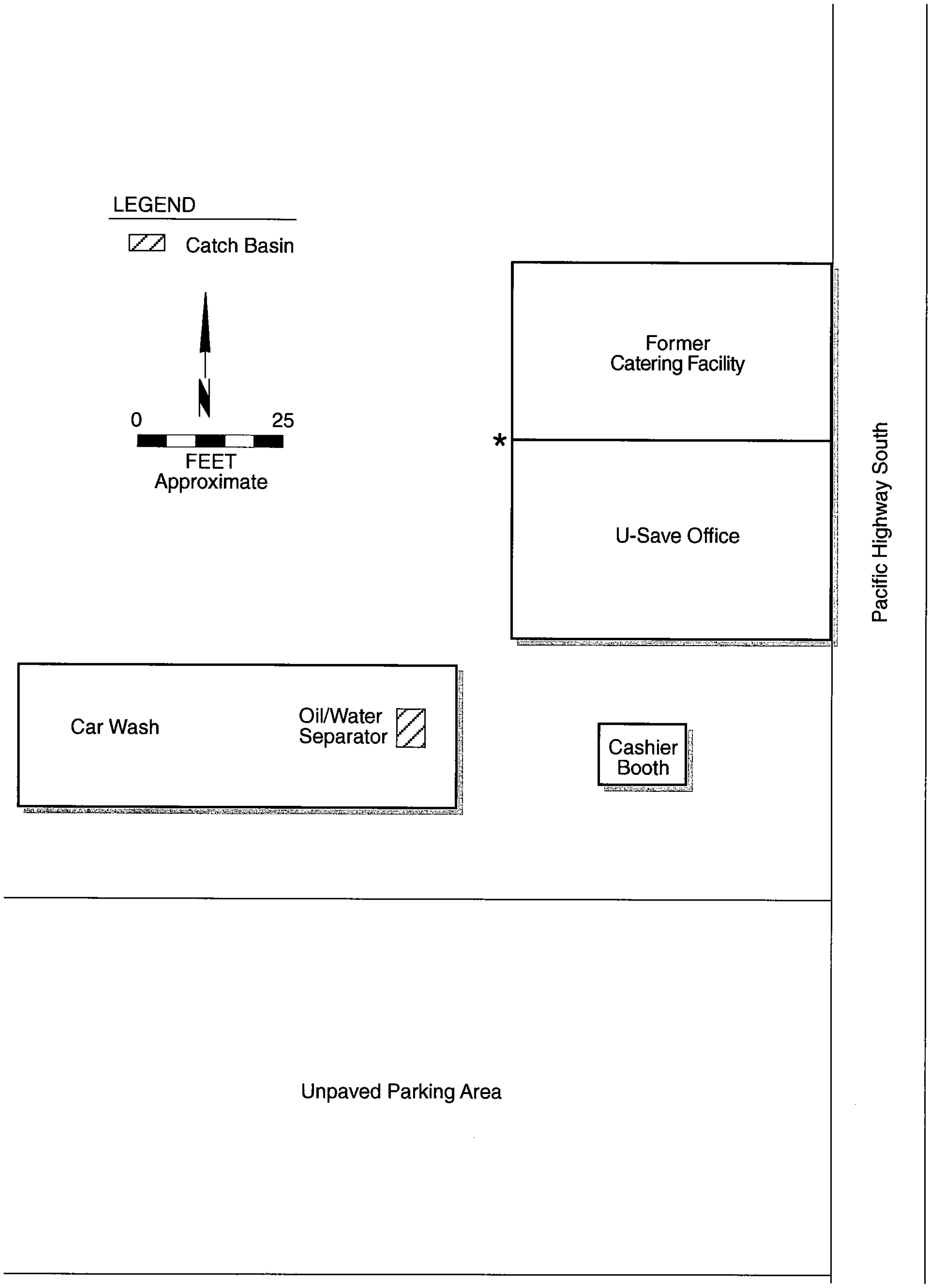
FIGURE 5

THE POOL WORKS SITE MAP

SUNREAL/SEATAC GARAGE ESA I/WA

PROJECT NO. 003 1133.1000 DRAWING NO. 10631 DATE 10/12/2000 DRAWN BY EA

Golder Associates



* Approximate Location

FIGURE **6**

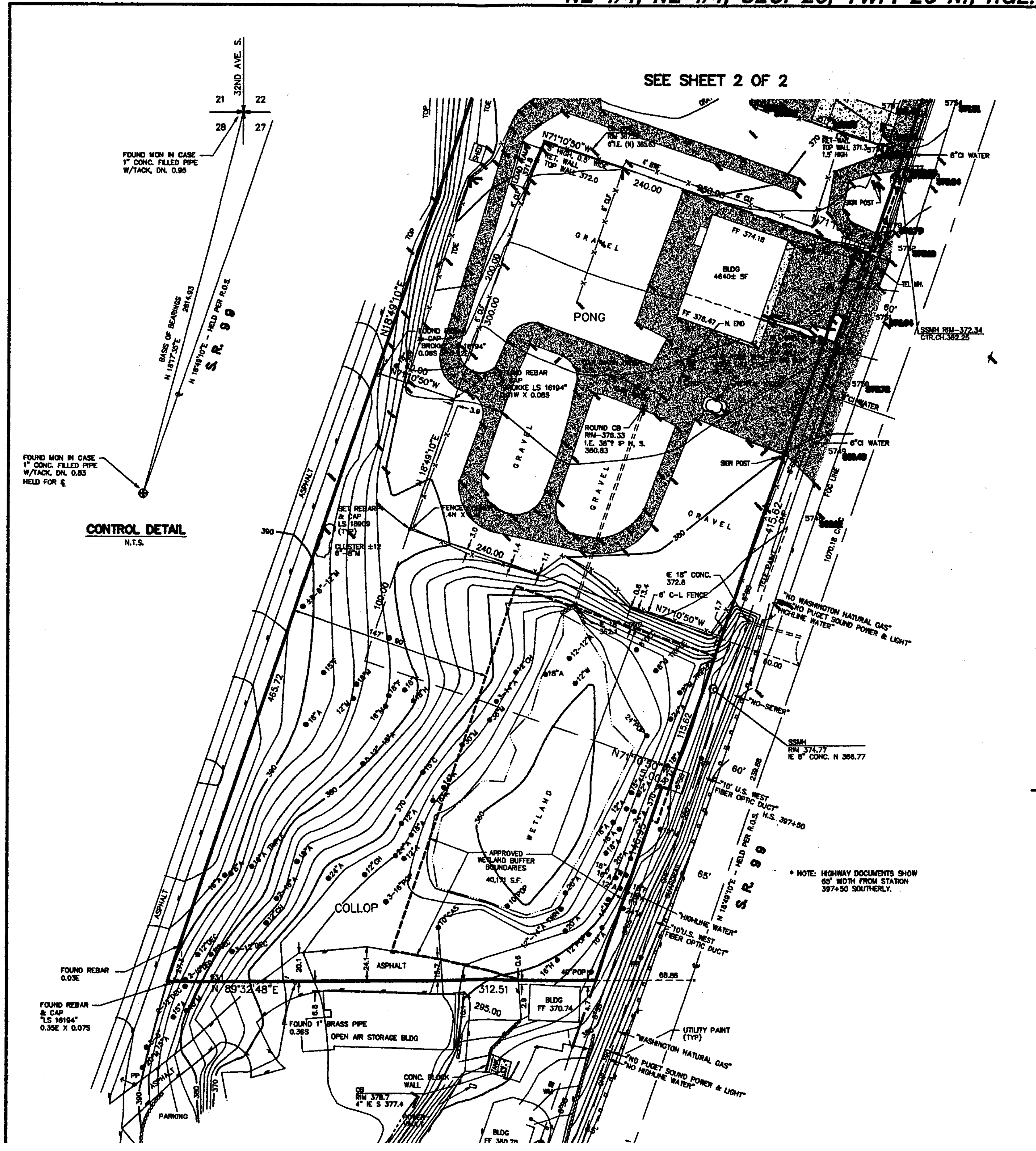
LIGHTFOOT/U-SAVE AUTO & CATERING FACILITY SITE MAP

SUNREAL/SEATAC GARAGE ESA I/WA

PROJECT NO. 003 1133.1000 DRAWING NO. 10633 DATE 10/12/2000 DRAWN BY EA

Golder Associates

NE 1/4, NE 1/4, SEC. 26, TWP. 23 N., RGE. 4 E., W.M.



* NOTE: HIGHWAY DOCUMENTS SHOW 65' WIDTH FROM STATION 397+50 SOUTHERLY.

SCALE: 1" = 80'

0 40 80 160

NOTE

BOUNDARY PER RECORD OF SURVEY BY GARDNER ENGINEERS, INC. FOR ANNY MOHR, RECORDED IN BK. 7 OF SURVEYS, PG. 144 UNDER REC. NO. 7610129007.

VERTICAL DATUM

CITY OF SEATAC - NAVD 88

BENCHMARK

ST-19 CHISELED 'X' ON NORTH END CONC. ISLAND, S.E. CORNER S. 167TH ST. & SR99
ELEV. - 403.65

ST-20 N.E. BOLT ON SIGNAL POLE BASE, N.E. CORNER TRAFFIC ISLAND, S. 160TH ST. & SR99
ELEV. - 352.65

PARCEL AREAS : SCARSELLA = 189,750± SF (4.3561± ACRES)
COLLOP = 99,250± SF (2.2785± ACRES)
PONG = 72,000± SF (1.6529± ACRES)
CAVEY*= 5,750± SF (0.1320± ACRES)

TOTAL SITE AREA = 361,000± SF (8.2875± ACRES)

*(NOT INCLUDED IN TOTAL SITE AREA)

APPROXIMATE PAVED AREAS : SCARSELLA = 17,743± SF (0.4073± ACRES)
COLLOP = 2,872± SF (0.0659± ACRES)
PONG = 23,170± SF (0.5319± ACRES)

TOTAL PAVED AREA = 43,785± SF (1.0051± ACRES)

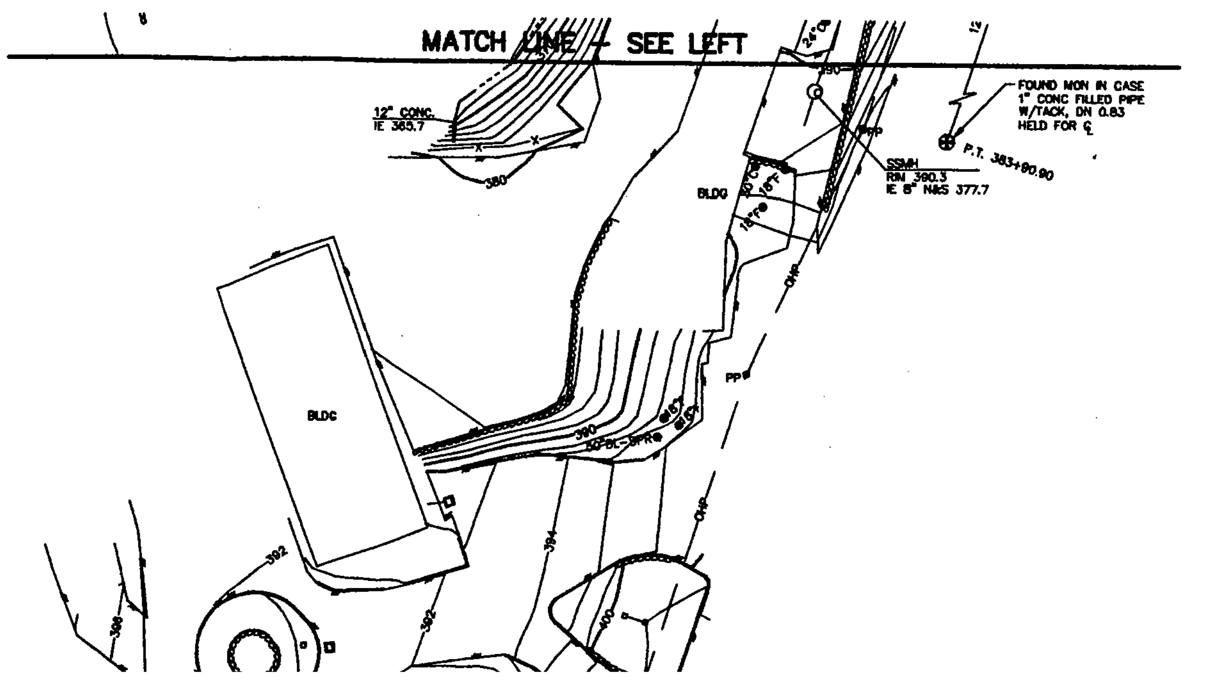
APPROXIMATE BUILDING AREAS : SCARSELLA = 7,978± SF*
PER OWNER
COLLOP = 0
PONG = 10,948± SF

*(DOES NOT INCLUDE SHEDS & OUT-BUILDINGS)

LEGEND

FH	FIRE HYDRANT (FH)	BWF	BARBED WIRE FENCE	IP	IRON PIPE	A	ALDER
WM	WATER METER (WM)	OHP	OVERHEAD POWER	SDMH	STORM DRAIN MANHOLE	CAS	CASCARA
● PP	POWER POLE (PP)	SVC	SERVICE	XFMR	POWER TRANSFORMER	C	CEDAR
PP	POWER POLE W/GUY ANCHOR	UG	UNDERGROUND	■ MTR	METER (GAS)	CH	CHERRY
PP	POWER POLE W/STREET LIGHT	EP	EDGE OF PAVEMENT	PWR	POWER	DEC	DECIDUOUS
	ROCKERY	SSMH	SANITARY SEWER MANHOLE	TEL MH	TELEPHONE MANHOLE	F	FIR
C-L, CLF	CHAIN-LINK FENCE	VLV	VALVE	▨	CONCRETE	H	HEMLOCK
	GUARD RAIL	PNT	PAINT			M	MAPLE
☐■ CB	CATCH BASIN T-1 TYPE 1 T-2 TYPE 2					POP	POPLAR

MATCH LINE - SEE LEFT



BOUNDARY & TOPOGRAPHIC SURVEY
SEATAC PROPERTY

SUN REAL
8273 CAMINITO LOCAYO
LA JOLLA, CA 92037

ER 1999

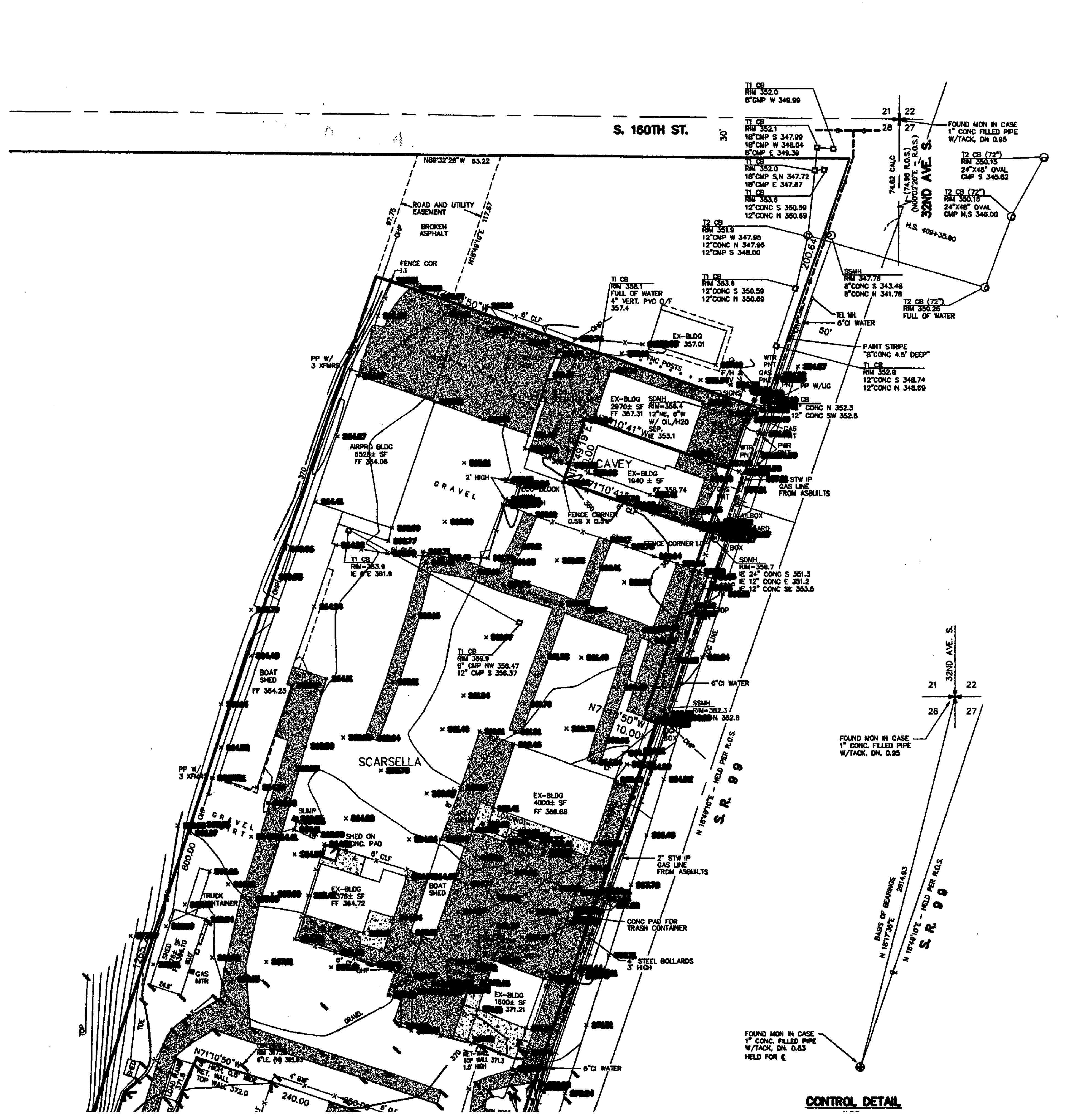
MERRYMAN P.L.S.
CT MANAGER

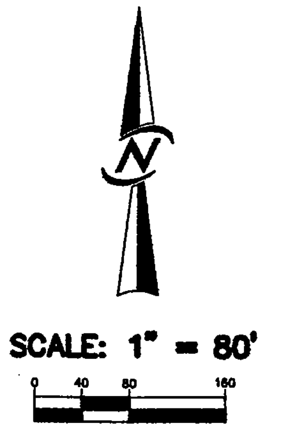
CORE DESIGN
4205 148th Ave. N.E. Suite 200
Bellevue, Washington 98007
425.885.7877 Fax 425.885.7963
ENGINEERING · PLANNING · SURVEYING

STEVEN A. MERRYMAN

NO.	REVISIONS	DATE
1	ADDED TREES	6/28/99
2	ADDED PARCELS TO NORTH	12/20/99
3	ADDED TOPO TO SOUTH	1/31/00
4	ADDED WETLAND BUFFERS	3/28/00
5	ADDED NORTHERLY PARCELS	8/31/00

NE 1/4, NE 1/4, SEC. 26, TWP. 23 N., RGE. 4 E., W.M.





SCALE: 1" = 80'

NOTE

BOUNDARY PER RECORD OF SURVEY BY GARDNER ENGINEERS, INC. FOR ANNY MOHR, RECORDED IN BK. 7 OF SURVEYS, PG. 144 UNDER REC. NO. 7610129007.

VERTICAL DATUM

CITY OF SEATAC – NAVD 88

BENCHMARK

ST-19 CHISELED "X" ON NORTH END CONC. ISLAND, S.E. CORNER S. 167TH ST. & SR99
ELEV. – 403.85

ST-20 N.E. BOLT ON SIGNAL POLE BASE, N.E. CORNER TRAFFIC ISLAND, S. 160TH ST. & SR99
ELEV. – 352.95

PARCEL AREAS : SCARSELLA = 189,750± SF (4.3561± ACRES)
COLLOP = 99,250± SF (2.2785± ACRES)
PONG = 72,000± SF (1.6529± ACRES)
CAVEY*= 5,750± SF (0.1320± ACRES)

TOTAL SITE AREA = 361,000± SF (8.2875± ACRES)

*(NOT INCLUDED IN TOTAL SITE AREA)

LEGAL DESCRIPTION

COLLOP PROPERTY PARCEL I:

THAT PORTION OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 28, TOWNSHIP 23 NORTH, RANGE 4 EAST, W.M., IN KING COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT THE INTERSECTION OF THE SOUTH LINE OF THE NORTH 30 FEET OF SAID SUBDIVISION WITH THE WEST LINE OF STATE ROAD NO. 1, AS CONVEYED TO THE STATE OF WASHINGTON UNDER KING COUNTY RECORDING NO. 1994317, RECORDS OF SAID COUNTY, SAID WEST LINE BEING 50 FEET WESTERLY, AS MEASURED AT RIGHT ANGLE FROM THE CENTERLINE OF SAID STATE ROAD NO. 1; THENCE S18°49'10"W, PARALLEL TO SAID CENTERLINE, 1200 FEET TO THE TRUE POINT OF BEGINNING; THENCE N71°10'50"W 250 FEET; THENCE N18°49'10"E 200 FEET; THENCE N71°10'50"W 60 FEET; THENCE S18°49'10"W 465.72 FEET, MORE OR LESS, TO THE SOUTH LINE OF SAID NORTHEAST QUARTER OF NORTHEAST QUARTER; THENCE N89°32'48"E, ALONG SAID SOUTH LINE, 312.51 FEET TO THE WESTERLY MARGIN OF AFORESAID SOUTH STATE ROAD NO. 1, SAID WESTERLY MARGIN BEING 65 FEET WESTERLY, AS MEASURED AT RIGHT ANGLES, FROM AFORESAID CENTERLINE; THENCE N18°49'10"E ALONG SAID MARGIN 121.23 FEET TO AN ANGLE POINT THEREIN; THENCE S71°10'50"E ALONG SAID MARGIN 15.00 FEET TO AN ANGLE POINT THEREIN; THENCE N18°49'10"E ALONG SAID MARGIN 41.34 FEET TO THE TRUE POINT OF BEGINNING.

COLLOP PROPERTY PARCEL II:

COMMENCING AT THE INTERSECTION OF THE NORTHWESTERLY MARGIN OF STATE HIGHWAY NO. 1, AS ESTABLISHED BY DEED RECORDED UNDER KING COUNTY RECORDING NO. 1994317, WITH A LINE 30.00 FEET SOUTH OF AND PARALLEL WITH THE NORTH LINE OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 28, TOWNSHIP 23 NORTH, RANGE 4 EAST, W.M., IN KING COUNTY, WASHINGTON; AND RUNNING THENCE ALONG THE SAID MARGIN S18°49'10"W 1,100.00 FEET TO THE TRUE POINT OF BEGINNING OF THIS DESCRIPTION; THENCE S18°49'10"W 100.00 FEET; THENCE N71°10'50"W 250.00 FEET; THENCE N18°49'10"E 100.00 FEET; THENCE S71°10'50"E 250.00 FEET TO THE TRUE POINT OF BEGINNING;
EXCEPT THAT PORTION THEREOF CONVEYED TO KING COUNTY BY DEED RECORDED UNDER KING COUNTY RECORDING NO. 2122273.

PONG PROPERTY PARCEL "A-1"

THAT PORTION OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 28, TOWNSHIP 23, RANGE 4 EAST, W.M., IN KING COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

COMMENCING AT INTERSECTION OF SOUTH LINE OF THE NORTH 30 FEET OF SAID SUBDIVISION WITH A LINE 50 FEET WESTERLY OF AND PARALLEL WITH THE CENTERLINE OF STATE ROAD NO. 1 AS CONVEYED TO STATE OF WASHINGTON BY DEED RECORDED UNDER KING COUNTY RECORDING NO. 1994317;
THENCE SOUTH 18°49'10" WEST PARALLEL WITH SAID CENTERLINE 800 FEET TO THE POINT OF BEGINNING;
THENCE SOUTH 18°49'10" WEST 300 FEET;
THENCE NORTH 71°10'50" WEST 250 FEET;
THENCE NORTH 18°49'10" EAST 300 FEET;
THENCE SOUTH 71°10'50" EAST 250 FEET TO TH EPOINT OF BEGINNING;
EXCEPT EASTERLY 10 FEET THEROF CONVEYED TO STATE OF WASHINGTON FOR ROAD PURPOSES BY DEED RECORDED UNDER KING COUNTY RECORDING NO. 2122273;

(BEING KNOW AS ALL OF TRACTS 55 THROUGH 60, INCLUSIVE, AN DWESTERLY 115 FEET OF TRACTS 38 THROUGH 43, INCLUSIVE, WILDON, ACCORDING TO THE UNRECORDED PLAN THEREOF).

SCARSELLA PROPERTY

THAT PORTION OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SECTION 28, TOWNSHIP 23 NORTH, RANGE 4 EAST, W.M., IN KING COUNTY, WASHINGTON, DESCRIBED AS FOLLOWS:

BEGINNING AT THE INTERSECTION OF THE NORTHWESTERLY LINE OF STATE HIGHWAY NO. 1, AS ESTABLISHED BY DEED RECORDED UNDER KING COUNTY RECORDING NO. 1994317, WITH THE SOUTH LINE OF THE NORTH 30 FEET OF SAID NORTHEAST QUARTER; THENCE S18°49'10"W ALONG SAID NORTHWESTERLY LINE 200 FEET TO THE TRUE POINT OF BEGINNING; THENCE N71°10'50"W 310 FEET; THENCE S18°49'10"W 800 FEET; THENCE S71°10'50"E 60 FEET; THENCE N18°49'10"E 200 FEET; THENCE S71°10'50"E 250 FEET TO SAID NORTHWESTERLY LINE; THENCE N18°49'10"E ALONG SAID NORTHWESTERLY LINE 500 FEET; THENCE N71°10'50"W 125 FEET; THENCE N18°49'10"E 50 FEET; THENCE S71°10'50"E 125 FEET; THENCE N18°49'10"E 50 FEET TO THE TRUE POINT OF BEGINNING;

EXCEPT THAT PORTION CONVEYED TO THE STATE OF WASHINGTON FOR ROAD BY DEEDS RECORDED UNDER KING COUNTY RECORDING NO.'S 3695689, 3696686 AND 3706373;

TOGETHER WITH AN EASEMENT FOR ROAD AND UTILITIES PURPOSES OVER A STRIP OF LAND DESCRIBED AS FOLLOWS:

BEGINNING AT THE MOST NORTHERLY CORNER OF THE ABOVE DESCRIBED PROPERTY; THENCE S71°10'50"E ALONG THE NORTHEASTERLY LINE THEREOF 60 FEET; THENCE N18°49'10"E TO THE SOUTHERLY LINE OF THE NORTH 30 FEET OF THE NORTHEAST QUARTER OF THE NORTHEAST QUARTER OF SAID SECTION; THENCE WESTERLY ALONG SAID SOUTHERLY LINE TO THE POINT FROM WHICH THE POINT OF BEGINNING BEARS S18°49'10"W; THENCE S18°49'10"W TO THE POINT OF BEGINNING;

TOGETHER WITH AN EASEMENT FOR INGRESS, EGRESS AND DRIVEWAY PURPOSES AS ESTABLISHED BY SUPERIOR COURT CAUSE NO. 90-2-02038-0;

(BEING KNOW AS LOTS 26, 28 THROUGH 37, INCLUSIVE, AND 61 THROUGH 72, INCLUSIVE, AND THE UNPLATTED 60 FOOT STRIP ADJOINING NORTHWESTERLY OF LOTS 57 THROUGH 72, ALL IN WILDON, ACCORDING TO THE UNRECORDED PLAT THEREOF;

EXCEPT THAT PORTION CONVEYED FOR PSH NO. 1).

CAVEY PROPERTY

BEGINNING AT THE INTERSECTION OF THE WESTERLY MARGIN OF STATE ROAD NO. 1 WITH A LINE 30.00 FEET SOUTHERLY AND PARALLEL TO THE NORTH LINE OF SECTION 26, TOWNSHIP 23 NORTH, RANGE 4 EAST, W.M.; THENCE S18°49'10"W, ALONG SAID WESTERLY MARGIN, 250.00 FEET TO THE TRUE POINT OF BEGINNING; THENCE CONTINUING S18°49'10"W 50.00 FEET; THENCE N71°10'50"W 125.00 FEET; THENCE N18°49'10"E 50.00 FEET; THENCE S71°10'50"E 125.00 FEET TO THE TRUE POINT OF BEGINNING.

LEGEND

FH	FIRE HYDRANT (FH)	BWF	BARBED WIRE FENCE	IP	IRON PIPE	A	ALDER
☐▣ WM	WATER METER (WM)	OHP	OVERHEAD POWER	SDMH	STORM DRAIN MANHOLE	CAS	CASCARA
● PP	POWER POLE (PP)	SVC	SERVICE	XFMR	POWER TRANSFORMER	C	CEDAR
←● PP	POWER POLE W/GUY ANCHOR	UG	UNDERGROUND	■ MTR	METER (GAS)	CH	CHERRY
-◇-● PP	POWER POLE W/STREET LIGHT	EP	EDGE OF PAVEMENT	PWR	POWER	DEC	DECIDUOUS
○○○	ROCKERY	● ○ SSMH	SANITARY SEWER MANHOLE	TEL MH	TELEPHONE MANHOLE	F	FIR
C-L, CLF	CHAIN-LINK FENCE	⋈ VLV	VALVE	▨	CONCRETE	H	HEMLOCK
▫–▫–▫	GUARD RAIL	PNT	PAINT			M	MAPLE
☐■ CB	CATCH BASIN T-1 TYPE 1 T-2 TYPE 2					POP	POPLAR

NO.	REVISIONS	DATE
1	ADDED TREES	6/28/99
2	ADDED PARCELS TO NORTH	12/20/99
3	ADDED TOPO TO SOUTH	1/31/00
4	ADDED WETLAND BUFFERS	3/28/00
5	ADDED NORTHERLY PARCELS	6/31/00

STEVEN A. MERRYMAN

CORE DESIGN
4205 148th Ave. N.E. Suite 200
Bellevue, Washington 98007
425.885.7877 Fax 425.885.7963
ENGINEERING · PLANNING · SURVEYING

BOUNDARY & TOPOGRAPHIC SURVEY
SEATAC PROPERTY

SUN REAL
8273 CAMINITO LOCAYO
LA JOLLA, CA 92037

DECEMBER 1999
ED
L.R.B.
VED
VEN A. MERRYMAN P.L.S.
PROJECT MANAGER

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

FINAL
PHASE II ENVIRONMENTAL SITE ASSESSMENT REPORT
SEATAC PARKING GARAGE DEVELOPMENT SITE
SEATAC, WASHINGTON

Prepared for:

Sea-Tac Investments LLC.
(as the successor to
SunReal Inc.)

Submitted by:

Golder Associates Inc.
Redmond, Washington

April 5, 2001

013-1427.200
0404rhbl1.doc

TABLES

TABLE 1
Field Investigation Sampling Scenario
SeaTac Parking Garage

Sample ID	Depth	Sample Type	Area	Primary Focus	Potential Release/Constituents of Concern	Suite of Analyses
MW1-7.5	7.5 - 9	Deep soil HSA	AirPro repair shop yard	UST, general screening	TPH	TPH
MW1-45	45 - 46	Deep soil HSA	AirPro repair shop yard	UST, general screening	TPH	TPH, BTEX, lead
MW2-12.5	12.5 - 14	Deep soil HSA	PWS retail building	UST	TPH	TPH, BTEX, lead
MW3-2.5	2.5 - 4	Shallow soil HSA	PWS manufactuing building	General screening potential release	Solvents, MEKP, acetone, styrene metals and TPH	TPH, VOAs, metals
MW3-5	4 - 5	Shallow soil HSA	PWS manufactuing building	General screening potential release	Solvents, MEKP, acetone, styrene and TPH	TPH
MW4-10	10 - 10.9	Deep soil HSA	AirPro finishing building	UST	TPH	TPH
GP1-3	9 - 10	Deep soil StratoProbe	AirPro office building	Oil water separator	TPH, solvents, metals	TPH, VOAs, metals,
GP2-2	4 - 5	Shallow soil StratoProbe	AirPro repair shop	Septic drain field	Solvents, MEKP, acetone, styrene, paint, thinners	TPH, VOAs, metals,
GP3-3	6 -7	Deep soil StratoProbe	AirPro repair shop catch basin	Stormwater catch basin	TPH	TPH, VOAs, metals,
GP4-1	0 - 3	Shallow soil StratoProbe	AirPro repair shop yard	Hydraulic equipment repair and leaking equipment	TPH, solvents, chemical compounds, metals, PCBs	TPH, VOAs, metals, PCBs, SVOCs
GP4-2	4 -5	Shallow soil StratoProbe	AirPro repair shop yard	Hydraulic equipment repair and leaking equipment	TPH, solvents, chemical compounds, metals, PCBs	TPH, VOAs, metals,
GP5-2	2 - 3	Shallow soil StratoProbe	PWS manufacturing building and utility trench	General screening potential release	Solvents, MEKP, acetone, styrene, paint, thinners and general TPH	TPH, VOA, metals,
GP5-4	4 - 6	Deep soil StratoProbe	PWS manufacturing building and utility trench	General screening for potential releases	Solvents, MEKP, acetone, styrene, paint, thinners and general TPH	TPH, VOA, metals,
GP6-2	4 - 5	Shallow soil StratoProbe	General parking area utility trench	General screening for potential releases	Non-point source TPH, and metals	TPH , metals
GP7-1	2 - 4	Shallow soil StratoProbe	PWS finishing building	PWS finishing building	Solvents, MEKP, acetone, styrene, paint, thinners and general TPH	TPH, VOA, metals,
GP8-2	3 - 5	Shallow soil StratoProbe	General parking area utility trench	General screening for potential releases	Non-point source TPH, and metals	TPH , metals
GP9-1	1 - 2	Shallow soil StratoProbe	General parking area utility trench	General screening for potential releases	Non-point source TPH, and metals	TPH, VOA, metals,
GP10-4	14	Deep soil StratoProbe	PWS retail building	UST	TPH	TPH , metals
HD1-1	3.5	Shallow soil hand-auger	PWS manufacturing building	PWS manufacturing building	Solvents, MEKP, acetone, styrene, paint, thinners and general TPH	TPH, VOA, metals,
HD2-1	4 -5	Shallow soil hand-auger	Utility trench and stormwater catch basin	General screening for potential releases	General TPH, and metals	TPH and metals
HD2-2	Duplicate HD2-1	Duplicate of HD2-1	Utility trench and stormwater catch basin	General screening for potential releases	General TPH, and metals	TPH and metals
HD3-1	1.5	Shallow soil hand-auger	PWS manufacturing building interior	Screening for improper disposal	Solvents, MEKP, acetone, styrene, paint, thinners and general TPH	TPH, VOAs, metals,
OWS-1	-	Manual grab	Oil/Water separator	General screening for indicators of site releases	Solvents, MEKP, acetone, styrene, paint, thinners,metals, PCBs and general TPH	TPH, VOAs, metals, PCBs, SVOCs
CB-1	-	Manual grab	AirPro Catch Basin	General screening for indicators of site releases	Solvents, MEKP, acetone, styrene, paint, thinners,metals, PCBs and general TPH	TPH, VOAs, metals, PCBs, SVOCs
MW-1	-	Groundwater	AirPro repair shop yard	Groundwater quality	Solvents, paint, thinners, metals and general TPH	TPH, VOAs, metals, PCBs, SVOCs
MW-2	-	Groundwater	PWS retail building	Groundwater quality	TPH	TPH, VOAs, metals,
MW-3	-	Groundwater	PWS manufacturing building	Groundwater quality	Solvents, MEKP, acetone, styrene, paint, thinners, metals and general TPH	TPH, VOAs, metals,
SW-1	-	Surface water	Wetland area	Surface water quality	General chemisty	TPH, VOAs, metals,

TABLE 2

Compounds Detected In Soil Samples

		MONITORING WELL SOIL						STRATOPROBE SOIL												HAND SAMPLING SOIL				REGULATORY CLEANUP LEVELS		
Compounds/Analysis	**Sample ID**	**MW1-7.5**	**MW1-45**	**MW2-12.5**	**MW3-2.5**	**MW3-5**	**MW4-10**	**GP1-3**	**GP2-2**	**GP3-3**	**GP4-1**	**GP4-2**	**GP5-2**	**GP5-4**	**GP6-2**	**GP7-1**	**GP8-2**	**GP9-1**	**GP10-4**	**HD1-1**	**HD2-1**	**HD2-2**	**HD3-1**	MTCA Method A Cleanup Levels (Current)	MTCA Method A Cleanup Levels (Proposed)	MTCA Method B Cleanup Levels
Total Petroleum Hydrocarbons and BTEX	Depth ft bgs/ Units	**7.5 - 9**	**45 - 46**	**12.5 - 14**	**2.5 - 4**	**4 - 5**	**10 - 10.9**	**9- 10**	**5 - 6**	**6 -7**	**0 - 3**	**4 - 5**	**2 - 3**	**4 - 6**	**4 - 5**	**2 - 4**	**3 - 5**	**1 - 2**	**14**	**3.5**	**4 - 5**	**Duplicate**	**1.5**			
TPH-Gas	mg/Kg	<27*	1,900	6,500	<380	-	<27*	<27*	<31*	<27*	7	<32*	54	<29*	<27*	<28*	<27*	<30*	<30*	<28*	<29*	<29*	<30*	100	100	
TPH-Diesel	mg/Kg	<54*	<28	810	15,000	430	<53*	<54*	<63*	<53*	<28	<64*	<31	<58*	<54*	<28*	<55*	<31	<60*	<28	<29	<29	<30	200	2,000	
TPH-Oil	mg/Kg	<110*	<56	<57	6,100	< 57	<110*	<110*	<130*	<110*	3,200	<130*	93	<120*	<110*	310	<110*	93	<120*	130	270	200	290	200	2,000	
Benzene	mg/Kg	-	<0.28	0.63	-	-	-	-	-	-	<0.057	-	<0.061	-	-	-	-	-	-	-	-	-	-	0.5	0.03	
Toluene	mg/Kg	-	1.2	4	-	-	-	-	-	-	<0.057	-	0.61	-	-	-	-	-	-	-	-	-	-	40	7	
Ethylbenzene	mg/Kg	-	3.4	50	-	-	-	-	-	-	<0.057	-	<0.061	-	-	-	-	-	-	-	-	-	-	20	6	
Total Xylenes	mg/Kg	-	14	331	-	-	-	-	-	-	<0.057	-	0.35	-	-	-	-	-	-	-	-	-	-	20	9	
VOCs by 8260B																										
Acetone	mg/Kg	-	-	-	<0.38	-	-	<0.27	<0.31	<0.27	<0.28	<0.32	0.5	<0.29	-	<0.28	-	<0.30	-	0.36	-	-	<0.30			8,000
Ethylbenzene	mg/Kg	-	-	-	0.082	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060	20	6	
Total Xylenes	mg/Kg	-	-	-	0.14	-	-	<0.11	<0.13	<0.11	<0.11	<0.13	<0.12	<0.12	-	<0.11	-	<0.12	-	<0.11	-	-	<0.12	20	9	
Isopropylbenzene	mg/Kg	-	-	-	0.1	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060			
n-Propylbenzene	mg/Kg	-	-	-	0.25	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060			
1,3,5-Trimethylbenzene	mg/Kg	-	-	-	1.4	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060			
1,2,4-Trimethylbenzene	mg/Kg	-	-	-	2.7	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060			
sec-Butylbenzene	mg/Kg	-	-	-	0.21	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060			
p-Isopropyltoluene	mg/Kg	-	-	-	2.2	-	-	<0.054	<0.063	<0.053	0.39	<0.064	1.3	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060			
Naphthalene	mg/Kg	-	-	-	1.7	-	-	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	<0.057	-	-	<0.060	- -	5	3,200
SVOCs by 8270C	mg/Kg	-	-	-	-	-	-	-	ND	-	ND	-	-	-	-	-	-	ND	-	-	-	-	-	- -	- -	- -
PCBs by EPA 8082	mg/Kg	-	-	-	-	-	-	-	<0.063	-	<0.057	-	-	-	-	-	-	ND	-	-	-	-	-	- -	- -	- -
TOTAL METALS 6000/7000 Series																										
Arsenic	mg/Kg	-	-	-	<15	-	-	<11	<13	<11	<11	<13	<12	<12	<11	<11	<11	<12	<12	<11	<12	<12	<12	20	- -	- -
Barium	mg/Kg	-	-	-	150	-	-	41	76	32	100	96	100	52	35	83	71	130	35	49	77	74	62	- -	- -	5,600
Cadmium	mg/Kg	-	-	-	1.6	-	-	<0.54	<0.63	<0.53	0.59	<0.64	<0.61	<0.58	<0.54	<0.56	<0.55	<0.61	<0.60	<0.57	<0.58	<0.58	<0.60	2	- -	- -
Chromium	mg/Kg	-	-	-	50	-	-	16	40	12	24	38	22	26	15	22	21	26	18	15	26	25	18	100	19 VI , 2,000 III	- -
Lead	mg/Kg	-	6.7	<5.7	670	-	-	<0.54	<6.3	<5.3	58	<6.4	18	10	<5.4	7.9	9	29	<6.0	11	19	15	13	250	- -	- -
Mercury	mg/Kg	-	-	-	<0.38	-	-	<0.27	<0.31	<0.27	<0.28	<0.32	<0.30	0.37	<0.27	<0.28	<0.27	<0.30	<0.30	<0.28	<0.29	<0.29	<0.30	1	2	- -
Selenium	mg/Kg	-	-	-	<15	-	-	<11	<13	<11	<11	<13	<12	<12	<11	<11	<11	<12	<12	<11	<12	<12	<12	- -	- -	400
Silver	mg/Kg	-	-	-	<0.77	-	-	<0.54	<0.63	<0.53	<0.57	<0.64	<0.61	<0.58	<0.54	<0.56	<0.55	<0.61	<0.60	<0.57	<0.58	<0.58	<0.60	- -	- -	400

* Analysis based upon NWTPH-HCID
" - " Sample was not analyzed for that compound
ND - Not Detected
"<" - Not detected and the PQL is shown on this table
Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.
Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.
- - indicates there is not a MTCA cleanup level identified under the respective MTCA Method

TABLE 3

Compounds Detected in Groundwater Samples

	Well:	MW-1	MW-2	MW-3	MTCA Method A Cleanup Level (Current)	MTCA Method A Cleanup Level (Proposed)	MTCA Method B Cleanup Levels
Compound	Units						
TPH-Gas	ug/L	71000	14000	<250*	1000 Total TPH	800	- -
TPH-Diesel	ug/L	<250	<250	<630*	1000 Total TPH	500	- -
TPH-Oil	ug/L	<500	<500	<630*	1000 Total TPH	500	- -
VOCs by 8260B							
Chloroform	ug/L	<20	<20	0.8	- -	- -	- -
Benzene	ug/L	2300	<20	<0.20	5	5	- -
Toluene	ug/L	5900	120	<0.20	40	1,000	- -
Ethylbenzene	ug/L	1400	380	<0.20	30	700	- -
m,p-Xylene	ug/L	5200	1600	0.41	20 Total xylenes	1,000	- -
o-Xylene	ug/L	1900	570	<0.20	20 Total xylenes	- -	- -
Isopropylbenzene	ug/L	55	<20	<0.20	- -	- -	- -
n-Propylbenzene	ug/L	140	54	<0.20	- -	- -	- -
1,3,5-Trimethylbenzene	ug/L	520	110	<0.20	- -	- -	- -
1,2,4-Trimethylbenzene	ug/L	1900	420	0.26	- -	- -	- -
sec-Butylbenzene	ug/L	<20	<20	<0.20	- -	- -	- -
p-Isopropyltoluene	ug/L	<20	<20	<0.20	- -	- -	- -
Naphthalene	ug/L	130	<100	<1.0	- -	160	- -
SVOCs by 8270C							
2-Methylphenol	ug/L	0.51	-	-	- -	- -	- -
4-Methylphenol	ug/L	0.96	-	-	- -	- -	- -
2,4-Dimethylphenol	ug/L	0.71	-	-	- -	- -	3,200
Naphthalene	ug/L	160	-	-	- -	- -	- -
2-Methylnaphthalene	ug/L	31	-	-	- -	- -	- -
Acenaphthene	ug/L	0.71	-	-	- -	- -	960
Dibenzofuran	ug/L	0.58	-	-	- -	- -	- -
Fluorene	ug/L	1.7	-	-	- -	- -	640
Diethylphthalate	ug/L	1.2	-	-	- -	- -	12,800
Phenanthrene	ug/L	4.6	-	-	- -	- -	- -
Anthracene	ug/L	2.1	-	-	- -	- -	4,800
Di-n-butylphthalate	ug/L	1.4	-	-	- -	- -	1,600
Fluoranthene	ug/L	0.83	-	-	- -	- -	640
Pyrene	ug/L	0.77	-	-	- -	- -	480
Benzo[a]anthracene*	ug/L	0.075	-	-	- -	- -	0.012
Chrysene*	ug/L	0.073	-	-	- -	- -	0.012
Benzo[b]fluoranthene*	ug/L	0.016	-	-	- -	- -	0.012
Benzo[k]fluoranthene*	ug/L	0.02	-	-	- -	- -	0.012
Benzo[a]pyrene*	ug/L	0.016	-	-	- -	0.1	0.012
Total Carcinogenic PAHs		0.2			0.1		
Total Carcinogenic PAHs (Benzo[a]pyrene equivalent)		0.03				0.1	
PCBs by EPA 8082	ug/L	<0.050	-	<0.050	0.1	0.1	- -
TOTAL METALS							
Arsenic	ug/L	3.4	<3.3	<3.0	5	5	- -
Barium	ug/L	80	<56	<50	- -	- -	1,120
Cadmium	ug/L	<4.0	<4.4	<4.0	5	5	- -
Chromium	ug/L	12	<11	11	50	50	- -
Lead	ug/L	1	<1.1	<1.0	5	15	- -
Mercury	ug/L	<0.50	<0.50	<0.50	2	2	- -
Selenium	ug/L	5.4	<5.6	<5.0	- -	- -	80
Silver	ug/L	<10	<11	<10	- -	- -	80

* Analysis based upon NWTPH-HCID

" - " Sample was not analyzed for that compound "<" - Not detected and the PQL is shown on this table

Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.

Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.

- - indicates there is not a MTCA cleanup level identified under the respective MTCA Method

TABLE 4

Compounds Detected in Sludge Samples

Compound	Sample ID:	OWS-1	CB-1
	Units		
TPH-Gas	mg/Kg	<21	150
TPH-Diesel	mg/Kg	<2600	<2200
TPH-Oil	mg/Kg	57000	73000
Benzene	mg/Kg	<0.21	<0.43
Toluene	mg/Kg	0.31	1.3
Ethylbenzene	mg/Kg	<0.21	2.5
m,p-Xylenes	mg/Kg	0.77	9
o-Xylenes	mg/Kg	0.36	2
VOCs by 8260B			
Acetone	mg/Kg	<0.52	0.83
Toluene	mg/Kg	<0.10	0.88
Ethylbenzene	mg/Kg	0.19	1.9
m,p-Xylene	mg/Kg	0.78	6.9
o-Xylene	mg/Kg	0.37	1.5
1,3,5-Trimethylbenzene	mg/Kg	<0.10	0.19
1,2,4-Trimethylbenzene	mg/Kg	<0.10	0.53
p-Isopropyltoluene	mg/Kg	0.26	<0.086
Naphthalene	mg/Kg	<0.10	16
SVOCs by 8270C			
Naphthalene	mg/Kg	<2.8	76
2-Methylnaphthalene	mg/Kg	1.5	36
Acenaphthylene	mg/Kg	<2.8	320
Acenaphthene	mg/Kg	<2.8	13
Dibenzofuran	mg/Kg	<2.8	79
Fluorene	mg/Kg	<2.8	110
Phenanthrene	mg/Kg	2.6	760
Anthracene	mg/Kg	<2.8	150
Fluoranthene	mg/Kg	1.5	490
Pyrene	mg/Kg	2.6	560
Butylbenzylphthalate	mg/Kg	6.6	15
Benzo[a]anthracene*	mg/Kg	<2.8	130
Chrysene*	mg/Kg	1.6	140
bis(2-Ethylhexyl)phthalate	mg/Kg	120	130
Di-n-octylphthalate	mg/Kg	11	8.5
Benzo[b]fluoranthene*	mg/Kg	<2.8	84
Benzo[k]fluoranthene*	mg/Kg	<2.8	150
Benzo[a]pyrene*	mg/Kg	<2.8	140
Indeno[1,2,3-cd]pyrene*	mg/Kg	<2.8	110
Dibenz[a,h]anthracene*	mg/Kg	<2.8	18
Benzo[g,h,i]perylene	mg/Kg	<2.8	150
Total cPAHs	mg/Kg	1.6	772
PCBs by EPA 8082			
Aroclor 1254	mg/Kg	0.12	0.25
Aroclor 1260	mg/Kg	<0.10	0.32

Compounds Detected in Sludge Samples

Compound	Sample ID: Units	OWS-1	CB-1
TOTAL METALS			
Arsenic	mg/Kg	<14	<17
Barium	mg/Kg	340	440
Cadmium	mg/Kg	14	18
Chromium	mg/Kg	74	65
Lead	mg/Kg	330	250
Mercury	mg/Kg	<0.52	<0.43
Selenium	mg/Kg	<21	<17
Silver	mg/Kg	<1	<0.86

ND - Not Detected
"<" - Not detected and the PQL is shown on this table
* compound is a carcinogenic PAH

FIGURES

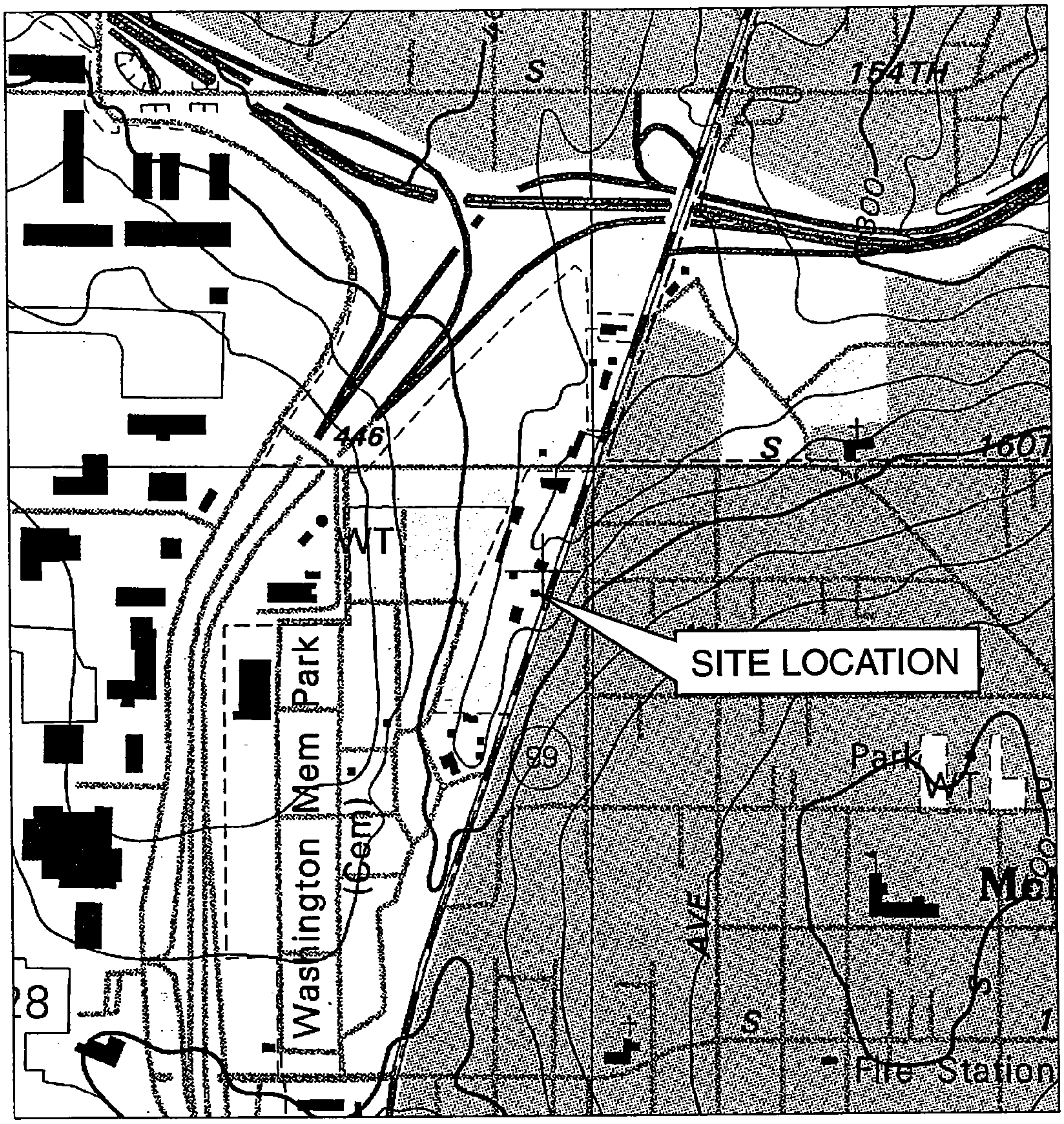


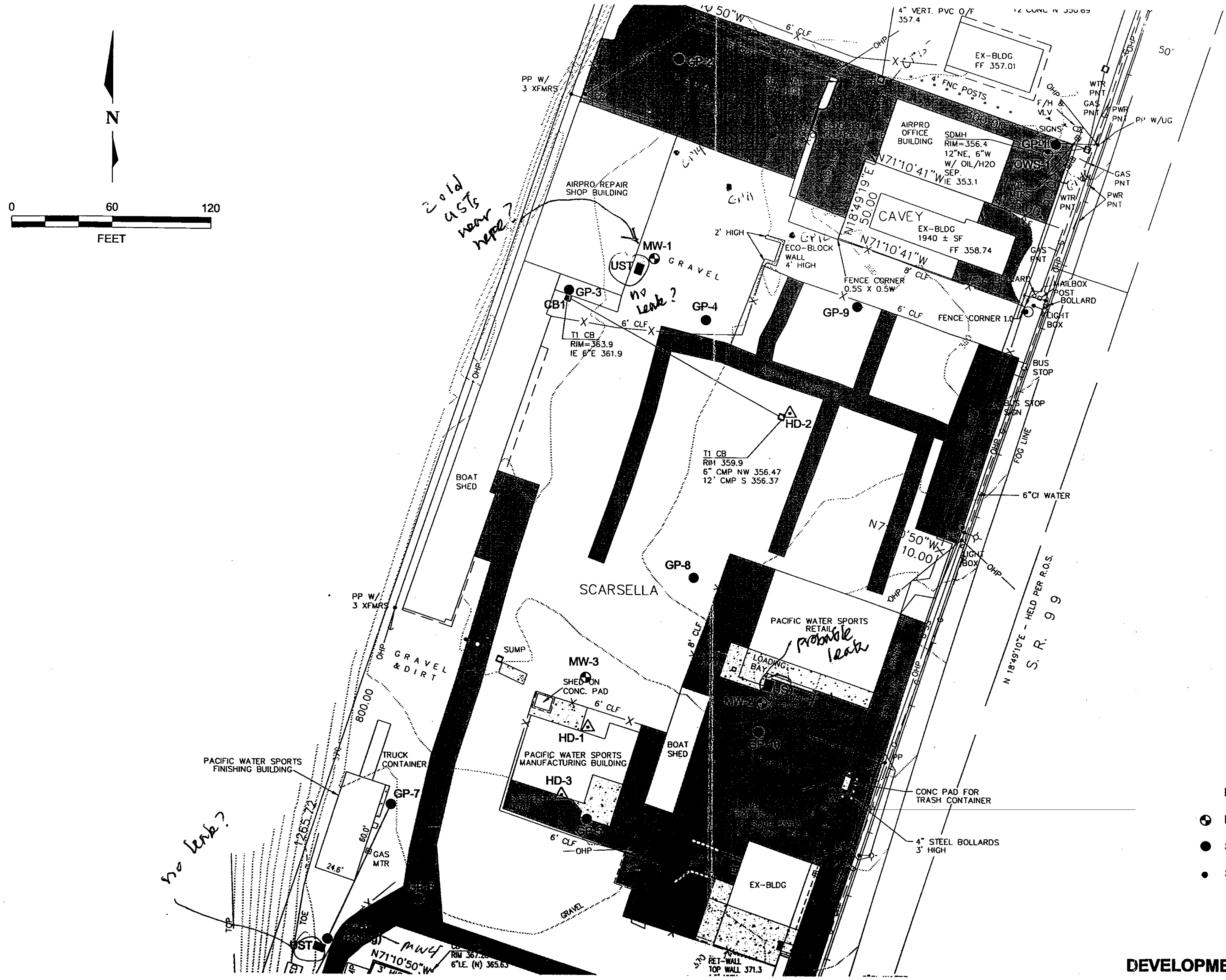
FIGURE **1**

SITE VICINITY MAP

SUNREAL/SEATAC GARAGE ESA/WA

PROJECT NO. 003 1321.600 DRAWING NO. 94540 DATE 12/8/00 DRAWN BY PWF

Golder Associates



LEGEND

- ⊕ MONITORING WELL
- ● SOIL SAMPLE LOCATION
- • SLUDGE SAMPLE LOCATION

FIGURE **2**

SEATAC PARKING GARAGE
DEVELOPMENT SITE SAMPLING LOCATIONS
SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

flemos|K:\Projects\2000\0031321\600\93433.dwg|12-8-0 14:05|xx-xbase,x-htch|t:-

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

FINAL REPORT FOR EXTENDED PHASE II ENVIRONMENTAL SITE ASSESSMENT SEATAC PARKING GARAGE DEVELOPMENT SITE SEATAC, WASHINGTON

Prepared for:

Sea-Tac Investments LLC.
(as the successor to
SunReal Inc.)

Submitted by:

Golder Associates Inc.
Redmond, Washington

April 5, 2001

013-1427.200
0405rhbl3.doc

TABLES

TABLE 1

Soil Sample Analyltical Results
Extended Phase II Investigation

COMPOUNDS/ANALYSIS	SAMPLE ID	STRATOPROBE SOIL								REGULATORY CLEANUP LEVELS	
		GP11-4-14	GP11-7-21	GP12-2-7	GP12-4-14	GP13-4-12	GP14-4-14	GP15-6-16	GP16-6-18	MTCA Method A Cleanup Levels (Current)	MTCA Method A Cleanup Levels (Proposed)
Total Petroleum Hydrocarbons and BTEX	**Depth ft bgs/Units**	**14-15.5**	**21-23**	**7-8**	**14-16**	**12-12.8**	**14-16**	**16-18**	**18-20**		
Mineral Spirits	mg/Kg	**<5**	**<5**	**<5**	**<5**	**<5**	**<5**	**<5**	**<5**		
TPH-Gas	mg/Kg	▨ 440	▨ 320	**<5**	**<5**	**<5**	**<5**	**<5**	**<5**	100	100
Kerosene/Jet Fuel	mg/Kg	<20	<20	<20	<20	<20	<20	<20	<20		
TPH-Diesel	mg/Kg	<20	<20	<20	<20	<20	<20	<20	<20	200	2,000
TPH-Oil	mg/Kg	<50	<50	<50	<50	<50	<50	<50	<50	200	2,000
Benzene	mg/Kg	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	0.5	0.03
Toluene	mg/Kg	<0.050	0.27	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	40	7
Ethylbenzene	mg/Kg	0.56	1.2	<0.050	<0.050	<0.050	<0.050	<0.050	<0.050	20	6
Total Xylenes	mg/Kg	3.2	▨ 9.5	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	**<0.050**	20	9
PAHs by 810070C											
Naphthalene*	mg/Kg	0.87	-	-	-	-	-	-	-	- -	5
TOTAL METALS 6000/7000 Series											
Lead	mg/Kg	<5	-	-	-	-	-	-	-	250	- -

"*" = Indicates that no other PAHs were detected above their respective MDL.
"-" = Sample was not analyzed for that compound.
"<" = Not detected and the PQL is shown on this table.
Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.
Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.
"- -" = indicates there is not a MTCA cleanup level identified under the respective MTCA Method.

TABLE 2

Groundwater Sample Analytical Results
Extended Phase II Investigation

Compound	Units	Well GP12-GW	MTCA Method A Cleanup Level (Current)	MTCA Method A Cleanup Level (Proposed)	MTCA Method B Cleanup Levels
ORGANICS					
Mineral Spirits	µg/L	<100	1000 Total TPH		
Gasoline Range	µg/L	<100	1000 Total TPH	800	- -
Diesel Range	µg/L	21,000	1000 Total TPH	500	- -
Kerosene/Jet Fuel	µg/L	<200	1000 Total TPH		- -
Heavy Oil	µg/L	<500	1000 Total TPH	500	- -
Benzene	µg/L	<1	5	5	- -
Toluene	µg/L	<1	40	1000	- -
Ethylbenzene	µg/L	<1	30	700	- -
Total Xylene	µg/L	2.5	20	1000	- -
TOTAL METALS					
Arsenic	µg/L	1.5	5	5	- -
Barium	µg/L	16	- -	- -	1,120
Cadmium	µg/L	<0.5	5	5	- -
Chromium	µg/L	<10	50	50	- -
Lead	µg/L	<0.5	5	15	- -
Mercury	µg/L	<0.20	2	2	- -
Selenium	µg/L	<50	- -	- -	80
Silver	µg/L	<10	- -	- -	80

"*" = Analysis based upon NWTPH-HCID.

"-" Sample was not analyzed for that compound.

Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.

Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.

"- -" = indicates there is not a MTCA cleanup level identified under the respective MTCA Method.

FIGURES

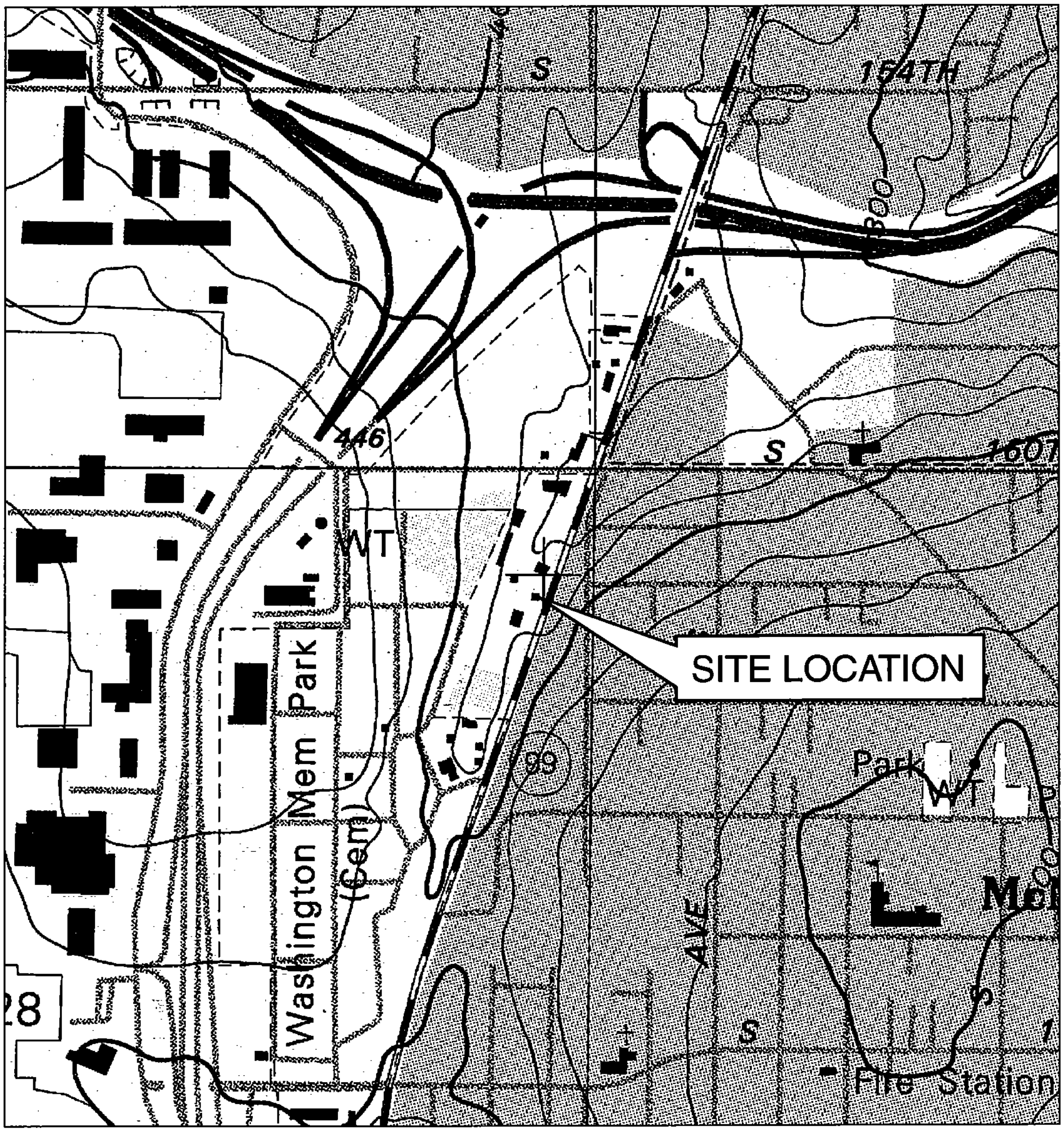


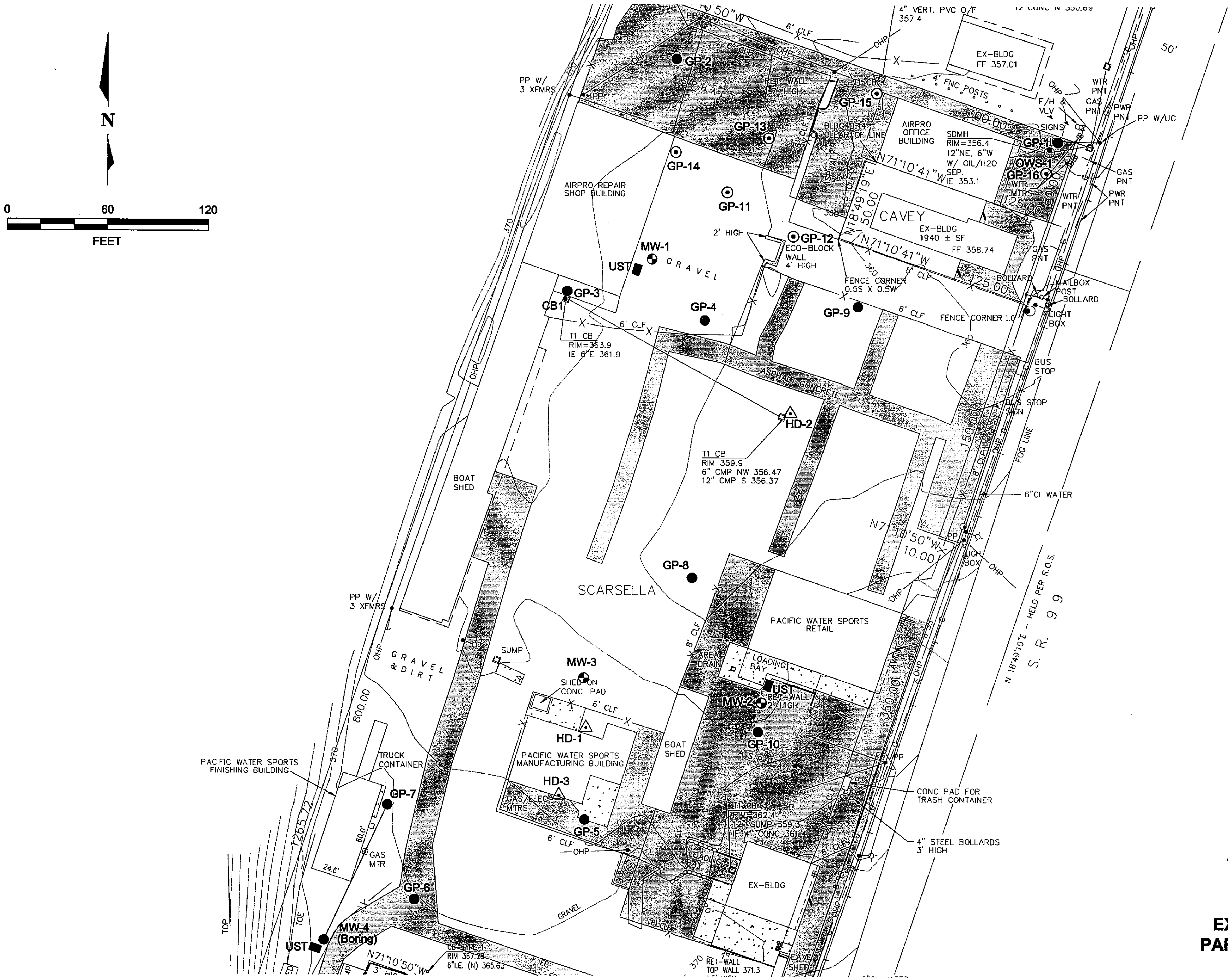
FIGURE 1

SITE VICINITY MAP

SUNREAL/SEATAC GARAGE ESA/WA

PROJECT NO. 003 1321.800 DRAWING NO. 92275 DATE 01/12/01 DRAWN BY KH

Golder Associates



LEGEND

⊙ EXTENDED PHASE II SOIL SAMPLE LOCATIONS

MONITORING WELL

● SOIL SAMPLE LOCATION

• SLUDGE SAMPLE LOCATION

△ HAND SAMPLE SOIL LOCATION

FIGURE 2

EXTENDED PHASE II ESA SEATAC PARKING GARAGE DEVELOPMENT SITE SAMPLING LOCATIONS

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

FINAL REPORT FOR THE PHASE III ENVIRONMENTAL SITE ASSESSMENT SEATAC PARKING GARAGE DEVELOPMENT SITE SEATAC, WASHINGTON

Prepared for:

Sea-Tac Investments LLC.
(as the successor to
SunReal Inc.)

Submitted by:

Golder Associates Inc.
Redmond, Washington

April 5, 2001

013-1427.200
0405rhbl2.doc

TABLES

TABLE 1

Water Level Data

Monitoring Well	Date	Aquifer	MP Elevation	Depth to Water (Ft BMP)	Water Elevation (Ft AMSL)
MW1	01/08/2001	Regional	363.30	49.45	313.85
MW2	01/08/2001	Perched	362.96	11.82	351.14
MW3	01/08/2001	Perched	363.97	19.84	344.13
MW5	01/08/2001	Regional	364.17	50.35	313.82
MW6	01/08/2001	Regional	367.10	53.26	313.84
MW7	01/08/2001	Regional	358.65	44.68	313.97
MW8a	01/08/2001	Regional	359.79	45.75	314.04
MW9	01/08/2001	Regional	363.64	49.80	313.84
MW10	01/08/2001	Regional	362.79	49.10	313.69
MW8 Boring	01/04/2001	Perched	360 est.	17.5	342.5
GP12 Probe	12/13/2000	Perched	361 est.	8	353

TABLE 2

Soil Sample Results

		MONITORING WELL SOIL															REGULATORY CLEANUP LEVELS		
Compounds/Analysis	**Sample ID**	MW1-7.5	MW1-45	MW2-12.5	MW3-2.5	MW3-5	MW4-10	MW5-8-40	MW6-4-20	MW6-8-40	MW7-6-29	MW8-3-14.	MW8a-2-34	MW9-6-30	MW10-6-3	MW10-10-50	MTCA Method A Cleanup Levels (Current)	MTCA Method A Cleanup Levels (Proposed)	MTCA Method B Cleanup Levels
Total Petroleum Hydrocarbons and BTEX	Depth ft bgs/ Units	7.5 - 9	45 - 46	12.5 - 14	2.5 - 4	4 - 5	10 - 10.9	40	20	40	29	15	34	30	30	50			
TPH-Gas	mg/Kg	<27*	1,900	6,500	<380	-	<27*	<5.3	<5.7	<5.4	<5.6	<5.9	<5.7	<5.9	<5.6	300	100	100	
TPH-Diesel	mg/Kg	<54*	<28	810	15,000	430	<53*	<26	<29	<27	<28	<29	<28	<29	<28	<29	200	2,000	
TPH-Oil	mg/Kg	<110*	<56	<57	6,100	< 57	<110*	<53	<57	<54	<56	<59	<57	<59	<56	<58	200	2,000	
Benzene	mg/Kg	-	<0.28	0.63	-	-	-	<0.053	<0.057	<0.054	<0.056	<0.059	<0.057	<0.059	<0.056	8.7	0.5	0.03	
Toluene	mg/Kg	-	1.2	4	-	-	-	<0.053	<0.057	<0.054	<0.056	<0.059	<0.057	<0.059	<0.056	3	40	7	
Ethylbenzene	mg/Kg	-	3.4	50	-	-	-	<0.053	<0.057	<0.054	<0.056	<0.059	<0.057	<0.059	0.081	14	20	6	
Total Xylenes	mg/Kg	-	14	331	-	-	-	<0.053	<0.057	<0.054	<0.056	<0.059	<0.057	<0.059	<0.056	187	20	9	
VOCs by 8260B																			
Acetone	mg/Kg	-	-	-	<0.38	-	-	-	-	-	-	-	-	-	-	-			8,000
Ethylbenzene	mg/Kg	-	-	-	0.082	-	-	-	-	-	-	-	-	-	-	-	20	6	
Total Xylenes	mg/Kg	-	-	-	0.14	-	-	-	-	-	-	-	-	-	-	-	20	9	
Isopropylbenzene	mg/Kg	-	-	-	0.1	-	-	-	-	-	-	-	-	-	-	-			
n-Propylbenzene	mg/Kg	-	-	-	0.25	-	-	-	-	-	-	-	-	-	-	-			
1,3,5-Trimethylbenzene	mg/Kg	-	-	-	1.4	-	-	-	-	-	-	-	-	-	-	-			
1,2,4-Trimethylbenzene	mg/Kg	-	-	-	2.7	-	-	-	-	-	-	-	-	-	-	-			
sec-Butylbenzene	mg/Kg	-	-	-	0.21	-	-	-	-	-	-	-	-	-	-	-			
p-Isopropyltoluene	mg/Kg	-	-	-	2.2	-	-	-	-	-	-	-	-	-	-	-			
Naphthalene	mg/Kg	-	-	-	1.7	-	-	-	-	-	-	-	-	-	-	-	- -	5	3,200
SVOCs by 8270C	mg/Kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	- -	- -	- -
PCBs by EPA 8082	mg/Kg	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	- -	- -	- -
TOTAL METALS 6000/7000 Series																			
Arsenic	mg/Kg	-	-	-	<15	-	-	-	-	-	-	-	-	-	-	-	20	- -	- -
Barium	mg/Kg	-	-	-	150	-	-	-	-	-	-	-	-	-	-	-	- -	- -	5,600
Cadmium	mg/Kg	-	-	-	1.6	-	-	-	-	-	-	-	-	-	-	-	2	- -	- -
Chromium	mg/Kg	-	-	-	50	-	-	-	-	-	-	-	-	-	-	-	100	19 VI , 2,000 III	- -
Lead	mg/Kg	-	6.7	<5.7	670	-	-	-	-	-	-	-	-	-	-	-	250	- -	- -
Mercury	mg/Kg	-	-	-	<0.38	-	-	-	-	-	-	-	-	-	-	-	1	2	- -
Selenium	mg/Kg	-	-	-	<15	-	-	-	-	-	-	-	-	-	-	-	- -	- -	400
Silver	mg/Kg	-	-	-	<0.77	-	-	-	-	-	-	-	-	-	-	-	- -	- -	400

* Analysis based upon NWTPH-HCID
"-" Sample was not analyzed for that compound
ND - Not Detected
"<" - Not detected and the PQL is shown on this table
Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.
Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.
- - indicates there is not a MTCA cleanup level identified under the respective MTCA Method

TABLE 2

Soil Sample Results

		STRATOPROBE SOIL																REGULATORY CLEANUP LEVELS		
Compounds/Analysis	**Sample ID**	**GP1-3**	**GP2-2**	**GP3-3**	**GP4-1**	**GP4-2**	**GP5-2**	**GP5-4**	**GP6-2**	**GP7-1**	**GP8-2**	**GP9-1**	**GP10-4**	**GP11-4-14**	**GP11-7-21**	**GP12-2-7**	**GP12-4-14**	MTCA Method A Cleanup Levels (Current)	MTCA Method A Cleanup Levels (Proposed)	MTCA Method B Cleanup Levels
Total Petroleum Hydrocarbons and BTEX	Depth ft bgs/ Units	**9- 10**	**5 - 6**	**6 -7**	**0 - 3**	**4 - 5**	**2 - 3**	**4 - 6**	**4 - 5**	**2 - 4**	**3 - 5**	**1 - 2**	**14**	**14-15.5**	**21-23**	**7-8**	**14-16**			
TPH-Gas	mg/Kg	<27*	<31*	<27*	7	<32*	54	<29*	<27*	<28*	<27*	<30*	<30*	440	320	<5	<5	100	100	
TPH-Diesel	mg/Kg	<54*	<63*	<53*	<28	<64*	<31	<58*	<54*	<28*	<55*	<31	<60*	<20	<20	<20	<20	200	2,000	
TPH-Oil	mg/Kg	<110*	<130*	<110*	3,200	<130*	93	<120*	<110*	310	<110*	93	<120*	<50	<50	<50	<50	200	2,000	
Benzene	mg/Kg	-	-	-	<0.057	-	<0.061	-	-	-	-	-	-	<0.050	<0.050	<0.050	<0.050	0.5	0.03	
Toluene	mg/Kg	-	-	-	<0.057	-	0.61	-	-	-	-	-	-	<0.050	0.27	<0.050	<0.050	40	7	
Ethylbenzene	mg/Kg	-	-	-	<0.057	-	<0.061	-	-	-	-	-	-	0.56	1.2	<0.050	<0.050	20	6	
Total Xylenes	mg/Kg	-	-	-	<0.057	-	0.35	-	-	-	-	-	-	3.2	9.5	<0.050	<0.050	20	9	
VOCs by 8260B																				
Acetone	mg/Kg	<0.27	<0.31	<0.27	<0.28	<0.32	0.5	<0.29	-	<0.28	-	<0.30	-	-	-	-	-			8,000
Ethylbenzene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	-	-	-	-	20	6	
Total Xylenes	mg/Kg	<0.11	<0.13	<0.11	<0.11	<0.13	<0.12	<0.12	-	<0.11	-	<0.12	-	-	-	-	-	20	9	
Isopropylbenzene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	-	-	-	-			
n-Propylbenzene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	-	-	-	-			
1,3,5-Trimethylbenzene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	-	-	-	-			
1,2,4-Trimethylbenzene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	-	-	-	-			
sec-Butylbenzene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	-	-	-	-			
p-Isopropyltoluene	mg/Kg	<0.054	<0.063	<0.053	0.39	<0.064	1.3	<0.058	-	<0.056	-	<0.061	-	-	-	-	-			
Naphthalene	mg/Kg	<0.054	<0.063	<0.053	<0.057	<0.064	<0.061	<0.058	-	<0.056	-	<0.061	-	0.87	-	-	-	--	5	3,200
SVOCs by 8270C	mg/Kg	-	ND	-	ND	-	-	-	-	-	-	ND	-	-	-	-	-	--	--	--
PCBs by EPA 8082	mg/Kg	-	<0.063	-	<0.057	-	-	-	-	-	-	ND	-	-	-	-	-	--	--	--
TOTAL METALS 6000/7000 Series																				
Arsenic	mg/Kg	<11	<13	<11	<11	<13	<12	<12	<11	<11	<11	<12	<12	-	-	-	-	20	--	--
Barium	mg/Kg	41	76	32	100	96	100	52	35	83	71	130	35	-	-	-	-	--	--	5,600
Cadmium	mg/Kg	<0.54	<0.63	<0.53	0.59	<0.64	<0.61	<0.58	<0.54	<0.56	<0.55	<0.61	<0.60	-	-	-	-	2	--	--
Chromium	mg/Kg	16	40	12	24	38	22	26	15	22	21	26	18	-	-	-	-	100	19 VI , 2,000 III	--
Lead	mg/Kg	<0.54	<6.3	<5.3	58	<6.4	18	10	<5.4	7.9	9	29	<6.0	<5	-	-	-	250	--	--
Mercury	mg/Kg	<0.27	<0.31	<0.27	<0.28	<0.32	<0.30	0.37	<0.27	<0.28	<0.27	<0.30	<0.30	-	-	-	-	1	2	--
Selenium	mg/Kg	<11	<13	<11	<11	<13	<12	<12	<11	<11	<11	<12	<12	-	-	-	-	--	--	400
Silver	mg/Kg	<0.54	<0.63	<0.53	<0.57	<0.64	<0.61	<0.58	<0.54	<0.56	<0.55	<0.61	<0.60	-	-	-	-	--	--	400

* Analysis based upon NWTPH-HCID
"-" Sample was not analyzed for that compound
ND - Not Detected
"<" - Not detected and the PQL is shown on this table
Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.
Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.
-- indicates there is not a MTCA cleanup level identified under the respective MTCA Method

TABLE 2

Soil Sample Results

		STRATOPROBE SOIL				HAND SAMPLING SOIL				REGULATORY CLEANUP LEVELS		
Compounds/Analysis	**Sample ID**	**GP13-4-12**	**GP14-4-14**	**GP15-6-16**	**GP16-6-18**	**HD1-1**	**HD2-1**	**HD2-2**	**HD3-1**	MTCA Method A Cleanup Levels (Current)	MTCA Method A Cleanup Levels (Proposed)	MTCA Method B Cleanup Levels
Total Petroleum Hydrocarbons and BTEX	Depth ft bgs/ Units	**12-12.8**	**14-16**	**16-18**	**18-20**	**3.5**	**4 - 5**	**Duplicate**	**1.5**			
TPH-Gas	mg/Kg	<5	<5	<5	<5	<28*	<29*	<29*	<30*	100	100	
TPH-Diesel	mg/Kg	<20	<20	<20	<20	<28	<29	<29	<30	200	2,000	
TPH-Oil	mg/Kg	<50	<50	<50	<50	130	270	200	290	200	2,000	
Benzene	mg/Kg	<0.050	<0.050	<0.050	<0.050	-	-	-	-	0.5	0.03	
Toluene	mg/Kg	<0.050	<0.050	<0.050	<0.050	-	-	-	-	40	7	
Ethylbenzene	mg/Kg	<0.050	<0.050	<0.050	<0.050	-	-	-	-	20	6	
Total Xylenes	mg/Kg	<0.050	<0.050	<0.050	<0.050	-	-	-	-	20	9	
VOCs by 8260B												
Acetone	mg/Kg	-	-	-	-	0.36	-	-	<0.30			8,000
Ethylbenzene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060	20	6	
Total Xylenes	mg/Kg	-	-	-	-	<0.11	-	-	<0.12	20	9	
Isopropylbenzene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060			
n-Propylbenzene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060			
1,3,5-Trimethylbenzene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060			
1,2,4-Trimethylbenzene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060			
sec-Butylbenzene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060			
p-Isopropyltoluene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060			
Naphthalene	mg/Kg	-	-	-	-	<0.057	-	-	<0.060	- -	5	3,200
SVOCs by 8270C	mg/Kg	-	-	-	-	-	-	-	-	- -	- -	- -
PCBs by EPA 8082	mg/Kg	-	-	-	-	-	-	-	-	- -	- -	- -
TOTAL METALS 6000/7000 Series												
Arsenic	mg/Kg	-	-	-	-	<11	<12	<12	<12	20	- -	- -
Barium	mg/Kg	-	-	-	-	49	77	74	62	- -	- -	5,600
Cadmium	mg/Kg	-	-	-	-	<0.57	<0.58	<0.58	<0.60	2	- -	- -
Chromium	mg/Kg	-	-	-	-	15	26	25	18	100	19 VI , 2,000 III	- -
Lead	mg/Kg	-	-	-	-	11	19	15	13	250	- -	- -
Mercury	mg/Kg	-	-	-	-	<0.28	<0.29	<0.29	<0.30	1	2	- -
Selenium	mg/Kg	-	-	-	-	<11	<12	<12	<12	- -	- -	400
Silver	mg/Kg	-	-	-	-	<0.57	<0.58	<0.58	<0.60	- -	- -	400

* Analysis based upon NWTPH-HCID
"-" Sample was not analyzed for that compound
ND - Not Detected
"<" - Not detected and the PQL is shown on this table
Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.
Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.
-- indicates there is not a MTCA cleanup level identified under the respective MTCA Method

TABLE 3

Groundwater Sample Analytical Results

	Well:	MW-1	MW-1	MW-2 (perched)	MW-3 (perched)	MW-5	MW-6	MW-7	MW-8-B (perched)	MW-8a	MW-9	MW-10	Dup MW-9 (MW-19)	BLANK (MW-20)	GP12-GW (perched)	MTCA Method A Cleanup Level (Current)	MTCA Method A Cleanup Level (Proposed)
	Date	11/16/2000	01/05/2001	11/16/2000	11/16/2000	01/05/2001	01/05/2001	01/05/2001	01/04/2001	01/08/2001	01/05/2001	01/08/2001	01/05/2001	01/08/2001	12/13/2000		
Compound	Units																
TPH-Diesel	ug/L	<250	2300	<250	<630*	<250	<250	<250	550	<250	<250	<250	<250	<250	2100	1000 Total TPH	500
TPH-Oil	ug/L	<500	530	<500	<630*	<500	<500	<500	1100	<500	<500	<500	<500	<500	<500	1000 Total TPH	500
TPH-Gas	ug/L	71000	57000	14000	<250*	780	<100	80000	<100	160	90000	1600	78000	<100	<100	1000 Total TPH	800
Benzene	ug/L	2300	2800	<20	<0.20	12	<1.0	470	<1.0	5.3	1900	31	1900	<1.0	<1.0	5	5
Toluene	ug/L	5900	7300	120	<0.20	9.3	<1.0	7200	<1.0	<1.0	12000	100	12000	<1.0	<1.0	40	1,000
Ethylbenzene	ug/L	1400	1300	380	<0.20	16	<1.0	2000	<1.0	<1.0	1800	21	1600	<1.0	<1.0	30	700
m,p-Xylene	ug/L	5200	5100	1600	0.41	15	<1.0	8300	<1.0	<1.0	7200	86	6500	<1.0	2.5	20 Total xylenes	1,000
o-Xylene	ug/L	1900	1800	570	<0.20	6.3	<1.0	2900	<1.0	<1.0	2500	32	2300	<1.0	-	20 Total xylenes	- -

* Analysis based upon NWTPH-HCID.

" - " Sample was not analyzed for that compound.

"<" - Not detected and the PQL is shown on this table.

Shading indicates that the concentration exceeds the proposed MTCA Method A cleanup level.

Underline indicates that the concentration exceeds the current MTCA Method A cleanup level.

Sample MW-8-B (perched) was a perched groundwater sample collected from augers during drilling.

Sample MW-8-B (perched) was also analyzed for total RCRA metals, all metals were reported below there respective PQls,, the both the current and proposed MTCA Method A cleanup level.

- - indicates there is not a MTCA cleanup level identified under the respective MTCA Method.

FIGURES

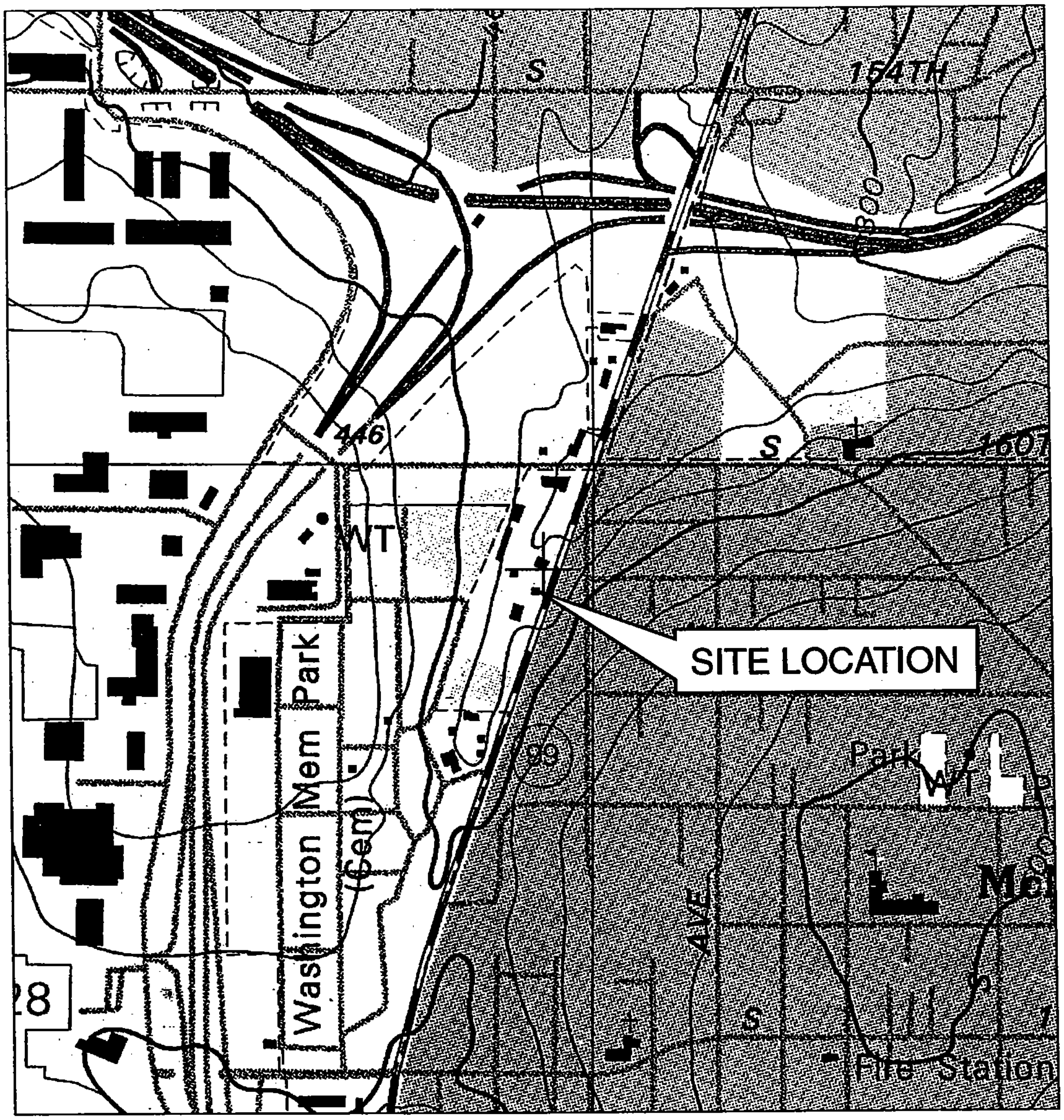


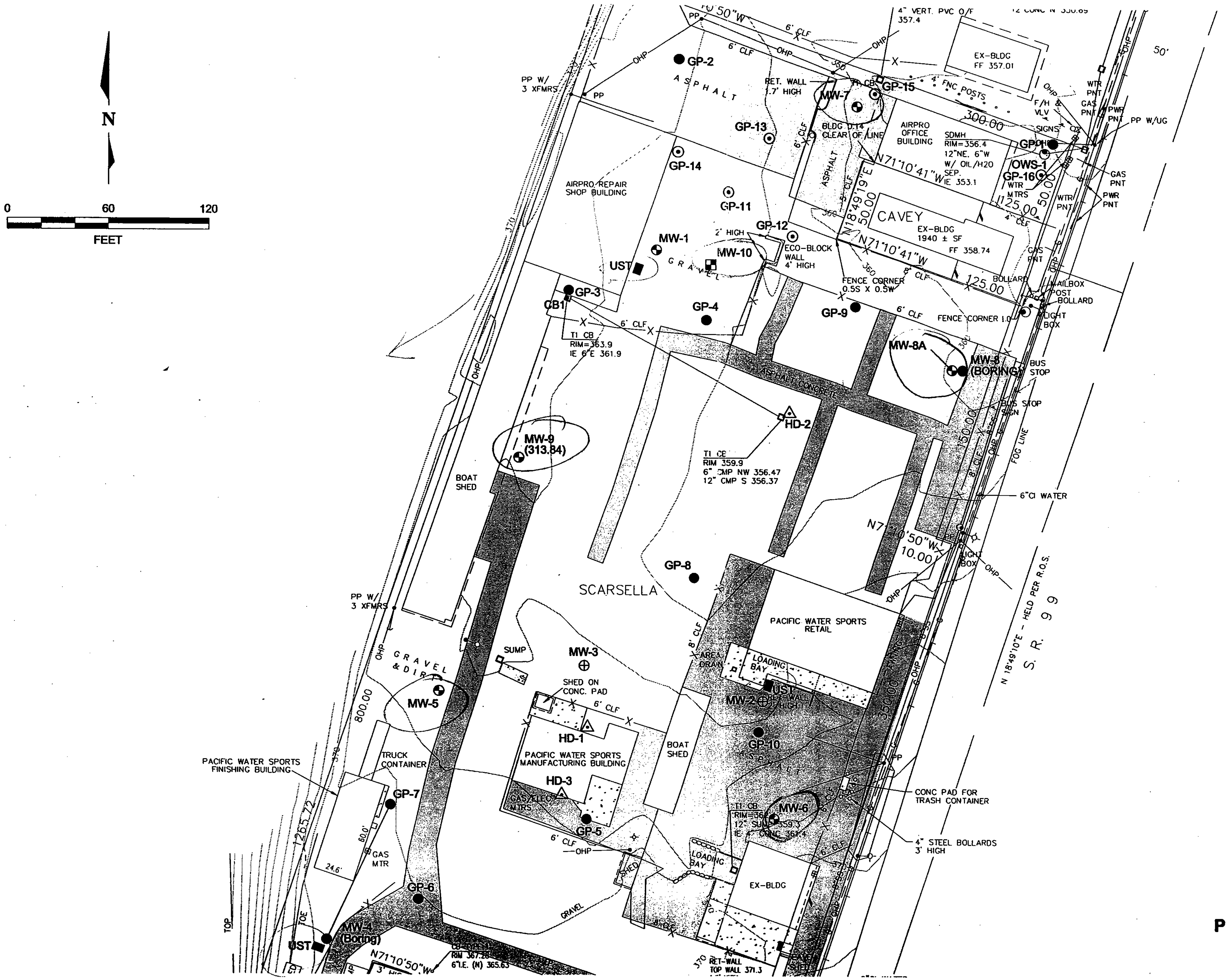
FIGURE 1

SITE VICINITY MAP

SUNREAL/SEATAC PARKING PHASE III ESA/WA

PROJECT NO. 003 1321.900 DRAWING NO. 92302 DATE 01/18/01 DRAWN BY KH

Golder Associates



LEGEND

◪	REGIONAL AQUIFER DEEP COMPLETION MONITORING WELL
⊕	PERCHED WATER ZONE MONITORING WELL
⊙	EXTENDED PHASE II SOIL SAMPLE LOCATIONS
◕	REGIONAL AQUIFER MONITORING WELL
●	SOIL SAMPLE LOCATION
•	SLUDGE SAMPLE LOCATION
⚠	HAND AUGER SAMPLE LOCATIONS

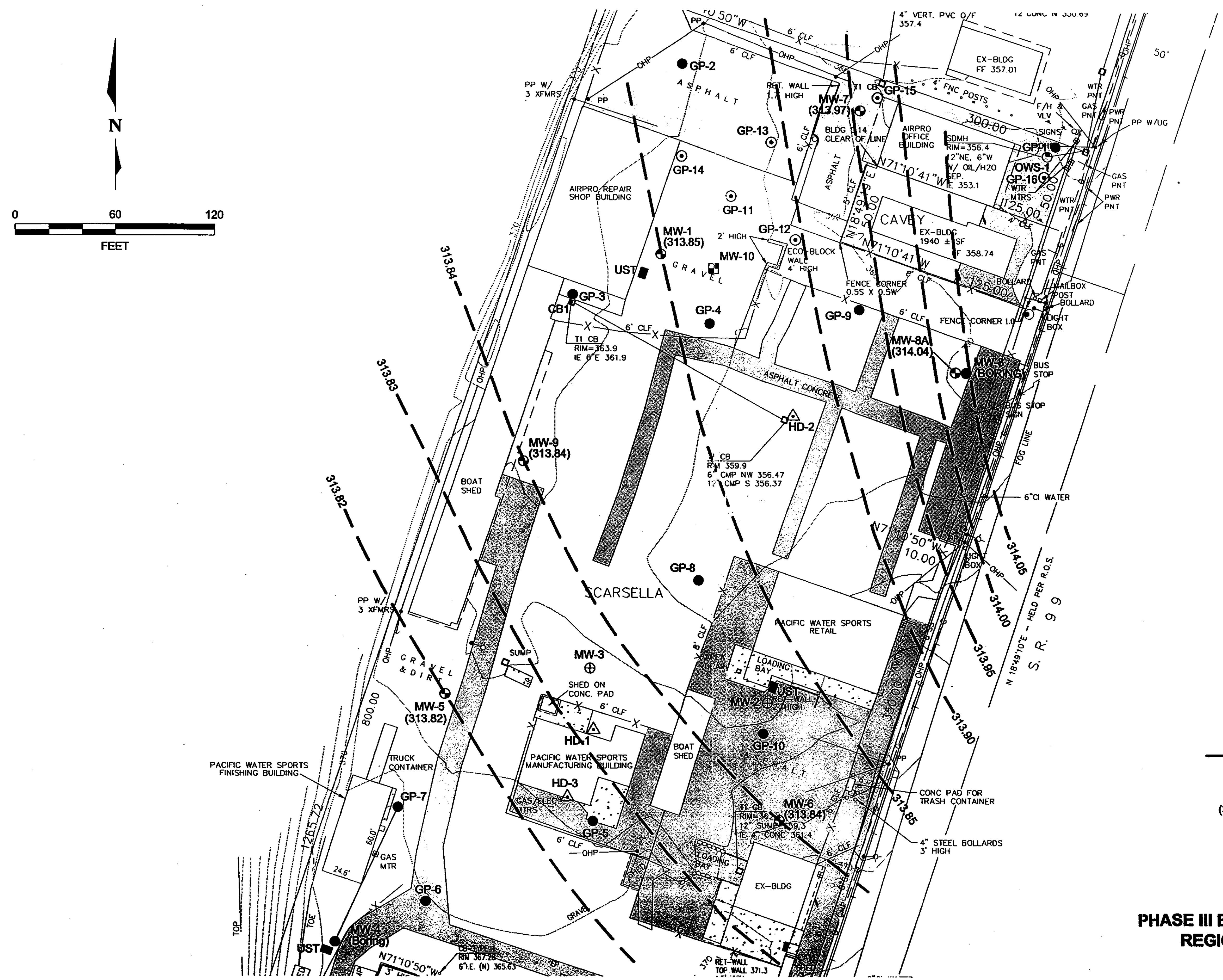
FIGURE 2

PHASE III ESA SEATAC PARKING GARAGE DEVELOPMENT SITE SAMPLING LOCATIONS

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

femos|K:\Projects\2000\0031321\900\93475.dwg|1-18-1 14:48|pcx-xbase,x-htchjt-



LEGEND

◪	REGIONAL AQUIFER DEEP COMPLETION MONITORING WELL
⊕	PERCHED WATER ZONE MONITORING WELL
⊙	EXTENDED PHASE II SOIL SAMPLE LOCATIONS
◕	REGIONAL AQUIFER MONITORING WELL
●	SOIL SAMPLE LOCATION
•	SLUDGE SAMPLE LOCATION
— —	WATER TABLE CONTOURS
△	HAND AUGER SAMPLE LOCATIONS
(313.84)	GROUNDWATER ELEVATION AMSL

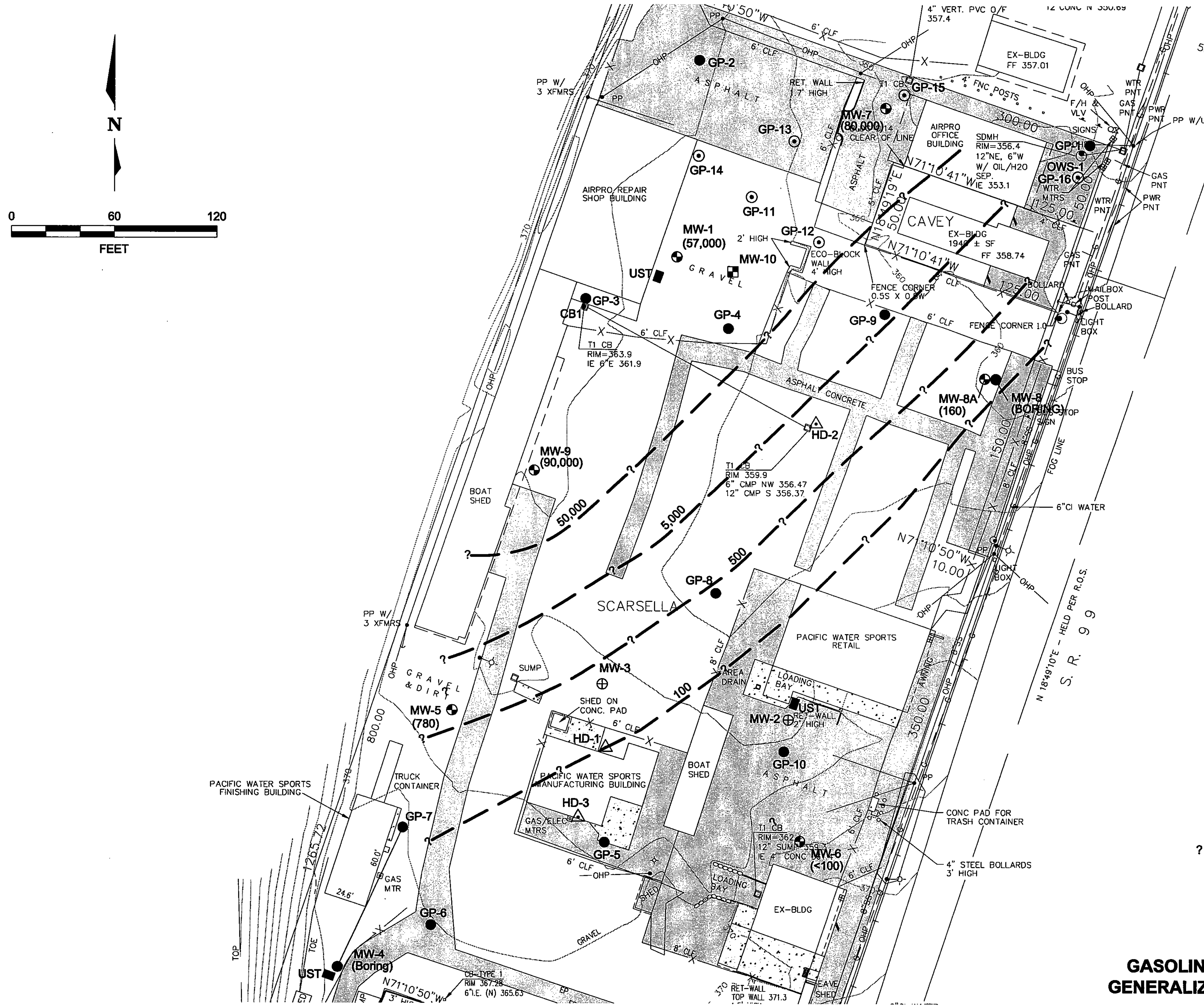
FIGURE 3

PHASE III ESA SEATAC PARKING GARAGE REGIONAL AQUIFER GROUNDWATER LEVEL CONTOURS (1/08/01)

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

filemos|K:\Projects\2000\0031321\900\93919.dwg|1-18-1 15:50|pcx-xbase,x-htch|t-



LEGEND

▣	REGIONAL AQUIFER DEEP COMPLETION MONITORING WELL
⊕	PERCHED WATER ZONE MONITORING WELL
⊙	EXTENDED PHASE II SOIL SAMPLE LOCATIONS
◐	REGIONAL AQUIFER MONITORING WELL
●	SOIL SAMPLE LOCATION
•	SLUDGE SAMPLE LOCATION
△	HAND AUGER SAMPLE LOCATIONS
(80,000)	CONCENTRATION OF GASOLINE RANGE PETROLEUM HYDROCARBON
?—— 500 ——?	APPROXIMATE ISO CONCENTRATION

FIGURE 4

PHASE III SEATAC PARKING GARAGE
GASOLINE RANGE PETROLEUM HYDROCARBON
GENERALIZED ISO CONCENTRATION MAP (1/08/01)

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

flemos|K:\Projects\2000\0031321\900\93955.dwg|1-18-1 15:52|cx-xbase,x-htch|l:-

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

Golder Associates

September 27, 2001

Our ref: 013-1427.700

SeaTac Investments LLC
600 Stewart Street, Suite 601
Seattle, Washington 98101

ATTENTION: Mr. Doug Rigoni

RE: COLLECTION AND ANALYTICAL RESULTS OF GROUNDWATER SAMPLE FROM WASHINGTON MEMORIAL PARK CEMEMTERY PRIVATE WELL

Dear Mr. Rigoni:

Golder Associates Inc. (Golder) is pleased to present SeaTac Investments LLC. This letter report and appreciates the opportunity to continue our work with you on this project. This letter report describes the well sampling activities conducted for the Washington Memorial Park Cemetery (Cemetery) private water supply well and analytical results. This work was conducted in accordance with the scope of work outlined in our July 5, 2001 Cost Estimate letter sent to you: "Cost Estimate for Sampling and Analysis of Groundwater From the Washington Memorial Park Cemetery."

As you are aware, Golder conducted an extensive environmental site assessment during the due diligence period on behalf of SeaTac Investments LLC and their predecessor for the Master Park Lot C development. The development is located along the west side of the 16,000 block of International Boulevard (Highway 99) SeaTac, Washington. As a result of the ESA investigations several recognized environmental conditions (RECs) were identified on site. One of the RECs identified was that the groundwater in the regional aquifer in the northwest portion of the site was contaminated with gasoline range hydrocarbons and benzene above MTCA cleanup standards. SeaTac Investments LLC, with the consent of the Cemetery, elected to collect a groundwater sample from the Cemetery's water supply well. The groundwater sample was collected and analyzed to confirm that the petroleum hydrocarbon contamination in the regional aquifer at the Master Park Lot C development does not extend to the Cemetery well.

As outlined in our letter, one groundwater sample was collected from the private water supply well located at 16445 International Boulevard, SeaTac, Washington. The attached Figure 1 shows the location of the Cemetery and approximate well location. The water supply well is completed at a depth of approximately 130 feet below ground surface (bgs). The well pumps groundwater to a holding pond that provides water for irrigation for the Cemetery during summer. Mr. Dean Smith with the Washington Memorial Park Cemetery stated that the well is generally in use starting in April and extending through the end of September/beginning of October of each year. Mr. Smith indicated that 2001 was no exception, and that the well had "generally been in operation everyday since April of this year."

One groundwater sample (CemWell) was collected from the Cemetery well on July 23, 2001. Sample collection and handling were conducted in substantive accordance with Golder's Technical Procedure TP 1.2-20 "Collection of Groundwater Quality Samples" and TP 1.2-23 "Chain of Custody."

A float that monitors the water level in the irrigation water holding pond actuates the pump to the well when the water level drops. The pump was off when Golder personnel arrived on site. Prior to starting the pump, the depth to water was measured in the well at 73.15 feet below the top of the casing. The pump was turned on by artificially lowering the float in the irrigation pond. The rate of discharge from the well was estimated to be 50 to 100 gallons per minute (GPM). Discharge from the well could not actually be measured because of the pipe configuration and direct discharge into the irrigation pond. The well was allowed to continuously discharge for approximately 30 minutes before a groundwater sample was collected. The sample was collected by directly capturing water from a spigot on the side of the discharge pipe into the appropriate sample containers supplied by the analytical laboratory. The attached photographs present the tap and discharge pipe that supplies the holding pond.

Upon collection of the groundwater samples, the sample containers were sealed with Teflon lined lids, labeled, and placed in an ice chest equipped with blue ice to maintain the samples at approximately 4° C until relinquished to the analytical laboratory. The sample was submitted for total petroleum hydrocarbon in both the gasoline and diesel ranges with quantification of benzene, toluene, ethylbenzene, and xylene (BTEX) compounds. The diesel analysis was performed using NWTPH-D Method and the gasoline/BTEX analysis was performed using NWTPH-Gx/EPA 8021. OnSite Environmental Laboratory Inc. (OnSite) located in Redmond, Washington performed the analyses. The analytical laboratory report is included as an attachment.

Chemical analysis of the groundwater sample did not detect petroleum hydrocarbons in the gasoline, diesel or oil range or BTEX constituents above their respective practical quantitation limits (PQLs). Results of the chemical analysis of the groundwater sample collected at Washington Memorial Park Cemetery supply well confirms that the groundwater has not been impacted by the petroleum hydrocarbons. Furthermore, the petroleum hydrocarbon contamination known to exist in the regional aquifer in the northwest portion of the SeaTac Investments

LLC's Master Park Lot C development at 16055 International Boulevard SeaTac, Washington has not impacted the groundwater at the Cemetery well.

If you have any questions or require any additional information, please contact Ted Norton at (425) 883-0777.

Sincerely,

GOLDER ASSOCIATES INC.

Ted J. Norton
Senior Environmental Scientist

Douglas J. Morell, Ph.D.
Principal

TNJ/DJM/lag
0927tjn2.doc

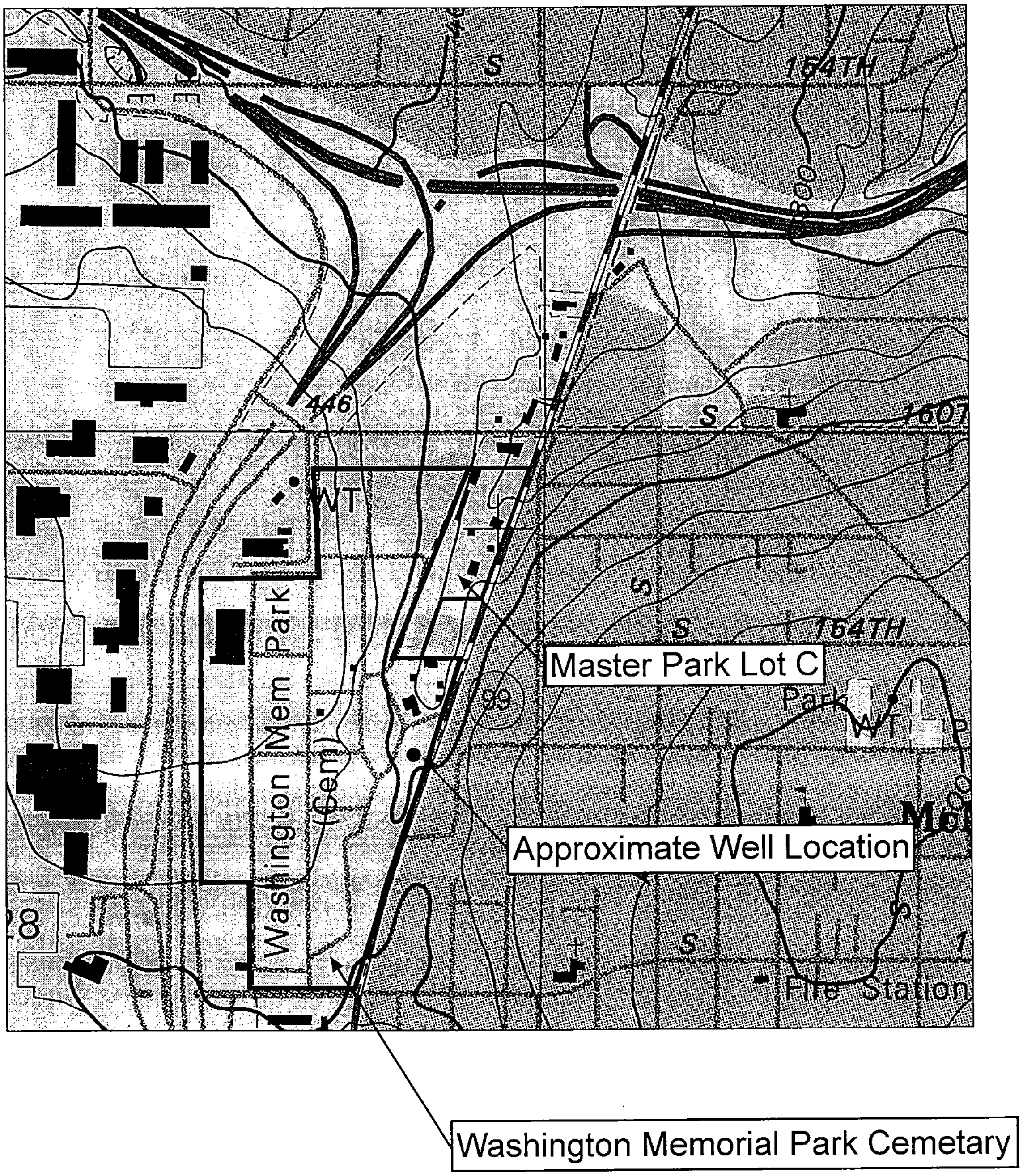


FIGURE 1

LOCATION MAP

SEATAC/CEM WELL/WA

PROJECT NO. 013 1427_700 DRAWING NO. 96651 DATE 09/11/01 DRAWN BY EL

Golder Associates

Photo 1. Washington Memorial Park Cemetary well and sample tap.

Photo 2. Discharge pipe in storage pond.

PHOTOGRAPHS
SEATAC/CEM WELL/WA

PROJECT NO. 013 1427_700 DRAWING NO. 96652 DATE 09/11/01 DRAWN BY EL

Golder Associates

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

SITE ASSESSMENT CONDUCT FOR THE CLOSURE OF A 1,000–GALLON HEATING OIL UNDERGROUND STORAGE TANK

MASTER PARK LOT C
16000 BLOCK INTERNATIONAL BOULEVARD
SEATAC, WASHINGTON

Prepared for:

SeaTac Investments LLC

Submitted by:

Golder Associates Inc.
Redmond, Washington

Ted Norton
Project Manager

for Douglas Morell
Principal

October 4, 2001

013-1427.500
1004STACustFinaldraft.doc

TABLES

TABLE 1

Analysis Results for Soil Samples Associated With the 1,000-Gallon Heating Oil UST, SeaTac Master Park Lot C.

Sample Number	Location	Gasoline Range Petroleum (mg/kg)	Diesel Range Petroleum (mg/kg)	Oil Range Petroleum (mg/kg)
ST1-B-9	Below UST in bottom of excavation 8 feet bgs	< 21	< 53	< 110
ST2-WW-6.5	West wall of excavation 6.5 feet bgs	< 22	<55	< 110
ST3-NW-7	North wall of excavation 7 feet bgs	< 21	< 53	< 110
ST-SP1	Stockpile sample	< 22	<55	< 110
ST-SP2	Stockpile sample	< 22	<56	< 110

Note:
MTCA Method A cleanup levels prior to August 15, 2001
- gasoline range petroleum hydrocarbons 100 mg/kg
- diesel range petroleum hydrocarbons 200 mg/kg
- heavy oil range petroleum hydrocarbons 200 mg/kg

MTCA Method A cleanup levels after August 15, 2001
- gasoline range petroleum hydrocarbons 100 mg/kg
- diesel range petroleum hydrocarbons 2,000 mg/kg
- heavy oil range petroleum hydrocarbons 2,000 mg/kg

FIGURES

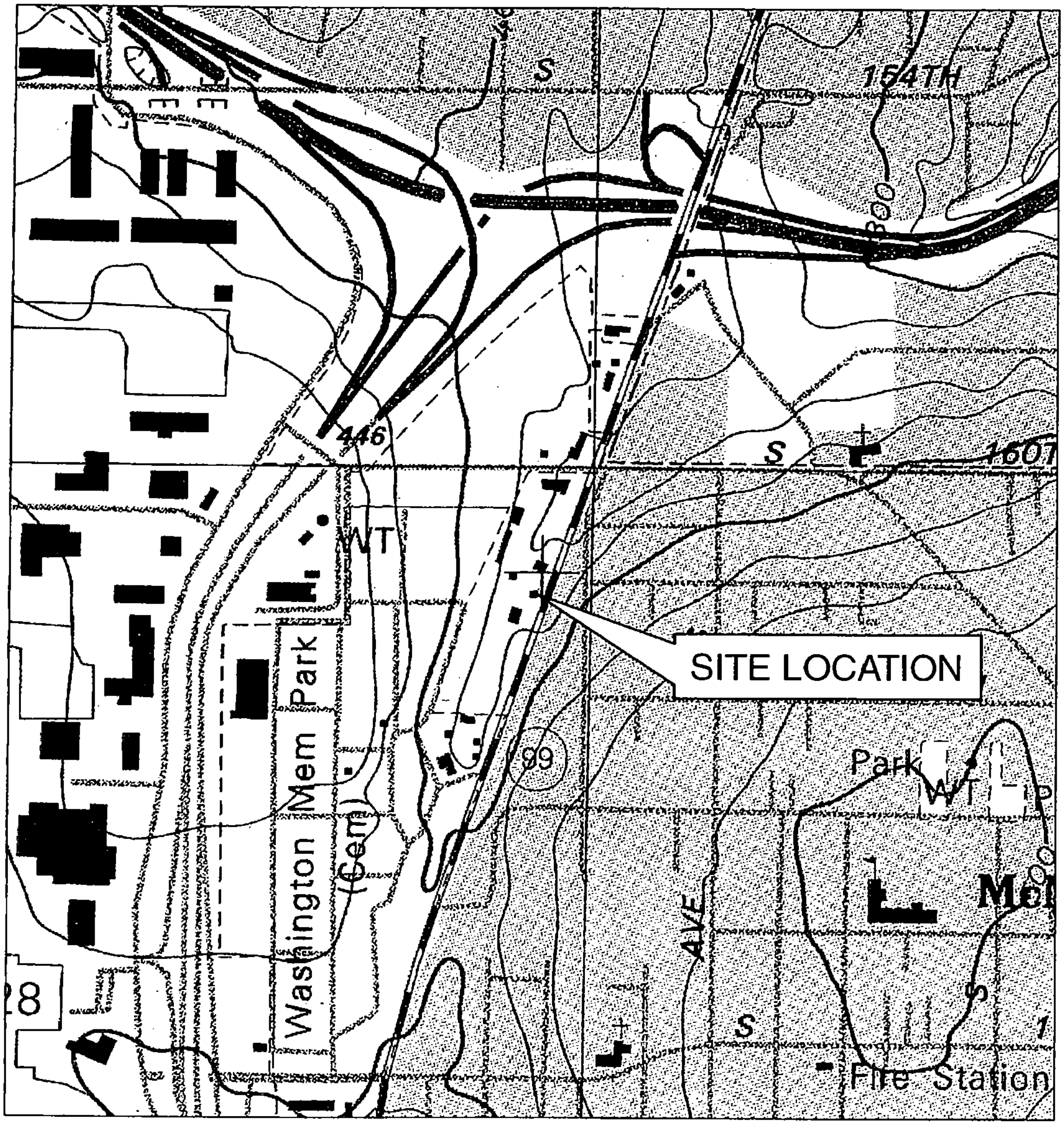


FIGURE 1

SITE VICINITY MAP

SEATAC/I0K REPORT/WA

PROJECT NO. 013 1427_500 DRAWING NO. 92275b DATE 08/22/01 DRAWN BY KH

Golder Associates

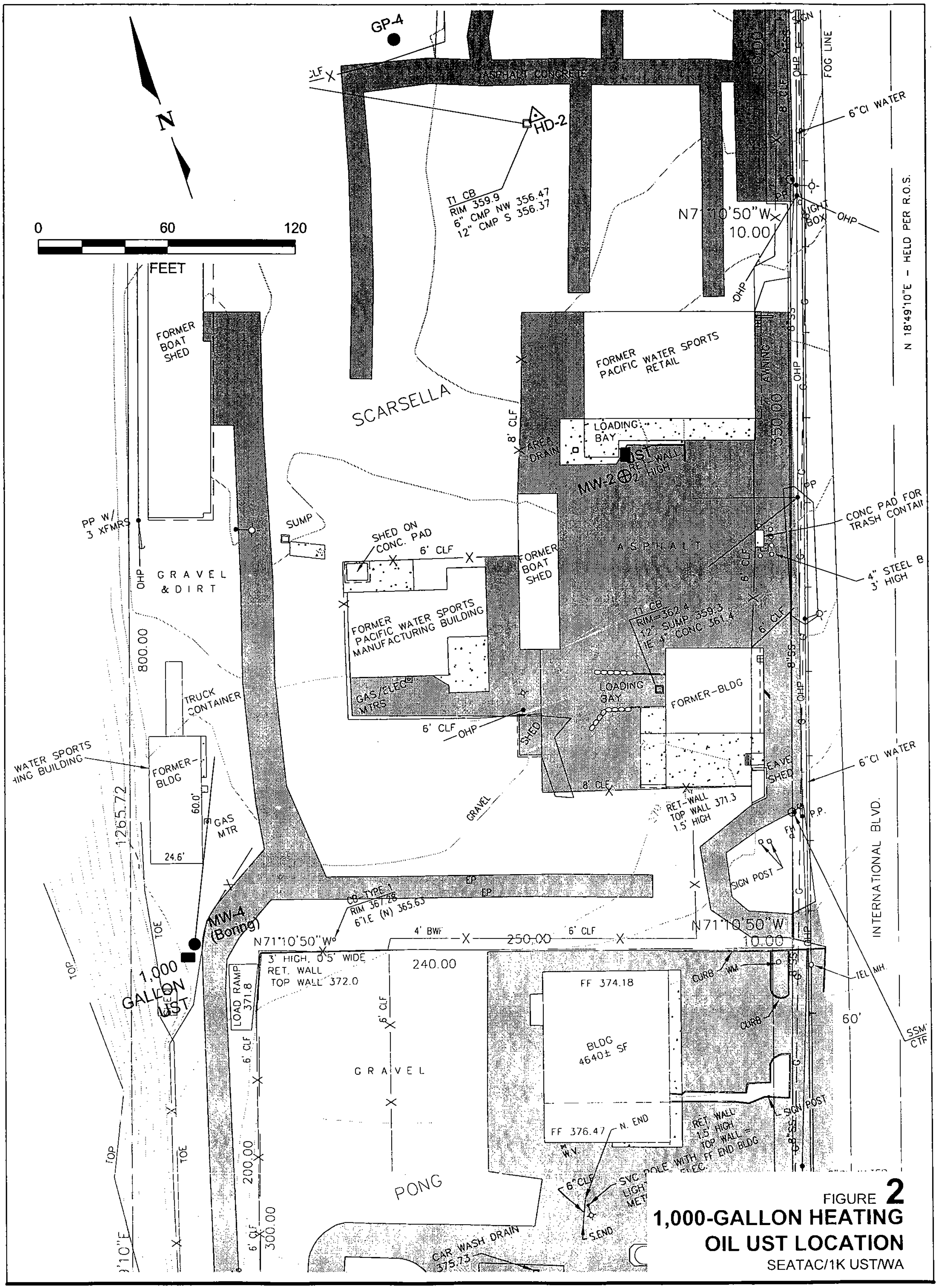


FIGURE **2**

1,000-GALLON HEATING OIL UST LOCATION

SEATAC/1K UST/WA

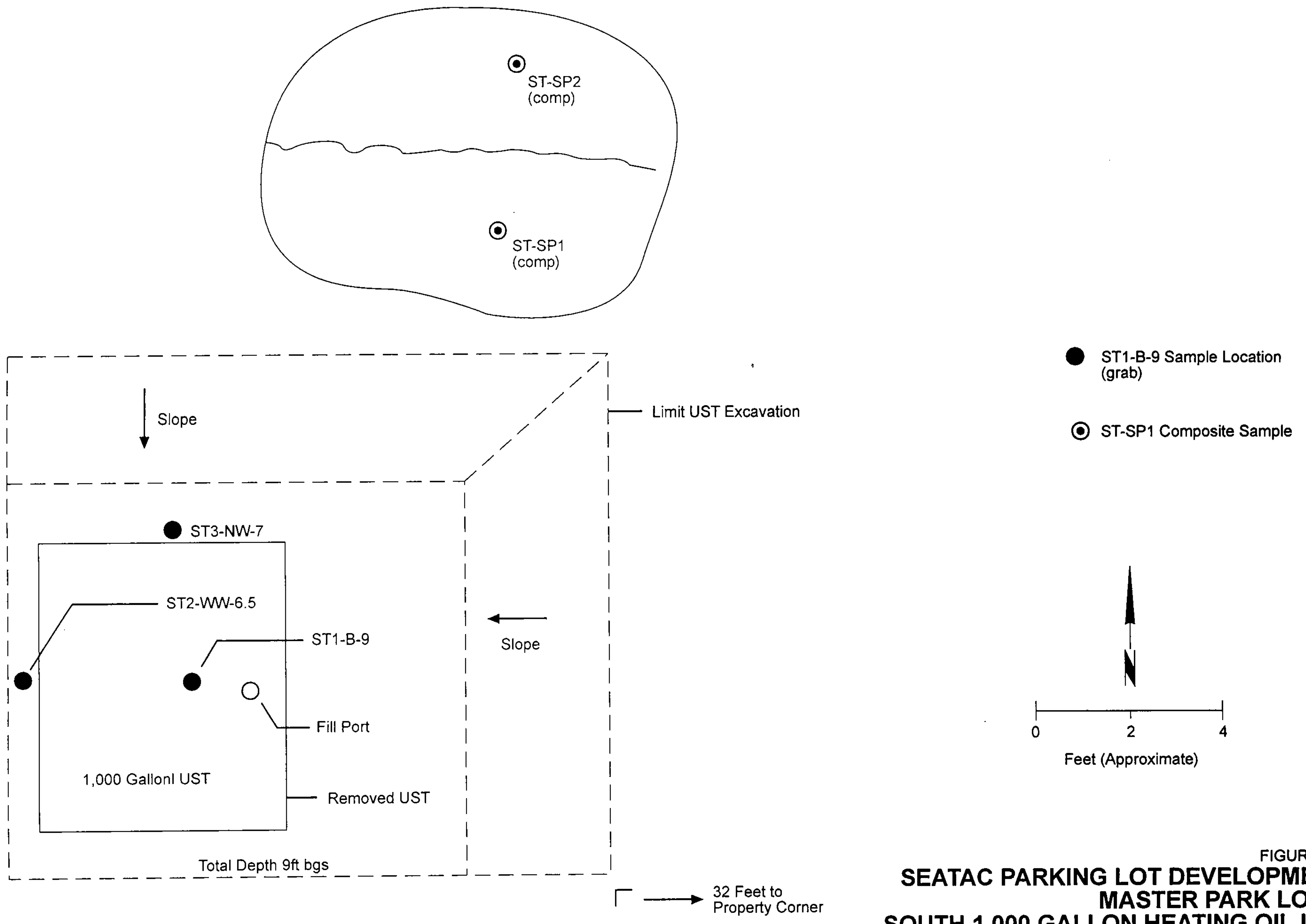


FIGURE 3

SEATAC PARKING LOT DEVELOPMENT
MASTER PARK LOT C
SOUTH 1,000 GALLON HEATING OIL UST
CLOSURE SAMPLE LOCATIONS

SEATAC/UST/WA

PROJECT NO. 013 1427_500 DRAWING NO. 92494 DATE 08/22/01 DRAWN BY EL

Golder Associates

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

CLOSURE OF A 1,000-GALLON GASOLINE UNDERGROUND STORAGE TANK AND ASSOCIATED INDEPENDENT REMEDIAL ACTION

MASTER PARK LOT C
16000 BLOCK INTERNATIONAL BOULEVARD
SEATAC, WASHINGTON

Prepared for:

SeaTac Investments LLC

Submitted by:

Golder Associates Inc.
Redmond, Washington

Ted Norton
Project Manager

Douglas Morell
Principal

October 4, 2001

013-1427.500
1004tjn2.doc

TABLES

TABLE 1

Underground Storage Tank Site Assessment Soil Sample Analytical Results

Sample ID	Date	Analytical Method	Media	Gasoline Range Petroleum Hydrocarbons (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylene (mg/kg)	Methly Tertiarybutyl Ether (MTBE) (mg/kg)	1-2, Dichloroethane (EDC) (mg/kg)	1-2, Dibromoethane (EBC) (mg/kg)	Diesel Range Petroleum Hydrocarbons (mg/kg)	Heavy Oil Range Petroleum Hydrocarbons (mg/kg)	Total Lead (mg/kg)
GT1-B-8	6/18/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	9,100	0.93	21	48	530	<0.27	<0.013	<0.011	1,600	150	42
GT2-EW-6	6/18/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	<5.9	<0.059	<0.059	<0.059	<0.059	<0.059	N/A	N/A	N/A	N/A	28
GT-SP1	6/18/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	20	<0.058	<0.058	<0.058	0.31	<0.058	N/A	N/A	N/A	N/A	19
GT-SP2	6/18/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	<5.7	<0.057	0.061	<0.057	0.07	<0.057	N/A	N/A	N/A	N/A	15
GT-TP1-6	6/18/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	<5.4	<0.054	<0.054	<0.054	0.089	<0.054	N/A	N/A	N/A	N/A	40
GT-TP2-7	6/18/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	<30	<0.30	<0.30	<0.30	<0.30	<0.30	N/A	N/A	N/A	N/A	<6.0
MTCA Method A (or B) cleanup level at the time of closure	NA	NA	Soil	100 mg/kg	0.5	40	20	20	_	11	0.001	200	200	250
MTCA Method A cleanup level effective as of August 15, 2001	NA	NA	Soil	100 mg/kg*	0.03	7	6	9	0.1	0.005	0.005	2,000	2,000	250

Note:

N/A not analyzed based on HCID results.

< indicates that the constituent was not detected above it's respective practical quantitation limit (PQL)

EDC and EDB were not analyzed in subsequent samples due to the absence in GT1-B-8

* without the presents of benzene

Shading indicates that the constituent exceeds the effective MTCA Method A cleanup level at the time of closure.

Underling indicates that the constituent exceeds the current MTCA Method A cleanup level (effective as of August 15, 2001).

TABLE 2

Petroleum Hydrocarbon and BTEX Analytical Results Associated With the Impacted Soil Remediation

Sample ID	Date	Analytical Method	Media	Gasoline Range Petroleum Hydrocarbons (mg/kg)	Benzene (mg/kg)	Toluene (mg/kg)	Ethylbenzene (mg/kg)	Total Xylene (mg/kg)	Diesel Range Petroleum Hydrocarbons (mg/kg)	Heavy Oil Range Petroleum Hydrocarbons (mg/kg)
Confirmatory Samples										
GT-N69W6D16	6/22/01	NWTPH-HCID	Soil	<24	N/A	N/A	N/A	N/A	<60	<120
GT-N58W8D16	6/22/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	<6.1	<0.061	0.078	0.08	0.5	<31	<61
GT-SP-Southeast	6/22/01	NWTPH-HCID	Soil	<22	N/A	N/A	N/A	N/A	<54	<110
GT-SP-East	6/22/01	NWTPH-HCID	Soil	<22	N/A	N/A	N/A	N/A	<56	<110
GT-SP-North	6/22/01	NWTPH-HCID	Soil	<22	N/A	N/A	N/A	N/A	<55	<110
GT-N23E1D13 E-Wall	6/26/01	NWTPH-HCID	Soil	<12	N/A	N/A	N/A	N/A	<30	<61
GT-N30W20D16 Floor	6/26/01	NWTPH-HCID	Soil	<11	N/A	N/A	N/A	N/A	<29	<57
GT-N4W25D13 S-Wall	6/26/01	NWTPH-HCID	Soil	<12	N/A	N/A	N/A	N/A	<30	<60
GT-Stockpile-SW	6/26/01	NWTPH-HCID	Soil	<11	N/A	N/A	N/A	N/A	<28	<56
GT-N23W10D13 Impacted	6/26/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil	<30	<0.30	0.62	0.41	2.29	<30	<60
GT-N20W55D16	6/27/01	NWTPH-HCID	Soil	<23	N/A	N/A	N/A	N/A	<57	<110
GT-N85W5D13	6/27/01	NWTPH-HCID	Soil	32	N/A	N/A	N/A	N/A	<57	<110
GT-N48W24D13	6/27/01	NWTPH-HCID	Soil	<24	N/A	N/A	N/A	N/A	<60	<120
GT-N55W10D13	6/27/01	NWTPH-HCID	Soil	<25	N/A	N/A	N/A	N/A	<62	<120
Cistern Samples										
GT-SP-Sump^{A}	6/22/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil/Sludge	<30	<0.30	<0.30	<0.30	1.48	520	490
GT-Stockpile W. Cistern	6/27/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Soil/Sludge	39	<0.057	<0.057	0.099	0.075	<28	390
MTCA Method Cleanup Levels										
MTCA Method A cleanup level at the time of closure	NA	NA	Soil	100 mg/kg	0.5	40	20	20	200	200
MTCA Method A cleanup level effective as of August 15, 2001	NA	NA	Soil	100 mg/kg*	0.03	7	6	9	2,000	2,000

Note:

N/A not analyzed based on HCID results.

< indicates that the constituent was not detected above it's respective practical quantitation limit (PQL)

EDC and EDB were not analyzed in subsequent samples due to the absence in GT1-B-8

* without the presents of benzene

Shading indicates that the constituent exceeds the effective MTCA Method A cleanup level at the time of closure.

Underling indicates that the constituent exceeds the current MTCA Method A cleanup level (effective as of August 15, 2001).

^{A} additional analysis for semivolatile organics and metals are presented on Table 3.

TABLE 3
Non-Petroleum Hydrocarbon Analytical Results for Cistern Samples

Sample ID	Date	Media	2,4-dimethylphenol (mg/kg)	Naphthalene (mg/kg)	2-methylnapthalene (mg/kg)	1-methylnapthalene (mg/kg)	Phenanthrene (mg/kg)	Butylbenzylphthalate (mg/kg)	bis(2-ethylhexyl)phthalate (mg/kg)	Barium (mg/kg)	Chromium (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)
			Semivolatiles							Metals			
Cistern Samples													
GT-SP-Sump*	6/22/01	Soil/Sludge	0.11 J	0.067 J	0.24	0.15	0.09 J	0.096 J	8.7	58	17	26	0.42
MTCA Method Cleanup Levels													
MTCA Method A cleanup level at the time of closure	NA	Soil	-	-	-	-	-	-	-	-	100	250	1
MTCA Method A cleanup level effective August 15, 2001	NA	Soil	-	-	-	-	-	-	-	-	19 Cr VI 2,000 Cr III	250	2
MTCA Method B cleanup level	NA	Soil	32	32	-	-	-	320	320	112	-	-	-

Note:

* indicates that the petroleum hydrocarbon and BTEX results are presented in Table 2.

MTCA Method B cleanup levels are based the Model Toxics Control Act Cleanup Levels and Risk Calculations (CLARC II) Update (WDOE 1996) on the lowest allowable soil concentration protective of groundwater.

\- indicates that there is not an established MTCA cleanup level.

J indicates an estimated value.

TABLE 4

Post Impacted Soil Remediation Groundwater Sample Anlytical Results

Sample ID	Date	Analytical Method	Media	Gasoline Range Petroleum Hydrocarbons (ug/L)	Benzene (ug/L)	Toluene (ug/L)	Ethylbenzene (ug/L)	Total Xylene (ug/L)	Diesel Range Petroleum Hydrocarbons (ug/L)	Heavy Oil Range Petroleum Hydrocarbons (ug/L)
Groundwater Sample										
GT-GW1	7/2/01	NWTPH-Gas$_{(BTEX)}$ and Dx	Groundwater	<100	<1.0	<1.0	<1.0	<1.0	<250	<500
MTCA Method A cleanup level at the time of closure	NA	NA	Groundwater	1,000*	5	40	30	20	1,000*	1,000*
MTCA Method A cleanup level effective as of August 15, 2001	NA	NA	Groundwater	1000^{A}	5	1,000	700	1,000	500	500

Note:

< indicates that the constituent was not detected above it's respective practical quantitation limit (PQL)

* indicates 1,000 ug/L total petroleum hydrocarbons.

^{A} without the presents of benzene

FIGURES

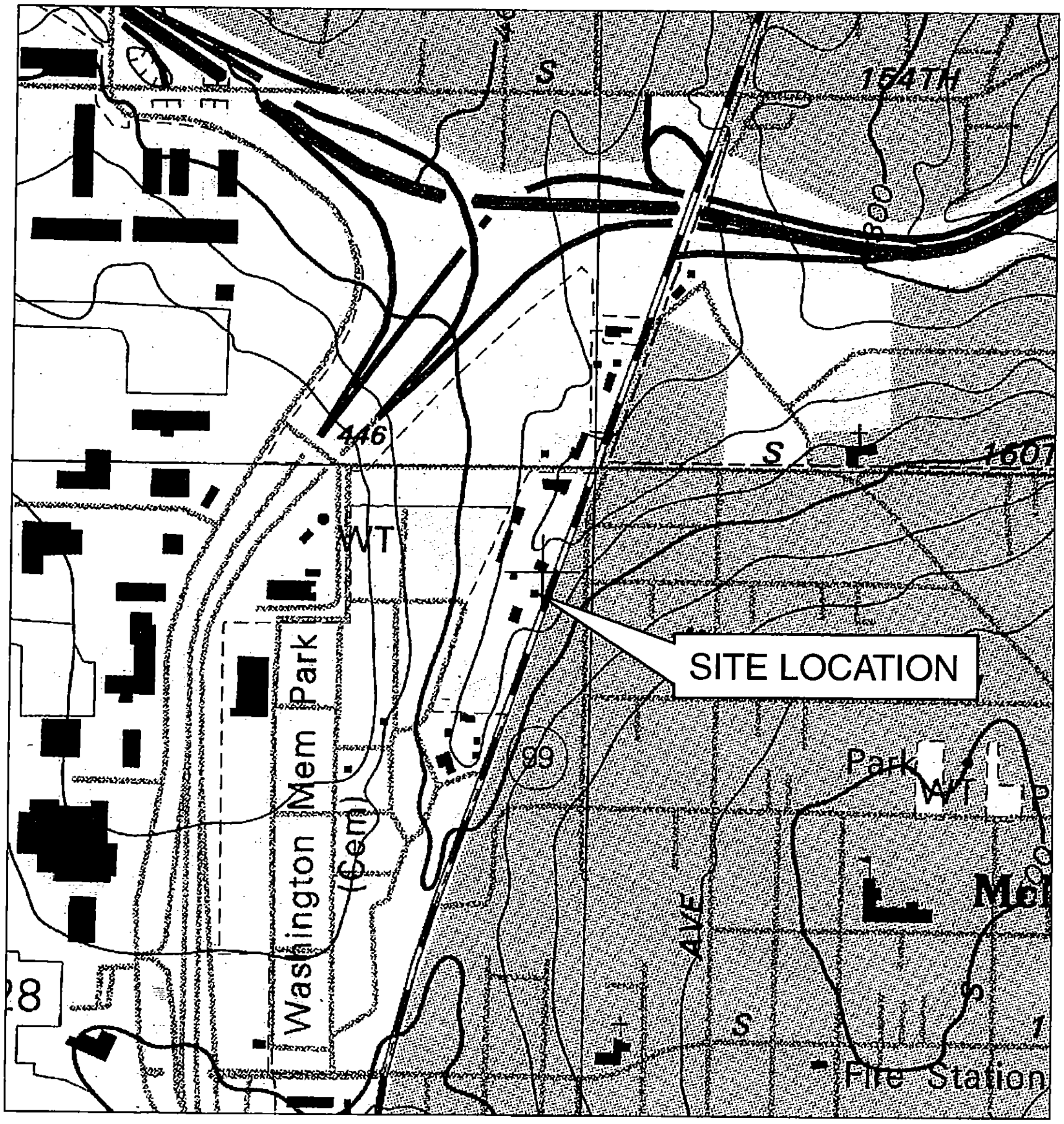


FIGURE **1**

SITE VICINITY MAP

SEATAC/I0K REPORT/WA

PROJECT NO. 013 1427_500 DRAWING NO. 92275b DATE 08/22/01 DRAWN BY KH

Golder Associates

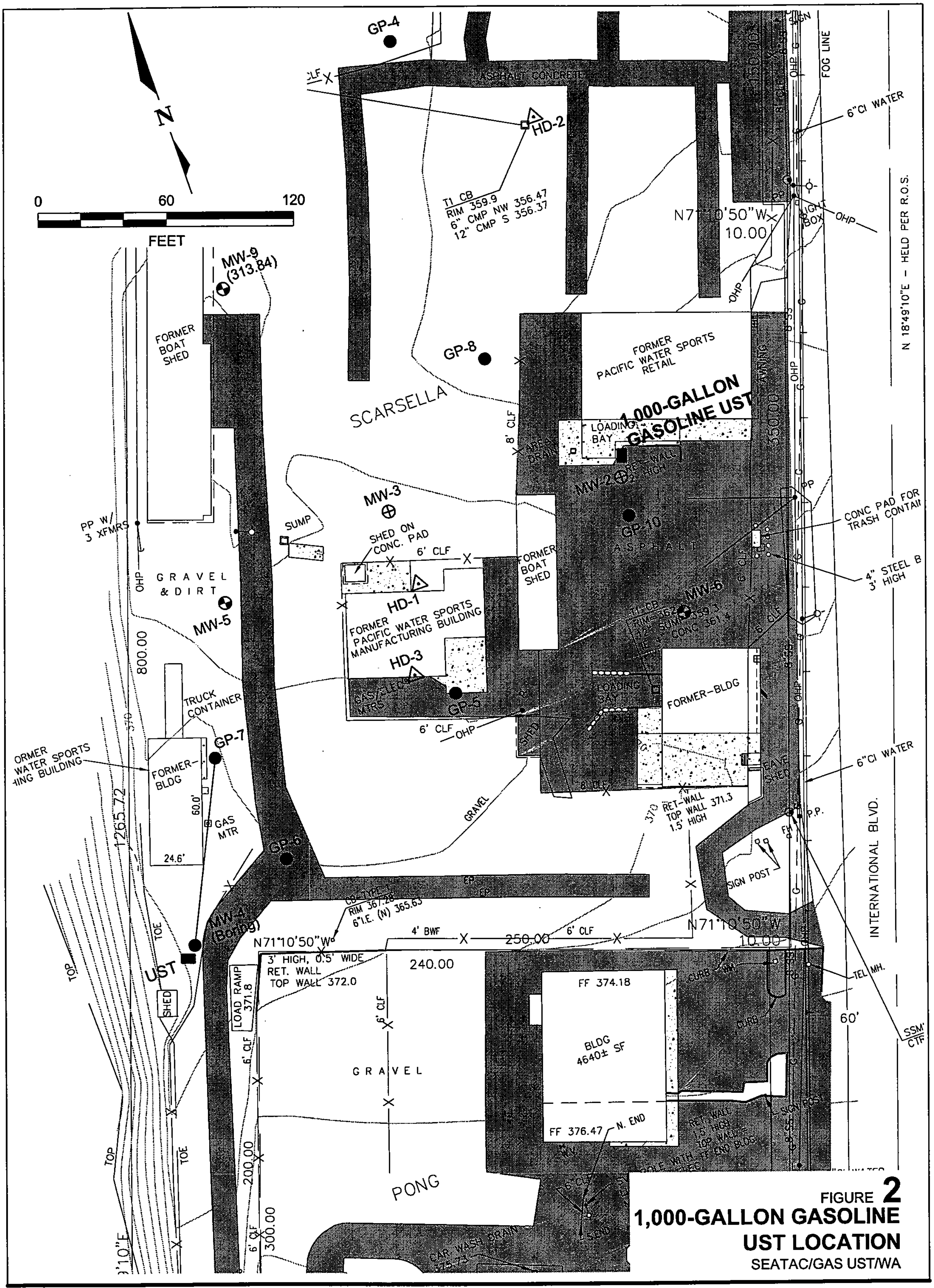


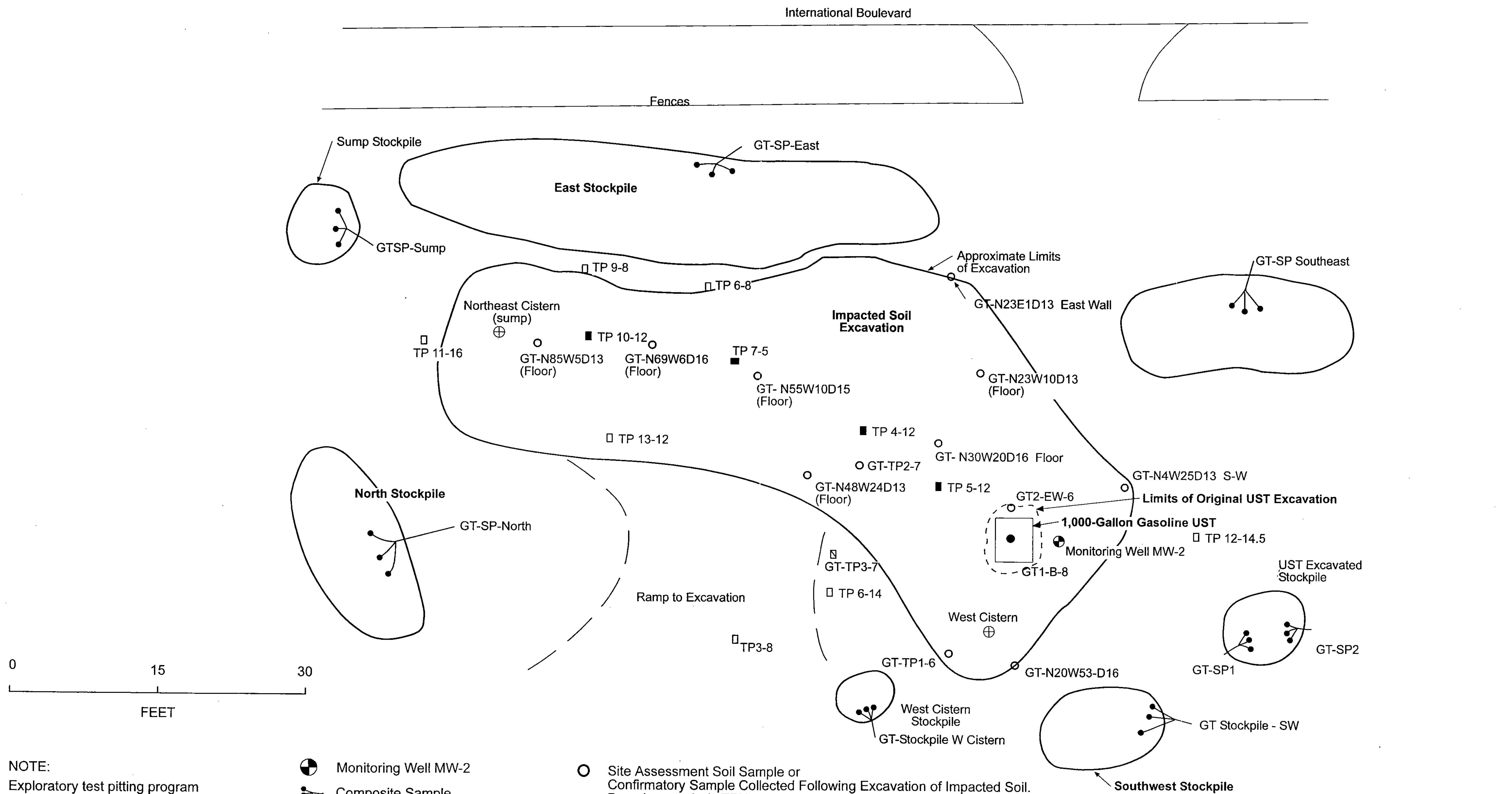
FIGURE **2**

1,000-GALLON GASOLINE UST LOCATION

SEATAC/GAS UST/WA

bclark|K:\Projects\2001\0131427\500\96196.dwg|9-13-1 3:12|x:x-xbase,x-htch,XR-SAMPLES|i:-

Golder Associates



NOTE:

Exploratory test pitting program (designated by rectangle symbols) was conducted prior to remedial excavation activities. Confirmatory samples (designated by hollow circles) with TPH concentrations below MTCA Method A cleanup levels were collected following remedial excavation activities.

◐ Monitoring Well MW-2

Composite Sample

■ Test Pit with Impacted Soil Based on Field Screening

☐ Test Pit with Unimpacted Soil Based on Field Screening

☒ Test Pit with Unimpacted Soil Based on Analysis

○ Site Assessment Soil Sample or Confirmatory Sample Collected Following Excavation of Impacted Soil. Based on analysis TPH concentrations were below MTCA Method A cleanup levels

⊕ Cistern (Sump) Removed

● Site Assessment Soil Sample (collected prior to remedial excavation activities). TPH concentrations were above MTCA Method A cleanup levels - confirming a product release.

FIGURE 3

1,000 GALLON GASOLINE UST SOIL REMEDIATION SITE ASSESMENT AND SAMPLE LOCATIONS

SEATAC/GAS UST/WA

PROJECT NO. 013 1427_500-11x17 DRAWING NO. 92835 DATE 09/28/01 DRAWN BY EL

Golder Associates

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

SITE ASSESSMENT CONDUCTED FOR THE CLOSURE OF A 3,000 AND 10,000–GALLON UNDERGROUND STORAGE TANKS

MASTER PARK LOT C
16000 BLOCK INTERNATIONAL BOULEVARD
SEATAC, WASHINGTON

Prepared for:

SeaTac Investments LLC

Submitted by:

Golder Associates Inc.
Redmond, Washington

Ted Norton
Project Manager

for Doug

Douglas Morell
Principal

October 4, 2001

013-1427.500
1004tjn1

TABLES

TABLE 1

Analysis Results for Soil Samples Associated With the
3,000 and 10,000-Gallon USTs, SeaTac Master Park Lot C.

Sample Number	**Location**	**Gasoline Range Petroleum (mg/kg)**	**Diesel Range Petroleum (mg/kg)**	**Oil Range Petroleum (mg/kg)**
NT1-B-9	Below 3,000-gallon UST in bottom of excavation 8 feet bgs	< 21	< 53	< 110
NT2-SW-6.5	South wall of excavation 6.5 feet bgs	< 22	<56	< 110
NT3-B-10.5	Below 10,000-gallon UST in bottom of excavation 10.5 feet bgs	< 22	< 54	< 110
NT4-EW-8	East wall of excavation 8 feet bgs	<26	<65	<130
NT5-B-12	Below 10,000-gallon UST in bottom of excavation 12 feet bgs	< 21	< 53	< 110
NT6-NWW-8	Northwest corner wall of excavation 8 feet bgs	< 22	160	110
NT-SP1	Stockpile sample	< 22	<56	< 110
NT-SP2	Stockpile sample	N/A	N/A	N/A
NT-SP3	Stockpile sample	< 22	**280**	160
NT7-SP4	Stockpile sample	< 22	170	160

Note:
MTCA Method A cleanup levels prior to August 15, 2001
- gasoline range petroleum hydrocarbons 100 mg/kg
- diesel range petroleum hydrocarbons 200 mg/kg
- heavy oil range petroleum hydrocarbons 200 mg/kg

MTCA Method A cleanup levels after August 15, 2001
- gasoline range petroleum hydrocarbons 100 mg/kg
- diesel range petroleum hydrocarbons 2,000 mg/kg
- heavy oil range petroleum hydrocarbons 2,000 mg/kg

Bold – Indicates that the concentration exceeds the MTCA Method A cleanup level prior to August 15, 2001.
N/A – Not Analyzed

FIGURES

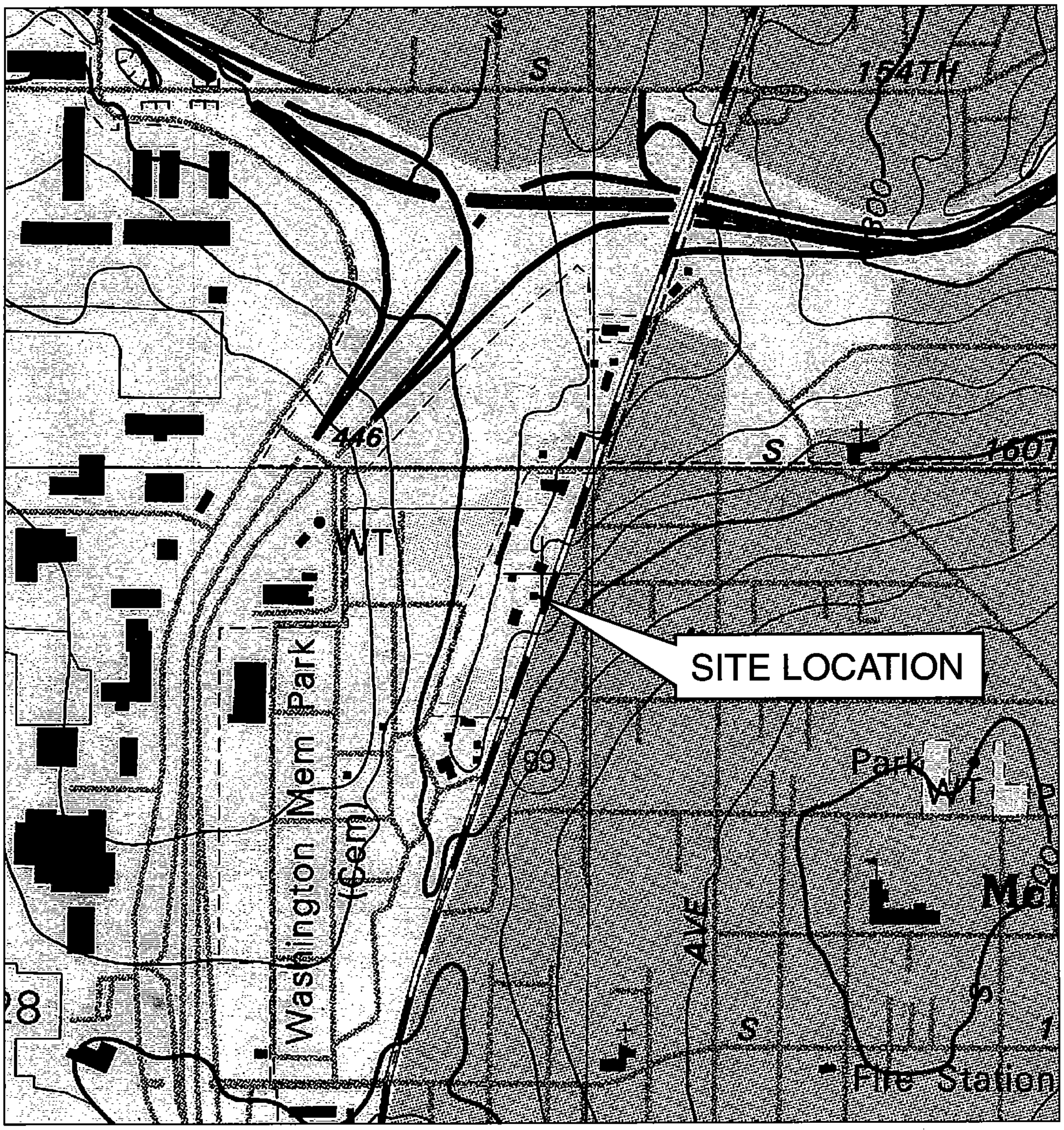


FIGURE **1**

SITE VICINITY MAP

SEATAC/I0K REPORT/WA

PROJECT NO. 013 1427_500 DRAWING NO. 92275b DATE 08/22/01 DRAWN BY KH

Golder Associates

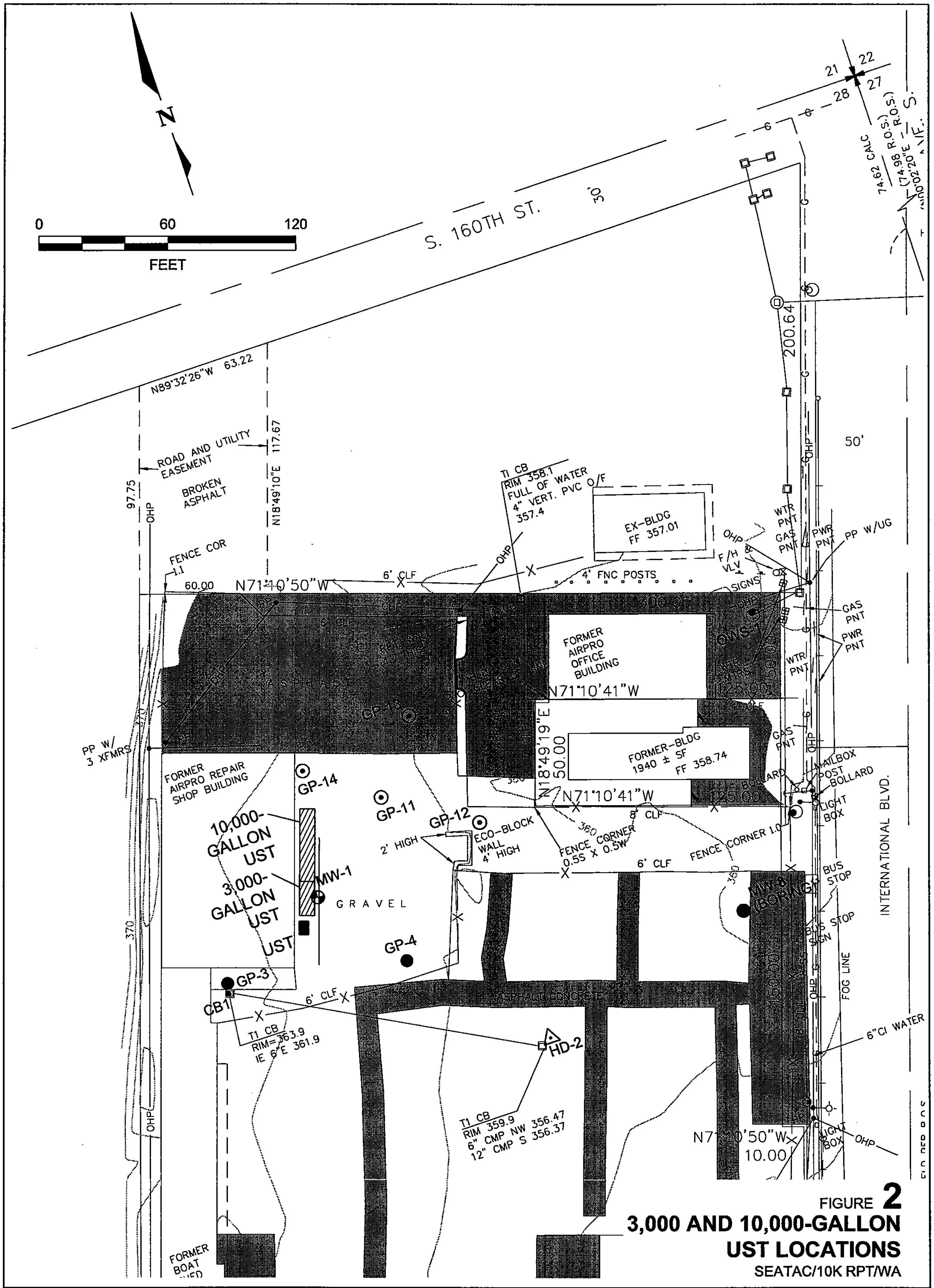


FIGURE **2**

3,000 AND 10,000-GALLON UST LOCATIONS

SEATAC/10K RPT/WA

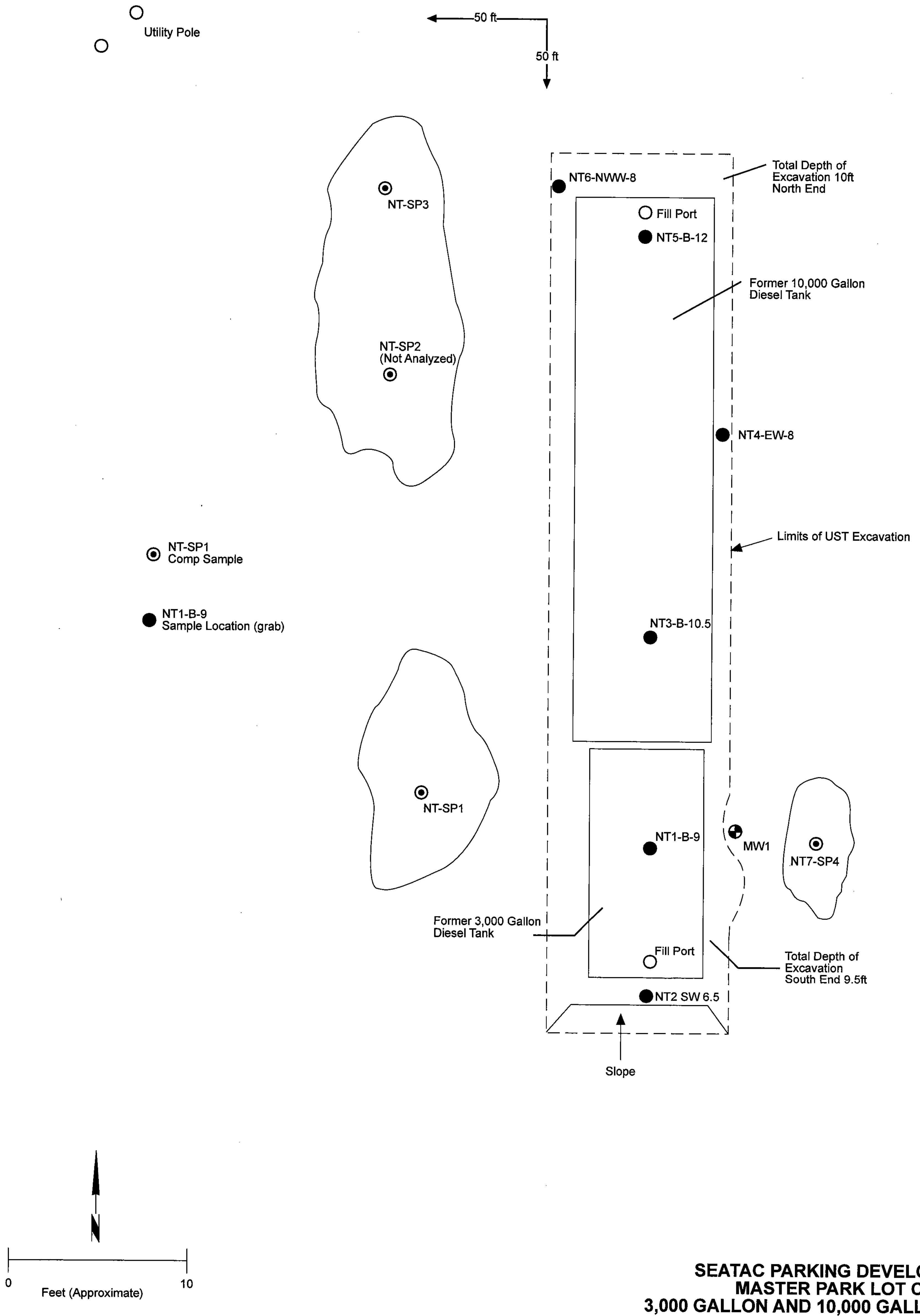


FIGURE 3

SEATAC PARKING DEVELOPMENT
MASTER PARK LOT C NORTH
3,000 GALLON AND 10,000 GALLON UST
SITE ASSESSMENT SAMPLE LOCATIONS
SEATAC/UST/WA

PROJECT NO. 013 1427_500 DRAWING NO. 92493 DATE 08/22/01 DRAWN BY EL

Golder Associates

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

Golder Associates

SITE ASSESSMENT FOR THE CLOSURE OF A 300–GALLON HEATING OIL UNDERGROUND STORAGE TANK

MASTER PARK LOT C
16000 BLOCK INTERNATIONAL BOULEVARD
SEATAC, WASHINGTON

Prepared for:

SeaTac Investments LLC

Submitted by:

Golder Associates Inc.
Redmond, Washington

for Gary Zimmerman
Senior Environmental Scientist

for Ted Norton
Project Manager

Douglas Morell
Principal

October 24, 2001

013-1427.500
1024tjn1

TABLES

TABLE 1

SOIL SAMPLING ANALYTICAL RESULTS ASSOCIATED WITH REMOVAL OF THE 300-GALLON HEATING OIL UST
SeaTac Master Park Lot C.

Sample Number	Location	Sample Depth (feet below ground surface)	Diesel Range Petroleum (mg/Kg)	Oil Range Petroleum (mg/Kg)	Gasoline Range Petroleum (mg/Kg)	Benzene (mg/Kg)	Toluene (mg/Kg)	Ethylbenzene (mg/Kg)	Total Xylenes (mg/Kg)
COT-Grab	UST Spilled Product in Soil Near top of UST	1	36000	<1100	<28	<0.056	<0.28	1.9	6.2
EX-Bottom	Floor of excavation, beneath UST	5	<27	<54	-	<0.011	<0.054	<0.054	<0.054
Ex-West	West side wall of excavation	4	<27	<54	-	-	-	-	-
EX-South	South side wall of excavation	4.5	130	<54	-	-	-	-	-
EX-East	East side wall of excavation	4.5	<28	<55	-	-	-	-	-
EX-North	North side wall of excavation	4.5	<27	<53	-	-	-	-	-
SPC-1	Composite of stockpile*	na	7900	<290	-	-	-	-	-
SPC-2	Composite of stockpile*	na	2000	<55	-	<0.011	0.1	1.3	4.2

Notes:
MTCA Method A Cleanup Levels:
- Gasoline range petroleum hydrocarbons without benzene 100 mg/Kg
- Diesel range petroleum hydrocarbons 2,000 mg/Kg
- Heavy Oil range petroleum hydrocarbons 2,000 mg/Kg
- Benzene 0.03 mg/Kg
- Toluene 7 mg/Kg
- Ethylebenzene 6 mg/Kg
- Xylenes 9 mg/Kg

*Stockpile soil was removed from the site and disposed of at Waste Management Olympic View Landfill
"-" Indicates sample not analyzed for that compound

FIGURES

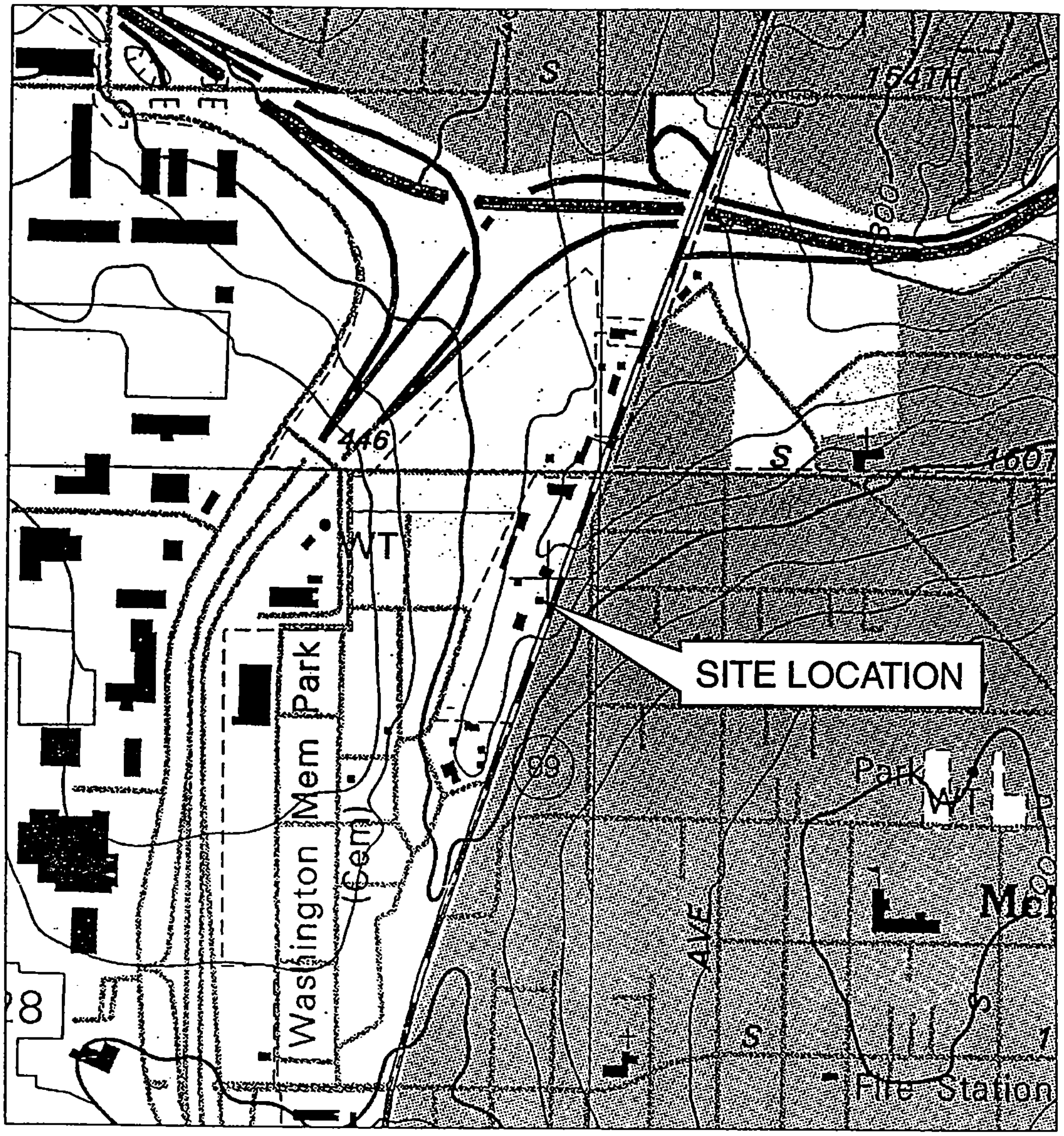
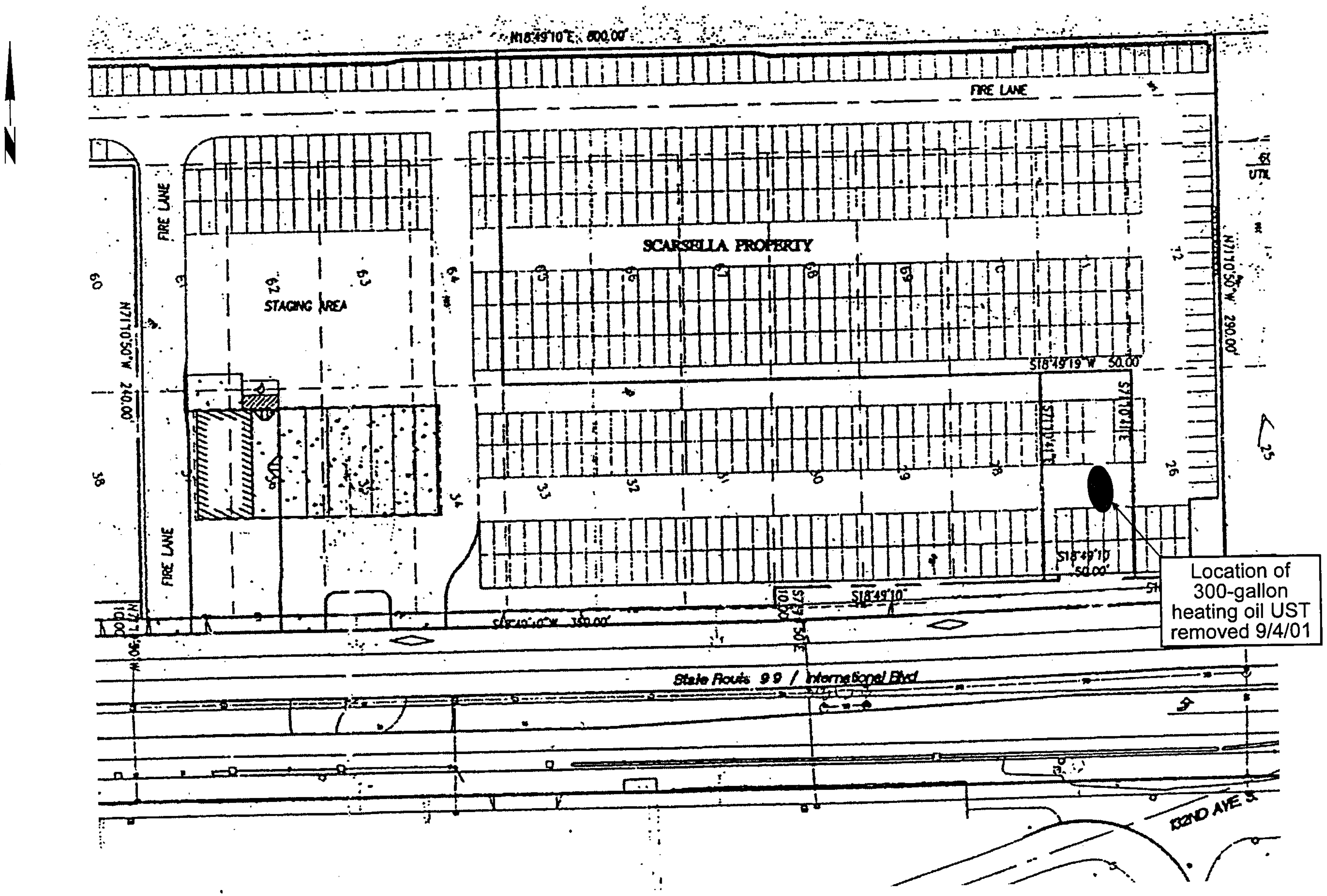


FIGURE 1
SITE VICINITY MAP
SEATAC/IK UST/WA

PROJECT NO. 013 1427_500 DRAWING NO 92275 DATE 08/22/01 DRAWN BY KH

Golder Associates



Location of
300-gallon
heating oil UST
removed 9/4/01

FIGURE **2**

300-GALLON HEATING OIL UST LOCATION

SEATAC/HEATING OIL UST/WA

PROJECT NO. 013 1427_500 DRAWING NO. 96695 DATE 10/04/01 DRAWN BY EL

Golder Associates

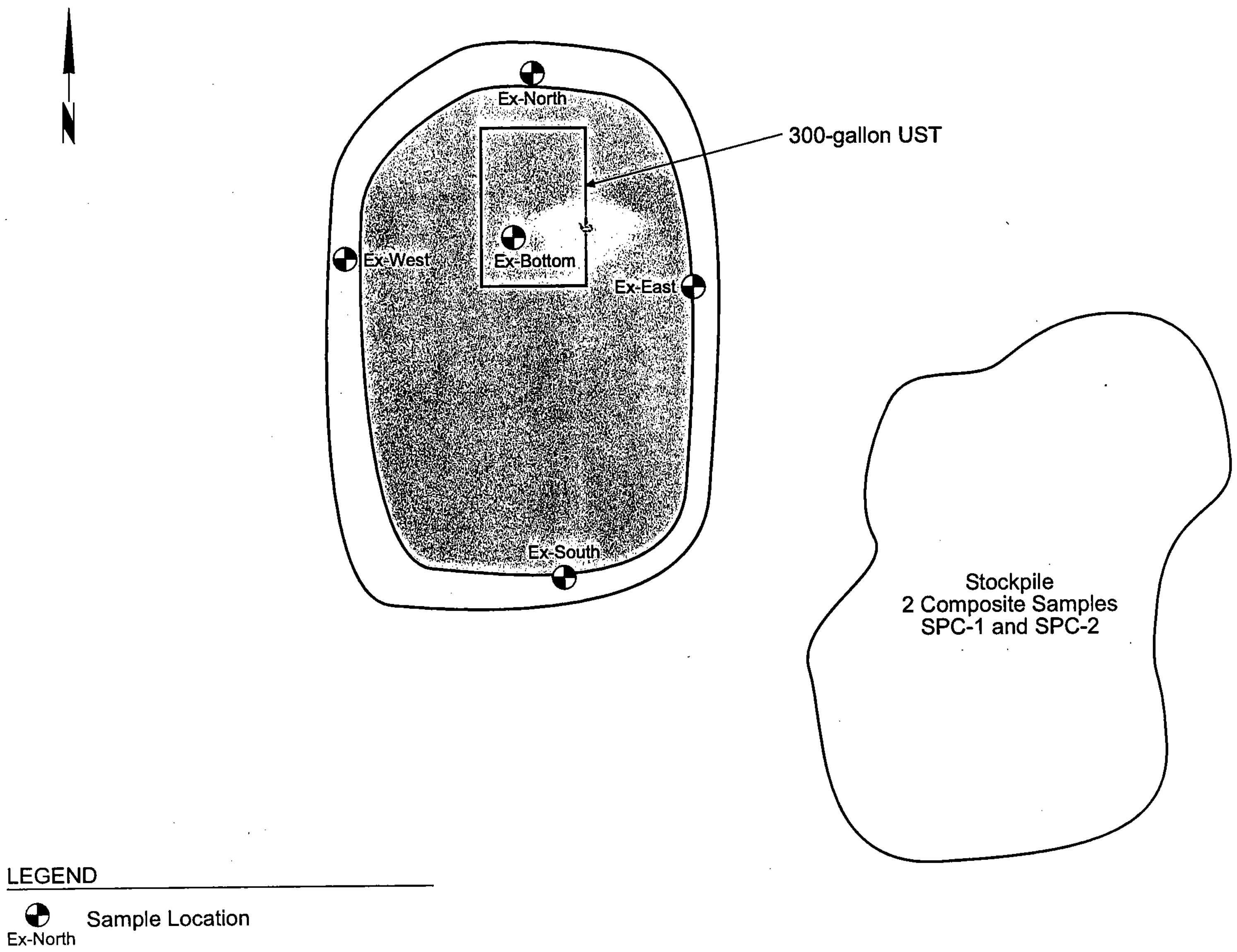


FIGURE **3**

300-GALLON HEATING OIL UST CLOSURE
SAMPLE LOCATIONS
SEATAC/HEATING OIL UST/WA

PROJECT NO. 013 1427_500 DRAWING NO. 96696 DATE 10/04/01 DRAWN BY EL

Golder Associates

Golder Associates Inc.

18300 NE Union Hill Road, Suite 200
Redmond, WA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498

FINAL
INDEPENDENT REMEDIAL ACTION REPORT SEATAC PARKING GARAGE DEVELOPMENT SITE SEATAC, WASHINGTON (MASTER PARK LOT C)

Prepared for:

SeaTac Investments LLC

Submitted by:

Golder Associates Inc.
Redmond, Washington

January 24, 2002

013-1427.600
0124tjn1

TABLES

Analytical Results for Near Surface Soil Composite Sample (Extractable Petroleum Hydrocarbons)

Compounds/Analysis	Units	Sample ID ITPH-Comp
Total Aliphatic Hydrocarbons		
Aliphatic C10-C12	mg/kg	9.1
Aliphatic C12-C16	mg/kg	71
Aliphatic C16-C18	mg/kg	270
Aliphatic C18-C21	mg/kg	1300
Aliphatic C21-C28	mg/kg	15000
Aliphatic C28-C36	mg/kg	20000
Total Aromatic Hydrocarbons		
Aromatic C10-C12	mg/kg	< 54
Aromatic C12-C16	mg/kg	< 54
Aromatic C16-C18	mg/kg	81
Aromatic C18-C21	mg/kg	220
Aromatic C21-C28	mg/kg	630
Aromatic C28-C34	mg/kg	240

Note: "<" - Not detected and the PQL is shown on this table

Trenching Soil Field Screening and Confirmatory Sample Results

Sample ID	Date	Field Screen TPH (ppm)	Laboratory diesel (ppm)	Laboratory heavy oil (ppm)	Comments
7-27-01-1	7/27/01	352	-	-	Used for Backfill
7-27-01-2	7/27/01	485	-	-	Used for Backfill
7-30-01-1	7/30/01	547	-	-	Used for Backfill
7-30-01-2	7/30/01	54	-	-	Used for Backfill
7-30-01-3	7/30/01	162	-	-	Used for Backfill
7-30-01-4	7/30/01	761	-	-	Used for Backfill
7-30-01-4	7/30/01	62	ND<27	ND<54	Used for Backfill
7-30-01-5	7/30/01	106	-	-	Used for Backfill
7-30-01-6	7/30/01	70	-	-	Used for Backfill
7-30-01-7	7/30/01	65	-	-	Used for Backfill
7-30-01-8	7/30/01	73	-	-	Used for Backfill
7-30-01-9	7/30/01	87	-	-	Used for Backfill
7-31-01-1	7/31/01	11	-	-	Used for Backfill
7-31-01-2	7/31/01	1	-	-	Used for Backfill
7-31-01-3	7/31/01	21	-	-	Used for Backfill
7-31-01-4	7/31/01	180	-	-	Used for Backfill
7-31-01-5	7/31/01	687	190	340	Used for Backfill
7-31-01-6	7/31/01	758	-	-	Used for Backfill
7-31-01-7	7/31/01	526	-	-	Used for Backfill
7-31-01-8	7/31/01	151	-	-	Used for Backfill
7-31-01-9	7/31/01	110	-	-	Used for Backfill
8-01-01-1	8/1/01	72	-	-	Used for Backfill
8-01-01-2	8/1/01	143	-	-	Used for Backfill
8-01-01-3	8/1/01	84	-	-	Used for Backfill
8-01-01-4	8/1/01	108	-	-	Used for Backfill
8-03-01-4	8/3/01	50	-	-	Used for Backfill
8-09-01-1	8/9/01	126	-	-	Used for Backfill
8-31-01-1	8/31/01	9	-	-	Used for Backfill
8-31-01-2	8/31/01	79	-	-	Used for Backfill
8-31-01-4	8/31/01	110	-	-	Used for Backfill
9-13-01-1	9/13/01	55	<28	<56	Used for Backfill
9-13-01-2	9/13/01	17	-	-	Used for Backfill
9-15-01-1	9/15/01	148	<28	130	Used for Backfill
9-15-01-2	9/15/01	84	-	-	Used for Backfill

Note: "<" - Not detected and the PQL is shown on this table

TABLE 3

Grading Soil Field Screening and Confirmatory Sample Results

Area	Sample ID	Date	Field Screen	Laboratory		Comments
			TPH (ppm)	heavy oil (ppm)	diesel (ppm)	
1	7-18-01-1	7/18/01	1598	-	-	Removed
	7-18-01-1	7/19/01	982	710	<130	
	7-18-01-2	7/18/01	>2000	-	-	
	7-18-01-3	7/18/01	2003	-	-	
	7-18-01-4	7/18/01	>2000	-	-	
	7-18-01-5	7/18/01	1913	-	-	
	7-18-01-7	7/18/01	1848	-	-	
	7-18-01-7	7/19/01	970	950	<27	
	7-18-01-10	7/18/01	534	-	-	
	7-18-01-14	7/18/01	1130	-	-	
	7-18-01-16	7/18/01	721	-	-	
	7-18-01-21	7/18/01	>2000	-	-	
2	7-30-01-g.s.	7/30/01	1132	-	-	Used for Backfill
3	7-31-01-10	7/31/01	930	-	-	Used for Backfill
4	8-02-01-1	8/2/01	423	-	-	Used for Backfill
	8-02-01-2	8/2/01	292	-	-	
	8-02-01-3	8/2/01	219	120	<28	
5	8-02-01-4	8/2/01	876	-	-	Used for Backfill
6	8-03-01-1	8/3/01	544	-	-	Used for Backfill
	8-03-01-2	8/3/01	238	-	-	
	8-03-01-3	8/3/01	556	-	-	
	8-03-01-6	8/3/01	66	-	-	
7	8-03-01-5	8/3/01	>2000	-	-	Removed
8	8-06-01-1	8/6/01	675	-	-	Used for Backfill
9	8-21-01-1	8/21/01	372	-	-	Used for Backfill
	8-21-01-2	8/21/01	13	-	-	
	9-15-01-1	9/15/01	128	-	-	
10	8-31-01-3	8/31/01	697	-	-	Used for Backfill
11	9-04-01-5	9/4/01	1246	1000	<27	Used for Backfill

Note: "<" - Not detected and the PQL is shown on this table

TABLE 4

Storm Water Retention Vault and Canopy Footing Field Screening and Confimatory Results

Area	Sample ID	Date	Field Screen	Laboratory		Comments
			TPH (ppm)	heavy oil (ppm)	diesel (ppm)	
Storm Water	7-19-01-1	7/19/01	33	-	-	Used for Backfill
	7-19-01-2	7/19/01	52	-	-	
	7-19-01-3	7/19/01	21	-	-	
	7-19-01-4	7/19/01	122	-	-	
	7-19-01-5	7/19/01	290	-	-	
	7-19-01-6	7/19/01	73	-	-	
	7-19-01-7	7/19/01	68	<56	<28	
	7-19-01-8	7/19/01	1277	-	-	
	7-19-01-9	7/19/01	92	-	-	
	7-19-01-10	7/19/01	72	-	-	
	7-19-01-11	7/19/01	59	-	-	
	7-19-01-12	7/19/01	21	<57	<29	
	7-21-01-1	7/21/01	0	-	-	
	7-23-01-1	7/23/01	11	-	-	
	7-23-01-2	7/23/01	244	-	-	
	7-23-01-3	7/23/01	42	-	-	
	7-23-01-4	7/23/01	493	520	<28	
	7-23-01-5	7/23/01	1185	1200	170	
	7-23-01-6	7/23/01	23	-	-	
	7-24-01-1	7/24/01	60	-	-	
	7-24-01-2	7/24/01	35	-	-	
	7-24-01-3	7/24/01	45	-	-	
Canopy	8-09-01-2	8/9/01	202	-	-	Used for Backfill
	8-09-01-3	8/9/01	162	69	<27	
	8-14-01-1	8/14/01	94	-	-	

Note: "<" - Not detected and the PQL is shown on this table

TABLE 5

Cavey Drainfield Soil Sample Analytical Results

Compounds/Analysis	Units	Sample ID	REGULATORY CLEANUP LEVELS		
		7/18-CDF	MTCA Method A Cleanup Levels (Previous)	MTCA Method A Cleanup Levels (Current)	MTCA Method B Cleanup Levels
Total Petroleum Hydrocarbons (TPH) by NWTPH-HCID					
TPH Gasoline	mg/kg	< 24	100	100	
TPH Diesel	mg/kg	< 60	200	2,000	
TPH Oil	mg/kg	< 120	200	2,000	
VOCs by 8260B					
Acetone	mg/kg	0	8,000		8,000
SVOCs by 8270C					
4-Chloroaniline	mg/kg	0	320		320
Organochlorine Pesiticides 8081					
Chlordane (Technical)	mg/kg	70	0.769		2.86
TOTAL METALS 6010B/7471A					
Barium	mg/kg	90	5,600		5,600
Chromium	mg/kg	26	100	19 (VI), 2,000 (III)	
Lead	mg/kg	29	250	250	
Silver	mg/kg	290	400		400

Note: Constituents in analytical suite not shown were not detected above the PQLs

"<" - Not detected and the PQL is shown on this table

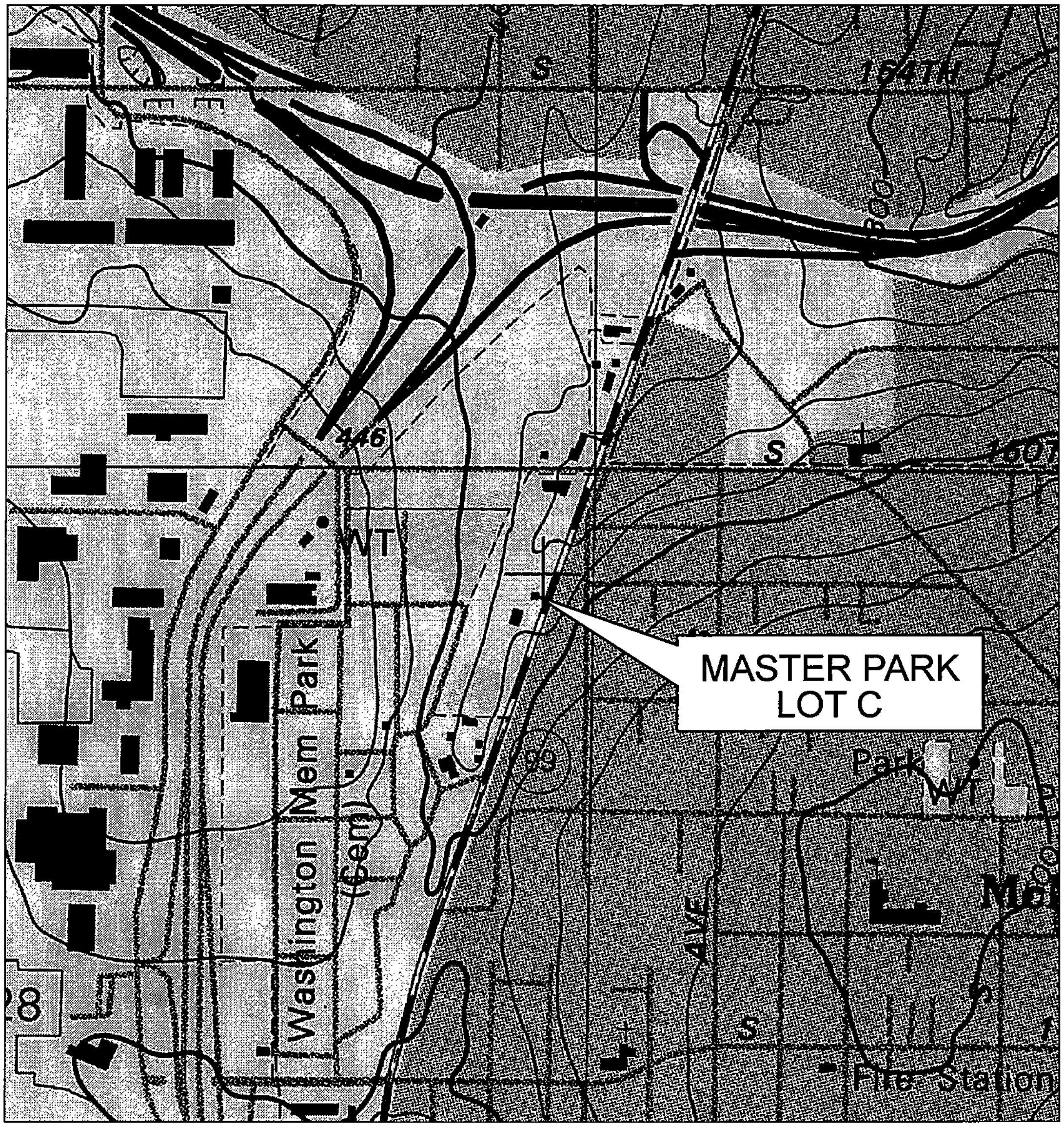
TABLE 6

Oil-Water Separator and Northwest Sump Soil Samples Analytical Results

Compounds/Analysis	Units	Sample ID					REGULATORY CLEANUP LEVELS		
		OWS 8-30-01 1B	OWS 8-30-01 2W	OWS 8-30-01 3STK	NWCB-STK	NWCB-Bot	MTCA Method A Cleanup Levels (Previous)	MTCA Method A Cleanup Levels (Current)	MTCA Method B Cleanup Levels
Total Petroleum Hydrocarbons and BTEX by NWTPH-(Gx/BTEX and Dx)									
TPH Gas	mg/kg	<5.4	<6.1	<5.8	< 5.6	< 5.3	100	100	
m,p-Xylene$_{(Gx/BTEX)}$	mg/kg	< 0.054	< 0.061	< 0.058	0.092	< 0.053	20	9.0	
TPH Diesel$_{(Dx)}$	mg/kg	<27	<31	<29	1200	64	200	2,000	
TPH Oil$_{(Dx)}$	mg/kg	<54	<61	<58	580	83	200	2,000	
PAHs by 8270C									
Napthalene	mg/kg	< 0.036	NA	< 0.078	0.59	< 0.089	1.0	5.0	
2-Methylnaphthalene	mg/kg	< 0.036	NA	< 0.078	4.8	< 0.089	1.0		
1-Methylnaphthalene	mg/kg	< 0.036	NA	< 0.078	3.9	< 0.089	1.0		
Acenaphthalene	mg/kg	< 0.036	NA	< 0.078	0.16	< 0.089	1.0		
Acenaphthene	mg/kg	< 0.036	NA	< 0.078	0.4	< 0.089	1.0		4,800
Fluorene	mg/kg	< 0.036	NA	< 0.078	1.1	< 0.089	1.0		3,200
Phenanthrene	mg/kg	< 0.036	NA	< 0.078	2.1	< 0.089	1.0		
Anthracene	mg/kg	< 0.036	NA	< 0.078	0.17	< 0.089	1.0		24,000
PCBs by 8082									
	mg/kg	< 0.054	NA	< 0.058	< 0.056	< 0.053	320		320
Total Lead 6010B									
	mg/kg	< 5.4	NA	< 5.8	37	< 5.3	250	250.0	

Note: Constituents in analytical suite not shown were not detected above the PQLs
"<" - Not detected and the PQL is shown on this table
NA - Not analyzed

FIGURES



MASTER PARK
LOT C

FIGURE **1**

SITE VICINITY MAP

SEATAC INVESTMENTS/IRAR LOT/WA

PROJECT NO. 013 1427_600 DRAWING NO. 96960 DATE 01/23/02 DRAWN BY EL

Golder Associates

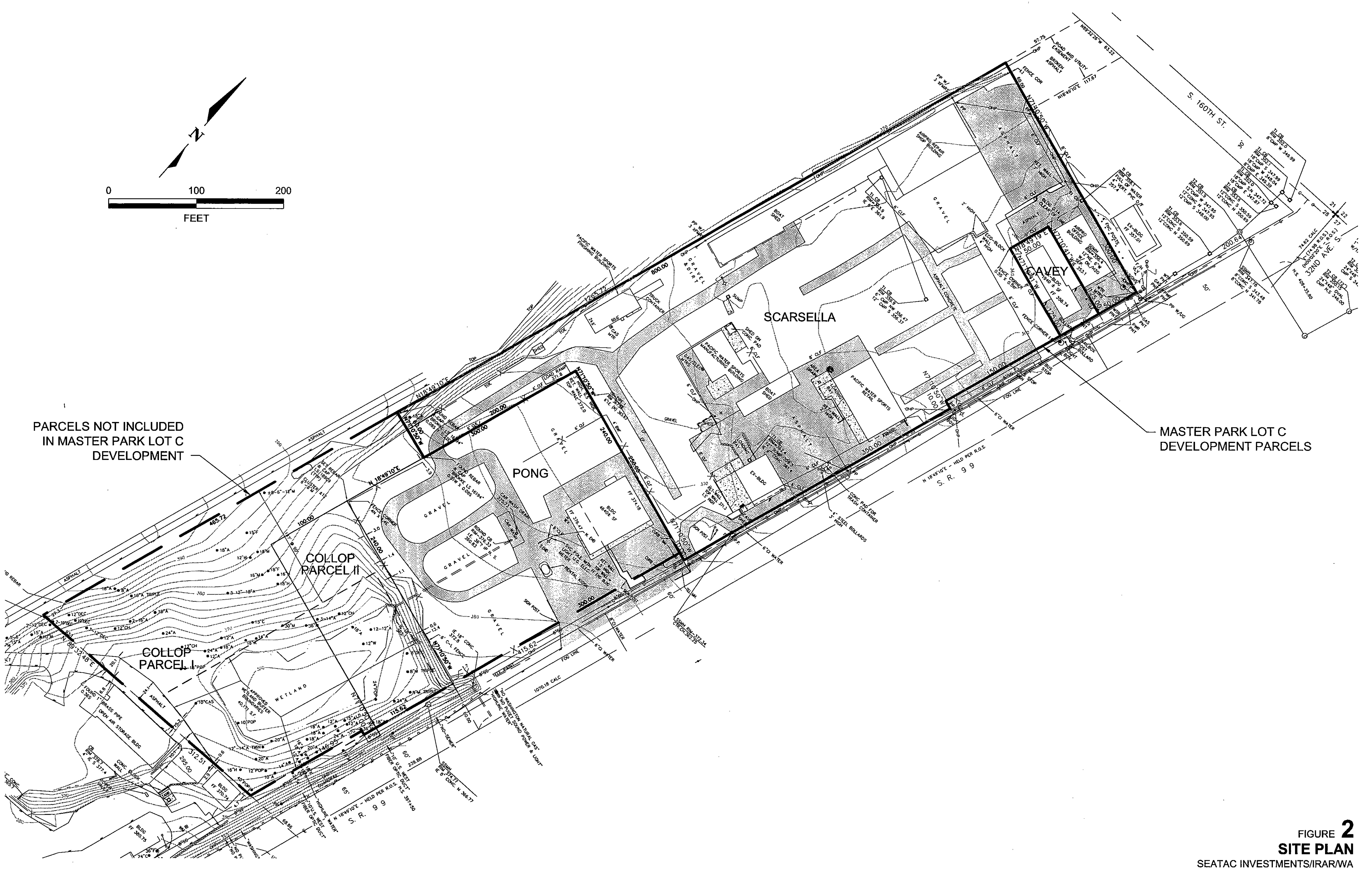


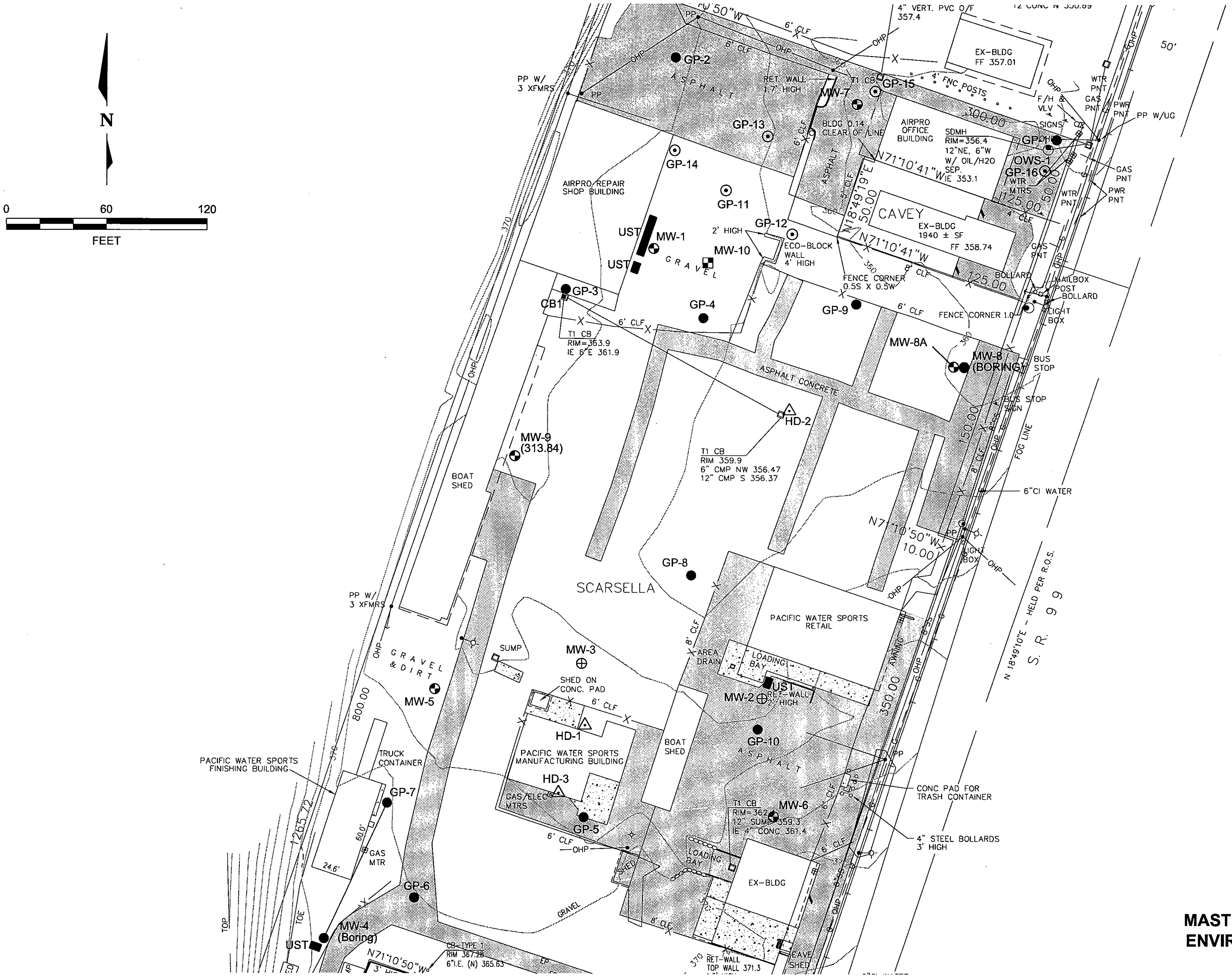
FIGURE **2**

SITE PLAN

SEATAC INVESTMENTS/IRAR/WA

DCabe|K:\Projects\2001\0131427\600\94990.dwg|1-23-2 15:55|x:x-xbase,x-htch|i:-

Golder Associates



	LEGEND
▣	REGIONAL AQUIFER DEEP COMPLETION MONITORING WELL
⊕	PERCHED WATER ZONE MONITORING WELL
⊙	EXTENDED PHASE II SOIL SAMPLE LOCATIONS
◕	REGIONAL AQUIFER MONITORING WELL
●	SOIL SAMPLE LOCATION
•	SLUDGE SAMPLE LOCATION
△	HAND AUGER SAMPLE LOCATIONS

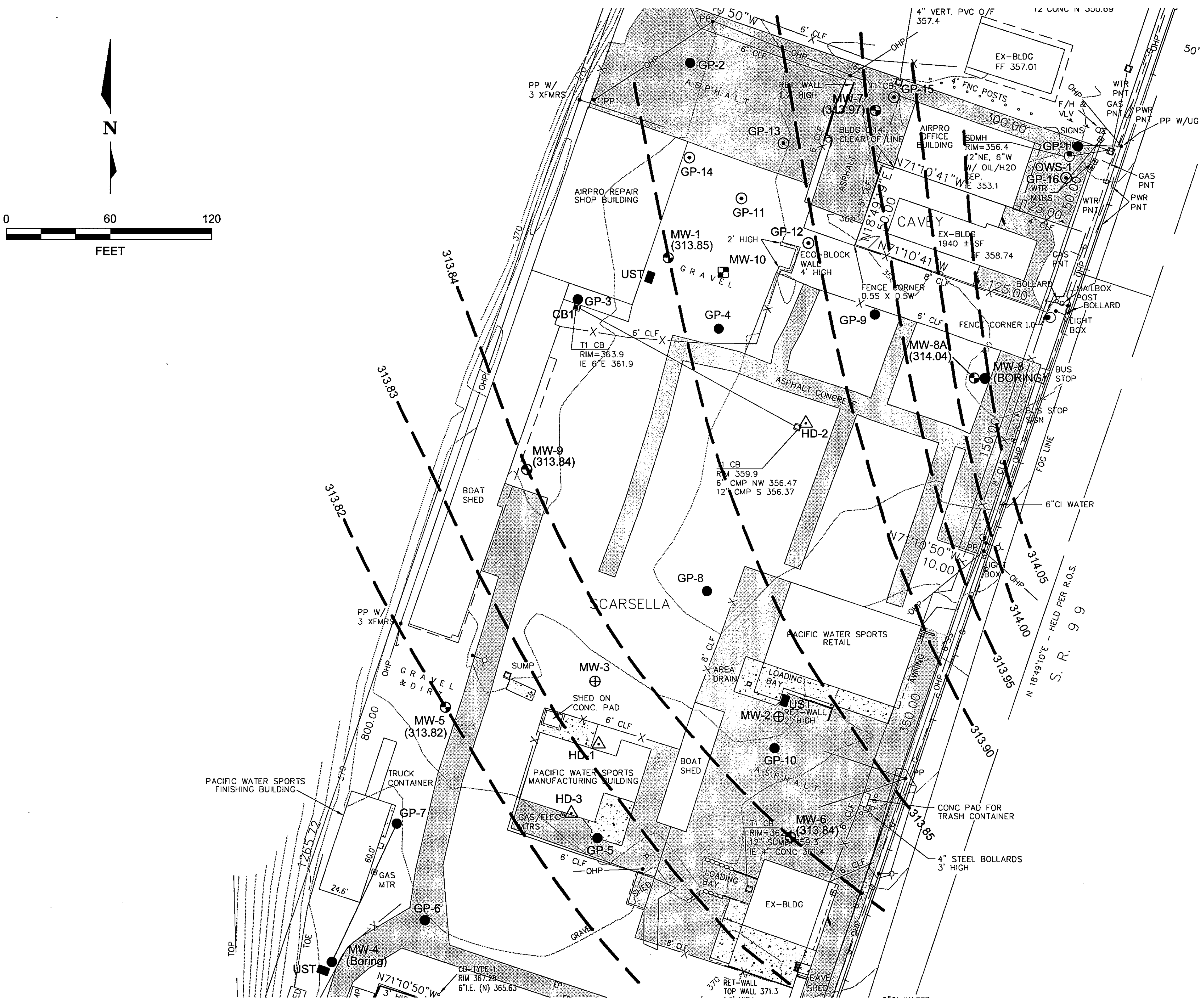
FIGURE 3

MASTER PARK LOT C DEVELOPMENT ENVIRONMENTAL SITE ASSESSMENT SAMPLING LOCATIONS

SEATAC INVESTMENTS/IRAR/WA

DCabe|K:\Projects\2001\0131427\600\94991.dwg|1-23-2 15:56|x:x-xbase,x-htch|i:-

Golder Associates



LEGEND

▣	REGIONAL AQUIFER DEEP COMPLETION MONITORING WELL
⊕	PERCHED WATER ZONE MONITORING WELL
⊙	EXTENDED PHASE II SOIL SAMPLE LOCATIONS
◐	REGIONAL AQUIFER MONITORING WELL
●	SOIL SAMPLE LOCATION
•	SLUDGE SAMPLE LOCATION
— —	WATER TABLE CONTOURS
△	HAND AUGER SAMPLE LOCATIONS
(313.84)	GROUNDWATER ELEVATION FEET AMSL

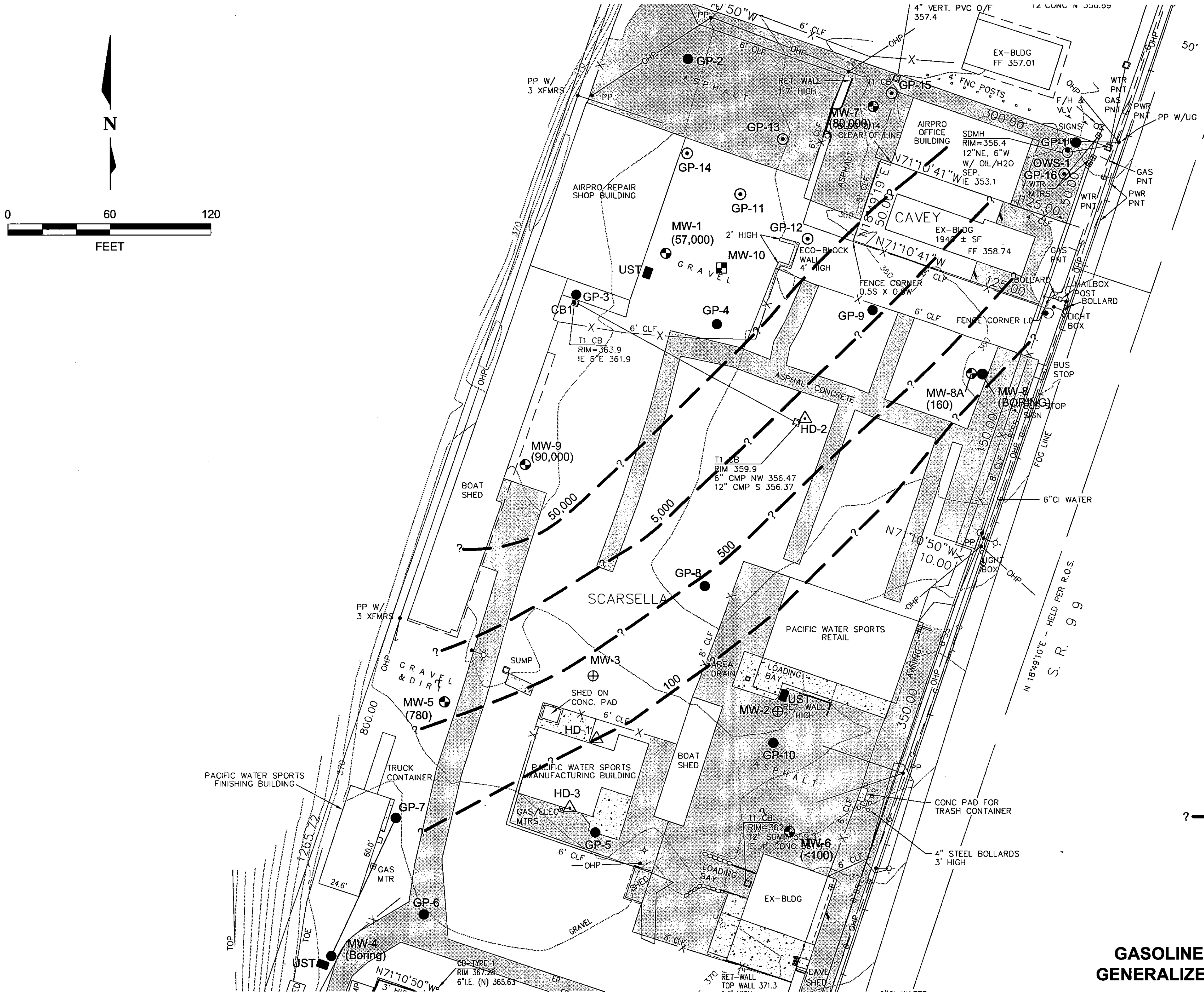
FIGURE 4

MASTER PARK LOT C DEVELOPMENT REGIONAL AQUIFER GROUNDWATER LEVEL CONTOURS (1/08/01)

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

DCabe|K:\Projects\2001\0131427\600\96975.dwg|1-23-2 15:58|x:x-xbase,x-htch|i:-



LEGEND

▣	REGIONAL AQUIFER DEEP COMPLETION MONITORING WELL
⊕	PERCHED WATER ZONE MONITORING WELL
⊙	EXTENDED PHASE II SOIL SAMPLE LOCATIONS
◉	REGIONAL AQUIFER MONITORING WELL
●	SOIL SAMPLE LOCATION
•	SLUDGE SAMPLE LOCATION
△	HAND AUGER SAMPLE LOCATIONS
(80,000)	CONCENTRATION OF GASOLINE RANGE PETROLEUM HYDROCARBON
?— 500 — —?	APPROXIMATE ISO CONCENTRATION µg/L GASOLINE RANGE PETROLEUM HYDROCARBON

FIGURE **5**

MASTER PARK LOT C DEVELOPMENT
REGIONAL AQUIFER
GASOLINE RANGE PETROLEUM HYDROCARBON
GENERALIZED ISO CONCENTRATION MAP (1/08/01)

SUNREAL/SEATAC GARAGE ESA/WA

DCabe|K:\Projects\2001\0131427\600\96976.dwg|1-23-2 15:59|x:x-xbase,x-htch|i:-

Golder Associates

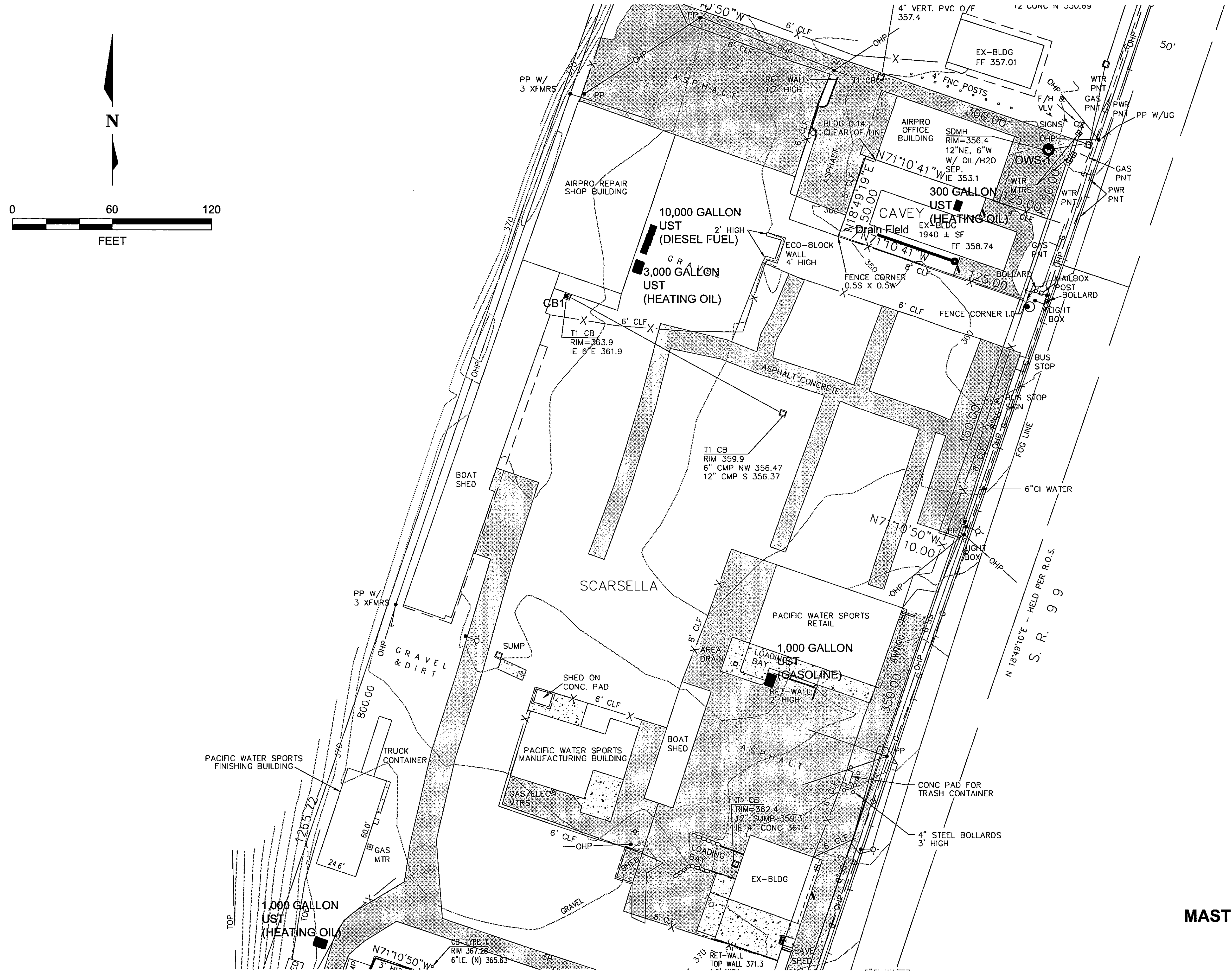


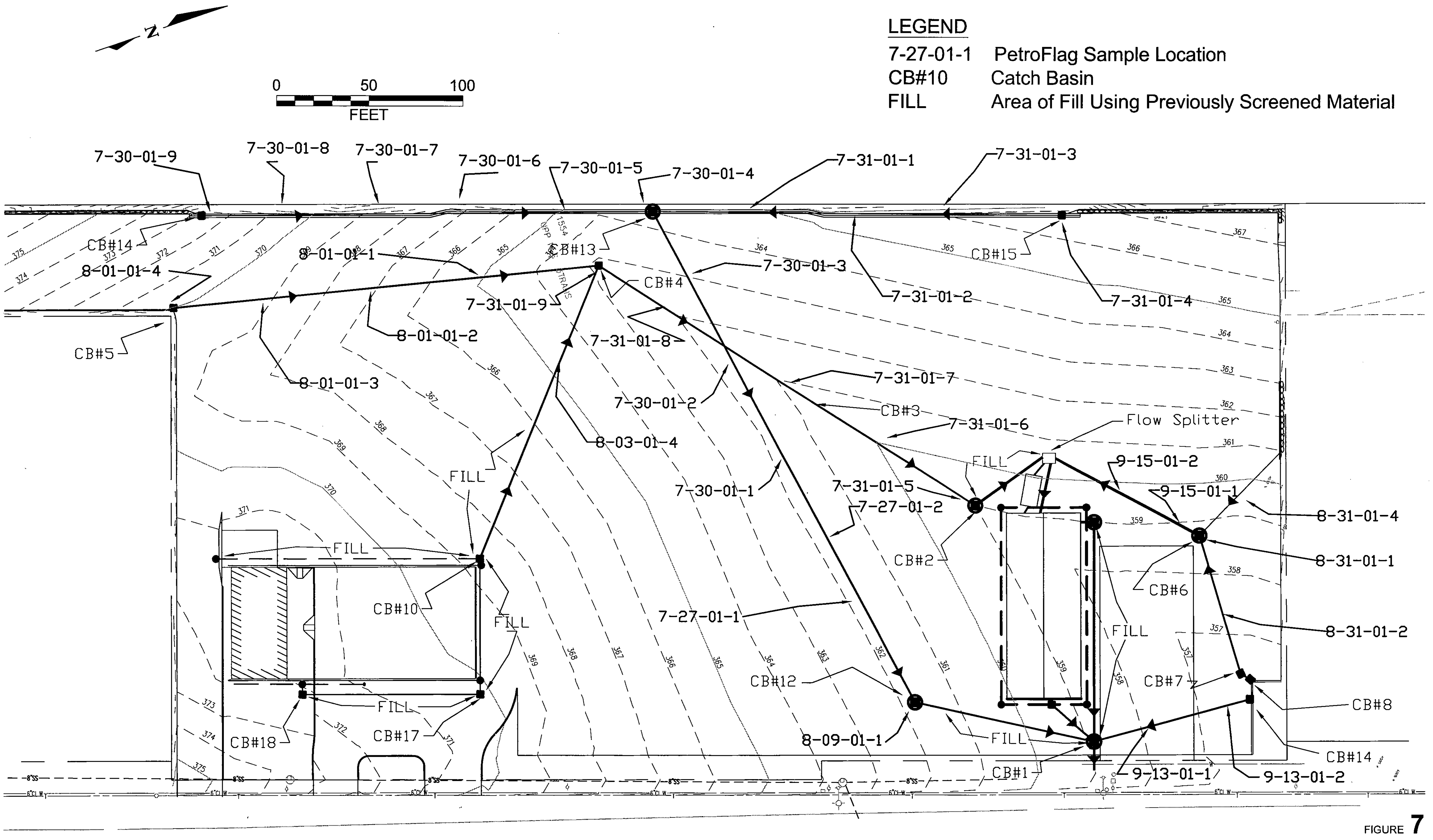
FIGURE 6

MASTER PARK LOT C DEVELOPMENT REMOVED SUBSURFACE STRUCTURE LOCATIONS

SEATAC INVESTMENTS/IRAR/WA

DCabe|K:\Projects\2001\0131427\600\94992.dwg|1-23-2 15:57|x:x-xbase,x-htch|i:-

Golder Associates



LEGEND

7-27-01-1	PetroFlag Sample Location
CB#10	Catch Basin
FILL	Area of Fill Using Previously Screened Material

FIGURE **7**

MASTER PARK LOT C DEVELOPMENT
FIELD SCREENED TRENCHING SAMPLE LOCATIONS
SEATAC INVESTMENTS/IRAR/WA

DCabe|K:\Projects\2001\0131427\600\94993.dwg|1-23-2 15:57|x:Xr-Base|i:-

Golder Associates

LEGEND

Area 1 **Approximate area of soil above site specific near surface soil clean up level (1,600 mg/kg) (removed)**

Area 2 Approximate area of soil within site specific near surface soil clean up level (1,600 mg/kg) (used onsite)

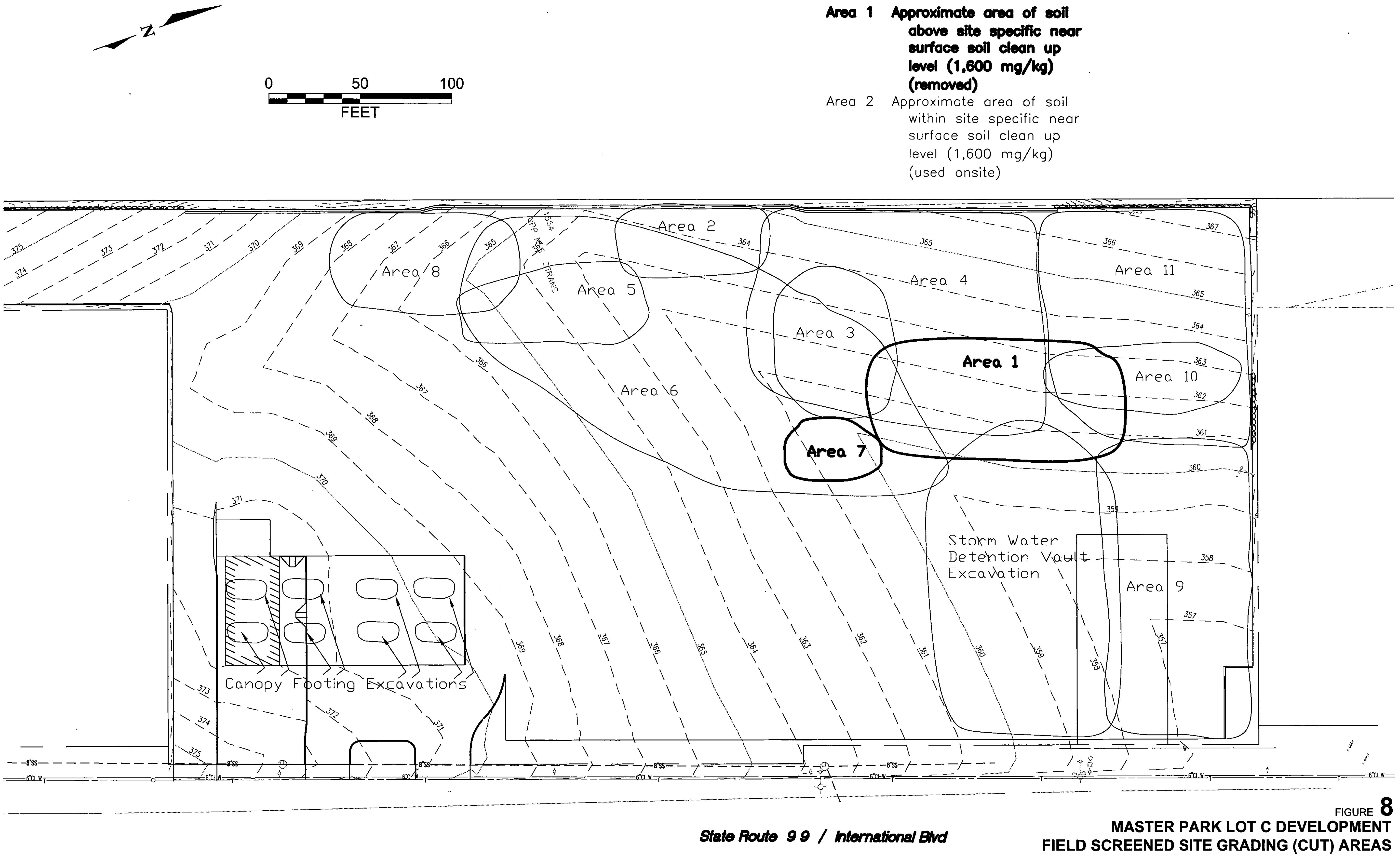


FIGURE **8**

MASTER PARK LOT C DEVELOPMENT

FIELD SCREENED SITE GRADING (CUT) AREAS

SEATAC INVESTMENTS/IRAR/WA

DCabe|K:\Projects\2001\0131427\600\94994.dwg|1-23-2 15:58|x:Xr-Base|i:-

Golder Associates

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA USA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498
www.golder.com

Golder Associates

January 14, 2008

Our ref: 073-93368-01.004

Riddell Williams P.S.
1001 Fourth Avenue Plaza Suite 400
Seattle, Washington 98154-1065

Attention: Harry Grant,

RE: ON-SITE SOURCE AND GROUNDWATER INVESTIGATION SUMMARY – JUNE TO NOVEMBER 2007

Dear Mr. Grant:

Golder Associates Inc. (Golder) completed an investigation of petroleum impacted groundwater in the Qva aquifer at the MasterPark Lot C property (Lot C) located at 16025 International Boulevard, SeaTac, Washington (Figure 1). Golder conducted further investigations to determine if there where any on-site sources contributing to the impacts in the groundwater. The MasterPark Lot C property covers approximately 7 acres and is presented on Figure 2. Investigation activities consisted of four different phases spanning the months of June to November, 2007. This report summarizes Golder's findings for this investigation.

INTRODUCTION

Historical data indicate groundwater in the regional Qva aquifer underlying the northeast portion of the MasterPark Lot C property has been impacted by gasoline range petroleum hydrocarbons. An underground storage tank (UST) for gasoline has been alleged to have been removed during the 1970s. Golder implemented a series of investigations during the later half of 2007 with the intent of identifying potential on-site sources that may have contributed impacts to the Qva aquifer and delineating their extent in the vadose zone including the allegedly removed gasoline UST. Individual investigations encompassed geophysical and soil gas surveys to locate potential on-site sources of gasoline contamination in the northwest portion of the Property, and confirmation with chemical analyses of soil samples collected from test pits and soil borings. Groundwater impacts were further defined by additional groundwater monitoring well installations and groundwater sampling and analyses. All wells (except MW-18) were surveyed for elevation to measure groundwater elevations and determine groundwater flow directions in the Qva aquifer for the site.

The following provides a description of the individual investigations conducted at the Site during 2007 and presents the results.

Geophysical and Subsurface Investigation

To verify that there were no undocumented USTs that might be potential sources of gasoline on Lot C; Golder performed a non-intrusive geophysical subsurface survey of the northeast portion of the property in September 2007. Ground-penetrating radar, magnetometry, and TDEM (time domain electromagnetic method) were used for the survey. As shown in Figure 3, three anomalies were detected that suggested the presence of massive or metallic objects buried within near-surface soils (<10 feet bgs). These three features could not be accounted for by surface features and known utilities, and could not be positively identified without a more intrusive investigation. A detailed summary of geophysical survey is provided in Attachment A

Golder conducted further exploration of the three subsurface anomalies in October 2007 by means of excavating test pits in each of the locations (Figure 3). As detailed in the test pitting report (provided as Attachment B), no USTs or objects of particular significance were discovered in near-surface soils. However, strong odors and instrument readings suggested the presence of petroleum hydrocarbon contamination in soil excavated from Test Pit 3, coinciding roughly with the position of historical soil boring GP-11. Two soil samples were collected from Test Pit 3, and all test pits were then backfilled and later re-paved.

Analyses of the soil samples from Test Pit 3 were performed by Analytical Resources, Inc., of Tukwila, Washington. These analytical results are summarized in Table 1 and laboratory data reports are included in Attachment C (Provided on the attached CD). The resulting analytical data indicated the presence of diesel, motor oil, gasoline, toluene, ethylbenzene, and total xylenes; benzene was not detected in either sample. These results corresponded to analytical results noted in samples collected from nearby soil boring GP-11 (GeoProbe boring GP-11 was conducted in 2001), which also indicated similar contaminants in this location over MTCA cleanup levels (i.e. gasoline was detected at 440 and 330 mg/kg at 14 and 23 feet bgs respectively, an total xylenes were detected at 9.5 mg/kg at 23 feet bgs)

Soil Vapor Investigation

To delineate the migration of volatilized petroleum hydrocarbons in Lot C soils and help locate potential sources of gasoline, Golder advanced a series of probes in northern portion of the Lot C and collected soil vapor samples from each of these locations (see Figure 4). The depth to which the soil vapor probes were advanced was consistent with the expected bottom depth of most USTs – approximately 8 to 10 feet below ground surface (bgs).

Analyses of the soil vapor samples were performed by Air Toxics, Ltd., of Folsom, California, and are summarized in Table 2. The analytical data reports are included in Attachment C. Table 2 in conjunction with Figure 4 shows gasoline and benzene vapors were found at the highest concentration in the vicinity of Test Pit 3 and soil boring GP-11, suggesting this location as a potential on-site source of gasoline.

Monitoring Well Installation

To improve characterization of groundwater hydraulic gradient, direction of groundwater flow and delineation of gasoline within the Qva aquifer underlying Lot C, four monitoring wells were installed in August 2007 by ATC Associates, Inc. (ATC) of Seattle, Washington. ATC installed monitoring wells MW-11 and MW-12 near the northeast and northwest corners of the Lot C property boundary, respectively, and MW-13 and MW-14 near the western property boundary (Figures 5a and 5b). A summary of ATC's operations is included in Attachment D. A fifth additional monitoring well, MW-18, was installed on Lot C in November 2007 to improve delineation of on-site contaminant concentrations and provide groundwater data in the immediate vicinity of Test Pit 3 and soil boring GP-11 (Figures 5a and 5b).

Golder installed an additional three monitoring wells off-site to further characterize the groundwater hydraulic gradient, direction of groundwater flow in the Qva aquifer and possible off-site migration of gasoline. In October 2007, monitoring well MW-15 was installed in the City of SeaTac right-of-way in South 160th Street, located north of the site. In November 2007, monitoring wells MW-16 and MW-17 were installed to the northwest and west of the site, respectively, on the adjoining property owned by Washington Memorial Park and Cemetery (Figures 5a and 5b).

A complete horizontal and elevation geodetic survey of all Qva monitoring wells associated with the site (except MW-18) was performed by Core Design, Inc., of Bellevue, Washington. Elevations for top of casing measuring points, top of screen and bottom of screen for these wells are provided in Table 3. Locations of all on-site and off-site wells, as well as groundwater elevations and gasoline and benzene concentrations in groundwater, may be seen in Figures 5a and 5b. Well completion diagrams for the monitoring wells installed in 2007 are included in Attachment E.

Soil samples were collected for geologic information and screening of volatile organics while drilling borings for installation of monitoring wells MW-15, MW-16, MW-17, and MW-18. A number of soil samples were submitted for chemical analysis by the analytical laboratory. Groundwater samples were collected from all viable monitoring wells associated with the Site. Analyses of Golder's soil and groundwater samples were performed by Analytical Resources, Inc., and are summarized in Tables 1 and 4, respectively. Analytical data reports for both media are included in Attachment C. As shown in the figures and tables, groundwater measurements and analytical data indicate a westward migration of on-site contaminants centered in the vicinity of MW-18, which corresponds to the location of Test Pit 3 and historical soil boring GP-11.

Soil Boring Subsurface Investigation

To delineate the horizontal and vertical extent of contamination in the vicinity of Test Pit 3 and GP-11, Golder advanced a series of five soil borings to 45 feet below ground surface (see Figure 6). Soil borings SB-01, SB-02, and SB-03 were arrayed surrounding the immediate vicinity of monitoring well MW-18, borings SB-04 and SB-05 were located to the south and north, respectively, of historical soil boring GP-11.

Soil samples were screened every five feet, both visually and with a photo-ionization detector (PID), for relative comparison and to determine which samples to collect and submit for analysis. Analyses of soil samples were performed by Analytical Resources, Inc., and are summarized in Table 1. Analytical data reports are included in Attachment C. Soil boring diagrams are included in Attachment E.

For comparison of gasoline and benzene concentrations at depth, a cross-section is presented of analytical results in this area of the site (Figure 7). Table 1 shows the highest concentrations of gasoline and benzene in soil were collected from soil borings SB-01, SB-02 and SB-05, those borings in nearest proximity to historical soil boring GP-11. Comparing these data with those from GP-11, Test Pit 3, and monitoring well MW-18, concentrations of gasoline and associated BTEX constituents above MTCA cleanup levels are continuous within this area from approximately 8 feet bgs to the top of the Qva aquifer. Relative concentrations of gasoline (and BTEX) are highest at depths between 10 feet and 30 feet bgs.

SUMMARY

As a result of both non-intrusive and intrusive subsurface investigation, Golder has found no evidence of any remaining USTs or subsurface structures on Lot C that may have been or are currently potential sources of gasoline. The soil investigation which included soil vapor surveys, test pits and soil borings as shown in Figures 3, 4, 6, and 7, delineated the vertical and horizontal extent of gasoline in the vadose zone in the vicinity of historical soil boring GP-11. The installation of additional monitoring wells has improved the understanding of both the local hydraulic gradient in the Qva aquifer and the associated gasoline plume. The series of 2007 investigations established that gasoline impacts identified in the area of GP-11 are continuous from approximately 8 feet below land surface to the upper portion of the Qva aquifer and likely impacted the groundwater underlying Lot C. However, it has not been established that this area is the only contributing source impacting groundwater, other contributing sources of gasoline could potentially be impacting groundwater from off-site source to the north or from east of the Site.

If you have any questions or require any additional information, please contact Ted Norton or Douglas Morell at (425) 883-0777.

Sincerely,

GOLDER ASSOCIATES INC.

Ian Young
Project Hydrogeologist

Douglas J. Morell, Ph.D., L.Hy.
Principal

Attachments:
Tables
Figures
Attachments A-E

cc:
Dale Myers, Ecology
Melissa Rouke, AAG
Doug Rigoni, SeaTac Investments, LLC

IDY/DJM/sb

TABLES

TABLE 1
2007 Subsurface Soil Analytical Results
MasterPark Lot C

Sample Location	Depth (ft bgs)	Date	Motor Oil	Diesel	Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes
Test Pit 3	6	10/26/2007	580,000	180,000	**130,000**	<16	32	170	760
	8	10/26/2007	23,000	72,000	**2,700,000**	<14	220	2,500	4,560
MW-15	52	10/30/2007	<11,000	<5,300	<5,500	<14	<14	<14	<42
MW-16	60	11/8/2007	<11,000	10,000	**320,000**	<13	<13	35	159
	65	11/8/2007	<11,000	<5,400	26,000	<13	130	76	450
MW-17	75	11/9/2007	<11,000	<5,400	<5,400	<13	<13	<13	<40
	80	11/9/2007	<12,000	<5,800	**38,000**	<11	13	31	288
MW-18	15	11/26/2007	<11,000	<5,400	**1,400,000**	**290**	1,100	**8,600**	**53,000**
	30	11/26/2007	29,000	<5,600	6,600	**64**	33	24	136
	35	11/26/2007	<11,000	<5,500	10,000	**140**	290	74	420
	40	11/26/2007	<11,000	<5,300	**150,000**	**360**	1,800	770	4,400
	45	11/26/2007	<11,000	<5,500	18,000	**71**	330	95	610
SB-01	25	11/27/2007	<11,000	14,000	**1,600,000**	**2,100**	**40,000**	**12,000**	**72,000**
	40	11/27/2007	<11,000	<5,400	**360,000**	**68**	660	740	5,200
	45	11/27/2007	<12,000	<5,800	**35,000**	**690**	1,900	270	1,680
SB-02	25	11/27/2007	<11,000	17,000	**3,800,000**	**2,900**	**74,000**	**35,000**	**215,000**
	35	11/27/2007	<11,000	6,000	**150,000**	26	110	150	960
	45	11/27/2007	<11,000	<5,400	**64,000**	**36**	280	160	930
SB-03	25	11/27/2007	<11,000	<5,400	3,600	<15	<15	<15	<45
	45	11/27/2007	<11,000	<5,400	**380,000**	**530**	4,900	2,400	**13,600**
SB-04	25	11/27/2007	--	--	**41,000**	**2,600**	3,500	310	1,970
	40	11/27/2007	--	--	**550,000**	**730**	**9,300**	4,100	**14,800**
	45	11/27/2007	--	--	**32,000**	**67**	360	84	560
SB-05	25	11/28/2007	22,000	18,000	**860,000**	**1,800**	**24,000**	**6,400**	**40,000**
	35	11/28/2007	<11,000	18,000	**1,800,000**	**2,300**	**13,000**	**9,000**	**50,000**
	45	11/28/2007	<10,000	<5,300	**49,000**	**53**	330	150	1,100
MTCA Method A Cleanup Values			2,000,000	2,000,000	30,000	30	7,000	6,000	9,000

All concentrations indicated in µg/Kg (parts per billion)
ft bgs = feet below ground surface
Bold - Indicates concentration above regulatory cleanup values

TABLE 2

2007 Soil Vapor Analytical Results
MasterPark Lot C

Sample Location	Depth (ft bgs)	Sample Date	Benzene	Toluene	Ethylbenzene	m,p-Xylene	o-Xylene
SG-00*	NA	11/15/2007	4.6	150	14	52	22
SG-1	10	11/15/2007	<22	470	<31	84	<31
SG-2	10	11/15/2007	<24	380	<32	66	<32
SG-3	10	11/15/2007	31	250	<34	64	<34
SG-4	10	11/15/2007	<23	300	<31	80	<31
SG-5	10	11/15/2007	<23	200	<31	76	<31
SG-6	10	11/15/2007	21,000	4,400	64,000	110,000	22,000
SG-7	10	11/15/2007	<22	180	<30	69	<30
SG-8	10	11/15/2007	<22	330	<30	66	<30
SG-9	10	11/15/2007	<23	300	75	200	47
SG-10	10	11/16/2007	<24	92	<32	49	<32
SG-11	10	11/16/2007	<22	150	<30	56	<30
SG-12	10	11/16/2007	<22	130	<30	51	<30
SG-13	10	11/16/2007	41	130	<32	62	<32
SG-14	10	11/16/2007	<23	210	<32	50	<32

All concentrations indicated in µg/m^3 (micrograms per cubic meter)

ft bgs = feet below ground surface

SG-00* Ambient air sample, represents background concentrations in ambient air.

NA not applicable

TABLE 3
2007 Monitoring Well Elevation Data
MasterPark Lot C

	Elevations (feet above mean sea level)		
Well ID	**Top of Casing**	**Top of Screen**	**Bottom of Screen**
MW-1	361.38	320.38	310.38
MW-5	364.26	316.26	306.26
MW-6	369.68	319.68	309.68
MW-7	358.69	315.19	305.19
MW-8A	359.16	315.16	305.16
MW-9	362.14	314.64	305.14
MW-10	360.18	280.18	270.18
MW-11	357.53	315.53	300.53
MW-12	364.86	312.86	297.86
MW-13	365.42	315.42	300.42
MW-14	363.76	313.76	298.76
MW-15	364.60	314.60	299.60
MW-16	376.36	313.36	303.36
MW-17	385.81	312.81	302.81
MW-18	--	--	--

All elevations correspond to NAVD 88
-- = Elevation not measured

TABLE 4
2007 Groundwater Analytical Results
MasterPark Lot C

Sample Location	Depth to Water (ft bgs)	Sample Date	Motor Oil	Diesel	Gasoline	Benzene	Toluene	Ethylbenzene	Total Xylenes
MW-5	54.07	8/16/2007	--	--	**1,600**	**7**	5.9	37	3.2
MW-5		8/16/2007	--	--	270	3.3	6.9	7.1	4.5
MW-5 DUP		8/16/2007	--	--	340	**5.2**	8	6.5	6.6
MW-6	59.38	8/16/2007	--	--	<0.25	<1.0	<1.0	<1.0	<1.0
MW-6		8/16/2007	--	--	ND	ND	ND	ND	ND
MW-7	48.04	8/16/2007	--	--	**68,000**	**500**	**3,200**	**1,600**	**8,690**
MW-7		8/16/2007	--	--	**45,000**	**600**	**2,800**	**1,300**	**8,200**
MW-9	51.78	8/16/2007	--	--	**34,000**	**280**	230	**750**	**3,270**
MW-9		8/16/2007	--	--	**28,000**	**350**	300	**740**	**3,900**
MW-11	46.80	8/16/2007	--	--	**31,000**	**48**	**1,400**	650	**3,400**
MW-11		8/16/2007	--	--	**26,000**	**140**	**1,700**	**860**	**4,400**
MW-12	54.42	8/16/2007	--	--	**92,000**	**710**	**7,600**	**1,800**	**11,000**
MW-12		8/16/2007	--	--	**57,000**	**590**	**6,400**	**1,700**	**10,000**
MW-13	55.04	8/16/2007	--	--	**92,000**	**180**	**5,600**	**2,100**	**12,600**
MW-13		8/16/2007	--	--	**77,000**	**330**	**6,100**	**2,600**	**16,000**
MW-14	53.46	8/16/2007	--	--	**96,000**	**150**	**6,300**	**2,100**	**12,700**
MW-14		8/16/2007	--	--	**56,000**	**93**	**5,600**	**1,800**	**12,000**
MW-14 DUP		8/16/2007	--	--	**41,000**	**160**	**4,100**	**1,200**	**8,500**
MW-15	54.19	11/1/2007	<500	440	**10,000**	**18**	16	350	418
MW-16	61.20	11/13/2007	<500	**1,700**	**26,000**	**160**	320	**830**	**1,733**
MW-17	76.86	11/13/2007	<500	**7,300**	**17,000**	1.0	5.2	45	507
MW-18	52.50	11/28/2007	<500	**660**	**79,000**	**2,900**	**7,500**	**1,600**	**6,290**
MW-18 DUP		11/28/2007	<500	**690**	**100,000**	**3,000**	**7,500**	**1,600**	**6,340**
MTCA Method A Cleanup Values			500	500	800	5.0	1,000	700	1,000

ft bgs = feet below ground surface

All concentrations indicated in µg/Kg (parts per billion)

-- = Not Analyzed

ND- Not Detected

Bold - Indicates concentration above regulatory cleanup values

Shading - Indicates split sample collected by ATC

FIGURES

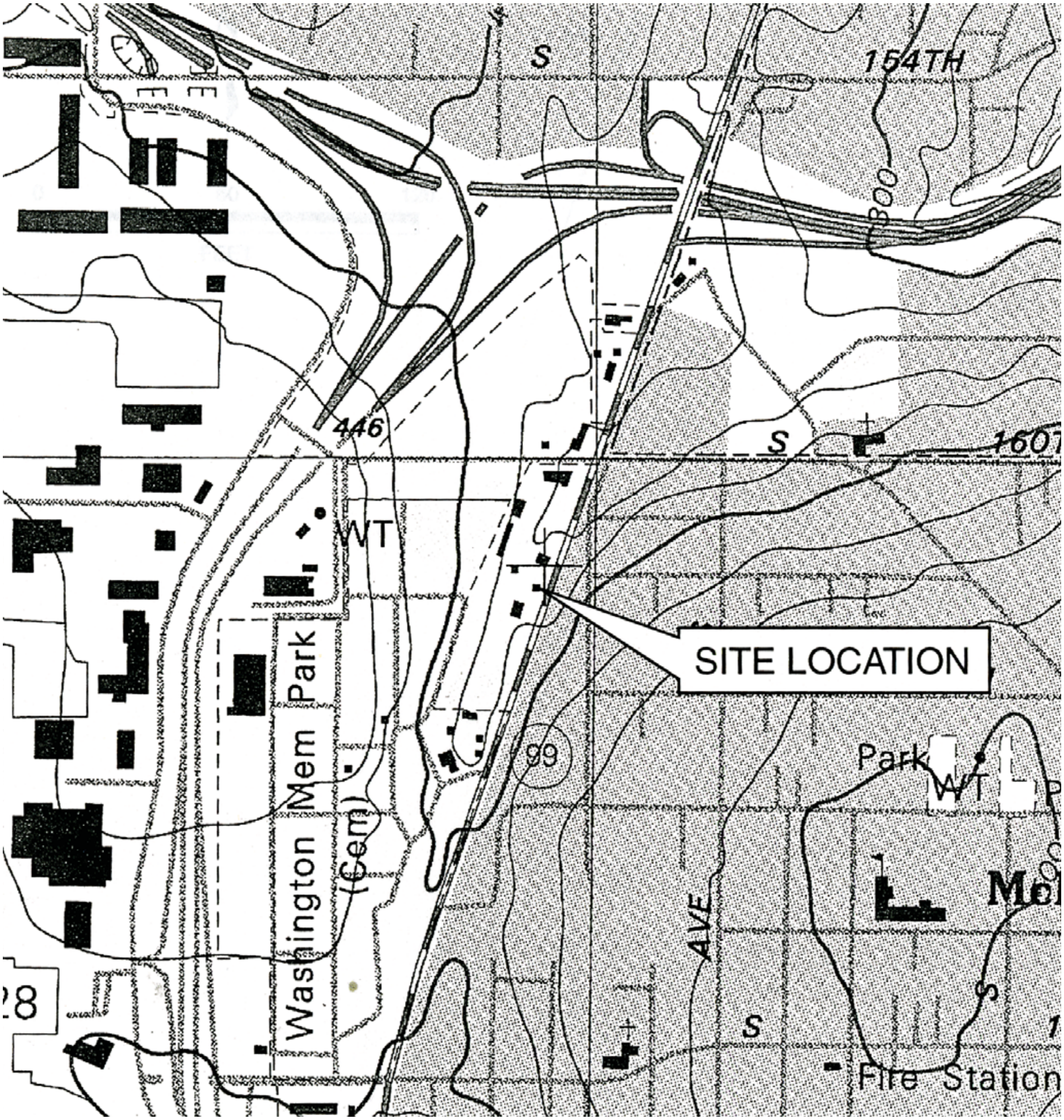
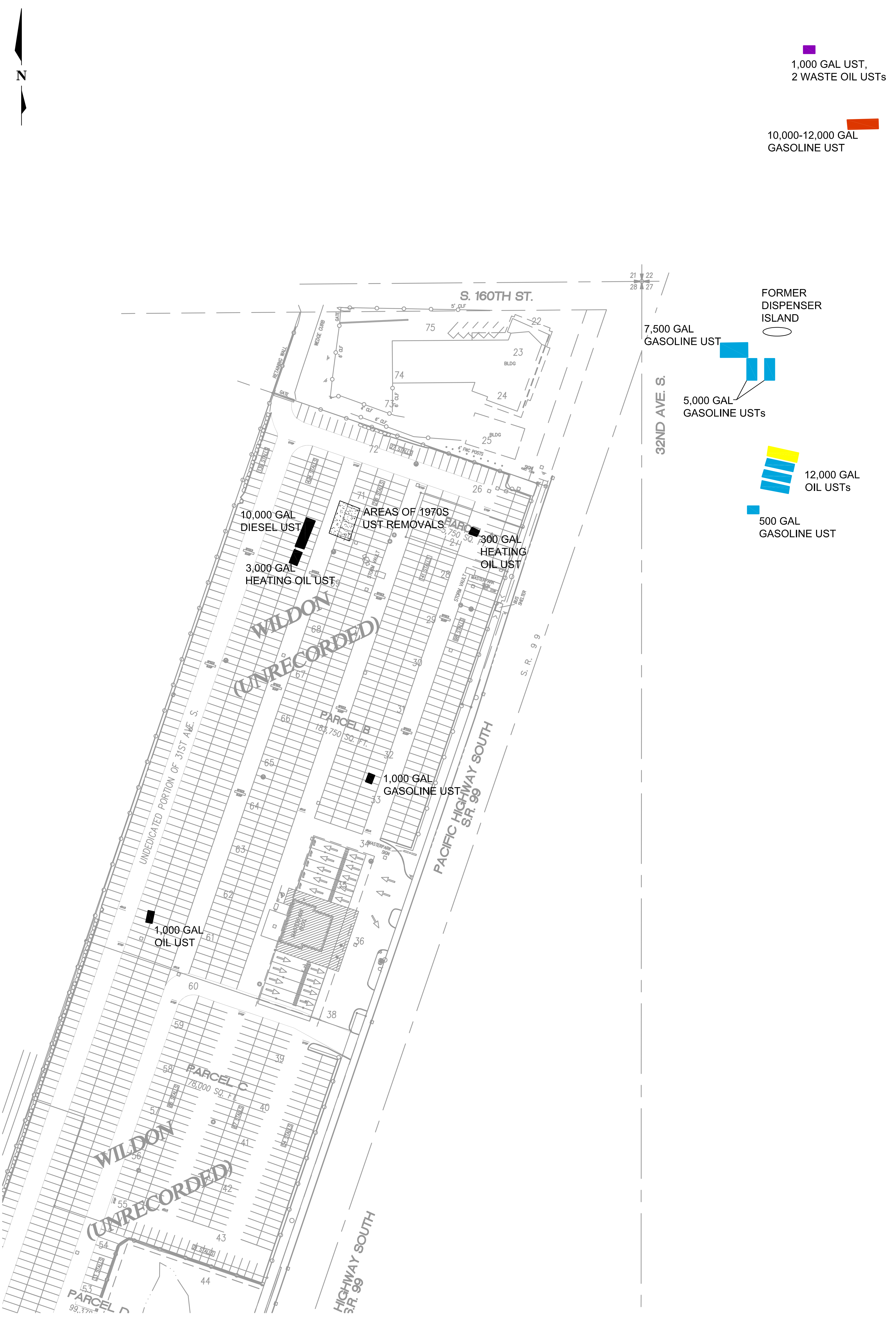


FIGURE 1

SITE VICINITY MAP

RW/GEOPHYSICS INVESTIGATION/WA

Golder Associates



LEGEND
- ⬛ ON SITE UST, REMOVED IN 2001
- 🟦 OFF SITE UST, INACTIVE REMOVED
- 🟧 OFF SITE UST, ACTIVE, IN PLACE
- 🟨 OFF SITE UST, INACTIVE, IN PLACE
- 🟪 OFF SITE UST, STATUS UNKNOWN
- ▨ APPROXIMATE AREA WHERE GASOLINE AND DIESEL TANKS WERE REMOVED IN THE 1970'S

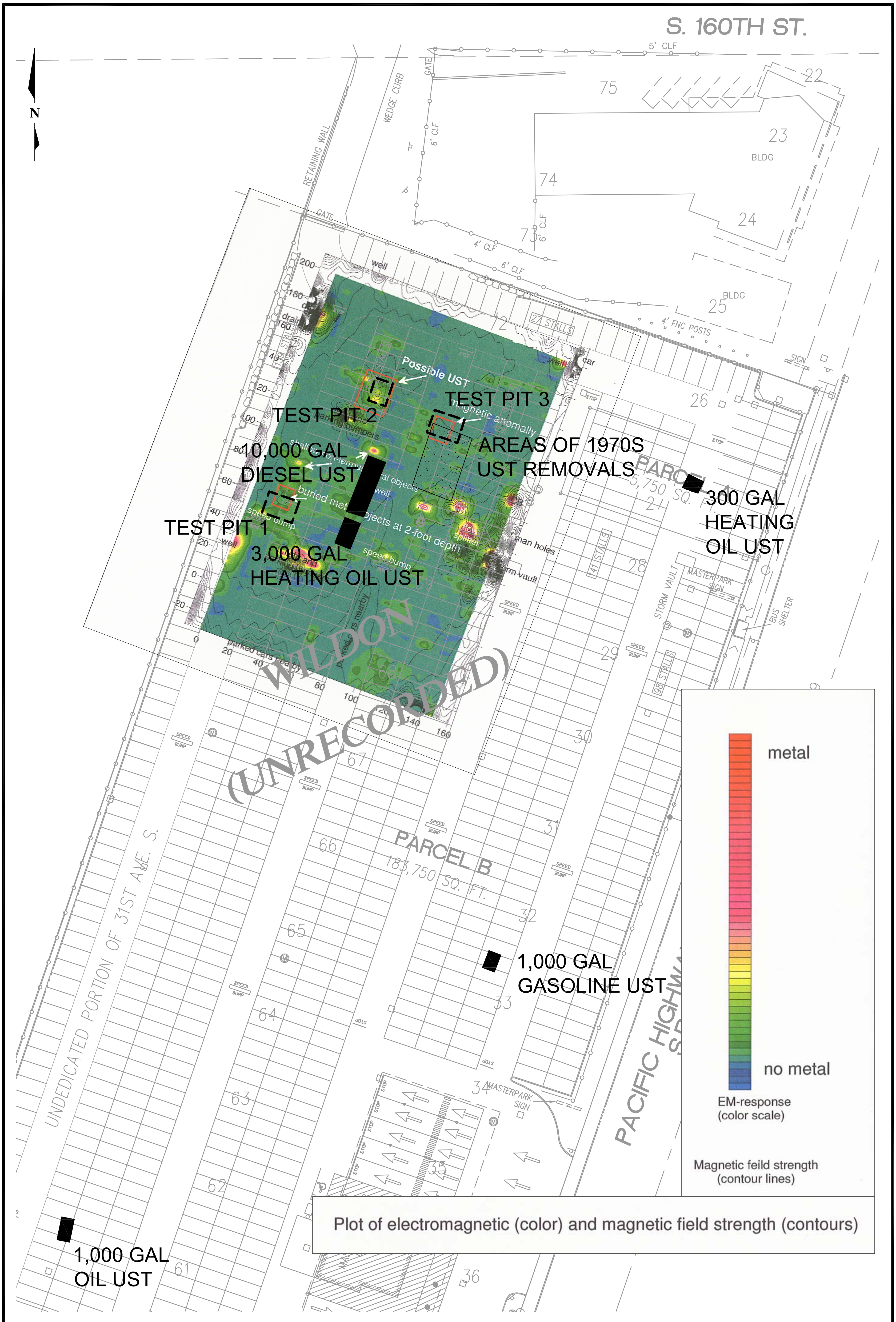
0 100 200
SCALE IN FEET

FIGURE **2**

MASTERPARK LOT C
AND AREA USTs

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates



LEGEND

- ON SITE UST, REMOVED IN 2001
- APPROXIMATE AREA WHERE GASOLINE AND DIESEL TANKS WERE REMOVED IN THE 1970'S
- APPROXIMATE TEST PIT LOCATIONS

0 50 100

SCALE IN FEET

FIGURE 3

GEOPHYSICAL SURVEY AND TEST PIT LOCATIONS

SUNREAL/SEATAC GARAGE ESA/WA

LEGEND

⬛	ON SITE UST, REMOVED IN 2001
🟦	OFF SITE UST, INACTIVE REMOVED
🟥	OFF SITE UST, ACTIVE, IN PLACE
🟨	OFF SITE UST, INACTIVE, IN PLACE
🟪	OFF SITE UST, STATUS UNKNOWN
▨	APPROXIMATE AREA WHERE GASOLINE AND DIESEL TANKS WERE REMOVED IN THE 1970'S
⊠ SG-1	APPROXIMATE SOIL VAPOR PROBE LOCATIONS

0 100 200

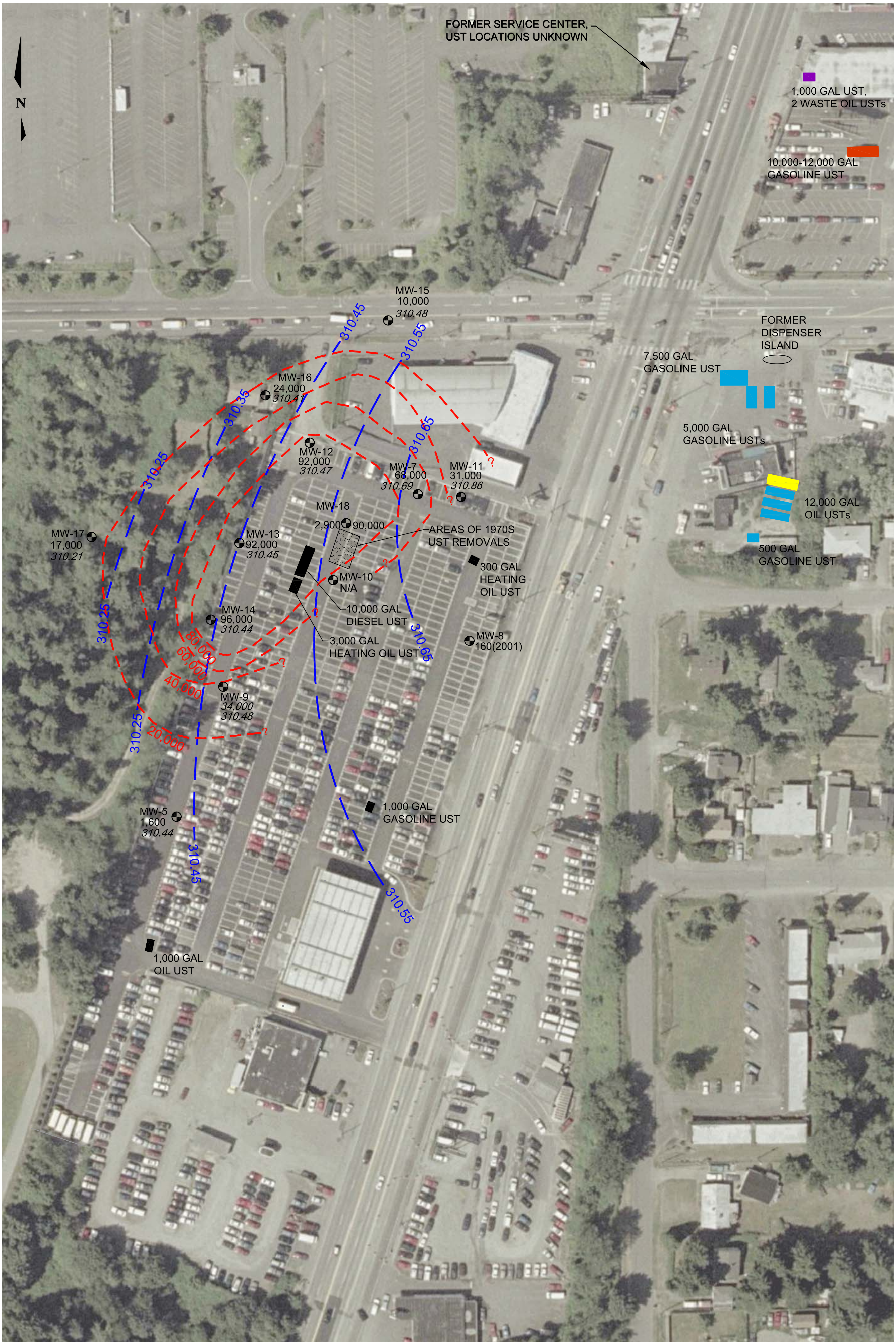
SCALE IN FEET

FIGURE 4

SOIL VAPOR PROBE LOCATIONS

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates



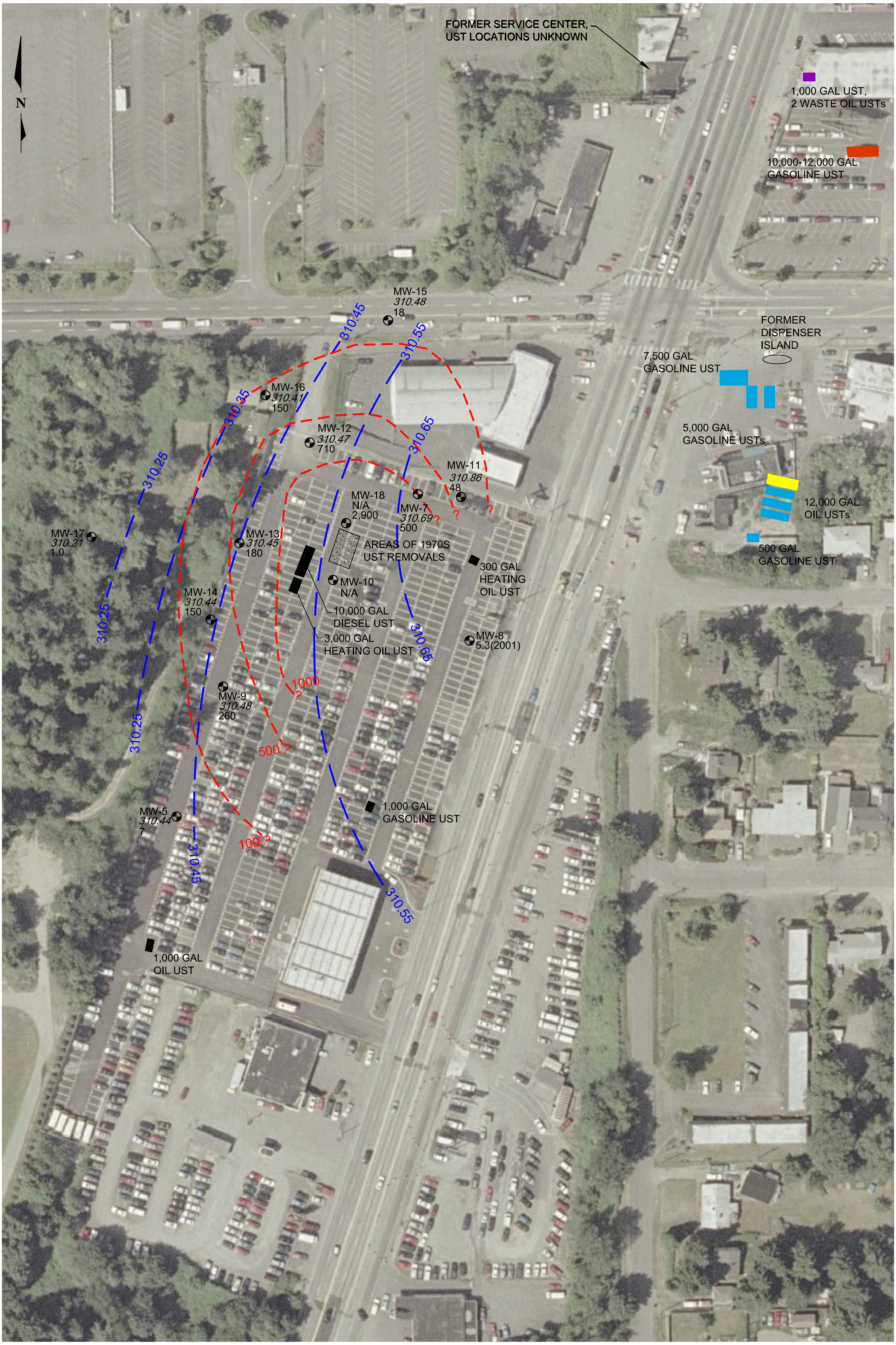
LEGEND

■	ON SITE UST, REMOVED IN 2001
■	OFF SITE UST, INACTIVE REMOVED
■	OFF SITE UST, ACTIVE, IN PLACE
■	OFF SITE UST, INACTIVE, IN PLACE
■	OFF SITE UST, STATUS UNKNOWN
▨	APPROXIMATE AREA WHERE GASOLINE AND DIESEL TANKS WERE REMOVED IN THE 1970'S
MW-9 260 310.48	APPROXIMATE MONITORING WELL LOCATIONS, GASOLINE PPB, AND ELEVATIONS
20,000	GASOLINE ISO-CONCENTRATION CONTOUR, IN PARTS PER BILLION (PPB)

FIGURE 5a

MONITORING WELL LOCATIONS, GROUNDWATER GRADIENT, AND GASOLINE CONCENTRATION

SUNREAL/SEATAC GARAGE ESA/WA



LEGEND

■	ON SITE UST, REMOVED IN 2001
🟦	OFF SITE UST, INACTIVE REMOVED
🟧	OFF SITE UST, ACTIVE, IN PLACE
🟨	OFF SITE UST, INACTIVE, IN PLACE
🟪	OFF SITE UST, STATUS UNKNOWN
▨	APPROXIMATE AREA WHERE GASOLINE AND DIESEL TANKS WERE REMOVED IN THE 1970'S
MW-9 *34,000* 260	APPROXIMATE MONITORING WELL LOCATIONS, BENZENE PPB, AND ELEVATIONS
100	BENZENE ISO-CONCENTRATION CONTOUR, IN PARTS PER BILLION (PPB)

0 100 200
SCALE IN FEET

FIGURE **5b**

MONITORING WELL LOCATIONS, GROUNDWATER GRADIENT, AND BENZENE CONCENTRATION

SUNREAL/SEATAC GARAGE ESA/WA

K:\CAD\Projects\2007\07393368\01\002\073_93368_01_002_F02_Rev1.DWG | Fig (5b) | Mod: 03/12/2008, 14:39 | Plotted: 03/12/2008, 14:53 | aforcier

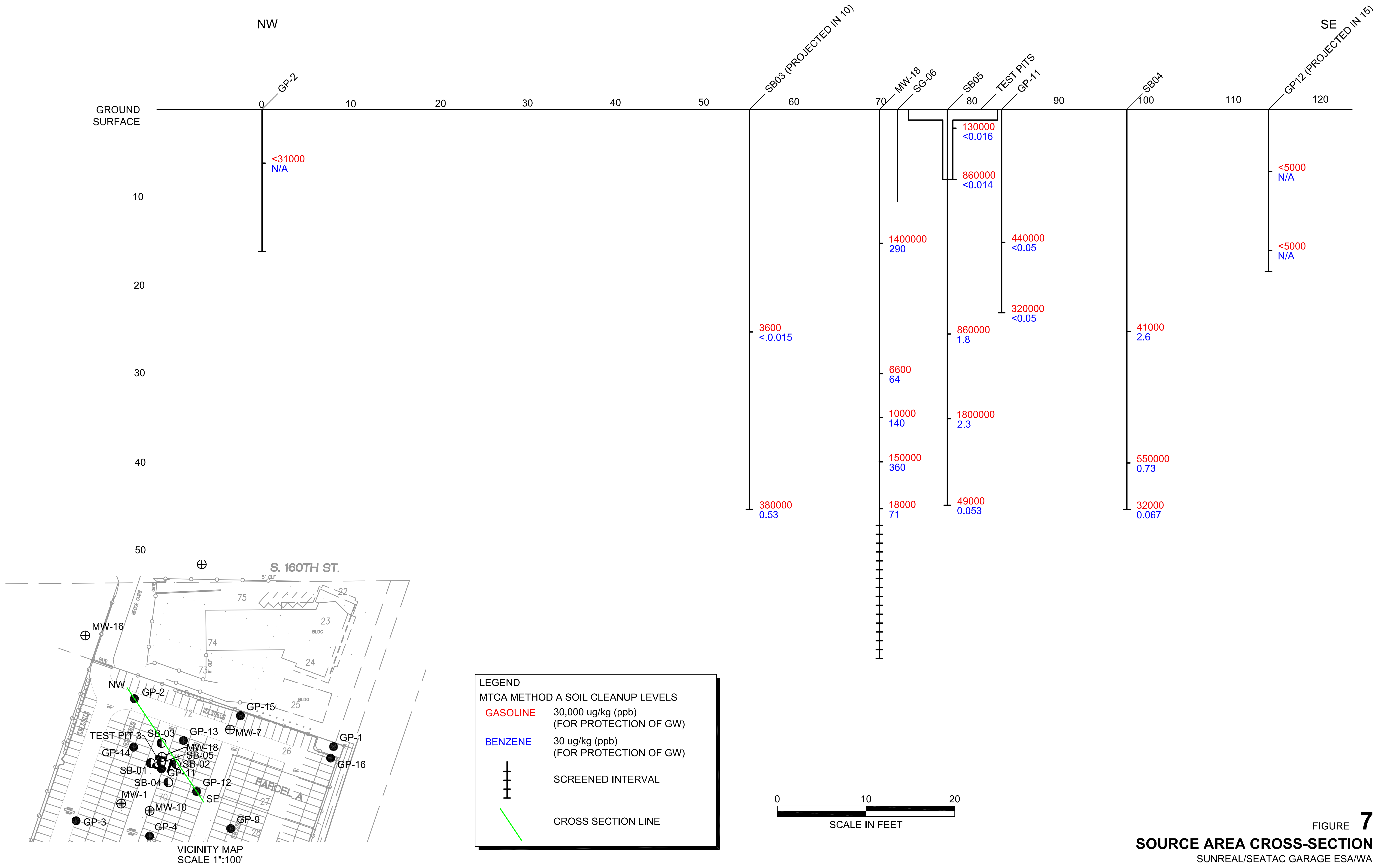
Golder Associates

FIGURE 6

SOIL BORINGS

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates



VICINITY MAP
SCALE 1":100'

LEGEND

MTCA METHOD A SOIL CLEANUP LEVELS

GASOLINE	30,000 ug/kg (ppb) (FOR PROTECTION OF GW)
BENZENE	30 ug/kg (ppb) (FOR PROTECTION OF GW)
┼┼┼	SCREENED INTERVAL
╱	CROSS SECTION LINE

FIGURE 7

SOURCE AREA CROSS-SECTION

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

Golder Associates Inc.
18300 NE Union Hill Road, Suite 200
Redmond, WA USA 98052-3333
Telephone (425) 883-0777
Fax (425) 882-5498
www.golder.com

Golder Associates

March 13, 2008

Our Ref: 073-93368-03.000

Riddell Williams P.S.
1001 Fourth Avenue Plaza Suite 400
Seattle, Washington 98154-1065

Attention: Harry Grant

RE: ADDENDUM TO ON-SITE SOURCE AND GROUNDWATER INVESTIGATION SUMMARY – JUNE TO NOVEMBER 2007 REPORT (DATED JANUARY 14, 2008)

Dear Mr. Grant:

Golder Associates Inc. (Golder) completed an investigation of petroleum impacted groundwater in the Qva aquifer at the MasterPark Lot C property (Lot C) located at 16025 International Boulevard, SeaTac, Washington (Figure 1). The investigation results were presented and submitted in our report entitled "On-Site Source and Groundwater Investigation Summary – June to November 2007" (Golder, January 14, 2008). Golder conducted further investigations to delineate the gasoline groundwater plume and to determine if there were off-site sources contributing to the impacts in the groundwater east of Lot C. This report is an addendum to, and supplements data in, the previous Golder January 14, 2008 report. The MasterPark Lot C property covers approximately 4.3 acres and is presented on Figure 2. Recent activities consisted of two phases spanning the months of December 2007 to February 2008. This report summarizes Golder's activities and findings for this work.

INTRODUCTION

Historical data indicate groundwater in the regional Qva aquifer underlying the northeast portion of the MasterPark Lot C property has been impacted by gasoline range petroleum hydrocarbons. Golder's previous investigations during the latter half of 2007 identified a gap in the delineation of the Qva aquifer in the northeast portion of the Property from which potential off-site sources might contribute impacts to Site. To address this gap in delineation, an existing, but damaged, monitoring well MW-8A in this vicinity was rehabilitated to allow resumed groundwater monitoring. Groundwater impacts were further defined by the installation of an additional groundwater monitoring well (MW-19), and groundwater samples were obtained for analyses from MW-8A and MW-19 and compared with groundwater quality provided in the January 14, 2008 report. All wells were surveyed for elevation to measure groundwater elevations and determine groundwater flow directions in the Qva aquifer for the site.

The following provides a description of the individual operations conducted at the Site during December 2007 to February 2008 and presents the results.

Monitoring Well MW-8A Rehabilitation
To better define the groundwater hydraulic gradient, direction of groundwater flow and improve delineation of gasoline within the Qva aquifer underlying Lot C, and in lieu of the costly installation of a replacement monitoring well, Golder rehabilitated existing monitoring well MW-8A, which had become obstructed near the groundwater level interface. Monitoring well MW-8A lies in the northeast portion of the Lot C property (Figure 2) near the property boundary at International Boulevard.

In December 2007, the obstruction in the well casing was cleared and the interior of the entire length of the casing swabbed to remove any accreted material and flushed with approximately 120 gallons of tap water. Due to the well casing being damaged, approximately five feet below ground surface (bgs) during lot construction activities in 2001, well development tools could not be used. Golder returned to well MW-8A in February 2007 to develop and sample the well with equipment suitable to the conditions of the well. A groundwater sample was collected prior to redevelopment, after which 150 gallons of water were pumped from the well, whereupon a second groundwater sample was collected.

Analyses of the groundwater samples were performed by Analytical Resources, Inc., of Tukwila, Washington, and are summarized in Table 1. Analytical data reports are included in Attachment A. The well head was also resurveyed for elevation and water measurements during this period of activity.

Monitoring Well MW-19 Installation
Golder installed one additional on-site monitoring well MW-19, to further characterize the groundwater hydraulic gradient, direction of groundwater flow in the Qva aquifer underlying Lot C, and possible migration of gasoline from off-site. In January 2008, monitoring well MW-19 was installed in the northeast corner of the property (Figure 2).

Soil samples were collected for geologic information and screening of volatile organics while drilling the boring for installation of monitoring well MW-19. Three soil samples were submitted for chemical analysis by the analytical laboratory. A groundwater sample was collected from the well. Analyses of the soil and groundwater samples were performed by Analytical Resources, Inc., and are summarized in Tables 2 and 1, respectively. As shown in the figures and tables, groundwater measurements and cumulative analytical data indicate a westward migration of on-site contaminants centered in the vicinity of MW-18. Soil and groundwater analytical data from well MW-19 do not suggest a migration of off-site contaminants onto the site at this location. Analytical data reports for both media are included in Attachment A.

A complete horizontal and elevation geodetic survey of the new Qva monitoring wells associated with the site (including well MW-18, which had been installed previously in 2007) was performed by CORE Design, Inc., of Bellevue, Washington. Depth to groundwater, groundwater elevation, top of casing measuring point, top of screen, and bottom of screen for all wells are provided in Table 3. Locations of all on-site and off-site wells, as well as groundwater elevations (water levels obtained on February 4, 2008) are provided on Figure 3. Gasoline and benzene concentrations in groundwater are provided on Figures 4 and 5, respectively. Well completion diagrams for the monitoring wells MW-18 and MW-19 are included in Attachment B.

SUMMARY

The rehabilitation of monitoring well MW-8A and the installation of monitoring well MW-19, both located at the northeast boundary of the Lot C property has improved the understanding of both the local hydraulic gradient in the Qva aquifer and the associated gasoline plume underlying Lot C. Water level measurements collected from site Qva aquifer monitoring wells indicated the general direction of groundwater flow is to the west with a southwesterly component towards the south end of Lot C. Based on the results of the groundwater sampling conducted at MW-8A and MW-19 and from previous sampling efforts the gasoline groundwater plume in the Qva aquifer has been adequately delineated to confirm that the MasterPark Lot C property is a contributing source to the gasoline impacts observed in the aquifer. If you have any questions or require any additional information, please contact Doug Morell or Ted Norton at (425) 883-0777.

Sincerely,

GOLDER ASSOCIATES INC.

Ian Young,
Project Hydrogeologist

Douglas J. Morell, Ph.D.; L.Hy.
Principal

Attachments: Tables
Figures
Appendix A
Appendix B

cc:
Dale Myers, Ecology
Melissa Rourke, AAG
Doug Rigoni, SeaTac Investments, LLC

IDY/DJM/sb

TABLES

TABLE 1

2007 - 2008 Groundwater Analytical Results
MasterPark Lot C

Sample Location	**Sample Date**	**Motor Oil**	**Diesel**	**Gasoline**	**Benzene**	**Toluene**	**Ethylbenzene**	**Total Xylenes**
MW-5	8/16/2007	--	--	**1,600**	**7**	5.9	37	3.2
MW-5	8/16/2007	--	--	270	3.3	6.9	7.1	4.5
MW-5 DUP	8/16/2007	--	--	340	**5.2**	8	6.5	6.6
MW-6	8/16/2007	--	--	<250	<1.0	<1.0	<1.0	<2.0
MW-6	8/16/2007	--	--	ND	ND	ND	ND	ND
MW-7	8/16/2007	--	--	**68,000**	**500**	**3,200**	**1,600**	**8,690**
MW-7	8/16/2007	--	--	**45,000**	**600**	**2,800**	**1,300**	**8,200**
MW-8A[1]	2/4/2008	--	--	<250	<1.0	1.0	<1.0	<2.0
MW-8A[2]	2/4/2008	--	--	290	<1.0	2.7	<1.0	1.4
MW-9	8/16/2007	--	--	**34,000**	**280**	230	**750**	**3,270**
MW-9	8/16/2007	--	--	**28,000**	**350**	300	**740**	**3,900**
MW-11	8/16/2007	--	--	**31,000**	**48**	**1,400**	650	**3,400**
MW-11	8/16/2007	--	--	**26,000**	**140**	**1,700**	**860**	**4,400**
MW-12	8/16/2007	--	--	**92,000**	**710**	**7,600**	**1,800**	**11,000**
MW-12	8/16/2007	--	--	**57,000**	**590**	**6,400**	**1,700**	**10,000**
MW-13	8/16/2007	--	--	**92,000**	**180**	**5,600**	**2,100**	**12,600**
MW-13	8/16/2007	--	--	**77,000**	**330**	**6,100**	**2,600**	**16,000**
MW-14	8/16/2007	--	--	**96,000**	**150**	**6,300**	**2,100**	**12,700**
MW-14	8/16/2007	--	--	**56,000**	**93**	**5,600**	**1,800**	**12,000**
MW-14 DUP	8/16/2007	--	--	**41,000**	**160**	**4,100**	**1,200**	**8,500**
MW-15	11/1/2007	<500	440	**10,000**	**18**	16	350	418
MW-16	11/13/2007	<500	**1,700**	**26,000**	**160**	320	**830**	**1,733**
MW-17	11/13/2007	<500	**7,300**	**17,000**	1.0	5.2	45	507
MW-18	11/28/2007	<500	**660**	**79,000**	**2,900**	**7,500**	**1,600**	**6,290**
MW-18 DUP	11/28/2007	<500	**690**	**100,000**	**3,000**	**7,500**	**1,600**	**6,340**
MW-19	2/4/2008	--	--	<250	<1.0	1.6	<1.0	1.1
MTCA Method A Cleanup Values		500	500	800	5.0	1,000	700	1,000

ft bgs = feet below ground surface

All concentrations indicated in µg/L (parts per billion)

-- = Not Analyzed, No Value

ND- Not Detected

Bold - Indicates concentration above regulatory cleanup values

Shading - Indicates split sample collected by ATC

[1] Sample collected prior to purging well.

[2] Sample collected following complete purging of well.

TABLE 2

2008 Subsurface Soil Analytical Results
MasterPark Lot C

Sample Location	Depth (ft bgs)	Date	Gasoline	Benzene	Toluene	Ethylbenzene	m,p-Xylenes	o-Xylene
MW-19	10.5	1/31/2008	8,800	< 12 U	< 12 U	< 12 U	< 24 U	< 12 U
	25.0	1/31/2008	8,000	< 15 U	< 15 U	< 15 U	< 29 U	18
	50.0	1/31/2008	< 5,400 U	< 13 U	< 13 U	< 13 U	< 27 U	< 13 U
MTCA Method A Cleanup Values			30,000	30	7,000	6,000	900	900

All concentrations indicated in µg/Kg (parts per billion)

ft bgs = feet below ground surface

Bold - Indicates concentration above regulatory cleanup values

TABLE 3

2008 Monitoring Well Elevation Data
MasterPark Lot C

Well ID	Date Measured	Depth to Water	Elevations (feet above mean sea level)			
			Groundwater Elevation	Top of Casing	Top of Screen	Bottom of Screen
MW-1	--	--	--	361.38	320.38	310.38
MW-5	2/4/2008	53.99	310.27	364.26	316.26	306.26
MW-6	2/4/2008	59.23	310.45	369.68	319.68	309.68
MW-7	2/4/2008	48.00	310.69	358.69	315.19	305.19
MW-8A	2/4/2008	48.54	310.62	359.16	315.16	305.16
MW-9	2/4/2008	51.74	310.40	362.14	314.64	305.14
MW-10	2/4/2008	50.04	310.14	360.18	280.18	270.18
MW-11	2/4/2008	46.84	310.69	357.53	315.53	300.53
MW-12	2/4/2008	54.45	310.41	364.86	312.86	297.86
MW-13	2/4/2008	55.05	310.37	365.42	315.42	300.42
MW-14	2/4/2008	53.43	310.33	363.76	313.76	298.76
MW-15	--	--	--	364.60	314.60	299.60
MW-16	2/4/2008	66.08	310.28	376.36	313.36	303.36
MW-17	2/4/2008	75.70	310.11	385.81	312.81	302.81
MW-18	2/4/2008	50.03	310.42	360.45	313.45	298.45
MW-19	2/4/2008	45.90	310.71	356.61	313.61	298.61

All elevations correspond to NAVD 88
-- = Depth or Elevation not measured

FIGURES

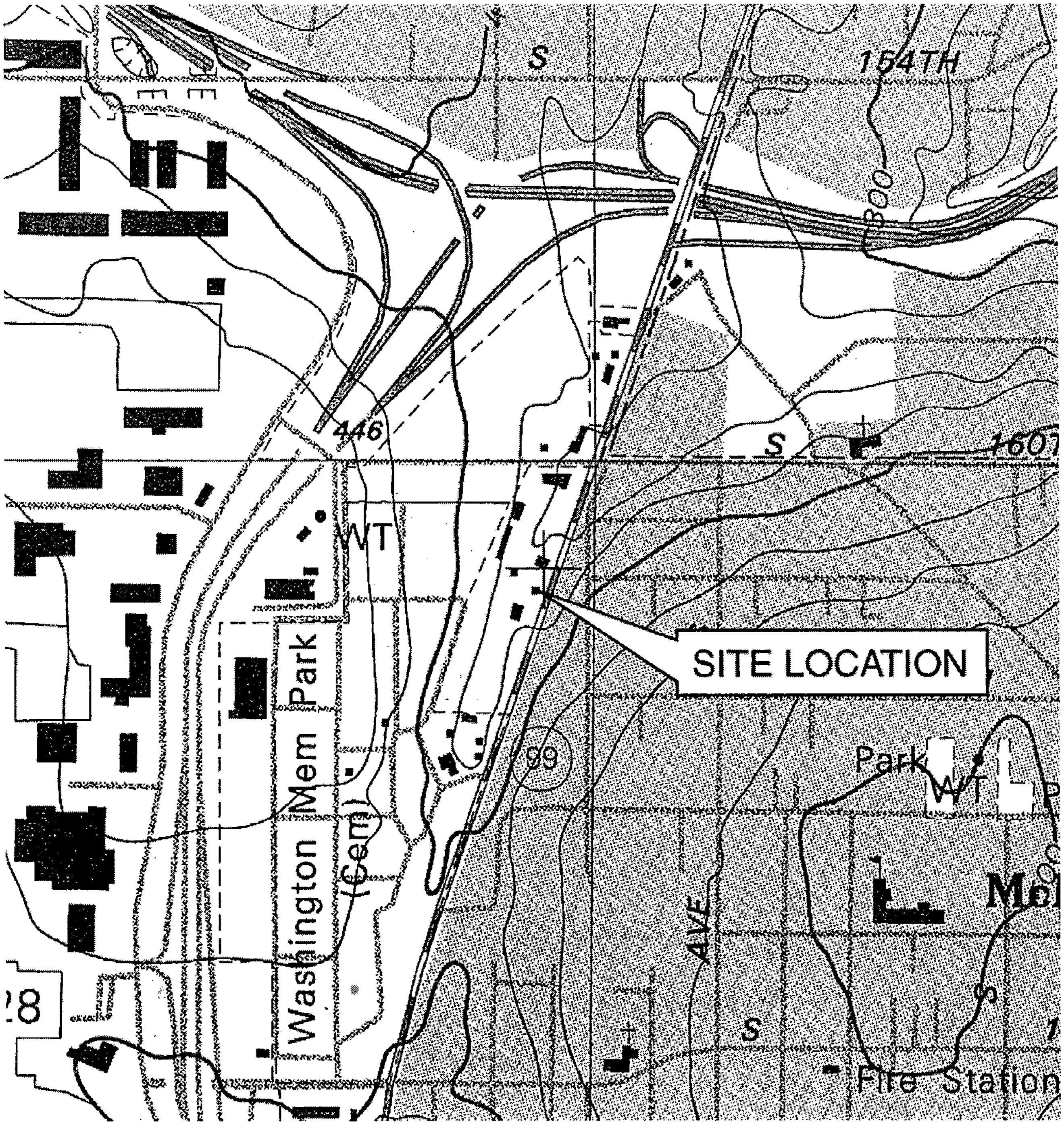


FIGURE **1**

SITE VICINITY MAP

RW/GEOPHYSICS INVESTIGATION/WA

0739336801004fig01.ai | Mod: 01/11/08 | AMP

Golder Associates

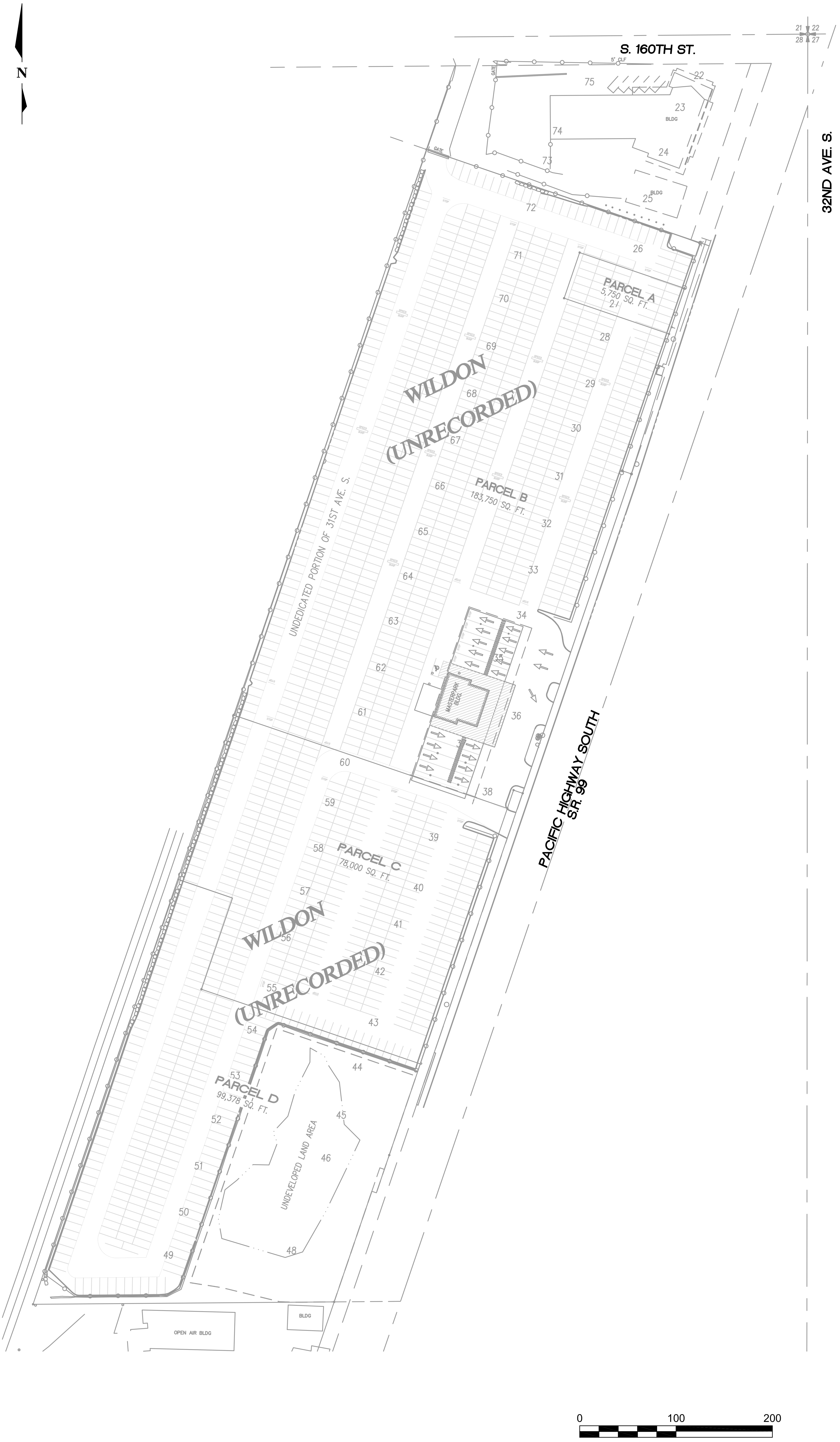


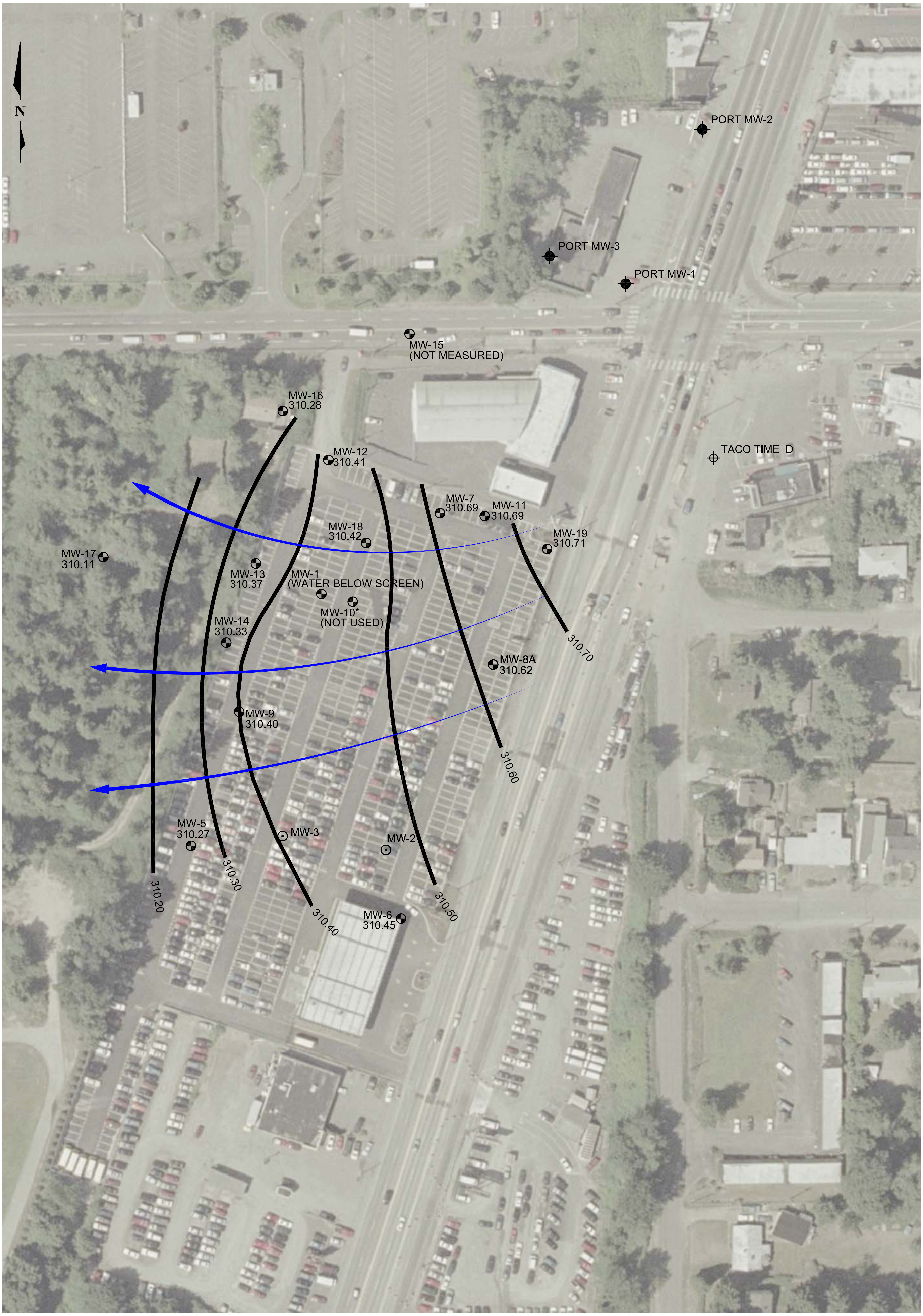
FIGURE **2**

MASTERPARK LOT C
SITE DRAWING

SUNREAL/SEATAC GARAGE ESA/WA

K:\CAD\Projects\2007\07393368\03\000\073_93368_03_000_F02.dwg | F02 | Mod: 03/12/2008, 14:35 | Plotted: 03/12/2008, 14:56 | aforcier

Golder Associates



LEGEND

● MW-10*	NOT USED FOR CONTOURING, THE WELL IS COMPLETED IN A DEEPER PORTION OF AQUIFER
←	APPROXIMATE DIRECTION OF GROUNDWATER FLOW
━ 310.20	GROUNDWATER ELEVATION CONTOUR (FEET ABOVE MEAN SEA LEVEL ON FEB. 4, 2008)
● MW-5	QVA AQUIFER MONITORING WELL LOCATIONS
⊙ MW-2	MONITORING WELLS SCREENED IN PERCHED AQUIFER
● PORT MW-1	PORT OF SEATTLE (QVA) MONITORING WELLS (ABANDONED)
⊕ TACO TIME D	TACO TIME (QVA) MONITORING WELL (ABANDONED)

0 100 200

SCALE IN FEET

FIGURE 3

QVA AQUIFER MONITORING WELL LOCATIONS AND GROUNDWATER ELEVATION CONTOUR

SUNREAL/SEATAC GARAGE ESA/WA

K:\CAD\Projects\2007\07393368\03\000\073_93368_03_000_F03.DWG | Fig 3 | Mod: 03/12/2008, 14:35 | Plotted: 03/12/2008, 14:57 | aforcier

Golder Associates

LEGEND

▬	800	GASOLINE CONCENTRATION CONTOUR (ug/L)
◐	MW-5	QVA AQUIFER MONITORING WELL LOCATIONS
⊙	MW-2	MONITORING WELLS SCREENED IN PERCHED AQUIFER
●	PORT MW-1	PORT OF SEATTLE (QVA) MONITORING WELLS (ABANDONED)
⊕	TACO TIME D	TACO TIME (QVA) MONITORING WELL (ABANDONED)

0 100 200

SCALE IN FEET

FIGURE 4

QVA AQUIFER MONITORING WELL LOCATIONS AND GASOLINE ISOCONCENTRATION CONTOURS

SUNREAL/SEATAC GARAGE ESA/WA

K:\CAD\Projects\2007\07393368\03\000\073_93368_03_000_F03.DWG | Fig 4 | Mod: 03/12/2008, 14:35 | Plotted: 03/12/2008, 14:58 | aforcier

Golder Associates

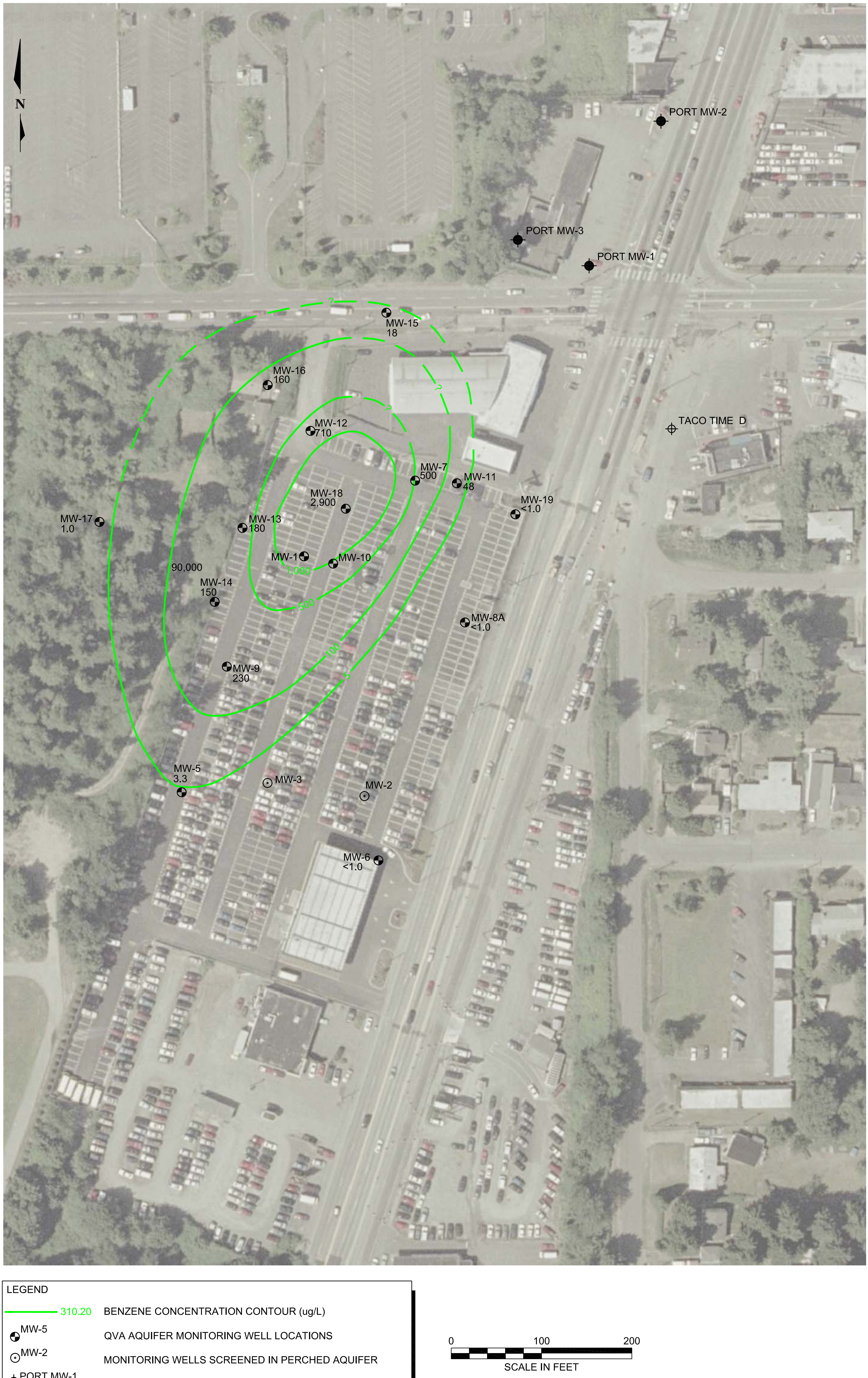


FIGURE **5**

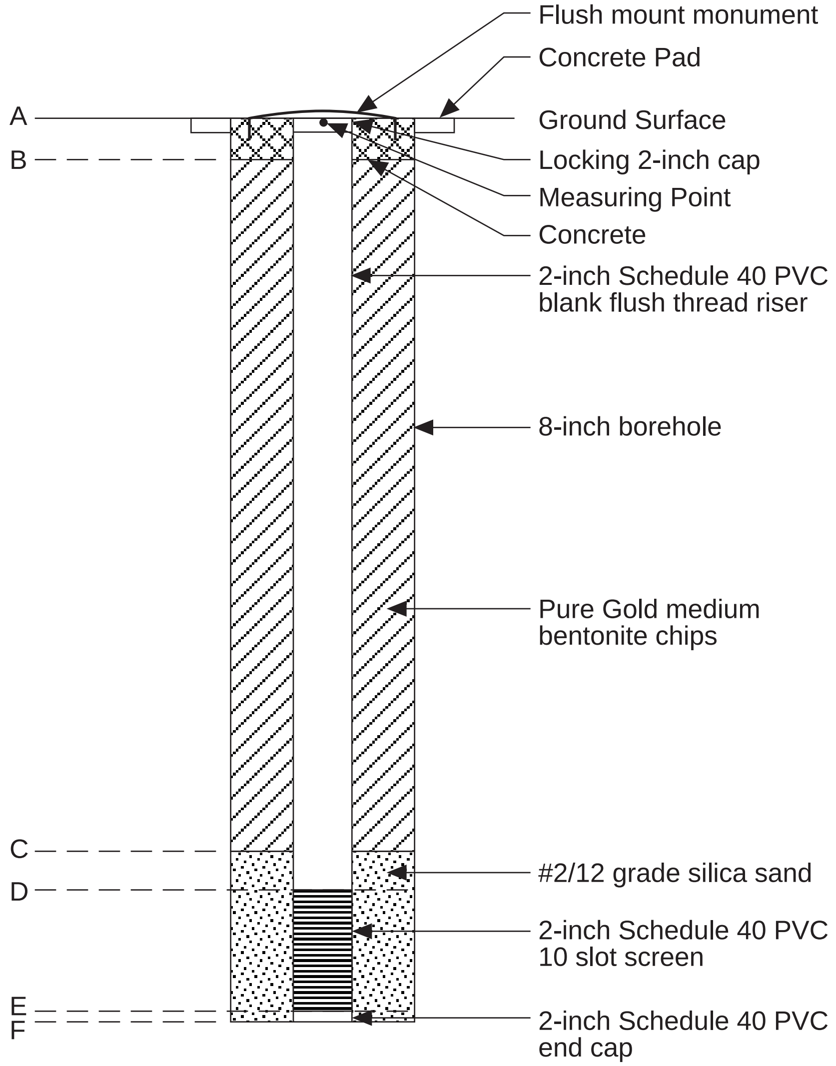
BENZENE ISOCONCENTRATION CONTOURS

SUNREAL/SEATAC GARAGE ESA/WA

Golder Associates

APPENDIX D

MONITORING WELL COMPLETION LOGS



LEGEND

A	Measuring Point
B	Concrete
C	Top of Sand Pack
D	Top of Screened Interval
E	Bottom of Screened Interval
F	Total Depth

VARIATIONS

Well	**A (ft amsl)**	**B**	**C**	**D (ft bgs)**	**E**	**F**
MW1	363.30	3.0	38.0	41.0	51.0	52.0
MW2	362.96	3.0	13.0	15.0	20.0	21.5
MW3	363.97	3.0	14.0	17.0	27.0	28.0
MW5	364.17	4.0	45.0	48.0	58.0	58.0
MW6	367.10	4.0	48.0	50.0	60.0	60.0
MW7	358.65	3.5	41.0	43.5	53.5	53.5
MW9	363.64	4.0	45.9	47.5	57.0	58.0

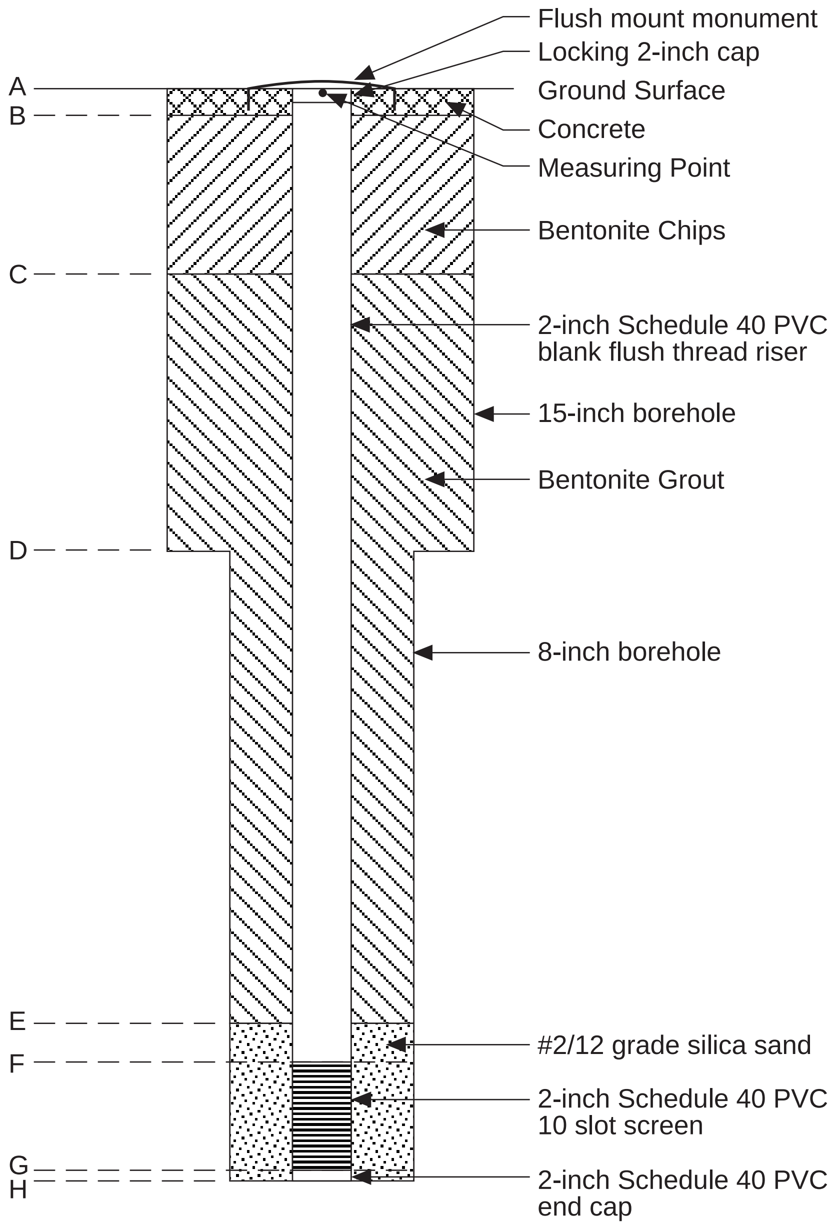
FIGURE **C-1**

MONITORING WELL COMPLETION

SUNREAL/SEATAC PARKING PHASE III/WA

PROJECT NO. 003 1321.900 DRAWING NO. 11063 DATE 1/18/2001 DRAWN BY EA

Golder Associates



LEGEND

A	Measuring Point
B	Concrete
C	Bentonite Chips
D	Bottom of 15-inch Diameter Boring
E	Top of Sand Pack
F	Top of Screened Interval
G	Bottom of Screened Interval
H	Total Depth

VARIATIONS

Well	A (ft amsl)	B	C	D	E (ft bgs)	F	G	H
MW8a	359.79	3.0	NA	24.0	42.0	44.0	54.0	54.0
MW10	362.79	4.2	29.0	62.5	77.0	80.0	90.0	92.0

NOTE

The annulus in MW8A above the sand pack was backfilled with all chips to the concrete level

FIGURE **C-2**

TEMPORARY CASING
MONITORING WELL COMPLETIONS
SUNREAL/SEATAC PARKING PHASE III/WA

PROJECT NO. 003 1321.800 DRAWING NO. 11064 DATE 1/18/2001 DRAWN BY EA

Golder Associates

RECORD OF BOREHOLE #MW-1

STA. MW-1 OFFSET L R
PROJECT NO. 003-1321.300
INCLINATION 90° AZIMUTH

ELEVATION
DRILLING DATE 11-13-00

SHEET 1 OF 3
DATUM
DRILL RIG CME-75

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES — PIEZOMETER — STANDPIPE INSTALLATION
0	[illegible]	Gravel							1355 1st attempt at 2.5ft 50-6" then stop Move hole further from UST No damage done to UST	
1		Loose, moderate yellowish brown, Silty F-m. SAND little f.-C. Gravel FILL								
2	300 lb									
3					1	HD	5-5-4 (9)	1.4 1.5	1408 2.5-4 Loose, Mod Yellowish Br Silty F-M. SAND, little f-C. Gravel, FILL PID=0	
4	[illegible]	V. Loose, Mod. Yellowish Brown, Non-Stratified Silty F. SAND, little subrounded f-C. Gravel Post Glacial Sediments								
5				SM	2	HD	1-1-1 (3)	.5 1.5	1412 5-6.5 V. Loose, Mod Yell Br. Non-Stratified Silty F. SAND, little subrounded f-C Gravel PID-2 ~~with~~ stratified	
8	4" I.D. HSA	V. Dense, Brownish Gray Silty f. SAND to a F. Sandy SILT, trace subrounded f-C. Gravel ABLATION TILL		SM	3	HD	12-35-50 (85)	1.5 1.5	1418-7.5-9.0 V. Dense, Brownish Gray, Silty F. SAND, little sub rounded, f-C. GRAVEL, PID: 0 ABLATION TILL non-stratified	
10				SM	4	HD	25-50/6 >50	10 10	1422 10-11 V. Dense, Brownish Gray f-C. Sandy SILT trace sub- rounded f-C. Gravel PID-1 ABLATION TILL	
15		slight increase in fine Gravel		SM	5	HD	17-50/6 >50	10 10	1430 15-16 As Above increase in gravel to little PID-2	
20										

DEPTH SCALE 1" = 2.5'
DRILLING CONTRACTOR Cascade
DRILLER

Golder Associates

LOGGED BY
CHECKED
DATE

RECORD OF BOREHOLE # MW-1

STA. MW-1 OFFSET L R
PROJECT NO. 003-1321
INCLINATION 90° AZIMUTH
ELEVATION
DRILLING DATE 11-13-00
SHEET 2 OF 3
DATUM
DRILL RIG

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ 6 IN.	SAMPLES RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20				SM	6		17-50/6 >50	1.0 1.0	1435 20-21 V. Dense, Brownish Gray, Non-stratified, f-C. Sandy SILT, trace f. Gravel PID-0	
21										
22										
23										
24										
25				SM	7		25-50/3	0.8 0.8	1445 25-25^{8} Same As above PID-0	
26										
27										
28										
29										
30		Lense of Silty f-C. SAND		SM	8		20-50/5	0.8 0.8	1455 30-30^{9} V. Dense Brownish Gray Weakly Stratified, f-C. Sandy SILT lense of Silty f-C. SAND at 30.4 + 30.6 moist, trace f.-C. Gravel PID-0	
31										
32										
33										
34										
35		V. Dense, Olive Gray [illegible] Stratified Silty f-C. SAND trace f. Gravel Advanced Outwash		SM SP	9		31-50/4	0.8 0.8	1505 35-35^{8} V. Dense, Olive Gray Non-Stratified, Silty f-C. SAND trace f. Gravel, moist PID-0	
36										
37										
38										
39										
40										

DEPTH SCALE 1" = 2.5'
DRILLING CONTRACTOR Cascade
DRILLER

Golder Associates

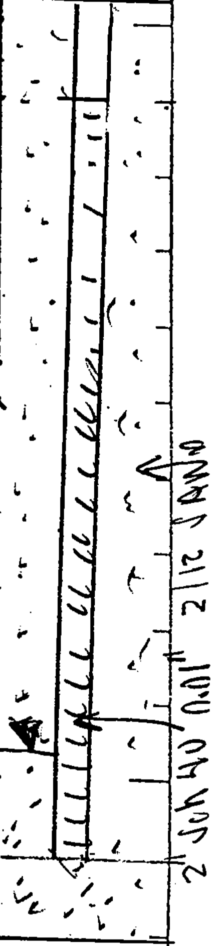
LOGGED BY
CHECKED
DATE

RECORD OF BOREHOLE # MW-1

SHEET 3 OF 3

STA. OFFSET L R
PROJECT NO. 003-1321
INCLINATION 90°
AZIMUTH
ELEVATION
DRILLING DATE 11-13-00
DATUM
DRILL RIG CME-75

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES — PIEZOMETER — STANDPIPE INSTALLATION
40		Graded to F-M SAND		SP	10		50/6	.5 .5	1512 40-40.5 V. Dense, Olive Gray Non Stratified f-M SAND PID-4.	
41										
42										
43										
44										
45		Petroleum odor increased moisture							✓ Petro (gas) odor 1525 45-46 V. Dense, Olive Gray	
46				SP	11		22-50/6	1.0 1.0	Non-Strat. f-M. SAND, trace subrounded Gravel, moist PID-350	
47										
48										
49										
50									1540 50-51.2 V. Dense, Olive Gray to	
51				SP	12		15-25-50/6	0.8 1.0	Med Gray, Non-Stratified f-M. SAND, ~~moist~~ wet PID-24	
52		EOH 52							1550 ~0.2 ft water in hole Construct well from 51-41 ft 1703 Well Constructed water @ 49.7 ft bgs	



DEPTH SCALE 1" = 2.5'
DRILLING CONTRACTOR Cascade
DRILLER

Golder Associates

LOGGED BY
CHECKED
DATE

RECORD OF BOREHOLE #MW 2

STA. MW-2 OFFSET L R
PROJECT NO. 003-1321.310
INCLINATION 90° AZIMUTH
ELEVATION
DRILLING DATE 10-13-00
SHEET 1 OF 2
DATUM
DRILL RIG CME-75

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0	300lb Hammer	Asphalt								
1		V. Loose-Loose Olive Gray, Mod. Brown SILT becoming Silty F-C. SAND below 5.5 ft, little f.-C. Gravel. FILL								
3					1	HD	3/3/2 (5)	1.4/1.5	Olive gray Heter. 1116 2.5~4 Loose PID 2.0, Clayey SILT, some f gravel, FILL	2" Sch 40 PVC
6	Dames & Moore				2	NO	1/1/2 (3)	1.5/1.5	1120 5-6.5 PID-20 V. Loose, Heter. Silty f-C SAND, little f.-C. Gravel FILL	Med. Bent Chips
7		Compact, Mod. Yellowish Brown, Homogeneous Silty F. SAND trace subrounded F. Gravel Petroleum Odor Recessional OUTWASH								
8				SM	3	NO	6/6/7 (15)	1.5/1.5	1124 7.5-9 Faint gas smell, Compact Mod Yellowish Brown, Homogen. Silty f SAND, PID-20	
11	4¼" ID HSA			SM	4		9-10-12 (22)	1.5/1.5	1133 10-11.5 Faint gas odor, Compact Mod Yellowish brown, Homogen. Silty f SAND, trace subrounded Gravel PID-0.0 Recessional OUTWASH	
13				SM	5		4-7-8 (15)	1.6/1.5	1137 12.5-14 PID=200 As above 10-11.5	
15		Color change @15 ft to Olive Gray Wet below 15 ft								
16				SM	6		9-7-11 (18)		1142 15-16.5 PID=20 Wet As above wet below 15 ft Olive Gray	5' Screen
17										
18										
19										
20										

DEPTH SCALE 1"=2.5'
DRILLING CONTRACTOR Cascade
DRILLER Cody

Golder Associates

LOGGED BY GLZ
CHECKED
DATE

RECORD OF BOREHOLE # MW-2

SHEET 2 OF 2

STA. MW-2 OFFSET L R

PROJECT NO. 003-1321

INCLINATION 90°

AZIMUTH

ELEVATION

DRILLING DATE 11-13-00

DATUM

DRILL RIG

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	 TYPE	 BLOWS/ 6 IN.	 RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20				ML	7		4-6-13 (21)	1.4/1.5	1147 20-21.5 Compact, Dark greenish Gray, Homogeneous, SILT, little C. SAND, little f. Subrounded gravel imbedded, damp Ablation Till PID-0	
21										
22										
23										
24										
25										
26										
27										
28										
29										
30										
31										

DEPTH SCALE 1" = 2.5'

DRILLING CONTRACTOR Cascade

DRILLER

Golder Associates

LOGGED BY GLZ

CHECKED

DATE

RECORD OF BOREHOLE #MW-3

STA. MW-3 OFFSET L R
PROJECT NO. 003-1321.310
INCLINATION 90° AZIMUTH
ELEVATION
DRILLING DATE 11-13-00
SHEET 1 OF 2
DATUM
DRILL RIG CME-75

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0	300lb Hammer Dames & Moore	Gravel,								
1 2		Loose, Dusky Yellowish Brown, SILT, WOOD BARK little f. Gravel, FILL								
3 4		Heterogeneous		1	1	HD	5/3/4 (7)	1.3 1.5	0812 2.5-4 Loose, Dusky Yellowish brown, Heterogeneous, Silt, Wood Bark little f. Gravel, FILL PID-25 odor	
5 6 7		Loose-Compact, Dark Yellowish Brown, Silty F.-C. SAND, trace f. Gravel, Plastic debris, FILL			2	HD	3/5/8 (13)	1.5 1.5	0817 5-6.5 Compact, Dark Yellowish brown Heter., Silty F-C. SAND, trace f. Gravel Plastic drum material, FILL, odor PID=8	
8 9					3	HD	2/3/3 (6)	1.5 1.5	0820 7.5-9 Loose, Dark Yell. Brown Heter., Silty f-C. SAND, trace f. Gravel trace Organic roots. PID=6	Mod Chips, Pure Gold
10 11	4" ID HSA	Loose, Mod. Yellowish brown, Homogeneous, Silty F-M. SAND RECESSIONAL OUTWASH		SM	4	HD	2/2/3 (5)	1.5 1.5	0825 10-11.5 Loose, Mod Yellowish Brown Homogen. Silty f-M. SAND PID 1	
12										▽ 12.8' bgs
13 14		Compact - Dense, Olive Gray-Brownish Gray Nonstratified, Silty f.-M. SAND, little to some subangular f.-M. Gravel, trace Cobble Ablation Till or Advanced Outwash							1314 Drilling is harder (Till?)	
15 16 17				SM-GM	5	HD	8/16/13 (29)	0.5 1.5	0832 15-16.5 Compact, Olive Gray Heter. Silty f.-M. SAND, some f.-C. GRAVEL, 1 Cobble. Ablation Till or Advanced Outwash PID-0	
18 19 20										

DEPTH SCALE 1" = 2.5'
DRILLING CONTRACTOR Cascade
DRILLER Cody

Golder Associates

LOGGED BY
CHECKED
DATE

RECORD OF BOREHOLE # MW-3

SHEET 2 OF 2

STA. OFFSET L R

PROJECT NO. 003-1321

INCLINATION 90° AZIMUTH

ELEVATION

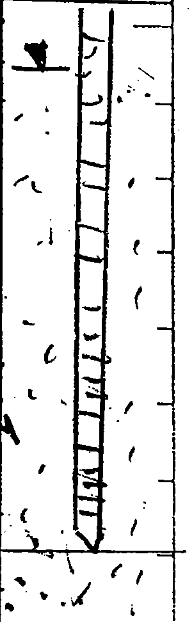
DRILLING DATE 11-13-06

DATUM

DRILL RIG

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS/ 6 IN.	SAMPLES RECOVERY	SAMPLE DESCRIPTION
20				SM GM	6		7/21/25 ㊻	1.4/1.5	0840 20-21.4 Dense, Brownish Gray Stratified, Silty f-M SAND, some little subrounded f. Gravel, moist ABLATION TILL 900-0
21		moist at 21 ft							
22									
23									
24									
25		wet at 25 ft		SM GM	7		50-6"	0.5/0.5	Cobble 0847 25-25.5 V. Dense, Brownish Gray Silty f-C SAND and f-C GRAVEL trace Subangular Cobbles, wet
26									
27									
28		EOH 28							0855 Auger 28 ft, pull up 3 ft
29									
30									
									#2-12 Sand 28-14 BOS 27.0 Sand is bridging have to add water
									1015 Well Construction Completed Water at ~21 ft bgs

NOTES — PIEZOMETER — STANDPIPE INSTALLATION



DEPTH SCALE 1" = 2.5'

DRILLING CONTRACTOR Cascade

DRILLER

Golder Associates

LOGGED BY

CHECKED

DATE

RECORD OF BOREHOLE # MW-4

STA. MW-4 OFFSET L R
PROJECT NO. 003-1321.300
INCLINATION 90° AZIMUTH

ELEVATION
DRILLING DATE 11-14-00

SHEET 1 OF 3
DATUM
DRILL RIG CME-75

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0 1 2	300 lb Auto Hammer Dames & Moore 4" I.D HSA	Compact, Greenish Brown Non-Stratified, fine Sandy SILT, trace Subrounded F.-C. Gravel FILL							Surface tr gravel	
3 4				SM-ML	1	HD	5-9-20 (29)	1.5/1.5	0818 2.5-4.0 Compact, Greenish Brown-Olive Gray Non-Stratified, f. Sandy SILT, trace Subrounded f-C. Gravel No Odor	
5 6 7		V. Dense, Pale Yellowish Brown, Olive Gray Non-Stratified SILT, little fine Sand, trace Subrounded f.-C. Gravel, TILL		ML-SM	2	HD	17-25-30 (55)	1.5/1.5	0823 5-6.5 V. Dense, Pale Yellowish brown, Non-Stratified SILT, little f. Sand, trace, subrounded f-C. Gravel, trace Organic matter No Odor	
8 9				ML-SM	3	HD	50/6	.5/.5	0830 7.5-8 V. Dense, Olive Gray, Non-Stratified, SILT, little f. Sand, little subrounded f.-C. Gravel TILL No Odor	
10 11 12 13 14				ML-SM	4	HD	17-50/5 (750)	.4/.5	0835 10-10.9 V. Dense, Olive Gray, Non-Stratified, SILT, little f. Sand trace subrounded f. Gravel TILL No Odor	
15 16 17 18 19 20				ML-SM	5	HD	27-50/3 (750)	.5/1	0840-15-15.7 V. Dense, Olive Gray Non-Stratified, SILT, little f. Sand, trace Subrounded, f. Gravel TILL No Odor	

DEPTH SCALE 1" = 2.5'
DRILLING CONTRACTOR Cascade
DRILLER Cody

Golder Associates

LOGGED BY GLZ
CHECKED
DATE

RECORD OF BOREHOLE #MW-4

STA. MW-4 OFFSET L R
PROJECT NO. 003-1321
INCLINATION 90° AZIMUTH

ELEVATION
DRILLING DATE 11-14-00

SHEET 2 OF 3
DATUM
DRILL RIG

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20		increase in amount of fine sands		ML- SM	6	HD	17-50/5 750	.8 .9	0850 20-20.9 V. Dense, Olive Gray Non-Stratified, Silty f. SAND trace subrounded f-C. Gravel TILL No Odor	
21										
22										
23										
24										
25				SM	7	HD	20-50/4 >50	.8 .8	0855 25-25.8 V. Dense Olive Gray NON-Stratified, f. Sandy SILT, trace f Gravel TILL Slight increase in moisture sample is damp, but does not appear to be saturated No Odor	
26										
27										
28										
29										
30		V. Dense, Olive Gray Non-Stratified, Silty F-C. SAND, trace to little F-C. subrounded Gravel damp ADVANCED OUTWASH		SW SM	8	HD	50/6	.5 .5	0902 30-30.5 V. Dense. Olive Gray Non-Stratified Silty f-C. SAND trace to little f-C. Gravel, damp Advanced OUTWASH No Odor	
31										
32										
33										
34										
35				SW- SM	9	HD	22- 50/6	1.0 1.0	0915 35-36 V. Dense Olive Gray NON-Stratified Silty f-C. SAND trace subrounded f-C Gravel damp ADVANCED OUTWASH No Odor	
36										
37										
38										
39										
40										

DEPTH SCALE 1" = 2.5'
DRILLING CONTRACTOR Cascade
DRILLER

Golder Associates

LOGGED BY GLZ
CHECKED
DATE

RECORD OF BOREHOLE # MW-4

STA. MW-4 OFFSET L R

PROJECT NO. 003-1321

INCLINATION 90°

AZIMUTH

ELEVATION

DRILLING DATE 11-14-00

SHEET 3 OF 3

DATUM

DRILL RIG

DEPTH SCALE (FEET)	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS/ 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES — PIEZOMETER — STANDPIPE INSTALLATION
40		reduction in Coarse sands		SW	10	HO	22 50/6	10/10	0930 40-41 V. Dense, Olive Gray Non-stratified, f-M SAND trace f-C Gravel ADVANCED OUTWASH No Odor	
41										
42										
43										
44										
45		45 EOH			11		90/6	.5/.6	0945 45-45.5 As above	
46									Allow hole to sit open for 15 minutes. No water collects in hole. Chip the hole closed	
47										
48										

DEPTH SCALE 1" = 2.5'

DRILLING CONTRACTOR Cascade

DRILLER

Golder Associates

LOGGED BY GLZ

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW5

SHEET 1 OF 3

LOCATION: SeaTac Parking

ELEVATION

DRILLING DATE 1/2/01

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	 TYPE	 BLOWS / 6 IN.	 RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0										930 Start post-hole
5				SW	1		100-6	06/05	~~Very~~ Dense, dark yellowish brown (10YR 4/2) unstratified SAND, some silt, little gravel damp	840 HS-PID 0.0ppm No odor
10				SW	2		50-5	06/04	Same as above - Dense	842 HS PID 0.0 ppm No odor
	HSA									
15				SW	3		100-6		V Dense, dark yellowish Brown (10YR 4/2) unstratified, SAND Some Silt Some to little gravel damp	845 HS PID 0.0 ppm No odor
20										850

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

LOCATION: Sea Tac Parking

RECORD OF BOREHOLE # MW 5

ELEVATION

DRILLING DATE 1/2/01

SHEET 2 OF 3

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20				SW	4		80-6	06/05	V. Dense, Dark yellowish Brown (10YR 4/2) unstratified, Silty SAND to SAndy SILT, some to little gravel dmp	~~850~~ HS PID 0.0 PPM
25				SP	5		100-6	09/05	Dense Dark Yellowish Brown (10YR 4/2) unstratified, SAND dmp	HS PID 0.0 ppm 854
30	HSA			ML	6		40,50-6	15/18	30 ID" Dense Dark Yellowish Brown (10YR 4/2) unstratified to slightly bedded SILT dmp to moist	858 HS PID 0.0 ppm
				SW					30.4 - 31.0 Dense Dark Yellowish Brown (10YR 4/2) unstratified f. to C SAND and f gravel dmp	
35				SW	7		32 50-6	10/10	Compact to Dense Dark yellowish Brown (10YR (4/2) unstratified f to c Sand little to some gravel dmp	902 HS PID 0.0 ppm
40					8					

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Gies

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW5

SHEET 3 OF 3

LOCATION: SeaTac Parking

ELEVATION

DRILLING DATE 1/02/01

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / 6 IN.	SAMPLES RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
40				SP	8		65-6	07/05	V. Dense, dark yellowish Brown (10YR 4/2) unstratified SAND (M to C) little gravel dry	chem Sample 912 HS PID 0.0 ppm Bentonite Chips Blank
45				SP	9		70-6	07/05	V. Dense dark yellowish brown (10YR 4/2) unstratified M SAND dry HS PID 0.0 ppm	916 Chem Sample Sand
50				SP	10		50-6	07/05	Same as above HS PID 0.0 ppm	920 chem Sample Screen SAND 10 Slot screen
55	HSA			SP	11		25,50-6		Same as above HS PID 0.0 ppm	chem Sample
									TD 58 ft bgs ∇ ~ 50.5 ft bgs	
60										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

12000K

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW6

SHEET 1 OF 3

LOCATION: Sea-Tac Parking

ELEVATION

DATUM

DRILLING DATE 1/02/01

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	 TYPE	 BLOWS / 6 IN.	 RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0									0-0³ Asphalt	1210 Start Hand auger
5				SP	1	HD	13,33 25	15/15	Loose to compact Moderate Brown (5YR 4/4) stratified m SAND little gravel little silt trace charcoal FILL	1222 HS PID 0.0 ppm
10				SP	2	HD	15 15 17	15/15	Loose Dark Yellowish Brown (10YR 4/4) unstratified f-m SAND damp	1226
15				SP	3	HD	50-6	05/05	Compact to dense Dark Yellowish Brown (10YR 4/2) unstratified f-m SAND Damp	1230 chem sample
										17 ft → wet ? zone ? outside of sample muddy @ 4
20					u					1232

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

LOCATION: Sea-Tac Parking

RECORD OF BOREHOLE # MW 6

ELEVATION

DRILLING DATE 1/02/01

SHEET 2 OF 3

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20				ML	4	HN	23 50-6	10/10	Dense, Dark Yellowish Brown (10YR 4/2) unstratified SILT little m-c SAND little fine Gravel damp	Chem Sample PID HS 0.0 ppm
25				SP	5	HN	50-6	07/05	Dense, Dark Yellowish Brown (10YR 4/2) unstratified f SAND trace gravel damp	1235 PID HS 0.0 ppm
30				SW	6	HN	50-6	05/05	Dense, Dark Yellowish Brown (10YR 4/2) unstratified f-c SAND little to some gravel dry	1239 PID HS 0.0 ppm
35				SP	7	HN	50-6	07/05	Dense, Dark Yellowish Brown (10YR 4/2) unstratified f-m SAND damp	1245 HS PID 0.0 ppm
40					8					1248

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 6

SHEET 3 OF 3

LOCATION: SeaTac Parking

ELEVATION

DRILLING DATE 1/02/01

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
40		*		SW to SP	8	HD	50-6	01/05	Dense, Dark Yellowish Brown (10YR 4/2) unstratified, f-c SAND Trace silt Trace gravel dry	1248 HS PID 0.0 ppm chem sample
45				SP	9	HD	50-6	07/05	Dense, Dark Yellowish Brown (10YR4/2) unstratified f-m SAND dry	1252 HS PID 0.0 ppm Chem sample
50				SP	10	HD	50-6	07/05	Same as above	1256 HS PID 0.0 ppm chem sample
										water?
55				SP	11	HD	51-5	06/05	Same as above "wet"	1300 HS PID 0.0 ppm
60									TD 60 ∇~53ft	

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Gores

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 7

SHEET 1 OF 3

LOCATION: Sea-Tac Parking

ELEVATION

DRILLING DATE 1/3/01

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	 TYPE	 BLOWS / 6 IN.	 RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0		ASPHALT $0-0^5$								1055 Start
		Crushed Gravel								
										1110 dug by hand to 2.5
					1	HD	50-6	07/05	Dense, Dark Yellowish Brown (10YR 4/2) Slightly Stratified f-m SAND little silt dry	1112 HS PID 0.0ppm
5										
										gravel in cuttings
					2	HD	50-6	08/06	Dense, Dark Yellowish Brown (10YR 4/2) unstratified Sandy SILT some gravel damp (TILL)	1120 HS PID 0.0ppm
10										
					3	HD	100-6	07/05	V Dense Dark Yellowish Brown (10YR4/2) unstratified Silty SAND to SAndy SILT some gravel damp (TILL)	HS PID 0.0ppm 1125
15										
					4	HD	100-6	07/05	V Dense, Dark Yellowish Brown (10YR4/2) f-m SAND some silt Some gravel dry (TILL)	HS PID 0.0ppm 1130
20										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Coes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 7

SHEET 2 OF 3

LOCATION: Sea-Tac Parking

ELEVATION

DRILLING DATE 1/3/01

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION	
20											
					5	HD	100-6	05/05	V. Dense, Dark Yellowish Brown (10YR4/2) unstratified, f-m SAND some to little Silt, some gravel damp (TILL)	HS PID 0.0ppm	1238
25											
		X			6	HD	100-6	07/95	V. Dense, Dark Yellowish Brown (10YR4/2) unstratified, f-c SAND ~~lit~~ Some Gravel little Silt moist ~~damp~~ (TILL)	Chem Sample HS PID 0.0 ppm	~~12~~ 1245
30											
					7	HD	800-6	06/55	V. Dense Dark Yellowish Brown (10YR 4/2) unstratified med SAND trace silt trace gravel damp to moist (outwash SAND)	Chem Sample faint TPH odor PID 13 ppm HS	[illegible]
35											
					8	HD	50-6	07/05	V Dense, Dark Yellowish Brown (10Y4/2) unstratified f-m SAND moist to damp (Outwash SAND) TPH odor	48 ppm Chem Sample	[illegible]
40											

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW7

SHEET 3 OF 3

LOCATION: Sea-Tac Parking

ELEVATION

DATUM

DRILLING DATE 1/3/00

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
40										
					9	HD	50-6	05/05	Very Dense, Dark yellowish Brown (10YR 4/2) unstratified m SAND moist to wet	HS PID 225 ppm wet TPH odor
45										1205
					10	HD	50-6	05/05	~~Very~~ Same as above wet	
50										1208
5										
0										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 8

SHEET 1 OF 2

LOCATION: Sea Tac Parking

ELEVATION

DRILLING DATE 1/4/00

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0		crushed gravel / Asphalt 10"								935
5					1	HB	23, 20, 20	15/15	4.5 - Compact, olive gray ( ) Sandy SILT some gravel damp (Ablation TILL)	940 HS PID 0.0 ppm
10	HSA 9⅝" ID				2	HD	14, 14, 14	14/15	same as above	945 HS PID 0.0 ppm
15					3	HB	50-6	07/05	Dense, Dark Yellowish Brown (10YR 4/2) and Med gray unstratified slightly mottled (with FeOx) Sandy SILT some gravel damp	950 chem sample HS 0.0 PID ppm
									Dense (olive gray ( ) unstratified f-med SAND some silt little gravel	collected GW sample through augers ∇ wet
20					4		55-6	5/05	moist to wet	955 PID HS 0.0 ppm

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW 8

SHEET 2 OF 2

LOCATION: Sea Tac Parking

ELEVATION

DRILLING DATE 1/4/00

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE			SAMPLES				SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
		SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY		
20										
25					5	HD	50-6	06/06	Same as above	1010 HS PID 0.0 ppm
30										
35										
40										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 8a

SHEET 1 OF 3

LOCATION: Sea-Tac Parking

ELEVATION

DRILLING DATE 1/6/01

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	SAMPLES TYPE	SAMPLES BLOWS / 6 IN.	SAMPLES RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0	HSA – 10^{3}	Asphalt Compact, Dark yellowish Brown, unstratified, f-m SAND Some Gravel little Silt damp (FILL Compact Olive Gray unstratified slightly weathered f-med SAND Some to little Silt Some gravel (TILL FILL) (Gravel & Cobble)								845 Auger at 4¼ ID
5										4.5 ft large cobble in hole move aside 2 ft
		Brownish Black, Sandy SILT with little organics wood & Roots (cuttings)								
10		(cuttings Dark Yellowish Brown (10 YR 4/2) med Sand Some SILT some Gravel (TILL)								12 feet check No Water 930
15										15 feet check for water cutting moist No water
										wet at 17.5 940
20										945 water in hole at 19.5

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER C.

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

LOCATION: Sea-Tac Parking

RECORD OF BOREHOLE # MW 8a

ELEVATION

DRILLING DATE 1/6/01

SHEET 2 OF 3

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20										
										24^5 check hole then attaching [illegible]
25										
									Dense, Dark Yellowish Brown (10YR 4/4)	
					1	HD	50-6	0.5/0.5	unstratified SAND some gravel some to little Silt damp (T.O.C)	1103 PID HS 0.0 ppm
30									[illegible] on outside of Sample	
					2	HD	50-6	1/0.5	Same as Above	1109 PID HS 0.0 ppm
35										
					3	HD	100-4	NR		1114 PID 0.0 ppm
40										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER C

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

LOCATION: Sea-Tac Parking

RECORD OF BOREHOLE # MW8a

ELEVATION
DRILLING DATE 1/6/01

SHEET 3 **OF** 3
DATUM
DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
40										
					4	HD	100-6	0/05	V. Dense, Dark Yellowish Brown (10YR 4/2) unstratified, med SAND	check hole dry 1120
45										PID 0.0 ppm
									Dense, Olive gray ( ) to	
					5	[illegible]	50-6	5/05	Dark yellowish Brown (10YR 4/4) unstratified med SAND Outwash SAND	1125
50										1128 ▽ 46.5
										1145 sample HD PID 0.0 ppm
									Same as above	1148
					6		100-6	0/05	TD	
55										PID 0.0 ppm
60										

DEPTH SCALE 7.5 inches = 2 feet
DRILLING CONTRACTOR Cascade
DRILLER C

Golder Associates

LOGGED BY T. Norton
CHECKED
DATE

PROJECT NO. 003-1321-900

LOCATION: Sea-Tac Parking

RECORD OF BOREHOLE # MW 9

ELEVATION

DRILLING DATE 1/4/00

SHEET 1 OF 3

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0		ASPHALT								1230 cut asphalt
5					1	HD	50-6	06/05	Dense, Dark Yellowish Brown slightly stratified and mottled with Fe Ox Sandy SILT, some to little gravel clumps (TILL)	1246 HS PID 0.0 ppm
10					2	HD	60-6	0/05	Very Dense Olive gray ([illegible]) unstratified Silty SAND some to little gravel clumps (TILL)	1251 PID HS 0.0 ppm
15					3	HA	70-6	0/05	Same as above	1255 PID HS 0.0 ppm
20					4					

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW 9

SHEET 2 OF 3
ELEVATION
DATUM
LOCATION: Sea-Tac Parking
DRILLING DATE 1/4/01
DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
20										
					4	HS	100-6	05/05	Dense Dark Yellowish Brown (10YR 4/2) unstratified f-m SAND some to little Silt some to little gravel damp (TILL)	1259 PID HS 0.0ppm
25					5	HS	100-6	05/05	Same as above	1305 chem sample PID HS 0.0 ppm
									$30^{0}-30^{3}$	silt
30					6	HS	100-6	07/05	Dense, Dark Yellowish Brown (10YR 4/2) Stratified SILT and fine sand SILT. damp to moist	chem sample silt 1310 PID HS 0.0 ppm
									$30^{3}-30^{6}$ Dense Olive gray ( ) unstratified coarse SAND little gravel moist.	
35					7	HS	50-6		Dense, Olive gray unstratified medium SAND trace gravel damp (Outwash SAND)	1315 chem sample PID problems No odor
40										

DEPTH SCALE 7.5 inches = 2 feet
DRILLING CONTRACTOR Cascade
DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton
CHECKED
DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 9

SHEET 3 OF 3

LOCATION: Sea-Tac Parking

ELEVATION

DRILLING DATE 1/4/00

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
40										
					8	HA	50-6		Dense, Olive gray to Dark yellow Brown, ( ) unstratified f to med SAND	1315 slight TPH odor
45									Same as above	
					9	HA	50-4			1320 mild TPH odor
										Strong TPH odor
50										
					10	HA	50-6		Dense, Olive gray ( ) unstratified med SAND moist	1325 ▽ ATD 51.58
55										
					11	HA			Same as above wet	1330 strong tph odor
60										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW 10

SHEET 1 OF

ELEVATION

DATUM

LOCATION: Sea Tac Parking

DRILLING DATE 1/5/01

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
0										8:00 post hole
5					1	HP	50-6	0.9/.5	Dense, Dark Yellowish Brown (10YR 4/2) slightly stratified to mottled, SILT, Some to little Sand Some to little gravel Fe ox staining damp (FILL TILL)	810
10					2	HD	50-6	[illegible]/.5	Dense Dark Yellowish Brown (10YR 4/2) unstratified f-med SAND. Some silt (6" silt bed at 10') Some to little gravel damp (TILL)	815
15					3	HD	60-6	0.5/.5	Dense Dark Yellowish Brown (10YR 4/2) slightly stratified V. fine Silty SAND little gravel damp (TILL)	820
20										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW 10

SHEET 2 OF

LOCATION: SeaTac Parking

ELEVATION

DRILLING DATE 1/5/01

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	 TYPE	 BLOWS / 6 IN.	 RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
-20					4	HD	65-6	8/8	V. Dense Dark yellowish Brown (10YR4/2) unstratified f-md SAND Some to little gravel Some to little silt damp (TILL)	825 HS PID 0.0ppm
-25					5	HD	100-6	85/85	V. Dense Dark yellowish Brown (10YR4/2) unstratified f-med SAND little silt, little Gravel damp (TILL)	830 HS PID 0.0ppm
-30					6	HD	100-6		V. Dense Dark Yellowish Brown (10YR4/2) unstratified f-c SAND some to little gravel little silt damp (TILL)	835 chem Sample PID HS 0.0ppm
-35					7	HD	75-6		V. Dense olive gray ( ) unstratified m-f SAND trace f. gravel damp (outwash sand)	840 chem Sample PID 0.8 -1.2 ppm
-40					8					

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Gross

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321-900

RECORD OF BOREHOLE # MW 10

SHEET 3 **OF**

LOCATION: Sea Tac Parking

ELEVATION

DRILLING DATE 1/5/01

DATUM

DRILL RIG CME 75

DEPTH FEET	BORING METHOD	SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
40					8	HD	58-6	0.7/1.5	Dense, Dark Yellowish Brown (10YR4/2) to Olive Gray ( ) slightly stratified (0°) fine to med and fine to coarse SAND trace gravel damp (TPH odor) OUTWASH SAND	846 chem sample HS PID 45 ppm
45					9	HD	50-6	0.7/1.5	Dense, Olive Gray ( ) unstratified medium SAND damp (TPH odor) (OUTWASH SAND)	853 TPH odor chem sample 75 ppm HS PID
50					10	HD	50-6	0.6/1.5	Same as above wet (TPH odor)	858 wet TPH odor moderate 425 ppm HS PID
55					11	HD	60-6	0.6/1.5	Dense Olive Gray ( ) unstratified med to coarse SAND wet (TPH odor) Outwash SAND	906 tripping out / 7¼ OD auger 275 ppm HS PID
60					12					911

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Goes

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW10

SHEET 4 OF

LOCATION: SeaTac Parking

ELEVATION

DRILLING DATE 1/5/00

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE		USCS	SAMPLES				SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
		SOIL PROFILE DESCRIPTION	GRAPHIC LOG		NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY		
60					12	HD	50-6	$0^{5}/0^{5}$	Same as: MW10-11	PID HS 90 ppm Pulled augers 1247 drilled 10¾ augers [illegible]
65					13				Tried sample heave & quit	1342
70					14	HS	60-5	$0/0^{5}$	Dense, Olive to med gray unstratified f-m SAND outwash/ Stain / Heave?	Blows not accurate HS PID 104 ppm 1352
75					15	HD	50-6	[illegible]	Same as above	1405 Blows not accurate PID Switch sampler to 17 spt
80					16	HD				

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER B. Cole

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

PROJECT NO. 003-1321.900

RECORD OF BOREHOLE # MW 10

SHEET 5 OF 5

LOCATION: Sea Tac Parking

ELEVATION

DRILLING DATE 1/5/00

DATUM

DRILL RIG CME

DEPTH FEET	BORING METHOD	SOIL PROFILE SOIL PROFILE DESCRIPTION	GRAPHIC LOG	USCS	SAMPLES NUMBER	TYPE	BLOWS / 6 IN.	RECOVERY	SAMPLE DESCRIPTION	NOTES PIEZOMETER STANDPIPE INSTALLATION
80					16	SPT		15/15	SAME AS #Above	1415
85					17	SPT		5/15	0^15 in shoe 86^4-86^5 Dense Olive gray ( ) unstratified, f-c sand some fine Gravel, trace silt (OUTWASH SAND)	1432
90					18	SPT		15/10	Same as #16	1445
										1448 TD 92
5										
-0										

DEPTH SCALE 7.5 inches = 2 feet

DRILLING CONTRACTOR Cascade

DRILLER

Golder Associates

LOGGED BY T. Norton

CHECKED

DATE

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. R 71930

Construction/Decommission

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* ____

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner: **Master Park Lot A**

Site Address: **18220 International Blvd**

City: **Seattle** County: **King**

Consulting Firm: **ATC Associates**

Unique Ecology Well ID Tag No. BAT 048

Location 1/4 SE 1/4 **NE** Sec 33 Twn **23N** R **4E** ☒ EWM or WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Lat/Long (s,t,r still Required)

Lat Deg: x Lat Min/Sec: x

Long Deg: x Long Min/Sec: x

Tax Parcel No. N/A

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature

Driller/Trainee License No. 2073

Cased or Uncased Diameter ____ Static Level 30

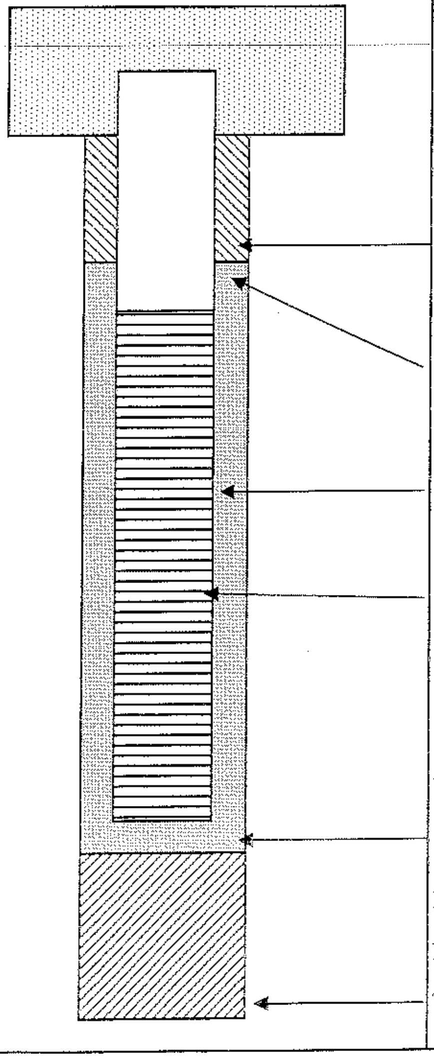
Work/Decommision Start Date 8/17/2007

If trainee, licensed driller's Signature and License No. ____

Work/Decommision End Date " "

Construction/Design

Well Data **W07-549**



Concrete Surface Seal Depth 4 FT

Blank Casing (dia x dep) 2 25

Material pvc

Backfill 19 FT

Type Bent Chips

Seal ____

Material ____

Gravel Pack 17 FT

Material 2/12

Screen (dia x dep) 2 15

Slot Size 1010

Material pvc

Well Depth 40 FT

Backfill ____

Material ____

Total Hole Depth ____ FT

Formation Description

0 - 13 FT

brown med Sand

0/13 - 40 FT

gray silty Sand, some gravel

0 - FT

Scale 1" = ____

Page ____ of ____

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. R 71791

Construction/Decommission
☒ Construction
☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* MW-11

Type of Well
☒ Resource Protection
☐ Geotechnical Soil Boring

Property Owner **Master Park C**
Site Address **16025 International Blvd**
City **Seattle** County **King**

Consulting Firm **ATC Associates**

Location 1/4 **NE** 1/4 **NE** Sec **28** Twn **23N** R **4E** ☒ EWM or WWM

Unique Ecology Well ID Tag No. BAT 255

Lat/Long (s,t,r still Required) Lat Deg x Lat Min/Sec x
Long Deg x Long Min/Sec x

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards. Materials used and the information reported above are true to my best knowledge and belief.

Tax Parcel No. **N/A**

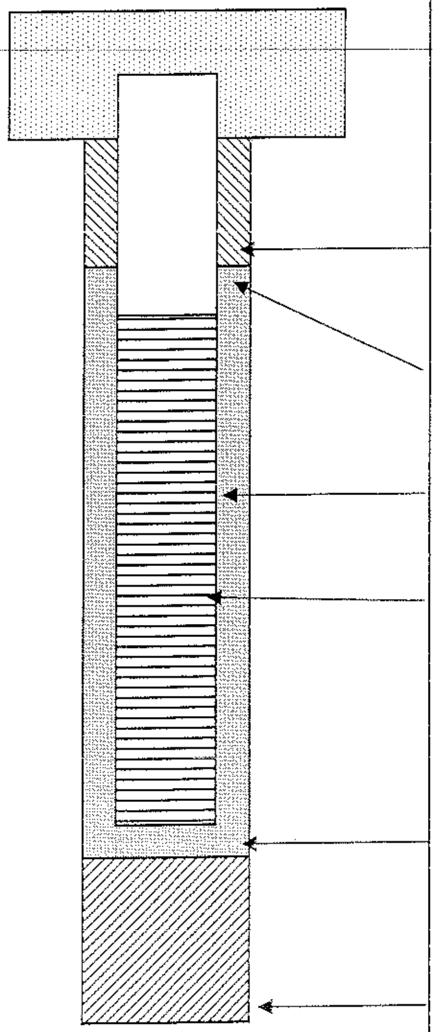
☒ Driller ☐ Trainee Name (Print) Scott Krueger
Driller/Trainee Signature
Driller/Trainee License No. 2073

Cased or Uncased Diameter
Static Level 32.46

Work/Decommision Start Date **8/9/2007**
Work/Decommision End Date " "

If trainee, licensed driller's Signature and License No.

Construction/Design



Well Data **W07-549**

Concrete Surface Seal Depth 5 **FT**
Blank Casing (dia x dep) 2 42
Material pvc
Backfill 35 **FT**
Type Bent chips
Seal
Material
Gravel Pack 17 **FT**
Material 2/12
Screen (dia x dep) 2 15
Slot Size .010
Material pvc
Well Depth 57 **FT**
Backfill
Material
Total Hole Depth **FT**

Formation Description

0 - 45 **FT**
brown silty sandy gravel

45 - 57 **FT**
brown med sand

0 - **FT**

Scale 1" =

Page of

ECY 050-12 (Rev 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT
Notice of Intent No. R 71791

Construction/Decommission

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* MW-12

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner **Master Park**

Site Address **16025 International Blvd**

City **Seattle** County **King**

Consulting Firm **ATC Associates**

Unique Ecology Well ID Tag No. BAT 256

Location 1/4 **NE** 1/4 **NE** Sec **28** Twn **23N** R **4E** [✓ EWM] or WWM

Lat/Long (s,t,r still Required) Lat Deg x Lat Min/Sec x

Long Deg x Long Min/Sec x

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Tax Parcel No. N/A

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature

Driller/Trainee License No. 2073

Cased or Uncased Diameter

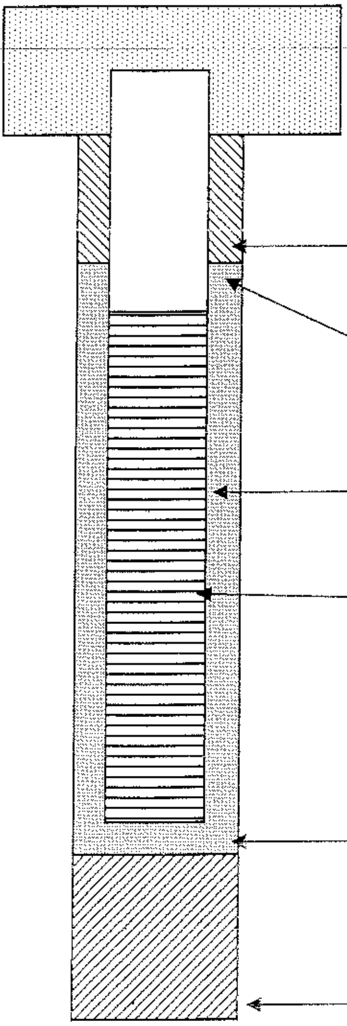
Static Level 55

If trainee, licensed driller's Signature and License No.

Work/Decommision Start Date 8/9/2007

Work/Decommision End Date 8/10/07

Construction/Design



Well Data **W07-549**

Concrete Surface Seal Depth 3 FT

Blank Casing (dia x dep) 2 50

Material

Backfill 45 FT

Type Bent. chips

Seal

Material

Gravel Pack 17 FT

Material 2/12

Screen (dia x dep) 2 15

Slot Size 010

Material pvc

Well Depth 65 FT

Backfill 2

Material 2/12

Total Hole Depth 67 FT

Formation Description

0 - 8 FT
Silty Sandy clay

0 8 - 32 FT
brown Silty Sandy gravel

0 32 - 65 FT
brown med Sand

Scale 1" =

Page of

ECY 050-12 (Rec=v 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No. R 71791

Construction/Decommission

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* MW-13

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner **Master Park**

Site Address **16025 International Blvd**

City **Seattle** County **King**

Consulting Firm **ATC Associates**

Unique Ecology Well ID Tag No. BAT 257

Location 1/4 **NE** 1/4 **NE** Sec **28** Twn **23N** R **4E** ☒ EWM or WWM

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

Lat/Long (s,t,r still Required) Lat Deg **x** Lat Min/Sec **x**

Long Deg **x** Long Min/Sec **x**

Tax Parcel No. **N/A**

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature

Driller/Trainee License No. 2073

Cased or Uncased Diameter

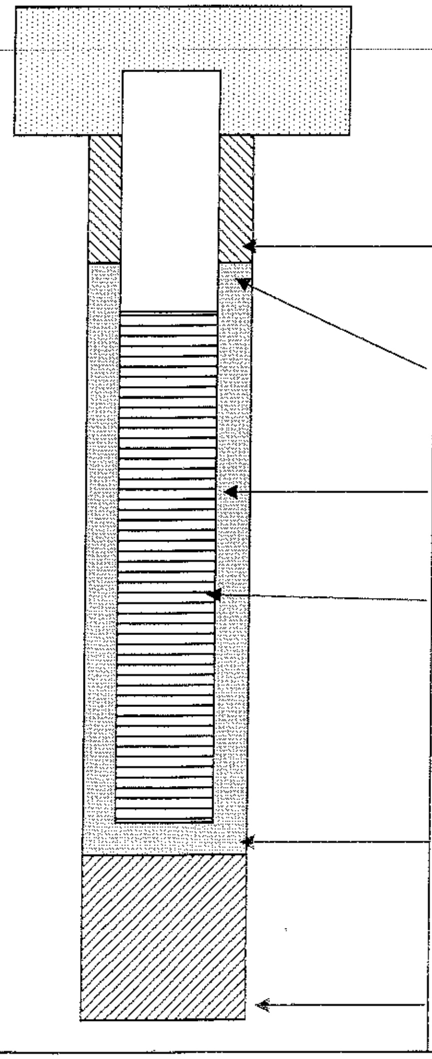
Static Level 66

Work/Decommision Start Date **8/9/2007**

If trainee, licensed driller's Signature and License No.

Work/Decommision End Date 8-13-07

Construction/Design



Well Data **W07-549**

Concrete Surface Seal Depth 5 **FT**

Blank Casing (dia x dep) 2 50

Material pvc

Backfill 43 **FT**

Type Bent chips

Seal

Material

Gravel Pack 17 **FT**

Material 2/12

Screen (dia x dep) 2 15

Slot Size .010

Material pvc

Well Depth 65 **FT**

Backfill

Material

Total Hole Depth **FT**

Formation Description

0 - 35 **FT**

brown Silty Sand, gravel

035 - 65 **FT**

brown med Sand

0 - **FT**

Scale 1" =

Page of

ECY 050-12 (Rec=v 2/01)

RESOURCE PROTECTION WELL REPORT

(SUBMIT ONE WELL REPORT PER WELL INSTALLED)

CURRENT

Notice of Intent No. R 71791

Construction/Decommission

☒ Construction

☐ Decommission *ORIGINAL INSTALLATION Notice of Intent Number* MW - 14

Type of Well

☒ Resource Protection

☐ Geotechnical Soil Boring

Property Owner **Master Park**

Site Address **16025 International Blvd**

City **Seattle** County **King**

Consulting Firm **ATC Associates**

Unique Ecology Well ID Tag No. BAT 258

Location 1/4 **NE** 1/4 **NE** Sec **28** Twn **23N** R **4E** EWM or WWM

Lat/Long (s,t,r still Required) Lat Deg x Lat Min/Sec x

Long Deg x Long Min/Sec x

WELL CONSTRUCTION CERTIFICATION: I constructed and/or accept responsibility for construction of this well, and its compliance with all Washington well construction standards Materials used and the information reported above are true to my best knowledge and belief

☒ Driller ☐ Trainee Name (Print) Scott Krueger

Driller/Trainee Signature

Driller/Trainee License No. 2073

If trainee, licensed driller's Signature and License No.

Tax Parcel No. N/A

Cased or Uncased Diameter Static Level 55

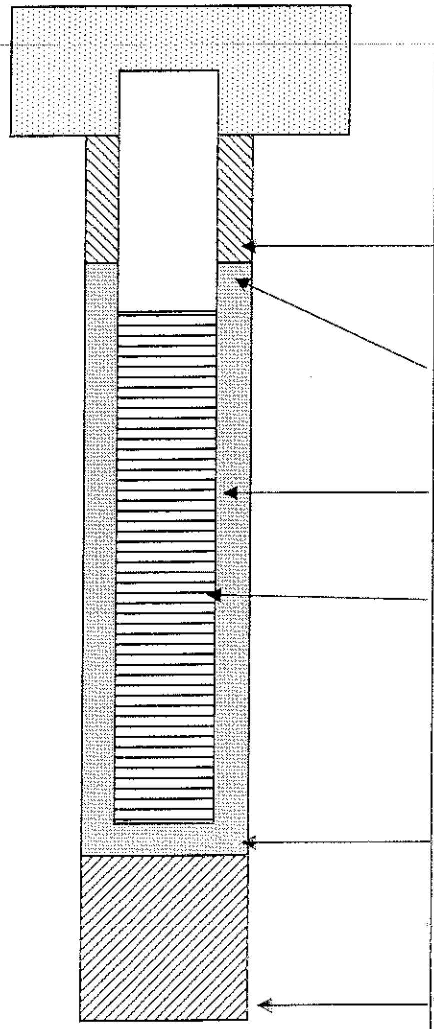
Work/Decommision Start Date 8/9/2007

Work/Decommision End Date 8-14-07

Construction/Design

Well Data **W07-549**

Formation Description



Concrete Surface Seal Depth 5 FT

Blank Casing (dia x dep) 2 50

Material pvc

Backfill 43 FT

Type Bent Chips

Seal

Material

Gravel Pack 17 FT

Material 2/12

Screen (dia x dep) 2 15

Slot Size .010

Material pvc

Well Depth 65 FT

Backfill

Material

Total Hole Depth FT

0 - 35 FT

brown Silty Sand, gravel,

0 35 - 65 FT

brown med Sand

0 - FT

Scale 1" =

Page of

ECY 050-12 (Rev 2/01)

RECORD OF BOREHOLE MW-15

SHEET 1 of 2

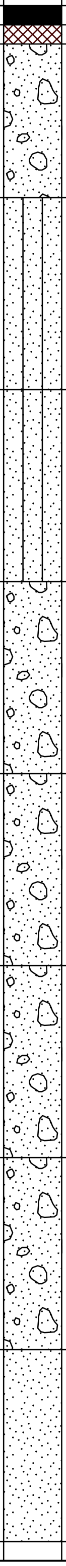
PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 60.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 10/29/07
DATE COMPLETED: 10/30/07
WEATHER:

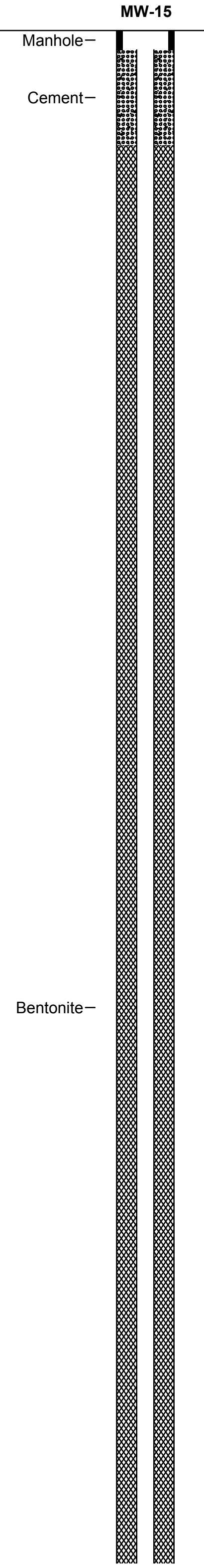
DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: 56.8 ft
ELEVATION W.L.:
DATE W.L.: 10/29/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
0		0.0 - 0.5 ASPHALT								
		0.5 - 1.0 SUBGRADE and FILL, concrete fragments and sand		0.5						
		1.0 - 5.0 Silty SAND with gravel (SP)	SP	1.0						
5		5.0 - 10.0 Light Red to Brown Silty fine SAND, medium dense, damp, no odor (SM)	SM	5.0		1	SS	5 -6 -5		
10		10.0 - 15.0 Medium Brown Silty fine SAND, some fine gravel, damp, no odor (SM)	SM	10.0		2	SS	19 -20 -22		
15		15.0 - 20.0 Light Brown medium SAND with fine to medium gravel, some silt, medium dense, no odor (SP)	SP	15.0		3	SS	27 -50/4"		
20		20.0 - 25.0 Brownish Gray Silty fine SANDwith fine to medium gravel, damp (SP-SM)	SP-SM	20.0		4	SS	50/6"		
25		25.0 - 30.0 Grayish Brown medium SAND with fine to medium gravel, some silt, no odor (SP)	SP	25.0		5	SS	50/6"		
30		30.0 - 35.0 Medium Brown Silty fine to medium SAND with fine to medium gravel, damp (SP-SM)	SP-SM	30.0		6	SS	6 -14 -26		
35		35.0 - 40.0 Medium Brown medium to coarse SAND, with some silt, samp, no odor or staining (SP)	SP	35.0		7	SS	14 -14 -15		
40		Log continued on next page								



MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-15
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0-50 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 50-65 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 48-65 FT
Type: Sand
Quantity: 17 FT
FILTER PACK SEAL
Interval: 3-48 FT
Type: Bentonite Chips
Quantity: 45 FT
ANNULUS SEAL
Interval: 0-3
Type: Cement
Quantity: 3 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Andy

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-15

SHEET 2 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 60.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

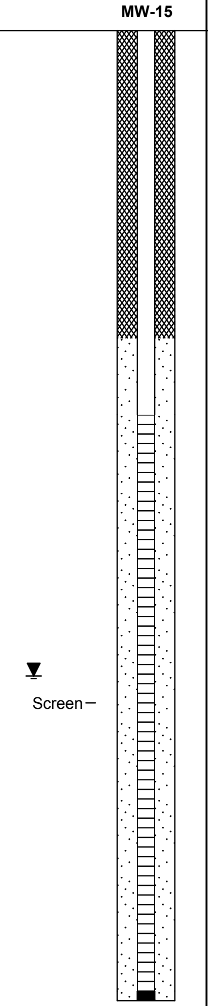
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 10/29/07
DATE COMPLETED: 10/30/07
WEATHER:

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: 56.8 ft
ELEVATION W.L.:
DATE W.L.: 10/29/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
40		40.0 - 45.0 Medium Brown medium to coarse SAND with rare medium gravel, damp to moist, noodor or staining (SP)	SP		40.0		8	SS	18 -19 -20		
45		45.0 - 50.0 Medium Brown to Grayish Brown medium to coarse SAND interbedded with silt layers, some fine to medium gravel, damp to moist, no odor (SP)	SP		45.0		9	SS	8 -14 -15		
50		50.0 - 55.0 Medium to coarse SAND with fine gravel, wet, with slight petroleum odor (SP)	SP		50.0		10	SS	10 -13 -13		
55		55.0 - 60.0 Medium to coarse SAND, saturated (SW)	SW		55.0		11	SS	3 -16 -17		
60		Boring completed at 60.0 ft									
65											
70											
75											
80											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-15
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0-50 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 50-65 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 48-65 FT
Type: Sand
Quantity: 17 FT
FILTER PACK SEAL
Interval: 3-48 FT
Type: Bentonite Chips
Quantity: 45 FT
ANNULUS SEAL
Interval: 0-3
Type: Cement
Quantity: 3 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Andy

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-16

SHEET 1 of 2

PROJECT: MasterPark Lot C	DRILL METHOD: Hollow-stem auger	DATUM: Geodetic	INCLINATION: 90
PROJECT NUMBER: 073-9336801	DRILL RIG: CME 75	COORDS: not surveyed	DEPTH W.L.: 66.1 ft
DRILLED DEPTH: 73.0 ft	DATE STARTED: 11/8/07	GS ELEVATION:	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 11/8/07	TOC ELEVATION:	DATE W.L.: 11/8/07
LOCATION: SeaTac, WA	WEATHER:	TEMPERATURE:	TIME W.L.:

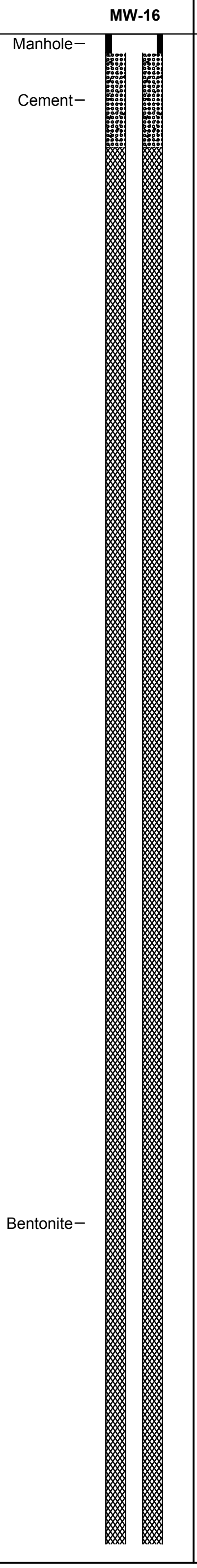
SOIL PROFILE

DEPTH (ft)	ELEVATION (ft)	DESCRIPTION	USCS	ELEV. DEPTH (ft)
0		0.0 - 0.3 ASPHALT		
		0.3 - 0.7 SUBGRADE		0.7
		0.7 - 5.0 Medium Brwon Silty fine to medium SAND, some fine gravel, dry (SP-SM)	SP-SM	
5		5.0 - 13.0 Medium Brown Silty SAND, some fine gravel, dry (SP-SM)	SP-SM	5.0
10				
		13.0 - 23.0 Grayish Brwon SILT with some fine sand, medium dense, damp (SM)	SM	13.0
15				
20				
		23.0 - 27.0 Grayish Brown Silty medium SAND with fine to medium gravel, damp (SP-SM)	SP-SM	23.0
25				
		27.0 - 30.0 Brownish Gray Silty fine to medium SAND, no gravel, damp (SM)	SM	27.0
30		30.0 - 35.0 Grayish Brown fine to medium SAND with some silt, trace gravel, damp (SP)	SP	30.0
35		35.0 - 40.0 Grayish Brown fine to medium SAND with trace silt, no gravel, damp (SP)	SP	35.0
40		Log continued on next page		

SAMPLES

PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
	1	SS	19 -21 -25		
	2	SS	18 -23 -25		
	3	SS	19 -24 -26		
	4	SS	17 -20 -23		
	5	SS	14 -19 -20		
	6	SS	11 -20 -20		

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-16
Borehole Diameter: 8.0 IN

WELL CASING
Interval: 0-60 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded

WELL SCREEN
Interval: 63-73 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:

FILTER PACK
Interval: 60-73 FT
Type: Sand
Quantity: 13 FT

FILTER PACK SEAL
Interval: 3-60 FT
Type: Bentonite
Quantity: 57 FT

ANNULUS SEAL
Interval: 0-3 FT
Type: Cement
Quantity: 3 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Curtis

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-16

SHEET 2 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 73.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

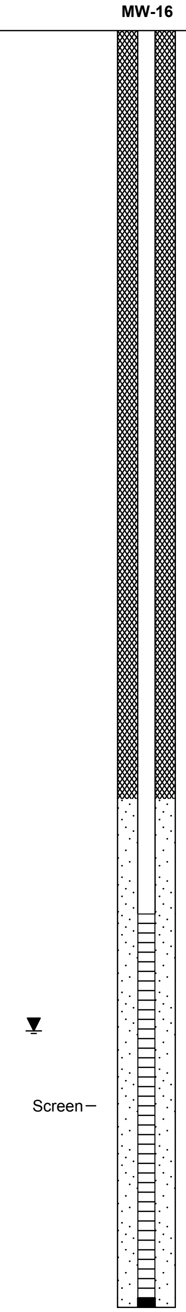
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 11/8/07
DATE COMPLETED: 11/8/07
WEATHER:

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: 66.1 ft
ELEVATION W.L.:
DATE W.L.: 11/8/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE				SAMPLES					
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
40		40.0 - 45.0 Grayish Brown fine to medium SAND with trace silt, no gravel, damp (SP)	SP		40.0		6 7	SS SS	11 -20 -20 17 -18 -18		
45		45.0 - 50.0 Brownish Gray medium to coarse SAND, trace silt, damp (SP)	SP		45.0		8	SS	19 -24 -25		
50		50.0 - 55.0 Grayish Brown fine to medium SAND with some silt, damp (SP); Gravelly SAND with a large cobble at 54 FT	SP		50.0		9	SS	14 -17 -18		
55		55.0 - 60.0 Grayish Brown medium to coarse SAND, trace silt, damp to moist, strong petroleum odor (SP)	SP		55.0		10	SS	7 -13 -13		
60		60.0 - 65.0 Brownish Gray SAND with some silt, saturated (SP)	SP		60.0		11	SS	11 -14 -15		
65		65.0 - 73.0 SAND with silt	SP		65.0						
70											
75		Boring completed at 73.0 ft									
80											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-16
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0-60 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 63-73 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 60-73 FT
Type: Sand
Quantity: 13 FT
FILTER PACK SEAL
Interval: 3-60 FT
Type: Bentonite
Quantity: 57 FT
ANNULUS SEAL
Interval: 0-3 FT
Type: Cement
Quantity: 3 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Curtis

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

Golder Associates

AA BOREHOLE RECORD MASTERPARK LOT C BORINGS 11.26.2007.GPJ GOLDER NJ-PA 05-24-06.GDT 3/13/08

RECORD OF BOREHOLE MW-17

SHEET 1 of 3

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 83.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

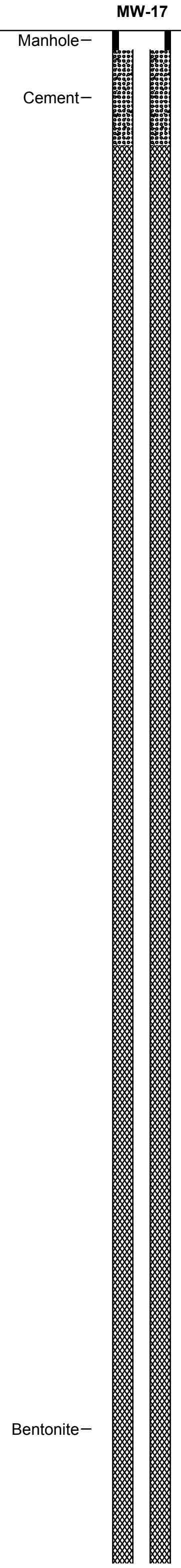
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 11/9/07
DATE COMPLETED: 11/9/07
WEATHER:

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: 76.0 ft
ELEVATION W.L.:
DATE W.L.: 11/9/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
0		0.0 - 40.0 Medium Brown Silty fine to medium SAND, dry; grass at surface (SM)									
5											
10											
15											
20			SM								
25											
30											
35											
							1	SS	50/5"		
40		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-17
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0-73
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 73-83 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 70-83 FT
Type: SAND
Quantity: 13 FT
FILTER PACK SEAL
Interval: 3-70
Type: Bentonite
Quantity: 67 FT
ANNULUS SEAL
Interval: 0-3 FT
Type: Cement
Quantity: 3 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Curtis

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

RECORD OF BOREHOLE MW-17

SHEET 2 of 3

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 83.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 11/9/07
DATE COMPLETED: 11/9/07
WEATHER:

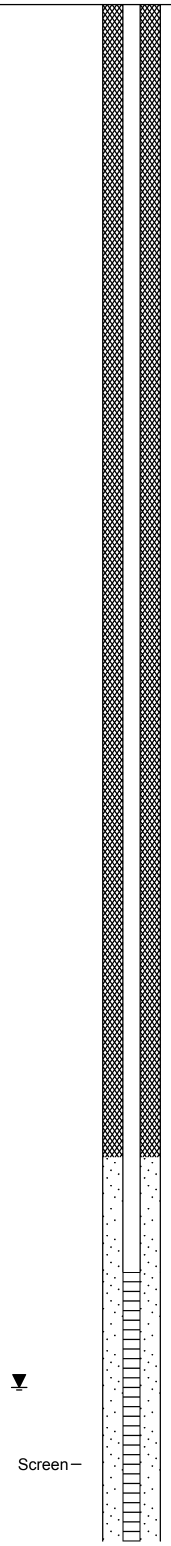
DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE:

INCLINATION: 90
DEPTH W.L.: 76.0 ft
ELEVATION W.L.:
DATE W.L.: 11/9/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
40		40.0 - 45.0 Brownish Gray fine to medium SAND with silt and fine gravel, damp, no odor (SP)	SP		40.0		2	SS	50/5"		
45		45.0 - 50.0 Grayish Brown fine to medium SAND with sand, trace fine gravel, damp, no odor (SP)	SP		45.0		3	SS	50/6"		
50		50.0 - 55.0 Grayish Brown Silty fine SAND, damp to moist, no odor (SM)	SM		50.0		4	SS	50/6"		
55		55.0 - 60.0 Grayish Brown medium to coarse SAND, some fine gravel, damp to moist (SP)	SP		55.0		5	SS	50/4"		
60		60.0 - 65.0 Brownish Gray coarse SAND with fine gravel, moist, no odor (SP)	SP		60.0		6	SS	50/6"		
65		65.0 - 70.0 Brownish Gray coarse SAND with fine gravel, moist, no odor (SP)	SP		65.0		7	SS	50/6"		
70		70.0 - 75.0 Brownish Gray coarse SAND with fine gravel, moist, no odor (SP)	SP		70.0		8	SS	50/6"		
75		75.0 - 80.0 Grayish Brown coarse SAND with fine to medium gravel, very moist, no odor (SP)	SP		75.0		9	SS	50/6"		
80		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES

MW-17



WELL CONSTRUCTION DETAILS

MW-17
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0-73
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 73-83 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 70-83 FT
Type: SAND
Quantity: 13 FT
FILTER PACK SEAL
Interval: 3-70
Type: Bentonite
Quantity: 67 FT
ANNULUS SEAL
Interval: 0-3 FT
Type: Cement
Quantity: 3 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Curtis

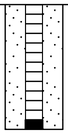
GA INSPECTOR: I. Young
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-17

SHEET 3 of 3

PROJECT: MasterPark Lot C	DRILL METHOD: Hollow-stem auger	DATUM: Geodetic	INCLINATION: 90
PROJECT NUMBER: 073-9336801	DRILL RIG: CME 75	COORDS: not surveyed	DEPTH W.L.: 76.0 ft
DRILLED DEPTH: 83.0 ft	DATE STARTED: 11/9/07	GS ELEVATION:	ELEVATION W.L.:
AZIMUTH: N/A	DATE COMPLETED: 11/9/07	TOC ELEVATION:	DATE W.L.: 11/9/07
LOCATION: SeaTac, WA	WEATHER:	TEMPERATURE:	TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES MW-17	WELL CONSTRUCTION DETAILS
80		80.0 - 83.0 Brownish Gray coarse SAND with some fine gravel, wet, slight petroleum odor	SP		80.0								**MW-17** Borehole Diameter: 8.0 IN **WELL CASING** Interval: 0-73 Material: PVC Diameter: 2.0 IN Joint Type: Threaded **WELL SCREEN** Interval: 73-83 FT Material: PVC Diameter: 2.0 IN Slot Size: 0.010 IN End Cap: **FILTER PACK** Interval: 70-83 FT Type: SAND Quantity: 13 FT **FILTER PACK SEAL** Interval: 3-70 Type: Bentonite Quantity: 67 FT **ANNULUS SEAL** Interval: 0-3 FT Type: Cement Quantity: 3 FT
		Boring completed at 83.0 ft											
85													
90													
95													
100													
105													
110													
115													
120													

LOG SCALE: 1 in = 5 ft

DRILLING COMPANY: Cascade Drilling Inc

DRILLER: Curtis

GA INSPECTOR: I. Young

CHECKED BY:

DATE:

RECORD OF BOREHOLE MW-18

SHEET 1 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 62.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

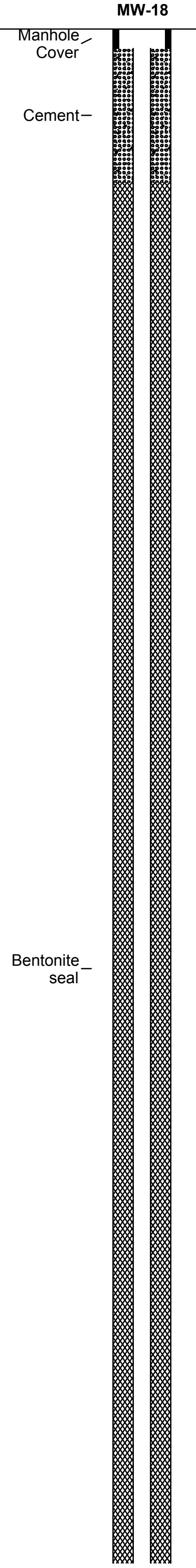
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 11/26/07
DATE COMPLETED: 11/26/07
WEATHER: Clear

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 34

INCLINATION: 90
DEPTH W.L.: 52.5 ft
ELEVATION W.L.:
DATE W.L.: 11/26/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
0		0.0 - 0.5 ASPHALT									
		0.5 - 4.0 Brown Silty fine SAND with fine gravel, large concrete boulders at approximately 4.0-ft, gray silty clay lenses, soft, pliable (FILL)			0.5						
5		4.0 - 5.5 Light Gray Clayey SAND with fine to medium gravel, dry	SP		4.0	0.0	1	SS	5 -7 -20		1.5/1.5
		5.5 - 6.0 Gray medium SAND, slight TPH odor, dry	SW		5.5						
		6.0 - 8.0 Auger			6.0						
		8.0 - 9.5 Gray Silty medium SAND with fine to medium gravel and rare cobbles, slight TPH odor, dry	SP-SM		8.0	832	2	SS	15 -17 -18		1.5/1.5
10		9.5 - 14.5 Auger			9.5						
15		14.5 - 16.0 Gray Silty medium SAND with fine to medium gravel and rare cobbles, slight TPH odor, dry	SP-SM		14.5	1857	3	SS	28 -50/6"		1.0/1.5
		16.0 - 18.5 Auger			16.0						
		18.5 - 20.0 4.0-in of Light Brown fine SAND and 2.0-in of a large cobble/boudler, dry	SP		18.5	2000	4	SS	50/6"		0.5/1.5
20		20.0 - 23.5 Auger			20.0						
		23.5 - 25.0 Light Brown fine SAND with fine gravel and a large cobble/boulder, dry	SP		23.5	83	5	SS	50/6"		0.5/1.5
25		25.0 - 28.5 Auger			25.0						
		28.5 - 30.0 Gray-brown Clayey fine SAND with rare fine gravel , moist	SP-SC		28.5	18	6	SS	50/6"		0.5/1.5
30		30.0 - 33.5 Auger			30.0						
		33.5 - 35.0 Brown fine SAND with rare fine gravel, some large cobbles, dry, slight TPH odor	SP		33.5	90.9	7	SS	29 -50/6"		1.0/1.5
35		35.0 - 38.5 Auger			35.0						
		38.5 - 40.0 Brown fine SAND, dry, slight TPH odor	SW		38.5	729	8	SS	50/6"		0.5/1.5
40		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-18
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0 - 47 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 47 - 62 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 45 - 62 FT
Type: Sand
Quantity: 17 FT
FILTER PACK SEAL
Interval: 4 - 45 FT
Type: Bentonie
Quantity: 41 FT
ANNULUS SEAL
Interval: 0 - 4 FT
Type: Cement
Quantity: 4 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: D. Gose

GA INSPECTOR: D.Gorman
CHECKED BY:
DATE:

RECORD OF BOREHOLE MW-18

SHEET 2 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 62.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

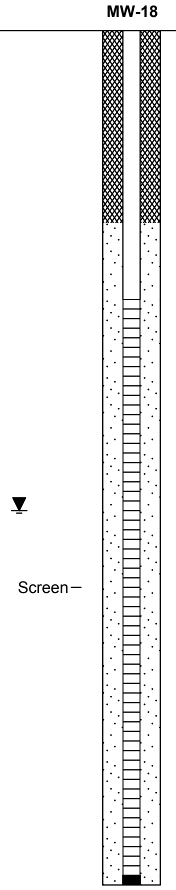
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 11/26/07
DATE COMPLETED: 11/26/07
WEATHER: Clear

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 34

INCLINATION: 90
DEPTH W.L.: 52.5 ft
ELEVATION W.L.:
DATE W.L.: 11/26/07
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE				SAMPLES					
		DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
40		40.0 - 43.5 Auger			40.0						
		43.5 - 45.0 Brown medium SAND with rare fine to medium gravel, few cobbles, moist, slight TPH odor	SP	░	43.5	1252	9	SS	50/6"		0.5 / 1.5
45		45.0 - 48.5 Auger			45.0						
		48.5 - 50.0 Gray fine SAND with rare fine gravel, moist, slight TPH odor	SP	░	48.5	198	10	SS	14 -27 -29		1.5 / 1.5
50		50.0 - 53.5 Auger			50.0						
		53.5 - 55.0 Gray fine to medium SAND, saturated, TPH odor	SW	▒	53.5	71.8	11	SS	12 -23 -50/6"		1.5 / 1.5
55		55.0 - 58.5 Auger			55.0						
		58.5 - 60.0 Assumed SAND; heaved to approximately 57.0 FT, no sample	SW	▒	58.5		12	SS	7 -26 -50/3"		1.5 / 1.5
60		60.0 - 62.0 Auger			60.0						
		Boring completed at 62.0 ft									
65											
70											
75											
80											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-18
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0 - 47 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 47 - 62 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010 IN
End Cap:
FILTER PACK
Interval: 45 - 62 FT
Type: Sand
Quantity: 17 FT
FILTER PACK SEAL
Interval: 4 - 45 FT
Type: Bentonie
Quantity: 41 FT
ANNULUS SEAL
Interval: 0 - 4 FT
Type: Cement
Quantity: 4 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: D. Gose

GA INSPECTOR: D.Gorman
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-19

SHEET 1 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 59.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

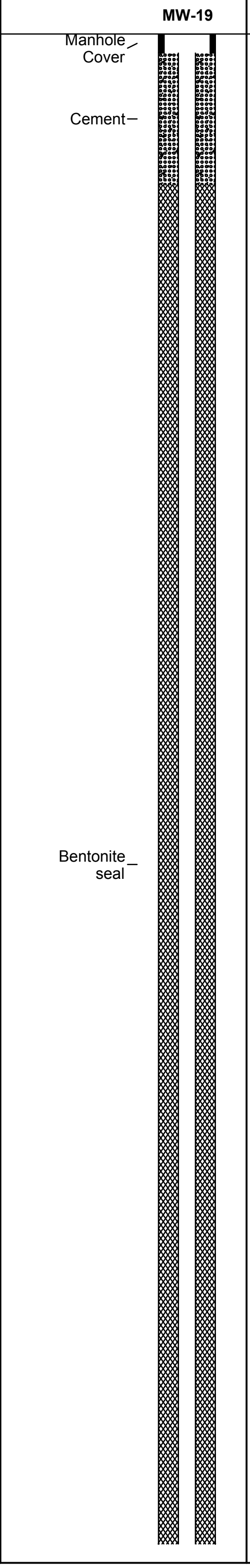
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 1/31/08
DATE COMPLETED: 1/31/08
WEATHER: Cloudy

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 32

INCLINATION: 90
DEPTH W.L.: 47.3 ft
ELEVATION W.L.:
DATE W.L.: 1/31/08
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (140 lb hammer 30 inch drop)	N	REC / ATT
0		0.0 - 0.5 ASPHALT								
		0.5 - 2.5 Brown Silty Sandy fine to medium GRAVEL (FILL)		0.5						
		2.5 - 5.5 Brown Gravelly Sandy SILT, damp, medium density	ML	2.5	0.0	1	SPT	3 -4 -4		1.5/1.5
5		5.5 - 9.0 Auger		5.5						
		9.0 - 10.5 Brownish grey fine to medium SAND with Silt and fine Gravel, dry	SP-SM	9.0	0.0	2	SPT	6 -18 -19		1.5/1.5
10		10.5 - 11.5 Auger		10.5						
		11.5 - 12.5 Brownish grey fine to medium SAND with Silt and fine Gravel, dry	SP-SM	11.5	0.0	3	SPT	60 -50/6"		1.0/1.5
		12.5 - 14.0 Auger		12.5						
		14.0 - 14.5 No recovery. Cobble in sampler.		14.0		4	SPT	60/6"		0.0/1.5
15		14.5 - 16.5 Auger		14.5						
		16.5 - 17.5 Brownish grey fine to medium Gravelly fine to medium SAND with Silt, dry, very compact	SP	16.5	0.0	5	SPT	26 -50/6"		1.0/1.5
		17.5 - 19.0 Auger		17.5						
20		19.0 - 20.5 Brownish grey Silty fine to medium SAND and medium GRAVEL with some cobbles, dry, very compact	SP-SM	19.0	0.0	6	SPT	26 -50/3"		0.8/1.5
		20.5 - 21.5 Auger		20.5						
		21.5 - 22.0 Brownish grey Silty fine to medium SAND and medium GRAVEL with some cobbles, dry	SP	21.5	0.0	7	SPT	50/6"		0.5/1.5
		22.0 - 24.0 Auger		22.0						
25		24.0 - 25.0 Light grey fine SAND with Silt and fine Gravel, some cobbles, moist	SP-SM	24.0	0.0	8	SPT	23 -50/6"		1.0/1.5
		25.0 - 29.0 Auger		25.0						
		29.0 - 29.5 Greyish brown Silty fine to medium SAND with fine Gravel, some cobbles, damp	SP-SM	29.0	0.0	9	SPT	50/6"		0.5/1.5
30		29.5 - 34.0 Auger		29.5						
		34.0 - 35.5 Greyish brown medium to course SAND with fine Gravel, moist	SP	34.0	0.0	10	SPT	12 -48 -50/3"		1.3/1.5
35		35.5 - 39.0 Auger		35.5						
			SP	39.0	7.2	11	SPT	24 -24 -47		
40		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-19
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0 - 43 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 43 - 58 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010
End Cap:
FILTER PACK
Interval: 40 - 58 FT
Type: Sand
Quantity: 17 FT
FILTER PACK SEAL
Interval: 4 - 40 FT
Type: Bentonite
Quantity: 36 FT
ANNULUS SEAL
Interval: 0 - 4 FT
Type: Cement
Quantity: 4 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: A. Flagan

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

AA BOREHOLE RECORD MASTERPARK LOT C BORINGS 11.26.2007.GPJ GOLDER NJ-PA 05-24-06.GDT 3/13/08

RECORD OF BOREHOLE MW-19

SHEET 2 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-9336801
DRILLED DEPTH: 59.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

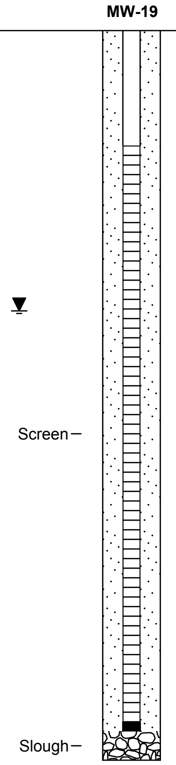
DRILL METHOD: Hollow-stem auger
DRILL RIG: CME 75
DATE STARTED: 1/31/08
DATE COMPLETED: 1/31/08
WEATHER: Cloudy

DATUM: Geodetic
COORDS: not surveyed
GS ELEVATION:
TOC ELEVATION:
TEMPERATURE: 32

INCLINATION: 90
DEPTH W.L.: 47.3 ft
ELEVATION W.L.:
DATE W.L.: 1/31/08
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 140 lb hammer 30 inch drop	N	REC / ATT
40		39.0 - 40.5 Greyish brown medium to course SAND with Silt, some fine gravel, moist *(Continued)*	SP	⁚⁚⁚	40.5	7.2	11	SPT	24 -24 -47		1.5 1.5
		40.5 - 44.0 Auger									
45		44.0 - 45.5 Greyish brown medium to course SAND, trace Silt, moist	SW	⁘⁘⁘	44.0	48.0	12	SPT	21 -24 -24		1.5 1.5
		45.5 - 49.0 Auger			45.5						
50		49.0 - 50.0 Greyish brown fine to medium SAND with Silt, trace fine Gravel, moist	SW	⁘⁘⁘	49.0	53.8	13	SPT	29 -50/2"		0.8 1.5
		50.0 - 54.0 Auger			50.0						
55		54.0 - 55.5 Grey fine to medium SAND with Silt, wet	SW	⁘⁘⁘	54.0		14	SPT	4 -8 -12		1.5 1.5
					55.5						
60		Boring completed at 59.0 ft									
65											
70											
75											
80											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-19
Borehole Diameter: 8.0 IN
WELL CASING
Interval: 0 - 43 FT
Material: PVC
Diameter: 2.0 IN
Joint Type: Threaded
WELL SCREEN
Interval: 43 - 58 FT
Material: PVC
Diameter: 2.0 IN
Slot Size: 0.010
End Cap:
FILTER PACK
Interval: 40 - 58 FT
Type: Sand
Quantity: 17 FT
FILTER PACK SEAL
Interval: 4 - 40 FT
Type: Bentonite
Quantity: 36 FT
ANNULUS SEAL
Interval: 0 - 4 FT
Type: Cement
Quantity: 4 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: A. Flagan

GA INSPECTOR: I. Young
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-20

SHEET 1 of 4

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 128.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

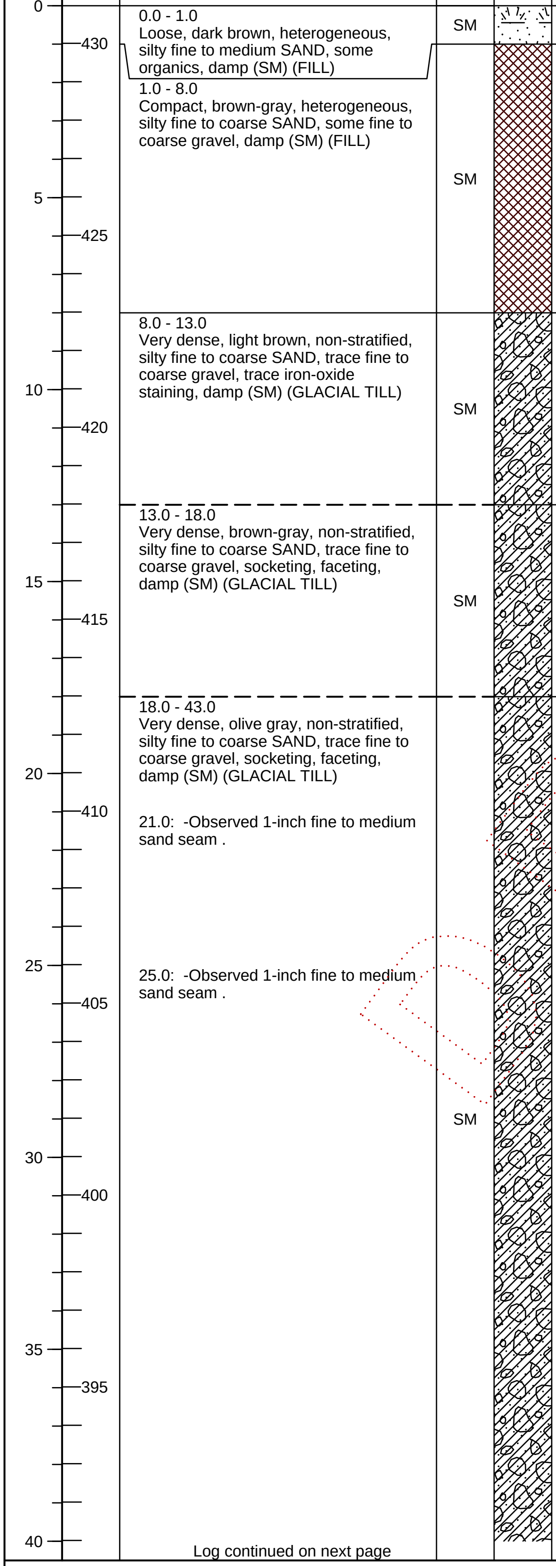
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: CME 75
DATE STARTED: 5/15/09
DATE COMPLETED: 5/15/09
WEATHER: Sunny

DATUM: Geodetic
COORDS: N: 170,757.8 E: 1,278,702.3
GS ELEVATION: 431.0 ft
TOC ELEVATION: 431.0 ft
TEMPERATURE: 60

INCLINATION: -90
DEPTH W.L.: 118.9 ft
ELEVATION W.L.: 312.1 ft
DATE W.L.: 5/15/09
TIME W.L.:

SOIL PROFILE

DESCRIPTION	USCS	ELEV. / DEPTH (ft)
0.0 - 1.0 Loose, dark brown, heterogeneous, silty fine to medium SAND, some organics, damp (SM) (FILL)	SM	430.0 1.0
1.0 - 8.0 Compact, brown-gray, heterogeneous, silty fine to coarse SAND, some fine to coarse gravel, damp (SM) (FILL)	SM	423.0 8.0
8.0 - 13.0 Very dense, light brown, non-stratified, silty fine to coarse SAND, trace fine to coarse gravel, trace iron-oxide staining, damp (SM) (GLACIAL TILL)	SM	418.0 13.0
13.0 - 18.0 Very dense, brown-gray, non-stratified, silty fine to coarse SAND, trace fine to coarse gravel, socketing, faceting, damp (SM) (GLACIAL TILL)	SM	413.0 18.0
18.0 - 43.0 Very dense, olive gray, non-stratified, silty fine to coarse SAND, trace fine to coarse gravel, socketing, faceting, damp (SM) (GLACIAL TILL) 21.0: -Observed 1-inch fine to medium sand seam . 25.0: -Observed 1-inch fine to medium sand seam .	SM	

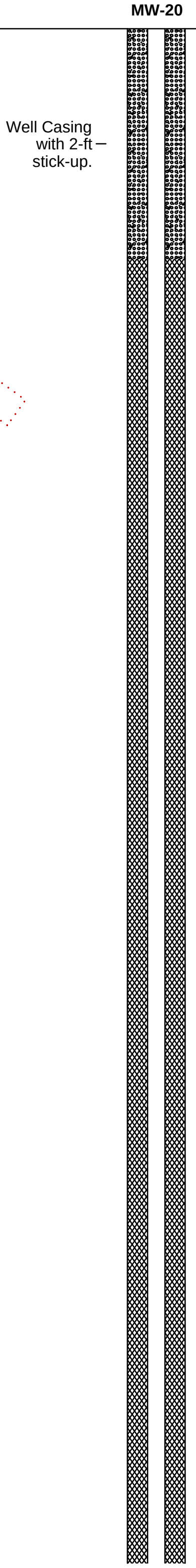


Log continued on next page

SAMPLES

PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 300 lb hammer 30 inch drop	N	REC / ATT
0.0	1	SPT	6 -9 -9		1.5 1.5
0.0	2	SPT	32 -50/6"		0.8 1.0
0.0	3	SPT	50/4"		0.4 0.5
0.0	4	SPT	50/3"		0.3 0.5
0.0	5	SPT	50/4"		0.4 0.5
0.0	6	SPT	50/5"		0.5 0.5
0.0	7	SPT	50/4"		0.5 0.5

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-20
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 117 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 117 - 127 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.010
End Cap: End Cap
FILTER PACK
Interval: 115 - 128 FT
Type: Sand
Quantity: 9 Bags
FILTER PACK SEAL
Interval: 6 - 115 FT
Type: Bentonite
Quantity: 68 Bags
ANNULUS SEAL
Interval: 0 - 6 FT
Type: Cement
Quantity: 6 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Steve L.

GA INSPECTOR: A. Dennison
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-20

SHEET 2 of 4

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 128.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: CME 75
DATE STARTED: 5/15/09
DATE COMPLETED: 5/15/09
WEATHER: Sunny

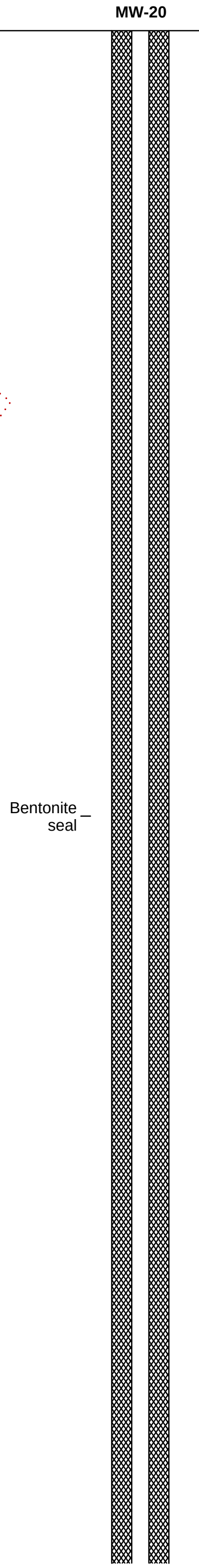
DATUM: Geodetic
COORDS: N: 170,757.8 E: 1,278,702.3
GS ELEVATION: 431.0 ft
TOC ELEVATION: 431.0 ft
TEMPERATURE: 60

INCLINATION: -90
DEPTH W.L.: 118.9 ft
ELEVATION W.L.: 312.1 ft
DATE W.L.: 5/15/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT
40		18.0 - 43.0 Very dense, olive gray, non-stratified, silty fine to coarse SAND, trace fine to coarse gravel, socketing, faceting, damp (SM) (GLACIAL TILL) *(Continued)*	SM			0.0	8	SPT	50/2"		0.2 0.5
	390										
		43.0 - 68.0 Very dense, brown gray, non-stratified, fine to coarse SAND, trace silt, damp (SP) (ADVANCE OUTWASH)	SP		388.0 43.0						
45						0.0	9	SPT	50/4"		0.4 0.5
	385										
50						0.0	10	SPT	50/5"		0.5 0.5
	380										
55						0.0	11	SPT	50/6"		0.5 0.5
	375										
60						0.0	12	SPT	50/6"		0.5 0.5
	370										
65						0.0	13	SPT	50/4"		0.5 0.5
	365										
		68.0 - 78.0 Very dense, brown gray, non-stratified, fine to coarse SAND, little to trace fine to coarse gravel, trace silt, damp (SP) (ADVANCE OUTWASH)	SP		363.0 68.0						
70											
	360										
75						0.0	15	SPT	50/6"		0.5 0.5
	355										
		78.0 - 93.0 Very dense, light brown, stratified, fine to medium SAND, trace silt, damp (SP) (ADVANCE OUTWASH)	SP		353.0 78.0						
80											

Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-20
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 117 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 117 - 127 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.010
End Cap: End Cap
FILTER PACK
Interval: 115 - 128 FT
Type: Sand
Quantity: 9 Bags
FILTER PACK SEAL
Interval: 6 - 115 FT
Type: Bentonite
Quantity: 68 Bags
ANNULUS SEAL
Interval: 0 - 6 FT
Type: Cement
Quantity: 6 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Steve L.

GA INSPECTOR: A. Dennison
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-20

SHEET 3 of 4

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 128.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

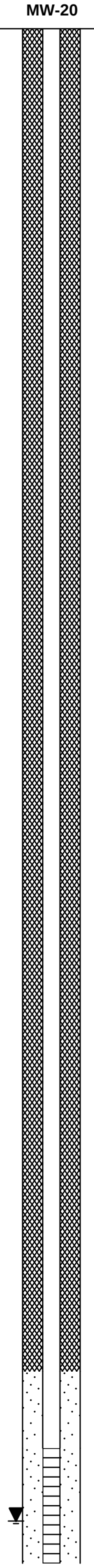
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: CME 75
DATE STARTED: 5/15/09
DATE COMPLETED: 5/15/09
WEATHER: Sunny

DATUM: Geodetic
COORDS: N: 170,757.8 E: 1,278,702.3
GS ELEVATION: 431.0 ft
TOC ELEVATION: 431.0 ft
TEMPERATURE: 60

INCLINATION: -90
DEPTH W.L.: 118.9 ft
ELEVATION W.L.: 312.1 ft
DATE W.L.: 5/15/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT
80	350	78.0 - 93.0 Very dense, light brown, stratified, fine to medium SAND, trace silt, damp (SP) (ADVANCE OUTWASH) *(Continued)*	SP		0.0	16	SPT	50/5"		0.5 0.5
85	345				0.0	17	SPT	50/5"		0.5 0.5
90	340				0.0	18	SPT	50/6"		0.5 0.5
		93.0 - 98.0 Very dense, brown, non-stratified, fine to coarse SAND, trace silt, damp (SP) (ADVANCE OUTWASH)	SP	338.0 93.0						
95	335				0.0	19	SPT	50/6"		0.5 0.5
		98.0 - 128.0 Very dense, brown, non-stratified, fine to coarse SAND, little to trace fine to coarse gravel, trace silt, damp (SP) (ADVANCE OUTWASH)	SP	333.0 98.0						
100	330				0.0	20	SPT	50/6"		0.5 0.5
105	325				0.0	21	SPT	50/6"		0.5 0.5
110	320				0.0	22	SPT	50/5"		0.5 0.5
115	315				0.0	23	SPT	50/6"		0.5 0.5
120		Log continued on next page								

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-20
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 117 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 117 - 127 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.010
End Cap: End Cap
FILTER PACK
Interval: 115 - 128 FT
Type: Sand
Quantity: 9 Bags
FILTER PACK SEAL
Interval: 6 - 115 FT
Type: Bentonite
Quantity: 68 Bags
ANNULUS SEAL
Interval: 0 - 6 FT
Type: Cement
Quantity: 6 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Steve L.

GA INSPECTOR: A. Dennison
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-20

SHEET 4 of 4

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 128.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

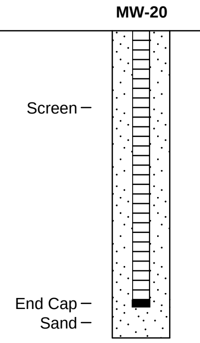
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: CME 75
DATE STARTED: 5/15/09
DATE COMPLETED: 5/15/09
WEATHER: Sunny

DATUM: Geodetic
COORDS: N: 170,757.8 E: 1,278,702.3
GS ELEVATION: 431.0 ft
TOC ELEVATION: 431.0 ft
TEMPERATURE: 60

INCLINATION: -90
DEPTH W.L.: 118.9 ft
ELEVATION W.L.: 312.1 ft
DATE W.L.: 5/15/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 300 lb hammer 30 inch drop	N	REC / ATT
120	310	98.0 - 128.0 Very dense, brown, non-stratified, fine to coarse SAND, little to trace fine to coarse gravel, trace silt, damp (SP) (ADVANCE OUTWASH) *(Continued)*	SP			0.0	24	SPT	50/5"		0.5 0.5
125	305					0.0	25	SPT	50/5"		0.5 0.5
					303.0	0.0	26	SPT	50/5"		0.5 0.5
		Boring completed at 128.0 ft									
130	300										
135	295										
140	290										
145	285										
150	280										
155	275										
160											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-20
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 117 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 117 - 127 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.010
End Cap: End Cap
FILTER PACK
Interval: 115 - 128 FT
Type: Sand
Quantity: 9 Bags
FILTER PACK SEAL
Interval: 6 - 115 FT
Type: Bentonite
Quantity: 68 Bags
ANNULUS SEAL
Interval: 0 - 6 FT
Type: Cement
Quantity: 6 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Cascade Drilling Inc
DRILLER: Steve L.

GA INSPECTOR: A. Dennison
CHECKED BY:
DATE:

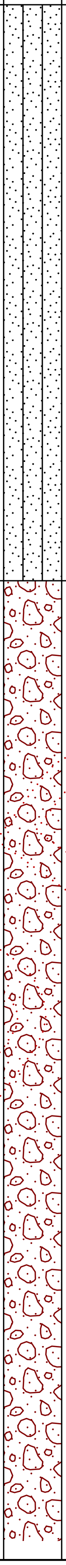
Golder Associates

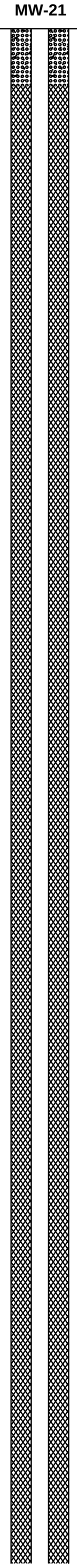
RECORD OF BOREHOLE MW-21

SHEET 1 of 3

PROJECT: MasterPark Lot C	DRILL METHOD: 4-in ID Hollow Stem Auger	DATUM: Geodetic	INCLINATION: -90
PROJECT NUMBER: 073-93368-05	DRILL RIG: Mobile B-53	COORDS: N: 170,455.2 E: 1,278,982.1	DEPTH W.L.: 82.7 ft
DRILLED DEPTH: 92.0 ft	DATE STARTED: 11/30/09	GS ELEVATION: 390.8 ft	ELEVATION W.L.: 308.1 ft
AZIMUTH: N/A	DATE COMPLETED: 12/1/09	TOC ELEVATION: 390.8 ft	DATE W.L.: 12/3/09
LOCATION: SeaTac, WA	WEATHER: Overcast, snowing.	TEMPERATURE: 30	TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
0	390	0.0 - 15.0 Compact, brown, non-stratified, silty, fine to coarse SAND, some fine coarse gravel, damp to moist. (SM)	SM									Well Casing with 2-ft stick-up.	**MW-21** Borehole Diameter: 6 IN **WELL CASING** Interval: 0 - 60 FT Material: Schedule 40 PVC Diameter: 2.0 IN Joint Type: Threaded, O-ring **WELL SCREEN** Interval: 42.5 - 57.5 FT Material: Schedule 40 PVC Diameter: 2.0 IN Slot Size: .020 End Cap: End Cap **FILTER PACK** Interval: 39.9 - 60 FT Type: Sand Quantity: 10 Bags **FILTER PACK SEAL** Interval: 1.5- 39.9 FT Type: Bentonite Quantity: 35 Bags **ANNULUS SEAL** Interval: 0 - 1.5 FT Type: Concrete Quantity: 1.5 FT
5	385												
10	380												
15	375	15.0 - 92.0 Compact to dense, brownish-grey, non-stratified, fine SAND, little medium to coarse sand and fine gravel, trace silt, coarse gravel, and cobbles, damp to moist. (SP)* *pockets of increased coarse gravel and cobble content, especially at approximately 15 to 40ft bgs.			375.8 15.0								
20	370												
25	365		SP										
30	360												
35	355											Bentonite seal	
40													





Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

RECORD OF BOREHOLE MW-21

SHEET 2 of 3

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 92.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

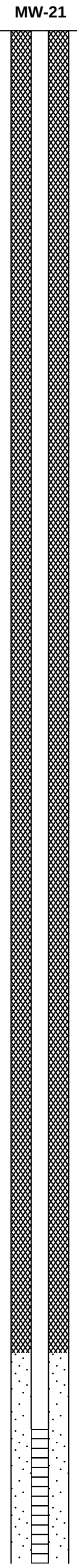
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: Mobile B-53
DATE STARTED: 11/30/09
DATE COMPLETED: 12/1/09
WEATHER: Overcast, snowing.

DATUM: Geodetic
COORDS: N: 170,455.2 E: 1,278,982.1
GS ELEVATION: 390.8 ft
TOC ELEVATION: 390.8 ft
TEMPERATURE: 30

INCLINATION: -90
DEPTH W.L.: 82.7 ft
ELEVATION W.L.: 308.1 ft
DATE W.L.: 12/3/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT
40	350	15.0 - 92.0 Compact to dense, brownish-grey, non-stratified, fine SAND, little medium to coarse sand and fine gravel, trace silt, coarse gravel, and cobbles, damp to moist. (SP)* *pockets of increased coarse gravel and cobble content, especially at approximately 15 to 40ft bgs. *(Continued)*									
45	345										
50	340										
55	335										
60	330		SP								
65	325										
70	320										
75	315										
80		Log continued on next page									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-21
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 60 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 42.5 - 57.5 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: .020
End Cap: End Cap
FILTER PACK
Interval: 39.9 - 60 FT
Type: Sand
Quantity: 10 Bags
FILTER PACK SEAL
Interval: 1.5- 39.9 FT
Type: Bentonite
Quantity: 35 Bags
ANNULUS SEAL
Interval: 0 - 1.5 FT
Type: Concrete
Quantity: 1.5 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-21

SHEET 3 of 3

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 92.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

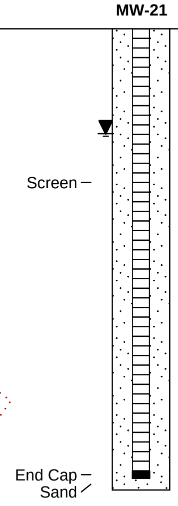
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: Mobile B-53
DATE STARTED: 11/30/09
DATE COMPLETED: 12/1/09
WEATHER: Overcast, snowing.

DATUM: Geodetic
COORDS: N: 170,455.2 E: 1,278,982.1
GS ELEVATION: 390.8 ft
TOC ELEVATION: 390.8 ft
TEMPERATURE: 30

INCLINATION: -90
DEPTH W.L.: 82.7 ft
ELEVATION W.L.: 308.1 ft
DATE W.L.: 12/3/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT
80	310	15.0 - 92.0 Compact to dense, brownish-grey, non-stratified, fine SAND, little medium to coarse sand and fine gravel, trace silt, coarse gravel, and cobbles, damp to moist. (SP)* *pockets of increased coarse gravel and cobble content, especially at approximately 15 to 40ft bgs. *(Continued)*									
85	305	85.0: No odor, sheen, or other visible signs of contamination.	SP					SPT	20 -31 -32		1.5 1.5
90	300	91.0: No odor, sheen, or other visible signs of contamination.			298.8			SPT	10 -18 -28		1.5 1.5
		Boring completed at 92.0 ft									
95	295										
100	290										
105	285										
110	280										
115	275										
120											

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-21
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 60 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 42.5 - 57.5 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: .020
End Cap: End Cap
FILTER PACK
Interval: 39.9 - 60 FT
Type: Sand
Quantity: 10 Bags
FILTER PACK SEAL
Interval: 1.5- 39.9 FT
Type: Bentonite
Quantity: 35 Bags
ANNULUS SEAL
Interval: 0 - 1.5 FT
Type: Concrete
Quantity: 1.5 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

Golder Associates

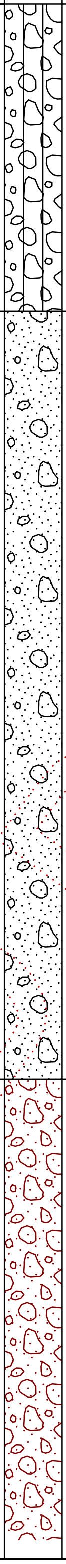
AA BOREHOLE RECORD MPLOT-MW-20-23-BB.GPJ GOLDER NJ-PA 05-24-06.GDT 1/20/10

RECORD OF BOREHOLE MW-22

SHEET 1 of 3

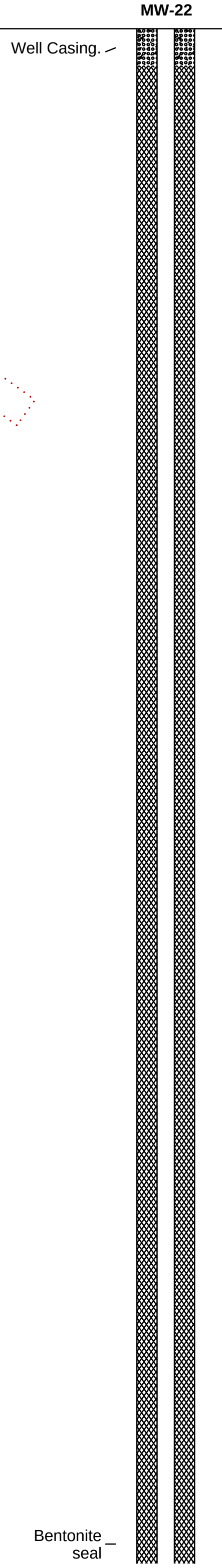
PROJECT: MasterPark Lot C	DRILL METHOD: 4-in ID Hollow Stem Auger	DATUM: Geodetic	INCLINATION: -90
PROJECT NUMBER: 073-93368-05	DRILL RIG: Mobile B-53	COORDS: N: 171,097.8 E: 1,279,059.6	DEPTH W.L.: 84.5 ft
DRILLED DEPTH: 97.0 ft	DATE STARTED: 12/1/09	GS ELEVATION: 393.3 ft	ELEVATION W.L.: 308.8 ft
AZIMUTH: N/A	DATE COMPLETED: 12/1/09	TOC ELEVATION: 393.3 ft	DATE W.L.: 12/3/09
LOCATION: SeaTac, WA	WEATHER: Overcast.	TEMPERATURE: 25	TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT
0		0.0 - 8.0 Compact, brown, non-stratified, silty, fine to coarse GRAVEL, some fine coarse sand, damp to moist. (GM)	GM		385.3 8.0						
5	390										
10	385	8.0 - 28.0 Compact, grey, non-stratified, silty, fine SAND, little fine to coarse gravel and medium to coarse sand, dry to damp. (SM)	SM		365.3 28.0						
15	380	15.0: Faint, diesel-like odor. No sheen or other visible signs of contamination.						GRAB			
20	375	20.0: Faint, diesel-like odor. No sheen or other visible signs of contamination.						GRAB			
25	370										
30	365	28.0 - 94.0 Compact to dense, brownish-grey, non-stratified, silty, fine SAND, little medium to coarse sand and fine gravel, trace coarse gravel, moist. (SM)	SM								
35	360										
40	355										



Log continued on next page

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-22
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 97 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 80 - 95 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.020
End Cap: End Cap
FILTER PACK
Interval: 78 - 95 FT
Type: Sand
Quantity: 11 Bags
FILTER PACK SEAL
Interval: 1 - 78 FT
Type: Bentonite
Quantity: 39 Bags
ANNULUS SEAL
Interval: 0 - 1 FT
Type: Concrete
Quantity: 1 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

RECORD OF BOREHOLE MW-22

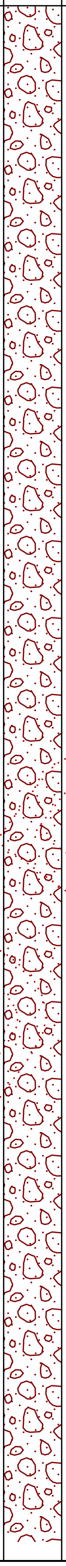
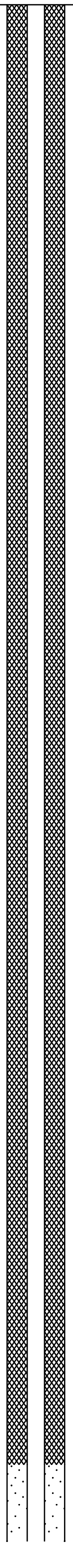
SHEET 2 of 3

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 97.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: Mobile B-53
DATE STARTED: 12/1/09
DATE COMPLETED: 12/1/09
WEATHER: Overcast.

DATUM: Geodetic
COORDS: N: 171,097.8 E: 1,279,059.6
GS ELEVATION: 393.3 ft
TOC ELEVATION: 393.3 ft
TEMPERATURE: 25

INCLINATION: -90
DEPTH W.L.: 84.5 ft
ELEVATION W.L.: 308.8 ft
DATE W.L.: 12/3/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	GRAPHIC LOG	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT	MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES	WELL CONSTRUCTION DETAILS
40		28.0 - 94.0 Compact to dense, brownish-grey, non-stratified, silty, fine SAND, little medium to coarse sand and fine gravel, trace coarse gravel, moist. (SM) *(Continued)* 40.0: Faint, diesel-like odor. No sheen or other visible signs of contamination.						GRAB				**MW-22** 	**MW-22** Borehole Diameter: 6 IN **WELL CASING** Interval: 0 - 97 FT Material: Schedule 40 PVC Diameter: 2.0 IN Joint Type: Threaded, O-ring **WELL SCREEN** Interval: 80 - 95 FT Material: Schedule 40 PVC Diameter: 2.0 IN Slot Size: 0.020 End Cap: End Cap **FILTER PACK** Interval: 78 - 95 FT Type: Sand Quantity: 11 Bags **FILTER PACK SEAL** Interval: 1 - 78 FT Type: Bentonite Quantity: 39 Bags **ANNULUS SEAL** Interval: 0 - 1 FT Type: Concrete Quantity: 1 FT
	350												
45													
	345												
50													
	340												
55													
	335												
60		60.0: Faint, diesel-like odor. No sheen or other visible signs of contamination.	SM					GRAB					
	330												
65													
	325												
70													
	320												
75		75.0: Diesel-like odor. No sheen or other visible signs of contamination.						GRAB					
	315												
80													

Log continued on next page

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-22

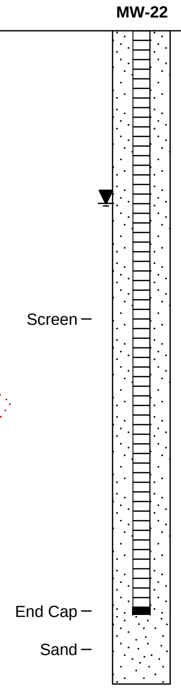
SHEET 3 of 3

PROJECT: MasterPark Lot C	DRILL METHOD: 4-in ID Hollow Stem Auger	DATUM: Geodetic	INCLINATION: -90
PROJECT NUMBER: 073-93368-05	DRILL RIG: Mobile B-53	COORDS: N: 171,097.8 E: 1,279,059.6	DEPTH W.L.: 84.5 ft
DRILLED DEPTH: 97.0 ft	DATE STARTED: 12/1/09	GS ELEVATION: 393.3 ft	ELEVATION W.L.: 308.8 ft
AZIMUTH: N/A	DATE COMPLETED: 12/1/09	TOC ELEVATION: 393.3 ft	DATE W.L.: 12/3/09
LOCATION: SeaTac, WA	WEATHER: Overcast.	TEMPERATURE: 25	TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	GRAPHIC LOG	ELEV. DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 300 lb hammer 30 inch drop	N	REC / ATT
80		28.0 - 94.0 Compact to dense, brownish-grey, non-stratified, silty, fine SAND, little medium to coarse sand and fine gravel, trace coarse gravel, moist. (SM) *(Continued)*	SM								
90		90.0: Diesel-like odor. No sheen or other visible signs of contamination.						SPT	22-50=1"		0.6 1.5
					299.3 94.0						
95		94.0 - 97.0 Dense, grey, non-stratified, fine SAND, some coarse gravel, little medium to coarse sand and fine gravel, wet. (SP)	SP		296.3						
		Boring completed at 97.0 ft									

Depth scale: 80, 85, 90, 95, 100, 105, 110, 115, 120
Elevation scale: 310, 305, 300, 295, 290, 285, 280, 275

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-22
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 97 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 80 - 95 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.020
End Cap: End Cap
FILTER PACK
Interval: 78 - 95 FT
Type: Sand
Quantity: 11 Bags
FILTER PACK SEAL
Interval: 1 - 78 FT
Type: Bentonite
Quantity: 39 Bags
ANNULUS SEAL
Interval: 0 - 1 FT
Type: Concrete
Quantity: 1 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-23

SHEET 1 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 65.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

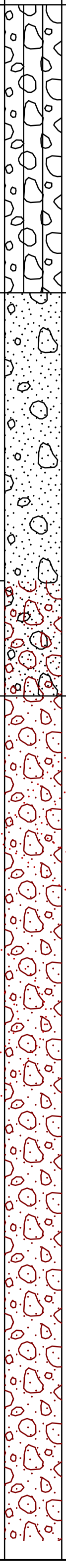
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: Mobile B-53
DATE STARTED: 12/2/09
DATE COMPLETED: 12/2/09
WEATHER: Overcast.

DATUM: Geodetic
COORDS: N: 171,093.0 E: 1,279,494.1
GS ELEVATION: 354.9 ft
TOC ELEVATION: 354.9 ft
TEMPERATURE: 25

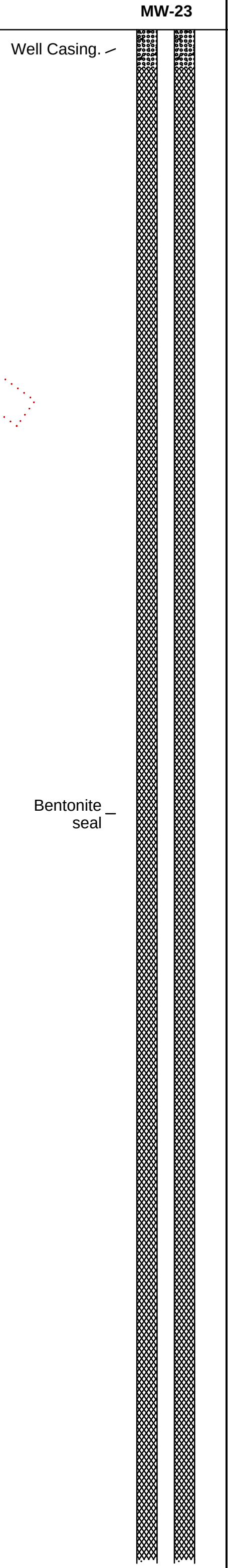
INCLINATION: -90
DEPTH W.L.: 46.6 ft
ELEVATION W.L.: 308.3 ft
DATE W.L.: 12/3/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES PID (ppm)	NUMBER	TYPE	BLOWS per 6 in 300 lb hammer 30 inch drop	N	REC / ATT
0		0.0 - 7.5 Compact, brown, non-stratified, silty, fine to coarse GRAVEL, some fine coarse sand, damp to moist. (GM)	GM	347.4 7.5						
5	350									
7.5		7.5 - 18.0 Compact, brown, non-stratified, silty, fine SAND, some fine coarse gravel, little medium to coarse sand, cobbles, and boulders, damp to moist. (SM)	SM	336.9						
10	345									
15	340	15.0 - 45.0 Compact to dense, brownish-grey, non-stratified, silty, fine to coarse SAND, little fine to coarse gravel, trace clay, moist. (SM)								
20	335									
25	330		SM							
30	325									
35	320									
37.5		37.5: No odor, sheen, or other visible signs of contamination.					SPT	10 -50=5"		0.5 1.5
40	315	Log continued on next page								

GRAPHIC LOG



MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-23
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 57.5 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 42.5 - 57.5 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.020
End Cap: End Cap
FILTER PACK
Interval: 39.9 - 60 FT
Type: Sand
Quantity: 10 Bags
FILTER PACK SEAL
Interval: 1 - 39.9 FT
Type: Bentonite
Quantity: 14 Bags
ANNULUS SEAL
Interval: 0 - 1 FT
Type: Concrete
Quantity: 1 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

Golder Associates

RECORD OF BOREHOLE MW-23

SHEET 2 of 2

PROJECT: MasterPark Lot C
PROJECT NUMBER: 073-93368-05
DRILLED DEPTH: 65.0 ft
AZIMUTH: N/A
LOCATION: SeaTac, WA

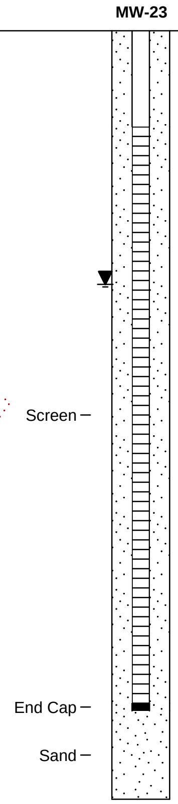
DRILL METHOD: 4-in ID Hollow Stem Auger
DRILL RIG: Mobile B-53
DATE STARTED: 12/2/09
DATE COMPLETED: 12/2/09
WEATHER: Overcast.

DATUM: Geodetic
COORDS: N: 171,093.0 E: 1,279,494.1
GS ELEVATION: 354.9 ft
TOC ELEVATION: 354.9 ft
TEMPERATURE: 25

INCLINATION: -90
DEPTH W.L.: 46.6 ft
ELEVATION W.L.: 308.3 ft
DATE W.L.: 12/3/09
TIME W.L.:

DEPTH (ft)	ELEVATION (ft)	SOIL PROFILE: DESCRIPTION	USCS	ELEV. / DEPTH (ft)	SAMPLES: PID (ppm)	NUMBER	TYPE	BLOWS per 6 in (300 lb hammer 30 inch drop)	N	REC / ATT
40		15.0 - 45.0 Compact to dense, brownish-grey, non-stratified, silty, fine to coarse SAND, little fine to coarse gravel, trace clay, moist. (SM) *(Continued)* 40.0: No odor, sheen, or other visible signs of contamination.	SM				SPT	18 -23 -27		1.5 / 1.5
45	310	45.0 - 60.0 Dense, grey, non-stratified, fine to medium SAND, little fine gravel, wet. (SP) No odor, sheen, or other visible signs of contamination.		309.9 45.0			SPT	13 -20 -29		1.5 / 1.5
50	305	50.0: No odor, sheen, or other visible signs of contamination.	SP				SPT	18 -22 -34		1.3 / 1.5
55	300									
60	295			294.9 60.0						
65	290	Boring completed at 65.0 ft								
70	285									
75	280									
80	275									

MONITORING WELL/ PIEZOMETER DIAGRAM and NOTES



WELL CONSTRUCTION DETAILS

MW-23
Borehole Diameter: 6 IN
WELL CASING
Interval: 0 - 57.5 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Joint Type: Threaded, O-ring
WELL SCREEN
Interval: 42.5 - 57.5 FT
Material: Schedule 40 PVC
Diameter: 2.0 IN
Slot Size: 0.020
End Cap: End Cap
FILTER PACK
Interval: 39.9 - 60 FT
Type: Sand
Quantity: 10 Bags
FILTER PACK SEAL
Interval: 1 - 39.9 FT
Type: Bentonite
Quantity: 14 Bags
ANNULUS SEAL
Interval: 0 - 1 FT
Type: Concrete
Quantity: 1 FT

LOG SCALE: 1 in = 5 ft
DRILLING COMPANY: Boart Longyear
DRILLER: J. Bennet

GA INSPECTOR: B. Borer
CHECKED BY:
DATE:

Golder Associates

APPENDIX E

GEODETIC DATA

Core No. 07128
Masterpark
Golder No. 073-93368

Date	Point#	Description	Northing	Easting	Elev
	North Lot				
7/30/2007	5001	MW 1 (Port)	171139.8623	1279581.079	352.84
7/30/2007	5002	MW 3	171168.5061	1279502.15	354.46
7/30/2007	5003	MW 2	171299.9966	1279660.697	355.46
	South Lot				
7/30/2007	5004	MW 6	170476.9957	1279330.494	369.68
11/14/2007	5022		170477.0157	1279330.573	369.68
7/30/2007	5005	MW 8A	170744.922	1279443.778	359.16
7/30/2007	5006	MW 7	170901.8175	1279388.462	358.69
2/6/2008		MW 7			358.71

Date	Point#	Description	Northing	Easting	Elev
7/30/2007	5007	MW 10	170809.3662	1279297.839	360.16
8/27/2007	5017	MW 10	170809.4099	1279297.883	360.18
2/6/2008		MW 10			360.19
7/30/2007	5008	MW 1	170818.0543	1279265.653	361.36
8/27/2007	5016	MW 1	170818.051	1279265.6	361.38
7/30/2007	5009	MW 9	170695.7863	1279179.991	362.14
7/30/2007	5010	MW 5	170556.5915	1279129.978	364.26
8/27/2007	5011	MW 11	170898.8537	1279434.624	357.53
8/27/2007	5012	MW 12	170956.9635	1279272.613	364.86
12/23/2009	5027		170956.97	1279272.83	364.89
8/27/2007	5013	AERIAL PT #1	170910.5399	1279311.61	361.88

Date	Point#	Description	Northing	Easting	Elev
8/27/2007	5014	MW 13	170849.4735	1279197.283	365.42
8/27/2007	5015	MW 14	170767.5033	1279166.573	363.76
8/27/2007	5018	AERIAL PT #2	170524.0821	1279271.032	367.77
11/14/2007	5020	MW 15	171092.5954	1279361.193	364.60
12/23/2009	5025		171092.66	1279361.21	364.67
11/14/2007	5019	MW 16	171015.4467	1279230.35	376.36
11/14/2007	5021	MW 17	170863.8069	1279044.193	385.81

Date	Point#	Description	Northing	Easting	Elev
2/6/2008	6018	MW 18	170870.42	1279318.84	360.45
2/6/2008	6019	MW 19	170864.30	1279503.19	356.61
	Cemetery				
12/23/2009	5023	MW 20	170757.78	1278702.26	430.98
12/23/2009	5028	MW 21	170455.22	1278982.10	390.79
	160TH				
12/23/2009	5024	MW 22	171097.75	1279059.64	393.31
12/23/2009	5026	MW 23	171093.04	1279494.13	354.94

APPENDIX F

PERTINENT FEDERAL AND STATE LAWS AND REGULATIONS

Pertinent Federal and State Laws and Regulations

Safe Drinking Water Act of 1974, 42 USC 300, et seq. National Primary Drinking Water Standards, 40 CFR 141	Establishes maximum contaminant levels (MCLs) and maximum contaminant level goals (MCLGs) that are drinking water criteria designed to protect human health from the potential adverse effects of contaminants in drinking water.	Ground water at the Site is not a current drinking water source, but it is considered a potential future source of drinking water. MCLs and MCLGs should be considered in establishing cleanup levels that are protective of ground-water, points of compliance, and institutional controls.
National Secondary Drinking Water Standards, 40 CFR 143	Establishes secondary drinking water standards for use in establishing cleanup levels.	Federal secondary standards are not enforceable standards and are not typically applicable or relevant and appropriate requirements; however, the State of Washington Model Toxics Control Act requires that these standards be considered in establishing cleanup levels protective of ground-water.
Clean Water Act of 1977, 33 USC 1251, as amended Water Quality Standards, 40 CFR 131	Establishes the requirements and procedures for states to develop and adopt water quality standards based on federal water quality criteria that are at least as stringent as the federal standards. Provides USEPA authority to review and approve state standards. Washington State has received USEPA approval and has adopted more stringent standards under WAC 173-201A.	Not applicable (the requirement to develop standards applies to the states, not individual facilities) but relevant in establishing the basis for state regulations.
Resource Conservation and Recovery Act, 42 USC 6901, et seq. Criteria for Classification of Solid Waste Disposal Facilities and Practices, 40 CFR 257	Criteria specified under this standard are used to determine which solid waste disposal facilities and practices pose a reasonable possibility of adverse risk to human health and the environment.	Most of the provisions of this chapter have been delegated to the state. (See State Hazardous Waste Management Act.).

Clean Air Act of 1977, as amended 42 USC 7401, et seq. National Ambient Air Quality Standards, 40 CFR 50	Requirements of these regulations are applicable to airborne releases of criteria pollutants specified under the statute. Specific release limits for particulates are set at 50 µg/m 3 annually or 150 µg/m 3 per 24-hour period.	Applicable to airborne releases of criteria pollutants that might be generated during assessment or response actions.
Ambient Air Quality Monitoring, 40 CFR 58 areas.	This regulation presents the criteria and requirements for ambient air quality monitoring and reporting for local air pollution control agencies and operators of new sources of air pollutants.	Applicable to assessment or response actions that meet the regulatory definition of a new source. Also, these requirements may be considered relevant and appropriate to response actions that have the potential to emit air contaminants, even if they are not a new source.
Standards of Performance for New Stationary Sources, 40 CFR 60	These requirements provide standards for new stationary or modifications of existing sources.	Applicable if assessment or response actions include stationary sources.
National Emission Standard for Hazardous Air Pollutants (NESHAP), 40 CFR 61	40 CFR 61 provides general requirements and listings for actions that will generate regulated emissions at a regulated facility.	These requirements are applicable to assessment or response actions that release air emissions into unrestricted
Hazardous Materials Transportation Act, 49 USC 1801, et seq. Hazardous Materials Regulation, 49 CFR 171 Hazardous Materials Tables, Hazardous Materials Communications Requirements, and Emergency Response Information Requirements, 49 CFR 172	These requirements state that no person may offer to accept hazardous material for transportation in commerce unless the material is properly classed, described, packaged, marked, labeled, and in condition for shipment. Tables are used to identify requirements for labeling, packaging, and transportation based on categories of waste types. Small quantities of radioactive wastes are not subject to the requirements of the standard if activity levels are below limits established in paragraph 173.421, 173.422, or 173.424. Specific performance requirements are established for packages used for shipping and transport of hazardous materials.	These requirements are applicable to hazardous material generated during assessment or response actions, which is sent offsite for disposal. These requirements are applicable if hazardous materials are transported offsite during assessment or response actions. In the event of a discharge of hazardous waste during transportation from the treatment facility to the disposal facility, this section is applicable.

Hazardous Waste Clean Up/Model Toxics Control Act, Ch. 70.105D RCW Model Toxics Control Act, WAC 173-340-700	Establishes a process and requirements for cleanup of contaminated sites in the state. MTCA regulations have been authorized for use in implementing corrective action in the state. Specifies that all cleanup actions be protective of human health; comply with all applicable state and federal regulations; and provide for compliance monitoring. Identifies the methods used to develop cleanup standards and their use in selection of a cleanup action. Specifies cleanup goals, which implement the strictest federal or state cleanup criteria. In addition to meeting requirements of other regulations, MTCA uses three basic methods for establishing cleanup levels. These methods may be used to identify cleanup standards for ground-water, surface water, soils, and protection of air quality. Cleanup levels for soils may be calculated using Method A – routine; Method B - standard method; and Method C – conditional standards. MCLs, MCLGs, and secondary drinking water standards are identified in the regulation as ground-water cleanup criteria.	Requirements of MTCA are applicable to the Site. Remedial actions at the Site are being conducted pursuant to MTCA under an Agreed Order.
Hazardous Waste Management Act, 70.105 RCW Dangerous Waste Regulations, WAC 173-303	Establishes the design, operation, and monitoring requirements for managing dangerous waste.	Dangerous waste is not present at the Site.
Solid Waste Management, Recovery and Recycling Act, Ch. 70.95 RCW Minimum Functional Standards for Solid Waste Handling, WAC 173-304	These standards establish requirements to be met for the management of solid waste. Solid waste controlled by this Act includes garbage, industrial waste, construction waste, and ashes. Requirements for containerized storage, collection, transportation, treatment, and disposal of solid waste are included. These standards set ground-water MCLs at the same levels as the state drinking water standards.	These regulations are applicable when solid waste is generated during assessment or response actions, and may be relevant and appropriate to the Site.

Water Pollution Control/Water Resource Act of 1971, Ch. 90.48 RCW/Ch.90.54 RCW Surface Water Quality Standards, WAC 173-201A	These standards set water quality standards at levels protective of aquatic life.	Surface water quality criteria established under this chapter are not applicable in assessing risk and response actions.
Protection of Upper Aquifer Zones, WAC 173-154	This regulation directs Ecology to provide for protection of upper aquifers and upper aquifer zones to avoid depletions, excessive water level declines, or reductions in water quality.	This regulation is not applicable because it establishes the policy and program for Ecology. However, the regulation is relevant and appropriate because protection of the aquifer from adverse impacts caused by solid waste is a primary goal.
State Waste Discharge Program, WAC 173-216	The regulation establishes requirements for industrial and commercial operations that discharge to the ground-water, surface waters, or municipal sewerage systems. Specific discharges prohibited under the program are identified. The intent of the regulation is to maintain the highest possible standards, and the law requires the use of all known available and reasonable methods to prevent and control the discharge of wastes into the waters of the state.	Requirements of this program are applicable to assessment or response actions that include discharges to the ground.
Department of Health Standards for Public Water Supplies, WAC 246-290	The rule established under WAC 246-290 defines the regulatory requirements necessary to protect consumers using public drinking water supplies. The rules are intended to conform with the federal SDWA, as amended. WAC 246-290-310 establishes MCLs that define the water quality requirements for public water supplies. WAC 246-290-310 establishes both primary and secondary MCLs and identifies that enforcement of the primary standards is the Department of Health's first priority.	The requirements of WAC 246-290-310 are relevant and appropriate. Although the ground-water at the Site is not a source of drinking water, groundwater at the Site has sufficient yield and quality to be considered a potential future resource.
State Environmental Policy Act, Chapter 43.21C RCW SEPA Rules, WAC 197-11	These requirements establish compliance with the State Environmental Policy Act.	These requirements are applicable for response or cleanup actions at the Site.
Water Quality Standards for Ground Waters of the State of Washington; WAC 173-200	Establishes ground-water quality standards to provide for protection of the environment and human health, as well as an antidegradation policy to protect existing and future beneficial uses of ground-water.	WAC 173-200 standards do not apply to cleanup actions undertaken pursuant to the Model Toxics Control Act (MTCA). Instead, MTCA establishes ground-water cleanup standards at such sites.

Ambient Air Quality Standards for Particulate Matter, WAC 173-470	These requirements set maximum acceptable levels for particulate matter in the ambient air and the 24-hour ambient air concentration standard for particles less than 10 µm in diameter (PM10). The section defines standards for particle fallout in industrial, commercial, and residential areas. Alternate levels are set for areas where natural dust levels are high.	These requirements are applicable to assessment and response actions (e.g., drilling) that might emit particulate matter to the air.
Washington Clean Air Act, Ch. 70.94 RCW and Ch. 43.21A RCW General Regulations for Air Pollution, WAC 173-400	The regulation requires that all sources of air contaminants meet emission standards for visible, particulate, fugitive, odors, and hazardous air emissions. This section requires that all emission units use reasonably available control technology, which may be determined for some source categories to be more stringent than the emission limitations listed in this chapter. The regulation requires that source testing and monitoring be performed. A new source would include any process or source that may increase emissions or ambient air concentration of any contaminant for which federal or state ambient or emission standards have been established.	Requirements of this standard are applicable to assessment and response actions that could result in the emission of hazardous air pollutants.
Controls for New Sources of Air Pollution, WAC 173-460	This standard requires that new sources of air emissions provide emission estimates for toxic air contaminants listed in the regulation. The standard requires that emissions be quantified and used in risk modeling to evaluate ambient impacts and to establish acceptable source impact levels. The standard establishes three major requirements for new sources of air pollutants: use of best available control technology; quantification of toxic emissions; and demonstration that human health is protected.	The standard is applicable to assessment and response actions where contaminants identified as toxic air pollutants are present and air emissions might be generated.
Water Well Construction, Ch. 18.104 RCW Minimum Standards for Construction and Maintenance of Water Wells, WAC 173-160	These requirements establish minimum standards for design, construction, capping, and sealing of all wells. The requirements set additional requirements, including disinfection of equipment, decommissioning of wells, and quality of drilling water.	These requirements are applicable because assessment or response actions include construction of wells for ground-water monitoring or for remediation purposes.

Rules and Regulations Governing the Licensing of Well Contractors and Operators, WAC 173-162	This regulation establishes training standards for well contractors and operators.	This regulation is relevant and appropriate because assessment or response actions could involve ground-water well installation or construction of geotechnical borings.

CFR = Code of Federal Regulations
Ecology = Washington Department of Ecology
MCL = maximum contaminant level
MCLG = maximum contaminant level goal
MTCA = Model Toxics Control Act
RCW = Revised Code of Washington
SEPA = State Environmental Policy Act
SDWA = Safe Drinking Water Act
WAC = Washington Administrative Code.

APPENDIX G

COST ESTIMATE DETAILS

TABLE G-1
Derived Unit Costs

Item	Quantity	Units	Unit Cost	Cost [a, b]	Notes
SVE Trench Unit Cost					
Trench width	2	ft			
Trench depth	5	ft			
Cut & remove asphalt	2	sf/lf	$ 0.50	$ 1.00	
Excavation	0.74	cy/lf	$ 15.00	$ 11.11	100% overexcavation
Gravel, 1 ft thick	0.07	cy/lf	$ 30.00	$ 2.22	
Geotextile	4	sf/lf	$ 0.50	$ 2.00	
Collector pipe, 6 PVC	1	ft/lf	$ 16.00	$ 16.00	
Backfill	0.67	cy/lf	$ 15.00	$ 10.00	
Asphalt repair	4	sf/lf	$ 3.00	$ 12.00	
SVE Trench Unit Cost		lf		**$ 54.00**	Rounded
Header Trench Unit Cost					Not including pipe
Trench width	2	ft			
Trench depth	2	ft			
Cut & remove asphalt	2	sf/lf	$ 0.50	$ 1.00	
Excavation	0.18	cy/lf	$ 15.00	$ 2.67	20% overexcavation
Backfill	0.18	cy/lf	$ 15.00	$ 2.67	
Asphalt repair	2	sf/lf	$ 3.00	$ 6.00	
Header Trench Unit Cost		lf		**$ 12.00**	Rounded
SVE for Source Area					
SVE wells for source area	2	ea	$ 5,000	$ 10,000	
Electrical		LS		$ 30,000	
Well/riser connection & traffic boxes	2	ea	$ 750	$ 1,500	
Header trenching	50	lf	$ 12.00	$ 600	
PVC pipe, 4"	50	lf	$ 10.00	$ 500	
SVE blowers and controls		LS		$ 15,000	
Carbon vessels for offgas treatment	1	ea	$ 20,000	$ 20,000	Includes carbon
SVE for Source Area		lf		**$ 77,600**	

NOTES:

[a] Costs are for early 2010.

[b] Costs do not include engineering or contingency, but include contractor overhead and profit.

Golder Associates

TABLE G-2
Basic Unit Costs

Item	Unit Cost	Units	Source/Comments
Institutional controls & permits	$ 35,000	LS	Allowance
Land access cost	$ 50,000	LS	Allowance
Installation			
Equipment mobilization/demobilization	$ 10,000	LS	Allowance
Chain-link fencing	$ 20	lf	
ISCO well, 55 ft depth	$ 6,300	ea	On Facility
Ozone sparge well	$ 5,500	ea	On Facility
SVE well, 40 ft deep	$ 3,300	ea	On Facility
IAS or SVE well, 80 ft deep	$ 6,300	ea	On Facility
SVE well, 120 ft deep	$ 10,000	ea	Off-property
IAS well, 160 ft deep	$ 18,000	ea	Off-property
Groundwater extraction well, 55 ft deep	$ 12,000	ea	On Facility, with pump
Groundwater extraction well, 130 ft deep	$ 20,000	ea	Off-property, with pump
IAS, SVE, or groundwater wellhead in traffic box	$ 750	ea	Pasco Site costs
ISCO wellhead in traffic box	$ 500	ea	Pasco Site costs
Trench excavation	$ 15.00	cy	Estimate
Backfill trench	$ 15.00	cy	Estimate
Aspahlt paving repair	$ 3.00	sf	Means plus extra for small area
Cut and remove asphalt	$ 0.50	sf	Estimate
Gravel (trench, etc.), in place	$ 30.00	cy	Estimate
Geotextile	$ 0.50	sf	Estimate
Pipe, PVC, 2" (installed)	$ 5.00	ft	Means 2004 750-4010 + inflation allowance
Pipe, PVC, 3" (installed)	$ 8.00	ft	
Pipe, PVC, 4" (installed)	$ 10.00	ft	Means 2004 750-4040 + inflation allowance
Pipe, PVC, 6" (installed)	$ 16.00	ft	Means 2004 750-40500 + inflation allowance
Ozone tubing (installed)	$ 5.00	ft	Vendor quote + installation
Pipe manifold	$ 2,000	ea	Estimate
Ozone generation unit	$ 60,000	ea	Vendor quote
Vapor-phase carbon vessel (10,000 lb)	$ 20,000	ea	Pasco Site costs; w/ carbon
Liquid-phase carbon vessel (2,000 lb)	$ 5,000	ea	Pasco Site costs; w/ carbon
Operations, Maintenance, and Monitoring			
Carbon	$ 1.50	lb	
Electricity	$ 0.10	KWH	
SVE offgas monitoring costs (per system)	$ 11,000	yr	
POTW discharge costs	$ 20,000	yr	Discharge fees and monitoring
Groundwater monitoring	$ 18,000	yr	
Inspect & maintain asphalt cap	$ 5,000	yr	Allowance

NOTES:

Costs include overhead & profit for general contractor
Means = RS Means Heavy Construction Cost Data 2007
Means = RS Means Site Work and Landscape Cost Data 2004