

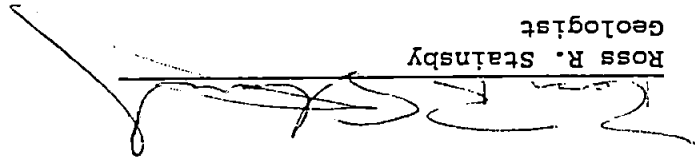
A Report Prepared For

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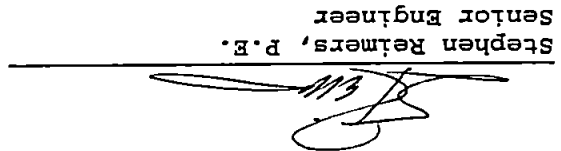
VOLUME I
SITE CLEANUP ACTIONS
INDEPENDENT REMEDIAL ACTION
HOUGHTON BEACH PARK
KIRKLAND, WASHINGTON

AGI Project No. 15,582.021

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EXECUTIVE SUMMARY

This report documents site cleanup actions at Houghton Beach Park in Kirkland, Washington. The cleanup actions were performed as part of an independent remedial action following requirements specified in the Washington State Department of Ecology (Ecology) Model Toxics Control Act Cleanup Regulation (MTCA). A summary of remedial action steps taken prior to the site cleanup actions is also provided.

Independent remedial action at Houghton Beach Park is being undertaken by Chevron U.S.A. Products Company (Chevron), Shell Oil Company (Shell), and the City of Kirkland (City).

Following the discovery of petroleum hydrocarbons at Houghton Beach Park, initial and supplemental site assessments were performed. Site specific risk-based cleanup levels were developed for both soil and groundwater in accordance with MTCA Method B Cleanup Standards. Selection of site cleanup actions was performed based on the assessments and cleanup levels. The site cleanup actions consisted of soil remediation, groundwater remediation, and compliance monitoring. These actions were initiated December 9, 1991. Soil and groundwater remediation was completed September 15, 1992.

Soil remediation consisted of excavating approximately 2,200 cubic yards of soil, treating the soil on site, and backfilling the excavations. Excavation activities were guided by collecting and analyzing soil samples. Prior to backfilling, treated soil was further sampled and analyzed to confirm established cleanup levels were achieved. The soil remediation was successful in meeting cleanup levels. Following backfill operations, an aesthetic barrier of clean soil, asphalt, or concrete pavement was placed over the entire site.

Groundwater remediation consisted of collecting approximately 161,000 gallons of groundwater from the excavations, treating the water on site, and discharging it to the local sanitary sewer. Samples of treated water were collected and analyzed prior to discharge to confirm compliance with the requirement of Metro's Water Pollution Control Department.

Following completion of soil and groundwater remediation, a monitoring well network was installed for compliance monitoring of groundwater. Analysis of the initial round of samples collected from this network was completed and results indicate all analyte concentrations are below the cleanup levels. Quarterly monitoring will continue until analyses indicate groundwater at each location on site is in compliance with cleanup levels for four consecutive quarters or until compliance with cleanup levels is demonstrated statistically.

1.0 INTRODUCTION

1.1 OVERVIEW

This report documents site cleanup actions at Houghton Beach Park in Kirkland, Washington. The cleanup actions were performed as part of an independent remedial action following requirements specified in the Washington State Department of Ecology (Ecology) Model Toxics Control Act Cleanup Regulation (MTCA). A summary of independent remedial action steps taken prior to the site cleanup actions is also provided.

The independent remedial action at Houghton Beach Park is being undertaken by Chevron U.S.A. Products Company (Chevron), Shell Oil Company (Shell), and the City of Kirkland (City).

The objectives of the independent remedial action were to:

- ▶ Meet MTCA requirements for protection of public health and the environment.
- ▶ Allow the City to return the park to its intended recreational use.

1.2 BACKGROUND

1.2.1 Site History

Prior to approximately 1917, a majority of the area now occupied by Houghton Beach Park was submerged beneath the waters of Lake Washington. Following the completion of the Hiram Chittenden Locks, the level of Lake Washington was lowered and the site emerged along the shoreline of the lake.

Chevron, Shell, and their predecessors operated bulk fuel storage terminals on the northern and southern portions of the current park site from approximately 1917 to 1970. A parcel of land between the bulk fuel terminals remained undeveloped until approximately 1956 when it became the Town of Houghton Park. Operations at the bulk fuel terminals ceased in 1970 and the properties were purchased by the City. The City has operated a public park on all portions of the property since.

1.2.2 Independent Remedial Action Summary

The presence of petroleum hydrocarbons in soil was initially reported in April 1991 by City contractors. Based on these reports, the City retained GeoEngineers, Inc. to perform an environmental assessment of the park site. Investigations performed by GeoEngineers confirmed the presence of petroleum hydrocarbons in soil and groundwater. At Chevron's request, Applied Geotechnology Inc. (AGI) performed a supplemental site assessment to obtain additional specific chemical data necessary to support a risk-based site cleanup approach.

Based on the substances identified in the assessments, the age and weathered condition of the petroleum products present, and consideration of other site-specific factors (e.g., land use), MTCA Method B was selected as the appropriate approach to establish cleanup levels. PTI Environmental Services (PTI) formulated cleanup levels for soil and groundwater in accordance with the requirements of MTCA Method B.

AGI selected site cleanup actions based on the site assessments and cleanup levels developed by PTI. A Corrective Action Plan was prepared by AGI describing the actions, including soil remediation, groundwater remediation, and compliance monitoring. Planned site cleanup actions were discussed with the City, GeoEngineers, and Ecology.

AGI's services related to implementation of the site cleanup actions were authorized by Mr. Bob Brinkmann of Chevron on January 24, 1992, as Change Order No. 1 to Release No. 6131150.

1.3 PROJECT DOCUMENTS

Several documents, described in the following list, were prepared during the initial steps of the independent remedial action. These steps are summarized in the following section of this report. For a more thorough description of the initial steps, the reader is encouraged to refer to these documents.

- ▶ GeoEngineers - *Report of Geoenvironmental Services, Summary of Subsurface Contamination and Cleanup Options - Houghton Beach Park, Kirkland Washington, for City of Kirkland, July 9, 1991.*
- ▶ GeoEngineers - *Report of Geoenvironmental Services, Subsurface Contamination Study. Houghton Beach Park, Kirkland, Washington. April 24, 1992.*
- ▶ PTI Environmental Services - *Development of Model Toxics Control Act Cleanup Standards for the Houghton Beach Park Site in Kirkland, Washington, November 1991.*
- ▶ David L. Eaton, Ph.D., DABT - *Adequacy of the Proposed Corrective Action Plan to Reduce Health Risks Associated with Petroleum Hydrocarbons at Houghton Beach Park, Kirkland, Washington, undated.*
- ▶ Applied Geotechnology Inc. - *Corrective Action Plan, Houghton Beach Park, Kirkland, Washington, November 12, 1991.*
- ▶ Applied Geotechnology Inc. - *Sampling and Analysis Plan, Houghton Beach Park Remediation, Kirkland, Washington, December, 1991.*
- ▶ Applied Geotechnology Inc. - *Project Health and Safety Plan, Houghton Beach Park Remediation, Kirkland, Washington, December 12, 1991.*
- ▶ Applied Geotechnology Inc. - *Supplemental Site Investigation, Houghton Beach Park, Kirkland, Washington, March 26, 1992.*
- ▶ Applied Geotechnology Inc. - *Addendum No. 1 - Corrective Action Plan, Houghton Beach Park, Kirkland, Washington, June 18, 1992.*

2.0 INDEPENDENT REMEDIAL ACTION SUMMARY

2.1 INITIAL SITE ASSESSMENT

Based on the reported presence of hydrocarbons in site soil detected by City contractors making park improvements, the City retained GeoEngineers to perform an environmental assessment of Houghton Beach Park in April 1991.

GeoEngineers installed 26 power borings, 26 hand borings, and excavated 15 test pits. Monitoring wells were installed in eight of the power borings. A total of 97 soil samples and 8 groundwater samples were collected and analyzed. GeoEngineers concluded that soil containing petroleum hydrocarbons existed over widespread portions of the site, but that groundwater had only been affected in one area of the site.

2.2 SUPPLEMENTAL SITE ASSESSMENT

Following a review of the initial site assessment, Chevron and Shell requested that AGI perform a supplemental site assessment to more completely determine the type and concentration of individual petroleum hydrocarbon constituents. Specific chemicals of concern evaluated during this assessment were volatile organic compounds (including benzene, ethylbenzene, toluene, and total xylenes [BETX]), semivolatile organic compounds (including polycyclic aromatic hydrocarbons [PAHs]), and total lead.

2.3 DEVELOPMENT OF SITE SPECIFIC CLEANUP LEVELS

Based on data from the GeoEngineers and AGI site assessments, and the methods prescribed by MTCA Method B, PTI developed cleanup levels for soil and groundwater based on constituents detected above method reporting limits. As permitted under MTCA (WAC 173-340-740(3)(a)(ii)(B)), cleanup levels were developed for individual toxic components of total petroleum hydrocarbons (TPH), rather than TPH as a group of chemicals, to more accurately reflect the human health and environmental risks present.

Cleanup levels were developed by considering applicable state and federal laws, risk-based concentrations, and concentrations in soil that are protective of groundwater. For each chemical, the most stringent of the possible cleanup levels was chosen. Most of the site-specific cleanup levels developed for soil and groundwater were based on protection of groundwater quality as a drinking water source. However, site groundwater is not currently used as a drinking water supply and it is highly unlikely, if not impossible, that it ever would. Thus, this approach provides conservative cleanup levels for soil and groundwater because risk-based cleanup levels based on direct soil contact (a more plausible exposure route for this site) are generally higher than those based on groundwater protection. Cleanup levels developed by PTI are summarized in Table 1.

Conclusions based on the data developed by GeoEngineers and AGI site assessments, and MTCA Method B cleanup levels developed by PTI, are summarized as follows:

- ▶ Volatile organic compound (VOC) constituents in soil samples were detected at concentrations below cleanup levels except for benzene, ethylbenzene, toluene, and total xylenes, which exceeded cleanup levels in one localized area. In general, BETX concentrations in soil samples were low relative to TPH concentrations.
- ▶ Semivolatile organic compounds constituents in soil samples were detected at concentrations below cleanup levels, except for chrysene, which was detected in two localized areas.
- ▶ Total lead concentrations in soil samples were below the cleanup level.
- ▶ PAH, BETX, and lead concentrations in near-shore sediment samples were below cleanup levels.
- ▶ PAH concentrations in groundwater samples were below cleanup levels.
- ▶ BETX concentrations in groundwater samples were below cleanup levels in all locations except MW-7, where benzene was detected at 97 parts per billion (ppb), versus the cleanup level of 5 ppb.

2.4 CORRECTIVE ACTION PLAN

A Corrective Action Plan (CAP) was prepared by AGI describing the site cleanup actions necessary to remediate soil and groundwater based on site-specific MTCA Method B cleanup levels. In summary, this plan recommended that: 1) soil from two locations be excavated, treated using physical and biological techniques, and backfilled on site; 2) groundwater in the vicinity of MW-7 be treated in an aboveground tank and discharged to the sanitary sewer system; and 3) following cleanup, a barrier of clean soil be placed as a cap above all future grassed and landscaped areas of the park.

The CAP required that analytical procedures be performed during site cleanup. Specific analyses were required where site assessment data indicated constituent concentrations exceeded cleanup levels. Chemical analysis was not required, however, where site assessment data indicated detectable constituent concentrations below cleanup levels. For example, 1,2-dichloropropane, methylene chloride, 1,1,1-trichloroethane, and lead were not detected at concentrations above cleanup levels during pre-site-cleanup assessments. Soil samples were, therefore, not systematically analyzed for these constituents, even though cleanup levels had been calculated.

2.5 SAMPLING AND ANALYSIS PLAN

A Sampling and Analysis Plan (SAP) was prepared by AGI for use during site cleanup actions. The SAP describes the technical approach and procedures used to ensure that sample collection, handling, and analysis resulted in data of sufficient quality.

2.6 PUBLIC PARTICIPATION AND INVOLVEMENT OF OTHERS

Prior to implementation, plans for the site cleanup actions for Houghton Beach Park were presented to representatives of Ecology, the City, and the general public (at a Kirkland City Council meeting). Additionally, Dr. David Eaton, a toxicologist from the University of Washington, reviewed the planned site cleanup actions and cleanup levels. Input from each of these parties was evaluated and included in the final Corrective Action Plan.

2.7 SITE CLEANUP ACTIONS

Soil and groundwater remediation was accomplished using on-site, aboveground, physical and biological treatment methods. The remediation was successful in meeting the established Method B cleanup levels. Additionally, aesthetic protection was provided by placing a barrier of clean soil, concrete, or asphalt over all areas of the park.

To demonstrate that the site cleanup actions have been effective, a groundwater monitoring network was established. Groundwater samples will be collected and analyzed on a quarterly basis for at least one year from the completion of cleanup actions. The results of initial quarterly sampling and analysis indicate that hydrocarbon concentrations in site groundwater are below cleanup levels.

The remainder of this report summarizes the site cleanup actions in greater detail.

3.0 SITE CLEANUP TEAM

3.1 APPLIED GEOTECHNOLOGY INC.

The purpose of AGI's services during site cleanup actions was to provide project management and technical oversight services, monitor and verify the effectiveness of soil and groundwater remediation, initiate compliance monitoring, and document the results. Specifically, AGI's scope of services for the site cleanup actions consisted of:

- ▶ Preparing a Health and Safety Plan providing guidance and procedures to ensure the physical well being of AGI personnel.
- ▶ Obtaining necessary permits for implementation of the site cleanup actions.
- ▶ Providing project quality assurance.
- ▶ Overseeing and directing the day-to-day activities of the remediation services contractor.
- ▶ Performing soil sampling and analysis to define the limits of materials requiring remediation and monitoring treatment progress.
- ▶ Performing the groundwater remediation.
- ▶ Providing liaison functions between the City and their contractors and designers.
- ▶ Installing additional groundwater monitoring wells, as required, and performing compliance monitoring to assess remediation effectiveness.
- ▶ Preparing this report describing and documenting results of the site cleanup actions.

3.2 OLYMPUS ENVIRONMENTAL, INC.

Olympus Environmental, Inc. (OEI) provided on-site remediation services and acted as general contractor for the site cleanup actions. OEI responsibilities included:

- ▶ Preparing a Health and Safety Plan providing guidance and procedures to ensure the physical well being of OEI personnel.
- ▶ Excavating, treating, and backfilling soil.
- ▶ Pumping and dewatering of the excavations.
- ▶ Removing and disposing of concrete and asphalt.
- ▶ Making contractual arrangements for material procurement and specialty subcontracting.

4.0 SOIL REMEDIATION

4.1 OVERVIEW

As presented in the Corrective Action Plan, soil requiring cleanup was located in two principle areas of the site. The first area, Area A, was in the north-central portion of the park in the vicinity of a former bulk fuel facility warehouse. The second, Area B, was in the central portion of the park in the vicinity of a former garage. These areas and other pertinent site features are shown on Figure 1, Houghton Beach Park Site Plan.

A smaller area, Area C, on the western edge of the southern lobe of the park, also required localized excavation and treatment. This location is within an area reclaimed from Lake Washington by filling, following transfer of the property to the City of Kirkland. Area D, in the southeastern portion of the park within the present day parking lot, was excavated to install a catch basin and manhole as a part of parking lot reconstruction.

In addition to the above localized excavations, two other areas of the park were excavated as a part of the cleanup actions. The Beach Area, consisting of beach sands adjacent to the shoreline of Lake Washington and extending from the present day restroom facilities north to a point approximately 60 feet beyond the existing dock, was excavated for aesthetic purposes to remove hydrocarbon-stained soils. A series of Remedial Test Pits (RTPs) was excavated west of Area B and east of the Beach Area to further define the limit of soil requiring treatment and/or excavation for aesthetic purposes.

On-site soil treatment was accomplished using Solid Phase treatment techniques. Solid Phase treatment incorporates aboveground physical and biological methods to reduce petroleum hydrocarbon constituent levels in soil. In total, approximately 2,200 cubic yards of soil were treated. This total included soil generated from the excavations described above, and approximately 1,000 cubic yards of soil excavated from the playground area by City contractors prior to initiation of site cleanup actions.

Backfill operations consisted of backfilling excavations created during the removal of soil requiring treatment, increasing grades at the parking lot and southern portions of the park, and placing an aesthetic barrier of clean soil over the entire site. Backfill soil included both imported select material and on-site treated soil. Detailed discussions of backfill operations are presented in the following sections.

4.2 EXCAVATION

In all areas, soil excavation was accomplished using either a track-mounted or rubber-tired excavator. During excavation, soil samples were collected from the base and sidewalls of the excavations in accordance with the SAP. All samples were submitted to Columbia Analytical Services (CAS) in Bothell, Washington under chain-of-custody procedures. Samples were tested for the presence of BETX and PAHs by EPA Methods 8020 and 8310, respectively. Selected samples were also analyzed for PAHs using EPA Method 3550/GC/MS Selective Ion Monitoring (SIM) techniques and for VOCs by EPA Method 8240.

Where sample analyses indicated chemical constituent concentrations above Method B cleanup levels, the region was overexcavated and resampled. This process was repeated until laboratory analysis of all base and sidewall samples indicated concentrations of chemicals of concern were below the established cleanup levels.

4.2.1 Area A

Site assessment data indicated that groundwater in the vicinity of Area A contained benzene concentrations above cleanup levels. The objective of this excavation was to remove soils potentially serving as a source of benzene to groundwater, and to provide access for treatment of groundwater. Complete removal of soil in Area A with hydrocarbon constituent concentrations above cleanup levels required iterative sequences of sampling, overexcavation, and resampling. In total, approximately 500 bank cubic yards were removed and 24 base and sidewall samples were collected and analyzed. Results of all base and sidewall sample analyses from Area A are summarized in Tables 2, 3, and 4. Full analytical reports as received from the laboratory, and AGI's Quality Assurance Reports, are in Appendix B. Approximate sample locations are shown on Figure 2, North Area Site Plan.

In two samples from Area A and one from Area B, analytical results of EPA Method 8310 analysis for PAHs were influenced by matrix interference. In these instances, the results could not establish whether PAHs in the soil sample were below cleanup levels. In order to obtain increased resolution of the PAH compound(s) in question, additional analyses were completed using EPA Method 3550/GC/MS SIM techniques. This method allows attainment of method reporting limits for specific compounds below or equal to risk-based cleanup levels. Results of their analyses are also summarized in Tables 2, 3, and 5.

A portion of an abandoned pipeline, thought to be associated with the former fuel facility, was encountered at the southern extent of the excavation at Area A. Because former use of the pipeline was unknown and stained soils were observed in the vicinity, soil surrounding the line was analyzed for VOCs by EPA Method 8240 in addition to the standard EPA Methods 8020 and 8310. The results of these analyses, summarized in Table 4, indicated there were no VOCs above cleanup levels.

Subsurface conditions encountered in Area A consisted of a surficial layer of 2 to 3 feet of brown silty sand with heavy hydrocarbon staining overlying 1 to 2 feet of light gray clay showing no obvious hydrocarbon staining. The clay unit was underlain by 1 to 2 feet of mottled gray to brown silty sand exhibiting irregular hydrocarbon staining, which, in turn, was underlain by at least 4 feet of very dense, gray sandy silt to gravely silt exhibiting no signs of hydrocarbon staining. In our judgement, this lowermost deposit is Vashon Till. This Till underlies the entire area¹. The clay unit, also observed in Area B, appears to be fairly continuous over the site and may represent former lake bottom sediments, deposited prior to lowering of the Lake Washington water level.

¹Waldron, Liesch, Mullineaux, and Crandell. 1962. USGS Map I-354, Preliminary Geologic Map of Seattle and Vicinity, Washington.

Groundwater conditions observed within the Area A excavation and typical of the site in general consisted of small seeps exiting the base of one or both of the silty sand deposits encountered directly above both the clay and Till units. In our judgement, these seeps represent groundwater perched above the less permeable clay and Till. Both the clay and Till units were observed to dip slightly to the west (toward Lake Washington) allowing perched groundwater to drain toward the lake.

4.2.2 Area B

Area B is directly east of the new play area, as shown on Figures 1 and 2. This location was chosen based on elevated concentrations of PAHs and BETX, and review of historic site plans. As in Area A, excavation and sampling were repeated until all base and sidewall samples showed BETX and PAH concentrations below cleanup levels. In total, approximately 200 bank cubic yards were excavated and 13 base and sidewall samples were collected from this area and analyzed for PAHs and BETX. Results of all base and sidewall sample analyses from Area B are summarized in Tables 3 and 5. Approximate sample locations are shown on Figure 2.

Subsurface conditions encountered in Area B consisted of approximately 2 feet of crushed rock fill over an 8-inch concrete slab, thought to be a relic of a garage structure known to have been in the general vicinity of this excavation. Below the concrete slab, a 5- to 6-foot-thick sequence of grey silty sand, light grey clay, and brown silty sand was encountered. The upper deposit of silty sand had noticeable hydrocarbon staining while the underlying clay and brown silty sand did not. Till was not encountered in Area B, presumably because the excavation was not deep enough.

As noted above, the Area B excavation was directly east of the new concrete playground structure. Based on analytical chemistry results of sidewall samples, this excavation was extended to include an area below the footing of the playground structure in one location. As-built drawings of this excavation, shoring of the playground footing, and placement of backfill concrete are shown on Figure 3, As-Built, Playground Excavation and Backfill.

Groundwater conditions in Area B were similar to those in Area A, (e.g., seeps emerged from the silty sand deposits within the excavation). The volume of water encountered was small and exhibited no hydrocarbon sheen.

4.2.3 Area C

Area C is on the western edge of the southwestern corner of the park (Figure 1). Excavation in this area was conducted based on detection of chrysene during AGI's site assessment activities. In total, approximately 100 bank cubic yards were excavated and seven soil samples from this area were collected and analyzed. Results of chemical analyses of soil samples from Area C are summarized in Table 6. Approximate sample locations are shown on Figure 4, South Area Site Plan.

Subsurface conditions encountered in the excavation in Area C consisted of loose fill mixed with debris, including pieces of asphalt, concrete, and bags of unopened cement. This material is consistent with historical reports indicating this area was constructed by filling into Lake Washington.

Groundwater at this location was observed to exist under unconfined conditions with the depth to water closely corresponding to the level of the adjacent Lake Washington.

4.2.4 Area D

Area D is in the center of the parking lot in the southeastern corner of the park (Figure 1). Excavation at Area D was accomplished as a part of installation of a new catch basin and manhole. Approximately 50 bank cubic yards of soil were excavated and four soil samples were collected and analyzed. None of the samples were found to contain BETX or PAH compounds at concentrations above cleanup levels. Results of chemical analyses of soil samples from Area D are summarized in Table 7. Approximate sample locations are shown on Figure 4.

Subsurface conditions, described from the surface to the base of the excavation, consisted of 0.5 to 1 foot of fill soil over approximately 7 feet of grey silty sand over 2 feet of brown silty sand. No hydrocarbon staining was observed in any of the excavated soil.

Groundwater was not encountered in the excavation in Area D.

4.2.5 Beach Area

The Beach Area consisted of beach sands adjacent to the shoreline of Lake Washington, extending north from the present day restroom facilities to a point approximately 60 feet north of the existing dock structure. Site assessment data revealed that the beach sand in this area exhibited obvious hydrocarbon staining. Analytical testing, however, indicated these concentrations were below cleanup levels. Excavation of the beach sand was therefore accomplished based on aesthetic considerations of the anticipated recreational use of the park and the likelihood that children playing on the beach could be exposed to the hydrocarbon-stained sand. Excavated sand was treated along with soil from other areas of the park.

The beach excavation was bordered by three test pits (RTP9 through RTP11) and a series of non-numbered hand excavated test pits. Each of the test pits was excavated until groundwater or glacial till was encountered, or to a maximum depth of 2 feet. A visual inspection was made of each test pit. If evidence of hydrocarbon contamination was observed, the surrounding beach sand was removed to the contact between the sand and glacial till, or to a maximum depth of 2 feet.

Soil samples were collected from the base of the excavation at approximately 25 foot intervals. Each sample was analyzed for BETX and PAHs by EPA Methods 8020 and 8310, respectively. The results are summarized in Table 8. None of the samples contained hydrocarbon constituents above cleanup levels.

Subsurface and groundwater conditions encountered were similar in all locations. Beach sand was continuous from the surface to the depth where Till was encountered, generally 1/2 to 2 feet below ground surface. Groundwater was encountered under unconfined conditions in all areas. Depth to groundwater varied from essentially zero, adjacent to the shoreline, to as

deep as approximately 2 feet at locations 20 feet from the shoreline. It should be noted that excavation was completed in the winter months when the level of Lake Washington is at its lowest. Much of the Beach Area will typically be submerged in summer months.

4.2.6 Remedial Test Pits

A series of Remedial Test Pits (RTP1 through RTP11) were excavated in the area west of Area B and east of the Beach Area, to further define the limit of soil requiring treatment or excavation for aesthetic purposes. One or two soil samples were collected from RTP1 through RTP8 and analyzed for BETX and PAHs by EPA Methods 8020 and 8310, respectively. As summarized in Table 9, none of these samples contained constituents above cleanup levels. Test pits RTP9 through RTP11 were excavated to define the limits of necessary aesthetic excavation, and no samples were collected.

Subsurface and groundwater conditions varied in different test pit locations and with depth, but were generally similar to those encountered in Areas A and B, and the Beach Area. A soil classification/legend is shown on Plate A1 and logs of the remedial test pits are shown on Plates A3 through A8 in Appendix A.

4.3 TREATMENT

Soil treatment was initiated immediately following excavation. Excavated soil was transported by dump truck to a staging area where nutrients were added at a ratio of approximately 2 pounds of ammonium phosphate (16-20-0) per cubic yard of soil. The nutrient amended soil was then screened using a motorized screening plant to remove oversized materials, aerate the soil mass, and help mix in nutrients. Following screening, the soil was transported to one of two on-site treatment pads, as shown on Figure 5, Treatment Pad Location Map.

Moisture content of the soil within the treatment pads was controlled by selectively covering and uncovering the treatment pads with tarps in response to the local weather conditions. Oxygen was added by periodically tilling the soils using a rototiller towed behind a four wheel drive tractor. Tilling and moisture control efforts took place continuously, as permitted by weather, during the period from mid-December 1991 through mid-April 1992.

To verify that treated soil was in compliance with cleanup levels, a systematic sampling and analysis program was implemented. Detailed sampling and analysis procedures are presented in the SAP and will only be summarized here. As shown on Figure 5, the two treatment pads were divided into seven separate cells, four on Treatment Pad #1 and three on Treatment Pad #2. Each cell contained approximately 150 cubic yards of soil per 18-inch lift. Sampling of each 150-cubic-yard cell was accomplished by collecting five separate samples from within each cell, and field compositing them to generate one composite sample.

Samples were transported to CAS under chain-of-custody procedures and analyzed for BETX and PAHs by EPA Methods 8020 and 8310, respectively. Fourteen composite samples, representing 2,200 cubic yards, were collected and analyzed. Results of analytical testing verified that treated soil was in compliance with cleanup levels, as summarized in Table 10, Treatment Pad Compliance Samples.

4.4 BACKFILL

4.4.1 Excavations

Excavations were backfilled during April and May 1992, following completion of soil treatment. Backfill material consisted of treated and/or imported soil depending on location and planned future use of the area being back-filled.

Area A was backfilled using imported structural grade material to accommodate future use of the area as a paved drive. Coarse-grained quarry spalls were placed at the base of the excavation to within 2 to 3 feet of the surface. The upper 2 to 3 feet was then backfilled with imported 1-1/4 minus crushed rock (base coarse material). This material was placed in 8-inch lifts and compacted to a minimum of 95 percent relative compaction per American Society for Testing and Materials Method D1557.

The base of Area B was backfilled with lean concrete to provide support for the playground footing undermined during excavation. Details of this construction are shown on Figure 3. Treated soil was placed above the concrete, extending to within approximately 18 inches of the surface. To provide support for a future concrete sidewalk, the upper 18 inches of Area B was backfilled with imported 1-1/4 minus crushed rock, and compacted as described for Area A.

Area C is in a future grassed area of the park and therefore required no structural backfill materials. This area was backfilled using treated soil.

Area D, in the center of the parking lot, was backfilled using a combination of the material generated during excavation and treated soil to within 6 inches of final grade. Backfill was compacted as described above. The upper 6 inches, placed as a part of the parking lot pavement, consisted of 4 inches of imported 5/8-inch minus crushed rock (base coarse material) and 2 inches of hot mixed asphalt.

The Beach Area was backfilled with imported clean sand resembling typical beach sand. RTPs were backfilled with imported pit run gravel.

4.4.2 Parking Lot and General Fill

Approximately 700 cubic yards of treated soil were placed as excavation backfill, as described above. The remaining 1,400 cubic yards of treated soil were placed as sub-base material for the new parking lot and as general fill to raise the grade of the southern portions of the park.

As a part of general park improvements, plans were made to reconstruct the existing parking lot. These plans, providing for placement of approximately 900 cubic yards of treated soil as sub-base material below new asphalt and concrete pavements, were implemented during site cleanup actions. Total compacted thickness of treated soil placed in this area ranged from 6 to 24 inches.

Approximately 500 cubic yards of treated soil were placed as general fill to raise the grade of grassed areas in the southern portion of the park. Prior to placement of this soil, existing ground cover, consisting mostly of sparse grasses, was rototilled to provide a uniform bond between the fill and the underlying soil. Following placement of treated soil, this area received additional fill as discussed below.

4.4.3 Aesthetic Barrier

Following site cleanup actions, the city reestablished a contract with Lakeside Landscaping, Inc. for completion of park improvements. All future grassed and landscaped areas of the park were topped with a minimum of 6 inches of sandy topsoil fill prior to replanting. This cap, consisting of topsoil and the planted grasses, provides a barrier between human activities and potentially aesthetically displeasing subsoil.

5.0 GROUNDWATER REMEDIATION

5.1 OVERVIEW

Groundwater samples analyzed as a part of site assessment activities indicated benzene concentrations in groundwater in the vicinity of MW-7 exceeded the cleanup level. Therefore, Area A was excavated as described above not only to remove soil exceeding cleanup levels, but to gain access to groundwater for treatment.

5.2 TREATMENT

Groundwater was collected in Area A, where the excavation extended approximately 6 to 8 feet below the local groundwater table. During the period from mid-December 1991 to late May 1992, approximately 161,000 gallons of water were pumped from the open excavation. Continued pumping caused groundwater within the area to migrate toward the excavation, thereby flushing hydrocarbon constituents from the local soil and groundwater.

Water pumped from the excavation was discharged into an on-site holding tank in batches of approximately 15,000 gallons. Water within the tank was aerated, promoting physical and biological reduction of VOCs. Once treatment was complete, as confirmed by sample analytical results meeting discharge criteria, the water was discharged to the local sanitary sewer.

Written authorization to discharge to the sanitary sewer was obtained from Metro's Water Pollution Control Department on December 6, 1991, (included as Appendix C). Verbal authorization to extend the duration of the original permit was obtained in April 1992.

Discharge criteria required chemical analysis of each batch for BETX and non-polar fats, oils, and grease prior to release to the sanitary sewer. Results of EPA Methods 8020 and 418.1 analyses are summarized in Table 11, Discharge Water Analysis.

6.0 COMPLIANCE MONITORING

6.1 GROUNDWATER MONITORING NETWORK

Addendum No. 1 to the Corrective Action Plan described post-site cleanup groundwater monitoring as required by MTCA, WAC 173-430-410. The objective of post-site cleanup groundwater monitoring is to demonstrate that site cleanup actions were effective and fully protective of groundwater quality.

The groundwater monitoring network consists of two wells installed during site assessment activities (MW-3D, and MW-8), five new wells (MW-10, MW-11A, MW-12, MW-13 and MW-14), and three under drainage outfalls (OF-1, OF-2, and OF-3). Approximate locations of these monitoring points are presented on Figure 6.

Groundwater conditions observed during excavation activities, and typical of the site in general, consisted of small seeps exiting silty sand deposits at depths of 4 to 7 feet. In our judgement, these seeps represent groundwater perched above the less permeable clay and Till units. Both the clay and Till units were observed to dip slightly to the west (toward Lake Washington) allowing perched groundwater to migrate toward the lake. Therefore, monitoring points have been placed along the Lake Washington shoreline, down-gradient of areas where hydrocarbon constituents have been identified in soil.

Monitoring wells installed during site assessment studies, but which are not part of the post-site-cleanup groundwater monitoring network (e.g., MW-1, MW-2, MW-4, MW-5, MW-6D, MW-7 and MW-9A) were abandoned in accordance with applicable state regulations.

6.2 MONITORING WELL CONSTRUCTION

Five monitoring wells, MW-10 through MW-14, were installed on July 15, 1992. MW-11 was subsequently damaged by the City contractor. On September 11, 1992, MW-11 was abandoned per applicable regulations and MW-11A was installed as a replacement. Monitoring well locations are shown on Figure 6. Installation was accomplished in accordance with the monitoring well construction detail shown on Plate A2 in Appendix A.

Monitoring wells were installed using a truck-mounted Mobile B-61 drill rig equipped with hollow-stem auger. Monitoring wells were completed 8.5 to 9.3 feet below ground surface (bgs). The monitoring well logs, presented in Appendix A, Plates A9 through A13, describe the deposits encountered during installation and the details of well construction.

Wells were constructed of 2-inch-diameter, flush-threaded coupled Schedule 40 PVC pipe with 0.010-inch milled slots for screened intervals. Screen lengths were 5 feet in all wells and the screened interval was typically from approximately 3.5 to 8.5 feet bgs. The base of the screened interval was sealed with stainless steel riveted PVC slip caps. Wells were backfilled with silica sand and sealed at the surface with bentonite grout. Flush-mount monuments were used for well protection. Monuments were set in concrete and equipped with tamper-resistant locking screws.

The shallow depth to groundwater required modification of Ecology resource protection well construction standards, WAC Chapter 173-340, which typically requires a 3-foot bentonite seal above the well filter pack. This modification was discussed with Ecology and a written variance was obtained prior to well installation. This variance is included as Appendix D of this report.

Monitoring wells were developed on July 16, 1992. Replacement well MW-11A was developed on September 14, 1992. Development consisted of purging wells to remove 10 casing volumes or until the wells became dry.

6.3 SAMPLING AND ANALYSIS

Groundwater compliance monitoring will be conducted to fulfill compliance monitoring requirements under WAC 173-340-410 and confirm the long-term effectiveness of site remedial actions. Groundwater from each of seven monitoring wells and three under-drainage outfalls will be sampled quarterly according to procedures outlined in the SAP. Under-drainage outfalls will likely only produce water immediately following local precipitation events; the sampling schedule for these monitoring points, therefore, will likely vary from that of the monitoring wells. Samples will be analyzed for BETX by EPA Method 8020 and for PAHs by EPA Method 8310. Quarterly monitoring will continue until analyses indicate groundwater at each location on site is in compliance with cleanup levels for four consecutive quarters or until compliance with cleanup levels is demonstrated statistically.

Statistical procedures employed to evaluate compliance with cleanup levels will be based on MTCA regulations and Ecology guidance². Cleanup levels at the Houghton Beach Park site are based on chronic or carcinogenic threats rather than short-term or acute toxic effects on human health and the environment. Therefore, the appropriate statistical approach for each constituent of concern is to calculate the upper 95 percent confidence interval on the mean of the compliance monitoring data set for each sampling location.

Thus, the site will be considered to be in compliance with MTCA requirements when analyses indicate groundwater at all monitoring locations is in compliance with cleanup levels for four consecutive quarters or when the upper 95 percent confidence interval on the mean of each compliance monitoring data set for each sample location is less than the cleanup level. A confidence interval approach will be employed only when the following two conditions are satisfied: 1) no single sample concentration may be greater than two times the groundwater cleanup level; and 2) less than 10 percent of the samples collected during a representative sampling period show concentrations exceeding the groundwater cleanup level.

²Washington State Department of Ecology. 1992. *Statistical Guidance for Ecology Site Managers*. Toxic Cleanup Program. Washington State Department of Ecology, Olympia, Washington.

6.4 REPORTING

A brief report will be prepared following each quarterly sampling event documenting results, chemical analysis, and other pertinent information. Following completion of the final round of sampling, a report will be prepared summarizing the results of the post-site cleanup groundwater monitoring.

6.5 RESULTS OF INITIAL SAMPLING AND ANALYSIS

The initial round of planned quarterly groundwater sampling and analysis was conducted during September 1992. Samples were collected from all active on-site monitoring wells, (MW-3D, MW-8, MW-10, MW-11A, MW-12, MW-13 and MW-14), according to the procedures outlined in the SAP. Under drainage outfall monitoring points were not sampled because they were dry.

Samples were submitted to CAS under chain-of-custody procedures for analysis of BETX and PAHs by EPA Methods 8020 and 8310, respectively. Analytical results, summarized in Table 12, indicate that there were no detectable concentrations of BETX or PAHs with the exception of MW-10. PAHs were detected in MW-10, but were below cleanup levels.

The next round of groundwater monitoring sampling and analysis is scheduled for December 1992.

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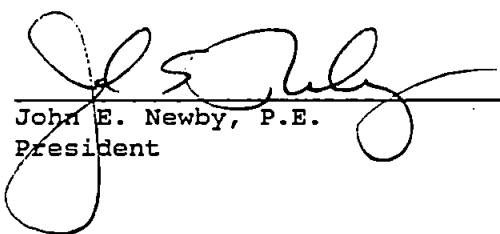
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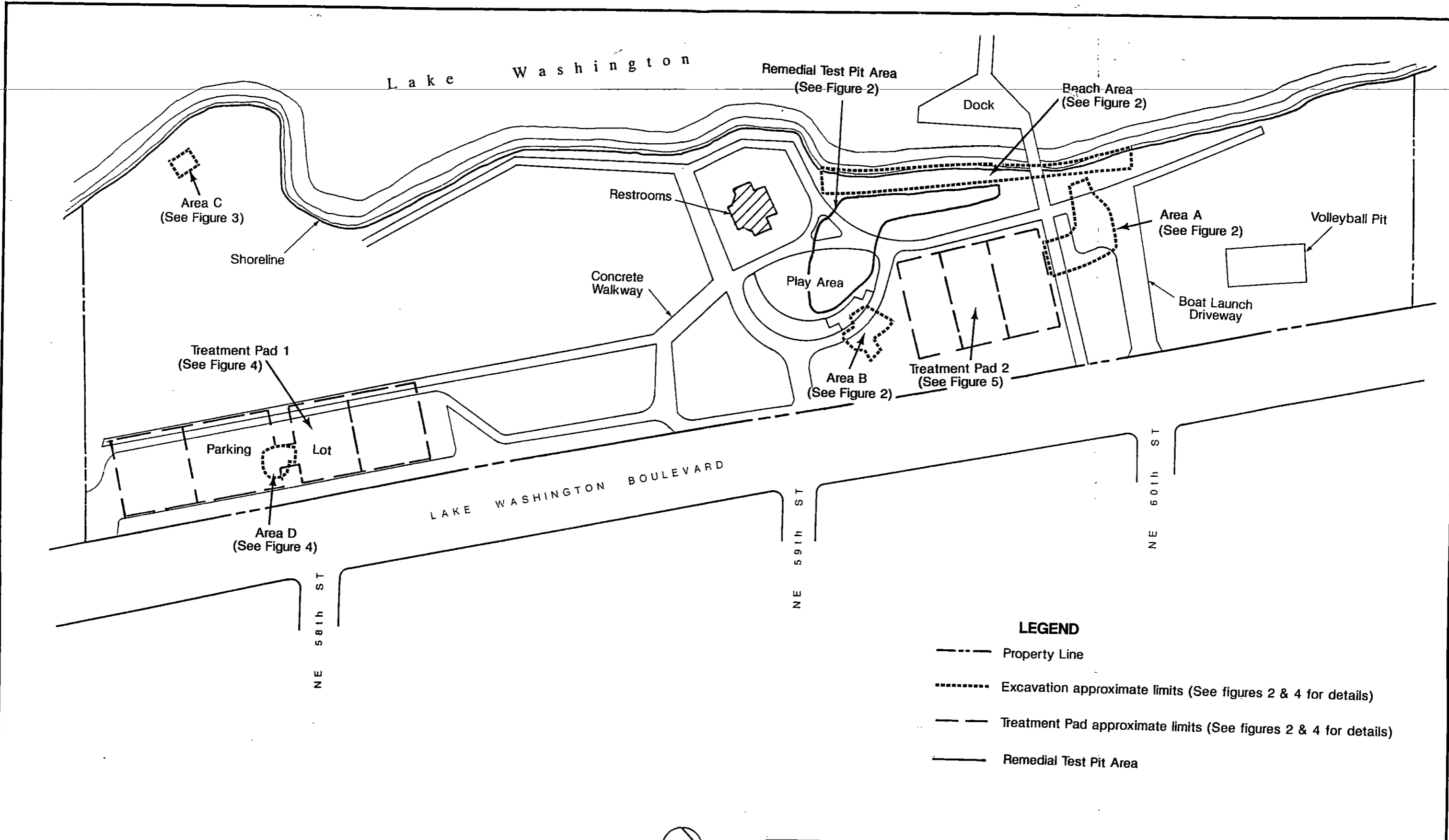
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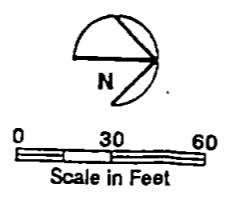
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FIGURES



LEGEND

- Property Line
- Excavation approximate limits (See figures 2 & 4 for details)
- Treatment Pad approximate limits (See figures 2 & 4 for details)
- Remedial Test Pit Area



Reference: Drawing titled "Areas of Known Petroleum - Contaminated Soil Based on Test Pit and Borings (Existing Features)" by GeoEngineers.



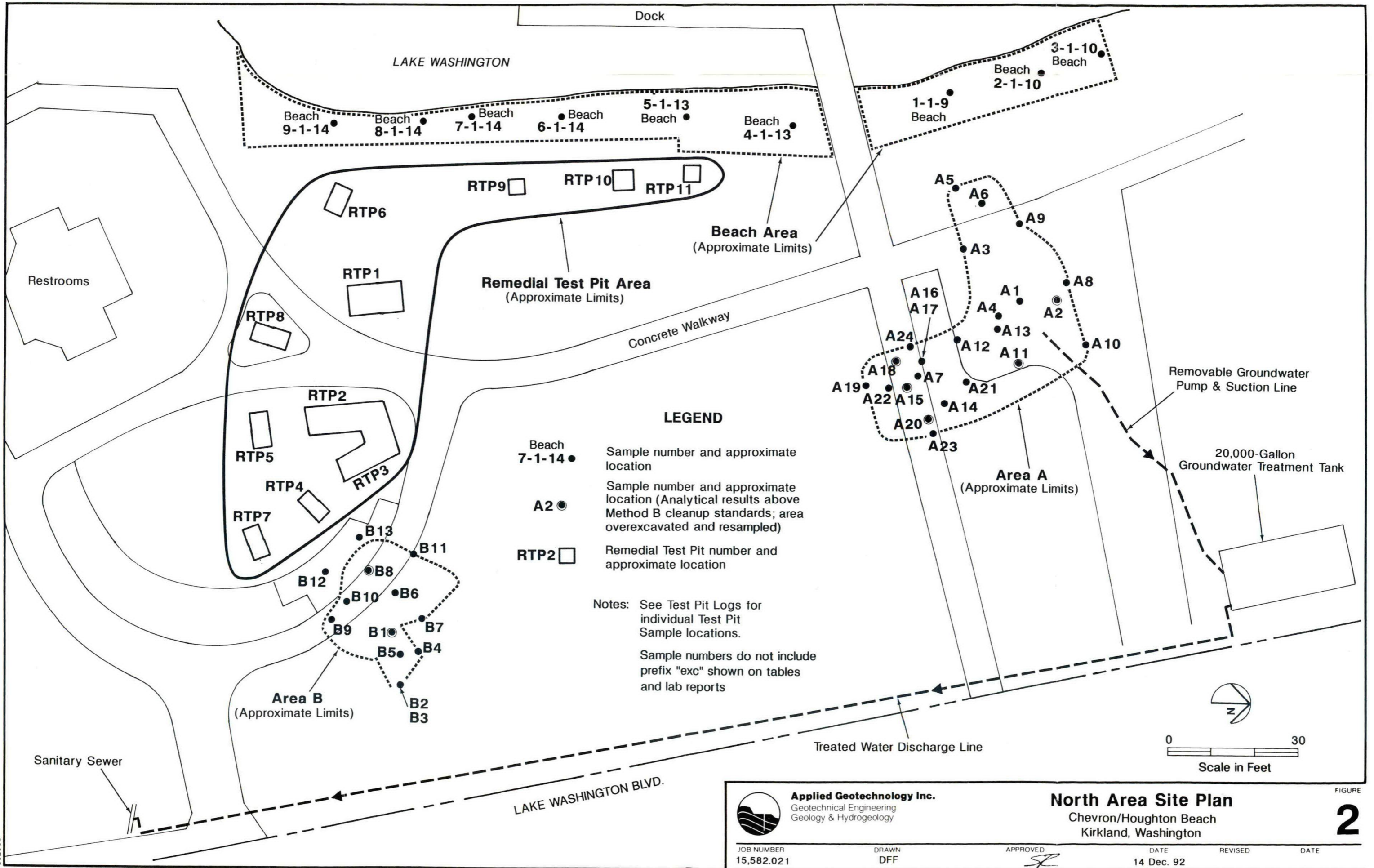
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Houghton Beach Park Site Plan
 Chevron/Houghton Beach
 Kirkland, Washington

FIGURE
1

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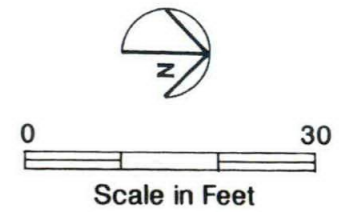
552900



LEGEND

- Beach 7-1-14 ● Sample number and approximate location
- A2 ● Sample number and approximate location (Analytical results above Method B cleanup standards; area overexcavated and resampled)
- RTP2 □ Remedial Test Pit number and approximate location

Notes: See Test Pit Logs for individual Test Pit Sample locations.
 Sample numbers do not include prefix "exc" shown on tables and lab reports



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North Area Site Plan
 Chevron/Houghton Beach
 Kirkland, Washington

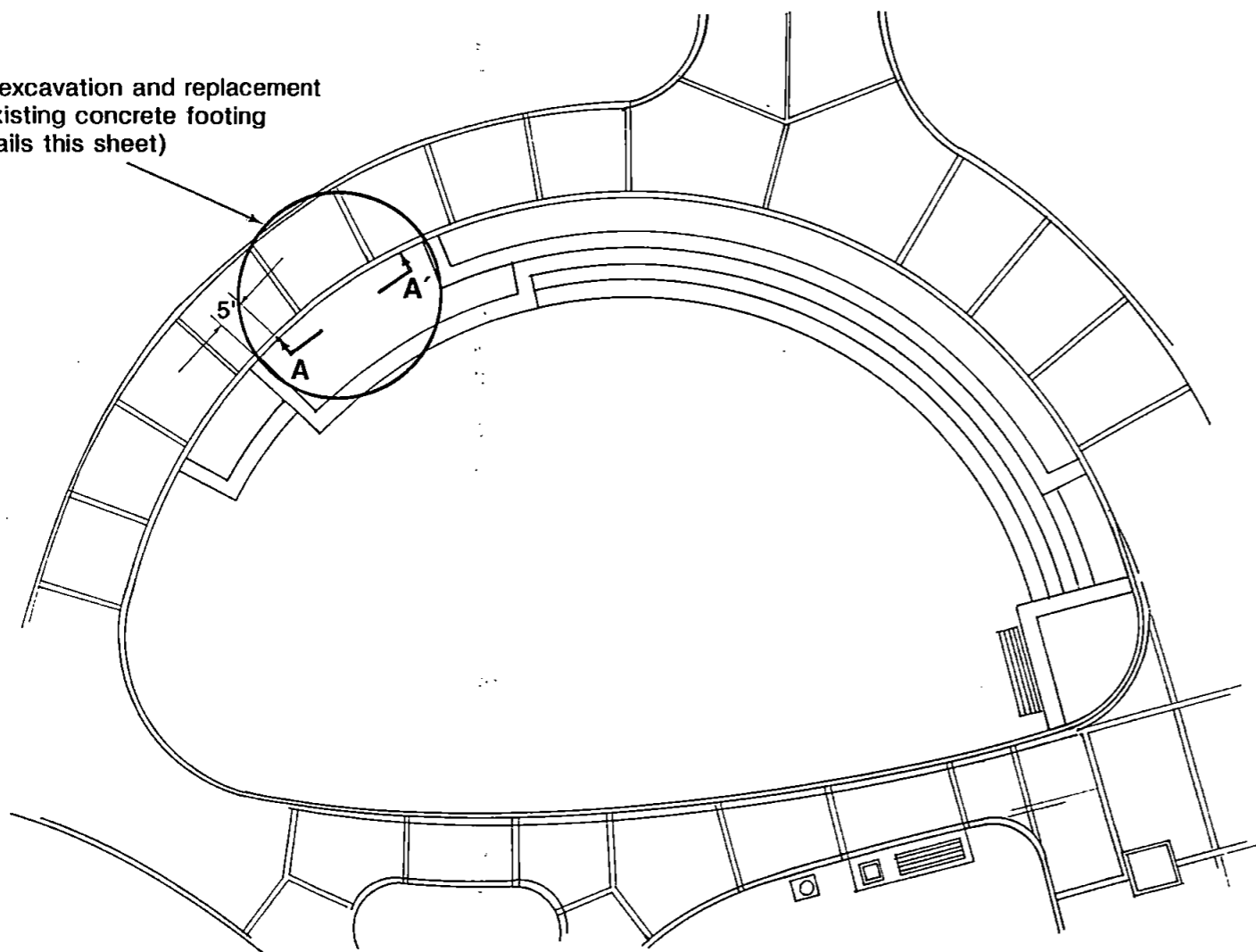
FIGURE

2

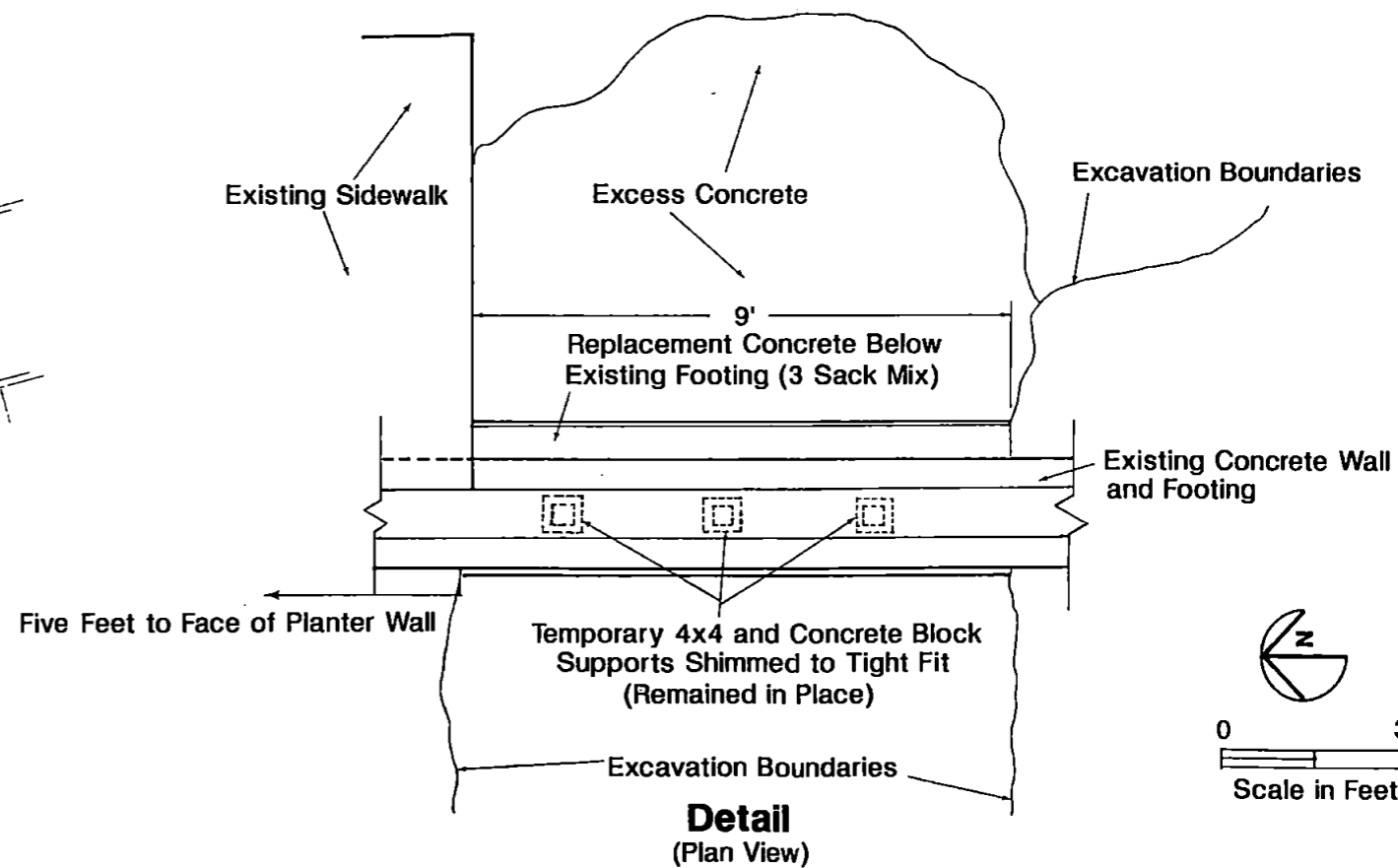
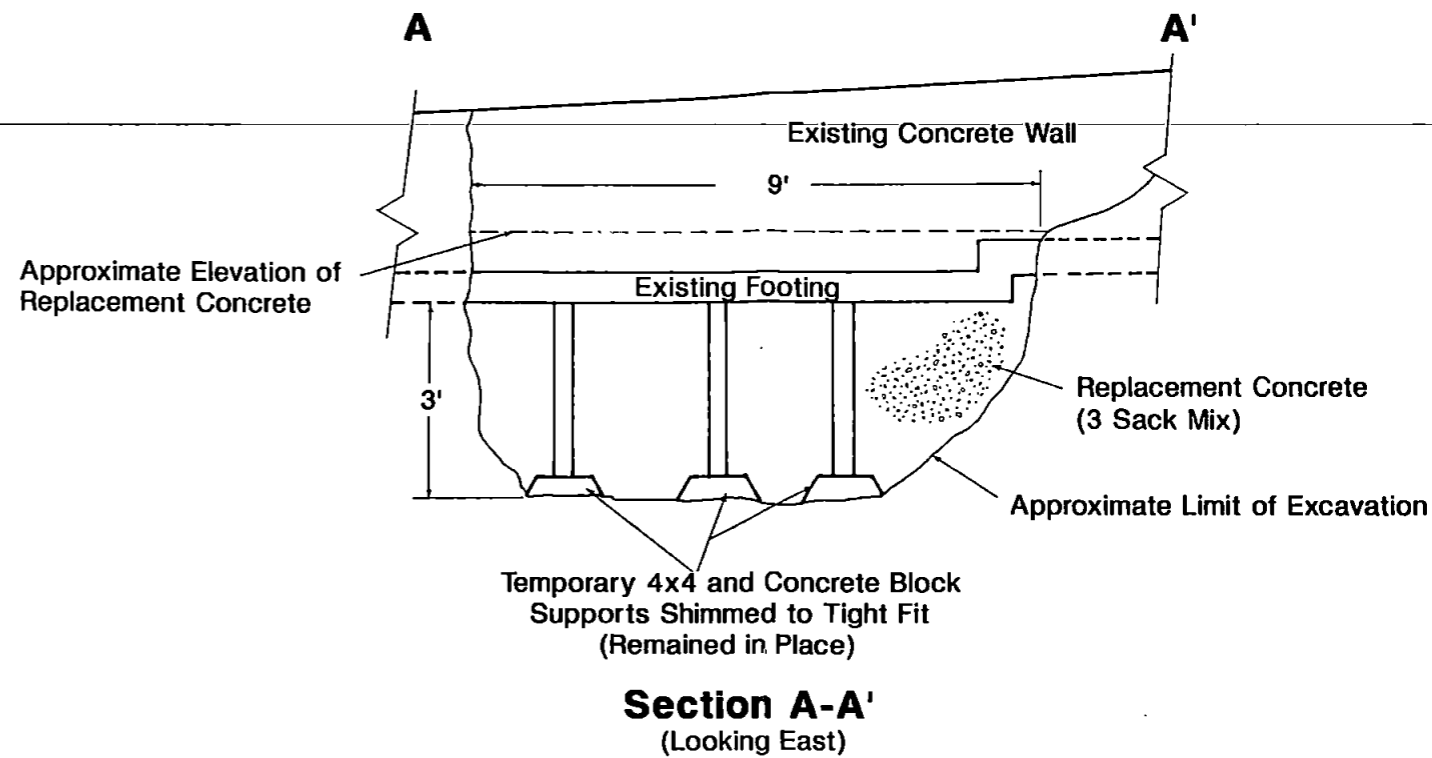
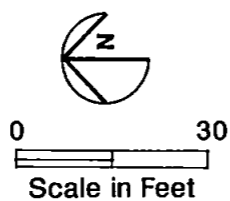
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552900

Area of excavation and replacement below existing concrete footing (see details this sheet)



Plan



552900



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As-Built, Playground Excavation and Backfill
Chevron/Houghton Beach Park Remediation
Kirkland, Washington

FIGURE

3

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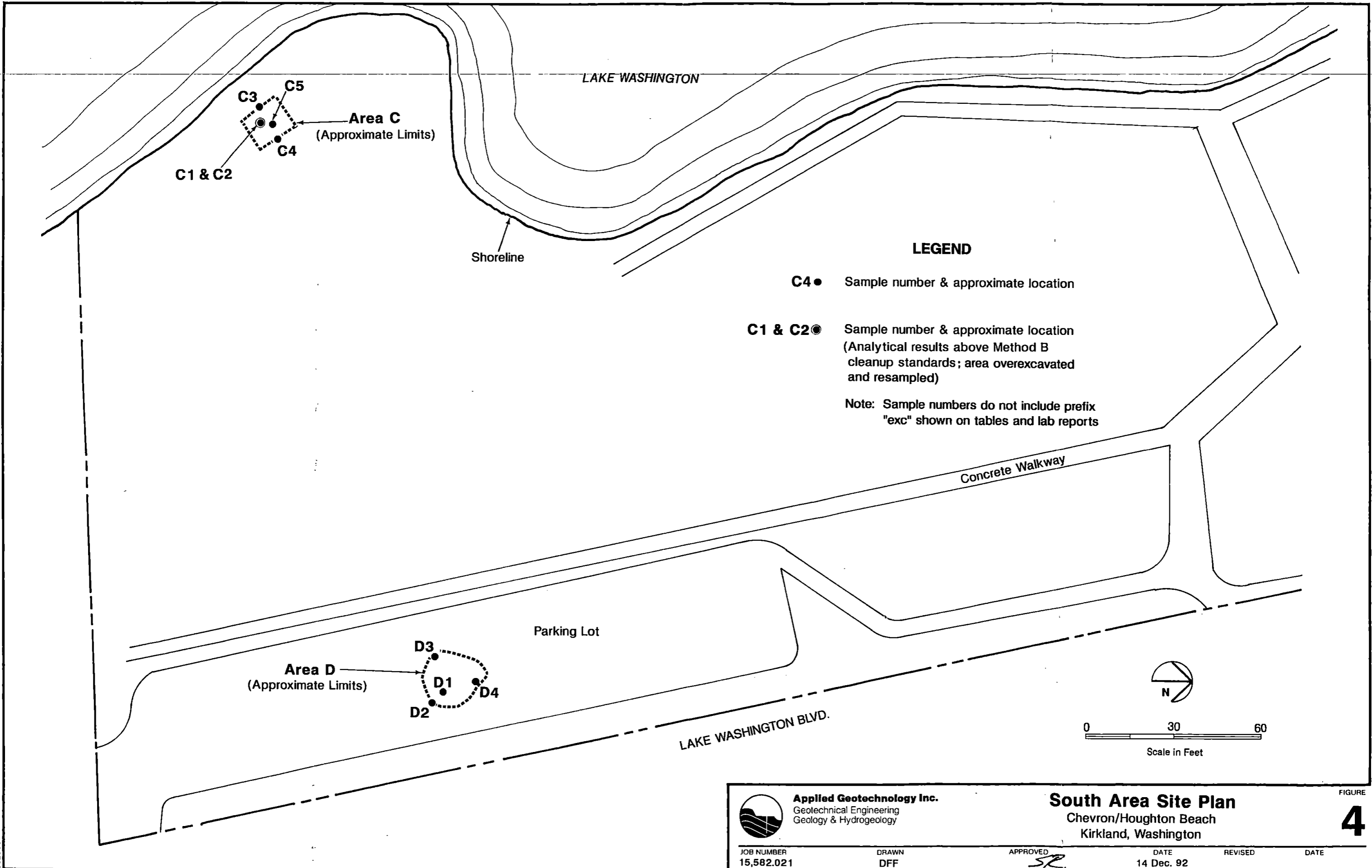
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LAKE WASHINGTON

C3
C5
Area C
(Approximate Limits)
C4
C1 & C2

Shoreline

LEGEND

- C4 ● Sample number & approximate location
- C1 & C2 ● Sample number & approximate location
(Analytical results above Method B
cleanup standards; area overexcavated
and resampled)

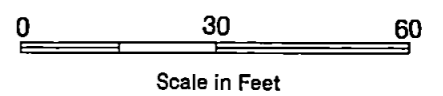
Note: Sample numbers do not include prefix
"exc" shown on tables and lab reports

Concrete Walkway

Parking Lot

D3
Area D
(Approximate Limits)
D1
D2
D4

LAKE WASHINGTON BLVD.



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South Area Site Plan
Chevron/Houghton Beach
Kirkland, Washington

FIGURE

4

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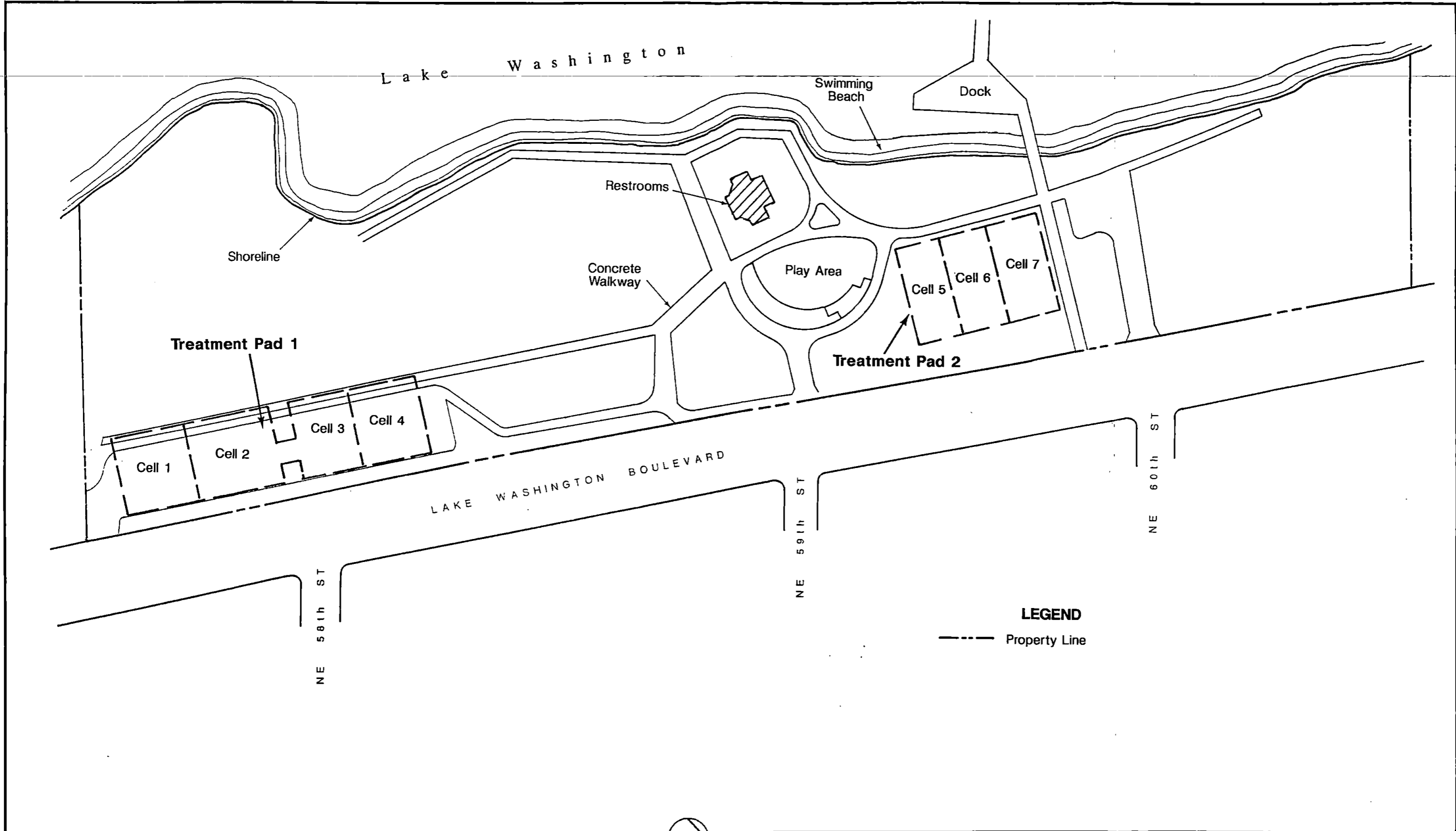
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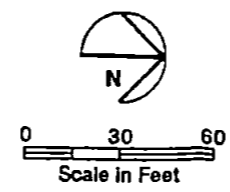
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Reference: Drawing titled "Areas of Known Petroleum - Contaminated Soil Based on Test Pit and Borings (Existing Features)" by GeoEngineers.



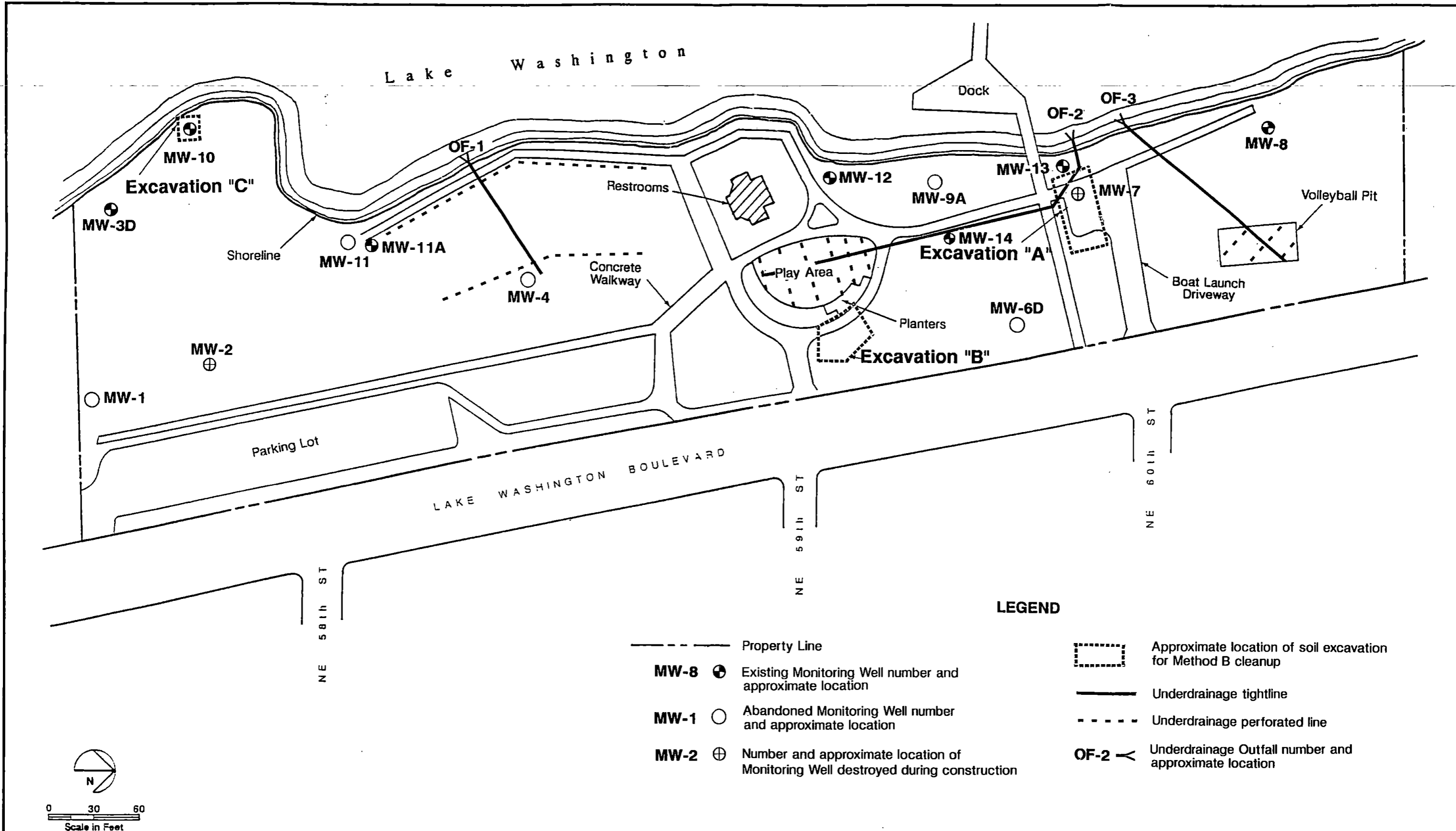
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Treatment Pad Location Map
 Chevron/Houghton Beach
 Kirkland, Washington

FIGURE
5

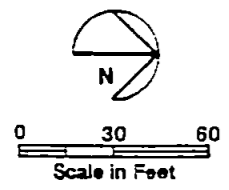
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LEGEND

- Property Line
- MW-8 ⊕ Existing Monitoring Well number and approximate location
- MW-1 ○ Abandoned Monitoring Well number and approximate location
- MW-2 ⊕ Number and approximate location of Monitoring Well destroyed during construction
- ⊔ Approximate location of soil excavation for Method B cleanup
- Underdrainage tightline
- Underdrainage perforated line
- OF-2 < Underdrainage Outfall number and approximate location



Reference: Drawing titled "Areas of Known Petroleum-Contaminated Soil Based on Test Pit and Borings (Existing Features)" by GeoEngineers.

<p>Applied Geotechnology Inc. Geotechnical Engineering Geology & Hydrogeology</p>	<p>Groundwater Monitoring Network</p> <p>Chevron/Houghton Beach Kirkland, Washington</p>		<p>FIGURE 6</p>
	<p>JOB NUMBER 15,582.021</p>	<p>DRAWN SLB</p>	<p>APPROVED </p>

547301

TABLES

Table 1
Cleanup Levels for Houghton Beach Park
 Chevron/Houghton Beach Park
 Kirkland, Washington

Contaminant	Cleanup Level	Basis for Standard ^a
<u>Groundwater (ug/L)</u>		
Benzene	5	ARAR
Ethylbenzene	5	ADJ RBC
Toluene	5	ADJ RBC
Xylenes	20	ARAR
Fluorene	320	ADJ RBC
Naphthalene	64	ADJ RBC
<u>Soil (mg/kg)</u>		
Benzene	0.5	GWP (ARAR)
Ethylbenzene	5	GWP (ADJ RBC)
Toluene	5	GWP (ADJ RBC)
Xylenes	20	GWP (ARAR)
Acenaphthylene	NDT	--
Anthracene	480	GWP (RBC)
Benz (a) anthracene	0.02	BKGD
Benzo (a) pyrene	0.1	BKGD
Chrysene	0.04	BKGD
Fluoranthene	29	GWP (ADJ RBC)
Fluorene	32	GWP (ADJ RBC)
2-Methylnaphthalene	NDT	--
Naphthalene	6.4	GWP (RBC)
Phenanthrene	NDT	--
Pyrene	22	GWP (ADJ RBC)
1,2-Dichloropropane	0.06	GWP (RBC)
Methylene chloride	0.5	GWP (ARAR)
1,1,1-Trichloroethane	20	GWP (ARAR)
Lead	500	OSWER

Notes:

- a) ADJ RBC – RBC standard adjusted to account for multiple exposures.
 ARAR – Standard based on applicable or relevant and appropriate requirement.
 BKGD – Standard based on background concentration in rural areas.
 GWP – Standard based on groundwater protection (basis for target groundwater concentration in parentheses).
 OSWER – Standard based on directive from EPA's Office of Solid Waste and Emergency Response as adopted by Washington Department of Ecology.
 RBC – Standard based on risk-based concentration.
 NDT – Not determined due to the lack of ARARs and toxicity factors for this substance.

Table 2

Area A

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	EXC-A-1	EXC-A-2	EXC-A-3	EXC-A-4	EXC-A-5	EXC-A-6	EXC-A-7
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
PAH – 8310									
Acenaphthene	0.1		ND	ND J	ND J	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND J	ND J	ND	ND	ND	ND
Anthracene	0.01	480	ND	0.11 J	0.02 J	ND	<0.04	ND	<0.04
Benzo (a) anthracene	0.01	0.02	ND	0.12 J	ND J	ND	<0.04 *	ND	<0.04 *
Benzo (b) fluoranthene	0.02		ND	ND J	ND J	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND J	ND J	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND J	ND J	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND J	ND J	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND J	ND J	ND	<0.04	ND	<0.04
Dibenzo (a,h) anthracene	0.01		ND	ND J	ND J	ND	ND	ND	ND
Fluoranthene	0.02	29	ND	2.88 J	0.53 J	ND	1.07	ND	0.91
Fluorene	0.02	32	ND	2.37 J	0.4 J	ND	0.69	ND	0.55
Indeno (1,2,3-cd) pyrene	0.01		ND	ND J	ND J	ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	0.4 J	0.1 J	ND	0.9	ND	ND
Phenanthrene	0.01	NDT	ND	5.27 J	0.94 J	ND	1.67	ND	1.3
Pyrene	0.02	22	ND	ND J	ND J	ND	<0.08	ND	<0.08
BETX – 8020									
Benzene	0.025	0.5	ND	0.139 J	0.073 J	ND	0.109	ND	0.117 /
Ethylbenzene	0.025	5	ND	1.57 J	0.154 J	0.334	1.24	ND	1.36
Toluene	0.025	5	ND	1.17 J	0.073 J	0.267	0.723	ND	2.14
Total Xylenes	0.025	20	ND	8.82 J	0.638 J	1.55	3.28	ND	4.52

Table 2
Area A
PAHs and BETX – Soil
Quantified by EPA Method 8310 & 8020
 Chevron/Houghton Beach Park
 Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	EXC-A-8	EXC-A-9	EXC-A-10	EXC-A-11	EXC-A-12	EXC-A-13
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
PAH – 8310								
Acenaphthene	0.1		ND	ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND	ND
Anthracene	0.01	480	ND	0.03	ND	0.02	0.01	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	ND	ND	ND	0.22	ND	ND
Fluorene	0.02	32	0.37	0.96	0.04	0.34	1.12	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	0.1	1.1	ND	ND	3.2	ND
Phenanthrene	0.01	NDT	0.85	2.3	0.11	0.81	2.1	ND
Pyrene	0.02	22	ND	ND	ND	ND	ND	ND
BETX – 8020								
Benzene	0.025	0.5	ND	0.117	0.029	9.4	0.36	ND
Ethylbenzene	0.025	5	0.092	1.51	0.064	18	10	0.043
Toluene	0.025	5	0.037	0.797	ND	43	4.4	ND
Total Xylenes	0.025	20	0.39	4.29	0.252	64	42	0.09

Table 2

Area A

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	EXC-A-14	EXC-A-15	EXC-A-16	EXC-A-17 ^a	EXC-A-18	EXC-A-19
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
PAH – 8310								
Acenaphthene	0.1		ND	ND J	ND J	ND J	ND	ND
Acenaphthylene	0.1	NDT	ND	ND J	ND J	ND J	ND	ND
Anthracene	0.01	480	ND	ND J	ND J	ND J	0.02	ND
Benzo (a) anthracene	0.01	0.02	ND	ND J	ND J	ND J	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND J	ND J	ND J	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND J	ND J	ND J	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND J	ND J	ND J	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND J	ND J	ND J	ND	ND
Chrysene	0.01	0.04	ND	ND J	ND J	ND J	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND J	ND J	ND J	ND	ND
Fluoranthene	0.02	29	ND	ND J	ND J	ND J	ND	ND
Fluorene	0.02	32	0.08	0.26 J	0.13	0.59	0.85	0.03
Indeno (1,2,3-cd) pyrene	0.01		ND	ND J	ND J	ND J	ND	ND
Naphthalene	0.1	6.4	ND	0.5 J	0.4	1.5	1.4	0.23
Phenanthrene	0.01	NDT	0.2	0.45 J	0.26	1.2	<2	0.04
Pyrene	0.02	22	ND	ND J	ND J	ND J	ND	ND
BETX – 8020								
Benzene	0.025	0.5	ND	0.505	0.322	0.252	1.2	ND
Ethylbenzene	0.025	5	0.15	3.06 J	3.71	3.24	5.1	0.983
Toluene	0.025	5	0.129	1.56 J	2.11	2.82	4.2	2.25
Total Xylenes	0.025	20	0.935	12.4 J	11.6	12	23	6.19

Table 2

Area A

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	EXC-A-20	EXC-A-21	EXC-A-22	EXC-A-23	EXC-A-24
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
PAH – 8310							
Acenaphthene	0.1		ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND
Anthracene	0.01	480	<0.1	ND	ND	ND	0.02
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND
Fluoranthene	0.02	29	0.54	ND	0.27	ND	0.28
Fluorene	0.02	32	0.39	ND	0.17	0.1	0.62
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	0.75	ND	ND	0.3	0.69
Phenanthrene	0.01	NDT	0.61	ND	0.21	0.14	0.88
Pyrene	0.02	22	ND	ND	ND	ND	ND
BETX – 8020							
Benzene	0.025	0.5	ND	ND	ND	ND	0.31
Ethylbenzene	0.025	5	15	0.64	ND	1.2	4.8
Toluene	0.025	5	9.2	0.31	ND	ND	3.1
Total Xylenes	0.025	20	62	2.3	ND	4.8	11

Table 2

Area A

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Notes:

Shaded values indicate sample was above cleanup level. These areas were overexcavated and resampled until hydrocarbon constituent concentrations measured below cleanup levels.

*Elevated detection limit due to matrix interference.

a) Sample EXC-A-17 is a duplicate of Sample EXC-A-16.

J – Estimated value.

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to the lack of applicable or relevant and appropriate requirements (ARARs) and toxicity factors for this substance.

Table 3
Semivolatile Organic Compounds – Soil
Quantified by EPA Method 3550/GC/MS SIM
 Chevron/Houghton Beach Park
 Kirkland, Washington

Acid Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	EXC-A-5 ^a (mg/kg)	EXC-A-7 ^b (mg/kg)	EXC-B-12 (mg/kg)
Acenaphthalene	0.020	NDT	0.16	ND	ND
Benz (a) anthracene	0.020	0.02	ND	ND	0.008
Chrysene	0.020	0.02	ND	ND	0.019
Fluorene	0.020	32	0.74	0.43	ND
2-Methylphthalene	0.020	NDT	1.2	1.4	ND
Naphthalene	0.020	6.4	0.15	ND	ND
Phenanthrene	0.020	NDT	0.86	0.49	ND

Notes:

- a) Detection limit raised to 0.140 because sample required dilution.
 - b) Detection limit raised to 0.150 because sample required dilution.
- mg/kg – Milligrams per kilogram is equivalent to parts per million.
 ND – Not detected.
 NDT – Not determined due to lack of ARARs and toxicity factors for this substance.

Table 4
Volatile Organic Compounds – Soil
Quantified by EPA Method 8240
 Chevron/Houghton Beach Park
 Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	EXC-A-7 (mg/kg)
Ethylbenzene	0.05	5	0.05
Total Xylenes	0.05	20	0.2

Note:

mg/kg – Milligrams per kilogram is equivalent to parts per million.

Table 5

Area B

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/Kg)	Cleanup Levels (mg/Kg)								
			EXC-B-1 (mg/Kg)	EXC-B-2 (mg/Kg)	EXC-B-3 ^a (mg/Kg)	EXC-B-4 (mg/Kg)	EXC-B-5 (mg/Kg)	EXC-B-6 (mg/Kg)	EXC-B-7 (mg/Kg)	
PAH – 8310										
Acenaphthene	0.1		<1	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	<1	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.01	480	<0.1	ND	ND	ND	ND	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	<0.1 *	ND	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		<0.2	ND	ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		<0.1	ND	ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		<0.2	ND	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	<0.1	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	<0.1 *	ND	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		<0.1	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	<0.2	ND	ND	ND	ND	ND	ND	ND
Fluorene	0.02	32	<0.2	ND	ND	ND	ND	ND	ND	0.04
Indeno (1,2,3-cd) pyrene	0.01		<0.1	ND	ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	14	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.01	NDT	<0.1	ND	ND	ND	ND	ND	ND	0.17
Pyrene	0.02	22	<0.2	ND	ND	ND	ND	ND	ND	ND
BETX – 8020										
Benzene	0.025	0.5	0.346	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	9.2	0.031	ND	ND	ND	ND	ND	0.069
Toluene	0.025	5	4.95	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	0.025	20	46	0.158 J	ND J	ND	ND	ND	ND	0.211

Table 5

Area B

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection		EXC-B-8 (mg/Kg)	EXC-B-9 (mg/Kg)	EXC-B-10 (mg/Kg)	EXC-B-11 (mg/Kg)	EXC-B-12 (mg/Kg)	EXC-B-13 (mg/Kg)
	Limit (mg/Kg)	Cleanup Levels						
PAH – 8310								
Acenaphthene	0.1		<10	ND	ND	ND	<1	ND
Acenaphthylene	0.1	NDT	<10	ND	ND	ND	<1	ND
Anthracene	0.01	480	<1	ND	ND	ND	<0.1	ND
Benzo (a) anthracene	0.01	0.02	<1 *	ND	ND	ND	<0.1 *	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	<1 *	ND	ND	ND	<0.1 *	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	<2	ND	ND	ND	<0.2	ND
Fluorene	0.02	32	<2	ND	0.03	ND	1	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	1	ND	ND	ND	2.8	ND
Phenanthrene	0.01	NDT	<1	ND	0.12	ND	3.5	ND
Pyrene	0.02	22	<2	ND	ND	ND	<0.2	ND
BETX – 8020								
Benzene	0.025	0.5	1.4	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	25	ND	ND	0.067	0.412	0.47
Toluene	0.025	5	13	ND	ND	0.076	0.131	0.154
Total Xylenes	0.025	20	93	ND	0.058	0.314	0.944	0.871

Table 5

Area B

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Notes:

Shaded values indicate sample was above cleanup level. These areas were overexcavated and resampled until hydrocarbon constituent concentrations measured below cleanup levels.

*Elevated detection limit due to matrix interference.

a) Sample EXC-B-3 is a duplicate of Sample EXC-B-2.

J – Estimated value.

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to the lack of applicable or relevant and appropriate requirements (ARARs) and toxicity factors for this substance.

Table 6

Area C

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/Kg)	Cleanup Levels (mg/Kg)								
			EXC-C-1 (mg/Kg)	EXC-C-2 ^a (mg/Kg)	EXC-C-1R ^b (mg/Kg)	EXC-C-2R ^b (mg/Kg)	EXC-C-3 (mg/Kg)	EXC-C-4 (mg/Kg)	EXC-C-5 (mg/Kg)	
PAH – 8310										
Acenaphthene	0.1		ND	ND	<1	<1	ND	ND	ND	
Acenaphthylene	0.1	NDT	ND	ND	<1	<1	ND	ND	ND	
Anthracene	0.01	480	0.05 J	ND	0.03	<0.1	ND	ND	ND	
Benzo (a) anthracene	0.01	0.02	0.07	ND	0.09	<0.1 *	ND	ND	ND	
Benzo (b) fluoranthene	0.02		ND	ND	<0.2	<0.2	ND	ND	ND	
Benzo (k) fluoranthene	0.01		0.03	ND	0.03	<0.1	ND	ND	ND	
Benzo (g,h,i) perylene	0.02		ND	ND	<0.2	<0.2	ND	ND	0.15	
Benzo (a) pyrene	0.01	0.1	0.08	ND	0.1	<0.1	ND	0.01	0.03	
Chrysene	0.01	0.04	0.1 J	ND	0.23	<0.1 *	ND	ND	ND	
Dibenzo (a,h) anthracene	0.01		ND	ND	<0.1	<0.1	ND	ND	ND	
Fluoranthene	0.02	29	0.2	ND	0.2	<0.2	ND	ND	ND	
Fluorene	0.02	32	0.05	ND	<0.2	<0.2	ND	ND	ND	
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	<0.1	<0.1	ND	ND	ND	
Naphthalene	0.1	6.4	ND	ND	<1	<1	ND	ND	ND	
Phenanthrene	0.01	NDT	0.32	ND	<0.1	<0.1	0.03	0.02	0.05	
Pyrene	0.02	22	0.17 J	ND	0.08	<0.2	ND	ND	0.05	
BETX – 8020										
Benzene	0.025	0.5	ND	ND	NA	NA	ND	ND	ND	
Ethylbenzene	0.025	5	ND	ND	NA	NA	ND	ND	ND	
Toluene	0.025	5	ND	ND	NA	NA	ND	ND	ND	
Total Xylenes	0.025	20	ND	ND	NA	NA	ND	ND	ND	

Table 6

Area C

PAHs and BETX – Soil

Quantified by EPA Method 8310 & 8020

Chevron/Houghton Beach Park
Kirkland, Washington

Notes:

Shaded values indicate sample was above cleanup level. These areas were overexcavated and resampled until hydrocarbon constituent concentrations measured below cleanup levels.

*Elevated detection limit due to matrix interference.

a) Sample EXC-C-2 is a duplicate of Sample EXC-C-1.

b) Sample EXC C-1R and EXC-C-2R are retests of Samples EXC-C-1 and EXC-C-2, respectively.

J – Estimated value.

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to the lack of applicable or relevant and appropriate requirements (ARARs) and toxicity factors for this substance.

Table 7
Area D
PAHs and BETX – Soil
Quantified by EPA Method 8310 & 8020
Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Level (mg/kg)	EXC-D-1	EXC-D-2	EXC-D-3	EXC-D-4
			(mg/kg)	(mg/kg)	(mg/kg)	(mg/kg)
PAH – 8310						
Acenaphthene	0.1		ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND
Anthracene	0.01	480	ND	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	0.02
Chrysene	0.01	0.04	ND	ND	ND	0.05
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND
Fluoranthene	0.02	29	ND	ND	ND	ND
Fluorene	0.02	32	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	ND	ND	ND
Phenanthrene	0.01	NDT	ND	ND	ND	0.03
Pyrene	0.02	22	ND	ND	ND	ND
BETX – 8020						
Benzene	0.025	0.5	ND	ND	ND	ND
Ethylbenzene	0.025	5	ND	ND	ND	ND
Toluene	0.025	5	ND	ND	ND	ND
Total Xylenes	0.025	20	ND	ND	ND	ND

Notes:

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to lack of applicable or relevant and appropriate requirements (ARARs) and toxicity factors for this substance.

Table 8
Beach Area
PAHs and BETX – Soil
Quantified by EPA Method 8310 & 8020
Chevron/Houghton Beach Park
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Level (mg/kg)	BEACH-	BEACH-	BEACH-	BEACH-	BEACH-	BEACH-	BEACH-	BEACH-	BEACH-
			1-1/9 (mg/kg)	2-1/10 (mg/kg)	3-1/10 (mg/kg)	4-1/13 (mg/kg)	5-1/13 (mg/kg)	6-1/14 (mg/kg)	7-1/14 (mg/kg)	8-1/14 (mg/kg)	9-1/14 (mg/kg)
PAH – 8310											
Acenaphthene	0.1		ND	ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.01	480	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	ND	ND	ND	ND	ND	ND	ND	ND	ND
Fluorene	0.02	32	ND	ND	ND	ND	ND	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.01	NDT	0.02	ND	ND	ND	ND	ND	ND	ND	ND
Pyrene	0.02	22	ND	ND	ND	ND	ND	ND	ND	ND	ND
BETX – 8020											
Benzene	0.025	0.5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	ND	ND	ND	ND	ND	0.057	ND	ND	ND
Toluene	0.025	5	ND	ND	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	0.025	20	ND	ND	ND	ND	ND	0.152	ND	ND	ND

Notes:

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to lack of applicable or relevant and appropriate requirements (ARARs) and toxicity factors for this substance.

Table 9
Remedial Test Pits
PAHs and BETX – Soil
Quantified by EPA Method 8310 & 8020
Chevron/Houghton Beach
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Level (mg/kg)	RTP1-1 (mg/kg)	RTP1-2 (mg/kg)	RTP2 (mg/kg)	RTP3-1 (mg/kg)	RTP3-2 (mg/kg)	RTP4-1 (mg/kg)
PAH – 8310								
Acenaphthene	0.1		ND	ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND	ND
Anthracene	0.01	480	ND	ND	ND	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	ND	ND	ND	ND	ND	ND
Fluorene	0.02	32	ND	ND	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	ND	ND	ND	ND	ND
Phenanthrene	0.01	NDT	ND	ND	ND	ND	ND	ND
Pyrene	0.02	22	ND	ND	ND	ND	ND	ND
BETX – 8020								
Benzene	0.025	0.5	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	ND	ND	ND	ND	ND	ND
Toluene	0.025	5	ND	ND	ND	ND	ND	ND
Total Xylenes	0.025	20	ND	ND	ND	ND	ND	ND

Table 9
Remedial Test Pits
PAHs and BETX – Soil
Quantified by EPA Method 8310 & 8020
Chevron/Houghton Beach
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Standards (mg/kg)	RTP4-2 (mg/kg)	RTP5-1 (mg/kg)	RTP6-1 (mg/kg)	RTP7-1 (mg/kg)	RTP8-1 (mg/kg)
PAH – 8310							
Acenaphthene	0.1		ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND
Anthracene	0.01	480	ND	ND	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND
Fluoranthene	0.02	29	ND	ND	ND	ND	ND
Fluorene	0.02	32	ND	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	ND	ND	ND	ND
Phenanthrene	0.01	NDT	ND	ND	ND	ND	ND
Pyrene	0.02	22	ND	ND	ND	ND	ND
BETX – 8020							
Benzene	0.025	0.5	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	ND	ND	ND	ND	ND
Toluene	0.025	5	ND	ND	ND	ND	0.054
Total Xylenes	0.025	20	ND	ND	ND	ND	0.049

Notes:

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to lack of applicable or relevant and appropriate requirements (ARARs) and toxicity factors for this substance.

Table 10
Treatment Pad Compliance Samples
PAHs & BETX – Soil
Quantified by EPA Method 8310 & 8020
Chevron/Houghton Beach
Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	TC1	TC1	TC1	TC1	TC1	TC1	TC1
			1-4/2 (mg/kg)	2-4/2 (mg/kg)	3-4/2 (mg/kg)	4-4/2 (mg/kg)	5-4/2 (mg/kg)	6-4/2 (mg/kg)	7-4/2 (mg/kg)
PAH – 8310									
Acenaphthene	0.1		ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.01	480	ND	ND	ND	0.01	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	ND	0.02	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	0.07	0.14	ND	0.4	0.31	ND	ND
Fluorene	0.02	32	ND	ND	0.04	0.11	0.11	0.03	ND
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.01	NDT	0.03	0.14	0.16	0.25	0.29	0.06	0.04
Pyrene	0.02	22	ND	ND	ND	ND	ND	ND	ND
BETX – 8020									
Benzene	0.025	0.5	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	ND	ND	ND	0.2	0.6	0.2	0.3
Toluene	0.025	5	ND	ND	ND	0.1	0.6	1	0.3
Total Xylenes	0.025	20	0.3	0.2	0.4	1	3.9	1	2

Table 10
Treatment Pad Compliance Samples
PAHs & BETX – Soil
Quantified by EPA Method 8310 & 8020
 Chevron/Houghton Beach
 Kirkland, Washington

Compounds	Detection Limit (mg/kg)	Cleanup Levels (mg/kg)	TC2	TC2	TC2	TC2	TC2	TC2	TC2	
			1-4/14 (mg/kg)	2-4/14 (mg/kg)	3-4/14 (mg/kg)	4-4/14 (mg/kg)	5-4/14 (mg/kg)	6-4/14 (mg/kg)	7-4/14 (mg/kg)	
PAH – 8310										
Acenaphthene	0.1		ND	ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	0.1	NDT	ND	ND	ND	ND	ND	ND	ND	ND
Anthracene	0.01	480	ND	0.02	ND	ND	ND	ND	ND	ND
Benzo (a) anthracene	0.01	0.02	ND	ND	ND	ND	ND	ND	ND	ND
Benzo (b) fluoranthene	0.02		ND	ND	ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.01		ND	ND	ND	ND	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.02		ND	ND	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.01	0.1	0.02	ND	ND	ND	ND	ND	ND	ND
Chrysene	0.01	0.04	ND	ND	ND	ND	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.01		ND	ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.02	29	ND	0.15	ND	ND	ND	ND	ND	ND
Fluorene	0.02	32	ND	0.02	ND	ND	ND	ND	0.06	0.14
Indeno (1,2,3-cd) pyrene	0.01		ND	ND	ND	ND	ND	ND	ND	ND
Naphthalene	0.1	6.4	ND	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.01	NDT	ND	0.15	ND	ND	ND	ND	0.1	0.21
Pyrene	0.02	22	ND	0.05	ND	ND	ND	ND	ND	ND
BETX – 8020										
Benzene	0.025	0.5	ND	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.025	5	ND	ND	0.3	0.1	0.4	ND	ND	0.3
Toluene	0.025	5	ND	ND	0.2	ND	0.2	ND	ND	ND
Total Xylenes	0.025	20	0.1	ND	0.4	0.8	2.1	0.6	0.6	1.4

Notes:

mg/kg – Milligrams per kilogram is equivalent to parts per million.

ND – Not detected.

NDT – Not determined due to lack of ARARs and toxicity factors for this substance.

Table 11
Discharge Water Analysis
TPH and BETX – Water
Quantified by EPA Method 418.1 & 8020
 Chevron/Houghton Beach Park
 Kirkland, Washington

Compounds	Detection Limit (mg/L)	Discharge Limit* (mg/L)	B-TANK 1-6 (mg/L)	B-TANK 1-13 (mg/L)	B-TANK 2-3-A (mg/L)	B-TANK 2-3-B (mg/L)	B-TANK 2-5 (mg/L)	B-TANK 2-19 (mg/L)	B-TANK 2-24 (mg/L)
Total Petroleum Hydrocarbons (418.1)	1	100	ND	2	1	1	1	ND	ND
<u>BETX – 8020</u>									
Benzene	0.001	0.13	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.001	1.4	ND	ND	ND	ND	ND	ND	ND
Toluene	0.001	1.5	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	0.001		ND	ND	ND	ND	ND	ND	ND

Table 11
Discharge Water Analysis
TPH and BETX – Water
Quantified by EPA Method 418.1 & 8020
 Chevron/Houghton Beach Park
 Kirkland, Washington

Compounds	Detection Limit (mg/L)	Discharge Limit* (mg/L)	B-TANK 2-27 (mg/L)	B-TANK 3-9 (mg/L)	B-TANK 3-27 (mg/L)	B-TANK 4-7 (mg/L)	B-TANK 5-13 (mg/L)	B-TANK 5-18 (mg/L)	B-TANK 5-21 (mg/L)
Total Petroleum Hydrocarbons (418.1)	1	100	ND	ND	ND	ND	ND	ND	ND
BETX – 8020									
Benzene	0.001	0.13	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.001	1.4	ND	ND	ND	ND	ND	ND	ND
Toluene	0.001	1.5	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	0.001		ND	ND	ND	ND	ND	ND	ND

Notes:

*Discharge limits set by Seattle Metro.

mg/L – Milligrams per liter is approximately equivalent to parts per million, depending on density of water sample.

ND – Not detected.

Table 12
Groundwater Monitoring Samples
PAHs & BETX – Water
Quantified by EPA Method 8310 & 8020
Chevron/Houghton Beach
Kirkland, Washington

Compounds	Detection Limit (mg/L)	Cleanup Levels (mg/L)	MW	MW	MW	MW	MW	MW	MW
			3D-1 (mg/L)	8-1 (mg/L)	10-1 (mg/L)	11A-1 (mg/L)	12-1 (mg/L)	13-1 (mg/L)	14-1 (mg/L)
PAH – 8310									
Acenaphthene	0.001		ND	ND	ND	ND	ND	ND	ND
Acenaphthylene	0.001		ND	ND	ND	ND	ND	ND	ND
Anthracene	0.0001		ND	ND	ND	ND	ND	ND	ND
Benzo (a) anthracene	0.0001		ND	ND	<0.0005 *	ND	ND	ND	ND
Benzo (b) fluoranthene	0.0002		ND	ND	ND	ND	ND	ND	ND
Benzo (k) fluoranthene	0.0001		ND	ND	<0.0003 *	ND	ND	ND	ND
Benzo (g,h,i) perylene	0.0002		ND	ND	ND	ND	ND	ND	ND
Benzo (a) pyrene	0.0001		ND	ND	<0.002 *	ND	ND	ND	ND
Chrysene	0.0001		ND	ND	<0.0005 *	ND	ND	ND	ND
Dibenzo (a,h) anthracene	0.0001		ND	ND	ND	ND	ND	ND	ND
Fluoranthene	0.0002		ND	ND	ND	ND	ND	ND	ND
Fluorene	0.0002	0.320	ND	ND	0.0004	ND	ND	ND	ND
Indeno (1,2,3-cd) pyrene	0.0001		ND	ND	ND	ND	ND	ND	ND
Naphthalene	0.001	0.064	ND	ND	ND	ND	ND	ND	ND
Phenanthrene	0.0001		ND	ND	0.0012	ND	ND	ND	ND
Pyrene	0.0002		ND	ND	0.0014	ND	ND	ND	ND
BETX – 8020									
Benzene	0.0005	0.005	ND	ND	ND	ND	ND	ND	ND
Ethylbenzene	0.001	0.005	ND	ND	ND	ND	ND	ND	ND
Toluene	0.001	0.005	ND	ND	ND	ND	ND	ND	ND
Total Xylenes	0.001	0.020	ND	ND	ND	ND	ND	ND	ND

Notes:

*Elevated detection limit due to matrix interference.

mg/L – Milligrams per liter is approximately equivalent to parts per million, depending on density of water sample.

ND – Not detected.

APPENDIX A

**Soil Classification/Legend,
Monitoring Well Construction, and
Logs of Remedial Test Pits and Monitoring Wells**

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS					TYPICAL NAMES	
COARSE GRAINED SOILS MORE THAN HALF IS LARGER THAN NO. 200 SIEVE	GRAVELS MORE THAN HALF COARSE FRACTION IS LARGER THAN NO. 4 SIEVE SIZE	CLEAN GRAVELS WITH LESS THAN 5% FINES	GW		WELL GRADED GRAVELS, GRAVEL-SAND MIXTURES	
			GP		POORLY GRADED GRAVELS, GRAVEL-SAND MIXTURES	
		GRAVELS WITH OVER 12% FINES	GM		SILTY GRAVELS, POORLY GRADED GRAVEL-SAND-SILT MIXTURES	
			GC		CLAYEY GRAVELS, POORLY GRADED GRAVEL-SAND-CLAY MIXTURES	
	SANDS MORE THAN HALF COARSE FRACTION IS SMALLER THAN NO. 4 SIEVE SIZE	CLEAN SANDS WITH LESS THAN 5% FINES	SW		WELL GRADED SANDS, GRAVELLY SANDS	
			SP		POORLY GRADED SANDS, GRAVELLY SANDS	
		SANDS WITH OVER 12% FINES	SM		SILTY SANDS, POORLY GRADED SAND-SILT MIXTURES	
			SC		CLAYEY SANDS, POORLY GRADED SAND-CLAY MIXTURES	
			SILTS AND CLAYS LIQUID LIMIT LESS THAN 50	ML		INORGANIC SILTS AND VERY FINE SANDS, ROCK FLOUR, SILTY OR CLAYEY FINE SANDS, OR CLAYEY SILTS WITH SLIGHT PLASTICITY
				CL		INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
OL		ORGANIC CLAYS AND ORGANIC SILTY CLAYS OF LOW PLASTICITY				
SILTS AND CLAYS LIQUID LIMIT GREATER THAN 50	MH		INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SANDY OR SILTY SOILS, ELASTIC SILTS			
	CH		INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS			
	OH		ORGANIC CLAYS OF MEDIUM TO HIGH PLASTICITY, ORGANIC SILTS			
HIGHLY ORGANIC SOILS			PT		PEAT AND OTHER HIGHLY ORGANIC SOILS	

LEGEND

SAMPLE	CONTACT BETWEEN UNITS	LABORATORY TESTS
<ul style="list-style-type: none"> "Undisturbed" Bulk/Grab Not Recovered Recovered, Not Retained 	<ul style="list-style-type: none"> Well Defined Change Gradational Change Obscure Change End of Exploration 	<ul style="list-style-type: none"> Consol - Consolidation LL - Liquid Limit PL - Plastic Limit Gs - Specific Gravity SA - Size Analysis TxS - Triaxial Shear TxP - Triaxial Permeability Perm - Permeability Po - Porosity MD - Moisture/Density DS - Direct Shear VS - Vane Shear Comp - Compaction
BLOWS/FOOT Hammer is 140 pounds with 30-inch drop, unless otherwise noted S - SPT Sampler (2.0-Inch O.D.) T - Thin Wall Sampler (2.8-Inch Sample) H - Split Barrel Sampler (2.4-Inch Sample)		<ul style="list-style-type: none"> UU - Unconsolidated, Undrained CU - Consolidated, Undrained CD - Consolidated, Drained
MOISTURE DESCRIPTION Dry - Considerably less than optimum for compaction Moist - Near optimum moisture content Wet - Over optimum moisture content Saturated - Below water table, in capillary zone, or in perched groundwater		



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 Geotechnical Engineering
 Geology & Hydrogeology

Soil Classification/Legend
 Chevron/Houghton Beach Park
 Kirkland, Washington

PLATE

A1

JOB NUMBER
15,582.021

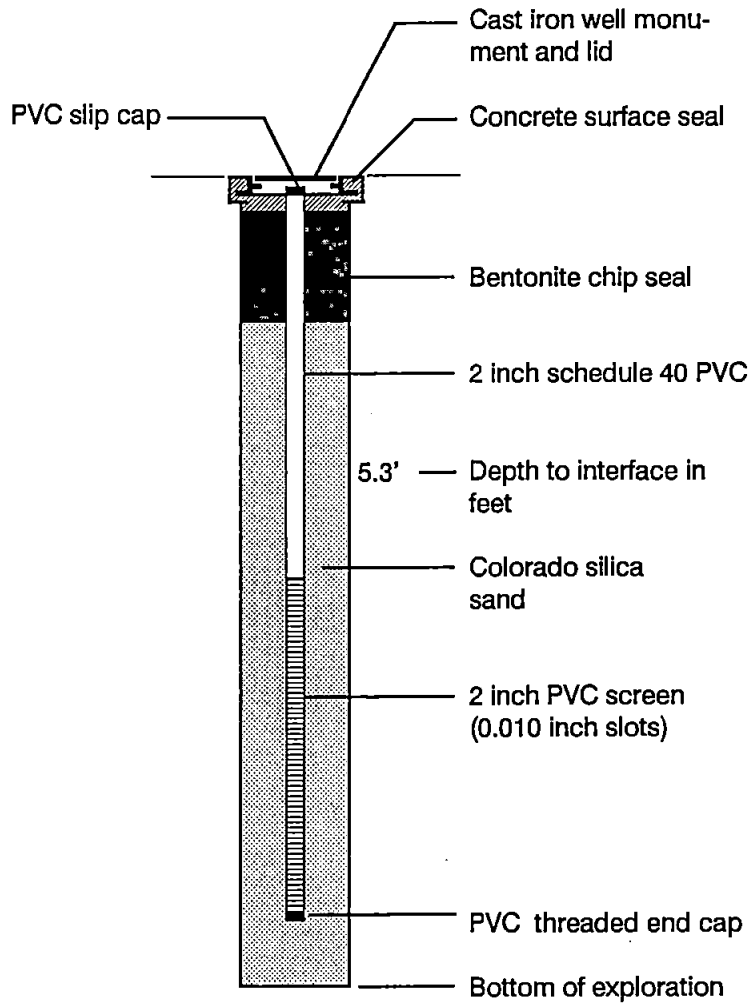
DRAWN
SES

APPROVED

DATE
14 Dec. 92

REVISED

DATE



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Monitoring Well Construction

Chevron/Houghton Beach
Kirkland, Washington

PLATE

A2

JOB NUMBER
15,582.021

DRAWN
SES

APPROVED
SR

DATE
14 Dec. 92

REVISED

DATE

Laboratory Tests

OVMM (ppm)

Depth

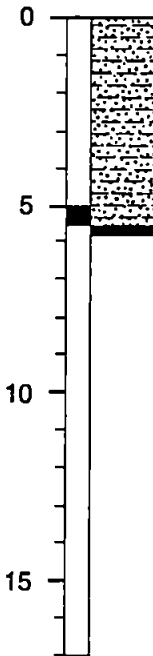
Sample

Test Pit Number RTP1

Date 12/19/91 Elevation 16.4 feet*

X

2



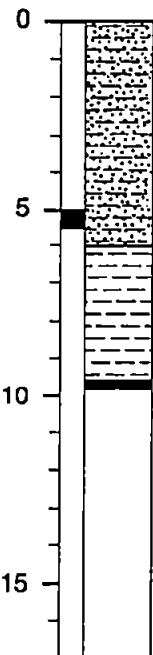
BROWN SILTY SAND (SM) loose, dry; fine to medium grained, with some rounded gravel.
 Becomes gray, medium dense, moist; medium grained, with a trace of gravel at 2 feet.
 Becomes brown at 3.5 feet
 Becomes gray, very dense at 5 feet (Till).
 Water seepage encountered at 4.5 feet.

Test Pit Number RTP2

Date 12/19/91 Elevation 18.6 feet*

X

1



BROWN SILTY SAND (SM) loose, dry; fine to medium grained, with some rounded gravel.
 Becomes gray, medium dense, moist, medium grained, with some gravel at 2 feet.
 Becomes brown at 4 feet.
 GRAY SANDY SILT (ML) very dense, dry; with some gravel (Till).

*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Remedial Test Pits 1 and 2

Chevron/Houghton Beach Park
Kirkland, Washington

PLATE

A3

JOB NUMBER
15,582.021

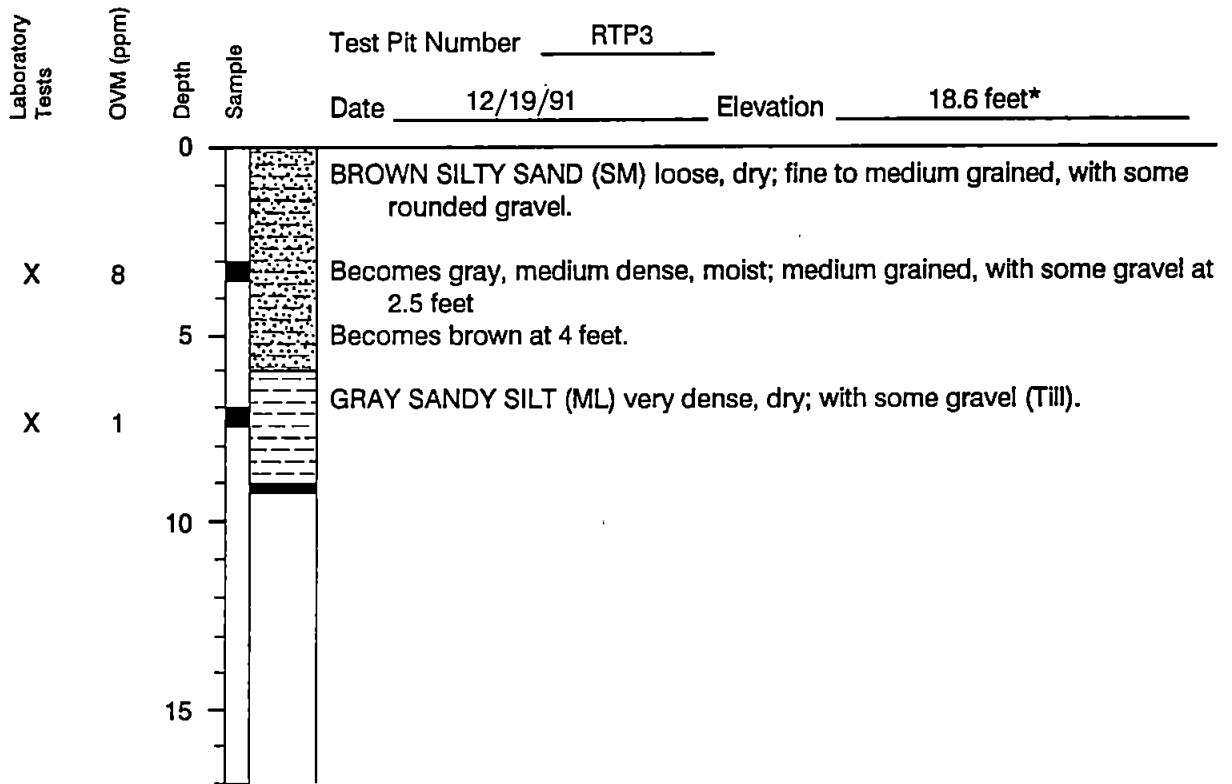
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SES

APPROVED
[Signature]

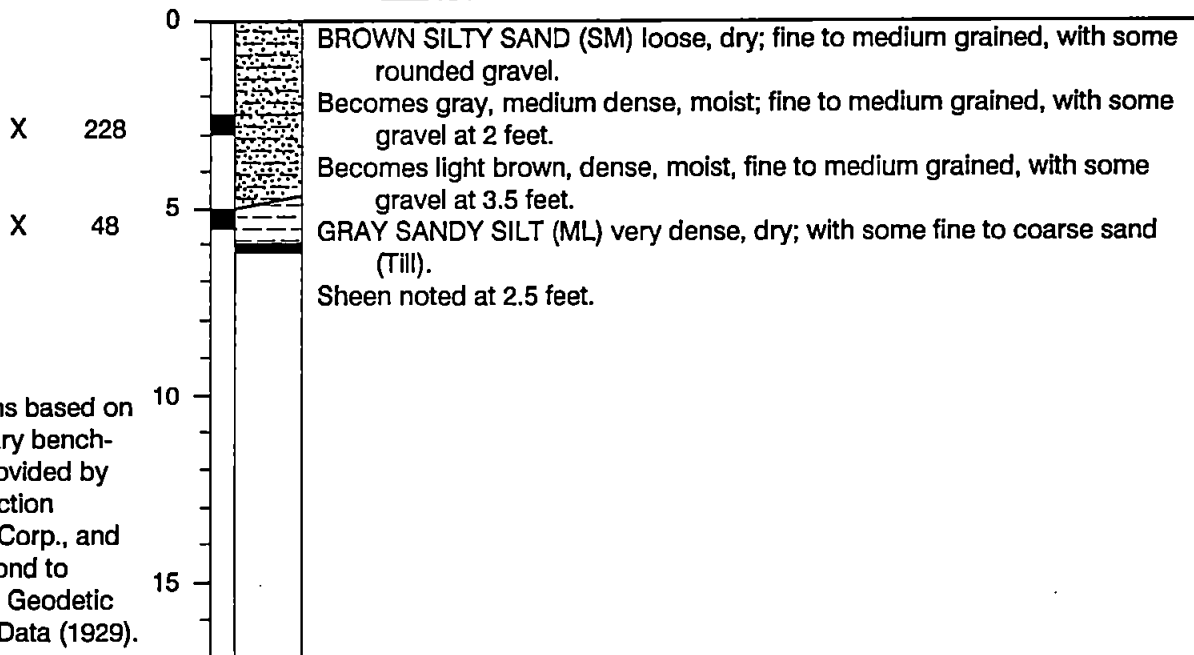
DATE
19 Oct. 92

REVISED

DATE



Test Pit Number RTP4
 Date 12/26/91 Elevation 18.8 feet*



*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Remedial Test Pits 3 and 4

Chevron/Houghton Beach Park
 Kirkland, Washington

PLATE

A4

JOB NUMBER
15,582.021

DRAWN
SES

APPROVED
SR

DATE
19 Oct. 92

REVISED

DATE

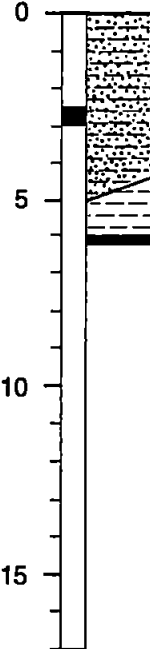
Laboratory Tests
OVM (ppm)

Depth
Sample

Test Pit Number RTP5

Date 12/26/91

Elevation 18.7 feet*



BROWN SILTY SAND (SM) loose, dry; fine to medium grained, with some rounded gravel.

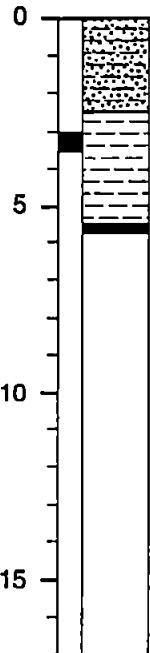
X 0

GRAY SANDY SILT (ML) very dense, dry; with some gravel (Till).

Test Pit Number RTP6

Date 12/26/91

Elevation 18.7 feet*



LIGHT BROWN SILTY SAND (SM) loose, dry; fine to medium grained, with some gravel.

X 0

GRAY SANDY SILT (ML) very dense, dry; fine to medium grained, with some rounded gravel (Till).

*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Remedial Test Pits 5 and 6

Chevron/Houghton Beach Park
Kirkland, Washington

PLATE

A5

JOB NUMBER
15,582.021

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SES

APPROVED
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DATE
19 Oct. 92

REVISED

DATE

Laboratory Tests

OVM (ppm)

Depth

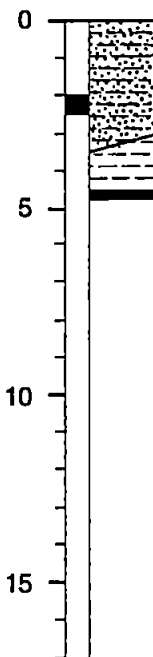
Sample

Test Pit Number RTP7

Date 12/30/91 Elevation 18.7 feet*

X

0



SILTY SAND (SM) loose, dry; fine to medium grained, with some gravel.

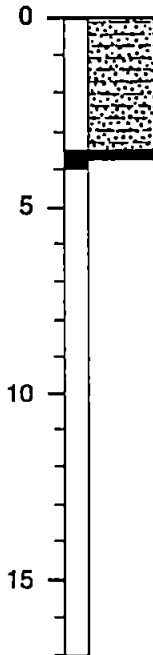
GRAY SANDY SILT (ML) very dense, dry; with some gravel (Till).

Test Pit Number RTP8

Date 1/2/92 Elevation 16.5 feet*

X

0



BROWN SILTY SAND (SM) loose, moist; with some gravel.

Becomes medium dense.

Water seepage encountered at 3.5 feet.

*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Remedial Test Pits 7 and 8

Chevron/Houghton Beach Park
Kirkland, Washington

PLATE

A6

JOB NUMBER
15,582.021

DRAWN
SES

APPROVED
SR

DATE
19 Oct. 92

REVISED

DATE

Laboratory Tests

OVM (ppm)



Test Pit Number RTP9

Date 1/6/92 Elevation 15.7 feet *

BROWN SAND (SW) loose, moist; medium grained, with some gravel.

GRAY SILTY SAND (SM) loose, wet; with some gravel, and hydrocarbon staining.

Test Pit Number RTP10

Date 1/6/92 Elevation 15.6 feet *



BROWN SAND (SW) loose, moist; medium grained, with some gravel.

GRAY SILTY SAND (SM) loose, wet; medium grained, with some gravel, and hydrocarbon staining.

*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Remedial Test Pits 9 and 10

Chevron/Houghton Beach Park
Kirkland, Washington

PLATE

A7

JOB NUMBER
15,582.021

DRAWN
SES

APPROVED
SR

DATE
19 Oct. 92

REVISED

DATE

Laboratory
Tests

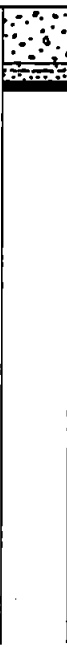
OVM (ppm)

Depth

Sample

Test Pit Number RTP11

Date 1/6/92 Elevation 15.4 feet *



BROWN SAND (SW) loose, moist; medium grained, with some gravel.
GRAY SILTY SAND (SM) loose, wet; medium grained, with some gravel, and hydrocarbon staining.

*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).

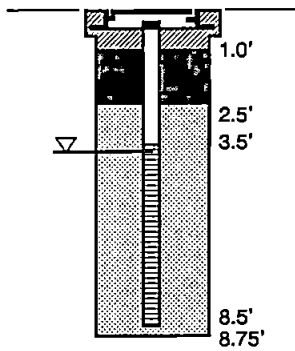


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Log of Remedial Test Pit 11
Chevron/Houghton Beach Park
Kirkland, Washington

PLATE
A8

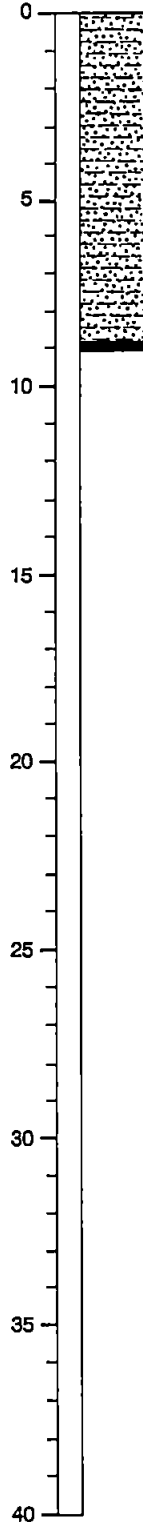
Well Construction Summary



Equipment HSA Mobile B-61

Top of Casing Elevation 18.2 feet * Date 7/15/92

Depth
Sample



BROWN SILTY SAND (SM) loose (Fill).

Boring terminated at 8.75 feet on 7/14/92.

*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Monitoring Well 10

Chevron/Houghton Beach
Kirkland, Washington

PLATE

A9

JOB NUMBER
15,582.021

DRAWN
SES

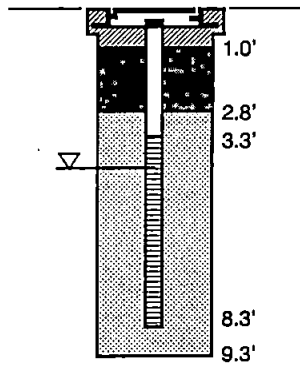
APPROVED
SR

DATE
19 Oct. 92

REVISED

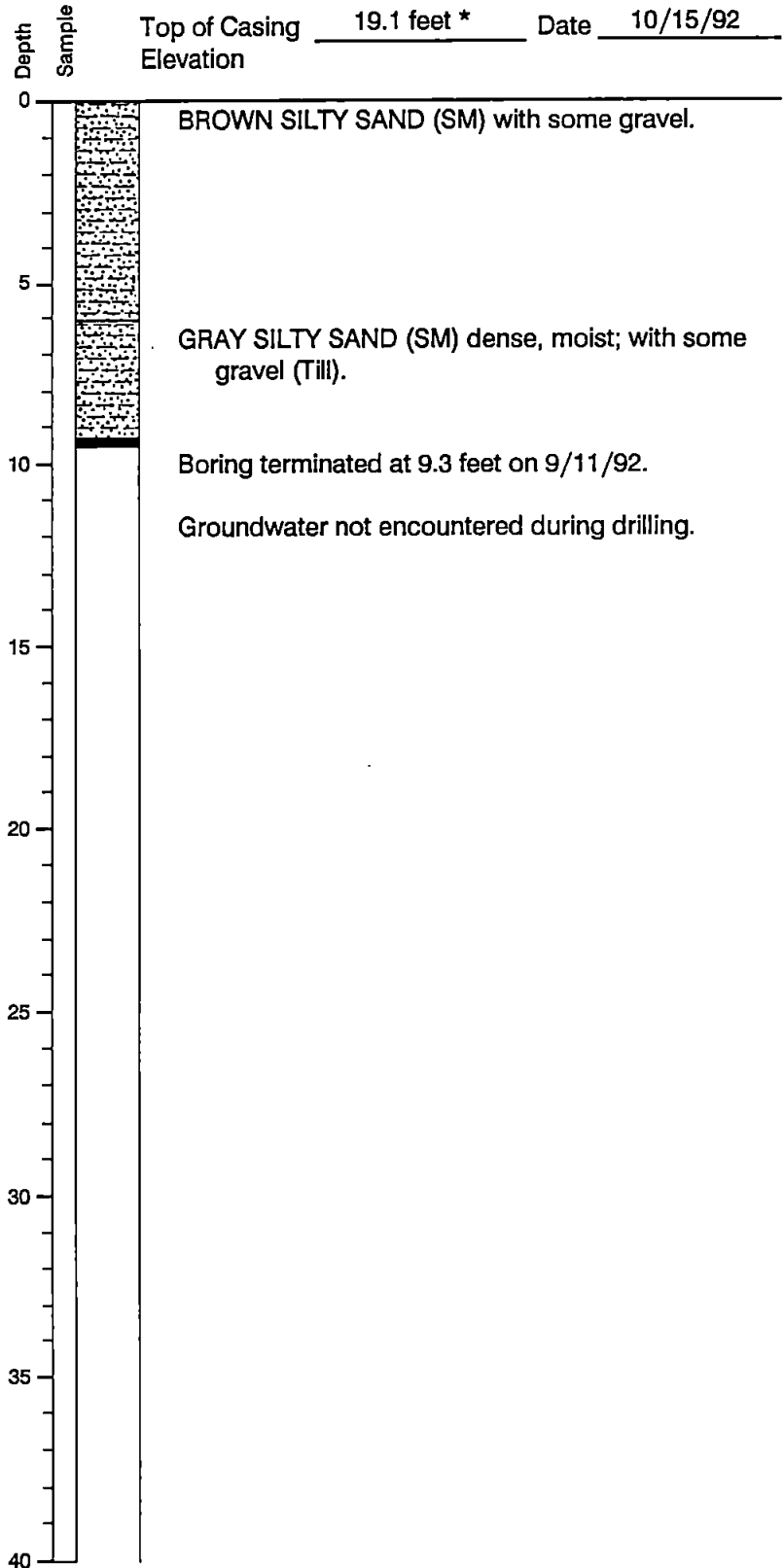
DATE

Well Construction
Summary



Equipment HSA Mobile B-61

Top of Casing Elevation 19.1 feet * Date 10/15/92



*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Monitoring Well 11A

Chevron/Houghton Beach
Kirkland, Washington

PLATE

A10

JOB NUMBER
15,582.021

DRAWN
SES

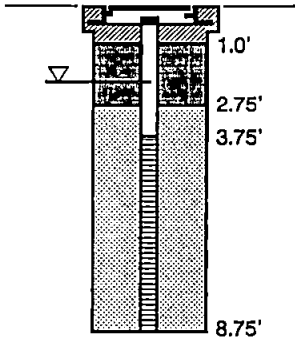
APPROVED
SES

DATE
19 Oct. 92

REVISED

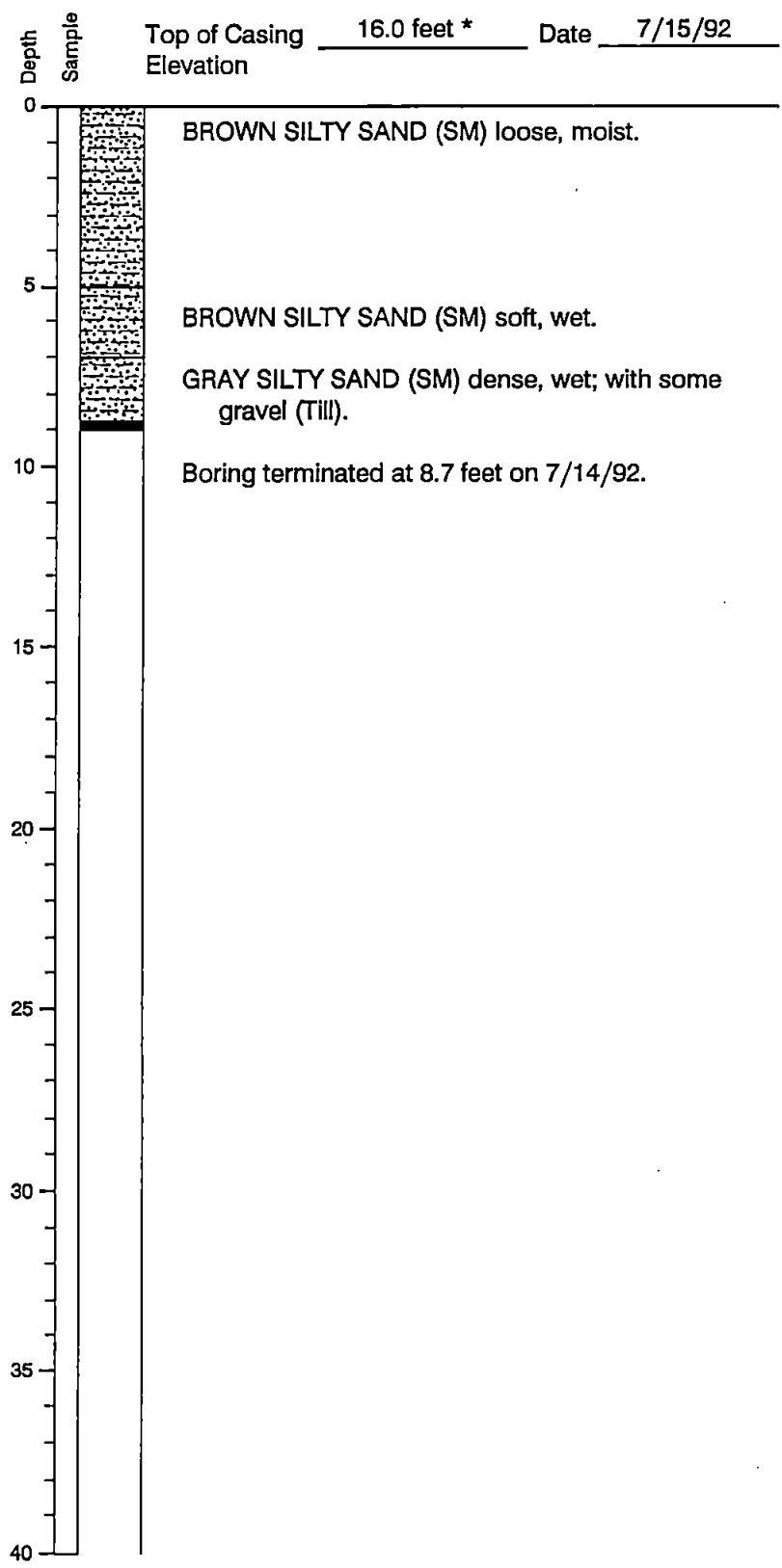
DATE

Well Construction
Summary



Equipment HSA Mobile B-61

Top of Casing Elevation 16.0 feet * Date 7/15/92



*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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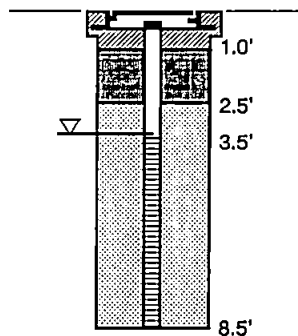
Log of Monitoring Well 12

Chevron/Houghton Beach
Kirkland, Washington

PLATE

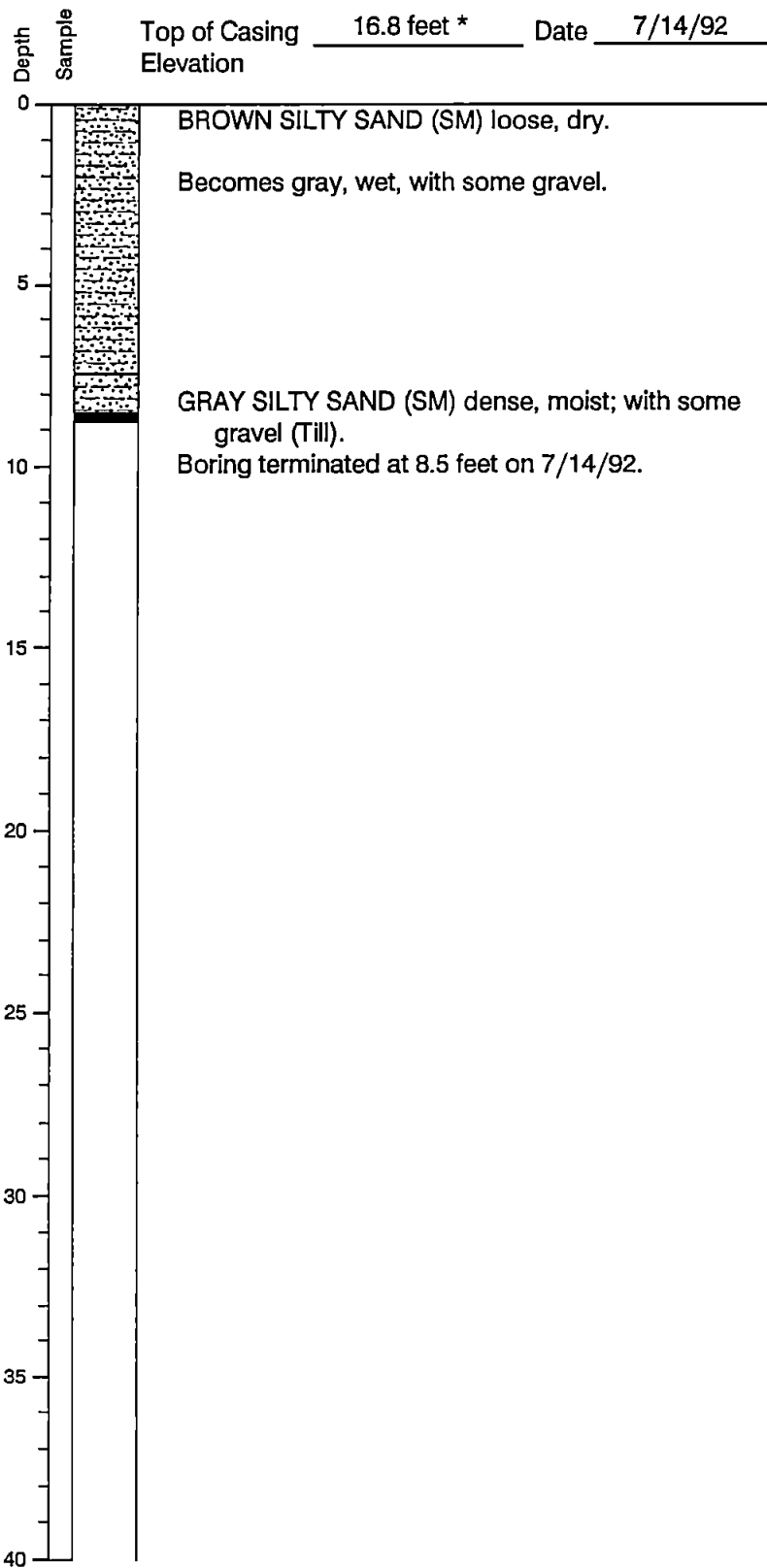
A11

Well Construction Summary



Equipment HSA Mobile B-61

Top of Casing Elevation 16.8 feet * Date 7/14/92



*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Monitoring Well 13

Chevron/Houghton Beach
Kirkland, Washington

PLATE

A12

JOB NUMBER
15,582.021

DRAWN
SES

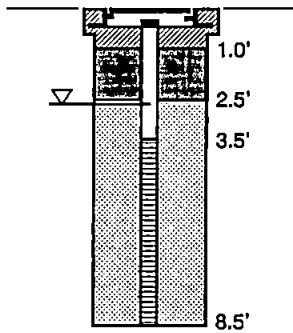
APPROVED
SR

DATE
19 Oct. 92

REVISED

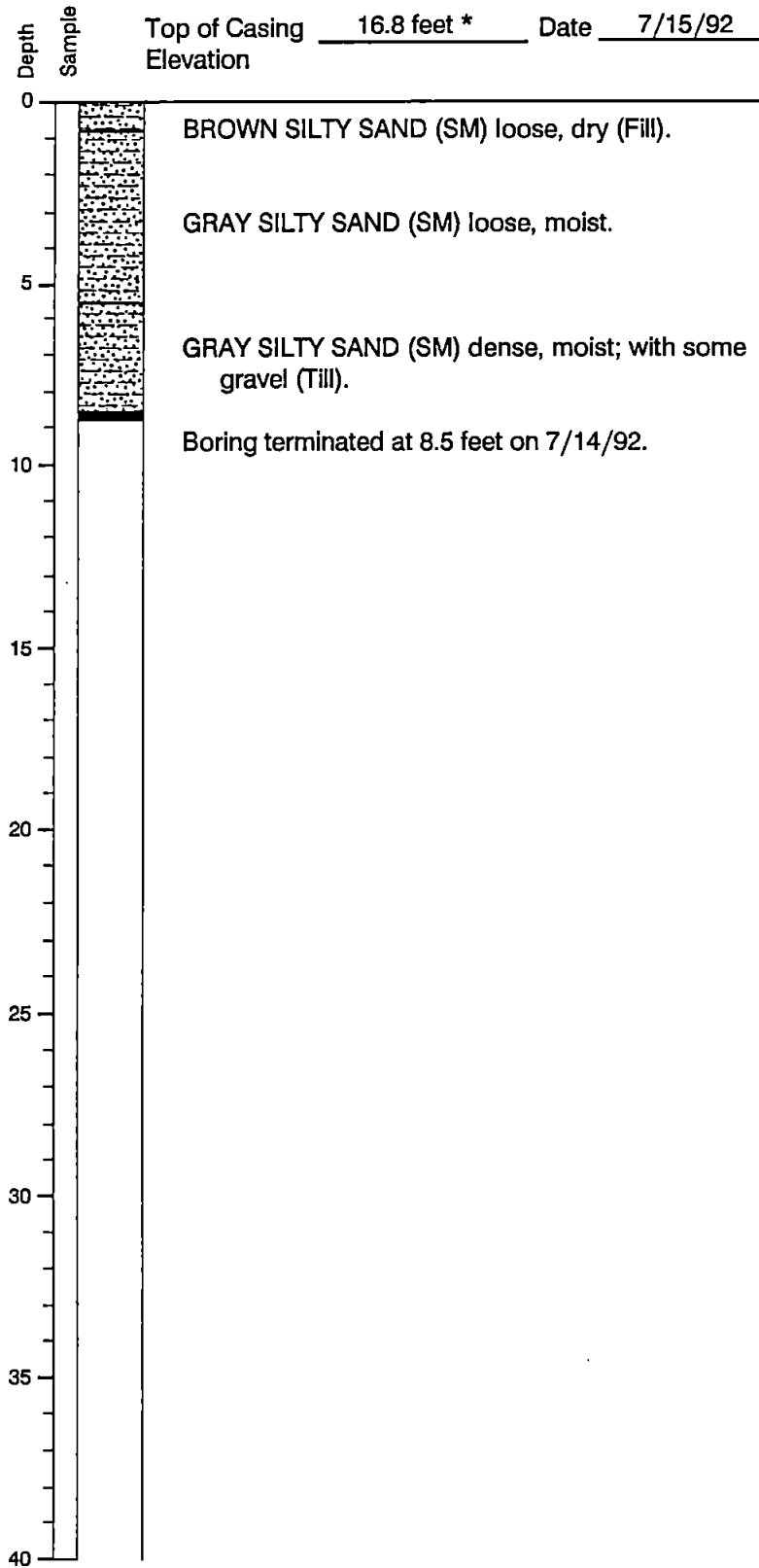
DATE

Well Construction
Summary



Equipment HSA Mobile B-61

Top of Casing 16.8 feet * Date 7/15/92
Elevation



*Elevations based on temporary benchmark provided by Construction Control Corp., and correspond to National Geodetic Vertical Data (1929).



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Log of Monitoring Well 14

Chevron/Houghton Beach
Kirkland, Washington

PLATE

A13

JOB NUMBER
15,582.021

DRAWN
SES

APPROVED

DATE
19 Oct. 92

REVISED

DATE