

**SUMMARY REPORT OF
PREVIOUS ENVIRONMENTAL WORK
PUGET PARK (SW HUDSON STREET SITE)
SEATTLE, WASHINGTON**

E-0290-6



Group Northwest, Inc.

Geotechnical Engineers, Geologists & Environmental Scientists



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Prepared for

Seattle Department of Parks and Recreation
800 Maynard Avenue South, Third Floor
Seattle, Washington 98134-1336

October 20, 2003

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October 20, 2003

E-0290-6

Ms. Coll  en Browne
Senior Project Manager
Seattle Department of Parks and Recreation
800 Maynard Avenue South, Third Floor
Seattle, Washington 98134-1336

Subject: Summary Report of Previous Environmental Work
Puget Park (SW Hudson Street Site)
Seattle, Washington

Agreement No. PR03-028

Dear Ms. Browne:

Geo Group Northwest, Inc., is pleased to present the final Summary Report of Previous Environmental Work for the above-referenced project located in Seattle, Washington. This report completes Task 1 in the scope of work for Geo Group Northwest, Inc., as outlined in the above-referenced agreement between Geo Group Northwest, Inc., and the Seattle Department of Parks and Recreation (Seattle Parks).

We appreciate the opportunity to provide Seattle Parks with environmental consulting services. If you have any questions regarding this report, please do not hesitate to call us.

Sincerely,

GEO GROUP NORTHWEST, INC.

A handwritten signature in cursive script that reads "William Chang".

William Chang, P.E.
Principal

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**SUMMARY REPORT OF
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SEATTLE, WASHINGTON**

E-0290-6

1 INTRODUCTION

The Seattle Department of Parks and Recreation (Seattle Parks) contracted with Geo Group Northwest, Inc., to complete a review of previous environmental and geotechnical work that had been performed at the Puget Park property and at immediately surrounding properties (including City of Seattle public rights-of-way). The purpose of the review was to prepare this report that describes the work that had been performed and summarizes the findings of the previous work. This report is intended to be a resource which can be used for future reference during the design, implementation, and review of further remedial action on the project.

Geo Group Northwest, Inc., has obtained the information used in its preparation of this report by performing the following tasks:

- reviewing its own project files,
- obtaining and reviewing copies of available pertinent documents from the project files maintained by Seattle Parks, and
- obtaining and reviewing copies of available pertinent records for the project from the Washington Department of Ecology (WDOE), Northwest Region Office in Bellevue, Washington, and
- discussions with Mr. John M. McFarland, the owner of property comprising the eastern part of the project site.

A bibliography of the specific records that we reviewed is provided in Appendix A to this report.

2 AUTHORIZATION FOR WORK

The preparation of this report was conducted consistent with Agreement No. PR03-028 between the Seattle Department of Parks and Recreation (Seattle Parks) and Geo Group Northwest, Inc. Task 1 under this agreement consists of preparing a report that summarizes the previous

Geo Group Northwest, Inc.

environmental and related work performed at the project site. Per the agreement, Geo Group Northwest, Inc., used resources available from the City of Seattle (primarily from Seattle Parks), its own project files, and Mr. John M. McFarland, the owner of the eastern part of the project site.

3 SITE SETTING

3.1 Site Location

Puget Park is located in a greenbelt area that straddles the east margin of the West Seattle neighborhood and the west margin of the Duwamish Valley area within the city limits of Seattle, Washington, as shown on Plate 1 - Site Location Map. The portion of the park property located along the west side of Puget Way SW near the intersection with SW Edmunds Street is the part of the park that is the subject of the environmental work summarized in this report.

The project site is bordered on the east by Puget Way SW. Land to the east of Puget Way consists of a homesite and multiple undeveloped land parcels. Land south of the site generally consists of an undeveloped greenbelt area. A single-family residence is located along the west side of Puget Way SW north of the site. Additional homes and vacant lots are present further to the north along both sides of the street. Development and land uses in the local area are identified on Plate 2 - Site Vicinity Map, which was adapted from a City of Seattle GIS map.

3.2 Topographic Setting

The project site generally consists of irregularly sloping land with a limited, east-sloping, upland area along its western side. A small stream, Puget Creek, flows generally southeastward along the southern edge of the site. The creek empties into the Duwamish River about 0.5 miles southeast of the site.

The topography of the project site was surveyed in December 1990 by Mr. Herbert Miller, Licensed Surveyor, and during April 1997 by W & H Pacific. The ground elevations recorded in the 1990 survey were referenced to a City of Seattle bench mark located approximately 43 feet northeast of the intersection of 15th Avenue SW and SW Edmunds Street. The ground elevations recorded in the 1997 survey were referenced to a City of Seattle benchmark located at the north end of a retaining wall at 4745 - 16th Avenue SW (on the west side of the street).

According to these surveys, ground elevations along the upper, north side of the site range between approximately 120 and 130 feet. Ground elevations along the lower, south side of the site range between approximately 60 and 30 feet, as measured along the course of Puget Creek. The site topography is illustrated on the site plans in Plates 3 and 4 using the ground elevation contours from the 1990 and 1997 surveys.

3.3 Geologic Setting

According to the geologic literature¹, the project site vicinity is underlain with Quaternary-age glacial deposits from the Vashon Stade of the Fraser Glaciation. The deposits in the site vicinity typically consist of dense silt and clay, referred to as the Lawton Clay, that were deposited before the approach of the Puget Lobe glacier. These deposits are characterized as having both finely bedded and thick, massive strata. Permeability of these deposits typically is very low, and groundwater typically is not found in this geologic unit except in limited quantities within narrow sandy lenses.

3.4 Land Use History

3.4.1 Ownership and Development History

The Puget Way SW roadway has been in existence in approximately its present location since about 1939, according to previous reports. The Puget Park property is owned by the City of Seattle. This land has not been developed or substantially modified except for the placement of cement kiln dust (CKD) fill. The McFarland property immediately east from Puget Park is owned by Mr. John McFarland, and also has not been developed or substantially modified with the exception of the placement of CKD fill and the construction of Puget Way SW.

3.4.2 Placement of CKD Fills

According to the information reviewed by Geo Group Northwest, Inc., the placement of fills containing CKD occurred during 1969 and 1970. Mr. John Yates (doing business as Duwamish Excavating) hauled the CKD to the project site and used it to fill a then-existing ravine. A total of approximately 51,000 cubic yards of CKD were placed on the site, according to Hart Crowser. The CKD reportedly was generated as waste from cement production at the former Ideal Cement

¹ Waldron, H.H., et al., 1962, Preliminary Geologic Map of Seattle and Vicinity, Washington. U.S. Geological Survey Miscellaneous Geologic Investigations Map I-354.

plant located nearby along West Marginal Way SW. The Ideal Cement Company plant (which opened in 1967) later became the Holnam, Inc., cement plant. Since 1998, the plant has been owned and operated by Lafarge Corporation.

According to Hart Crowser, chipped batteries also were placed in the fill areas to function as temporary road base material. The battery chips reportedly came from RSR/Quemetco, a battery recycling company, and were placed on the site by Mr. Yates. Hart-Crowser stated the source of the battery chips was a secondary lead smelter that was located nearby on Harbor Island in Seattle. In addition, Geo Group Northwest, Inc., understands that the Ideal Cement Company used slag material from ASARCO smelter operations in its cement manufacturing process. This slag is considered to contain lead, cadmium, and arsenic, based on records pertinent to this project.

The CKD material imported onto the project site was used to fill in naturally-occurring topographically low areas. Based on the observations from test pit and soil boring explorations in the filled areas, the CKD fill apparently was placed directly on the existing surface soils without prior clearing or grading work. Thin layers of topsoil and organics have been found between the base of the fills and the top of the native soils in some borings and test pits that were completed in the fill areas.

4 SUBSURFACE CONDITIONS

Several previous investigations have been performed on the project site to assess the site subsurface conditions from environmental and geotechnical perspectives. The earliest investigations were performed in 1980 and 1992 by Dames & Moore for geotechnical engineering studies associated with a proposed residential development to have been located north of the project site. Soil borings were drilled along the existing Puget Way SW alignment and in a proposed roadway realignment that crossed the site.

Subsequent subsurface investigation work was performed by Geo Group Northwest, Inc., in 1993 and 1994 for additional geotechnical assessment of the proposed realignment of Puget Way SW through the project site area. The additional assessment involved drilling soil borings along the proposed realignment and excavating test pits along the existing alignment and in the proposed realignment.

Neither the Dames & Moore investigations nor the Geo Group Northwest, Inc., investigations involved subsurface exploration work in the Puget Park portion of the site. In 1996, Hart Crowser, Inc., conducted a limited subsurface investigation in the Puget Park portion of the site. The investigation was focused to assess the thickness and extent of CKD fills comprising the Puget Park lobe for geotechnical and environmental engineering purposes. The exploratory test pits completed for this investigation were terminated either at the base of the CKD fills or at shallow depths if no CKD fills were found.

4.1 1980 and 1992 Dames & Moore Investigations

4.1.1 Scope of Investigation

As part of a geotechnical engineering study for a proposed residential development north of the project site, Dames & Moore drilled two exploratory soil borings, B-7-80 and B-8-80, along the Puget Way SW right of way in 1980; and three additional soil borings (B-1-92, B-2-92, and B-3-92) at various locations on and near the project site in 1992. The locations of the borings are noted in Plate 5 - Soil Boring and Test Pit Locations - McFarland Lobe Area. The borings were drilled to depths ranging between 33 and 43 feet below the ground surface using hollow-stem equipment. None of the borings were completed with wells or piezometers.

4.1.2 Findings

Soils encountered in borings B-7-80, B-8-80, and B-3-92 drilled along the Puget Way right-of-way consisted of a thin layer of surficial fills underlain by native soils. About two feet of fills were encountered at boring B-7-80 in the east side of the right of way. About four feet of fills were present in boring B-8-80 and about two feet of fills were found in boring B-3-92; both of these borings were located in the west side of the right of way. These fills did not contain CKD material, according to boring logs.

The native soils encountered in these borings typically consisted of damp to moist, medium stiff to hard silt and clayey silt. In boring B-7-80, a layer of wet, native, silty sand was encountered between depths of 25 and 32 feet. This layer was not found in the other borings drilled for this project. In boring B-8-80, the fills were directly underlain with five to six feet of wet silty sand and sandy silt that were interpreted in the logs to be native soils. This layer also was not found in the other borings drilled for this project.

Soils encountered in boring B-2-92 located at the top of the slope east of Puget Way SW consisted of silty clay and clayey silt from the ground surface to the bottom depth of the boring at 43 feet below the ground surface. The bottom depth of this boring is approximately equivalent to 11 feet below the Puget Way SW road surface directly to the west.

Soils conditions encountered in boring B-1-92 drilled within the McFarland lobe area consisted of a layer of CKD fills approximately 21 feet thick, underlain by native silt and clayey silt soils. No fill soils were found on top of the CKD material. The CKD contained pockets of clayey silt and gravel, particularly in its lower portion. At the base of the CKD fills, a thin layer (about six inches thick) of moist to wet topsoil and organics was found. The silt soils below the fills and topsoil were typically medium stiff to stiff, but became hard at a depth of 37 feet, at the bottom of the boring.

Groundwater was encountered in some of the borings that were drilled by Dames & Moore, specifically in borings B-7-80 and B-8-80 located along Puget Way SW, and in boring B-1-92 located in the McFarland lobe. The water reported in boring B-7-80 was encountered at a depth of 24 feet below the ground surface in a silty sand layer found within the native silt. The water reported in boring B-8-80 was encountered at 8 feet below the ground surface in a native silty sand layer that overlies the typical silt soils found beneath the site. Water reported in boring B-1-92 was encountered at depths of 9 feet (within the CKD fills) and again at 21 feet below the ground surface, at the base of the CKD fills.

4.2 1993 and 1994 Geo Group Northwest Investigations

4.2.1 Scope of Investigation

Geo Group Northwest, Inc., drilled two exploratory soil borings, B-1 and B-2, and excavated five test pits, TP-1 through TP-5, in and near to the McFarland lobe during 1993. The borings were drilled using hollow-stem auger equipment to depths of 33 and 32 feet below the ground surface. Neither boring was completed with a well or piezometer. The test pits were excavated to depths ranging between 4.5 and 13 feet below the ground surface using a backhoe.

Five additional test pits, TP-6 through TP-10, were excavated during 1994 along the existing Puget Way SW right of way to evaluate the extent of CKD fills in and near the right of way. These test pits were excavated to depths ranging between 2 and 8 feet below the ground surface using a backhoe. The locations of the test pits and borings that Geo Group Northwest, Inc., completed are illustrated in Plate 5 - Soil Boring and Test Pit Locations - McFarland Lobe Area.

4.2.2 Findings

Soils encountered in the borings consisted of a 16-foot thick layer of CKD fills underlain by native silt soils. At the base of the CKD fills, a thin layer of topsoil and organics was found in boring B-1. The underlying native silt soils typically were damp to moist and medium stiff to very stiff, but became hard near the bottom depths of the borings. Logs for the two borings indicated that the silt and clay soils contained some sand lenses. These sand lenses were very limited in thickness and were not continuous from boring to boring.

Soils encountered in test pits TP-2, TP-4, TP-5, and TP-10 consisted of a discontinuous thin veneer of surficial topsoil, forest duff, or imported soil cover underlain by the CKD fills. At test pits TP-1 TP-3, TP-6, TP-7, TP-8, and TP-9, the CKD fills were exposed at the ground surface. Thicknesses of the CKD fills found in the test pits excavated near the right of way limits, were observed to increase with greater distance away from the road, especially at test pits TP-9 and TP-10.

Most of the test pits were excavated to the base of the CKD fills but not into the underlying native soils. Test pits TP-4, TP-5, and TP-8 were excavated into the underlying native soils and encountered medium stiff to stiff, moist clayey silt and silty clay. Test pits TP-6 and TP-7 were excavated into deeper fill soils composed of silt, sand, and gravel with brick, wood, and glass debris.

Perched water was encountered at 14 feet below the ground surface in borings B-1 and B-2 drilled by Geo Group Northwest, Inc., in the McFarland lobe. This perched water was reported to be present within the bottom two feet of the CKD fills. Groundwater was encountered in boring B-1 at a depth of 24 feet within the native, clayey silt soils. No groundwater was observed in the test pits that were excavated by Geo Group Northwest, Inc.

4.3 Subsurface Exploration in the Puget Park Lobe by Hart Crowser

Hart Crowser, Inc. performed subsurface investigation work to assess the thickness of the CKD fills in the Puget Park lobe. A brief report of these activities was obtained from the City of Seattle for review. According to the report, 21 test pits were excavated within and around the Puget Park lobe. Locations of these test pits are indicated in Plate 6 - Exploration and Sample Locations - Puget Park Lobe Area.

According to the report, no test pit logs were prepared for this investigation. Also, no detailed information about the depths of the test pits nor the subsurface conditions encountered at individual test pit locations was described in the report. No groundwater was encountered in the test pits, but a zone of very moist, weathered organic soil was found immediately below the CKD fills, according to the report by Hart Crowser. The date that this work was performed is not stated in the report, but the Remedial Evaluation Report prepared by Hart Crowser, Inc., mentions that this work was performed in 1996.

4.4 Summary Interpretation of Investigation Findings

In general, the soil types encountered in the test pits and borings completed within the McFarland lobe area of the site typically consisted of a thin, discontinuous, surface layer of silty soil that overlies CKD fills that are up to 21 feet thick. A layer of topsoil and forest duff was encountered immediately below the CKD fills at some of the exploration locations. The topsoil layer apparently marks the former ground surface which existed before the CKD fills were placed on the site. Plate 7 - Cross Section A - A' illustrates the general geologic conditions present at the McFarland lobe. No subsurface soils information beyond CKD fill thicknesses is available for the Puget Park lobe area of the project site.

Native soils encountered below the fills and topsoil typically consisted of medium stiff to hard silt and clayey silt. At some locations, the upper few feet of these soils were weathered and moist to wet. However, the native soils typically were damp to moist, medium stiff to stiff, and relatively unoxidized. These soils are similar to the Lawton Clay deposits reported in the geologic map for the vicinity.

Borings located outside the limits of the McFarland lobe encountered minimal amounts of fills. About two to four feet of fills were encountered in borings along the Puget Way SW right of way east of the McFarland lobe. These fills did not contain CKD material. Test pits excavated near the right of way limits, however, did encounter CKD fills that thickened with increasing distance away from the road.

4.5 Estimated Extent of CKD Fills

Previous explorations on the Puget Park property and the McFarland property west of Puget Way SW have approximately delineated the lateral extent of the existing CKD fills. As illustrated in Plate 3 - Site Plan (After Remediation Construction), the CKD fills occur as two lobate-shaped areas which have been referred to as the Puget Park Lobe and the McFarland Lobe. The Puget

Park Lobe is located on the Puget Park property, and the McFarland Lobe is located on the McFarland Property. The top surface of each lobe is relatively flat and has moderate to thick vegetative cover of grass, shrubs, and alders. The southern margin of the Puget Park lobe and the southern and western margins of the McFarland lobe have slopes with inclinations ranging between 20 and 45 degrees. The lobe slopes are similarly vegetated as the tops of the lobes.

The Puget Park Lobe has been estimated to cover 100,000 square feet of area (in plan view) and contain approximately 40,000 cubic yards of CKD. The McFarland Lobe has been estimated to cover 30,000 square feet (in plan view) and contain approximately 11,000 cubic yards of CKD.

Estimates of the thickness of the CKD fill were reported to be up to approximately 21 feet for the McFarland lobe. Thicknesses of CKD fill comprising the Puget Park Lobe were reported by Hart Crowser also to be up to approximately 20 feet. However, test pit logs from explorations within the Puget Park Lobe are not available to confirm the reported CKD thickness.

Based on exploration findings reported by Geo Group Northwest, Dames & Moore, and Hart Crowser, CKD fill is present within the western portion of the public right-of-way for Puget Way SW. The CKD fill, however, does not appear to extend below the existing street pavement. This finding is consistent with the understanding that the roadway has remained in its present location since a time before the placement of the CKD fills.

5 PHYSICAL AND CHEMICAL PROPERTIES OF CKD

5.1 Physical and Engineering Characteristics

The CKD present at the project site typically consists of a white, powder-like material that has a fine crystalline texture. The particles that comprise the CKD are generally very angular. In 1994, AGRA reviewed two publications regarding CKD use and disposal. According to this literature, CKD typically consists of particles finer in size than a No. 200 mesh. The particle size distribution is concentrated toward the finer end of the size range, with more than 90 percent of the particles finer than 12 microns ($1 \text{ micron} = 1 \times 10^{-6} \text{ m}$).

Geo Group Northwest, Inc., reported in 1994 that research into the engineering properties of CKD had been reported in a University of Washington Masters thesis published in 1971 by Irwin Keith Johnson and titled "Evaluation of Waste Dust from a Cement Plant Kiln as Landfill."

According to research results reported by Johnson, CKD was found to have an effective angle of internal friction of 38 to 44 degrees.

Geotechnical engineering soil parameters for the CKD at the site previously were developed by Geo Group Northwest, Inc., and presented in its design parameters report dated November 1, 1994, for a proposed realignment of Puget Way SW. The engineering parameters for the in-situ CKD fills were developed for use in the design of geogrid-reinforced fills that were to be up to 18 feet high and located on the existing CKD fill lobes. These parameters are as follows:

Uncompacted, In-Situ CKD

Unit weight (pcf)	90
Soil friction angle (degrees)	25
Soil cohesion (psf)	0

Compacted, In-Situ CKD

Unit weight (pcf)	100
Soil friction angle (degrees)	35
Soil cohesion (psf)	500

5.2 Chemical Constituents and Characteristics

5.2.1 General Characteristics

Cement kiln dust is a waste product of the Portland cement manufacturing process. Literature reviewed by RZA-AGRA reported that an average of approximately 12 percent of the material used to manufacture cement becomes kiln dust which is carried away by exhaust gases. Dust is generated during manufacturing by the grinding and conveying of the raw materials, heating of the raw materials in a rotary kiln to produce a material called "clinker," and grinding of the produced clinker into cement product. Much of the dust produced during the manufacturing process is recycled back into the material stream; however, the dust that is generated in the rotary kiln often cannot be recycled due to its high content of alkalies. This waste product is the cement kiln dust that results.

Portland cement is composed of the oxides of calcium, aluminum, silicon, and iron. The materials typically used to produce the cement include a calcium carbonate source (limestone, marl, chalk, oyster shell), a silica source (sand, quartzite, Fuller's earth), an alumina source (clay, shale, slag, ore tailings, fly ash), and an iron source (iron ore or oxide, pyrite, blast furnace dust).

These source materials may also contain other components, such as alkalies or heavy metals, that become incorporated in the cement product and the waste dust. The chemical composition of the CKD is dependent upon the composition of the source materials used. So, the composition of CKD is variable.

Sulfates, chlorides, and carbonates of sodium and potassium tend to be concentrated in the CKD by the manufacturing process. Heavy metals concentrations also tend to be concentrated in the CKD. CKD undergoes some degree of calcination (i.e., the transformation of calcium carbonate to lime by driving off carbon dioxide) during the manufacturing process. As a result, the dust has a lower carbonate content than the source material. The partial calcination of the CKD results in its ability to harden upon exposure to moisture. This effect has been observed in the CKD fills at the site, according to test pit and boring logs presented in previous reports.

5.2.2 Chemical Analysis of CKD Samples from Project Site

Testing of CKD material collected from the project site was performed by RZA-AGRA during 1994. A total of 16 samples were tested for metals (i.e., RCRA toxicity characteristic metals: Arsenic, barium, cadmium, chromium, lead, mercury, selenium, and silver) and for pH during June 1994. Two additional samples were collected and tested for selected metals and pH during November 1994.

The reported laboratory analysis results indicate that the CKD contains detected concentrations of lead, arsenic, barium, cadmium, chromium, and silver. Mercury was detected in one of 16 samples that were tested. Selenium was not detected in the samples that were tested. The laboratory analysis results are summarized in Table 1 - Laboratory Analysis Results - Cement Kiln Dust Fill Samples. The total lead, arsenic, and cadmium concentrations in most of the samples exceeded the Washington State Model Toxics Control Act (MTCA)² Method A cleanup levels for these metals in soil. The locations where the CKD samples were collected are shown in Plate 8 - CKD Sample Locations.

Four of the samples were also tested for leachable metals by using the U.S. EPA Toxicity Characteristic Leaching Procedure (TCLP). These samples were reported to not have concentrations of leachable metals above regulated levels.

² Model Toxics Control Act Cleanup Regulation, Washington Administrative Code, Chapter 173-340 (amended February 12, 2001).

Corrosivity testing of the CKD has found that it typically has pH values ranging between about 7.9 and 12.5. None of the tested samples have had a pH value higher than 12.5, which is a criterion for designation of a waste material as corrosive dangerous waste.

5.2.3 Toxicity Testing of CKD Samples by Bioassay

One of the two samples that were collected by AGRA during November 1994 was also analyzed for toxicity by using the Static Acute Fish Toxicity Test bioassay procedure established by the Washington Department of Ecology (WDOE). This test was developed by the WDOE for determining if a waste meets the definition of a dangerous waste on the basis of toxicity as described in Washington state regulations. The test results found that the samples did not characterize as toxic material.

AGRA reported that some difficulties were encountered during the testing procedure involving the maintenance of the pH and temperature of the water in the tank. However, the testing laboratory reviewed the circumstances and results and concluded that the test results were valid. The WDOE also reviewed the test procedures with the laboratory and similarly concluded that the test results appeared valid.

The analytical results summarized above indicate that the CKD material does not meet the criteria for designation as dangerous waste under current Washington state regulations. AGRA had previously reported in 1994 that the CKD material may be designated as dangerous waste on the basis of carcinogenicity because of the concentrations of arsenic (a potential carcinogen) detected in the samples. However, after AGRA's 1994 evaluation, the criteria for designation of dangerous wastes was modified, and these modifications included the removal of the carcinogenicity criteria and changes to the toxicity criteria.

6 ENVIRONMENTAL QUALITY OF SURFACE WATER, SEEPAGE WATER, AND CARBONATE PRECIPITATE

6.1 Water Seepage below CKD Fills

Water seepage which exits the base of the CKD fill lobes was sampled and tested in 1996 and in 1998 and 1999 for selected chemical constituents (metals such as lead, arsenic, and cadmium), and for general parameters (pH, dissolved solids, suspended solids, and hardness). The sample

collection locations are illustrated in Plate 6 - Exploration Sample Locations - Puget Park Lobe Area.

Test results have reported that the seep water samples collected both before and after the remedial actions by Hart Crowser contained lead at concentrations that exceed the WDOE Surface Water Quality criteria³. Detected concentrations of arsenic in the water samples were below the WDOE Surface Water Quality criteria. Cadmium was not detected in the water samples. The pH levels measured in seven of the ten seep water samples exceeded the allowable level for surface water. The laboratory analysis results and regulatory criteria for the seepage water samples are summarized in Table 2 - Laboratory Analysis Results - Puget Creek and Seepage Water Samples.

6.2 Puget Creek Surface Water

Water samples were collected from two locations along Puget Creek on an annual frequency from 1996 to 1999. One location, SW-1, was located relatively downstream from the CKD fill lobes (i.e., south of the McFarland lobe). The other location, SW-2, was located about 100 feet upstream from the western edge of the CKD fill lobes. The sample collection locations are illustrated in Plate 6 - Exploration Sample Locations - Puget Park Lobe Area.

Testing of water samples collected from Puget Creek has not found lead, arsenic, or cadmium concentrations or pH levels in excess of the WDOE water quality criteria. The laboratory analysis results regulatory criteria for the creek water samples are summarized in Table 2 - Laboratory Analysis Results - Puget Creek and Seepage Water Samples.

6.3 Carbonate Precipitate Downslope from CKD Fills

Twelve samples of the precipitate material that had been deposited below and downslope from the CKD fill lobes were tested for selected metals (total arsenic, cadmium, and lead) and pH. Three of the samples (MC-1, MC-2, and MC-3) were from the precipitate area below the McFarland lobe and the other nine samples (PP-1 through PP-9) were from precipitates found below the Puget Park lobe. The sample collection locations are illustrated in Plate 6 - Exploration Sample Locations - Puget Park Lobe Area.

³ Water Quality Standards for Surface Waters of the State of Washington, Washington Administrative Code, Chapter 173-201A, revised November 18, 1997.

Total lead and arsenic concentrations above the MTCA Method A cleanup levels were detected in one of the samples (MC-1) collected from below the McFarland lobe. Total lead concentrations above the Method A cleanup level were detected in six of the samples collected from below the Puget Park lobe. Total arsenic concentrations in three of these samples and total cadmium concentrations in two of these samples also exceeded Method A cleanup levels. The test data are summarized in Table 3 - Laboratory Analysis Results - Carbonate Precipitate Samples.

7 PREVIOUS REMEDIAL ACTIONS

In 1997, Hart Crowser, Inc., prepared a Remedial Evaluation Report for the project site. The report outlined the remedial action objectives that had been identified at that time. Those objectives consisted of 1) preventing human contact with the CKD fills and precipitate on the site, 2) preventing dust generation from the CKD, 3) controlling further sedimentation and precipitation of CKD in the surrounding environment, and 4) controlling runoff of water that comes into contact with the CKD.

The remedial measures that were selected to achieve these objectives consisted of 1) installation of an enhanced soil cover at designated locations across the two CKD lobes, 2) removal of the precipitate deposits below the CKD fill areas and construction of gravel-lined chambers to control the future precipitation from CKD leachate, 3) installation of erosion and sedimentation controls on the CKD fill lobes and downslope from the lobes to aid in re-establishing a vegetative cover, and 4) installation of a drain culvert across Puget Way SW just north of the CKD fills to divert surface water drainage away from the CKD. These remedial measures were performed during September and October 1997.

7.1 Drainage Culvert Installation

Hart Crowser supervised the installation of a drainage culvert under Puget Way SW near the northeast corner of the Puget Park CKD lobe. The culvert was designed to divert surface water drainage that had run southward down a ravine between the CKD lobes. The new culvert directs the diverted water to a ditch that runs along the east side of Puget Way SW. The culvert was constructed using a 12-inch diameter ductile iron pipe. The culvert was installed at an elevation lower than the already existing drain pipe (eight-inch diameter steel pipe) that had conveyed drainage from the roadside ditch to the ravine between the CKD lobes, with the intention of

preferentially intercepting the drainage. The trench excavation for the culvert was backfilled using controlled-density fill. The older, existing drain pipe was not disturbed.

7.2 Placement of Soil Cover over CKD Fills

During 1997, Hart Crowser oversaw the placement of a soil cover over limited areas of the two CKD fill lobes as part of its remediation program for the project site. The areas that received the soil cover had no existing cover or a minimal amount (about six inches or less) of existing cover, according to Hart Crowser. The soil cover material reportedly was placed to create an average 24-inch thick layer. The soil cover was then lightly compacted by using a dozer and a backhoe. The areas where soil cover was added are identified in Plate 3 - Site Plan (After Remediation Construction).

In total, 6,200 square feet of the western portion of the Puget Park lobe received an average 24-inch thick soil cover. Approximately 3,000 square feet of the lobe, mostly on the steep southern slope, has a 2- to 4-inch thick layer of soil cover that was not supplemented during the remediation work. Hart Crowser reported that the WDOE representative on site indicated that this undisturbed area supports an adequate protective cover for the fills. The remaining approximately 89,300 square feet of the Puget Park lobe already had an 18- to 24-inch thick soil cover.

In total, 26,500 square feet of the McFarland lobe received an average 24-inch thick soil cover, and an additional 2,000 square feet of the lobe received a thinner, 4- to 6-inch thick soil cover. Hart Crowser did not explain in its voluntary cleanup report why the smaller area received a thinner cover. The remaining 12,800 square feet of the McFarland lobe has a 12- to 18-inch thick soil cover that was left undisturbed.

The material that was imported to the site and used as soil cover was provided from other City of Seattle projects and consisted of slightly gravelly and sandy silt that contained minor amounts of cobbles and roots, according to Hart Crowser. Representative samples of the soils reportedly were collected and tested for metals and petroleum hydrocarbons. No petroleum hydrocarbons or arsenic were reported as detected in the tested samples, but background concentrations of lead and chromium were reported as detected in two of the samples. The total number of samples that were tested was not reported. The locations where and dates when the samples were collected were not reported. The laboratory analysis reports were not provided.

7.3 Excavation of Carbonate Precipitate and Construction of Gravel Precipitation Chambers

During September and October 1997, Hart Crowser oversaw the excavation of the precipitate material that had formed on the ground downslope from the CKD fills. Four areas were excavated, and these areas are identified as A1, A2, A3, and A4, on Plate 4 - Site Plan (Before Remediation Construction). The excavated material was relocated to the upper, northern area of the McFarland lobe, where it was covered with a new soil layer.

After the excavation of the precipitates was completed, two precipitation chambers were constructed. One of the chambers was constructed at location A1 below the base of the Puget Park CKD fill lobe. The other chamber was constructed at location A3 in the drainage ravine that separates the two lobes. The locations of the installed chambers are illustrated in Plate 3 - Site Plan (After Remediation Construction). No chambers were constructed at the other two excavated areas.

The chambers consist of a lens-shaped body of gravel surrounded with a layer of geotextile filter fabric. The gravel body consisted of an 18-inch thick layer of 2-inch crushed rock (railroad ballast). The geotextile filter fabric used to line the chambers consisted of a woven product (Mirafi 600X) reported to have a permeability of approximately 0.25 cm/sec. The chambers were designed to intercept contaminated seepage water flowing from the CKD fill lobes and promote the precipitation of metals out of the water and onto the gravel within the chamber. The "treated" water would then flow out from the chamber and down the slope toward Puget Creek. A generalized cross-section view of the typical construction of these chambers is shown in Plate 9 - Precipitate Chamber Construction Details.

7.4 Installation of Erosion and Sedimentation Controls

Approximately 250 linear feet of hay bale sediment barriers and 200 linear feet of geotextile silt fences were installed below the McFarland lobe soil cover, the precipitate excavation and chamber locations, and the haul road that was used on and below the Puget Park lobe. These features were left in place after the completion of the remedial activities to provide long-term erosion control while the vegetative cover established itself. Redevelopment of the vegetative cover was initiated with plantings of shrubs and trees and with hydroseeding by Hart Crowser.

8 POST-REMEDIATION MONITORING AND EVALUATION

8.1 Gravel Precipitation Chamber Performance

During March 1998, approximately six months after the chambers were constructed, the precipitate chambers reportedly became clogged and filled with trapped seepage water. The seepage had burst out from the chambers and migrated down the slope toward Puget Creek. The blockage in the chambers reportedly occurred because the geotextile filter fabric that lined the chambers had become clogged with sediment. Reportedly, the blockage was alleviated by puncturing the fabric in several locations. Currently, the chambers are receiving and accumulating the sediment carried by the inflowing seepage and are expected to eventually become filled with sediment.

8.2 Seepage Water Quality

Sampling and testing of the seepage water and the creek water was performed during June 1998 and June 1999, to evaluate the performance of the precipitate chambers. Samples of seepage water flowing into, through, and out from gravel chamber A3 were collected, and a sample of seepage water flowing out from gravel chamber A1 was collected. The laboratory analysis results for the water samples are summarized in Table 2 - Laboratory Analysis Results - Puget Creek and Seep Water Samples.

A comparison of the laboratory analysis results for the gravel chamber A3 seepage inflow (Sample A3-In) and outflow (Sample A3-Out) samples indicates that the hardness levels in the outflow samples were lower than in the inflow samples. However, the pH levels and the dissolved lead concentrations were higher in the outflow samples than in the inflow samples. The total lead and the total and dissolved arsenic concentrations were neither consistently higher nor lower in the inflow samples compared to the outflow samples. Analyses for total dissolved and suspended solids were not run on the samples.

9 WASHINGTON DEPARTMENT OF ECOLOGY FILE REVIEW

9.1 Contaminated Sites Database Listings

We reviewed Washington state environmental databases of hazardous waste sites (HSL and CSCSL), underground storage tank sites (UST sites) and leaking underground storage tank sites

(LUST sites), and federal databases of hazardous materials handlers (small and large-quantity hazardous waste generators; and transfer, storage and disposal facilities in the RCRIS database). We accessed these databases via the U.S. Environmental Protection Agency website (www.epa.gov) for the RCRIS database; and via the Washington Department of Ecology (WDOE) website (www.ecy.wa.gov) for the HSL, CSCSL, UST, and LUST databases.

Based on our review of the databases noted above, the project site is identified as two sites in the May 2003 update of the CSCSL database. One of the listed sites is identified as Puget Park with the address of 16th Avenue SW, Seattle (Site No. 2479). The other listed site is identified as McFarland Property with the address of SW Edmunds Street and 15th Avenue SW, Seattle (Site No. 2575). The Puget Park listing notes that EPA Priority Pollutant Metals are suspected to be present in soil, surface water, and groundwater at this site. The McFarland Property listing notes that EPA Priority Pollutant Metals are confirmed present at concentrations above MTCA cleanup levels in soil at this site. The listings for both sites note that the sites have independent remedial action underway.

9.2 Review of WDOE Case Files

We visited the offices of the WDOE Northwest Region in Bellevue, Washington, to review the available files that the WDOE has for the project site (i.e., files for the two sites listed in the CSCSL database). Among the records we found in these files were documents that involve requests for WDOE review or action regarding environmental issues for the project site; preparation of legal depositions by WDOE personnel involved in the project site; initial notification of suspected contamination at the Puget Park and the McFarland lobe properties; and copies of the remedial evaluation and voluntary cleanup reports for the site.

The most recent information in the files consisted of a letter dated March 25, 2002, from Holcim's attorney to Mr. Dan Cargill of the WDOE. In this letter, Mr. Cargill was requested to provide an opinion in regard to the WDOE's likely response to an inquiry about environmental concerns for fly ash. No other documents or records of WDOE actions or requests following receipt of the December 19, 1997, voluntary cleanup report for the project site were found in the files. Thus, there appears to be no record that the WDOE had reviewed or commented on the remediation work that was performed in 1997.

Information on two subjects not specifically discussed in the previous assessment work that has been performed for the project site was discovered in the WDOE case files. These subjects are 1) surface water sampling and testing that was conducted by Seattle Parks in 1993, and 2)

discussions and determination if the CKD at the site constituted dangerous waste. These subjects are summarized in the following sections.

9.2.1 Surface Water Sampling by Seattle Parks

Two surface water samples were collected in May 1993 by Seattle Parks personnel and submitted for laboratory analysis for metals and pH. One sample was collected from seepage present below the CKD lobes, and the other sample was collected from Puget Creek below the seepage area, but the specific sample locations were not indicated or mapped. The samples were found to have pH levels of 11.96 (seep) and 8.6 (creek). Lead concentrations of 6.0 mg/l (seep) and 3.0 mg/l (creek) were reported for the samples, which were above the surface water standard of 0.008 mg/l for lead. The samples also were found to have arsenic concentrations of 0.059 mg/l (seep) and 0.066 mg/l (creek), above the surface water standard of 8.42×10^{-5} mg/l for arsenic. These appear to be the first water samples collected at the project site and tested for environmental quality; however, they have not been included in previous environmental reports for the project.

9.2.2 Evaluation of CKD per Dangerous Waste Criteria

Correspondence between the WDOE and legal representatives of parties involved with negotiations regarding the CKD fills on the site discussed the waste characterization of the CKD material. The WDOE was asked in 1994 to provide a determination as to whether the CKD would be characterized as dangerous waste based on the results of laboratory testing and updated guidelines for identifying dangerous wastes. The WDOE stated in a letter dated February 7, 1995, that the CKD at the site would not be designated as dangerous waste, based on new regulatory criteria which includes consideration of the results of fish bioassay testing.

10 CONCLUSIONS AND RECOMMENDATIONS

Based on our review of the documents available to us regarding the previous environmental assessment and remediation work performed at the site, Geo Group Northwest, Inc., has developed the following conclusions regarding the work that has been completed and the progress that has been achieved toward the completion of remediation work.

10.1 Site Hydrogeology

Native soils explored at the site consist almost entirely of clayey silt and silty clay. A layer of wet silty sand soils was found at depth at one location east of the McFarland lobe, but was not encountered in other exploration locations. In summary, there is not sufficient evidence to indicate that a water-bearing soil layer exists in the shallow subsurface at the project site.

It is our opinion that "groundwater" at the project site essentially consists of near-surface water within the topsoil and very shallow, weathered soil horizon of the native soils. Where this water encounters the CKD fills, it then travels along the subsurface contact between the CKD fills and the underlying native soils. This water then returns to the ground surface and appears as seepage at the base of the fills. The seepage then travels downslope over the ground surface or through the shallow topsoil and weathered native soils to Puget Creek.

For this reason, it is the opinion of Geo Group Northwest, Inc., that the most effective approach toward improving the quality of the water seepage below the CKD fills and thereby the quality of the water in Puget Creek is to significantly reduce or eliminate the potential for contact of water with the CKD fills. However, it is also our opinion that it may not be possible to improve the quality of the water seepage to levels established in the applicable regulations. Therefore, we anticipate that diversion of the water seepage away from Puget Creek may be necessary to achieve a level of water quality in the creek that is protective of the environment.

10.2 Evaluation of In-Place Engineering Controls

Based on the site observations by Dames & Moore in 1998 and the laboratory analysis results for water samples collected from Puget Creek in 1998 and 1999, it is our opinion that the precipitation chambers have had a negligible effect on the quality of the surface water entering Puget Creek. However, our conclusion in this regard is based on a very limited set of water quality data (from both before and after the remediation work). We anticipate that what effect—if any—the gravel chambers have on the quality of the water seepage will decrease with time as the gravel and geotextile in the chambers become clogged with sediment and precipitate.

The enhanced soil cover over portions of the CKD fill areas likely has reduced the areal extent of relatively exposed CKD at the project site. We understand that the remaining areas of exposed or poorly covered CKD were allowed to remain per on-site discussions with the WDOE. These areas reportedly were heavily vegetated with shrubs and other plants and were considered

practically inaccessible for human contact. These areas, however, are relatively exposed to rainfall or runoff and may allow infiltration of water into and through the CKD.

The diversion of the surface water drainage from the ditch along the west side of 16th Avenue SW (northeast of the Puget Park lobe) into the culvert that crosses the street may be reducing the amount of water that passes through the CKD fills at the site. However, the older drain pipe at the end of the ditch remains in place. There is a possibility that during periods of high rainfall, water may overflow the ditch and flow through the older pipe and be discharged down the ravine between CKD fill lobes.

An additional concern regarding the redirected drainage involves the drainage conditions along the section of Puget Way SW adjacent to the McFarland lobe. In this area, the road surface slopes downward toward the McFarland lobe, and the existing drainage ditch along the east side of the street is relatively shallow. We have been told by Mr. John McFarland that this ditch overflows during periods of high rainfall, and that the overflow water runs across the road and onto the McFarland lobe. This overflow water may be contributing to the seepage that occurs at the base of the CKD fills.

In summary, the remedial actions that have been performed on the soil cap layer and the drainage along Puget Way SW have had a beneficial effect toward reducing the amount of precipitation and surface water that comes into contact with the CKD fills. However, these actions were not pursued to a fuller extent to where they could be considered complete. With respect to the installation of the gravel precipitation chambers, there is no evidence that the chambers have improved the quality of the water seepage that enters Puget Creek.

10.3 Progress Achieved toward WDOE "No Further Action" Status

Geo Group Northwest, Inc., discussed the project status from the perspective of the WDOE with Mr. Dan R. Cargill of the WDOE on September 3, 2003. Mr. Cargill stated that—with regard to the WDOE's involvement in the project—the project had essentially been dormant since approximately 1998. The last site activity that Mr. Cargill was aware of consisted of a visit to the site to observe the gravel precipitation chambers after the chambers were found to have burst.

According to Mr. Cargill, the WDOE will restart its review the project in the context of the current regulations regarding environmental assessment and cleanup criteria for contaminated sites. In particular, the site will need to be re-evaluated with respect to ecological protection criteria which have been modified since 1997. Since that time, the WDOE Surface Water

Quality Standards have been revised, and the Model Toxics Control Act (MTCA) has been extensively revised. As a result of these changes, the WDOE will be looking more closely than it may have previously at the impacts of the contamination on ecological factors at the site and downstream from the site.

An additional issue that Mr. Cargill introduced was the potential for dioxin to be present in the CKD fills and possibly other materials at the site which have come into contact with the CKD fills (i.e., water seepage, carbonate precipitate, and sediment in Puget Creek). He noted that dioxin had been detected previously in CKD generated at the former Holnam cement plant, and stated that the CKD fills at the site would need to be investigated for the presence of dioxin if an NFA status is to be achieved. If dioxin is detected in the CKD fills or other materials at the site, progress toward an NFA status may become much more difficult, according to Mr. Cargill.

10.3.1 CKD Fills

As noted above in **Section 9.2.2 - Review of WDOE Case Files**, there is no written record of what criteria the WDOE has applied or will apply to the project site with regard to the completion of remedial action for the CKD fills at the site.

Nearly the entire area of CKD fills has been capped with a layer of imported silty soil. The limited, remaining, uncapped areas are thickly vegetated with shrubs and brush, and the soils in these areas are thereby inaccessible to people. Thus, the potential for human contact with the CKD material has been substantially mitigated. However, the potential for wildlife to come into contact with the CKD fill has not been a focus of the previous remedial action. The existing soil cap layer may not be an adequate control to mitigate potential impacts to wildlife.

The potential presence of dioxin in the CKD fills and in other media at the site raises possible concerns about the feasibility of obtaining NFA status with regard to the CKD fills at the site. If dioxin is detected in the CKD fills or other materials on site, the existing soil cap layer may need to be improved into a type of impermeable liner typically associated with hazardous waste or sanitary landfill sites to obtain NFA status from the WDOE.

It is our opinion that the WDOE is unlikely to issue an NFA status for the capped CKD fills at the site until it can be shown that the soil cap layer and other control measures are able to provide protection from contact with the CKD to both humans and wildlife. For this reason, the WDOE should be consulted before further remedial action is performed to determine what additional work will be required to achieve an acceptable cap for the CKD fills at the site.

10.3.2 Seepage Water and Puget Creek

During its previous work at the site, Hart Crowser applied the WDOE Ambient Water Quality Criteria as its cleanup criteria for the seepage water at the site and the water in Puget Creek. Hart Crowser also identified the point of compliance for meeting the cleanup criteria as being the locations at which the seepage water reaches Puget Creek. However, as noted above in **Section 9.2.2 - Review of WDOE Case Files**, there is no written record of what cleanup criteria the WDOE has applied or will apply to the project site with regard to the remediation of water (either groundwater or surface water) quality at the site. Also, we found no written record that the WDOE has accepted the point of compliance that Hart Crowser has used in its previous assessment.

To date, there has been very limited post-remediation monitoring of water quality at the site. Without a record of such monitoring, it is difficult to demonstrate that (or even determine whether) the remedial actions already completed have improved the quality of the water seepage or of the water in Puget Creek. As stated above in **Section 10.2 - Evaluation of In-Place Engineering Controls**, we have provisionally concluded that the quality of the water seepage and of the water in Puget Creek at the site has not been improved by the remedial actions already completed, based on the limited post-remediation monitoring data that is available. Also, the WDOE intends to restart its review of the project by using the revised regulations, which will involve a new evaluation of the existing data and possibly the acquisition of additional data. Therefore, the progress achieved toward an NFA status for the seepage water or for Puget Creek is probably minimal.

Based on our understanding of the current status of the site cleanup, we understand the current issues with regard to obtaining a NFA letter from the WDOE for water at the site include the following:

- 1) Evaluating the potential presence of dioxin in the CKD fills, precipitate, seepage water, and creek sediment;
- 2) Identifying what criteria will be applied to evaluate the cleanup of seepage water at the site;
- 3) Identifying at what locations the cleanup criteria will need to be met;
- 4) Determining for what length of time monitoring of the seepage water quality will be required in order to receive NFA status; and
- 5) Performing sufficient monitoring to demonstrate that the water seepage and the water in Puget Creek meet the cleanup criteria established for the project.

We also anticipate that the existing carbonate precipitate that has developed in the vicinity of the gravel chambers will need to be removed, and the future accumulation of precipitate will need to be controlled or prevented.

If dioxin is found in the seepage water, carbonate precipitate, or creek sediment at the site, the ability to achieve NFA status at the site may become significantly more difficult because of the extremely low concentrations of dioxin that are permitted in water under the existing regulatory criteria and the persistence of dioxin in the environment.

10.4 Focus of Further Remedial Action

Geo Group Northwest, Inc., recommends that the primary focus of further remedial action at the project site be directed toward the further reduction or elimination of the flow of contaminated water seepage into Puget Creek. Future work toward this end should proceed on two tracks—one focused on minimizing the infiltration of surface water into the CKD fills, and the other focused on intercepting (and possibly treating) the water seepage below the CKD fills before it reaches Puget Creek.

In our opinion, the infiltration of water into the CKD fills can be best reduced by implementing additional engineering controls at and near the project site. These controls consist of the following tasks:

- enhancing and contouring the soil cap layer on the CKD fills to prevent surface water from standing on the cap and to essentially prevent water infiltration through the cap;
- improve the existing drainage ditches and construct new swales on the soil cap layer to collect surface water convey it to a location (or multiple locations) away from the cap where it can be discharged without coming into contact with the CKD fills;
- construct an interceptor trench system along the base of the CKD fills to collect the water seepage that occurs and convey it to the municipal sanitary sewer system for discharge; and
- improve the existing drainage systems along Puget Way SW so that they are capable of collecting all drainage associated with the roadway and conveying it to an appropriate

discharge location where it will not come into contact with the CKD fills nor the soil cap layer.

It may be desirable also to excavate the existing carbonate precipitate that has developed since 1997 on the surficial soils below the CKD fills at the site. This material is located adjacent to Puget Creek, and water that contacts this material may adversely impact the quality of the water in the creek.

If dioxin is found at the site, the above recommendations would need to be re-evaluated. The existing soil cap may require upgrading to meet federal hazardous waste site requirements, and discharge of the water seepage to the sanitary sewer may not be permitted.

Geo Group Northwest, Inc., does not recommend undertaking attempts to intercept and divert potential, limited bodies of groundwater that may present upgradient from the CKD fills. We anticipate that substantial costs would be incurred to locate, delineate, and evaluate these water-bearing zones, if present. This groundwater, if present, would then need to be extracted and discharged to a suitable location either on or off the site, at significant expense in engineering, construction, and operations and maintenance. It is our opinion that this work would result in minimal or no reduction of the amount of seepage that contacts the CKD and reaches the ground surface and Puget Creek.

11 LIMITATIONS

This project has been prepared for the specific application to this site for the exclusive use of the City of Seattle and its authorized agents. Any use of this report by third parties is solely at that party's own risk.

Our findings and recommendations stated herein are based on the information that was provided to us from a variety of sources. For the purposes of this report, we have relied on the documents and other records and information that have been provided to us or obtained by us. Geo Group Northwest, Inc., makes no assertion that information prepared or provided by others is accurate or correct.

The recommendations are our professional opinion derived in a manner as discussed above and consistent with the level of care and skill ordinarily exercised by other members of the profession currently practicing under similar conditions in this area and within the existing budget and

October 20, 2003

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Ms. Colleen Browne - Seattle Department of Parks and Recreation

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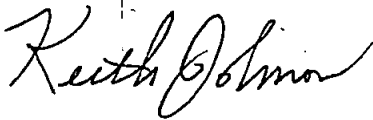
schedule constraints. No warranty as to the findings, conclusions, or recommendations in this report is expressed nor implied.

12 CLOSING

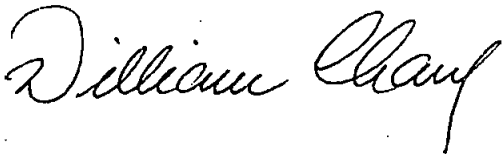
We appreciate this opportunity to provide the Seattle Department of Parks and Recreation with environmental consulting services. Please do not hesitate to call us if you have any questions regarding the information in this report.

Sincerely,

GEO GROUP NORTHWEST, INC.



Keith Johnson
Geologist



William Chang, P.E.
Principal

Geo Group Northwest, Inc.

TABLES

E-0290-6

TABLE 1

LABORATORY ANALYSIS RESULTS - CEMENT KILN DUST FILL SAMPLES

Puget Park (SW Hudson Street Site)
Seattle, Washington

G-0290-6

Sample Identification	Date Collected	Location	Depth (feet)	pH	Total Lead (ppm)	TCLP Lead	Total Arsenic (ppm)	TCLP Arsenic	Total Cadmium (ppm)	TCLP Cadmium	Total Mercury (ppm)	TCLP Mercury	Total Chromium (ppm)	TCLP Chromium	Total Silver (ppm)	TCLP Silver	Total Selenium (ppm)	TCLP Selenium	Total Barium (ppm)	TCLP Barium (ppm)
10 + 19	6/21/94	City R-O-W	1.5	12.34	2500	2.1	370	ND	8.8	ND	ND	ND	11	ND	8.3	0.22	ND	ND	120	0.46
7 + 00	6/21/94	City R-O-W	4.0	8.38	13	NT	12	NT	2.1	NT	ND	NT	35	NT	0.8	NT	ND	NT	66	NT
Mayer-2	6/21/94	City R-O-W	2.5	9.38	890	NT	150	NT	3.1	NT	ND	NT	13	NT	3.9	NT	ND	NT	74	NT
Mayer-3	6/21/94	City R-O-W	3.0	12.36	880	0.58	140	ND	3.2	ND	ND	ND	14	ND	4.4	0.017	ND	ND	39	0.42
Mayer-4	6/21/94	City R-O-W	1.5	8.29	12	NT	14	NT	3.2	NT	ND	NT	70	NT	0.91	NT	ND	NT	160	NT
Mayer-5	6/21/94	City R-O-W	1.5	8.15	34	NT	9.3	NT	1.7	NT	ND	NT	29	NT	0.78	NT	ND	NT	46	NT
9 + 25	6/21/94	McFarland	1.5	7.87	3000	NT	330	NT	10	NT	ND	NT	10	NT	8.5	NT	ND	NT	110	NT
9 + 25	6/21/94	McFarland	4.0	12.37	2600	1.7	330	ND	8.6	ND	ND	ND	12	ND	8.3	0.019	ND	ND	110	1.3
8 + 50	6/21/94	McFarland	2.5	12.31	1800	NT	230	NT	7.3	NT	ND	NT	14	NT	6.1	NT	ND	NT	93	NT
7 + 75	6/21/94	McFarland	4.0	12.29	1400	NT	150	NT	5.4	NT	ND	NT	21	NT	6.4	NT	ND	NT	130	NT
9 + 49 - 10W	6/21/94	McFarland	0.5	12.32	3500	NT	390	NT	12	NT	ND	NT	12	NT	9.8	NT	ND	NT	120	NT
9 + 35 - 15E	6/21/94	McFarland	0.4	12.27	3100	NT	360	NT	9.6	NT	ND	NT	12	NT	9	NT	ND	NT	110	NT
9 + 08 - 26W	6/21/94	McFarland	0.3	12.29	2200	NT	320	NT	8.4	NT	ND	NT	13	NT	7.6	NT	ND	NT	120	NT
8 + 10 - 30W	6/21/94	McFarland	0.4	11.61	920	NT	120	NT	4.7	NT	ND	NT	27	NT	3.8	NT	ND	NT	86	NT
8 + 63 - 11W	6/21/94	McFarland	0.5	12.39	3600	NT	440	NT	13	NT	ND	NT	15	NT	10	NT	ND	NT	120	NT
7 + 50	6/21/94	McFarland	0.5	12.33	980	NT	130	NT	5.2	NT	0.13	NT	13	NT	4.1	NT	ND	NT	57	NT
9 + 25, 6"E	11/11/94	McFarland	1.5	8.1	NT	0.53	NT	1.4	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
9 + 35, 10"E	11/11/94	McFarland	1.0	12.5	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT	NT
Regulatory Criteria																				
MTCA Method A Cleanup Level - Soil				NE	250	NE	20	NE	2	NE	2	NE	2000 *	NE	NE	NE	NE	NE	NE	NE
Washington Dangerous Waste Designation Criteria																				
Corrosivity and Toxicity Characteristics				12.5	NE	5	NE	5	NE	1	NE	0.2	NE	5	NE	5	NE	1	NE	100
Toxic Dangerous Waste				-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes:

NT = Not tested.

ND = Not detected. Refer to laboratory report for detection limits.

NE = Not established.

+ = Bioassay testing is required to determine whether the Toxic Dangerous Waste criterion is passed or failed.

* = For Cr III; cleanup level for Cr VI is 19 ppm.

Concentrations exceeding regulatory criteria are shown in bold text.

Total Metals analyses were performed using EPA Method 6000/7000 Series; pH analyses were performed using EPA Method 9045.

TCLP Metals analyses were performed using EPA Method 1311 for extraction, and then EPA Method 6000/7000 Series.

TABLE 2

LABORATORY ANALYSIS RESULTS - PUGET CREEK AND SEEPAGE WATER SAMPLES

Puget Park (SW Hudson Street Site)
Seattle, Washington

G-0290-6

Sample Identification	Date Collected	Temperature (deg C)	pH	Dissolved Solids (ppm)	Suspended Solids (ppm)	Hardness (ppm)	Total Lead (ppm)	Dissolved Lead (ppm)	Total Arsenic (ppm)	Dissolved Arsenic (ppm)	Total Cadmium (ppm)	Dissolved Cadmium (ppm)
Puget Creek Samples												
Downgradient from Site												
SW-1	8/29/96	NT	8.0	760	33	350	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
	7/25/97	NT	8.0	450	12	220	0.0037	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
Stream 3	6/30/98	15.1	8.21	NT	NT	210	0.00075	(0.0005)	0.0025	0.0031	(0.0005)	(0.0005)
	6/25/99	NT	8.23	NT	NT	150	(0.001)	(0.001)	0.0025	0.0023	(0.001)	(0.001)
Upgradient from Site												
SW-2	8/29/96	NT	8.1	240	(10)	200	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
	7/25/97	NT	6.2	370	(10)	180	(0.003)	(0.003)	(0.005)	(0.005)	(0.005)	(0.005)
Stream 2	6/30/98	15.1	8.11	NT	NT	180	(0.0005)	(0.0005)	0.0026	0.0024	(0.0005)	(0.0005)
	6/25/99	NT	7.94	NT	NT	150	(0.001)	(0.001)	0.0021	0.0018	(0.001)	(0.001)
Seepage Water Samples												
PP-Seep	8/29/96	NT	12.3	2500	18	1200	1.3	1.0	(0.005)	(0.005)	(0.005)	(0.005)
PP-Seep-2	10/4/96	NT	12.3	2400	36	1000	1.3	1.1	(0.005)	(0.005)	(0.005)	(0.005)
A1-Out	6/30/98	20.0	11.8	NT	NT	77	0.0057	0.0022	0.0044	0.0043	(0.0005)	(0.0005)
	6/25/99	NT	11.4	NT	NT	120	200	0.0038	0.0067	0.0019	(0.001)	(0.001)
A3-In	6/30/98	15.3	8.1	NT	NT	560	0.093	(0.0005)	0.0061	0.0033	(0.0005)	(0.0005)
	6/25/99	NT	7.9	NT	NT	480	0.056	0.0029	0.0050	0.0054	(0.001)	(0.001)

TABLE 2

LABORATORY ANALYSIS RESULTS - PUGET CREEK AND SEEPAGE WATER SAMPLES

Puget Park (SW Hudson Street Site)
Seattle, Washington

G-0290-6

Sample Identification	Date Collected	Temperature (deg C)	pH	Dissolved Solids (ppm)	Suspended Solids (ppm)	Hardness (ppm)	Total Lead (ppm)	Dissolved Lead (ppm)	Total Arsenic (ppm)	Dissolved Arsenic (ppm)	Total Cadmium (ppm)	Dissolved Cadmium (ppm)
Seepage Water Samples (cont'd)												
A3-SE	6/30/98	17.7	12.5	NT	NT	920	0.54	0.21	0.0063	0.0038	(0.0005)	(0.0005)
	6/25/99	NT	12.1	NT	NT	760	0.27	0.058	0.004	0.0021	(0.001)	(0.001)
A3-Out	6/30/98	16.1	9.8	NT	NT	150	0.026	0.012	0.010	0.010	(0.0005)	(0.0005)
	6/25/99	NT	8.9	NT	NT	190	0.34	0.0014	0.029	0.0088	(0.001)	(0.001)
Regulatory Criteria												
Surface Water Quality Standards - Acute		NE	NE	NE	NE	NE	NE	HD	NE	0.360	NE	HD
Surface Water Quality Standards - Chronic		NE	NE	NE	NE	NE	NE	HD	NE	0.190	NE	HD
Class B Surface Water - Freshwater Criteria		21.0 max. *	6.5 - 8.5 **	NE	NE	NE	as above	as above	as above	as above	as above	as above

Notes:

Results in parentheses indicate the analyte was not detected in the sample; the value in parentheses represents the laboratory reporting limit.

NE = Not established.

NT = Not tested.

HD = Value is dependent on hardness of sample. Refer to the equations presented below for details.

Concentrations exceeding regulatory criteria are shown in bold text.

Metals analyses were performed using EPA 6000/7000 Series methods.

Hardness analysis were performed by calculation using EPA Method 6010.

TABLE 2

LABORATORY ANALYSIS RESULTS - PUGET CREEK AND SEEPAGE WATER SAMPLES

**Puget Park (SW Hudson Street Site)
Seattle, Washington**

G-0290-6

Notes (cont'd):

Total Dissolved Solids, total suspended solids, and pH were analyzed using EPA Methods 160.1, 160.2, and 150.1, respectively.

Surface Water Quality Standards are presented in Washington Administrative Code (WAC) Chapter 173-201A-040 (revision 11/18/97).

Class B Surface Water Standards are presented in Washington Administrative Code (WAC) Chapter 173-201A-030 (revision 11/18/97).

* = When natural temperature exceeds 21.0, no temperature increase exceeding 0.3 degrees shall be allowed. Refer to regulation text for further details.

** = Human-caused variation within this range shall not exceed 0.5 units.

Calculations of hardness-dependent criteria (noted HD in above table) for surface water (identified as X in the following equations):

For Cadmium

$X_{acute} = (CF)(e^{(1.128[Inv(H)]-3.828)})$, where H = hardness and CF = correction factor (which is a function of H).

$CF = 1.136672 - [(Inv[H])(0.041838)]$

X and H are expressed in units of mg/L.

$X_{chron} = (CF)(e^{(0.7852[Inv(H)]-3.490)})$, where H = hardness and CF = correction factor (which is a function of H).

$CF = 1.101672 - [Inv(H)(0.041838)]$

X and H are expressed in units of mg/L.

For Lead

$X_{acute} = (CF)(e^{(1.273[Inv(H)]-1.460)})$, where H = hardness and CF = correction factor (which is a function of H).

$CF = 1.146203 - [(Inv[H])(0.145712)]$

X and H are expressed in units of mg/L.

$X_{chron} = (CF)(e^{(1.273[Inv(H)]-4.705)})$, where H = hardness and CF = correction factor (which is a function of H).

$CF = 1.146203 - [(Inv[H])(0.145712)]$

X and H are expressed in units of mg/L.

TABLE 3

LABORATORY ANALYSIS RESULTS - CARBONATE PRECIPITATE SAMPLES

Puget Park (SW Hudson Street Site)
Seattle, Washington

G-0290-6

Sample Identification	Date Collected	Collected by	Location	pH	Total Lead (ppm)	Total Arsenic (ppm)	Total Cadmium (ppm)
MC-1	8/29/96	HC	McFarland	10.0	410	35	ND
MC-2	8/29/96	HC	McFarland	9.6	13	5.2	ND
MC-3	8/29/96	HC	McFarland	7.9	130	2.4	ND
PP-1	8/29/96	HC	Puget Park	7.2	51	9.0	0.70
PP-2	8/29/96	HC	Puget Park	9.2	95	2.9	0.60
PP-3	8/29/96	HC	Puget Park	9.7	1500	16	ND
PP-4	8/29/96	HC	Puget Park	12.3	250	270	ND
PP-5	8/29/96	HC	Puget Park	8.7	5300	100	19
PP-6	8/29/96	HC	Puget Park	11.5	1300	10	ND
PP-7	8/29/96	HC	Puget Park	10.8	280	10	0.88
PP-8	8/29/96	HC	Puget Park	7.0	38	6.2	ND
PP-9	8/29/96	HC	Puget Park	7.9	1600	35	1.9

Regulatory Criteria

MTCA Method A Cleanup Level - Soil	NE	250	20	2
Washington Dangerous Waste Designation Criteria				
Corrosivity and Toxicity Characteristics	12.5	NE	NE	NE
Toxic Dangerous Waste ⁺	-	-	-	-

Notes:

NT = Not tested.

ND = Not detected. Refer to laboratory report for detection limits.

NE = Not established.

+ = Bioassay testing is required to determine whether the Toxic Dangerous Waste criterion is passed or failed.

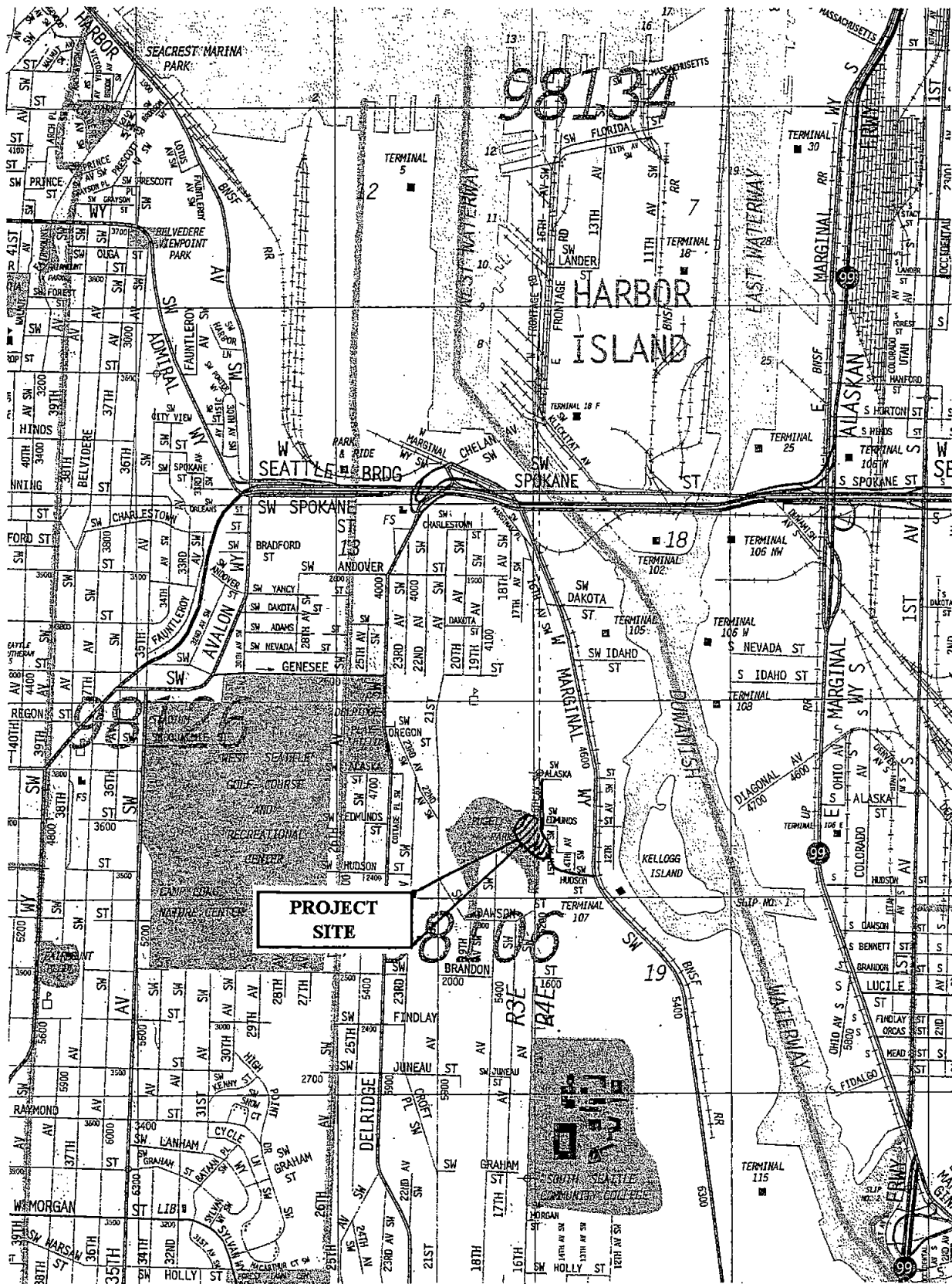
* = For Cr III; cleanup level for Cr VI is 19 ppm.

Concentrations exceeding regulatory criteria are shown in bold text.

Total Metals analyses were performed using EPA Method 6000/7000 Series; pH analyses were performed using EPA Method 9045.

ILLUSTRATIONS

E-0290-6



Group Northwest, Inc.

Geotechnical Engineers, Geologists, &
Environmental Scientists

SITE LOCATION MAP

SEATTLE DEPT. OF PARKS AND RECREATION
PUGET PARK
SEATTLE, WASHINGTON

SCALE: 1" = 2000'

DATE: 6/27/03

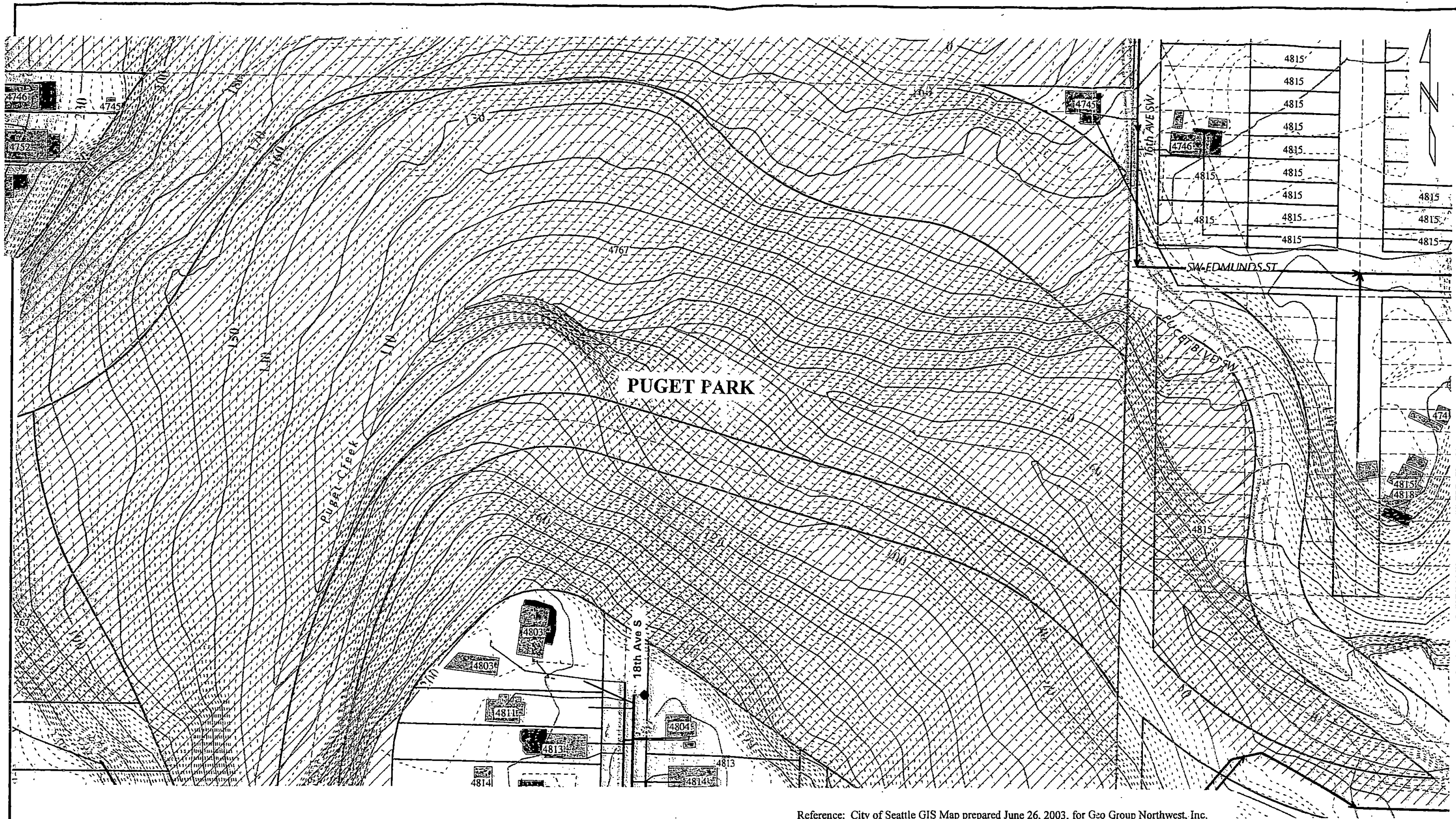
MADE: KJ

CHKD: WC

JOB NO: E-0290-6

PLATE

1



Reference: City of Seattle GIS Map prepared June 26, 2003, for Geo Group Northwest, Inc.



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SITE VICINITY MAP

SEATTLE DEPT. OF PARKS AND RECREATION
PUGET PARK
SEATTLE, WASHINGTON

SCALE: 1" = 100'

DATE: 7/15/03

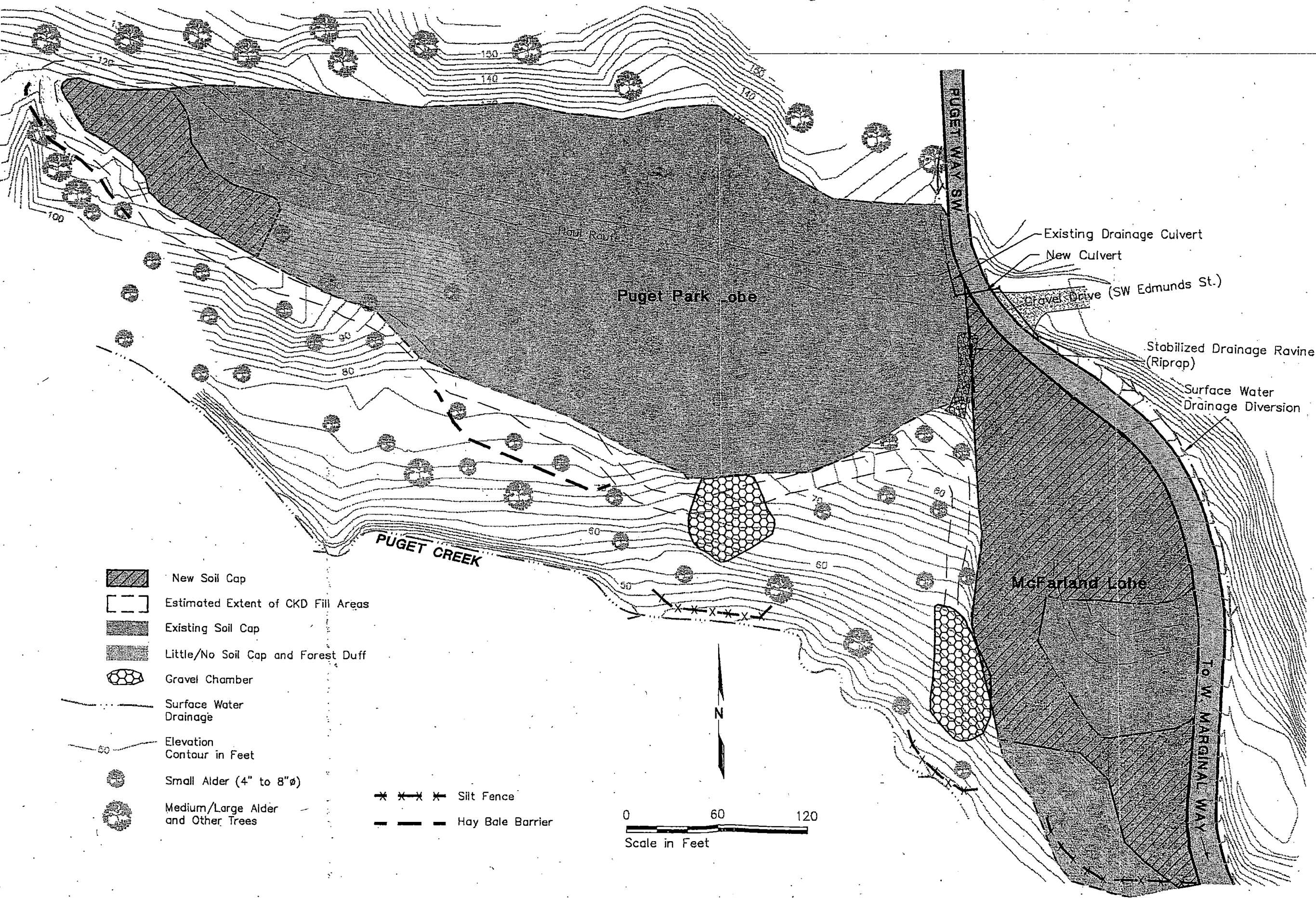
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CHKD: WC

JOB NO: E-0290-6

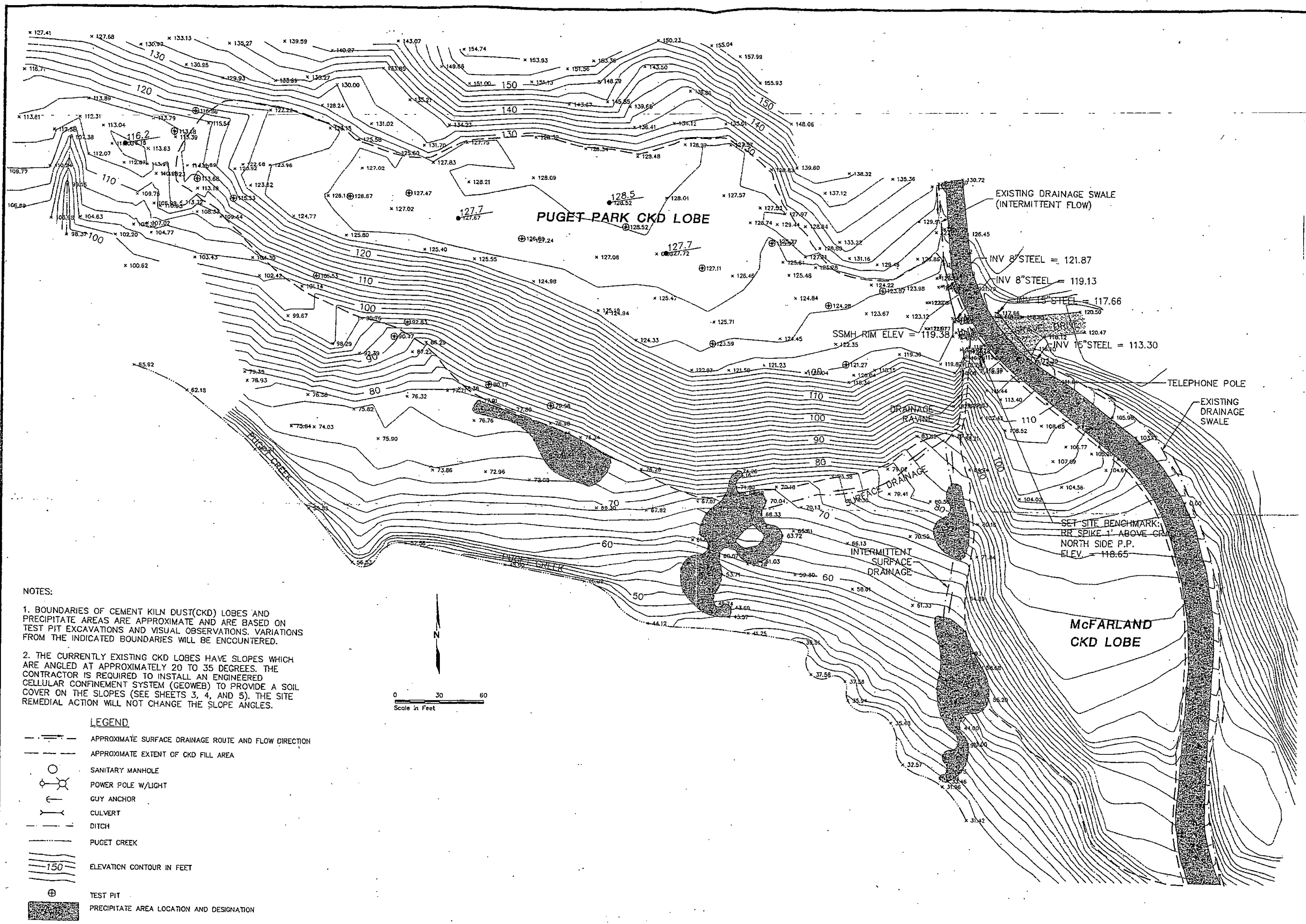
PLATE 2

Site Conditions after Remedial Action - As-Built Construction Map
Hudson Street Site



GEO Group Northwest, Inc. Geotechnical Engineers, Geologists, & Environmental Scientists			SITE PLAN (AFTER REMEDIATION CONSTRUCTION) SEATTLE DEPT. OF PARKS AND RECREATION PUGET PARK SEATTLE, WASHINGTON		
SCALE:	1" = 60'	DATE:	7/2/03	MADE:	KJ
		CHKD:	WC	JOB NO:	E-0290-6
				PLATE	3

Reference: Hart Crowser, December 19, 1997.

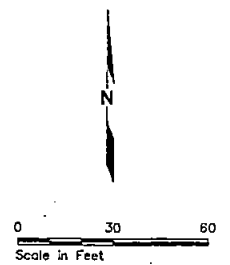


NOTES:

1. BOUNDARIES OF CEMENT KILN DUST(CKD) LOBES AND PRECIPITATE AREAS ARE APPROXIMATE AND ARE BASED ON TEST PIT EXCAVATIONS AND VISUAL OBSERVATIONS. VARIATIONS FROM THE INDICATED BOUNDARIES WILL BE ENCOUNTERED.

2. THE CURRENTLY EXISTING CKD LOBES HAVE SLOPES WHICH ARE ANGLED AT APPROXIMATELY 20 TO 35 DEGREES. THE CONTRACTOR IS REQUIRED TO INSTALL AN ENGINEERED CELLULAR CONFINEMENT SYSTEM (GEOWEB) TO PROVIDE A SOIL COVER ON THE SLOPES (SEE SHEETS 3, 4, AND 5). THE SITE REMEDIAL ACTION WILL NOT CHANGE THE SLOPE ANGLES.

- LEGEND**
- APPROXIMATE SURFACE DRAINAGE ROUTE AND FLOW DIRECTION
 - APPROXIMATE EXTENT OF CKD FILL AREA
 - SANITARY MANHOLE
 - ⊕ POWER POLE W/LIGHT
 - ⊕ GUY ANCHOR
 - CULVERT
 - DITCH
 - PUGET CREEK
 - 150 ELEVATION CONTOUR IN FEET
 - ⊕ TEST PIT
 - PRECIPITATE AREA LOCATION AND DESIGNATION

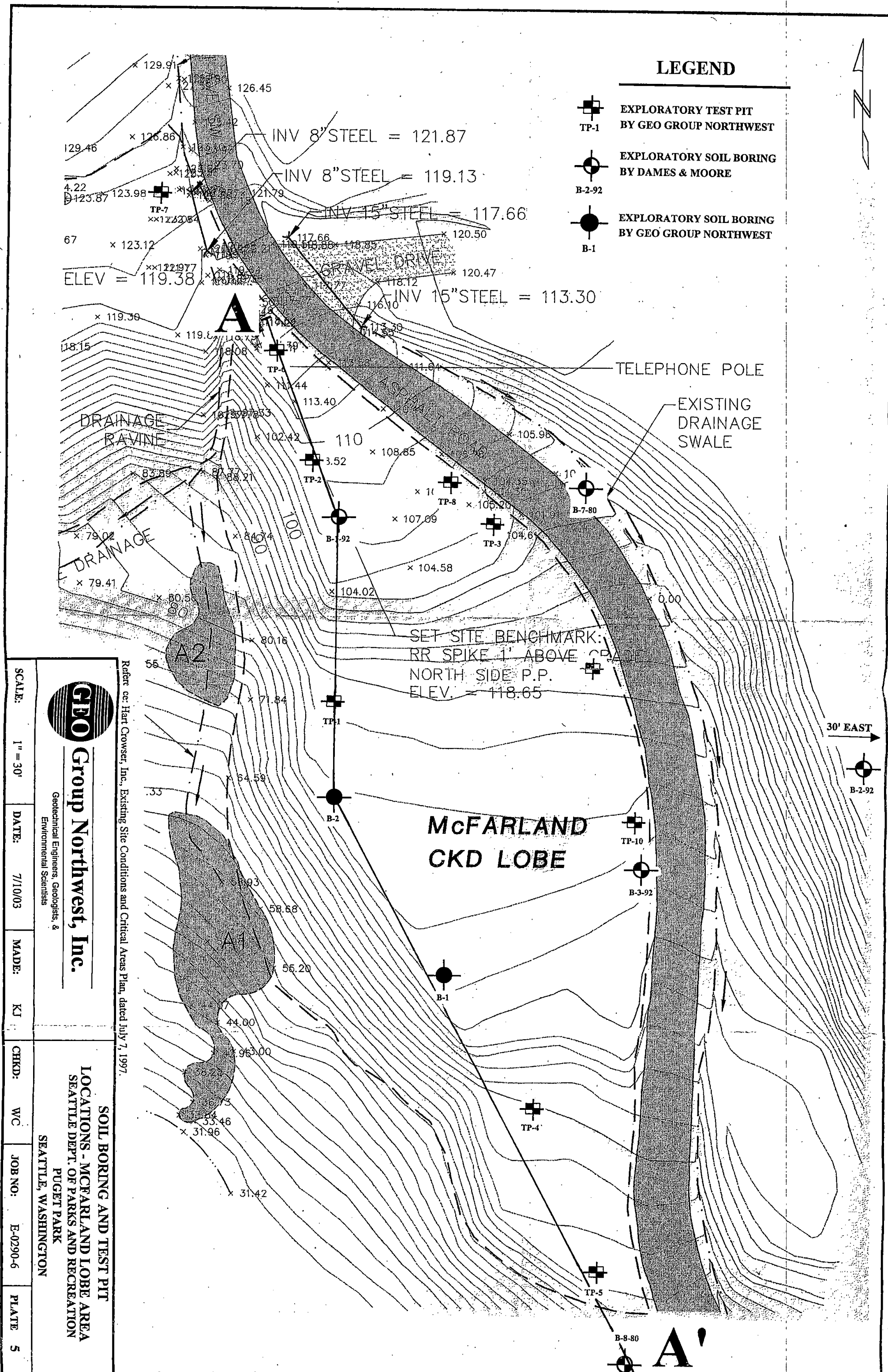


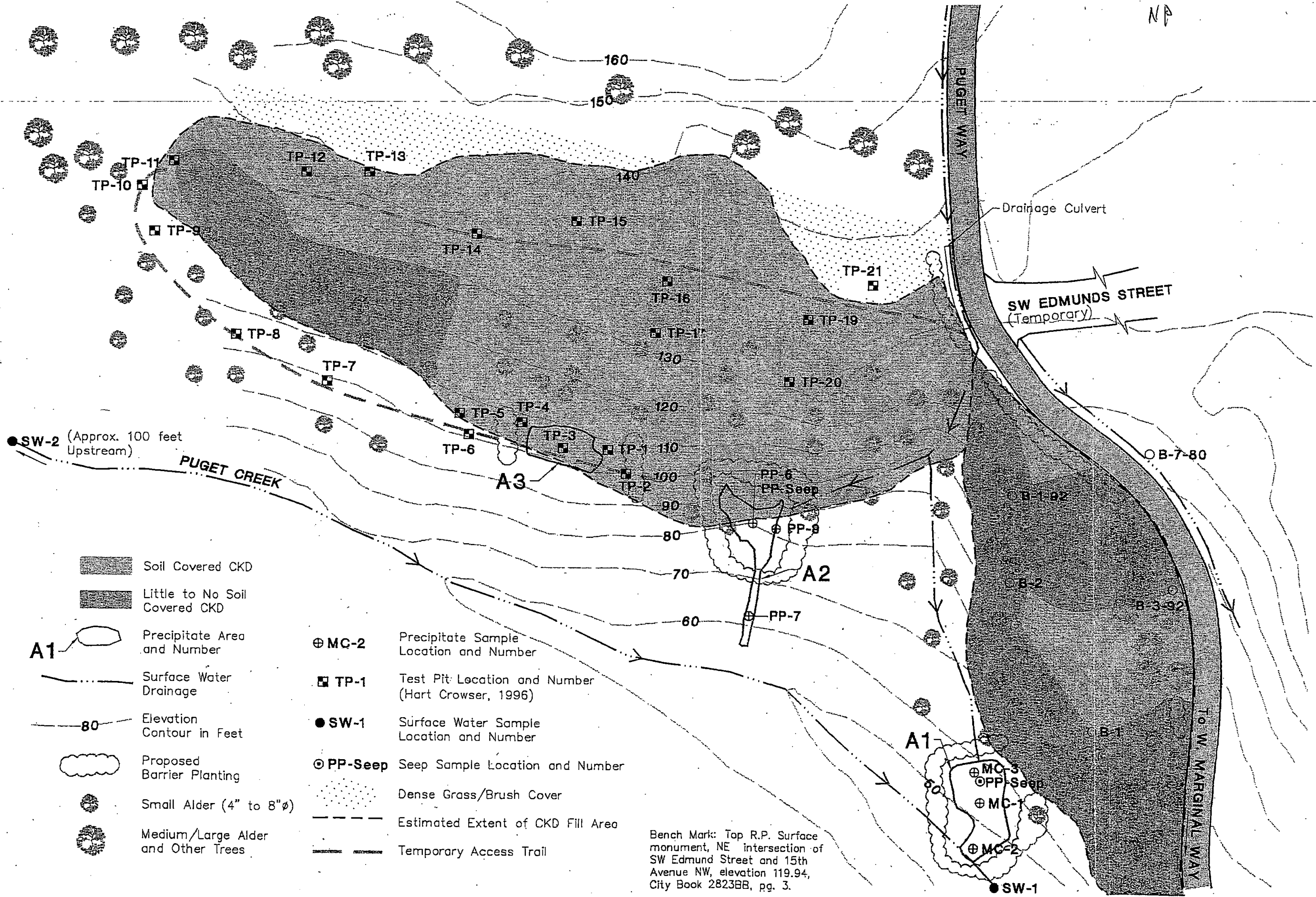
Reference: Hart Crowder, Inc., Existing Site Conditions and Critical Areas Plan, dated July 7, 1997.

GEO Group Northwest, Inc.
Geotechnical Engineers, Geologists, &
Environmental Scientists

SITE PLAN
(BEFORE REMEDIATION CONSTRUCTION)
SEATTLE DEPT. OF PARKS AND RECREATION
PUGET PARK
SEATTLE, WASHINGTON

SCALE: 1" = 60'	DATE: 7/11/03	MADE: KJ	CHKD: WC	JOB NO: E-0290-6	PLATE 4
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- Soil Covered CKD
- Little to No Soil Covered CKD
- A1** Precipitate Area and Number
- Surface Water Drainage
- Elevation Contour in Feet
- Proposed Barrier Planting
- Small Alder (4" to 8"φ)
- Medium/Large Alder and Other Trees
- MC-2** Precipitate Sample Location and Number
- TP-1** Test Pit Location and Number (Hart Crowser, 1996)
- SW-1** Surface Water Sample Location and Number
- PP-Seep** Seep Sample Location and Number
- Dense Grass/Brush Cover
- Estimated Extent of CKD Fill Area
- Temporary Access Trail

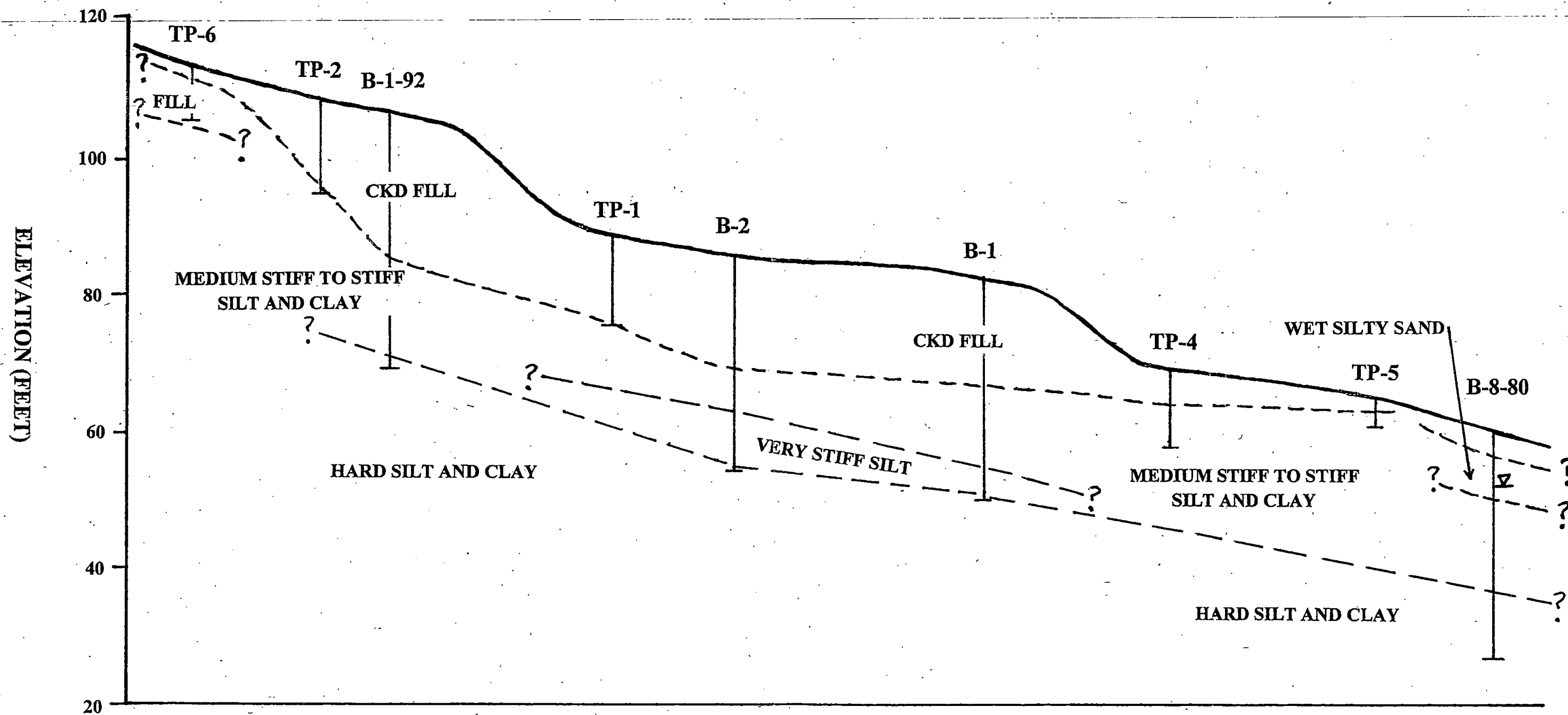
Bench Mark: Top R.P. Surface monument, NE intersection of SW Edmund Street and 15th Avenue NW, elevation 119.94, City Book 2823BB, pg. 3.

Reference: Hart Crowser, September 5, 1997.

GEO Group Northwest, Inc. Geotechnical Engineers, Geologists, & Environmental Scientists			EXPLORATION AND SAMPLE LOCATIONS - PUGET PARK LOBE AREA SEATTLE DEPT. OF PARKS AND RECREATION PUGET PARK SEATTLE, WASHINGTON		
SCALE: 1" = 60'	DATE: 7/2/03	MADE: KJ	CHKD: WC	JOB NO: E-0290-6	PLATE 6

A

A'



0 30 60
HORIZONTAL SCALE: 1 inch = 30 feet

0 15 30
VERTICAL SCALE: 1 inch = 15 feet



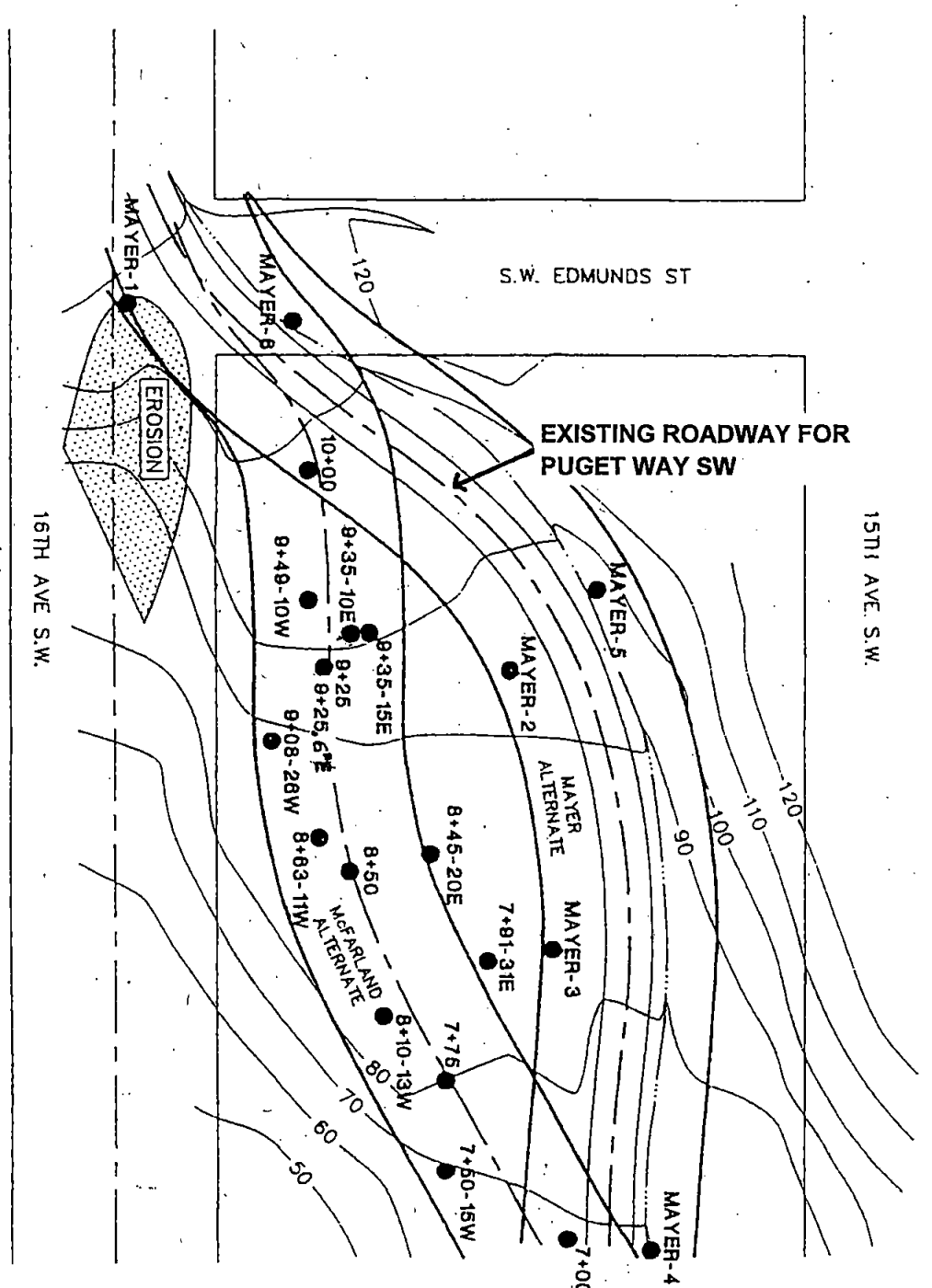
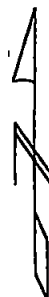
GEO Group Northwest, Inc.

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Environmental Scientists

CROSS SECTION A - A'

SEATTLE DEPT. OF PARKS AND RECREATION
PUGET PARK
SEATTLE, WASHINGTON

SCALE: As Noted	DATE: 8/12/03	MADE: KJ	CHKD: WC	JOB NO: E-0290-6	PLATE 7
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Reference: AGRA Earth & Environmental, December 29, 1994 (Draft).

Note: Sample locations are approximate.



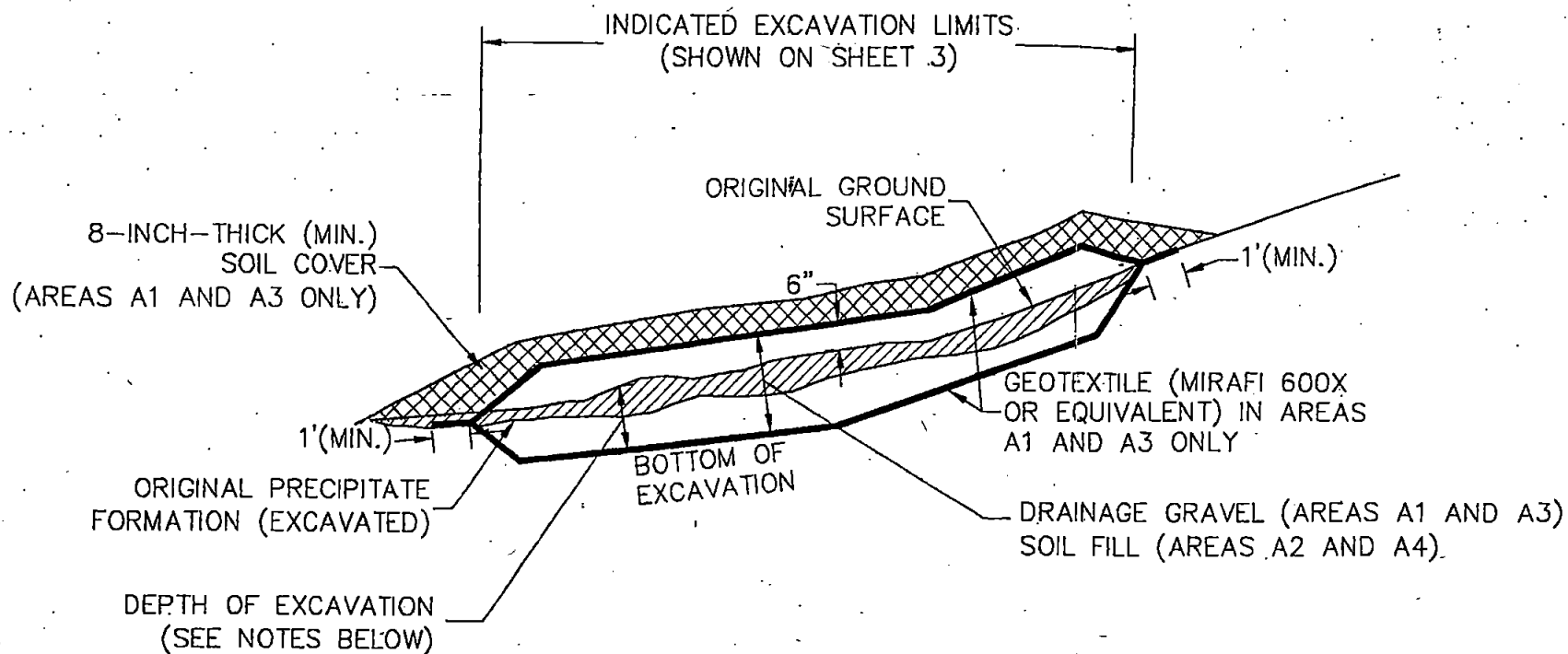
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CKD SAMPLE LOCATIONS

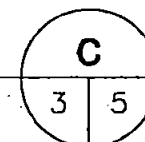
SEATTLE DEPT. OF PARKS AND RECREATION
PUGET PARK
SEATTLE, WASHINGTON

SCALE:	NONE	DATE:	7/2/03	MADE:	KJ	CHKD:	WC	JOB NO:	E-0290-6	PLATE	8
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SECTION - PRECIPITATE EXCAVATION AREA (TYP.)

NOT TO SCALE



Reference: Soil-Geoweb Cover and Excavation Area Details by Hart Crowser, Inc., dated July 7, 1997.



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**PRECIPITATE CHAMBER
CONSTRUCTION DETAILS**
SEATTLE DEPT. OF PARKS AND RECREATION
PUGET PARK
SEATTLE, WASHINGTON

SCALE: NONE	DRAWN BY: KJ	CHECKED BY: WC	DATE: 7/11/03	PROJECT NO.: E-0290-6	PLATE 9
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APPENDIX A
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E-0290-6

BIBLIOGRAPHY

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