Final

Preliminary Site Investigation Report for the South Park Bridge Project

July 2004

Prepared for:
King County Department of Transportation
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Table of Contents

Executive Summary **1**
Study Objectives 1
Field Work 2
Sampling Activities 4
Laboratory Results 5
Soil Results 5
Groundwater Results 5
Sediment Results 5
Summary of Study Findings 6
Conclusions and Recommendations 7
1.0 Introduction **9**
1.1 Responsible Offices/Consultants 9
1.2 Site-Specific Information 9
1.3 Purpose 11
2.0 Site Description **12**
2.1 Location 12
2.2 Land Uses 12
2.2.1 Geology 12
2.2.2 Soil 13
2.2.3 Groundwater 14
2.2.4 Sediment 14
2.2.5 Hydrology 15
3.0 Records Review **17**
3.1 Historical Research 17
3.2 Regulatory Database Review 21
3.2.1 Additional Available Environmental Data 21
3.2.2 Summary of Sites of Environmental Concern 21
4.0 Field Investigation Activities **25**
4.1 Sampling Program Summary 25
4.2 Soil Sampling Activities 31
4.3 Groundwater Sampling Activities 31
4.4 Sediment Sampling Activities 32
5.0 Laboratory Analysis **36**
5.1 Laboratory 36
5.2 Analytical Methods 36
5.3 Sample Details 36
5.4 Analytical Results 37
5.4.1 Analytical Results for Soil 40
5.4.2 Analytical Results for Groundwater 40
5.4.3 Analytical Results for Sediment 40
5.5 Analytical Reports 42

6.0 Discussion of Findings and Conclusions 45
6.1 Sediment Sampling 45
6.2 Results Summary 45
6.2.1 Soil Sample Results 46
6.2.2 Groundwater Sample Results 48
6.2.3 Sediment Sample Results 48
6.3 Contaminant Characteristics 49
6.3.1 Identify the Suspected Source of Contamination 49
6.3.2 Comparison of Contamination Associated with Various Bridge Alternatives 51
6.4 Data Validity 51
7.0 Aquifer Testing 53
7.1 Boeing Dewatering Aquifer Test Results 54
7.2 Findings and Costs for Potential Dewatering Activities 55
8.0 Recommendations 56
8.1 Construction 56
8.2 Cleanup Liability 57
8.3 Construction Impacts 58
8.4 Worker Safety 61
8.5 Monitoring 62
9.0 Necessity of Further Assessments of Remediation 63
10.0 Regulatory Requirements 64
10.1 Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund) Regulations (Title 40 CFR, Part 300) 64
10.2 Model Toxics Control Act (MTCA) Regulations (WAC 173-340) 64
10.3 Washington Sediment Management Standards (WAC 173-204-310 through -520; WAC 173-340-760) 64
10.4 Dangerous Waste Regulations (WAC 173-303) 65
10.5 Solid (Non-Dangerous) Waste Disposal (RCW 70.95, WAC 173-304) 65
10.6 Hazardous Waste Operations and Treatment, Storage, and Disposal Facilities (WAC 296-62 Part P, RCW 49-17) 66
10.7 General Occupational Health Standards – Asbestos (WAC 296-62 Part I-1) 66
10.8 Safety Standards for Construction Work—Lead (WAC 296-155) 66
10.9 Water Quality Standards for Surface Waters (WAC 173-201A) 67
10.10 Wastewater Discharges to Ground (WAC 173-216). 67
10.11 Stormwater Permit for Construction Activities and Other Water-Related Permits 67
10.12 National Emission Standards for Hazardous Air Pollutants (NESHAP) (CFR Title 40, Volume 5, Parts 61 to 71) 67
10.13 Puget Sound Clean Air Agency Regulations I-III 68

10.14 Underground Storage Tank Statute and Regulations (RCW 90-76, WAC 173-360) 68
10.15 Underground Utilities (RCW 19.122) 68
10.16 Endangered Species Act (ESA) 69
Limitations 70
References 74

Appendix A Soil Boring Logs
Appendix B PSI Work Plan
Appendix C Analytical Results (CD)
Appendix D MTCA Cleanup Regulation (WAC 173-340-900)
Appendix E Sediment Management Standards (WAC 173-204)
Appendix F King County Letter (December 2003): *Authorization 10451-01 to Discharge to the Sanitary Sewer*
Appendix G Dewatering Pump Test Report

List of Figures

Figure 1 Project Alternative Alignments and Approximate Soil Boring and Monitoring Well Locations....3
Figure 2 Project Area and Vicinity....10
Figure 3 Geologic Cross Section (General View in Project Area)....13
Figure 4 Groundwater Flow Map....16
Figure 5 Substantially Contaminated and Reasonably Predictable Sites....20
Figure 6 Boring Location Map....33
Figure 7 Boring Cross-Section Map with Soil and Sediment Sample Results....43

List of Tables

Table 1 Substantially Contaminated Properties....18
Table 2 Reasonably Predictable Properties....19
Table 3 Upland Soil Samples Analytical Results....27
Table 4 Groundwater Samples Analytical Results (South Park Bridge PSI)....30
Table 5 Sediment Samples Analytical Results (South Park Bridge PSI)....30
Table 6 Method A Soil Cleanup Levels for Unrestricted Land Uses....38
Table 7 Method A Cleanup Levels for Groundwater....39
Table 8 Puget Sound Marine Sediment Cleanup Screening Levels and Minimum Cleanup Levels—Chemical Criteria....41
Table 9 Summary of Contamination in Soil, Groundwater, and Sediment by Bridge Alternative....52
Table 10 Soil Excavation Estimate: 24-Inch Steel Pipe Piles....59
Table 11 Soil Excavation Estimate: Concrete Drilled Shafts....60
Table 12 Summary of Estimated Costs for Handling Contaminated Excavation Materials by Bridge Alternative and Support Design....61
Table 13 Chemical Compounds of Concern: Action Levels....62

Executive Summary

A Preliminary Site Investigation (PSI) was performed for the 14th/16th Avenue South Park Bridge Project to determine if contamination is present in the subsurface soil, groundwater, and sediment near the footprint of the five proposed design alternatives. The PSI focuses on the three proposed bridge replacement alternatives: Bascule, Mid-Level Fixed-Span, and High-Level Fixed-Span. Washington State Department of Transportation (WSDOT) guidelines (2001) were followed in developing and conducting this PSI.

Study Objectives

The PSI was determined to be necessary based on the findings of the *Draft Hazardous Material Technical Report* (Wilbur 2002) completed in 2002. The environmental analysis in that report focused on the 58 properties that would be affected by the proposed replacement alternatives for the South Park Bridge. As a part of that analysis, an Initial Site Assessment (ISA) screening process was conducted based on WSDOT guidelines for identifying properties with known and/or suspected contamination issues.

Of the 58 individual properties assessed under the ISA, 15 sites were identified as having confirmed and documented environmental issues and/or were suspected to have a high probability of environmental risk based on current or past land use.

A PSI is usually conducted on an individual property that needs to be purchased in order to complete a transportation construction project. However, this PSI focused on the eight locations identified as having environmental risks that are located near the footprint of the proposed bridge replacement alternatives (Bascule, Mid-Level Fixed-Span, and High-Level Fixed-Span). Based on the findings of the *Draft Hazardous Material Technical Report* (Wilbur 2002), three sites were found to be substantially contaminated and another twelve were identified as being reasonably predictable to be contaminated. Eight of the fifteen sites were chosen as sample locations because these eight sites would best represent contamination present in the areas of the proposed bridge alternatives. These substantially contaminated and reasonably predictable sites are discussed further in Section 3.1 of this PSI.

WSDOT has adopted the terms *substantially contaminated* and *reasonably predicable* from the Federal Highway Administration (FHWA) environmental guidelines (2001) developed to describe and generally identify the severity of potential environmental risks and to quantify the environmental risks and liabilities. Sites are identified as being either substantially contaminated or reasonably predictable based on the findings of the *Draft Hazardous Materials Technical Report* (Wilbur 2002).

Substantially contaminated sites create more liability either in construction or acquisition than sites identified as reasonably predictable. A substantially contaminated site tends to be a larger site with a long history of heavy industrial operations that handled hazardous materials or has documented releases of hazardous materials to the environment. These sites are usually listed by federal, state, or local regulatory agencies as being contaminated.

Reasonably predictable sites tend to be smaller operations that usually handled or stored less toxic hazardous materials than substantially contaminated sites. Reasonably predictable sites may or may not be listed by federal, state, or local regulatory agencies as being contaminated. Each type of site presents different degrees of environmental risks and liabilities to a transportation construction project. Generally, substantially contaminated sites have the greatest degree of impacts. Sites found to be substantially contaminated or reasonably predictable require a detailed investigation of the nature and extent of contamination in order to quantify the environmental risks to a transportation project's cost and schedule.

Environmental cleanup costs are directly related to the following items: 1) volume of contaminated soil, sediment, and/or groundwater to be removed and disposed of during construction activities; 2) any required dewatering and/or stabilization of excavation material that is contaminated prior to its transport and disposal; 3) the design, permitting, and construction of temporary storage areas to handle contaminated material; and 4) project schedule delays related to permitting and regulatory oversight requirements for the management of contaminated soil, sediment, and groundwater.

Field Work

An extensive work plan was developed for the PSI fieldwork activities to investigate the nature and extent of potential environmental risks in the subsurface soil, groundwater, and sediments near the footprints of the South Park Bridge alternatives. Figure 1 displays project alternative alignments and approximate soil boring and monitoring well locations conducted for this PSI. To identify any potential environmental risks that may be present, borings were drilled and sampled at locations where structural support columns for the bridge alternatives would be constructed. The proposed PSI fieldwork activities were outlined in the work plan. Field activities were carried out during a 65-calendar-day period from June 24 to August 7, 2003.

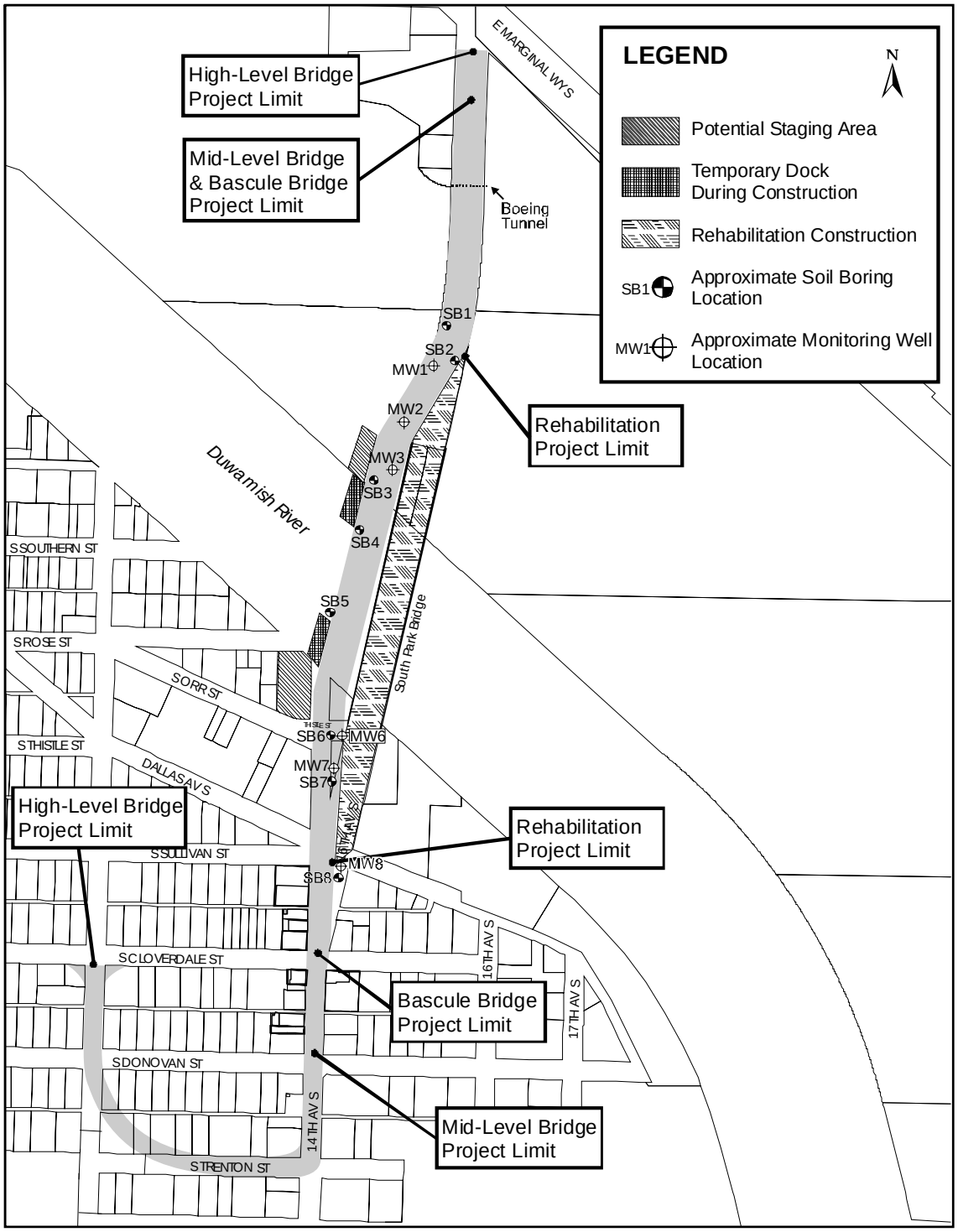


Figure 1
Project Alternative Alignments and Approximate Soil Boring and Monitoring Well Locations

Fifteen borings were drilled into the soil of the upland areas and two borings were drilled into the sediments of the Duwamish Waterway near the footprint of the replacement alternatives. Six of the upland borings were drilled to a depth of 100 feet below the existing ground surface (bgs) by a mud rotary drilling technique to collect geotechnical and soil samples. Seven borings were drilled using a hollow stem auger technique to collect soil samples. However, because of an obstruction, one of these borings was abandoned. The remaining six borings were drilled to a depth of 25 bgs and completed as monitoring wells for the collection of environmental samples. Groundwater samples were collected from each of the monitoring wells. The two in-water borings were drilled to a depth of approximately 100 feet below the water sediment interface in the Duwamish Waterway channel to collect geotechnical and environmental soil samples.

Sampling Activities

The sample analysis plan (SAP) section of the work plan for the PSI outlined the number of soil samples to be collected during the drilling of the environmental and the geotechnical borings. The SAP projected that 84 soil samples would be collected during environmental sampling fieldwork from the six environmental and eight geotechnical borings. The SAP projected that environmental samples were to be collected at 2.5-foot intervals from the environmental borings and from 50-, 75- and 100-foot intervals in the geotechnical borings. Ideally, 60 soil samples from the six environmental borings and 24 soil samples from the eight geotechnical borings were to be collected.

A total of 72 soil samples were collected from the 15 borings and were submitted to the laboratory for analysis. Six sets of groundwater samples were collected from the six environmental borings that were completed as monitoring wells and submitted to the laboratory for analysis. An additional 11 sediment samples were collected from the two borings that were drilled in the water and submitted to the laboratory for analysis.

The actual number of environmental soil samples collected was 54 from the environmental borings and 18 from the geotechnical borings. Several factors led to the reduced number of soil samples collected, including: 1) loss of sampling material when retrieved from the bore hole; 2) saturated fine-grained materials drained out of sampling equipment prevented retrieval below the water table; and 3) asphalt and/or concrete with thickness greater than 2.5 feet at the surface reduced the amount of material available for sampling from some borings.

The loss of sample material during drilling activities is common when collecting environmental samples. Collection equipment used for environmental sampling has a larger diameter barrel than geotechnical sample

collection equipment, and this can result in spillage of the sample material when used in a geotechnical well. Loss of sample tends to increase in a boring below the water table because the material is saturated and easily drains out. No samples were taken of asphalt or concrete surface areas, because no soil or groundwater would be present. Groundwater and soil below asphalt and concrete were sampled. Overall, the number of environmental samples collected and analyzed provided a sufficient data set in which to characterize subsurface soils for the presence of hazardous materials in the saturated and unsaturated soil within the project area

Laboratory Results

Soil Results

A total of 17 soil samples from five borings were found to contain compounds with concentrations above Washington State Model Toxics Control Act (MTCA) Method A levels for soil at an unrestricted land use site.

When these soils are encountered during construction, appropriate actions must be taken to store and contain them, prevent stormwater runoff, control fugitive emissions, ensure proper site management, and document disposal to an appropriate regulated landfill. A designated contaminated materials storage area at the construction site is typically used for managing and controlling contaminated materials, thereby addressing these concerns. Construction workers will be required to comply with the Hazardous Worker Training requirements set forth in Code of Federal Regulations 29 CFR 1910.120 and the Washington Administrative Code (WAC) 296-62 Part P in order to work in an area where contaminated soil is encountered.

Groundwater Results

One groundwater set of samples from a single monitoring well exceeded the MTCA Method A levels for groundwater at an unrestricted land use site.

When this groundwater is encountered during bridge construction, the contaminated groundwater must be managed by either discharge to the sanitary sewer (see Appendix F) or by storing it in onsite storage tanks for ultimate disposal offsite. The management of contaminated groundwater should be documented.

Sediment Results

Six of the eleven sediment samples collected from the upper 10 feet of borings in the Duwamish Waterway channel exceeded U.S. Army Corps of Engineers Puget Sound Dredge Disposal levels for several compounds.

Potential in-water excavation activities of or involving these sediments will require the development and documentation of a detailed sediment management plan. A bio-analysis study may also be required in order to obtain a dredging permit from the U.S. Army Corps of Engineers for the in-water construction activities.

Summary of Study Findings

The soil, groundwater, and sediment from all of the borings were sampled for environmental parameters. The laboratory analysis results and recommendations to mitigate the identified impacts are presented in detail in the body of this report and summarized below.

The PSI confirmed several locations near the footprint of the proposed bridge replacement alternatives where subsurface contamination was found in the soil, groundwater, and sediment. In general, based on the findings, it appears that the larger the footprint of the proposed bridge replacement alternative, the greater and more complex the potential contamination of the soil, groundwater, and sediment will likely be.

Soil located within the north and the south bridge approach areas are also contaminated. Soil contamination was detected in the soil column for all three of the proposed replacement bridge alternatives. The contamination detected is a mix of chemical compounds, located at various depths in the upper 14 feet of the soil column, depending on the location of the boring where the sample was collected.

Groundwater contaminated with chlorinated solvents was encountered in the south bridge approach areas of the proposed alignments of the Mid-Level Fixed-Span and High-Level Fixed-Span bridge alternatives. These chlorinated solvents were more than likely released to the groundwater from local business operations adjacent to the south bridge approach area. Groundwater samples collected within the footprint of the proposed Bascule Bridge Alternative were not contaminated.

Sediment contaminated with polychlorinated biphenyls (PCB) and other chemical compounds were detected within all samples collected in the upper 7 feet of the water-sediment interface on both sides of the Duwamish Waterway. PCB and chemical compounds detected in the samples are likely related to urban and industrial runoff entering the Duwamish Waterway. Sediment samples collected at 50-, 75- and 100-foot depths below the water-sediment interface were found to contain concentrations of metals above regulated levels. The metals contained within these deep sediment samples, however, are naturally occurring elements related to source rock (the source materials from which they were eroded and then deposited) and are not related to human operations.

The environmental risks of each proposed bridge replacement alternative on soil, groundwater, and sediment vary. Environmental risks would likely affect project costs and schedule. Each alternative design is affected by contamination that is present in the soil and sediment, and two alternatives are affected by groundwater contamination. Contaminated soil and sediment will need to be addressed no matter which proposed alternative is selected. Groundwater contamination impacts affect the Mid-Level Fixed-Span and High-Level Fixed-Span bridge alternatives. Contaminated groundwater and soil and sediment impacts will have to be addressed if either the Mid-Level Fixed-Span or the High-Level Fixed-Span bridge alternative design is selected.

Conclusions and Recommendations

The findings of this PSI indicate that the South Park Bridge project area has several sites where the subsurface materials have been contaminated. However, in the samples analyzed, these impacts were not found to exceed federal hazardous waste or Washington State dangerous waste disposal requirements. Nonetheless, some results exceed Washington State Model Toxics Control Act Method A levels and U.S. Army Corps Puget Sound Dredge Disposal levels, and will require special management practices when encountered.

Costs for handling and disposing of these contaminated materials will be much less than they would be if the subsurface materials exceeded federal hazardous waste or Washington State dangerous waste disposal requirements. Estimated costs for handling the contaminated subsurface materials range from $851,000 (Mid-Level Fixed-Span Bridge Alternative) to $1,835,000 (Rehabilitation Alternatives) using 24-inch-steel-pipe piles for construction and $469,000 (Mid-Level Fixed-Span Bridge Alternative) to $631,000 (Rehabilitation Alternatives) using concrete drilled shafts for construction. How these costs were arrived at and costs regarding the proposed Bascule Bridge Alternative and the High-Level Fixed-Span Bridge Alternative are described in this report.

A review of existing aquifer test data for a large-scale dewatering study adjacent to the project site was done as part of the PSI. The total estimated cost for each dewatering system, for a 50-foot-by-50-foot area excavation in which the water table is lowered 8 feet for a period of 74 days, is $762,900. This estimate is based on dewatering system estimated costs of $552,000 and system operational estimated costs of $210,900. Dewatering costs would be in addition to the costs associated with handling and disposal of contaminated materials. Wilbur Consulting, Inc. (WCI) recommends that excavations and/or other construction activities that would require a dewatering system be avoided if at all possible for the South Park Bridge Project. If used, dewatering costs would be incurred for all Build Alternatives.

Based on the analytical results, the following actions are recommended no matter which of the potential project alternatives is selected.

- A focused environmental investigation should be conducted in the actual support column locations and within utility trenching areas of the approach ramp areas after the final bridge design has been selected. This focused investigation would provide the best data set for subsurface conditions that would actually be encountered during construction.

- A detailed environmental investigation of the area under the wharf located on The Boeing Company's (Boeing) property along the shore of the Duwamish Waterway should be conducted after selecting a final bridge design alternative. The wharf area has not been investigated in detail at this time. Based on WCI field surveys of the environment under the wharf during in-water sampling activities, it appears that the wharf is built on fill consisting of construction debris and other previously used materials of indeterminate origin. Thus, the potential for environmental and geotechnical problems that may affect bridge construction activities appears to be high. The wharf area was identified as being potentially contaminated in the *Hazardous Materials Technical Report* (Wilbur 2004), but it was not possible to sample this area during the PSI.

- A stockpile sampling and analysis plan should be developed to ensure quick processing of unforeseen contaminated materials encountered during bridge construction. Establishment of a process with procedures for sampling, analyzing, and determining disposal requirements for unforeseen contaminated soil is essential for successful construction of this project.

- WCI recommends that non-invasive construction techniques (e.g., push piles, when possible) should be used to limit the volume of excavation material generated during bridge construction. By employing non-invasive construction techniques or techniques that limit the volume of the excavated material generated, smaller amounts of contaminated excavation material will need to be stockpiled, analyzed, transported, and disposed of. This will keep construction costs lower.

- WCI recommends that excavations and/or other construction activities that would require a dewatering system be avoided if at all possible for the South Park Bridge Project.

- Two excavated soil stockpile storage areas should be constructed (one on each side of the Duwamish Waterway) to contain and manage contaminated spoil materials generated during construction. Transportation of contaminated soils around and through the construction site, crossing local jurisdictional boundaries and the Duwamish Waterway, will create unnecessary risks and permitting issues for the project. Contaminated soil generated on the north shore of the Duwamish Waterway should remain on the north shore. This is also true for any contaminated soil generated on the south shore.

1.0 Introduction

This report presents the PSI findings and recommendations for the five proposed alternatives for the 14th/16th Avenue South Park Bridge in South Park. The PSI was conducted by Wilbur Consulting Inc. (WCI) as a subconsultant to Parsons Brinckerhoff at the request of King County's Department of Transportation Roads and Bridge Division. The results of the PSI will be incorporated as a part of the Environmental Impact Statement (EIS) for the South Park Bridge Project.

The PSI built on the results of the *Draft Hazardous Material Technical Report* (Wilbur 2002) completed by WCI for Parsons Brinckerhoff for the South Park Bridge Project. This study reviewed 58 properties as a screening process to identify properties with known or suspected environmental risks, and identified a number of substantially contaminated sites or potentially contaminated sites within and/or adjacent to the proposed construction footprints of the five proposed South Park Bridge alternatives. Based on the results of the *Draft Hazardous Materials Technical Report* (Wilbur 2002), the King County Department of Transportation requested that a PSI be conducted to evaluate potential environmental risks and estimated costs associated with construction for the proposed bridge alternatives.

1.1 Responsible Offices/Consultants

The PSI was conducted by WCI as a subconsultant to Parsons Brinckerhoff at the request of King County's Department of Transportation. Shannon & Wilson, a subcontractor to Parsons Brinckerhoff, conducted the geotechnical sampling efforts. Geotechnical sampling was conducted simultaneously with PSI sample collection activities. GeoTech was the contractor that drilled all of the geotechnical and PSI borings and constructed the groundwater monitoring wells. Analytic Resources Inc. (ARI) was the laboratory contracted to analyze all soil, groundwater, and sediment samples collected as a part of the PSI.

1.2 Site-Specific Information

The project area extends from the intersection of East Marginal Way South and 16th Avenue South in the City of Tukwila to the intersection of 14th Avenue South and South Concord Street in the City of Seattle. The street name changes from 16th Avenue South to 14th Avenue South at the mid-span of the South Park Bridge. The bridge is a north-south arterial that crosses the Duwamish Waterway. Its northern half is located within the City of Tukwila and its southern half is located within King County and the City of Seattle. See Figure 2 for project area location.

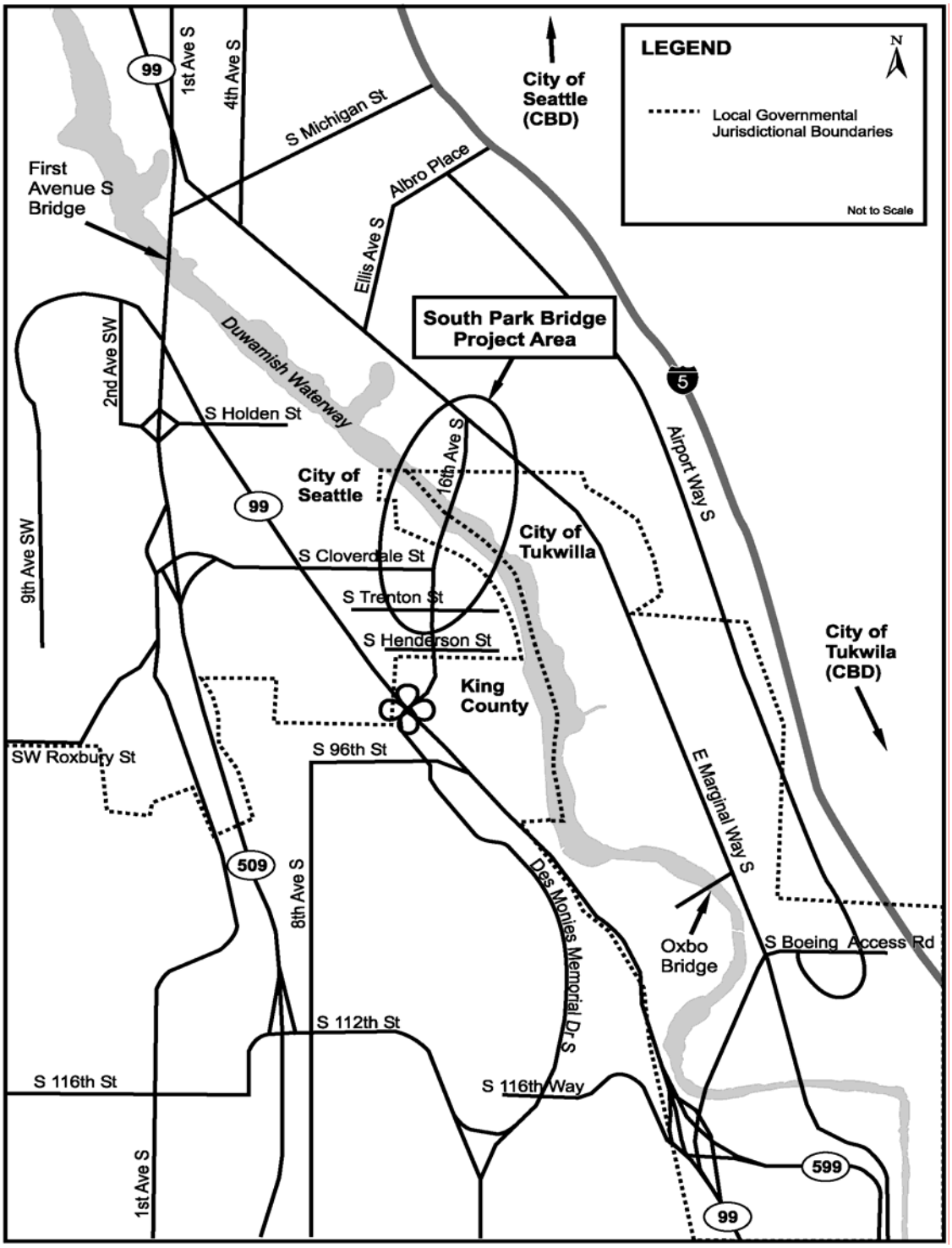


Figure 2
Project Area and Vicinity

1.3 Purpose

This PSI report presents environmental data on soil, groundwater, and sediments that were gathered during fieldwork that began on June 24, 2003, and was completed on August 7, 2003. A PSI usually focuses on an individual property and/or a business operation that is found to be substantially contaminated or suspected to be contaminated based on the results of an ISA. This PSI was designed to investigate the footprint area of the five proposed South Park Bridge alternatives, focusing on the three bridge replacement alternatives (Bascule, Mid-Level Fixed-Span, and High-Level Fixed-Span bridge alternatives). Several properties within the footprint area of the five alternatives or adjacent to this area were found to be contaminated or likely to be contaminated based on the *Draft Hazardous Materials Technical Report* (Wilbur 2002).

The purposes of this PSI are to: 1) confirm whether or not hazardous materials are present within the proposed bridge alternative construction footprints; 2) provide estimated costs of construction activities based on environmental risks to be used in the selection of a specific bridge alternative; and 3) establish a beginning baseline condition for site appraisal activities. The findings presented in this report describe the environmental risks to the soil, groundwater and sediment within or adjacent to the footprints of the proposed bridge alternatives.

2.0 Site Description

2.1 Location

The South Park community is about four miles south of downtown Seattle. The project area lies south of the industrial Georgetown area of Seattle and the King County International Airport (also known as Boeing Field). It encompasses the roadway corridor defined by 16th Avenue South between East Marginal Way South and the South Park Bridge and 14th Avenue South between the South Park Bridge and South Concord Street.

The area is governed by three local government jurisdictions. The area north of the Duwamish Waterway (between East Marginal Way South and the Duwamish Waterway) lies within the City of Tukwila. This is the northern portion of the project area. The area south of the Duwamish Waterway (between the river and South Concord Street) lies within unincorporated King County and the City of Seattle. The two-block area between the riverbank and Dallas Avenue South is in King County, and the city blocks to the south are located in the City of Seattle. This is the southern portion of the project area.

2.2 Land Uses

The project area contains multiple land uses: mixed residential, commercial, and industrial. Boeing Plant 2 dominates the north side of the Duwamish Waterway. On the south side, retail commercial and light industrial land uses front on 14th Avenue South and along the south river bank upstream of the South Park Bridge.

2.2.1 Geology

Generally, the stratigraphic column within the area of interest is underlain by fill material ranging in thickness from 2 to 3 feet. This fill consists of sand with varying amounts of silt mixed with anthropogenic materials, (e.g., bricks, rubble, and wood). An alluvium deposit extends to a depth of approximately 95 feet bgs and is made up of discontinuous silt units resting on interbedded sands and silts. A fine-grained lower silt unit contains shell fragments and has been observed in the boring beneath the lower silt. Dense sand and gravel have been observed at depths below 95 feet bgs (see Figure 3). For a detailed description of the subsurface geology of the project area, see the *Geotechnical Report Phase II, South Park Bridge Project (*Shannon & Wilson 2003).

The Duwamish Waterway estuary was carved by glacial ice and subsequently in-filled by river sediment. The lower boundary of that geologic trough has been reached sporadically by deep borings. Data from these borings indicate that the trough lies roughly 100 feet below the modern ground surface within the project area, and generally shallows to the south and toward the east and west valley walls. The boundary of these deposits is marked either by bedrock

(where present to the south) or by very dense sediment that has been glacially overridden.

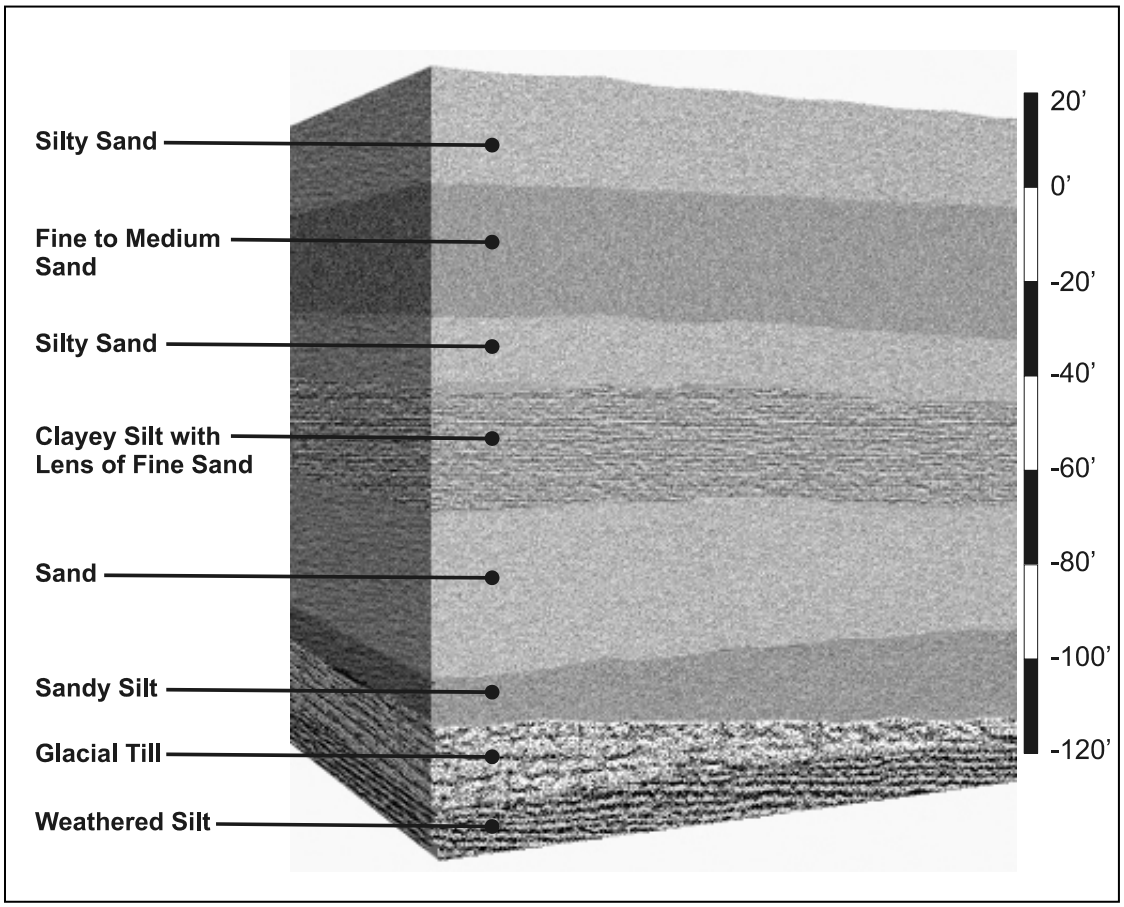


Figure 3
Geologic Cross Section (General View in Project Area)

2.2.2 Soil

Above the glacially overridden boundary, the geologic history of the area suggests that a sequence of estuarine deposits (typically fine sands and silts with shells) should be found and should progress up into a more complexly interbedded river-dominated sequence of sand, silt, and gravel (Weston 1999). The upper part of the river-deposited sediment is comprised of the classic over bank deposition of fine sand and silt, colonization by marshland plants, and occasional erosion and refilling by coarser sediment associated with the migrating Duwamish Waterway. The upper sediment beds contain the unconfined shallow aquifer of the Duwamish Waterway estuary.

2.2.3 Groundwater

The general direction of groundwater flow in the estuary is toward the waterway, although the direction may vary locally, depending on the nature of subsurface material and proximity to the waterway where tidal action can alter groundwater flows. Although high tides can cause temporary groundwater flow reversal, the net groundwater flow direction is toward the waterway. Areas affected by tide-related temporal groundwater flow direction are generally within 300 feet of the waterway. In those areas, the density difference between the freshwater groundwater aquifer and the saltwater tend to focus the outflow of the unconfined aquifer into the intertidal area. Many chemicals experience enhanced natural attenuation in these tidal fluctuating groundwater zones due to the active biogeochemical processes taking place.

Alluvial deposits within the unconfined upper aquifer of the Duwamish Valley are generally fine-grained (fine sand and silty sand) with low to moderate permeability (Pentec Environmental 2001). Based on limited studies at industrial sites within the project area, groundwater gradients are moderate and velocity is low. Although sand and gravel strata with higher permeability may occur in localized areas, thick sections of silt and clay are more common. Permeability of fill materials can vary over short distances and is generally greater than overlying or adjacent natural deposits. Permeability of the soil in the unsaturated zone of the aquifer is moderately slow. The depth to groundwater in the project area varies from the ground surface along the shore of the Lower Duwamish Waterway (LDW) to about 12 feet bgs on average, depending on location and tide level.

2.2.4 Sediment

Bottom sediment composition throughout the LDW ranges from sands to mud, depending on the sediment source and current speed. Sediment typically consists of slightly sandy silt with varying amounts of organic content. Coarser sediments are present in near-shore areas adjacent to combined sewer outfalls (CSO) and storm drain discharges. Finer-grain sediments are typically located in remnant mudflats, along channel side slopes, and within portions of the navigation channel. Main-channel sediments are predominantly sands, whereas sediments toward the mouth are predominately fine-grained silts. Because of the affinity of organic compounds for fine-grained sediment with high organic carbon content, sediment type is an important indicator of areas where chemicals and hazardous materials may accumulate.

2.2.5 Hydrology

An unconfined aquifer in the Duwamish Valley is located within the alluvium unit. Groundwater in the unit is recharged from the highland areas that form the basin of the Duwamish Valley. Water-table elevation within the study area is influenced by tidal action. The average depth to groundwater is 12 feet bgs within the study area. The direction of groundwater flow is toward the channel of the Duwamish Waterway. The unconfined aquifer discharges into the Duwamish Waterway (see Figure 4).

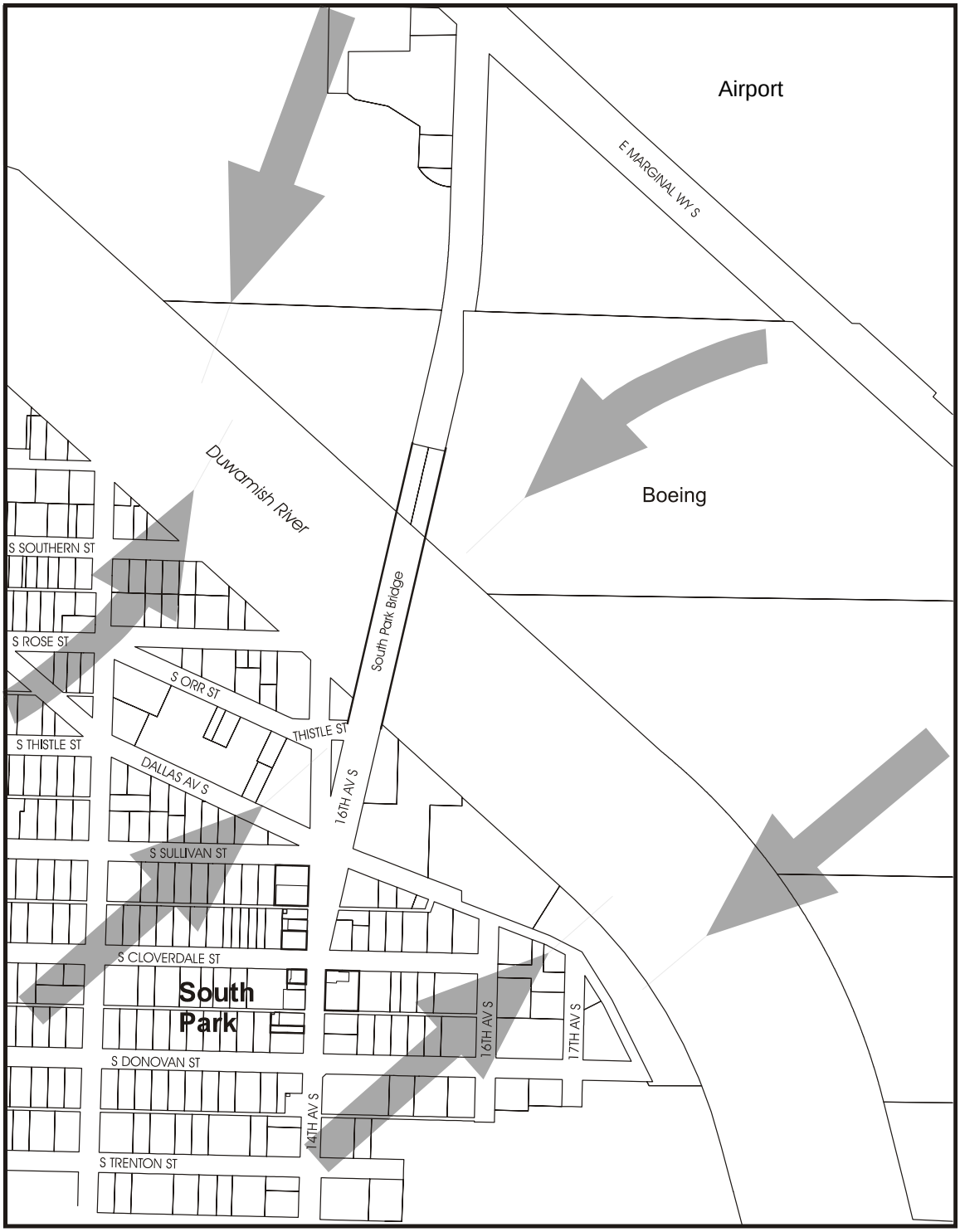


Figure 4
Groundwater Flow Map

3.0 Records Review

The *Draft Hazardous Materials Technical Report* (Wilbur 2002) identified 15 sites of concern located in or adjacent to the footprint of the ground disturbance areas of the proposed bridge alternatives. These 15 sites are comprised of 3 substantially contaminated and 12 reasonably predictable (to be contaminated) properties. A summary of the findings of the *Draft Hazardous Materials Technical Report* (Wilbur 2002) is provided below, and each site is described in Section 3.1 of this report. Regulatory records and databases that were reviewed to identify sites of concern identified in the *Draft Hazardous Materials Technical Report* (Wilbur 2002) are also summarized below.

The terms *substantially contaminated* and *reasonably predicable* are terms that WSDOT has adopted from the FHWA environmental guidelines developed to describe and generally identify the severity of environmental risks and to quantify environmental risks and liabilities. Sites are identified as being either substantially contaminated or reasonably predictable.

A substantially contaminated site has a higher risk factor for environmental contamination and greater impacts to the cost and schedule of a transportation construction project than does a site identified as reasonably predictable. A substantially contaminated site tends to be a larger site with a long history of heavy industrial operations that handled hazardous materials or has documented releases of hazardous materials to the environment. These sites are usually listed by federal, state, or local regulatory agencies as being contaminated. Reasonably predictable sites tend to be smaller operations that usually handle or store less toxic hazardous materials than substantially contaminated sites. Reasonably predictable sites may or may not be listed by federal, state, or local regulatory agencies as being contaminated. Each type of site presents different degrees of environmental risk and liabilities to a transportation construction project. Generally, the substantially contaminated sites have the greatest risks. Sites found to be substantially contaminated or reasonably predictable require a detailed investigation of the nature and extent of contamination in order to quantify the environmental risks to a transportation project's cost and schedule.

3.1 Historical Research

The *Draft Hazardous Materials Technical Report* (Wilbur 2002) completed during the summer of 2002 reviewed 58 properties situated within and adjacent to the right-of-way of all five bridge alternatives for the South Park Bridge.

The 15 sites identified as either substantially contaminated or reasonably predictable are located within or adjacent to the ground disturbance areas of the proposed bridge alternatives. Figure 5 is a site map identifying the location

of these substantially contaminated and reasonably predictable sites. Eight of the fifteen sites were chosen as sample locations because these eight sites would best represent contamination present in the areas of the proposed bridge alternatives. PSI activities were performed at sites A, B, and 5. These substantially contaminated and reasonably predictable sites are summarized in Table 1 and Table 2 and became the focus of this PSI.

Table 1. Substantially Contaminated Properties

Site Number/ Letter	Owner/Operation	Address	Rationale
5	Boeing Plant 2 RCRA Corrective Action	Plant 2 North Campus Area	Ongoing RCRA Corrective Action cleanup of soil, groundwater, and sediments impacted by PCB, chlorinated solvents, and metals.
A	Lower Duwamish Waterway Superfund Site (Eastern)	Sediments within the Duwamish Waterway	Listed on the National Priority List Superfund site for sediments in the Duwamish Waterway contaminated by PCBs, PAHs, chlorinated solvents, and metals.
B	Lower Duwamish Waterway Superfund Site (Western)	Sediments within the Duwamish Waterway	Listed on the National Priority List Superfund site for sediments in the Duwamish Waterway contaminated by PCBs, PAHs, chlorinated solvents, and metals.

Table 2. Reasonably Predictable Properties

Site Number	Owner/Operation	Address	Rationale
8	Boat Repair Yards	1289 S. Rose St.	Years of boat repair activities conducted in the upland areas next to the Duwamish Waterway. Heavy staining of the ground seen in several aerial photographs. Surface drains appear to connect to the Duwamish. Use of petroleum hydrocarbons, chlorinated solvents, metals, and tributyltin.
9	Boat Repair Yards	1400 S. Thistle St.	Same as above
10	Boat Repair Yards	8456 14th Ave. S.	Same as above
11	House with Junk Yard	1401 S. Thistle St.	The backyard of the property is covered with old cars and trucks. There is heavy staining of the exposed surface. Several hundred plastic containers and drums are located at the site.
17	Salon Expo (adjacent to Dry Cleaner)	8520 14th Ave. S. (Dry Cleaner located at 8506 14th Ave. S.	Listed as Leaking Underground Storage Tank (LUST) site by WADOE. Age of building indicates possible ACM/LBP contamination. Former site operator conducted an independent voluntary cleanup at site (without WADOE oversight and/or approval).
18	Herb's Repair	8524 14th Ave. S.	Listed as a LUST site by WADOE. Age of building indicated possible ACM/LBP contamination. Poor housekeeping activities noted on site.
25	Napoli Pizzeria	8600 14th Ave. S.	Site is a proposed project construction lay down yard. Pre-purchase environmental site assessment needs to be conducted per industry standards.
29	Babia's Sewing	8621 14th Ave. S.	Former auto repair and service station listed as a LUST site by WADOE. Age of building indicates possible ACM/LBP contamination. Former site operator conducted an independent voluntary cleanup at site (without WADOE oversight and/or approval).
30	Former Gas Station/Dry Cleaner	8620 14th Ave. S.	Miscellaneous storage of abandoned chemical containers on site. Age of building indicates possible ACM/LBP contamination. Long history of dry cleaning operation (1956s to mid-1990s) and vent pipes observed from back of structure indicate potential environmental issues.
32	R.L. Cook Sales and Supply Warehouse	8700 14th Ave. S.	Former Chevron service station listed as a LUST site by WADOE. Former site operator conducted an independent voluntary cleanup at site (without WADOE oversight and/or approval).
35	A.D. Swayne Company	8456 14th Ave. S.	Former operation conducted an independent voluntary cleanup at site (without WADOE oversight and/or approval).
49	Spencer Industries	8721 Dallas Ave. S.	Aircraft part manufacturing facility. Chlorinated solvents released from this facility have contaminated the groundwater. Potential for the migration of contaminated groundwater to project site.

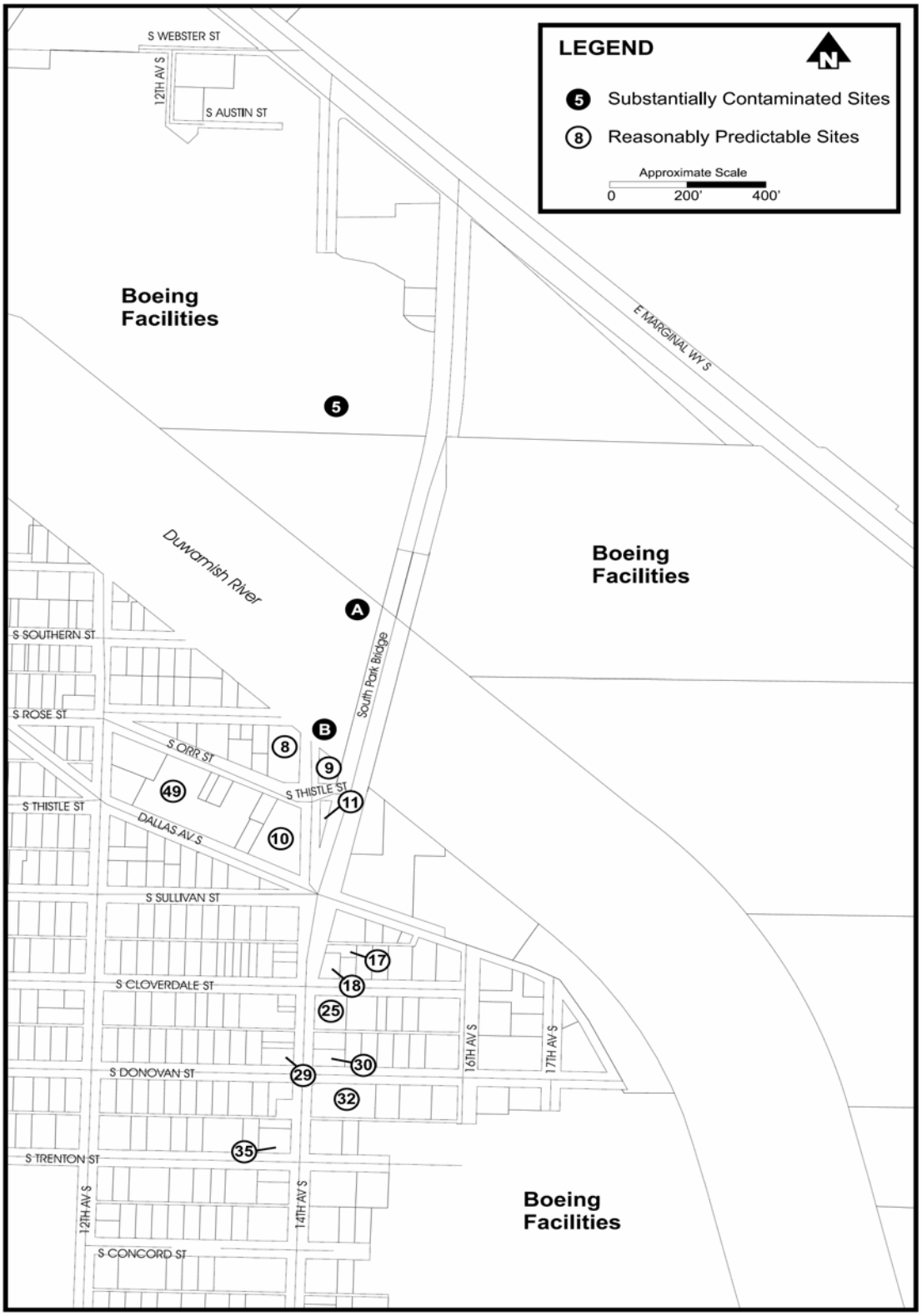


Figure 5
Substantially Contaminated and Reasonably Predictable Sites

3.2 Regulatory Database Review

A regulatory data search was conducted for the *Draft Hazardous Materials Technical Report* (Wilbur 2002), which was consistent with standard guidance established by the American Society for Testing and Materials (ASTM) for a Phase I Environmental Site Assessment (ESA), with the WSDOT Environmental Procedures Manual M31-11, and the FHWA.

Environmental Data Resources, Inc. (EDR), was contracted to provide a comprehensive search of existing environmental regulatory agency databases for known or suspected environmental concerns within the study area. The EDR report used for the *Draft Hazardous Materials Technical Report* (Wilbur 2002) was the EDR Radius Map with GeoCheck, South Park Bridge, 16th Avenue South, Seattle, Washington, Inquiry Number 806613.2s. This report provided information from the regulatory database of sites within a one-mile radius of the center of the South Park Bridge. For the full database list and results of the EDR database research Inquiry Number 806613.2s see the *Hazardous Materials Technical Report* (Wilbur 2004).

3.2.1 Additional Available Environmental Data

For the *Draft Hazardous Materials Technical Report* (Wilbur 2002), available information was reviewed to identify sites that historically had operations with potential environmental concerns to determine if there were any potential sites of environmental concern not included in the EDR report. The EDR report only includes information that is required to be reported to regulatory agencies—not all existing or potential environmental contamination is required to be reported. Also, the regulatory database may be limited or out-of-date. Existing or potential contamination can often be observed through field investigation. Therefore, additional available information was reviewed to identify sites that historically had operations with potential environmental concerns.

A review of historical land use was conducted using Walker and Associates aerial photographs (1936, 1946, 1956, 1968, 1977, 1985, and 1997), the City of Seattle Sanborn Fire Insurance maps, the City of Seattle Department of Construction and Land Use (DCLU) building permit files, Metsker Map files, and Polk Reverse telephone directories for years in the 1930s, 1940s, 1950s, 1970s, 1980s, and 1990s. The purpose of these reviews was to accurately characterize land use activities within the project area over the past 50 years and in some cases over the past 75 years.

3.2.2 Summary of Sites of Environmental Concern

This section summarizes the sites found to be substantially contaminated or reasonably predictable (to be contaminated) based on the *Draft Hazardous*

Materials Technical Report (Wilbur 2002) findings. Site summaries are listed from north to south in sequence across the South Park Bridge Project site. Site numbers and letters have been provided for location references on Figure 5. The site number/letter references property parcels (which in some cases have multiple addresses) and the number of current and past business operations.

Two of these sites—Boeing Plant 2 and the LDW—are considered to be substantially contaminated properties. The first site is under Resource Conservation and Recovery Act (RCRA) Corrective Action (RCRA CA) and the other site has been listed as a Superfund site. Substantially contaminated properties are typically large or have large volumes of contaminated materials, have a long history of industrial or commercial land use, and the contaminants are persistent or difficult and expensive to manage.

An additional 12 sites are considered to be reasonably predictable properties. These sites are properties where recognized environmental conditions are known based on existing data or can be predicted based on site observations, previous experience in similar situations, or by using best professional judgment. These sites are typically small, the contaminants are localized and are relatively non-toxic, or abatement/remediation activities are routine (e.g., asbestos abatement or petroleum hydrocarbon contaminated soil remediation).

3.2.2.1 Substantially Contaminated Properties

- **Boeing Plant 2 (Site 5):** Boeing Plant 2 is a 107-acre aircraft manufacturing and assembly facility that has been in operation since the mid-1930s. Soil and groundwater contamination beneath the facility and sediment contamination along the plant's shoreline of the Lower Duwamish Waterway has been confirmed. In 1994, the Environmental Protection Agency and Boeing signed an Administrative Order of Consent requiring that Boeing investigate and perform corrective action at Plant 2 under the RCRA. Boeing is currently investigating and performing corrective action cleanups for soil, groundwater, and sediment at Plant 2 under RCRA, and has begun a corrective measures study to evaluate and select final cleanup actions for the Plant 2 facility and the sediments in the LDW adjacent to the facility.

- **Sediments within the Lower Duwamish Waterway (Sites A and B):** The LDW is listed as a Superfund site currently in the initial phases of investigation for cleanup of sediments, upland source control areas, and storm sewer drainage basins. The northern shore, Site A, of the LDW for this study is bounded by the Boeing Plant 2 facility and the southern shore, Site B, is bounded by the South Park neighborhood. For this report, the sediments within the Lower Duwamish Waterway are described as two separate sites.

3.2.2.2 Reasonably Predictable Properties

- **1289 S. Rose Street (Site 8):** At the boat repair yard, ship maintenance and repair activities, as well as hull cleaning and painting, were conducted in the open without surface seal. There is a high probability of soil and stormwater contaminations at the site. Aerial photographs show heavy staining on the ground surface prior to placement of asphalt service.

- **1400 S. Thistle Street (Site 9):** Ship maintenance and repair activities, as well as hull cleaning and painting, were conducted in the open without surface seal. There is a high probability of soil and stormwater contaminations at the site.

- **8456 14th Avenue S. (Site 10):** The northern portion of this property was used as a boat repair yard. Ship maintenance and repair activities, as well as hull cleaning and painting, were conducted in the open without surface seal. There is a high probability of soil and stormwater contaminations at the site.

- **1401 S. Thistle Street (Site 11):** This is a house with a junk yard surrounding the residence. Several abandoned vehicles are located on the property. Several hundred plastic containers are stored onsite.

- **8520 14th Avenue S. (Site 17):** This is a former gasoline service station with a reported leaking underground storage tank site with petroleum contamination.

- **8524 14th Avenue S. (Site 18):** This is an existing auto repair and service station with a reported leaking underground storage tank site with petroleum contamination.

- **8600 14th Avenue S. (Site 25):** The Napoli Pizzeria restaurant site is in the Washington Department of Ecology (WADOE) records, but they do not indicate that the company currently participates in dangerous waste activities. Based on a site visit from public areas, there is high potential that asbestos containing materials/lead based paint (ACM/LBP) are present in the building structure**.**

- **8621 14th Avenue S. (Site 29):** This is a former auto repair shop and service station with a reported leaking underground storage tank site with petroleum contamination. Based on a site visit from public areas, there is high potential that ACM/LBP materials are present in the building structure**.**

- **8620 14th Avenue S. (Site 30):** This is a former dry cleaning operation with a long operational history. Chemical containers are stored on the

property. Based on a site visit from public areas, there is high potential that ACM/LBP materials are present in the building structure**.**

- **8700 14th Avenue S. (Site 32):** This former Chevron service station site has a reported leaking underground storage tank site with petroleum contamination in soil and groundwater.

- **8721 14th Avenue S. (Site 35):** This is a former machine shop operation which is listed as having released chlorinated solvents into the soil. A warehouse currently occupies the site.

- **8410 Dallas Avenue S. (Site 49):** The Spencer Industries Incorporated aircraft part manufacturing facility has released chlorinated solvents contaminating the groundwater.

4.0 Field Investigation Activities

4.1 Sampling Program Summary

The objective of the sampling and analysis work was to obtain information on environmental risks to the soil, groundwater and the sediment within or adjacent to the footprint of the replacement bridge alternatives (Bascule, Mid-Level Fixed-Span, and High-Level Fixed-Span bridge alternatives). Prior to the PSI, there was little or no environmental data available for soil, groundwater and sediments within the pier support areas for these bridge alternatives. This PSI sampling effort provides missing environmental analytical data.

Laboratory results for soil, groundwater and sediment samples collected were used to define environmental contamination to the soil, groundwater, and sediments and were used to develop estimated impacts to construction costs for each of the design alternatives. Environmental contamination and the associated costs to address it in an appropriate manner have been applied to the design alternatives as a part of this PSI. This information will be incorporated into the EIS and alternative selection process for the South Park Bridge Project.

Subsurface investigation of the soil, groundwater and sediment within the area of the replacement bridge alternatives was conducted from June 24, 2003, through August 7, 2003. Fifteen borings were drilled as part of this PSI, however one boring was abandoned when obstruction was encountered during drilling. Eight deep borings were drilled using a mud rotary technique and are referred to hereafter as the geotechnical borings. The remaining shallow borings were drilled using a hollow stem auger and are referred to hereafter as the environmental borings. See Appendix A for boring logs.

The geotechnical borings' drill depths ranged from 96 to 130 feet bgs. The primary purpose for these deep borings was to collect geotechnical samples for engineering analysis to be used for bridge foundation design and engineering. Shannon & Wilson personnel collected the geotechnical samples. WCI collected environmental samples to support the PSI from the geotechnical borings at 25, 50, 75, 100 and 130 feet bgs. The deep environmental soil samples were collected to provide screening data on soils that may be excavated, from depths greater than 25 feet bgs within the replacement alternatives. The potential for the presence of chlorinated solvents, petroleum hydrocarbons, and metals in the subsurface was suspected as a result of the *Draft Hazardous Materials Technical Report* (Wilbur 2002). All geotechnical borings were abandoned according to WADOE regulations. Geotechnical soil samples submitted for laboratory analysis were labeled SB for soil boring.

The environmental borings were drilled to a depth of approximately 25 feet bgs and completed as groundwater monitoring wells. The primary purpose for these shallow borings was to collect environmental samples to be used to determine the nature and extent of contamination in the subsurface that would impact construction activities for each of the bridge replacement alternatives. Soil samples were collected at 2.5-foot intervals at the top 25 feet or until the water table was encountered. Samples at some intervals were not collected due to: 1) loss of material sampling collection equipment when retrieved from the bore hole; 2) below the water table, saturated fine-grained materials drained out of sampling equipment prevented retrieval; and 3) asphalt and/or concrete with thickness greater than 2.5 feet at the surface reduced the amount of material available for sampling from some borings. A soil sample was collected for the water table contact and another soil sample was collected from the bottom of the boring. WCI personnel collected the environmental soil samples. Shallow borings were completed as groundwater monitoring wells. Monitoring wells were surveyed and will be abandoned according to WADOE regulations, once it has been determined that the wells are of no further use to the project and its construction activities. King County is responsible for the abandonment of these wells after their potential use for sampling or dewatering has been completed.

Upland soil samples (see Table 3) and groundwater samples (see Table 4) were analyzed using the following laboratory analytical methodologies established by the U.S. Environmental Protection Agency (USEPA) and WADOE for environmental sampling: 1) volatile organic compounds (VOC); 2) semi-volatile organic compounds (SVOC); 3) pesticides/polychlorinated biphenyls (PCB); 4) polynuclear aromatic hydrocarbons (PAH); 5) total petroleum hydrocarbon (TPH); and 6) total metals. Analytical methods used in soil and groundwater samples are presented in Tables 3 and 4.

Sediment samples (see Table 5) were analyzed using the following laboratory analytical methodologies established by the USEPA and WADOE: 1) Puget Sound Dredge Disposal Analysis (PSDDA) volatiles and semi-volatiles (PSDDA SVOA); 2) volatile organic compounds (VOC); 3) PSDDA pesticides/PCB; 4) total metals; 5) polynuclear aromatic hydrocarbons (PAH); 6) total petroleum hydrocarbon (TPH); and 7) tributyltin (TBT). Analytical methods used for sediment samples are presented in Table5.

Table 3. Upland Soil Samples Analytical Results

Upland Soil Samples									
Sample Label	**Collection Date**	**VOC**	**SVOC**	**PAH**	**NWTPH-Dx**	**Pest/PCB**	**Metals**	**TBT**	**PSSDA SVOA**
SB1-SOIL-50	7/10/2003	X	**X**	X	X	NA	**X**	NA	NA
SB1-SOIL-62.5	7/10/2003	X	**X**	X	X	NA	**X**	NA	NA
SB1-SOIL-95	7/10/2003	X	**X**	X	X	NA	**X**	NA	NA
MW1-SOIL-1.5	7/17/2003	**X**	X	**X**	**X**	**X**	**(X)**	NA	NA
MW1-SOIL-4	7/17/2003	**X**	X	**X**	**X**	X	**(X)**	NA	NA
MW1-SOIL-5	7/17/2003	X	X	X	**X**	X	**(X)**	NA	NA
MW1-SOIL-7	7/17/2003	X	X	X	X	NA	**X**	NA	NA
MW1-SOIL-10	7/17/2003	**X**	X	**X**	X	NA	**(X)**	NA	NA
MW1-SOIL-12.5	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW1-SOIL-15	7/17/2003	**X**	**X**	X	**X**	NA	**X**	NA	NA
MW1-SOIL-17.5	7/17/2003	**X**	X	X	X	NA	**X**	NA	NA
MW1-SOIL-20	7/17/2003	**X**	**X**	X	X	NA	**X**	NA	NA
MW1-SOIL-25	7/17/2003	X	X	X	X	NA	X	NA	NA
SB2-SOIL-50	7/11/2003	X	**X**	X	X	NA	**X**	NA	NA
SB2-SOIL-65	7/11/2003	X	**X**	X	X	NA	X	NA	NA
SB2-SOIL-110	7/11/2003	X	**X**	X	**X**	NA	**X**	NA	NA
MW2-SOIL-1.5	7/17/2003	X	X	X	X	X	**X**	NA	NA
MW2-SOIL-3	7/17/2003	X	X	X	X	X	**X**	NA	NA
MW2-SOIL-5	7/17/2003	X	X	X	X	X	**X**	NA	NA
MW2A-SOIL-1.5	7/17/2003	X	X	X	X	X	**X**	NA	NA
MW2A-SOIL-3	7/17/2003	**X**	X	X	**X**	X	**X**	NA	NA
MW2A-SOIL-3.5	7/17/2003	X	X	X	**X**	**X**	**X**	NA	NA
MW2A-SOIL-4	7/17/2003	**X**	**(X)**	**(X)**	**(X)**	**X**	**(X)**	NA	NA
MW2A-SOIL-5	7/17/2003	**X**	X	X	X	X	**(X)**	NA	NA
MW2A-SOIL-7.5	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW2A-SOIL-10	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW2A-SOIL-12.5	7/17/2003	**X**	X	X	**X**	NA	**(X)**	NA	NA
MW2A-SOIL-15	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA

X = Laboratory Analysis Conducted
X = Chemical Compound Detected
(X) = Chemical Compound Detected above Soil Cleanup Levels (see Table 6)

Table 3. Upland Soil Samples Analytical Results (continued)

Upland Soil Samples (continued)									
Sample Label	**Collection Date**	**VOC**	**SVOC**	**PAH**	**NWTPH-Dx**	**Pest/PCB**	**Metals**	**TBT**	**PSSDASVOA**
MW2A-SOIL-20	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW2A-SOIL-22.5	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW2A-SOIL-25	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
SB3-SOIL-50	7/15/2003	X	X	**X**	X	NA	**X**	NA	NA
SB3-SOIL-85	7/15/2003	X	X	X	X	X	**X**	NA	NA
SB3-SOIL-130	7/16/2003	**X**	X	**X**	X	NA	**X**	NA	NA
MW3-SOIL-3	7/17/2003	X	X	X	X	X	**X**	NA	NA
MW3-SOIL-5	7/17/2003	**X**	X	**X**	**X**	**X**	**X**	NA	NA
MW3-SOIL-7.5	7/17/2003	X	**X**	**X**	**X**	**X**	**X**	NA	NA
MW3-SOIL-10	7/17/2003	X	**X**	**X**	X	**NA**	**X**	NA	NA
MW3-SOIL-12	7/17/2003	X	X	X	X	NA	**X**	NA	NA
MW3-SOIL-15	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW3-SOIL-20	7/17/2003	**X**	X	X	X	NA	**(X)**	NA	NA
MW3-SOIL-25	7/17/2003	X	X	X	X	NA	**(X)**	NA	NA
SB6-SOIL-50	6/27/2003	X	X	X	X	NA	**X**	NA	NA
SB6-SOIL-75	6/27/2003	X	X	X	X	NA	**X**	NA	NA
SB6-SOIL-110	6/30/2003	X	**X**	X	X	NA	X	NA	NA
MW6-SOIL-1.5	7/1/2003	X	X	X	X	X	X	NA	NA
MW6-SOIL-7.5-9	7/1/2003	X	X	X	X	X	**X**	NA	NA
MW6-SOIL-10-11.5	7/1/2003	X	**X**	X	X	NA	**X**	NA	NA
MW6-SOIL-14.5-16	7/1/2003	X	X	X	X	NA	**X**	NA	NA
MW6-SOIL-25	7/1/2003	X	X	X	X	NA	X	NA	NA
MW6-SOIL-12-13.5	7/1/2003	X	X	X	X	NA	**X**	NA	NA
SB7-SOIL-45	6/25/2003	X	X	X	X	NA	**X**	NA	NA
SB7-SOIL-75	6/26/2003	X	X	X	X	NA	**X**	NA	NA
SB7-SOIL-105	6/26/2003	X	X	X	X	NA	**X**	NA	NA
MW7-SOIL-2	7/2/2003	X	**X**	**(X)**	**(X)**	**X**	**(X)**	NA	NA
MW7-SOIL-5	7/2/2003	X	**X**	**(X)**	**(X)**	**X**	**(X)**	NA	NA

X = Laboratory Analysis Conducted
X = Chemical Compound Detected
(X) = Chemical Compound Detected above Soil Cleanup Levels (see Table 6)

Table 3. Upland Soil Samples Analytical Results (continued)

Upland Soil Samples (continued)									
Sample Label	**Collection Date**	**VOC**	**SVOC**	**PAH**	**NWTPH-Dx**	**Pest/PCB**	**Metals**	**TBT**	**PSSDASVOA**
MW7-SOIL-7.5	7/2/2003	X	X	X	X	X	**X**	NA	NA
MW7-SOIL-10	7/2/2003	X	X	X	X	NA	**X**	NA	NA
MW7-SOIL-12.5	7/2/2003	X	**(X)**	**(X)**	**X**	NA	**X**	NA	NA
MW7-SOIL-17.5	7/2/2003	X	X	X	**X**	NA	**X**	NA	NA
MW7-SOIL-25	7/2/2003	X	X	X	X	NA	**X**	NA	NA
SB8-SOIL-50	6/24/2003	X	X	X	X	NA	**X**	NA	NA
SB8-SOIL-75	6/24/2003	X	X	**X**	X	NA	**X**	NA	NA
SB8-SOIL-90	6/25/2003	X	X	X	X	NA	**X**	NA	NA
MW8-SOIL-2.5	7/2/2003	X	X	**X**	**X**	X	**X**	NA	NA
MW8-SOIL-4	7/2/2003	X	X	**X**	X	X	**X**	NA	NA
MW8-SOIL-7	7/2/2003	X	X	X	X	X	**X**	NA	NA
MW8-SOIL-9.5	7/2/2003	X	X	X	X	NA	**X**	NA	NA
MW8-SOIL-12	7/2/2003	X	X	X	X	NA	**X**	NA	NA
MW8-SOIL-14	7/2/2003	**X**	X	X	X	NA	**X**	NA	NA
MW8-SOIL-17	7/2/2003	X	**X**	X	X	NA	**X**	NA	NA
MW8-SOIL-24	7/2/2003	X	**X**	**X**	X	NA	**X**	NA	NA

X = Laboratory Analysis Conducted
X = Chemical Compound Detected
(X) = Chemical Compound Detected above Soil Cleanup Levels (see Table 6)

Table 4. Groundwater Samples Analytical Results (South Park Bridge PSI)

Groundwater Samples									
Sample Label	**Collection Date**	**VOC**	**SVOC**	**PAH**	**NWTPH-Dx**	**Pest/PCB**	**Metals**	**TBT**	**PSSDA SVOA**
MW8-GH2O	8/5/2003	**(X)**	**X**	X	X	X	**X**	NA	NA
MW7-GH2O	8/5/2003	X	X	X	X	X	**X**	NA	NA
MW6-GH2O	8/5/2003	X	X	X	X	X	**X**	NA	NA
MW3-GH2O	8/6/2003	X	X	X	X	X	**X**	NA	NA
MW2-GH2O	8/6/2003	X	X	X	X	X	**X**	NA	NA
MW1-GH2O	8/6/2003	X	**X**	X	X	X	**X**	NA	NA

X = Laboratory Analysis Conducted
X = Chemical Compound Detected
(X) = Chemical Compound Detected above Groundwater Cleanup Levels (see Table 7)

Table 5. Sediment Samples Analytical Results (South Park Bridge PSI)

Sediment Samples									
Sample Label	**Collection Date**	**VOC**	**SVOC**	**PAH**	**NWTPH-Dx**	**Pest/PCB**	**Metals**	**TBT**	**PSSDA SVOA**
SB5-SED-2.5	7/22/2003	**X**	NA	**(X)**	**X**	**(X)**	**(X)**	X	**X**
SB5-SED-5	7/22/2003	**X**	NA	**(X)**	**X**	**(X)**	**(X)**	X	**(X)**
SB5-SED-7.5	7/22/2003	**X**	NA	**(X)**	**X**	**(X)**	**(X)**	X	**(X)**
SB5-SED-50	7/22/2003	**X**	NA	X	X	NA	**(X)**	X	**X**
SB5-SED-75	7/22/2003	**X**	NA	X	X	NA	**(X)**	X	**X**
SB4-SED-5	7/23/2003	**X**	NA	**X**	**(X)**	**(X)**	**(X)**	X	**X**
SB4-SED-7	7/23/2003	**X**	NA	**X**	**(X)**	**(X)**	**(X)**	X	**X**
SB4-SED-10	7/23/2003	**X**	NA	**X**	**(X)**	X	**(X)**	X	**X**
SB4-SED-50	7/23/2003	**X**	NA	X	X	NA	**(X)**	X	**X**
SB4-SED-64	7/23/2003	**X**	NA	X	X	X	**(X)**	X	**X**
SB4-SED-100	7/23/2003	**X**	NA	X	X	NA	**(X)**	X	**X**

X = Laboratory Analysis Conducted
X = Chemical Compound Detected
(X) = Chemical Compound Detected above Sediment Cleanup Levels (see Table 8)

4.2 Soil Sampling Activities

Geotechnical and environmental soil boring locations were selected to provide data on subsurface conditions at locations associated with potential bridge support structures for the bridge replacement alternatives. Geotechnical and environmental borings were drilled within a few feet of each other (see Figure 6). Systematically placing the geotechnical and the environmental borings to corresponding support structures bridge alternatives provides insight as to the nature of environmental risks most likely to be encountered. Any environmental risks to the soil identified in the PSI study area will be applied to construction cost estimates for handling contaminated soil, groundwater and sediment encountered for the replacement bridge design alternatives.

All environmental soil samples were collected using a split spoon-sampling device for retrieving material from the borehole. Samples collected were field screened using a photo-ionizing detector (PID) to denote the presence of high-vapor volatile compounds. Samples were described, labeled, and then containerized into jars for transport to the laboratory for analysis.

Sampling of soil was completed in accordance with the procedures outlined in the SAP, which is part of the PSI Work Plan (see Appendix B).

A total of 72 soil samples were collected from the 15 soil borings. Soil samples were submitted to ARI for analysis. A total of 374 individual analyses were performed on the 72 samples submitted. For a list of soil sample analytical results, see Appendix C (CD-ROM).

4.3 Groundwater Sampling Activities

All groundwater samples collected during this PSI were analyzed for the following constituents: 1) VOC; 2) SVOC; 3) pesticides/PCB; 4) PAH; 5) TPH; and 6) total metals. See Appendix B for the groundwater sampling protocols for monitoring activities for the PSI Work Plan. After each monitoring well was constructed, the driller developed the well using a bailer and surge block tool. Approximately 165 gallons of water were removed and drummed from each monitoring well. All monitoring wells were allowed to equilibrate for a period of one week prior to sample collection.

Monitoring wells were purged by removing at least three well volumes of groundwater from the casing or by pumping the well casing dry. Wells were purged using a combination of bailers and a centrifugal pump. Only dedicated purging equipment was used during well purging activities. Information on purge volume and the time of pumping initiation and termination, plus a description of the physical characteristics of purge water (turbidity,

conductivity, pH, sheen, color) based on field observation was recorded. Groundwater samples were collected immediately after well purging.

A peristaltic pump and disposable bailers were used to remove purge water from the monitoring wells prior to sample collection. Only disposable bailers were used to collect the VOC, BAN, total metals, and pesticides/PCB samples.

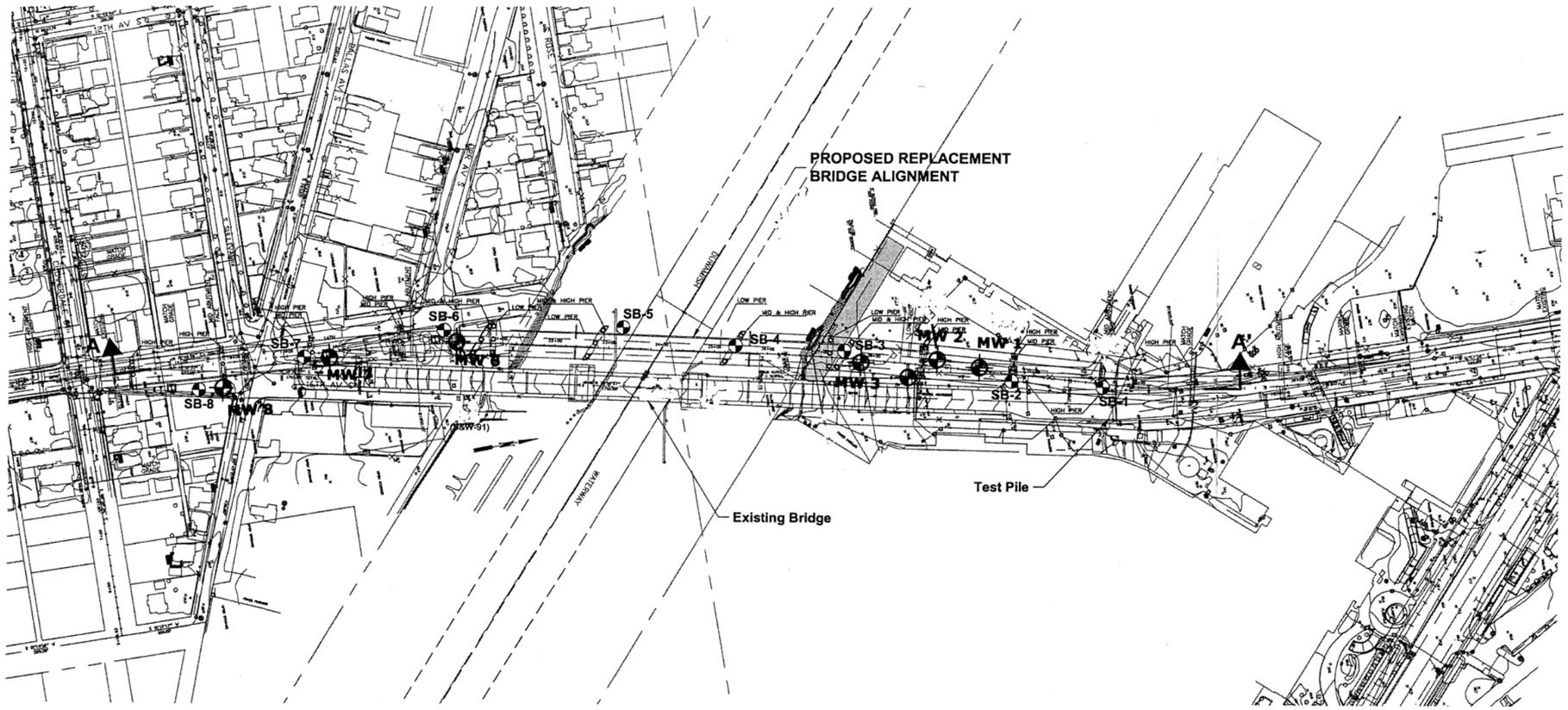
Note that all water removed from the monitoring wells was properly drummed and labeled. Each drum containing purge water was labeled with the monitoring well identification number and the date the purge water was generated. Drummed purge water corresponds to a set of laboratory analysis results from a single monitoring well. A complete set of laboratory procedures and analysis results for all groundwater samples collected under this PSI were provided to the King County Department of Transportation.

Groundwater samples were collected from the six monitoring wells. Six separate sample containers were collected from each of the monitoring wells for submittal to the ARI for analysis. A total of 42 analytical procedures were performed on the groundwater samples collected. For a list of groundwater sample analytical results, see Appendix C (CD-ROM).

4.4 Sediment Sampling Activities

All environmental sediment samples collected from the geotechnical mud-rotary borings drilled within the Duwamish Waterway followed the guidance provided by the Puget Sound Estuary Program protocols (EPA 2004 as revised).

The volatile sediment samples were collected immediately upon opening the split tube sampler. The remaining sediment was then described using the procedures set forth in the PSI Work Plan. After each sediment sample was described, the sample was placed into a clean stainless steel bowl and homogenized. The homogenized sediment sample was then placed into the appropriate sample container with the proper label and placed into an iced cooler for storage prior to delivery to the laboratory for analysis. A total of 11 sediment samples were collected from the two sediment borings. Sediment samples were submitted to ARI for analysis and a total of 84 analyses were performed on sediment samples. For a list of sediment sample analytical results see Appendix C (CD-ROM).



LEGEND	
SB-1	– Soil Boring
MW 1	– Monitoring Well
A	– Generalized Subsurface Profile

Figure 6
Boring Location Map

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Soil and sediment samples were photo-documented when possible using digital photographs. A registered geologist logged each sediment sample for grain size distribution using the Universal Soil Classification. Field notes for logged sediment samples are provided in Appendix A (soil boring logs).

Cuttings generated during drilling of the sediment borings were placed in 55-gallon drums and stored in a secured area under the bridge ramp on the south side of the South Park Bridge. All drum labels were identified with a boring identification number, depth interval, and the date of drummed cuttings. A complete set of laboratory procedures and analysis results for sediment samples collected under this PSI were transmitted to the King County Department of Transportation.

5.0 Laboratory Analysis

5.1 Laboratory

ARI was used to conduct all of the PSI sample analysis work. ARI is a WADOE accredited laboratory. Laboratory Quality Assurance procedures are listed in Appendix A of the PSI Work Plan (Appendix B).

5.2 Analytical Methods

Soil and groundwater samples were analyzed using the following laboratory analytical methodologies established by the USEPA and WADOE: 1) VOC; 2) SVOC; 3) pesticides/PCB; 4) PAH; 5) TPH; and 6) total metals. See Table 3 for a summary of the number of samples collected by methodology.

Sediment samples were analyzed using the following laboratory analytical methodologies established by the USEPA and WADOE: 1) PSDDA volatiles; 2) PSDDA SVOA; 3) PSDDA pesticides/PCB; 4) total metals; 5) total organic carbon (TOC); and 6) TBT. See Table 3 for a summary of the number of samples collected by media type.

5.3 Sample Details

In total, 15 borings were drilled during field activities associated with this PSI. Eight deep geotechnical borings were drilled using a mud rotary drilling technique and six shallow environmental borings were drilled using a hollow stem auger drilling technique. A total of 72 soil samples were collected from the 15 soil borings. Soil samples were submitted to the ARI Laboratory for a total of 374 analytical procedures. For a list of soil sample analytical results see Appendix C (CD-ROM).

Six of the eight deep geotechnical borings were drilled in the upland areas and sampled as a part of this PSI. Three sets of environmental samples were collected from each of the six upland deep geotechnical borings (soil borings 1, 2, 3, 6, 7, and 8) drilled in the upland areas of the PSI study area. The deep environmental samples were collected at 50, 75, and between 96 and 130 feet bgs. These samples were collected and submitted for analysis, to determine if any contaminants had migrated to that depth and adversely impacted the soils in areas where the proposed bridge support columns would be excavated. Deep-soil boring samples were submitted to the laboratory for the following analyses: 1) VOC; 2) SVOC; 3) TPH, and 4) total metals.

The seven shallow borings were drilled using a hollow stem auger drilling technique. Due to obstruction encountered during drilling, only six borings were drilled to a depth of 25 feet and completed as groundwater monitoring wells. Soil samples were collected at 2.5-foot intervals to the water table. A sample was collected at groundwater surface and another was collected from

the completion depth of the boring. The shallow borings were drilled to sample soils and groundwater where a majority of the bridge construction work would be conducted. Shallow soil boring samples were submitted to the laboratory for the following analyses: 1) VOC; 2) SVOC; 3) pesticides/PCB; 4) TPH, and 5) total metals.

Six groundwater monitoring wells were constructed in shallow boring locations during the PSI. These wells were constructed and sampled to obtain information on impacts to the groundwater within the footprint of the bridge replacement alternatives. Groundwater samples were submitted to the laboratory for the following analyses: 1) VOC; 2) SVOC; 3) TPH; 4) pesticides/PCB, and 5) total metals.

Two deep sediment borings were drilled using the mud rotary technique within the channel of the LDW as a part of the geotechnical sampling. Eleven environmental samples were collected from these two sediment borings. Sediment samples were submitted to the laboratory for the following analyses: 1) PSDDS volatiles; 2) PSDDA SVOA; 3) PSSDA pesticides/PCB; 5) total metals; 6) TOC; and 7) TBT.

5.4 Analytical Results

As a part of the PSI, individual results for detected chemical compounds and metals for soil and groundwater sample results were compared to MTCA Method A cleanup standards for soil in unrestricted land use areas. The unrestricted land use cleanup standards are more conservative than the MTCA cleanup standards for an industrial site (see Table 6 and Table 7). The more conservative cleanup standard was selected for this PSI for several reasons:

1) A majority of the samples found to contain chemical compounds in concentrations above regulatory concern were not located on an industrial site. Samples of regulatory concern were found in borings located within the public right-of-ways;

2) During any construction activities for the proposed five bridge alternatives, the general public will be able to come in contact with excavated materials and fugitive air emissions; and

3) The more conservative cleanup standards' lower threshold concentrations should ensure that estimated increases to the project cost and schedule are realistic.

All estimated environmental risks from soil contamination and the estimated mitigation costs presented in this PSI are based on the MTCA Method A unrestricted land use cleanup standards for soil.

Table 6. Method A Soil Cleanup Levels for Unrestricted Land Uses[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	20 mg/kg[b]
Benzene	71-43-2	0.03 mg/kg[c]
Benzo(a)pyrene	50-32-8	0.1 mg/kg[d]
Cadmium	7440-43-9	2 mg/kg[e]
Chromium Chromium VI Chromium III	 18540-29-9 16065-83-1	 19 mg/kg[f1] 2,000 mg/kg[f2]
DDT	50-29-3	3 mg/kg[g]
Ethylbenzene	100-41-4	6 mg/kg[h]
Ethylene dibromide (EDB)	106-93-4	0.005 mg/kg[i]
Lead	7439-92-1	250 mg/kg[j]
Lindane	58-89-9	0.01 mg/kg[k]
Methylene chloride	75-09-2	0.02 mg/kg[l]
Mercury (inorganic)	7439-97-6	2 mg/kg[m]
MTBE	1634-04-4	0.01 mg/kg[n]
Naphthalenes	91-20-3	5 mg/kg[o]
PAHs (carcinogenic)	--	See benzo(a)pyrene[d]
PCB mixtures	--	1 mg/kg[p]
Tetrachloroethylene	127-18-4	0.05 mg/kg[q]
Toluene	108-88-3	7 mg/kg[r]
Total Petroleum Hydrocarbons[s]		
Gas Range Organics Gasoline mixtures without benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture	--	100 mg/kg
All Other Gasoline Mixtures	--	30 mg/kg
Diesel Range Organics	--	2,000 mg/kg
Heavy Oils	--	2,000 mg/kg
Mineral Oil	--	2,000 mg/kg
1,1,1 Trichloroethane	71-55-6	2 mg/kg[t]
Trichloroethylene	79-01-6	0.03 mg/kg[u]
Xylenes	1330-20-7	9 mg/kg[v]

Please see Appendix D for detailed descriptions of all footnotes
Note: Must also test for and meet cleanup levels for other petroleum components—see footnotes in Appendix D.
Source: WAC 173-340-900 MTCA Cleanup Regulation

Table 7. Method A Cleanup Levels for Ground Water[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	5 µg/liter[b]
Benzene	71-43-2	5 µg/liter[c]
Benzo(a)pyrene	50-32-8	0.1 µg/liter[d]
Cadmium	7440-43-9	5 µg/liter[e]
Chromium (Total)	7440-47-3	50 µg/liter[f]
DDT	50-29-3	0.3 µg/liter[g]
1,2 Dichloroethane (EDC)	107-06-2	5 µg/liter[h]
Ethylbenzene	100-41-4	700 µg/liter[i]
Ethylene dibromide (EDB)	106-93-4	0.01 µg/liter[j]
Gross Alpha Particle Activity	--	15 pCi/liter[k]
Gross Beta Particle Activity	--	4 mrem/yr[l]
Lead	7439-92-1	15 µg/liter[m]
Lindane	58-89-9	0.2 µg/liter[n]
Methylene chloride	75-09-2	5 µg/liter[o]
Mercury	7439-97-6	2 µg/liter[p]
MTBE	1634-04-4	20 µg/liter[q]
Naphthalenes	91-20-3	160 µg/liter[r]
PAHs (carcinogenic)	--	See benzo(a)pyrene[d]
PCB mixtures	--	0.1 µg/liter[s]
Radium 226 and 228	--	5 pCi/liter[t]
Radium 226	--	3 pCi/liter[u]
Tetrachloroethylene	127-18-4	5 µg/liter[v]
Toluene	108-88-3	1,000 µg/liter[w]
Total Petroleum Hydrocarbons[x]		5 µg/liter[b]
Gas Range Organics		
Benzene present in groundwater	--	800 µg/liter
No detectable benzene in groundwater	--	1,000 µg/liter
Diesel Range Organics	--	500 µg/liter
Heavy Oils	--	500 µg/liter
Mineral Oil	--	500 µg/liter
1,1,1 Trichloroethane	71-55-6	200 µg/liter[y]
Trichloroethylene	79-01-6	5 µg/liter[z]
Vinyl chloride	75-01-4	0.2 µg/liter[aa]
Xylenes	1330-20-7	1,000 µg/liter[bb]

Please see Appendix D for detailed descriptions of all footnotes
Note: Must also test for and meet cleanup levels for other petroleum components—see footnotes.
Source: WAC 173-340-900 MTCA Cleanup Regulation

5.4.1 Analytical Results for Soil

A total of 72 soil samples were collected from the geotechnical and environmental borings and submitted to the laboratory for analysis for this PSI. A total of 374 laboratory methods were run on these samples, which produced 26,712 individual compound results (see Figure 7). Of the 72 soil samples submitted, 69 samples were found to contain detectable amounts of chemical compounds and/or individual elements. The majority of these detections were very low-level concentrations and not of environmental regulatory concern because the results are below clean up standards. Some of the low-level detections were of common laboratory compounds such as methylene chloride and acetone or of naturally occurring elements (metals) with reported concentrations that are well below regulatory concern. However, 26 of these samples contained concentrations for compounds and/or elements that are of environmental concern because they exceeded the levels set by MTCA Method A unrestricted land use cleanup standards for soil. The results for these soil samples and their potential impacts on the South Park Bridge alternatives are discussed in detail in the soil sample results section.

5.4.2 Analytical Results for Groundwater

Six groundwater samples were collected from the six monitoring wells completed during the PSI and submitted to the laboratory for analysis. A total of 36 laboratory methods were run on these groundwater samples, which produced 1,194 individual compound results. Of the six groundwater samples submitted, all six contained detectable quantities of metals. Two groundwater samples contained detectable quantities of semi-volatile compounds, but only one result exceeded cleanup standards. One groundwater sample contained quantities of chlorinated solvents and oxidation compounds of chlorinated solvents such as vinyl chloride in concentrations above MTCA Method A unrestricted land use cleanup standards for groundwater. The other groundwater result was below cleanup standards. The results for these groundwater samples and their impacts on the South Park Bridge Project are discussed in detail in the groundwater sample results section.

5.4.3 Analytical Results for Sediment

Eleven sediment samples were collected and submitted to the laboratory for analysis. All five sediment samples collected from water/sediment interface (the mud line) to a depth of 7 feet below the mud line have concentrations of compounds and/or metals that exceed PSDDA levels for open-water disposal (see Table 8). The results for these sediment samples and their potential impacts on the South Park Bridge Project alternatives are discussed in detail in the sediment sample results section.

Table 8. Puget Sound Marine Sediment Cleanup Screening Levels and Minimum Cleanup Levels—Chemical Criteria

Chemical Parameter	MG/KG Dry Weight (parts per million [PPM] dry)
Arsenic	93
Cadmium	6.7
Chromium	270
Copper	390
Lead	530
Mercury	0.59
Silver	601
Zinc	960
LPAH	780
Naphthalene	170
Acenaphthylene	66
Acenaphthene	57
Fluorene	79
Phenathrene	480
Anthracene	1200
2-Methylnaphthalene	64
HPAH	5300
Fluoranthene	1200
Pyrene	1400
Benz(a)anthracene	270
Chrysene	460
Total Benzofluoranthenes	450
Benzo(a)pyrene	210
Indeno (1,2,3-C,D) Pyrene	88
Dibenzo (A,H) Anthracene	33
Benzo (G,H,I) Perylene	78
1,2-Dichlorobenzene	2.3
1,4-Dichlorobenzene	9
1,2,4-Trichlorobenzene	1.8
Hexachlorobenzene	2.3
Dimethyl Phthalate	53
Diethyl Phthalate	110
Di-N-Butyl Phthalate	1700
Butyl Benzyl Phthalate	64
Bis (2-Ethylhexyl) Phthalate	78
Di-N-Octyl Phthalate	4500
Dibenzofuran	58
Hexachlorobutadiene	6.2
N-Nitrosodiphenylamine	11
Total PCBs	65
Phenol	1200
2-Methylphenol	63
4-Methylphenol	670
2,4-Dimethyl Phenol	29
Pentachlorophenol	690
Benzyl Alcohol	73
Benzoic Acid	650

Source: WAC 173-204 Sediment Management Standards
See Appendix E for detailed descriptions of Sediment Management Standards

5.5 Analytical Reports

Analytical summaries of laboratory analytical reports and laboratory quality assurance/quality controls (QA/QC) documentation for soil, groundwater, and sediment samples can be found in Appendix C. This appendix is a CD ROM containing images of all the chain-of-custody record forms, laboratory analytical results, and QA/QC documentation for the PSI.

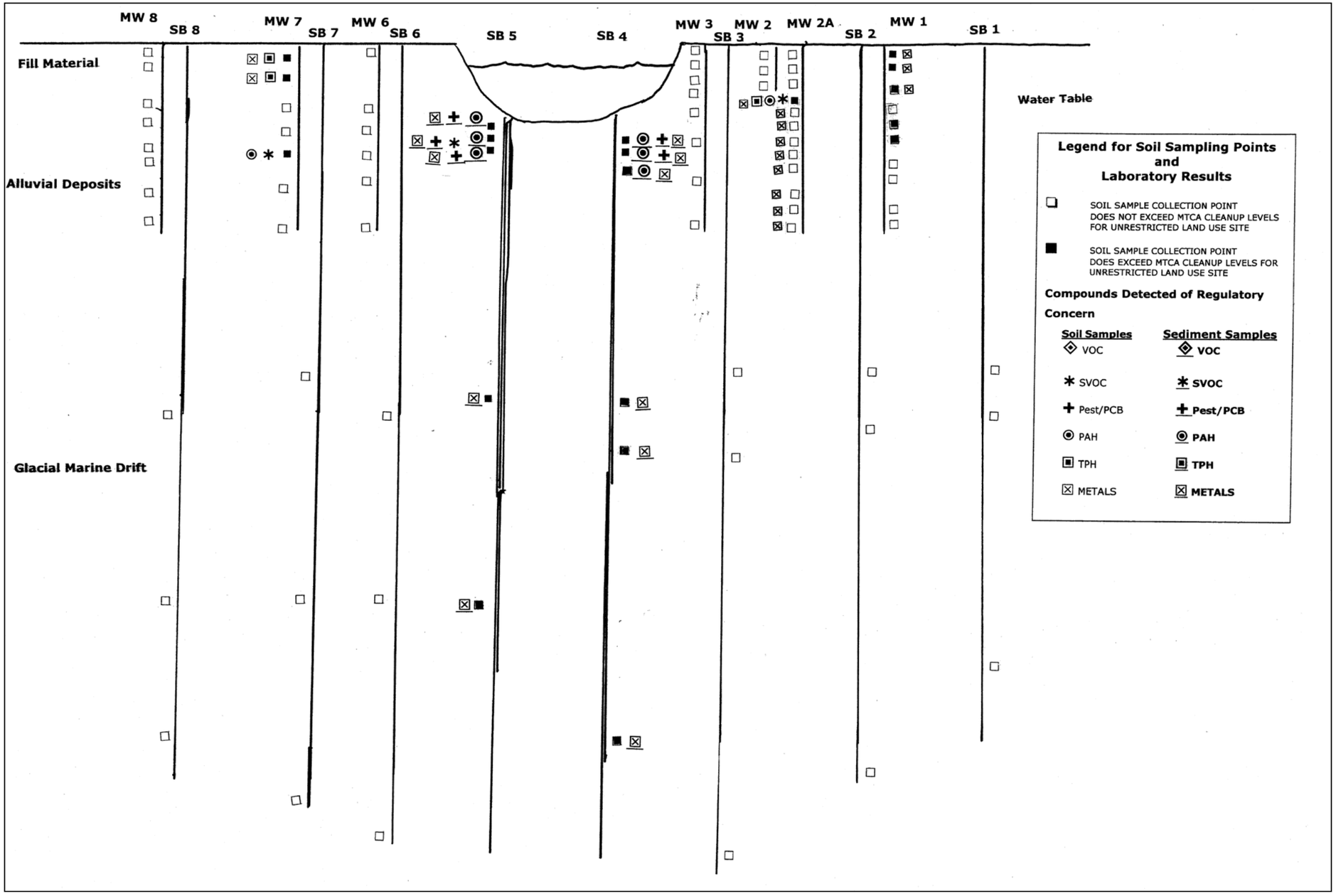

Figure 7
Boring Cross-Section Map with Soil and Sediment Sample Results

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6.0 Discussion of Findings and Conclusions

6.1 Sediment Sampling

Contaminated sediments such as those found within the South Park Bridge project area require special sampling and laboratory analysis protocols. All environmental sediment samples were collected umder the Puget Sound Estuary Program protocols (PSEP 1986) as revised. Sediment sample results were compared to Washington State marine sediment quality and cleanup standards, which are set forth in Chapter 173-204 WAC, Sediments Management Standards. The Sediment Management Standards impose unique requirements for sediments that are found to be contaminated. Laboratory results for sediments were compared to US Army Corps of Engineers Puget Sound Dredge Disposal Analysis (PSDDA) requirements to determine required actions for handling and disposal of the environmentally impacted sediments generated during construction activities.

6.2 Results Summary

The foundation for determining if a material is regulated as "hazardous" is based on the provisions of the RCRA. This statute and its implementing regulations provide the definitions and methods for designating hazardous wastes. They also require a generator of hazardous waste to obtain an EPA identification number and to manifest hazardous waste transported off-site for disposal. Sample results were screened for compliance using the RCRA contaminants concentrations to determine if the sampled material results would be regulated as hazardous waste under RCRA.

In addition to RCRA, sample results were compared to the Washington State dangerous waste law and regulations set forth in The Revised Code of Washington (RCW) 70-105 and WAC 173-303, respectively. Washington State requirements are often more stringent than the counterpart federal RCRA law and regulations. The Washington State dangerous waste requirements apply to waste-generating activities in Washington State.

The laboratory results were also compared to the MTCA Cleanup Regulation, WAC 173-340, which are the regulations implementing the Washington State MTCA, RCW 70.105D. MTCA and its implementing regulations contain requirements for site discovery and reporting, site assessments, and state hazardous site lists. Hazardous substances released to the environment must be reported to WADOE within 90 days of discovery. Most importantly, the regulations define the standard methods used to assess whether the soil and/or groundwater at a site is contaminated.

Sediment sample results were compared to Washington State marine sediment quality and cleanup standards, which are set forth in WAC 173-204, Sediments Management Standards, and are similar to those contained in MTCA. The Sediment Management Standards impose unique requirements for sediments found to be contaminated. Contaminated sediments such as those found within the South Park Bridge Project area require special sampling and laboratory analysis protocols. These protocols were performed on all sediment samples collected under this PSI. The results were used to determine required actions for handling and disposing of the sediments during construction activities.

The results provided in the following section were derived from comparing the laboratory analysis of the soil, groundwater, and sediment samples collected for this PSI to the aforementioned federal and Washington State statutes and regulations governing hazardous material designation, handling requirements, and cleanup levels applicable to the sampled material.

6.2.1 Soil Sample Results

See Table 3 for a summary of all soil sample results. Note that all sample labels highlighted in bold have concentrations of compounds and/or metals above MTCA Method A unrestricted land use cleanup standards for soil. The laboratory method in which the reportable compound was found is also highlighted in bold.

No analytical results for compounds and/or elements above MTCA Method A cleanup standards for unrestricted land use were reported for samples collected from the deep geotechnical borings.

Ten soil samples collected from the shallow environmental borings that contained compounds and/or elements in concentrations above MTCA Method A cleanup standards for an unrestricted land use were collected from five borings (MW7, MW8, MW2A, MW3 and MW1). Two of these borings (MW7 and MW8) are located on the south side of the South Park Bridge Project area within the south approach ramps for the Mid-Level Fixed-Span and High-Level Fixed-Span bridge alternatives. The other three borings (MW2A, MW3 and MW1) are located on the north side of the South Park Bridge Project area within or adjacent to the footprints of the five proposed bridge replacement alternatives.

6.2.1.1 Boring MW8 Soil Results

Results for the 2.5-, 4-, and 17-foot bgs samples contained concentrations of PAH that were above MTCA Method A cleanup standards for an unrestricted land use site. The compound of concern in all of these samples is the carcinogen benzo(a)pyrene. The near-surface sample results may be the result of years of street and nearby business stormwater runoff entering the near

surface soil. The deeper sample result may be the result of the discharge from one of the several operating septic systems in the area. This area of South Park has numerous septic systems with long operational histories. Because PAHs tend to migrate very slowly in the subsurface, the septic systems may be potential sources of PAH. Another potential source for these PAHs may be the automotive repair shop/service station located upgradient half a block from boring MW8. PAHs are commonly associated with substances used in automotive repair. This site has been an automotive repair shop/service station in operation since the 1920s.

6.2.1.2 Boring MW7 Soil Results

Results for the 2-, 5-, and 12.5-foot bgs samples contained concentrations of SVOC, PAH, TPH, or metals above MTCA Method A cleanup standards for an unrestricted land use site. The shallow samples collected from 2 feet and 5 feet bgs contained elevated concentrations for metals, PAH, and TPH. These compounds probably relate to unpaved surface conditions at the MW7 boring location. The surface gravels and sand are heavily stained with oil and grease from years of parking in the area. Several abandoned vehicles were parked on this unpaved area. Several junk cars were removed from the boring location just prior to drilling activities. The 12.5-foot bgs sample contained elevated concentrations of SVOC and PAH. One potential source for these contaminants may be the storm sewer line that runs north-south along 14th Avenue South. Another potential source for these deeper contaminants are local business and residential septic systems that have long operational histories in the area.

6.2.1.3 Boring MW3 Soil Results

Results from the 15-, 20-, and 25-foot bgs samples contained cadmium concentrations above MTCA Method A cleanup standards for unrestricted land use site. PCB aroclors were detected in the 3- and 5-foot bgs samples, but combined concentrations for each sample were below the MTCA Method A cleanup standard of 1.0 ppm for PCB at an unrestricted land use site. Low-level concentrations of PCB have been reported in this area from past sampling efforts conducted by Boeing.

6.2.1.4 Boring MW2A Soil Results

Results for the 4-foot bgs sample contained elevated concentrations above MTCA Method A cleanup standards for an unrestricted land use site for PAHs, metals and Benzo(a)pyrene. Results for the 4-, 5-, 7.5-, 10-, 12.5-, 15-, 20-, 22.5- and 25-foot bgs samples contained Cadmium concentrations above MTCA Method A cleanup standards for an unrestricted land use site. Note that boring MW2 was abandoned because of drill refusal (i.e., obstacle debris) at

seven feet bgs. Boring MW2A was drilled about 30 feet from the location sited for MW2.

6.2.1.5 Boring MW1 Soil Results

Results for the 1.5-, 4-, 10-, and 12.5-foot bgs samples contained cadmium concentrations above MTCA Method A cleanup standards for an unrestricted land use site. Results for the 4-foot bgs sample contained cadmium concentrations above MTCA Method A cleanup standards for an unrestricted land use site. PCB aroclors were detected in the 1.5-, 4-, and 5-foot bgs samples. However, the combined concentrations for each of the samples were below the MTCA Method A cleanup standard of 1.0 ppm for PCB at an unrestricted land use site. Low-level concentrations of PCB have been reported for this area from past sampling efforts conducted by Boeing.

6.2.2 Groundwater Sample Results

All of the monitoring well laboratory results were below MTCA Method A cleanup levels for hazardous substances in groundwater except for MW8. All of the groundwater analysis results were obtained from unfiltered samples. MW8 is located on the south end of the South Park Bridge Project area within the south approach ramp of the Mid-Level Fixed-Span and High-Level Fixed-Span bridge alternatives.

The MW8 groundwater sample results contained concentrations of vinyl chloride, trichloroethene, tetrachloroethene, and 1,2-dichloroethane that are several orders of magnitude above the MTCA Method A cleanup levels for groundwater. The concentrations for these chlorinated solvents are 65 ppb, 13 ppb, 17 ppb and 160 ppb respectively. MTCA Method A cleanup levels for vinyl chloride, trichloroethene, tetrachloroethene, and 1,2-dichloroethane are 0.2 ppb, 5 ppb, 5ppb and 0.3 ppb, respectively. Groundwater at this location has been adversely impacted. Note that the soil samples collected from boring MW8 did not contain detectable concentrations of any chlorinated solvents. This indicates that the chlorinated solvents detected in boring MW8 are being transported from the source area via groundwater transport in the soluble phase.

6.2.3 Sediment Sample Results

All of the sediment samples collected from borings SB4 and SB5 from the water/mud line interface to a depth of 10 feet below the mud line (bml) were found to exceed either the PAH and/or the PCB concentrations for WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards.

All sediment samples collected from borings SB4 and SB5 exceeded metal concentrations for WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards.

Samples collected from boring SB4 at the 5-, 7-, and 10-foot bml contained several PAH compounds at concentrations above WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards. Several PAH compounds in samples collected from boring SB5 at the 2.5-, 5-, and 7.5-foot bml were found to be above WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards.

Samples collected from boring SB4 at the 5- and 7-foot bml contained concentrations for PCB above WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards. PCB concentrations for samples collected from boring SB5 at the 2.5-, 5-, and 7.5-foot bml exceeded WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards.

Concentrations for metals from all samples collected from boring SB4 from the 5-, 7-, 10-, 50-, 64-, and 100-foot bml exceed WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards. Concentrations for metals from all samples collected from boring SB5 at the 2.5-, 5-, 7.5-, 50-, and 75-foot bml line exceed WADOE's Sediment Cleanup Screening Level/Minimum Cleanup Level Management Standards. Metals found in the sediment samples collected at depths below seven feet are native metals derived from the source rock where the sediment originated. Source rock erodes into smaller-sized sediment grains, which are then transported to depositional areas where they are deposited. The sediments have the same chemical makeup as the source rock material.

6.3 Contaminant Characteristics

6.3.1 Identify the Suspected Source of Contamination

Several sources for contaminant releases have been identified within and adjacent to the footprint of the replacement alternatives in the PSI study area. See the *Hazardous Materials Technical Report* (Wilbur 2004) for the South Park Bridge Project.

Environmental risks to the soil, groundwater, and sediment in the southern portion of the PSI study area appear to be the result of the following:

1) Contamination may be the result of releases to the subsurface from the sanitary sewer and/or storm sewer drains connected to industrial operations. The chlorinated solvents found in groundwater from boring

MW8 are in the dissolved phase and are migrating with the groundwater. These solvents were not detected in the soil samples collected from boring MW8. This indicates that there has been or is currently an ongoing release of chlorinated solvents over a long period of time occurring at this location upgradient and/or cross-gradient to groundwater flow at MW8. Potential sources for the chlorinated solvents detected in the groundwater at MW8 include the dry cleaning operation and the auto repair shop located near MW8.

2) Contamination may be the result of releases to subsurface from the storm sewer drains discharging stormwater runoff from the streets or surface water infiltration. The potential sources for the PAH detected in the soil from MW8 described above are based on the low transport values for PAH compounds to migrate in groundwater.

3) Septic system discharges from business operations and residents may result in contamination. Potential sources of the chlorinated solvents detected in the groundwater from boring MW8 and of the PAHs detected in soil from borings MW8 and MW7 may be discharges to septic systems used in the area.

4) Stormwater runoff discharged directly into the channel of the Duwamish Waterway may be a potential source for PAH, PCB and metals detected in sediments samples collected from boring SB5.

Environmental risks to the soil, groundwater, and sediment in the northern portion of the PSI study area appear to be the result of historical and current industrial uses. There has been 80 years of industrial operations at what is now Boeing's property. Prior to Boeing's operation, this portion of the PSI study area was a bulk petroleum storage site, a tile manufacturing site, and a U.S. Army vehicle maintenance area. All of these historical and current operations potentially released contaminants to the soil groundwater and sediment in the northern portion of the PSI study area. Potential sources of contamination in the northern portion of the PSI study area include:

1) Releases to ground from past and current operations that have impacted the near-surface soils with PAH, PCB, and metals.

2) Stormwater and past direct discharges from local industrial operations to the Duwamish Waterway that have impacted near-surface sediments.

6.3.2 Comparison of Contamination Associated with Various Bridge Alternatives

The subsurface soil, groundwater, and sediment samples were collected and analyzed for the three bridge replacement alternatives as a part of this PSI. Efforts were made to locate the sample collection points to coincide proposed column and pier support structure locations for the proposed bridge replacement alternatives. Note that the soil, groundwater and sediment of the No Action and Rehabilitation bridge alternatives were not sampled under this PSI. For these two alternatives, sample results from existing environmental studies reviewed in the *Draft Hazardous Materials Technical Report* (Wilbur 2002) were used to determine if contamination was present in the soil, groundwater and sediment. The *Draft Hazardous Materials Technical Report* (Wilbur 2002) found the potential for sediment contamination. There is also the potential for these areas to be contaminated with lead from bridge painting operations.

For the bridge replacement alternatives, the larger the footprint area, the higher the likelihood that contaminated materials will be encountered in the subsurface. The proposed support structure locations for all of the replacement alternatives encounter contamination in the soil and sediment. The proposed support structure locations for the Mid-Level Fixed-Span and High-Level Fixed-Span bridge alternatives encounter groundwater, soil, and sediment contamination in the south terminus areas between South Sullivan and South Donovan streets. In descending order of estimated environmental cost, the bridge replacement alternatives are the High-Level Fixed-Span, Mid-Level Fixed-Span, and Bascule.

The Rehabilitation Alternative has a smaller footprint area compared to the bridge replacement alternatives. However, because of the large volume of sediment that would be required to be excavated during rehabilitation of the support piers in the waterway and the likelihood of contamination, the Rehabilitation Alternative is estimated to have the highest environmental costs of all the proposed bridge alternatives. Table 9 lists contamination by bridge alternative.

6.4 Data Validity

All samples collected were submitted to ARI laboratory for analytical work. The goal for the analytical data for this PSI was to produce data of sufficient quality to meet all QA/QC requirements set forth in the Work Plan for this PSI study. All samples were extracted and analyzed by ARI in accordance with the USEPA's laboratory analysis method protocols. Reproducibility of analytical results was measured by matrix duplicate spike samples that were run for each batch of samples submitted. All matrix duplicate spike sample results met the

QA/QC goals for this project. All groundwater samples were transported to the laboratory with trip blank samples to assure that any potential cross-contamination issues for groundwater samples would be noted. Trip blank analytical results showed that cross-contamination was not an issue for the transport of groundwater samples from the field to the laboratory.

Based on the reported matrix duplicate spike sample results, the data presented in this report are valid and meet all of the PSI analytical goals.

Table 9. Summary of Contamination in Soil, Groundwater, and Sediment by Bridge Alternative

Bridge Alternative	Contaminated soil found within or adjacent to footprint area	Contaminated groundwater found within or adjacent to footprint area	Contaminated sediment found within or adjacent to footprint area
No Action	✓*		✓*
Bascule Bridge	✓		✓
Mid-Level Fixed-Span Bridge	✓	✓	✓
High-Level Fixed-Span Bridge	✓	✓	✓
Rehabilitation	✓*		✓*
* = environmental data collected for the *Hazardous Materials Technical Report* (Wilbur 2004)			

7.0 Aquifer Testing

As a part of this PSI, the Work Plan provided procedures for conducting an aquifer test to determine pumping requirements for dewatering activities in support of potential construction activities. The goal of the aquifer testing was to obtain data to estimate pumping rates needed to temporarily lower the level of groundwater during construction. The purposes of an aquifer test are: 1) to establish potential pumping requirements for dewatering the aquifer in the vicinity of excavation activity; and 2) to obtain groundwater samples representative of the water that would be discharged from the dewatering system. The results would be used to design the dewatering system to meet specific construction project needs and to apply for a permit to allow for the discharge of pumping effluent to the sanitary sewer system.

Laboratory results for groundwater collected during the PSI were found to be acceptable for discharge to the local sanitary sewer system. Based on PSI groundwater results, WCI obtained authorization to discharge to the sanitary sewer from King County Wastewater Treatment Division on December 4, 2003 (see Appendix F**)**. The question concerning groundwater quality and the ability to obtain a discharge permit for disposal to the sanitary sewer has thus been answered.

Establishing appropriate pumping rates for dewatering was determined through a literature review. Dewatering aquifer tests are designed to address specific construction needs related to a defined structural design specification. With no defined structural design and no specific construction method, performing an in-depth aquifer test at this time would be premature.

Dewatering tests are designed to address specific construction parameters such as the shape and depth of the excavation and the duration of excavation activities. A credible dewatering test requires a monitoring well array to be set up to reflect the boundary of the excavation and the desired construction activities. Due to the lack of specific structural design and construction data, WCI recommended that a review of the available aquifer testing data previously conducted in or near the area be undertaken in lieu of conducting a costly aquifer test that would produce limited results.

Boeing conducted large-scale dewatering aquifer tests within a few hundred feet of the South Park Bridge corridor in support of one of Boeing's large-scale construction projects. WCI obtained a copy of the dewatering aquifer test report and the geotechnical engineering document. The results of this aquifer test are summarized below.

7.1 Boeing Dewatering Aquifer Test Results

In 1991, Boeing hired GeoEngineers, Inc., to conduct a dewatering aquifer test to support construction of the Integrated Aircraft Systems Laboratory (IASL) (see Appendix G). The IASL site is located 700 feet north of the South Park Bridge. The dewatering test was designed to reflect a foundation excavation for a 12-foot-deep basement approximately 90 feet by 90 feet.

The aquifer test required the initialization of one test well and three observation wells. The dewatering well was drilled to a total depth of 55 feet bgs and was completed with an 8-inch diameter screen and casing. The screened interval was set from 20 feet to 50 feet bgs. An 8-inch blank casing was used from 20 feet bgs to the surface. The observation wells were completed at depths ranging from 14 feet to 30 feet bgs, using hollow-stem auger equipment at distances of 25, 50, and 70 feet from the test well. An initial step-drawdown test was performed to provide bases for estimating the pumping rate of the subsequent 24-hour aquifer test. It was determined that a pumping rate of 110 gallons per minute (gpm) could be maintained for the 24-hour test.

After 24 hours of pumping, the drawdown achieved at the test well was 22.97 feet and the drawdown in three observation wells ranged from 1.41 to 1.74 feet. Based on these data, Boeing's consultant estimated the hydraulic conductivity, transmissivity and storativity of the aquifer. The hydraulic conductivity was estimated to range between 550 and 1,000 gallons per day per square foot. The aquifer transmissivity was estimated to range between 19,000 gallons to 35,000 gallons per day per square foot. The aquifer recharge rate was estimated to be about 0.01 gallons/day.

Boeing's consultant made the following observations: 1) the water table should be lowered at least 2 feet below the base of the excavation during all tide conditions; 2) 8 feet of drawdown would drop the water table an estimated 2 feet below the 12-foot excavation depth; 3) a total discharge of 500 to 900 gpm would produce the specified 8-foot drawdown; 4) six dewatering wells should be installed, each capable of pumping 150 gpm with a maximum drawdown of 25 feet; and 5) the dewatering system needs to be put into operation two weeks before excavation activities begin, to allow sufficient lowering of the groundwater.

The proposed dewatering system was installed and operated by Boeing, and the basement foundation for the IASL facility was constructed on time and within budget. As such, the prescribed dewatering methods were accurate.

7.2 Findings and Costs for Potential Dewatering Activities

The Boeing consultant's estimation of pumping rates of 500 to 1,000 gpm, to lower the water table 8 feet in a 90-by-90-foot excavation area can be used to estimate dewatering requirements for proposed excavations associated with the South Park Bridge Project. The dewatering pump rates that were estimated would be within an order of magnitude for any proposed dewatering within the South Park Bridge Project area.

For estimating the dewatering costs to lower the water table 8 feet in a 50-by-50-foot excavation area, WCI made the following conservative assumptions: 1) the pumping rate required to lower the water table 8 feet would be 1,500 gpm; 2) five 8-inch diameter dewatering wells would need to be drilled around the excavation area to depths that range from 25 to 40 feet bgs; and 3) dewater effluent discharges to the sanitary sewer would be billed at a rate of $23.40 per 5,600 gallons of water discharged.

Additional assumptions were also made to estimate costs. Well installation costs would be $18,500 for the five dewatering wells. The estimated discharge volume for a pumping rate of 1,200 gpm for two weeks prior to excavation work and for two months of construction work would be 128 million gallons. The disposal rate for discharging dewatering effluent to the sanitary sewer is $23.40 per 5,600 gallons of water discharged, for a total of $542,300. The costs for each 50-by-50-foot excavation where the water table is lowered 8 feet is estimated to be $552,000 for construction and discharge. Operating costs (e.g., power for the pumping system and management oversight 24 hours per day) are estimated to be $2,850 per day. Operating and system management oversight are estimated to be $210,900 for 74 days of dewatering operation.

The total estimated cost for each dewater system for excavation of a 50-by-50-foot area for which the water table is lowered 8 feet for a period of 74 days is $762,900. The total estimate is based on dewatering system costs of $552,000 combined with the system operational costs of $210,900. WCI recommends that excavations and/or other construction activities that would require a dewatering system be avoided, if possible, for the South Park Bridge alternative designs.

8.0 Recommendations

Analytical laboratory results for soil and sediment show that a vast majority of the subsurface materials within or adjacent to the footprint of the potential bridge alternatives are slightly contaminated. All near-surface excavation spoils generated during the construction of any selected bridge alternative would require special handling procedures, including preparation of a detailed Stormwater Management Plan and a Spill Control Plan.

8.1 Construction

Based on the laboratory findings for soil, groundwater and sediment throughout the PSI study area, WCI makes the following recommendations for properly addressing excavation materials that will be associated with any selected bridge alternative:

1) Construct two contained stockpile storage areas for handling environmentally impacted excavation spoils. One storage area should be located on the northern side of the Duwamish Waterway and the other on the southern side of the Duwamish Waterway. Each storage area would require an equipment wash rack area and liquid containment system. All saturated excavation materials would need to be stabilized in the stockpile storage areas prior to being transported on a highway to a landfill for disposal. WCI also recommends that an excavation stockpile storage area be designed and built for the project on each side of the Duwamish Waterway. Based on calculated excavation volumes, two approximately 20,000-square-foot stock pile storage areas should be established prior to excavation activities begin. The design work for the storage area should be conducted in conjunction with the project stormwater permit process and incorporated into the project's Stormwater Management Plan and Spill Prevention Plan.

2) After the bridge alternative is selected, conduct a detailed subsurface investigation at all of the pier support locations and along major utility trenches that would be dug during bridge construction. A more precise and accurate delineation of risks to the subsurface will be required before construction is initiated. The 15 borings that were drilled and sampled during this PSI confirmed that several areas within the proposed bridge footprint are contaminated. The true nature and actual knowledge of the extent of the contamination at the final support column sites is still limited. This subsequent investigation will be particularly necessary if the Rehabilitation Bridge Alternative is selected, because no samples were taken along this alignment and contamination is likely in the sediments that would be excavated.

3) Develop an excavation stockpile sampling and analysis plan for handling unforeseen contaminated materials that are encountered. Having a plan in place would allow for rapid and systematic sampling and analysis. This would allow for quicker decision-making for handling and disposing of contaminated materials.

4) Investigate the subsurface area under the wharf structure that is located along the north shore of the Duwamish Waterway on Boeing's property. No soil borings were drilled within the area of the wharf during this PSI. The subsurface materials under the wharf are known to be fill material deposited in the 1930s and 1940s. These materials may not be compatible with the proposed bridge construction methods. This fill material also has a high potential for being contaminated.

5) Explore the use of push piles and/or any techniques that limit the generation of excavation material during construction. Cost and time requirements associated with handling, storing, loading and disposing of contaminated excavation materials will have a negative effect on the construction project costs and schedule.

8.2 Cleanup Liability

The construction of the selected bridge alternative may result in the excavation of contaminated material. King County would be responsible for ensuring that these materials are properly characterized, handled, and disposed of in accordance with applicable law. During any construction project of this nature, there is a risk of releases or spills of contaminated material into surface waters. King County should plan to manage and require its subcontractors to work in a manner which tries to avoid such spills and releases and, thereby, the liability associated with any such spills or releases.

There is a risk of encountering historical contamination in the project area, including, but not limited to, the Boeing Plant 2 RCRA CA, which is being conducted under USEPA and WADOE oversight and the LDW Superfund Site. In fact, all of the proposed alternatives would impact the LDW Superfund Site.

King County should anticipate the need to address requests to review and comment on design and construction proposals and permit applications from USEPA, WADOE, Boeing, and other third parties, particularly when proposed projects activities may impact property rights, ongoing corrective action, or other cleanup activities. Managing and coordinating agency responses to, as well as private sector reviews of, draft and final plans for the selected bridge alternative designs and associated environmental concerns could be time consuming and may take six months to one year to complete.

8.3 Construction Impacts

Estimated costs for construction activities based on the two possible construction support designs using 24-inch steel pipe piles or concrete drilled shafts are provided below. Parsons Brinckerhoff provided WCI with the excavation volumes for these activities. This estimate assumes that all excavated material generated during construction from the first 12 feet bgs and/or water mud line interface would be disposed off-site. See Tables 10 and 11 for the details and variables used to calculate costs estimates for construction of the 24-inch steel pipe piles and concrete drilled shafts. See Table 12 for a summary of the estimated costs for handling contaminated excavation material for the proposed bridge alternatives. Note that these estimates include design, construction, and management of the excavation stockpile area. A summary of the assumptions and the variables used to generate the cost estimates for these costs.

The estimates are based on two potential construction methods: 1) the concrete drilled-shaft method; and 2) the 24-inch steel pipe pile method. PB provided WCI with estimated volumes of excavation material to be generated by each of the two construction methods. Laboratory analysis results for soil and sediment obtained by WCI during the South Park Bridge PSI were applied to the provided volumes of excavation material to estimate the volumes and tons of contaminated materials that may be encountered during construction excavation of the support structures for the South Park Bridge alternatives.

Table 10. Soil Excavation Estimate: 24-Inch Steel Pipe Piles

Cofferdam + Footing Excavation

Alternative		Total Excavation Volume		Excavation Volume, 0-20 feet Under Mud Line	60 Percent of Total Excavation (upper 12 feet) Under Mud Line Assumed to be Contaminated	Estimated Tons of Saturated Contaminated Material to be Generated (1.5 tons/CY)	Tons of Material to be Added (50%) to Stabilize Saturated Contaminated Material to be Transported to Landfill for Disposal	Total Tons of Contaminated Material to be Transported for Disposal	Estimated Cost of Material to Stabilize Saturated Contaminated Soil or Sediment ($12/ton)	Estimated Cost for Contractor to Blend Contaminated Material with Stabilization Material in Storage Area ($7.5/ton)	Disposal Costs to a CLASS C Landfill ($45/ton tipping fees)	Disposal Costs to a CLASS B Landfill ($85/ton tipping fees)
		(CF)	(CY)	(CY)	(CY)	(Tons)	(Tons)	(Tons)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
Rehabilitation	Bascule	299000	11074	9630	5778	7684	3842	11527	$ 46,107	$ 28,817	$ 518,700	$ 979,767
Steel	Approach	21504	796	796	478	636	318	953	$ 3,813	$ 2,383	$ 42,900	$ 81,034
Conc.	Approach	32256	1195	1195	717	953	477	1430	$ 5,720	$ 3,575	$ 64,351	$ 121,551
	Abutment	10752	398	398	239	318	159	477	$ 1,907	$ 1,192	$ 21,450	$ 40,517
High-Level	Bents	109056	4039	4039	2423	3223	1612	4835	$ 19,339	$ 12,087	$ 217,567	$ 410,959
	Abutment	13632	505	505	303	403	201	604	$ 2,417	$ 1,511	$ 27,196	$ 51,370
Mid-Level	Bents	81792	3029	3029	1818	2417	1209	3626	$ 14,504	$ 9,065	$ 163,175	$ 308,220
	Abutment	13632	505	505	303	403	201	604	$ 2,417	$ 1,511	$ 27,196	$ 51,370
Bascule	Bascule	313950	11628	10111	6067	8069	4034	12103	$ 48,412	$ 30,258	$ 544,635	$ 1,028,755
	Approach	13632	505	505	303	403	201	604	$ 2,417	$ 1,511	$ 27,196	$ 51,370
	Abutment	13632	505	505	303	403	201	604	$ 2,417	$ 3,324	$ 27,196	$ 51,370

Cofferdam + Footing Excavation (continued)

Alternative		Estimated Transportation Costs to Move Contaminated Material to Landfill ($11/ton)	Estimated Costs for Confirmation Sampling and Laboratory Analysis for Contaminated Materials to be Disposed (bybridge alternative - 1 sample at $250/every 25 tons of material to be disposed)	Estimated Labor Costs for Permitting, Manifesting, and Managing Contaminated Excavation Material, Contaminated Storage and Staging Area (by bridge alternative - 8 months @ $75/hour)	Estimated Costs for Permitting, Construction, and Operation of a Contaminated Material Storage and Staging Area for Six Months (by bridge alternative - two 20K sq.ft. staging areas @ $3.75/sq.ft.)	Estimated Costs to Handle, Transport, and Dispose of Solid Contaminated Materials Generated During Cofferdam and Casing Excavation Activities (by bridge alternative - CLASS C material)	Total Estimated Cost for Handling and Disposing of Contaminated Solid Materials for All Bridge Alternatives Using the 24inch Steel Pipe Piles Design Option (Class C material)	Estimated Costs to Handle, Transport, and Dispose of Solid Contaminated Materials Generated During Cofferdam and Casing Excavation Activities (by bridge alternative - CLASS B material)	Total Estimated Cost for Handling and Disposing of Contaminated Solid Materials for All Bridge Alternatives Using the 24-inch Steel Pipe Piles Design Option (CLASS B Material)
		(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
Rehabilitation	Bascule	$ 126,793	$ 115,267	$ 96,000	$ 150,000	$ 1,081,683		$ 1,542,750	
Steel	Approach	$ 10,487				$ 59,584		$ 97,718	
Conc.	Approach	$ 15,730				$ 89,376		$ 146,577	
	Abutment	$ 5,243				$ 29,792	$ 1,260,435	$ 48,859	$ 1,835,903
High-Level	Bents	$ 53,183	$ 48,348	$ 96,000	$ 150,000	$ 596,524		$ 789,917	
	Abutment	$ 6,648				$ 37,772	$ 634,296	$ 61,946	$ 851,863
Mid-Level	Bents	$ 39,887	$ 36,261	$ 96,000	$ 150,000	$ 508,893		$ 653,938	
	Abutment	$ 6,648				$ 37,772	$ 546,665	$ 61,946	$ 715,884
Bascule	Bascule	$ 133,133	$ 121,030	$ 96,000	$ 150,000	$ 1,123,468		$ 1,607,588	
	Approach	$ 6,648				$ 37,772		$ 61,946	
	Abutment	$ 6,648				$ 39,585	$ 1,200,825	$ 63,759	$ 1,733,293

Table 11. Soil Excavation Estimate: Concrete Drilled Shafts

Shaft Excavation

Alternative		Shaft Excavation Volume, 0-20 feet Under Mud Line	60 Percent of Total Excavation (Upper 12 feet) under Mud Line Assumed to be Contaminated	Estimated Tons of Saturated Contaminated Material Estimated to be Generated (1.5 tons/CY)	Tons of Material to be added (50%) to Stabilize Saturated Contaminated Material to be Transported to Landfill for Disposal	Total Tons of Contaminated Material to be Transported for Disposal	Estimated Cost of Material to Stabilize Saturated Material ($12/ton)	Estimated Cost for Contractor to Blend Contaminated Material with Stabilization Material in Storage Area ($7.5/ton)	Disposal Costs to a CLASS C Landfill ($45/ton tipping fees)	Disposal Costs to a CLASS B Landfill ($85/ton tipping fees)
		(CY)	(CY)	(Tons)	(Tons)	(Tons)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
Rehabilitation	Bascule	1164	698	929	464	1393	$ 5,571	$ 3,482	$ 62,675	$ 118,386
Steel	Approach	465	279	371	186	557	$ 2,228	$ 1,393	$ 25,070	$ 47,354
Concrete	Approach	1047	628	836	418	1253	$ 5,014	$ 3,134	$ 56,407	$ 106,547
	Abutment	349	209	279	139	418	$ 1,671	$ 1,045	$ 18,802	$ 35,516
High Level	Bents	2094	1257	1671	836	2507	$ 10,028	$ 6,267	$ 112,815	$ 213,094
	Abutment	349	209	279	139	418	$ 1,671	$ 1,045	$ 18,802	$ 35,516
Mid Level	Bents	1338	803	1068	534	1602	$ 6,407	$ 4,004	$ 72,076	$ 136,144
	Abutment	349	209	279	139	418	$ 1,671	$ 1,045	$ 18,802	$ 35,516
Bascule	Bascule	1396	838	1114	557	1671	$ 6,685	$ 4,178	$ 75,210	$ 142,063
	Approach	349	209	279	139	418	$ 1,671	$ 1,045	$ 18,802	$ 35,516
	Abutment	349	209	279	139	418	$ 1,671	$ 2,298	$ 18,802	$ 35,516

Shaft Excavation (continued)

Alternative		Estimated Transportation Costs to Move Contaminated Material to Landfill ($11/Ton)	Estimated Costs for Confirmation Sampling and Laboratory Analysis for Contaminated Materials Disposed (by bridge alternative - 1 sample at $250/every 25 tons of material to be disposed)	Estimated Labor Costs for Permitting, Manifesting, and Managing Contaminated Excavation Material, Contaminated Storage, and Staging Area (by bridge alternative - 8 months @ $75/hour)	Estimated Costs for Permitting, Constructing, and Operation of a Contaminated Material Storage and Staging Area for Six Months (by bridge alternative - two 20K sq.ft. staging areas @ $3.75/sq.ft.)	Estimated Costs to Handle, Transport, and Dispose of Solid Contaminated Materials Generated During Cofferdam and Casing Excavation Activities (by bridge alternative - CLASS C material)	Total Estimated Cost for Handling and Disposal of Contaminated Solid Materials for all Bridge Alternatives Using the Shaft Excavation (CLASS C material)	Estimated Costs to Handle, Transport, and Dispose of Solid Contaminated Materials Generated During Cofferdam and Casing Excavation Activities (by bridge alternative - CLASS B material)	Total Estimated Cost for Handling and Disposal of Contaminated Solid Materials for All Bridge Alternatives Using the Shaft Excavation (CLASS B material)
		(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)	(Dollars)
Rehabilitation	Bascule	$ 15,320	$ 13,928	$ 96,000	$ 150,000	$ 346,976		$ 402,687	
Steel	Approach	$ 6,128				$ 34,819		$ 57,104	
Concrete	Approach	$ 13,788				$ 78,343		$ 128,483	
	Abutment	$ 4,596				$ 26,114	$ 486,253	$ 42,828	$ 631,102
High-Level	Bents	$ 27,577	$ 25,070	$ 96,000	$ 150,000	$ 427,757		$ 528,036	
	Abutment	$ 4,596				$ 26,114	$ 453,871	$ 42,828	$ 570,864
Mid-Level	Bents	$ 17,619	$ 16,017	$ 96,000	$ 150,000	$ 362,122		$ 426,190	
	Abutment	$ 4,596				$ 26,114	$ 388,237	$ 42,828	$ 469,018
Bascule	Bascule	$ 18,385	$ 16,713	$ 96,000	$ 150,000	$ 367,171		$ 434,024	
	Approach	$ 4,596				$ 26,114		$ 42,828	
	Abutment	$ 4,596				$ 27,368	$ 420,654	$ 44,081	$ 520,933

Table 12. Summary of Estimated Costs for Handling Contaminated Excavation Materials by Bridge Alternative and Support Design

Bridge Alternative	Estimated costs for handling contaminated soil and sediment using the 24-inch steel pipe piles construction method	Estimated costs for handling contaminated soil and sediment using the concrete drilled-shaft construction method
Rehabilitation	$1,835,000	$631,000
High-Level Fixed-Span	$851,900	$570,000
Mid-Level Fixed-Span	$715,000	$469,000
New Bascule	$1,733,000	$520,000

8.4 Worker Safety

In several areas within the footprint of the five bridge alternatives, construction workers would be required to wear protective clothing and follow a health and safety plan. A project specific health and safety plan should be drafted that applies to any additional environmental and/or geotechnical subsurface soil, groundwater, and sediment investigation.

Based on information obtained in the *Hazardous Materials Technical Report* (Wilbur 2004) and the finding of the PSI, the following chemical contaminates have been identified in the project area or may be present in the project area: PCBs, TCE, toluene, metals, and hydrocarbon fuels. The health and safety plan would need to comply with the procedures and requirements described in 29 CFR 1910.120b 1-4, the Washington General Occupational Health and Safety Standards in WAC 296-62 Part P for a site-specific Safety and Health Plan, and WAC 296-155.

Exclusion zones should be set up to prevent untrained personnel from entering these areas and would be accessed by 40-hour trained HAZWOPER personnel only. All work activities conducted with the exclusion zone would be defined by yellow cautionary boundary. Areas outside the exclusion zone would be safe for the general public. Because the project area is relatively small in size compared to the area surrounding the project area that has been primarily industrial with a long history of contamination, workers in all areas within the construction zone should follow the precautions set forth in the health and safety plan. Workers within exclusion zones should also be monitored for PCB's should these materials be identified in sample excavated material.

Considering known contamination risks, excavation activities during project construction and/or additional investigation should be conducted under the Washington General Occupational Health and Safety Standards (WAC 296-62) Level D protection, and upgraded to Level C protection, if airborne action

levels are exceeded. All personnel should wear the following personal protective equipment (Level D), during drilling and sampling activities.

- Neoprene safety boots with a steel toe/shank
- Hard hat
- Tyvek coveralls
- Gloves (undergloves vinyl, outergloves nitrile)
- Safety glass (during drilling activities)
- Hearing protection
- Half-face respirator, cartridge-type organic vapor (available, if upgraded to Level C protection)

8.5 Monitoring

Excavation areas shall be monitored periodically using an organic vapor monitor (OVM) in the breathing zone. If any OVM readings are above monitoring limits for a sustained period of 10 to 15 seconds, background Drager tube readings should be collected for all chemicals of concern. See Table 13 for action levels for upgrading to Level C protection for chemical compounds of concern. If the Drager Tube measurements exceed 10 percent of the lower explosive limit (LEL), all workers should leave the area until safe levels are maintained. Additional measures and protection may be required. The exclusion zone would be established to prevent the public from entering unsafe areas.

If the Drager tube measurements do not exceed action levels and OVM readings continuously exceed 50 ppm, purifying respirators should be worn until measured vapors in the workspace are measured to be below the 50-ppm limit.

Table 13. Chemical Compounds of Concern: Action Levels

Chemical Compounds of Concern	Action Level
TCE	>12.5 ppm
Carbon Tetrachloride	>1.0 ppm
Volatile Carbons	> 0.5 ppm
Benzene	> .05 ppm

Note that in the areas where the potential for chemical exposure exists, the wet nature of the soil and sediment is limited to skin contact for the most part.

9.0 Necessity of Further Assessments of Remediation

WCI recommends that a PSI study be completed for any property purchase and/or other land acquisitions planned in support of this project. Due-diligence investigations for properties being purchased for a highway construction project are required under WSDOT environmental procedures. It is recommended that these properties be investigated for environmental contamination following selection of a preferred alternative, publication of the Final EIS, issuance of the EIS Record of Decision, and completion of preliminary engineering. This additional analysis would be to a PSI level of evaluation.

10.0 Regulatory Requirements

Federal, state, and local regulation of hazardous materials may affect the construction project. Regulatory requirements most likely to affect the project are briefly discussed below.

10.1 Comprehensive Environmental Response Compensation and Liability Act (CERCLA or Superfund) Regulations (Title 40 CFR, Part 300)

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) as amended, 42 U.S.C. 9601 et seq., and the Clean Water Act (CWA), 33 U.S.C. 1251-1376 provide that natural resource trustees may assess damages to natural resources resulting from a discharge of oil or a release of a hazardous substance covered under CERCLA. The Superfund Amendments and Reauthorization Act (SARA) of 1986 establishes a comprehensive framework to identify, investigate, and clean up releases of hazardous substances released to the environment. CERCLA, commonly referred to as Superfund, tracks hazardous waste sites that are inactive and/or abandoned. The sites are tracked from initial discovery to listing on the National Priorities List (NPL). NPL sites are Superfund sites that are determined to be a priority for cleanup and remediation by EPA.

10.2 Model Toxics Control Act (MTCA) Regulations (WAC 173-340)

MTCA applies to any site identified with environmental contamination that may pose a threat to human health and/or the environment. MTCA establishes acceptable cleanup limits for contaminated media. Any necessary cleanup associated with the proposed South Park Bridge Project would likely be accomplished during construction as an independent action by WSDOT, with technical review by the WADOE on an as-needed basis. WAC 173-340-450 sets forth the requirements for addressing releases that may pose a threat to human health or the environment from underground storage tanks. An overview of the cleanup standards is detailed in WAC 173-340-700. Soil, groundwater, and sediment cleanup standards are listed in WAC 173-340-740, WAC 173-340-730, and WAC 173-340-760, respectively.

10.3 Washington Sediment Management Standards (WAC 173-204-310 through -520; WAC 173-340-760)

The Sediment Management Standards apply to any in-water and/or near-shore activities that will disturb sediment materials. The Water Pollution Control Act, RCW 90.48, provides WADOE with the ability to regulate and manage existing and proposed discharges to control sediment quality. Like the MTCA,

RCW 70.105D enables WADOE to address necessary environmental cleanups. The Sediment Management Standards were established to set uniform standards for managing the sites and activities affecting sediments, such as in-water activities and environmental cleanups. Sediment standards are established to be protective of biological risk and human health factors.

10.4 Dangerous Waste Regulations (WAC 173-303)

Compliance with waste designation procedures and disposal requirements will most likely affect project construction. Any contaminated materials generated during construction, including soil, water, and debris, will need to be properly designated prior to disposal. In addition, wastes generated by the contractor during construction will require proper designation prior to disposal. WAC 173-303-070 through 173-303-110 include specific regulations that identify dangerous waste characteristics and criteria. The requirements for generators of dangerous waste are included in WAC 173-303-170 through WAC 173-303-230. A transporter of dangerous waste must comply with the procedures listed in WAC 173-303-240 through 173-303-250.

WAC 173-303-145 lists the reporting requirements for spills and discharges into the environment. This section of the WAC applies "when any dangerous waste or hazardous substance is intentionally or accidentally spilled or discharged into the environment such that human health or the environment is threatened, regardless of the quantity of dangerous waste or hazardous substance." The regulations also establish required procedures for notification and mitigation, should a spill occur.

10.5 Solid (Non-Dangerous) Waste Disposal (RCW 70.95, WAC 173-304)

The Washington State Solid Waste Management Act (RCW 70.95) states the primary responsibility for managing solid waste is assigned to local government. The state, however, is responsible for assuring the establishment of effective local programs throughout the state.

Local jurisdiction health departments regulate the handling and disposal of solid waste. Identifying the appropriate waste disposal facility is most likely the portion of local solid waste regulation that could affect the project. Local health departments determine whether a waste material is acceptable at one or more of the public or private solid waste facilities in the county. In some cases, testing may be required prior to disposal. Even waste that is shipped to a disposal facility or soil treatment facilities located outside of the county fall under the jurisdiction of local health departments.

WAC 173-304 lists the Minimum Functional Standards for Solid Waste Handling. WAC 173-304-200 designates the on-site containerized storage,

collection, and transportation standards for solid waste. The regulations apply to all persons storing containerized solid waste generated on-site. Revisions are anticipated for WAC 173-304 and the final revised rules should be reviewed prior to the commencement of construction. The updated solid waste rule is likely to include new provisions for demolition and inert waste streams.

10.6 Hazardous Waste Operations and Treatment, Storage, and Disposal Facilities (WAC 296-62 Part P, RCW 49-17)

WAC 296-62 Part P, includes all of the required procedures for work involving hazardous materials. Due to the possible risks indicated above for specific sites, there are sections of WAC 296-62 that are important to prevent workers from being exposed to contamination during project construction.

WAC 296-62, Part P, also details requirements for handling drums and containers. Unlabeled drums and containers are assumed to contain hazardous waste and must be handled accordingly until the contents are positively identified and labeled. Drums and containers that cannot be moved without rupture, leakage, or spillage must be emptied into a sound container. Personal protective equipment selection protocol is outlined in WAC 296-62-30605. The training requirements for site personnel are included within multiple sections of Part P, depending upon the designation of the contamination encountered.

10.7 General Occupational Health Standards—Asbestos (WAC 296-62 Part I-1)

WAC 296-62 requires that prior to commencement of construction work, the property owner must conduct a good faith inspection to determine whether materials to be worked on or removed contain asbestos. An accredited inspector must conduct a good faith inspection. WAC 296-62, Part I-1, requires that an employer shall ensure that no employee is exposed to an airborne concentration of asbestos in excess of 0.1 fiber per cubic centimeter (f/cc) of air during an eight-hour time-weighted average. Besides the permissible exposure limit, the regulation also requires appropriate respiratory protection as well as exposure assessment and monitoring.

10.8 Safety Standards for Construction Work—Lead (WAC 296-155)

WAC 296-166 states that workers may not be exposed to lead at concentrations greater than 50 micrograms per cubic meter ($\mu g/m^3$) averaged over an eight-hour period. It also outlines the personal protective equipment that shall be given to employees and identifies the medical surveillance procedures that should be implemented for exposed personnel.

10.9 Water Quality Standards for Surface Waters (WAC 173-201A)

The state regulates discharges into surface water. WAC 173-201A-040 is the section of the Water Quality Standards that specifically deals with toxic substances within surface waters of the state. The regulations mandate that toxic substances, above natural background levels, shall not be introduced into waters of the state if: 1) the substance will singularly or cumulatively adversely affect characteristic water uses; 2) cause acute or chronic toxicity to the most sensitive biota dependent on the water; or 3) adversely affect public health. The WADOE shall employ or require chemical toxicity testing and biological assessments as appropriate to determine compliance with the above-mentioned requirements. WAC 173-201A-160 lists the primary means to control municipal, commercial, and industrial waste discharges through the issuance of waste disposal permits. See the *Water Resources Technical Report* (Parametrix 2004) for additional discussion.

10.10 Wastewater Discharges to Ground (WAC 173-216).

The State regulates discharges to groundwater. However, the State Water Discharge Permit program includes a variety of exemptions, most of which relate to discharges permitted under a National Pollution Discharge Elimination System (NPDES) permit or otherwise authorized by a publicly owned treatment works (POTW) with an authorized pretreatment program. This regulation may apply to stormwater detention vaults planned on the project if the water contains unacceptable concentrations of polluting materials. See the *Water Resources Technical Report* (Parametrix 2004) for additional discussion.

10.11 Stormwater Permit for Construction Activities and Other Water-Related Permits

Washington regulates discharge to stormwater from construction projects under a general permit. The filing of a Notice of Intent, a stormwater pollution prevention plan (SWPPP) and best management procedures will be required for project construction activities. Other stormwater and/or in-water permits include: 1) Hydraulic Project Approval; and 2) permits for work in navigable waters issued by the U.S. Army Corps of Engineers. See the *Water Resources Technical Report* (Parametrix 2004) for additional discussion.

10.12 National Emission Standards for Hazardous Air Pollutants (NESHAP) (CFR Title 40, Volume 5, Parts 61 to 71)

The Environmental Protection Agency's rules concerning the removal and disposal of asbestos-containing materials (ACM) were issued under NESHAP. NESHAP requires a thorough inspection for friable and nonfriable ACM

within a structure prior to demolition activities. The Asbestos Hazard Emergency Response Act (AHERA) requires that an accredited inspector conduct all inspections. The NESHAP regulation also includes specific notification, work practice, packaging, labeling, and disposal requirements.

The Puget Sound Clean Air Agency (PSCAA) requires a Notice of Intent to be submitted prior to beginning any work on an asbestos demolition. The only exception is for asbestos projects involving less than 48 square feet and the removal of nonfriable asbestos containing roofing material. An AHERA building inspector or other competent person must make the determination if materials are nonfriable. There is a notification waiting period and fee required prior to planning any abatement work. Asbestos removed from buildings prior to demolition must be disposed in a landfill permitted to receive ACM.

10.13 Puget Sound Clean Air Agency Regulations I-III

Air quality regulation is also managed by the PSCAA. The regulations adopted by PSCAA control the emissions of air contaminants. The PSCAA regulations carry out the requirements of the Washington Clean Air Act and the federal Clean Air Act. Of particular concern are the requirements to control fugitive emissions from construction sites.

10.14 Underground Storage Tank Statute and Regulations (RCW 90-76, WAC 173-360)

This regulation addresses the serious threat posed to human health and the environment by leaking underground storage tank systems containing petroleum and other regulated substances. The regulations describe the enforcement, notification, and reporting requirements for underground storage tanks. The regulation also details performance standards, as well as operating and closure requirements.

10.15 Underground Utilities (RCW 19.122)

There are multiple operating utilities within the project areas, but RCW 19.122 states that an excavator shall provide notice of the scheduled commencement of excavation to all owners of underground facilities through a one-number locator service. The RCW also states that all owners of underground facilities within a one-number locator service shall subscribe to the service. Notice needs to be communicated to the locator service no less than two days and no more than ten days prior to the commencement of excavation activities.

If the excavator discovers utilities that were not identified or damages a utility, the excavator must stop work and notify the locator service and the owner of the utility service, if possible. If the damage causes an emergency situation, the excavator must alert the appropriate public health agencies and take all steps necessary to ensure public safety.

A failure to notify the locator service of damage to a hazardous liquid or gas pipeline is subject to a civil penalty. Any excavator who willfully or maliciously damages a field-marked underground facility is liable for triple the costs incurred in repairing or relocating the facility.

10.16 Endangered Species Act (ESA)

The federal Endangered Species Act (ESA) regulates a wide range of activities affecting plants and animals designated as “endangered” or “threatened”. The ESA states that it is unlawful to “take” any animal listed as an endangered species. The ESA defines “endangered” as an animal or plant that is in danger of becoming extinct. A “take” under ESA is broadly defined to include “harass, harm, pursue, hunt, shoot, wound, kill, trap, capture, or collect,” or an attempt to engage in such conduct. Endangered species within the Duwamish Waterway include Chinook salmon, bull trout, and bald eagles. King County must consider whether it will be necessary to obtain permission for “accidental takes” that could occur as a result of construction or operation activities associated with the proposed project.

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Limitations

The technical limitations and exceptions for this PSI study are as follow:

1) Distances between environmental borings combined with the laboratory analysis results for regulated compounds did not allow for computer-generated contour maps for plan views or cross-section views. Soil samples from each environmental boring contained a different set of reported compounds than did the nearest boring location. Least square contouring programs require more similar data sets between boring locations in order to generate meaningful concentration plots for individual contaminants and/or families of contaminant compounds.

2) Because access agreements were not obtained for properties located on the south shore and upland areas of the Duwamish Waterway, a large portion of the footprint of the five bridge alternatives was not investigated during this PSI study. These properties are of interest based on the Draft Hazardous Materials Technical Report (Wilbur 2002), which found that several properties are suspected of being contaminated. One property is a boat repair yard and the other is an auto repair business. It is recommended that these properties be further investigated for environmental contamination. This additional analysis would be to a PSI level of evaluation.

3) Two borings were drilled within the sediment of the LDW Superfund Site during this PSI study. The two borings were located very near the anticipated future in-water pier locations. Analytical data from samples collected within the two borings provide insight to the potential compounds and concentrations that may be encountered during in-water excavation. Considering the volume of excavated materials that could be generated from the sediments in the LDW to construct the South Park Bridge, additional sampling during excavation would be required to characterize the constituents of the soil, groundwater, and sediment transported off-site for disposal.

4) No samples were taken at the site of the existing bridge location. This location is within the LDW Superfund Site. If the Rehabilitation Alternative is selected, environmental sampling would be necessary to determine the presence and type of contamination at the site.

The professional limitations for this PSI are as follows:

1) WCI prepared this report for the exclusive use of Parsons Brinckerhoff and King County, as part of technical studies supporting the potential rehabilitation or replacement of the South Park Bridge. Use of or reliance on this information by any other party without the express written permission granted by WCI, Parsons Brinckerhoff, or King County is not authorized and is completely at the risk of the user.

2) WCI does not claim responsibility for any incorrect information that may have been supplied by agencies, organizations, or individuals that may be included in the findings or recommendations of this report.

3) WCI claims no responsibility for any environmental issues, the detection of which would require examinations beyond the scope of this PSI. Although this study has attempted to identify recognized environmental conditions associated with the properties discussed, potential sources of environmental concern may have been undetected as a result of the limitations of this study, the inaccuracy of government records, or the presence of undetected or unreported environmental accidents.

4) No PSI can wholly eliminate uncertainty regarding the potential for recognized environmental conditions in connection with any property or properties. This PSI was intended to reduce, but not eliminate, uncertainty regarding the environmental condition of the subject properties. This assessment is not exhaustive and was limited by the time available and the costs authorized to be expended by Parsons Brinckerhoff and King County in completing this assignment. Additional investigation including more soil, groundwater and sediment testing at the exact location of the footings for the selected bridge alternative could provide additional insight into the present environmental condition and is recommended.

5) The analysis, conclusions, and recommendations contained in this report are based on current site conditions. WCI assumes that the exploratory borings and samples collected are representative of the subsurface conditions throughout the site (i.e., subsurface conditions everywhere are not significantly different from those detected by the explorations and subsequent laboratory analysis work). If conditions different from those described in this report are observed or appear to be present during construction, WCI should be advised at once so that WCI can review these conditions and reconsider its recommendations, where necessary. If conditions have changed due to natural causes or construction operations at or near the site, it is recommended that this report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

6) Within the limitations of the scope, schedule, and budget, the analysis, conclusions and recommendations presented in this report were prepared in accordance with generally accepted professional environmental principals and practices in this area at the time it was prepared. WCI makes no other warranty, either expressed or implied.

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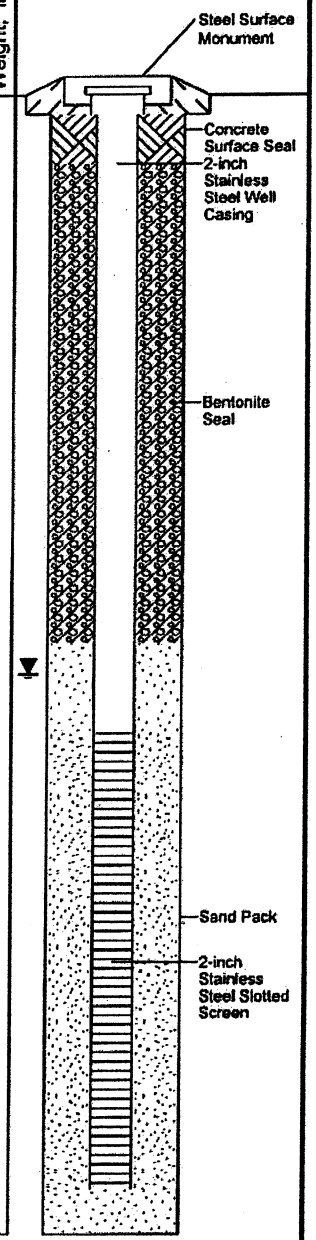
Appendix A: Soil Boring Logs

Date(s) Drilled	7/1/03	Logged By	J.S. Wilbur	Checked By	J.S. Wilbur
Drilling Contractor	Geo Tech Explorations	Drilling Method	HSA	Sampling Methods	3 inch Spilt Spoon
Total Boring Depth (ft)	25	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	
Well Depth (ft)	25	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12.7
System/ Datum					

Depth feet	SAMPLES Interval	Number	Recovered (in)	Blows/6in	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, lbs/ft³
0						SM	Moist, medium to fine sand with trace of fine to very fine pebbles, sub-base fill material		
		1				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
5		2				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
		3				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
10		4				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
		5				ML	Saturated, poorly sorted sand sized grains that are very coarse to fine in size, trace of silt, sands are sub-rounded with an angular to sub-rounded texture		
15		6				ML	Saturated, poorly sorted sand sized grains that are very coarse to fine in size, trace of silt, sands are sub-rounded with an angular to sub-rounded texture		
		7				SW	Saturated, well sorted large to medium sand sized grains with some silt interbeds		
20									
25		8							

WELL CONSTRUCTION



LOG OF MONITORING WELL MW8

WILBUR CONSULTING INC.

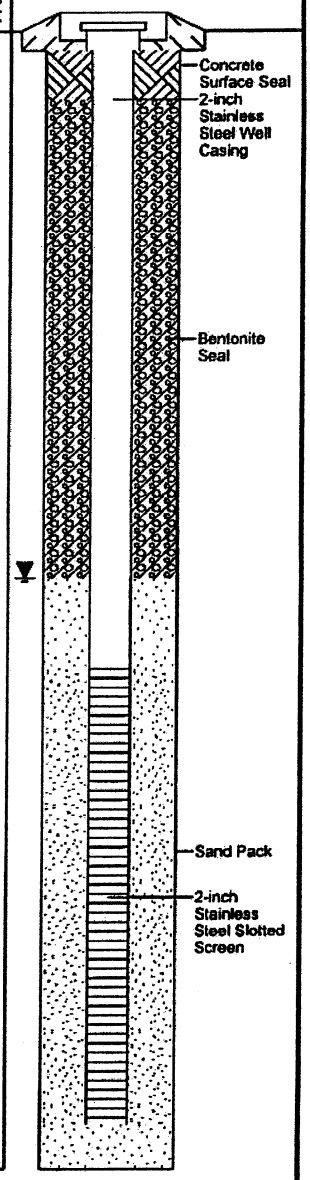
Project: South Park Bridge
Project Location: King County, Washington
Project Number: WCIPBSPB

Figure: 6
Sheet 1 of 1

Date(s) Drilled	7/2/03	Logged By	J.S. Wilbur	Checked By	J.S. Wilbur
Drilling Contractor	Geo Tech Explorations	Drilling Method	HSA	Sampling Methods	3 inch Spilt Spoon
Total Boring Depth (ft)	25	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	
Well Depth (ft)	25	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12
System/ Datum					

Depth feet	SAMPLES Interval	Number	Recovered (in)	Blows/6in	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, lbs/ft³
0						SM	Moist, medium to fine sand with trace of fine to very fine pebbles, sub-base fill material		
		1				SM	Moist, medium to fine sand with trace of fine to very fine pebble-sized grains		
5		2				SM	Moist, medium to fine sand with trace of fine to very fine pebble-sized grains		
		3				SM	Moist, medium to fine sand with trace of fine to medium pebble-sized grains		
10		4				ML	Saturated, poorly sorted sand sized grains that are very coarse to fine in size, trace of silt, sands are sub rounded with an angular to sub-rounded texture		
		5				ML	Saturated, poorly sorted sand sized grains that are very coarse to fine in size, trace of silt, sands are sub rounded with an angular to sub-rounded texture		
15									
		6				SW	Saturated well sorted large to medium sand sized grains with some silt interbeds		
20									
25		7							

WELL CONSTRUCTION



LOG OF MONITORING WELL MW7

WILBUR CONSULTING INC.

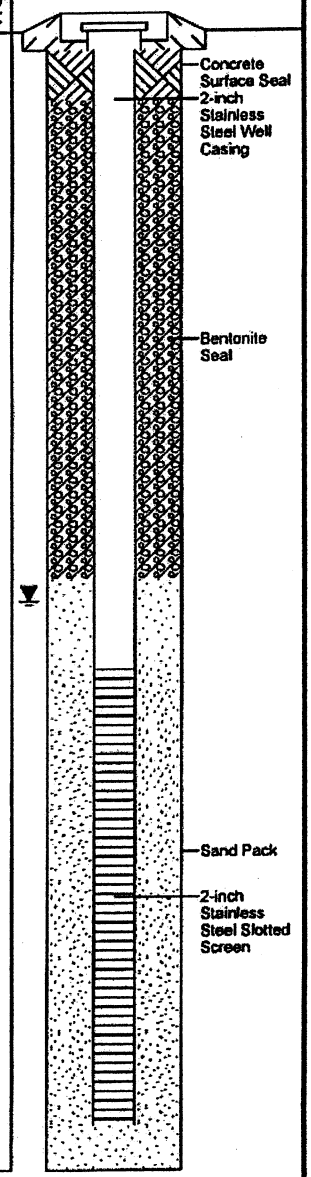
Project: South Park Bridge
Project Location: King County, Washington
Project Number: WCIPBSPB

Figure: 5
Sheet 1 of 1

Date(s) Drilled	7/1/03	Logged By	J.S. Wilbur	Checked By	J.S. Wilbur
Drilling Contractor	Geo Tech Explorations	Drilling Method	HSA	Sampling Methods	3 inch Spilt Spoon
Total Boring Depth (ft)	25	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	
Well Depth (ft)	25	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12.5
System/ Datum					

Depth feet	SAMPLES Interval	Number	Recovered (in)	Blows/6in	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, lbs/ft³
0						SM	Medium to fine sand with trace of fine to very fine pebbles, sub-base mill material (moist)		
		1				SM	Medium to fine sand with trace of fine to very fine pebbles (moist)		
5									
		2				SM	Medium to fine sand with trace of fine to very fine pebbles (moist)		
10		3				ML	Well sorted medium sand with race of medium to large pebbles (wet)		
		4				ML	Well-sorted medium sand with trace of medium pebbles (saturated)		
15		5				SP	Slightly silty, fine to medium sand sized grains with trace of large pebbles; sand and pebble size grains are well subangular and well rounded (saturated)		
20									
25		6							

WELL CONSTRUCTION



LOG OF MONITORING WELL MW6

WILBUR CONSULTING INC.

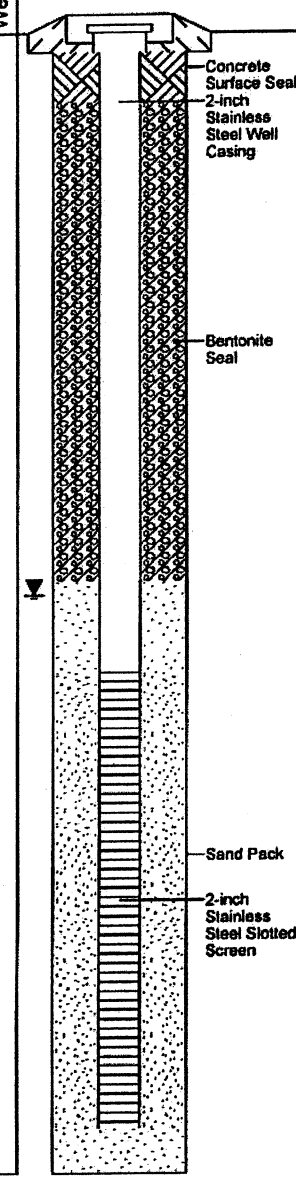
Project: South Park Bridge
Project Location: King County, Washington
Project Number: WCIPBSPB

Figure: 4
Sheet 1 of 1

Date(s) Drilled	7/17/03	Logged By	J.S. Wilbur	Checked By	J.S. Wilbur
Drilling Contractor	Geo Tech Explorations	Drilling Method	HSA	Sampling Methods	3 inch Spilt Spoon
Total Boring Depth (ft)	25	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	
Well Depth (ft)	25	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12.3
System/ Datum					

Depth feet	SAMPLES Interval	Number	Recovered (in)	Blows/6in	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, lbs/ft³
0						SM	Dry, medium to fine sand with trace of fine to very fine pebbles		
		1				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
5		2				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
		3				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
10		4				SM/ML	Saturated, medium to large sand with large pebble-sized grains, wood debris and organic material		
		5				SW	Saturated, well sorted medium sand		
15		6				SW	Saturated, well sorted medium sand		
20		7				SP	Saturated, poorly sorted medium to very coarse sand with medium to large pebble-sized grains		
25		8							

WELL CONSTRUCTION



LOG OF MONITORING WELL MW3

WILBUR CONSULTING INC.

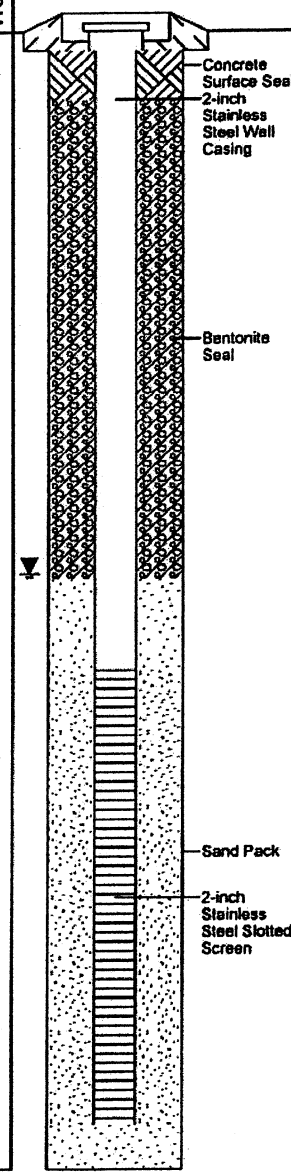
Project: South Park Bridge
Project Location: King County, Washington
Project Number: WCIPBSPB

Figure: 3
Sheet 1 of 1

Date(s) Drilled	7/18/03	Logged By	J.S. Wilbur	Checked By	J.S. Wilbur
Drilling Contractor	Geo Tech Explorations	Drilling Method	HSA	Sampling Methods	3 inch Spilt Spoon
Total Boring Depth (ft)	25	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	
Well Depth (ft)	25	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	11.9
System/ Datum					

Depth feet	SAMPLES Interval	Number	Recovered (in)	Blows/6in	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, lbs/ft³
0						SP/SP-SM	Dry, medium to fine sand with trace of fine to very fine pebbles, sub-base fill material		
		1				SM	Moist, sorted medium to fine sand with trace of fine to very fine pebbles		
		2				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
		3				SM			
		4				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
5		5				SM	Moist, fine to coarse sand with trace of silt and fine pebbles sized grains		
							Moist, medium to fine sand with trace of fine to very fine pebble-sized grains		
		6				SM	Moist, medium to fine sand with trace of medium pebble-sized grains		
10		7				SM/ML	Saturated, medium to large sand with some silt sized grains, wood debris and organic material		
		8				SM/ML	Saturated, medium to large sand with large pebble-sized grains, wood debris and organic material		
15		9				SW	Saturated, well sorted medium sand		
20		10				SW	Saturated, well sorted medium sand		
		11				SP	Saturated, poorly sorted medium to very coarse sand with medium to large pebble-sized grains		
25		12							

WELL CONSTRUCTION



LOG OF MONITORING WELL MW2A

WILBUR CONSULTING INC.

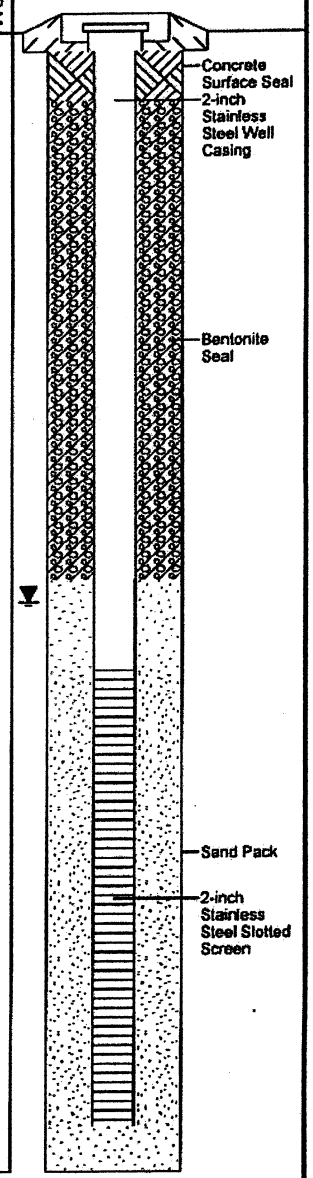
Project: South Park Bridge
Project Location: King County, Washington
Project Number: WCIPBSPB

Figure: 2
Sheet 1 of 1

Date(s) Drilled	7/17/03	Logged By	J.S. Wilbur	Checked By	J.S. Wilbur
Drilling Contractor	Geo Tech Explorations	Drilling Method	HSA	Sampling Methods	3 inch Spilt Spoon
Total Boring Depth (ft)	25	Hammer Data	300 (lb) hammer/ 30 (in) drop	Drilling Equipment	
Well Depth (ft)	25	Top of Well Elevation (ft)		Groundwater Level (ft. bgs)	12.5
System/ Datum					

Depth feet	SAMPLES Interval Number	Recovered (in)	Blows/6in	Graphic Log	Group Symbol	MATERIAL DESCRIPTION	Water Content, %	Dry Unit Weight, lbs/ft³
0					SM	Dry medium to fine sand with trace of fine to very fine pebbles		
	1				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
	2				SM	Moist, medium to fine sand with trace of fine to very fine pebbles		
5	3				SM/ML	Saturated, medium to large sand with some silt-sized grains, wood debris and organic material		
	4				SM/ML	Saturated, medium to large sand with large pebble-sized grains, wood debris and organic material		
10	5				ML	Saturated, well sorted medium sand with trace of medium pebbles		
	6				ML	Saturated, well sorted medium sand with trace of medium pebbles		
15	7				SP	Saturated poorly sorted medium to very coarse sand with medium to large pebble-sized grains		
	8				SP	Saturated poorly sorted medium to very coarse sand with medium to large pebble-sized grains		
20	9				SP	Saturated poorly sorted medium to very coarse sand with medium to large pebble-sized grains		
25	10							

WELL CONSTRUCTION



LOG OF MONITORING WELL MW1

WILBUR CONSULTING INC.

Project: South Park Bridge
Project Location: King County, Washington
Project Number: WCIPBSPB

Figure: 1
Sheet 1 of 1

Appendix B: PSI Work Plan

Final Work Plan

South Park Bridge

Preliminary Site Investigation for Waste Characterization and Geotechnical Data

June 22, 2003

Prepared for:
King County Department of Transportation
201 South Jackson Street
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Submitted by:
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Table of Contents

1.0 Introduction iv
1.1 Project Strategy 1
1.2 Project Tasks and Schedules 1
1.2.2 Task 1: Preliminary Site Investigation and Geotechnical Investigation of Soil 2
1.2.3 Task 2: Preliminary Site Investigation of Groundwater and Aquifer Yield Test 2
1.2.4 Task 3: Preliminary Site Investigation and Geotechnical Investigation of the Sediment 2
1.3 Primary Project Deliverables 3
1.4 Work Plan Organization 3
1.5 Project Participants and Responsibilities / Organization Chart 4
1.5.1 King County Department of Transportation 4
1.5.2 Parsons Brinckerhoff 6
1.5.3 Wilbur Consulting Inc. 6
1.5.4 Historical Resource Associates Inc. 6
1.5.5 Shannon and Wilson 7
1.5.6 Pile Contractors 7
1.5.7 Apollo Geophysics 7
1.5.8 Geo-Tech Explorations 7
1.5.9 Emerald Services 8
1.5.10 Northern Marine Salvage 8
2.0 Investigated Areas 8
2.1 Location of Investigated Areas 8
2.1.1 North Shore Area Land Uses 9
2.1.2 South Shore Area Land Uses 9
2.2 Geology and Hydrology 9
2.2.1 Geology 9
2.2.2 Hydrology 10
3.0 Project Management 10
3.1 King County Department of Transportation 10
3.2 Parsons Brinckerhoff 10
3.2.1 Wilbur Consulting Inc. 11
3.2.2 Historical Research Associates, Inc 11
3.2.3 Shannon and Wilson 12
3.2.4 Pile Contractors 12
3.2.5 Apollo Geophysics 12
3.2.6 Geo-Tech Explorations 13
3.2.7 Emerald Services 13
3.2.8 Northern Marine Salvage 13
3.2.9 The Boeing Company 13

3.3 Project Schedule 14
3.3.1 Project Schedules 14
3.3.2 Project Deliverables 15
4.0 Fieldwork Activities 15
4.1 Environmental Investigations 15
4.1.1 Shallow Soil Preliminary Site Investigation Environmental Sampling 15
4.1.2 Deep Soil Preliminary Site Investigation Environmental Sampling 16
4.1.3 Groundwater Monitoring and Aquifer Testing 16
4.1.4 Preliminary Site Investigation: Environmental Sediment Sampling 16
4.2 Geotechnical Investigations 17
4.2.1 Deep Geotechnical Soil Borings 17
4.2.2 Geotechnical Sediment: In-Water Sampling 18
4.3 Drilling, Well Completion, and Sampling 18
4.3.1 Sequence for Drilling Borings 18
4.3.2 Construction of Monitoring Wells and Instrument Piezometer 22
4.3.3 Preliminary Site Investigation Soil and Groundwater Sampling Procedures 22
5.0 Sampling and Analysis Plan 24
5.1 Soil Sampling 25
5.2 Groundwater Sampling 25
5.3 Sediment Sampling 26
5.4 Sample and Laboratory Quality Assurance/Quality Control 26
5.5 Field Quality Assurance 28
5.6 Test Pile Data Collection Activities 30
5.7 Down-Hole Geophysical Sampling Procedure 31

****Please note: Figures, Tables, and Appendices follow the report text****

Figures

Figure 1 Project Area Locations
Figure 2 Geologic Cross Section
Figure 3 Groundwater Flow Map
Figure 4 Boring Locations and Barge Placement
Figure 5 Well Completion Diagram

Tables

Table 1 Summary of Laboratory Analysis Methodology
Table 2 Residual Waste Management
Table 3 QA/QC Sample Requirements
Table 4 Sediment: Analytical Concentration Goals and Methodology
Table 5 Water: Analytical Concentration Goals and Methodology
Table 6 QA/QC Sample Goals for Analytical Analysis of Sediment and Water
Table 7 Evaluation of Data Quality

Appendices

Appendix A Sample Analysis Plan
Appendix B Geotechnical Laboratory Testing Procedures
Appendix C Health and Safety Plan
Appendix D In-Water Emergency Procedures and Spill Response Plan
Appendix E Field Forms and Sampling Guides
Appendix F Access License for Sampling Activities at Boeing

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1.0 Introduction

The King County Department of Transportation is conducting an Environmental Impact Statement (EIS) for the rehabilitation or replacement of the South Park Bridge across the Duwamish Waterway at 16th/14th Avenues South. All federally funded transportation projects conducted in Washington State are subject to the Washington State Department of Transportation (WSDOT) Environmental Procedures Manual M31-11 procedures to collect environmental and geotechnical data. As part of the EIS and WSDOT M31-11 processes, costs associated with environmental impacts and engineering design options are required in order to develop preliminary engineering and evaluate the potential impacts of alternatives in the South Park Bridge EIS. This Work Plan (WP) focuses on the tasks designed to obtain the environmental and geotechnical data required to more fully develop and evaluate the preliminary design alternatives for the South Park Bridge EIS. Figure 1 (Project Area Locations) details the area of investigation.

1.1 Project Strategy

The first task involves the collection of environmental data requirements detailed in the WSDOT M31-11 Environmental Procedures Manual guidelines for a Preliminary Site Investigation. A Preliminary Site Investigation follows the procedures set forth in the American Society for Testing and Materials (ASTM) Standard E 1903-97 or a Phase II Environmental Site Assessment (ESA). The second task involves the collection of geotechnical data requirements detailed in the WSDOT M31-11 procedures, referring to procedures set forth in WSDOT Design Manual M22-02 and other applicable engineering standards for conducting geotechnical explorations and soil investigations.

1.2 Project Tasks and Schedules

Three separate project tasks will be conducted jointly to characterize the subsurface soil, groundwater, and sediment within the general footprint for the five bridge design alternatives. Each phase will have a hazardous material delineation component (namely the Preliminary Site Investigation) and an engineering geotechnical component, for collection of the required data to assess any subsurface contamination and address preliminary design and/or engineering criteria. The Preliminary Site Investigation component of each task will collect data to address location-specific contamination in the soil, groundwater, and sediments, and to develop more reliable construction cost estimates. The geotechnical component of each task will collect data for the proposed design and/or engineering requirements for the bridge alternatives.

The three project tasks include:

- Task 1 Preliminary Site Investigation and geotechnical investigation of soil
- Task 2 Preliminary Site Investigation of the groundwater and aquifer yield test
- Task 3 Preliminary Site Investigation and geotechnical investigation of the sediment

1.2.2 Task 1: Preliminary Site Investigation and Geotechnical Investigation of Soil

Task 1 includes investigations and evaluations of soil in the upland areas of both shores of the Duwamish Waterway within the footprint of the five bridge alternatives. Six hollow-stem auger (HSA) borings will be advanced under the Preliminary Site Investigation portion of Task 1. The HSA boring will be advanced to a depth of 15 ft. below the water table which is approximately 25 feet below ground surface (bgs). All HSA borings will be completed as monitoring wells. Soil samples will be collected at 2.5-ft. intervals for description and laboratory analysis. Six mud rotary borings will be advanced for the geotechnical portion of Task 1. The mud rotary borings will be advanced to an average depth of approximately 110 feet bgs to collect geotechnical and Preliminary Site Investigation samples. Geotechnical samples will be collected at 2.5-ft. intervals for the first 20 ft. bgs and at 5-ft. intervals thereafter. Preliminary Site Investigation soil samples will be collected at 50, 75, and 110-ft. depths bgs from the mud-rotary borings. Seismic instrumentation will be placed in two of the mud-rotary borings located next to the Duwamish Waterway. Sondex rings, for settlement measurements, will be installed in a third mud rotary boring. A total of three HSA and three-mud rotary borings will be advanced within the northern and southern upland shoreline areas along the Duwamish Waterway under Task 1. Preliminary Site Investigation soil samples collected will be analyzed for the following perimeters: Pesticides/PCB, Volatile Organic Compounds (VOC), Semi-Volatile, Poly Aromatic Hydrocarbons (PAH), Priority Pollutant Metals, and Total Petroleum Hydrocarbon (TPH).

1.2.3 Task 2: Preliminary Site Investigation of Groundwater and Aquifer Yield Test

Under Task 2, groundwater samples will be collected from each of the HSA borings completed at monitoring wells as part of the Task 1 Preliminary Site Investigation. Groundwater samples will be collected upon completion of the well development. Aquifer yield tests will be conducted on one of the completed monitoring wells located on each side of the waterway. Aquifer yield tests will provide information on aquifer draw down versus pumping discharge rates. These data will be used to determine required dewatering requirements for each of the bridge design alternatives. Time-sequence sampling of the groundwater will be conducted during the 24-hour aquifer yield testing events. Analytical results from the time-sequence groundwater sampling will be used to determine disposal options and associated costs for the alternative bridge designs. Preliminary Site Investigation groundwater samples collected will be analyzed for the following perimeters: Pesticides/PCB, VOC, Semi-Volatile, PAH, Priority Pollutant Metals, and TPH.

1.2.4 Task 3: Preliminary Site Investigation and Geotechnical Investigation of the Sediment

Task 3 includes the investigation and evaluation of sediments and soils in the Duwamish Waterway near the proposed supports for the alternative bridge designs. A barge-mounted mud-rotary rig will be used to collect sediment and geotechnical samples. Two

mud-rotary borings will be advanced to an average depth of approximately 110 ft. below the channel bottom to the south and north of the main ship channel in the Duwamish Waterway. Geotechnical samples will be collected at 2.5-ft. intervals for the first 20 ft. bgs and at 5-ft. intervals thereafter. The Preliminary Site Investigation sediment samples will be collected at 2.5-ft. intervals from the uppermost 10 ft. of the sediment surface. Additional Preliminary Site Investigation sediment samples will be collected from 50, 75, and 110 ft. below the mudline. Preliminary Site Investigation sediment samples collected will be analyzed for the following perimeters: Pesticides/PCB, VOC, Semi-Volatile, PAH, Priority Pollutant Metals, and TPH.

1.3 Primary Project Deliverables

Based on the requirements set forth in WSDOT *Environmental Procedures Manual M31-11*, data collected is to be used to determine the following information:

- Determine the presence of location-specific contamination and/or hazardous materials within the soil, groundwater, and sediment within the footprint of the South Park Bridge Project design alternatives;
- Characterize contamination in the soil, groundwater, and sediment within the project area;
- Determine the effect of environmental impacts to the schedule and the associated cost for each of the five bridge alternatives;
- Characterize soil, groundwater, and sediment to be excavated for waste disposal;
- Document the disposal options and cost estimates for handling impacted soil, groundwater, and sediment for the bridge design alternatives;
- Document cost estimates for providing worker safety for the bridge design alternatives;
- Establish the lithology and geotechnical properties of the material in the subsurface within the footprint of the bridge alternative designs; and
- Develop geotechnical engineering recommendations for preliminary design of the bridge alternatives.

1.4 Work Plan Organization

The Work Plan (WP) is organized into six sections and a set of Appendices:

- Section 1: Project Strategy. This section describes the purpose and the objectives of the WP and the supporting documents.
- Section 2: Areas to be Investigated. This section describes the current knowledge of the project area based on the results of the Baseline Site Investigation (BSI). Included is a summary of the areas, past activities, current uses, and descriptions of the areas of geologic and hydrologic interest.

- Section 3: Project Management. This section describes the project organization and responsibilities of key personnel, communication and reporting requirements, project schedule, and project deliverables.
- Section 4: Fieldwork Activities. This section describes the objectives of the Preliminary Site Investigation and geotechnical soil, groundwater, and sediment investigations to be conducted.
- Section 5: Sampling and Analysis Plan. This section specifies the methods to be used in conducting the field investigation for soil, groundwater, and sediment contamination and geotechnical sampling.
- Section 6: Quality Assurance Plan. This plan outlines the procedures to be followed during the project. This includes sample handling, field and laboratory quality control procedures and frequency, analytical methods and procedures, data validation and reporting, and quality assurance (QA) auditing and reporting.
- Appendices include the following:

  Sample Analysis Plan (SAP)
  Geotechnical Laboratory Testing Procedures
  Health and Safety Plan (H&SP)
  In-Water Emergency Procedures and Spill Response Plan
  Field Forms and Sampling Guides

  Access License for Sampling Activities at Boeing

1.5 Project Participants and Responsibilities

An organization chart defining project personnel is provided on the following page.

1.5.1 King County Department of Transportation

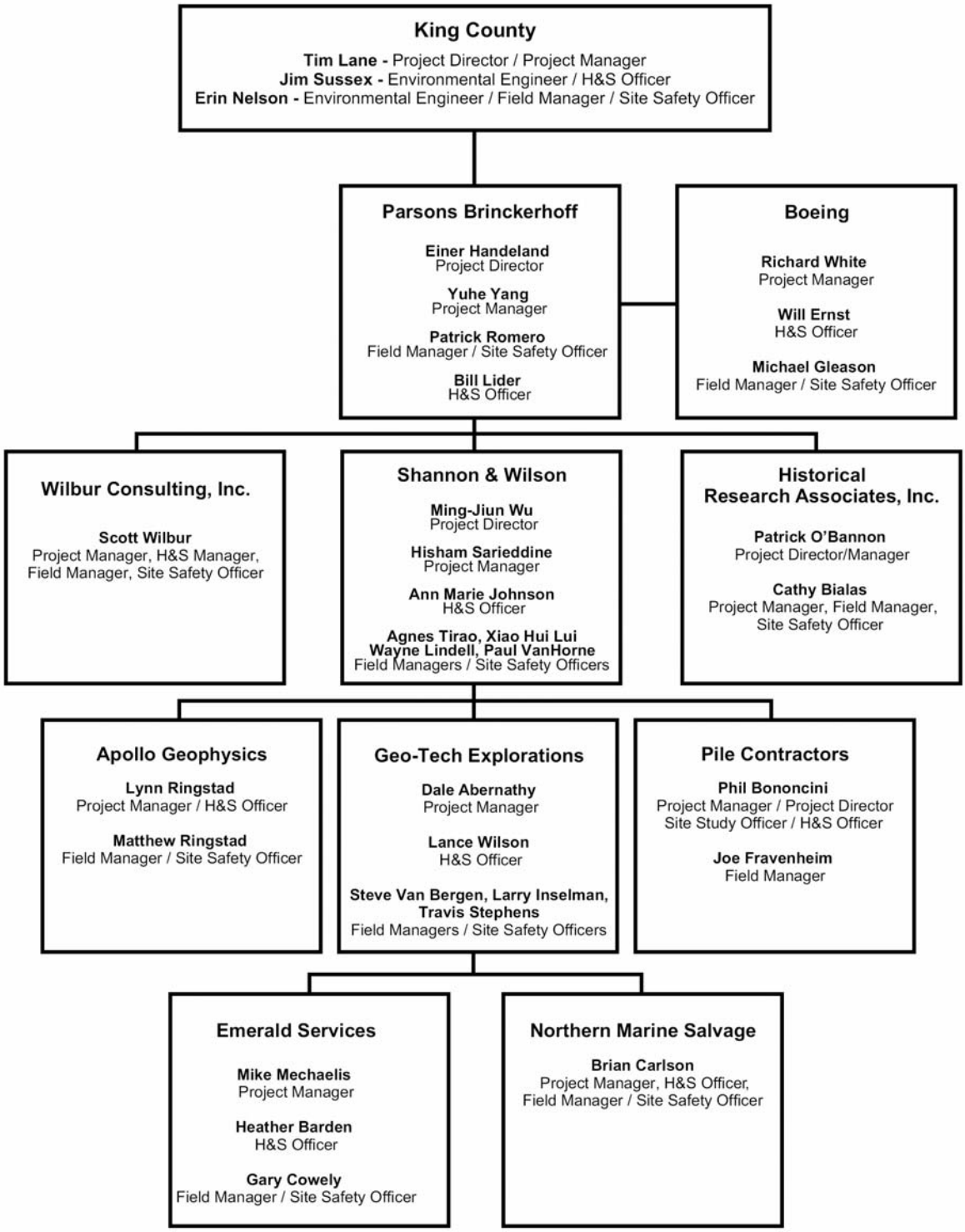
King County is conducting an EIS for the rehabilitation or replacement of the South Park Bridge. King County will be responsible for the overall project management, and will obtain access agreements from private property owners for investigation work and regulatory permitting requirements for work discussed in the WP, unless specified otherwise.

King County has contracted Parsons Brinckerhoff (PB) to prepare the South Park Bridge Project EIS including 10 percent design and engineering for the EIS alternatives.

King County's responsibilities include:

- Obtaining authorization for all parties to work at the site
- Obtaining all environmental permits for fieldwork activities

Work Plan Organization Chart



1.5.2 Parsons Brinckerhoff

Parsons Brinckerhoff (PB) is managing the completion of the EIS and the design and engineering requirements supporting the South Park Bridge Project. Responsibilities include project oversight, integration of data collection activities to support the EIS process, and design engineering. In addition, PB manages items associated with planning and performing the work. PB has contracted with eight firms to conduct the fieldwork activities described in this Work Plan. These firms include Wilbur Consulting Inc. (WCI), Shannon and Wilson (S&W), Historical Resource Associates, Inc. (HRA), Geo-Tech Explorations, Emerald Services, Northern Marine Salvage, Apollo Geophysics, and Analytical Resources, Inc. (ARI).

PB's responsibilities include:

- Directing communication with King County
- Coordinating and supervising subcontractors in the field
- Overseeing compliance of the activities set forth in the Work Plan
- Overseeing compliance with the site-specific Health and Safety Plan

1.5.3 Wilbur Consulting Inc. (WCI)

WCI will be responsible for conducting the Preliminary Site Investigation fieldwork for delineating hazardous material in the soil, groundwater, and sediment investigation within the footprint of the bridge design alternatives. WCI will manage the subcontract with the laboratory conducting analysis work for soil, groundwater, and sediment samples. ARI is the selected subconsultant to WCI for the analytical work to be conducted on the samples collected during the Preliminary Site Investigation tasks described in this Work Plan (WP). ARI personnel are not anticipated on the project site.

WCI's responsibilities include:

- Providing field personnel to perform or supervise fieldwork for hazardous material delineation investigation, including logging and collection of environmental samples and assistance with decontamination of sampling equipment
- Providing sample containers and necessary sampling supplies for all environmental samples
- Following the chain-of-custody procedures and providing transport of environmental samples to the laboratory

1.5.4 Historical Resource Associates Inc. (HRA)

HRA is contracted by PB to support historical or archaeological findings issues encountered during fieldwork activities if necessary.

1.5.5 Shannon and Wilson (S&W)

S&W will be responsible for conducting the fieldwork for the geotechnical sampling of the soil and sediment within the footprint of the bridge design. S&W will conduct geotechnical analysis of samples collected using the S&W laboratory. S&W has contracted Geo-Tech Explorations to drill environmental HSA bores and construct monitoring wells. Geo-Tech Explorations will also drill borings with a mud rotary drill unit for geotechnical sample collection. S&W has contracted Emerald Services to handle, transport, and dispose of generated waste that is not on the Boeing Company's property. S&W has contracted Apollo Geophysics to perform the down-hole geophysical procedures.

S&W's responsibilities include:

- Coordinating and supervising their subcontractors in the field
- Acting as the primary point of contact for all field activities
- Providing qualified field personnel to perform fieldwork for geotechnical investigation, including logging and collection of geotechnical samples and assistance with decontamination of sampling equipment
- Providing sample containers and necessary sampling supplies for all geotechnical samples
- Following chain-of-custody procedures and providing transport of geotechnical samples to the S&W laboratory
- Overseeing placement and construction of the geotechnical instrumentation
- Overseeing proper abandonment of mud-rotary bore holes

1.5.6 Pile Contractors

Pile Contractors will provide geophysical testing services to Shannon and Wilson for the test pile.

1.5.7 Apollo Geophysics

Apollo Geophysics will provide down-hole geophysical testing services to Shannon and Wilson.

1.5.8 Geo-Tech Explorations

Geo-Tech Explorations, a subcontractor to Shannon Wilson, will be responsible for providing drilling equipment and qualified personnel for operation and maintenance. A drill rig equipped with hollow-steam augers will be used to advance the collection of the shallow environmental soil borings and to construct the monitoring wells. A mud rotary drill rig will be used to advance the deep geotechnical and environmental soil borings. The rotary unit will also be used to advance the deep geotechnical and environmental sediment borings. Geo-Tech has contracted Northern Marine Salvage to provide a barge to conduct the in-water drilling activities

Geo-Tech Explorations' responsibilities include:

- Providing equipment and properly certified field personnel to perform drilling activities
- Drilling all required borings and properly abandoning boring holes
- Properly abandon all geotech boring hole
- Decontaminating all equipment between each sample location
- Containerizing all drill cuttings and liquids generated during drilling and well development activities
- Managing and containing all drill cuttings, decontamination fluids, and well development water generated during drilling and well development activities
- Providing drums for storage of all drill cuttings, decontamination fluids, and well development water generated
- Providing and managing Baker Tanks on site
- Constructing and developing monitoring wells
- Setting up the aquifer testing equipment
- Providing a barge for drilling and sediment samples collection

1.5.9 Emerald Services

Emerald Services, a subcontractor to Geo-Tech Explorations, will be responsible for providing equipment including a crane and/or a boom truck to off-load 55-gallon drums from the barge to a secure holding area along one or both shores of the Duwamish Waterway and the personnel to operate and maintain their equipment. Emerald Services will manage, transport and dispose of all containerized wastes that are not generated on Boeing Company property during fieldwork activities.

1.5.10 Northern Marine Salvage

Northern Marine Salvage, a subcontractor to Geo-Tech Explorations, will be responsible for providing the barge and personnel to operate and maintain the barge for the in-water borings.

2.0 Investigated Areas

2.1 Location of Investigated Areas

The near-shore upland areas and sediments in the channel of the Duwamish Waterway within the proposed footprint of the replacement bridge design alternatives have been determined to have a reasonable potential for soil, groundwater, and sediment contamination. These findings were determined based on the results of the South Park Bridge Project Baseline Site Investigation. The footprint area for all the replacement bridge design alternatives is parallel and to the northwest of the existing South Park Bridge. The area on the north shore of the Duwamish Waterway is owned and occupied

by the Boeing Company. The area on the south shore of the Duwamish Waterway is owned by several private landowners, King County, and the City of Seattle. This WP describes the rationale for conducting the investigations and documents proposed field activities.

2.1.1 North Shore Area Land Uses

The north shore area is currently occupied by facilities that belong to the Boeing Company. Boeing operations for the manufacturing and the assembly of aircraft began in the late 1930's. The Boeing site is currently under a Resource Conservation and Recovery Act (RCRA) Corrective Action cleanup order with the US Environmental Protection Agency (EPA). Prior to the Boeing Company's operations, the north shore area was the site of the Standard Oil of California bulk oil tank storage facility from the late 1910's through the early 1930's. Review of Sanborn Insurance Maps and aerial photographs show the tank farm was located along the shoreline within the footprint of the bridge design alternatives. During the 1940's the US Army operated a vehicle maintenance facility and motor pools in the north shore area.

2.1.2 South Shore Area Land Uses

The south shore area is currently occupied by several different properties with facilities and operations that could potentially create environmental impacts. Operations include several boat repair yards, a taxi repair shop, a residence with a junkyard located on-site, and the street right-of-way for 14th Avenue South. Little has changed in this area since the existing South Park Bridge was constructed in the early 1930's. Prior to the early 1930's, the area was occupied by a tire manufacturer. A machine shop that operated from the early 1940's through 2002 is located adjacent and to the west of the south shore area. This machine shop is listed on the Washington State Department of Ecology's (WSDOE) Hazardous Site Index as a known site for contamination of soil and groundwater for chlorinated solvents. Note that much of the south shore area is not connected to the local sanitary sewer system, but relies on individual septic systems.

2.2 Geology and Hydrology

2.2.1 Geology

Prior to the 1910's, the Duwamish River Valley in the areas of this investigation was a low-lying floodplain and tidal flat environment. The Duwamish River's meandering channel was channelized to create the Duwamish Waterway starting in 1910. The former river channel and surrounding floodplain were filled and graded to form level topography.

The general stratigraphic column within the area of interest is underlain by fill material ranging in thickness from 3 to 8 ft. This fill consists of sand with varying amounts of silt mixed with anthropogenic materials, (e.g., bricks, rubble, and wood). An alluvium deposit extends to a depth of 95 ft. bgs and is made up of discontinuous silt units resting on interbedded sands and silts. A fine-grained lower silt unit contains shell fragments

and has been observed in the boring beneath the lower silt. Dense sand and gravel are observed at depths below 95 ft. bgs (see Figure 2).

2.2.2 Hydrology

An unconfined aquifer in the Duwamish River Valley is located within the alluvium unit. Groundwater in the unit is recharged from the highland areas that form the basin of the Duwamish River Valley. The depth to the unconfined water-table surface is generally 9 to 15 ft. bgs in the areas of interest. The groundwater flow direction is toward the channel of the Duwamish Waterway. The unconfined aquifer discharges into the Duwamish Waterway (see Figure 3).

3.0 Project Management

The following section describes the roles and responsibilities of key individuals from King County, Parsons Brinckerhoff, Wilbur Consulting Inc., Shannon and Wilson, Geo-Tech Exploration, The Boeing Company, Emerald Services, Northern Marine Salvage, Apollo Geophysics, Historical Research Associates, Inc., and other landowners and/or their agents.

3.1 King County Department of Transportation

The King County Department of Transportation (KCDOT) will be responsible for overall project management, obtaining access agreements from private property owners for investigative work, and adhering to regulatory permitting requirements for work described in this WP. Key King County personnel are:

Tim Lane, PE, Project Manager
Telephone Number……(206) 296-3708
E-mail Address:…….Tim.Lane@metrokc.gov

Jim Sussex, Environmental Engineer
Telephone Number……(206) 296-8737
E-mail Address:…….Jim.Sussex@metrokc.gov

Erin Nelson, PE, LG, Environmental Engineer (40 Hr HAZWOPER)
Telephone Number……(206) 296-0274
E-mail Address:…….Erin.Nelson@metrokc.gov

3.2 Parsons Brinckerhoff

Parsons Brinckerhoff (PB), as the prime contractor to King County DOT, is responsible for developing the EIS and 10-percent design and engineering for the South Park Bridge alternatives. PB manages the project tasks, deliverables, schedule, and subcontractors for King County. Key PB personnel are:

Einer Handeland, PE, Project Director
Responsible for the EIS work completed on behalf of King County DOT.

Telephone Number……(206) 382-6320
E-mail Address:…….Handeland@pbworld.com

Yuhe Yang , PE, SE, Project Manager
Responsible for the overall coordination of Parsons Brinckerhoff's work activities and will serve as the primary contact for the project.

Telephone Number……(206) 382-5273
E-mail Address:…….Yang @pbworld.com

Patrick Romero, Environmental Scientist (40 Hr HAZWOPER)
Responsible for over all management of field activities during drilling and sampling activities. Patrick will support the Preliminary Site Investigation soil, groundwater, and sediment investigation activities for the project.

Telephone Number……(206) 382-8311
E-mail Address:…….RomeroP@pbworld.com

Bill Lider, P.E, (40 Hr HAZWOPER)
Telephone Number……(206) 382-5260
E-mail Address:…….Lider@pbworld.com

3.2.1 Wilbur Consulting Inc.

Wilbur Consulting Inc. will conduct and/or supervise all soil, groundwater, and sediment investigations, including the contamination characterization for the above media. Wilbur Consulting will manage the sample collection and analytical activities to ensure that the data are of known and appropriate quality.

Scott Wilbur, L.G, Hydrogeologist (40 Hr HAZWOPER)
Responsible for overall fieldwork for the environmental investigations and characterization work, and for overseeing QA/QC for the environmental sample laboratory results.

Telephone Number……(206) 935-1506
Cellular Phone..…….(206) 605-7387
E-mail Address:…….JSWilbur@aol.com

3.2.2 Historical Research Associates Inc.

Historical Resource Associates Inc. will support any historical findings issues encountered during fieldwork activities.

Patrick O'Bannon, Director of Cultural Resources
Telephone Number……(206) 343-0226

Cathy Bialas, Field Archeologist (40 Hr HAZWOPER)
Telephone Number……(206) 343-0226

3.2.3 Shannon and Wilson

Shannon and Wilson will direct and conduct all geotechnical soil investigations and analysis work. Key Shannon and Wilson personnel are:

Ming-Jiun Wu, PE, PhD., Senior Vice President
Responsible for the overall review of S&W's work activities.

Telephone Number……(206) 695-6820
E-mail Address:…….JW@shanwil.com

Hisham Sarieddine, PE, Soil Engineer
Responsible for coordinating all geotechnical fieldwork sampling and laboratory analysis activities.

Telephone Number……(206) 695-6873
E-mail Address:…….HJS@shanwil.com

3.2.4 Pile Contractors

Pile Contractors will be providing geophysical testing services for the test-pile.

Phil Bononcini, Project Manager
Telephone Number……(206) 714-5872
Email Address:……..phil@impacthydros.com

Joe Frauenheim, Field Manager
Telephone Number……(206) 713-2395

3.2.5 Apollo Geophysics

Apollo Geophysics will be providing down-hole geophysical testing services for the deep borings.

Matthew C. Ringstad, Field Manager
Telephone Number……(206) 276-4800

3.2.6 Geo-Tech Explorations

Geo-Tech Explorations will conduct all drilling activities for soil and sediment sample collection. They will also construct groundwater monitoring wells and manage the drill cuttings and all effluents generated during fieldwork activities. Key Geo-Tech personnel are:

Dale Abernathy, Project Manager
Telephone Number……(253)-395-1223
E-mail Address:…….dmaber@qwest.net

Steve Van Bergen, Project Driller (40 Hr HAZWOPER)
Contact information not available at the time of this report.

Jake Butler, Project Driller Assistant (40 Hr HAZWOPER)

Contact information not available at the time of this report.

3.2.7 Emerald Services

Emerald Services, a subcontractor to Geo-Tech Explorations, will be responsible for providing equipment, including a crane and or a boom truck to off-load 55-gallon drums from the barge to a secure holding area along one or both shores of the Duwamish Waterway and the personnel to operate and maintain their equipment.

Mike Mechaelis, Emerald Services Project Manager (40 Hr HAZWOPER)

Telephone Number……(206) 755-8486
Cell Number ……..(206) 755-8486
E-Mail Address…….MikeM@EmeraldNW.Com

3.2.8 Northern Marine Salvage

Northern Marine Salvage, a subcontractor to Geo-Tech Explorations, will be responsible for providing the barge and personnel to operate and maintain the barge for in-water borings.

Brian Carlson, Northern Marine Salvage Project Manager

Telephone Number……(206) 320-0081

3.2.9 The Boeing Company

Boeing is the property owner for the upland areas on the northern shore of the Duwamish Waterway where investigations are to be conducted. Key Boeing Company personnel are:

Richard White, Boeing Governmental Affairs Office

Telephone Number……(206) 655-3640
E-mail Address:…….Richard.A.White7@Boeing.com

Will Ernst, RG, Plant II RCRA Project Manager (40 Hr HAZWOPER), Boeing Environmental Affairs Office

Telephone Number……(425) 891 7724
E-mail Address:…….William.D.Ernst@Boeing.com

Michael Gleason, PE, Plant II RCRA Project Engineer (40 Hr HAZWOPER), Boeing Environmental Affairs Office

Telephone Number……(206) 655-2222
E-mail Address:…….Michael.J.Gleason@Boeing.com

3.3 Project Schedule

The fieldwork for this investigation is dependent on King County obtaining an access agreement from the property owners as well as regulatory permits. The in-water boring activities require permits in addition to those required for the upland project activities. For the purpose of this schedule, it assumed that the County receives in-water permit approvals from regulatory agencies in the summer of 2003. In-water fieldwork would start within five calendar days of permit approval or as soon as an appropriate tide level window was available. In-water fieldwork is expected to take no more than five working days to complete. The on-shore investigation tasks would be initiated once the necessary permits and access agreements for upland activities have been obtained. The on-shore Preliminary Site Investigation and geotechnical sampling fieldwork would be completed in 21 days. The estimated schedule and duration of field sampling tasks, laboratory analysis, compiling and tabulating laboratory results, and document generation are presented below.

3.3.1 Project Schedules

Fieldwork Tasks:

Task 1 :	**Preliminary Site Investigation and Geotechnical Investigation of Soil**	
	Preliminary Site Investigation	
	Fieldwork for soil sampling hollow-stem auger work	1 week
	Laboratory Analysis work	4 weeks
	Environmental data analysis	5 weeks
	Geotechnical Investigation	
	Fieldwork for soil sampling mud-rotary drilling	2 weeks
	Test Pile	3 days
	Laboratory analysis work	3 weeks
	Perform Engineering Analyses	5 weeks
	Generate Geotechnical Report	4 weeks
Task 2 :	**Preliminary Site Investigation of the Groundwater and Aquifer Yield Test**	
	Groundwater monitoring	2 days
	Aquifer Testing	4 days
Task 3 :	**Preliminary Site Investigation and Geotechnical Investigation of Sediment and Documentation Work**	
	Fieldwork for sediment sampling mud-rotary drilling	5 days
	Preliminary Site Investigation	
	Laboratory analysis work	5 weeks
	Evaluate laboratory results	2.5 weeks
	Perform data quality review	3 weeks
	Compile and tabulate field notes	1 week

Generate Preliminary Site Investigation Report	2.5 weeks
Geotechnical Investigation	
Laboratory analysis work	3 weeks
Perform Engineering Analyses	5 weeks
Generate Geotechnical Report	2 weeks

Project fieldwork tasks and deliverables for the up-land work activities will be completed within 90 days of obtaining the access agreement. The in-water work will be completed within 90 days of obtaining the required permits. This project schedule reflects overlap in certain tasks. Split sample results will be included as an Appendix within the report.

3.3.2 Project Deliverables

A Preliminary Site Investigation report will be generated summarizing the findings of impacts to the soil, groundwater, and sediment. These findings will be used to generate estimated environmental impacts due to contamination for each of the bridge design alternatives. Estimated impacts will be applied to the budget, schedule, and construction activities for the bridge design alternatives.

The Geotechnical Investigation Report will summarize the engineering data and provide geotechnical engineering recommendations that will be applied to the design and engineering costs for each of the five bridge alternatives.

4.0 Fieldwork Activities

4.1 Environmental Investigations

4.1.1 Shallow Soil Preliminary Site Investigation Environmental Sampling

Advance and collect soil samples from six borings that will be drilled to a depth of 25 ft. bgs. (See Figure 4 for boring locations). Each boring will be drilled using a hollow-stem auger drill rig. Soil samples will be collected at 2.5-ft. intervals from each boring for laboratory analysis. Soil samples will be described, labeled, and containerized for daily delivery to the laboratory. Drilling and sampling equipment shall be decontaminated between boreholes and the decontamination fluids containerized in USDOT approved drums. A list of laboratory analytical procedures to be conducted on soil samples is provided in the Summary of Laboratory Analysis Methodology and Costs (Table 1). All six borings will be completed as groundwater monitoring wells. Groundwater monitoring wells will be completed with 4-inch PVC casing and will have 15-ft. screen sections (see Figure 3). This size casing will ensure that an adequately sized submersible pump can be placed in the well for aquifer testing and for any future potential dewatering activities.

4.1.2 Deep Soil Preliminary Site Investigation Environmental Sampling

Collect deep environmental soil samples from the geotechnical soil boring drilling activities. Deep soil borings (average depth approximately 110 ft. bgs) will be advanced using a mud-rotary drill rig. Deep Preliminary Site Investigation soil samples will be collected at 50, 75, and 100 ft. bgs for environmental analysis.

4.1.3 Groundwater Monitoring and Aquifer Testing

WCI will collect one groundwater sample from each of the six monitoring wells constructed and will conduct aquifer testing on two of these wells. Currently aquifer tests are planned for being conducted on the middle two wells located on the north and south up-land areas of the Duwamish Waterway. One aquifer test will be conducted on a well located on Boeing's property and the other will be conducted on a well located in South Park. The aquifer test will be a step draw-down test conducted to determine the amount of draw-down in the well versus the rate of discharge. Results from the step draw-down will be used to estimate the water volumes generated as the result of dewatering activities associated with bridge construction.

Sequenced groundwater samples will be collected during each aquifer test to measure changes in groundwater chemistry over time due to increased discharge volume. Three sets of groundwater samples will be collected during each of the aquifer tests. Analytical results will be used to determine disposal options, costs, and other fees for handling dewatering effluent associated with construction activities for each of the bridge alternatives.

Preliminary Site Investigation groundwater samples will be analyzed for the following constituents: Volatile Organic Compounds (VOCs), Base Acid Neutrals (BANs), Total Petroleum Hydrocarbons (TPH), Pesticides and PCBs, and Total Metals. See Appendix B for groundwater sampling protocols for this Work Plan's monitoring activities.

4.1.4 Preliminary Site Investigation: Environmental Sediment Sampling

WCI will collect environmental sediment samples during the advancement of the two in-water geotechnical borings. Three sediment samples will be collected from the upper 10 ft. of sediments in the channel from each of the borings that are drilled in the Duwamish Waterway during geotechnical sampling. Drilling and sampling equipment shall be decontaminated between boreholes and decontamination fluids containerized in USDOT-approved drums. Analytical results for sediment samples will be used to determine disposal options and associated costs for each bridge alternative. Results of the sediment analysis will be shared with other EIS team members after completion of the final Preliminary Site Investigation.

4.2 Geotechnical Investigations

4.2.1 Deep Geotechnical Soil Borings

Per Shannon and Wilson's Proposal for Geotechnical Engineering Services, geotechnical samples will be collected from six deep soil borings that will be advanced in the upland shore areas. The deep soil borings will be advanced using a combination hollow-stem auger and mud-rotary drilling techniques. Borings will be started with a hollow-stem auger advanced to below the fill/native material contact (approximately 15 ft. bgs).

Three deep borings will be advanced on the Boeing side of the Duwamish Waterway and the other three borings advanced on the South Park side of the Duwamish Waterway. The deep geotechnical borings will be advanced in a two-phase drilling approach. The first phase of each deep soil boring will be advanced using a hollow-stem auger to depth of 25 ft. bgs. This depth should be well below the fill/native material contact. Once the contact between the fill/native material has been reached, the borehole shall be cased off to a depth of at least 5 ft. into the native material.

This action should reduce the potential for cross-contamination from the fill deposits to the underlying native materials. The driller shall then circulate the drilling mud that has been used out of the hole and into USDOT-approved drums. Drill rods, drill augers, and other drilling equipment shall be decontaminated with a steam cleaner prior to continuing drilling. The decontamination water shall also be containerized in drums. The drums containing cuttings, mud, and decontamination water shall be labeled and then transported (by the Emerald Services) to the designated storage location.

The storage site for waste generated on Boeing Company property will be staged allocation that Boeing maintains. Waste generated on property other that Boeing Company property will be stored under the south approach ramp of the $14^{th}/16^{th}$ bridge in South Park. For the second phase of the deep bore drilling, drilling below the initial 25 ft bgs the driller shall mix new mud and continue drilling through native deposits to the bottom of the boring. All drill mud generated during drilling operations will be drummed and labeled by the driller.

The two deep soil borings nearest to the south shoreline of the Duwamish Waterway and the second to the nearest to its north shoreline, will be completed with a 2-inch diameter PVC casing to house shear wave velocity measuring instrumentation.

One of the deep soil borings located on the Boeing side of the Duwamish Waterway will be completed with a 2-inch diameter PVC casing to house Sondex system instrumentation to conduct settlement measurements during the test pile program. Upon completion of the shear measurement study the 2-inch boring will be abandoned according to WADOE standards.

All deep geotechnical soil borings shall be backfilled according to the WADOE and Washington Administration Code (WAC) for boring and well abandonment procedures and specifications, which are summarized in Appendix B.

4.2.2 Geotechnical Sediment: In-Water Sampling

Per Shannon and Wilson's Proposal for Geotechnical Services, sediment samples will be collected from two deep in-water mud-rotary borings. These two borings will be located near each of the proposed north and south main-span pier locations for the new bridge within the Duwamish Waterway. The deep geotechnical sediment boring will be advanced using a mud-rotary drill rig mounted onto a barge. Geo-Tech Explorations is responsible for operation of the barge and the associated drilling. The deep geotechnical sediment borings will be advanced to an average depth of 110 below the mudline in the Duwamish Waterway. Geotechnical samples will be colleted at 2.5-ft. intervals to 20 ft. below the mudline and at 5-ft. intervals thereafter.

4.3 Drilling, Well Completion, and Sampling

Fieldwork activities for drilling activities and sampling procedures including sampling locations, sample methods, and sample analysis for soil, groundwater, and sediments are described below for the Preliminary Site Investigation and geotechnical investigations.

Subsurface soil and sediment samples will be collected from hollow-stem auger and/or mud-rotary borings at the locations shown in Figure 4 at the end of this report. Split samples can be collected at any time by King County, Boeing, and/or by other property owners.

4.3.1 Sequence for Drilling Borings

Utility location surveys will be coordinated by Parsons Brinckerhoff for all proposed boring locations. After the utility location survey findings have been reviewed and approved by the landowner, a boring location will be established. Only then will a boring location be drilled and sampled.

Geo-Tech Explorations is responsible for mobilizing and demobilizing the required drilling, excavation, and sampling equipment to and from the site. Geo-Tech Explorations is also responsible for arriving at the site with clean equipment, decontaminating all equipment between borings and before leaving the site, and providing notification to the Washington State Department of Ecology (Ecology) and other permitting agencies, as required.

Where appropriate, concrete coring will be completed by a technician who has completed 40 hours of OSHA HAZWOPER health and safety training. A core of approximately 10 inches in diameter will be cut in the location of the desired boring. A wet/dry vacuum will be used to collect and contain the slurry generated by the cutting fluid. The slurry will be drummed and labeled for disposal in accordance with applicable regulations. Table 2 identifies handling instructions for waste materials. Concrete cores will remain

in place until drilling activity at that location has commenced. A threaded anchor will be installed in the center of the cores for easy removal. The removed cores will be stored in a central location with the waste drums until they can be disposed.

All borings will be conducted under the supervision of a registered geologist for the Preliminary Site Investigation sampling and geotechnical sampling. A detailed log will be maintained that shows sampling depths, sampling method, soil type, stratification, groundwater conditions, potential contamination, and other pertinent information. Each field log will also contain names of the drilling company and driller, the type of drill rig, drilling start and finish times, hole diameter, boring number, and boring location. Detailed field logs and completion diagrams for each monitoring well will be prepared for each boring drilled.

4.3.1.1 Hollow-Stem Auger Borings and Soil Sampling

Hollow-stem auger borings will be advanced by the driller, Geo-Tech Explorations. A truck-mounted drill rig using a 4-inch-side-diameter auger will be used to drill the Preliminary Site Investigation borings. Soil samples will be collected from 2.5-ft. intervals using a split-spoon sampler. Samples will be collected with an 18-inch long by 2.4 inch split spoon sampler. After advancing the drill to the top of the sample interval with the hollow-stem auger, the sampler will be driven or pushed approximately 1.5 ft. below the bottom of the borehole to collect the sample. If a solid stem auger is used, the boring will be sounded after the auger is removed to determine how much cave has occurred; then the sampler is inserted and pushed or driven to obtain the sample. Each Preliminary Site Investigation soil sample collected will be described using a standard Soil Classification System. All down-hole sampling equipment will be decontaminated prior to each use and after the last use. Decontamination fluids will be containerized in USDOT-approved drums.

4.3.1.2 Mud-Rotary Soil Borings and Sampling

A combination of hollow-stem auger and mud-rotary drilling techniques will be used to advance the deep geotechnical soil boring. The deep soil borings will be started with a hollow-stem auger to a depth of 5 ft. below the water table (25 ft. bgs) then switch to mud rotary. Heaving sand makes it difficult to collect good undisturbed soil samples for geotechnical analysis by a hollow-stem auger. Starting the boring with a hollow-stem auger reduces the amount of fluid infiltration that can occur with a mud rotary in the unsaturated zone. For the following reasons, mud-rotary is the preferred drilling method for deep soil borings:

- It allows for the collection of relatively undisturbed geotechnical soil samples;
- It helps maintain a stable borehole, to reach the depth necessary to evaluate the extent of the lower silt unit and the presence of gravel and sand unit (approximately 110 ft. bgs); and

- It involves the use of the bentonite drill fluid, which will help prevent cross-contamination in the borehole.

Soil samples will be collected by inserting a sampler down the drill rod ahead of the drill bit. Preliminary Site Investigation soil samples will be collected with a split spoon sampler (as described in Section 4.3.1.1) at 50, 75, and 100 ft. bgs in each mud-rotary boring. Geotechnical soil sampling and penetration tests will be collected using ASTM Standards 1586 and 1587 (see Appendix B for copies of these standards). Geotechnical soil samples will be collected at 2.5-ft. intervals for the first 20 ft. bgs and at 5-ft. intervals thereafter.

4.3.1.3 Mud-Rotary Sediment Borings and Sampling

A mud rotary drill unit mounted onto a barge will be used to collect geotechnical and Preliminary Site Investigation in-water sediment samples. Two borings will be advanced to approximately 110 ft. bgs near each of the proposed north and south main-span pier locations.

In-water borings will be started by advancing a drill bit within a 5-inch diameter casing to a depth of 25 ft. below the mudline. Below the 25-ft. depth, the drill will be advanced without the 5-inch casing in open hole to a depth of 110 ft. below the mudline.

The barge will be held in position during drilling activities by two anchor columns that will be driven in the sediments to a depth of approximately 20 ft. Anchoring columns will hold the barge on station against the current and tidal cycle. All cutting fluids and drill spoils generated during in-water drilling shall be containerized in 55-gallon drums and properly labeled. All containerized drill fluids and cuttings will be off-loaded from the barge to a secured on-shore storage area after completion of the in-water drilling activities.

Preliminary Site Investigation sediment samples will be collected from the first 15 ft. bgs of the bore hole at 2.5-ft. intervals. Additional Preliminary Site Investigation sediment samples will be collected from each of the in-water borings at 50, 75, and 110-ft. depths below the sediment/water interface. Geotechnical samples will be collected at 2.5-ft. intervals for the upper 20 ft. bgs and will be collected at 5-ft. intervals below 20 ft. bgs.

Mud rotary borings will be advanced by circulating thick drilling mud from the drill rig down through standard 2-5/8-inch outside-diameter NX rods to a 2 15/16-inch or 3 7/8-inch-diameter tri-cone bit at the bottom of the borehole. The drilling mud is a mixture of bentonite powder and water. Cuttings will be transported from the bottom of the borehole to the surface by drilling mud flowing between the drilling rods and the sides of the borehole. The cuttings will be deposited in a settling tank at the ground surface and the mud will be recirculated. After completion of drilling and sampling, the drilling mud will be pumped out of the casing, the casing will be removed, and all boreholes will be sealed with bentonite

grout and/or chips. As this description indicates, the drilling mud and soil cuttings produced during drilling will flow from the borehole directly into a settling tank. At the completion of the drilling operation, the settling tank contents will be pumped into 55-gallon drums. The chance of sediment disturbance around the borehole is minimal.

The Northern Marine Salvage will provide and operate the barge used during in-water work. The barge would originate either from Lake Union or Bainbridge Island. The drill rig, drilling equipment, and crew would load the barge at an off-site loading dock. The approximate size of the barge is anticipated to be 20 X 44 ft. The barge shall be moved to the job site by either on-board power or assisted by a tugboat.

Drill cuttings and drilling mud will flow from the borehole into a settling tank and then be pumped into 55-gallon drums. The drums will be sealed and stored at a temporary site until environmental testing is complete. They will then be properly disposed of, based on laboratory analytical results. The chance for the waste material to return to the waterway is minimal.

Once on site and positioned over the drilling location, the barge will be anchored with two spud anchors or four Danforth-type anchors, depending on water depth. For the most southerly drill location, the barge may need to be maneuvered behind the existing pier protection (fender system). The barge would stay at a drilling location until drilling is complete at that location, and then be moved to the northerly location. This drill location should be located behind the pier protection (Figure 4) and if located in front of the pier protection, the barge should not encroach into the navigable waterway. Drilling at each location is expected to last no more than two days. Therefore, the barge is expected to stay overnight at each drilling location.

The Hydraulic Project Approval (HPA) for the in-water boring activities requires that the all activities be conducted during high tides, and that all equipment, including the barge, be located a minimum of 10 feet from the waters edge at all times. This will require that the timing and positioning of the drilling barge is carefully coordinated with the anticipated tide levels such that incidental grounding of the barge is avoided and the minimum 10-foot migration corridor for juvenile salmon maintained. Barge operation and in-water drilling activities shall comply with all applicable permit conditions. Approximate barge locations are provided in Figure 4.

A skiff boat would be used to transport people on and off the barge during drilling operations. The skiff boat would also be used in emergency situations.

The barge crew would stay on the barge overnight. Others, including the drilling crew and people logging the borings, would leave the barge after drilling is complete for the day.

On-site fueling would only be required for the drilling equipment. Fueling for the barge and drill rig would be accomplished off-site. 5-gallon containers would be used to fuel the drilling equipment.

4.3.2 Construction of Monitoring Wells and Instrument Piezometer

Six groundwater monitoring wells and two instrument piezometers will be installed as part of the Preliminary Site Investigation and Geotechnical Investigation. A well completion diagram included at the end of the Work Plan, see Figure 5.

4.3.2.1 Construction of Monitoring Wells

The six hollow-stem auger borings will be completed as monitoring wells. Each monitoring well will be constructed in accordance with Ecology's Chapter 173-160 WAC, *Minimum Standards for Construction and Maintenance of Wells.* Well casing and screens will be 4 inches in diameter, schedule 40 PVC, and a 15-ft.-long screen. Screen slot size for monitoring wells screens will be 0.010 inch. After auguring to the desired depth, the field crew will lower the screen and casing into the borehole. The annulus between the screen section and the borehole will be backfilled with 10 to 20-size Colorado silica sand from the bottom of the screen to a depth of 3 ft. above the top of the screen. A 2-ft. bentonite chip plug will be placed above the sand pack. A bentonite grout seal will be placed immediately above the chip plug to a depth of 2 ft. bgs. A concrete surface seal housing a flush mount well monument and locking well cap will complete the well installation. A typical construction diagram is presented in Figure 3 at the end of this Work Plan.

4.3.2.2 Construction of Instrument Piezometer

Two instrument piezometer tubes will be installed in the mud-rotary boring next to the shore of the Duwamish Waterway. A 2-inch diameter PVC casing will be placed to the bottom of the boring. The annulus between the borehole and 2-inch PVC casing will be filled with liquid grout. Grout will be placed in the annulus by trimmy pipe to limit void spaces in the grout.

4.3.3 Preliminary Site Investigation Soil and Groundwater Sampling Procedures

4.3.3.1 Preliminary Site Investigation Soil Sampling Procedures

To avoid volatilization of volatile contaminants that may be present, representative portion of samples will be immediately removed from the split spoon sampler and placed in separate laboratory-supplied containers for Volatile Organic Compounds (VOC) analysis. The container shall be filled completely, with no headspace. A representative portion of the remaining sample will be

described, homogenized in a stainless steel bowl, then placed in other appropriately labeled sample containers for analyses. Containerized samples will be placed in iced coolers for on-site storage. WCI will deliver all samples collected under chain-of-custody protocols daily to the laboratory. Soil samples will be labeled as follows:

SPB SSB#-Depth

SPB	Project Name: South Park Bridge
SSB#	Shallow Soil Boring Number
Depth	in ft. bgs where samples were collected

Prior to collecting each soil sample, the sampling equipment will be cleaned by scrubbing with a solution of Alconox and tap water, rinsing with tap water, and rinsing with distilled water. All liquids generated during sample equipment decontamination will be containerized in 55-gallon drums labeled with the boring location.

4.3.3.2 Preliminary Site Investigation Groundwater Sampling Procedures

The driller shall perform well development as part of the monitoring well installation process. Monitoring wells will be developed with a high-capacity 2-inch submersible pump. Development will continue until water has cleared, and at least 55 gallons will be removed from each well during development. Groundwater monitoring wells will not be sampled for two days after development.

Prior to collecting groundwater samples, a minimum of three casing volumes will be purged with a Teflon bailer. Water quality parameters will be measured following the removal of each well casing volume, until the water quality parameters stabilize (i.e. pH, temperature, redox potential, and conductivity). Stable parameter readings indicate that representative groundwater can be sampled. Note that prior to purging to the depth, groundwater needs to be measured to calculate the casing volume.

Groundwater samples will be labeled as follows:

SPB MW#-Date

SPB	Project Name: South Park Bridge
MW#	Monitoring Well Number
Date	Date of collection

Water samples will be collected from monitoring wells using a disposable bailer. See the Sample Analysis Plan (SAP) in Appendix A for details on the sequence for collecting groundwater samples.

4.3.3.3 Geotechnical Soil Sampling Procedures

All geotechnical soil samples will be collected with a Shelby tube sampler. Samples will be collected at 2.5-ft. intervals for the first 20 ft. of each mud rotary boring and at 5-ft. intervals below 20 ft. Filled Shelby tubes will be properly labeled and end-capped with Teflon tape, stored on site, and transported to the S&W laboratory daily for analysis.

Sediment samples will be labeled as follows:

SPB DSB#-Depth

SPB	Project Name: South Park Bridge
DSB#	Sediment Boring Number
Depth	In ft. bgs that the samples were colleted

5.0 Sampling and Analysis Plan

This Sample Analysis Plan (SAP) defines the environmental sample collection objectives and the laboratory analysis being performed, in order to evaluate environmental contamination issues associated with the replacement and alternatives for the South Park Bridge EIS Project.

The sampling and analysis work's objective is to obtain initial information on environmental impacts to the soil, groundwater, and the sediment within the footprints of the five bridge alternatives. There is no environmental data currently available for soil, groundwater and sediments for the locations of the prospective pier locations for the five bridge alternatives. This sampling effort will provide the needed data.

Laboratory results will be used to define environmental contamination to soil, groundwater, and sediments to estimate impacts to construction costs and schedule for each of the design alternatives. Environmental contamination and the associated costs to address them in an appropriate manner will be applied to each design alternative. This information will be used as a part of the EIS selection process for the South Park Bridge Project.

The following estimates and costs will be developed using the results of this analysis:

- Estimated volumes of contaminated material for each bridge alternative during construction
- Disposal options and costs per ton disposal for each alternative
- Estimated transport costs and tipping fees for each disposal option
- Estimated costs for worker safety requirements during construction
- Information on subsurface contamination for design and engineering plans

- Locations and design of staging areas for handling contaminated material during construction

Fieldwork activities will follow the health and safety requirements specified in the Health and Safety Plan (Appendix C). All sample handling and processing will occur within a secured exclusion zone and personnel will wear Level D protection. One sample will be handled and processed at a time during all fieldwork activities.

5.1 Soil Sampling

Soil samples will be collected from hollow-stem auger and mud-rotary borings for Preliminary Site Investigation and geotechnical investigations. Collection protocols and procedures for the geotechnical soil samples are defined in Appendix B.

The sample collection intervals for Preliminary Site Investigation and geotechnical samples have been described above.

Volatile soil samples will be collected immediately upon opening the split-tube sampler. The remaining sample will then be described using the procedures described below. After samples have been described, they will be placed in a clean stainless steel bowl and homogenized. The homogenized soil sample will then be placed into an appropriate sample container with the proper label, and placed into an iced cooler for storage prior to delivery to the laboratory for analysis.

Soil samples will be photo-documented using either still photographs or video. Each soil sample will be logged for grain size distribution using the Universal Soil Classification. The presence of any structures, shells, or organic materials shall be noted. Each field log sheet will also contain names of the drilling company and driller, type of drill rig, drilling start and finish times, hole diameter, boring label, and boring location.

Cuttings generated during drilling will be placed in 55-gallon drums and stored in a secured, designated area on site. Each drum will be labeled with its contents, boring number, and date. Cuttings from one boring will not be mixed with cuttings from another boring. Final disposal of the cuttings will be based on the results of the soil analyses.

5.2 Groundwater Sampling

Preliminary Site Investigation groundwater samples will be analyzed for the following constituents: Volatile Organic Compounds (VOCs), Base Acid Neutrals (BANs), Total Petroleum Hydrocarbons (TPH), Pesticides and PCBs, and Total Metals. See Appendix B for groundwater sampling protocols for this Work Plan's monitoring activities.

During the aquifer testing event, groundwater samples will be collected in a time-sequenced manner. Analytical results will be compared to determine whether constituents of concern are being transported in the groundwater during pumping. This data is needed to determine disposal options and costs for groundwater effluent generated

during construction. See Appendix D for the driller's in-water emergency procedures and spill response plan.

5.3 Sediment Sampling

Preliminary Site Investigation and geotechnical sediment sampling activities will follow the guidance provided by the Evaluation of Puget Sound AET prepared by PTI Environmental Services for Puget Sound Estuary Program, U.S. EPA, Office of Puget Sound, Seattle, Washington dated 1986 with revisions in 1988.

Volatile sediment samples will be collected immediately upon opening the split-tube sampler. The remaining sediment will then be described using the procedures described below. After sediment samples have been described, they will be placed in a clean stainless steel bowl and homogenized. The homogenized sediment sample will then be placed into an appropriate sample container with the proper label, and placed into an iced cooler for storage prior to delivery to the laboratory for analysis.

Sediment samples will be photo-documented using either still photographs or video. Each sediment sample will be logged for grain size distribution using the Universal Soil Classification. The presence of any structures, shells, or organic materials shall be noted. Each field log sheet will also contain names of the drilling company and driller, type of drill rig, drilling start and finish times, hole diameter, boring label, and boring location.

Cuttings generated during drilling sediment samples will be placed in 55-gallon drums and stored in a secured, designated area on site. Each drum will be labeled with its contents, boring number, and date. Cuttings from one boring will not be mixed with cuttings from another boring. Final disposal of the cuttings will be based on the results of the soil analyses.

5.4 Sample and Laboratory Quality Assurance/Quality Control

Analytical Resources, Inc. (ARI) will conduct all of the Preliminary Site Investigation sample analysis work under this Work Plan. ARI is an EPS CLP laboratory with a wide range of certifications and accreditations.

For this Level I review of data precision and accuracy will be conducted using the quality control summary sheet results provided by the laboratory for each data package. Level I review is based on the same quality control criteria as the more extensive Level II review, except raw data (instrument tuning, calibrations, chromatograms, spectra, instrument printouts, bench sheets, and laboratory worksheets) are not reviewed. The following is an outline of a Level I review:

- Verify that sample numbers and analysis match the chain-of-custody
- Verify that sample preservation and holding times are met
- Verify that field and laboratory blanks were performed at the proper frequency and that no analytes were present in the blanks

- Verify that field and laboratory duplicates, matrix spikes, and laboratory control samples were run at the proper frequency and control limits were met
- Verify that surrogate compound analyses have been performed and results meet QC criteria
- Verify that the required detection limits have been achieved.

5.4.1 Field QA/QC Samples

Trip blanks will be submitted to the laboratory with each cooler, containing water samples submitted for VOC analysis. The laboratory will prepare the trip blanks made up of distilled water. These blanks will accompany the sample bottles in the cooler to the site and back to the laboratory.

5.4.2 Laboratory Quality Control

Quality control in the laboratory will be maintained by strict adherence to the analytical protocols of the applicable EPA method of analysis. Samples shall be preserved as described and analyzed within EPA protocols. The laboratory will also analyze QC samples to provide an indication of the quality of the reported data. See Table 1 for a summary of method quality objectives that will be conducted for this project to insure reliable and defendable laboratory results. The QC procedures listed in the Table 1 are protocols that allow the individual tracking of all samples from the field through the Laboratory. These protocols allow for the tracking of laboratory analysis procedures and the reported results for all the individual constituents by sample. QC protocols insure reported results and accurate and meet regulatory requirements. See Tables 3 through 7 for a summary of the laboratory analysis methods, constituents, and detection limits for soil, groundwater, and sediment samples that will collected for the Preliminary Site Investigation goals and analytical methods.

Method blanks shall be at the rate of one per 20 samples analyzed or one per batch of samples digested, whichever is more frequent. Distilled water will be used whenever possible. Method blanks will contain all reagents used for analysis.

Matrix spike samples (predetermined quantities of specific analyses) are added to a sample matrix prior to sample extraction or digestion of a sample in the laboratory. Recent recoveries are calculated for each analysis to assess laboratory accuracy. Matrix spikes monitor the overall analytical accuracy, including any sample matrix effects. Matrix spikes shall be at the rate of one per 20 samples.

Laboratory duplicates shall be at a rate of one per 20 samples. The difference between the analytical results can be used to evaluate the precision of the sample results.

5.5 Field Quality Assurance

QC samples will be collected in the field and used to evaluate the validity of the field sampling effort. Field QC samples are used to assess sample variability (replicates), and evaluate potential sources of contamination (rinsate blanks and trip blanks).

5.5.1 Field Replicates

Field replicates are additional samples collected at a station to provide statistical analysis of the resulting data. Their origin is not revealed to the laboratory. Collecting new sediment at the sampling location will generate replicate samples, to determine natural variability associated with the environment and sampling operations. Field replicates will be collected at approximately 5% of the sampling stations.

5.5.2 Field Splits

Field splits are sediment samples taken from the same composite as the field sample. The resulting data provides information on the variability associated with sample handling and laboratory analysis. Blind field splits will be generated at approximately 5% of the sampling stations.

5.5.3 Equipment (Rinsate) Blanks

Field equipment blanks will be used to evaluate the introduction of chemical contaminants during the sampling and field processing activities. Field equipment blanks will be collected by pouring from 3 to 6 Liters of de-ionized water over or through decontaminated sampling equipment and will be collected in the appropriate sample containers at approximately 5% of the sampling stations.

5.5.4 Trip Blanks

Field trip blanks will be evaluated to determine if VOC contaminants are introduced to samples during holding, shipping, or storage prior to analysis. Trip blanks will be provided by the laboratory, transported to and from the field, and returned to the laboratory unopened. These will be evaluated at a minimum of one per sample delivery group. Detection limits for trip blank analysis are listed in Table 5.

The laboratory will perform continuous data assessment and comparison of data precision, accuracy and completeness to data acceptance criteria and project DQOs (Data Quality Objectives). The Laboratory Manager or Project Manager will be responsible for keeping WCI apprised of the laboratory status during all analytical events.

QC procedures will be consistent with the requirements described in the laboratory's protocols and methods. These requirements are detailed in the laboratory's Standard Operating Procedures as part of the laboratory's QA program. In addition to meeting the requirements of valid MDL studies, instrument tuning, and initial and continuing calibration, the laboratory will analyze internal QC samples and checks. These internal QC samples will be analyzed as described below and shown in Table 7.

5.5.5 MRL Check

A daily MRL check will be run to ascertain that the laboratory instrumentation can achieve the required MRL, as listed in Tables 4 and 5. This check is not required if the laboratory MRL is the lowest standard of the initial calibration.

5.5.6 Method Blanks

Introduction of contaminants during sample preparation and analysis will be evaluated by the analysis of method blanks. Laboratory method blanks will be analyzed at a minimum of 5% per prep batch (one per 20 samples prepared the same day), or every 12-hour QC period for volatile analyses. These blanks will contain no contaminants of concern above the reporting limit, with the exception of compounds recognized as normal laboratory contaminants. Any compounds recognized as normal laboratory contaminants will not be present at more than five times detection. Any deviations will trigger corrective action.

5.5.7 Surrogate Spikes

Surrogate spikes, which are compounds of similar characteristics and composition to target organic analytes, will demonstrate the laboratory's ability to recover the organic analytes of interest. If data fall outside the established limits, corrective action must be taken. This may include evaluation and correction of instrument conditions, reanalysis of samples, or re-extraction of the samples. If sample surrogates are still outside of established limits after these actions and blank and spike blank surrogates are within limits, this will be considered matrix effect and no further action will be necessary.

5.5.8 Laboratory Control Samples

Laboratory Control Samples (LCS) will be prepared by spiking clean matrices with standard solutions. They are used to monitor the laboratory's day-to-day performance of routine analytical methods, independent of matrix effect. LCS will be analyzed at a minimum of 5% per prep batch (one per 20 samples prepared the same day), or every 12 hour QC period for volatile analyses. These samples should fall within the required limits, as shown in Tables 4 and 5. Batches with LCS outside control limits will require corrective action.

5.5.9 Matrix Spike and Duplicate (Inorganics)

The Matrix Spike (MS) provides information to assess sample accuracy, and sample analytical variability will be determined by the analysis of a laboratory duplicate. Recovery and RPD objectives are listed in Table 6. These objectives will be used for evaluating sample matrices and variability, and will not be used to trigger corrective action.

5.5.10 Standard Reference Material

A standard reference material (SRM) is a routinely or commercially available sample that has established control limits for evaluating laboratory performance. For this project, the routinely analyzed SQ-1 will be included at a minimum of 5%. No corrective action will be required based on the analysis of this sample.

5.6 Test Pile Data Collection Activities

A pile-driving system would be used to drive the test pile consisting of a 24-inch-diameter steel pipe pile with flat bottom plate. The test pile would be driven to approximate depth of 110 feet bgs. The system would likely include a crane, a driving hammer (i.e., a Delmag D46-32 diesel hammer), and a swinging lead. The following list describes the general procedures that would be used to drive the test pile:

- **Pile Preparation:** The pile would be transported and stored at the site in 40- to 50-ft.-long sections. The pile sections would be painted at 1-ft. increments. Small holes would be drilled near the top of each pile section for the attachment of PDA instruments.
- **Pile Positioning:** The first pile section would be lifted by the crane, slowly rotated into a vertical position, and slowly lowered to the ground. A hand level would be used to position the pile section in an approximately vertical position.
- **Hammer Positioning:** The hammer and leads would be picked up by the crane and placed onto the pile. A gate would be closed at the base of the leads to keep the leads connected to the pile.
- **Pile Driving:** Each pile section would be driven continuously until the top of the pile was within 5 ft. of the ground surface. The next section would then be welded to the first one, and driving would continue until the last section is driven into the ground.
- **Setting the Pile and Connecting PDA Instruments:** PDA instruments would be connected to each pile section before it is driven, and disconnected from each pile section after driving is complete.
- **Vibration Monitoring**: Vibration monitoring would be performed during pile driving, using portable seismographs equipped with internal and external geophones. One seismograph (and microphone) would be installed approximately 50 feet from pile being driven, and the external geophone would be located approximately 100 feet from the pile being driven. The probe is aligned in the vertical grooves and incrementally pulled through the casing to measure the angle of each segment of casing with respect to horizontal. The measurement would provide a profile of ground settlement out away from pile.
- **Settlement Measurements of the ground surface**: Settlement of the ground surface would be monitored by installing a horizontal profiler consisting of an inclinometer casing, a gravity sensitive probe, a portable readout unit, and a graduated electrical cable linking the probe to the readout unit
- **Settlement Measurements of the subsurface soils**: Settlement of the subsurface soils would be monitored by using the Sondex system attached to observation well casing in one of the on-land borings. This method employs steel rings and a magnetic probe to measure vertical settlements within a soil column.

After completion of the test pile program, the test pile would be cut off about 2 ft. below ground surface, and will then be filled with lean mix concrete or control density fill.

5.7 Down-Hole Geophysical Sampling Procedure

Down-hole geophysical testing will be performed in two borings, one located north and one located south of the Duwamish Waterway. These borings will be cased with 2-inch-diameter PVC pipe. After placing the casings in the borehole, the borehole annulus will be filled with cement/bentonite grout, and a monument will installed at the top of the borehole. Resting will be conducted by using a wooden plank-vehicle combination positioned adjacent to the top of the borehole, and each end of the plank will be struck with a hammer that acts as an energy source. This energy source produces a shear wave down the borehole, which is measured with the geophone at set intervals in the borehole. A compressional wave is produced by striking a steel plate on the ground surface. The compressional wave energy is measured with the geophone at set intervals in the borehole.

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FIGURES

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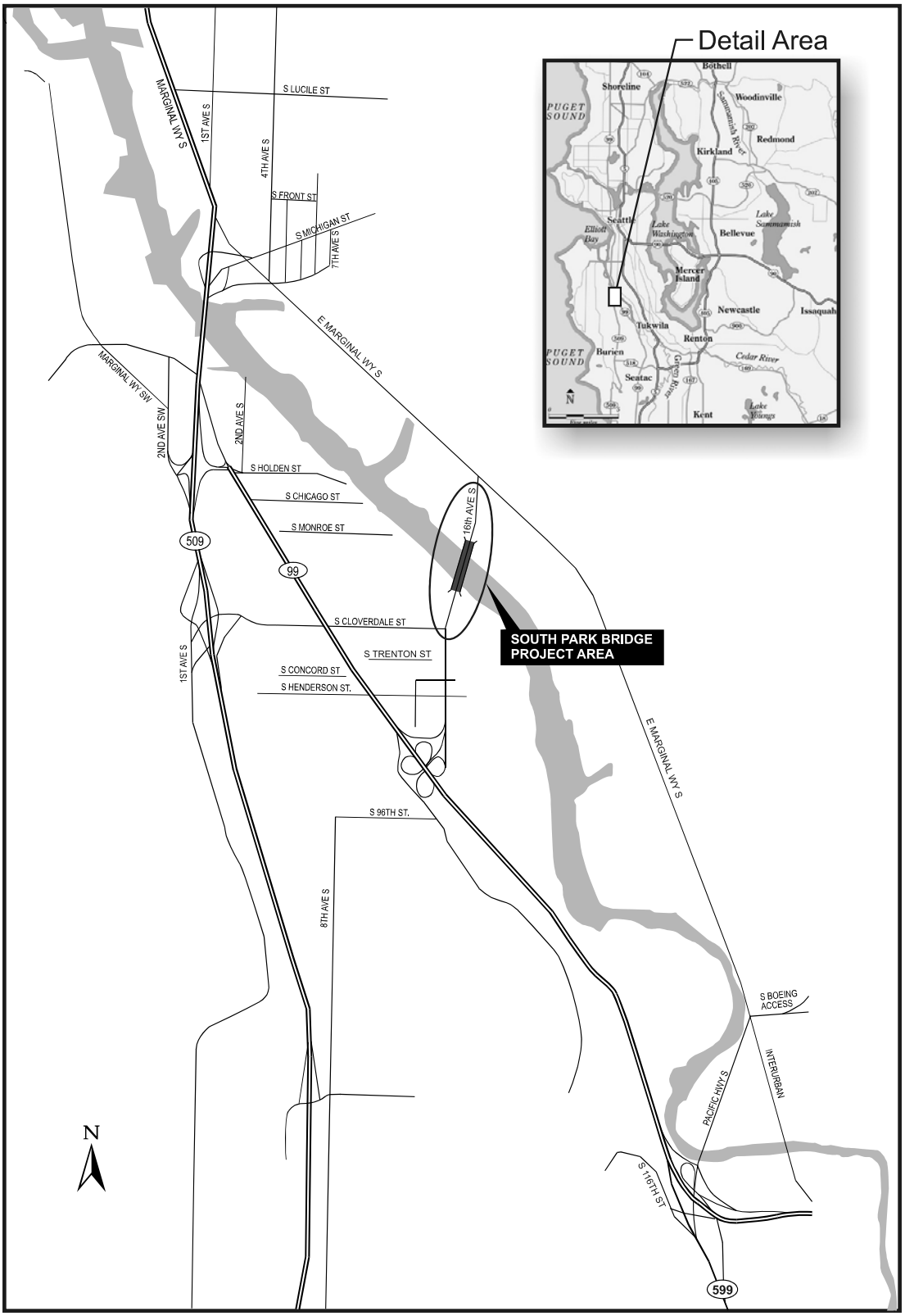

Figure 1: Project Area Locations

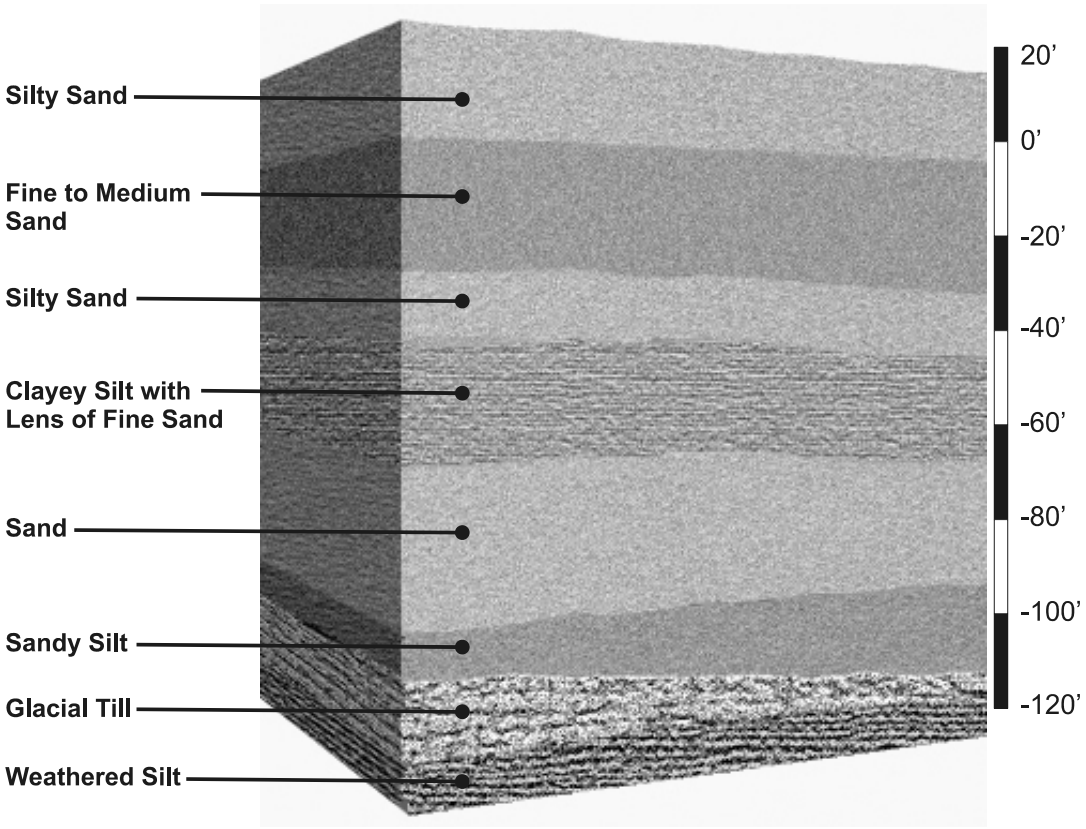

Figure 2: Geologic Cross Section
General View Based on Boeing Plant 2 Data

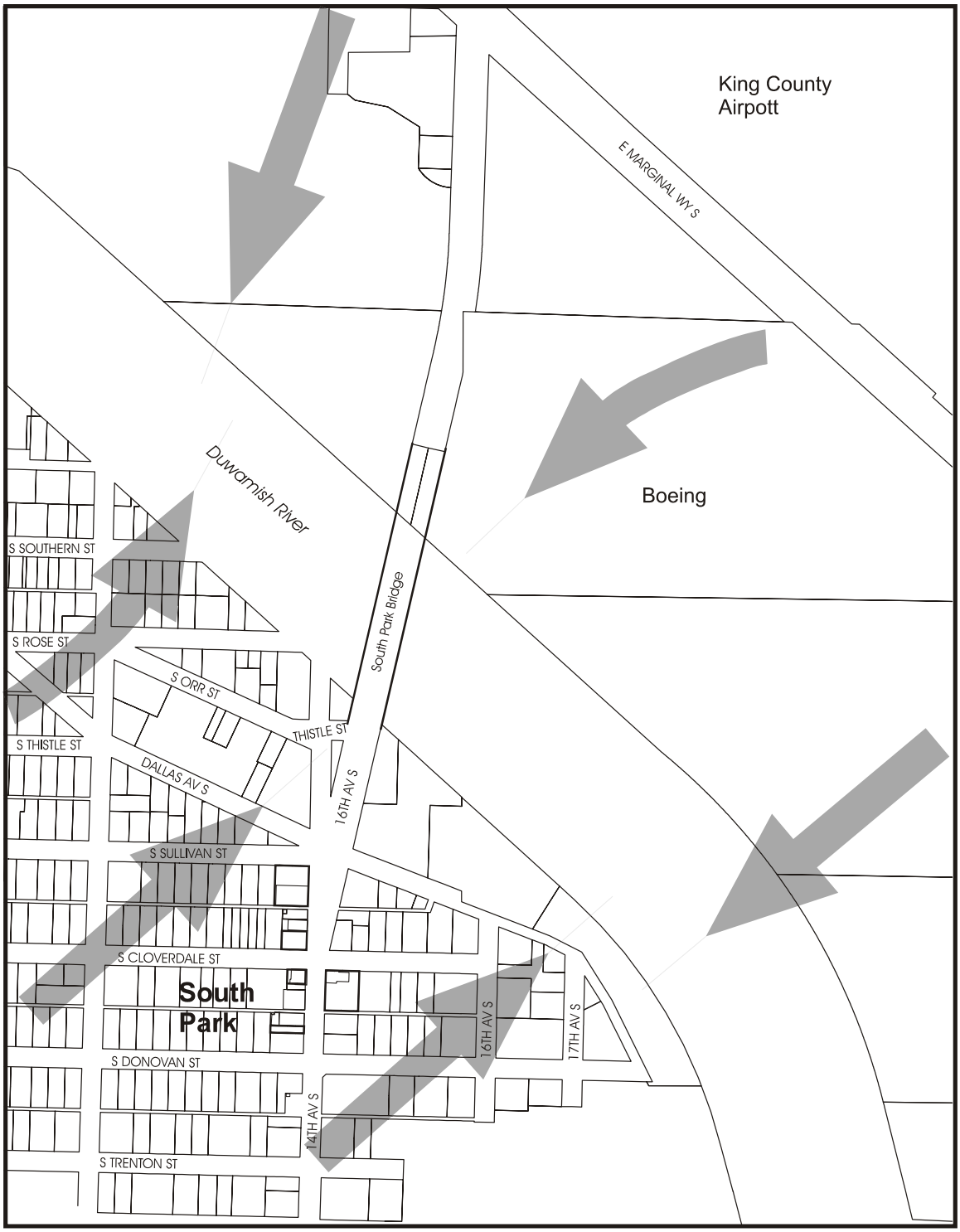

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Figure 3: Duwamish River Groundwater Flow Map

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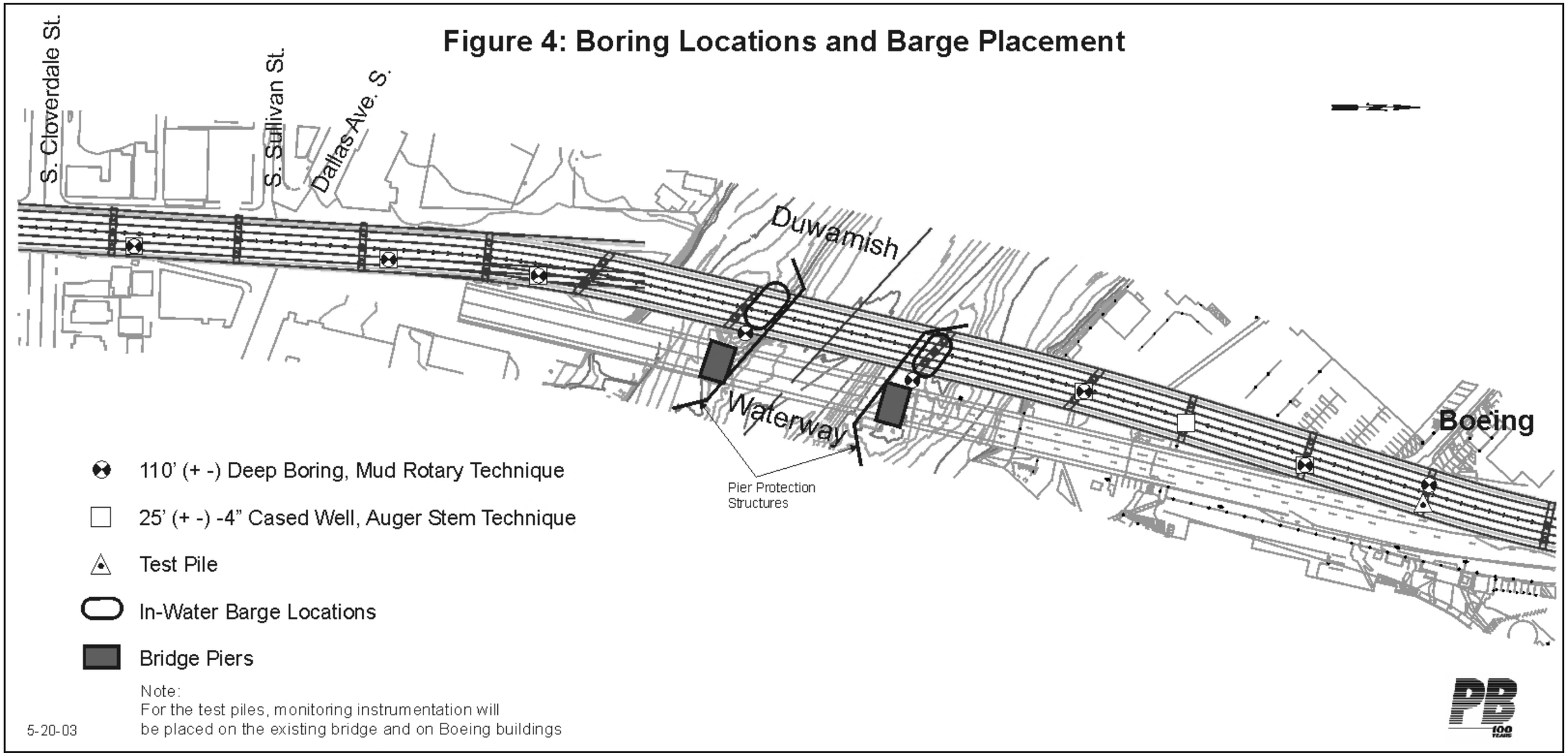
Figure 4: Boring Locations and Barge Placement
S. Cloverdale St.
S. Sullivan St.
Dallas Ave. S.
Duwamish
Waterway
Boeing
Pier Protection Structures
110' (+ -) Deep Boring, Mud Rotary Technique
25' (+ -) -4" Cased Well, Auger Stem Technique
Test Pile
In-Water Barge Locations
Bridge Piers
Note:
For the test piles, monitoring instrumentation will be placed on the existing bridge and on Boeing buildings
5-20-03
PB

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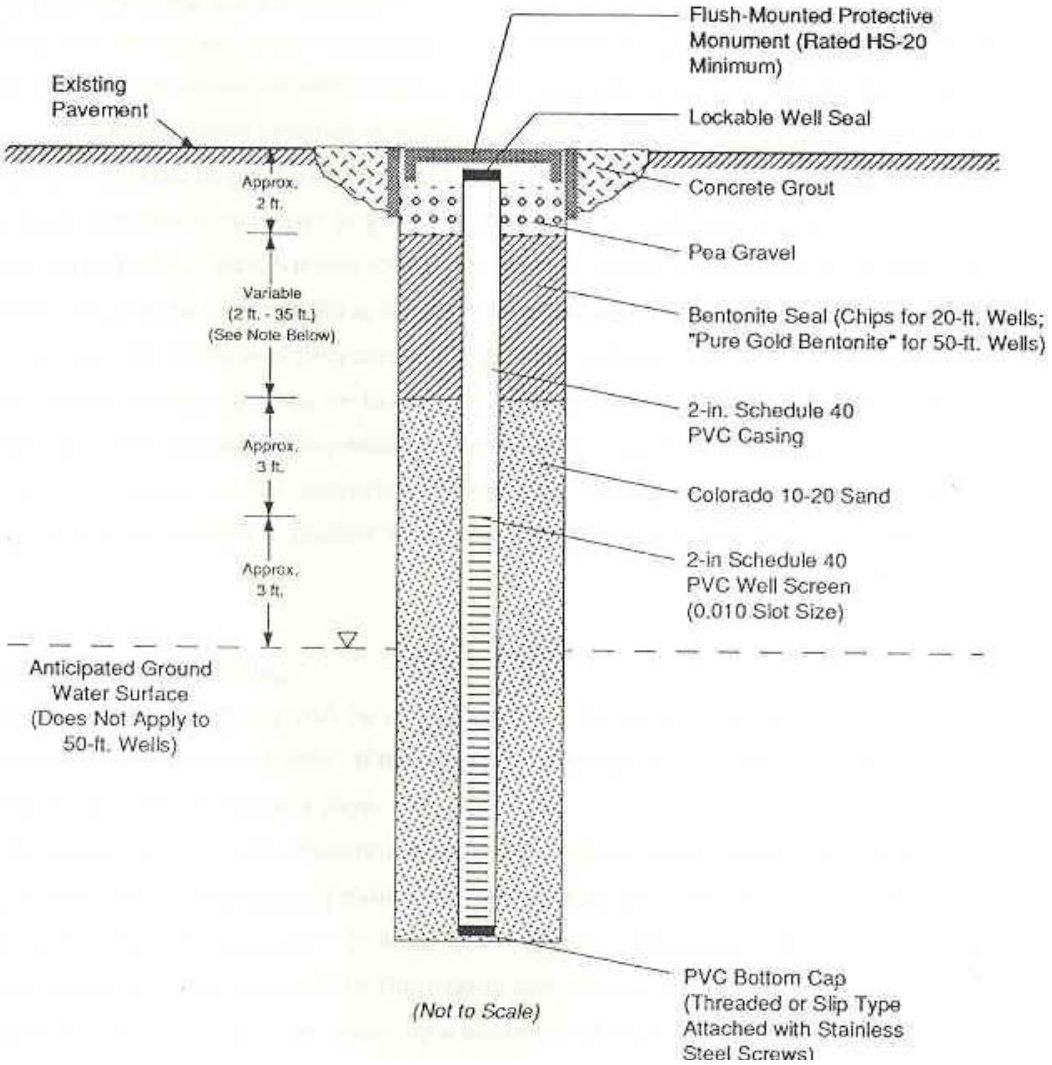
Figure 5
Well Completion Diagram



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TABLES

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Table 1
Summary of Laboratory Analysis Methodology

Laboratory Method	Number of Soil Samples	Number of Groundwater Samples	Number of Sediment Samples
Pesticides/PCB	18	12	N/S
Semi Volatile	60	12	N/S
Volatile	60	12	N/S
Polynuclear Aromatic Hydrocarbons (PAH)	60	12	N/S
Priority Pollutant Metals	60	12	N/S
Total Petroleum Hydrocarbons (TPH)	60	12	N/S
PSDDA Volatiles	N/S	N/S	6
PSDDA Semi Volatiles	N/S	N/S	6
PSDDA Pesticides/PCB	N/S	N/S	6
Butyl Tin	N/S	N/S	6
Total Metals	N/S	N/S	6
N/S – No Sample Taken			

Table 2
Residual Waste Management

HANDLING INSTRUCTIONS FOR WASTE MATERIALS

Source	Handling Instructions
Soil Cuttings and Excess Sediment	Place in sealed open-top drums or 5-gallon buckets. Label drums and place on pallets. Store pallets with drums at locations indicated by client Field Coordinator.
Drilling Equipment Decontamination Water	Place in sealed bung-top drums at point of generation. Transport drums to staging area and pump the water into the Baker Tank.
Soil Sampling Equipment Decontamination Water	Place in sealed bung top drums at point of generation. Transport drums to staging area and pump the water into the Baker Tank.
Well Development and Purge Water	Place in sealed bung-top drums at point of generation. Transport drums to staging area and pump the water into the Baker Tank. If well contains free petroleum product or contains obviously gross contamination, do not mix with water in the Baker Tank. Instead, place drums on pallets. Store pallets at locations indicated by client Field Coordinator.
Used Personal Protective Clothing and Disposables that have Contacted Soil, Sediment, or Ground Water	Place in sealed open-top drums. Label drums and place on pallets. Store pallets at locations indicated by client Field Coordinator.
Personal Protective Clothing and Disposables that have not Contacted Soil, Sediment, or Ground Water	Place in dumpster boxes or tub skids supplied by client.

- Pumping water stored in 55-gallong drums to Baker Tanks is not within Work Plan.

Table 3
QA/QC Sample Requirements

Analysis	Field Duplicates: Soil and Sediment	Field Reps: Soil, Sediment and Water	Method Blanks	Blank Spike	MD (Duplicates)	MS (Matrix Spike)	SD (Spike Duplicate)	Surrogates	SRM
Volatile Organics (SW8260)	X	X	X	X		X	X	X	X
Semivolatiles Organics (SW8270)	X	X	X	X		X	X	X	X
PCB (SW8082)	X	X	X	X		X	X	X	X
Diesel (NWTPHd)	X	X	X	X		X	X	X	
Metals (Waters)	X	X	X	X	X	X	X		
Metals (Soils & Sediments)	X	X	X		X	X	X		X
Total Organic Carbon	X	X	X		X[1]	X			X

[1] Laboratory Triplicate

Table 4
Sediment: Analytical Concentration Goals and Methodology

CAS#	Analytes	Analytical Method	Reporting Limit
	Conventionals		**mg/Kg dw (ppm)**
NA	Total Organic Carbon	EPA 415.1	500
	Metals		**mg/Kg dw (ppm)**
7782-49-2	Silver	SW846-6010B ICP	0.3
7429-90-5	Aluminum	SW846-6010B ICP	5.0
7440-66-6	Arsenic	SW846-6010B ICP	5.0
7440-43-9	Cadmium	SW846-6010B ICP	0.2
7440-47-3	Chromium	SW846-6010B ICP	0.50
7440-50-8	Copper	SW846-6010B ICP	0.2
7439-97-6	Mercury	SW846- 7471A CVA	0.05
7440-50-8	Nickel	SW846-6010B ICP	1.0
7439-92-1	Lead	SW846-6010B ICP	2.0
7440-36-0	Antimony	SW846-6010B ICP	5.0
7782-49-2	Selenium	SW846-6010B ICP	5.0
7440-66-6	Zinc	SW846-6010B ICP	0.6
	NWTPHD		**mg/Kg dw (ppm)**
NA	Diesel Range Hydrocarbons	NWTPHd	20
	PCBs Aroclors		**µg/Kg dw (ppb)**
12674-11-2	Aroclor 1016	SW846-8082	20
11104-28-2	Aroclor 1221	SW846-8082	40
11141-16-5	Aroclor 1232	SW846-8082	20
53469-21-9	Aroclor 1242	SW846-8082	20
12672-29-6	Aroclor 1248	SW846-8082	20
11097-69-1	Aroclor 1254	SW846-8082	20
11096-82-5	Aroclor 1260	SW846-8082	20
	Volatile Organic Compounds		**µg/Kg dw (ppb)**
630-20-6	1,1,1,2-Tetrachloroethane	SW846-8260B	1.0
71-55-6	1,1,1-Trichloroethane	SW846-8260B	1.0
79-34-5	1,1,2,2-Tetrachloroethane	SW846-8260B	1.0
79-00-5	1,1,2-Trichloroethane	SW846-8260B	1.0
75-34-3	1,1-Dichloroethane	SW846-8260B	1.0
75-35-4	1,1-Dichloroethene	SW846-8260B	1.0
96-18-4	1,2,3-Trichloropropane	SW846-8260B	3.0
107-06-2	1,2-Dichloroethane	SW846-8260B	1.0
78-87-5	1,2-Dichloropropane	SW846-8260B	1.0
78-93-3	2-Butanone	SW846-8260B	5.0
110-75-8	2-Chloroethyl Vinyl Ether	SW846-8260B	5.0
591-78-6	2-Hexanone	SW846-8260B	5.0

Table 4 (continued)
Sediment: Analytical Concentration Goals and Methodology

108-10-1	4-Methyl-2-Pentanone	SW846-8260B	5.0
67-64-1	Acetone	SW846-8260B	5.0
107-02-8	Acrolein	SW846-8260B	50.0
107-13-1	Acrylonitrile	SW846-8260B	5.0
71-43-2	Benzene	SW846-8260B	1.0
74-97-5	Bromochloromethane	SW846-8260B	1.0
75-27-4	Bromodichloromethane	SW846-8260B	1.0
598-31-2	Bromoethane	SW846-8260B	2.0
75-25-2	Bromoform	SW846-8260B	1.0
74-83-9	Bromomethane	SW846-8260B	1.0
75-15-0	Carbon Disulfide	SW846-8260B	1.0
56-23-5	Carbon Tetrachloride	SW846-8260B	1.0
108-90-7	Chlorobenzene	SW846-8260B	1.0
124-48-1	Chlorodibromomethane	SW846-8260B	1.0
75-00-3	Chloroethane	SW846-8260B	1.0
67-66-3	Chloroform	SW846-8260B	1.0
74-87-3	Chloromethane	SW846-8260B	1.0
10061-01-5	cis-1,3-Dichloropropene	SW846-8260B	1.0
74-95-3	Dibromomethane	SW846-8260B	1.0
75-71-8	Dichlorodifluoromethane	SW846-8260B	1.0
100-41-4	Ethyl Benzene	SW846-8260B	1.0
87-68-3	Hexachloro-1,3-Butadiene	SW846-8260B	5.0
74-88-4	Iodomethane	SW846-8260B	1.0
98-82-8	Isopropyl Benzene	SW846-8260B	10.0
108-38-3/106-42-3	m,p-Xylene	SW846-8260B	1.0
75-09-2	Methylene Chloride	SW846-8260B	2.0
80-62-6	Methyl-t-butyl ether (MTBE)	SW846-8260B	1.0
91-20-3	Naphthalene	SW846-8260B	5.0
95-47-6	o-Xylene	SW846-8260B	1.0
100-42-5	Styrene	SW846-8260B	1.0
127-18-4	Tetrachloroethene	SW846-8260B	1.0
108-88-3	Toluene	SW846-8260B	1.0
156-60-5	trans-1,2-Dichloroethene	SW846-8260B	1.0
10061-02-6	trans-1,3-Dichloropropene	SW846-8260B	1.0
110-57-6	trans-1,4-Dichloro-2-Butene	SW846-8260B	5.0
79-01-6	Trichloroethene	SW846-8260B	1.0
75-69-4	Trichlorofluoromethane	SW846-8260B	1.0
108-05-4	Vinyl Acetate	SW846-8260B	5.0
75-01-4	Vinyl Chloride	SW846-8260B	1.0

Table 4 (continued)
Sediment: Analytical Concentration Goals and Methodology

	Semi-Volatile Organic Compounds		µg/Kg dw (ppb)
120-82-1	1,2,4-Trichlorobenzene	SW846-8270C	20
95-50-1	1,2-Dichlorobenzene	SW846-8270C	20
541-73-1	1,3-Dichlorobenzene	SW846-8270C	20
106-46-7	1,4-Dichlorobenzene	SW846-8270C	20
108-60-1	2,2'-oxybis(1-chloropropane)	SW846-8270C	40
95-95-4	2,4,5-trichlorophenol	SW846-8270C	20
88-06-2	2,4,6-trichlorophenol	SW846-8270C	20
120-83-2	2,4-Dichlorophenol	SW846-8270C	20
105-67-9	2,4-Dimethylphenol	SW846-8270C	20
51-28-5	2,4-Dinitrophenol	SW846-8270C	20
121-14-2	2,4-Dinitrotoluene	SW846-8270C	20
606-20-2	2,6-Dinitrotoluene	SW846-8270C	20
91-58-7	2-Chloronaphthalene	SW846-8270C	20
95-57-8	2-Chlorophenol	SW846-8270C	40
91-57-6	2-Methylnaphthalene	SW846-8270C	20
95-48-7	2-Methylphenol	SW846-8270C	20
88-74-4	2-Nitroaniline	SW846-8270C	20
88-75-5	2-Nitrophenol	SW846-8270C	100
91-94-1	3,3’-Dichlorbenzidine	SW846-8270C	20
99-09-2	3-Nitroaniline	SW846-8270C	20
534-52-1	4,6-Dinitro-2-Methylphenol	SW846-8270C	200
101-55-3	4-bromophenyl-phenyl ether	SW846-8270C	60
59-50-7	4-Chloro-3-methylphenol	SW846-8270C	20
106-47-8	4-Chloroaniline	SW846-8270C	20
7005-72-3	4-Chlorophenyl-phenyl ether	SW846-8270C	60
106-44-5	4-Methylphenol	SW846-8270C	20
100-01-6	4-Nitroaniline	SW846-8270C	40
100-02-7	4-Nitrophenol	SW846-8270C	20
83-32-9	Acenaphthene	SW846-8270C	20
208-96-8	Acenaphthylene	SW846-8270C	20
120-12-7	Anthracene	SW846-8270C	20
56-55-3	Benzo(a)Anthracene	SW846-8270C	20
50-32-8	Benzo(a)Pyrene	SW846-8270C	20
205-99-2	Benzo(b)Fluoranthene	SW846-8270C	20
191-24-2	Benzo(ghi)Perylene	SW846-8270C	20
207-08-9	Benzo(k)Fluoranthene	SW846-8270C	20
65-85-0	Benzoic Acid	SW846-8270C	200
100-51-6	Benzyl Alcohol	SW846-8270C	20
111-91-1	Bis-(2-chloroethoxy) methane	SW846-8270C	100
111-44-4	Bis-(2-chloroethyl) ether	SW846-8270C	20

Table 4 (continued)
Sediment: Analytical Concentration Goals and Methodology

117-81-7	bis(2-Ethylhexyl) phthalate	SW846-8270C	20
85-68-7	Butylbenzylphthalate	SW846-8270C	100
86-74-8	Carbazole	SW846-8270C	20
218-01-9	Chrysene	SW846-8270C	20
53-70-3	Dibenz(a,h)Anthracene	SW846-8270C	20
132-64-9	Dibenzofuran	SW846-8270C	20
84-66-2	Diethylphthlalate	SW846-8270C	20
131-11-3	Dimethylphthalate	SW846-8270C	20
84-74-2	Di-n-butylphthalate	SW846-8270C	20
117-84-0	Di-n-octylphthalate	SW846-8270C	20
206-44-0	Fluoranthene	SW846-8270C	20
86-73-7	Fluorene	SW846-8270C	20
118-74-1	Hexachlorobenzene	SW846-8270C	20
87-68-3	Hexachlorobutadiene	SW846-8270C	100
77-47-4	Hexachlorocyclopentadiene	SW846-8270C	20
67-72-1	Hexachloroethane	SW846-8270C	20
193-39-5	Indeno(1,2,3-cd)Pyrene	SW846-8270C	20
78-59-1	Isophorone	SW846-8270C	20
91-20-3	Naphthalene	SW846-8270C	20
98-95-3	Nitrobenzene	SW846-8270C	20
621-64-7	N-Nitroso-di-n-propylamine	SW846-8270C	20
87-86-5	Pentachlorophenol	SW846-8270C	100
85-01-8	Phenanthrene	SW846-8270C	20
108-95-2	Phenol	SW846-8270C	100
129-00-0	Pyrene	SW846-8270C	20

Table 5
Water: Analytical Concentration Goals and Methodology

CAS#		Analytical Method	Reporting Limit
	Conventionals		**mg/L (ppm)**
NA	Total Organic Carbon	EPA 415.1	500
	Metals		**mg/L (ppm)**
7782-49-2	Silver	Method 6010 ICP	0.003
7429-90-5	Aluminum	Method 6010 ICP	0.050
7440-66-6	Arsenic	Method 6010 ICP	0.050
7440-43-9	Cadmium	Method 6010 ICP	0.002
7440-47-3	Chromium	Method 6010 ICP	0.005
7440-50-8	Copper	Method 6010 ICP	0.002
7439-97-6	Mercury	CVAA 7040A	0.0001
7440-50-8	Nickel	Method 6010 ICP	0.01
7439-92-1	Lead	Method 6010 ICP	0.02
7440-36-0	Antimony	Method 6010 ICP	0.05
7782-49-2	Selenium	Method 6010 ICP	0.05
7440-66-6	Zinc	Method 6010 ICP	0.006
	PCBs (Aroclors)		**µg/L (ppb)**
12674-11-2	Aroclor 1016	SW846-8082	1.0
11104-28-2	Aroclor 1221	SW846-8082	2.0
11141-16-5	Aroclor 1232	SW846-8082	1.0
53469-21-9	Aroclor 1242	SW846-8082	1.0
12672-29-6	Aroclor 1248	SW846-8082	1.0
11097-69-1	Aroclor 1254	SW846-8082	1.0
11096-82-5	Aroclor 1260	SW846-8082	1.0
	Volatile Organic Compounds		**µg/L (ppb)**
630-20-6	1,1,1,2-Tetrachloroethane	SW846-8260B	0.2
71-55-6	1,1,1-Trichloroethane	SW846-8260B	0.2
79-34-5	1,1,2,2-Tetrachloroethane	SW846-8260B	0.2
79-00-5	1,1,2-Trichloroethane	SW846-8260B	0.2
75-34-3	1,1-Dichloroethane	SW846-8260B	0.2
75-35-4	1,1-Dichloroethene	SW846-8260B	0.2
96-18-4	1,2,3-Trichloropropane	SW846-8260B	0.5
107-06-2	1,2-Dichloroethane	SW846-8260B	0.2
78-87-5	1,2-Dichloropropane	SW846-8260B	0.2
78-93-3	2-Butanone	SW846-8260B	1.0
110-75-8	2-Chloroethyl Vinyl Ether	SW846-8260B	0.5
591-78-6	2-Hexanone	SW846-8260B	1.0
108-10-1	4-Methyl-2-Pentanone	SW846-8260B	1.0
67-64-1	Acetone	SW846-8260B	1.0

Table 5 (continued)
Water: Analytical Concentration Goals and Methodology

107-02-8	Acrolein	SW846-8260B	5.0
107-13-1	Acrylonitrile	SW846-8260B	1.0
71-43-2	Benzene	SW846-8260B	0.2
74-97-5	Bromochloromethane	SW846-8260B	0.2
75-27-4	Bromodichloromethane	SW846-8260B	0.2
598-31-2	Bromoethane	SW846-8260B	0.2
75-25-2	Bromoform	SW846-8260B	0.2
74-83-9	Bromomethane	SW846-8260B	0.2
75-15-0	Carbon Disulfide	SW846-8260B	0.2
56-23-5	Carbon Tetrachloride	SW846-8260B	0.2
108-90-7	Chlorobenzene	SW846-8260B	0.2
124-48-1	Chlorodibromomethane	SW846-8260B	0.2
75-00-3	Chloroethane	SW846-8260B	0.2
67-66-3	Chloroform	SW846-8260B	0.2
74-87-3	Chloromethane	SW846-8260B	0.2
10061-01-5	cis-1,3-Dichloropropene	SW846-8260B	0.2
74-95-3	Dibromomethane	SW846-8260B	0.2
75-71-8	Dichlorodifluoromethane	SW846-8260B	0.2
100-41-4	Ethyl Benzene	SW846-8260B	0.2
87-68-3	Hexachloro-1,3-Butadiene	SW846-8260B	0.5
74-88-4	Iodomethane	SW846-8260B	0.2
98-82-8	Isopropyl Benzene	SW846-8260B	0.2
108-38-3/106-42-3	m,p-Xylene	SW846-8260B	0.4
75-09-2	Methylene Chloride	SW846-8260B	0.3
80-62-6	Methyl-t-butyl ether (MTBE)	SW846-8260B	3.0
91-20-3	Naphthalene	SW846-8260B	0.5
95-47-6	o-Xylene	SW846-8260B	0.2
100-42-5	Styrene	SW846-8260B	0.2
127-18-4	Tetrachloroethene	SW846-8260B	0.2
108-88-3	Toluene	SW846-8260B	0.2
156-60-5	trans-1,2-Dichloroethene	SW846-8260B	0.2
10061-02-6	trans-1,3-Dichloropropene	SW846-8260B	0.2
110-57-6	trans-1,4-Dichloro-2-Butene	SW846-8260B	1.0
79-01-6	Trichloroethene	SW846-8260B	0.2
75-69-4	Trichlorofluoromethane	SW846-8260B	0.2
108-05-4	Vinyl Acetate	SW846-8260B	0.2
75-01-4	Vinyl Chloride	SW846-8260B	0.2

Table 5 (continued)
Water: Analytical Concentration Goals and Methodology

	Semi-B2		**µg/L (ppb)**
120-82-1	1,2,4-Trichlorobenzene	SW846-8270C	1.0
95-50-1	1,2-Dichlorobenzene	SW846-8270C	1.0
541-73-1	1,3-Dichlorobenzene	SW846-8270C	1.0
106-46-7	1,4-Dichlorobenzene	SW846-8270C	1.0
108-60-1	2,2'-oxybis(1-chloropropane)	SW846-8270C	1.0
95-95-4	2,4,5-trichlorophenol	SW846-8270C	5.0
88-06-2	2,4,6-trichlorophenol	SW846-8270C	5.0
120-83-2	2,4-Dichlorophenol	SW846-8270C	3.0
105-67-9	2,4-Dimethylphenol	SW846-8270C	3.0
51-28-5	2,4-Dinitrophenol	SW846-8270C	25
121-14-2	2,4-Dinitrotoluene	SW846-8270C	5.0
606-20-2	2,6-Dinitrotoluene	SW846-8270C	5.0
91-58-7	2-Chloronaphthalene	SW846-8270C	1.0
95-57-8	2-Chlorophenol	SW846-8270C	1.0
91-57-6	2-Methylnaphthalene	SW846-8270C	1.0
95-48-7	2-Methylphenol	SW846-8270C	2.0
88-74-4	2-Nitroaniline	SW846-8270C	5.0
88-75-5	2-Nitrophenol	SW846-8270C	5.0
91-94-1	3,3’-Dichlorbenzidine	SW846-8270C	5.0
99-09-2	3-Nitroaniline	SW846-8270C	6.0
534-52-1	4,6-Dinitro-2-Methylphenol	SW846-8270C	15
101-55-3	4-bromophenyl-phenyl ether	SW846-8270C	1.0
59-50-7	4-Chloro-3-methylphenol	SW846-8270C	2.0
106-47-8	4-Chloroaniline	SW846-8270C	3.0
7005-72-3	4-Chlorophenyl-phenyl ether	SW846-8270C	1.0
106-44-5	4-Methylphenol	SW846-8270C	1.0
100-01-6	4-Nitroaniline	SW846-8270C	5.0
100-02-7	4-Nitrophenol	SW846-8270C	5.0
83-32-9	Acenaphthene	SW846-8270C	1.0
208-96-8	Acenaphthylene	SW846-8270C	1.0
120-12-7	Anthracene	SW846-8270C	1.0
56-55-3	Benzo(a)Anthracene	SW846-8270C	1.0
50-32-8	Benzo(a)Pyrene	SW846-8270C	1.0
205-99-2	Benzo(b)Fluoranthene	SW846-8270C	1.0
191-24-2	Benzo(ghi)Perylene	SW846-8270C	1.0
207-08-9	Benzo(k)Fluoranthene	SW846-8270C	1.0
65-85-0	Benzoic Acid	SW846-8270C	60
100-51-6	Benzyl Alcohol	SW846-8270C	5.0
111-91-1	Bis-(2-chloroethoxy) methane	SW846-8270C	1.0
111-44-4	Bis-(2-chloroethyl) ether	SW846-8270C	2.0

Table 5 (continued)
Water: Analytical Concentration Goals and Methodology

117-81-7	bis(2-Ethylhexyl) phthalate	SW846-8270C	1.0
85-68-7	Butylbenzylphthalate	SW846-8270C	1.0
86-74-8	Carbazole	SW846-8270C	1.0
218-01-9	Chrysene	SW846-8270C	1.0
53-70-3	Dibenz(a,h)Anthracene	SW846-8270C	1.0
132-64-9	Dibenzofuran	SW846-8270C	1.0
84-66-2	Diethylphthlalate	SW846-8270C	1.0
131-11-3	Dimethylphthalate	SW846-8270C	1.0
84-74-2	Di-n-butylphthalate	SW846-8270C	1.0
117-84-0	Di-n-octylphthalate	SW846-8270C	1.0
206-44-0	Fluoranthene	SW846-8270C	1.0
86-73-7	Fluorene	SW846-8270C	1.0
118-74-1	Hexachlorobenzene	SW846-8270C	1.0
87-68-3	Hexachlorobutadiene	SW846-8270C	2.0
77-47-4	Hexachlorocyclopentadiene	SW846-8270C	5.0
67-72-1	Hexachloroethane	SW846-8270C	2.0
193-39-5	Indeno(1,2,3-cd)Pyrene	SW846-8270C	1.0
78-59-1	Isophorone	SW846-8270C	1.0
91-20-3	Naphthalene	SW846-8270C	1.0
98-95-3	Nitrobenzene	SW846-8270C	1.0
62-75-9	N-Nitrosodimethylamine	SW846-8270C	5.0
621-64-7	N-Nitroso-di-n-propylamine	SW846-8270C	2.0
87-86-5	Pentachlorophenol	SW846-8270C	5.0
85-01-8	Phenanthrene	SW846-8270C	1.0
108-95-2	Phenol	SW846-8270C	2.0
129-00-0	Pyrene	SW846-8270C	1.0

Table 6: QA/QC Sample Goals for Analytical Analysis of Sediment and Water

Analysis	Analytes	Percent Recovery				RPD	% Completeness
		Sediment Sample Matrix Spike	Sediment Method Blank/LCS	Water Sample Matrix Spike	Water Method Blank/LCS		
Volatile Organics SW846-8260B							
surrogates	d4-1,2-Dichloroethane	71-143	74-128	74-142	74-133	30	90
	d8-Toluene	79-118	76-119	84-129	77-131		
	Bromofluorobenzene	69-126	78-116	77-122	79-127		
	d4-1,2-Dichlorobenzene	79-119	78-122	85-135	84-132		
spikes	Vinyl Chloride	27-187	44-149	31-162	49-133		
	1,1-Dichloroethene	48-147	63-135	62-139	66-128		
	Chloroform	65-124	74-122	72-123	69-122		
	1,2-Dichloropropane	66-131	83-122	80-125	75-123		
	Trichloroethene	55-140	72-126	38-170	74-118		
	Benzene	63-122	81-120	66-140	74-125		
	Chlorobenzene	60-130	86-118	77-121	73-122		
	Ethylbenzene	52-135	87-125	70-136	75-128		
Semivolatiles SW846-8270C							
surrogates	d4-2-Chlorophenol	20-108	41-114	47-108	56-104	30	90
	d4-1,2-Dichlorobenzene	12-108	33-120	32-89	40-88		
	2,4,6-Tribromophenol	10-124	32-105	37-127	42-114		
	2-Fluorophenol	17-110	42-118	38-114	46-110		
	d5-Phenol	16-116	36-121	29-117	46-105		
	d5-Nitrobenzene	11-111	39-113	43-112	55-105		
	2-fluorobiphenyl	10-124	37-119	40-105	46-105		
	d14-p-Terphenyl	13-125	36-125	32-129	59-116		
spikes	Phenol	25-116	45-123	41-130	49-115		
	2-Chlorophenol	23-113	49-116	52-120	59-112		
	1,4-Dichlorobenzene	16-108	30-115	29-80	27-86		
	N-nitroso-di-n-propylamine	12-121	26-102	36-108	41-101		
	1,2,4-Tirchlorobenzene	23-112	35-111	32-82	31-88		
	4-Chloro-3-methylphenol	24-121	31-119	40-139	54-112		
	Acenaphthene	15-125	37-102	35-112	50-98		
	4-Nitrophenol	10-141	28-111	46-136	43-124		
	2,4-Dinitrotuluene	10-139	33-118	42-122	53-112		
	Pentachlorophenol	10-141	18-125	18-154	10-129		
	Pyrene	10-139	29-95	38-105	42-103		
PCBs SW846-8082A							
surrogates	Tetrachloro-meta-xylene (TCMX)	18-132	37-139	33-111	31-111	30	90
	Decachlorobiphenyl	16-140	50-127	27-128	19-112		
spikes	Aroclor 1242	10-146	51-126	44-121	77-99		
Mercury SW846-7471A	Hg	75-125	75-125	75-125	75-125	20	90
Metals SW846-6010	ICP	75-125	75-125	75-125	75-125	20	90
Total Organic Carbon ASTM D4129-82m 415.1	TOC	70-130	70-130	70-130	70-130	20	90

Table 7
Evaluation of Data Quality

Indicator	Parameter
Precision	Field Duplicate Field Split Sample Laboratory Duplicate Matrix Spike Duplicates
Accuracy	Matrix Spike Surrogate Spike Initial Calibration Standards and Blanks Continuing Calibration Standards and Blanks Laboratory Control Samples Standard Reference Trip Blank Field Blank Method Blank
Representativeness	Field Blank Method Blank Chain of Custody Holding Times and Preservation Status
Comparability	Method Detection Limits Method Reporting Limits Sample Collection Methods Laboratory Analytical Methods
Completeness	Data Qualifiers Laboratory Deliverables Requested/Reported Valid Results

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APPENDICES

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APPENDIX A: SAMPLE ANALYSIS PLAN

Groundwater Sample Collection Procedure

These procedures are intended for collecting groundwater samples, and are a baseline for assuring that good standards and practices are being implemented.

General Preparation

Test and calibrate field equipment (pH/conductivity meter, temperature probe, and the Photo Ionizing Detector (PID) before leaving for the field. The following list of equipment is needed to collect groundwater samples.

Groundwater Sampling Equipment

- Teflon or stainless steel bailers
- Indelible marker
- Vacuum pump
- Sample labels
- Portable submersible pump
- Copies of relevant sample collection procedures
- pH and conductivity meters
- Sample containers with caps and liners (include extra 20 %)
- Thermometer
- Field Sampling Activity Report forms
- Steel measuring tapes
- Sample collection forms
- Electrical measuring tape
- Chain-of-Custody forms
- Stopwatch
- Trip blanks
- Bucket (for measuring flow rate)
- Filtration apparatus (extra filters)
- Ice chest
- Deionized water (1.5 gallons per well)
- Ziploc plastic bags
- Alconox detergent
- 80 mil nylon line
- Tyvek suit
- Batteries
- Personal protective gear
- Disposable plastic cups
- Plastic garbage bags
- Ice
- Duct tape

Field Sampling Procedures

Well Identification Step 1

Locate the well site and identify the well as the correct sampling point. Check the physical characteristics of the well to make sure they match the listed completion data for the well. Park the vehicle near the well (and downwind) to prevent any cross contamination problems. Record any visible problems with the well, well cap, or well vault on the Field Sampling data sheet. This information is critical to assure that the integrity of the monitoring well, samples, and analysis results are credible. Any structural damage to the well casing or the surface seal at a well must be reported so that repair work can be initiated.

Water-Level Measurement Step 2

Water-level measurements are taken to determine the volume of the water column in a well before sampling is initiated. Depth to water will be measured to the nearest 0.01 ft. An electrical water-level indicator can be used to determine the depth of water in a well for a purge volume calculation. The measuring point should be from the top of the casing on the north side. The depth to the bottom of the well should be measured after the water-level measurement has been taken.

Calculation of Well Volume Step 3

The difference between the depth-to-water measurement and the depth-to-bottom-of-well measurement should be determined to the nearest tenth of a foot. This difference is then multiplied by the gallons per linear foot value provided in the casing diameter/gallons per linear foot (see Table A below). The well volume equals the volume of water present in the well when the initial water level is taken. A minimum of three well volumes must be purged from the well before a sample is collected, to assure that formation water is being drawn from the well. Field parameters will be measured during well purging from an aliquot of water that has been collected at the end of a well volume discharge cycle.

Table A
Volume of Water in Casing or Hole

Diameter of Casing	Gallons per Foot of Depth	Cubic Feet per Foot
1	0.041	0.0055
2	0.163	2.024
3	0.367	4.558
4	0.653	8.110
5	1.020	12.67
6	1.469	18.24
7	2.000	24.84
8	2.611	32.43

To calculate the flow rate and volume of water discharged for a well with a submersible pump, a watch with a second hand and a five-gallon bucket are needed.

Note that all water removed from a monitoring well must be properly drummed, labeled, and banded and placed onto pallet.

Well Purging Step 4

Wells will be purged by removing at lease three well volumes of groundwater from the casing or by pumping the well casing dry. Wells will be purged using a bailer, a centrifugal pump, or a bladder pump. All non-dedicated purging equipment that comes in contact with groundwater will be decontaminated prior to use at another well. Information on purge volume, time of initiation and termination of pumping, and a description of the physical

characteristics of purge water (turbidity, sheen, color, etc.), based on field observation will be recorded on the Field Sampling Activity Report. Sampling will commence immediately after well purging. If the well becomes dry during purging, it will be sampled as soon as enough water is available in the well to collect a sample.

A peristaltic pump can be used to remove purge water from a monitoring well before sampling, but cannot be used to collect VOC samples. The peristaltic pump can be used to collect ABN, total metal, and chlorinated/PCB water samples from a monitoring well.

The bailer should be lowered slowly into the well during purging and sample collection to avoid agitating the water, which may affect the volatile content of the VOC sample.

Note that all water removed from a monitoring well must be properly drummed, labeled, and banded and placed onto pallet. Site personnel should be informed of the drum's status.

Field Parameter Measurements Step 5

Field parameters are measurements to be taken on water samples collected at the end of each well volume during purging. pH, conductivity, and temperature measurements are to be collected for each well volume removed from the well. Well volume samples should be collected in plastic disposable cups from the bailer or at the discharge port of the submersible pump. Collection cups for the field parameter measurements should be washed out three times with purge water before measurements are taken. These parameter data are to be recorded in the Field Monitoring Activity Report Form with a black ink pen. This process should be repeated until three well volumes have been removed and the measured parameters are within approximately 10 percent of one another.

Groundwater Sample Collection Step 6

General Precautions for Sampling

The general precautions that should be followed when collecting groundwater samples include:

- Do not smoke, drink, or eat during sampling, and avoid handling any objects not necessary for performing sampling procedures.
- Assure that the sample container labels correspond to the well location being sampled.
- Samples are not to be collected downwind from sources of volatile organic (e.g., car or generator exhausts, open fuel tanks). These sources could contaminate the sample. If any such sources are unavoidable, make a note of them on the Field Sampling Record Form.
- Leave caps on sample containers until just before filling. Avoid handling the Teflon bottle cap liners. Do not use liners that fall out of the cap onto the ground.

- Wear appropriate protective clothing and eye protection when taking samples and handling containers, especially those with added preservatives.

Sample Labeling

Each sample container will be labeled to include the following information: well name, date and time of sample collection (military time), sampler's initials, type of sample preservative, and analysis to be performed on the sample. Sample containers should be labeled before the samples are collected. Clear adhesive tape will be placed over each container label to assure that the label is attached, if the samples are in ice and being shipped by overnight delivery to the laboratory.

Sample Identification

The first line of the sample label will reflect following items: the media being sampled, sample location site and well name), and date of collection. To identify the media sampled, the abbreviation GW, SW, and SS will be used to denote groundwater, surface-water, and stream sediment samples respectively. For example, the sample identification label GW-SPB/MW-1- 01/15/03 reflects a groundwater sample collected at well MW1 at the South Park Bridge Site on January 15, 2003.

Order of Sample Collection

After Steps 1 through 3 have been completed, collection of the groundwater samples can be conducted. Collect the volatile organic samples first, followed by the semi-volatile samples, then the non-organic samples. The order that samples are to be collected is as follows; Volatile Organic Compounds (VOC), Base Acid Neutrals (BAN), Total Metals, cyanide, ammonia, N, General chemistry, and radionuclides.

Note that volatile samples require that zero-headspace containers have a septum lid. The bottle should be filled completely, so meniscus forms over the mouth of the 40-ml container. Cap the bottle immediately, turn it upside down, tap it a few times and check for air bubbles in the sample. If a bubble exists, discard the sample container and repeat the sample procedures until a bubble-free sample is obtained. Volatile sample containers will contain a preservative, and only one attempt should be made to obtain a bubble-free sample. On all other sample containers, fill the bottles as much as possible and do not be concerned about bubbles.

Chain-of Custody Form

The sample custody record will be maintained through the use of the chain-of-custody form. A chain-of custody form will accompany each cooler shipped to the analytical laboratory. This form will contain information similar to that recorded on the sample label.

A sample is under an individual's custody if one or more of the following criteria are met:

- It is in his/her possession
- It is in his/her view after being in his/her possession
- It was in his/her possession and locked up to prevent tampering
- It is in a designated secure area

The field sampler will be responsible for the care and custody of the samples from the time they are collected until they are transferred to another individual or shipped.

The custody record will be completed using waterproof ink. Any corrections will be made by drawing a single line through the error and initialing and dating the correction. Information may not be erased or rendered unreadable.

The field sampler will fill out the chain-of-custody record for each sample shipment. When transferring custody, the individual relinquishing and receiving samples will sign, date, and note the time of the exchange on the record. The only exception will be when the samples are shipped. In this case, it is permissible for the individual shipping the samples to sign the "relinquished by" portion of the chain-of-custody record, and included the original record inside the cooler before shipping. Enter the shipper's name as the "relinquished to" (e.g., Federal Express) and estimate the time. Once shipped, the correct time and air bill number will be recorded in the field sample collection notebook.

Equipment Decontamination

Sample collection equipment will be decontaminated between each sample in the following manner: (1) alconox and tap water wash, (2) tap water rinse and distilled-deionized water rinse, and (3) air dry. Stainless steel bailers should always be clean prior to sample collection. These bailers should be stored in a clean storage area with an aluminum foil wrap. For proper disposal, disposable Teflon sampling bailers will be placed in plastic garbage bags after each well has been sampled.

The materials needed for equipment decontamination should be located at a decontamination area.

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APPENDIX B: GEOTECHNICAL LABORATORY TESTING

Introduction

This appendix describes the geotechnical laboratory test procedures for soil samples to be collected from the borings. The samples would be tested at the Shannon & Wilson laboratory to determine basic index and engineering properties, such as static strength and compressibility of the subsurface soils. Geotechnical laboratory testing would consist of visual classification, water content determinations, Atterberg limits, and grain-size analyses. Soil strength and compressibility characteristics would be determined by performing consolidated undrained triaxial compression tests, unconsolidated undrained triaxial compression tests, unconfined compression tests, direct shear tests, and one-dimensional consolidation tests.

All laboratory testing would be performed in accordance with the American Society for Testing and Materials (ASTM) standard test procedures.

Index Tests

Visual Classification

All soil samples obtained from the borings would be visually reclassified in our laboratory using a system based on the following ASTM Designation D 2487 (*Standard Test Method for Classification of Soil for Engineering Purposes and ASTM Designation)* and ASTM Designation D-2488 (*Standard Recommendation Practice for Description of Soils, Visual-Manual Procedure*). This visual classification method allows for consistent correlation of soils. The individual sample classifications would be incorporated into the individual boring logs.

Water Content Determinations

The natural water content of each soil sample recovered from the borings would be determined in general accordance with ASTM Designation D 2216 (*Standard Method of Laboratory of Water (Moisture) Content of Soil, Rock, and Soil-Aggregate Mixtures*). Water contents would be plotted in the individual boring logs. Comparison of a soil's natural water content with its index properties is useful in characterizing soil unit weight, consistency, compressibility, and strength.

Atterberg Limits Determinations

Atterberg limits would be determined on selected samples of fine-grained soil obtained in the borings, in general accordance with ASTM Designation D 4318 (*Standard Test Method for Liquid Limit, Plastic Limit, and Plasticity Index of Soils*) (ASTM, 1997). The Atterberg limits include Liquid Limit (LL), Plastic Limit (PL), and Plasticity Index (PI=LL-PL). They are used to assist in classification of soils, soil consistency, and

evaluation of soil compressibility and strength. The results of the Atterberg limits determination would be shown in the boring logs and graphically on the plasticity charts.

Grain-Size Analysis

Grain-size analyses on selected samples of coarse- and fine-grained soils would be performed in general accordance with ASTM Designation D 422 (*Standard Method for Particle-Size Analysis of Soils*). The three general procedures to determine the grain-size distribution of a soil are sieve analysis, hydrometer analysis, and combined analysis. For this project, only sieve analysis would be performed.

Grain-size distribution is used to assist in classifying soils, evaluating their liquefaction potential, and providing correlation with soil correlation properties including permeability and capillarity. Results of the grain-size analyses would be plotted on grain-size distribution curves. Along with each grain-size distribution would be a tabulated summary containing the sample description and natural water content.

Strength Tests

Consolidated, Undrained Triaxial Compression Tests

Two consolidated, undrained triaxial compression tests (CU tests) with pore water pressure measurements would be performed on relatively undisturbed samples (fine-grained) in general accordance with ASTM Designation D 4767. The test results would be used to estimate the undrained (short-term) shear strength of fine-grained soils.

Prior to consolidating and shearing, each sample would be saturated using back pressure. The degree of saturation would be determined by measuring the pore pressure coefficient B. In addition to allowing top and bottom drainage, side drains would be used to facilitate consolidation and pore-pressure equalization. The specimens would then be sheared at a constant rate that allows equalization of pore pressure throughout the specimen. A strain-controlled testing machine would be used so that a more uniform pore-pressure distribution would be achieved throughout the sample during shearing. An electronic transducer would record pore-pressure measurements at the bottom of the tested samples.

Detailed test results, including individual stress path plots (p-q plots), Mohr's circles at failure, and corresponding Mohr Coulomb failure envelopes would be presented. Atterberg limits would be performed on a portion of the test samples and graphically shown on the plasticity charts.

Direct Shear Tests

Two direct shear tests would be performed on two relatively undisturbed, pre-cut samples (fine-grained soils) in general accordance with ASTM Designation D 3080-90 (*Standard Test Method for Direct Shear Test of Soils Under Consolidated Drained Conditions*).

Atterberg limits would be also performed and the results would be presented on the plasticity charts.

The results of the direct shear tests would be used to estimate the residual shear strength along a pre-selected plane. Within the test series, the same sample would be used with each of the three different normal loads. The specimen would be inundated with water, consolidated at a selected normal stress, and sheared at a constant rate of strain. Specimens would be sheared slowly to a displacement of about 0.25 inch. The shear displacement would be then reversed until the specimen was back in its initial position. This would be followed by slowly reshearing followed by another reversal. The process would be repeated until a constant residual friction resistance was reached. The samples would be sheared through a total cumulative displacement of 1.5 to 2.0 inches.

Test results would be presented and include plots of shear stress and normal displacement versus shear strain for each specimen under various normal stresses. A plot of shear stress versus normal stress and pertinent specimen data would be presented.

One-Dimensional Consolidation Tests

One-dimensional consolidation tests would be performed on two selected relatively undisturbed samples in general accordance with ASTM Designation D 2435 (*Standard Test Method for One-Dimensional Consolidation Properties of Soils*). In general, the consolidation test results (presented as consolidation curves) would be used to evaluate the maximum past consolidation pressure and the compression characteristics of the tested sample under the proposed loads.

References

American Society for Testing and Materials (ASTM), 1990. *Annual Book of ASTM Standards: Soil and Rock; Dimension Stone; Geosynthet*ic, v. 04.08. Philadelphia, Pennsylvania.

Department of the Army, 1986. *Manual of Laboratory Soils Testing, Appendix X: Triaxial Compression Test (2).*

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APPENDIX C: HEALTH AND SAFETY PLAN

Site Description

This Health and Safety Plan (HSP) applies to activities to be carried out during the environmental and geotechnical subsurface soil, groundwater, and sediment sampling activities for the South Park Bridge Environmental Impact Statement (EIS). Sampling activities will be conducted on Boeing Company property, King County property, City of Seattle property, and within the Lower Duwamish Waterway . The Boeing property is an active RCRA Corrective Action Site and the Lower Duwamish Waterway channel is a listed Superfund site. Based on existing environmental information regarding these sites and the duration of industrial operations at these properties, it is anticipated that the following chemical contaminates are present in the project area: PCBs, TCE, Toluene, metals, and hydrocarbon fuels. This HSP will follow the procedures and requirements described in 29 CFR 1910.120b 1-4, the Washington General Occupational Health and Safety Standards in WAC 296-62 Part P for a site-specific Safety and Health Plan, and WAC 296-155.

Each boring will be set up with a twenty-five foot exclusion zone when appropriate and will be accessed by 40-hour trained HAZWOPER personnel only. All work activities conducted with the exclusion zone will be defined by yellow cautionary boundary. Areas outside the exclusion zone will be safe to the general public.

Approach to Health and Safety

This HSP is designed to address anticipated hazards that will be encountered during the drilling and sampling activities conducted for this project. These activities and actual site conditions may vary during the project and require an upgrade and/or downgrade to the HSP's protection requirements. All changes to this HSP must be approved by each of the project contractors' Health and Safety Offices, with the concurrence of the Health and Safety Representative for the individual property owners. All changes to the HPS will be conveyed to all on-site contractor personnel and other personal seeking access to active project work sites by the site Health and Safety Officer (HSO).

All workers, visitors, and regulatory personnel are expected to be familiar with and comply with all aspects of this HSP. Any individual who fails to comply with on-site protection levels and/or provisions of this HSP will be excluded from all active work areas and/or exclusion zones. The site HSO and/or property owner representative will be responsible for maintaining a list of the approved personnel at the site.

All required personal protective clothing and equipment for on-site workers shall be provided by the individual contractors. Regulatory and local governmental personal and any visitors brought on site shall provide their own protective clothing and equipment that meets and or exceeds this plan's requirements.

All individuals conducting fieldwork for this project will read and sign off on the information documented in this HSP. The Plan will be read and signed off on before any individual enters the project work site prior to commencement of work activities. Individuals from each contractor shall read and sign off on the HSP and notify their representative Site Safety Officer assigned to the project that they understand their responsibilities with respect to worker health and safety as required on this project. Each individual contractor will have a copy of the Plan on-site at all times. An organizational chart defining health and safety plan personnel is provided on page 5 of this Work Plan.

Key Personnel and Responsibilities

King County Department of Transportation Personnel

Project Director: Tim Lane, PE (206) 296-3708
Responsible for technical and administrative oversight of the project. The Project Director is not required to be on site during the work activities but will be in contact with the Project Manager on a regular basis.

Project Manager: Tim Lane, PE (206) 296-3708
Responsible for oversight of all aspects of the project including health and safety, quality assurance, technical support, and all on-site work activities

Health and Safety Officer: Jim Sussex (206) 296-8737
Responsible for overseeing the HSP's implementation. The HSO is not required to be on site during work activities, but will be in contact with the Site Safety Officer on a regular basis. All changes in the HSP will be approved by the HSO and implemented by the Site Safety Officer.

Field Manager and Site Safety Officer: Erin Nelson, PE, LG (206) 296-0274
Responsible for coordinating all aspects of the field activities and providing direct oversight of the work crews. The FM will be the designated SSO and HSO in the event that the project HSO is not present. The FM is responsible for all subcontractors and for controlling site access.

Parsons Brinckerhoff Personnel

Project Director: Einer Handeland, PE (206) 382-6320
Responsible for technical and administrative oversight of the project. The Project Director is not required to be on site during the work activities but will be in contact with Project Manager on a regular basis.

Project Manager: Yuhe Yang, PE (206) 382-5273
Responsible for oversight of all aspects of the project including health and safety, quality assurance, technical support, and all on-site work activities

Health and Safety Officer: **Bill Lider (206) 382-5260**
Responsible for overseeing the HSP's implementation. The HSO is not required to be on site during work activities, but will be in contact with the Site Safety Officer on a regular basis. All changes in the HSP will be approved by the HSO and implemented by the Site Safety Officer. The HSO will act as the stand-in FM and SSO if needed.

Field Manager: **Patrick Romero (206) 382-8311**
Responsible for coordinating all aspects of the field activities and providing direct oversight of the work crews. The FM will be the designated HSO in the event that the project HSO is not present. The Parsons Brinckerhoff FM is responsible for all subcontractors and for controlling site access.

Site Safety Officer: **Patrick Romero (206) 382-8311**
Responsible for implementing the Site Safety Plan. The SSO is specifically responsible for:

- Site access control
- Safety and health records
- Selecting personnel protective equipment (PPE)
- Inspecting, maintaining, and storing PPE
- Controlling entry and exit at the access control points
- Monitoring on-site hazards and conditions
- Auditing compliance with the HSP
- Enforcing safety procedures
- Enforcing site control
- Notifying emergency response personnel in emergencies
- Setting up decontamination areas, controlling decontamination, preparing solutions, and labeling of contaminated materials
- Training employees on emergency procedures and evacuation routes
- Maintaining site security
- Dispensing PPE and ensuring PPE is available
- Conducting safety meetings

- Maintaining all necessary documentation for relevant activities listed and other applicable elements of the Work Plan

Wilbur Consulting Inc. Personnel

Project Manager, Health and Safety Manager, Field Manager, and Site Safety Officer:
Scott Wilbur, RG (206) 935-1506 Office
(206) 605-7387 Cell

Historical Research Associates Inc. Personnel

Cathy Bialas, Site Officer: (206) 935-1506 Office

Shannon and Wilson Personnel

Project Manager: Hisham Sarieddine, PE (206) 695-6873

Health and Safety Officer: Ann Marie Johnson (206) 695-6838

Field Managers and Site Safety Officers:
Agnes Tirao (206) 695 6881
Xiao Hui Lui (206) 695-6835
Wayne Lindell (206) 695-6855
Paul VanHorne (206) 695-6840

Geo-Tech Drilling Personnel

Project Manager: Dale Abernathy (253) 395-1223 Office
(206) 409-8199 Cell

Health and Safety Officer: Lance Wilson (253) 395-1223

Field Managers and Site Safety Officers:
Steve Van Bergen (253)395-1223
Larry Inselman (253) 395-1223
Travis Stephens (253) 395-1223

Pile Contractors

Project Manager / Project Director / Site Safety Officer / Health & Safety Officer:
Phil Bononcini (206) 714-5872

Field Manager:
Joe Frauenheim (206) 713-2395

Apollo Geophysics

Project Manager:
Lynn M Ringstad (206) 647-8303

Health and Safety Officer:
Lynn M Ringstad (206) 647-8303

Field Manager and Site Safety Officer:
Matthew C. Ringstad (206) 276-4800

Northern Marine Salvage

Project Manager, Health and Safety Manager,
Field Manager, and Site Safety Officer:
Brian Carlson (206) 832-3086

Emerald Services

Project Manager:
Mike Mechealis (206) 832-3086

Health and Safety Officer:
Heather Barden (206) 832-3089

Field Manager and Site Safety Officer :
Gary Cowely (206) 832-3054

The Boeing Company

Project Manager:
Richard White (206) 655-3640

Health and Safety Officer:
Will Ernst (425) 891-7724

Field Manager and Site Safety Officer :
Michael Gleason (206) 655-2222

Field Activities

The field activities described in this Work Plan for investigating a controlled site of interest will be conducted under Level D protection. All PSA and geotechnical fieldwork activities will be conducted under Level D protection, and upgraded to Level C protection if airborne action levels are exceeded. All personnel will wear the following personal protective equipment (Level D), during drilling and sampling activities.

Personal Protective Equipment (Level D)

- Neoprene safety boots with a steel toe/shank
- Hard hat
- Tyvek coveralls
- Gloves (undergloves vinyl, outergloves nitrile)
- Safety glass (during drilling activities)
- Hearing protection
- Half-face respirator, cartridge-type organic vapor (only if upgraded to Level C protection)

Monitoring

Areas where drilling and sample collection are being conducted will be monitored periodically using an Organic Vapor Monitor (OVM) in the breathing zone. If any OVM readings are above monitoring limits for a sustained period of 10 to 15 seconds, background Drager tube readings shall be collected for all chemicals of concern. See Table B for action levels for upgrading to Level C protection for chemical compounds of concern. If the Drager Tube measurements exceed 10 percent of the Lower Explosive Limit (LEL), all workers shall leave the area until safe levels are maintained. Additional measures and protection may be required. The exclusion zone will be placed to prevent the public from entering any unsafe areas.

If the Drager tube measurements do not exceed Action Levels and OVM readings continuously exceed 50 ppm, purifying respirators will be worn until measured vapors in the workspace are measured to be below the 50-ppm limit.

Table B
Chemical Compounds of Concern: Action Levels

Chemical Compounds of Concern	Action Level
TCE	>12.5 ppm
Carbon Tetrachloride	> 1.0 ppm
V.C.	>0,5 ppm
Benzene	> .05 ppm

Note that the wet nature of the soil and sediment in the areas where the potential for chemical exposure exists, is limited to skin contact for the most part.

Emergency Facilities and Numbers

The following numbers should be preprogrammed into the Site Safety Officer's cell phone, and should be posted in a conspicuous place at the site. All site personnel should be aware of this location.

The Boeing Company Property Contact Numbers

Boeing Fire and Security Emergency Number: (206) 655-2222
Boeing Emergency Transportation Systems: not provided

Hospital

Harborview Medical Center
325 9th Avenue
Seattle, Washington
Information Number: (206) 223-3000
Emergency Number: (206) 223-3074

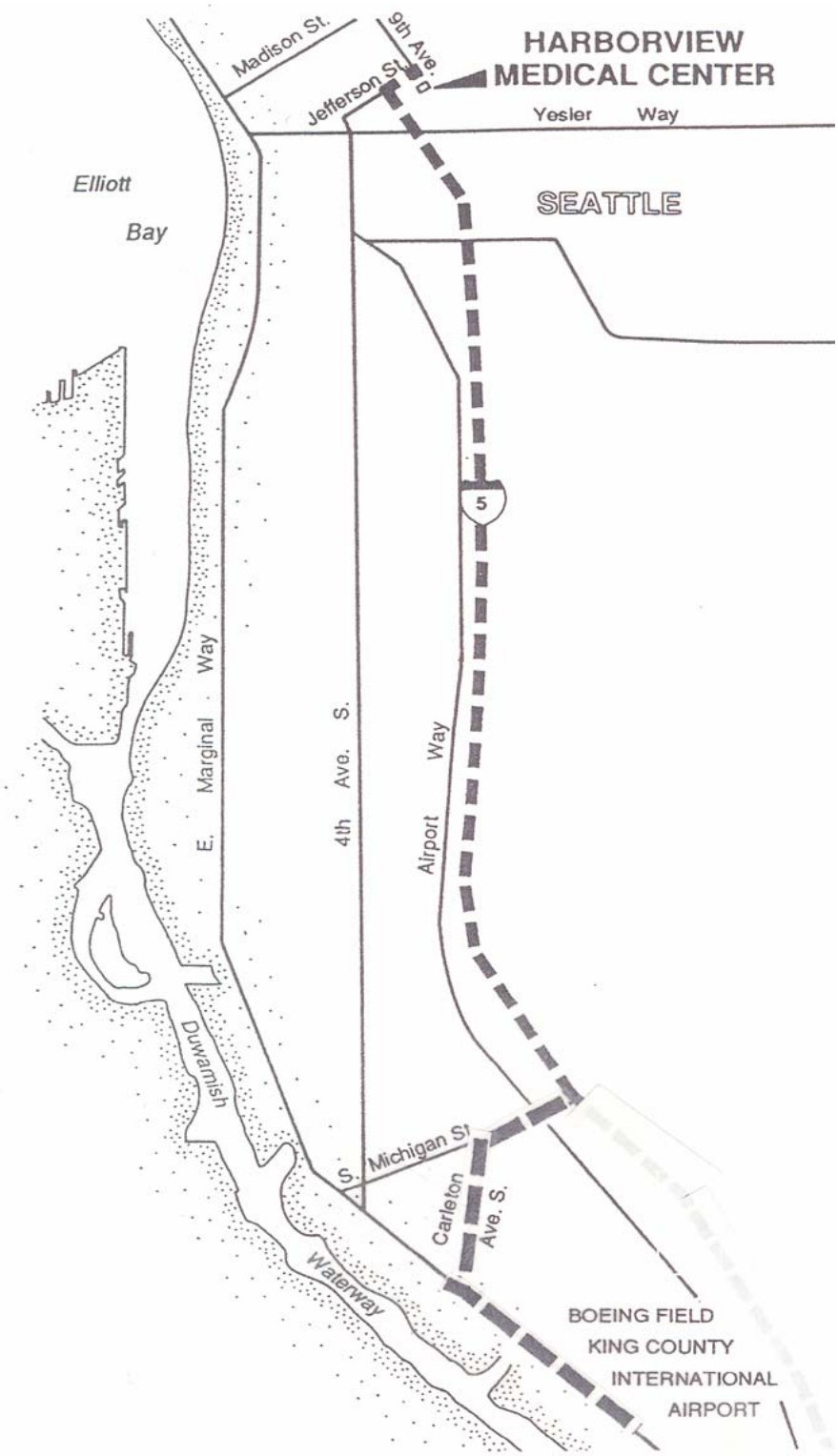
Directions to Harborview Medical Center from site:

> Exit project site to the east along 16th Avenue South. Turn left (northbound toward Seattle) onto East Marginal Way. Proceed north on East Marginal Way onto Carleton Avenue South, and follow to I-5. Get onto I-5 northbound. Exit onto James Street going east and drive to 9th Avenue. Turn right and follow signs to the emergency entrance. Map provided on following page 8 of Appendix C . Note because the project is being conducted within an urban setting with full community emergency support any medical incidents that occur on site shall be phoned in to 911. City of Seattle emergency response will respond. Do not attempt to transport an injured person to Harborview Medical Center wait for emergency response to arrive.

Fire, Police, and Ambulance: 911

For non-Boeing Company property emergencies call 911 and wait for response.

Map to Harborview Medical Center



APPENDIX D: IN-WATER EMERGENCY PROCEDURES AND SPILL RESPONSE PLAN

Emergency Procedures

It will be the Site Safety Officer (SSO)'s responsibility to determine appropriate responses to emergency incidents. The response sequence will be to (1) remove all personnel from the area, (2) assess the severity of the incident, (3) contact the appropriate emergency assistance, and (4) swiftly move to a rendezvous point for aid.

The following planning measures will be instituted to facilitate responses to emergency situations:

- The SSO will conduct a safety briefing before the start of work. Copies of this SSHP will be distributed to all project personnel. After reading the plan, all Geo-Tech Explorations project personnel will be required to sign a SSHP consent agreement.
- All Geo-Tech Explorations project personnel will be instructed in the use of all field safety equipment before field activities take place.
- The Project Manager will verify that all field staff has fulfilled the project training and medical monitoring requirements.
- The SSO will check to see that all required safety equipment is at the job site before the start of each day's field activities.
- The SSO will establish an emergency rendezvous or evacuation point before the start of each day's fieldwork.
- The Project Manager will make sure all Geo-Tech Explorations personnel know the emergency route to the hospital.
- Employees are required to notify the SSO of any suspected exposure. In the event of any injury or suspected exposure, the SSO will contact (through the 911 emergency number) the appropriate hospital and ambulance service, if necessary.

Required Notifications in the Event of a Spill

All spills of oil or hazardous substances into navigable waters and all spills of a reportable quantity of hazardous substances (40 CFR Part 302) must be immediately reported by the spiller to the National Response Center (NRC). The NRC will contact appropriate local United States Coast Guard (USCG) or Environmental Protection Agency (EPA) offices. Notifying state officers does not relieve the spiller from Federal requirements to notify NRC.

National Response Center
1-800-424-8802 Toll Free
1-202-267-2675 Toll Call

All spills of oil into Washington State waters must be immediately reported to the Washington State Emergency Management Division (WA EMD). Marine casualties, disabled vessels or near-miss incidents should also be reported.

The Washington Emergency Management Division (EMD)
24-Hour Emergency Spill Response
1-800-258-5990
or
1-800-OILS-911

For spills of hazardous substances, the spiller is required to notify the nearest Washington State Department of Ecology office:

The Washington State Department of Ecology
24-Hour Emergency Spill Response
Northwest Office, Bellevue: 1-425-649-7000

If oil is spilled into water of the State, or escape into waters of the State is likely, any quantity of oil that would produce a visible oily slick, oily solids, or coat aquatic life, habitat or property with oil, but excluding normal discharges from properly operating marine engines; if spilled on the surface of land, a quantity of oil over one barrel (42 gallons).

First Responder Guidelines

The following procedures needs to be followed should a hazardous substance or oil spill occur:

1. Remain upwind, uphill or upstream of the incident and assess the situation from a safe distance. Use binoculars, if available, to view the scene. Attempt to determine if radiological materials or hazardous substances are present. Observe and note the following:
    - Effects on people, animals, and the environment;
    - Container types, markings, placards, and labels. If available, use the USDOT *Emergency Response Guidebook* for reference;
    - Signs of any released or discharged substances and any unusual or pungent odors (move further away or upwind if you detect an odor and you are not positive if it is safe);
    - Wind direction and prevailing weather;
    - Distance and direction of nearby dwellings; and
    - Distance and direction of any nearby surface water.

2. The initial responder shall then make notifications, as listed above.
3. The initial responder shall not enter an area where the responder may become a victim, **even to rescue another**.
4. Until help arrives, the initial responder should:
    - Cordon off the incident area and establish a safe zone. If chemical vapors or flammable/explosive materials are involved, evacuate all persons from the immediate area and remain upwind of the incident area. If sources of radiation or radioactive materials are suspected to be involved, use the principles of time, distance and shielding to reduce potential exposure.
    - Enter the incident area only if properly trained and equipped with appropriate protective clothing and equipment.
    - Render first aid to victims, and be sure to notify medical personnel if radiation exposure or contamination is suspected.
    - Serve as an on-scene communication point.
    - Brief the response team leader or incident commander upon arrival.

Initial Assessment/Information Check-Off List

The following information should be provided by the spiller or reporting person:

1. Time of call
2. Caller name, address and telephone number
3. Vessel/facility information
    - Name
    - Name of vessel, railcar-truck number or other identifying information
    - Type and size of vessel/facility
    - Nationality (vessel only)
4. Date and time of incident (or when discovered)
5. Type of incident (explosion, grounding, etc.)
6. Pollutants/substances released
7. Source of material released
8. Estimated amount spilled
9. Total potential quantity
10. Total already released
11. Spill/released into air, ground, water or subsurface
12. Weather/sea conditions
13. Point of contact (responsible party name, telephone number, address)
14. Vessel/facility agent(s) (name and telephone number)
15. Name of carrier
16. Number and type of injuries or fatalities

17. Names of all people on scene
18. Response activities being done or that have been completed
19. Any evacuations that have occurred
20. Estimated dollar amount of property damage
21. Other agencies notified

Spill Prevention and Minor Spill Control

The following procedures are established for a minor release of oil or other hazardous material(s) during on-land or on-water boring activities.

1. It is the SSO's responsibility to inspect daily all vehicles and equipment in use by Geo Tech Explorations.
2. The SSO will be responsible for ensuring that each vehicle is supplied with petroleum sorbent pads, loose granular sorbent, and oil drain pans.
3. In the event of a leak or spill of oil or other hazardous materials:
   - Identify the source of the release.
   - Contain the released materials by establishing a barrier at the leading edge of the released material using the booms, sorbent pads and loose granular material.
   - If the release is the result of a leak, the spill may be contained by using a oil drip pan.
   - Isolate and repair the source of the leak. If the spill is the result of a tipped-over or damaged container, place the damaged container into a plastic bag filled with granular sorbent material. Store the damaged container on the support vehicle, protected by a dam (created with sorbent pads and loose granular material).
   - Clean all remaining spilled material using the sorbent pads and loose granular materials.
   - Dispose of all waste contents into a bucket (or drum if available) that is in good condition. Securely close the drum and label it with drum content, date of generation, and point of contact information. Waste materials must be disposed of in accordance with the established rules and regulations provided by the United States Environmental Protection Agency, Washington Department of Ecology, and/or Oregon Department of Environmental Quality.

All soils contaminated by the release of oil or other hazardous materials shall be removed and addressed in a fashion similar to the process described above.

14. HEALTH AND SAFETY PLAN APPROVAL

This Health and Safety Plan has been reviewed and hereby approved. By their signatures, the following undersigned certify that this Health and Safety Plan meets the requirements of 29 CFR 1910.120 and WAC 296-62-3010 and all other applicable regulations for the protection of the health and safety of all persons entering upon this site.

King County Site Safety Officer	Date
Parsons Brinckerhoff Site Safety Officer	Date
The Boeing Company Site Safety Officer	Date
Wilbur Consulting Inc. Site Safety Officer	Date
Shannon and Wilson Site Safety Officer	Date
Geo-Tech Explorations Site Safety Officer	Date
Emerald Services Site Safety Officer	Date
Northern Marine Salvage Site Safety Officer	Date
Apollo Geophysics Site Safety Officer	Date
Historical Research Associates Inc. Site Safety Officer	Date

By their signature, the following undersigned certify that this Health and Safety Plan has been read, or otherwise communicated to them. They further certify that they completely understand this plan and will follow its procedures for the protection of the health and safety of all persons entering upon this site.

NAME	DATE

APPENDIX E: FIELD FORMS AND SAMPLING GUIDES

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

BORING INSTRUCTION SHEET

SR99: Alaskan Way Viaduct Project

Site Location		
Purpose of Exploration		
Boring Name:		
Job Number:		
Utility Check	☐ Locate Complete: #_____ ☐ Check Side Sewers and Marks at Site ☐ Vactoring Performed - Drill at Vactor Mark	☐ Locate Complete: #_____ ☐ Check Side Sewers and marks at Site ☐ Vactoring Performed - Drill at Vactor Mark
Street-Use Permit	☐ Not Required ☐ Permit Obtained: #_____	☐ Not Required ☐ Permit Obtained: #_____
Traffic Control	☐ Not required ☐ Signs and Cones only ☐ Flaggers/Lane Closure ☐ Meter Hoods/No Parking Signs	☐ Not required ☐ Signs and Cones only ☐ Flaggers/Lane Closure ☐ Meter Hoods/No Parking Signs
Site Owner Contact	☐ Not required ☐ Contact Name/Phone on Next Line	☐ Not required ☐ Contact Name/Phone on Next Line
Drilling Method		
Proposed Depth		
Final Depth Criteria	☐ Stop at Proposed Depth ☐ Contact PM for final depth ☐ Other, Listed on Next Line	☐ Stop at Proposed Depth ☐ Contact PM for final depth ☐ Other, Listed on Next Line
Sample Interval Range:		
Every 2.5'		
Every 5'		
Other		
Well/VWP Installation	☐ None Required ☐ VWP (call for design depth) ☐ Observation Well (call for design depth)	☐ None Required ☐ VWP (call for design depth) ☐ Observation Well (call for design depth)
Environmental Samples	☑ When contamination suspected ☐ Just Above GWT (Smear Zone) ☐ At GWT ☐ At Fill/Native Contact ☐ Drilling Mud in Fill Zone	☑ When contamination suspected ☐ Just Above GWT (Smear Zone) ☐ At GWT ☐ At Fill/Native Contact ☐ Drilling Mud in Fill Zone
Special Instructions		

S&W Contact Names and Numbers

Project Manager (PM):	Gerard Buechel	# 6845 or cell 714-1120
Asst. Project Manager:	Monique Nykamp	# 6837 or cell 200-1683
Task Manager (TM):	Bill Nashem	# 6862 or cell 595-1830
Environmental Mngr. (EM):	Dawn Wulf	# 6839
	Scott Gaulke	# 6893 or cell 794-6790
Groundwater Manager:	Richard Martin	# 6787 or cell 979-1530
	Paul VanHorne	# 6840 or cell 300-~~6870~~ 0780

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

FIELD LOG OF BORING

JOB NO. _____

LOGGED BY _____
DRILL CONTRACTOR _____
DRILLER _____ TYPE DRILL _____
SIZE & TYPE OF CASING _____

JOB _____
BORING NO. _____ ELEV. _____
LOCATION _____
DATE _____ WEATHER _____

SAMPLE DATA

TIME / DATE	SAMPLE NO. / TYPE	DEPTH FROM / TO	DRIVING RESISTANCE BLOWS/6 IN.	LENGTH / NO. SAVED	DRILL ACTION	CONTACTS/ GROUNDWATER	PID	CHEMICAL SAMPLE (Y) OR (N)

FIELD CLASSIFICATION

DEPTH FROM	DEPTH TO	USCS	FIELD LOG OF BORING

REMARKS

HAMMER WT. _____ DROP _____
HAMMER SYSTEM _____
ROD DIA. _____ NO. OF TURNS _____

WATER LEVEL	TIME	DATE

FOOTAGE DRILLED _____
NO. SAMPLES: ATTEMPTED _____ RECOVERED _____

TIME DISTRIBUTION THIS HOLE
ON HOLE _____ DONE DRILLING _____
DRILLING _____ OFF HOLE _____

BORING NO. _____ SHEET ____ OF ____

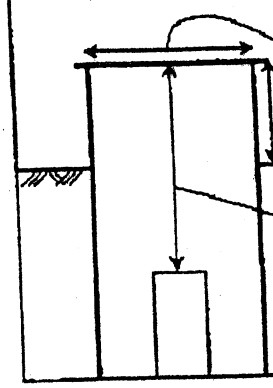
SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

WELL/VWP CONSTRUCTION LOG

JOB NO. _____

BORING NO: _____ APPROX. GROUND ELEV: _____ feet
INSPECTOR: _____ LOCATION: _____
INSTAL. DATE: _____ (Indicate if several installation dates)
ECOL TAG NO: _____
TOTAL DRILLED DEPTH: _____ feet
TOTAL SAMPL. DEPTH: _____ feet
DRILLING METHOD: _____ (HSA, Mud Rotary, etc.)
DRILLING FLUID USED: _____ (Bentonite, Polymer, etc.)
BOREHOLE DIAMETER: _____ inches
DRILL MUD REMOVAL RMKS: _____

SURFACE MONUMENT DETAILS



Diameter _____ in.
Distance _____ ft.
Distance _____ ft.
Key No.: _____

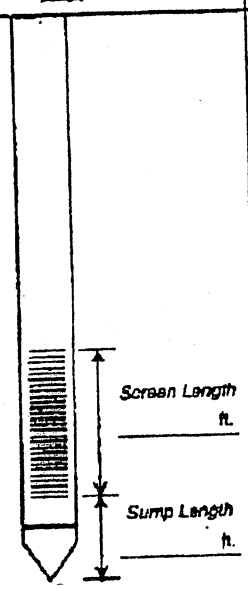
PIEZ/INSTRUMENT DETAILS

DEPTH FROM	DEPTH TO	WELL/ VWP NO.	SOLID	SLOTTED	DESCRIPTION (include OD/ID, slot width, pipe mat'l, sched., etc.)	VWP

SKETCH

Sand; Bent. Chips; Bent. Grout; Bent. Cement

Soil



Screen Length _____ ft.
Sump Length _____ ft.

NOT TO SCALE
Use Reverse Side if Desired

HOLE BACKFILL DETAILS

DEPTH FROM	DEPTH TO	FILTER	SEAL	DESCRIPTION (include seal or filter type, size, GINT code, etc.)	POUR	TREMIE

ADDITIONAL WELL DETAILS

Centralizers: ☐ Yes → Type: _____
☐ No → Depths: _____
Casing Joints: ☐ Threaded ☐ Glued
End Cap Type: _____
How Secured: _____
Depth to Water After Installation: _____ feet

INSTALLATION MATERIALS USED

SAND: _____ bags
CEMENT: _____ bags
BENTONITE POWDER: _____ bags
BENT. CHIPS/PELLETS: _____ bags
SLOTTED PVC: _____ feet
BLANK PVC: _____ feet

VWP INITIALIZATION DETAILS

Transducer Depth: VWP#1 _____ ft.
VWP#2 _____ ft.
Ser.# / Pressure Rating: VWP#1 _____ / _____ psi
VWP#2 _____ / _____ psi

VWP # and Reading Type	Zero Reading	Zero Temp	Date and Time of Reading	Readout Box S/N
#1 Unsaturat.				
#1 Saturated				
#2 Unsaturat.				
#2 Saturated				

ADDITIONAL COMMENTS: _____

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

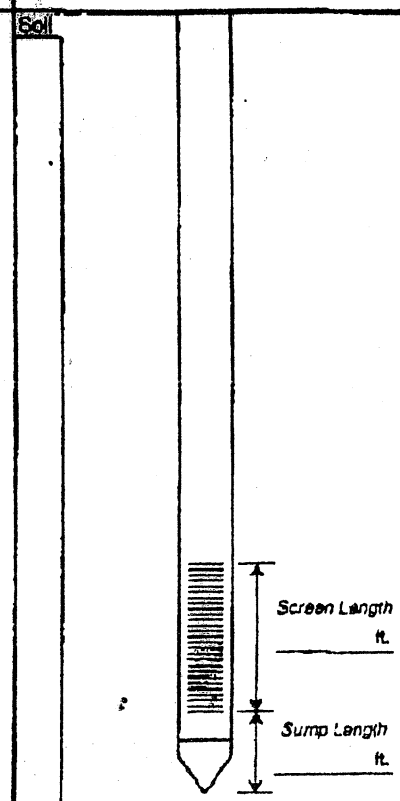
WELL/VWP CONSTRUCTION LOG

JOB NO. _____

BORING NO: _____

EXPANDED SKETCH (If required) - Fill out all other information on reverse side

DEPTH FROM	DEPTH TO	WELL/ VWP NO.	SOLID	SLOTTED	DESCRIPTION (include OD/ID, slot width, pipe mat'l, sched., etc.)	VWP



DEPTH FROM	DEPTH TO	FILTER	SEAL	DESCRIPTION (include seal or filter type, size, GINT code, etc.)	POUR	TREMIE

NOT TO SCALE

DAILY DRILLING SUMMARY

Project: _____ Job No: _____
Drill Rig: _____ Date: _____
Inspector: _____

	Boring No.	No.	No.
FOOTAGE	Rotary Drilling (5")		
	Auger Drilling (6")		
	Rock Coring (NX)		
SAMPLES	SPT (2"-140lb)		
	GSS (3"-300lb)		
	Shelby (3")		
	Shelby (2.5")		
	Osterberg (3")		
	Pitcher (3")		
HOURLY	Mob/Demob		
	Drilling		
	Cuttings Handling		
	Well Installation		
	Moving/Cleanup/Decon.		
	Start Card Prep.		
	Standby		
	Down Time		

PERMITS	City of Seattle		
	Parks Department		
	Parks Daily Fee		
	City of Tacoma		
S&W RENTALS	Cones		
	Flashing Barricades		
	Construction Ahead		
	No Parking Signs		
	Traffic Arrow		
	Hooding Meters		
	PID		
	CGI		
	Vehicle (Mileage only)		
	Water Level Indicator		
	VW Readout		
GENERAL	Inspector Labor (hrs)		
	Date Drilling Started		
	Date Drilling Completed		
	Date Well Started		
	Date Well Completed		

	Boring No.	No.	No.
MATERIALS	Polymer		
	Bentonite Powder		
	Tube, Shelby, 3" x 30"		
	Tube, Pitcher, 3" x 36"		
	Tube, Shelby, 2.5" x 30"		
	Monitoring Well Cover (8-inch)		
	Monitoring Well Cover (6-inch)		
	Start Card		
	Asphalt Patch		
	Portland Cement (94#)		
	Concrete		
	Bentonite Grout		
	Bentonite Chips (50#)		
	Silica Sand (100#)		
	Silica Sand (50#)		
	2-inch PVC Pipe (ft)		
	2-inch PVC Screen (ft)		
	PVC Bottom Cap		
	PVC Top Cap		
	Geokon VW Transducer		
	Geokon Wire (feet)		
	Drums		
SUBS	Tug and Barge		
	Concrete Coring (hrs)		

	Depth	General Description	Unit
GEOLOGY			

Comments _____

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

400 N. 34th Street, Suite 100
Seattle, WA 98103
(206) 632-8020
(206) 695-6777 Fax

11500 Olive Blvd., Suite 275
St. Louis, MO 63141
(314) 872-8170
(314) 872-8178 Fax

2055 Hill Road
Fairbanks, AK 99709
(907) 479-0600
(907) 479-5691 Fax

5430 Fairbanks Street, Suite 3
Anchorage, AK 99518
(907) 561-2120
(907) 561-4483 Fax

303 Wellsian Way
Richland, WA 99352
(509) 946-6309
(509) 945-6580 Fax

CHAIN-OF-CUSTODY RECORD

Page____ of____

Laboratory_____

Attn:_____

Analysis Parameters/Sample Container Description
(include preservative if used)

Sample Identity	Lab No.	Time	Date Sampled	Comp.	Grab							Total Number of Containers	Remarks/Matrix

Project Number:	Total Number of Containers	Signature: Time:	Signature: Time:	Signature: Time:
Project Name:	COC Seals/Intact? Y/N/NA	Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
Contact:	Received Good Cond./Cold	Company:	Company:	Company:
Ongoing Project? Yes ☐ No ☐	Delivery Method:			
Sampler:	(attach shipping bill, if any)			

Requested Turnaround Time:		Signature: Time:	Signature: Time:	Signature: Time:
Special Instructions:		Printed Name: Date:	Printed Name: Date:	Printed Name: Date:
		Company:	Company:	Company:

Distribution: White - w/shipment - returned to Shannon & Wilson w/ laboratory report
Yellow - w/shipment - for consignee files
Pink - Shannon & Wilson - Job File

F-19-91/UR

No._____

DAILY WORK REPORT

CLIENT:	PROJECT NO.:	DATE:	DAY:
JOB LOCATION:		C.D.I. JOB#:	

HOURS START	HOURS STOP	DESCRIPTION OF WORK (Please explain reasons for all Down Time and Stand-by Time. Please enter Client and State hole numbers.)	FOOTAGE DRILLED HOLE #	DRILLING	TRAVEL TO/FROM JOB SITE	OTHER CLEAN-UP GROUTING DECON	STAND BY DEVELOPING MOVE DRUMS	NON CHARGEABLE DOWN TIME	NON CHARGEABLE SHOP
		A.M. SHOP TIME							
		P.M. SHOP TIME							
		TOTAL CHARGEABLE RIG HOURS 4.5		1.0	2.5	1.0			

EQUIPMENT

DRILL RIG #	11	GROUT MIXER	
SUPPORT TRUCK #		GROUT PUMP	
SUPPORT TRUCK #		COMPRESSOR/JACK HAMMER	
DECON TRAILER		SERVICE RUNS	
TRAILER		CONTINUOUS SAMPLER	
BOBCAT		PERISTALTIC PUMP	
FORKLIFT		HYDROPUNCH	
# CORE CUTS			
#SAW CUTS			

LABOR

CREW WITH PERDIEM		CHARGEABLE EXTRA LABOR HRS.	

NAME	SIGNATURE	SHOP HRS.	DRILL HRS.	OTHER HRS.	TOTAL HRS.
Kelly					

CASING	DIA		
TYPE___SLOT___	2	4	6
20 FT. SCREEN			
10 FT. SCREEN			
5 FT. SCREEN			
20 FT. BLANK			
10 FT. BLANK			
5 FT. BLANK			
SLIP CAP			
THREADED CAP			
LOCKING CAPS			
DRIVE SHOE			

MATERIALS

ITEM	QTY.	ITEM	QTY.
SAND 8 X 12		WELL COVER 8"	
SAND 10 X 20		WELL COVER 12"	
SAND 2 / 12 X 20		MONUMENT CASING	
READY MIX		BOLLARDS	
QUICK SET		SOIL DRUMS	
PORTLAND		DEVELOPMENT DRUMS	
BENTONITE GROUT		DECON DRUMS	
BENTONITE CHIPS	1	HOLE COVER PLATES	
BENTONITE POWDER		TRAFFIC CONTROL	
BENTONITE PELLETS		PLASTIC SHEETING	
SAMPLER TUBES		L.B. LINERS	1
SHELBY TUBES		CORE BOXES	
PROBE POINTS		PLYWOOD	
GW PROBE POINTS		# SOIL SAMPLES	4
MACRO LINERS		# WATER SAMPLES	
SAMPLER SHOE		# HYDROPUNCH SAMPLES	

REMARKS

DIG ALERT #	DEPTH TO WATER

CLIENT SIGNATURE

OPERATOR SIGNATURE

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GRAPHIC SYMBOL	LETTER SYMBOL*	TYPICAL DESCRIPTIONS
COARSE-GRAINED SOIL (More than 50% of material is larger than #200 sieve size)	GRAVEL AND GRAVELLY SOIL (More than 50% of coarse fraction retained on #4 sieve)	CLEAN GRAVEL (Little or no fines)		GW	Well-graded gravel; gravel/sand mixture(s); little or no fines
				GP	Poorly-graded gravel; gravel/sand mixture(s); little or no fines
		GRAVEL WITH FINES (Appreciable amount of fines)		GM	Silty gravel; gravel/sand/silt mixture(s)
				GC	Clayey gravel; gravel/sand/silt mixture(s)
	SAND AND SANDY SOIL (More than 50% of coarse fraction passed through #4 sieve)	CLEAN SAND (Little or no fines)		SW	Well-graded sand; gravelly sand; little or no fines
				SP	Poorly-graded sand; gravelly sand; little or no fines
		SAND WITH FINES (Appreciable amount of fines)		SM	Silty sand; sand/silt mixture(s)
				SC	Clayey sand; sand/clay mixture(s)
FINE-GRAINED SOIL (More than 50% of material is smaller than #200 sieve size)	SILT AND CLAY (Liquid Limit less than 50)			ML	Inorganic silt and very fine sand; rock flour; silty- or clayey-fine sand or clayey silt with slight plasticity
				CL	Inorganic clay of low to medium plasticity; gravelly clay; sandy clay; silty clay; lean clay
				OL	Organic silt; organic, silty clay of low plasticity
	SILT AND CLAY (Liquid Limit greater than 50)			MH	Inorganic silt; micaceous or diatomaceous fine sand or silty soil
				CH	Inorganic clay of high plasticity; fat clay
				OH	Organic clay of medium to high plasticity; organic silt
HIGHLY ORGANIC SOIL				PT	Peat; humus; swamp soil with high organic content

Notes: 1. Dual letter symbols (i.e., SM-SP) for a sand or gravel indicate a soil with an estimated 5-15% fines. Multiple letter symbols (i.e., ML/CL) indicates borderline or multiple soil classifications. Only the first letter symbol's respective pattern is shown on logs.

2. Soil descriptions shown on logs use the terminology and general approach for the *Visual-Manual Procedure, Description and Identification of Soils*, as outlined in ASTM D 2488.

3. Soil descriptions (which are based on estimated values) are as follows: Primary Soil Type(s) - i.e., "GRAVEL", "SAND", "SILT", "CLAY", etc.
Secondary Soil Type(s) (>15%) - i.e., "gravelly", "sandy", "clayey", etc.
Modifier(s) (>5% and ≤15%) - i.e., "with gravel", "with sand", "with clay", etc.
Minor Component(s) (≤5%) - i.e., "trace gravel", "trace sand", "trace clay", etc.

Analysis	Matrix	Container	Preservative	Holding Time
TAL metals	Sediment	1 - 4 oz glass jar	Cool to 4°C	Mercury - 28 days Others - 6 months
Total Organic Carbon	Sediment	1 - 4 oz glass jar	Cool to 4°C	14 days
Total Sulfides	Sediment	1 - 4 oz glass jar	5mL .2 N Zinc acetate Cool to 4°C Store in dark	7 days
Volatile Organic Compounds	Sediment	2 - 2 oz VOA jars	Cool to 4°C	14 days
PAHs	Sediment	1 - 8 oz glass jar	Cool to 4°C	14 days (extract) 40 days (analysis)
PCBs	Sediment	1 - 8 oz glass jar	Cool to 4°C	14 days (extract) 40 days (analysis)
Interstitial Salinity	Sediment	1 - 16 oz glass jar	None	None specified
Grain size	Sediment	1 - 16 oz glass jar	None required	None specified

Analysis	Matrix	Container	Preservation	Holding Time[a]
WTPH-HCID	Water	1–1 L amber	Cool to 4°C	7 days
	Soil	1–8 oz glass jar	Cool to 4°C	14 days
WTPH-G	Water	2–40 mL VOA vials	HCl to pH < 2 Cool to 4°C	10 days
	Soil	1–2 oz glass jar	Cool to 4°C	10 days
WTPH-D	Water	1–1 L amber glass	Cool to 4°C	7 days
	Soil	1–8 oz glass jar	Cool to 4°C	14 days
TPH-418.1	Water	1–1 L amber glass	HCl to pH < 2 Cool to 4°C	7 days
	Soil	1–8 oz glass jar	Cool to 4°C	14 days
Total organic carbon	Water	1–125 mL poly bottle	H_2SO_4 to pH < 2 Cool to 4°C	28 days
	Soil	1–4 oz glass jar	Cool to 4°C	14 days
Percent moisture	Soil	1–4 oz glass jar	Cool to 4°C	None specified
Grain size	Soil	1–Shelby tube	Keep upright Avoid vibrations	None specified
		1–16 oz glass jar	None	None specified
Permeability	Soil	1–Shelby tube	Keep upright Avoid vibrations	None specified
Atterberg limits	Soil	1–Shelby tube	Keep upright Avoid vibrations	None specified

Analysis	Matrix	Container	Preservation	Holding Time[a]
Metals	Water	1–1 L poly bottle	HNO_3 to pH < 2	6 months (mercury–28 days)
	Soil	1–4 oz glass jar	None	6 months (mercury–28 days)
Cations (dissolved)	Water	1–1 L poly bottle	Field filter HNO_3 to pH < 2	6 months (mercury–28 days)
Hexavalent chromium (Cr^{+6})	Water	1–500 mL poly bottle	Cool to 4°C	24 hours
	Soil	1–4 oz glass jar	Cool to 4°C	3 days
Cyanide	Water	1–1 L poly bottle	NaOH to pH > 12 0.6 g ascorbic acid	14 days
	Soil	1–4 oz glass jar	None required	14 days
Vinyl chloride	Water	3–40 mL VOA vials	HCl to pH<2 Cool to 4°C	14 days
Volatiles (VOCs)	Water	3–40 mL VOA vials	HCl to pH < 2 Cool to 4°C	14 days
	Soil	2–2 oz VOA jars	Cool to 4°C	14 days
Semivolatiles (BNAs)	Water	2–1 L amber	Cool to 4°C	7 days (extraction) 40 days (analysis)
	Soil	1–8 oz glass jar	Cool to 4°C	14 days (extraction 40 days (analysis)
Polycyclic aromatic hydrocarbons (PAHs)	Water	2–1 L amber	Cool to 4°C	7 days (extraction) 40 days (analysis)
PCBs	Water	2–1 L amber	Cool to 4°C	7 days (extraction 40 days (analysis)
	Soil	1–8 oz glass jar	Cool to 4°C	14 days (extraction 40 days (analysis)

Analysis	Matrix	Container	Preservation	Holding Time[a]
Anions (Cl^-, F^-, Br^-, SO_4^{-2})	Water	1–1 L poly bottle	Cool to 4°C	28 days
Alkalinity/Nitrate/Nitrite (HCO_3^-, NO_3^-, NO_2^-,)	Water	1–1 L poly bottle	Cool to 4°C No headspace	Alkalinity–14 days NO_3^-/NO_2^-–48 hours
Total phosphate (PO_4^{-3})	Water	1–500 mL poly bottle	H_2SO_4 to pH < 2 cool to 4°C	28 days
Ammonia (NH_3)	Water	1–1 L poly bottle	H_2SO_4 to pH < 2	28 days
Solids (TDS & TSS)	Water	1–1 L poly bottle	None	7 days
pH	Water	Field analysis	None	Analyze immediately
Temperature	Water	Field analysis	None	Analyze immediately
Specific conductance	Water	Field analysis	None	Analyze immediately
Redox potential	Water	Field analysis	Avoid contact with air	Analyze immediately
Dissolved oxygen	Water	Field analysis	Avoid contact with air	Analyze immediately

SHANNON & WILSON, INC.
ENVIRONMENTAL AND GEOTECHNICAL CONSULTANTS

400 NORTH 34TH STREET, SUITE 100
P.O. BOX 300303
SEATTLE, WASHINGTON 98103
206-632-8020 FAX 206-633-6777

Laboratory Check-In – Soil Samples

Date: _____

Job Description: _____

Field Tech: _____ **Ext.:** _____

Proj. Mgr. _____ **Ext.:** _____

Client: _____ **Phone:** _____

Address: _____

_____

Date	Quiet	Noisy	Shelf or Location	No. of Boxes	Accum.	No. of Bags	Accum.	No. of Tubes	Accum.

Comments:

Store after testing ☐ **Discard after testing** ☐

For Laboratory use only
Date sent to warehouse: _____

			Initials	Date
☐ Send letter to client.	☐ Discard.	☐ Sample Discarded.	_____	_____

Job Name: _____

Job No.: _____

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

LABORATORY TESTING PROGRAM

Job No. _____ Job Name: _____ Prepared By: _____

Date: _____ Due Date: _____ Acknowledged By: _____

Boring	Sample	Depth/Unit	Visual Class.	Water Content	In-place γ	Max. & Min. γ	Mech. Anal.	Comb. Mech.	% passing 200	Atterberg	Spec. Gravity	Sticky Limit	Permeability	Compaction	Slake	Organic Content		1-D Consolid.	Q_u, w/ σ δ	Triaxial, CU	Triaxial, UU	Triaxial CD	Direct Shear	Point Load	UCS, Rock	
Total Tests For Boring:																										

Note:

Consolidation[1]

Compaction[2]

Triaxial[3]

Remarks

[1]Specify loading & saturation procedures [2]Specifiy standards [3]Specify pressure

LABELING INSTRUCTIONS
FOR IDW DRUMS

DRUMS FOR INVESTIGATION DERIVED WASTE (IDW)

- Label drums that are to be returned to the Client with the attached label.
- Track the number of drums generated and returned to the Client to ensure all drums are returned upon testing completion.
- Fill out the label as shown.
- Keep the drums covered when not in use. Place the drums in a designated storage area in a manner such that the labels are clearly visible.

Project Owner/Client Information

Shannon & Wilson Project Number

Contact Name/Number

Date of Generation

Contents/Type of Material in Drum/Drum No.
(i.e. cuttings, drilling mud, decon water, etc.)

APPENDIX F: ACCESS LICENSE FOR SAMPLING ACTIVITIES AT BOEING

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RECEIVED
MAR - 3 2003
PARSONS BRINCKERHOFF

Einar-Handeland, PB
Dennis M. Mahon
Jim Susser
Erin Nelson
FILECOPY

ACCESS LICENSE FOR SAMPLING ACTIVITIES

1. This license, dated February 10, 2003, is granted by THE BOEING COMPANY, a Delaware corporation (hereafter, "Boeing") to King County, a Washington State governmental entity (hereafter, "King County").

2. Boeing is the owner of certain real property located on the Duwamish Waterway. King County desires to undertake sampling activities on a certain portion of these properties. The approximate locations of the proposed sampling activities are described on the attached Exhibit A.

3. King County acknowledges this license is intended solely to provide King County with a temporary right of entry onto Boeing-owned property to undertake limited sampling activities.

4. Boeing grants to King County, its contractors, subcontractors, and suppliers (collectively "King County") reasonable access to the portion of Boeing's properties depicted on Exhibit A (hereafter "Premises") for the sole purpose of undertaking sampling for a geotechnical and hazardous materials investigation in connection with King County's contemplated rehabilitation or replacement of the South Park Bridge. Any such sampling activities on Boeing property shall be specifically approved in advance by Boeing.

5. King County shall comply with all Boeing Security requirements, including, but not limited to, obtaining Boeing badges prior to entering the Premises.

6. King County shall provide Boeing, if desired, with split samples of any and all samples King County may take on Boeing property pursuant to this license.

7. King County agrees to fully share with Boeing the results of the sampling and testing King County conducts in accordance with this license. King County also agrees to provide to Boeing, as soon as practicable, a copy of all analytical data.

8. As soon as practicable, King County further agrees to provide Boeing with its sampling and analysis plan, work plan, Quality Assurance plan, personnel roster and Health and Safety plan.

9. Boeing's representative(s) may accompany King County's representative(s) during King County's sampling activities. Boeing will timely provide to King County the names of the Boeing representative(s). King County shall provide to Boeing at least one week's notice prior to the commencement of the work contemplated by this license.

Boeing will move containerized waste onsite to a location specified by Boeing. Boeing will designate, transport and dispose of waste material. King County agrees to reimburse Boeing for the reasonable cost of the transport and disposal of this waste.

14. King County shall keep the Premises free and clear of any liens and encumbrances arising out of its activities relating to this license.

15. This license will terminate on December 31, 2003. Boeing may terminate this license upon 48 hours' written notice in the event King County breaches any of the terms of this license.

DATED this 10th day of February 2003.

LICENSEE:
KING COUNTY

By: [signature]

Its: Road Services Division Director

LICENSOR:
THE BOEING COMPANY

By: Paul R. Carlson

Its: Counsel

Appendix C: Analytical Results (CD)

Appendix D: MTCA Cleanup Regulation (WAC 173-340-900)

WAC 173-340-900 Tables.

Table 720-1
Method A Cleanup Levels for Ground Water.[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	5 ug/liter[b]
Benzene	71-43-2	5 ug/liter[c]
Benzo(a)pyrene	50-32-8	0.1 ug/liter[d]
Cadmium	7440-43-9	5 ug/liter[e]
Chromium (Total)	7440-47-3	50 ug/liter[f]
DDT	50-29-3	0.3 ug/liter[g]
1,2 Dichloroethane (EDC)	107-06-2	5 ug/liter[h]
Ethylbenzene	100-41-4	700 ug/liter[i]
Ethylene dibromide (EDB)	106-93-4	0.01 ug/liter[j]
Gross Alpha Particle Activity		15 pCi/liter[k]
Gross Beta Particle Activity		4 mrem/yr[l]
Lead	7439-92-1	15 ug/liter[m]
Lindane	58-89-9	0.2 ug/liter[n]
Methylene chloride	75-09-2	5 ug/liter[o]
Mercury	7439-97-6	2 ug/liter[p]
MTBE	1634-04-4	20 ug/liter[q]
Naphthalenes	91-20-3	160 ug/liter[r]
PAHs (carcinogenic)		See benzo(a)pyrene[d]
PCB mixtures		0.1 ug/liter[s]
Radium 226 and 228		5 pCi/liter[t]
Radium 226		3 pCi/liter[u]
Tetrachloroethylene	127-18-4	5 ug/liter[v]
Toluene	108-88-3	1,000 ug/liter[w]
Total Petroleum Hydrocarbons[x]		
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		
Gasoline Range Organics		
Benzene present in ground water		800 ug/liter
No detectable benzene in ground water		1,000 ug/liter
Diesel Range Organics		500 ug/liter
Heavy Oils		500 ug/liter
Mineral Oil		500 ug/liter
1,1,1 Trichloroethane	71-55-6	200 ug/liter[y]
Trichloroethylene	79-01-6	5 ug/liter[z]
Vinyl chloride	75-01-4	0.2 ug/liter[aa]
Xylenes	1330-20-7	1,000 ug/liter[bb]

Footnotes:

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels for drinking water beneficial uses at sites undergoing routine cleanup actions or those sites with relatively few hazardous substances. This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in this table do not necessarily mean the ground water must be restored to those levels at all sites. The level of restoration depends on the remedy selected under WAC 173-340-350 through 173-340-390.

b **Arsenic.** Cleanup level based on background concentrations for state of Washington.

c **Benzene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

d **Benzo(a)pyrene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61), adjusted to a 1×10^{-5} risk. If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carcinogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8).

e **Cadmium.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62).

f **Chromium (Total).** Cleanup level based on concentration derived using Equation 720-1 for hexavalent chromium. This is a total value for chromium III and chromium VI. If just chromium III is present at the site, a cleanup level of 100 ug/l may be used (based on WAC 246-290-310 and 40 C.F.R. 141.62).

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup levels based on concentration derived using Equation 720-2.

h **1,2 Dichloroethane (ethylene dichloride or EDC).** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

i **Ethylbenzene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

j **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on concentration derived using Equation 720-2, adjusted for the practical quantitation limit.

k **Gross Alpha Particle Activity, excluding uranium.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

l **Gross Beta Particle Activity, including gamma activity.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

m **Lead.** Cleanup level based on applicable state and federal law (40 C.F.R. 141.80).

n **Lindane.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

o **Methylene chloride (dichloromethane).** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

p **Mercury.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.62).

q **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on federal drinking water advisory level (EPA-822-F-97-009, December 1997).

r **Naphthalenes.** Cleanup level based on concentration derived using Equation 720-1. This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

s **PCB mixtures.** Cleanup level based on concentration derived using Equation 720-2, adjusted for the practical quantitation limit. This cleanup level is a total value for all PCBs.

t **Radium 226 and 228.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.15).

u **Radium 226.** Cleanup level based on applicable state law (WAC 246-290-310).

v **Tetrachloroethylene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

w **Toluene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

x **Total Petroleum Hydrocarbons (TPH).** TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites. Where there is a mixture of products or the product composition is unknown, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and the lowest applicable TPH cleanup level must be met.

- **Gasoline range organics** means organic compounds measured using method NWTPH-Gx. Examples are aviation and automotive gasoline. The cleanup level is based on protection of ground water for noncarcinogenic effects during drinking water use. Two cleanup levels are provided. The higher value is based on the assumption that no benzene is present in the ground water sample. If any detectable amount of benzene is present in the ground water sample, then the lower TPH cleanup level must be used. No interpolation between these cleanup levels is allowed. The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, EDB and EDC] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and MTBE], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for gasoline releases.
- **Diesel range organics** means organic compounds measured using NWTPH-Dx. Examples are diesel, kerosene, and #1 and #2 heating oil. The cleanup level is based on protection from noncarcinogenic effects during drinking water use. The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene and PAHs] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and naphthalenes], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for diesel releases.
- **Heavy oils** means organic compounds measured using NWTPH-Dx. Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil. The cleanup level is based on protection from noncarcinogenic effects during drinking water use, assuming a product composition similar to diesel fuel. The ground water cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs] and any noncarcinogenic components [such as ethylbenzene, toluene, xylenes and naphthalenes], if present at the site, must also be met. See Table 830-1 for the minimum testing requirements for heavy oil releases.
- **Mineral oil** means non-PCB mineral oil, typically used as an insulator and coolant in electrical devices such as transformers and capacitors measured using NWTPH-Dx. The cleanup level is based on protection from noncarcinogenic effects during drinking water use. Sites using this cleanup level must analyze ground water samples for PCBs and meet the PCB cleanup level in this table unless it can be demonstrated that: (1) The release originated from an electrical device manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B (or Method C, if applicable) must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.

y **1,1,1 Trichloroethane.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

z **Trichloroethylene.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61).

aa **Vinyl chloride.** Cleanup level based on applicable state and federal law (WAC 246-290-310 and 40 C.F.R. 141.61), adjusted to a 1×10^{-5} risk.

bb **Xylenes.** Cleanup level based on xylene not exceeding the maximum allowed cleanup level in this table for total petroleum hydrocarbons and on prevention of adverse aesthetic characteristics. This is a total value for all xylenes.

Table 740-1
Method A Soil Cleanup Levels for Unrestricted Land Uses.[a]

Hazardous Substance	CAS Number	Cleanup Level
Arsenic	7440-38-2	20 mg/kg[b]
Benzene	71-43-2	0.03 mg/kg[c]
Benzo(a)pyrene	50-32-8	0.1 mg/kg[d]
Cadmium	7440-43-9	2 mg/kg[e]
Chromium		
Chromium VI	18540-29-9	19 mg/kg[f1]
Chromium III	16065-83-1	2,000 mg/kg[f2]
DDT	50-29-3	3 mg/kg[g]
Ethylbenzene	100-41-4	6 mg/kg[h]
Ethylene dibromide (EDB)	106-93-4	0.005 mg/kg[i]
Lead	7439-92-1	250 mg/kg[j]
Lindane	58-89-9	0.01 mg/kg[k]
Methylene chloride	75-09-2	0.02 mg/kg[l]
Mercury (inorganic)	7439-97-6	2 mg/kg[m]
MTBE	1634-04-4	0.1 mg/kg[n]
Naphthalenes	91-20-3	5 mg/kg[o]
PAHs (carcinogenic)		See benzo(a)pyrene[d]
PCB Mixtures		1 mg/kg[p]
Tetrachloroethylene	127-18-4	0.05 mg/kg[q]
Toluene	108-88-3	7 mg/kg[r]
Total Petroleum Hydrocarbons[s]		
[Note: Must also test for and meet cleanup levels for other petroleum components--see footnotes!]		
Gasoline Range Organics		
Gasoline mixtures without benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture		100 mg/kg
All other gasoline mixtures		30 mg/kg
Diesel Range Organics		2,000 mg/kg
Heavy Oils		2,000 mg/kg
Mineral Oil		4,000 mg/kg
1,1,1 Trichloroethane	71-55-6	2 mg/kg[t]
Trichloroethylene	79-01-6	0.03 mg/kg[u]
Xylenes	1330-20-7	9 mg/kg[v]

Footnotes:

a **Caution on misusing this table.** This table has been developed for specific purposes. It is intended to provide conservative cleanup levels for sites undergoing routine cleanup actions or for sites with relatively few hazardous substances, and the site qualifies under WAC 173-340-7491 for an exclusion from conducting a simplified or site-specific terrestrial ecological evaluation, or it can be demonstrated using a terrestrial ecological evaluation under WAC 173-340-7492 or 173-340-7493 that the values in this table are ecologically protective for the site. This table may not be appropriate for defining cleanup levels at other sites. For these reasons, the values in this table should not automatically be used to define cleanup levels that must be met for financial, real estate, insurance coverage or placement, or similar transactions or purposes. Exceedances of the values in this table do not necessarily mean the soil must be restored to these levels at a site. The level of restoration depends on the remedy selected under WAC 173-340-350 through 173-340-390.

b **Arsenic.** Cleanup level based on direct contact using Equation 740-2 and protection of ground water for drinking water use using the procedures in WAC 173-340-747(4), adjusted for natural background for soil.

c **Benzene.** Cleanup level based on protection of ground water for drinking water use, using the procedures in WAC 173-340-747(4) and (6).

d **Benzo(a)pyrene.** Cleanup level based on direct contact using Equation 740-2. If other carcinogenic PAHs are suspected of being present at the site, test for them and use this value as the total concentration that all carginogenic PAHs must meet using the toxicity equivalency methodology in WAC 173-340-708(8).

e **Cadmium.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit for soil.

f1 **Chromium VI.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

f2 **Chromium III.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). Chromium VI must also be tested for and the cleanup level met when present at a site.

g **DDT (dichlorodiphenyltrichloroethane).** Cleanup level based on direct contact using Equation 740-2.

h **Ethylbenzene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

i **Ethylene dibromide (1,2 dibromoethane or EDB).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4) and adjusted for the practical quantitation limit for soil.

j **Lead.** Cleanup level based on preventing unacceptable blood lead levels.

k **Lindane.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4), adjusted for the practical quantitation limit.

l **Methylene chloride (dichloromethane).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

m **Mercury.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

n **Methyl tertiary-butyl ether (MTBE).** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

o **Naphthalenes.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for naphthalene, 1-methyl naphthalene and 2-methyl naphthalene.

p **PCB Mixtures.** Cleanup level based on applicable federal law (40 C.F.R. 761.61). This is a total value for all PCBs.

q **Tetrachloroethylene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

r **Toluene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

s **Total Petroleum Hydrocarbons (TPH).**
TPH cleanup values have been provided for the most common petroleum products encountered at contaminated sites. Where there is a mixture of products or the product composition is unknown, samples must be tested using both the NWTPH-Gx and NWTPH-Dx methods and the lowest applicable TPH cleanup level must be met.

- **Gasoline range organics** means organic compounds measured using method NWTPH-Gx. Examples are aviation and automotive gasoline. The cleanup level is based on protection of ground water for noncarcinogenic effects during drinking water use using the procedures described in WAC 173-340-747(6). Two cleanup levels are provided. The lower value of 30 mg/kg can be used at any site. When using this lower value, the soil must also be tested for and meet the benzene soil cleanup level. The higher value of 100 mg/kg can only be used if the soil is tested and found to contain no benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture. No interpolation between these cleanup levels is allowed. In both cases, the soil cleanup level for any other carcinogenic components of the petroleum [such as EDB and EDC], if present at the site, must also be met. Also, in both cases, soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes, naphthalene, and MTBE], also must be met if these substances are found to exceed ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for gasoline releases.
- **Diesel range organics** means organic compounds measured using method NWTPH-Dx. Examples are diesel, kerosene, and #1 and #2 heating oil. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10). The soil cleanup level for any carcinogenic components of the petroleum [such as benzene and PAHs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if these substances are found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for diesel releases.
- **Heavy oils means** organic compounds measured using NWTPH-Dx. Examples are #6 fuel oil, bunker C oil, hydraulic oil and waste oil. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10) and assuming a product composition similar to diesel fuel. The soil cleanup level for any carcinogenic components of the petroleum [such as benzene, PAHs and PCBs], if present at the site, must also be met. Soil cleanup levels for any noncarcinogenic components [such as toluene, ethylbenzene, xylenes and naphthalenes], also must be met if found to exceed the ground water cleanup levels at the site. See Table 830-1 for the minimum testing requirements for heavy oil releases.
- **Mineral oil** means non-PCB mineral oil, typically used as an insulator and coolant in electrical devices such as transformers and capacitors, measured using NWTPH-Dx. The cleanup level is based on preventing the accumulation of free product on the ground water, as described in WAC 173-340-747(10). Sites using this cleanup level must also analyze soil samples and meet the soil cleanup level for PCBs, unless it can be demonstrated that: (1) The release originated from an electrical device that was manufactured after July 1, 1979; or (2) oil containing PCBs was never used in the equipment suspected as the source of the release; or (3) it can be documented that the oil released was recently tested and did not contain PCBs. Method B must be used for releases of oils containing greater than 50 ppm PCBs. See Table 830-1 for the minimum testing requirements for mineral oil releases.

t **1,1,1 Trichloroethane.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

u **Trichloroethylene.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4).

v **Xylenes.** Cleanup level based on protection of ground water for drinking water use, using the procedures described in WAC 173-340-747(4). This is a total value for all xylenes.

Appendix E: Sediment Management Standards (WAC 173-204)

Chapter 173-204 WAC
SEDIMENT MANAGEMENT STANDARDS

WAC

PART I—GENERAL INFORMATION

173-204-100 Authority and purpose.
173-204-110 Applicability.
173-204-120 Antidegradation and designated use policies.
173-204-130 Administrative policies.

PART II—DEFINITIONS

173-204-200 Definitions.

PART III—SEDIMENT QUALITY STANDARDS

173-204-300 Purpose.
173-204-310 Sediment quality standards designation procedures.
173-204-315 Confirmatory marine sediment biological tests.
173-204-320 Marine sediment quality standards.
173-204-330 Low salinity sediment quality standards.
173-204-340 Freshwater sediment quality standards.
173-204-350 Sediment quality standards inventory.

PART IV—SEDIMENT SOURCE CONTROL

173-204-400 General considerations.
173-204-410 Sediment quality goal and sediment impact zone applicability.
173-204-412 Marine finfish rearing facilities.
173-204-415 Sediment impact zones.
173-204-420 Sediment impact zone maximum criteria.

PART V—SEDIMENT CLEANUP STANDARDS

173-204-500 Sediment cleanup decision process and policies.
173-204-510 Screening sediment station clusters of potential concern.
173-204-520 Cleanup screening levels criteria.
173-204-530 Hazard assessment and site identification.
173-204-540 Ranking and list of sites.
173-204-550 Types of cleanup and authority.
173-204-560 Cleanup study.
173-204-570 Sediment cleanup standards.
173-204-580 Cleanup action decision.
173-204-590 Sediment recovery zones.

PART VI—SAMPLING AND TESTING PLANS/RECORDKEEPING

173-204-600 Sampling and testing plan standards.
173-204-610 Records management.
173-204-620 Severability.

PART I—GENERAL INFORMATION

WAC 173-204-100 Authority and purpose. (1) This chapter is promulgated under the authority of chapter 90.48 RCW, the Water Pollution Control Act; chapter 70.105D RCW, the Model Toxics Control Act; chapter 90.70 RCW, the Puget Sound Water Quality Authority Act; chapter 90.52 RCW, the Pollution Disclosure Act of 1971; chapter 90.54 RCW, the Water Resources Act of 1971; and chapter 43.21C RCW, the state Environmental Policy Act, to establish marine, low salinity and freshwater surface sediment management standards for the state of Washington.

(2) The purpose of this chapter is to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from surface sediment contamination by:

(a) Establishing standards for the quality of surface sediments;

(b) Applying these standards as the basis for management and reduction of pollutant discharges; and

(c) Providing a management and decision process for the cleanup of contaminated sediments.

(3) Part III, Sediment quality standards of this chapter provides chemical concentration criteria, biological effects criteria, human health criteria, and other toxic, radioactive, biological, or deleterious substances criteria which identify surface sediments that have no adverse effects, including no acute or chronic adverse effects on biological resources and no significant health risk to humans, as defined in this regulation. The sediment quality standards provide a regulatory and management goal for the quality of sediments throughout the state.

(4) The sediment criteria of WAC 173-204-320 through 173-204-340 shall constitute surface sediment quality standards and be used to establish an inventory of surface sediment sampling stations where the sediments samples taken from these stations are determined to pass or fail the applicable sediment quality standards.

(5) Part IV, Sediment source control standards of this chapter shall be used as a basis for controlling the effects of point and nonpoint source discharges to sediments through the National Pollutant Discharge Elimination System (NPDES) federal permit program, state water quality management permit programs, issuance of administrative orders or other means determined appropriate by the department. The source control standards establish discharge sediment monitoring requirements and criteria for establishment and maintenance of sediment impact zones.

(6) Part V, Sediment cleanup standards of this chapter establishes administrative procedural requirements and criteria to identify, screen, rank and prioritize, and cleanup contaminated surface sediment sites. The sediment cleanup standards of WAC 173-204-500 through 173-204-590 shall be used pursuant to authorities established under chapters 90.48 and 70.105D RCW.

(7) This chapter establishes and defines a goal of minor adverse effects as the maximum level of sediment contamination allowed in sediment impact zones under the provisions of Part IV, Sediment source control standards and as the cleanup screening levels for identification of sediment cleanup sites and as the minimum cleanup levels to be achieved in all cleanup actions under Part V, Sediment cleanup standards.

(8) Local ordinances establishing requirements for the designation and management of marine, low salinity and freshwater sediments shall not be less stringent than this chapter.

Note: All codes, standards, statutes, rules or regulations cited in this chapter are available for inspection at the Department of Ecology, P.O. Box 47703, Olympia, Washington 98504-7703.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-100, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-100, filed 3/27/91, effective 4/27/91.]

WAC 173-204-110 Applicability. (1) The sediment quality standards of WAC 173-204-300 through 173-204-315, and 173-204-350, and the sediment cleanup standards of WAC 173-204-500 through 173-204-580 shall apply to all surface sediments.

(2) The sediment quality standards of WAC 173-204-320, 173-204-330, and 173-204-340 shall apply to marine, low salinity and freshwater surface sediments, respectively.

(3) The source control standards of WAC 173-204-400 through 173-204-420 shall apply to each person's actions which exposes or resuspends surface sediments which exceed, or otherwise cause or potentially cause surface sediments to exceed, the applicable standards of WAC 173-204-320 through 173-204-340.

(4) The sediment recovery zone standards of WAC 173-204-590 shall apply to each person's cleanup action decision made pursuant to WAC 173-204-580 where the selected cleanup action leaves in place marine, low salinity, or freshwater sediments that exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(5) The sediment quality standards of WAC 173-204-320 through 173-204-340 shall not apply:

(a) Within a sediment impact zone as authorized by the department under WAC 173-204-415; or

(b) Within a sediment recovery zone as authorized by the department under WAC 173-204-590; or

(c) To particulates suspended in the water column; or

(d) To particulates suspended in a permitted effluent discharge.

(6) Nothing in this chapter shall constrain the department's authority to make appropriate sediment management decisions on a case-specific basis using best professional judgment and latest scientific knowledge for cases where the standards of this chapter are reserved or standards are not available.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-110, filed 3/27/91, effective 4/27/91.]

WAC 173-204-120 Antidegradation and designated use policies. (1) Antidegradation policy. The antidegradation policy of the state of Washington as generally guided by chapters 90.48 and 90.54 RCW, is applicable to any person's new or increased activity and shall apply to this chapter as follows:

(a) Existing beneficial uses shall be maintained and protected and no further degradation which would interfere with or become injurious to existing beneficial uses shall be allowed.

(b) No degradation of existing sediment quality shall be allowed of waters constituting an outstanding national resource, such as waters of national and state parks and scenic and recreation areas, wildlife refuges, and waters of exceptional recreational or ecological significance.

(c) Whenever surface sediments are of a higher quality (i.e., lower chemical concentrations or adverse biological response) than the criteria assigned to said sediments, the existing surface sediment quality shall be protected and waste and other materials and substances shall not be allowed to contaminate such sediments or reduce the existing sediment quality thereof, except in those instances where:

(i) It is clear, after satisfactory public participation and intergovernmental coordination, that overriding considerations of the public interest will be served;

(ii) All wastes and other materials and substances proposed for discharge that may contaminate such sediments are provided with all known, available and reasonable methods of prevention, control, and treatment and/or best management practices;

(iii) The reduction of existing surface sediment quality is authorized by the department; and

(iv) Existing beneficial uses are maintained and protected, and no degradation which would interfere with and/or become injurious to existing sediment beneficial uses and/or causes long-term, irreparable harm to the environment is allowed.

(2) Designated use policy. The policy of the department and the purpose of this chapter shall be to manage waste discharges and sediment quality so as to protect existing beneficial uses and move towards attainment of designated beneficial uses as specified in section 101 (a)(2) of the federal Clean Water Act (33 USC 1251, et seq.) and chapter 173-201 WAC, the Water quality standards for surface waters of the state of Washington. This policy is applicable to any person's existing or proposed actions which may affect surface sediment quality.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-120, filed 3/27/91, effective 4/27/91.]

WAC 173-204-130 Administrative policies. The department shall implement this chapter in accordance with the following policies:

(1) The department shall seek to implement, and as necessary modify this chapter to protect biological resources and human health consistent with WAC 173-204-100(2). To implement the intent of this subsection, the department shall use methods that accurately reflect the latest scientific knowledge consistent with the definitions contained in WAC 173-204-200 (14) and (15), as applicable.

(2) At the interface between surface sediments, ground water or surface water, the applicable standards shall depend on which beneficial use is or could be adversely affected, as determined by the department. If beneficial uses of more than one resource are affected, the most restrictive standards shall apply.

(3) It shall be the goal of the department to modify this chapter so that methods such as confirmatory biological tests, sediment impact zone models, use of contaminated sediment site ranking models, etc., continue to accurately reflect the latest scientific knowledge as established through ongoing validation and refinement.

(4) Any person or the department may propose an alternate technical method to replace or enhance the application of a specific technical method required under this chapter. Using best professional judgment, the department shall pro-

vide advance review and approval of any alternate technical method proposed prior to its application. Application and use of alternate technical methods shall be allowed when the department determines that the technical merit of the resulting decisions will improve the department's ability to implement and meet the intent of this chapter as described in WAC 173-204-100(2), and will remain consistent with the scientific intent of definitions contained in WAC 173-204-200 (14) and (15). The department shall maintain a record of the department's decisions concerning application for use of alternate technical methods pursuant to this subsection. The record shall be made available to the public on request.

(5) Intergovernmental coordination. The department shall ensure appropriate coordination and consultation with federally recognized Indian tribes and local, state, and federal agencies to provide information on and to implement this chapter.

(6) The department shall conduct an annual review of this chapter, and modify its provisions every three years, or as necessary. Revision to this chapter shall be made pursuant to the procedures established within chapter 34.05 RCW, the Administrative Procedure Act.

(7) Review of scientific information. When evaluating this chapter for necessary revisions, the factors the department shall consider include:

(a) New or additional scientific information which is available relating surface sediment chemical quality to acute or chronic adverse effects on biological resources as defined in WAC 173-204-200 (1) and (7);

(b) New or additional scientific information which is available relating human health risk to marine, low salinity, or freshwater surface sediment chemical contaminant levels;

(c) New or additional scientific information which is available relating levels of other toxic, radioactive, biological and deleterious substances in marine, low salinity, or freshwater sediments to acute or chronic adverse effects on biological resources, or to a significant health risk to humans;

(d) New state or federal laws which have established environmental or human health protection standards applicable to surface sediment; or

(e) Scientific information which has been identified for addition, modification or deletion by a scientific review process established by the department.

(8) Public involvement and education. The goal of the department shall be to provide timely information and meaningful opportunities for participation by the public in the annual review conducted by the department under subsection (6) of this section, and any modification of this chapter. To meet the intent of this subsection the department shall:

(a) Provide public notice of the department's decision regarding the results of its annual review of this chapter, including:

(i) The department's findings for the annual review factors identified in subsection (7) of this section;

(ii) The department's decision regarding the need for modification of this chapter based on its annual review; and

(iii) Identification of a time period for public opportunity to comment on the department's findings and decisions pursuant to this subsection.

(b) Provide public notice by mail or by additional procedures determined necessary by the department which may include:

(i) Newspaper publication;

(ii) Other news media;

(iii) Press releases;

(iv) Fact sheets;

(v) Publications;

(vi) Any other method as determined by the department.

(c) Conduct public meetings as determined necessary by the department to educate and inform the public regarding the department's annual review determinations and decisions.

(d) Comply with the rule making and public participation requirements of chapter 34.05 RCW, the Administrative Procedure Act, for any revisions to this chapter.

(9) Test sediments evaluated for compliance with the sediment quality standards of WAC 173-204-320 through 173-204-340 and/or the sediment impact zone maximum criteria of WAC 173-204-420 and/or the cleanup screening levels criteria of WAC 173-204-520 shall be sampled and analyzed using the Puget Sound Protocols or other methods approved by the department. Determinations made pursuant to this chapter shall be based on sediment chemical and/or biological data that were developed using an appropriate quality assurance/quality control program, as determined by the department.

(10) The statutory authority for decisions under this chapter shall be clearly stated in the decision documents prepared pursuant to this chapter. The department shall undertake enforcement actions consistent with the stated authority under which the action is taken. The process for judicial review of these decisions shall be pursuant to the statutes under which the action is being taken.

(11) When the department identifies this chapter as an applicable, or relevant and appropriate requirement for a federal cleanup action under the Comprehensive Environmental Response, Compensation and Liability Act, the department shall identify the entire contents of this chapter as the appropriate state requirement.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-130, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-130, filed 3/27/91, effective 4/27/91.]

PART II—DEFINITIONS

WAC 173-204-200 Definitions. For the purpose of this chapter, the following definitions shall apply:

(1) "Acute" means measurements of biological effects using surface sediment bioassays conducted for time periods that are relatively short in comparison to the life cycle of the test organism. Acute effects may include mortality, larval abnormality, or other endpoints determined appropriate by the department.

(2) "Amphipod" means crustacean of the Class Amphipoda, e.g., Rhepoxynius abronius, Ampelisca abdita, or Eohaustorius estuarius.

(3) "Appropriate biological tests" means only tests designed to measure directly, or through established predictive capability, biologically significant adverse effects to the

established or potential benthic or aquatic resources at a given location, as determined by rule by the department.

(4) "Beneficial uses" means uses of waters of the state which include but are not limited to use for domestic, stock watering, industrial, commercial, agricultural, irrigation, mining, fish and wildlife maintenance and enhancement, recreation, generation of electric power, and preservation of environmental and aesthetic values, and all other uses compatible with the enjoyment of the public waters of the state.

(5) "Best management practices" or "BMPs" means schedules of activities, prohibitions of practices, maintenance procedures, and other management practices to prevent or reduce the pollution of surface sediments of the state. BMPs also include treatment requirements, operating procedures and practices to control plant site runoff, spillage or leaks, sludge or water disposal, or drainage from raw material storage.

(6) "Bioassay" means a test procedure that measures the response of living plants, animals, or tissues to a sediment sample.

(7) "Chronic" means measurements of biological effects using sediment bioassays conducted for, or simulating, prolonged exposure periods of not less than one complete life cycle, evaluations of indigenous field organisms for long-term effects, assessment of biological effects resulting from bioaccumulation and biomagnification, and/or extrapolated values or methods for simulating effects from prolonged exposure periods. Chronic effects may include mortality, reduced growth, impaired reproduction, histopathological abnormalities, adverse effects to birds and mammals, or other endpoints determined appropriate by the department.

(8) "Contaminated sediment" means surface sediments designated under the procedures of WAC 173-204-310 as exceeding the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(9) "Control sediment sample" means a surface sediment sample which is relatively free of contamination and is physically and chemically characteristic of the area from which bioassay test animals are collected. Control sediment sample bioassays provide information concerning a test animal's tolerance for stress due to transportation, laboratory handling, and bioassay procedures. Control sediment samples cannot exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(10) "Department" means the department of ecology.

(11) "Freshwater sediments" means surface sediments in which the sediment pore water contains less than or equal to 0.5 parts per thousand salinity.

(12) "Low salinity sediments" means surface sediments in which the sediment pore water contains greater than 0.5 parts per thousand salinity and less than 25 parts per thousand salinity.

(13) "Marine finfish rearing facilities" shall mean those private and public facilities located within state waters where finfish are fed, nurtured, held, maintained, or reared to reach the size of release or for market sale.

(14) "Marine sediments" means surface sediments in which the sediment pore water contains 25 parts per thousand salinity or greater.

(15) "Minor adverse effects" means a level of effects that:

(a) Has been determined by rule by the department, except in cases subject to WAC 173-204-110(6); and

(b) Meets the following criteria:

(i) An acute or chronic adverse effect to biological resources as measured by a statistically and biologically significant response relative to reference in no more than one appropriate biological test as defined in WAC 173-204-200(3); or

(ii) A statistically and biologically significant response that is significantly elevated relative to reference in any appropriate biological test as defined in WAC 173-204-200(3); or

(iii) Biological effects per (b)(i) or (ii) of this subsection as predicted by exceedance of an appropriate chemical or other deleterious substance standard, except where the prediction is overridden by direct biological testing evidence pursuant to (b)(i) and (ii) of this subsection; and

(c) Does not result in significant human health risk as predicted by exceedance of an appropriate chemical, biological, or other deleterious substance standard.

(16) "No adverse effects" means a level of effects that:

(a) Has been determined by rule by the department, except in cases subject to WAC 173-204-110(6); and

(b) Meets the following biological criteria:

(i) No acute or chronic adverse effects to biological resources as measured by a statistically and biologically significant response relative to reference in any appropriate biological test as defined in WAC 173-204-200(3); and

(ii) No acute or chronic adverse biological effect per (b)(i) of this subsection as predicted by exceedance of an appropriate chemical or other deleterious substance standard, except where the prediction is overridden by direct biological testing evidence pursuant to (b)(i) of this subsection; and

(iii) Does not result in significant human health risk as predicted by exceedance of an appropriate chemical, biological, or other deleterious substance standard.

(17) "Other toxic, radioactive, biological, or deleterious substances" means contaminants which are not specifically identified in the sediment quality standards chemical criteria of WAC 173-204-320 through 173-204-340 (e.g., organic debris, tributyltin, DDT, etc.).

(18) "Person" means an individual, firm, corporation, association, partnership, consortium, joint venture, commercial entity, industry, private corporation, port district, special purpose district, irrigation district, unit of local government, state government agency, federal government agency, Indian tribe, or any other entity whatsoever.

(19) "Practicable" means able to be completed in consideration of environmental effects, technical feasibility and cost.

(20) "Puget Sound basin" or "Puget Sound" means:

(a) Puget Sound south of Admiralty Inlet, including Hood Canal and Saratoga Passage;

(b) The waters north to the Canadian border, including portions of the Strait of Georgia;

(c) The Strait of Juan de Fuca south of the Canadian border; and

(d) All the lands draining into these waters as mapped in water resources inventory areas numbers 1 through 19, set forth in water resources management program established pursuant to the Water Resources Act of 1971, chapter 173-500 WAC.

(21) "Puget Sound protocols" means *Puget Sound Estuary Program. 1986. As amended. Recommended Protocols for Measuring Selected Environmental Variables in Puget Sound, U.S. Environmental Protection Agency, Region 10, Seattle, WA (looseleaf).*

(22) "Reference sediment sample" means a surface sediment sample which serves as a laboratory indicator of a test animal's tolerance to important natural physical and chemical characteristics of the sediment, e.g., grain size, organic content. Reference sediment samples represent the nonanthropogenically affected background surface sediment quality of the sediment sample. Reference sediment samples cannot exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(23) "Sediment impact zone" means an area where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded due to ongoing permitted or otherwise authorized wastewater, storm water, or nonpoint source discharges and authorized by the department within a federal or state wastewater or storm water discharge permit, or other formal department authorization.

(24) "Sediment recovery zone" means an area where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 are exceeded as a result of historical discharge activities, and authorized by the department as a result of a cleanup decision made pursuant to WAC 173-204-580, Cleanup action decision.

(25) "Site units" means discrete subdivisions of an individual contaminated sediment site that are being evaluated for the purpose of establishing cleanup standards. Site units are based on consideration of unique locational, environmental, spatial, or other conditions determined appropriate by the department, e.g., cleanup under piers, cleanup in eelgrass beds, cleanup in navigational lanes.

(26) "Surface sediments" or "sediment(s)" means settled particulate matter located in the predominant biologically active aquatic zone, or exposed to the water column. Sediment(s) also includes settled particulate matter exposed by human activity (e.g., dredging) to the biologically active aquatic zone or to the water column.

(27) "Test sediment" means a sediment sample that is evaluated for compliance with the sediment quality standards of WAC 173-204-320 through 173-204-340 and/or the sediment impact zone maximum criteria of WAC 173-240-420 and/or the cleanup screening levels criteria of WAC 173-204-520.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-200, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-200, filed 3/27/91, effective 4/27/91.]

PART III—SEDIMENT QUALITY STANDARDS

WAC 173-204-300 Purpose. The sediment quality standards of WAC 173-204-320 through 173-204-340 include chemical concentration criteria, biological effects criteria, human health criteria, other toxic, radioactive, biological, or deleterious substances criteria, and nonanthropogenically affected sediment quality criteria which are used to identify sediments that have no adverse effects on biological resources, and correspond to no significant health risk to humans. Designation determinations using the sediment quality standards of WAC 173-204-320 through 173-204-340 shall be conducted as stipulated in WAC 173-204-310, Sediment quality standards designation procedures.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-300, filed 3/27/91, effective 4/27/91.]

WAC 173-204-310 Sediment quality standards designation procedures. Any person may use these procedures to determine a sediment's designation using the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. Any person who designates test sediments using the procedures of this section shall meet the sampling and testing plan requirements of WAC 173-204-600 and records management requirements of WAC 173-204-610. Test sediments designated using the procedures of this section shall be sampled and analyzed using the Puget Sound protocols or other methods approved by the department, and shall use an appropriate quality assurance/quality control program, as determined by the department. A sediment sample that passes the initial designation procedures is designated as complying with the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, until such time as any person or the department confirms the sediment designation as failing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. A sediment sample that fails the initial designation procedures is designated as not complying with the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, until such time as any person or the department confirms the sediment designation as passing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. A sediment sample that passes or fails the confirmatory designation procedures is designated as such under the procedures of WAC 173-204-310. Sediments shall be designated with the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 as follows:

(1) Initial designation. Sediments that have been chemically analyzed for the applicable chemical concentration criteria of WAC 173-204-320 through 173-204-340 shall be designated as follows:

(a) Sediments with chemical concentrations equal to or less than all the applicable chemical and human health criteria are designated as having no adverse effects on biological resources, and not posing a significant health threat to humans, and pass the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(b) Sediments with chemical concentrations which exceed any one applicable chemical or human health criterion in WAC 173-204-320 through 173-204-340 are designated as having adverse effects on biological resources or posing significant human health threats, and fail the sediment quality standards of WAC 173-204-320 through 173-204-340, pending confirmatory designation.

(2) Confirmatory designation. Any person or the department may confirm the designation of sediments which have either passed or failed initial designation procedures listed in subsection (1) of this section using the applicable biological testing of WAC 173-204-315, as required below. Sediment samples that pass all the required confirmatory biological tests are designated as passing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, notwithstanding the sediment's previous initial designation under subsection (1) of this section. Any sediment sample which fails any one of the required confirmatory biological tests shall be designated as failing the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, notwithstanding the sediment's previous initial designation under subsection (1) of this section. The confirmatory biological test standards are described below.

(a) To confirm the designation of a sediment which either passed or failed any applicable chemical concentration criterion established in WAC 173-204-320 through 173-204-340, the sediment shall be tested for:

(i) Two of the acute effects biological tests described in the applicable standards of WAC 173-204-315; and

(ii) One of the chronic effects biological tests described in the applicable standards of WAC 173-204-315.

(b) Sediments with chemical concentrations which either passed or failed any applicable human health criterion of WAC 173-204-320 through 173-204-340 shall be eligible for confirmatory designation as follows: Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(3) Initial and confirmatory designation of sediments which contain other toxic, radioactive, biological, or deleterious substances. Sediments which contain other toxic, radioactive, biological, or deleterious substances, as defined in WAC 173-204-200(16), shall be designated by the department using the following procedures.

(a) The department shall:

(i) Identify individual contaminants of concern;

(ii) Identify appropriate and practicable sampling and analysis methodologies;

(iii) Identify test interpretation standards for initial and confirmatory designation; and

(iv) Identify acceptable levels of sediment contamination for sediments which contain other toxic, radioactive, biological, or deleterious substances.

(b) Where sediment containing other toxic, radioactive, biological or deleterious substances may also be contaminated by chemicals identified in WAC 173-204-320 through 173-204-340, the department shall require application of the appropriate tests and standards of WAC 173-204-320 through 173-204-340, as determined by the department, in addition to any requirements developed pursuant to (a) of this subsection.

(c) The department may use all or some of the sediment biological tests of WAC 173-204-320 through 173-204-340 to designate sediments with other toxic, radioactive, biological or deleterious substances in cases where those tests are technically appropriate, as determined by the department.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-310, filed 3/27/91, effective 4/27/91.]

WAC 173-204-315 Confirmatory marine sediment biological tests. (1) The following five acute and chronic effects biological tests shall be used to confirm designation of Puget Sound marine sediments using the procedures described in WAC 173-204-310(2). Use of alternate biological tests shall be subject to the review and approval of the department using the procedures of WAC 173-204-130(4).

(a) Acute effects tests.

(i) Amphipod: Ten-day mortality sediment bioassay for the Amphipod, i.e., Rhepoxynius abronius, Ampelisca abdita, or Eohaustorius estuarius.

(ii) Larval: Any one of the following mortality/abnormality sediment bioassays:

(A) Crassostrea gigas, i.e., Pacific oyster;

(B) Mytilus (edulis) galloprovincialis, i.e., Blue mussel;

(C) Strongylocentrotus purpuratus, i.e., Purple sea urchin;

(D) Strongylocentrotus droebachiensis, i.e., Green sea urchin; or

(E) Dendraster excentricus, i.e., Sand dollar.

(b) Chronic effects tests.

(i) Benthic infaunal abundance: Abundance of the following major taxa: Class Crustacea, Class Polychaeta, and Phylum Mollusca.

(ii) Juvenile polychaete: Twenty-day growth rate of the juvenile polychaete Neanthes arenaceodentata; or

(iii) Microtox saline extract: Decreased luminescence from the bacteria Vibrio fisheri after a fifteen minute exposure.

(2) Performance standards for control and reference sediment biological test results. The biological tests of this section shall not be considered valid unless test results for the appropriate control and reference sediments meet the performance standards of (a) through (e) of this subsection. The department may reject the results of a reference sediment biological test based on unacceptably high variability.

(a) Amphipod: The control sediment shall have less than ten percent mortality over the test period. The reference sediment shall have less than twenty-five percent mortality.

(b) Larval: The seawater control sample shall have less than thirty percent combined abnormality and mortality (i.e., a seventy percent normal survivorship at time-final).

(c) Benthic abundance: The reference benthic macroinvertebrate assemblage shall be representative of areas of Puget Sound removed from significant sources of contaminants, and to the extent possible shall have the following characteristics:

(i) The taxonomic richness of benthic macroinvertebrates and the abundances of higher taxonomic groups shall reflect seasonality and natural physical-chemical conditions (e.g., grain size composition and salinity of sediments, water depth) in a reference area, and not be obviously depressed as a result of chemical toxicity;

(ii) Normally abundant species that are known to be sensitive to chemical contaminants shall be present;

(iii) Normally rare species that are known to become abundant only under chemically disturbed conditions shall be rare or absent; and

(iv) The abundances of normally rare species that control community structure through physical modification of the sediment shall be similar to those observed at the test sediment site.

(d) Juvenile polychaete: The control sediment shall have less than ten percent mortality and mean individual growth of ≥ 0.72 mg/ind/day per dry weight basis. The reference sediment shall have a mean individual growth rate which is at least eighty percent of the mean individual growth rate found in the control sediment. Control sediments exhibiting growth below 0.72 mg/ind/day may be approved by the department on a case-by-case basis.

(e) Microtox: Reserved: The department shall determine performance standards on a case-by-case basis as necessary to meet the intent of this chapter.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-315, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-315, filed 3/27/91, effective 4/27/91.]

WAC 173-204-320 Marine sediment quality standards. (1) Goal and applicability.

(a) The sediment quality standards of this section shall correspond to a sediment quality that will result in no adverse effects, including no acute or chronic adverse effects on biological resources and no significant health risk to humans.

(b) The marine sediment quality standards of this section shall apply to marine sediments located within Puget Sound as defined in WAC 173-204-200(19).

(c) Non-Puget Sound marine sediment quality standards. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(2) Chemical concentration criteria. The chemical concentrations in Table I establish the marine sediment quality standards chemical criteria for designation of sediments.

(a) Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit shall be reported and shall be at or below the Marine Sediment Quality Standards chemical criteria value set in this table.

(b) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:

(i) Where chemical analyses identify an undetected value for every individual compound/isomer then the single highest detection limit shall represent the sum of the respective compounds/isomers; and

(ii) Where chemical analyses detect one or more individual compound/isomers, only the detected concentrations will be added to represent the group sum.

(c) The listed chemical parameter criteria represent concentrations in parts per million, "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

(d) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds as listed.

(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

(f) The TOTAL BENZOFLUORANTHENES criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

Table I
Marine Sediment Quality Standards
—Chemical Criteria

CHEMICAL PARAMETER	MG/KG DRY WEIGHT (PARTS PER MILLION (PPM) DRY)
ARSENIC	57
CADMIUM	5.1
CHROMIUM	260
COPPER	390
LEAD	450
MERCURY	0.41
SILVER	6.1
ZINC	410

CHEMICAL PARAMETER	MG/KG ORGANIC CARBON (PPM CARBON)
LPAH	370
NAPHTHALENE	99
ACENAPHTHYLENE	66
ACENAPHTHENE	16
FLUORENE	23
PHENANTHRENE	100
ANTHRACENE	220
2-METHYLNAPHTHALENE	38
HPAH	960
FLUORANTHENE	160
PYRENE	1000
BENZ(A)ANTHRACENE	110
CHRYSENE	110
TOTAL BENZOFLUORANTHENES	230
BENZO(A)PYRENE	99
INDENO (1,2,3,-C,D) PYRENE	34
DIBENZO (A,H) ANTHRACENE	12
BENZO(G,H,I)PERYLENE	31
1,2-DICHLOROBENZENE	2.3
1,4-DICHLOROBENZENE	3.1
1,2,4-TRICHLOROBENZENE	0.81
HEXACHLOROBENZENE	0.38
DIMETHYL PHTHALATE	53
DIETHYL PHTHALATE	61
DI-N-BUTYL PHTHALATE	220
BUTYL BENZYL PHTHALATE	4.9
BIS (2-ETHYLHEXYL) PHTHALATE	47
DI-N-OCTYL PHTHALATE	58
DIBENZOFURAN	15
HEXACHLOROBUTADIENE	3.9
N-NITROSODIPHENYLAMINE	11
TOTAL PCB'S	12

CHEMICAL PARAMETER	UG/KG DRY WEIGHT (PARTS PER BILLION (PPB) DRY)
PHENOL	420
2-METHYLPHENOL	63
4-METHYLPHENOL	670
2,4-DIMETHYL PHENOL	29
PENTACHLOROPHENOL	360
BENZYL ALCOHOL	57
BENZOIC ACID	650

(3) Biological effects criteria. For designation of sediments pursuant to WAC 173-204-310(2), sediments are determined to have adverse effects on biological resources when any one of the confirmatory marine sediment biological tests of WAC 173-204-315(1) demonstrate the following results:

(a) Amphipod: The test sediment has a higher (statistically significant, t test, $p \leq 0.05$) mean mortality than the reference sediment and the test sediment mean mortality exceeds twenty-five percent, on an absolute basis.

(b) Larval: The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t test, $p \leq 0.05$) than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than eighty-five percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than fifteen percent relative to time-final in the reference sediment).

(c) Benthic abundance: The test sediment has less than fifty percent of the reference sediment mean abundance of any one of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta, and the test sediment abundance is statistically different (t test, $p \leq 0.05$) from the reference sediment abundance.

(d) Juvenile polychaete: The test sediment has a mean individual growth rate of less than seventy percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t test, $p \leq 0.05$) from the reference sediment mean individual growth rate.

(e) Microtox: The mean light output of the highest concentration of the test sediment is less than eighty percent of the mean light output of the reference sediment, and the two means are statistically different from each other (t test, $p \leq 0.05$).

(4) Marine sediment human health criteria. Reserved: The department may determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(5) Marine sediment other toxic, radioactive, biological, or deleterious substances criteria. Other toxic, radioactive, biological or deleterious substances in, or on, sediments shall be at or below levels which cause no adverse effects in marine biological resources, and below levels which correspond to a significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter pursuant to WAC 173-204-310(3).

(6) Nonanthropogenically affected sediment quality criteria. Whenever the nonanthropogenically affected sediment quality is of a lower quality (i.e., higher chemical concentrations, higher levels of adverse biological response, or posing a greater health threat to humans) than the applicable sediment quality standards assigned for said sediments by this chapter, the existing sediment chemical and biological quality shall be identified on an area-wide basis as determined by the department, and used in place of the sediment quality standards of WAC 173-204-320.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-320, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-320, filed 3/27/91, effective 4/27/91.]

WAC 173-204-330 Low salinity sediment quality standards. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-330, filed 3/27/91, effective 4/27/91.]

WAC 173-204-340 Freshwater sediment quality standards. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-340, filed 3/27/91, effective 4/27/91.]

WAC 173-204-350 Sediment quality standards inventory. (1) The department shall gather available data on sediments and produce an inventory of sediment sampling stations which pass or fail the applicable sediment quality standards of WAC 173-204-320 through 173-204-340. Sediment sampling stations which are evaluated for compliance with the sediment quality standards of WAC 173-204-320 through 173-204-340 and placed on the inventory shall be sampled and analyzed using the Puget Sound Protocols or other methods approved by the department, and shall use an appropriate quality assurance/quality control program, as determined by the department. The sediment quality standards inventory produced per this section shall be used by the department, and made available upon request to the public and other federal, state, and local agencies for the following uses:

(a) To identify and target necessary source control activities, such as discharger monitoring, to eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination;

(b) To identify contaminated sediment cleanup sites per the procedures in WAC 173-204-500 through 173-204-590;

(c) To establish sediment quality ambient monitoring program status and trends analyses and reports;

(d) To identify the sediment quality of areas proposed for dredging, in-water construction, and other actions requiring federal, state, and/or local permits; and

(e) To complete other uses consistent with the intent of this chapter, as determined by the department.

(2) Sources of data. Sediment biological and chemical data shall be gathered by the department for review to pro-

duce and update the sediment quality inventory on a biennial basis. Data sources include, but are not limited to:

(a) Sediment data collected by the department for the Puget Sound ambient monitoring program, compliance monitoring of permitted discharges, and special environmental investigations.

(b) Sediment data submitted to the U.S. Army Corps of Engineers in support of dredging permit applications.

(c) Sediment data collected to identify problem areas and needed source controls in Puget Sound as defined in WAC 173-204-200(19), other marine waters, and all low salinity and freshwater areas in Washington state.

(d) Sediment data used or collected in compliance with chapter 70.105D RCW, and the Model Toxics Control Act cleanup regulation, chapter 173-340 WAC.

(e) Sediment data used or collected in compliance with the federal Comprehensive Environmental Response, Compensation and Liability Act.

(f) Sediment data collected as a requirement of a National Pollutant Discharge Elimination System or state discharge permit.

(g) Sediment data derived from other studies including:

(i) Federally sponsored monitoring studies.

(ii) Special monitoring studies conducted by local and municipal governments, or private industry.

(iii) Data derived through Washington state department of natural resources administration of use authorizations.

(3) The inventory shall be updated and made available to the public on a biennial basis.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-350, filed 3/27/91, effective 4/27/91.]

PART IV—SEDIMENT SOURCE CONTROL

WAC 173-204-400 General considerations. (1) The standards of WAC 173-204-400 through 173-204-420 specify a process for managing sources of sediment contamination. These procedures include:

(a) Evaluating the potential for a waste discharge to create a sediment impact;

(b) Requiring application for a sediment impact zone authorization;

(c) Verifying whether a discharge has received all known, available and reasonable methods of prevention, control, and treatment prior to discharge, and/or application of best management practices;

(d) Analysis and verification of the potential sediment impact;

(e) Determining whether the sediment impact zone would meet maximum allowable contamination requirements;

(f) Evaluating the proposed sediment impact zone in consideration of locational criteria;

(g) Design and/or constrain the sediment impact zone to be as small, and with the least contamination, as practicable;

(h) Public review of the proposed sediment impact zone authorization;

(i) Issuance of the sediment impact zone authorization with provisions for maintenance and closure; and

(j) Reducing and eventually eliminating the sediment impact zone via renewals and modifications of a sediment impact zone authorization.

(2) Permits and other authorizations of wastewater, storm water, and nonpoint source discharges to surface waters of the state of Washington under authority of chapter 90.48 RCW shall be conditioned so that the discharge receives all known, available and reasonable methods of prevention, control, and treatment, and best management practices prior to discharge, as required by chapters 90.48, 90.52, and 90.54 RCW. The department shall provide consistent guidance on the collection, analysis and evaluation of wastewater, receiving-water, and sediment samples to meet the intent of this section using consideration of pertinent sections of the *Department of Ecology Permit Writers' Manual,* as amended, and other guidance approved by the department.

(3) As determined necessary, the department shall require any person who proposes a new discharge to evaluate the potential for the proposed discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(4) As determined necessary, the department shall require existing permitted discharges to evaluate the potential for the permitted discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(5) Within permits authorizing existing discharges to surface waters of the state of Washington, the department may specify appropriate locations and methodologies for the collection and analysis of representative samples of wastewater, receiving-water, and sediments to evaluate the potential for the discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(6) In establishing the need for, and the appropriate, individual permit monitoring conditions, the department shall consider multiple factors relating to the potential for a discharge to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 including but not limited to:

(a) Discharge particulate characteristics;

(b) Discharge contaminant concentrations, flow, and loading rate;

(c) Sediment chemical concentration and biological effects levels;

(d) Receiving water characteristics;

(e) The geomorphology of sediments;

(f) Cost mitigating factors such as the available resources of the discharger; and

(g) Other factors determined necessary by the department.

(7) As determined necessary to ensure the wastewater discharge does not cause a violation of the applicable standards of WAC 173-204-320 through 173-204-340, except as authorized by the department under WAC 173-204-415, Sediment impact zones, the department shall stipulate permit terms and conditions which include wastewater discharge average and maximum mass loading per unit time, and wastewater discharge average and maximum chemical concentrations within new and existing facility permits authorizing

wastewater discharges to surface waters of the state of Washington.

(8) As determined necessary, the department shall modify wastewater discharge permits whenever it appears the discharge causes a violation, or creates a substantial potential to cause a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, as authorized by RCW 90.48.520.

(9) To meet the intent of this section, the sediment quality standards of WAC 173-204-320 through 173-204-340 and the sediment impact zone standards of WAC 173-204-415 through 173-204-420 are not considered to be federal discharge permit effluent limits subject to antibacksliding requirements of the federal Clean Water Act. Discharge permit sediment monitoring and sediment impact zone compliance requirements may be used to establish effluent limits sufficient to meet the standards of this chapter.

(10) As determined necessary, the department shall use issuance of administrative actions under authority of chapters 90.48 or 70.105D RCW to implement this chapter.

(11) Wastewater dilution zones. Water quality mixing zones authorized by the department pursuant to chapter 173-201A WAC, Water quality standards for surface waters of the state of Washington, do not satisfy the standards of WAC 173-204-415, Sediment impact zones.

(12) For the sediment source control standards of WAC 173-204-400 through 173-204-420, any and all references to violation of, potential to violate, exceedance of, or potential to exceed the applicable standards of WAC 173-204-320 through 173-204-340 shall also apply to the antidegradation and designated use policies of WAC 173-204-120. Any exceedances or potential exceedances of the antidegradation or designated use policies of WAC 173-204-120 shall meet the applicable requirements of WAC 173-204-400 through 173-204-420.

(13) Under no circumstances shall the provisions of sediment source control standards WAC 173-204-400 through 173-204-420 be construed as providing for the relaxation of discharge permit requirements under other authorities including, but not limited to, chapter 90.48 RCW, the Water Pollution Control Act, chapter 90.54 RCW, the Water Resources Act of 1971, and the Federal Water Pollution Control Act of 1972 and amendments.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-400, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-400, filed 3/27/91, effective 4/27/91.]

WAC 173-204-410 Sediment quality goal and sediment impact zone applicability. (1) Goal and policies.

(a) It is the established goal of the department to manage source control activities to reduce and ultimately eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination.

(b) The stated policy of the department shall be to only authorize sediment impact zones so as to minimize the number, size, and adverse effects of all zones, with the intent to eliminate the existence of all such zones whenever practicable. The department shall consider the relationship between environmental effects, technical feasibility and cost in determining whether it is practicable to minimize and/or eliminate sediment impact zones.

(c) The department shall implement the standards of WAC 173-204-400 through 173-204-420 so as to prevent the creation of new contaminated sediment cleanup sites identified under WAC 173-204-530(4).

(2) A sediment impact zone authorization issued by the department under the authority of chapter 90.48 RCW does not constitute authorization to trespass on lands not owned by the applicant. These standards do not address and in no way alter the legal rights, responsibilities, or liabilities of the permittee or landowner of the sediment impact zone for any applicable requirements of proprietary, real estate, tort, and/or other laws not directly expressed as a requirement of this chapter.

(3) Except as identified in subsection (6)(d) of this section, any person may apply for a sediment impact zone under the following conditions:

(a) The person's discharge is provided with all known, available and reasonable methods of prevention, control, and treatment, and meets best management practices as stipulated by the department; and

(b) The person's discharge activity exposes or resuspends sediments which exceed, or otherwise cause or potentially cause sediments to exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, or the antidegradation policy standards of WAC 173-204-120 (1)(a) and (c) within a period of ten years from the later date of either the department's formal approval of the application for a sediment impact zone authorization or the starting date of the discharge.

(4) The department shall only authorize sediment impact zones for permitted wastewater and storm water discharges, and other discharges authorized by the department. The department shall authorize all sediment impact zones via discharge permits or other formal administrative actions.

(5) The department shall not limit the application, establishment, maintenance, or closure of an authorized sediment impact zone via consideration of sediment contamination determined by the department to be the result of unknown, unpermitted or historic discharge sources.

(6) As determined necessary by the department, any person with a permitted discharge shall be required to meet the standards of WAC 173-204-400 through 173-204-420, as follows:

(a) Any person with a new or existing permitted wastewater discharge shall be required to meet the standards of WAC 173-204-400 through 173-204-420;

(b) Any person with a new or existing permitted industrial storm water discharge, regulated as process wastewater in National Pollutant Discharge Elimination System or state discharge permits, shall be required to meet the standards of WAC 173-204-400 through 173-204-420;

(c) Any person with a new or existing permitted storm water or nonpoint source discharge, which fully uses all known, available and reasonable methods of prevention, control, and treatment, and best management practices as stipulated by the department at the time of the person's application for a sediment impact zone, shall be required to meet the standards of WAC 173-204-400 through 173-204-420;

(d) Any person with a storm water discharge, existing prior to the adoption of this chapter, and determined by the department to not be fully using best management practices stipulated by the department at the time of the person's application for a permit from the department, shall be eligible for a sediment impact zone as follows:

(i) The department shall issue sediment impact zone authorizations with requirements for application of best management practices stipulated by the department on an approved time schedule.

(ii) Sediment impact zones authorized by the department for permitted storm water discharges under the applicability provisions of subsection (6)(d) of this section shall be subject to cleanup action determinations made by the department pursuant to WAC 173-204-500 through 173-204-590 when the sediment impact zone maximum criteria of WAC 173-204-420 are exceeded within the authorized sediment impact zone.

(iii) The department shall identify and include best management practices required to meet the sediment impact zone design standards of WAC 173-204-415(4) as soon as practicable within sediment impact zone authorizations established for storm water discharges per WAC 173-204-410 (6)(d).

(7) Dredged material and fill discharge activities subject to authorization under Section 401 of the federal Clean Water Act via chapter 90.48 RCW and chapter 173-225 WAC, establishment of implementation procedures of application for certification, are not subject to the standards of WAC 173-204-415 but are subject to the standards of WAC 173-204-400 through 173-204-410 and 173-204-420 as follows:

(a) Requirements for dredging activities and disposal sites shall be established by the department using best available dredged material management guidelines and applicable federal and state rules. These guidelines shall include the Puget Sound dredged disposal analysis (PSDDA) dredged material testing and disposal requirements cited in:

(i) *Management Plan Report - Unconfined Open-Water Disposal Of Dredged Material, Phase I, (Central Puget Sound), June 1988, or as amended;*

(ii) *Management Plan Report - Unconfined Open-Water Disposal Of Dredged Material, Phase II, (North And South Puget Sound), September 1989, or as amended;* and

(iii) *Users Manual For Dredged Material Management In Puget Sound, November 1990, or as amended.*

(b) In coordination with other applicable federal and state and local dredged material management programs, the department may issue administrative orders to establish approved disposal sites, to specify disposal site use conditions, and to specify disposal site monitoring requirements.

(c) The department may authorize sediment impact zones for dredged material disposal via federal Clean Water Act Section 401 certification actions.

(d) As determined necessary by the department, the department may authorize sediment impact zones for dredged material disposal via administrative orders issued under authority of chapter 90.48 RCW. The department shall authorize sediment impact zones for all Puget Sound dredged disposal analysis disposal sites via administrative orders issued under authority of chapter 90.48 RCW.

(e) Administrative orders and certifications establishing sediment impact zones for dredged material disposal sites shall describe establishment, maintenance, and closure requirements for the authorized site, consistent with the requirements described in (a) of this subsection.

(8) The source control standards of WAC 173-204-400 through 173-204-420 are applicable in cases where the sediment quality standards of WAC 173-204-320 through 173-204-340 are reserved.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-410, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-410, filed 3/27/91, effective 4/27/91.]

WAC 173-204-412 Marine finfish rearing facilities. (1) Purpose. This section sets forth the applicability of this chapter to marine finfish rearing facilities only. This section also identifies marine finfish rearing facility siting, operation, closure and monitoring requirements to meet the intent of this chapter, as applicable.

(2) Applicability. Marine finfish rearing facilities and their associated discharges are not subject to the authority and purpose standards of WAC 173-204-100 (3) and (7), and the marine sediment quality standards of WAC 173-204-320 and the sediment impact zone maximum criteria of WAC 173-204-420, within and including the distance of one hundred feet from the outer edge of the marine finfish rearing facility structure. Marine finfish rearing facilities are not subject to the sediment impact zone standards of WAC 173-204-415.

(3) Sediment monitoring. Sediment quality compliance and monitoring requirements for marine finfish rearing facilities shall be addressed through National Pollutant Discharge Elimination System or other permits issued by the department for facility operation. Marine finfish rearing facilities shall meet the following sediment quality monitoring requirements:

(a) Any person with a new facility shall identify a baseline sediment quality prior to facility operation for benthic infaunal abundance, total organic carbon and grain size in the location of the proposed operation and downcurrent areas that may be potentially impacted by the facility discharge;

(b) Any person with an existing operating facility shall monitor sediment quality for total organic carbon levels and identify the location of any sediments in the area of the facility statistically different (t test, $p \leq 0.05$) from the total organic carbon levels identified as facility baseline levels or statistically different from the applicable total organic carbon levels as identified in Table 1:

TABLE 1 - Puget Sound Reference Total Organic Carbon Values

Silt-Clay Particles (percent Dry Weight)	Total Organic Carbon (percent Dry Weight)
0-20	0.5
20-50	1.7
50-80	3.2
80-100	2.6

(c) The locations and frequency of monitoring for total organic carbon, benthic infaunal abundance and other parameters shall be determined by the department and identified in the applicable National Pollutant Discharge Elimination System permit;

(d) Antibacterials. Reserved: The department shall determine on a case-by-case basis the methods, procedure, locations, and frequency for monitoring antibacterials associated with the discharge from a marine finfish rearing facility;

(e) Closure. All permitted marine finfish rearing facilities shall monitor sediments impacted during facility operation to document recovery of sediment quality to background levels. The department shall determine on a case-by-case basis the methods, procedure, locations, and frequency for monitoring sediments after facility closure.

(4) Sediment impact zones. Marine finfish rearing facilities and their associated discharges that are permitted under a National Pollutant Discharge Elimination System permit are hereby provided a sediment impact zone by rule for any sediment quality impacts and biological effects within and including the distance of one hundred feet from the outer edge of the marine finfish rearing facility structure.

(a) The department may authorize an individual marine finfish rearing facility sediment impact zone for any sediments beyond a distance of one hundred feet from the facility perimeter via National Pollutant Discharge Elimination System permits or administrative actions. The authorized sediment impact zone shall meet the benthic infaunal abundance requirements of the sediment impact zone maximum criteria, WAC 173-204-420 (3)(c)(iii). Marine finfish rearing facilities that exceed the sediment quality conditions of subsection (3)(b) of this section beyond a distance of one hundred feet from the facility perimeter shall:

(i) Begin an enhanced sediment quality monitoring program to include benthic infaunal abundance consistent with the requirements of the National Pollutant Discharge Elimination System permit. The sediment quality monitoring program shall include a benthic infaunal abundance reference sediment sample as required in subsection (3)(a) of this section or a benthic infaunal abundance reference sediment sample in compliance with WAC 173-204-200(21); and

(ii) Be consistent with the sediment source control general considerations of WAC 173-204-400 and the sediment quality goal and sediment impact zone applicability requirements of WAC 173-204-410, apply for a sediment impact zone as determined necessary by the department.

(b) Administrative orders or permits establishing sediment impact zones for marine finfish rearing facilities shall describe establishment, maintenance, and closure requirements as determined necessary by the department.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-412, filed 12/29/95, effective 1/29/96.]

WAC 173-204-415 Sediment impact zones. The purpose of this section is to set forth the standards for establishment, maintenance, and closure of sediment impact zones to meet the intent of sediment quality dilution zones authorized pursuant to RCW 90.48.520, except for sediment impact zones authorized under WAC 173-204-410(7). The department shall authorize all sediment impact zones via discharge permits or other formal administrative actions.

(1) General requirements. Authorization, modification and renewal of a sediment impact zone by the department shall require compliance with the following general requirements:

(a) Permits authorizing wastewater discharges to surface waters of the state of Washington under authority of chapter 90.48 RCW shall be conditioned so that the discharge receives:

(i) All known, available and reasonable methods of prevention, control, and treatment prior to discharge, as required by chapters 90.48, 90.52, and 90.54 RCW; and

(ii) Best management practices as stipulated by the department.

(b) The maximum area, and maximum chemical contaminant concentration and/or allowable maximum biological effect level within sediments assigned to a sediment impact zone shall be as authorized by the department, in accordance with the standards of this section.

(c) The department shall determine that the person's activity generating effluent discharges which require authorization of a sediment impact zone is in the public interest.

(d) The department shall determine that any person's activity generating effluent discharges which require authorization of a sediment impact zone has adequately addressed alternative waste reduction, recycling, and disposal options through application of all known, available and reasonable methods of prevention, control, and treatment to minimize as best practicable the volume and concentration of waste contaminants in the discharge.

(e) The area boundaries of the sediment impact zone established by the department shall include the minimum practicable surface area, not to exceed the surface area allowed under subsection (4) of this section.

(f) Adverse effects to biological resources within an authorized sediment impact zone shall be maintained at the minimum chemical contamination and biological effects levels practicable at all times. The department shall consider the relationship between environmental effects, technical feasibility and cost in determining the minimum practicable chemical contamination and biological effects levels. Adverse effects to biological resources within an authorized sediment impact zone shall not exceed a minor adverse effects level as a result of the discharge, as determined by the procedures of subsection (4) of this section.

(g) The operational terms and conditions for the sediment impact zone shall be maintained at all times.

(h) Final closure of the sediment impact zone shall be conducted in strict accordance with the department's sediment impact zone authorization.

(i) Documents authorizing a sediment impact zone shall require that the permitted discharge not result in a violation of the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, outside the area limits of the established zone.

(j) All applications to the department for sediment impact zone authorizations shall be subject to public notice, comment and hearing procedures defined but not limited to the applicable discharge permit or other formal administra-

tive action requirements of chapter 43.21C RCW, the State Environmental Policy Act, chapter 197-11 WAC, SEPA rules, chapter 90.48 RCW, chapter 163-216 WAC, the State waste discharge permit program, and chapter 173-220 WAC, National Pollutant Discharge Elimination System Permit Program prior to issuance of the authorization. In determining the need for, location, and/or design of any sediment impact zone authorization, the department shall give consideration to all comments received during public review of the proposed sediment impact zone application.

(2) Application requirements.

(a) Whenever, in the opinion of the department, as a result of an ongoing or proposed effluent discharge, a person violates, shall violate, or creates a substantial potential to violate the sediment quality standards of WAC 173-204-320 through 173-204-340 as applicable within a period of ten years from the later date of either the department's evaluation of the ongoing discharge or the starting date of the proposed discharge, the department may require application for a sediment impact zone authorization under authority of chapter 90.48 RCW.

(b) Any person with a proposed or permitted effluent discharge shall apply to the department for authorization of a sediment impact zone when:

(i) The department requires the sediment impact zone application by written notification; or

(ii) The person independently identifies that the ongoing or proposed effluent discharge violates, shall violate, or creates a substantial potential to violate the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 within a period of ten years from the later date of the person's evaluation of the ongoing discharge or the starting date of the proposed discharge, using the procedures of this section.

(c) As necessary, the department may require any person to submit a sediment impact zone application in multiple steps concurrent with its ongoing review and determination concerning the adequacy of the application. The application shall provide the sediment impact zone design information required in subsection (4) of this section and other such information the department determines necessary. The application shall also provide the legal location and landowner(s) of property proposed for use as, or potentially affected by, a sediment impact zone, and shall be accompanied by such other relevant information as the department may require. The department shall issue a written approval of the complete sediment impact zone application prior to or concurrent with authorizing a sediment impact zone.

(d) Submittal of an application to the department for authorization of a sediment impact zone under the terms and conditions of this section shall establish the applicant's interim compliance with requirements of chapter 90.48 RCW and this chapter, as determined by the department. The department may authorize an interim compliance period within a valid discharge permit or administrative order to ensure ultimate compliance with chapter 90.48 RCW and this chapter. The interim compliance period shall not continue beyond the date of issuance of a sediment impact zone authorization within a valid discharge permit issued by the department.

(e) Prior to authorization, the department shall make a reasonable effort to identify and notify all landowners, adjacent landowners, and lessees affected by the proposed sediment impact zone. The department shall issue a sediment impact zone notification letter to any person it believes to be a potentially affected landowner and other parties determined appropriate by the department. The notification letter shall be sent by certified mail, return receipt requested, or by personal service. The notification letter shall provide:

(i) The name of the person the department believes to be the affected landowner;

(ii) The names and addresses of other affected landowners to whom the department has sent a proposed sediment impact zone notification letter;

(iii) The name and address of the sediment impact zone applicant;

(iv) A general description of the location, size, and contamination level proposed for the sediment impact zone;

(v) The intention of the department to release all specific sediment impact zone application information to the public upon written request to the department;

(vi) The determination of the department concerning whether the proposed sediment impact zone application meets the standards of this section;

(vii) The intention of the department whether to authorize the proposed sediment impact zone; and

(viii) Notification that the affected landowners, adjacent landowners, and lessees may comment on the proposed sediment impact zone. Any comments on the proposed sediment impact zone authorization shall be submitted in writing to the department within thirty days from the date of receipt of the notification letter, unless the department provides an extension.

(f) Prior to authorization, the department shall issue a sediment impact zone notification letter to affected port districts, the Washington state department of natural resources marine lands division, the U.S. Army Corps of Engineers, and other parties determined appropriate by the department. The notification letter shall be sent by certified mail, return receipt requested, or by personal service. The notification letter shall provide the information required under (e) of this subsection.

(3) Locational considerations. The department shall require any person applying for a sediment impact zone to submit information concerning potential location considerations of the zone. The location of an authorized sediment impact zone shall avoid whenever possible and minimize adverse impacts to areas of special importance. Prior to authorization of a sediment impact zone, the department shall consider all pertinent information from the applicant, all affected parties, local, state and federal agencies, federally recognized Indian tribes, and the public concerning locational considerations, including but not limited to:

(a) Spawning areas;

(b) Nursery areas;

(c) Waterfowl feeding areas;

(d) Shellfish harvest areas;

(e) Areas used by species of economic importance;

(f) Tribal areas of significance;

(g) Areas determined to be ecologically unique;

(h) Water supply intake areas;

(i) Areas used for primary contact public recreation;

(j) High quality waters that constitute an outstanding national resource; and

(k) Areas where sediment quality is substantially better than levels necessary for protection of biological resources and human health.

(4) Design requirements. The location, areal limitations, and degree of effects allowed within an authorized sediment impact zone shall be determined by application of the department's sediment impact zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment impact zone model(s) approved by the department under WAC 173-204-130(4), as limited by the standards of this section and the department's best professional judgment. The models shall be used by the department or by the discharger as required by the department, to estimate the impact of any person's wastewater or storm water discharge on the receiving water and sediment quality for a period of ten years from the later date of either the department's formal approval of the application for a sediment impact zone authorization or the starting date of the discharge.

(a) Data requirements. The discharger shall submit the following information to determine requirements for establishment and authorization of a sediment impact zone, as required by the department:

(i) Data reports and analyses results for all samples of wastewater or storm water, receiving water, and sediments collected by the discharger or other parties relating to evaluation of the potential effects of the permitted discharge, as required by WAC 173-204-400.

(ii) Data reports and analyses results determined necessary to:

(A) Apply discharge modeling to the permitted discharge; and

(B) To identify and evaluate potential alternative chemical and biological effects of the discharge on the receiving water and sediments; and

(C) To identify and evaluate potential alternatives to define the areal size and location of a sediment impact zone needed by the discharge.

(iii) Data reports and analyses results from the discharger's application of the "CORMIX," "PLUMES," and/or "WASP" or an alternate sediment impact zone model(s) approved by the department under WAC 173-204-130(4), to the permitted discharge to identify and evaluate:

(A) Potential alternative chemical and biological effects of the discharge on the receiving water and sediments; and

(B) Potential alternatives for the areal distribution and location of a potential sediment impact zone required by the discharge.

(iv) Preferred alternative for closure of the potential sediment impact zone by active removal and/or natural recovery, and identified costs of the preferred closure method.

(b) Overlapping sediment impact zones. Overlapping sediment impact zones, as predicted by the "CORMIX," "PLUMES," and/or "WASP" models or an alternate sediment impact zone model(s) approved by the department under WAC 173-204-130(4), and the department's best professional judgment, shall be authorized only as follows:

(i) The applicable sediment impact zone maximum criteria of WAC 173-204-420 shall not be exceeded as a result of the multiple discharge sediment impact zones overlap; and

(ii) If the department determines that the applicable chemical contaminant concentration and biological effects restrictions of WAC 173-204-420 would be exceeded as a result of the overlap of multiple discharge sediment impact zones, the department may authorize the sediment impact zones after:

(A) Application of a waste load allocation process to the individual permitted discharges to identify individual permit effluent limitations necessary to meet:

(I) The applicable chemical contaminant concentration and biological effects restrictions for sediment impact zones required by this section; and/or

(II) Storm water best management practices required by the department; and

(B) Establishment of individual permit compliance schedules for the multiple permitted discharges to ensure compliance with:

(I) The permit effluent limitations established by the department using the waste load allocation process and best professional judgment; and

(II) The standards of WAC 173-204-400 through 173-204-420.

(5) Maintenance requirements.

(a) The department shall review sediment impact zone monitoring conducted by the discharger to evaluate compliance with the department's sediment impact zone authorization and the standards of WAC 173-204-400 through 173-204-420. The department may require additional sediment impact zone monitoring when the department determines that any sediment sampling station within an authorized sediment impact zone exceeds the sediment impact zone maximum criteria of WAC 173-204-420 or violates the sediment impact zone authorization as a result of the discharge.

(b) Whenever the department can clearly demonstrate that, as a result of an effluent discharge, a discharger violates, shall violate, or creates a substantial potential to violate the department's sediment impact zone authorization, or the sediment impact zone maximum criteria of WAC 173-204-420, the department shall:

(i) Provide written notification and supporting documentation of the department's clear demonstration determination to the affected discharger;

(ii) Establish a reasonable time frame for the affected discharger to either submit a written statement and supporting documentation rebutting the department's clear demonstration determination, or accept the department's determination. The discharger may use the clear demonstration methods identified in (c) of this subsection for rebuttal of the department's clear demonstration; and

(iii) Provide written notification of the department's determination concerning approval or denial of the submitted clear demonstration rebuttal to the discharger.

(c) For the purpose of this section, a clear demonstration shall consist of:

(i) Use of the sediment impact zone model(s) "CORMIX," "PLUMES," and/or "WASP" or other model(s) to demonstrate a

discharge(s) is the source of the violation or potential violation; and

(ii) Use of one or more of the following methods to demonstrate a violation of the sediment impact zone authorization or the sediment impact zone maximum criteria of WAC 173-204-420:

(A) Direct sediment sampling. A violation of the sediment impact zone authorization and/or the sediment impact zone maximum criteria of WAC 173-204-420 is demonstrated when:

(I) The average chemical concentration for three stations within the sediment impact zone exceeds the sediment impact zone maximum criteria of WAC 173-204-420 due to the discharge source. This concentration average shall not include stations for which complete biological testing information shows that the biological effects requirements of WAC 173-204-420, or the authorized sediment impact zone if applicable, are met; or

(II) The biological effects at each of any three stations within the sediment impact zone exceed the sediment impact zone maximum biological effects criteria of WAC 173-204-420 or the authorized sediment impact zone as applicable, due to the discharge source; or

(B) Monitoring data which demonstrates a chemical contaminant concentration gradient toward the discharge source exists in sediments which violates the sediment impact zone authorization or the standards of WAC 173-204-420; or

(C) A trend analysis of the effluent chemical discharge quality and inplace sediment monitoring data which statistically demonstrates an ongoing violation or substantial potential to violate the sediment impact zone authorization or the standards of WAC 173-204-420; or

(D) Field depositional (e.g., sediment traps) and/or effluent particulate (e.g., centrifuge analysis) data which demonstrate an ongoing violation or substantial potential to violate the sediment impact zone authorization or the standards of WAC 173-204-420; or

(E) Mathematical or computer modeling which demonstrates an ongoing violation or substantial potential to violate the sediment impact zone authorization or the standards of WAC 173-204-420.

(d) The department's response to a clear demonstration of a violation or potential violation shall be to require maintenance activities in the following order:

(i) Require reanalysis of whether the discharger's effluent treatment complies with all known, available and reasonable methods of prevention, control, and treatment and best management practices based on the data used to establish the clear demonstration;

(ii) Alter the authorized sediment impact zone size and/or degree of effects consistent with the standards of this section and the results of direct sediment sampling;

(iii) Reduce impacts of the existing or potential violation by requiring additional discharge controls or additional sediment impact zone maintenance activities which can include, but are not limited to:

(A) Dredging and removal of sediments, solely for sediment impact zone maintenance needs or coordinated with maintenance dredging of commercially important areas, e.g., navigational lanes or ship berthing areas;

(B) Dredging, treatment, and replacement of sediments within the sediment impact zone; and/or

(C) Capping of sediments within the sediment impact zone;

(iv) Limit the quantity and/or quality of the existing permitted discharge; and/or

(v) Withdraw the department's sediment impact zone authorization and require final closure of the zone.

(e) All sediment impact zone maintenance actions conducted under this chapter shall provide for landowner review of the maintenance action plans prior to implementation of the action. In cases where the discharger is not able to secure access to lands subject to the sediment impact zone maintenance actions of this subsection, the department may facilitate negotiations or other proceedings to secure access to the lands. Requests for department facilitation of land access shall be submitted to the department in writing by the responsible discharger.

(6) Closure planning and requirements.

(a) The discharger shall select and identify a preferred method for closure of a sediment impact zone in the application required by WAC 173-204-415(2). Closure methods can include either active cleanup and/or natural recovery and monitoring. The department shall incorporate the discharger's identified closure method in the sediment impact zone authorization.

(b) The department may require closure of authorized sediment impact zones when the department determines that:

(i) The discharger has violated the sediment impact zone maintenance standards of subsection (5) of this section; or

(ii) The department determines that:

(A) The wastewater or storm water discharge quality will not violate the applicable sediment quality standards of WAC 173-204-320 through 173-204-340; or

(B) A sediment impact zone is no longer needed or eligible under the standards of WAC 173-204-410 through 173-204-415.

(7) Modification of sediment impact zones. The department may modify sediment impact zone authorization requirements where the nature of a person's activity which generates, transports, disposes, prevents, controls, or treats effluent discharges has substantially changed and been demonstrated to the department's satisfaction. The modification may occur after consideration of the following:

(a) Reduction of effects. Assessment of the discharge activities and treatment methods shall be conducted by the discharger to demonstrate to the satisfaction of the department that:

(i) Elimination of the sediment impact zone is not practicable; and

(ii) Further reduction in any existing or proposed sediment impact zone area size and/or level of contamination or effects is not practicable in consideration of discharge requirements for all known, available and reasonable methods of prevention, control, and treatment, best management practices, and applicable waste reduction and recycling provisions.

(b) Alterations. There are substantial alterations or additions to the person's activity generating effluent discharges which require authorization of a sediment impact zone which

occur after permit issuance and justify application of permit conditions different from, or absent in, the existing permit.

(c) New information. Sediment impact zones may be modified when new information is received by the department that was not available at the time of permit issuance that would have justified the application of different sediment impact zone authorization conditions.

(d) New regulations. The standards or regulations on which the permit was based have changed by amended standards, criteria, or by judicial decision after the permit was issued.

(e) Changes in technology. Advances in waste control technology that qualify as "all known, available and reasonable methods of prevention, control, and treatment" and "best management practices" shall be adopted as permit requirements, as appropriate, in all permits reissued by the department.

(8) Renewal of previously authorized sediment impact zones. Renewal of sediment impact zones previously authorized under the standards of WAC 173-204-410 and this section shall be allowed under the following conditions:

(a) The department determines the discharge activities and treatment methods meet all known, available and reasonable methods of prevention, control, and treatment and best management practices as stipulated by the department; and

(b) The discharger demonstrates to the department's satisfaction that the discharge activities comply with the standards of WAC 173-204-400 through 173-204-420 and with the existing sediment impact zone authorization; and

(c) Reduction of effects. The discharger conducts an assessment of the permitted discharge activities and treatment methods and demonstrates to the department's satisfaction that:

(i) Elimination of the sediment impact zone is not practicable; and

(ii) A further reduction in any existing or proposed sediment impact zone area size and/or level of contamination is not practicable in consideration of discharge requirements for all known, available and reasonable methods of prevention, control, and treatment, best management practices, and applicable waste reduction and recycling provisions.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-415, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-415, filed 3/27/91, effective 4/27/91.]

WAC 173-204-420 Sediment impact zone maximum criteria. This section establishes minor adverse effects as the maximum chemical contaminant concentration, maximum health risk to humans, maximum biological effects level, maximum other toxic, radioactive, biological, or deleterious substance level, and maximum nonanthropogenically affected sediment quality level allowed within authorized sediment impact zones due to an existing or proposed discharge. If the department determines that the standards of this section are or will be exceeded as a result of an existing or proposed discharge(s), the department shall authorize a sediment impact zone or modify a sediment impact zone authorization consistent with the standards of WAC 173-204-400 through 173-204-420 such that individual permit effluent limitations, requirements, and compliance time periods are sufficient to meet the standards of this section as applicable.

(1) Applicability.

(a) The marine sediment impact zone maximum chemical criteria, and the marine sediment biological effects criteria, and the marine sediment human health criteria, and the marine sediment other toxic, radioactive, biological or deleterious substance criteria and the marine sediment nonanthropogenically affected sediment criteria of this section shall apply to marine sediments within Puget Sound.

(b) Non-Puget Sound marine sediment impact zone maximum criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(c) Low salinity sediment impact zone maximum criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(d) Freshwater sediment impact zone maximum criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(2) Puget Sound marine sediment impact zone maximum chemical criteria. The maximum chemical concentration levels that may be allowed within an authorized sediment impact zone due to a permitted or otherwise authorized discharge shall be at or below the chemical levels stipulated in Table II, Sediment Impact Zone Maximum Chemical Criteria, except as provided for by the marine sediment biological effects restrictions of subsection (3) of this section, and any compliance time periods established under WAC 173-204-410 (6)(d) and 173-204-415.

(a) Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit shall be reported and shall be at or below the Marine Sediment Quality Standards chemical criteria value set in WAC 173-204-320(2).

(b) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:

(i) Where chemical analyses identify an undetected value for every individual compound/isomer then the single highest detection limit shall represent the sum of the respective compounds/isomers; and

(ii) Where chemical analyses detect one or more individual compound/isomers, only the detected concentrations will be added to represent the group sum.

(c) The listed chemical parameter criteria represent concentrations in parts per million, "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

(d) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds as listed.

(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

(f) The TOTAL BENZOFLUORANTHENES criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

Table II
Puget Sound Marine Sediment Impact Zones
Maximum Chemical Criteria

CHEMICAL PARAMETER	MG/KG DRY WEIGHT (PARTS PER MILLION (PPM) DRY)
ARSENIC	93
CADMIUM	6.7
CHROMIUM	270
COPPER	390
LEAD	530
MERCURY	0.59
SILVER	6.1
ZINC	960

CHEMICAL PARAMETER	MG/KG ORGANIC CARBON (PPM CARBON)
LPAH	780
NAPHTHALENE	170
ACENAPHTHYLENE	66
ACENAPHTHENE	57
FLUORENE	79
PHENANTHRENE	480
ANTHRACENE	1200
2-METHYLNAPHTHALENE	64
HPAH	5300
FLUORANTHENE	1200
PYRENE	1400
BENZ(A)ANTHRACENE	270
CHRYSENE	460
TOTAL BENZOFLUORANTHENES	450
BENZO(A)PYRENE	210
INDENO (1,2,3,-C,D) PYRENE	88
DIBENZO (A,H) ANTHRACENE	33
BENZO(G,H,I)PERYLENE	78
1,2-DICHLOROBENZENE	2.3
1,4-DICHLOROBENZENE	9
1,2,4-TRICHLOROBENZENE	1.8
HEXACHLOROBENZENE	2.3
DIMETHYL PHTHALATE	53
DIETHYL PHTHALATE	110
DI-N-BUTYL PHTHALATE	1700
BUTYL BENZYL PHTHALATE	64
BIS (2-ETHYLHEXYL) PHTHALATE	78
DI-N-OCTYL PHTHALATE	4500
DIBENZOFURAN	58
HEXACHLOROBUTADIENE	6.2
N-NITROSODIPHENYLAMINE	11
TOTAL PCB'S	65

CHEMICAL PARAMETER	UG/KG DRY WEIGHT (PARTS PER BILLION (PPB) DRY)
PHENOL	1200
2-METHYLPHENOL	63
4-METHYLPHENOL	670
2,4-DIMETHYL PHENOL	29
PENTACHLOROPHENOL	690
BENZYL ALCOHOL	73
BENZOIC ACID	650

(3) Puget Sound marine sediment impact zone maximum biological effects criteria. The maximum biological effects level that may be allowed within an authorized sediment impact zone shall be at or below a minor adverse biological effects level. The acute and chronic effects biological tests of WAC 173-204-315(1) may be used to determine compliance with the minor adverse biological effects restriction within an authorized sediment impact zone as follows:

(a) When using biological testing to determine compliance with the maximum biological effects criteria within a sediment impact zone, a person shall select and conduct any two acute effects tests and any one chronic effects test.

(b) The biological tests shall not be considered valid unless test results for the appropriate control and reference sediment samples meet the performance standards described in WAC 173-204-315(2).

(c) The sediment impact zone maximum biological effects level is established as that level below which any two of the biological tests in any combination exceed the criteria of WAC 173-204-320(3), or one of the following biological test determinations is made:

(i) Amphipod: The test sediment has a higher (statistically significant, t test, $p \leq 0.05$) mean mortality than the reference sediment and the test sediment mean mortality is greater than a value represented by the reference sediment mean mortality plus thirty percent; or

(ii) Larval: The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t test, $p \leq 0.05$) than the mean normal survivorship in the reference sediment sample and the test sediment mean normal survivorship is less than seventy percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than thirty percent relative to time-final in the reference sediment); or

(iii) Benthic abundance: The test sediment has less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta and the test sediment abundances are statistically different (t test, $p \leq 0.05$) from the reference sediment abundances; or

(iv) Juvenile polychaete: The test sediment has a mean individual growth rate of less than fifty percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t test, $p \leq 0.05$) from the reference sediment mean individual growth rate.

(4) Puget Sound marine sediment impact zone maximum human health criteria. Reserved: The department may determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(5) Puget Sound marine sediment impact zone maximum other toxic, radioactive, biological, or deleterious substances criteria. Other toxic, radioactive, biological or deleterious substances in, or on, sediments shall be below levels which

cause minor adverse effects in marine biological resources, or which correspond to a significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(6) Puget Sound marine sediment impact zone maximum nonanthropogenically affected sediment criteria. Whenever the nonanthropogenically affected sediment quality is of a lower quality (i.e., higher chemical concentrations, higher levels of adverse biological response, or posing a higher threat to human health) than the applicable sediment impact zone maximum criteria established under this section, the existing sediment chemical and biological quality shall be identified on an area-wide basis as determined by the department, and used in place of the standards of WAC 173-204-420.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-420, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-420, filed 3/27/91, effective 4/27/91.]

PART V—SEDIMENT CLEANUP STANDARDS

WAC 173-204-500 Sediment cleanup decision process and policies. (1) The standards of WAC 173-204-500 through 173-204-590 are procedures which specify a cleanup decision process for managing contaminated sediments. These procedures include:

(a) Screening sediment station clusters of potential concern;

(b) Conducting hazard assessments to identify cleanup sites;

(c) Ranking sites identified in (b) of this subsection;

(d) Determining the appropriate site cleanup authority;

(e) Conducting a site cleanup study;

(f) Determining the site-specific cleanup standard;

(g) Selecting a site cleanup action; and

(h) Where necessary, authorizing a cleanup site sediment recovery zone.

(2) Under this chapter, the department may require or take those actions necessary to implement the standards of WAC 173-204-500 through 173-204-580 for all contaminated sediment stations on the inventory identified in WAC 173-204-350.

(3) The cleanup process and procedures under this chapter and under other laws may be combined. The department may initiate a cleanup action under this chapter and may upon further analysis determine that another law is more appropriate, or vice versa.

(4) It is the policy of the department to manage sediment cleanup actions towards the goal of reducing and ultimately eliminating adverse effects on biological resources and significant health threats to humans from sediment contamination. To achieve this goal, the department will pursue sediment cleanup decisions and cleanup standards that are as close as practicable to the sediment quality standards of WAC 173-204-320 through 173-204-340, including the consideration of net environmental effects, cost and technical feasibility. The department shall only authorize sediment recovery zones so as to minimize the number, size and adverse effects of all zones, with the intent to eliminate the existence of all such zones whenever practicable.

(5) The department shall endeavor to make sediment cleanup decisions in an expeditious manner, as soon as all needed information is available, consistent with the availability of department resources and the priority of the cleanup site.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-500, filed 3/27/91, effective 4/27/91.]

WAC 173-204-510 Screening sediment station clusters of potential concern. (1) Using the sediment quality standards inventory of WAC 173-204-350, the department shall analyze the sediment sampling data to identify station clusters of potential concern and station clusters of low concern per the standards of this section. Station clusters of potential concern shall be further evaluated using the hazard assessment standards of WAC 173-204-530. Station clusters of low concern shall remain on the inventory and no further cleanup action determinations shall be taken by the department until the stations are reexamined per subsection (5) of this section.

(2) A station cluster is defined as any number of stations from the inventory of WAC 173-204-350 that are determined to be spatially and chemically similar. For the purpose of identifying a station cluster of potential concern per the procedures of this subsection, three stations with the highest contaminant concentration for any particular contaminant or the highest degree of biological effects as identified in WAC 173-204-520 are selected from a station cluster. This procedure may be repeated for multiple chemicals identified in WAC 173-204-520, recognizing that the three stations with the highest concentration for each particular contaminant may be different and the respective areas for all chemicals may overlap. The department shall review the inventory of WAC 173-204-350 to identify station clusters of potential concern via the following process:

(a) Identify if available, the three stations within a station cluster with the highest concentration of each chemical contaminant identified in WAC 173-204-520, Cleanup screening levels criteria; and

(b) For each contaminant identified in (a) of this subsection, determine the average concentration for the contaminant at the three stations identified in (a) of this subsection; and

(c) Identify if available, three stations within the station cluster with the highest level of biological effects for the biological tests identified in WAC 173-204-315(1); and

(d) If the average contaminant concentration for any three stations identified in (a) of this subsection, exceeds the applicable cleanup screening level in WAC 173-204-520, then the station cluster is defined as a station cluster of potential concern; and

(e) If the biological effects at each of the three stations from (c) of this subsection exceeds the cleanup screening level in WAC 173-204-520, then the station cluster is defined as a station cluster of potential concern; and

(f) If neither of the conditions of (d) or (e) of this subsection apply, then the station cluster is defined as a station cluster of low concern; and

(g) If the department determines that any three stations within a station cluster exceed the sediment cleanup screening levels human health criteria or the other toxic, radioactive, biological, or deleterious substances criteria or the nonanthropogenically affected criteria of WAC 173-204-520, then the station cluster is defined as a station cluster of potential concern.

(3) Notification. When a station cluster of potential concern has been identified, the department shall issue notification to the landowners, lessees, onsite dischargers, adjacent dischargers, and other persons determined appropriate by the department prior to the department's conducting a hazard assessment as defined in WAC 173-204-530.

(4) No further cleanup action determinations shall be taken with station clusters of low concern until the inventory of WAC 173-204-350 is updated and the stations reexamined per subsection (5) of this section. Station clusters of low concern shall receive no further consideration for active cleanup, unless new information indicates an increase of chemical contamination at the stations in question. Station clusters of low concern shall be evaluated by the department for improved source control and/or monitoring requirements of this chapter.

(5) The department may at any time reexamine a station or group of stations to reevaluate and identify station clusters of potential concern following the procedures of subsection (2) of this section when new information demonstrates to the department's satisfaction that reexamination actions are necessary to fulfill the purposes of WAC 173-204-500 through 173-204-590.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-510, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-510, filed 3/27/91, effective 4/27/91.]

WAC 173-204-520 Cleanup screening levels criteria. (1) Applicability.

(a) The marine sediment cleanup screening levels chemical criteria, and the marine sediment biological effects criteria, and the marine sediment other toxic, radioactive, biological, or deleterious substance criteria, and the marine sediment nonanthropogenically affected criteria of this section shall apply to marine sediments within Puget Sound. The cleanup screening levels establish minor adverse effects as the level above which station clusters of potential concern are defined, and at or below which station clusters of low concern are defined, per the procedures identified in WAC 173-204-510(2). The cleanup screening levels also establish the levels above which station clusters of potential concern are defined as cleanup sites, per the procedures identified in WAC 173-204-530, Hazard assessment. The criteria in Table III and this section also establish minor adverse effects as the Puget Sound marine sediment minimum cleanup level to be used in evaluation of cleanup alternatives per the procedures of WAC 173-204-560, and selection of a site cleanup standard(s) per the procedures of WAC 173-204-570.

(b) Non-Puget Sound marine sediment cleanup screening levels and minimum cleanup levels criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(c) Low salinity sediment cleanup screening levels and minimum cleanup levels criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(d) Freshwater sediment cleanup screening levels and minimum cleanup levels criteria. Reserved: The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(2) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels chemical criteria. The chemical concentration criteria in Table III establish the Puget Sound marine sediment cleanup screening levels and minimum cleanup levels chemical criteria.

(a) Where laboratory analysis indicates a chemical is not detected in a sediment sample, the detection limit shall be reported and shall be at or below the Marine Sediment Quality Standards chemical criteria value set in WAC 173-204-320(2).

(b) Where chemical criteria in this table represent the sum of individual compounds or isomers, the following methods shall be applied:

(i) Where chemical analyses identify an undetected value for every individual compound/isomer then the single highest detection limit shall represent the sum of the respective compounds/isomers; and

(ii) Where chemical analyses detect one or more individual compound/isomers, only the detected concentrations will be added to represent the group sum.

(c) The listed chemical parameter criteria represent concentrations in parts per million, "normalized," or expressed, on a total organic carbon basis. To normalize to total organic carbon, the dry weight concentration for each parameter is divided by the decimal fraction representing the percent total organic carbon content of the sediment.

(d) The LPAH criterion represents the sum of the following "low molecular weight polynuclear aromatic hydrocarbon" compounds: Naphthalene, Acenaphthylene, Acenaphthene, Fluorene, Phenanthrene, and Anthracene. The LPAH criterion is not the sum of the criteria values for the individual LPAH compounds as listed.

(e) The HPAH criterion represents the sum of the following "high molecular weight polynuclear aromatic hydrocarbon" compounds: Fluoranthene, Pyrene, Benz(a)anthracene, Chrysene, Total Benzofluoranthenes, Benzo(a)pyrene, Indeno(1,2,3,-c,d)pyrene, Dibenzo(a,h)anthracene, and Benzo(g,h,i)perylene. The HPAH criterion is not the sum of the criteria values for the individual HPAH compounds as listed.

(f) The TOTAL BENZOFLUORANTHENES criterion represents the sum of the concentrations of the "B," "J," and "K" isomers.

Table III
Puget Sound Marine Sediment
Cleanup Screening Levels
and
Minimum Cleanup Levels ---
Chemical Criteria

CHEMICAL PARAMETER	MG/KG DRY WEIGHT (PARTS PER MILLION (PPM) DRY)
ARSENIC	93
CADMIUM	6.7
CHROMIUM	270
COPPER	390
LEAD	530
MERCURY	0.59
SILVER	6.1
ZINC	960

CHEMICAL PARAMETER	MG/KG ORGANIC CARBON (PPM CARBON)
LPAH	780
NAPHTHALENE	170
ACENAPHTHYLENE	66
ACENAPHTHENE	57
FLUORENE	79
PHENANTHRENE	480
ANTHRACENE	1200
2-METHYLNAPHTHALENE	64
HPAH	5300
FLUORANTHENE	1200
PYRENE	1400
BENZ(A)ANTHRACENE	270
CHRYSENE	460
TOTAL BENZOFLUORANTHENES	450
BENZO(A)PYRENE	210
INDENO (1,2,3,-C,D) PYRENE	88
DIBENZO (A,H) ANTHRACENE	33
BENZO(G,H,I)PERYLENE	78
1,2-DICHLOROBENZENE	2.3
1,4-DICHLOROBENZENE	9
1,2,4-TRICHLOROBENZENE	1.8
HEXACHLOROBENZENE	2.3
DIMETHYL PHTHALATE	53
DIETHYL PHTHALATE	110
DI-N-BUTYL PHTHALATE	1700
BUTYL BENZYL PHTHALATE	64
BIS (2-ETHYLHEXYL) PHTHALATE	78
DI-N-OCTYL PHTHALATE	4500
DIBENZOFURAN	58
HEXACHLOROBUTADIENE	6.2
N-NITROSODIPHENYLAMINE	11
TOTAL PCB'S	65

CHEMICAL PARAMETER	UG/KG DRY WEIGHT (PARTS PER BILLION (PPB) DRY)
PHENOL	1200
2-METHYLPHENOL	63
4-METHYLPHENOL	670
2,4-DIMETHYL PHENOL	29
PENTACHLOROPHENOL	690
BENZYL ALCOHOL	73
BENZOIC ACID	650

(3) Puget Sound marine sediment cleanup screening levels and minimum cleanup level biological criteria. The biological effects criteria of this subsection establish the Puget Sound marine sediment cleanup screening level, and the Puget Sound marine sediment minimum cleanup level criteria.

(a) The acute and chronic effects biological tests of WAC 173-204-315(1) shall be used to:

(i) Identify the Puget Sound marine sediment cleanup screening level for the purpose of screening sediment station clusters of potential concern using the procedures of WAC 173-204-510(2); and

(ii) Identify the Puget Sound marine sediment cleanup screening level for the purpose of identifying station clusters of low concern and/or cleanup sites using the hazard assessment procedures of WAC 173-204-530(4); and/or

(iii) Identify the Puget Sound marine sediment minimum cleanup level to confirm minimum cleanup level determinations using the procedures of WAC 173-204-570(3).

(b) When using biological testing to determine if station clusters exceed the cleanup screening level or to identify the minimum cleanup level for a contaminated site, test results from at least two acute effects tests and one chronic effects test shall be evaluated.

(c) The biological tests shall not be considered valid unless test results for the appropriate control and reference sediment samples meet the performance standards described in WAC 173-204-315(2).

(d) The cleanup screening level and minimum cleanup level is exceeded when any two of the biological tests exceed the criteria of WAC 173-204-320(3); or one of the following test determinations is made:

(i) Amphipod: The test sediment has a higher (statistically significant, t test, $p \leq 0.05$) mean mortality than the reference sediment and the test sediment mean mortality is greater than a value represented by the reference sediment mean mortality plus thirty percent.

(ii) Larval: The test sediment has a mean survivorship of normal larvae that is less (statistically significant, t test, $p \leq 0.05$) than the mean normal survivorship in the reference sediment and the test sediment mean normal survivorship is less than seventy percent of the mean normal survivorship in the reference sediment (i.e., the test sediment has a mean combined abnormality and mortality that is greater than thirty percent relative to time-final in the reference sediment).

(iii) Benthic abundance: The test sediment has less than fifty percent of the reference sediment mean abundance of any two of the following major taxa: Class Crustacea, Phylum Mollusca or Class Polychaeta and the test sample abundances are statistically different (t test, $p \leq 0.05$) from the reference abundances.

(iv) Juvenile polychaete: The test sediment has a mean individual growth rate of less than fifty percent of the reference sediment mean individual growth rate and the test sediment mean individual growth rate is statistically different (t test, $p \leq 0.05$) from the reference sediment mean individual growth rate.

(4) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels human health criteria. Reserved: The department may determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(5) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels other toxic, radioactive, biological, or deleterious substances criteria. Other toxic, radioactive, biological, or deleterious substances in, or on, sediments shall be at or below levels which cause minor adverse effects in marine biological resources, or which correspond to a significant health risk to humans, as determined by the department. The department shall determine on a case-by-case basis the criteria, methods, and procedures necessary to meet the intent of this chapter.

(6) Puget Sound marine sediment cleanup screening levels and minimum cleanup levels nonanthropogenically affected sediment criteria. Whenever the nonanthropogenically affected sediment quality is of a lower quality (i.e., higher chemical concentrations, higher levels of adverse biological response, or posing a higher threat to human health) than the applicable cleanup screening levels or minimum cleanup levels criteria established under this section, the existing sediment chemical and biological quality shall be identified on an area-wide basis as determined by the department, and used in place of the standards of WAC 173-204-520.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-520, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-520, filed 3/27/91, effective 4/27/91.]

WAC 173-204-530 Hazard assessment and site identification. (1) Purpose. A hazard assessment shall be performed to gather existing and available information to further characterize each station cluster of potential concern identified per WAC 173-204-510.

(2) Hazard assessment requirements. Onsite dischargers, lessees, landowners, and adjacent dischargers shall submit, upon the department's request, all existing and available information that would enable the department to:

(a) Determine the concentration and/or areal extent and depth of sediment contamination at the station cluster of potential concern by:

(i) Identifying the contaminants exceeding the applicable sediment quality standards of WAC 173-204-320 through 173-204-340;

(ii) Identifying individual stations within the station cluster of potential concern which exceed the sediment cleanup screening levels criteria of WAC 173-204-520;

(iii) Identifying the level of toxicity to the applicable biological test organisms of WAC 173-204-320 through 173-204-340;

(iv) Determining where the applicable sediment quality standards of WAC 173-204-320 through 173-204-340, for any given contaminant, is met;

(v) Determining if concentrations of chemicals exist that potentially present a significant threat to human health;

(vi) Defining the location where the minimum cleanup level as defined in WAC 173-204-570 is met.

(b) Identify and characterize the present and historic source or sources of the contamination.

(c) Identify the location of sediment impact zones authorized under WAC 173-204-415.

(d) Identify sensitive resources in the vicinity of the station cluster of potential concern.

(e) Provide other information as determined necessary by the department for ranking sites under WAC 173-204-540.

(3) The department shall also compile existing and available information from other federal, state, and local governments that pertain to the topics in subsection (2) of this section.

(4) To identify cleanup sites, the department shall use all available information of acceptable quality gathered from the hazard assessment to evaluate station clusters of potential concern identified pursuant to WAC 173-204-510(2). For the purpose of identifying a cleanup site per the procedures of this subsection, three stations with the highest contaminant concentration for any particular contaminant or the highest degree of biological effects as identified in WAC 173-204-520 are selected from a station cluster of potential concern. This procedure may be repeated for multiple chemicals identified in WAC 173-204-520, recognizing that the three stations with the highest concentration for each particular contaminant may be different and the respective areas for all chemicals may overlap. The department shall review the list of station clusters of potential concern to identify cleanup sites via the following process:

(a) Identify if available, three stations within the station cluster of potential concern with the highest level of biological effects for the biological tests identified in WAC 173-204-315(1).

(b) Station clusters of potential concern where the level of biological effects for any three stations within the station cluster of potential concern exceeds the cleanup screening levels of WAC 173-204-520(3) shall be defined as cleanup sites.

(c) Identify if available, the three stations within a station cluster of potential concern with the highest concentration of each chemical contaminant identified in WAC 173-204-520, Cleanup screening levels criteria. For the purpose of identifying a cleanup site per the procedures of this subsection, stations that meet the biological standards of WAC 173-204-520(3) shall not be included in the evaluation of chemical contaminant concentrations.

(d) For each contaminant identified in (c) of this subsection, determine the average concentration for the contaminant at the three stations identified in (c) of this subsection.

(e) Station clusters of potential concern for which any average chemical concentration identified in (d) of this subsection exceeds the cleanup screening level chemical criteria of Table III shall be defined as cleanup sites.

(f) After completion of the hazard assessment, if neither of the conditions of (b) or (e) of this subsection apply, then the station cluster is defined as a station cluster of low concern.

(g) Station clusters of potential concern where the department determines that any three stations within the station cluster of potential concern exceed the sediment cleanup screening levels human health criteria or the other toxic, radioactive, biological, or deleterious substances criteria or the nonanthropogenically affected criteria of WAC 173-204-520, shall be defined as cleanup sites.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-530, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-530, filed 3/27/91, effective 4/27/91.]

WAC 173-204-540 Ranking and list of sites. (1) Purpose. The department shall prepare and maintain a list of contaminated sediment sites in the order of their relative hazard ranking. From this list, the department shall select sites where action shall be taken.

(2) Site ranking. The department shall evaluate each cleanup site identified by the procedures in WAC 173-204-

530 on a consistent basis using the procedure described in *Sediment Ranking System ("SEDRANK"), January 1990,* and all additions and revisions thereto or other procedures approved by the department. The purpose of ranking is to estimate, based on technical information compiled during the hazard assessment procedures in WAC 173-204-530, the relative potential risk posed by the site to human health and the environment. Information obtained during hazard assessment, plus any additional data specified in "SEDRANK," shall be included in the site hazard ranking evaluation.

(3) Considerations in ranking. In conducting sediment site ranking, the department shall assess both human health hazard and ecological hazard, and consider chemical toxicity, affected resources, and site characteristics for both types of hazards. The department shall also use best professional judgment and other information as necessary on a case-by-case basis to conduct site ranking.

(4) Site reranking. The department may, at its discretion, rerank a site. To rerank a site, the department shall use any additional information within the scope of the hazard ranking evaluation criteria and best professional judgment to establish that a significant change in rank should result.

(5) List of ranked sites.

(a) Contaminated sediment sites that are ranked via "SEDRANK" shall be placed on a list in the order of their relative hazard ranking. The list shall describe the current status of cleanup action at each site and be updated on an annual basis. The department may change a site's status to reflect current conditions on a more frequent basis. The status for each site shall be identified as one or more of the following:

(i) Sites awaiting cleanup action;

(ii) Sites where voluntary, incidental, partial or department initiated cleanup actions, as defined in WAC 173-204-550, are in progress;

(iii) Sites where a cleanup action has been completed and confirmational monitoring is underway;

(iv) Sites with sediment recovery zones authorized under WAC 173-204-590; and/or

(v) Other categories established by the department.

(b) The department shall routinely publish and make the list available to be used in conjunction with a review of ongoing and proposed regulatory actions to determine where and when a cleanup action should be taken. The department shall also make the list available to landowners and dischargers at or near listed sites, and to the public.

(6) Site delisting.

(a) The department may remove a site from the list only after it has determined that:

(i) All cleanup actions except confirmational monitoring have been completed and compliance with the site cleanup study and report and cleanup standard(s) has been achieved; or

(ii) The listing of the site was erroneous.

(b) A site owner or operator may request that a site be removed from the list by submitting a petition to the department. The petition shall state the reason for the site delisting request, and as determined appropriate by the department, shall include thorough documentation of all investigations performed, all cleanup actions taken, and all compliance monitoring data and results to demonstrate to the department's satisfaction that the site cleanup standards have been achieved. The department may require payment of costs incurred, including an advance deposit, for review and verification of the work performed. The department shall review such petitions, however the timing of the review shall be at its discretion and as resources may allow.

(c) The department shall maintain a record of sites that have been removed from the list under (a) of this subsection. This record shall be made available to the public on request.

(7) Relisting of sites. The department may relist a site which has previously been removed if it determines that the site requires further cleanup action.

(8) Delisting notice. The department shall provide public notice and an opportunity to comment when the department proposes to remove a site from the list.

(9) Relationship to hazardous sites list. The department may additionally evaluate cleanup sites on the site list developed under subsection (5) of this section for possible inclusion on the hazardous sites list published under WAC 173-340-330.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-540, filed 3/27/91, effective 4/27/91.]

WAC 173-204-550 Types of cleanup and authority. (1) Purpose. The department acknowledges that cleanups of contaminated sediment sites can occur under the authority of chapter 90.48 or 70.105D RCW. Sediment cleanups may also be initiated by the federal government pursuant to the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA). This section describes the department's role in department initiated and other cleanup actions.

(2) The department shall use best professional judgment and other information as necessary on a case-by-case basis to determine the appropriate administrative authority for conducting, or requiring contaminated sediment cleanup actions based on, but not limited to, the following considerations:

(a) Source of contaminants requiring cleanup including spills, dredging actions, and wastewater and/or storm water discharges;

(b) Significance of contamination threat to human health and the environment including the degree of contamination and types and number of contaminants;

(c) Public perception concerning the contaminant threat to human health and the environment;

(d) Personal or corporate financial status of the landowner(s) and/or discharger(s);

(e) Enforcement compliance history of the landowner(s) and/or discharger(s);

(f) Status of existing or pending federal, state, or local legal orders or administrative actions; and

(g) Size of cleanup action proposed or determined necessary.

(3) The types of cleanup actions below establish scenarios recognized by the department which may occur to effect cleanup of contaminated sediment sites. All of these types of cleanup actions shall be subject to administrative review and approval of the department under chapters 90.48 and/or 70.105D RCW.

(a) Department initiated cleanup. Department initiated cleanup actions occur when the department uses its authority under chapter 90.48 and/or 70.105D RCW to conduct or require and/or otherwise effect cleanup to meet the intent of this chapter.

(b) Voluntary cleanup. Voluntary cleanup actions are initiated by parties other than the department. The department shall encourage voluntary cleanup actions whenever possible, and as early as possible, to meet the intent of this chapter.

(c) Incidental cleanup. Incidental cleanup actions are conducted when other state or federally permitted activities are ongoing in and/or around the contaminated sediment site. Early coordination of incidental cleanup actions with the department is encouraged to meet the intent of this chapter, chapter 70.105D RCW, and chapter 90.48 RCW, as appropriate.

(d) Partial cleanup. Partial cleanup actions may be conducted when completion of cleanup study requirements under WAC 173-204-560 has identified and proposed discrete site units and cleanup standards, the department has approved the selection of the partial cleanup alternative per the standards of WAC 173-204-580, and the department has determined that awaiting action or decision on conducting a complete site cleanup would have a net detrimental effect on the environment or human health.

(e) CERCLA cleanup. Pursuant to the federal Comprehensive Environmental Response, Compensation and Liability Act, the department may identify chapter 173-204 WAC as an applicable state requirement for cleanup actions conducted by the federal government.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-550, filed 3/27/91, effective 4/27/91.]

WAC 173-204-560 Cleanup study. (1) Purpose. This section describes cleanup study plan and report standards which meet the intent of cleanup actions required under authority of chapter 90.48 and/or 70.105D RCW, and/or this chapter. Cleanup actions required under authority of chapter 70.105D RCW shall also meet all standards of chapter 173-340 WAC, the Model Toxics Control Act cleanup regulation. The cleanup study plan and report standards in this chapter include activities to collect, develop, and evaluate sufficient information to enable consideration of cleanup alternatives and selection of a site-specific sediment cleanup standard prior to making a cleanup decision. Each person performing a cleanup action to meet the intent of this chapter shall submit a cleanup study plan and cleanup study report to the department for review and written approval prior to implementation of the cleanup action. The department may approve the cleanup study plan as submitted, may approve the cleanup study plan with appropriate changes or additions, or may require preparation of a new cleanup study plan.

(2) Scope of cleanup study plan. The scope of a cleanup study plan shall depend on the specific site informational needs, the site hazard, the type of cleanup action proposed, and the authority cited by the department to require cleanup. In establishing the necessary scope of the cleanup study plan, the department may consider cost mitigation factors, such as the financial resources of the person(s) responsible for the cleanup action. In all cases sufficient information must be collected, developed, and evaluated to enable the appropriate selection of a cleanup standard under WAC 173-204-570 and a cleanup action decision under WAC 173-204-580. The sediment cleanup study plan shall address:

(a) Public information/education;

(b) Site investigation and cleanup alternatives evaluation;

(c) Sampling plan and recordkeeping; and

(d) Site safety.

(3) Cleanup study plan public information/education requirements. The cleanup study plan shall encourage coordinated and effective public involvement commensurate with the nature of the proposed cleanup action, the level of public concern, and the existence of, or potential for adverse effects on biological resources and/or a threat to human health. The cleanup study plan shall address proposed activities for the following subjects:

(a) When public notice will occur, the length of the comment periods accompanying each notice, the potentially affected vicinity, and any other areas to be provided notice;

(b) Where public information repositories will be located to provide site information to the public;

(c) Methods for identifying the public's concerns, e.g., interviews, questionnaires, community group meetings, etc.;

(d) Methods for providing information to the public, e.g., press releases, public meetings, fact sheets, etc.;

(e) Coordination of public participation requirements mandated by other federal, state, or local laws;

(f) Amendments to the planned public involvement activities; and

(g) Any other elements that the department determines to be appropriate for inclusion in the cleanup study plan.

(4) Cleanup study plan site investigation and cleanup alternatives evaluation requirements. The content of the cleanup study plan for the site investigation and cleanup alternatives evaluation is determined by the type of cleanup action selected as defined under WAC 173-204-550. As determined by the department, the cleanup study plan shall address the following subjects:

(a) General site information. General information, including: Project title; name, address, and phone number of project coordinator; legal description of the cleanup site; area and volume dimensions of the site; present owners and operators of contaminant source discharges to site; chronological listing of past owners and operators of contaminant source discharges to the site and their respective operational history; and other pertinent information determined by the department.

(b) Site conditions map. An existing site conditions map which illustrates site features as follows:

(i) Property boundaries.

(ii) The site boundary defined by the individual contaminants exceeding the applicable sediment quality standards of WAC 173-204-320 through 173-204-340 at the point where the concentration of the contaminant would meet the:

(A) Cleanup objective; and

(B) Minimum cleanup level; and

(C) Recommended cleanup standards.

(iii) Surface and subsurface topography.

(iv) Surface and subsurface structures.

(v) Utility lines.

(vi) Navigation lanes.

(vii) Current and ongoing sediment sources.

(viii) Other pertinent information determined by the department.

(c) Site investigation. Sufficient investigation to characterize the distribution of sediment contamination present at the site, and the threat or potential threat to human health and the environment. Where applicable to the site, these investigations shall address the following:

(i) Surface water and sediments. Investigations of surface water hydrodynamics and sediment transport mechanisms to characterize significant hydrologic features such as: Site surface water drainage patterns, quantities and flow rates, areas of sediment erosion and deposition including estimates of sedimentation rates, and actual or potential contaminant migration routes to and from the site and within the site. Sufficient surface water and sediment sampling shall be performed to adequately characterize the areal and vertical distribution and concentrations of contaminants. Recontamination potential of sediments which are likely to influence the type and rate of contaminant migration, or are likely to affect the ability to implement alternative cleanup actions shall be characterized;

(ii) Geology and ground water system characteristics. Investigations of site geology and hydrogeology to adequately characterize the physical properties and distribution of sediment types, and the characteristics of ground water flow rate, ground water gradient, ground water discharge areas, and ground water quality data which may affect site cleanup alternatives evaluations;

(iii) Climate. Information regarding local and regional climatological characteristics which are likely to affect surface water hydrodynamics, ground water flow characteristics, and migration of sediment contaminants such as: Seasonal patterns of rainfall; the magnitude and frequency of significant storm events; prevailing wind direction and velocity;

(iv) Land use. Information characterizing human populations exposed or potentially exposed to sediment contaminants released from the site and present and proposed uses and zoning for shoreline areas contiguous with the site; and

(v) Natural resources and ecology. Information to determine the impact or potential impact of sediment contaminants from the site on natural resources and ecology of the area such as: Sensitive environment, local and regional habitat, plant and animal species, and other environmental receptors.

(d) Sediment contaminant sources. A description of the location, quantity, areal and vertical extent, concentration and sources of active and inactive waste disposal and other sediment contaminant discharge sources which affect or potentially affect the site. Where determined relevant by the department, the following information shall be obtained by the department from the responsible discharger:

(i) The physical and chemical characteristics, and the biological effects of site sediment contaminant sources;

(ii) The status of source control actions for permitted and unpermitted site sediment contaminant sources; and

(iii) A recommended compliance time frame for known permitted and unpermitted site sediment contaminant sources which affect or potentially affect implementation of the timing and scope of the site cleanup action alternatives.

(e) Human health risk assessment. The current and potential threats to human health that may be posed by sediment site contamination shall be evaluated using a risk assessment procedure approved by the department.

(f) Cleanup action alternatives. Each cleanup study plan shall include an evaluation of alternative cleanup actions that protect human health and the environment by eliminating, reducing, or otherwise controlling risks posed through each exposure pathway and migration route. The number and types of alternatives to be evaluated shall take into account the characteristics and complexity of the site.

(i) The proposed site cleanup alternatives may include establishment of site units, as defined in WAC 173-204-200(24), with individual cleanup standards within the range required by WAC 173-204-570, based on site physical characteristics and complexity, and cleanup standard alternatives established on consideration of cost, technical feasibility, and net environmental impact.

(ii) The proposed site cleanup alternatives may include establishment of a sediment recovery zone as authorized under WAC 173-204-590, Sediment recovery zones. Establishment or expansion of a sediment recovery zone shall not be used as a substitute for active cleanup actions, when such actions are practicable and meet the standards of WAC 173-204-580. The cleanup study plan shall include the following information for evaluation of sediment recovery zone alternatives:

(A) The time period during which a sediment recovery zone is projected to be necessary based on source loading and net environmental recovery processes determined by application of the department's sediment recovery zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment recovery zone model(s) approved by the department under WAC 173-204-130(4) as limited by the standards of this section and the department's best professional judgment;

(B) The legal location and landowner(s) of property proposed as a sediment recovery zone;

(C) Operational terms and conditions including, but not limited to proposed confirmational monitoring actions for discharge effluent and/or receiving water column and/or sediment chemical monitoring studies and/or bioassays to evaluate ongoing water quality, sediment quality, and biological conditions within and adjacent to the proposed or authorized sediment recovery zone to confirm source loading and recovery rates in the proposed sediment recovery zone.

(D) Potential risks posed by the proposed sediment recovery zone to human health and the environment;

(E) The technical practicability of elimination or reduction of the size and/or degree of chemical contamination and/or level of biological effects within the proposed sediment recovery zone; and

(F) Current and potential use of the sediment recovery zone, surrounding areas, and associated resources that are, or may be, affected by releases from the zone.

(G) The need for institutional controls or other site use restrictions to reduce site contamination risks to human health.

(iii) A phased approach for evaluation of alternatives may be required for certain sites, including an initial screening of alternatives to reduce the number of potential remedies for the final detailed evaluation. The final evaluation of cleanup action alternatives that pass the initial screening shall consider the following factors:

(A) Overall protection of human health and the environment, time required to attain the cleanup standard(s), and on-site and off-site environmental impacts and risks to human health resulting from implementing the cleanup alternatives;

(B) Attainment of the cleanup standard(s) and compliance with applicable federal, state, and local laws;

(C) Short-term effectiveness, including protection of human health and the environment during construction and implementation of the alternative; and

(D) Long-term effectiveness, including degree of certainty that the alternative will be successful, long-term reliability, magnitude of residual, biological and human health risk, and effectiveness of controls for ongoing discharges and/or controls required to manage treatment residues or remaining wastes cleanup and/or disposal site risks;

(g) Ability to be implemented. The ability to be implemented including the potential for landowner cooperation, consideration of technical feasibility, availability of needed off-site facilities, services and materials, administrative and regulatory requirements, scheduling, monitoring requirements, access for construction, operations and monitoring, and integration with existing facility operations and other current or potential cleanup actions;

(h) Cost, including consideration of present and future direct and indirect capital, operation, and maintenance costs and other foreseeable costs;

(i) The degree to which community concerns are addressed;

(j) The degree to which recycling, reuse, and waste minimization are employed; and

(k) Environmental impact. Sufficient information shall be provided to fulfill the requirements of chapter 43.21C RCW, the State Environmental Policy Act. Discussions of significant short-term and long-term environmental impacts, significant irrevocable commitments of natural resources, significant alternatives including mitigation measures, and significant environmental impacts which cannot be mitigated shall be included.

(5) Cleanup study plan — sampling plan and recordkeeping requirements. The cleanup study plan shall address proposed sampling and recordkeeping activities to meet the standards of WAC 173-204-600, Sampling and testing plan standards, and WAC 173-204-610, Records management, and the standards of this section.

(6) Cleanup study plan site safety requirements. The cleanup study plan shall address proposed activities to meet the requirements of the Occupational Safety and Health Act of 1970 (29 U.S.C. Sec. 651 et seq.) and the Washington Industrial Safety and Health Act (chapter 49.17 RCW), and regulations promulgated pursuant thereto. These requirements are subject to enforcement by the designated federal and state agencies. Actions taken by the department under this chapter do not constitute an exercise of statutory authority within the meaning of section (4)(b)(1) of the Occupational Safety and Health Act.

(7) Cleanup study report. Each person performing a cleanup action to meet the intent of this chapter shall submit a cleanup study report to the department for review and written approval of a cleanup decision prior to implementation of the cleanup action. The sediment cleanup study report shall include the results of cleanup study site investigations conducted pursuant to subsection (4) of this section, and preferred and alternate cleanup action proposals based on the results of the approved cleanup study plan.

(8) Sampling access. In cases where the person(s) responsible for cleanup is not able to secure access to sample sediments on lands subject to a cleanup study plan approved by the department, the department may facilitate negotiations or other proceedings to secure access to the lands. Requests for department facilitation of land access for sampling shall be submitted to the department in writing by the person(s) responsible for the cleanup action study plan.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-560, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-560, filed 3/27/91, effective 4/27/91.]

WAC 173-204-570 Sediment cleanup standards. (1) Applicability and purpose. This section establishes the sediment cleanup standards requirements for cleanup actions required under authority of chapter 90.48 and/or 70.105D RCW, and/or this chapter, and describes the process to determine site-specific cleanup standards.

(2) Cleanup objective. The sediment cleanup objective shall be to eliminate adverse effects on biological resources and significant health threats to humans from sediment contamination. The sediment cleanup objective for all cleanup actions shall be the sediment quality standards as defined in WAC 173-204-320 through 173-204-340, as applicable. The sediment cleanup objective identifies sediments that have no acute or chronic adverse effects on biological resources, and which correspond to no significant health risk to humans, as defined in this chapter.

(3) Minimum cleanup level. The minimum cleanup level is the maximum allowed chemical concentration and level of biological effects permissible at the cleanup site to be achieved by year ten after completion of the active cleanup action.

(a) The minimum cleanup levels criteria of WAC 173-204-520 shall be used in evaluation of cleanup alternatives per the procedures of WAC 173-204-560, and selection of a site cleanup standard(s) per the procedures of this section.

(b) The Puget Sound marine sediment minimum cleanup level is established by the following:

(i) Sediments with chemical concentrations at or below the chemical criteria of Table III shall be determined to meet the minimum cleanup level, except as provided in (b)(iv) of this subsection; and

(ii) Sediments with chemical concentrations that are higher than the chemical criteria of Table III shall be deter-

mined to exceed the minimum cleanup level, except as provided in (b)(iii) of this subsection; and

(iii) Sediments with biological effects that do not exceed the levels of WAC 173-204-520(3) shall be determined to meet the minimum cleanup level; and

(iv) Sediments with biological effects that exceed the levels of WAC 173-204-520(3) shall be determined to exceed the minimum cleanup level; and

(v) Sediments which exceed the sediment minimum cleanup level human health criteria or the other toxic, radioactive, biological, or deleterious substances criteria or the nonanthropogenically affected criteria of WAC 173-204-520 as determined by the department, shall be determined to exceed the minimum cleanup level.

(4) Sediment cleanup standard. The sediment cleanup standards are established on a site-specific basis within an allowable range of contamination. The lower end of the range is the sediment cleanup objective as defined in subsection (2) of this section. The upper end of the range is the minimum cleanup level as defined in subsection (3) of this section. The site specific cleanup standards shall be as close as practicable to the cleanup objective but in no case shall exceed the minimum cleanup level. For any given cleanup action, either a site-specific sediment cleanup standard shall be defined, or multiple site unit sediment cleanup standards shall be defined. In all cases, the cleanup standards shall be defined in consideration of the net environmental effects (including the potential for natural recovery of the sediments over time), cost and engineering feasibility of different cleanup alternatives, as determined through the cleanup study plan and report standards of WAC 173-204-560.

(5) All cleanup standards must ensure protection of human health and the environment, and must meet all legally applicable federal, state, and local requirements.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-570, filed 3/27/91, effective 4/27/91.]

WAC 173-204-580 Cleanup action decision. (1) Each person performing a cleanup action to meet the intent of this chapter shall comply with the standards of WAC 173-204-560(7), Cleanup study report. Except for cleanups conducted under chapter 70.105D RCW, the department shall review each cleanup study report and issue a written approval of one or more of the cleanup action alternatives described in the cleanup study report, or issue a written disapproval of all alternatives described in the cleanup study report. The department's approval of one or more cleanup study report cleanup action alternatives shall constitute the cleanup decision and shall be referenced in one or more permit or administrative authorities established under chapter 90.48 or 70.105D RCW, Section 401 of the federal Clean Water Act, chapter 173-225 WAC, establishment of implementation procedures of application for certification, or other administrative authorities available to the department. The department may approve the cleanup alternative recommended in the cleanup study report, may approve a different alternative discussed in the report, or may approve an alternative(s) with appropriate conditions. The department's disapproval of all cleanup study report cleanup action alternatives shall be issued by certified mail, return receipt requested, to the cleanup action proponent(s). The procedures for department review of the cleanup study report and selection of a cleanup action under chapter 70.105D RCW shall be in accordance with the procedures of chapter 173-340 WAC.

(2) All cleanup actions conducted under this chapter shall meet the following requirements:

(a) Receive department review and written approval of the preferred and/or alternate cleanup actions and necessary sediment recovery zones proposed in the cleanup study report prior to implementing a cleanup action(s);

(b) Achieve a degree of cleanup that is protective of human health and the environment;

(c) Achieve compliance with applicable state, federal, and local laws;

(d) Achieve compliance with site cleanup standards;

(e) Achieve compliance with sediment source control requirements pursuant to WAC 173-204-400 through 173-204-420, if necessary;

(f) Provide for landowner review of the cleanup study plan and report, and consider public concerns raised during review of the draft cleanup report; and

(g) Provide adequate monitoring to ensure the effectiveness of the cleanup action.

(3) Cleanup time frame.

(a) The cleanup action selected shall provide for a reasonable time frame for completion of the cleanup action, based on consideration of the following factors:

(i) Potential risks posed by the site to biological resources and human health;

(ii) Practicability of achieving the site cleanup standards in less than a ten-year period;

(iii) Current use of the site, surrounding areas, and associated resources that are, or may be, affected by the site contamination;

(iv) Potential future use of the site, surrounding areas, and associated resources that are, or may be, affected by the site contamination;

(v) Likely effectiveness and reliability of institutional controls;

(vi) Degree of, and ability to control and monitor, migration of contamination from the site; and

(vii) Natural recovery processes which are expected to occur at the site that will reduce concentrations of contaminants.

(b) The department may authorize cleanup time frames that exceed the ten-year period used in deriving the site cleanup standards of WAC 173-204-570(4) where cleanup actions are not practicable to accomplish within a ten-year period.

(4) In evaluating cleanup action alternatives, the department shall consider:

(a) The net environmental effects of the alternatives, including consideration of residual effects, recovery rates, and any adverse effects of cleanup construction or disposal activities;

(b) The relative cost-effectiveness of the alternatives in achieving the approved site cleanup standards; and

(c) The technical effectiveness and reliability of the alternatives.

(5) Public participation. The department shall provide opportunity for public review and comment on all cleanup action study plans, reports, and decisions reviewed and approved by the department, for cleanup actions conducted under this chapter.

(6) Land access. In cases where the person(s) responsible for cleanup is not able to secure access to lands subject to a cleanup action decision made pursuant to this section, the department may facilitate negotiations or other proceedings to secure access to the lands. Requests for department facilitation of land access shall be submitted to the department in writing by the person(s) named in the cleanup action approval.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-580, filed 3/27/91, effective 4/27/91.]

WAC 173-204-590 Sediment recovery zones. (1) The purpose of this section is to set forth the requirements for establishment and monitoring of sediment recovery zones to meet the intent of sediment quality dilution zones authorized pursuant to RCW 90.48.520. The standards of this section are applicable to cleanup action decisions made pursuant to WAC 173-204-580 where selected actions leave in place marine, low salinity, or freshwater sediments that exceed the applicable sediment quality standards of WAC 173-204-320 through 173-204-340.

(2) General requirements. Authorization of a sediment recovery zone by the department shall require compliance with the following general requirements:

(a) The sediment recovery zone shall be determined by application of the department's sediment recovery zone computer models "CORMIX," "PLUMES," and/or "WASP," or an alternate sediment recovery zone model(s) approved by the department under WAC 173-204-130(4) as limited by the standards of this section and the department's best professional judgment.

(b) The department shall provide specific authorization for a sediment recovery zone within the written approval of the cleanup study report and cleanup decision required under WAC 173-204-580.

(c) The time period during which a sediment recovery zone is authorized by the department shall be so stated in the department's written approval of the cleanup study report and cleanup decision.

(d) The department's written sediment recovery zone authorization shall identify the legal location and landowners of property proposed as a sediment recovery zone.

(e) Operational terms and conditions for the authorized sediment recovery zone pursuant to subsection (5) of this section shall be maintained at all times.

(f) Where cleanup is not practicable pursuant to the analysis under WAC 173-204-570(4), sediment recovery zones may be authorized for periods in excess of ten years.

(3) A sediment recovery zone authorization issued by the department under the authority of chapter 90.48 or 70.105D RCW, or other administrative means available to the department, does not constitute authorization to trespass on lands not owned by the applicant. These requirements do not address, and in no way alter, the legal rights, responsibilities, or liabilities of the permittee or landowner of the sediment recovery zone for any applicable requirements of proprietary, real estate, tort, and/or other laws not directly expressed as a requirement of this chapter.

(4) Prior to authorization, the department shall make a reasonable effort to identify and notify all landowners affected by the proposed sediment recovery zone. The department shall issue a sediment recovery zone notification letter to any person it believes to be a potentially affected landowner and other parties determined appropriate by the department. The notification letter shall be sent by certified mail, return receipt requested, or by personal service. The notification letter shall provide:

(a) The name of the person the department believes to be the affected landowner; and

(b) The names of other affected landowners to whom the department has sent a proposed sediment recovery zone notification letter; and

(c) The name of the sediment recovery zone applicant; and

(d) A general description of the proposed sediment recovery zone including the chemical(s) of concern by name and concentration, and the area of affected sediment; and

(e) The determination of the department concerning whether the proposed sediment recovery zone application meets the standards of this section; and

(f) The intention of the department whether to authorize the proposed sediment recovery zone; and

(g) Notification that the affected landowner may comment on the proposed sediment recovery zone. Any landowner comments shall be submitted in writing to the department within thirty days from the date of receipt of the notification letter, unless the department provides an extension.

(5) As determined necessary by the department, operational terms and conditions for the sediment recovery zone may include completion and submittal to the department of discharge effluent and/or receiving water column and/or sediment chemical monitoring studies and/or bioassays to evaluate ongoing water quality, sediment quality, and biological conditions within and adjacent to the proposed or authorized sediment recovery zone.

(6) The department shall review all data or studies conducted in accordance with a sediment recovery zone authorization to ensure compliance with the terms and conditions of the authorization and the standards of this section. Whenever, in the opinion of the department, the operational terms and conditions of a sediment recovery zone or the standards of this section are violated or there is a potential to violate the sediment recovery zone authorization or the standards of this section, or new information or a reexamination of existing information indicates the sediment recovery zone is no longer appropriate, the department may at its discretion:

(a) Require additional chemical or biological monitoring as necessary;

(b) Revise the sediment recovery zone authorization as necessary to meet the standards of this section;

(c) Require active contaminated sediment maintenance actions including additional cleanup in accordance with the standards of WAC 173-204-500 through 173-204-580; and/or

(d) Withdraw the department's authorization of the sediment recovery zone.

[Statutory Authority: RCW 90.48.220. 96-02-058, § 173-204-590, filed 12/29/95, effective 1/29/96. Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-590, filed 3/27/91, effective 4/27/91.]

PART VI—SAMPLING AND TESTING PLANS/RECORDKEEPING

WAC 173-204-600 Sampling and testing plan standards. (1) Applicability. These standards apply to:

(a) Any person who samples sediments to determine compliance with this chapter;

(b) Any person who makes application to the department for authorization of a sediment impact zone under the standards of WAC 173-204-400 through 173-204-420; and

(c) Any person who samples sediments consistent with cleanup action plans approved and cleanup actions conducted under this chapter.

(2) All applicable persons shall at a minimum, develop, keep, and abide by a sediment sampling and testing plan. The sampling and testing plan shall be available for inspection at the request of the department. Sediment sampling and testing plans shall identify sampling dates, sample types, sample depths, sample composites, sample locations, sample positioning methods, sampling personnel, sampling equipment and methods, a description of methods of chemical analysis and biological testing, and quality assurance/quality control procedures.

(3) Sediment sampling locations and procedures and testing protocols and interpretations shall be those included in the Puget Sound protocols as amended and/or other methods approved by the department.

(4) The department reserves the right to revise these sampling and testing protocols when:

(a) The Puget Sound protocols are modified or updated per the approval of the department; or

(b) The department determines the Puget Sound protocols are not applicable to, or appropriate for analysis of sediment chemical contamination in any given case.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-600, filed 3/27/91, effective 4/27/91.]

WAC 173-204-610 Records management. (1) Applicability. These standards apply to:

(a) Any person who samples sediments to determine compliance with this chapter;

(b) Any person who makes application to the department for authorization of a sediment impact zone under the standards of WAC 173-204-400 through 173-204-420.

(2) All applicable persons shall keep sediment sampling and testing records as follows:

(a) Sediment sampling and testing plans which identify sampling dates, sample types, sample composites, sample locations, sample depths, sample positioning method, sampling personnel, sampling equipment and methods, quality assurance/quality control plans, and sampling procedures.

(b) Sediment removal records which identify removal dates, dredging contractor/equipment, volume of sediment removed, analytical data generated during the sediment removal process, and sediment disposal location(s).

(c) Records and results of sediment analyses conducted in accordance with this chapter, or as required under activities authorized under chapter 173-225 WAC, establishment of implementation procedures of application for certification.

(d) Records and results of inspections conducted as required under chapter 173-225 WAC, establishment of implementation procedures of application for certification.

(e) Sediment treatment records.

(f) Sediment onsite capping records.

(g) Sediment disposal records which identify sediment disposal location(s), onsite operating records, sediment volumes, disposal site property owner(s), and the chemical/biological nature of effluent discharges from the disposal location including the name, location, and quality of the receiving water.

(3) All sediment records as required under subsection (2) of this section must be furnished upon request, and made available at all reasonable times for inspection, by any officer, employee, or representative of the department who is designated by the director.

(4) All sediment records as required in this section shall be maintained for a period not less than ten years after the issuance, modification, or renewal of the applicable permit, or administrative order, or certification, or cleanup site delisting under WAC 173-204-540(6), whichever is greater.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-610, filed 3/27/91, effective 4/27/91.]

WAC 173-204-620 Severability. If any provision of this chapter or its application to any person or circumstance is held invalid, the remainder of this chapter or the application of the provision to other persons or circumstances shall not be affected.

[Statutory Authority: Chapters 43.21C, 70.105D, 90.48, 90.52, 90.54 and 90.70 RCW. 91-08-019 (Order 90-41), § 173-204-620, filed 3/27/91, effective 4/27/91.]

Appendix F: King County Letter (December 2003)

Authorization 10451-01 to Discharge to the Sanitary Sewer

King County
Wastewater Treatment Division
Industrial Waste Program
Department of Natural Resources and Parks
130 Nickerson Street, Suite 200
Seattle, WA 98109-1658
206-263-3000
206-263-3001 Fax

December 4, 2003

Scott Wilbur
Wilbur Consulting
1612 46th Avenue SW
Seattle, WA 98136

Authorization 10451-01 to Discharge to the Sanitary Sewer

Dear Mr. Wilbur:

The King County Industrial Waste Program has reviewed your November 24, 2003, letter requesting authorization to discharge wastewater from the aquifer testing operation at the South Park Bridge located at 16th Avenue S, Seattle, Washington, to the sanitary sewer. In accordance with King County Code 28.84.060 (enclosed), King County grants approval for the discharge of up to 18,000 gallons per day (gpd) from December 3, 2003 through December 31, 2003, provided that:

- King County is notified when the discharge begins;
- Approval from Seattle Public Utilities and City of Tukwila is received before discharge to allow for permitting of a connection to the sanitary sewer and assessment of sewer charges. Please call Jeff Smith (SPU) 206-684-4615 and Mike Cusick (Tukwila) 206-433-0179 to obtain required approval; and
- The discharge limitations, special conditions, monitoring and reporting requirements listed below are met.

Discharge Limitations

There shall be no odor of solvent, gasoline, or hydrogen sulfide (rotten egg odor), oil sheen, unusual color, or visible turbidity. The discharge must remain translucent. If any of the discharge limits are exceeded, you must stop discharging and notify the King County Industrial Waste Program at (206) 263-3000.

Settleable Solids
Settleable solids concentrations 7.0 ml/L

Monitoring Requirements

The following self-monitoring requirements shall be met for this discharge authorization:

Parameter	Frequency	Sample Type/Method
Discharge Volume	Daily	Pump Estimate

Reporting Requirements

A self-monitoring report containing results of required self-monitoring and total volume discharged to the sewer shall be submitted to King County by January 15, 2004.

If you propose to substantially increase the volume of your discharge or change the type and quantities of substances discharged, you must submit a new waste discharge permit application to King County.

If you have any questions about this authorization, or other questions about your discharge, please call me at (206) 263-3008.

Sincerely,

Jim Sifford
Investigator
Industrial Waste Program

Enclosure

cc: Jeff Smith, Seattle Public Utilities
Mike Cusick, City of Tukwila
Doug Hilderbrand, King County

southparkbridge.doc

Appendix G: Dewatering Pump Test Report

REPORT
SUPPLEMENTAL GEOTECHNICAL SERVICES
DEWATERING PUMP TEST PROGRAM
PROPOSED I.A.S.L. BUILDING NO. 2.122
BOEING NORTH DUWAMISH CAMPUS
SEATTLE, WASHINGTON
FOR
BE&C ENGINEERS

GeoEngineers

Consulting Geotechnical
Engineers and Geologists

January 31, 1991

BE&C Engineers
P.O. Box 3707
Seattle, Washington 98124

Attention: Mr. Bart Heath, M/S 8L-87

We are pleased to submit ten copies of our report "Supplemental Geotechnical Services, Dewatering Pump Test Program, Proposed Integrated Aircraft Systems Laboratory Building No. 2.122, Boeing North Duwamish Campus, Seattle, Washington." The scope of our services is outlined in our proposal dated November 26, 1990. Our services for the pump test were authorized verbally in a November 1, 1990 meeting with BE&C Engineers. This authorization is part of Work Order No. 90-0582 initially dated May 3, 1990 and subsequently revised.

It has been our pleasure to work with you on this project. Please call if you have any questions regarding the contents of this report.

Yours very truly,

GeoEngineers, Inc.

James D. Miller /for

Jack K. Tuttle, P.E.
Principal

DWM:JKT:cs

File No. 0120-078-B01

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TABLE OF CONTENTS

	Page No.
INTRODUCTION	1
PURPOSE AND SCOPE	2
WELL DRILLING AND CONSTRUCTION	2
SUBSURFACE SOIL CONDITIONS	3
PUMP TEST	4
CONCLUSIONS	6
AQUIFER ANALYSIS	6
CONSTRUCTION DEWATERING	6
Recommended Dewatering Levels	6
Dewatering Analyses	7
Dewatering Design Considerations	7
Discharge Recommendations	8
LIMITATIONS	8

List of Figures

	Figure No.
VICINITY MAP	1
SITE PLAN	2
WELL LOCATIONS	3
TEST WELL TW-1 WATER LEVEL VS. TIME	4
OBSERVATION WELLS OW-1, OW-2 AND OW-3 WATER LEVEL VS. TIME	5

APPENDIX A

	Figure No.
SOIL CLASSIFICATION SYSTEM	A-1
KEY TO BORING LOGS	A-2
LOGS OF TEST WELLS	A-3 and A-4
LOGS OF OBSERVATION WELLS	A-5 through A-7

APPENDIX B

	Page No.
RECOMMENDED TECHNICAL SPECIFICATIONS FOR DEWATERING WELLS	B-1 thru B-8

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REPORT

SUPPLEMENTAL GEOTECHNICAL SERVICES

DEWATERING PUMP TEST PROGRAM

PROPOSED I.A.S.L. BUILDING NO. 2.122

BOEING NORTH DUWAMISH CAMPUS

SEATTLE, WASHINGTON

FOR

BE&C ENGINEERS

INTRODUCTION

This report presents the results of a pump test performed for the proposed I.A.S.L. (Integrated Aircraft Systems Laboratory) Building to be located at the Boeing North Duwamish Campus, Seattle, Washington. The site is located about 500 feet west of East Marginal Way South at South Webster Street as shown on the Vicinity Map, Figure 1. The location of the pump test well with respect to the proposed I.A.S.L. building is shown in Figure 3.

Our services for the dewatering pump test program are part of our ongoing involvement with the geotechnical design of the I.A.S.L. Building. Much of these services is based on our previous geotechnical study at the site, the results of which are presented in our September 5, 1990 report titled "Geotechnical Engineering Services, Proposed Integrated Aircraft Systems Laboratory Building, Boeing North Duwamish Campus, Seattle, Washington".

We understand that a 12-foot-deep basement approximately 90 by 90 feet in plan dimensions will be located on the east side of the low-bay area in the new building, as shown in Figure 2. Temporary dewatering during construction of the basement foundations will be necessary to provide a dry, relatively stable working environment.

GeoEngineers was retained to design, monitor and evaluate a full-scale dewatering pump test to provide additional information for use in the design of a construction dewatering system. The technical specifications for the dewatering test well were transmitted to BE&C on December 6, 1990. A pump

test was completed by PumpTech, Inc. under subcontract to Baugh Construction Co. in December 1990 to evaluate the hydraulic conductivity, drawdown characteristics and water quality of the aquifer underlying the site.

PURPOSE AND SCOPE

The purposes of our services are to: (1) establish potential pumping requirements for dewatering the aquifer in the vicinity of the basement excavation, and (2) obtain a ground water sample representative of the water that will be discharged from the dewatering system for chemical testing. Our specific scope of services for this phase of the design includes:

1. Observe the drilling and construction of the test well and three observation wells.
2. Observe and evaluate well screen development activities.
3. Record time-drawdown data during a 24-hour pump test.
4. Measure the temperature and dissolved oxygen concentration of the water discharged from the pumping well during the test.
5. Collect a sample of water discharged from the pumping well 23 hours after the start of the pump test.
6. Submit a sample representative of the water to be discharged for laboratory analysis of the water quality parameters selected by Boeing Environmental.
7. Provide consultation to Boeing regarding permit requirements for temporary dewatering at the site.
8. Evaluate the pumping test data to provide estimates of aquifer hydraulic conductivity, transmissivity, storativity, drawdown characteristics and tidal effects.
9. Develop recommendations for a temporary dewatering system for use during construction of the basement area of the I.A.S.L. Building.
10. Prepare a report summarizing the results of the pump test and our dewatering recommendations.

WELL DRILLING AND CONSTRUCTION

The pump test program involved a test well (TW-1) and three observation wells (OW-1 through OW-3) located at varying distances from the test well. The locations of the four wells are shown in Figure 3. The observation

wells are used to monitor ground water levels away from the test well during pumping and recovery. This information is used in our analyses to evaluate the effectiveness of the dewatering test well. Details of the analyses are described in subsequent sections of this report.

DBM Drilling of Federal Way, Washington drilled Test Well TW-1 on December 5, 1990 using bucket auger equipment. The well was installed in general accordance with our technical specifications dated December 6, 1990. The test well was drilled to a total depth of 55 feet (Elevation -40 feet) below the asphalt surface. Eight-inch-diameter PVC (polyvinyl chloride) well screen was installed from a depth of 20 to 50 feet. Blank 8-inch PVC casing was used above 20 feet. TW-1 was constructed as a dewatering well with the intent that it will be used as part of the construction dewatering system. A log of soil conditions encountered while drilling and a schematic log of the test well construction are presented in Appendix A.

Subterranean Inc., of Sumner, Washington was contracted by GeoEngineers to drill three ground water observation wells on December 5, 1990. Observation wells OW-1 through OW-3 were completed at depths ranging from 14 to 30 feet below ground surface using hollow-stem auger equipment. These wells were constructed with 2-inch-diameter PVC casing. Observation well construction details and logs of the soil conditions encountered during drilling are given in Appendix A.

SUBSURFACE SOIL CONDITIONS

Surface and subsurface conditions in the vicinity of the proposed I.A.S.L. Building are described in our September 5, 1990 soils report. Soil conditions encountered while drilling the test and observation wells are consistent with those encountered in other explorations completed during our previous study. The asphalt pavement is underlain by 6 to 8 feet of loose sand with silt. The surficial sand is underlain by 3 to 5 feet of silt with fine sand, which is typically underlain by 2 to 5 feet of loose silty sand. At about 13 to 18 feet below the ground surface, soil conditions grade to medium dense to dense sand. The test well boring could not be logged accurately from 35 to 55 feet because of the open hole drilling method used by DBM. Based on nearby explorations, layers of silty sand and sand with silt are expected below a depth of about 40 feet.

PUMP TEST

An initial step-drawdown pump test was performed by PumpTech, Inc. on December 5, 1990 to provide a basis for estimating the pumping rate for the subsequent 24-hour test. We estimated that a pumping rate of 110 gpm (gallons per minute) could be maintained for the 24-hour test, based on the results of the initial step test.

The 24-hour pump test was begun on December 6, 1990 using a five horsepower submersible pump supplied by PumpTech. The static ground water level at the test and observation wells was 6.6 feet below ground surface (at approximately Elevation 9 feet) prior to starting the pump test. Water levels in the test and observation wells were monitored on a periodic basis during pumping. Plots of the water levels versus time are presented in Figures 4 and 5. A summary of the drawdowns achieved at the end of the pump test (after 24 hours) is presented below. The effect of tide fluctuations on these values is negligible since the start and the end of the test both corresponded to high tide conditions.

Location	Distance from Test Well (feet)	24-Hour Drawdown (feet)
Observation Well 1	25	1.74
Observation Well 2	50	1.41
Observation Well 3	70	1.72
Test Well 1	0	22.97

As discussed in our report dated September 5, 1990, ground water levels in the aquifer beneath the proposed I.A.S.L. Building are influenced by tidal fluctuations in the Duwamish River and slough (Slip No. 4). The basement area is approximately 400 feet from the slough and 750 feet from the river. Ground water level measurements in wells drilled at the site indicate that static ground water levels in the basement area can range from about 6 to 9 feet below ground surface depending on tide levels and well locations. These tidal influences are shown in the water level versus time plots shown in Figures 4 and 5. In our opinion, a significant portion of the water level decline measured in the test well and observation wells from

hour 11 to hour 17 of the pump test was caused by the ebb tide cycle during that period. It also appears that the increasing water levels measured in the wells from hour 17 to hour 24 of the pump test were responding to the rising tide.

The drawdown observed in OW-2, located 50 feet south of the pumping well, was about 1.4 feet at the end of the pump test. Observed drawdown in OW-3, located 70 feet south of the pumping well, was about 1.7 feet at that time. Generally, a greater drawdown is expected in the observation well that is located closer to the pumping well. The lesser amount of drawdown in the closer well appears to be related to the low hydraulic conductivity of the silt and silty sand units from 9 to 14 feet that are penetrated by the slotted well casing in OW-2. The slotted well casing in OW-3 is located at a depth of 20 to 30 feet in the permeable sand unit that underlies the silty sand. Therefore, drawdown at the test well has a greater influence on OW-3 than on OW-2.

A ground water quality sample that was representative of the discharge from the pumping well was collected 23 hours after the start of the pump test. A representative of GeoEngineers measured the temperature and dissolved oxygen concentration of the water at the time of sample collection. The sample was submitted to Analytical Technologies, Inc. of Renton, Washington for chemical analyses that are required for discharge permits for the temporary dewatering system. The type and number of tests were selected by Boeing Environmental. Ground water quality data from the chemical analyses and field measurements were transmitted to Boeing Environmental on December 13, 1990.

Boeing Environmental requested that we also collect a water sample from Observation Well OW-1 on December 21, 1990 to provide additional information for the discharge permits. Additional water quality samples were obtained from OW-1 on January 11, 1991. We also collected a water sample from the slough at the request of Boeing Environmental on January 11, 1991. Chemical data from these samples were transmitted to Boeing as results became available. Laboratory reports for all of the chemical testing related to discharge permitting will be presented in a subsequent report.

CONCLUSIONS

Drawdown information from the full-scale dewatering pump test on December 6 and 7, 1990 was used to evaluate aquifer parameters, tidal effects, and construction dewatering system design. The fine to medium sand unit from about 13 to 40 feet is capable of transmitting relatively large volumes of water. The aquifer located in this sand unit is hydraulically connected to the Duwamish River and slough. Based on our observations and analyses, a dewatering system with a total discharge capacity of 500 to 900 gpm will be required to dewater the basement excavation. Aquifer analyses and construction dewatering recommendations are presented in subsequent sections of this report.

AQUIFER ANALYSIS

The hydraulic conductivity, transmissivity and storativity of the aquifer were evaluated using the Thiem equilibrium equation and distance-drawdown methods. The aquifer underlying the site is assumed to be partially confined by the silt layer that is present between about 6 and 12 feet below the present ground surface.

Based on the soil and ground water conditions encountered in the test well boring and nearby borings drilled for the previous geotechnical study, an aquifer thickness of 35 feet was assumed to calculate hydraulic conductivity and transmissivity. We estimate that the hydraulic conductivity of the aquifer is between 550 and 1,000 gallons per day per square foot (2.6×10^{-2} and 4.7×10^{-2} centimeters per second). Our estimates of aquifer transmissivity range from about 19,000 to 35,000 gallons per day per foot. The aquifer storativity is estimated to be about 0.01.

CONSTRUCTION DEWATERING

Recommended Dewatering Levels: Ground water levels measured in Observation Wells OW-1 through OW-3 at high tide on December 5, 1990 were about 6 feet below grade. In our report dated September 5, 1990, we recommended that the temporary dewatering system be designed to lower the water table at least 2 feet below the base of the basement excavation during all tide conditions. Therefore, the required ground water drawdown for a

12-foot-deep excavation would be on the order of 8 feet at high tide. Eight feet of drawdown would drop the water table within the excavation to about Elevation 1 foot, which is 14.5 feet beneath current site grade.

Dewatering Analyses: We analyzed the aquifer drawdown and dewatering characteristics using both analytical solutions and an in-house computer program which uses the Thiem equilibrium equation and estimates of transmissivity to calculate drawdown. Based on these analyses, we estimate that a total discharge on the order of 500 to 900 gpm will produce the specified 8-foot drawdown beneath the proposed basement excavation. We recommend that a dewatering system be installed and put into operation approximately two weeks before excavation operations begin to allow sufficient lowering of the ground water table.

Dewatering Design Considerations: Based on our pump test observations and subsequent analyses, we recommend constructing five dewatering wells (PW-1 through PW-5) in addition to the existing Well TW-1 at the locations shown in Figure 3. Each well should be capable of pumping 150 gpm with a maximum drawdown of 25 feet. We recommend that each dewatering well be drilled as a 12-inch-diameter bore to a depth of about 45 feet using air rotary or cable tool drilling methods. Air rotary and cable tool methods generally produce wells with greater water production efficiencies than uncased drilling methods such as bucket auger. Detailed technical specifications for pre-construction permits, drilling equipment, well materials and well construction methods are given in Appendix B.

Because of variations in soil properties, actual field pumping requirements for dewatering may vary from our estimates. It may be necessary to use sumps and pumps to remove water from some areas at the base of the excavation, particularly where deeper excavations are required for pile cap construction. It may also be necessary to add one or more dewatering wells should excessive water inflow occur between planned well locations. At this time we feel there is a low probability of this occurring. It may be appropriate to construct several additional observation wells around the perimeter of the basement prior to the start of excavation. These wells would provide information regarding the effectiveness of the dewatering system so that modifications to the system can be made in a timely manner.

Discharge Recommendations: We understand that the dewatering wells will discharge directly into existing storm or sanitary sewers. With proper well construction, we anticipate that turbidity of the water discharged from the dewatering wells will likely be sufficiently low to preclude the need for settling basins. However, variations in the fines content of sand below the near-surface silt layer were encountered in our explorations. Thus, it is possible that water from some wells may require treatment in settling basins or by other methods should the turbidity exceed permit limits. Treatment may also be necessary for water removed from the excavation by sump pumping.

The discussion for construction dewatering presented above is intended as a general guideline during the planning stages of the project. We recommend that the specific method of dewatering be made the responsibility of the contractor. Methods other than those mentioned in this report may be used.

LIMITATIONS

We have prepared this report for use by BE&C Engineers and their project design team in the design and planning of a portion of this project. If design changes are made, GeoEngineers, Inc. should be retained to review our conclusions and recommendations relative to the new conditions. When the dewatering design has been finalized by the contractor, we recommend that GeoEngineers, Inc. be retained to review the final design and specifications to see that our recommendations have been interpreted and implemented as intended.

Our scope does not include services related to construction safety and our recommendations are not intended to direct the contractor's method, techniques, sequences or procedures, except as specifically described in our report for consideration in design.

Variations in subsurface conditions between the explorations and also with time should be expected. A contingency for unanticipated conditions should be included in the budget and schedule. Construction monitoring is important to confirm that the conditions encountered are consistent with those indicated by the explorations and to evaluate whether or not dewatering system construction activities comply with the intent of contract

plans and specifications. For consistency in the interpretation of subsurface conditions and the application of design recommendations, GeoEngineers, Inc. should be retained to provide construction monitoring and consultation services during installation and operation of the dewatering system.

- o O o -

Within the limitations of scope, schedule and budget, our services have been accomplished in accordance with generally accepted practices in this area at the time the report was prepared. No other conditions, express or implied, should be understood.

If there are any questions concerning this report, if more design details are needed, and when we can provide additional services, please contact us.

Respectfully submitted,

GeoEngineers, Inc.

James G. Roth
Hydrogeologist

Daniel W. Mageau, P.E.
Senior Engineer

Jack K. Tuttle, P.E.
Principal

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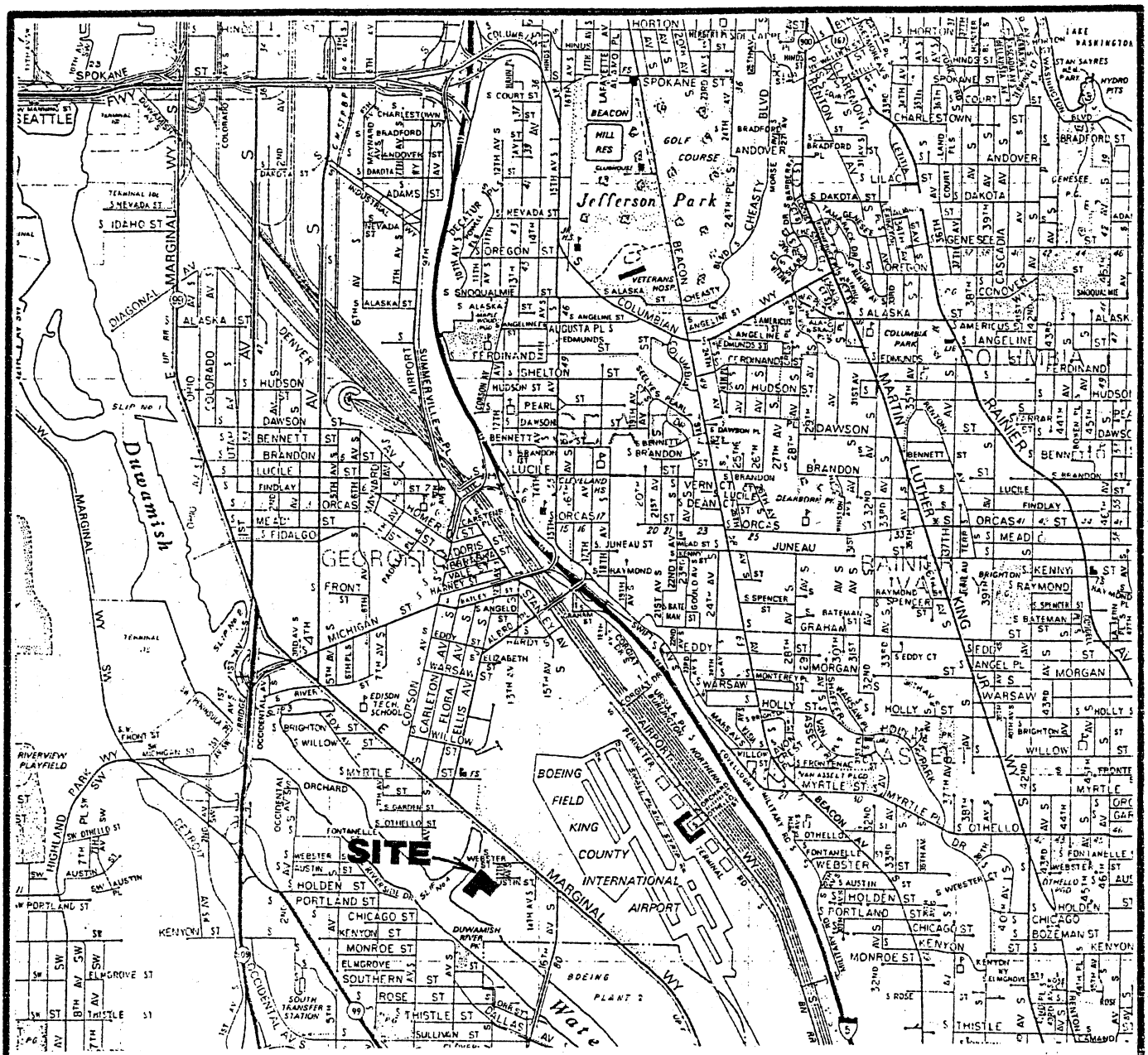

NO SCALE

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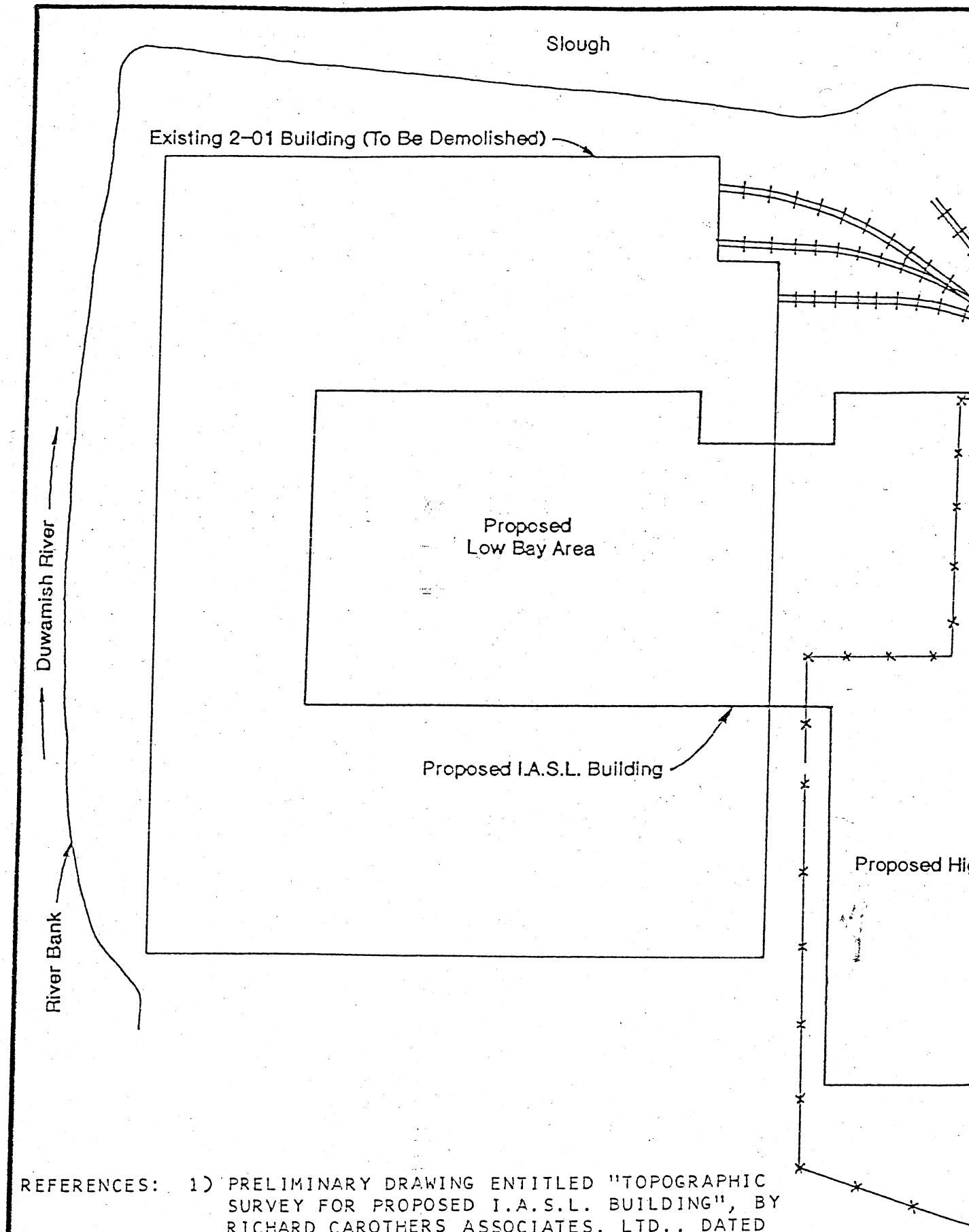
VICINITY MAP

FIGURE 1



REFERENCES: 1) PRELIMINARY DRAWING ENTITLED "TOPOGRAPHIC SURVEY FOR PROPOSED I.A.S.L. BUILDING", BY RICHARD CAROTHERS ASSOCIATES, LTD., DATED 5/15/90.

2) PRELIMINARY SITE PLAN (SCHEME 7) FOR PROPOSED I.A.S.L. BUILDING BY B.E. & C.E., DATED 6/6/90

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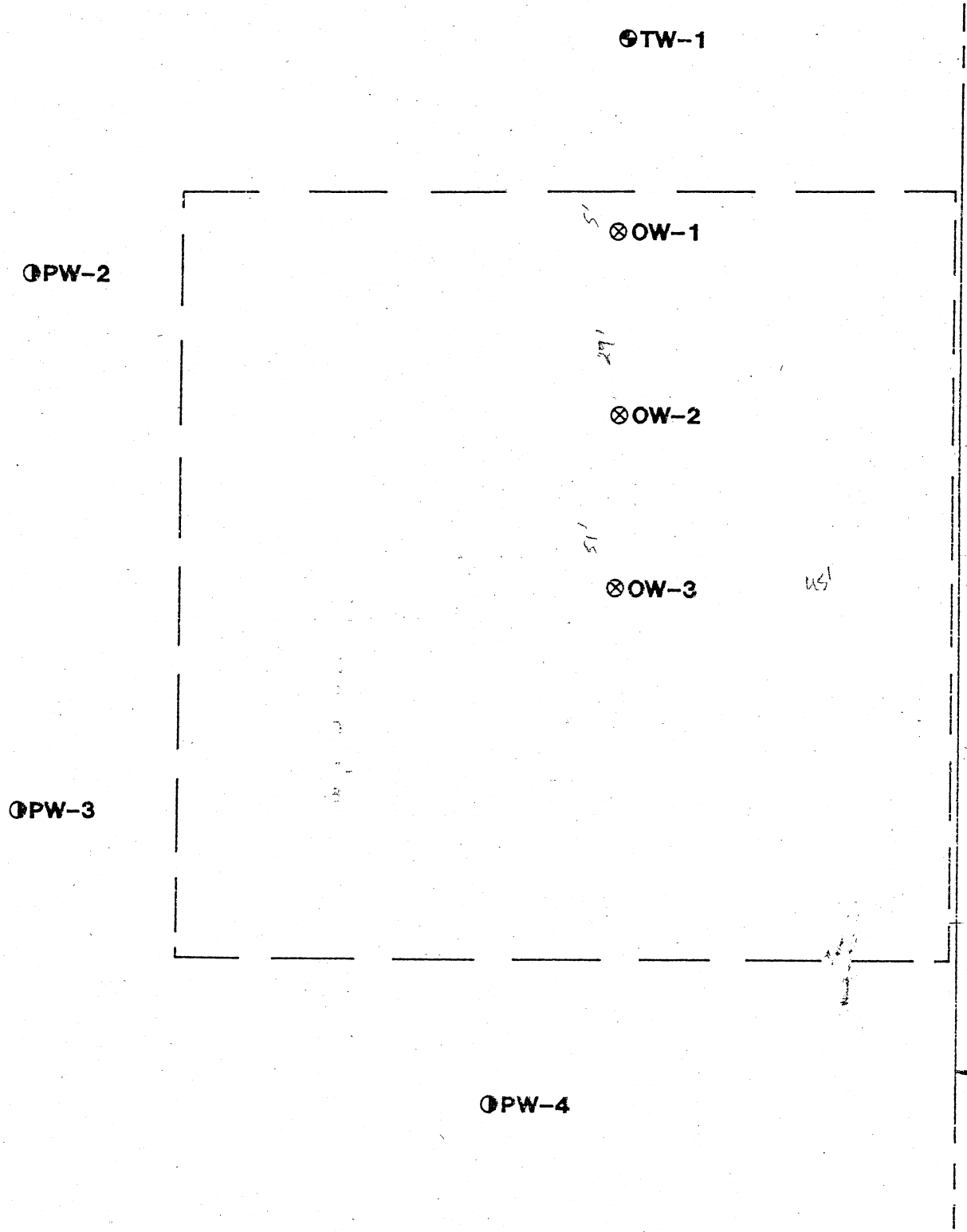

REFERENCE: PRELIMINARY SITE PLAN (SCHEME 7) FOR PROPOSED I.A.S.L. BUILDING BY B.E. AND C.E., DATED 6/6/90.

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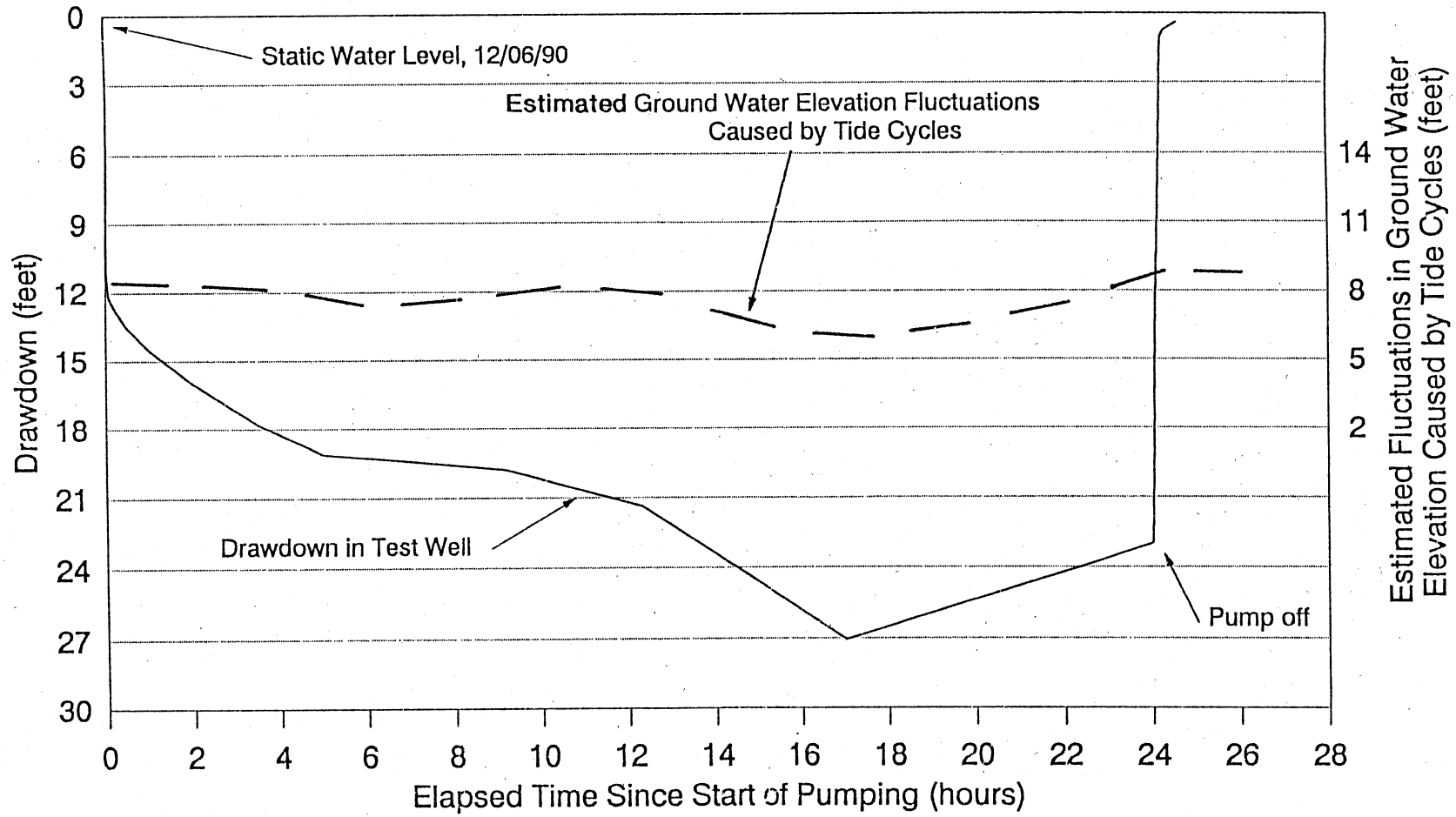
TEST WELL DRAWDOWN



TEST WELL TW-1
WATER LEVEL VS. TIME

FIGURE 4

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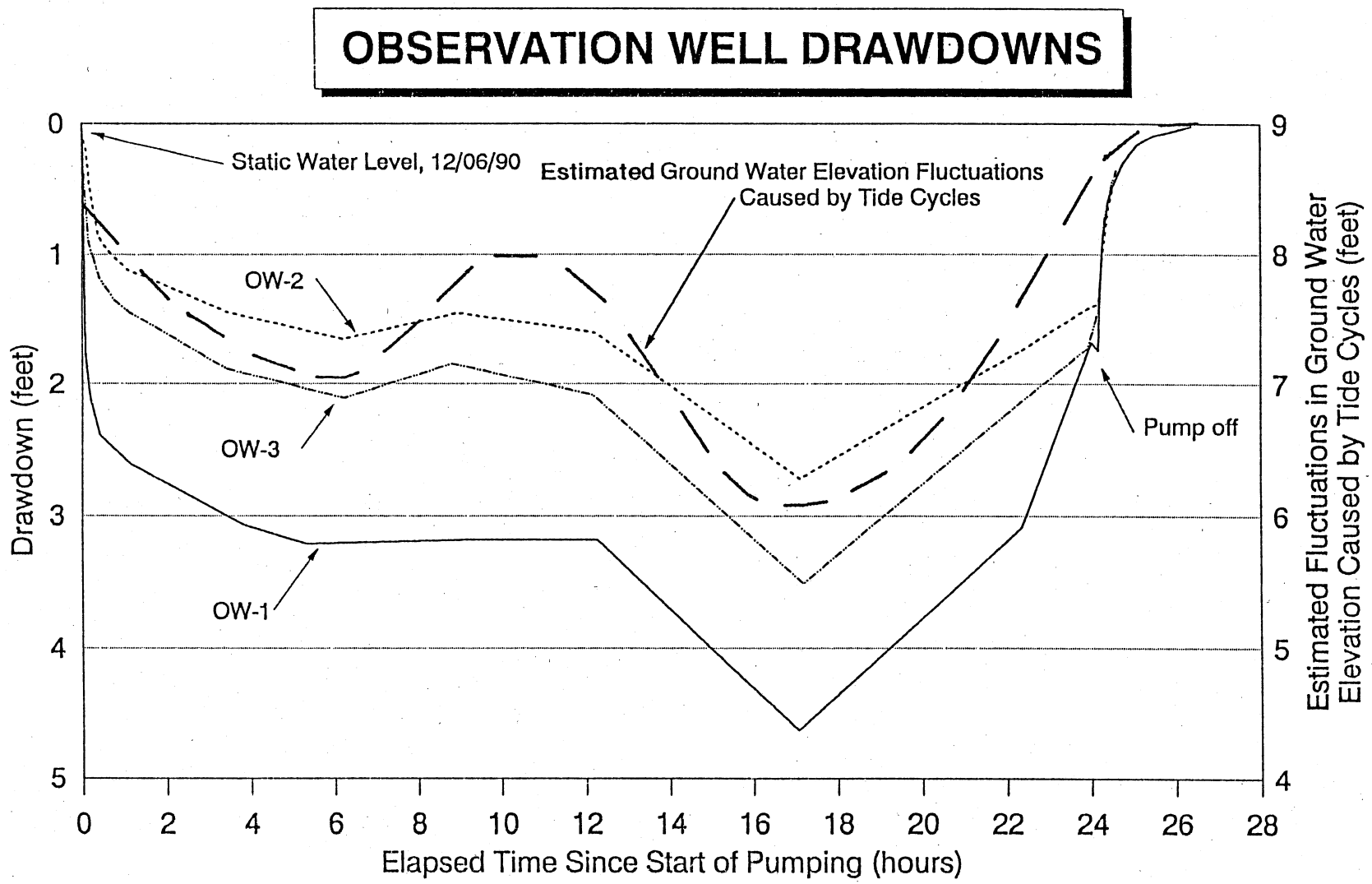

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OBSERVATION WELLS OW-1, OW-2 AND OW-3
WATER LEVEL VS. TIME

FIGURE 5

APPENDIX A

SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			GROUP SYMBOL	GROUP NAME
COARSE GRAINED SOILS MORE THAN 50% RETAINED ON NO. 200 SIEVE	GRAVEL MORE THAN 50% OF COARSE FRACTION RETAINED ON NO. 4 SIEVE	CLEAN GRAVEL	GW	WELL-GRADED GRAVEL, FINE TO COARSE GRAVEL
			GP	POORLY-GRADED GRAVEL
		GRAVEL WITH FINES	GM	SILTY GRAVEL
			GC	CLAYEY GRAVEL
	SAND MORE THAN 50% OF COARSE FRACTION PASSES NO. 4 SIEVE	CLEAN SAND	SW	WELL-GRADED SAND, FINE TO COARSE SAND
			SP	POORLY-GRADED SAND
		SAND WITH FINES	SM	SILTY SAND
			SC	CLAYEY SAND
FINE GRAINED SOILS MORE THAN 50% PASSES NO. 200 SIEVE	SILT AND CLAY LIQUID LIMIT LESS THAN 50	INORGANIC	ML	SILT
			CL	CLAY
		ORGANIC	OL	ORGANIC SILT, ORGANIC CLAY
	SILT AND CLAY LIQUID LIMIT 50 OR MORE	INORGANIC	MH	SILT OF HIGH PLASTICITY, ELASTIC SILT
			CH	CLAY OF HIGH PLASTICITY, FAT CLAY
		ORGANIC	OH	ORGANIC CLAY, ORGANIC SILT
HIGHLY ORGANIC SOILS			PT	PEAT

NOTES:

1. Field classification is based on visual examination of soil in general accordance with ASTM D2488-83.
2. Soil classification using laboratory tests is based on ASTM D2487-83.
3. Descriptions of soil density or consistency are based on interpretation of blowcount data, visual appearance of soils, and/or test data.

SOIL MOISTURE MODIFIERS:

Dry - Absence of moisture, dusty, dry to the touch

Moist - Damp, but no visible water

Wet - Visible free water or saturated, usually soil is obtained from below water table

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SOIL CLASSIFICATION SYSTEM

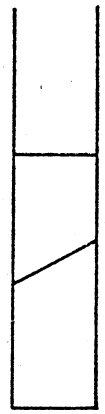
FIGURE A-1

GEI 85-88

LABORATORY TESTS:

AL	Atterberg limits
CP	Compaction
CS	Consolidation
DS	Direct shear
GS	Grain - size
%F	Percent fines
HA	Hydrometer analysis
SK	Permeability
SM	Moisture content
MD	Moisture and density
SP	Swelling pressure
TX	Triaxial compression
UC	Unconfined compression
CA	Chemical analysis

SOIL GRAPH:



SM Soil Group Symbol (See Note 2)

Distinct Contact Between Soil Strata

Gradual or Approximate Location of Change Between Soil Strata

Water Level

Bottom of Boring

BLOW-COUNT/SAMPLE DATA:

Blows required to drive a 2.4-inch I.D. split-barrel sampler 12 inches or other indicated distances using a 300-pound hammer falling 30 inches.

- 22 ■ Location of relatively undisturbed sample
- 12 ⊠ Location of disturbed sample
- 17 □ Location of sampling attempt with no recovery

Blows required to drive a 1.5-inch I.D. (SPT) split-barrel sampler 12 inches or other indicated distances using 140-pound hammer falling 30 inches.

- 10 ◧ Location of sample obtained in general accordance with Standard Penetration Test (ASTM D-1586) procedures
- 26 ◫ Location of SPT sampling attempt with no recovery

▤ Location of grab sample

"P" indicates sampler pushed with weight of hammer or against weight of drill rig.

NOTES:

1. The reader must refer to the discussion in the report text, the Key to Boring Log Symbols and the exploration logs for a proper understanding of subsurface conditions.

2. Soil classification system is summarized in Figure A-1.

GEI 86-88 Rev. 6/90

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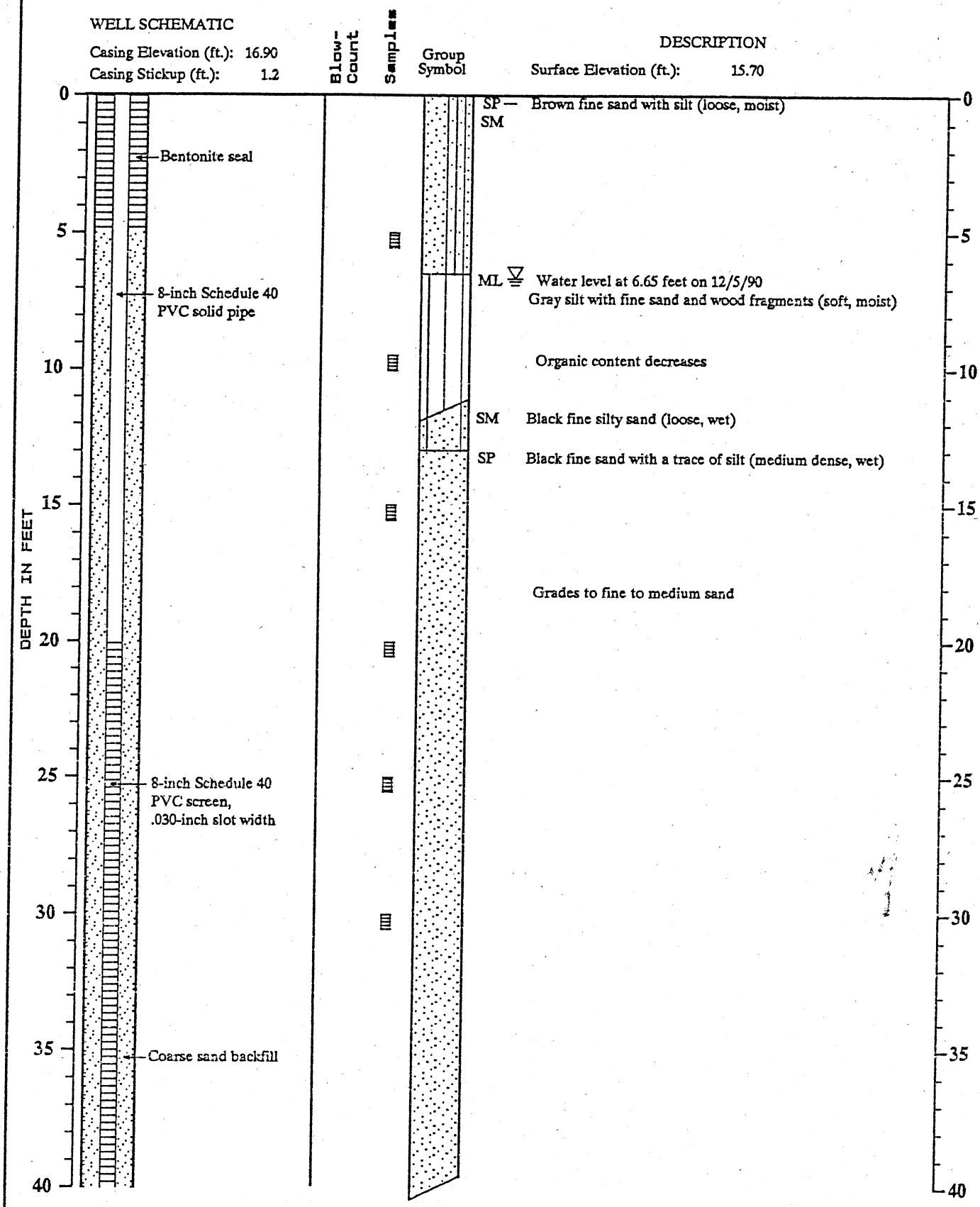
KEY TO BORING LOG SYMBOLS

FIGURE A-2

TEST WELL NO. TW-1



Note: See Figure A-2 for explanation of symbols

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Log of Test Well

Figure A-3

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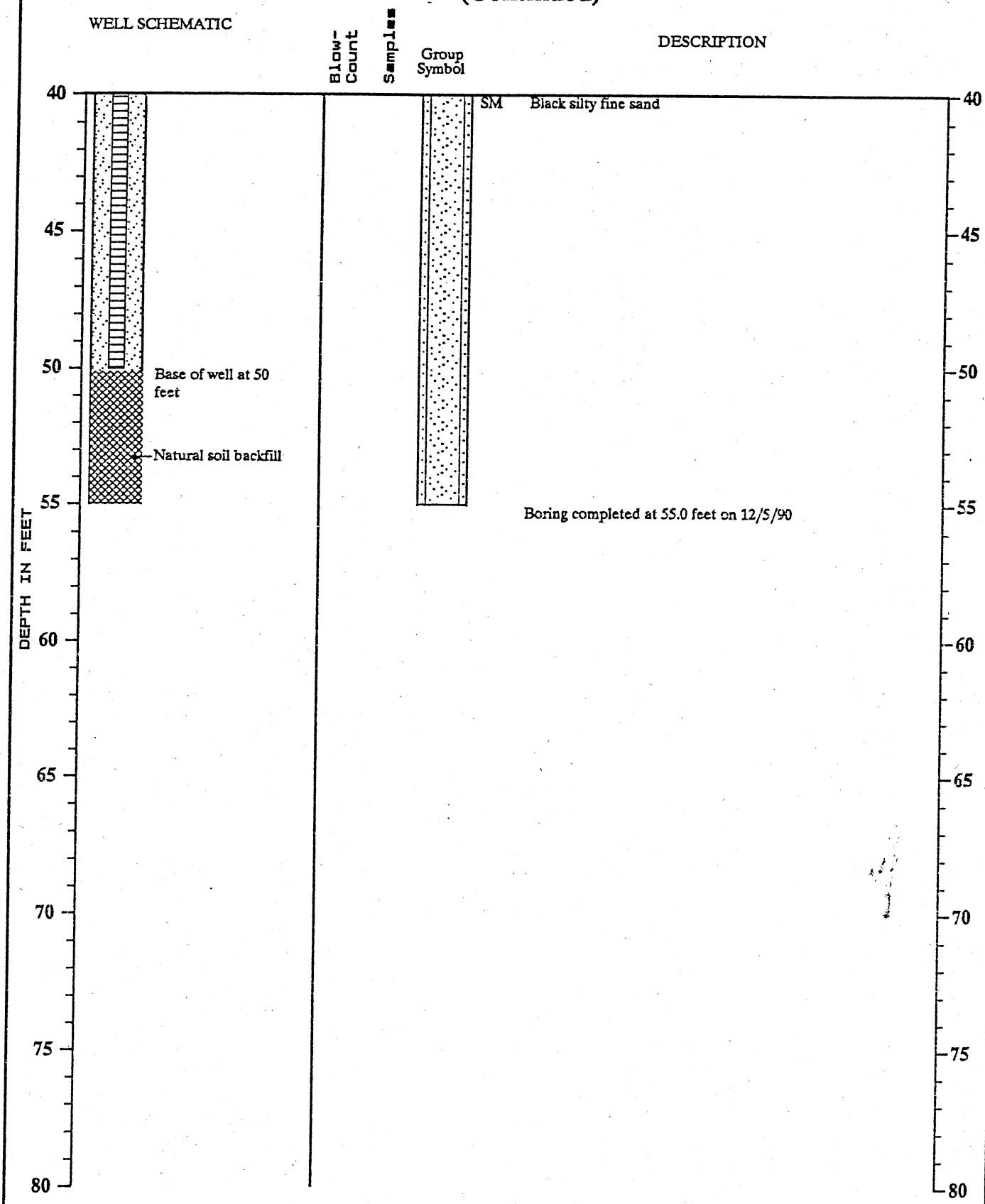
TEST WELL NO. TW-1
(Continued)



Note: See Figure A-2 for explanation of symbols

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Log of Test Well

Figure A-4

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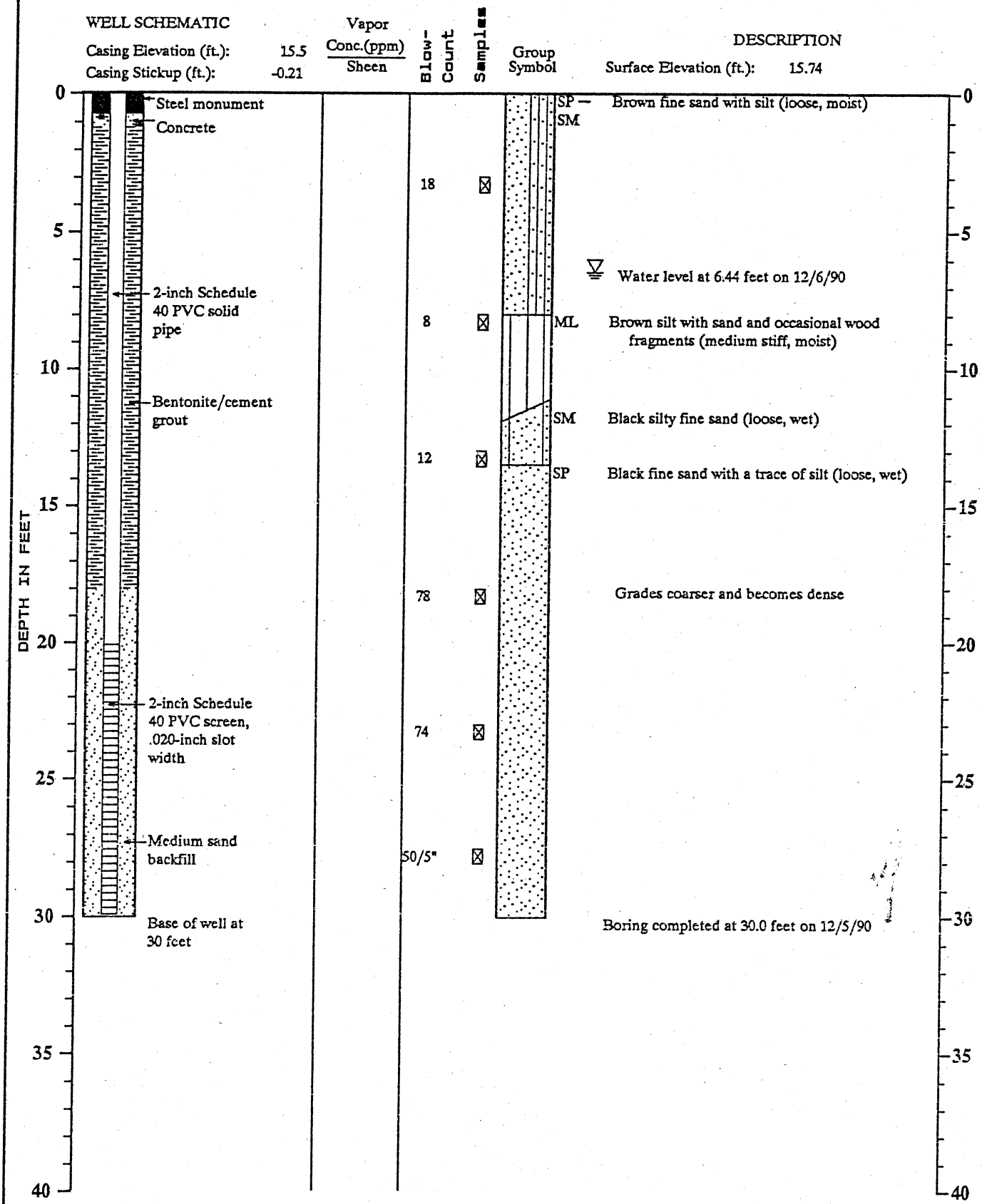
OBSERVATION WELL NO. OW-1



Note: See Figure A-2 for explanation symbols

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Log of Observation Well

Figure A-5

:GWM:DWM:IRA 1/17/91

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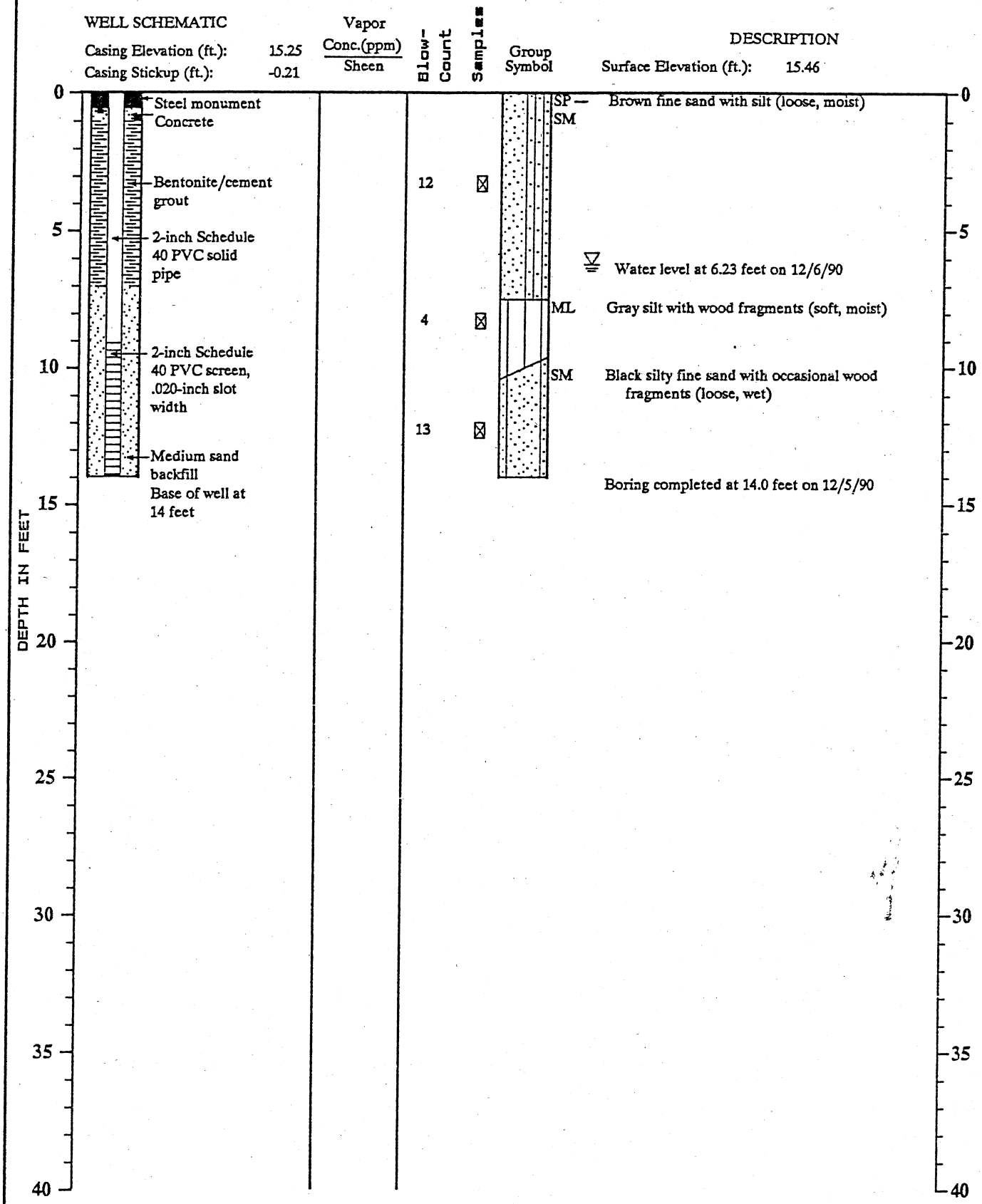
OBSERVATION WELL NO. OW-2



Note: See Figure A-2 for explanation symbols

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Log of Observation Well

Figure A-6

:GWM:DWM:IRA 1/17/91

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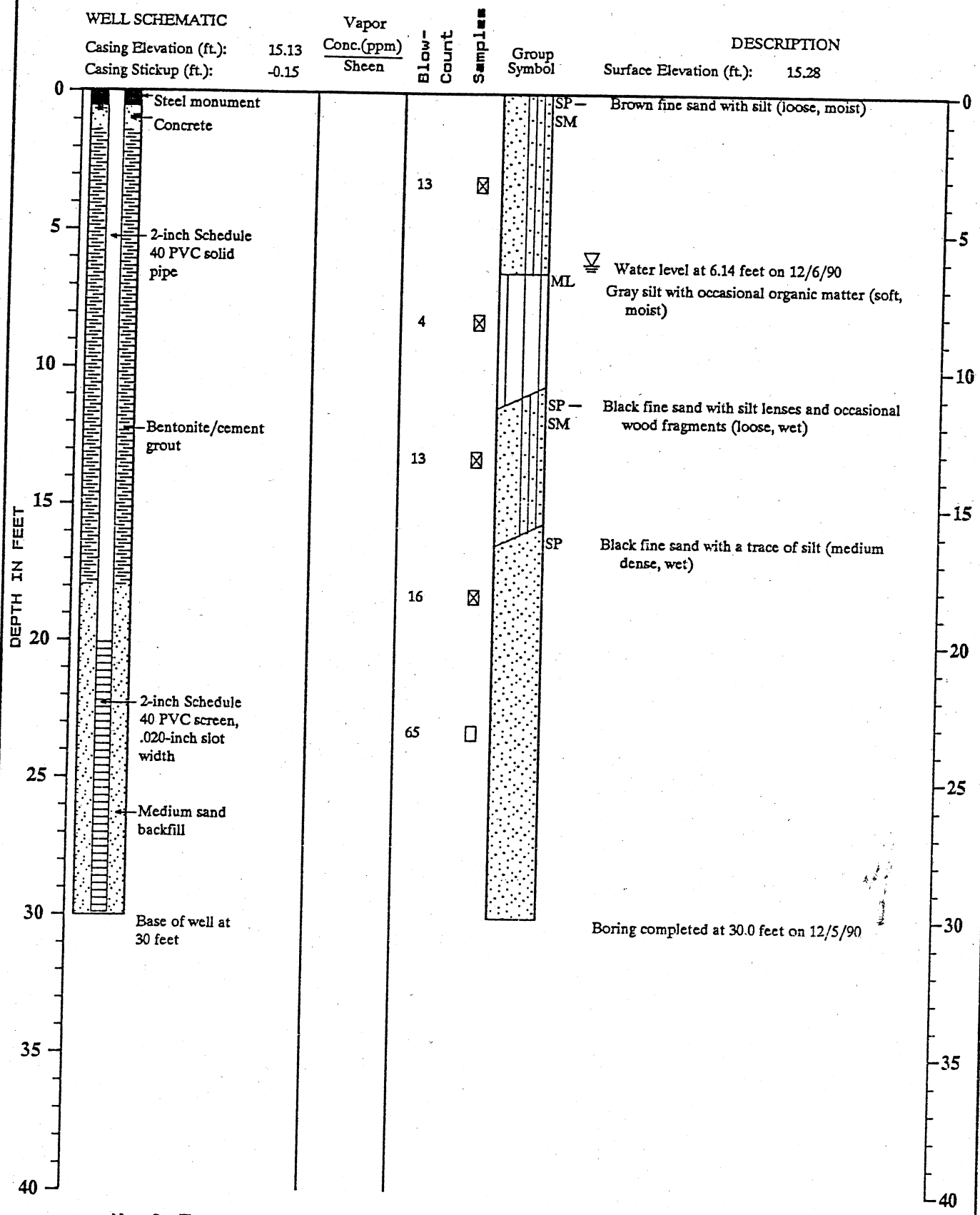
OBSERVATION WELL NO. OW-3



Note: See Figure A-2 for explanation symbols

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Log of Observation Well

Figure A-7

:GWM:DWM:IRA 1/17/91

20-078-B01

APPENDIX B

APPENDIX B

RECOMMENDED TECHNICAL SPECIFICATIONS FOR DEWATERING WELLS

1.0 GENERAL

The following specifications are intended to inform interested parties about the equipment, materials, and the nature of work required to construct five dewatering wells for the proposed Boeing I.A.S.L. Building. All work shall be completed in accordance with applicable federal and state safety regulations. The contractor and any subcontractors shall supply all equipment and personnel needed to complete the project. The work shall be completed in accordance with the Contract Documents and these Technical Specifications.

2.0 STANDARD SPECIFICATIONS

All work under this contract shall, in general, be performed in accordance with applicable sections of the Minimum Standards For Construction And Maintenance Of Wells, Chapter 173-160 WAC; Rules And Regulations Governing The Regulation And Licensing Of Well Contractors And Operators, Chapter 173-162 WAC; and the Water Well Construction Act, Chapter 18.104 RCW. Other referenced standards used in these specifications are applicable where noted. The dimensions and grades set forth herein shall be the basis for payment for all work performed under this contract.

All required notices shall be given by the contractor. The contractor shall comply with all codes, ordinances, rules, regulations, orders, and other legal requirements of public authorities which bear on the performance of this work.

3.0 PERMITS

The contractor shall apply for and receive any applicable permits from authorized agencies if required. A "start card" shall be submitted to Ecology (Washington State Department of Ecology) at least 72 hours before starting well construction. No field operations will begin until all necessary permits have been obtained.

4.0 PERSONNEL AND EQUIPMENT

The dewatering wells shall be drilled using air-rotary or cable tool drilling methods. The contractor shall supply capable and experienced personnel and suitable drilling equipment to perform the work. The contractor shall provide and pay for all labor, materials, tools, construction equipment, machinery, fuel, and other facilities and services as necessary for the proper execution and completion of this work. Adequate safety equipment shall be used by the drilling crew while on site.

Each bidder shall furnish with the bid additional information that shows:

1. Experience record of the contractor on wells of this depth and capacity.
2. Name and experience record of the person, or persons, most likely to act as the driller and/or supervisor during this work.
3. A list of major equipment to be used on the project by manufacturers name and model number, including: drilling rig, pumps, air compressor and any other pertinent equipment.

5.0 MOBILIZATION AND DEMOBILIZATION

The contractor shall move all the material, equipment and personnel for constructing and developing the wells to and from the work site. This item also includes cleaning any and all construction debris generated in the course of installing the wells from the site on completion of the work. Access to the drill site will be provided by the owner.

6.0 MATERIALS SPECIFICATIONS

6.1 Drilling Fluid: The primary drilling fluids, if needed, shall be air and water. All water introduced into the wells shall be potable. The contractor shall be responsible for the supply of suitable water at the work site. The contractor shall be permitted to inject foaming agents during air-rotary drilling. Foaming agents shall be biodegradable and nontoxic and have the engineer's and Boeing's approval prior to their use.

Discharge of any foaming agent or effluent containing any foaming agent to the Duwamish River is not permitted. This effluent must be discharged to the Metro sanitary sewer in accordance with Metro discharge limitations.

The contractor shall maintain a drilling fluid log recording the date, time, depth and volume of the introduction of any fluids used during drilling (with the exception of air) and any other pertinent comments.

6.2 Well Casing: All well casing shall be new. Casing shall be manufactured of steel and conform to Standard weight class, or to American National Standards Institute (ANSI) Schedule 40 steel pipe. Casing lengths shall be joined by welding in accordance with the standards of the American Welding Society. (AWS D.1.1 or correct AWS specification)

a. Temporary Casing: Shall have an internal diameter of 12 inches, a minimum wall thickness of 0.375 inches, and a minimum weight of 49.56 pounds per foot (lbs/ft).

b. Production Casing: Shall have an internal diameter of 8 inches, a minimum wall thickness of 0.322 inches, and a minimum weight of 28.55 lbs/ft. The production casing shall be welded to the top of the screen. A separate section of 8-inch steel well casing approximately 5 feet in length shall extend from the bottom of the well screen to the base of the well. A steel plate shall be welded to the bottom of the well.

6.3 Grout: Shall consist of one of the following:

a. Neat cement consisting of Type I or II Portland cement. Five percent by weight sodium-montmorillonite bentonite shall be added to the grout. Not more than 6 gallons of potable water will be used per sack of cement.

b. Sodium-montmorillonite bentonite slurry with a weight between 9 and 13 pounds per gallon.

6.4 Well Screen: The well screen shall be fabricated from Type 304 stainless steel and consist of continuous slot, wire wound design. The well screen shall be manufactured by Johnson Division, or equivalent.

a. The well screen shall consist of 8-inch-diameter pipe size with a length of 15 feet and a slot size of 0.020 inches.

b. Weld rings shall be provided with the screen and consist of Type 304 stainless steel.

c. A filter pack approximately 2 inches thick shall be installed around the well screen. The filter pack shall consist of clean, well rounded medium to coarse sand with fine gravel. The filter pack material shall consist of silica with not more than 5 percent calcareous material by weight. The specific gradation is presented below:

Sieve Size	Percent Passing
3/8 "	100
No. 4	70 to 95
No. 10	30 to 60
No. 20	5 to 15
No. 40	0

7.0 WELL CONSTRUCTION

7.1 General: The contractor shall drill the dewatering wells at the locations approved by the engineer. Air-rotary or cable tool drilling equipment shall be used to drill to a depth of about 45 feet. The contractor shall install the materials previously described. The contractor shall dispose of drill cuttings, drilling fluid and discharge water in a manner prescribed by The Boeing Company so as not to create damage to public or private property. The soil cuttings can be disposed of at a permitted landfill. If an anomaly is observed (i.e., unusual smell, coloration or texture) in the soil cuttings, the contractor will place the soil cuttings in a separate stockpile for further evaluation by Boeing personnel. Notes: (1) Discharge water and drilling fluid (including development water and disinfection water) will be discharged to the Metro sanitary sewer through a metered discharge point, (2) Under no circumstances will any water or soil generated during dewatering well construction and development be permitted to discharge to the Duwamish River or Slip No. 4.

7.2 Disinfection: All tools, drilling equipment and materials, including the well casing, shall be thoroughly disinfected with a 50 ppm chlorine solution before beginning well construction. All pumping equipment shall be disinfected with a 50 ppm chlorine solution and rinsed with potable water before installation in the well. Prior to use, the contractor shall provide a plan indicating expected volumes of rinsate and disposal methods.

7.3 Temporary Casing: The 12-inch-diameter temporary casing shall be installed to a depth of about 45 feet.

7.4 Casing Alignment: The alignment of the completed well shall be in accordance with WAC 173-160-215.

7.5 Formation Samples: Representative soil samples from each well bore shall be obtained by the contractor for the engineer at 5-foot intervals. The soil samples will be collected from bailer cuttings or from the discharge line if air-rotary drilling equipment is used. If the engineer is not present at the time the samples are collected, the samples shall be placed in plastic sample bags with a suitable closure, the bags labeled using indelible ink with the sampling date and sample depth, and the samples stored in a protected area until collected by the engineer.

7.6 Well Screen: The well screen shall be lowered to the base of the well by a method of the contractors choosing. Under no circumstances shall the screen be dropped into position. The contractor shall attempt to pull the temporary casing up about one foot prior to installation of the screen. If the casing cannot be moved, the drive shoe will be cut off using an inside casing cutter to reduce resistance to pulling. A second attempt to pull the casing shall be performed after the drive shoe has been separated from the casing.

7.7 Filter Pack: The filter pack shall be introduced into the annular space between the screen and the temporary casing as the casing is being pulled from the boring. Filter pack materials shall be placed uniformly and continuously to prevent hydraulic segregation and bridging. The filter pack shall be placed so that the top of the filter pack is a minimum of 5 feet above the top of the screen.

7.8 Surface Seal: The annular space between the temporary casing and production casing shall be filled with cement grout or bentonite slurry from ground surface to a depth of 18 feet as the temporary casing is pulled. The contractor may apply to Ecology for a variance in the depth of the surface seal.

8.0 WELL SCREEN DEVELOPMENT

Development of the well screen shall act to remove the silt and fine sand portion of the native soils surrounding the filter pack.

a. Development shall be accomplished using air lift surging, or surge block techniques. If the screen is developed by surge block methods, sediment shall be bailed from the well at frequent intervals during the development process to minimize blockage of the lower portion of the screen. Development shall begin by placing the surge block at the base of the screen and surging the screen in increments of 1 to 2 feet. If the screen is developed using air lift techniques, the contractor shall provide sufficient air volume and pressure to fully develop the well screen. Well development shall be accomplished progressively from the bottom of the screen to the top of the screen.

c. Development shall continue until both the contractor and engineer indicate that further development is unnecessary.

9.0 PUMPING EQUIPMENT

Submersible pumps shall be installed in each dewatering well. The pump intake shall be set at the depth agreed to by the contractor and engineer. The pump and power source shall be capable of discharging 200 gpm against a total head of 50 feet. All equipment shall be able to perform on a continuous basis at the design flow of 150 gpm. The contractor shall be responsible for all operation and maintenance of the pumping equipment.

a. The dewatering pumps shall have a check valve.

b. The pump intake and motor shall be shrouded such that water is forced to flow past the motor before entering the pump intake.

c. A 3/4-inch-diameter PVC pipe with an open bottom shall be installed to the base of each well, or a point directly above the pump for use in measuring water levels during construction dewatering.

d. A circular orifice meter or totalizing flow meter shall be supplied and installed on each water discharge line by the contractor. A ball valve shall be installed a minimum of 5 feet from the end of the discharge pipe to regulate the flow. The engineer shall approve the equipment and installation.

10.0 WATER DISCHARGE

The point of discharge from the dewatering system will be directly into existing storm or sanitary sewers. The dewatering system piping shall be designed so that discharge to sewers is in accordance with existing permit conditions. Specific discharge criteria will be developed by Boeing Environmental.

11.0 CAPPING OF THE WELLS

During construction and operation of the wells, the contractor shall use all reasonable measures to prevent the entrance of foreign matter into the wells. Upon termination of temporary dewatering operations, the contractor shall provide a suitable threaded, flanged or welded cap to prevent unauthorized intrusion into the wells.

12.0 WELL ABANDONMENT

The wells shall be sealed in accordance with the applicable sections of WAC 173-160-415, 173-160-420 and 173-160-465 upon the determination that the well is to be abandoned.

a. The wells shall be considered abandoned upon notice to the contractor by Boeing that the dewatering project is completed. At such time the contractor shall seal the wells in accordance with the terms of this contract.

b. The wells shall be considered abandoned if, through no fault of the contractor, the engineer or owner indicates that the well will not supply the required volume or quality of water, and directs the contractor to seal the well.

c. The wells shall be considered abandoned, through fault by the contractor, if the well fails to conform to the above specifications and the contractor is unable to correct the condition or negotiate a mutually agreeable cost reduction for specific deviations. If the well is considered abandoned, the contractor shall immediately start a new well at the location indicated by

the engineer. The contractor shall bear the cost of sealing the abandoned well and of drilling a new well if the abandonment results from failure to comply with the specifications presented herein.

13.0 RECORDS

Two copies of the driller's log, signed and dated by the driller, shall be provided to the engineer for each well. The logs will include the materials penetrated to the nearest foot, a record of all static water level measurements taken by the driller and any pertinent notes or comments recorded by the driller during construction of the dewatering wells. One copy of the Water Well Report form provided by Ecology shall be given to the engineer for each well. The report shall record the placement of all casing lengths, the screen, and the location of all plugs and seals constructed in the well.

In accordance with WAC 173-160-050, the contractor is required to submit to the Washington State Department of Ecology a complete record of the construction of each dewatering well within 30 days after completion of the well.