Cleanup Action Plan

Union Station Property
Seattle, Washington

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Prepared for

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1.0 INTRODUCTION

This cleanup action plan (CAP) describes the proposed cleanup action at the Union Station property located in Seattle, Washington. The property, which was the site of a former coal gasification plant, is being proposed for commercial development. As part of the development project, a property cleanup action will be undertaken. The purposes of this CAP are to describe the property, identify the property-specific cleanup standards, and identify the cleanup action and monitoring to be conducted at the property. The following sections present a summary of the information specified by the Model Toxics Control Act (MTCA) [WAC 173-340-360(10(a))] to be included in a CAP. The information presented in this CAP is based on evaluations and analyses developed in a focused remedial investigation and feasibility study (RI/FS; Landau Associates and Hart Crowser 1996) and supplemental monitoring completed after the RI/FS (Landau Associates 1996b). This CAP and associated documents were prepared in support of the application of Union Station Associates for a prospective purchaser agreement with the Washington State Department of Ecology (Ecology).

Remediation of property conditions will be accomplished pursuant to a prospective purchaser agreement with Ecology. The planned cleanup includes paving of currently exposed soil, groundwater monitoring, institutional controls, and construction of some components of a groundwater extraction and treatment system. The remainder of the groundwater extraction and treatment system will be constructed and operated if concentrations of contaminants in groundwater indicate groundwater remediation is necessary. Any soil excavated as part of the property development will be disposed of properly.

1.1 SUMMARY OF DEVELOPMENT PROJECT

Union Station Associates plans to develop the three Union Station parcels comprising the property to provide an opportunity for bridging a gap in developed property between the International District, Pioneer Square, and the downtown Seattle corridor. The total Union Station development project envisions 1.2 million square feet of commercial and retail area. Union Station itself will be rehabilitated, and an additional six buildings are planned. The project will provide 1,110 parking spaces, including a parking garage located south of S. Airport Way, and will allow for an array of complementary retail uses.

1.2 PROPERTY DESCRIPTION

The property consists of three parcels located in Seattle, Washington. Figure 1 provides a map of the vicinity of the property. Figure 2 shows the three parcels and the approximate configuration of the property boundary. The three parcels span six city blocks and include portions of the grade level beneath elevated viaduct portions of S. Jackson Street, S. Airport Way, and 4th Avenue S. Existing structures at the property include the Metro bus tunnel southern portal, Metro International District transit station, a lid constructed above the Metro transit lanes to the south of the Metro station, portions of the elevated viaducts for adjacent streets, and the Union Station building. The zoning in the vicinity of the property is international district mixed and surrounding development includes residential hotels and commercial businesses. The Burlington Northern Santa Fe railroad freight lines, an industrial use, run along the western property boundary.

The Union Station building has been designated a national historic landmark and is listed on the national register of historic places; its date of listing is August 30, 1974. Additionally, the Union Station building is located within two historic districts: the International Special Review District and the Pioneer Square Preservation District.

The nearest surface water body is Elliott Bay located approximately 2,000 ft to the west of the property. The Elliott Bay shoreline, prior to filling of tideflat areas in the late 19th century, cut through the property in a curved manner near S. Jackson Street and to the end of 5th Avenue S.

The topography of the main and southern parcels is generally flat. The ground surface of the main and southern parcels is approximately 20 ft below the level of S. Jackson Street. The ground surface of the northern parcel is almost at the street level of S. Jackson Street. Approximately 25 ft of fill soil was placed during the early 1900s at the north, main, and south property parcels. Approximately 15 to 20 ft of additional fill soil was placed at the north parcel in the late 1980s in conjunction with construction of the Metro tunnel. This fill raised the parcel grade to about the level of S. Jackson Street. Soil associated with the former Elliott Bay tideflat and estuary underlies the fill soil. Glacial soil underlies the tideflat and estuary soil.

There are no known groundwater uses for domestic purposes within 4 miles of the property. Drinking water is provided by the City of Seattle. Downgradient (west) land uses include railroad facilities, commercial businesses and parking, and commercial harbor activities.

1.3 PROPERTY HISTORY

A detailed description of industrial activity on the property is provided in the RI/FS prepared for the property (Landau Associates and Hart Crowser 1996). The property was originally part of the south Seattle industrial neighborhood. In 1874, the Seattle Gaslight Company constructed a coal gasification plant on the project property on pilings over the mudflats of Duwamish Bay. The area surrounding the pile-supported facility was filled prior to about 1912. Around the turn of the century, Vulcan Iron Works manufactured iron, brass, and steel on the southern portion of the property. In 1910, the gas plant was demolished, the property was leveled for construction of the existing Union Station, and Vulcan Iron Works was relocated to make room for new tracks leading to Union Station. Union Station served passengers until 1971, when Union Pacific discontinued passenger operations at the property.

Since 1971, the property has essentially been dormant. Since the abandonment of its use as a railroad station, the Union Station area has been the subject of a variety of proposals for new uses, most of which feature the distinguished old station as the historic centerpiece for a larger development. All of these efforts have failed, however, in part due to the uncertainty regarding the likelihood and cost of remediating environmental conditions at the property. The only recent construction activity on the property occurred when the downtown Seattle transit project bus tunnel was completed in 1990. The southernmost terminus of the bus tunnel is located on the property along 5th Avenue S.

In 1991, the property was placed on the Washington Hazardous Sites List. Ecology originally gave the property a hazard ranking of 5 (the lowest ranking on a scale of 1 to 5). In June 1994, Weston evaluated the property for the U.S. Environmental Protection Agency (EPA) and recommended no further action (Weston 1994). On August 4, 1994, as a result of Ecology's revision of the Washington ranking method, the ranking was changed to 3.

1.4 PROPERTY CHARACTERIZATION

An environmental investigation, referred to as a remedial investigation (part of the RI/FS), was conducted for the proposed redevelopment project. The investigation included review of the property's industrial history to confirm that the investigation included areas likely to have contamination, evaluation of existing soil and groundwater sampling information, and analysis of new groundwater samples. A total of 67 soil samples and 30 groundwater samples were included in this evaluation.

The RI compared chemical testing results for soil and groundwater to screening levels and identified constituents of concern that required additional evaluation. The RI identified high molecular weight organic constituents [carcinogenic polynuclear aromatic hydrocarbons (CPAH)] from the coal gasification process and metal constituents from the coal gasification process, and from the foundry, within fill soil (approximately 25 ft in thickness) that was placed on the former tideflat surface during operation of the historic industries. Groundwater test results during the past 11 years showed constituents including metals, total petroleum hydrocarbons (TPH) and organic compounds but, in the more recent samples taken during the RI, the only constituent in property wells that exceeded groundwater screening levels (arsenic) was found at higher concentrations in upgradient wells.

Supplemental monitoring activities were requested by Ecology following review of the RI/FS. The approved supplemental monitoring activities, described in the supplemental monitoring plan (Landau Associates 1996), included the installation of four additional monitoring wells (designated MW-104 through -107) and chemical analysis of soil and groundwater samples. Figure 3 shows the groundwater monitoring well system at the property.

Supplemental monitoring results are within the range of previously measured concentrations. Some exceedances of groundwater levels for CPAH and/or total petroleum hydrocarbons (TPH) and benzene were found in wells HC-101, MW-104, and MW-105. It is possible , however, that the CPAH concentrations will be below detection limits after the wells stabilize and turbidity decreases. There are also strong indications that a source or sources of TPH exist upgradient of the site. No pesticides, PCBs, herbicides, or evidence of DNAPL were detected.

2.0 CLEANUP ACTION SELECTION

The RI findings were used to develop alternatives to remediate the property. The evaluations of these alternatives were included in the feasibility study (FS). The FS defined cleanup standards, developed and evaluated four cleanup action alternatives, and identified a preferred cleanup action alternative that adequately protects human health and the environment. The following sections describe the FS results and the evaluated cleanup action alternatives.

2.1 PROPERTY CLEANUP LEVELS AND POINTS OF COMPLIANCE

Groundwater cleanup standards are based on the assumption that area groundwater is not currently used for drinking water and is extremely unlikely to be used as a future source of drinking water, but contact with property groundwater could potentially occur on a short-term basis during future construction activities. The cleanup standards are based on the assumption that the highest and best use of groundwater is discharge to marine surface water over 2,000 ft from the site. Consequently, groundwater cleanup levels are developed for protection of marine surface water and not the use of property groundwater as a drinking water source. Table 1 summarizes cleanup levels for groundwater. Cleanup levels that are adjusted upward to the practical quantitation limits may be periodically reviewed by Ecology. Ecology may require use of improved analytical techniques in accordance with WAC 173-340-707.

Soil cleanup levels were conservatively based on residential site use conditions, although the property is zoned international district mixed and future land use is likely to be commercial with limited potential for direct contact with soil. The surrounding area is currently used for residential, commercial, and industrial purposes. Soil cleanup levels address direct contact and protection of groundwater (marine surface water). Table 2 summarizes soil cleanup levels developed for constituents detected at the site.

The point of compliance for soil is throughout the property. The point of compliance for groundwater is the property boundary and extends from the uppermost level of the saturated zone vertically to the lowest most depth which could potentially be affected by the site . The point of compliance established for groundwater at the property is shown on Figure 3.

2.2 EVALUATED ALTERNATIVE CLEANUP ACTIONS

Development of cleanup alternatives included analysis of technologies and process options potentially applicable to conditions at the Union Station property. As a part of this analysis, remedial technologies that have been applied at other former coal gasification plants were reviewed for their potential application to remediation at the Union Station property. Technologies that have been applied at other facilities include *ex situ* technologies dependent on excavation (such as removal, biodegradation, and thermal technologies), and *in situ* technologies (such as air sparging and capping). Several of the characteristics of the contaminants at the Union Station property limited the application of these technologies to remediation of low-mobility contaminants such as CPAH. The characteristics included access restrictions due to the presence of historic and active public facilities, burial beneath fill soil at depths ranging from 8 up to 50 ft, an age of over 80 years for the contaminants, relatively near-surface groundwater levels, and relatively low concentration of organic contaminants in soil. Accordingly, contaminants could not be excavated without significant risk of damage to adjacent structures, effectively eliminating technologies best applied as *ex situ* processes. *In situ* processes such as air sparging (and variations) and capping had limited potential for achieving reduction in contaminant concentrations. Implementation of air sparging technologies were influenced by the access restrictions, low permeability of property soil, and presence of CPAH. Air sparging has demonstrated effectiveness for degrading lower molecular weight aromatic hydrocarbons such as naphthalene. However, the effectiveness of air sparging technologies in degrading the higher molecular weight aromatic (CPAH) contaminants is poor. No reports of field studies of successful air-sparging or bioventing remediation of CPAH contaminants were identified. Capping technologies designed to minimize infiltration would contribute little due to the relatively near-surface groundwater level with respect to contaminant distribution. These property characteristics were considered in developing the cleanup characteristics.

Four cleanup action alternatives for the property were evaluated in the FS. A brief summary of each alternative as described in the FS is presented below. The planned cleanup action described in this cleanup action plan builds on Alternative 2, but incorporates provisions for more extensive groundwater monitoring and provisions for groundwater treatment than included in the alternatives presented in the FS.

Alternative 1 - Monitoring, construction soil excavation, and institutional controls would isolate the contaminated soil to reduce the limited potential for direct contact. Contaminated soil encountered during construction activities would be tested, evaluated, removed if appropriate, and managed off-property in accordance with applicable waste management regulations. Groundwater monitoring would be conducted to evaluate compliance with groundwater cleanup standards. Institutional controls would be implemented to control access and potential exposure to contaminated soil (through fencing and deed restrictions) and to conduct periodic review of the status of the property. The present worth cost of this alternative is estimated to be $700,000.

Alternative 2 - Paving, construction soil excavation, monitoring, and institutional controls would isolate the contaminated soil through paving and construction of building structures over all contaminated soil areas to further reduce the limited potential for direct contact. Contaminated soil encountered during construction activities would be removed and managed off-property in accordance with applicable waste management standards. Groundwater monitoring would be conducted to evaluate compliance with groundwater cleanup standards. Institutional controls would be implemented to control access and potential exposure to contaminated soil or property groundwater and to conduct periodic review of the status of the property. The present worth cost of this alternative is estimated to be $1,200,000 although this cost estimate includes paving for the entire project, not just paving which would be required solely for remediation.

Alternative 3 - Air sparging, paving, construction soil excavation, monitoring, and institutional controls would implement the cleanup measures associated with Alternative 2 and would add *in situ* air sparging in an attempt to reduce the volume of high molecular weight organic constituents of concern (CPAH) in the property soil. Air sparging for remediation of semivolatile organic compounds uses low pressure subsurface air injection through a system of injection wells to stimulate *in situ* aerobic biodegradation. Air sparging could potentially achieve some small reduction of the volume of CPAH in the contaminated soil; however, this process is not expected to significantly enhance long-term effectiveness and is not capable of achieving soil cleanup standards. CPAH compounds strongly adsorb to the organic soil matrix and are not easily degraded by biological activity. In addition, full-scale implementation of this technology has never been undertaken under similar conditions. For FS evaluation purposes, a time frame of 10 years is used for operation of the air sparging system. The monitoring program for this alternative would add subsurface air analyses to monitor the air sparging operations in addition to groundwater monitoring. The duration of both monitoring activities would be the same as the air sparging operation. The present worth cost of this alternative is estimated to be $3,800,000.

Alternative 4 - Accessible soil excavation, air sparging, paving, construction soil excavation, monitoring, and institutional controls would implement the cleanup measures associated with Alternative 3 and would also include excavation of most accessible soil (soil that is not located beneath existing property structures) to permanently remove this portion of the contaminated soil from the property. Less than 30 percent of the total contaminated soil would be removed under this alternative. The presence of battered piles (piles installed at an angle extending outward) supporting the walls of the parking lid structure limits the amount of excavation that can be done. Soil beneath the bus tunnel, street viaducts, and Union Station building would not be excavated because of the high potential for damage and disruption. Portions of 4th Avenue S. and S. Airport Way would require temporary shoring and may require temporary closure to facilitate soil excavation. Supplemental cleanup measures for the contaminated soil remaining on-property would include modified versions of the air sparging, paving, institutional controls, and monitoring measures associated with Alternative 3. The present worth cost of this alternative is estimated to be $22,600,000.

3.0 PLANNED CLEANUP ACTION

Alternative 2 was selected in the FS as the preferred cleanup action for historic buried contamination at the Union Station property. Based on Ecology requirements, modifications were made to alternative 2 (as it was described in the FS) including addition of contingent soil removal and contingent groundwater extraction and treatment, and increases in the duration and frequency of groundwater monitoring. Elements of the planned cleanup action are described below. Elements of the planned cleanup action are also discussed in Appendix A (Groundwater Monitoring) and Appendix B (Construction Contingency Plan).

3.1 COMPONENTS OF THE PLANNED CLEANUP ACTION

3.1.1 PAVING

Asphalt concrete paving will be placed on areas of exposed soil in undeveloped areas to completely cover the property to further prevent the limited potential for direct human contact with remaining contaminated soil. Pavement and structures currently cover approximately 60 percent of the property. Where building structures are not present, the exposed soil will be paved using, for example, a standard 2-inch thick Class B asphalt concrete pavement.

3.1.2 CONSTRUCTION SOIL EXCAVATION

Contaminated soil excavated during construction activities, if any, will be tested, evaluated, and disposed of to permanently remove it from the property. Activities that have the potential to cause excavation of contaminated soil include installation of augercast piles and excavation for building foundations.

Dangerous waste characteristic testing summarized in the RI found that, although some contaminants were present that could potentially require designation as a dangerous waste if concentrations were high enough, the soil was typically not a dangerous waste, and will be suitable for disposal at a permitted Subtitle D municipal solid waste landfill. Pretreatment by solidification will be implemented as required to reduce the free-liquid content of the soil to levels suitable for disposal as a solid waste. For cost evaluation purposes, the preliminary estimate in the FS for contaminated soil quantities to be removed during construction has been refined to 3,000 to 5,000 tons of soil. This refined estimate of quantity has been used in the cost estimates presented in this plan. If disposal of the soil as a hazardous waste is necessary, the cost for this activity will be increased by up to $1,600,000. Appendix B presents the approach to be implemented if soil contamination is encountered during construction.

3.1.3 MONITORING

The planned cleanup action provides for appropriate and required monitoring, including: 1) protection monitoring in accordance with a health and safety plan to confirm that human health and the environment are adequately protected during site development and remedial construction and operation periods; 2) performance monitoring to confirm that the cleanup standards associated with a property cleanup have been attained; and 3) confirmational monitoring to confirm the long-term effectiveness of the cleanup actions.

Groundwater monitoring will be implemented at the property to provide an ongoing assessment of groundwater quality in the shallow aquifer. The groundwater monitoring program is described in Table 3. Groundwater monitoring wells will be maintained in good condition as long as the monitoring program continues. Groundwater monitoring procedures and analytical methods are presented in Appendix A. The program will begin with eight quarters of quarterly monitoring. As described in Appendix A, data analysis and evaluation procedures specified in Ecology Publication 92-54 (Ecology 1992), *Statistical Guidance for Ecology Site Managers* or another statistical method approved by Ecology will be used. If a statistical evaluation based on the upper 95 percent confidence limit on the mean (UCL) indicates groundwater concentrations do not exceed cleanup levels, frequency will decrease to annual monitoring until foundation construction is complete or until two years after foundation construction is initiated. Quarterly sampling will then be conducted for eight additional quarters. If sampling results indicate no statistical exceedances of cleanup levels, monitoring frequency will be decreased to annual until 3 years after completion of foundation loading (building construction). Three years after foundation loading is complete, and providing no exceedances have occurred, monitoring frequency may be reduced to every 5 years. Union Station Associates or its successors and assigns shall continue monitoring as long as residual hazardous substance concentrations contained onsite exceed site cleanup levels or unless or until some other party agrees to do such monitoring and Ecology agrees to such substitution.

This site is subject to periodic review pursuant to WAC 173-340-420.

During groundwater monitoring, groundwater samples will be analyzed for dissolved metals, semivolatile compounds , volatile compounds , TPH , and cyanide . Analytical methods and PQLs are presented in Appendix A. Comparable analytical methods may be substituted upon approval by Ecology. An estimate of the present worth value of groundwater monitoring costs is shown in Table 6.

3.1.4 GROUNDWATER REMEDIATION

Groundwater extraction and treatment will be implemented as needed to respond to groundwater contamination that may be encountered at the property. Because the substantial infrastructure to be developed at the property may represent an impediment to the future installation of a groundwater remediation system, some portions of the system will be constructed as part of property development. Other parts of the system will be constructed at the time groundwater treatment is triggered. The triggers for implementation of groundwater extraction and treatment, as well as the initial and contingent portions of the remediation system, are described below.

3.1.4.1 Triggers for Groundwater Remediation

Groundwater monitoring will be implemented as described in Section 3.1.3. Analysis results will be compared to site groundwater cleanup levels (Table 1). Triggers for implementation of groundwater remediation to prevent contamination from leaving the site are described in Table 3. The parties anticipate that Ecology may revise this cleanup action plan to incorporate new cleanup standards if the cleanup standards are revised by an amendment to MTCA regulations and Ecology determines use of the new standards is appropriate.

3.1.4.2 Preliminary Estimate of Groundwater Flow

An estimate of the amount of groundwater discharging from the western property boundary was prepared to provide an estimate of the rate at which water could potentially be extracted from the shallow fill groundwater zone, if monitoring showed that a groundwater remediation system was necessary. The estimated groundwater discharge is in the range of 1 to 10 gallons per minute. The discharge estimate (Q) was developed using a form of Darcy's law ($Q = K\ i\ A$; Freeze and Cherry 1979). The elements for the calculation are K (hydraulic conductivity), i (hydraulic gradient), and A (cross sectional area of groundwater zone oriented perpendicular to the direction of groundwater flow). Information on hydraulic conductivity and groundwater seepage velocity was obtained from Hart Crowser (1986) Table A-2 and the RI/FS page 3-5 (Landau Associates and Hart Crowser 1996). The hydraulic gradient for the shallow groundwater zone was estimated from groundwater elevation information presented in RI/FS Table 3-1 and Figure 3-5. The saturated cross sectional area was estimated using information from RI/FS Table 3-1 and monitoring well logs presented in Appendices B and H and from the *Supplemental Monitoring Report* (Landau Associates 1996), Table 3-1 and Appendix A.

3.1.4.3 Conceptual Design of Extraction System Components

The initial portions of the groundwater extraction system will be constructed along the western property boundary (Figure 4) because shallow groundwater generally flows westerly toward Elliott Bay. Up to three of the existing monitoring wells located under or near the 4th Avenue S. viaduct (HC-101 through HC-103 and MW-104 through MW-107) will be used as extraction points in a future groundwater cleanup remedy or, if necessary, new wells will be constructed. If existing wells are abandoned to facilitate construction of the foundation systems for the proposed parking garage and buildings, they will be abandoned in accordance with state regulations governing well drilling and abandonment, and up to three new 4-inch monitoring wells, constructed to also serve as potential extraction wells, will be installed in similar locations.

A 6-inch diameter corrugated high density polyethylene (HDPE) carrier pipe, or utility corridor, will be installed between the monitoring wells north of S. Airport Way. This will allow a remedial contractor to later install electrical conductors, hoses, and piping in the specific locations where they are required. A utility corridor will not initially be installed between monitoring wells MW-106 and MW-107 south of S. Airport Way. A utility corridor between the northern monitoring wells and MW-107 may be installed later, if extraction of contaminated groundwater from MW-107 seems likely. Subsurface vaults will be installed over the existing monitoring wells to provide a point of access to the well for groundwater monitoring and a limited amount of protected space within which pumps, blowers, instrumentation, and similar equipment, will be installed later if necessary. The vaults to the utility corridor will be connected to allow access to multiple wells and to facilitate integration of operation and control of the extraction system. Once installed and backfilled, the right-of-way beneath the 4th Avenue S. viaduct will be paved, and the buried utility corridor and vault network will provide reasonable access for installation of a future groundwater extraction system. Figure 5 illustrates the conceptual well vault and utility corridor design. Some or all of the existing monitoring wells and the utility corridors between them will be incorporated into the extraction system if groundwater extraction and treatment are needed in the future.

Installation of other components of an extraction system will be completed only if it is determined that groundwater extraction is required. After foundation construction is completed, access into the parking lot and under the 4th Avenue S. viaduct will be adequate for installation of additional extraction wells and related equipment, if needed. Union Station Associates and the City of Seattle have agreed that clearance beneath the 4th Avenue S. viaduct will remain adequate for maintenance trucks and a mezzanine parking level will not be constructed in that area. The available clearance beneath the viaduct will, therefore, remain adequate for installation of vertical or horizontal extraction wells and related equipment using readily available equipment.

3.1.4.4 Conceptual Design of Treatment System Components

The contaminants that may need to be treated at the Union Station property include volatile organic compounds, semivolatile organic compounds, cyanide, and heavy metals. Groundwater treatment system components include a particulate filter and two activated carbon adsorption units connected in series. The treatment system, if needed, will be located at the northwest corner of the property under the intersection of 4th Avenue S. and S. Jackson Street. The conceptual layout is shown on Figure 6. The treatment units will treat up to 10 gpm of groundwater. The sizes of the treatment components and other assumptions on which the system design is based are listed in Table 4. The rationale for incorporating the selected treatment components into the design to address the potential types of contaminants that could require remediation is discussed in the following paragraphs.

Volatile organic compounds, such as benzene, toluene, ethyl benzene, and xylene will be removed using carbon adsorption. A dual-unit carbon adsorption module capable of treating the design flow will be fabricated into a skid-mounted treatment system that will fit within the space shown on Figure 6.

Semivolatile organic compounds, such as naphthalene and other hydrocarbons associated with motor oils and coal tars, will also be treated by the activated carbon system.

Groundwater will be filtered to remove suspended sediments prior to treatment. Acceptable reductions in suspended sediments will generally be accomplished by conveying the groundwater through a bag or cartridge filter system. Filtering systems for low flow rate applications are very compact and easily monitored.

The treatment of heavy metals and cyanide is more difficult than the treatment of organic compounds because the most efficient metals treatment is constituent-specific. Ion exchange and precipitation are typical treatment technologies applied to reduce metals and cyanide. Ion exchange appears to offer the most efficient means of reducing metal concentrations in extracted groundwater to levels appropriate for discharge to the sanitary sewer. Ion exchange produces two liquid effluents (a wastewater and the treated groundwater) that would be easily managed at this site. Precipitation requires metered feed systems, pH control, and auxiliary equipment to separate, process, and store precipitate sludges. Thus, ion exchange is a preferred technology for metals treatment.

The conceptual treatment system illustrated on Figure 8 does not include supplemental treatment systems for metals and cyanide. Metals and cyanide have not been detected in concentrations above those typical of urban areas. Additionally, activated carbon has some capacity to adsorb metals. Further, even if metals or cyanide are detected at levels that may trigger groundwater pumping, the concentrations of metals that might reasonably be anticipated are not expected to exceed the criteria for discharge to the sanitary sewer.

An electrical panel from which electrical power will be obtained for power pumps and to energize instrumentation will be located near the treatment system. Extracted groundwater will be pumped to the treatment system through piping attached to the columns and ceiling of the parking garage. Treated water will be discharged to the sanitary sewer. System operations will be manually controlled. Security will be provided by erecting heavy duty chain-link fencing or constructing a small room around the treatment system.

3.1.4.5 Operation of Groundwater Extraction and Treatment System

If it is necessary, Union Station Associates will operate and fund the groundwater extraction and treatment system described above for a period of 2 years. After 2 years, Ecology or their designated agent will assume responsibility for operating and funding the system. An estimate of the present worth value of groundwater treatment plant operation costs is shown in Table 7.

3.1.4.6 Disposition of Groundwater Extraction and Treatment System

Dismantling and disposing of the groundwater extraction and treatment system shall be the obligation of the final operator of the system .

3.1.5 HAZARDOUS SUBSTANCES REMAINING ONSITE

As described in the RI, concentrations of arsenic, beryllium, lead, and CPAH in soil in some locations exceed either both direct contact soil cleanup levels which are less than soil background values and soil background values (7 mg/kg for arsenic and 0.6 mg/kg for beryllium), or direct contact soil cleanup levels which are greater than soil background values (250 mg/kg for lead and 1 mg/kg for CPAH). The locations of these exceedances are shown on Figure 4-1. Concentrations of metals and PAH in soil exceed soil cleanup levels based on protection of groundwater and using the MTCA default leaching factor of 100. Coal tar waste, which contains CPAHs, is buried beneath Union Station and the north end of the bus tunnel. This waste, which was discarded onto the tide flats underlying the coal gasification plant, is now buried by fill. Its exact amount and extent have not been characterized and are unknown.

3.1.6 REQUIRED INSTITUTIONAL CONTROLS

Institutional controls will be implemented to assure the continued protection of human health and the environment. Institutional controls include a restriction on installing wells at the property except as part of the remediation and a restriction on the use of site groundwater as drinking water.

Institutional controls will also include periodic reviews of property conditions and preparation of status reports on the effectiveness of the property cleanup action over time. This periodic review and reporting is a requirement of the MTCA (WAC 173-340-420). Periodic reviews will be conducted no less frequently than every 5 years after the initiation of the cleanup action.

3.2 COMPLIANCE WITH MTCA THRESHOLD REQUIREMENTS

The planned cleanup action complies with MTCA threshold requirements, including protection of human health and the environment, compliance with cleanup standards associated with a property cleanup, compliance with applicable state and federal laws, and provision for compliance monitoring. The planned cleanup action will protect human heath and the environment by permanent control of potential exposure to contaminated soil through paving, institutional controls, and monitoring. Cleanup levels will be achieved at the points of compliance upon completion of the cleanup action construction. The cleanup action will be constructed and operated in compliance with applicable local, state, and federal laws. Protection, performance, and confirmational monitoring programs will be implemented to confirm adequate protection of human health and the environment during and after construction to confirm compliance with the cleanup standards.

3.3 COST

The cost of the modified planned cleanup action is estimated at $1,800,000 (if no groundwater treatment is required) to $2,300,000 (see Table 8). The cost could increase by up to $1,600,000 in the unlikely event that all soil excavated during construction were required to be managed as hazardous waste.

4.0 JUSTIFICATION FOR SELECTING THE CLEANUP ACTION

The planned cleanup action effectively and permanently protects human health and the environment by: 1) effectively preventing any potential direct contact with contaminated soil, 2) managing contaminated soil generated during construction in compliance with applicable regulatory requirements, 3) identifying a contingent groundwater remedial measure, and 4) providing for monitoring and institutional controls.

The primary risk associated with the property (direct exposure to contaminated soil) will be effectively controlled through paving, property development, and institutional controls. It is extremely unlikely that area groundwater will be used as a drinking water source, given the availability of municipal water supply and regulations prohibiting development of water wells in this area. The low migration potential and the low solubility in groundwater cause the constituents of concern in the contaminated soil to be relatively immobile, as evidenced by the fact that there are only a few recent exceedances of groundwater quality standards from releases at the property at the downgradient property boundary, and the exceedances may have occurred as a result of unstable well conditions at the time of sampling.

The property represents a very valuable resource to the area in terms of development. Key public structures exist at and adjacent to the property that cannot be impacted by the cleanup action. Current property use includes the south portal of the Metro bus tunnel, the Metro International District transit station, a historic building (Union Station), parking lots, public streets (including sections of the S. Jackson Street and 4th Avenue S. viaducts), and sidewalks. The proposed development plan will further enhance the area through developing valuable commercial uses. The elements of the planned cleanup action are consistent both with the existing structures and facilities and with the planned property development. Other cleanup alternatives may jeopardize the existing structures and the planned property development. It is infeasible to disrupt the operations of the bus tunnel or the public streets to implement cleanup actions. Consequently, no cleanup action will be undertaken that poses a risk to the operations and function of these structures.

The planned cleanup action will effectively achieve the property remedial action objectives and cleanup standards, further limit the potential for exposure to contaminated soil and groundwater, and provide permanent protection of human health and the environment from potential risks posed by the property.

5.0 APPLICABLE STATE AND FEDERAL LAWS

The planned cleanup action will comply with applicable local, state, and federal laws and regulations including MTCA, which is the primary regulation that establishes the requirements and standards for the cleanup action. In addition to MTCA, the planned cleanup action will comply with applicable regulations addressing waste management for excavated soil.

Cleanup standards developed under MTCA must meet the statutory requirement to be at least as stringent as all applicable state and federal laws. The laws and implementing regulations that may be applicable to establishing cleanup standards at this property are identified and evaluated in Table 5. The applicable laws and regulations in addition to MTCA that are considered in the development of cleanup standards include the federal Comprehensive Environmental Response, Compensation and Liability Act (CERCLA), and the associated National Oil and Hazardous Substances Pollution Contingency Plan (NCP); the federal Clean Water Act and associated ambient water quality criteria; and the state Water Pollution Control Act and associated surface water quality standards.

The planned cleanup action is unlikely to cause damage to Union Station, a national historic landmark and, thus, also complies with the National Historic Preservation Act.

6.0 IMPLEMENTATION SCHEDULE AND RESTORATION TIME FRAME

Groundwater monitoring as described in Table 3 will begin within 3 months of the effective date of the consent decree. Paving will be accomplished in conjunction with property development.

Removal of contaminated soil excavated during foundation construction will be completed within three months of completion of foundation construction. If foundation construction proceeds in phases, removal of contaminated soil excavated during any phase will be completed within three months of completion of that phase.

Paving will be completed within six months of completion of foundation construction or within two years of the effective date of this decree, whichever is sooner.

For the purposes of issuing a Certificate of Completion pursuant to Section XXV of the Consent Decree, all remedial actions except confirmational monitoring will be considered to be complete when monitoring has been conducted for three years after completion of foundation loading, provided compliance with cleanup standards have been achieved and groundwater treatment has not been triggered.

If groundwater treatment has been triggered prior to three years after completion of foundation loading, all remedial actions except confirmational monitoring will be considered to be complete after three years of monitoring data collected after cessation of groundwater treatment demonstrates compliance with cleanup standards.

In the event that groundwater treatment is triggered at a time more than three years after completion of foundation loading, the site shall be relisted pursuant to WAC 173-340-330(5). The site shall not be removed from the hazardous sites list until three years of monitoring is completed after cessation of groundwater treatment.

7.0 REFERENCES

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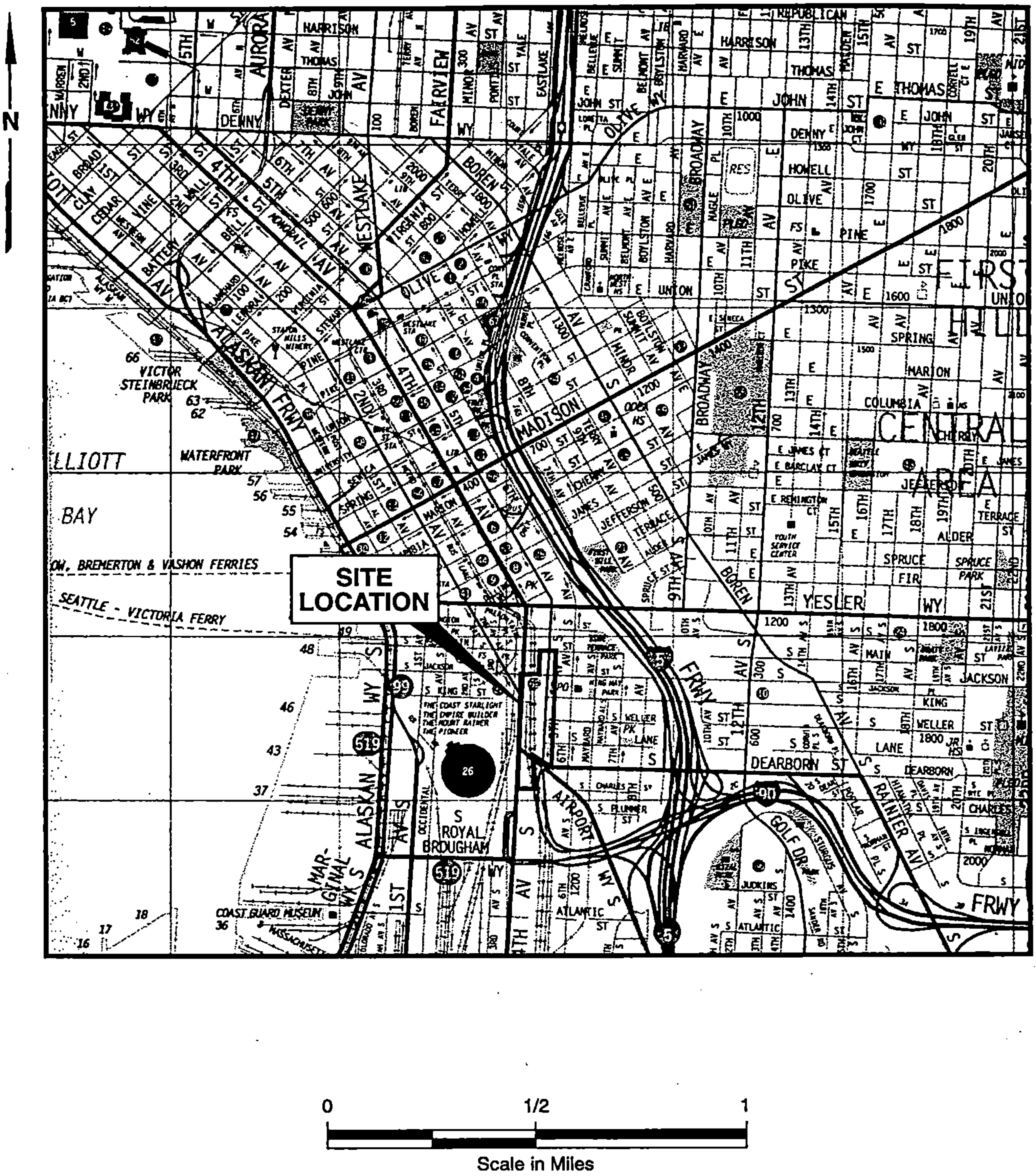
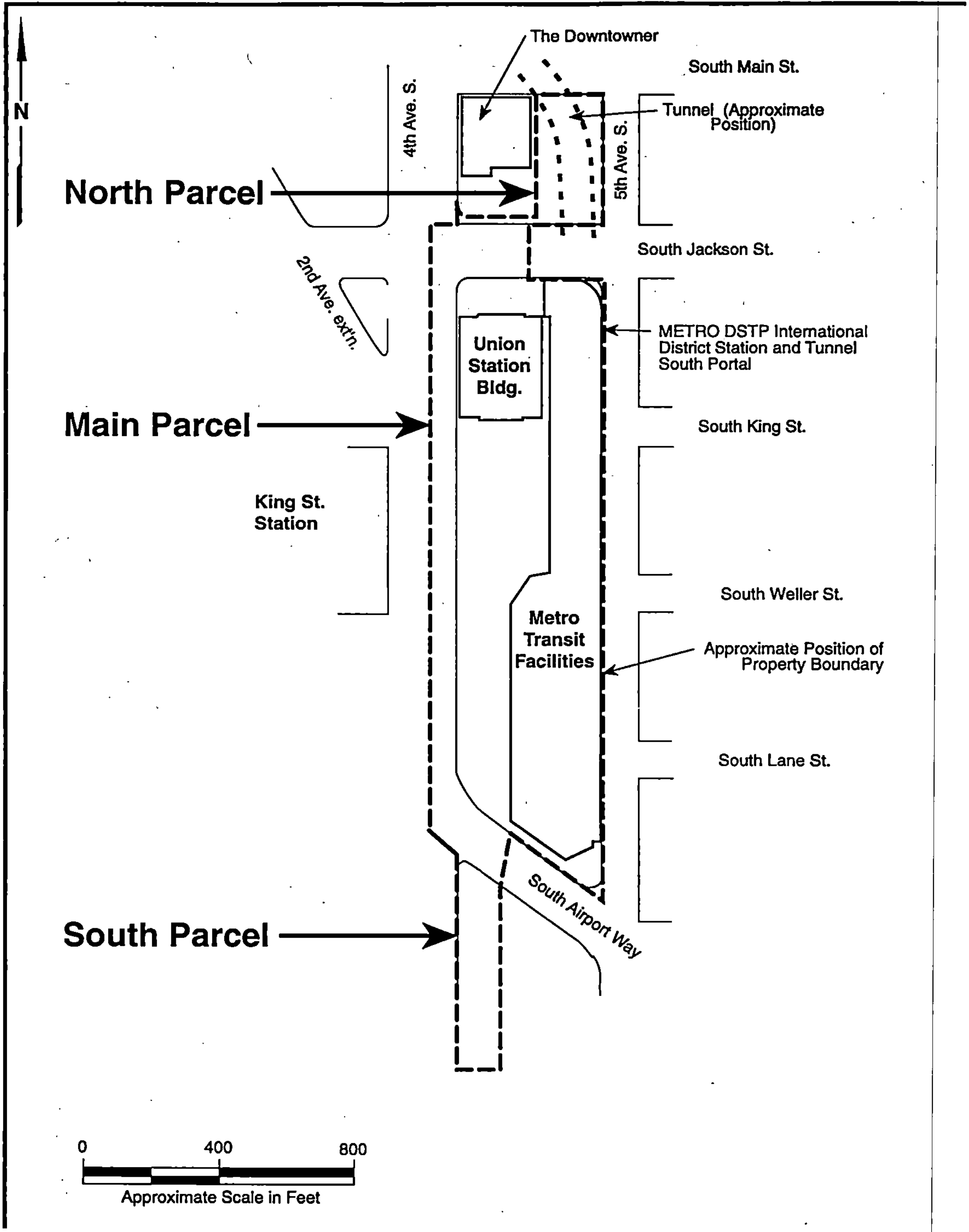


273008.31 Marten & Brown/Union Station/CAP/Fig1 (M) 4/97

Vicinity Map

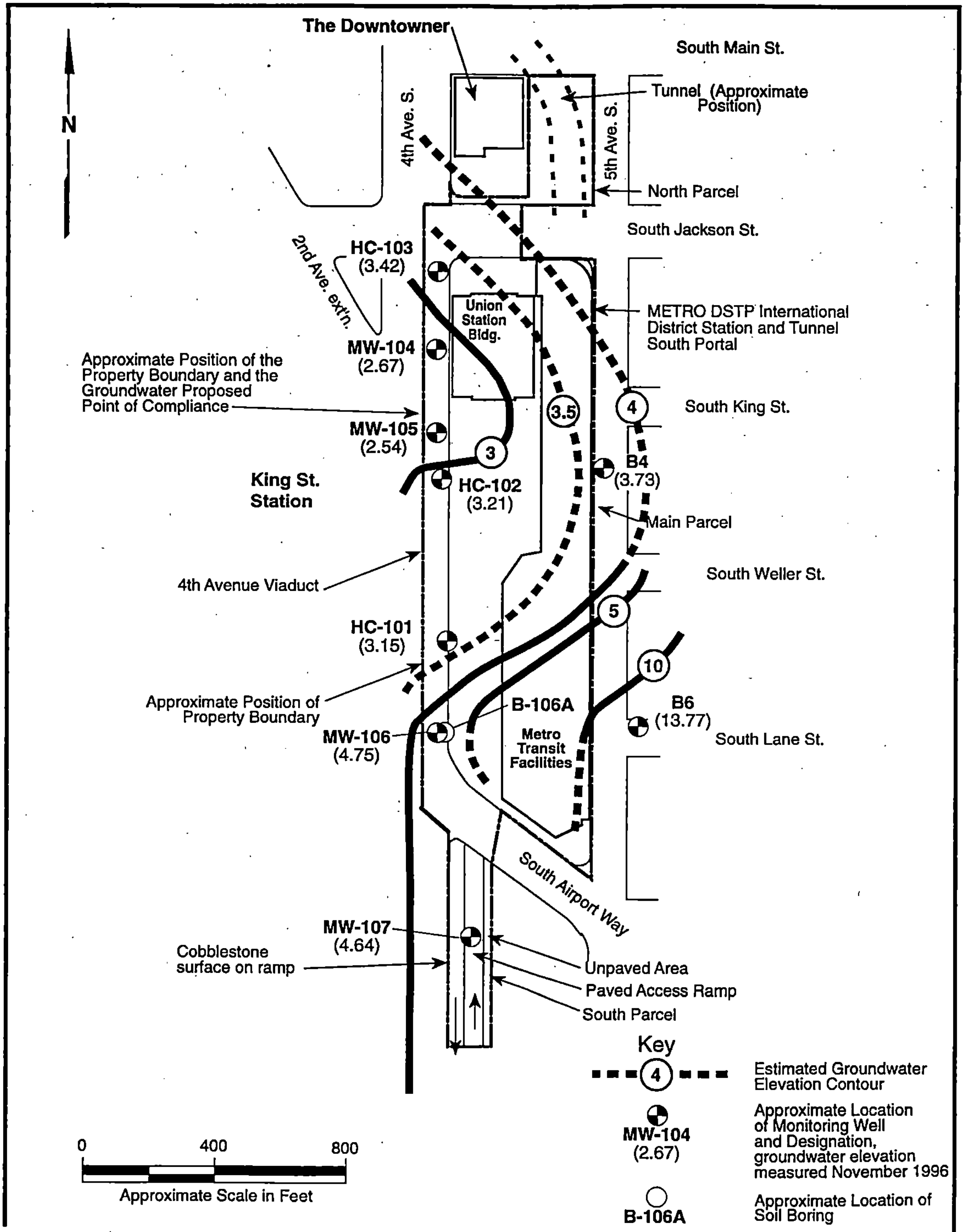
Figure 1



273008.31 Marten & Brown/Union Station/CAP/Fig 2 (M) 4/97

Plan Map with Existing Property Structures

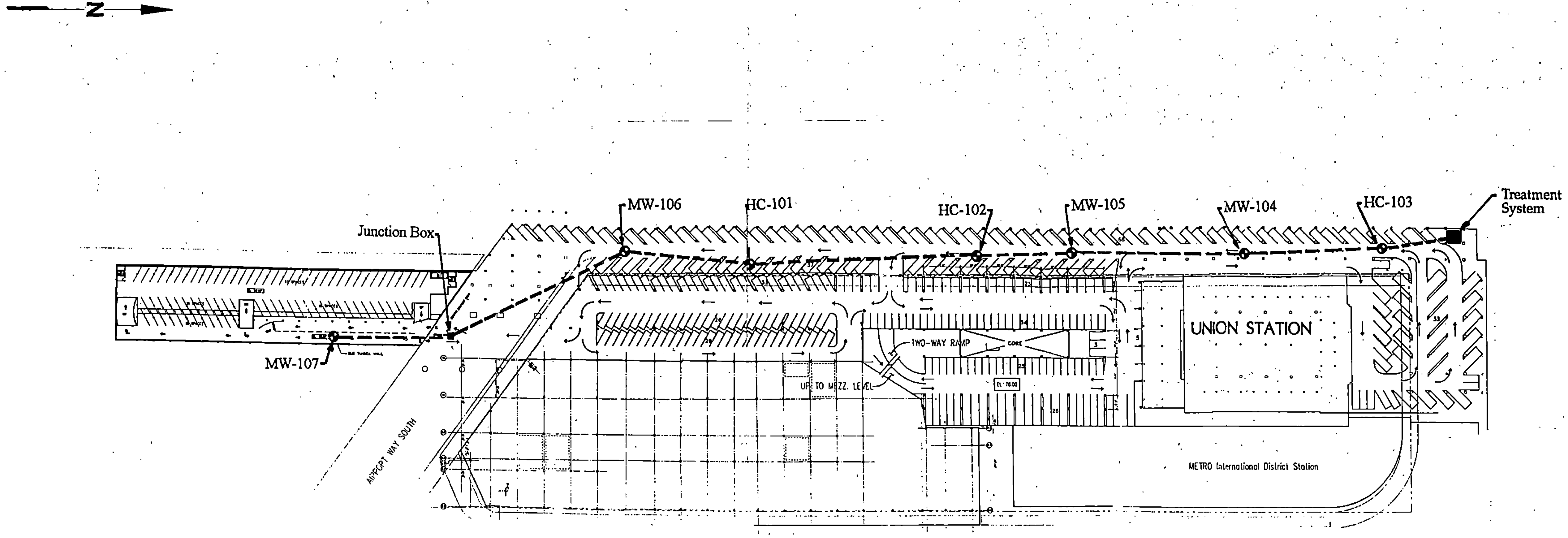
Figure 2



273008.31 Marten & Brown / Union Station / CAP / Fig 3 (M) 4/97

Union Station Property Plan Map
with Groundwater Monitoring Wells

Figure 3



Key

– – – – – – – Utility Corridor

Note:
The utility corridor between MW–107 and HC–101 will only be installed if extraction of contaminated groundwater from MW–107 is likely.

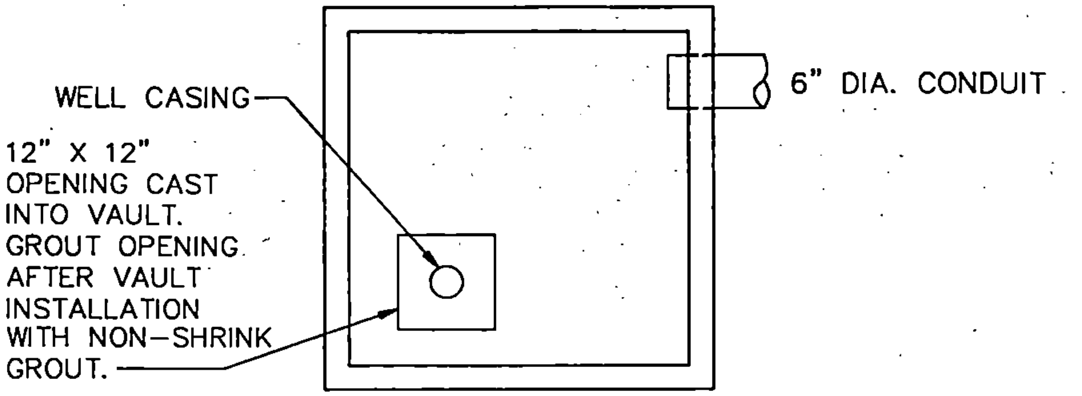
0 200' 400'

Approximate Scale: 1" = 200'

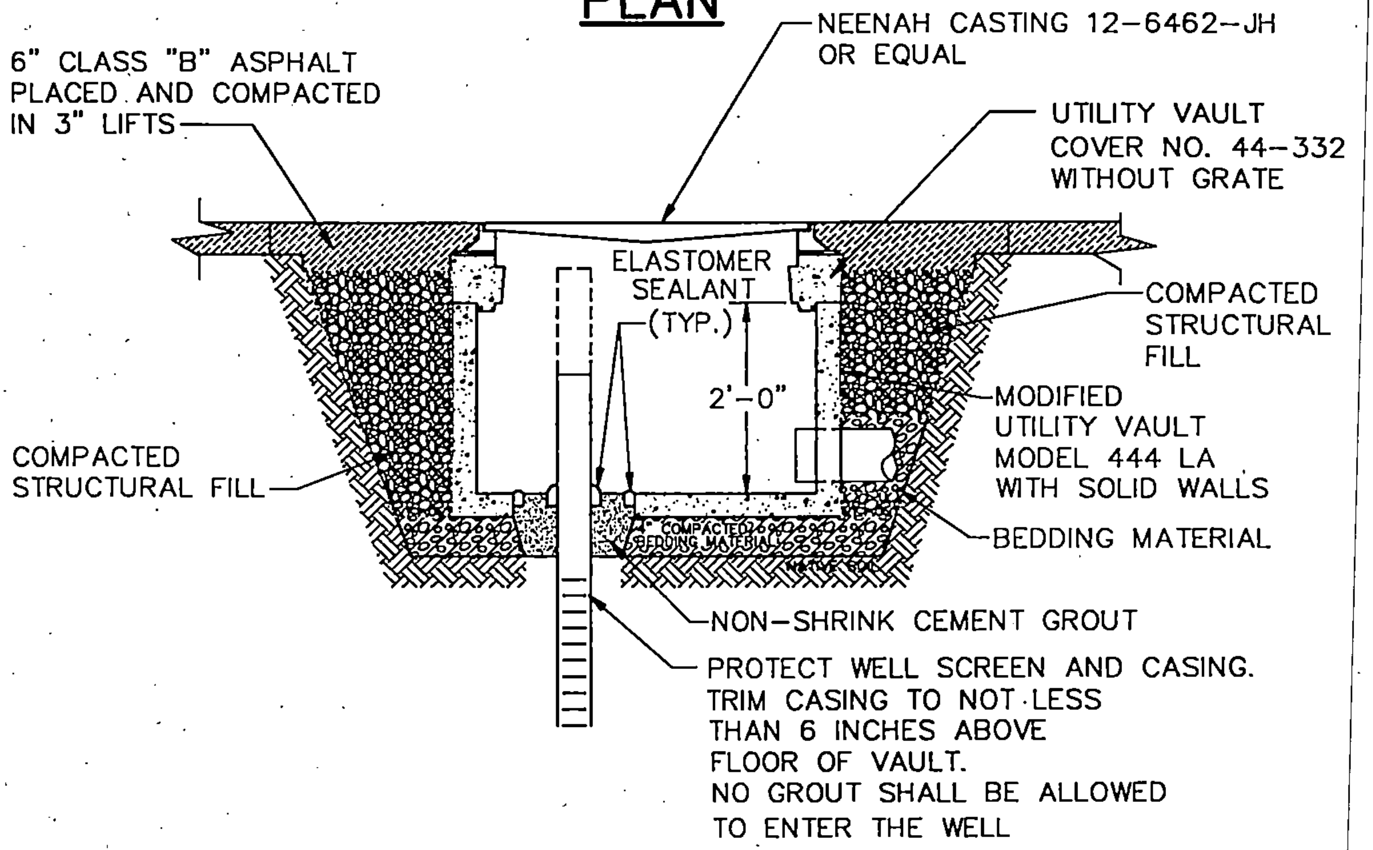
273008.31 Marten & Brown/Union Station/CAP N:\Union\Figs\CAP\Fig4 (A) 4/97

Location of Treatment System, Extraction Wells, and Utility Corridor

Figure 4



PLAN



SECTION

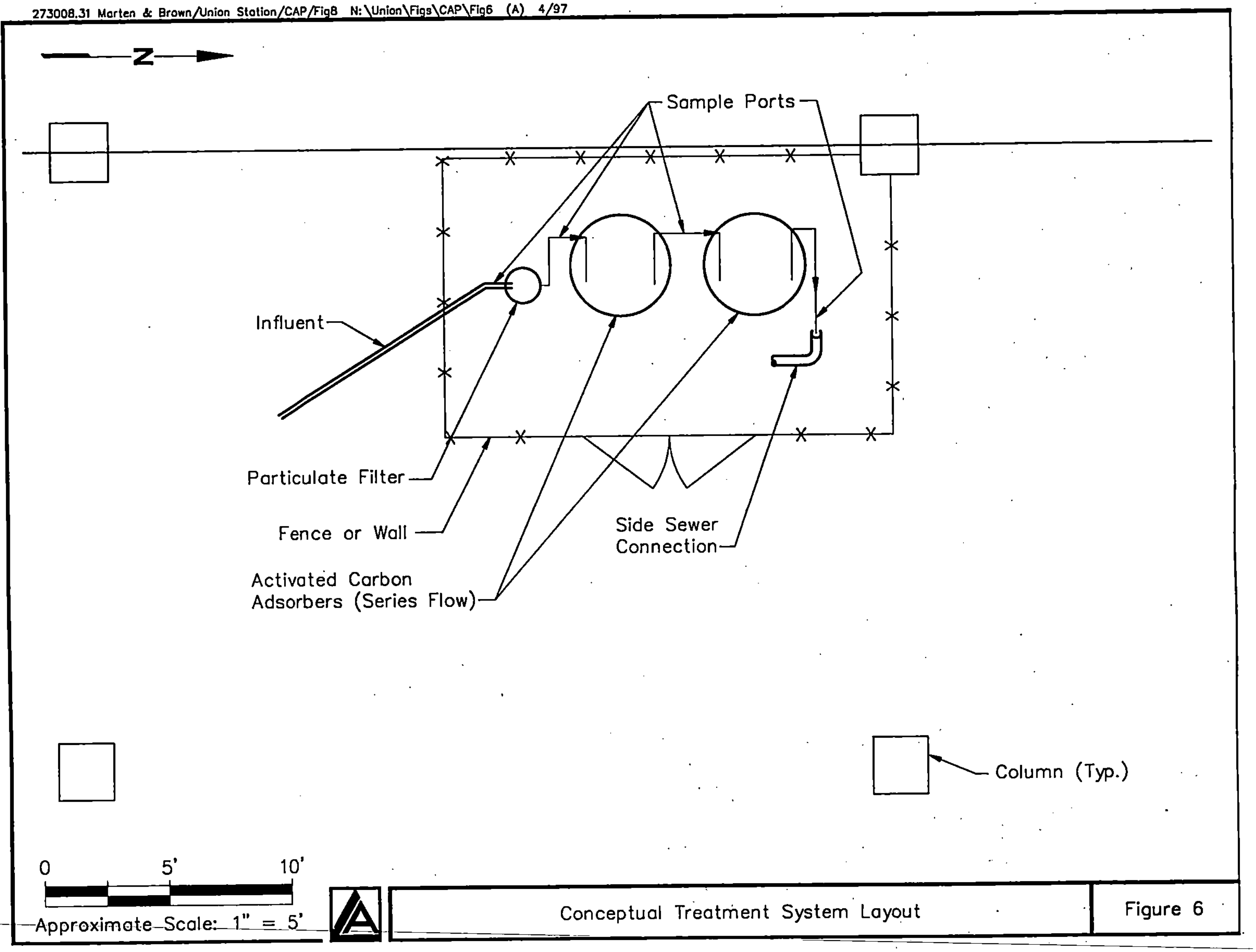
PUMP PACKAGE SHOWN IS BASED ON A PNEUMATICALLY-POWERED SYSTEM, WITH GROUNDWATER EXTRACTED THROUGH A SUCTION HOSE AND DISCHARGED THROUGH A HOSE PROTECTED BY THE 6-INCH CONDUIT. FINAL PUMP PACKAGE WILL BE SELECTED BASED ON TECHNICAL AND ECONOMIC FACTORS AT TIME OF ACTUAL IMPLEMENTATION.

273008.23 Martin & Brown\Union Station\CAP N:\Unionsta\CAP\Fig5 (A) 43/97

Conceptual Well Vault Detail

Figure 5

273008.31 Marten & Brown/Union Station/CAP/Fig8 N:\Union\Figs\CAP\Fig6 (A) 4/97

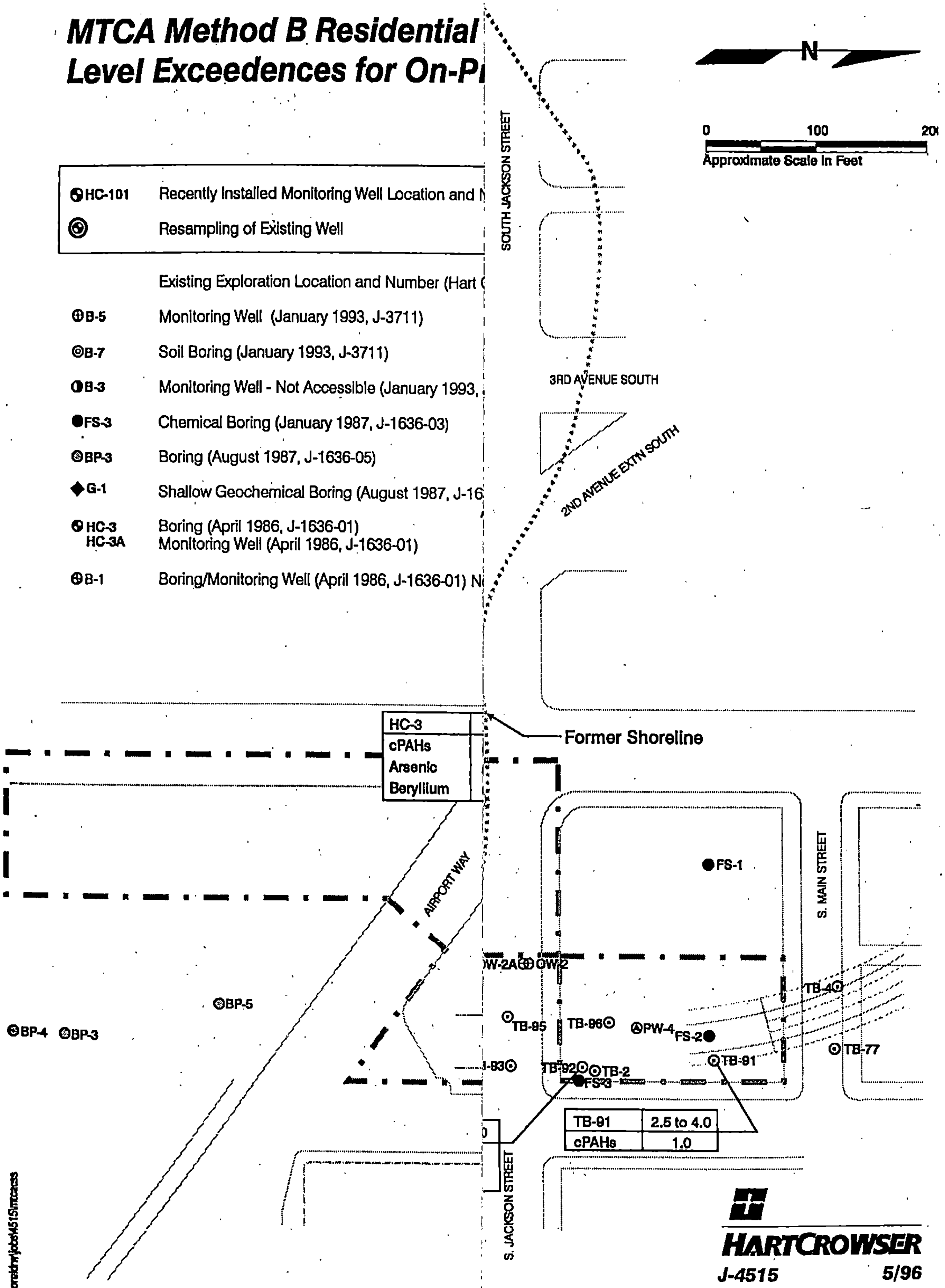


Conceptual Treatment System Layout

Figure 6

MTCA Method B Residential
Level Exceedences for On-P

⊕ HC-101	Recently Installed Monitoring Well Location and N
◎	Resampling of Existing Well
	Existing Exploration Location and Number (Hart C
⊕ B-5	Monitoring Well (January 1993, J-3711)
◎ B-7	Soil Boring (January 1993, J-3711)
◑ B-3	Monitoring Well - Not Accessible (January 1993,
● FS-3	Chemical Boring (January 1987, J-1636-03)
⊗ BP-3	Boring (August 1987, J-1636-05)
◆ G-1	Shallow Geochemical Boring (August 1987, J-16
⊗ HC-3 HC-3A	Boring (April 1986, J-1636-01) Monitoring Well (April 1986, J-1636-01)
⊕ B-1	Boring/Monitoring Well (April 1986, J-1636-01) N



HARTCROWSER

J-4515 5/96

Figure 4-1

TABLE 1
GROUNDWATER CLEANUP LEVELS BASED ON MARINE SURFACE WATER PROTECTION *
DEVELOPED FOR UNION STATION PROJECT
SEATTLE, WASHINGTON

Constituent	State Water Quality Criteria for Aquatic Life(a) (µg/L)	Federal Water Quality Criteria for Aquatic Life (b) (µg/L)	Federal Water Quality Criteria for Human Health (c)(µg/L)	WQC Carcinogenic Risk <10-6 or Hazard Index <1	MTCA Method B Surface Water Equation for Human Health (µg/L)	Practical Quantitation Limits (d)(µg/L)	Adjusted Cleanup Level (µg/L)
TPH-G	–	–	–	–	–	–	**
TPH-D	–	–	–	–	–	–	**
TPH-Other	–	–	–	–	–	–	**
Non-CPAH							
Naphthalene	–	–	–	–	9880	10(e)	9880
Acenaphthylene	–	–	–	–	–	10(e)	–
Acenaphthene	–	–	–	–	643	10(e)	225(f)
Anthracene	–	–	–	–	25900	10(e)	25900
Fluoranthene	–	–	370	No	90.2	10(e)	27.1(f)
Fluorene	–	–	14000	No	3460	10(e)	2,422(f)
Phenanthrene	–	–	–	–	–	10(e)	–
2-Methylnaphthalene	–	–	–	–	–	10(e)	–
Pyrene	–	–	11000	No	2590	10(e)	777(f)
Benzo(g,h,i)perylene	–	–	–	–	–	10(e)	–
Dibenzofuran	–	–	–	–	–	10(e)	–
CPAH							
Benzo(a)anthracene	–	–	0.031	Yes	0.0296	1.0(g)	1.0
Chrysene	–	–	0.031	Yes	0.0296	1.0(g)	1.0
Benzo(b)fluoranthene	–	–	0.031	Yes	0.0296	1.0(g)	1.0
Benzo(k)fluoranthene	–	–	0.031	Yes	0.0296	1.0(g)	1.0
Benzo(a)pyrene	–	–	0.031	Yes	0.0296	1.0(g)	1.0
Indeno(1,2,3-c,d)pyrene	–	–	0.031	Yes	0.0296	1.0(g)	1.0
Dibenzo(ah)anthracene	–	–	0.031	Yes	0.0296	1.0(g)	1.0

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Other Semivolatiles							
Phenol	–	–	4600000	No	1100000	10(e)	1.1x10^6
Bis-(2-Chloroethyl) Ether	–	–	1.4	Yes	0.854	10(e)	10
2-Chlorophenol	–	–	–	–	96.7	10(e)	96.7
1,3-Dichlorobenzene	–	–	2600	–	–	10(e)	2600
1,4-Dichlorobenzene	–	–	2600	No	4.86	10(e)	10
Benzyl alcohol	–	–	–	–	–	20(e)	–
1,2-Dichlorobenzene	–	–	17000	No	4200	10(e)	4200
2-Methylphenol	–	–	–	–	–	–	–
2,2'-Oxybis(1-Chloropropane)	–	–	–	–	–	–	–
4-Methylphenol	–	–	–	–	–	–	–
N-Nitroso-Di-N-Propylamine	–	–	–	–	0.819	10(e)	10
Hexachloroethane	–	–	8.9	Yes	5.33	10(e)	10
Nitrobenzene	–	–	1900	No	449	10(e)	449
Isophorone	–	–	600	Yes	1560	10(e)	600
2-Nitrophenol	–	–	–	–	–	10(e)	–
2,4-Dimethylphenol	–	–	–	–	553	10(e)	553
Benzoic acid	–	–	–	–	–	10(e)	–
bis(2-Chloroethoxy) Methane	–	–	–	–	–	10(e)	–
2,4-Dichlorophenol	–	–	790	No	191	10(e)	191
1,2,4-Trichlorobenzene	–	–	–	–	227	10(e)	227
4-Chloroaniline	–	–	–	–	–	20(e)	–
Hexachlorobutadiene	–	–	50	Yes	29.9	10(e)	50
4-Chloro-3-methylphenol	–	–	–	–	–	20(e)	–
Hexachlorocyclopentadiene	–	–	17000	No	4180	20(e)	4180
2,4,6-Trichlorophenol	–	–	6.5	Yes	3.93	10(e)	10
2,4,5-Trichlorophenol	–	–	–	–	–	10(e)	–
2-Chloronaphthalene	–	–	–	–	–	10(e)	–
2-Nitroaniline	–	–	–	–	–	50(e)	–
Dimethylphthalate	–	–	2900000	No	72000	10(e)	72000
3-Nitroaniline	–	–	–	–	–	50(e)	–
2,4-Dinitrophenol	–	–	14000	No	3460	50(e)	3460
4-Nitrophenol	–	–	–	–	–	50(e)	–

TABLE 1
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SEATTLE, WASHINGTON

Constituent	State Water Quality Criteria for Aquatic Life(a) (µg/L)	Federal Water Quality Criteria for Aquatic Life (b) (µg/L)	Federal Water Quality Criteria for Human Health (c)(µg/L)	WQC Carcinogenic Risk <10-6 or Hazard Index <1	MTCA Method B Surface Water Equation for Human Health (µg/L)	Practical Quantitation Limits (d)(µg/L)	Adjusted Cleanup Level (µg/L)
2,6-Dinitrotoluene	–	–	–	–	–	10(e)	–
2,4-Dinitrotoluene	–	–	9.1	Yes	1360	10(e)	10
Diethyl phthalate	–	–	120000	No	28400	10(e)	28400
4-Chlorophenyl phenyl ether	–	–	–	–	–	10(e)	–
4-Nitroaniline	–	–	–	–	–	20(e)	–
4,6-Dinitro-2-Methylphenol	–	–	–	–	–	–	–
N-Nitrosodiphenylamine	–	–	16	Yes	9.73	10(e)	16
4-Bromophenyl phenyl ether	–	–	–	–	–	10(e)	–
Hexachlorobenzene	–	–	0.00077	Yes	0.000466	10(e)	10
Pentachlorophenol	7.9	7.9	8.2	Yes	4.91	50(e)	50
Carbazole	–	–	–	–	–	10(e)	–
Di-n-Butylphthalate	–	–	12000	No	2910	–	2910
Butyl benzyl phthalate	–	–	–	–	1250	10(e)	1250
3,3'-Dichlorobenzidine	–	–	0.077	Yes	0.0462	20(e)	20
bis(2-ethylhexyl)phthalate	–	–	5.9	Yes	3.56	10(e)	10
Di-n-Octyl phthalate	–	–	–	–	–	10(e)	–
Volatiles							
Chloromethane	–	–	–	–	133	10(h)	133
Bromomethane	–	–	–	–	968	–	968
Vinyl chloride	–	–	525	No	2.92	10(h)	10
Chloroethane	–	–	–	–	–	10(h)	–
Methylene chloride	–	–	–	–	960	5(h)	960
Acetone	–	–	–	–	–	10(h)	–
Carbon Disulfide	–	–	–	–	–	10(h)	–
1,1-Dichloroethene	–	–	3.2	Yes	1.93	5(h)	5
1,1-Dichloroethane	–	–	–	–	–	5(h)	–
trans-1,2-Dichloroethene	–	–	–	–	32800	5(h)	32800
cis-1,2-Dichloroethene	–	–	–	–	–	5(h)	–
Chloroform	–	–	470	Yes	283	5(h)	470
1,2-Dichloroethane	–	–	99	Yes	59.4	5(h)	99
2-Butanone	–	–	–	–	–	–	–
1,1,1-Trichloroethane	–	–	–	–	417000	5(h)	41700
Carbon tetrachloride	–	–	4.4	Yes	2.66	5(h)	5

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Constituent	State Water Quality Criteria for Aquatic Life(a) (µg/L)	Federal Water Quality Criteria for Aquatic Life (b) (µg/L)	Federal Water Quality Criteria for Human Health (c)(µg/L)	WQC Carcinogenic Risk <10-5 or Hazard Index <1	MTCA Method B Surface Water Equation for Human Health (µg/L)	Practical Quantitation Limits (d)(µg/L)	Adjusted Cleanup Level (µg/L)
Vinyl acetate	–	–	–	–	–	50(h)	–
Bromodichloromethane	–	–	–	–	27.9	5(h)	28
1,2-Dichloropropane	–	–	–	–	23.2	5(h)	23
cis-1,3-Dichloropropene	–	–	–	–	18.9	5(h)	19
Trichloroethene	–	–	81	Yes	55.6	5(h)	81
Dibromochloromethane	–	–	–	–	20.6	–	21
1,1,2-Trichloroethane	–	–	42	Yes	25.3	5(h)	42
Benzene	–	–	71	Yes	43.0	5(h)	71
trans-1,3-Dichloropropene	–	–	–	–	18.9	5(h)	19
2-Chloroethyl vinyl ether	–	–	–	–	–	10(h)	–
Bromoform	–	–	360	Yes	219	5(h)	360
4-Methyl-2-Pentanone (MIBK)	–	–	–	–	–	–	–
2-Hexanone	–	–	–	–	–	50(h)	–
Tetrachloroethene	–	–	8.85	Yes	4.15	5(h)	8.9
1,1,2,2-Tetrachloroethane	–	–	–	–	6.48	5(h)	6.5
Toluene	–	–	200000	No	48500	5(h)	485(f)
Chlorobenzene	–	–	21000	No	5030	5(h)	5030
Ethylbenzene	–	–	29000	No	6910	5(h)	276(f)
Styrene	–	–	–	–	–	5(h)	–
Trichlorofluoromethane	–	–	–	–	–	–	–
1,1,2-Trichlorotrifluoroethane	–	–	–	–	–	–	–
m,p-Xylene	–	–	–	–	–	–	–
O-Xylene	–	–	–	–	–	–	–
Xylenes	–	–	–	–	–	5(h)	–
Acrolein	–	–	780	–	–	–	780
Methyl iodide	–	–	–	–	–	–	–
Bromoethane	–	–	–	–	–	–	–
Acrylonitrile	–	–	0.66	Yes	0.400	5(h)	5
1,1-Dichloropropene	–	–	–	–	–	–	–
Dibromomethane	–	–	–	–	–	–	–
1,1,1,2-Tetrachloroethane	–	–	–	–	–	–	–
1,2-Dibromo-3-chloropropane	–	–	–	–	–	–	–
1,2,3-Trichloropropane	–	–	–	–	–	–	–

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SEATTLE, WASHINGTON

Constituent	State Water Quality Criteria for Aquatic Life(a) (µg/L)	Federal Water Quality Criteria for Aquatic Life (b) (µg/L)	Federal Water Quality Criteria for Human Health (c)(µg/L)	WQC Carcinogenic Risk <10-6 or Hazard Index <1	MTCA Method B Surface Water Equation for Human Health (µg/L)	Practical Quantitation Limits (d)(µg/L)	Adjusted Cleanup Level (µg/L)
trans-1,4-Dichloro-2-butene	–	–	–	–	–	–	–
1,3,5-Trimethylbenzene	–	–	–	–	–	–	–
1,2,4-Trimethylbenzene	–	–	–	–	–	–	–
Hexachlorobutadiene	–	–	–	–	29.9	10(g)	30
Ethylene Dibromide	–	–	–	–	–	–	–
Bromochloromethane	–	–	–	–	–	–	–
2,2-Dichloropropane	–	–	–	–	–	–	–
1,3-Dichloropropane	–	–	–	–	–	–	–
Isopropylbenzene	–	–	–	–	–	–	–
n-Propylbenzene	–	–	–	–	–	–	–
Bromobenzene	–	–	–	–	–	–	–
2-Chlorotoluene	–	–	–	–	–	–	–
4-Chlorotoluene	–	–	–	–	–	–	–
tert-Butylbenzene	–	–	–	–	–	–	–
sec-Butylbenzene	–	–	–	–	–	–	–
4-Isopropyltoluene	–	–	–	–	–	–	–
n-Butylbenzene	–	–	–	–	–	–	–
1,2,3-Trichlorobenzene	–	–	–	–	–	–	–
1,2,5-Trimethylbenzene	–	–	–	–	–	–	–
p-Isopropyltoluene	–	–	–	–	–	–	–
Conventional Parameters							
Cyanide	–	1	220000	Yes	51900	50(l)	50

TABLE 1
GROUNDWATER CLEANUP LEVELS BASED ON MARINE SURFACE WATER PROTECTION *
DEVELOPED FOR UNION STATION PROJECT
SEATTLE, WASHINGTON

Constituent	State Water Quality Criteria for Aquatic Life(a) (µg/L)	Federal Water Quality Criteria for Aquatic Life (b) (µg/L)	Federal Water Quality Criteria for Human Health (c)(µg/L)	WQC Carcinogenic Risk <10-6 or Hazard Index <1	MTCA Method B Surface Water Equation for Human Health (µg/L)	Practical Quantitation Limits (d)(µg/L)	Adjusted Cleanup Level (µg/L)
Metals							
Antimony	–	–	4300	–(j)	–	320(k)	4300
Arsenic	36	36	0.14	Yes	0.098	4(l)	4
Beryllium	–	–	–	–	0.079	2(k)	2
Cadmium	8	9.3	–	Yes	20.3	2(m)	8
Chromium VI	50	50	–	Yes	810	50(n)	50
Copper	–	2.9	–	Yes	2600	10(o)	10
Lead	5.8	8.5	–	–	–	10(p)	10
Mercury	0.025	0.025	0.15	–	–	1(q)	1
Nickel	7.9	8.3	4600	Yes	1100	10(o)	10
Selenium	71	71	–	–	–	20(r)	71
Silver	1.2(s)	2.3(t)	–	Yes	25900	2(u)	2
Zinc	76.6	86	–	Yes	16500	20(k)	77

(a) Marine chronic criteria.
(b) Salt water continuous concentration.
(c) Consumption of organisms only.
(d) Based on Ecology 1995.
(e) Method 8270
(f) Adjustments made based on constituent's toxic end points. (See RI/FS Table 10-3 (Landau Associates and Hart Crowser, 1996))
(g) Method 8270 Selective Ion Method
(h) Method 8240.
(i) Method 9012.
(j) No toxicity value available to estimate corresponding risk level.
(k) Method 6010.
(l) Method 7060 or 200.8.
(m) Method 7131.
(n) Method 6010 PQL achievable by Analytical Resources, Inc.
(o) Method 200.8.
(p) Method 7421 or 200.8.
(q) Method 7471.
(r) Method 7740.
(s) Marine acute; chronic criteria not available.
(t) Marine maximum; chronic criteria not available.
(u) Method 7761 or 200.8.
– No criteria available.
* = If a constituent for which a cleanup level is not listed becomes of concern, cleanup levels specified in Chapter 173-340 WAC at the time the compound becomes of concern shall apply.
** = If TPH is detected, the data will be reviewed to evaluate whether groundwater is adequately protected pursuant to WAC 173-340-720 (3) (c).
Note: Shading indicates initial cleanup level.

TABLE 2
SOIL CLEANUP LEVELS *
UNION STATION PROJECT
SEATTLE, WA

Potential Chemicals of Concern	MTCA Method B (direct contact) (mg/kg) Residential	Protection of Surface Water(a) (mg/kg)	Practical Quantitation Limit(b) (mg/kg)	Natural Background Concentrations(c)	Soil Cleanup Level(d) (mg/kg)
TPH-G	–	–			**
TPH-D	–	–			**
TPH-Other	–	–			**
Non-CPAH					
Naphthalene	3200	988	0.66(e)		988
Acenaphthylene	–	–	0.66(e)		–
Acenaphthene	4800	22.5	0.66(e)		22.5
Fluorene	3200	242	0.66(e)		242
Phenanthrene	–	–	0.66(e)		–
Anthracene	24000	2590	0.66(e)		2590
2-Methylnaphthalene	–	–	0.66(e)		–
Fluoranthene	3200	2.7	0.66(e)		2.7
Pyrene	2400	77.7	0.66(e)		77.7
Benzo(g,h,i)perylene	–	–	0.66(e)		–
Dibenzofuran	–	–	0.33(e)		–
CPAH					
Benzo(a)anthracene	0.137	0.003	0.66(e)		0.66
Chrysene	0.137	0.003	0.66(e)		0.66
Benzo(b)fluoranthene	0.137	0.003	0.66(e)		0.66
Benzo(k)fluoranthene	0.137	0.003	0.66(e)		0.66
Benzo(a)pyrene	0.137	0.003	0.66(e)		0.66
Indeno(1,2,3-c,d)pyrene	0.137	0.003	0.66(e)		0.66
Dibenz(a,h)anthracene	0.137	0.003	0.66(e)		0.66
Other Semivolatiles					
Phenol	48000	110000	0.66(e)		48000
Bis-(2-Chloroethyl) Ether	0.909	0.14	0.66(e)		0.66(e)
2-Chlorophenol	400	9.67	0.66(e)		9.67
1,3-Dichlorobenzene	–	260	0.66(e)		260
1,4-Dichlorobenzene	41.7	0.486	0.66(e)		0.66(e)
Benzyl alcohol	24000	–	1.3(e)		24000
1,2-Dichlorobenzene	7200	1700	0.66(e)		1700
2-Methylphenol	–	–	–		–
2,2'-Oxybis(1-Chloropropane)	–	–	–		–
4-Methylphenol	–	–	–		–
N-Nitroso-Di-N-Propylamine	0.143	0.0819	1.3(e)		1.3(e)
Hexachloroethane	71.4	0.89	0.66(e)		0.89
Nitrobenzene	40	44.9	0.66(e)		40
Isophorone	1050	60	0.66(e)		60
2-Nitrophenol	–	–	0.66(e)		0.66(e)
2,4-Dimethylphenol	1600	55.3	0.66(e)		55.3
Benzoic acid	320000	–	3.3(e)		320000
bis(2-Chloroethoxy) Methane	–	–	0.66(e)		–
2,4-Dichlorophenol	240	19.1	0.66(e)		19.1
1,2,4-Trichlorobenzene	800	22.7	0.66(e)		22.7
4-Chloroaniline	–	–	0.33(e)		–
Hexachlorobutadiene	12.8	2.99	0.66(e)		2.99
4-Chloro-3-methylphenol	–	–	–		–
Hexachlorocyclopentadiene	560	418	0.66(e)		418
2,4,6-Trichlorophenol	90.9	0.65	0.66(e)		0.66(e)
2,4,5-Trichlorophenol	8000	–	0.66(e)		8000
2-Chloronaphthalene	–	–	0.66(e)		–
2-Nitroaniline	–	–	3.3(e)		–
Dimethylphthalate	8000	7200	0.66(e)		7200
3-Nitroaniline	–	–	3.3(e)		–
2,4-Dinitrophenol	160	346	3.3(e)		160
4-Nitrophenol	–	–	3.3(e)		–
2,6-Dinitrotoluene	80	–	0.66(e)		80
2,4-Dinitrotoluene	160	0.91	0.66(e)		0.91
Diethyl phthalate	64000	2840	0.66(e)		2840
4-Chlorophenyl phenyl ether	–	–	0.66(e)		–
4-Nitroaniline	–	–	1.6(e)		–
4,6-Dinitro-2-Methylphenol	–	–	–		–
N-Nitrosodiphenylamine	204	1.6	0.66(e)		1.6

TABLE 2
SOIL CLEANUP LEVELS *
UNION STATION PROJECT
SEATTLE, WA

Potential Chemicals of Concern	MTCA Method B (direct contact) (mg/kg) Residential	Protection of Surface Water(a) (mg/kg)	Practical Quantitation Limit(b) (mg/kg)	Natural Background Concentrations(c)	Soil Cleanup Level(d) (mg/kg)
4-Bromophenyl phenyl ether	–	–	0.66(e)		–
Hexachlorobenzene	0.625	0.000077	0.66(e)		0.66(e)
Pentachlorophenol	8.33	0.82	3.3(e)		3.3(e)
Carbazole	50.0	–	0.33(e)		50.0
Di-n-Butlyphthalate	8000	291	1.7(e)		291
Butyl benzyl phthalate	16000	125	0.66(e)		125
3,3-Dichlorobenzidine	2.22	0.0077	1.3(e)		1.3(e)
bis(2-ethylhexyl)phthalate	71.4	0.59	0.66(e)		0.66
Di-n-octylphthalate	1600	–	0.66(e)		1600
Volatiles					
Chloromethane	76.9	13.3	0.01(f)		13.3
Bromomethane	112	96.8	–		96.8
Vinyl chloride	0.526	0.292	0.02(f)		0.292
Chloroethane	–	–	0.01(f)		–
Methylene chloride	133	96.0	0.005(f)		96.0
Acetone	8000	–	0.01(f)		8000
Carbon Disulfide	8000	–	0.1(f)		8000
1,1-Dichloroethene	1.67	0.32	0.005(f)		0.32
1,1-Dichloroethane	8000	–	0.005(f)		8000
trans-1,2-Dichloroethene	1600	3280	0.005(f)		1600
cis-1,2-Dichloroethene	800	–	0.005(f)		800
Chloroform	164	47.0	0.005(f)		47.0
1,2-Dichloroethane	11.0	9.9	0.005(f)		9.9
2-Butanone	–	–	–		–
1,1,1-Trichloroethane	72000	41700	0.005(f)		41700
Carbon tetrachloride	7.69	0.44	0.005(f)		0.44
Vinyl acetate	80000	–	0.05(f)		80000
Bromodichloromethane	16.1	2.79	0.005(f)		2.79
1,2-Dichloropropane	14.7	2.32	0.005(f)		2.32
cis-1,3-Dichloropropene	5.56	1.89	0.005(f)		1.89
Trichloroethene	90.9	8.1	–		8.1
Dibromochloromethane	11.9	2.06	0.005(f)		2.06
1,1,2-Trichloroethane	17.5	4.2	0.005(f)		4.2
Benzene	34.5	7.1	0.005(f)		7.1
trans-1,3-Dichloropropene	5.56	1.89	0.005(f)		1.89
2-Chloroethyl vinyl ether	–	–	0.01(f)		–
Bromoform	127	36.0	0.005(f)		36.0
4-Methyl-2-Pentanone (MIBK)	–	–	–		–
2-Hexanone	–	–	0.05(f)		–
Tetrachloroethene	19.6	0.885	–		0.885
1,1,2,2-Tetrachloroethane	5.00	0.648	0.005(f)		0.648
Toluene	16000	4850	0.005(f)		4850
Chlorobenzene	16000	503	0.005(f)		503
Ethylbenzene	8000	691	0.005(f)		691
Styrene	33.3	–	0.005(f)		33.3
Trichlorofluoromethane	24000	–	0.005(f)		24000
1,1,2-Trichlorotrifluoroethane		–	–		–
m,p-Xylene	160000	–	0.005(f)		160000
O-Xylene	160000	–	0.005(f)		160000
Xylenes	160000	–	0.005(f)		160000
Acrolein	1600	78	–		78
Methyl Iodide	–	–	–		–
Bromoethane	–	–	–		–
Acrylonitrile	1.85	0.066	0.005(f)		0.066
1,1-Dichloropropene	–	–	–		–
Dibromomethane	–	–	–		–
1,1,1,2-Tetrachloroethane	38.5	–	–		38.5
1,2-Dibromo-3-chloropropane	0.174	–	–		0.174
1,2,3-Trichloropropane	0.143	–	–		0.143
trans-1,4-Dichloro-2-butene	–	–	–		–
1,3,5-Trimethylbenzene	–	–	–		–
1,2,4-Trimethylbenzene	–	–	–		–
Ethylene Dibromide	–	–	–		–
Bromochloromethane	–	–	–		–

TABLE 2
SOIL CLEANUP LEVELS *
UNION STATION PROJECT
SEATTLE, WA

Potential Chemicals of Concern	MTCA Method B (direct contact) (mg/kg) Residential	Protection of Surface Water(a) (mg/kg)	Practical Quantitation Limit(b) (mg/kg)	Natural Background Concentrations(c)	Soil Cleanup Level(d) (mg/kg)
2,2-Dichloropropane	–	–	–		–
1,3-Dichloropropane	–	–	–		–
Isopropylbenzene	–	–	–		–
n-Propylbenzene	–	–	–		–
Bromobenzene	–	–	–		–
2-Chlorotoluene	–	–	–		–
4-Chlorotoluene	–	–	–		–
tert-Butylbenzene	–	–	–		–
sec-Butylbenzene	–	–	–		–
4-Isopropyltoluene	–	–	–		–
n-Butylbenzene	–	–	–		–
1,2,4-Trichlorobenzene	800	22.7	0.66(e)		22.7
1,2,3-Trichlorobenzene	–	–	–		–
Metals					
Antimony	32	430	16(g)	–	32
Arsenic	1.67	0.014	0.5(h)	7	7
Beryllium	0.233	0.0079	0.15(g)	0.6	0.6
Cadmium	80	0.8	0.2(p)	1	1
Chromium VI	400	5	5(i)	–	5
Copper	2960	0.29	3(g)	36	36
Lead	250(j)	0.58	21(g)	24	24
Mercury	24	0.0025	0.05(k)	0.07	0.07
Nickel	1600	0.79	20(l)	48	48
Selenium	400	7.1	5(m)	–	7.1
Silver	400	0.12	0.1(n)	–	0.12
Zinc	24000	7.7	1(g)	85	85
Conventionals					
Cyanide	1600	0.1	5(o)	–	5

Note: Shading indicates initial cleanup level.
– Not applicable.
* = If a constituent for which a cleanup level is not listed becomes of concern, cleanup levels specified in Chapter 173-340 WAC at the time the compound becomes of concern shall apply.
** = Detections of TPH in soil will be evaluated on a case-by-case basis.
(a) 100 times adjusted surface water groundwater cleanup level from adjusted Table 1.
(b) Based on Ecology 1995; Method series 7000.
(c) Puget Sound background metal concentrations from Ecology 1994.
(d) Corrected for practical quantitation level and soil metal background concentrations, if appropriate.
(e) Method 8270.
(f) Method 8240.
(g) Method 6010.
(h) Method 7060.
(i) Method 6010 PQL achievable by Analytical Resources, Inc.
(j) Method A cleanup level.
(k) Method 7471 PQL achievable by Analytical Resources, Inc.
(l) Method 7520.
(m) Method 7740.
(n) Method 7741.
(o) Method SM4500-CN.
(p) Method 7131.

TABLE 3

GROUNDWATER MONITORING AND REMEDIATION

Groundwater Monitoring

Quarterly monitoring for 8 quarters beginning within 3 months of the effective date of the consent decree

- Calculate upper 95% confidence limit (UCL) using the eight quarters of data
- If UCL exceeds cleanup levels, implement groundwater treatment if directed by Ecology to prevent contamination from leaving the site. The parties anticipate that Ecology may revise this cleanup action plan to incorporate new cleanup standards if the cleanup standards are revised by an amendment to the regulations and Ecology determines the use of the new standards is appropriate.
- If UCL is less than or equal to cleanup levels, commence annual monitoring

Annual monitoring until all foundations are completed or until two years after any foundation construction is initiated

Quarterly sampling for 8 quarters beginning the first quarter after all foundations are completed or the first quarter occurring two years after any foundation construction is initiated

- Calculate upper 95% confidence limit (UCL) using the last eight quarters of data
- If UCL exceeds cleanup levels, implement groundwater treatment if directed by Ecology to prevent contamination from leaving the site. The parties anticipate that Ecology may revise this cleanup action plan to incorporate new cleanup standards if the cleanup standards are revised by an amendment to the regulations and Ecology determines the use of the new standards is appropriate.
- If UCL is less than or equal to cleanup levels, commence annual monitoring

Annual monitoring until foundation loading (building construction) is complete plus 3 additional years

- If any sample exceeds cleanup levels, collect another sample 1 quarter later
- If the second sample is less than cleanup levels , return to annual monitoring
- If the second sample exceeds cleanup levels , commence quarterly monitoring for 1 year (see below)
- If no exceedance of cleanup levels has occurred after 3 years, commence monitoring every 5 years

Monitoring every 5 years

- If any sample exceeds cleanup levels, collect another sample 1 quarter later
- If the second sample is less than cleanup levels, return to annual monitoring for 1 year
- If the second sample exceeds cleanup levels commence quarterly monitoring for 1 year (see below)
- If UCL is less than or equal to cleanup levels continue monitoring every 5 years so long as residual hazardous substance concentrations contained onsite exceed site cleanup levels [see WAC 173-340-360 (8)(b)].

TABLE 3

GROUNDWATER MONITORING AND REMEDIATION

Quarterly sampling for 1 year

- At end of year, if UCL based on four quarters of data is less than cleanup levels, return to annual monitoring for 3 years
- At end of year, if UCL based on four quarters of data is greater than cleanup levels and data show increasing trend and last sample exceeds twice the cleanup level, implement groundwater treatment if directed by Ecology to prevent contamination from leaving the site. Otherwise, continue monitoring for another four quarters.
- If, after eight quarters of data have been collected, the UCL based on the eight quarters of data exceed the cleanup level, implement groundwater treatment if directed by Ecology to prevent contamination from leaving the site.
- If, after eight quarters of data have been collected, the UCL based on the eight quarters of data is less than the cleanup level, continue monitoring for another four quarters.
- If, at the end of the last four quarters, the UCL based on the last eight quarters of data exceeds the cleanup level, implement groundwater treatment if directed by Ecology to prevent contamination from leaving the site.
- If, at the end of the last four quarters, the UCL based on the last eight quarters of data is less than the cleanup level, return to annual monitoring for 5 years. If there are no exceedances of cleanup levels during that time, return to monitoring every 5 years.

Groundwater Treatment

Minimize present worth of capital and O&M costs to determine the size and estimated operating time of the system

Performance monitoring

- Quarterly monitoring during groundwater treatment
- Plot data and do statistical evaluation as directed by Ecology to determine when to terminate treatment or when cleanup standards are met

Post-Treatment Monitoring

Quarterly monitoring for 8 quarters

- If UCL exceeds cleanup levels and trend analysis does not indicate decreasing trend, return to groundwater treatment
- If UCL exceeds cleanup levels and trend analysis indicates decreasing trend, continue monitoring quarterly. If UCL calculated using the last 8 quarters of data exceeds cleanup levels after 12 quarters of data have been collected, return to groundwater treatment.
- If UCL is less than or equal to cleanup levels, commence annual monitoring for 3 years

TABLE 3

GROUNDWATER MONITORING AND REMEDIATION

Annual monitoring for 3 years
  - If any sample exceeds cleanup levels, collect another sample 1 quarter later
  - If the second sample is less than cleanup levels return to annual monitoring
  - If the second sample exceeds cleanup levels commence quarterly monitoring for 1 year and use triggers in quarterly monitoring above
  - If no exceedance of cleanup levels has occurred after 3 years, commence monitoring every 5 years

Monitoring every 5 years
  - If any sample exceeds cleanup levels, collect another sample 1 quarter later
  - If the second sample is less than cleanup levels return to monitoring every 5 years
  - If the second sample exceeds cleanup levels commence quarterly monitoring (see above)
  - If UCL is less than or equal to cleanup levels, continue monitoring every 5 years so long as residual hazardous substance concentrations contained onsite exceed site cleanup levels [see WAC 173-340-360 (8)(b)].

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* As described in Appendix A, alternate statistical methods may be used upon approval by Ecology.

TABLE 4

COMPONENT AND DESIGN ASSUMPTIONS

Design Assumptions

Flow rate	10 gpm
Constituents to be treated	Assumed Concentrations
Naphthalene	up to 15,000 µg/L
CPAH	up to 50 µg/L
Benzene	up to 250 µg/L
Ethylbenzene	up to 500 µg/L
Toluene	up to 500 µg/L

Particulate Filter System

Modular unit plumbed to filter prior to carbon system
Filter media selected at time of treatment system final design

Activated Carbon System

Dual unit module piped for series flow
2,000 lb of activated carbon per unit
Each unit skid-mounted for ease in transportation and handling

Activated carbon assumed to be transported offsite for regeneration

Average usage rate of carbon assumed at 1 lb/day/gpm flow
Assumed cost for purchase of activated carbon: $1.20/lb
Assumed cost for transport and regeneration of activated carbon: $0.90/lb

Treatment System Operations

Assumed energy demand for system operations: 4 hp
Assumed cost of energy: $0.10/kilowatt-hour
Assumed cost for disposal of water to sanitary sewer: $4.00/100 ft^3

Operational visits by technician: six times/month
Average length of site visit: 4 hours
Cost of technician: $40/hour

Assume that major maintenance activity is conducted quarterly
Average length of major maintenance activity: 8 hours

Sampling and Analysis

Samples per month: 1
Sample collection: part of normal maintenance

Analysis:	EPA 8270	$250/sample
	Oil and grease	$40/sample
	Total toxic organics	$50/sample

Oversight and Ecology Reporting

Annual: $20,000

TABLE 5

IDENTIFICATION AND EVALUATION OF APPLICABLE LAWS AND REGULATIONS
UNION STATION PROJECT
SEATTLE, WA

Potential ARAR	Applicability	Rationale
Soil		
Federal		
Resource Conservation and Recovery Act (RCRA) (42 USC 6901)	NA	RCRA corrective action requirements are not applicable because the facility is not a permitted or interim status TSD facility.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9605)		
National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300)	A	Applicable.
Toxic Substances Control Act (TSCA) (15 USC 2601)	NA	No PCB contamination is known to be onsite.
State		
Model Toxics Control Act (MTCA) (RCW 70.105D) MTCA Regulation (WAC 173-340)	A	Applicable.
Hazardous Waste Management Act (HWMA) (RCW 70.105)	NA	HWMA corrective action requirements are not applicable because the facility is not a permitted or interim status TSD facility.
Groundwater		
Federal		
Safe Drinking Water Act (SDWA) (42 USC 300f)		
MCLs and MCLGs (40 CFR 141)	NA	Groundwater is not current or potential future drinking water source.
State		
Model Toxics Control Act (MTCA) (RCW 70.105D) MTCA Regulation (WAC 173-340)	A	Applicable.
Water Pollution Control Act (RCW 90.48)		

TABLE 5

IDENTIFICATION AND EVALUATION OF APPLICABLE LAWS AND REGULATIONS
UNION STATION PROJECT
SEATTLE, WA

Potential ARAR	Applicability	Rationale
Groundwater Quality Standards (WAC 173-200)	NA	Not applicable to cleanup actions approved by Ecology under MTCA.
Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) (42 USC 9605)		
National Oil and Hazardous Substances Pollution Contingency Plan (NCP) (40 CFR 300)	A	Applicable.
Surface Water		
Federal		
Clean Water Act (33 USC 1251)		
Ambient Water Quality Criteria (40 CFR 131)	A	Applicable.
State		
Model Toxics Control Act (MTCA) (RCW 70.105D) MTCA Regulation (WAC 173-340)	A	Applicable.
Water Pollution Control Act (RCW 90.48)		
Surface Water Quality Standards (WAC 173-201)	A	Applicable.
Other		
National Historic Preservation Act (16 USC 470)	A	Applicable. Union Station building is listed on the National Register of Historic Sites as a "National Historic Landmark."

A = Applicable
NA = Not applicable

TABLE 6
CALCULATION OF PRESENT WORTH
UNION STATION GROUNDWATER MONITORING PROGRAM

Present Date	1-Jan-97
Cost of Sampling Event	$ 22,000.00
Major Ion Cost	$ 1,200.00
Present Worth Factor	5%

		Present Worth Value	Cumulative Present Worth
Dates of Sampling Events			
Event 1a:	Mar-97	$21,822.92	
Major Ions 1	Mar-97	$1,190.34	
Event 1b:	Jun-97	$21,549.64	
Event 1c:	Sep-97	$21,279.77	
Event 1d:	Dec-97	$21,016.17	
Event 2a	Mar-98	$20,758.68	
Major Ions 2	Mar-98	$1,132.29	
Event 2b	Jun-98	$20,498.72	
Event 2c	Sep-98	$20,242.02	
Event 2d	Dec-98	$19,991.27	
Event 3a	Mar-99	$19,746.33	
Major Ions 3	Mar-99	$1,077.07	
Event 3b	Jun-99	$19,499.05	
Event 11	Jun-00	$18,545.59	
Major Ions 4	Jun-00	$1,011.58	
Event 12	Jun-01	$17,641.18	
Major Ions 5	Jun-01	$962.25	
Event 13	Jun-02	$16,780.86	
Event 14	Jun-03	$15,962.50	
Event 15	Jun-04	$15,181.98	
Event 16	Jun-09	$11,822.32	
Event 17	Jun-14	$9,206.13	
Event 18	Jun-19	$7,168.88	
Event 19	Jun-24	$5,581.70	
Event 20	Jun-29	$4,346.51	
Event 21	Jun-34	$3,384.66	
Event 22	Jun-39	$2,635.66	
Event 23	Jun-44	$2,052.13	
Event 24	Jun-49	$1,598.01	
Event 25	Jun-54	$1,244.38	
Event 26	Jun-59	$969.01	
Event 27	Jun-64	$754.47	
Event 28	Jun-69	$587.51	
Event 29	Jun-74	$457.50	$347,699.04

Note: For cost estimation, groundwater monitoring has been assumed through June 2074. Groundwater monitoring will continue, however, as long as residual hazardous substance concentrations on site exceed cleanup levels.

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TABLE 7

CALCULATION OF PRESENT WORTH

UNION STATION GROUNDWATER TREATMENT PLANT OPERATION AND MONITORING PROGRAM

Present Date	**1-Jan-97**
Present Worth Factor	**5%**

	Cost of Event	Present Worth Value	Total Present Worth Value
Dates of Events			
Jun-99	$79,251	$70,242	$137,049
Jun-00	$79,251	$66,807	

TABLE 8

UNION STATION CLEANUP ACTION PLAN COST ESTIMATE(a)

	Low Estimate	High Estimate
Institutional controls	$ 20,000 -	$ 20,000
Monitoring wells(b)	$ 80,000 -	$ 80,000
Construction soil management(c)	$ 120,000 -	$ 200,000
Observation of soil/groundwater during foundation construction	$ 20,000 -	$ 50,000
Repair/replace offsite wells	$ 1,000 -	$ 5,000
Provisions for extraction/treatment system(d)	$ 15,000 -	$ 30,000
Groundwater monitoring(e)	$ 348,000 -	$ 348,000
Ecology oversight	$ 50,000 -	$ 100,000
MOST LIKELY COST DIRECTLY ATTRIBUTABLE TO REMEDIATION	**$ 654,000 -**	**$ 833,000**
Treatment plant construction	$ 200,000 -	$ 200,000
Treatment plant operation(f)	$ 137,000 -	$ 137,000
ESTIMATED TOTAL COST IF GROUNDWATER TREATMENT IS NECESSARY	**$ 991,000 -**	**$ 1,170,000**
Paving to prevent direct contact(g)	$ 1,100,000 -	$ 1,100,000
ESTIMATED TOTAL COST INCLUDING PAVING	**$ 2,091,000 -**	**$ 2,270,000(h)**

(a) Cost assumes 1997 construction start date.

(b) Includes installation of three new wells, decommissioning of six wells, and associated engineering.

(c) Estimated at $\$40/yd^3$ for 3,000 to 5,000 yd^3 at excavated soil.

(d) Includes piping between wells HC-101, HC-102, HC-103, MW-105, and MW-106 and planned installation of electrical conductors, hoses, and piping.

(e) Represents present worth of quarterly, annual, and every 5 years groundwater monitoring described in the CAP.

(f) Represents present worth of 2 years of treatment plan operation at $79,250/year.

(g) Represents average of $\$5.50/ft^2$ for 200,200 ft^2 of pavement.

(h) Cost could increase by $1,550,000 in the unlikely event that 5,000 yd^3 of excavated soil must be managed as hazardous waste.

APPENDIX A

Groundwater Monitoring

APPENDIX A
GROUNDWATER MONITORING

GROUNDWATER SAMPLING AND ANALYSIS

MONITORING SCHEDULE

The monitoring schedule begins within 3 months of the effective date of the Consent Decree. The monitoring schedule is described in Table 3 of the text of this cleanup action plan. Monitoring wells to be included in this sampling are upgradient wells B-4 and B-6, and downgradient wells HC-101, HC-102, HC-103, MW-104, MW-105, MW-106 and MW-107. These wells or, if necessary, replacement wells in similar locations will be maintained in good condition as long as the monitoring program continues. Procedures for measuring water levels and collecting groundwater samples for chemical analysis are outlined in subsequent sections.

Groundwater samples will be collected from all monitoring wells and each sample will be analyzed for the constituents of environmental concern identified in the following section. The analytical results will be used to supplement data generated during previous investigations of the site.

WATER LEVEL MEASUREMENTS

Water level will also be measured in all the monitoring wells at the site prior to collection of groundwater samples to evaluate seasonal water level changes and provide a basis to estimate the direction of groundwater flow. The wells will also be inspected for damage, security, and needed repairs for the surface completions. All water levels will be measured using an electronic water level indicator or steel tape and will be recorded to the nearest 0.01 ft. Measurements will be taken from a marked survey point at the top of each PVC well casing, or, if no mark is present, from the highest point of the PVC casing.

Water levels will be used to prepare elevation contours of the groundwater surface in the shallow fill. The elevation contours will be used to estimate the horizontal groundwater flow direction and hydraulic gradient in the shallow zone.

GROUNDWATER SAMPLE COLLECTION AND ANALYSIS

Prior to well purging and sampling, groundwater level measurements will be taken from wells that are to be sampled as described above. Each monitoring well will be purged at a low rate using a peristaltic pump with dedicated tubing, disposable bailer, centrifugal purge pump, or sampling pump prior to sampling. Purging will continue until at least three well volumes have been removed or until well is purged dry. If the well is purged dry, purging will be considered complete and sampling, as appropriate, will commence as soon as sufficient volume is available to sample. Groundwater generated during well purging may be discharged to the ground surface, or following surface paving may be discharged into storm drains or may be contained for later discharge. Water purged from any well previously found to be out of compliance with cleanup levels shall be collected in 55-gallon drums and stored pending laboratory analysis. Water from such wells shall be collected in 55-gallon drums and disposed of properly so long as the well remains out of compliance. If purge water is contained, it will be disposed as described in the section on residuals management.

Samples will be collected in the appropriate container, as specified in Table A-1, following purging. Sample containers will be filled directly from the outlet of the sampling device, except that samples for metals will first be passed through a 40 µm filter. Samples will be preserved as specified in Table A-1.

Field parameters, including pH, specific conductance, and temperature will be recorded in replicate prior to collection of groundwater samples for chemical analysis. Field instrument calibration and maintenance will be in accordance with manufacturer's instructions and the QA/QC requirements identified later in this appendix, and will be noted in the field logbook. Decontamination procedures for sampling and field equipment are described in the following sections.

All groundwater samples will be analyzed for priority pollutant metals (dissolved), TPH, SVOC, VOC, specific conductance, cyanide, total dissolved solids (TDS), total suspended solids (TSS), and temperature. Major ion analysis will be conducted periodically, on a schedule to be determined, but not more than 5 times during the life of the monitoring program. Analytical methods and practical quantitation limits are listed on Table A-4. Sample analysis, handling, preservation, method detection limits, chain-of-custody, and other QA/QC criteria and objectives are described in the QA section of this appendix.

EVALUATION OF CHEMICAL RESULTS

Groundwater analytical results will be validated for quality assurance purposes. As data become available, time series plots will be prepared to allow visual evaluation of any data trends. Statistical information, including mean, standard deviation, upper 95 percent confidence level of the mean, and median values will be developed once sufficient data are available and will be presented with tabulated data. Groundwater analytical data will be compared to respective cleanup levels . . Evaluation of these data will provide a basis for determining the duration of monitoring. If groundwater analytical results indicate the presence of DNAPL, additional wells to evaluate the extent of contamination will be considered.

EVALUATION OF MONITORING DURATION

MONITORING APPROACH

A phased monitoring approach is planned as described in section 3.1.3 and shown in Table 3 of the text of this cleanup action plan.

EXCEEDANCE OF CLEANUP LEVELS

This section describes the procedures that will be used to evaluate exceedance of cleanup levels and to trigger any of the steps identified in the cleanup action plan (Table 3). An exceedance is defined as a confirmed exceedance of the cleanup level for any constituent, as determined using an applicable statistical method. Data analysis and evaluation procedures used to demonstrate and confirm compliance in accordance with chapter 173-340 WAC, including a description of statistical methods to be employed, are specified in Ecology Publication 92-54 (August 1992), *Statistical Guidance for Ecology Site Managers.* These procedures may be utilized to demonstrate compliance. Alternate statistical methods may be proposed for Ecology evaluation and approval. If alternate statistical methods are proposed, such methods shall be demonstrated to have comparable power to those described in Publication 92-54. Basic statistical parameters such as mean, median, and possibly tolerance limits will be developed for comparison of upgradient and downgradient results and as an indication of the range of data. Applicable cleanup levels will be used in conjunction with statistical information to evaluate monitoring exceedances. An exceedance will trigger application of the steps shown in Table 3.

SAMPLE DOCUMENTATION, HANDLING, AND CUSTODY

A sample collection form (Form A-1) will be completed at the time each groundwater sample is collected to document the sample. Sample container labels, which will be completed and affixed to each groundwater sample container, will identify the sample number/location, the date and time of collection, sampling personnel, and the project name. In addition, each sample container will be labeled and recorded on a chain-of-custody record (Form A-2). The chain-of-custody record will follow the sample from collection through transfer, analysis, and disposal. This procedure is designed to maintain the integrity of the sample, as well as to properly account for the sample at all stages through disposal.

Samples submitted to the analytical laboratories will be collected in the appropriate sample containers and preserved as specified in Table A-1. New, cleaned sample containers will be provided by the analytical laboratory. Samples will be placed on double-bagged ice. At the end of each day, samples will be inventoried and the coolers will be sealed with tape and, if appropriate, a custody seal (Form A-3), and labeled for transport. Samples will be transported to the laboratory within 24 hours after collection.

When transferring samples, the individuals relinquishing and receiving the samples will sign and date the chain-of-custody record. The chain-of-custody record will accompany each shipment. Custody seals are not deemed necessary when the samples are in continuous possession of technical or laboratory personnel. Custody seals will be used for samples that are shipped via courier service, in which case the method of shipment, courier name, and other pertinent shipping information will be entered on the chain-of-custody record.

Additional discussion of procedures for sample documentation, handling, and custody are included in the QA section of this appendix.

EQUIPMENT DECONTAMINATION PROCEDURES

SAMPLING EQUIPMENT

Groundwater sampling equipment will be decontaminated to minimize the possibility of cross-contaminating samples and/or monitoring wells. Decontamination procedures will vary, depending on the level of contamination observed during the various sampling activities. For sampling equipment used in media where contamination is not observed during the sampling process, decontamination will consist of the following procedures:

- Remove gross contamination from the equipment by brushing and then rinsing with tap water
- Wash with Alconox laboratory detergent and tap water solution
- Rinse with tap water
- Rinse with deionized water
- Repeat entire procedure or any parts of the procedure as necessary
- Steam cleaning may be used in place of detergent solutions where appropriate.

For sampling equipment used in media where contamination is observed, the following decontamination procedures will be followed:

- Remove gross contamination from the equipment by brushing and then rinsing with tap water
- Rinse with hexane
- Rinse with methanol
- Wash with Alconox and tap water solution
- Rinse with tap water
- Rinse with deionized water
- Repeat entire procedure or any parts of the procedure as necessary
- Steam cleaning may be used in place of detergent solutions where appropriate.

RESIDUALS MANAGEMENT

Residual liquids may include water purged from wells during development and sampling, if it is not discharged to the ground surface or to storm drains, and waste decontamination liquids. Residual liquids will be collected into 55-gallon drums and stored on pallets in a designated secured area onsite pending laboratory analysis. Decontamination fluids containing methanol and hexane will be stored separately.

The appropriate disposal method for residual materials will be determined based on the laboratory results for samples collected, provided the analytical results adequately characterize the residual for disposal. If adequate data are not available as a result of site characterization analytical data, individual drums will be analyzed for appropriate constituents needed for waste disposal.

Purge water will be discharged to the sanitary sewer if constituent levels do not exceed METRO discharge limits or dangerous waste criteria. METRO will be contacted to confirm discharge permit requirements. Purge water that exceeds METRO discharge permit levels or dangerous waste criteria, and decontamination fluids that contain methanol and hexane will be submitted to a licensed facility for treatment and disposal.

HEALTH AND SAFETY MONITORING

The health and safety plan identifies modified level D as the appropriate protection level. Accordingly, no respiratory protection is identified. In the event that strong organic odors are observed, monitoring will be conducted using a photoionization detector (PID).

To check for ambient concentrations of organic vapors, the probe nozzle will be placed at the breathing zone (5 to 6 ft above ground surface) within the work area. Quick field checks of analyzer operation can be conducted using a magic marker. When the instrument probe is placed next to the marker tip or within the marker cap, a reading of 5 to 10 ppm should be obtained.

The project health and safety plan should be referred to for a more complete discussion of health and safety procedures, and PID operation procedures.

QUALITY ASSURANCE

This section identifies the quality assurance/quality control (QA/QC) requirements and analytical methods applicable to supplemental monitoring activities. The QA/QC requirements were developed based on the procedures and methods established by Ecology and the U.S. Environmental Protection Agency (EPA) for remedial investigations and treatability studies under MTCA and the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA).

Ground water sampling and analysis will be conducted during supplemental monitoring.

PROJECT QA ORGANIZATION AND RESPONSIBILITIES

A project QA organization, including individuals with QA responsibility and lines of QA authority, will be developed. Specific project QA responsibilities are listed in Table A-2. Laboratory analysis will be performed by a laboratory with appropriate Ecology certification.

PROJECT QUALITY ASSURANCE

Quality Assurance Goals

The overall goal of the project QA program is to provide a reasonable degree of confidence in project data and results through the establishment of a system of quality and performance checks on data collection, analysis, and reporting activities, as well as to provide for appropriate and timely corrective action to achieve compliance with established performance and quality criteria. Subsequent sections of this plan present the general procedures and methods for sampling and sample handling, sample custody, analytical procedures, internal quality control, and data assessment.

Data Quality Objectives

Results from the sampling activities will be used to identify the constituents of concern at the site and to compare with cleanup levels established for the site. Therefore, the objectives for sample results are to be precise, accurate, representative, complete, and comparable, as summarized in Table A-3. Data review for quality assurance and validation purposes will be in accordance with appropriate EPA and Ecology guidance, and consistent with the approach used in the focused RI/FS (Landau Associates and Hart Crowser 1996).

SAMPLING PROCEDURES

Sample Collection and Handling

Sampling procedures and sampling locations for the groundwater investigations are identified in the groundwater monitoring and sample documentation sections of this appendix, respectively.

Sample containers and preservatives and holding times will be appropriate for the type of sample collected and the analytical method to be used. Maximum sample holding times will be strictly adhered to. Sample containers, preservatives, and holding times for each analyses are presented in Table A-1. Each sample will be documented, labeled, and identified as noted in the section on groundwater samples.

Sampling equipment will be properly decontaminated prior to collection of each sample to avoid cross contamination between samples. Decontaminated sampling equipment will be handled in a manner that minimizes contact with potentially contaminated surfaces. Specific procedures for sampling equipment decontamination associated with groundwater sampling are presented in the equipment decontamination section of this appendix.

Sample Packaging and Shipping

The transportation and handling of samples will be accomplished in a manner that not only protects the integrity of the sample, but also prevents any detrimental effects due to the possible hazardous nature of samples. Regulations for packaging, marking, labeling, and shipping hazardous materials are promulgated by the U.S. Department of Transportation (DOT) in the Code of Federal Regulations (CFR), 49 CFR 171 through 177.

Samples will be placed on sealed, double-bagged ice in coolers following collection. At the end of each day, samples sent to the analytical laboratory will be inventoried. A picnic cooler will be used as a shipping container. In preparation for shipping samples, the drain plug will be taped shut, and a plastic bag will be used as a liner for the cooler. When appropriate, approximately 1 inch of packing material will be placed in the bottom of the liner.

The sample bottles will be placed in the lined cooler containing ice. Samples will be carefully packaged using sufficient packing material to avoid breakage or cross contamination, and will be shipped to the offsite analytical laboratory at proper temperatures (4°C). The liner bag will be taped shut and the paperwork accompanying the samples to the laboratory will be placed inside a separate plastic bag and taped inside the cooler lid.

The cooler will be taped shut with strapping tape. Custody seals will be placed on the cooler (see Form A-3). The cooler will either be shipped to the laboratory by an overnight carrier or commercial transport (bus), or transported by private vehicle.

SAMPLE CUSTODY AND DOCUMENTATION

Sample Custody

The primary objective of sample custody is to create an accurate, written record that can be used to trace the possession and handling of samples so that their quality and integrity can be maintained from collection until completion of all required analyses. Adequate sample custody will be achieved by means of approved field and laboratory documentation. Such documentation includes the chain-of-custody record which is initially completed by the sampler and is, thereafter, signed by those individuals who accept custody of the sample. An example chain-of-custody record is shown on Form A-2. A sample will be considered to be in custody if it is:

- In someone's physical possession
- In someone's view
- Locked up or secured in a locked container or otherwise sealed so that tampering will be evident
- Kept in a secured area, restricted to authorized personnel only.

Sample control and chain-of-custody in the field and during transport to the laboratory will be conducted in general conformance with the procedures described below and in Section 4 of *A Compendium of Superfund Field Operations Methods* (EPA 1987).

Field Custody Procedures

The following field custody procedures will be followed:

- As few persons as possible will handle samples
- Sample bottles will be purchased directly from the manufacturer or obtained new or precleaned from the laboratory performing the analyses
- The sample collector will be personally responsible for the completion of the chain-of-custody record and the care and custody of collected samples until they are transferred to another person, or dispatched properly under chain-of-custody rules
- The site field coordinator will oversee implementation of the field custody procedures during the fieldwork and in the event of noncompliance, will determine if corrective action is required.

Sample Shipment Custody Procedures

The following custody sample shipment procedures will be followed:

- The coolers in which the samples are shipped will be accompanied by the chain-of-custody record identifying their contents. The original record and laboratory copy will accompany the shipment (sealed inside the shipping container). The other copy will be distributed as appropriate to the QAO or QA task leader.
- Shipping containers will be sealed with custody seals for shipment to the laboratory. The method of shipment, name of courier, and other pertinent information will be entered in the "Remarks" section of the chain-of-custody record and traffic report.
- If sent by mail, the package will be registered with return receipt requested. If sent by common carrier, a bill of lading will be used. Freight bills, postal services receipts, and bills of lading will be retained as part of the permanent documentation.

Transfer of Custody

The sample collector will sign the form in the first signature space. When samples are transferred, the individuals relinquishing and receiving the samples will sign the chain-of-custody record and document the date and time of transfer. The only exception to this is the shipment of samples via commercial carriers. Because sample containers are sealed with the chain-of-custody record inside prior to delivery to the carrier, the custody signature will be that of the individual taking possession of the samples from the carrier at its final destination. Each person taking custody will observe whether the shipping container is correctly sealed and in the same condition as noted by the previous custodian; deviations will be noted on the appropriate section of the chain-of-custody record.

Project documentation of sample custody will be verified by the QAO during regular review of the data validation package.

Laboratory Custody Procedures

A designated sample custodian at the laboratory will accept custody of the shipped samples, verify the integrity of the custody seals, and certify that the sample identification numbers match those on the chain-of-custody record. The custodian will then enter sample identification number data into a bound logbook, which is arranged by a project code and station number. If containers arrive with broken custody seals, the laboratory will note this on the chain-of-custody record and will immediately notify the QA task leader. The laboratory will maintain sample security and custody as appropriate and as outlined in its quality assurance project plan (QAPP).

Documentation

Documentation necessary to meet the QA objectives for this project includes the following:

- Field notebooks (logbooks), in which general field observations and activities are recorded
- Field sampling forms specific to sampling, chain-of-custody, etc.
- Sample container labels
- Photographs (optional).

General methods for this documentation are outlined below. Forms A-4, A-5, and A-6 are examples of related documentation forms.

If an error is made on a document, corrections will be made by drawing a single line through the error and entering the correct information. The erroneous information will not be obliterated. Corrections will be initialed and dated, and, if necessary, a footnote explaining the correction will be included. Errors will be corrected by the person who made the entry, whenever practical.

All documentation and other project records will be safeguarded to prevent loss, damage, or alteration.

Field Notebook

Daily field documentation is necessary to provide sufficient data and observations to enable participants to reconstruct events that occurred during the project and to refresh the memory of the field personnel if called upon to give testimony during legal proceedings. Daily field notes pertinent to the individual field tasks will be recorded in a bound waterproof field notebook containing consecutively numbered pages. Corrections will be made according to the procedures given above. Information documented on field sampling forms need not be repeated in the field notebook. However, reference must then be made in the field notebook to the field forms.

Field Sampling Forms

Task-specific field sampling forms (e.g., chain-of-custody record, sample collection form, etc.) will be used to document sampling activities. Use of sampling forms aid in achieving complete data for field sampling activities.

Sample Container Labels and Identification Format

Sample container labels will be filled out using waterproof ink and will be firmly affixed to the sample containers. Samples will be numbered in a manner that identifies the Union Station project, the sample location (e.g., monitoring well HC-103), and the date.

The sample container label will contain the following information:

- Sample number
- Date and time of collection
- Name of sampler(s)
- Analysis required
- Preservation (if applicable).

Field QC samples will be coded as individual samples, and identified in the field notes and on sample collection forms.

Photographs

Photographs (optional) may be taken in the field to document sampling locations and conditions. When taken, photographs will be recorded on the photograph documentation form (see Form A-4) and/or in field logbooks. The final print will be dated, initialed, and entered into the project file with a brief description of photograph location and purpose.

PREVENTIVE MAINTENANCE/CALIBRATION PROCEDURES

Laboratory and field instruments will be properly operated, calibrated, and maintained by qualified personnel according to the manufacturer's guidelines and recommendations, as well as criteria set forth in the applicable analytical methodology reference. Documentation of routine and special preventive maintenance and calibration information will be maintained in the appropriate field or laboratory logbook or reference file, and will be available upon request. Each maintenance and calibration logbook entry will include the date and initials of the individual performing the activity. Specific laboratory preventive maintenance and calibration procedures and schedules are outlined in the laboratory QAPPs.

Field Instruments

Periodic schedules for preventive maintenance of field instruments, including equipment testing, parts replacement, and general cleaning will be followed according to the manufacturer's instructions.

Field equipment performance will be evaluated against check standards and calibration blanks, as appropriate, for each parameter prior to use on each day that the equipment is used. Field instruments used during supplemental monitoring site activities will include pH and conductivity/temperature meters for groundwater sampling events and PID instrument available for health and safety.

Laboratory Instruments

The analytical laboratory project manager has ultimate responsibility for maintaining laboratory instruments in good working order, including responsibilities for routine maintenance and calibration and the training of personnel in maintenance and calibration procedures. Laboratory instruments will be properly calibrated with appropriate check standards and calibration blanks for each parameter prior to commencing actual analysis on each analysis to be performed. Instrument performance check standards, where required, and calibration blank results will be recorded in a laboratory logbook dedicated to each instrument. At a minimum, the preventive maintenance schedules contained in the EPA methods and in the equipment manufacturer's instructions will be followed.

Laboratory calibration procedures and schedules will be as described in the laboratory's QAPPs and will be available for review by Ecology.

ANALYTICAL PROCEDURES

Analytical procedures for the analysis of groundwater samples will include total suspended solids, total dissolved solids, dissolved metals, cyanide, VOC, SVOC, TPH, specific conductance, temperature, and pH. Major ion analyses will also be conducted at a schedule to be determined but not to exceed 5 times during the life of the monitoring program.

Specific methods to be used for each analysis are listed in Table A-4 and are referenced from SW 846 (EPA 1992) unless otherwise noted. Comparable analytical methods may be substituted upon approval by Ecology. If revised total petroleum hydrocarbon analytical methods are adopted by Ecology, their use may be substituted for the listed methods. Laboratory chemical analyses will be conducted by a laboratory certified by Ecology and qualified to perform the analyses using standard, documented laboratory analytical procedures.

Required analysis methods and practical quantitation limits may be revised by Ecology during their periodic review of the site in accordance with WAC 173-340-707. The limits listed are goals only, because instances may arise where high sample concentrations, nonhomogeneity of samples, or matrix interferences preclude achieving the desired detection limits and associated QC criteria. In such instances, the laboratory will report the reason(s) for deviations or noncompliance with QC criteria.

DATA REDUCTION, VALIDATION, AND REPORTING

Analytical reports from the laboratory for this project will be accompanied by sufficient backup data and QC results to enable reviewers to determine the quality of the data. The QAO (or designee) will also prepare a laboratory data validation report. If significant nonconformities are found, additional laboratory data will be evaluated by the QAO.

Analytical data for the specific tasks will be reported in the units specified by the detection limit goals listed in Ecology (1995). The offsite analytical laboratories will provide deliverables that will include the following:

- Case narrative, including adherence to prescribed protocols, nonconformity events, corrective measures, and/or data deficiencies
- Sample analytical results
- Surrogate recoveries
- Matrix spike/matrix spike duplicate results
- Blank spike/blank spike duplicate results
- Laboratory duplicates
- Blank results
- Sample custody (including signed, original chain-of-custody records)
- Analytical responsibility.

A limited data validation will be performed on all sample data collected as part of monitoring activities. Validation will be performed on data included in the laboratory data package according to portions of the EPA Functional Guidelines and will include evaluations of the following:

- Chain-of-custody records
- Holding times
- Field blanks
- Laboratory method blanks
- Surrogate recoveries

- Laboratory matrix spikes and matrix spike duplicates
- Blank spikes and blank spike duplicates
- Laboratory duplicates
- Field duplicates
- Detection limits/reporting limits
- Audit/corrective action records
- Completeness
- Overall assessment of data Quality.

The analytical laboratory will archive initial and continuing calibration data, chromatograms, and quantitation reports, in addition to those deliverables listed above, in case further validation of analytical data becomes necessary.

In the event that a portion of the data is outside the limits specified in EPA Functional Guidelines, or sample collection and/or documentation practices are deficient, corrective action(s) will be initiated. Corrective action will be determined by the QA task leader and QAO in consultation with the project manager. Data qualification arising from data validation activities will be described in the data validation report, rather than in individual correction action reports.

INTERNAL QUALITY CONTROL

Internal quality control will consist of samples collected and/or measurements performed in the field and laboratory. The quality control samples are used to evaluate data precision, accuracy, representativeness, completeness, and comparability of the analytical results for this project. Analytical methods specify routine procedures required to evaluate whether data are within proper QC limits. Additional internal QC includes collection and analysis of a number of field and laboratory QC samples, which are described in the following subsections.

For the purposes of QC sample frequency, a sampling round yields a set of samples of similar matrix, collected within a 14 (calendar) day interval.

Field/Laboratory QC Samples

Blind Field Duplicate

The blind field duplicate for groundwater samples will consist of a split sample collected at a single sample location. Duplicate groundwater samples will be collected by alternately filling sample containers for the original sample and the corresponding duplicate sample for every sample container filled to decrease variability between duplicates. Blind field duplicates will be collected at a frequency of 1 per 20 samples, not including QC samples, but not less than 1 duplicate per sampling round per matrix.

Field Trip Blank

Field trip blanks will be analyzed for volatile organics, and will consist of deionized distilled water passed through activated carbon (prepared by the analytical laboratory), and sealed in a sample container. The trip blank will be transported to and from the field, then returned to the laboratory unopened for analysis. One trip blank per cooler containing samples for volatile organic analysis will be evaluated to determine possible sample contamination during transport and storage.

Laboratory Matrix Spike

For each sample matrix, a minimum of 1 laboratory matrix spike per 20 samples, not including QC samples, or 1 matrix spike sample per sampling round, if fewer than 20 samples are obtained, will be analyzed for metals, VOC, SVOC, and TPH. These analyses will be performed to provide information on accuracy and to verify that extraction and concentration levels are acceptable. The laboratory spikes will follow Ecology and EPA guidance for matrix and blank spikes.

Laboratory Matrix Spike Duplicate

For each sample matrix, a minimum of 1 laboratory matrix spike duplicate per 20 samples, not including QC samples, or 1 matrix spike sample per sampling round, if fewer than 20 samples are obtained, will be analyzed for metals, VOC, SVOC, and TPH. These analyses will be performed to provide information on the precision of chemical analyses. The laboratory spikes will follow EPA guidance for matrix and blank spike duplicates.

Laboratory Duplicates

For each sample matrix, a minimum of 1 laboratory duplicate per 10 samples, not including QC samples, or 1 duplicate sample per sampling round, if fewer than 10 samples are obtained, will be analyzed for VOC, SVOC, cyanide, TPH, inorganic conventionals, and metals in groundwater. A minimum of 1 laboratory triplicate per 20 samples, not including QC sample, or 1 triplicate sample per sampling round of fewer than 20 samples are obtained, will be analyzed for TOC. These analyses will be performed to provide information on the precision of chemical analyses. The laboratory duplicate will follow Ecology and EPA guidance for the method.

Laboratory Method Blanks

A minimum of 1 laboratory method blank will be analyzed for all chemical parameters per 20 samples, one every 12 hours, or 1 per batch of samples analyzed (if fewer than 20 samples are analyzed) to assess possible laboratory contamination. Dilution water will be used whenever possible. Method blanks will contain all reagents used for analysis.

CORRECTIVE ACTIONS

Corrective actions will be needed for two categories of nonconformance:

- Deviations from the methods or QA requirements
- Equipment or analytical malfunctions.

Corrective action procedures to be implemented based on detection of unacceptable data are developed on a case-by-case basis. Such actions may include one or more of the following:

- Altering procedures in the field
- Using a different batch of sample containers
- Performing an audit of field or laboratory procedures
- Reanalyzing samples (if holding times allow
- Resampling and analyzing
- Evaluating sampling and analytical procedures to determine possible causes of the discrepancies

- Accepting the data with no action, acknowledging the level of uncertainty
- Rejecting the data as unusable.

During field operations and sampling procedures, the field personnel will be responsible for conducting and reporting required corrective action; an example corrective action report is provided as Form A-5. A description of any such action taken will be entered in the daily field notebook. If field conditions are such that conformance with the QA/QC requirements identified in this plan is not possible, the project manager and/or QA task leader will be consulted immediately. The QA task leader will consult with the QAO, who may authorize changes or exceptions to the QA/QC procedures as necessary and appropriate. If significant modifications are required for procedures specified in this plan, and time or field circumstances do not allow for prior notification to the project manager or the QA task leader, a Sampling Procedure Alteration Checklist will be filed with the QA task leader by field personnel as soon as possible; an example of the checklist is provided as Form A-6.

During laboratory analysis, the Laboratory QAO will be responsible for taking required corrective actions in response to equipment malfunctions. If an analysis does not meet data quality goals outlined in this plan, corrective action will follow the guidelines in the Ecology or EPA analytical methods noted herein, and the EPA guidelines for data validation for organics analyses. At a minimum, the Laboratory QAO will be responsible for monitoring the following:

- Calibration check compounds must be within performance criteria specified in the Ecology or EPA method or corrective action must be taken prior to initiation of sample analysis. No analyses may be performed until these criteria are met.
- Before processing any samples, the analyst should demonstrate, through analysis of a reagent blank, that interferences from the analytical system, glassware, and reagents are within acceptable limits. Each time a set of samples is extracted or there is a change in reagents, a reagent blank should be processed as a safeguard against chronic laboratory contamination. The blank samples should be carried through all stages of the sample preparation and measurement steps.
- Method blanks should, in general, be below instrument detection limits. If contaminants are present, then the source of contamination must be investigated, corrective action taken and documented, and all samples associated with a contaminated blank reanalyzed. If, upon reanalysis, blanks do not meet these requirements, the QAO will be notified immediately to discuss whether analyses may proceed.
- Surrogate spike analysis must be within the specified range for recovery limits for each analytical method utilized or corrective action must be taken and documented.

Corrective action includes: 1) reviewing calculations; 2) checking surrogate solutions; 3) checking internal standards; and 4) checking instrument performance followed by re-extraction and re-analysis. If the problem is determined to be caused by matrix interference, reanalysis may be waived if so directed following consultation with the QAO. If the problem cannot be corrected through reanalysis, the QAO will be notified by the laboratory prior to data submittal, so that additional corrective action can be taken, if appropriate.

- If the recovery of a surrogate compound in the method blank is outside the recovery limits, the blank will be reanalyzed along with all samples associated with that blank. If the surrogate recovery is still outside the limits, the QAO will be notified immediately to discuss whether analyses may proceed.
- If detection limit goals or matrix spike control limits cannot be met for a sample, the QAO will be notified immediately to discuss corrective action required.
- If holding times are exceeded, all positive and nondetected results may need to be qualified as estimated concentrations. If holding times are grossly exceeded, the QAO may determine the data to be unusable.

If analytical conditions are such that nonconformance with the QA/QC requirements in this plan is indicated, the QAO and/or QA task leader will be notified as soon as possible so that any additional corrective actions can be taken.

Corrective action reports will be used to document responses to reported nonconformances. These reports may be generated from internal or external audits or from informal reviews of project activities.

Corrective action reports will be reviewed initially for appropriateness of recommendations and actions by the QAO (for QA matters) and by the project manager (for technical approach). The project manager and QAO will jointly define responsibilities for scheduling, performing, documenting, and assessing the effectiveness of the required action. The QAO is ultimately responsible for implementation of appropriate corrective action and maintenance of a complete record of QC issues and corrective actions.

The QAO will keep the project manager informed of significant deviations from the QAPP due to equipment or analytical malfunctions, and any corrective action reports written for this project.

Ecology may require systems or performance audits be performed in the event of significant concerns about the validity of the data.

REPORTING

Laboratory Reports

The laboratory project manager from each laboratory will transmit reports by facsimile to the consultant project manager upon the completion of a sampling round or laboratory batch of samples. Laboratory reports and analysis results will be signed by the appropriate laboratory project manager and submitted in data packages to the project manager.

Quality Assurance Reports to Management

Reports of significant QA deficiencies will be immediately provided to the QAO by the QA task leader upon discovery. Verbal notice will be followed with written documentation such as a memorandum and corrective action report. The QAO will be responsible for reporting QA problems to the project manager.

All data reports will include results of the QA data validation review and conclusions containing information regarding data accuracy, precision, completeness, as well as results of system and performance audits, and any corrective action and sampling procedure alteration documentation. Data validation results will be appended to data reports in accordance with Section 9.9 and, therefore, will not be published in a separate data validation report.

SITE SAFETY

Sampling activities will be conducted in accordance with the project health and safety plan. The health and safety plan presents safety rules and procedures, criteria for hazard and risk analysis, description of levels of personal protection and required equipment, air monitoring procedures, emergency response information, contingency and spill control plans, training requirements, and requirements for routine health care and health monitoring. Adherence to the health and safety plan will be the responsibility of each individual at the site who is involved with project efforts. This includes employees of the consultant and their subcontractors.

REFERENCES

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TABLE A-1

SAMPLE CONTAINERS, PRESERVATION, AND HOLDING TIMES

Matrix	Analytes	Sample Container[a]	Preservation	Maximum Holding Times[b]
Groundwater				
	Metals	1 L HDPE	HNO_3	6 months
	Mercury	500 mL HDPE	HNO_3	28 days
	Cyanide (total)	500 mL HDPE	10 N NaOH	14 days
	Volatile organics	3 each - 40 mL glass vials; teflon-lined cap	HCl to pH<2 Cool to 4°C No headspace	14 days
	SVOC	3 each - 1 L amber glass; teflon-lined cap	Cool to 4°C	7 days until extraction; 40 days after extraction
	TPH-G	3 each - 40 mL glass vials; teflon-lined cap	HCl to pH<2 Cool to 4°C No headspace	14 days
	TPH-D (extended)	2 L glass, teflon-lined cap	HCl to pH<2 Cool to 4°C	7 days until extraction; 30 days from collection to analysis
	Turbidity	500 mL HPDE	Cool to 4°C	48 hours
	Conductivity	NA	NA	NA
	pH	NA	NA	NA

(a) Additional sample will be required for MS/MSD analysis.
(b) Holding times are from date of collection unless otherwise specified.

TABLE A-2

QUALITY ASSURANCE RESPONSIBILITIES

Personnel	Responsibilities
Client representative (Union Station Associates Project Coordinator or designee)	Provide technical project direction, review project QA needs and approve appropriate QA corrective actions as required.
Consultant Project Manager	Oversee technical project team performance to verify successful accomplishment of technical and QA project objectives. Review project QA needs and approve appropriate QA corrective actions as needed.
Consultant QA Officer	Provide technical review for QA project requirements; review corrective action responses and deviations from the QA requirements; direct or perform data validation and prepare data validation reports; prepare and review QA reports; and supervise field performance audits.
Consultant QA/QC Task Leader	Provide technical QA assistance, direct implementation of QA/QC activities, prepare QA reports, and provide corrective action response.
Laboratory QA Officer	Oversee laboratory implementation of QA/QC protocols so that QA objectives are met and to provide for properly documented and reported laboratory QA/QC information.
Laboratory Project Manager	Oversee analytical laboratory performance to verify adherence to project specifications and QA objectives and confirm that technical, financial, and scheduling objectives are achieved.

TABLE A-3

DATA QUALITY OBJECTIVES FOR SUPPLEMENTAL MONITORING PROGRAMS

DQO Parameter	Soil Investigations	Groundwater Investigations
Data users	Union Station Associates, Ecology	Union Station Associates, Ecology
Data use/decision	Monitoring	Monitoring
Data type	Chemical concentrations[a]	Chemical concentrations[a]
Data quality objectives[b]		
Analytical level	Level III[c]	Level III
QA goals:		
- Precision[d]	Matrix spike, laboratory, and field duplicates	Matrix spike, laboratory, and field duplicates
- Accuracy[c]	Matrix spikes	Matrix spikes
- Representativeness	Field and laboratory blanks[e] Sampling protocols[f]	Field and laboratory blanks Sampling protocols
- Completeness	90%	90%
Quantitation limit[g] or reporting limits	See Ecology (1995)	See Ecology (1995)

(a) Groundwater analyses include turbidity, VOC, SVOC, TPH, metals, TSS, TDS, pH, specific conductance, and temperature. Major ion analyses will be conducted periodically.

(b) Developed in accordance with EPA guidance documents.

(c) Ecology may direct that level IV QA/QC protocols be used if questions arise regarding data integrity.

(d) Control limits for evaluation of precision and accuracy for constituents analyzed for this project will be confirmed with the selected laboratory.

(e) Blank concentrations will be monitored and corrective action determined on a case-by-case basis, as described in Section 9.10.

(f) Sampling protocols will be monitored for adherence to the sampling procedures discussed in Sections 2.0 and 3.0; corrective action will be determined on a case-by-case basis.

(g) Quantitation limits may be affected by matrix interferences. Values are based on current laboratory data.

TABLE A-4
PHYSICAL AND CHEMICAL GROUNDWATER ANALYTICAL METHODS[a]

Sample Type	Analysis Method	Practical Quantitation Limit (PQL)
Metals		
Antimony	6010 or 200.8	320 µg/L
Arsenic	7060 or 200.8	4 µg/L
Beryllium	6010 or 200.8	2 µg/L
Cadmium	7131 or 200.8	2 µg/L
Chromium	6010 or 200.8	50 µg/L
Copper	200.8	10 µg/L
Lead	7421 or 200.8	10 µg/L
Mercury	7470	1 µg/L
Nickel	200.8	10 µg/L
Selenium	7740 or 200.8	20 µg/L
Silver	7761 or 200.8	2 µg/L
Zinc	6010 or 200.8	20 µg/L
Cyanide	9012	50 µg/L
Volatile organic compounds	8240/8260	5-10 µg/L[b]
CPAH	8270 selective ion method	1.0 µg/L
Other semivolatile organic compounds	8270	10-20 µg/L[c]
TPH	WTPH-D (extended)[d] WTPH-G[b]	100 mg/L 50 mg/L
Cations	6010	--
Anions	Standard EPA Methods (300 series)	--
Total suspended solids	160.2	--
Total dissolved solids	160.1	--
Conductivity	Field	--
pH	Field	--
Temperature	Field	--

(a) Methods are from SW-846 (EPA 1992) unless otherwise referenced. Comparable methods may be substituted upon approval by Ecology.

(b) PQLs for vinyl acetate and 2-hexanone are 50 µg/L.

(c) PQLs for 2-nitroaniline, 3-nitroaniline, 2,4 dinitrophenol, 4-nitrophenol, and pentachlorophenol are 50 µg/L.

(d) Washington State Department of Ecology. *Total Petroleum Hydrocarbons Analytical Methods for Soil and Water.* 1994.

LANDAU
ASSOCIATES,
INC.
Edmonds, WA · (206) 778-0907
FAX (206) 778-6409

Groundwater/Surface Water Sample Collection Form

PROJECT ____________ PROJECT NO. ________
EVENT ____________

SAMPLE NO. ____________
DATE COLLECTED ____________ TIME ________

Weather ____________ Collector(s) ____________

WATER LEVEL/WELL/PURGE DATA

Sample Type: ☐ Groundwater ☐ Surface Water ☐ Other ____________
Sample Location: ____________

Depth to Water (ft): ________ Time: ________ Measured from: ☐ Top of Protective Casing ☐ Top of Well Casing

Well Casing Type: ☐ PVC ☐ Stainless Steel ☐ Fiberglass Well Diameter: ________

Well Condition: Secure (☐ Yes / ☐ No) Damaged (☐ Yes / ☐ No) Describe ____________

Begin Purge: Date/Time: ________ Casing Volume (gal): ________

End Purge: Date/Time: ________ Purge Volume (gal): ________

Total Depth of Well (ft. below top of well casing): ________

VOLUME OF SCHEDULE 40 PVC PIPE				
Diameter (Inch)	O.D. (Inch)	I.D. (Inch)	Volume (gal/linear ft)	Wt. Water (lbs/lineal ft)
1-1/4	1.660	1.380	0.08	0.64
2	2.375	2.067	0.17	1.45
4	4.500	4.026	0.66	5.51

Purge Volume Calculation: ____________

Purge Water Disposal to: ☐ 55-gal Drum ☐ Storage Tank ☐ Ground ☐ Other ________ Gallons Purged: ____

Time	Vol. Purged (gal)	pH	Temperature (°F/°C)	Conductivity	Comments/Observations

SAMPLE COLLECTION DATA

Sample Collected With: ☐ Bailer ☐ Pump/Pump Type ____________ Dedicated (☐ Yes / ☐ No)

Made of: ☐ Stainless Steel ☐ PVC ☐ Teflon ☐ Polyethylene ☐ Other ________

Decon Procedure: *(By Numerical Order)* ☐ Alconox Wash ☐ Tap Rinse ☐ DI Water ☐ Other ________ ☐ Other ________
☐ Other ____________

Sample Description (color, turbidity, odor, sheen, etc.): ____________

Replicate	pH	Temperature (°F/°C)	Conductivity (µS)	Other
1				
2				
3				
4				

pH Meter: ________ Cond. Meter: ________ Cond. Range: ________ ATC: ☐ On ☐ Off

Meter Calibration Check: Ph7 Buffer Reads ______ at ______ ° C after Sample Collection.

SIZE	QUANTITY	TYPE	FIELD FILTERED	LABORATORY ANALYSIS
		☐ Glass ☐ Plastic	☐ Yes / ☐ No	
		☐ Glass ☐ Plastic	☐ Yes / ☐ No	
		☐ Glass ☐ Plastic	☐ Yes / ☐ No	
		☐ Glass ☐ Plastic	☐ Yes / ☐ No	

Duplicate Sample No(s). ____________
Comments: ____________

☐ *Continued on Back*

Signature ____________ Date ____________

2/93

FORM A-1

LANDAU ASSOCIATES, INC.
Edmonds, WA (206) 778-0907
FAX (206)778-6409

Chain-of-Custody Record

№ 2580

Date ____________
Page ______ of ______

Project ______________________ Job No. ____________
Client ______________________
Project Location ______________________
Sampler's Name ______________________

Sample No.	Date	Time	Location	No. of Containers	Testing Parameters										Observations/Comments

Special Shipment/Handling or Storage Requirements

Method of Shipment

Relinquished by	**Received by**	**Relinquished by**	**Received by**
Signature	Signature	Signature	Signature
Printed Name	Printed Name	Printed Name	Printed Name
Company	Company	Company	Company
Date ______ Time ______	Date ______ Time ______	Date ______ Time ______	Date ______ Time ______

FORM A-2

3/91

WHITE COPY - Project File **YELLOW COPY - Laboratory** **PINK COPY - Client Representative**

CUSTODY SEAL

LANDAU ASSOCIATES, INC.
P.O. Box 1029 / Edmonds, WA 98020-9129
Phone: (206)778-0907 / FAX: (206)778-6409

Signature ______________________________ **Date** ______________

FORM A-3

25110.11 Boeing Portland/Photograph Documentation Form 2/94

Project: ____________________
Project No.: ____________________

PHOTOGRAPH DOCUMENTATION FORM

ROLL NO.	PHOTO NO.	DATE	TIME	TAKEN BY	ORIENTATION	DESCRIPTION/PURPOSE OF PHOTO

FORM A-4

CORRECTIVE ACTION REPORT

Project Task and Name: ____________________

Sampling Dates Involved: ____________________

Material to be Sampled: ____________________

Measurement Parameter: ____________________

Acceptable Data Range: ____________________

____

Means of Detecting Problems (field observations, systems audit, etc.): ____________________

____

Problem Areas Requiring Corrective Action: ____________________

____

____

____

____

Schedule for Corrective Action: ____________________

____

____

Measures to Correct Problems: ____________________

____

____

____

____

Corrective Actions Initiated By: ____________________

Title: ____________________

Approval for Corrective Actions: ____________________

Title: ____________________ Date: __________

Signature: ____________________

SAMPLING PROCEDURE ALTERATION CHECKLIST

Project Name and Number:

Material to be Sampled:

Measurement Parameter:

Standard Procedure for Field Collection (cite reference):

Reason for Change in Field Procedure:

Variation from Field Procedure:

Special Equipment, Materials, or Personnel Required:

Initiator's Name:	Date:
Project Approval:	Date:
QA Officer Reviewer:	Date:

APPENDIX B

Construction Contingency Plan

APPENDIX B

CONSTRUCTION CONTINGENCY PLAN

INTRODUCTION

There is a small potential for unexpected contamination, related to prior property use, to be encountered at the Union Station property during foundation construction. This plan identifies the approach to monitor for indications of contamination during foundation construction and to manage contamination if encountered. The approach identified in this plan will be considered when preparing earthwork and foundation construction specifications.

MONITORING AND OBSERVATIONS DURING CONSTRUCTION

During construction activities performed as part of foundation construction, soil and groundwater conditions will be observed for visual and olfactory indications of contamination.

ACTIONS IF CONTAMINATED SOIL IS ENCOUNTERED

If soil is encountered that, due to color, texture, sheen, or odor, appears to be contaminated, the following steps will be taken:

- Appropriate health and safety measures will be implemented.
- The location characteristics, presence of groundwater, and odor of the apparently contaminated soil (or, if it has been excavated, the former location) will be documented.
- The property owner and the Washington State Department of Ecology (Ecology) will be advised that indications of possible contamination have been encountered and further evaluation is in progress.
- If the soil has already been excavated, it will be staged at the property and temporarily stored on plastic sheeting, separate from other excavated soil to allow sampling and evaluation. If the soil has not been excavated and excavation is planned as part of construction, the soil will be excavated and handled as above. If the soil has not been excavated and excavation is not planned as part of construction, the soil will not be disturbed unless excavation is necessary to prevent construction delays.
- Samples of the excavated soil will be collected and chemically analyzed for likely contaminants based on observed characteristics and constituents already detected or likely to be present at the property. The sampling approach and number of samples to be collected from excavated soil will be appropriate to characterize the volume of excavated soil. If the potentially contaminated soil has not been excavated, the number

of samples to be collected will be appropriate for the areal extent of apparent contamination. Analytical results will be submitted to Ecology within 30 days of receipt.

- Excavated soil will managed appropriately, based on the analytical results, and in accordance with the applicable regulations.

ACTIONS IF CONTAMINATED GROUNDWATER IS ENCOUNTERED

If groundwater is encountered that, due to color, appearance, sheen, or odor appears to be contaminated the following steps will be taken.

- Appropriate health and safety measures will be implemented.
- The location and characteristics of the apparently contaminated groundwater will be documented.
- The property owner and Ecology will be advised that indications of possible contamination have been encountered and further evaluation is in progress.
- A sample of the groundwater will be collected and analyzed for likely contaminants based on observed characteristics and constituents already detected or likely to be present in groundwater at the property, to allow management of water as described below.

MANAGEMENT OF CONTAMINATED MATERIAL

If concentrations of constituents in excavated soil exceed dangerous waste criteria, the soil will be taken to a permitted facility for treatment or disposal. If concentrations of constituents in excavated soil do not exceed dangerous waste criteria, the soil may be removed to a facility authorized to treat or dispose of that soil or it may be managed onsite. Disposition of soil will be documented.

If the sampling results indicate contamination, and if contaminated groundwater must be removed from the property to facilitate construction, King County - METRO will be contacted and any required approvals will be obtained prior to pumping the groundwater to the sanitary sewer. If analysis results are not yet available, the groundwater may be pumped into a storage tank for temporary storage. If the groundwater cannot be discharged to the sanitary sewer, treatment or disposal will be arranged in conformance with applicable regulations.