Draft Technical Memorandum No. 2: Remediation Areas

Site Wide Feasibility Study

PSC Georgetown Facility

Seattle, Washington

Prepared for:

Philip Services Corporation
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Kent, Washington 98032

June 2006

Project No. 8770

Geomatrix

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1.0 PURPOSE AND SCOPE

This Technical Memorandum has been prepared to document work completed to date for the revised Site Wide Feasibility Study (SWFS) for the Philip Services Corporation (PSC) Georgetown facility.[1] This SWFS is intended to meet corrective action provisions of the PSC Georgetown facility RCRA Part B Permit and the requirements of the MTCA. The Permit, as issued under the authority of the Washington Department of Ecology (Ecology), covers the regulated areas of the former PSC facility operations. PSC closed these areas (and all dangerous waste operations within these areas) in August 2003 under a closure plan approved by Ecology. At that time, all dangerous waste operations at the facility ceased.

During 2003 and 2004, PSC implemented the hydraulic control interim measure (HCIM). The HCIM required construction of a subsurface barrier wall keyed into the aquitard underlying the Site and a pump-and-treat system designed to maintain an inward gradient to contain contaminated groundwater beneath the facility and adjacent properties. Implementation of the HCIM required PSC to purchase the TASCO property and adjoining railroad spur, and to acquire easements on two other properties adjacent to the facility (the Stone-Drew/ Ashe &

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[1] Throughout this memorandum, the term "facility" is used to refer to the former Resource Conservation and Recovery Act (RCRA) dangerous waste operations located at 734 South Lucile Street, owned and operated by PSC. The term may also include certain properties adjacent to the former dangerous waste facility property that were acquired by PSC following closure of the dangerous waste operations in August 2003 (e.g., adjacent property to the northwest formerly owned by The Amalgamated Sugar Company [TASCO] that was impacted by historical releases from the PSC facility). The facility RCRA Part B permit (Permit) requires PSC to perform corrective action beyond the boundaries of the permitted facility to address such releases. The Washington Model Toxics Control Act (MTCA) regulations, Chapter 173-340 WAC, also require PSC to perform cleanup actions to address releases from the facility at "any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located (*see* WAC 173-340-200). For purposes of this Technical Memorandum, the term "Site" includes both the facility and other areas (e.g., TASCO) that have been affected by releases that occurred at the facility.

Jones [SAD] property and the Aronson property). The HCIM has proven effective in providing hydraulic control of contaminated groundwater in these areas of the Site.

The Permit requires that the SWFS address all areas affected by releases from the facility. The area addressed by the SWFS (i.e., the SWFS Area) includes the properties currently owned by PSC (the facility and the adjacent TASCO property), properties adjacent to the PSC properties (Union Pacific Rail Road [UPRR]), Aronson, and SAD properties), and the contiguous areas affected by releases from the facility extending downgradient (west) to Fourth Avenue South. After the RI Report was completed, additional releases to soil and groundwater from non-PSC sources were identified downgradient from the facility, near Fourth Avenue South. The specific chemicals released in these downgradient areas include many of the facility COCs. These downgradient releases have resulted in an area of co-mingled releases that extend from approximately Fourth Avenue South to the Duwamish Waterway. Due to the presence of these downgradient source areas and the complexity of dealing with impacted groundwater from multiple sources, the scope of the SWFS has been limited, with Ecology concurrence, to the SWFS Area. Remedial action for the area downgradient from Fourth Avenue South will be addressed separately.

In response to comments received from Ecology on the initial draft SWFS report, PSC and Ecology have agreed to use a collaborative, phased process in preparing the revised draft SWFS report to ensure consensus among PSC, Ecology, and other interested parties on key issues that affect the SWFS. During this process, PSC will develop the five separate Technical Memoranda addressing the topics listed below to satisfy Permit and MTCA requirements for the complete SWFS:

1. Cleanup Levels, Constituents of Concern, Point of Compliance, Fate and Transport Modeling, and Corrective Action Schedule
2. Remediation Areas
3. Inhalation Pathway Interim Measure
4. Technology Identification and Screening
5. Remedial Alternatives Development and Evaluation

PSC will prepare and submit each technical memorandum in draft form to Ecology. Following Ecology review and comment, PSC will revise the draft memoranda as appropriate for final approval by Ecology. It was agreed that work on Technical Memoranda No. 2 (this memorandum) and 3 would begin simultaneously after Ecology's final approval of Technical Memorandum No. 1. Technical Memorandum No. 4 will be prepared after final approval of both Memoranda Nos. 2 and 3, and Technical Memorandum No. 5 will be prepared after final approval of Technical Memorandum No. 4. PSC will prepare the complete revised draft SWFS following Ecology approval of Technical Memorandum No. 5 by combining the five memoranda listed above.[2]

This memorandum describes remediation areas to be addressed by the SWFS, both within the HCIM Area and the Outside Area. Additionally, this memorandum describes considerations related to the Site, applicable regulations, or the surrounding area that may affect the remedial alternatives considered in the SWFS. The remediation areas described in this memorandum have been defined based on the following considerations:

- Type and number of COCs present;
- Depth of affected soil and/or groundwater;
- Land ownership;
- Land use above and adjacent to the affected area; and
- Potential need for and effectiveness of institutional controls.

To avoid creating acronyms in the continuing text of this memorandum, a list of acronyms and shortened names for terms not otherwise defined in the text is presented below:

API	Asian Pacific Islander
ARAR	Applicable state and federal laws
BTEX	benzene, toluene, ethylbenzene, and xylenes
bgs	below ground surface
C1	Commercial 1 zone
cis-1,2-DCE	cis-1,2-dichloroethene
cm/sec	centimeters per second

[2] These memoranda have been designed so that individual sections may be incorporated directly into the revised draft FSWP. It is anticipated that the text from the individual memoranda will appear in the report in a sequence different from the sequence of the memoranda as submitted to Ecology.

CPOC	conditional point of compliance
COC	constituent of concern
COI	constituent of interest
COPC	constituent of potential concern
DNAPL	dense non-aqueous phase liquid
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
FS	feasibility study
GAC	granular activated compound
gpm	gallons per minute
HCIM Area	the area within the hydraulic control interim measure barrier wall
HRC	hydrogen releasing compound
HWMU	hazardous waste management unit
ICOC	indicator constituent of concern
IG1	General Industrial 1 zone
IG2	General Industrial 2 zone
IPIM	inhalation pathway interim measure
LNAPL	light non-aqueous phase liquid
µg/kg	micrograms per kilogram
µg/L	micrograms per liter
mV	millivolts
mg	milligram
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MDL	method detection limit
NAPL	non-aqueous phase liquid
NPDES	National Pollutant Discharge Elimination System
NPV	net present value

ORC	Oxygen Release Compound™
Outside Area	the SWFS Area outside the boundaries of the HCIM Area
PAH	polyaromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PRB	permeable reactive barrier
PQL	practical quantitation limit
redox	reduction/oxidation
RI	remedial investigation
RL	remediation level
scfm	standard cubic feet per minute
SVOC	semi-volatile organic compound
SWFS	Site Wide Feasibility Study
SWFS Area	the area within the scope of the SWFS
SWMU	solid waste management unit
SPOC	standard point of compliance
SVE	soil vapor extraction
TCE	trichloroethene
TPH	total petroleum hydrocarbon
TSD	treatment storage disposal
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WAC	Washington Administrative Code

2.0 GENERAL REGULATORY CONSIDERATIONS

The MTCA regulations (WAC 173-340-360) present the general requirements for selecting cleanup actions for a contaminated site. The minimum requirements applicable to all cleanup actions include specific threshold requirements and other requirements that must be met by all cleanup actions. The threshold requirements include the following:

- Protect human health and the environment;
- Comply with cleanup standards specified in WAC 173-340-700 through WAC 173-340- 760;
- Comply with applicable state and federal laws; and
- Provide for compliance monitoring.

The other requirements cited in the MTCA regulations include the following:

- Use permanent solutions to the maximum extent practicable, as determined by the requirements of WAC 173-340- 173-340-360(3);
- Provide for a reasonable restoration time, as determined by the requirements of WAC 173-340- 173-340-360(4); and
- Consider public concerns.

For remediation of impacted groundwater, MTCA requires that, if practicable, a permanent cleanup action must be implemented to achieve the SPOC. If it is not practicable to implement a permanent groundwater cleanup action, the following requirements are specified by the MTCA regulations:

- Treatment or removal of the source area must be conducted for liquid wastes, highly impacted areas, highly mobile constituents, or hazardous constituents that cannot be reliably contained;
- LNAPL must be removed using normally accepted practice;
- If DNAPL is present, source containment may be appropriate if the DNAPL cannot be recovered; and
- Groundwater containment shall be implemented to the maximum extent practicable to control lateral and vertical expansion of the affected groundwater volume.

Cleanup actions that rely on engineering controls to achieve remedial objectives must also incorporate appropriate institutional controls developed and implemented in accordance with WAC 173-340-440. Additionally, cleanup actions must prevent or minimize present and future constituent releases and shall not rely primarily on dilution and dispersion to attain the cleanup standard unless the incremental costs of active remedial measures over the costs of dilution and dispersion grossly exceed incremental benefits achieved by active remediation. If remediation levels are used in a cleanup action, the regulations require that it be demonstrated that more permanent actions are not practicable and that the action using remediation levels meets all regulatory requirements and is protective of human health and the environment. The preferred remedial alternative identified by this SWFS must be capable of meeting the above regulatory requirements.

Permanent solutions are defined as solutions "… in which cleanup standards of WAC 173-340-700 through 173-340-760 can be met without further action…". Ecology's goal in obtaining a permanent solution is to reduce potential risks that may be posed by hazardous substances present at a site, either by destroying, immobilizing, or by otherwise rendering the substance non-toxic. As noted in the regulations, Ecology recognizes that permanent solutions are not always practical; the MTCA regulations have provided for implementation of non-permanent remedies provided that applicable regulatory requirements are met and the solution is approved by Ecology.

In WAC 173-340-360(3) the MTCA regulations outline the identification of permanent solutions and provide a framework for accepting non-permanent solutions, including conducting a disproportionate cost analysis , as described at WAC 173-340-360(3)(e). A classic example of a site that would use a disproportionate cost analysis to support selection of a non-permanent remedy is a landfill. Landfills contain large quantities of waste material and the waste is typically highly variable. The only practicable permanent solution for a specific landfill site is excavation and off-site disposal at another landfill. The cost of doing a complete landfill excavation and removal is disproportionate to any benefit gained over simply capping and permanently containing the landfill materials. As a result, EPA has recognized that landfill removals are not practicable and have adopted a "presumptive remedy" for landfill sites that assumes containment by capping, combined, if necessary, with groundwater/leachate control and landfill gas management.

Restoration time is the time required to achieve the cleanup standard. The regulatory requirements for assessing the reasonableness of the restoration time for a cleanup action are described at WAC 173-340-360(4). In determining a reasonable restoration time frame, the following factors must be considered:

- Potential risks to human health and the environment and the toxicity of site constituents;
- Practicability of achieving a shorter restoration time;
- Current and future land use for the site and surrounding area;
- Availability of alternate water supplies;
- The effectiveness and reliability of institutional controls; and
- Proven natural processes that reduce concentrations of site constituents.

In assessing the restoration time for this SWFS, it is necessary to assess the technical capability of achieving restoration. The remediation alternatives considered in this SWFS and presumptive remedies established by EPA will be reviewed to assess the capability to fully restore the Site. As noted in WAC 173-340-360(4)(d), any remedial action that cannot achieve Method C cleanup levels is considered an interim measure.

In addition to the regulatory issues related to the MTCA regulations, corrective actions at the Site must be performed in accordance with the Facility Permit and applicable RCRA regulations. Since the former TSD was covered by a RCRA Part B permit, corrective action provisions apply to all HWMUs and SWMUs that were present at the time the Permit application was prepared or that were subsequently created under the terms of the Permit. However, the provisions of the Permit do not apply to any SWMUs that were not present on the Facility at the time the Permit application was prepared. Although PSC is the present owner of the TASCO property, neither PSC nor Burlington/Chempro conducted permitted TSD operations on the TASCO property and the Permit did not cover operations at TASCO. Therefore, there are no SWMUs located on the TASCO site that are covered by the provisions of the Permit or RCRA. The applicability of the Permit to the TASCO property is limited to subsurface media affected by releases from the Facility.

3.0 HCIM AREA REMEDIATION CONSIDERATIONS

As noted previously, the HCIM Area is defined as the area contained by the barrier wall and includes portions of the facility, the TASCO property, the Aronson Property, and the SAD property. Several features specific to the HCIM Area will affect remediation and development of remediation alternatives. The considerations for the HCIM Area are discussed in the following subsections based on the various physical, ownership, land use, interim measure, and regulatory considerations. Based on these considerations and the distribution of site constituents within impacted soil and groundwater, remediation areas are defined for the HCIM Area. Specific remediation areas within the HCIM Area are identified.

3.1 HISTORIC AND FUTURE LAND USE

The HCIM Area has a long history of industrial land use and is expected to continue to be used for either industrial or commercial use in the foreseeable future. As noted previously, the facility and adjacent properties comprising the HCIM Area are zoned General Industrial 1 (IG1), which allows the heaviest degree of industrial use and typically relies on rail and marine transportation. This zoning is consistent with historical ownership and use of the industrial use of the facility since about 1936.

The facility property has been owned by Preservative Paint Company, Chempro, and Burlington Environmental. Burlington Environmental is currently a wholly-owned subsidiary of PSC. The former west field, which was an unpaved area located near the boundary of the facility with the SAD property, was used for staining wood shakes and shingles and storing stains, solvents, and wastes. Two USTs were located east of the west field, to the south and east of the former facility warehouse, and 22 USTs (installed between 1958 and 1965) were located within the former north field at the facility. The USTs have been used to store materials such as thinners, solvents, and mineral spirits prior to 1970 and by Chempro and Burlington to store solvents, cyanide wastes, and other materials between 1970 and 1987. All USTs have been removed from the facility. Oils containing PCBs were also used at the facility and transformers containing PCB oils were temporarily stored on the western portion of the site during the period from 1970 to 1989. Under the RCRA Part B permit, hazardous waste TSD operations occurred throughout the facility. TSD operations at the facility ended in 2002 and the facility was formally closed under the RCRA process in 2003. Given the prior facility uses, releases of a wide variety of thinners, solvents, mineral spirits, painting products, cyanide wastes, solvent wastes (including a variety of chlorinated solvents), and PCBs, have likely occurred over much of the facility.

The HCIM Area incorporates portions of the facility, the former TASCO property, the Aronson property, and the SAD property. The TASCO site was an industrial site used for sugar processing from the 1930s until 2003. The Aronson property is a light industrial property used as a warehouse and service facility. The SAD property is also a light industrial site used for offices and warehousing. These properties have been used for industrial purposes since about 1915. The property to the east of the facility is a rail yard owned and operated by UPRR with a long history of industrial use.

Given the long history of industrial use within and immediately adjacent to the HCIM Area and the present zoning for the area, it is expected that the long-term future use of the HCIM Area will remain industrial. Therefore, the future land uses that will be considered by the SWFS for the HCIM Area will be limited to industrial activities.

3.2 LAND OWNERSHIP

The HCIM Area includes properties owned by three independent parties, including PSC, Aronson, and SAD. Different ownership of the properties can affect access needed to implement cleanup actions, and must be considered in the development and evaluation of potential remediation alternatives in this SWFS. These different properties have not had known releases of COCs; impacts to these areas are primarily a result of migration of releases that occurred on the facility. For this reason, remediation areas for the portion of these properties within the HCIM Area may be considered separately from those for the facility.

PSC purchased the TASCO property in 2003 in order to construct the HCIM. Therefore, access to the TASCO property is not a significant issue for the SWFS. However, the barrier wall was constructed to contain impacted portions of the Aronson and SAD properties. In order to construct the barrier wall on these properties, easements were obtained by PSC for the SAD and Aronson properties. The easements provide PSC limited access to portions of the properties. HCIM Area remediation alternatives that can be implemented within the terms of the easements would be more readily implemented than alternatives that would require additional access agreements.

3.3 INTERIM MEASURES

PSC has performed two interim remedial actions within the HCIM Area. These include a SVE system that was installed on the facility in the former North Field area and the HCIM surrounding much of the PSC properties and a portion of two neighboring properties. These two remedial actions are described in the following sections.

3.3.1 Soil Vapor Extraction Interim Measure

An interim measure to address soil contamination within a source area identified within the facility was installed and commissioned in 1994 in accordance with the requirements of the facility Permit. The SVE system was installed in the former North Field area of the facility to recover VOCs and to limit the spread of volatile constituents present in the vadose zone.

The SVE system showed the highest removal rate during the first year of operation, after which time the removal rate dropped, eventually showing the typical tailing effect (PSC, 1998a). Approximately 19,000 pounds of VOCs were removed from the vadose zone by the SVE system. This removal is likely to have impacted remaining VOC concentrations in soil in the former North Field. Since much of the soil data collected on the facility was collected prior to installation of the SVE system, conclusions based on that data would likely overestimate actual soil VOC concentrations that remain in soils within the HCIM Area.

The SVE system was turned off from February to August 1996 to allow the vadose zone to re-equilibrate; however, after resuming system operations, no significant increase in contaminant removal was observed. The SVE system was operated sporadically over the next eight years, with minimal recovery of VOCs. Operation of the SVE system was suspended on February 1, 2004. This interim measure permanently removed a substantial quantity of VOCs from the vadose zone soils at the facility.

3.3.2 Hydraulic Control Interim Measure

The HCIM was designed and installed to contain near-facility impacted groundwater and to minimize the release of Site constituents to groundwater migrating to the Duwamish Waterway. Between October 2003 and January 2004, the low-permeability barrier wall was installed to surround the contamination source areas and near-facility impacted groundwater. This barrier wall was keyed into the underlying aquitard, the intermediate silt unit, to effectively contain the most highly impacted groundwater. The barrier wall is coupled with groundwater extraction and pretreatment system designed to recover groundwater inside the barrier wall and to maintain an inward-directed hydraulic gradient. The area enclosed includes the source areas, and extends onto the TASCO site, now owned by PSC and the SAD and Aronson properties not owned by PSC.

The HCIM Area currently is capped with either low-permeability microsilica concrete or asphalt. The HCIM has substantially altered groundwater flow patterns within the HCIM Area. This is likely to have somewhat altered the distribution of groundwater concentrations within the HCIM Area presented in the RI report. This system is presently being maintained and operated. The HCIM provides substantial containment for the Site. Remedial alternatives and remedial strategies considered for the HCIM Area must be consistent with the continued maintenance and operation of the HCIM system.

3.4 Constituent Distribution

The perimeter of the HCIM Area is totally enclosed by a low-permeability barrier wall. The bottom of the HCIM Area consists of an aquitard with a permeability estimated on the order of 10-6 to 10-5 cm/sec. The former source areas associated with the facility at which historical releases are thought to have primarily occurred are located on the facility within the HCIM Area. Therefore, the highest observed constituent concentrations in both soil and groundwater are contained by the barrier wall. The exception to this is related to impacts on UPRR property on the east side of the HCIM Area .

Groundwater concentrations within the HCIM Area indicate that DNAPL is present in the subsurface. Soil and groundwater constituent distribution within the HCIM Area have been summarized previously; relevant information concerning the distribution of hazardous constituents within the HCIM Area and how they may affect remediation areas are described in the following subsections.

3.4.1 Soil

The distribution of COC within HCIM Area soils has been discussed in detail in the RI report. The data used to assess soil constituents include soil analytical data from the RI Report as well as any soil data collected subsequent to completion of the RI Report. Only soil samples collected above 15 feet bgs were evaluated to assess soil contamination for this SWFS; COCs present in the saturated zone are addressed in the SWFS as a groundwater issue.

The portions of the TASCO, Aronson and SAD properties within the HCIM Area have not had site uses that would have resulted in releases to the subsurface. The barrier wall was extended to encompass portions of these properties based on concentrations of VOCs in groundwater rather than soil. VOC concentrations west of the former North Field were identified during the RI as being at levels indicative of possible DNAPL, particularly in wells screened in the intermediate sampling depth. There are no soil data on the TASCO, Aronson, and SAD properties for the upper 15 feet of soil; however, there is also no evidence that soils in these properties have been impacted, with the possible exception of limited areas immediately adjacent to the facility property line.

The COC distribution for soils is discussed below in relation to the portions of the facility within the HCIM Area

3.4.1.1 VOCs

A variety of VOCs have been detected in soil samples collected throughout the facility The detected volatiles include BTEX, chlorinated ethenes, chlorinated ethanes, chlorinated methanes, ketones, and aromatic compounds. These constituents have been found at various locations and depths within the facility. The highest VOC concentrations were generally detected in the former North Field, near the former location of the USTs, and south of the former North Field. Drum storage occurred over much of the facility during the mid 1970s to early 1980s and incidental releases are known to have occurred. In general, VOCs in soil appear, and should be expected, to exceed cleanup levels in most portions of the facility.

It should be noted that most of the VOC concentrations were measured in soil samples collected during the RI. Implementation of the SVE interim measure in 1994 has likely affected soil VOC concentrations and it is likely that the concentrations observed in the RI are greater than present day soil concentrations. However, it is expected that the SVE did not substantially alter the overall distribution of soil VOCs. Since groundwater at the facility during the time the SVE interim measure was conducted was about 6 to 8 feet bgs; the SVE system would have been limited to soil shallower than the water table. Current concentrations are likely to be lower than those presented in the RI report for many of the sample locations.

3.4.1.2 SVOCs

A fairly broad variety of SVOCs have been detected in soil samples collected throughout the facility and within the HCIM Area. Light PAHs, heavy PAHs, Phenols, Phthalates, and other

SVOCs (such as 1,4-dichlorobenzene and dibenzofuran) have all been detected at various locations and depths in the HCIM Area. Based on facility history and the distribution of SVOCs on the facility within the HCIM Area appears to be similar to the distribution for VOCs; in general, most of the facility within the HCIM Area has been impacted by SVOCs at concentrations exceeding cleanup levels. The highest SVOC concentrations were generally detected in the former North Field of the facility and just south of the former North Field. The highest SVOC concentrations generally coincide with the location of soil VOCs. It is also likely that SVOCs, particularly the lightest SVOCs, have been partially removed by the SVE interim measure.

3.4.1.3 PCBs

PCBs have been detected at concentrations exceeding cleanup levels in soil samples within and adjacent to facility. Elevated concentrations have generally been detected in the upper 2 feet of soil, decreasing with depth. The highest concentrations have been detected in samples collected near the west side of the facility and near the east side of the facility, south of the former North Field. Both these areas were used for drum storage. Only limited soil data are available for PCBs. However, based on soil data collected adjacent to the facility (i.e., on both the east and west sides of the facility) and during pretrenching for construction of the HCIM, it is expected that PCBs exceed cleanup levels in soil may be widespread throughout most of the facility.

3.4.1.4 Inorganics

Several inorganic COCs have been detected in the facility area. Arsenic, barium, and chromium were detected consistently at concentrations exceeding cleanup levels in soil samples collected on the portion of the facility within the HCIM Area. Lead and mercury were detected in some soil samples collected in the facility area, with the highest concentrations generally detected in the shallowest samples. No obvious source areas can be identified from available data. Although data are insufficient to map source areas for inorganics, known site history and use, specifically the drum storage areas and the metal finishing process waste tanks in the North Field, are likely areas where releases of metals-containing wastes may have occurred.

3.4.1.5 TPH

Minimal TPH data have been collected for soils within the HCIM Area. TPH data are available for several samples collected near the facility as part of the Offsite Area investigation, as described in Section 2.0 of the SWFS report. Since TPH-impacted and/or Stoddard solvent-impacted soil has been identified to the west, east, and north of the facility and these COCs were handled on site (drum storage areas as well as in USTs in the North Field), it is expected that much of the soil within the portions of the facility inside the HCIM Area has been affected by TPH.

3.4.2 Groundwater

The distribution of COCs in groundwater inside the HCIM Area was identified by reviewing RI Report analytical data for the water table, shallow, and intermediate depth intervals. Limited groundwater quality data have been collected within the HCIM Area since completion of the RI report; however, several wells were sampled early in 2006 to collect current groundwater quality data within the HCIM Area. The 2006 data have been included in this evaluation; however, it should be noted that the 2006 data are preliminary and have not been validated. It should be noted that deep interval groundwater is considered part of the Outside Area since groundwater in the deep aquifer is not contained by the HCIM. Limited data have been collected within the HCIM Area since completion of the RI Report.

3.4.2.1 VOCs

A wide variety of VOCs have been detected in samples collected throughout the HCIM Area, including on both the facility and the other properties enclosed by the barrier wall. BTEX, chlorinated ethenes, chlorinated ethanes, chlorinated methanes, ketones, and aromatic VOCs have all been detected at concentrations exceeding cleanup levels at various locations and depths in the HCIM Area. Thus, both chlorinated and non-chlorinated VOCs are distributed throughout the areal and vertical extent of groundwater within the HCIM Area.

In the water table interval, two areas were identified with higher VOC concentrations: one area is the northwest corner of the TASCO property, extending onto the southeast corner of Aronson property, and the second area is within the facility property, near the SW corner of the HCIM Area along the PSC/SAD property boundary. VOC concentrations were also high at these locations within the shallow depth interval, particularly at the location on the TASCO property. Elevated concentrations of degradation products (DCE and VC) are also present within the water table and shallow depth intervals on the facility, near and south of the former North Field. In the intermediate interval, the highest concentrations have been detected on the TASCO property and in the former North Field of the facility. Figures 9-7, 9-8, 9-11, 9-12, 9-15, and 9-16 from the RI report show the distribution for non-chlorinated VOCs and Figures 9-

19, 9-21, 9-23, 9-25, 9-27, and 9-29 from the RI report show the distribution for chlorinated VOCs. Recent VOC concentrations observed in samples collected after installation of the HCIM are shown in the Fourth Quarter 2005 Corrective Action Report, Figures 5 through 25.

Concentrations detected in the water table, shallow, and intermediate depth intervals on the TASCO property exceed 1% of the solubility, indicating that DNAPL is present in this area. The DNAPL along the border of the facility and the TASCO property, west of the North Field appears to be within the finer grained lenses of the sand and silt unit extending to the aquitard. The observed distribution of elevated concentrations of the chlorinated solvents is consistent with a release of solvents from the North Field USTs followed by the downward and down-dip movement of DNAPL through interbedded silts and sands of the saturated zone overlying the aquitard. The distribution is also consistent with a trail of DNAPL ganglia, likely due to residual saturation, as described in Section 3 of the SWFS report. Consistent with a ganglia-type DNAPL distribution, free phase product has not been actually seen in samples collected on PSC property, but its presence is inferred from the groundwater data. DNAPL present as ganglia cannot be effectively recovered.

A second area considered likely to be affected with DNAPL is in the former West Field, east of the SAD property. Although TCE concentrations are relatively low in this area, the reductive dechlorination products of TCE are relatively high. If the degradation products are summed and expressed as TCE equivalents, it appears that TCE concentrations exceeded 1% of its solubility. Therefore, it is expected that DNAPL is present beneath the facility in this area.

Recently collected groundwater monitoring data for facility wells indicate that the containment system has maintained conditions conducive to active biodegradation. Data collected in the spring of 2006 show a general decreasing trend for TCE in some monitoring wells. Data from the same wells show an increasing trend for VC and cis-1,2-DCE, both of which are biodegradation products of TCE. These data indicate that reductive dechlorination is active in the HCIM Area; it is expected that concentrations of VC and cis-1,2-DCE will decrease in the future after the degradation rate for TCE decreases. Trend plots for BTEX show a generally constant concentration through the spring 2006 data, which is expected for hydrocarbons within the reducing environment required to support reductive dechlorination. Figures displaying these trends at several wells within the HCIM Area are included in Appendix A.

3.4.2.2 SVOCs

Groundwater sampling data show a broad range of SVOCs are present in samples collected throughout the areal and vertical extent of the HCIM Area. The highest concentrations have been detected on the northern portion of the TASCO property, generally coinciding with the presence of high VOCs. Based on available data and the presence of the pump and treat system inside the wall, most of the HCIM Area groundwater above the silt aquitard can be assumed to have SVOCs at concentrations exceeding the cleanup levels.

3.4.2.3 PCBs

Limited PCB data are available for groundwater within the HCIM Area, but available results do indicate the presence of PCBs in at least the water table sample interval. Groundwater sampling data indicate that the Aroclor COCs are present within the North Field, West Field, and central portions of the former facility.

3.4.2.4 Inorganics

Groundwater monitoring data indicate that the inorganic COCs (metals and cyanide) exceed cleanup levels throughout the HCIM Area and at all depth intervals above the aquitard. No source areas for organics were identified, based on data presented in the RI report figures (Figures 9-41 to 9-46).

3.4.2.5 TPH

TPH was detected in groundwater at concentrations exceeding clean up levels throughout the HCIM Area in the water table interval. Limited data exists for the shallow and intermediate intervals, but the available data at these depth intervals suggest a localized hot spot within the intermediate depth interval on TASCO property and within the former North Field portion of the facility.

3.5 SUMMARY

Soil beneath the facility has been impacted by a broad variety of constituents, including VOCs, SVOCs, PCBs, metals, and TPH. VOC concentrations in soil above the water table are likely lower today than when the RI sampling was performed as a result of implementing a SVE system. The HCIM Area soils present on TASCO, SAD, and Aronson properties are not anticipated to be significantly impacted except in the areas immediately adjacent to portions of the facility actively used for site operations.

Groundwater within the HCIM Area has been impacted with the same types of constituents found in soil; however, the impacts to groundwater for constituents other than PCBs are known to be present through the entire HCIM Area, including all saturated zones above the aquitard. Groundwater impacted by PCBs appears to be limited to the North Field, West Field, and the central portion of the facility. Groundwater recovery and natural biodegradation reactions are expected to change the nature and distribution of groundwater COCs within the HCIM Area.

Groundwater monitoring data show that reductive dechlorination reactions are active within the HCIM Area. These reactions are expected to reduce groundwater concentrations of the chlorinated solvents. The monitoring data show that groundwater concentrations for the less toxic non-chlorinated VOCs are generally constant within the HCIM Area, which is expected due to the reducing conditions that are present.

4.0 HCIM REMEDIATION AREAS

Remediation areas have been defined for soil and groundwater within the HCIM Area. These areas are based on consideration of the following:

- Nature of soil and groundwater constituents;
- Distribution of soil and groundwater constituents;
- Presence of NAPL;
- Previous and/or ongoing interim measures implementation
- Site ownership; and
- Land use.

The specific nature and distribution of soil and groundwater constituents can affect remediation of an area. As an example, chlorinated VOCs such as TCE and its degradation products may be remediated differently from non-chlorinated such as BTEX. If both types of VOCs co-exist in the same area the remediation methods considered must be capable of addressing both types of VOCs. Similarly, the presence of NAPL (LNAPL or DNAPL) will invoke specific regulatory requirements and significantly affect the list of potentially applicable technologies. Interim measures may have an effect on the distribution of COCs and also may affect the type of remedial actions considered for a specific area. Site ownership and land use both affect access to an area to conduct remediation. Site ownership also affects the effectiveness of institutional controls. These factors must be considered collectively to identify remediation areas.

Based on the previous remedial investigations conducted within the HCIM Area and a general consideration of potentially applicable remediation methods, four general classes of COCs have been identified to facilitate identification of remediation areas within the HCIM Area. These COC classes are: VOCs (both chlorinated and non-chlorinated), SVOCs, PCBs, Inorganics (metals and cyanide), and TPH. Remediation areas are considered independently for impacted soil and groundwater; however, simultaneous remediation of both media may be feasible and is considered in development and evaluation of remediation alternatives, as appropriate.

4.1 Soil Remediation Areas

Based on the summary of soil quality data presented in Section 3.4.1 above, all four COC classes appear to co-exist in soils over most of the facility inside the HCIM Area; however, these soil constituents have not been observed within the adjacent properties, including TASCO (now owned by PSC), SAD or Aronson. Appendix 9A of the RI report indicates that a number of COCs exceed cleanup levels on the facility. The nature and distribution of soil constituents in the HCIM Area provides a general basis for selection of soil remediation areas; specifically, the portions of the facility inside the HCIM Area will be considered a single remediation area for soil and the TASCO, SAD and Aronson properties will be considered a second remediation area. Figure 6-1 shows the two soil remediation areas defined for the HCIM Area. The remediation area incorporating the facility is referred to as HCIM Area Soil Remediation Area 1; the TASCO, SAD, and Aronson properties within the HCIM Area are referred to as HCIM Area Soil Remediation Area 2 These remediation areas are shown on Figure 4-1.

The interim measures that have been or are being conducted within the HCIM Area are not expected to significantly affect soil remediation. The ongoing HCIM is effective, and the components of the HCIM should be protected as appropriate in developing and evaluating soil remediation alternatives.

4.2 Groundwater Remediation Areas

Based on the summary presented in Section 3.4.2 above, groundwater impacted by COCs at concentrations greater than cleanup levels are present at the three groundwater depth intervals within the HCIM Area. Impacted groundwater is also present throughout the HCIM Area, including the facility and the TASCO, Aronson, and SAD properties. The different COC classes defined above generally co-exist in groundwater distributed over most of the HCIM Area. Therefore, the nature and distribution of groundwater constituents does not provide a basis for defining groundwater remediation areas.

Site investigation data indicate that DNAPL is likely present within two portions of the HCIM Area. The areas considered most likely to be impacted by DNAPL, based on groundwater constituent concentrations exceeding 1% of the TCE solubility include the North Field area and portions of the TASCO property and the area North East of the SAD property. DNAPL is likely present in the silt layers of the interbedded sand and silt aquifer down to the Silt Aquitard. The DNAPL distribution within the HCIM Area subsurface is characterized as predominantly a ganglia-type DNAPL and, therefore, cannot be readily remediated to attain cleanup levels, as discussed previously. Due to the high dispersion of DNAPL and the significant depth of the impacted groundwater zone, it is expected that DNAPL and its dissolved components will remain beneath the HCIM Area for a very long time. Therefore, it will be necessary to maintain institutional controls over essentially all of the HCIM Area for an extended period of time. Based on this distribution, a single HCIM Groundwater Remediation Area has been created, as shown on Figure 4-2.

Access to the HCIM Area is reasonably available. Most of the property within the HCIM Area is owned by PSC and is not actively used. The two small areas extending onto the Aronson and SAD properties are covered by an easement. Land use over the Aronson and SAD areas is for parking and/or equipment storage, which would not significantly affect access needed for remediation. Therefore, access and land use considerations would not affect remedial action, and do not provide a basis for defining groundwater remediation areas inside the HCIM Area.

The existing pavement and microsilica concrete cap improve the effectiveness of the HCIM, but would not significantly affect implementation of remedial action. These site features and the HCIM components must be taken into consideration for development and evaluation of remediation alternatives.

5.0 OUTSIDE AREA REMEDIATION CONSIDERATIONS

Remedial alternatives for the Outside Area must address many complex issues. The considerations for different portions of the Outside Area are discussed in the following subsections based on current and projected future land use, property ownership and access, existing interim measures, and technical considerations. Based on these considerations and the nature and distribution of Site constituents within impacted soil and groundwater, remediation areas are defined for soil and groundwater within the Outside Area.

5.1 HISTORIC AND FUTURE LAND USE

The Outside Area is a densely developed urban area that includes private and public landowners. Land uses are varied and include residences and both commercial and industrial businesses. Many active subsurface utilities are also present in this area.

The Outside Area incorporates properties neighboring the facility, including UPRR (to the east of the PSC property), SAD (to the southwest of the PSC property), and Aronson (to the north of the PSC property). The Outside Area also includes areas extending west of Denver Avenue South. As noted previously, the properties adjacent to the facility are zoned General Industrial 1 (IG1), which allows the heaviest degree of industrial use and typically relies on rail and marine transportation. This zoning is consistent with historical ownership and the industrial use of the neighboring properties. The area west of Denver Avenue South and extending to Fourth Avenue South is zoned General Industrial 2 (IG2), which allows mixed industrial and commercial use that does interfere with industrial use. These areas are described further below.

5.1.1 UPRR (Argo Yard)

The UPRR property has been industrially developed as an operating railroad and active rail yard since 1915, as noted in the Off-site Soil Characterization Report (Geomatrix, 2006). Historical information showed other uses of the UPRR property including: equipment storage or parking area at the south end of the property, a truck maintenance facility at the southwest corner of the property, an equipment wash area, freight sheds (associated with the railroad), and two lumberyards that extended partially onto the current PSC property, and shingle staining building that was in place from 1943 to 1946 until it burned down.

5.1.2 SAD (710 South Lucile Street)

The SAD property was residential until approximately 1965, according to several Sanborn maps and aerial photographs. It has been developed as light industrial/commercial since 1965. There is one building located on the property and it abuts the PSC facility along the property boundary. In 2003, a sub-slab depressurization system was installed in the building as part of the inhalation pathway interim measure described later in this section.

5.1.3 Aronson (5300 Denver Avenue South)

The Aronson property was residential until approximately 1952, based on several Sanborn maps and aerial photographs. This property has, since 1952, been developed as a light industrial/commercial property used as a warehouse and service facility.

5.1.4 Area West of Denver Avenue South

The area west of Denver Avenue comprises most of the SWFS area. The Georgetown neighborhood west of Denver Avenue South was predominantly residential until the 1970s, when industrial development of the area increased substantially. Aerial photos from the 1970s and 1980s show that many houses were replaced by larger industrial and commercial buildings during this period. The neighborhood continues today to be a mixture of industrial, commercial, and residential use with several major urban transportation corridors running through it.

Given the long history of mixed use within the Outside Area and present zoning, it is expected that the long-term future uses of the Outside Area will remain heavy industrial immediately adjacent to the facility and mixed use in the areas further west. Therefore, the future land uses that will be considered by the SWFS for the Outside Area will be limited to industrial activities on the properties neighboring the facility and all activities, including residential, on the properties west of Denver Avenue South.

5.2 LAND OWNERSHIP

Except for the TASCO property, PSC does not own any properties within the Outside Area. Properties within this area have numerous owners, including both public and private parties. The large number of independent property owners and tenants significantly complicates gaining property access to perform remediation. Access agreements typically require extended negotiations, significantly increase costs, and prevent timely implementation of any remedial action requiring extensive access to the properties.

As described in the previous section, the Outside Area includes the neighboring UPRR property. PSC has previously leased and used a portion of the UPRR property immediately adjacent to the east side of the PSC property. This lease agreement is still in effect and could be used to facilitate remedial action within the leased area. No other access agreements are currently in place for other properties within the Outside Area.

5.3 CONSTITUENT DISTRIBUTION

Soil and groundwater in the Outside Area have been impacted by releases from the facility. Data presented in the RI report indicate that natural degradation and attenuation of groundwater COCs is active within the groundwater plume downgradient of the facility. Due to the nature and extent of affected groundwater, the complexity in gaining access for remediation, and the potential presence of co-mingled plumes originating from other sources, natural attenuation or enhanced natural attenuation of groundwater constituents is expected to be a significant component of the remediation approach. Therefore, remediation technologies are assessed and judged as to their respective abilities to enhance, or at least not interfere with, areas where natural attenuation is effectively reducing the concentrations of the most critical COCs. The constituent distribution in this area has been previously described; relevant information concerning the distribution of hazardous constituents within the Outside Area and how they may affect remediation areas are described in the following subsections.

Most of the soil within the Outside Area has not been affected by facility releases. The impacted soil areas are either on or adjacent to the facility. The largest impacted soil area is located on UPRR property adjacent to the facility property boundary. This area is described in detail in the Offsite Soil Investigation Report. Figure 9-1 from the Offsite Soil Investigation Report identifies the area along the facility property line with UPRR that appears to have been impacted by facility releases. Distribution of specific constituent groups and how they affect remediation areas are described in the following subsections.

5.3.1 Soil

The data used to assess soil constituents include soil analytical data from the RI report and the Offsite Soil Investigation Report. Only soil samples collected in close proximity to the facility and above 15 feet bgs were evaluated to assess soil contamination for this SWFS; COCs present in the saturated zone are addressed in the SWFS as a groundwater issue.

5.3.1.1 VOCs

A variety of VOCs have been detected in soil samples collected in the Outside Area. The detected volatiles include BTEX, chlorinated ethenes, chlorinated ethanes, chlorinated methanes, ketones, and aromatic compounds. BTEX and chlorinated ethenes are the primary VOCs of concern. The highest concentrations of BTEX appear to be primarily limited to areas within approximately 20 feet of the facility/UPRR property line. In the area north of the former North field, BTEX compounds exceed clean-up levels although at generally lower concentrations than along the property line. Chlorinated VOCs are also found in areas within approximately 20 feet of the facility/UPRR property line at concentrations well above cleanup levels. Chlorinated VOCs extend eastward; however, the concentrations are orders of magnitude lower and the exceedances are primarily limited to shallow depths.

The portion of the Outside Area between the SAD building and the barrier wall on the facility is highly impacted with VOCs known to be present on the facility in the HCIM Area, and this potentially extends beneath the SAD building. The full extent of impacted soil in the vicinity of the SAD building is not possible to delineate due to the building constraints, but based on improving groundwater quality downgradient of this area, it is unlikely to extend much farther beyond the PSC property line (PSC, 2006b).

5.3.1.2 SVOCs

A fairly broad variety of SVOCs have been detected in soil samples collected in the Outside Area. Light PAHs, heavy PAHs, Phenols, Phthalates, and other SVOCs (such as 1,2-dichlorobenzene) have all been detected at various locations and depths in the Outside Area. The distribution of SVOCs appears to be similar to the VOCs. The highest SVOC concentrations generally coincide with the location of the soil VOCs that exceed cleanup levels.

5.3.1.3 PCBs

PCBs have been detected at concentrations exceeding cleanup levels in soil samples in the Outside Area. Elevated concentrations have generally been detected in the upper 2 feet of soil, decreasing with depth. The highest concentrations in the Outside Area have been detected in samples collected between the barrier wall and the SAD building, and near the facility/UPRR property boundary south of the former North Field, but this area has not been investigated farther north.

5.3.1.4 Inorganics

Inorganics have been detected in soil samples in the Outside Area. Several inorganic exceedances were identified near the facility/UPRR property boundary at relatively high concentrations: a copper hot spot near the property boundary south of the former North Field, a zinc hot spot north of the former North Field, and lead hot spots near the property boundary south of the former North Field and north of the former North Field. These highest concentrations of inorganics are generally found in the upper 5 feet of soil. The sporadic metals exceedances throughout the Outside Area indicate that impact may be associated with filling, possibly related to the presence of slag in the fill.

5.3.1.5 TPH

TPH and Stoddard solvent have been detected in soil samples in the Outside Area. The highest TPH concentrations that are likely related to a release from the facility are primarily found within 20 feet of the facility/UPRR property boundary south of the jog in the property line. Impacted soil north of this area is less consistent and there does not appear to be a correlation to facility historical use. TPH was also detected at elevated concentrations in the area between the barrier wall and the SAD building.

5.3.2 Groundwater

The distribution of COCs in groundwater in the Outside Area was discussed in Section 4 of Technical Memorandum 1. This distribution was identified by reviewing the RI report and subsequently collected analytical data for the water table, shallow, intermediate, and deep depth intervals.

Groundwater COCs were detected in samples throughout the Outside Area at various depths. Due to the large number of COCs identified in the Outside Area, indicator COCs are identified in Technical Memorandum No. 1 based on the constituent toxicity, persistence, mobility in the environment, thoroughness of testing, frequency of detection, and potential for generating hazardous degradation products. Indicator COCs are identified for the SWFS so that fate and transport analyses and remedial alternatives that comprehensively address Site COCs can be evaluated efficiently. The indicator COCs are used to assess constituent distribution in the Outside Area. The distribution of groundwater COCs was considered separated for the water table depth interval, shallow/intermediate depth intervals, and the deep aquifer.

5.3.2.1 Water Table Depth Interval

The water table depth interval has been impacted by VOCs, SVOCs, and metals. Based on groundwater data, metals concentrations exceed cleanup levels over the entire Outside Area. Groundwater has been impacted by VOCs over much of the Outside Area, and SVOCs exceed cleanup levels over about a third of the Outside Area. The impacted portions of the Outside Area where these three classes of constituents exceed cleanup levels are shown on Figure 5-1.

VOCs were detected at concentrations exceeding cleanup levels over a significant portion of the Outside Area, extending downgradient to between Third and Fourth Avenue South, as shown on Figure 5-1. . The highest VOC concentrations were found in the area immediately east of the SAD property. Additionally, the area along and just to the southwest of Denver Avenue South has been impacted with VOCs well above cleanup levels. This area has been affected by both chlorinated and non-chlorinated VOCs. In general, the groundwater downgradient from the Denver Avenue area has cleanup level ratios less than 2, with localized exceptions.

The portion of the water table depth interval impacted by SVOCs at concentrations exceeding cleanup levels is significantly smaller than the area impacted by VOCs, as shown on Figure 5-1. Much of this area coincides with the VOC impacted area, but SVOCs extend to the north and southeast of the VOC impacted area. The areas more highly impacted by SVOCs are located near the facility, extending to the area around Denver Avenue South. Thus, the area impacted by higher concentrations of SVOCs coincides with the location of the higher VOC concentrations.

Additionally, chlorinated ethenes were detected during the HCIM preliminary investigation in the water table east of the barrier on the UPRR property. Chlorinated ethenes, BTEX, and aromatic VOCs were detected north of the barrier wall on the UPRR property. Data are not available for all COCs east and north of the HCIM Area since limited sampling has been conducted in these areas.

5.3.2.2 Shallow/Intermediate Depth Intervals

Due to similarities in observed groundwater concentrations, the shallow and intermediate depth intervals have been combined. Impacted groundwater that exceeds cleanup levels extends over most of the Outside Area. Constituents identified in these depth intervals include VOCs, SVOCs, metals, and 1,4-dioxane. The areas impacted by these constituents at concentrations exceeding cleanup levels are shown on Figure 5-2. As noted for the water table depth interval, metals exceed cleanup levels over the entire Outside Area. SVOCs exceed cleanup levels in a limited area located relatively near the facility; VOCs and 1,4-dioxane impacted areas extend downgradient to fourth Avenue South.

The distribution of VOCs found in the shallow/intermediate intervals shows two "lobes" that extend downgradient from the HCIM Area. These lobes are primarily based on VC concentrations, and appear to extend downgradient from the two DNAPL areas identified for the HCIM Area. The most significant VOCs detected in these depth intervals are the chlorinated VOCs; concentrations for non-chlorinated VOCs are relatively low. The most highly impacted area for VOCs is immediately east of the SAD property. The next higher area in these depth intervals extends from the HCIM barrier wall to the area near Denver Avenue South. This area generally coincides with the more highly impacted area in the water table depth interval.

The area within the shallow and intermediate depth intervals impacted by SVOCs is substantially smaller than the impacted area in the water table depth interval. This area generally underlies the similarly impacted area in the water table depth interval. This area generally extends downgradient from the HCIM Area to the area near Denver Avenue South, as shown in Figure 5-2. A small lobe of SVOC-impacted groundwater in the center of the SWFS Area extends to the area near the intersection of Maynard Avenue South and South Lucile Street. The more highly impacted portions of this area are mostly located between the HCIM Area and Denver Avenue South.

The distribution for 1,4-dioxane is different from all other COCs. Based on available data, 1,4-dioxane appears to be present within an area extending downgradient from about the southwest side of Denver Avenue South to Fourth Avenue South; concentrations of 1,4-dioxane in the area immediately downgradient of the HCIM Area are below cleanup levels (see Figure 5-2). Thus, 1,4-dioxane appears to be present as a detached plume. The highest detected concentrations of 1,4-dioxane are located west of Maynard Avenue South.

5.3.2.3 Deep Aquifer

Based on historical data, groundwater in the deep aquifer has been impacted by VOCs, SVOCs, TPH, and metals. However, recent monitoring data for the VOCs show a decreasing trend, with all chlorinated VOCs below surface water cleanup levels; the highest concentrations were found during early sampling of the wells, shortly after well construction. The chlorinated VOCs currently exceed only cleanup levels based on drinking water. Deep aquifer groundwater exceeded cleanup levels for TPH and SVOCs in only one well. Metals have been found to exceed cleanup levels in all deep aquifer wells, including the upgradient wells. Therefore, it is expected that deep aquifer groundwater exceeds cleanup levels throughout the SWFS Area.

5.4 NON-PSC SOURCE AREAS

Characterization data presented in the RI report indicate that the plume emanating from releases that occurred at the facility intermingle with other plumes originating from non-PSC source areas downgradient of Fourth Avenue South. Many of the constituents detected in these non-PSC plumes are the same as those released from the facility and include TCE and its breakdown products. The presence of these downgradient source areas further complicates the remediation of the facility releases. Based on discussions with Ecology, the scope of the SWFS has been limited to the SWFS Area, which is hydrogeologically upgradient of Fourth Avenue South. Limiting the scope to this area removes several non-facility source areas from this SWFS; however, groundwater characterization data collected between the facility and Fourth Avenue South appear to show that there may be other non-PSC source areas present within the scope of the SWFS.

The presence of the non-PSC sources can affect the quality of groundwater discharged to the Duwamish Waterway. As discussed in Technical Memorandum No. 1, groundwater remediation levels have been established for use in this SWFS. These remediation levels address only releases from the facility and were established to ensure that releases from the facility do not adversely affect surface water in the Duwamish Waterway. The remediation levels do not consider the presence of non-PSC source areas downgradient from the facility. Available groundwater monitoring data indicate that these remediation levels have already been attained for releases from the facility, thereby indicating that the facility releases do not adversely affect nearby surface water. Remedial alternatives considered for this SWFS will not consider any effects non-facility source areas would have on groundwater quality.

5.5 INTERIM MEASURES

One of the two primary exposure pathways of concern for the Outside Area is migration of VOCs in vapors released from affected groundwater. PSC is currently implementing IPIMs in several residences and businesses within the Outside Area. These IPIMs, which are described in detail in Technical Memorandum 3, will be maintained so that they may be combined with other remedial measures as appropriate to meet remedial objectives. It is not expected that the IPIMs will affect remediation of soil and/or groundwater within the Outside Area.

6.0 OUTSIDE AREA REMEDIATION AREAS

Remediation areas have been defined for soil and groundwater within the Outside Area. Delineation of remediation areas is based on consideration of the following:

- Nature of soil and groundwater constituents;
- Distribution of soil and groundwater constituents;
- Presence of NAPL;
- Site ownership; and
- Land use.

The specific nature and distribution of soil and groundwater constituents can affect remediation of an area. As an example, chlorinated VOCs such as TCE and its degradation products may be remediated differently from non-chlorinated such as BTEX. If both types of VOCs co-exist in the same area, the remediation methods considered must be capable of addressing both types of VOCs. The only interim measures that have been implemented within the Outside Area are the IPIM systems. These interim measures, which are described in detail in Technical Memorandum No. 3, are not expected to affect remediation activities and, therefore, are not considered for identifying remediation areas. Site ownership and land use within the Outside Area both significantly affect access needed to conduct remediation and locations where remediation can be conducted. Site ownership within the Outside Area also affects the effectiveness of institutional controls. These factors must be considered collectively to identify remediation areas.

Based on the previous remedial investigations conducted within the Outside Area and a general consideration of potentially applicable remediation methods, five general classes of COCs have been identified to facilitate identification of remediation areas. These COC classes are: VOCs (both chlorinated and non-chlorinated), SVOCs, PCBs, Inorganics (metals and cyanide), and TPH. Remediation areas are considered independently for impacted soil and groundwater.

6.1 SOIL REMEDIATION AREAS

Site investigations have identified limited portions of the Outside Area where soil has been impacted at concentrations exceeding final SWFS cleanup levels. Most of the soil within the Outside Area has not been affected by facility releases. The impacted soil areas are either on or adjacent to the facility. Since the impacted soil areas are located on heavy industrial areas, the presence of soil COCs exceeding final SWFS cleanup levels has been the only criterion used to identify soil remediation areas. Data presented in the Offsite Soil Investigation Report and the RI report, indicate that there are three general areas that have been impacted by COCs at concentrations exceeding final SWFS cleanup levels and that have been defined as remediation areas.

The first soil remediation area is located on UPRR property adjacent to the facility property boundary. This area is described in detail in the Offsite Soil Investigation Report. Figure 9-1 from the Offsite Soil Investigation Report identifies the area along the facility property line with UPRR that appears to have been impacted by facility releases. This area has been designated as a soil remediation area. For the SWFS, it will be designated as Outside Soil Remediation Area 1 (OSRA-1). Soil within OSRA-1 has been affected by several organic COCs, including VOCs (both chlorinated and non-chlorinated), SVOCs, TPH, paint thinner, metals, and PCBs. This area is used as a rail yard, and is adjacent to active rail lines. Remedial actions in OSRA-1 must be protective of rail lines, require property negotiations, and detailed planning to minimize adverse impacts to UPRR operations. OSRA-1 is shown on Figure 4-1

The second soil remediation area is located on facility property, southeast of the HCIM barrier wall. This area has been impacted by VOCs, metals, and PCBs. This area has been designated as Outside Soil Remediation Area 2 (OSRA-2) and is shown on Figure 4-1. Although located on PSC property, this area extends onto the utility easement along South Lucile Street. The utility easement may represent a constraint for some remediation technologies for this area.

The third Outside Area soil remediation area identified is located on facility property and extends onto SAD property. This includes soils between the barrier wall and the SAD building, soils beneath the SAD building, and soils extending to South Lucile Street and Denver Avenue South. Soils in this soil area are impacted by VOCs, SVOCs, TPH, metals, and PCBs. This soil remediation area has been designated as Outside Soil Remediation Area 3 (OSRA-3), as shown on Figure 4-1. This soil remediation area is constrained by the SAD building, the HCIM barrier wall, and utility easements along both South Lucile Street and Denver Avenue South. These two structures and easements will affect access to conduct soil remediation in this area.

6.2 GROUNDWATER REMEDIATION AREAS

Groundwater within much of the Outside Area has been affected by COCs at concentrations exceeding final SWFS cleanup levels. Substantial evidence has also been collected that almost all organic COCs are actively degrading and/or attenuating within the saturated zone. In general, groundwater COCs are highest in the area near the facility and decrease in concentration as groundwater moves downgradient, toward the Duwamish Waterway. Given the nature and extent of groundwater COCs within the Outside Area, it is appropriate to identify groundwater remediation areas. Based on the considerations identified above, three groundwater remediation areas have been defined for the Outside Area, as discussed below.

6.2.1 SAD Property Area

Based on the highest observed Outside Area COC concentrations in groundwater, the area located between the barrier wall and likely extending west and south, below the SAD property, groundwater remediation areas have been defined for the water table and shallow/intermediate depth intervals. These groundwater remediation areas have been designated as Outside Water Table Remediation Area 1 (OWTRA-1) and Outside Area Shallow/Intermediate Remediation Area 1 (OSIRA-1), as shown on Figures 6-1 and 6-2. These remediation areas are co-located within the area extending from the barrier wall west to Denver Avenue South and south to South Lucile Street. These remediation areas are co-located with soil remediation area OSRA-3. Groundwater within OWTRA-1 and OSIRA-1 has multiple groundwater COCs, including VOCs(both chlorinated and non-chlorinated), SVOCs, TPH, PCBs, and metals. Groundwater within OWTRA-1 has generally higher COC concentrations than groundwater within OSIRA-1. PSC can readily access this portion of these remediation area located on the upgradient portion of this area which is located on PSC property, remediation will be constrained by the SAD structures, the barrier wall, SAD site activities, and the utility easements along South Lucile Street and Denver Avenue South. Due to the proximity of this remediation to the SAD building and the likelihood that groundwater remediation would extend beneath their property, it is expected that SAD would need to approve remediation plans for both of these remediation areas prior to implementing remediation.

6.2.2 South Denver Avenue Area

Groundwater beneath the area located downgradient of the HCIM barrier wall and extending to the area near South Denver Avenue has been impacted by relatively high concentrations of VOCs and SVOCs, although this area is less impacted than the area near and beneath the SAD property. This area has been impacted by VOCs (chlorinated and non-chlorinated), SVOCs, TPH, and metals in the water table, shallow, and intermediate depth intervals. Remediation areas have been defined separately for the water table and the shallow/intermediate depth intervals. The water table remediation area has been designated as Outside Area Water Table Remediation Area 2 (OWTRA-2) and the shallow/intermediate remediation area has been designated as Outside Area Shallow/Intermediate Remediation Area 2 (OSIRA-2). Both remediation areas encompass properties owned by PSC, Aronson, SAD, the City of Seattle, and several property owners along the west side of Denver Avenue South. Remediation in these areas would be constrained by access issues due to the multiple property owners, current land use at these properties, and the presence of utilities beneath and along Denver Avenue South. These remediation areas are shown in Figures 6-1 and 6-2.

6.2.3 Remaining Outside Area

The remaining portion of the Outside Area groundwater extends from the area near Denver Avenue South downgradient to the westernmost extent of the SWFS Area, along Fourth Avenue South. This area is a heavily developed urban area with numerous and diverse property owners and several public roads. Due to the heavy urban development, number of property owners, and extensive network of underground utilities in this area, access issues related to remediation will be extremely complex. It should be noted that in the time since the facility source area has been contained by the HCIM, groundwater monitoring data within the Outside Area have shown a decreasing trend for most COCs, especially near the former facility. Remediation areas have been defined separately for the water table depth interval and the shallow/intermediate depth intervals based on different COCs and different cleanup levels.

The water table remediation area has been designated as Outside Area Water Table Remediation Area 3 (OWTRA-3). This area is shown in Figure 6-1 and covers the area extending from OWTRA-2 to Fourth Avenue South. The COCs present in this area include VOCs (primarily chlorinated), SVOCs, TPH, and metals. 1,4-dioxane has not been detected in this remediation area at concentrations exceeding cleanup levels.

The shallow/intermediate remediation area has been designated as Outside Area Shallow/Intermediate Remediation Area 3 (OSIRA-3), as shown on Figure 6-2. COCs present in this remediation include VOCs, SVOCs, TPH, and metals. This remediation includes the 1,4-dioxane plume that has been identified within the SWFS Area. Remediation of 1,4-dioxane requires different considerations than the other constituents.

6.2.4 Deep Aquifer

A separate remediation area has been designated for the deep aquifer. This remediation area is designated as the Deep Aquifer Remediation Area (DARA). This remediation area extends from the facility property boundaries to the area downgradient of the facility. Available data and observed trends indicate that organic COCs, including VOCs and SVOCs, may not exceed cleanup levels in the DARA. Metals concentrations exceed cleanup levels in the DARA; the same metals exceed cleanup levels in the area upgradient of the DARA. Remediation of the deep aquifer will be constrained by access and by the presence of impacted groundwater in the overlying water table, shallow, and intermediate depth intervals.

7.0 POTENTIALLY APPLICABLE REMEDIATION TECHNOLOGIES

The remediation technologies that may be applicable to the different soil remediation areas are listed in Table 7-1. The potentially applicable groundwater remediation technologies are listed in Table 7-2 for each groundwater remediation area.

8.0 REFERENCES

Geomatrix Consultants, Inc., 2006, Off-site Soil Characterization Report, in preparation.

Philip Services Corporation (PSC), 1998, Interim Measures Completion Report for the Soil Vapor Extraction System, May 13.

PSC, 2006, Quarterly Progress Report, January – March 2006, May.

TABLES

TABLE 7-1

SOIL TECHNOLOGY SCREENING

PSC Georgetown Facility
Seattle, Washington

Technology Characteristics		HCIM Area		Outside Area		
General Response Actions	**Remediation Technologies**	**Soil Remediation Area 1**	**Soil Remediation Area 2**	**Soil Remediation Area 1**	**Soil Remediation Area 2**	**Soil Remediation Area 3**
In Situ Biological Treatment	Bioventing	X		X	X	X
	Enhanced Bioremediation	X		X	X	X
In Situ Physical/Chemical Treatment	Chemical Oxidation	X		X	X	X
	Soil Flushing	X		X	X	X
	Soil Vapor Extraction	X		X	X	X
	Solidification/ Stabilization	X		X	X	X
	Steam Injection	X		X	X	X
Ex Situ Biological Treatment (assumes excavation)	Biopiles	X		X	X	X
Ex Situ Physical/Chemical Treatment (assumes excavation)	Soil Washing	X		X	X	X
Ex Situ Physical/Chemical Treatment (assumes excavation)	Solidification/ Stabilization	X		X	X	X
Ex Situ Thermal Treatment (assumes excavation)	Thermal Desorption	X		X	X	X
Containment	Cap/Surface Cover	X	X	X	X	X
Disposal (assumes excavation)	Off-Site Disposal	X		X	X	X
Institutional Controls	Deed Restrictions and Property Use Limitations	X	X	X	X	X

TABLE 7-2

GROUNDWATER TECHNOLOGY SCREENING

PSC Georgetown Facility
Seattle, Washington

Technology Characteristics		HCIM Area	Outside Area						
General Response Actions	**Remediation Technologies**	**Groundwater Remediation Area**	**Water Table Remediation Area 1**	**Water Table Remediation Area 2**	**Water Table Remediation Area 3**	**Shallow/Int. Remediation Area 1**	**Shallow/Int. Remediation Area 2**	**Shallow/Int. Remediation Area 3**	**Deep Aquifer Remediation Area**
In Situ Biological Treatment	Enhanced Biodegradation with Biosparging	X	X	X	X	X	X	X	X
	Oxygen Enhancement with Hydrogen Peroxide or ORC	X	X	X	X	X	X	X	X
	Co-Metabolic Treatment	X	X	X	X	X	X	X	X
	Reductive Dechlorination Biostimulation (Anaerobic)	X	X	X	X	X	X	X	X
	Bioaugmentation	X	X	X	X	X	X	X	X
	Natural Attenuation	X	X	X	X	X	X	X	X
In Situ Physical/Chemical Treatment	Phytoremediation	X							
	Air Sparging	X	X	X	X	X	X	X	X
	Chemical Oxidation	X	X	X	X	X	X	X	X
	Thermal Treatment	X	X	X	X	X	X	X	X
	In-Well Stripping	X	X	X	X	X	X	X	X

TABLE 7-2

GROUNDWATER TECHNOLOGY SCREENING

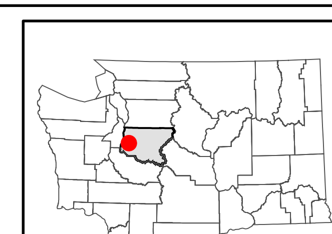
PSC Georgetown Facility
Seattle, Washington

Technology Characteristics		HCIM Area	Outside Area						
General Response Actions	**Remediation Technologies**	**Groundwater Remediation Area**	**Water Table Remediation Area 1**	**Water Table Remediation Area 2**	**Water Table Remediation Area 3**	**Shallow/Int. Remediation Area 1**	**Shallow/Int. Remediation Area 2**	**Shallow/Int. Remediation Area 3**	**Deep Aquifer Remediation Area**
In Situ Physical/Chemical Treatment (continued)	Dynamic Underground Stripping (DUS)	X	X	X	X	X	X	X	X
	Steam Enhanced Extraction	X	X	X	X	X	X	X	X
	Co-Solvent Flooding	X	X	X	X	X	X	X	X
	Surfactant-Enhanced Aquifer Remediation (SEAR)	X	X	X	X	X	X	X	X
	Passive/Reactive Treatment Walls	X	X	X	X	X	X	X	X
Ground Water Extraction/ Hydraulic Control	Ground Water Extraction (Pump and Treat)	X	X	X	X	X	X	X	X
Ex Situ Physical/Chemical Treatment	Air Stripping	X							
Ex Situ Physical/Chemical Treatment	Adsorption	X							
Physical Containment	Barrier Wall	X	X	X	X	X	X	X	X
Institutional Controls	Deed Restriction and Property Use Limitations	X	X	X	X	X	X	X	X

FIGURES

Explanation

- Barrier Wall
- Site Wide Feasibility Study Area
- Parcel Boundary
- Outside Soil Remediation Area 1
- HCIM Soil Remediation Area 2
- HCIM Soil Remediation Area 1
- Outside Soil Remediation Area 2
- Outside Soil Remediation Area 3



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SOIL REMEDIATION AREAS
PSC Georgetown
Seattle, Washington

By: jem | Date: 6/21/2006 | Project No. 8770

Geomatrix | Figure **4-1**

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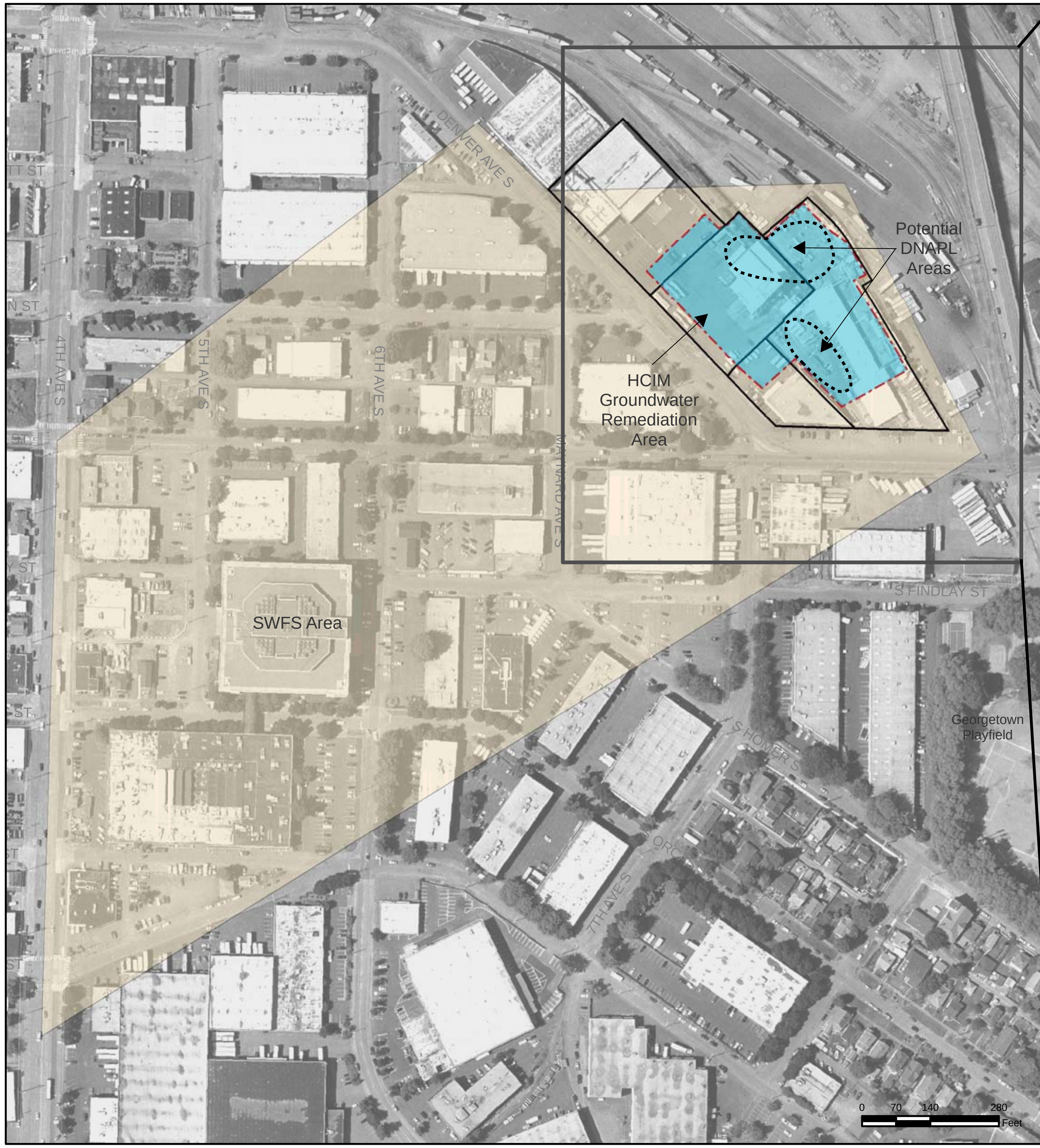

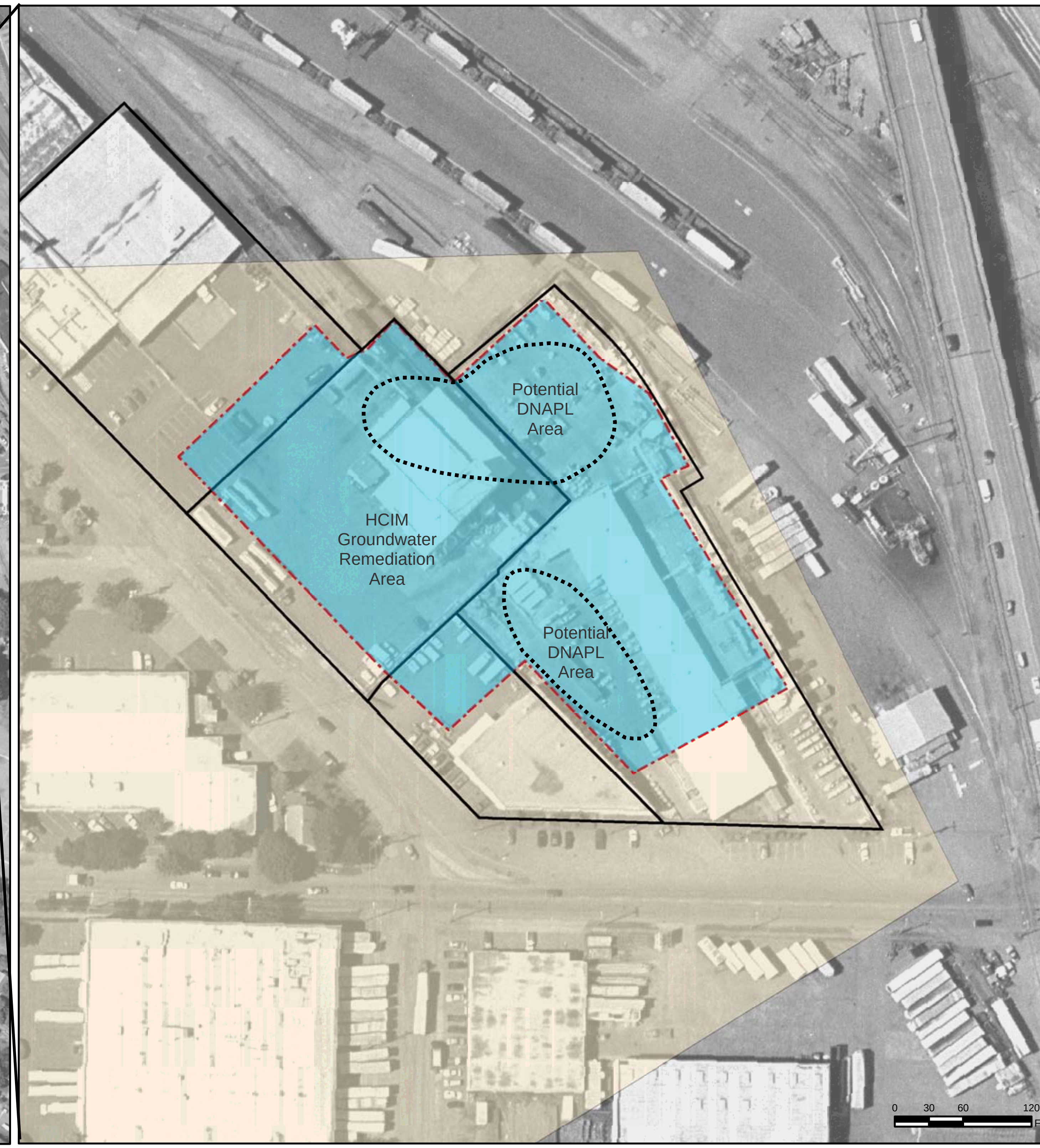

Explanation

- Barrier Wall
- Site Wide Feasibility Study Area
- Parcel Boundary
- HCIM Groundwater Remediation Area
- Potential DNAPL area

Washington

N

HCIM GROUNDWATER REMEDIATION AREA
PSC Georgetown
Seattle, Washington

By: jem	Date: 6/30/2006	Project No. 8770
Geomatrix		Figure 4-2

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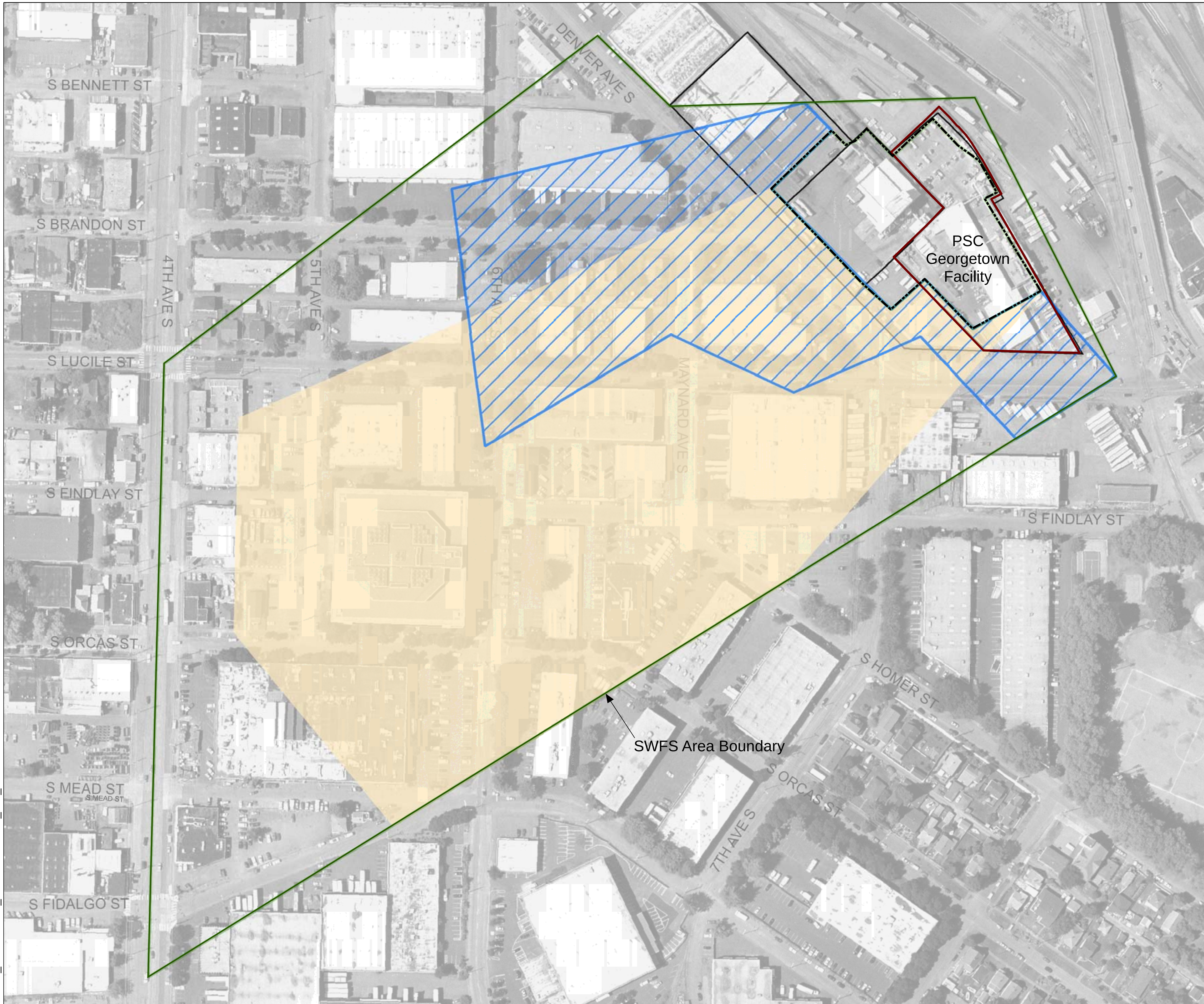

LEGEND:

- HCIM barrier wall
- Fence (from Goldsmith & Associates 3/05 survey)
- Parcel Boundary
- SVOC Area
- VOC Area
- Metals Area

Notes:
1. Cleanup levels, Source Site Wide Feasibility Study (GMX, 2006).
2. Base from 2002 King County Orthophotos.
3. Chlorinated VOCs based on VC, TCE, Toluene, PCE, cis-1,2-dichloroethylene and ethylbenzene sampling.
4. SVOCs based on bis(2-ethylhexyl)phthalate, cumene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and napthalene sampling.
5. Metals based on arsenic, barium, chromium, copper, iron, manganese and nickel sampling.

0 50 100 200 Feet

N

OUTSIDE AREA WATER TABLE
CONSTITUENTS OF CONCERN
PSC Georgetown Facility
Seattle, Washington

By: JEM	Date: 06/30/06	Project No. 8770
Geomatrix		Figure **5-1**

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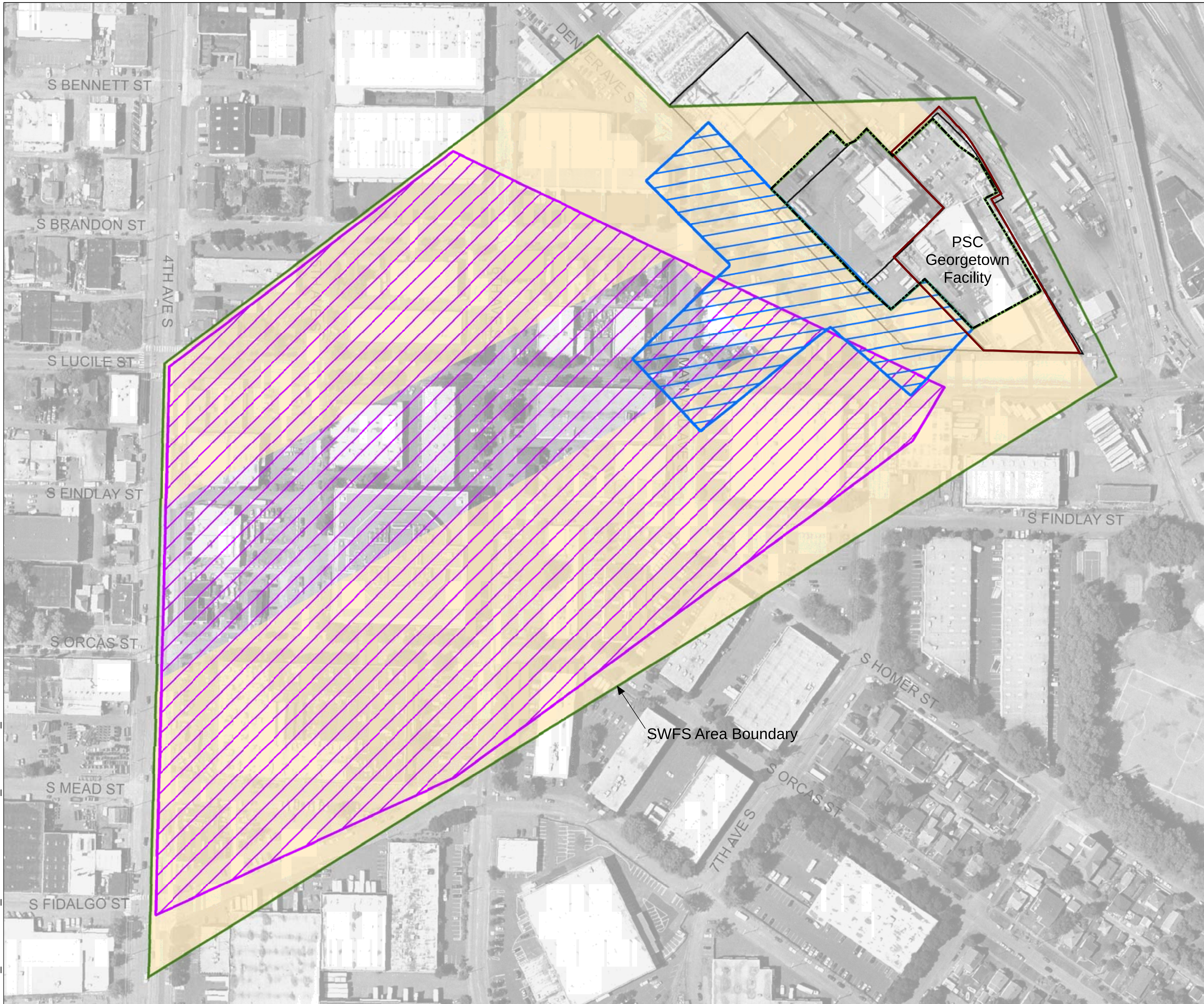

LEGEND:

- HCIM barrier wall
- Fence (from Goldsmith & Associates 3/05 survey)
- Parcel Boundary
- SVOC Area
- VOC Area
- 1,4 Dioxane Area
- Metals Area

Notes:
1. Cleanup levels, Source Site Wide Feasibility Study (GMX, 2006).
2. Base from 2002 King County Orthophotos.
3. Chlorinated VOCs based on VC, TCE, Toluene, PCE, cis-1,2-dichloroethylene and ethylbenzene sampling.
4. SVOCs based on bis(2-ethylhexyl)phthalate, cumene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and napthalene sampling.
5. Metals based on arsenic, barium, chromium, copper, iron, manganese and nickel sampling.

0 50 100 200 Feet

N

OUTSIDE AREA SHALLOW
AND INTERMEDIATE
CONSTITUENTS OF CONCERN
PSC Georgetown Facility
Seattle, Washington

By: JEM	Date: 02/12/06	Project No. 8770
Geomatrix		Figure 5-2

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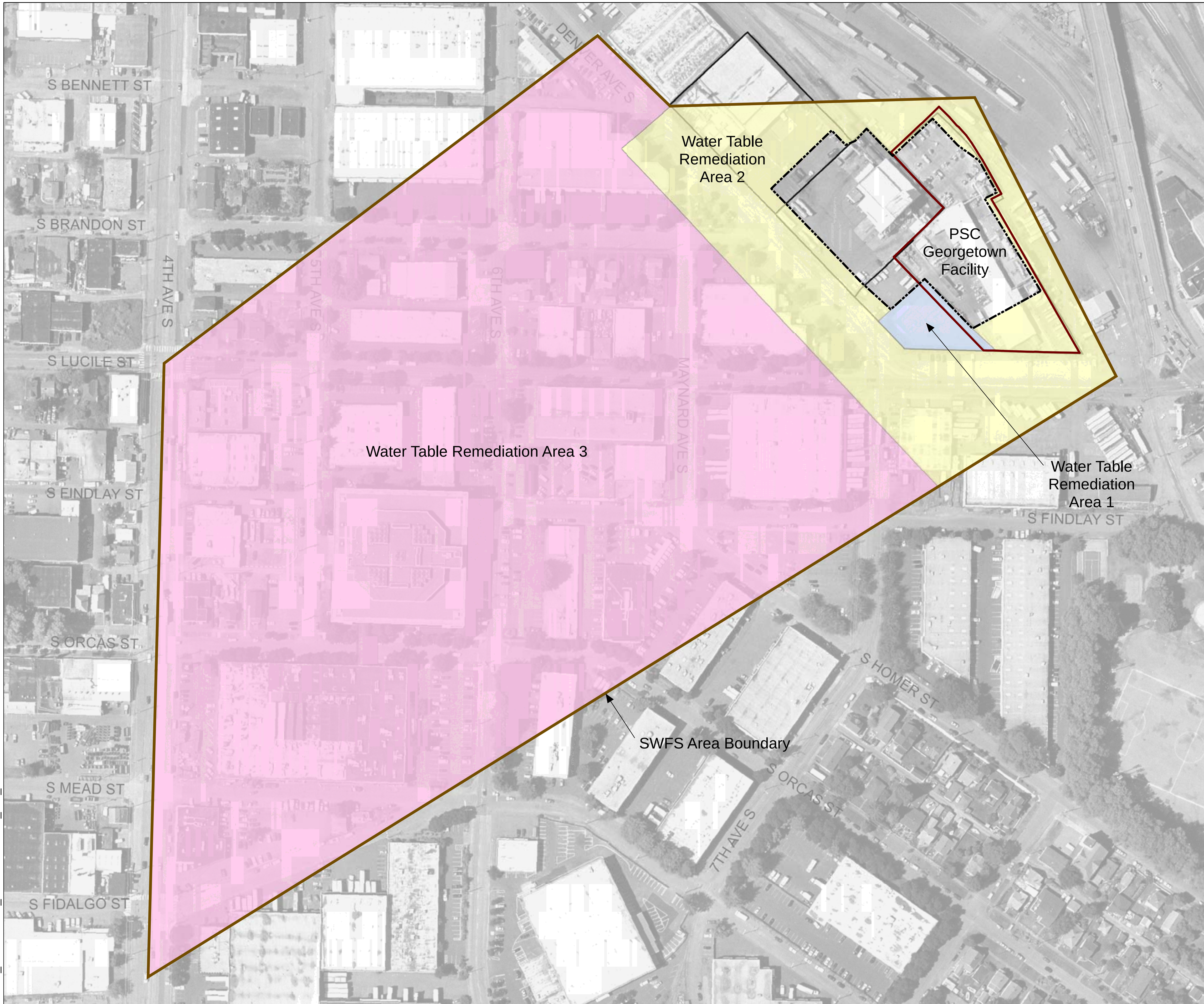

LEGEND:

- HCIM barrier wall
- Fence (from Goldsmith & Associates 3/05 survey)
- Parcel Boundary
- Water Table Remediation Area 1
- Water Table Remediation Area 2
- Water Table Remediation Area 3

Notes:
1. Cleanup levels, Source Site Wide Feasibility Study (GMX, 2006).
2. Base from 2002 King County Orthophotos.
3. Chlorinated VOCs based on VC, TCE, Toluene, PCE, cis-1,2-dichloroethylene and ethylbenzene sampling.
4. SVOCs based on bis(2-ethylhexyl)phthalate, cumene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and napthalene sampling.
5. Metals based on arsenic, barium, chromium, copper, iron, manganese and nickel sampling.

0 50 100 200 Feet

N

OUTSIDE AREA WATER TABLE REMEDIATION AREAS
PSC Georgetown Facility
Seattle, Washington

By: JEM	Date: 06/30/06	Project No. 8770
Geomatrix		Figure 6-1

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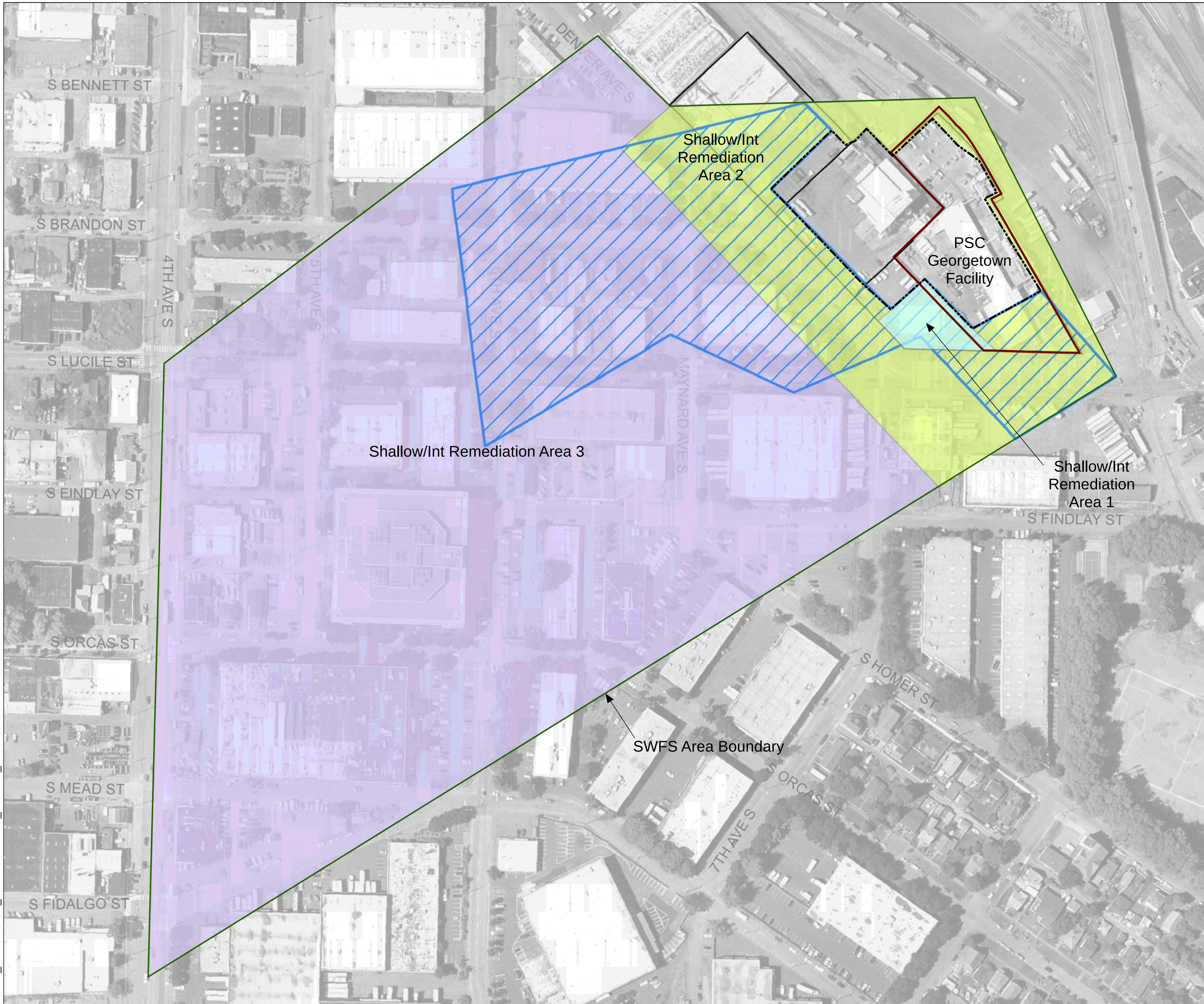

LEGEND:

- HCIM barrier wall
- Fence (from Goldsmith & Associates 3/05 survey)
- Parcel Boundary
- Shallow/Int Remediation Area 1
- Shallow/Int Remediation Area 2
- Shallow/Int Remediation Area 3
- SVOC Area

Notes:
1. Cleanup levels, Source Site Wide Feasibility Study (GMX, 2006).
2. Base from 2002 King County Orthophotos.
3. Chlorinated VOCs based on VC, TCE, Toluene, PCE, cis-1,2-dichloroethylene and ethylbenzene sampling.
4. SVOCs based on bis(2-ethylhexyl)phthalate, cumene, dibenzo(a,h)anthracene, indeno(1,2,3-cd)pyrene and napthalene sampling.
5. Metals based on arsenic, barium, chromium, copper, iron, manganese and nickel sampling.

0 55 110 220 Feet

N

OUTSIDE AREA
SHALLOW/INTERMEDIATE
REMEDIATION AREAS
PSC Georgetown Facility
Seattle, Washington

By: JEM	Date: 06/30/06	Project No. 8770
Geomatrix		Figure 6-2

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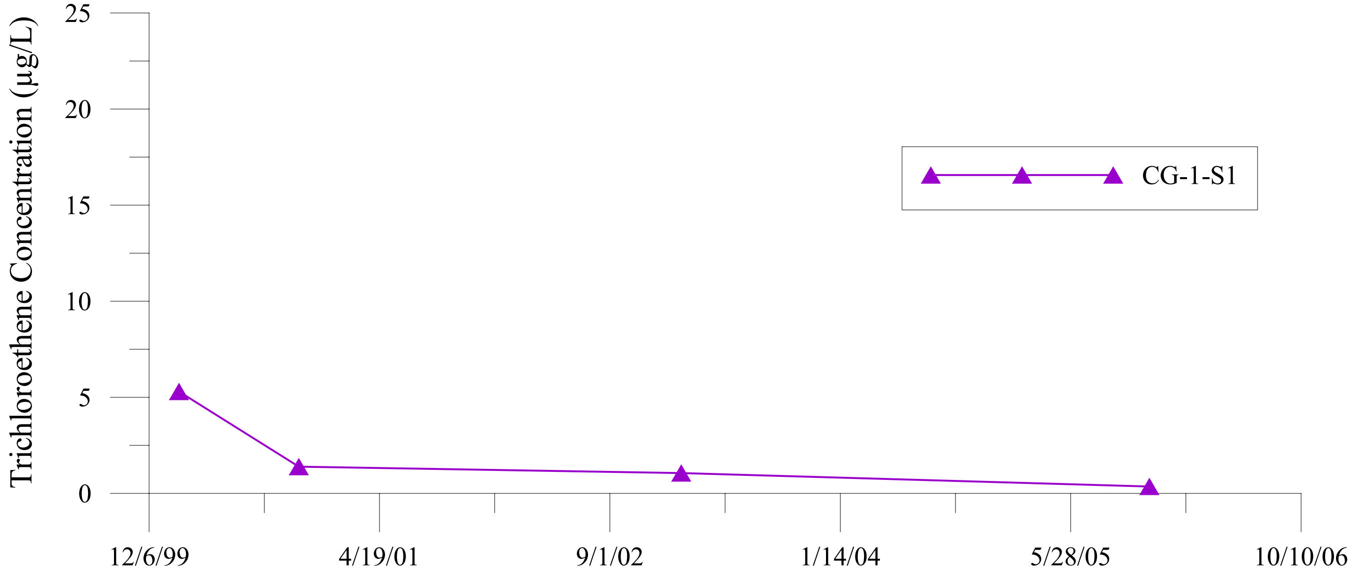
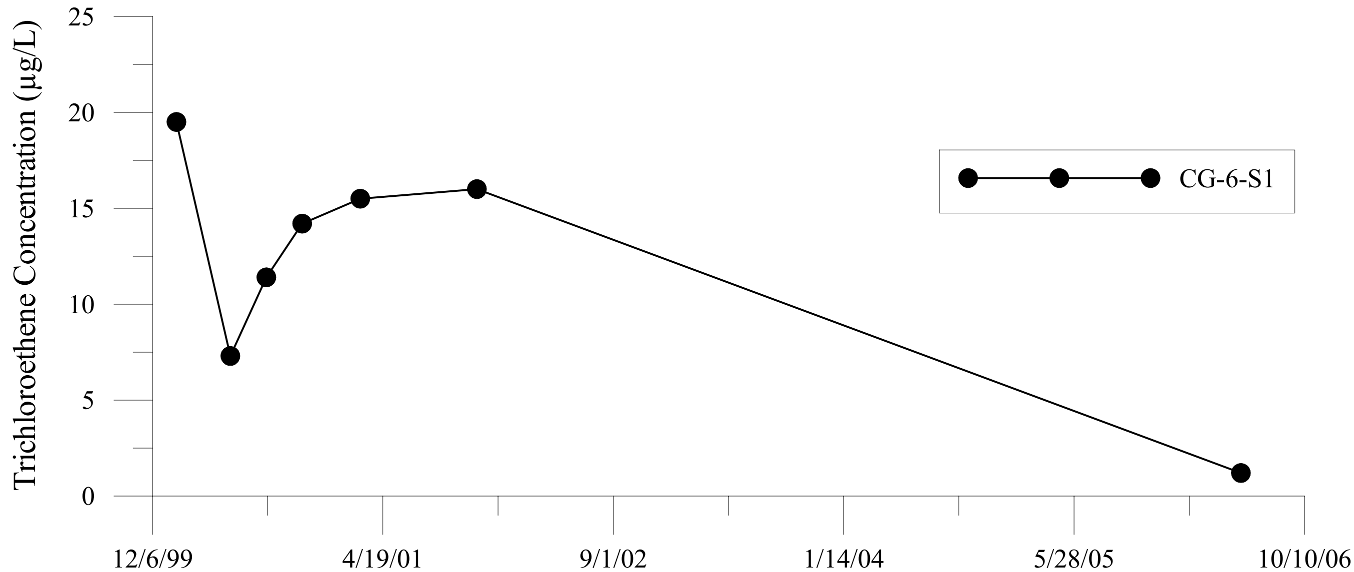
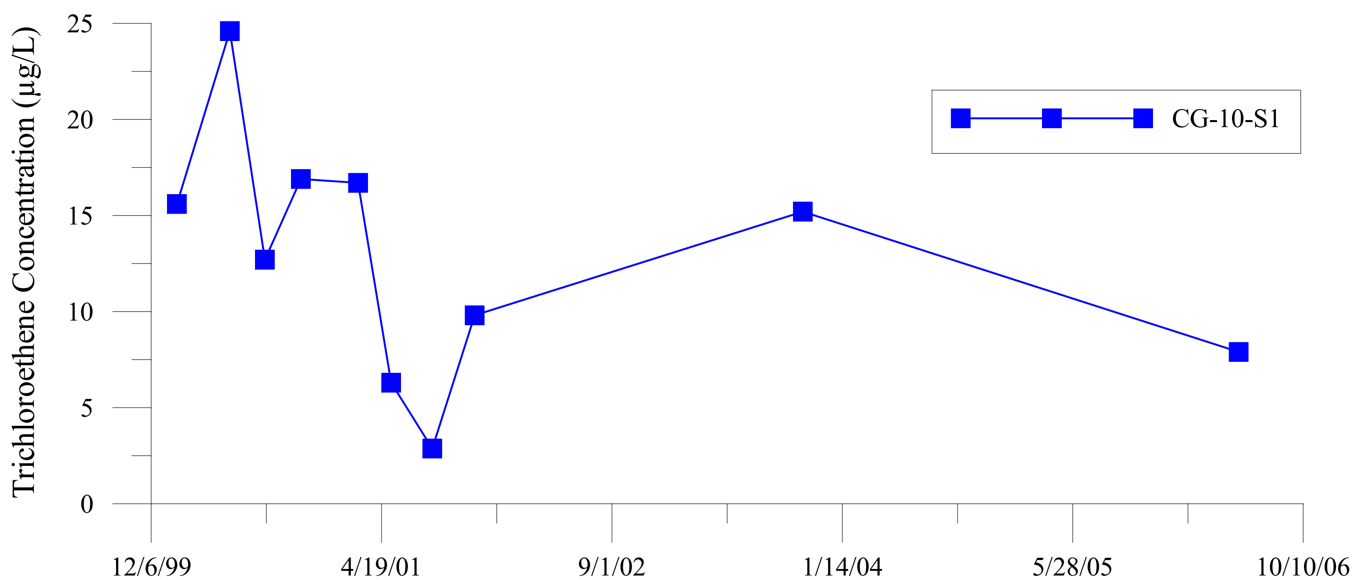
APPENDIX A

Trend Plots

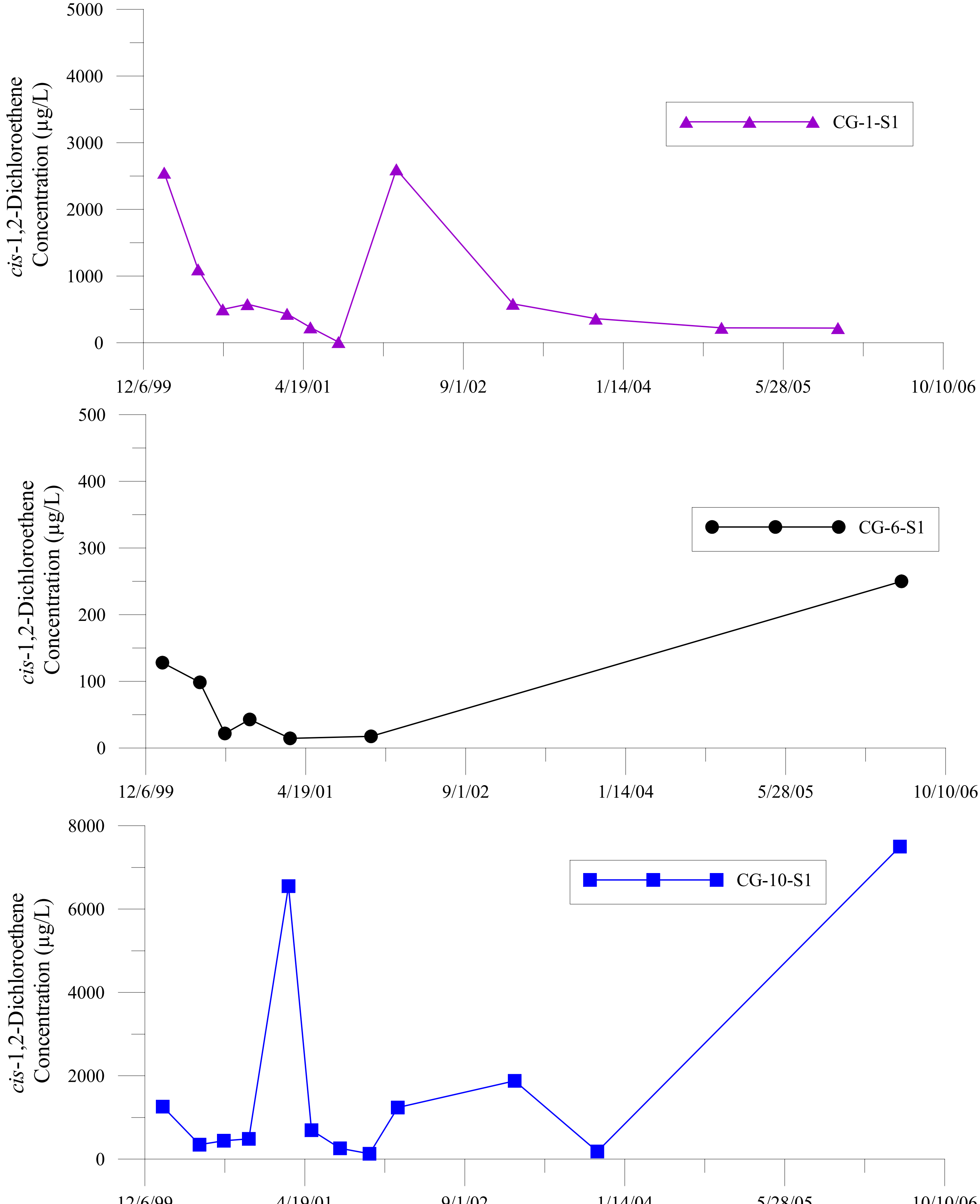






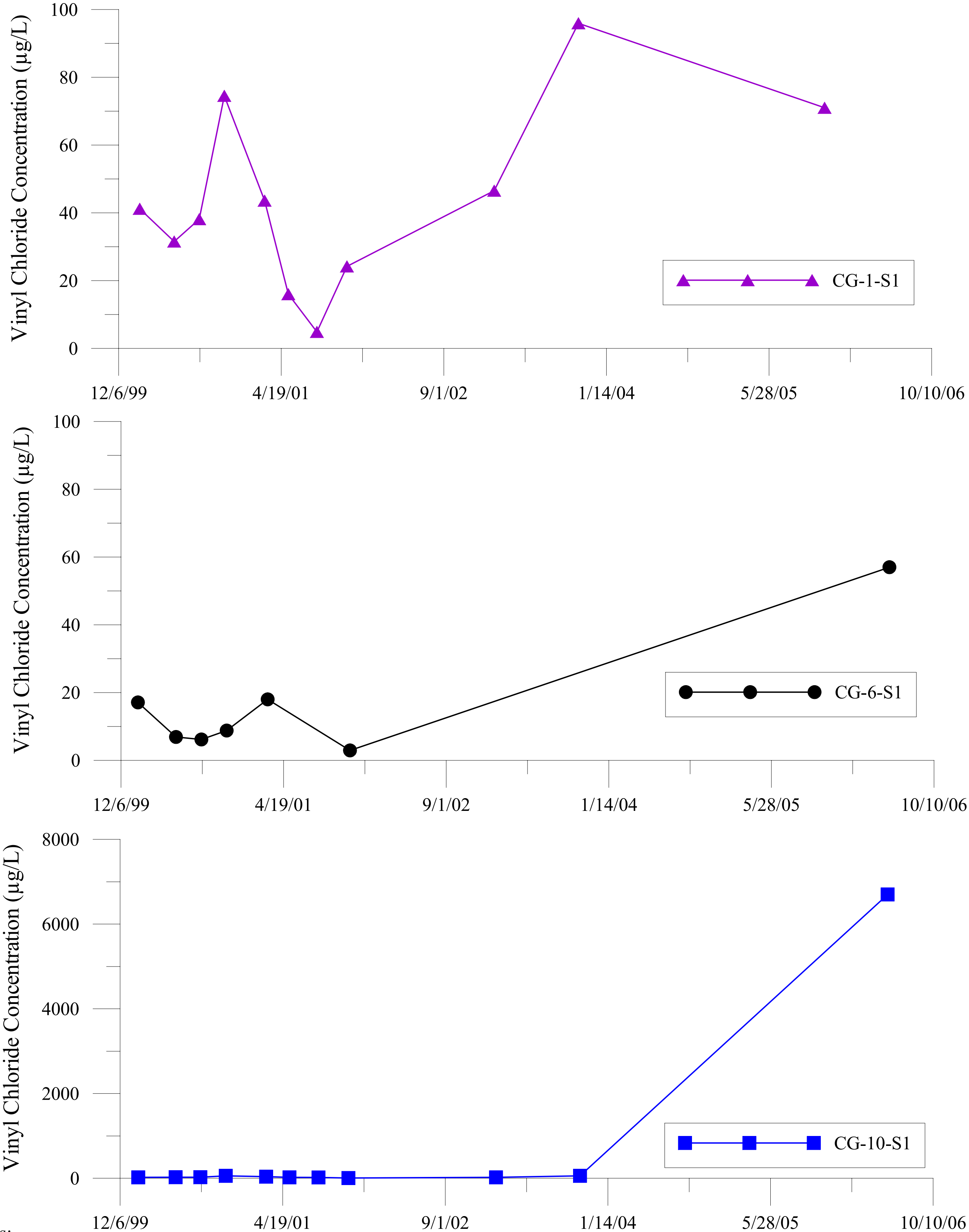
Notes:
Non-detect values excluded from plots.
Data from May 2006 sampling event are considered preliminary (unvalidated).

Geomatrix	**TRICHLOROETHENE CONCENTRATION TRENDS** **WATER TABLE INTERVAL - HCIM AREA** PSC Georgetown Seattle, Washington	Project No. 8770 Figure A-1



Notes:
Non-detect values excluded from plots.
Data from May 2006 sampling event are considered preliminary (unvalidated).

Geomatrix	***CIS*-1,2-DICHLOROETHENE CONCENTRATION TRENDS** **WATER TABLE INTERVAL - HCIM AREA** PSC Georgetown Seattle, Washington	Project No. 8770 Figure A-2



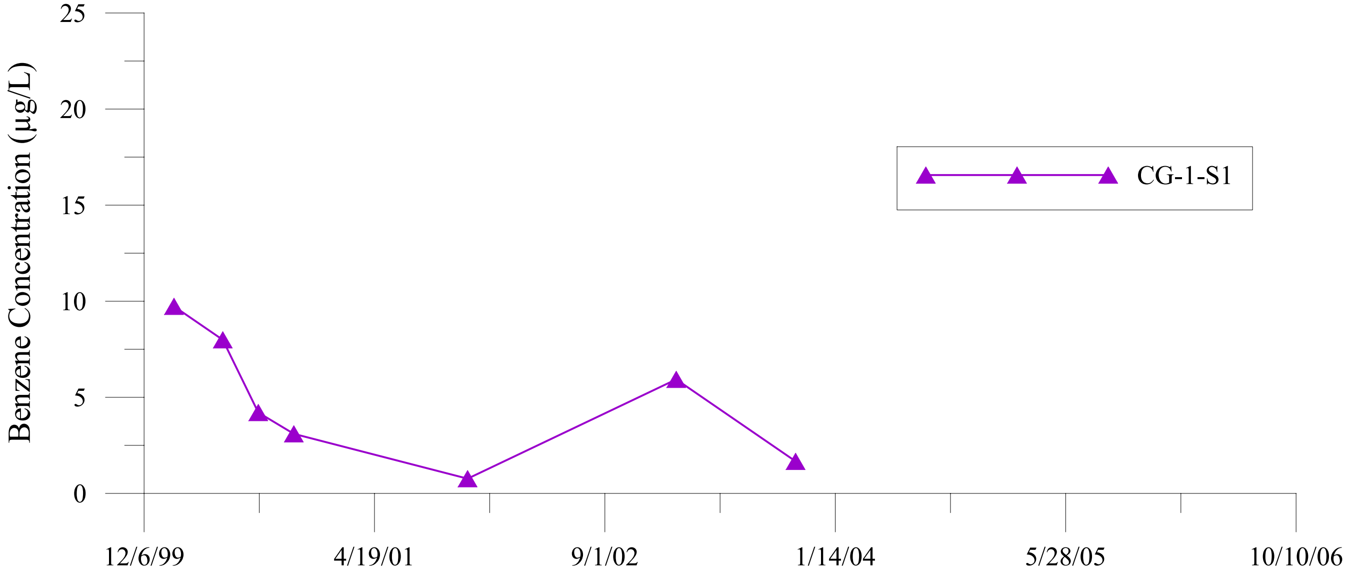
Notes:
Non-detect values excluded from plots.
Data from May 2006 sampling event are considered preliminary (unvalidated).

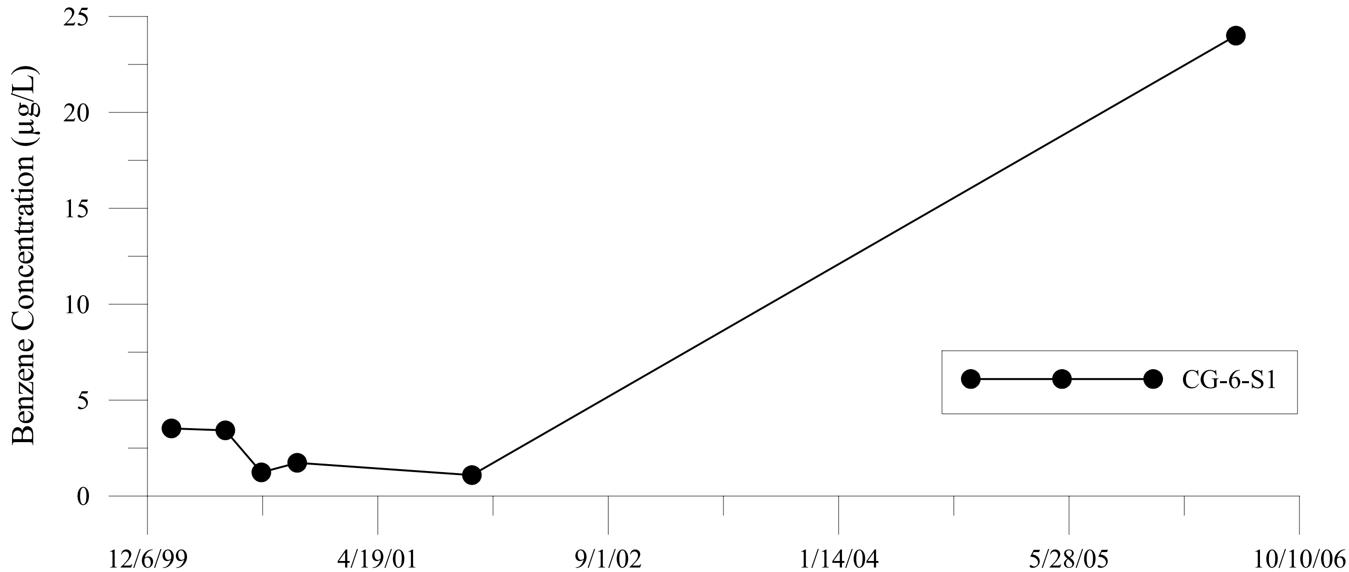
Geomatrix

VINYL CHLORIDE CONCENTRATION TRENDS
WATER TABLE INTERVAL - HCIM AREA
PSC Georgetown
Seattle, Washington

Project No. 8770

Figure A-3





Benzene was not detected at CG-10-S1

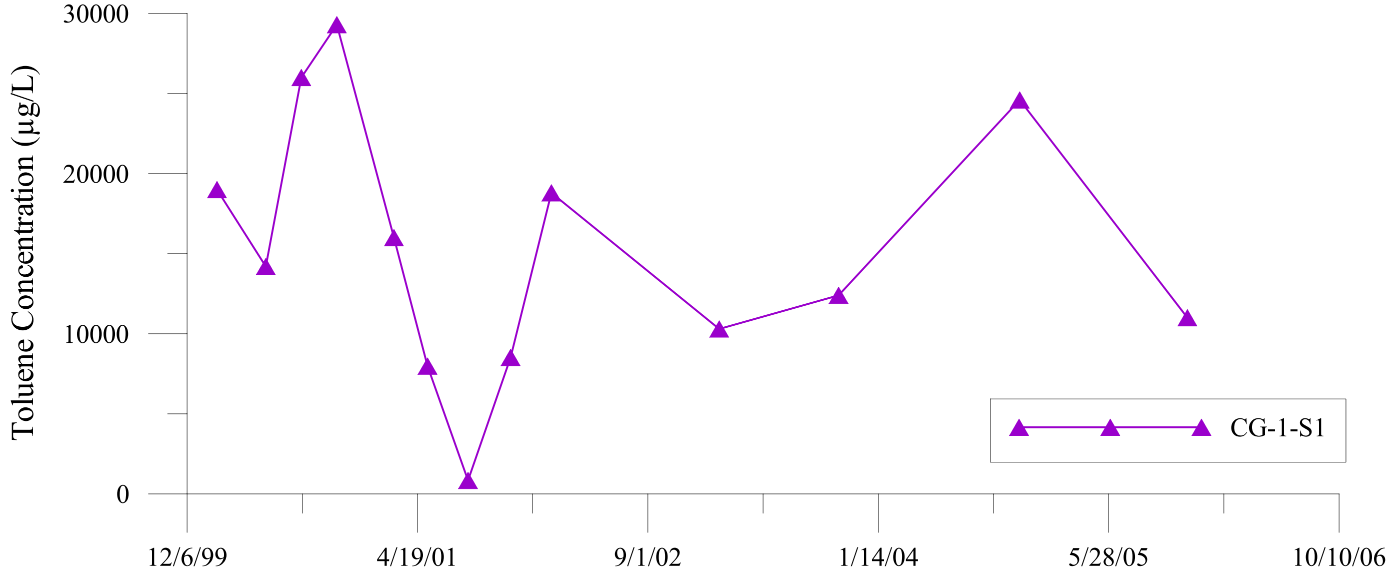
Notes:
Non-detect values excluded from plots.
Data from May 2006 sampling event are considered preliminary (unvalidated).

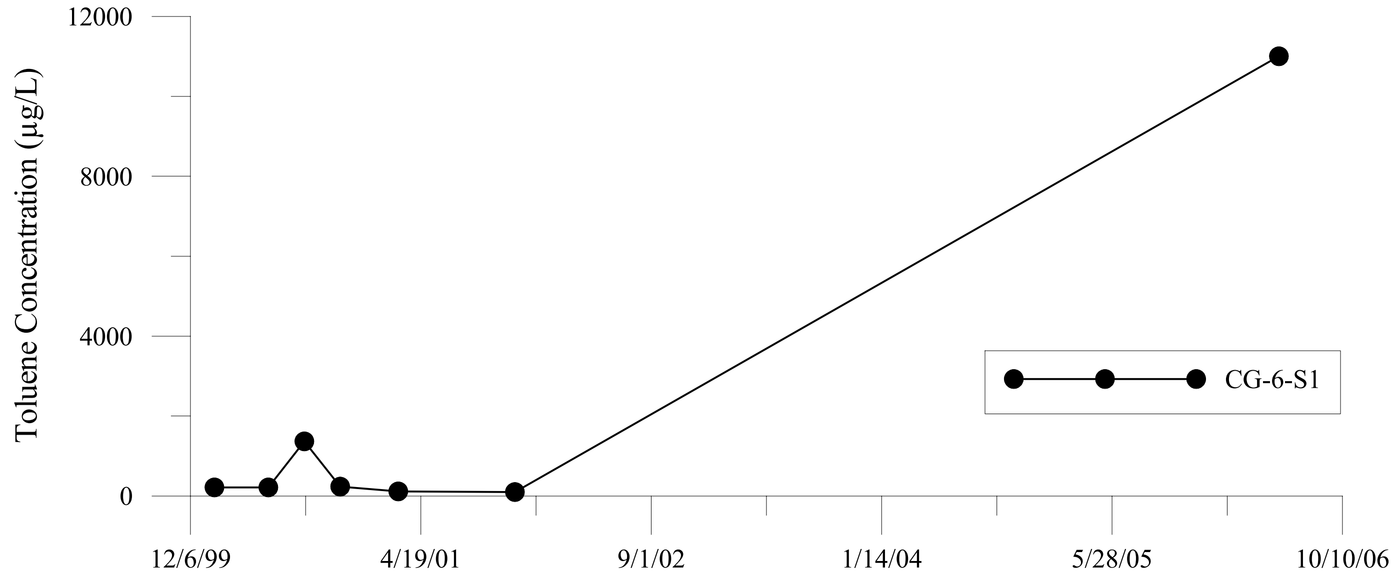
Geomatrix

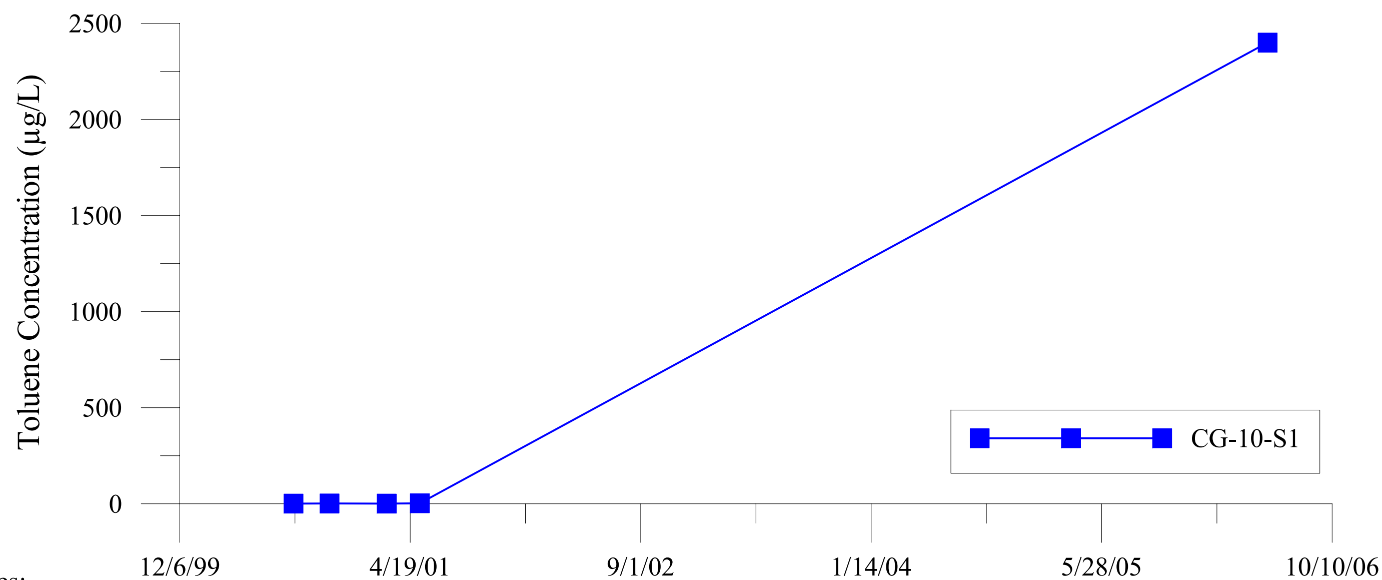
BENZENE CONCENTRATION TRENDS
WATER TABLE INTERVAL - HCIM AREA
PSC Georgetown
Seattle, Washington

Project No. 8770

Figure A-4

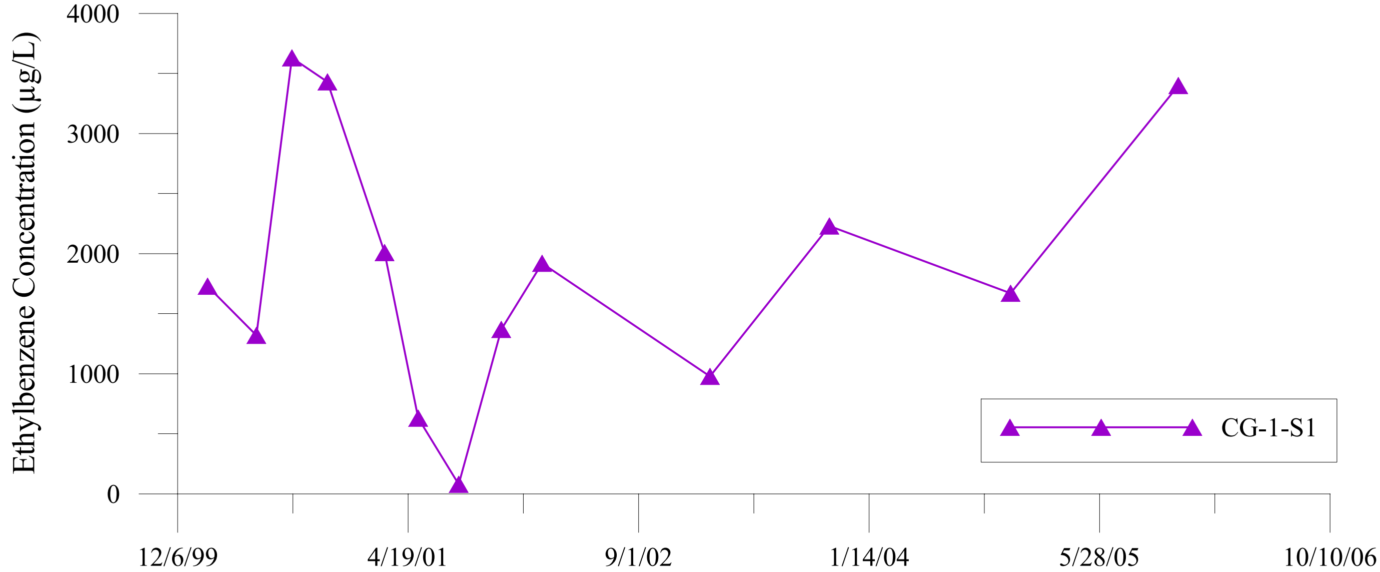


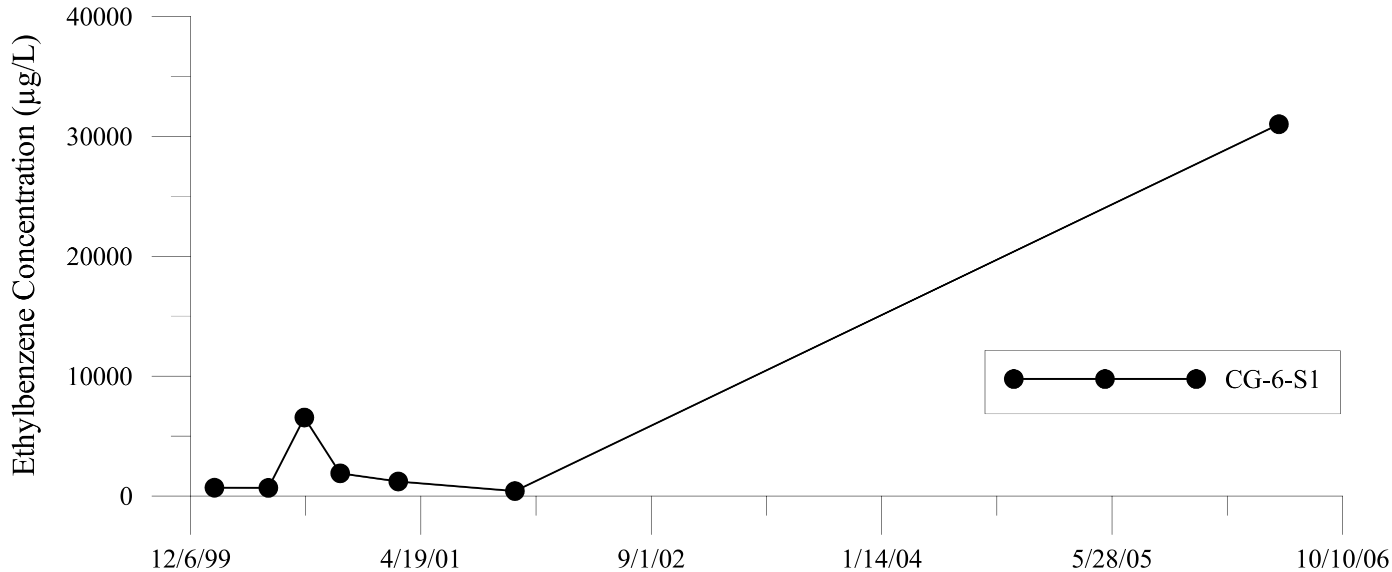


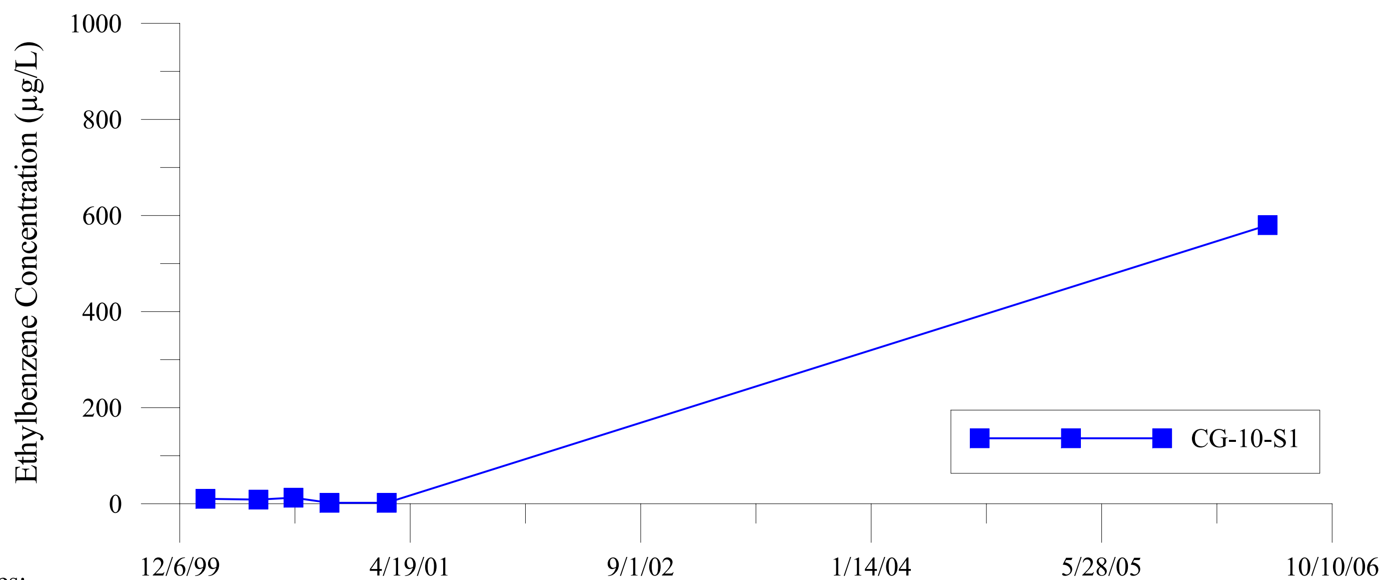


Notes:
Non-detect values excluded from plots.
Data from May 2006 sampling event are considered preliminary (unvalidated).

Geomatrix	**TOLUENE CONCENTRATION TRENDS** **WATER TABLE INTERVAL - HCIM AREA** PSC Georgetown Seattle, Washington	Project No. 8770 Figure A-5





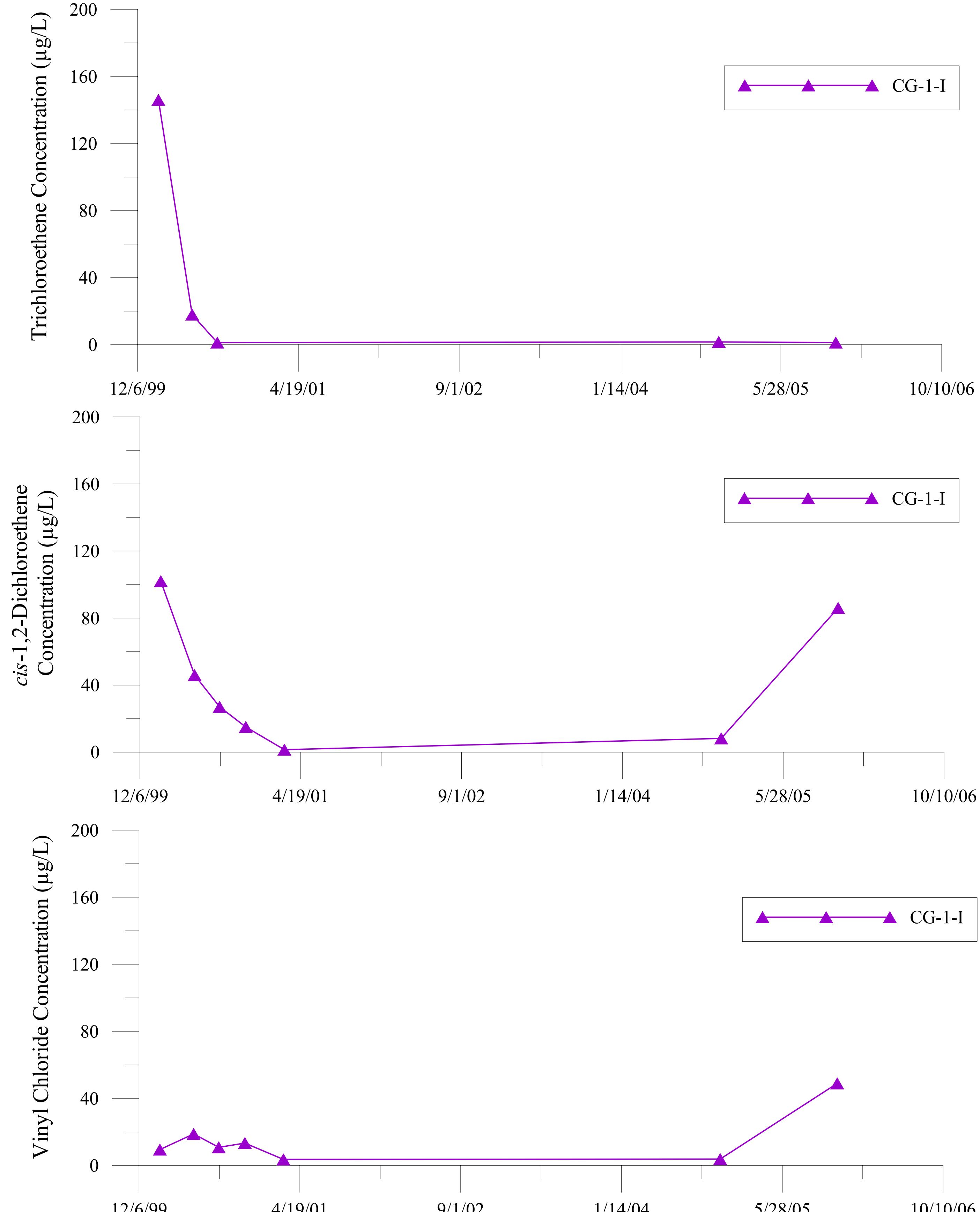


Notes:

Non-detect values excluded from plots.

Data from May 2006 sampling event are considered preliminary (unvalidated).

Geomatrix	ETHYLBENZENE CONCENTRATION TRENDS WATER TABLE INTERVAL - HCIM AREA PSC Georgetown Seattle, Washington	Project No. 8770 Figure A-6



Notes:
Non-detect values excluded from plots.
Data from May 2006 sampling event are considered preliminary (unvalidated).

Geomatrix	**CONCENTRATION TRENDS** **INTERMEDIATE INTERVAL - HCIM AREA** PSC Georgetown Seattle, Washington	Project No. 8770 Figure A-7