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Technical Memorandum DRAFT

To: Eugene Freeman, Washington State Department of Ecology

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Subject: Former Precision Engineering Facility
Site Summary and Data Gaps Assessment
K/J 1396024*00

The purpose of this Technical Memorandum is to summarize documents reviewed by Kennedy/Jenks Consultants for the Precision Engineering facility (Site) that were provided by Washington State Department of Ecology (Ecology) and to identify the current Site conditions related to environmental conditions, including the potential for impacts to the Lower Duwamish Waterway (LDW) Superfund Site.

This Technical Memorandum also identifies potential data gaps that will be addressed in developing a Remedial Investigation Work Plan (RIWP). This Technical Memorandum also presents a preliminary conceptual site model (CSM) for the property and adjacent areas.

Several figures prepared by Kennedy/Jenks Consultants are enclosed depicting areas of concern and prior sampling and investigation locations. Select materials prepared by others for prior reports are included in Attachment 1 and depict details of previous remedial actions and historical Site conditions. Concentration maps for primary contaminants of concern (which include arsenic, total chromium, hexavalent chromium, diesel-range hydrocarbons, trichloroethene, and vinyl chloride) in soil and groundwater are provided in Attachment 2 for reference.

Site Overview

The Site is a former manufacturing facility that specialized in the production and repair of large hydraulic cylinders used in the manufacture of paper and metal sheets. The facility operated from 1968 through 2005. The property was sold in 2005 and is now operated as a retail warehouse (Pacific Industrial Supply) for construction and machinery supplies.

While the property was operated as Precision Engineering, activities at the Site included grinding and polishing, honing, hard-chrome plating, milling, welding, and other flame and arc-applied metal coatings. Precision Engineering's work involved the use of a number of chemicals, particularly chromic acid for plating and trichloroethene (TCE) as a solvent. A number of chromic acid plating tanks were located in the former chrome shop, as were tanks containing hydrochloric acid, sodium carbonate, and sodium hydroxide. At least four trench drains were present in the grinding and chrome shops, located along the eastern and western walls of the shop. Locations of these features are shown on attached Figure 1 and are based on the available information regarding process areas within the facility.

The Site is located in unincorporated King County near the municipal boundary between the cities of Seattle and Tukwila, Washington, near the southwestern corner of South Director Street and 14th Street South, and is situated less than 200 feet west of the Lower Duwamish Waterway.

Adjacent properties are developed with residences to the north and northwest, Seattle Refrigeration to the west up a steep embankment, highway US-99/West Marginal Way with a cloverleaf interchange to the south and southeast, and Seattle Limousine to the east. Sea King Industrial Park is located east of Seattle Limousine and 14th Avenue South, which extends to the west bank of the Lower Duwamish Waterway. These adjacent properties are depicted on attached Figure 2.

A drainage ditch is located along the southern property line of the Site, and extends eastward along the southern margin and then northward along the eastern property line of the Seattle Limousine property (see Figures 1 and 2). Based on available information, the drainage ditch does not appear to have an outlet (i.e., it does not appear to discharge to surface water beyond the margins of the ditch). The 2011 Feasibility Study (prepared by Maul Foster Alongi) does reference a possible discharge from the ditch to the municipal storm drain system, but no indication of this possible outlet was observed during a recent Site visit.

Environmental Investigation and Cleanup Background

A series of regulatory events, beginning in the mid-1980s, has initiated a number of environmental investigations and remedial actions at the Site. Initially, environmental concerns were raised in February 1986, when Seattle Metro issued a discharge violation to Precision Engineering for discharging chrome-plating wastes to the sanitary sewer after Precision Engineering cancelled its Waste Discharge Permit in September 1985. Ecology and Metro inspected the Site in March 1986 and identified the following environmental conditions of concern:

- Leaks in the concrete sump containing spent/waste chromic acid.
- Improper hazardous waste storage.
- Discharge of wastewater, detergent, and oil from the steam cleaning area into the adjacent drainage ditch located along the southern property margin.
- Chromium contamination on the building roof due to ineffective scrubbers.
- Oil contaminated surface and shallow subsurface soil adjacent to the facility dumpster.
- Groundwater accumulation in Tank 7.

An Administrative Order was issued by Ecology later in 1986 requiring compliance activities to address the identified issues. The Administrative Order also required characterization of the nature and extent of contaminant impacts to soil and groundwater at the Site, including the drainage ditch south of the Site. A series of investigation and remediation activities have been subsequently performed at the Site and are summarized in the following sections.

Several potential source areas and/or areas of concern have been identified at the Site, many of which have been investigated by Maul Foster Alongi (MFA), Sweet Edwards/EMCON (SE/E), or Ecology and reported previously. Individual areas of concern, previous investigation areas, and previous remedial actions are summarized in attached Table 1 and depicted on Figure 1. Each issue is discussed further in the following sections.

Groundwater conditions were initially investigated in 1988 by SE/E when four monitoring wells and two piezometers were installed at the Site. Additional groundwater wells were installed by MFA in 2005.

Prior Investigation and Remediation Reports

The following reports have been reviewed by Kennedy/Jenks Consultants to establish an understanding of Site conditions and a chronology of events. A brief summary of the reported activities and findings is presented below. Maps showing previous sample locations are provided on attached Figures 3 through 6, and concentration maps for the primary soil and groundwater contaminants are provided in Attachment 2.

Note: Cleanup levels referenced in the following sections are those referenced in the previous reports and are not necessarily current or the cleanup levels that will be applicable for the Site in the future. Cleanup levels for the Site will be identified as part of the ongoing RI process.

1990 M&M Environmental – Letter to Ecology Regarding Precision Engineering, Inc.

This letter report summarizes initial investigation activities conducted near Former Plating Tanks 1 and 2 and the Plating Tank 7 vault, as well as initial sediment sampling in the southern drainage ditch.

Yellow-stained soil was observed near Former Plating Tanks 1 and 2, after which soils were sampled, and the tanks and vaults were later removed and disposed offsite. Concrete and soils were excavated to approximately 13 feet below ground surface (bgs). Groundwater was encountered at the base of the excavation beneath the tanks at an approximate depth of 10 feet bgs.

An investigation was conducted at Plating Tank 7 after a crack was observed in the northeastern corner of the deep containment vault. A soil boring was advanced northeast of the tank to a depth of 20.4 feet bgs, and a monitoring well was constructed in the borehole (boring B-1). Dense, silty sand and gravel was encountered between 18 and 20 feet bgs and interpreted to be glacial till by M&M Environmental. Soil samples were analyzed for soluble metals using the EP Toxicity method [predecessor to the current Toxicity Characteristic Leaching Procedure (TCLP) technique], which reported detected concentrations of barium, copper, nickel, and zinc (results were not tabulated within this document). Soil pH was also analyzed, with the highest reported pH of 9.4.

Reportedly, two phases of surface sediment sampling occurred in the drainage ditch south of the Site, and samples were analyzed for soluble chromium using the EP Toxicity method. The results of this sampling were not directly included within the report; however, sampling results were reportedly below the 0.5 milligrams per liter (mg/L) level for hazardous waste designation of chromium in accordance with WAC 173-303-090.

1993 Precision Engineering – Independent Remedial Action Report

This report was prepared by Douglas Richardson, the environmental health and safety manager at Precision Engineering, and includes a summary of remedial activities completed between March 1988 and April 1993 at the Site. Prior to 1992 tank removal activities, Precision Engineering reportedly negotiated a soil cleanup level of 400 parts per million (ppm) [milligrams per kilogram (mg/kg)] for hexavalent chromium.

In 1992, Former Plating Tanks 3, 4, 5, and 6 were removed and disposed. A 35-foot by 40-foot section of concrete flooring was cut and removed. Impacted soil was reportedly excavated and stockpiled based on visual observation, and soils were sampled beneath the removed concrete slab. The report suggests that excavated soil and concrete with concentrations of soluble (TCLP) chromium less than 400 mg/L were placed into the excavation as backfill, and a new concrete slab was poured. Analytical results for total chromium and soluble total chromium (analyzed using the TCLP method) are summarized within the report and show soils with soluble total chromium concentrations exceeding 5.0 mg/L were present beneath the replaced concrete slab.

Also in 1992, the deep containment vault for Plating Tank 7 was repaired to reduce flow of groundwater into the vault. Reportedly, the containment vault was pressure washed and damaged concrete was removed and repaired. A polyester/vinyl liner was installed at the base of the vault and partially up the sidewalls, and a new concrete slab was poured at the base of the containment vault. Prior to containment vault repairs, a groundwater sample was collected from within the vault and analyzed for total chromium with a reported concentration below the detection limit (quantified results were not available in the report).

The Independent Remedial Action Report indicates prior remedial activities were conducted in 1990 near Chrome Plating Tanks 1 and 2, resulting in the removal of the two tanks and adjacent soils (approximately 114 cubic yards). Reportedly, three rounds of soil sampling were conducted prior to excavation and removal of Chrome Plating Tanks 1 and 2, with samples analyzed for soluble total chromium using the EP Toxicity extraction method. A total of 13 hand-auger boreholes and five drilled boreholes were advanced adjacent to Chrome Plating Tanks 1 and 2. The process tanks, concrete vaults, and soil were excavated and disposed offsite in 1990. The excavation area extended 19 feet east-west by 13.5 feet north-south to a depth of approximately 12.5 feet below grade.

Final sampling indicated hexavalent chromium concentrations in soils ranged from below the 0.05 mg/kg reporting limit up to 73 mg/kg in the southern sidewall; however, a soluble (EP Toxicity) chromium concentration of 9.6 mg/L was detected along the southern sidewall and exceeded the limit of 5.0 mg/L for designation as a dangerous waste. Final soil sampling results from the southern sidewall, northern sidewall, and excavation floor indicate hexavalent chromium concentrations exceeding the current Model Toxics Control Act (MTCA) Method A cleanup level of 19 mg/kg for unrestricted land use were left in place.

Reportedly, an investigation into Tank 7 was conducted in 1989. Boring B-1 was drilled to a depth of 20.4 feet, just northeast of the tank, and soils were sampled and analyzed for pH and soluble (EP Toxicity) metals. Results for metals analyses did not indicate soil impacts above cleanup levels at that time. A groundwater monitoring well was installed in boring B-1 and later abandoned. The exact location of boring B-1 was unclear and, therefore, is not shown on attached Figure 3.

2005 Maul, Foster & Alongi, Inc. – Preliminary Soil and Groundwater Site Assessment Report

In 2005, additional Site investigation activities were conducted by MFA and consisted of advancing 11 direct-push borings (GP-1 through GP-11) at the Site near former tanks, floor drains, and trenches. Soil samples were collected at each boring location, and reconnaissance groundwater samples were collected at several other select locations. MFA's initial 2005 investigation identified concentrations of trivalent chromium, hexavalent chromium, and TCE in soil that exceeded MTCA Method A soil cleanup levels for unrestricted land use. Concentrations of diesel-range hydrocarbons, oil-range hydrocarbons, hexavalent chromium, dissolved total chromium, TCE, and cis-1,2-dichloroethene (cis-1,2-DCE) were detected in one or more groundwater samples above MTCA Method A/B cleanup levels.

2006 MFA – Supplemental Remedial Investigation

In late 2005, MFA conducted additional direct-push drilling and soil sampling at locations GP-12 through GP-31, including groundwater reconnaissance sampling at GP-13 and GP-15, and installed new groundwater monitoring wells MW-5 through MW-8. Results and findings of the supplemental remedial investigation are discussed below in the Final Remedial Investigation and Risk Assessment (RI/RA) Report section.

2008 MFA – Final RI/RA Report

Results and findings of the 2005 and 2006 investigations conducted by MFA are summarized in the RI/RA Report. No additional investigation was recommended for soil or groundwater at the Site. RI/RA findings included:

- Hexavalent and trivalent chromium, diesel- and oil-range petroleum hydrocarbons, and TCE were identified as indicator hazardous substances (IHSs) in soil at the Site.

- Arsenic, cadmium, copper, hexavalent chromium, trivalent chromium, lead, chrysene, and heavy oil-range petroleum hydrocarbons were identified as IHSs for soil in the drainage ditch located immediately south of the former Site. The drainage ditch receives surface water runoff from the former Site and adjacent properties to the south and east.

- IHSs were also identified in groundwater and include arsenic, copper, hexavalent chromium, trivalent chromium, and selenium, as well as heavy oil range-petroleum hydrocarbons, TCE, and vinyl chloride.

Between October 2007 and March 2008, approximately 100 cubic yards of sediment and surface soil was excavated from the drainage ditch south of the Site to address IHSs present offsite. Reportedly, less than 2 cubic yards of soil impacted above site cleanup levels was left in place and covered with fill material. The report does not state why residual impacted soils were left in place or how this volume was calculated if clean soils were not documented in the confirmational soil samples. The excavated areas in the drainage ditch were reportedly regraded and reseeded following remedial excavation. Since documentation of complete removal was not provided in the confirmational results, this may present a data gap for the Site.

The RI/RA report suggests groundwater impacts are confined to the Site. Using a fate and transport model, MFA derived site-specific groundwater cleanup levels, protective of surface water, then used EPA's BIOCHLOR model to show whether those contaminants would reach the Duwamish Waterway. According to MFA, their model predicts that concentrations of the modeled contaminants above analytical detection limits would not reach the Duwamish Waterway. Groundwater modeling was conducted for indicator hazardous substances, including arsenic, copper, hexavalent chromium, trivalent chromium, selenium, diesel-range hydrocarbons, oil-range hydrocarbons, TCE, and vinyl chloride. The BIOCHLOR model does not account for possible co-mingling of groundwater from the immediately downgradient

KASPAC/Chiyoda site to the east. As mentioned in Ecology's September 2009 opinion letter regarding the final RI/RA report, the model has not been validated with field data from groundwater monitoring downgradient from the Site.

A sub-slab vapor intrusion mitigation system was suggested by MFA to address concentrations of TCE and breakdown product vinyl chloride present in groundwater at concentrations where vapor intrusion to indoor or outdoor air may occur. In October 2008, MFA submitted a work plan to Ecology regarding vapor intrusion system installation and long-term monitoring; however, there is no documentation in Ecology's files indicating a vapor intrusion mitigation system was actually installed or operated at the Site.

2011 MFA – Final Feasibility Study

The feasibility study summarizes an interim remediation that occurred within the drainage ditch south of the Site between October 2007 and March 2008. Several cleanup alternatives were considered, including:

- Alternative 1: A no-action alternative.
- Alternative 2: An alternative where the building slab would be used as an engineered cap combined with groundwater monitoring and a covenant prohibiting groundwater use.
- Alternative 3: An alternative where approximately 1,000 cubic yards of impacted soil would be excavated, followed by groundwater monitoring and institutional controls.
- Alternative 4: An alternative implementing strategic excavation of approximately 67 cubic yards of soil, combined with injection of EHC-M (an in situ metals immobilization treatment) to treat hexavalent chromium contaminated groundwater, and groundwater monitoring.

Alternative 2 was recommended and included implementing institutional controls, groundwater monitoring, and use of the current building slab and asphalt cover as a cap. In July 2011, Ecology issued an opinion letter responding to the proposed remedial action, which indicated Site characterization was insufficient to establish cleanup standards and select a cleanup action. Ecology's opinion letter indicates the nature and extent of groundwater contamination, particularly downgradient of the Site boundary and the adjacent KASPAC/Chiyoda site, has not been adequately characterized.

Areas of Concern

Based on review of the available Site information, a number of potential source areas have been identified. These areas associated contaminants of concern and confirmed or suspected affected media are summarized on Table 1. Figure 1 depicts the location of each area or concern on the Site. Locations where prior sampling has occurred are shown on the attached Figures 3 through 6, and concentration maps for primary contaminants are provided in Attachment 2.

Identification of Data Gaps

Following review of the available reports, a number of potential data gaps have been identified for consideration in developing an RI work plan for the former Site. These data gaps are summarized below.

1) **No information is currently available that indicates the complete scope of Site closure activities.**
   a. It is unclear whether or how some containment vaults were taken out of service and what residual contamination may have been left in place.
   b. What subgrade features remain beneath the building that may present preferential pathways for vapor intrusion or groundwater flow or serve as a continuing source of contamination?
      i. Former containment vaults/testing vaults.
      ii. Trenches/drains/sewer lines.

2) **Lithologic boring logs for wells MW-1, MW-2, and MW-3 were not available for review. This missing data makes it difficult to confirm/interpret the hydrogeologic Site conditions and modeling results described by MFA.**
   a. The definition of glacial till, which may be acting as an upper confining layer of the advance outwash hydrogeologic unit, is not explicitly identified. Near surface soils containing gravels appear in many boring logs to be described similarly to the generalized till description on SE/E's generalized cross section (see Attachment 1).
   b. Many of the soil borings advanced in 2005 were only to the first occurrence of groundwater and not to refusal or glacial till. Therefore, the thickness and lithology of the alluvial unit beneath the building is not fully characterized.
   c. It is unclear from the existing boring logs whether the alluvium is homogenous or interbedded with zones of higher permeability. The depth to and thickness of the glacial till does not appear to be defined throughout the Site.
   d. It is unclear from existing data whether, or not, the glacial till is acting as a competent confining layer.

e. The hydraulic connectivity between the advance outwash, till, alluvial aquifer, and Duwamish Waterway is not fully explained. There is very limited data provided for the regional area as to the correlation of the stratigraphic units.
f. It is unclear whether some of the existing wells are installed exclusively in the alluvial aquifer or if they penetrate the top of the till unit (i.e., bridge two stratigraphic units).

3) **There is no long-term groundwater sampling record for existing monitoring wells.**
   a. Wells have not been sampled regularly, and it is difficult to determine seasonal variations from any long-term trend.
   b. The most recent groundwater sampling event occurred in 2010. Current groundwater conditions onsite and offsite are not fully characterized.

4) **There are only two deeper monitoring wells**. **A groundwater flow gradient and direction for deeper groundwater in the advance outwash cannot be established with this limited information.**

5) **Air sampling data for TCE and vinyl chloride suggests there is likely a complete pathway connecting soil, groundwater, shallow vapor, and indoor air.**
   a. It is unclear whether cracks in the concrete slab or other features may be contributing to the apparently widespread distribution of TCE in indoor air across the eastern half of the building.
   b. The source (or sources) of TCE in vapor does not appear to be identified or defined with currently available data. The distribution of deeper soil samples (those below the groundwater interface or the base of alluvium) analyzed for volatile organic compounds (VOCs) does not adequately define the extent of impacted soil or groundwater. Reportedly, parts washing was conducted in many areas of the shop, suggesting one or more possible source areas, in addition to the former floor drain system.

6) **It is unclear from the available groundwater elevation data record whether groundwater flow may be contributing to surface water in the drainage ditch south of the Site**.
   a. If shallow groundwater flow from beneath the current structure is southerly, it may discharge to the southern drainage ditch.

7) **Groundwater conditions south of the drainage ditch and east of the ditch along the eastern edge of the adjacent KASPAC/Chiyoda/Seattle Limousine site are not currently known.**
   a. It is not known what contaminant concentrations are migrating onto the KASPAC/Chiyoda/Seattle Limousine site from the west or what is leaving the site from the east. A better understanding of these conditions will help assess possible impacts to the LDW from the Site.

8) **Former Plating Tanks 1 and 2.** Immediately following the 1990 remedial action, groundwater was not sampled, although it was encountered at the base of the excavation. Additional drilling was conducted by MFA in 2005, and grab groundwater samples were collected from two locations.
   a. Existing monitoring well MW-5 is located crossgradient, well MW-4 is located upgradient, and well MW-8 is located at least 50 feet downgradient.
   b. Groundwater grab samples were collected nearby at GP-4 and GP-8. In June 2005, hexavalent chromium was detected at concentrations of 294 mg/L at GP-8 and 236 mg/L at GP-4, above the MTCA Method A groundwater cleanup level of 50 mg/L.
   c. TCE was detected above the method detection limit in groundwater at GP-8 (16.8 µg/L in June 2005). The only soil sample at GP-8 analyzed for VOCs was collected at 1.5 feet bgs, and TCE was reported below the detection/reporting limit.
   d. Groundwater to the south of Former Plating Tanks 1 and 2 has not been characterized.
   e. TCE may be a contaminant of concern in soil/groundwater; however, soil samples below the groundwater interface have not been collected at GP-4, GP-8, or south of Former Plating Tanks 1 and 2.

9) **Former Plating Tanks 3, 4, 5, and 6.** In 1992, tanks and associated shallow, visibly impacted soil were removed. Additional drilling and sampling was conducted by MFA in 2005 to evaluate possible recontamination of soils following 1992 remedial action.
   a. Soil samples were collected by MFA at GP-18, GP-32, GP-6, GP-2, and GP-3.
      i. Samples collected from a depth of 1 foot bgs at GP-18, GP-32, GP-2, and GP-6 suggest hexavalent chromium impacted soil is present above the MTCA Method B soil cleanup levels (240 mg/kg), and remedial action may be warranted.
      ii. Soil sample collected from GP-6 at 14.5 feet bgs contains TCE at a concentration above the MTCA Method A cleanup level and above concentrations protective of vapor intrusion.
   b. Groundwater grab samples were collected at GP-6 and GP-2 in 2005. TCE was detected in the sample collected from GP-6 at a concentration of 1,130 µg/L. Hexavalent chromium was detected in both GP-6 (300,000 µg/L) and GP-2 (4,720 µg/L) samples at concentrations exceeding the MTCA Method B cleanup level (490 µg/L) for surface water.
   c. Monitoring well MW-5 is located downgradient of the former tank locations, but not in the potential source area itself. Sampling results from 2005, 2006, and 2010 report concentrations of hexavalent chromium up to 450,000 µg/L, above the MTCA Method B surface water cleanup level of 490 µg/L. During two of the last three groundwater sampling events, TCE has been detected in groundwater at well MW-5 at concentrations exceeding the MTCA Method B cleanup levels.

d. The lateral and vertical extent of TCE and chromium impacted groundwater is not fully defined to the northeast and east of the Site. Additional definition between well MW-5 and the eastern exterior building wall is needed.
e. TCLP chromium results in soils at base of 1992 excavation all exceed the regulatory limit of 5.0 mg/L for designation as a dangerous waste. Additional TCLP analysis of soils in the Former Plating Tanks 3, 4, 5, and 6 areas is needed to identify soils requiring special handling for waste disposal.

10) **Trenches and floor drains in the grinding and chrome plating shop areas.** Reportedly, the trenches and floor drains in these shops conveyed liquid process waste to the sanitary sewer until about 1986 when they were rerouted and then operated as sumps. Reportedly, the trenches were inspected and determined to be in good condition prior to being filled with concrete. These subgrade features may serve as a preferential pathway for vapor or as a source of chromium and/or solvent impacts to soil and groundwater.
    a. Soil and/or groundwater samples have been previously collected and analyzed more extensively in the chrome shop area, but not as much in the grinding shop. Groundwater sampling (grab) and soil sampling adjacent to the former trench drains may assist in determining whether these features represent a source of soil and/or groundwater impacts.

11) **Former and current sanitary sewer piping beneath the building and connecting to the main sewer line.** Reportedly, cleanout activities were necessary for the Metro sewer lines following the 1986 discharge violation. It is unclear whether these pipes are still in place beneath the slab and whether the pipes or the trenches they are set in may be serving as an ongoing source of metals or solvent impacts to soil and groundwater. These could also be acting as conduits for vapor migration.

12) **Plating Tank 7 Vault.** This vault was reportedly 24 feet long, 8 feet wide, and 16 feet deep. The closure/decommissioning of the vault was not reported in the files reviewed. Previously, groundwater infiltration was observed in the vault. In 1989, repairs and improvements were made to the vault to reduce groundwater infiltration. The current status/condition of the Tank 7 vault is not currently known.
    a. Borings GP-9, GP-10, GP-7, GP-23, GP-3, and GP-22 were advanced and soils sampled by MFA in 2005. Soils were not sampled at depths equal to or greater than the total depth of the vault. Concentrations of hexavalent chromium reported in three samples collected at GP-3 exceeded MTCA Method A cleanup levels; however, location GP-3 is more closely located to the southern end of the western chrome shop trench drain than to Tank 7. None of these sampling locations are located south of the Tank 7 vault.
    b. In 2005, a grab groundwater sample was collected at GP-7. GP-7 is located adjacent to, but upgradient of, the Tank 7 vault. Hexavalent chromium was reported at a concentration of 101 µg/L.

c. The nearest groundwater monitoring wells are MW-4, approximately 45 feet to the south, and MW-5, approximately 80 feet to the northeast. Relative to the presumed shallow groundwater gradient (generally to the east), well MW-5 is downgradient from the Tank 7 vault, and well MW-4 is lateral to slightly downgradient. Groundwater sampling results for hexavalent chromium and TCE exceeded one or more MTCA cleanup levels at well MW-5. Detected hexavalent chromium concentrations at well MW-4 are below MTCA Method B cleanup levels, and concentrations of TCE are reported to be below reporting/detection limits.

13) **Hydraulic Cylinder Test Vault.** Reportedly, a deep test vault (25 feet deep) for testing hydraulic cylinders was located near the western edge of the building, outside the structure. In 2005, sample location GP-5 was drilled and soil and groundwater sampled to characterize the area near the former test vault. The current status/disposition of the test vault is not known. Both soil samples collected at GP-5 were located above the base of the test vault. Hexavalent chromium was detected in groundwater at GP-5 above the MTCA Method B cleanup level. (Note: There are discrepancies in data presented for total chromium in reconnaissance groundwater between Table 9 in the RI versus Table 12 in the Feasibility Study.)

14) **Scrubber Room.** The scrubber room is located south of the Tank 7 vault and previously contained a chromic acid purification unit, holding tank, and evaporator. The evaporator was reportedly used after 1986 for the incineration/management of liquid plating waste, which accumulated in the floor drains and trenches. Reportedly, the evaporator was contained within a subgrade containment vault. The current status of that vault is not known.
   a. In 2005, GP-26 and GP-28 were drilled south of the scrubber room with GP-26 located upgradient from the scrubber room and GP-28 located downgradient. Borings GP-9, GP-7, and GP-22 are located north of the Tank 7 vault. GP-22 is located downgradient from the scrubber room, and GP-7 and GP-9 are located lateral to the scrubber room (with respect to the presumed shallow zone groundwater gradient). No soil borings were drilled immediately north, east, or west of the evaporator within the scrubber room. Soil samples were collected and analyzed at locations GP-26 and GP-28. Concentrations of hexavalent chromium and TCE in soil samples within the upper 10 feet were below method reporting limits. Arsenic was detected in GP-28 above the MTCA Method B soil cleanup level.
   b. No soil sampling or groundwater sampling was conducted in the center of the scrubber room or along the northern wall separating the scrubber room from the Tank 7 vault area.

While not a data gap, the selected site cleanup levels for each affected media should be evaluated and revised appropriately. A number of the cleanup levels selected in the reports provided by prior consultants may not be appropriate for protection of all possible receptors. Appropriate cleanup levels are necessary to begin estimating the volume and extent of contamination associated with the Site.

Preliminary Draft CSM

A preliminary CSM based on the information reviewed in previous reports is presented on Figure 7 and summarized below. The preliminary CSM presents a generalized representation of Kennedy/Jenks Consultants understanding of current Site conditions and potential exposure pathways. Areas where the current data is insufficient (i.e., data gaps) to evaluate the completeness of potential exposure pathways are also identified.

Geology

Previous reports describe three main geologic units at the Site, in addition to shallow fill materials primarily located beneath Site structures. These reportedly include:

- Silt and sandy alluvium with some gravel and organics locally. The shallow alluvium is described as occurring only on the eastern portion of the Site (generally beneath the central part of the main Site structure and eastward) from ground surface to a depth of up to approximately 20 feet bgs (and over 30 feet on the eastern-adjoining Seattle Limousine site). The thickness of shallow alluvium reportedly increases eastward.

- Glacial till described as dense gravely, sandy silt occurs below the shallow alluvium (where shallow alluvium is present). The top of the till unit was reportedly encountered at or near ground surface on the western portion of the Site and at increasing depth to approximately 20 feet bgs in the central to eastern portions of the Site. The top of the till reportedly slopes to the east from the central part of the Site, with the steepest slope beneath the main Site structure (refer to the cross-section in Attachment 1). The till appears to be up to 30 feet thick in the western portion of the Site, decreasing to 20 feet or less beneath the eastern portion of the Site, as the upper surface slopes downward to the east, but the bottom of the till unit is not well defined, as only a limited number of borings have been advanced through the till.

  Some boring logs show a weathered zone at the top of the till unit, suggesting the upper surface may have been exposed at ground surface for a period of time. Some boring logs also describe organic debris and woody debris at depths that may correlate with the top of the till.

- Advance outwash described as sand and gravel alluvium is located below the till. The thickness of the advance outwash alluvium was not determined, and it has been described in only a few soil borings advanced to sufficient depth (30 or more feet bgs).

The geologic units described in previous Site reports are shown a 2005 Geologic Map of Seattle [U.S. Geological Survey (USGS) 2005] and are described as follows:

- Shallow alluvium. Holocene alluvium (Qal) described as sand, silt, gravel, and cobbles deposited by streams and running water a few meters to 30 meters thick and loose to dense or soft to stiff.

- Glacial till. Pleistocene Vashon till (Qvt) described as compact diamict of silt, sand and subrounded to well-rounded gravel, glacially transported and deposited under ice. Commonly fractured and has intercalated sand lenses. Qvt is described as 1 to 10 meters thick and very dense.

- Advance outwash. Advance outwash deposits (Qva) described as well-sorted sand and gravel deposited by streams issuing from advancing ice sheet. May grade upward into till. Silt lenses locally present in upper part and are common in lower part. Advance outwash deposits are locally over 60 meters thick and are dense to very dense.

Other geologic units shown on the 2005 Geologic Map of Seattle and located in proximity to the Site include:

- Peat (Qp) described as organic matter consisting of plant material and woody debris, accumulated in bodies greater than about 1 meter in thickness and of mappable extent. Peat may range in thickness from greater than 1 to 10 meters. The geologic map shows peat deposits to the south and east of the Site.

- Recessional outwash deposits (Qvr) described as stratified sand and gravel, moderately sorted to well sorted, and less common silty sand and silt, typically 1 to 6 meters thick and loose to dense. Recessional outwash deposits are depicted to the north and west of the Site on the southern portion of the hill that adjoins the Site to the north and west.

- Blakeley Formation Bedrock (Tb) described as medium–grained sandstone, coarse-grained sandstone, conglomerate, and minor siltstone that is over 1,000 meters thick and weakly to moderately lithified. The Blakeley formation is shown on the geologic map to the north of the Site (forming the northern portion of the hill that adjoins the Site to the north and west) and to the northwest.

The cross-section included in Attachment 1 was prepared by SE/E [included in the 1993 Independent Remedial Action Report (Precision Engineering 1993)] and provides a generalized overview of the geologic conditions as described in the previous Site reports, including the Final Feasibility Study prepared in 2011. The cross-section provides a plausible representation of the big-picture interpretation of Site geology and is generally consistent with the geologic units depicted on the 2005 Geologic Map, but with some exceptions:

- Layering depicted in the shallow alluvium unit above the till is simplified. Based on the available boring logs, lateral correlation of individual layers within the alluvium unit does not appear to be as straightforward as depicted on the cross-section (i.e., textural descriptions do not appear to support the presence of distinct laterally continuous layers) and may be inconsistent with the description of the shallow alluvium as predominantly sandy and horizontally bedded with fine and coarser-grained lenses provided on the 2005 Geologic Map. In addition, many of the soil borings at the Site did not fully penetrate the shallow alluvium unit.

- Areas of possible fill, primarily under the existing building, are not well defined.

- The till is shown as a massive (i.e., not stratified) unit although textural variation and saturated intervals within the till unit are described on boring logs, suggesting some degree of heterogeneity or layering. In addition, the 2005 Geologic Map describes sand lenses occurring within the till. Some boring logs also describe a weathered interval at the top of the till unit, which is consistent with the 2005 Geologic Map description.

- The upper surface of the till unit may not be as well-defined as depicted on the cross-section, but this is difficult to determine based on the boring logs, because they do not necessarily provide an adequate description of density differences between different units, and because many borings appear to have been terminated above the top of the till unit.

- On the western portion of the Site, it is possible the shallow soil may include some recessional outwash deposits above the till. The southern portion of the hill to the north and west of the Site appears to be capped with recessional outwash deposits. A portion of the hill appears to have been removed when the Site was developed (i.e., a notch was cut out of the hill), but the degree to which the till beneath the recessional outwash was exposed by the cut is not evident.

- As indicated on the cross-section, the contact between the till and underlying advance outwash deposits is not well defined based on a limited number of borings advanced to sufficient depth.

Hydrogeology

The previous reports suggest that two separate saturated zones may be present beneath the Site, including a shallow saturated zone within both the shallow alluvium and till units and a deeper saturated zone within the advance outwash alluvium as follows:

Shallow Saturated Zone

A shallow saturated zone is described in the 2011 Final Feasibility Study as a confined alluvial water bearing zone within the upper alluvium (eastern part of Site only) and glacial till units (western part of the Site). Groundwater is reportedly initially encountered between 5 and 8 feet bgs in the shallow alluvium and between 7 and 14 feet bgs in the till. The shallow saturated zone is described as confined, based on static water elevations in wells being typically at higher elevations than the saturated intervals spanned by the well screens. The hydraulic gradient in the shallow saturated zone is, reportedly, generally to the east, toward the LDW.

A 1995 USGS water resources investigation report for southwestern King County (USGS, 1995) indicates the upper alluvium may include both confined and unconfined saturated conditions. The Vashon till is described in the 1995 USGS report as a confining bed, but does contain saturated sand and gravel lenses particularly in the upper portions.

Within both of the shallow zone lithologic units (shallow alluvium and till), saturated conditions do not appear to be continuous vertically (dry conditions are noted in layers located below the initial occurrence of saturated conditions on the boring logs). Lateral continuity of shallow saturated intervals also does not appear to be well characterized across the Site based on the descriptions provided in the boring logs, including hydraulic connections between the shallow saturated intervals within the upper alluvium and glacial till units.

In general, shallow saturated conditions at the Site do not appear to be fully characterized and could include various elements, such as, but not necessarily limited to, the following:

- Laterally continuous saturated layers with varying degrees of lateral and vertical interconnectivity.
- Saturated lenses with varying degrees of lateral and vertical interconnectivity.
- Localized perched saturated zones.
- The extent and hydrogeologic effect of the weathered zone described at the top of the till unit, which appears to slope to the east.
- Shallow depressions on the upper surface of the till unit possibly facilitating DNAPL accumulation, if any is present.

Saturated conditions may also differ between the shallow alluvium and glacial till units, and the nature of the hydraulic connections between the two units is not adequately characterized to evaluate potential contaminant migration to the Duwamish Waterway.

As discussed above, the 1993 cross section (refer to Attachment 1) depicts the upper surface of the till sloping steeply to the east approximately beneath the building, with the shallow alluvium contacting the till laterally along the steeper sections of the slope. To the east of the building, the till is shown beneath the shallow alluvium with a more gradual slope to the east.

The locally steep slope of the upper surface of the till unit indicates a potential for lateral hydraulic connectivity between the shallow saturated zones within the till and those in the shallow alluvium to the east. The nature and degree of hydraulic interaction between the upper saturated zone units is not adequately characterized.

Deep Saturated Zone

A deeper saturated zone is described in the 2011 Final Feasibility Study as a confined sand and gravel water bearing zone within the advance outwash alluvium located below the glacial till unit. The nature of the deeper saturated zone is not fully characterized, as only two wells have been installed in the advance outwash alluvium. The gradient is assumed to be generally to the east (based on the head elevation in the two wells), but this has not been verified.

The 1995 USGS water resources investigation report indicates the advance outwash unit typically serves as an aquifer where the coarse-grained portions are saturated (silt lenses are common) and is typically encountered below the Vashon till.

The till unit at the Site is likely acting as a confining layer to some degree, particularly with respect to the underlying advance outwash unit but also for the saturated intervals that have been identified within the till. The degree to which potential migration pathways (lateral and vertical) may be present within the till (i.e., along fractures and/or interconnected coarser-grained saturated intervals) and the degree of interconnectivity between the shallow and deep saturated zones have not been adequately characterized.

Potential Exposure Pathways

Based on the available information, potential exposure pathways for the Site may include (but are not necessarily limited to) the following:

- Direct contact with soil and surface water in the drainage ditch.
- Direct contact with groundwater in wells through seepage into tanks/vaults in the building or through seepage into the drainage ditch.
- Direct contact with soil throughout the Site by workers for any subsurface work.
- Soil to groundwater (leaching) pathway in saturated intervals.

- Groundwater to surface water pathway by shallow groundwater seepage into the drainage ditch or possibly the LDW.
- Surface water pathway through the drainage ditch and possibly into the municipal storm drain system with possible discharge to the LDW.
- Surface water infiltration to groundwater in the drainage ditch and any unpaved portions of the Site.
- Vapor infiltration into the building from impacted soil and/or groundwater with former pipelines, trenches, vaults, etc. possibly acting as conduits.

The potential exposure pathways are illustrated on Figure 7. Evaluation of potential human and ecological receptors will be performed during the ongoing RI process.

CSM Data Gaps Summary

Based on the available information, additional data is needed to characterize the nature of the saturated zones previously identified at the Site and to refine the CSM. These data needs are primarily related to characterization of the structure of the saturated intervals identified at the Site and how these saturated intervals are (or are not) interconnected. The nature of the shallow saturated zones has a significant bearing on contaminant transport in the subsurface, particularly for those contaminants with higher specific gravities (i.e., solvents) and identification of potential exposure pathways.

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Enclosure(s): Table 1 – Summary of Areas of Concern
Figure 1 – Former Process Areas
Figure 2 – Neighboring Properties
Figure 3 – Prior Drilling and Sampling Locations
Figure 4 – Groundwater Monitoring Wells and Sampling Locations
Figure 5 – Air and Vapor Sampling Locations
Figure 6 – Drainage Ditch Sampling and Excavation Locations
Figure 7 – Preliminary Draft Conceptual Site Model
Attachment 1 – Select Reference Materials from Previous Reports
Attachment 2 – Concentration Contour Maps

Table

Figures

Attachment 1

Select Reference Materials from Previous Reports

Attachment 2

Concentration Contour Maps

S DIRECTOR ST

12TH AVE S

14TH AVE S

RAMP

MW3

GP13

GP15

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Arsenic in Groundwater >0.12 ug/L
(2x MTCA Method B Groundwater)

Legend

- Deep Monitoring Well
- Shallow Monitoring Well
- Reconnaissance Groundwater Sample
- ParcelBoundary

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80 40 0 80
Feet

Kennedy/ Jenks Consultants

Precision Engineering Facility
Seattle, Washington

Groundwater Monitoring Wells and Sampling Locations

Arsenic in Groundwater

K/J Project Number 1396024.00

S DIRECTOR ST

12TH AVE S

14TH AVE S

RAMP

MW3 IA1 GP11 A1 GP13 A3 A2 GP11 GP24 GP14 GP15 GP05 IA2 A4 IA3 GP16 GP17 IA4 IA5 MW6 GP12 A5 A6 GP06 GP19 MW5 GP21 GP10 GP23 GP02 GP03 GP04 MW2 MW7 GP09 GP07 GP01 GP08 IA6 GP22 A7 GP26 GP29 GP30 GP3 MW4 GP25 GP27 GP28 MW1 MW8 HA20 HA14 HA17 HA21 HA27 HA1 HA6 HA11 HA2 HA8 HA9 HA10 IA7 HA13 HA15 HA18 HA22 HA3 HA26 HA12 HA16 HA19 HA4 HA25 HA5 HA23 HA24

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Legend

- Air Sample Point
- Deep Monitoring Well
- Geoprobe boring
- Hand Auger Boring
- Reconnaissance Groundwater Sample
- Shallow Monitoring Well
- Staff Gauge
- Vapor Monitoring Sample
- Excavation Area
- ParcelBoundary

Arsenic in Soil > 1.4 mg/kg
(2x MTCA Method B Soil)

N W E S

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Precision Engineering Facility
Seattle, Washington

Prior Drilling and Sampling Locations

Arsenic in Soil

K/J Project Number 1396024.00

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Chromium (total) in Groundwater > 100 ug/L
(2x MTCA Method A Groundwater)

Legend

- Deep Monitoring Well
- Shallow Monitoring Well
- Reconnaissance Groundwater Sample
- ParcelBoundary

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Feet

Kennedy/ Jenks Consultants

Precision Engineering Facility
Seattle, Washington

Groundwater Monitoring Wells and Sampling Locations

Chromium in Groundwater

K/J Project Number 1396024.00

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Hexavalent Chromium in Groundwater > 96 ug/L
(2x MTCA Method B Groundwater)

Legend

- Deep Monitoring Well
- Shallow Monitoring Well
- Reconnaissance Groundwater Sample
- ParcelBoundary

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Groundwater Monitoring Wells and Sampling Locations

Hexavalent Chromium in Groundwater

K/J Project Number 1396024.00

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Legend

- Air Sample Point
- Deep Monitoring Well
- Geoprobe boring
- Hand Auger Boring
- Reconnaissance Groundwater Sample
- Shallow Monitoring Well
- Staff Gauge
- Vapor Monitoring Sample
- Excavation Area
- ParcelBoundary

Hexavalent Chromium in Soil > 38 mg/kg
(2x MTCA Method A Soil)

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Prior Drilling and Sampling Locations
Hexavalent Chromium
in Soil

K/J Project Number 1396024.00

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Diesel-Range Organics in Groundwater > 1,000 ug/L
(2x MTCA Method A Groundwater)

Legend

- Deep Monitoring Well
- Shallow Monitoring Well
- Reconnaissance Groundwater Sample
- ParcelBoundary

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Groundwater Monitoring Wells and Sampling Locations

Diesel-Range Organics in Groundwater

K/J Project Number 1396024.00

S DIRECTOR ST

12TH AVE S

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MW3 IA1 GP12 A1 GP13 A3 A2 GP11 GP14 GP16 GP15 GP05 IA2 A4 IA3 GP10 GP17 MW6 IA4 IA5 GP32 GP18 A5 A6 GP06 GP19 MW5 GP20 GP10 GP23 GP02 GP03 GP04 MW2 MW7 GP09 GP07 GP01 GP08 IA6 GP 7 A7 GP26 GP28 GP30 GP31 MW8 GP25 GP27 GP29 MW1 MW6 HA20 HA21 HA14 HA17 HA27 HA1 HA11 HA2 IA7 HA15 HA22 HA26 HA6 HA8 HA9 HA13 HA18 HA3 HA12 HA10 HA16 HA25 HA5 HA19 HA4 HA23 HA24

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Legend

- Air Sample Point
- Deep Monitoring Well
- Geoprobe boring
- Hand Auger Boring
- Reconnaissance Groundwater Sample
- Shallow Monitoring Well
- Staff Gauge
- Vapor Monitoring Sample
- Excavation Area
- ParcelBoundary

Diesel-Range Organics in Soil > 4,000 mg/kg
(2x MTCA Method A Soil)

N W E S

80 40 0 80 Feet

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Prior Drilling and Sampling Locations
Diesel-Range Organics in Soil

K/J Project Number 1396024.00

S DIRECTOR ST

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Trichloroethene (TCE) in Groundwater > 10 ug/L
(2x MTCA Method A Groundwater)

Legend

- Deep Monitoring Well
- Shallow Monitoring Well
- Reconnaissance Groundwater Sample
- ParcelBoundary

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Feet

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Groundwater Monitoring Wells and Sampling Locations

Trichloroethene in Groundwater

K/J Project Number 1396024.00

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14TH AVE S

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MW3 MW6 MW5 MW2 MW7 MW4 MW8 MW1 MW8

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A1 A2 A3 A4 A5 A6 A7

HA1 HA2 HA3 HA4 HA5 HA6 HA7 HA8 HA9 HA10 HA11 HA12 HA13 HA14 HA15 HA16 HA17 HA18 HA19 HA20 HA21 HA22 HA23 HA24 HA25 HA26 HA27

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Legend

- Air Sample Point
- Deep Monitoring Well
- Geoprobe boring
- Hand Auger Boring
- Reconnaissance Groundwater Sample
- Shallow Monitoring Well
- Staff Gauge
- Vapor Monitoring Sample
- Excavation Area
- ParcelBoundary

○ Trichloroethene (TCE) in Soil > 0.06 mg/kg
(2x MTCA Method A Soil)

N W E S

80 40 0 80 Feet

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Prior Drilling and Sampling Locations

Trichloroethene in Soil

K/J Project Number 1396024.00

S DIRECTOR ST

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Legend

- Deep Monitoring Well
- Shallow Monitoring Well
- Reconnaissance Groundwater Sample
- ParcelBoundary

Vinyl Chloride (VC) in Groundwater > 0.4 ug/L
(2x MTCA Method A Groundwater)

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80 40 0 80
Feet

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Groundwater Monitoring Wells and Sampling Locations

Vinyl Chloride in Groundwater

K/J Project Number 1396024.00