5.0 CONCEPTUAL SITE MODEL, SCREENING LEVELS, AND INDICATOR HAZARDOUS SUBSTANCES

This section presents a conceptual Site model (CSM), discusses terrestrial ecological evaluation (TEE), and describes the development of screening levels based on the CSM. The CSM evaluates potential exposure pathways, and the mechanisms, media, and routes by which receptors have the potential to be exposed to hazardous substances. The CSM was used to determine exposure potential in development of screening levels. Screening levels were developed to evaluate soil, groundwater, air, and surface water data, based on potential exposure pathways identified in the CSM, MTCA requirements, and Ecology's Cleanup Levels and Risk Calculations (CLARC) spreadsheets. All RI data were compared to screening levels to determine which compounds contribute the majority of the risk at the Site, and to identify indicator hazardous substances (IHSs). IHSs will be used in the FS to inform cleanup level development.

5.1 Conceptual Site Model

A CSM is used to identify IHSs, affected media, potential migration routes, and exposure pathways by which human and ecological receptors may be exposed to hazardous substances (WAC 173-340-708[3][e]). A preliminary CSM was described in the RI work plan (Geomatrix 2003b) and has been updated several times throughout the RI as more data and information has become available. The most recent update to the CSM was presented in a 2012 supplemental RI report (LAI 2014j) and a summary is presented in the following sections.

The preliminary CSM described by Geomatrix addressed potential exposure pathways at the Facility. Since 2009, additional RI activities have identified groundwater plumes and the presence of VOCs in surface water off Boeing property (LAI 2012e, f, 2014b, c, g) and in soil gas (LAI 2012c, g, 2013f, 2014d, 2016l). Consequently additional exposure pathways and receptors are now included in the CSM.

An exposure pathway consists of four main parts (WAC 173-340-200), as follows:

- Source of contamination (e.g., primary sources, such as spills and leaks, and secondary sources, such as impacted soil or groundwater)
- Transport or exposure medium (e.g., a solute moving with groundwater flow and contamination present in soil)
- Point of exposure (e.g., an open excavation)
- Route of exposure (e.g., inhalation and dermal contact).

When all of these parts are present, connecting the source of contamination to a receptor and result in an unacceptable health risk, the exposure pathway is considered complete. If one or more parts are not present, the pathway is incomplete and exposure does not occur. For example, the shallow aquifer beneath the Site is considered a drinking water aquifer and groundwater as a drinking water

source was evaluated as part of the CSM. However, groundwater as a drinking water source[37] is considered an incomplete pathway for all receptors because drinking water is not being extracted from the impacted portion of the aquifer. All homes and businesses within the Site were found to be using municipal drinking water (no drinking water wells were found within the Site); therefore, there is no point of exposure.

It is also possible to have a potentially complete exposure pathway without health risk if chemicals are not detected or chemical concentrations are within an acceptable range. For example, VOCs have been detected in stormwater collection features but concentrations are below health-based screening levels, which demonstrates that the surface water pathway, while potentially complete, does not represent a health concern. These pathways are identified in the CSM Figures 5-1 through 5-3.

Potential human and ecological receptors were identified for the Site based on current and reasonable future land use. Land uses within the plume footprint include industrial, commercial, and residential. The Boeing Auburn property is expected to retain its industrial character and future land uses are expected to be consistent with current zoning and land use regulations. The CSM on Boeing property is summarized in Figure 5-1. The off Boeing property CSM is summarized in Figure 5-2. A pictorial representation of the Site-wide CSM is presented on Figure 5-3.

5.1.1 On Boeing Property Conceptual Site Model

Potential sources at the Facility include releases of hazardous substances to soil and groundwater from current and former manufacturing processes associated with the SWMUs and AOCs. Spills and leaks from containment structures or equipment associated with each SWMU or AOC are the primary release mechanism by which constituents of concern may be transferred from the primary source (SWMUs and AOCs) to secondary sources (soil and groundwater). Transport mechanisms on Boeing property consist of leaching and infiltration from soil into groundwater and volatilization of VOCs in soil or groundwater into soil gas. Contaminants in soil gas could potentially migrate to indoor or ambient air; however, sampling and laboratory analysis has not detected VOCs in indoor or ambient air on Boeing property. Exposure pathways through which human receptors could be exposed on Boeing property include:

- Ingestion of or dermal contact with soil or inhalation of soil particulates,
- Ingestion of or dermal contact with groundwater[38], and
- Inhalation of ambient/trench air (e.g., in an open trench) or indoor air.

Potential receptors on Boeing property include industrial workers and temporary workers (e.g., construction workers or remediation workers). Sources, transport mechanisms, and exposure

[37] For the purpose of developing screening levels, protection of groundwater as drinking water was used because there is a potential for the aquifer to be used for drinking water in the future.
[38] Groundwater as a drinking water source is considered an incomplete pathway for all receptors.

pathways for industrial workers and temporary workers on Boeing property are presented in Figure 5-1. These exposure pathways were considered in development of screening levels in Sections 5.3.

Although MTCA requires consideration of terrestrial plants and animals that may potentially be exposed to hazardous substances, the Boeing property qualifies for exclusion from further TEE under WAC 173-340-7491 because all contaminated soil is covered by buildings, paved roads, pavement, or other physical barriers that will prevent exposure. Consequently, there are no terrestrial ecological exposure pathways on Boeing property. Additional information about exclusion from a TEE is presented in Section 5.2.

5.1.1.1 Industrial Workers

The exposure pathway for industrial workers is potentially complete for indoor air but is not a health concern because sampling data indicate that vapor intrusion is not currently occurring at buildings on Boeing property. VOCs were not detected in indoor air samples collected from Buildings 17-07 and 17-70 (LAI 2012g). Additionally, sub-slab samples collected below Building 17-12 did not indicate concentrations of VOCs in soil gas above screening levels protective of indoor air (see Section 5.3.4 for more information on air screening levels). Buildings 17-07, 17-70, and 17-12 were the only buildings on Boeing property identified as being at risk for vapor intrusion based on their proximity to groundwater VOC concentrations that exceeded vapor intrusion groundwater screening levels. Section 10.0 provides additional information about air investigations on Boeing property. All other potential exposure pathways identified in Sec 5.1.1 are incomplete for industrial workers.

5.1.1.2 Temporary Workers

Temporary workers include remediation workers who are conducting investigations or remediation activities and construction workers who are working on short-term construction projects that involve subsurface excavation. Exposure pathways for temporary workers include incidental contact with soil, inhalation of VOCs in air (e.g., while working in trenches), and incidental contact with groundwater. Exposure pathways for temporary workers related to soil and groundwater are potentially complete, but chronic exposures are not likely to occur (WDOH 2014b). Although this pathway is potentially complete, it is not a concern due to low concentrations of chemicals in these media and limited duration of exposure; additionally, the use of health and safety measures and personal protective equipment (PPE) while completing work reduces risk for temporary workers. The exposure pathways for temporary workers related to ambient or trench air is also potentially complete but is not a health concern based on the absence of VOC detections in ambient air samples collected to date. Additionally, health and safety monitoring for VOCs is routinely conducted during drilling and excavation activities at the site and VOCs have not been detected in air at unsafe levels during these activities. Sections 6.0 and 10.0 provide additional information about groundwater, soil, and air investigations on Boeing property. All other potential exposure pathways identified in Section 5.1.1 are incomplete.

5.1.2 Off Boeing Property Conceptual Site Model

Off Boeing property, the two VOC groundwater plumes (western plume and Area 1 plume) represent a secondary source of contamination due to contaminant migration from primary sources located on Boeing property. No primary sources of contamination related to Facility operations are located off Boeing property. Transport mechanisms, for off Boeing property, include subsurface flow of contaminated groundwater, discharge of contaminated groundwater to surface water, and volatilization of VOCs from groundwater into soil gas or indoor air. Potential exposure media include groundwater, surface water, ambient/trench air (e.g., in an open trench), and indoor air. Contaminated soil has not been detected outside of the Facility. Exposure pathways through which human receptors could be exposed off Boeing property include:

- Incidental ingestion of or dermal contact with groundwater[39]
- Incidental ingestion of or dermal contact with surface water
- Inhalation of ambient or trench air (e.g., while conducting remediation work or in an open trench)
- Inhalation of indoor air (if vapor intrusion occurs in the future), the indoor air inhalation exposure pathway is currently incomplete.

Human receptors off Boeing property include commercial workers, visitors to commercial buildings, temporary workers (e.g., construction workers or remediation workers), and residents. Sources, transport mechanisms, and exposure pathways for human receptors off Boeing property are presented on Figure 5-2.

5.1.2.1 Commercial Workers and Visitors

The inhalation of VOCs in indoor air may be a potentially complete exposure pathway for workers and visitors at commercial properties if conditions change in the future; however, sampling conducted to date indicates that vapor intrusion is not impacting indoor air at commercial properties. This pathway has been investigated at or adjacent to all commercial buildings in Auburn and Algona that were determined to potentially be at risk for vapor intrusion based on shallow groundwater concentrations. At all commercial properties where vapor intrusion studies have been completed, VOCs were either not detected or detected concentrations could not be positively attributed to vapor intrusion and were below indoor air screening levels protective of human health; therefore, inhalation via the vapor intrusion pathway is not a complete pathway. Section 10.0 provides additional information about air investigations off Boeing property. All other potential exposure pathways identified in Section 5.1.2 are incomplete for commercial workers and visitors.

5.1.2.2 Temporary Workers

Exposure pathways related to direct contact or incidental ingestion of groundwater and surface water are potentially complete for temporary workers. Exposure of temporary workers could include

[39] Groundwater as a drinking water source is considered an incomplete pathway for all receptors.

remediation workers, construction workers conducting deep excavations, or workers conducting maintenance on stormwater features. However, exposure is not currently a health concern for these groups because concentrations in affected media are low and are not expected to cause health effects for short-term exposure. An evaluation of short-term exposure of workers to surface water was conducted in the process of developing surface water screening levels for stormwater features; concentrations of VOCs in surface water were found to be well below levels that could potentially cause adverse health effects for workers (see Section 5.3.3 for more information). Additionally, the use of health and safety measures and PPE while completing work reduces exposure to potentially impacted media. Sections 8.0 and 9.0 present additional information about off Boeing property groundwater and surface water quality, respectively.

The exposure pathway related to ambient or trench air could be a potentially complete pathway, but this pathway does not present a health concern for temporary workers based on sampling to date and the absence of VOC detections in ambient air samples collected near VOC impacted media (i.e. Chicago Avenue ditch over-water air sampling, see Section 10.2.3). Additionally, health and safety monitoring for VOCs, routinely conducted during all RI activities, has not detected harmful concentrations of VOCs in ambient air near affected media. Concentrations of VOCs in groundwater appear to be insufficient to cause adverse impacts to ambient air. Although there are currently no indications of VOC impacts to ambient air, routine air monitoring is an appropriate protective measure when conducting subsurface work in areas with shallow groundwater or soil gas impacted by VOCs. Section 10.0 provides additional information about air investigations off Boeing property. All other potential exposure pathways identified in Section 5.1.2 are incomplete for temporary workers.

5.1.2.3 Residents

The exposure pathway related to surface water is potentially complete for residents in Algona where concentrations of VOCs below screening levels have been detected in stormwater ditches and yards. However, the VOC detections in both stormwater ditches and water in yards in residential Algona are below health-based screening levels and WDOH has reported that the levels of VOCs are not expected to cause health problems for people who come into contact with the water (WDOH 2013). Additional discussion of surface water quality is presented in Section 9.0.

The exposure pathway related to inhalation of indoor air impacted by vapor intrusion is potentially complete. This pathway has been investigated at residences in Algona that were determined by Ecology to be at risk for vapor intrusion. The results of the indoor air studies in residential Algona indicate vapor intrusion is not adversely affecting indoor air. Although VOCs were detected occasionally in indoor air, the detections appear to be related to background sources (chemicals stored or used by occupants) and not to vapor intrusion. All indoor air detections, except one sample where a background source was the cause of the detection, were below applicable screening levels. Additional discussion and results of vapor intrusion investigations are presented in Section 10.0. All other potential exposure pathways identified in Section 5.1.2 are incomplete for residents.

5.2 Terrestrial Ecological Evaluation

WAC 173-340-7490 and 173-340-7491 describe procedures for determining whether a release of hazardous substances to soil may pose a threat to the terrestrial environment, and whether a site may be exempt from further TEE. A site is exempt from TEE if soil contaminated with hazardous substances is or will be covered by buildings, pavement, or other physical barriers that prevent plants or wildlife from being exposed to the soil contamination. To qualify for this exclusion, an institutional control is required. All soil contamination at the Site is located within the Facility in areas that are currently covered by buildings and pavement. Land use at the Site is expected to remain as is for the foreseeable future. As part of the cleanup action at the Site, Boeing plans to implement institutional controls limiting future land use in compliance with the TEE exemption.

5.3 Screening levels

Screening levels are tools used to help remediation professionals and regulators evaluate RI data and are typically established as concentrations for each compound and media of potential concern at a site. Screening levels are often established at the most conservative regulatory concentrations in order to ensure that appropriate analytical methods are employed, but may also be set at health-based concentrations to evaluate potential health risk. Screening levels are not cleanup levels; cleanup levels are typically developed during the FS phase of the project and are often different than the screening levels for a particular compound or media. Cleanup standards, also typically developed during the FS phase, include cleanup levels; the point of compliance, the location where cleanup levels must be met; and other regulatory requirements that apply to the Site.

Soil, groundwater, surface water, and air screening levels were developed based on the CSM and MTCA requirements, as described below. Some screening levels for groundwater and soil presented in this document have been revised from those included in the original RI work plan (Geomatrix 2003b) because Ecology has made updates to the published regulatory limits. Screening levels for surface water and air were not included in the original RI work plan because they were not identified as media of potential concern until later in the RI. Original screening levels for groundwater and soil included in the RI work plan are provided in Appendix J.

5.3.1 Soil Screening Levels

Soil screening levels were developed for unrestricted land use in accordance with WAC 173-340-740 using MTCA Method B. Although it appears the Facility will meet the MTCA definition for an industrial property, Ecology has not made a determination that industrial land use represents the reasonable maximum exposure. Basing screening levels on unrestricted land use provides a conservative evaluation of constituents for initial screening of data and addresses potential exposure pathways identified in the CSM, including potential exposure of future receptors if the Facility use changes and protection of groundwater that could potentially be used as drinking water in the future. Under MTCA Method B, soil cleanup levels must be at least as stringent as all of the following:

- Concentrations established under applicable state and federal laws
- Concentrations determined using MTCA Equations 740-1 or 740-2
- Concentrations protective of groundwater.

These criteria were considered during development of soil screening levels. Soil screening levels were developed for all constituents detected in soil. Soil screening levels and the basis for their development are presented in Table 5-1.

Site groundwater data was used to make an empirical demonstration that some constituents detected in soil will not cause an exceedance of groundwater screening levels in accordance with WAC-173-340-747. The criteria in WAC-173-340-747(9) for an empirical demonstration include:

- The measured groundwater concentration is less than or equal to the groundwater screening level.
- The measured soil concentration will not cause an exceedance of the groundwater screening level in the future.

If a constituent is not detected in groundwater above the screening level, then soil concentrations are not causing an exceedance of groundwater screening levels. Table 5-1 identifies which constituents exceed groundwater screening levels and which do not. Additionally, given the age of the historical releases (mostly before the mid-1970s[40]) and the limited opportunity for infiltration in source areas (source areas are paved or covered by buildings), it is unlikely that that soil concentrations will cause future exceedances of groundwater cleanup levels.

For constituents that exceed groundwater screening levels, both human direct contact and protection of groundwater as drinking water were evaluated. The soil screening levels were then set at the lower of the two concentrations, and then, if appropriate, adjusted for natural background (Ecology 1994b).

The only detected constituents for which concentrations have been established under other applicable state and federal laws besides MTCA are PCBs. PCB cleanup levels are established under the Toxic Substances Control Act (TSCA) for high occupancy uses at 1.0 milligram per kilogram (mg/kg). Therefore, for PCBs, the screening levels were set at the lowest of the TSCA cleanup level and the concentration protective of direct human contact[41].

Standard MTCA Method B formula values for unrestricted land use protective of direct human contact were determined in accordance with WAC 173 340 740(3) using MTCA equations 740-1 and 740-2 for constituents in soil that did not exceed groundwater screening levels. For lead, mercury, and

[40] TCE use in vapor degreasers had mostly ceased by the mid-1970s (Boeing 1976a, b). The most likely sources of TCE releases at the Site appear to date back to an approximate 10-year period between 1966 and 1976 when vapor degreasers at the Facility used TCE. Use of TCE in vapor degreasers was discontinued around 1976 when Boeing converted the degreasers to use TCA. TCE was continually used at the Facility in small quantities (spray cans and small mobile cold degreasing stations) up until the 1990s; however, the potential for a release from small quantity containers or units is low.

[41] PCBs have not been detected in groundwater at the Site; therefore, existing soil concentrations are protective of groundwater.

petroleum hydrocarbon results, screening levels were set at the Method A soil cleanup levels for unrestricted land uses because appropriate Method B values are not available. Additional explanation on the use of Method A values for lead, mercury, and petroleum hydrocarbons is provided below.

Lead and mercury do not have soil Method B values for direct contact, but do have a Method A value, which is protective of human health. Neither constituent exceeds applicable screening levels in groundwater; therefore, protection of groundwater values are not applicable to soil.

Standard soil Method B values are not available for diesel- and oil-range petroleum hydrocarbons (DRO and ORO). To calculate Method B values for DRO and ORO, samples must be analyzed for petroleum fractions (extractable petroleum hydrocarbons [EPH]) and other constituents. EPH analysis consists of analysis of aromatic and aliphatic hydrocarbons in specific carbon range (e.g., C10 to C12). EPH data are then entered into Ecology's workbook tool (Ecology 2007b). The calculated Method B values will vary depending on the composition of the sample. Ten soil samples where hydrocarbons were suspected were analyzed for EPH during the RI. The data were then entered into Ecology's workbook tool to calculate Method B values protective of direct contact and groundwater. The calculated Method B values were then compared to the Method A value of 2,000 mg/kg. The accuracy of the calculated values using the workbook is reduced with very low (less than 10 mg/kg) concentrations of petroleum hydrocarbons, so only samples with concentrations greater than 10 mg/kg were considered when evaluating calculated Method B values. Only two EPH samples had petroleum hydrocarbon concentrations greater than 10 mg/kg (ASB0171-17.5 and ASB0160R-17.5); the calculated Method B value for both samples (14,159 mg/kg and 16,078 mg/kg, respectively) is greater than the Method A value for unrestricted land use. Therefore, the lower Method A value was chosen as the screening level for the purpose of the RI. Additional EPH data may be collected and used in combination with the Ecology workbook to determine cleanup levels during the FS. The results of EPH screening evaluations are presented in Appendix K for each sample analyzed. The EPH results are discussed by SWMU or AOC in Section 6.0.

Where applicable, soil screening levels protective of groundwater were determined using the fixed parameter three-phase partitioning model in accordance with WAC 173-340-747(4) for all constituents except TPH. The three-phase model provides a conservative estimate of the concentration of a constituent in soil that is protective of groundwater. Finally, the soil screening levels for metals were adjusted to be no less than natural background in accordance with WAC 173-340-740(5)(c). The screening levels for arsenic, cadmium, copper, and zinc were adjusted upward to the natural background levels published by Ecology (Ecology 1994b)

5.3.2 Groundwater Screening Levels

Groundwater screening levels were developed for detected constituents using standard MTCA Method B (WAC 173-340-720[4]). Groundwater at the Site is not used as drinking water; however, to provide a conservative evaluation of constituents and to address potential future use of groundwater

impacted by releases from the Facility as drinking water, screening levels were based on drinking water as the highest potential beneficial use for groundwater. Under MTCA Method B, groundwater cleanup levels must be at least as stringent as all of the following:

- Concentrations established under state and federal laws
- Concentrations protective of surface water beneficial uses unless hazardous substances are not likely to reach surface water
- Concentrations determined using MTCA Equations 720-1 or 720-2, if sufficiently protective; health-based criteria have not been established under applicable state and federal laws.

Screening levels were established based on these cleanup level requirements. Although MTCA allows for a maximum carcinogenic risk of $1x10^{-5}$ for constituents for which MCLs have been established under applicable state or federal laws, screening levels were based on a maximum carcinogenic risk of $1x10^{-6}$. Screening levels were set at the lowest of the federal and state MCLs, if applicable, and the MTCA Method B formula value (calculated using MTCA Equation 720-1 for non-carcinogens and Equation 720-2 for carcinogens). If no federal or state criteria were available, the MTCA Method B formula value was used as the screening criterion. Groundwater screening levels are presented in Table 5-2.

5.3.3 Surface Water Screening levels

Constituents of concern in surface water include TCE and VC[42]. Other detected VOCs in surface water include PCE, cDCE, acetone, carbon disulfide, chloroform, and toluene; however, with the exception of cDCE, these constituents are not associated with the Boeing groundwater plumes.

Surface water screening levels for Mill Creek and associated wetlands were developed in accordance with the MTCA cleanup regulation (WAC 173-340-730, surface water standards). Under MTCA, applicable state and federal laws must be considered in addition to water quality standards developed using MTCA Method B. Surface water standards developed under MTCA include consideration of applicable, relevant, and appropriate requirements (ARARs) including consideration of federal water quality criteria developed under the Clean Water Act and National Toxics Rule. Water quality criteria are determined at the state and federal level and use exposure assumptions related to beneficial use as drinking water, consumption of aquatic organisms, and protection of aquatic organisms to determine acceptable concentrations. Due to the unique surface water features in the vicinity and varied potential exposure scenarios, Site-specific surface water screening levels for TCE and VC were developed based on human health risk for several surface water features including stormwater features and standing water not connected to other surface water features (typically in yards). Site-specific screening levels were developed in consultation with WDOH and Ecology and were based on estimates of the highest beneficial use and the reasonable maximum exposure expected to occur

[42] Screening levels for other VOCs that are not constituents of concern, when available, are shown in Table 5-4. Surface water screening levels based on reasonable maximum exposure scenarios were not developed for VOCs that are not constituents of concern in surface water.

under both current and potential future Site use conditions. The Site-specific screening levels were based on modified Method B calculations that incorporate ingestion, dermal contact, and inhalation.

For the purpose of developing TCE and VC screening levels, surface water has been divided into four areas based on the types of features present in each area. The screening levels for Mill Creek and associated wetlands are based on applicable criteria for drinking water and fish consumption. For wetlands that are not a drinking water source, screening levels are based on applicable criteria for fish consumption only. No criteria for protection of aquatic organisms are available for the detected compounds in surface water. For stormwater control and conveyance features, Site-specific screening criteria were developed based on access either by children or by adult workers. The surface water screening level areas are identified in the bullets below and detailed descriptions of each area are provided in the following subsections:

- Area A - Mill Creek north of SR 18
- Area B - Wetlands west of SR 167 and south of SR 18, Wetlands east of SR 167 and north of SR 18 that may have connections to Mill Creek via culverts under SR 167 (Auburn Environmental Park)
- Area C - Stormwater ponds and stormwater infrastructure east of SR 167 between SR 18 and Boundary Boulevard
- Area D - Open stormwater ditches (e.g., Chicago Avenue ditch) and standing water east of SR 167 between Boundary Boulevard and 7th Avenue North in Algona.

Each of these areas is shown on Figure 5-4 along with the TCE and VC screening levels. A summary of the TCE and VC screening levels and rationale is provided for each area in the following sections. TCE and VC screening levels for each area are presented in Table 5-3, along with screening levels for other detected constituents in surface water.

5.3.3.1 Area A – Mill Creek

Surface water screening levels for Mill Creek are based on an assumption that although the creek is not currently used for drinking water, it may be used for drinking water at some point in the future. Domestic water supply is a listed use designation for the Green River and its tributaries (i.e., Mill Creek) under WAC 173-201A-602. Criteria considered[43] for Area A were:

- Washington State MTCA Method B criteria for surface water as drinking water
- Federal Clean Water Act
- National Recommended Water Quality Criteria (Clean Water Act [Section 304(a)]) for human health
- National Toxics Rule (40 Code of Federal Regulations 131.36)

[43] MTCA requires evaluation of other ARARs. In the case of potable surface water, both state and federal water quality criteria exist and were evaluated in determining the appropriate screening level.

- Water Quality Standards for Surface Waters of the State of Washington (Washington WQS) (WAC 173-201A and 40CFR 131.45)

The most stringent of the above criteria, Washington WQS, were used as the screening levels for TCE and VC in Area A. The final cleanup levels for surface water features in Area A may differ from the screening levels.

5.3.3.2 Area B – Wetlands West of State Route 167 and South of State Route 18

Area B comprises the wetland complex south of SR 18 between SR 167 and West Valley Highway and wetlands east of SR 167 and north of SR 18 that may have connections to Mill Creek via culverts under SR 167 (Auburn Environmental Park). Washington State Department of Natural Resources identified a portion of the wetland west of SR 167 as fish bearing. This area is a wetland and is not used for drinking water or fishing; however, consumption of fish was considered in this area because portions of the wetland may be used by fish that travel downstream to areas that are used for commercial or recreational fishing. The Washington WQS for consumption of organisms were used as screening levels for TCE and VC in Area B. The final cleanup levels for surface water features in Area B may differ from the screening levels.

5.3.3.3 Area C – Stormwater Ponds and Infrastructure East of State Route 167 in Auburn

Area C comprises the stormwater ponds and other stormwater infrastructure east of State Route (SR) 167 between Boundary Boulevard and SR 18. Health-based surface water screening levels for stormwater ditches in Algona were developed in consultation with Ecology and WDOH (Ecology 2013). The health-based screening levels were based on conservative exposure scenarios, such as workers cleaning the ditches, and included evaluation of dermal contact, inhalation, and incidental ingestion pathways. Ecology has not previously approved screening levels for Area C; however, the stormwater features in Area C can reasonably be expected to have a similar worker exposure scenario to the stormwater ditches in Algona and, thus, the health-based worker screening criteria for the Algona ditches were applied to stormwater ponds and infrastructure in Area C. The stormwater features in Area C are generally inaccessible by the public due to physical access limitations and it is highly unlikely that young children would be exposed to water in the ponds; therefore, a child exposure scenario was not considered for Area C. The health-based screening levels are used to evaluate potential health risk in the context of the RI Site conceptual model and exposure pathways; the final cleanup levels for surface water features in Area C may differ from the screening levels.

5.3.3.4 Area D – Stormwater Ditches East of State Route 167 in Algona

Ecology, in consultation with WDOH, has approved health-based surface water screening levels for stormwater ditches (e.g., Chicago Avenue ditch) in northern Algona based on conservative exposure scenarios for this type of surface water feature, such as children playing in the ditch or workers cleaning the ditches. These scenarios include an evaluation of dermal contact, inhalation, and incidental ingestion. The screening levels for Area D are based on the most conservative criteria for

multiple exposure scenarios[44]. The Algona ditch screening levels were provided for Ecology review in a technical memorandum (LAI 2013d). Ecology approved these screening levels for ditches in northern Algona (Ecology 2013). The health-based screening levels are used to evaluate potential health risk in the context of the RI Site conceptual model and exposure pathways; the final cleanup levels for surface water features in Area D may differ from the screening levels.

5.3.4 Air Screening Levels

Vapor intrusion screening levels were established for select compounds[45] in indoor air, soil gas, and groundwater (LAI 2012b). Indoor air screening levels were established based on reasonable maximum exposure for three scenarios – residential, commercial (worker based), and industrial, and applied based on land use. Groundwater and soil gas screening levels for vapor intrusion were developed based on indoor air screening levels for each exposure scenario. The development of the vapor intrusion screening levels was described in detail in the proposed cleanup levels and screening levels technical memorandum (LAI 2012b), and subsequently approved by Ecology (Ecology 2012a). Indoor air, soil gas, and vapor intrusion groundwater screening levels are summarized on Table 5-4. Appendix L provides detailed calculations for indoor air, soil gas, and groundwater vapor intrusion screening levels for PCE, TCE, and VC[46].

5.4 Indicator Hazardous Substances and Contaminants of Concern

IHSs are constituents that make a significant contribution to the overall exposure risk at a Site. IHSs are also considered in the evaluation of total Site risk. Total site risk evaluation will be conducted during the FS in conjunction with development of Site cleanup levels. For the purpose of this document, IHSs are not the same as constituents of concern. A constituent of concern may be any constituent that is considered important to the overall understanding of contaminant fate and transport in a given area or for a given media. For example, concentrations of cDCE at the Site do not exceed the screening level and do not significantly contribute to overall Site risk. However, cDCE is an important breakdown product of TCE and its presence and concentrations are important in understanding the fate and transport of TCE in groundwater. CDCE is considered a contaminant of concern for some media and specific areas of the Site, but is not an IHS for the purposes of evaluating total Site risk. Constituents of concern for individual areas and media are discussed in their respective sections of this report.

[44] For TCE the most conservative criterion is for worker exposure (58 µg/L for workers vs 77 µg/L for children); for VC the most conservative criterion is for children (15 µg/L for children vs 98 µg/L for workers). Differences are related to anticipated exposure frequency and duration and to differences in age-dependent toxicity.

[45] Compounds analyzed in air samples were selected in consultation with Ecology and based on compounds in groundwater (or soil) with concentrations suspected to pose a risk to indoor air.

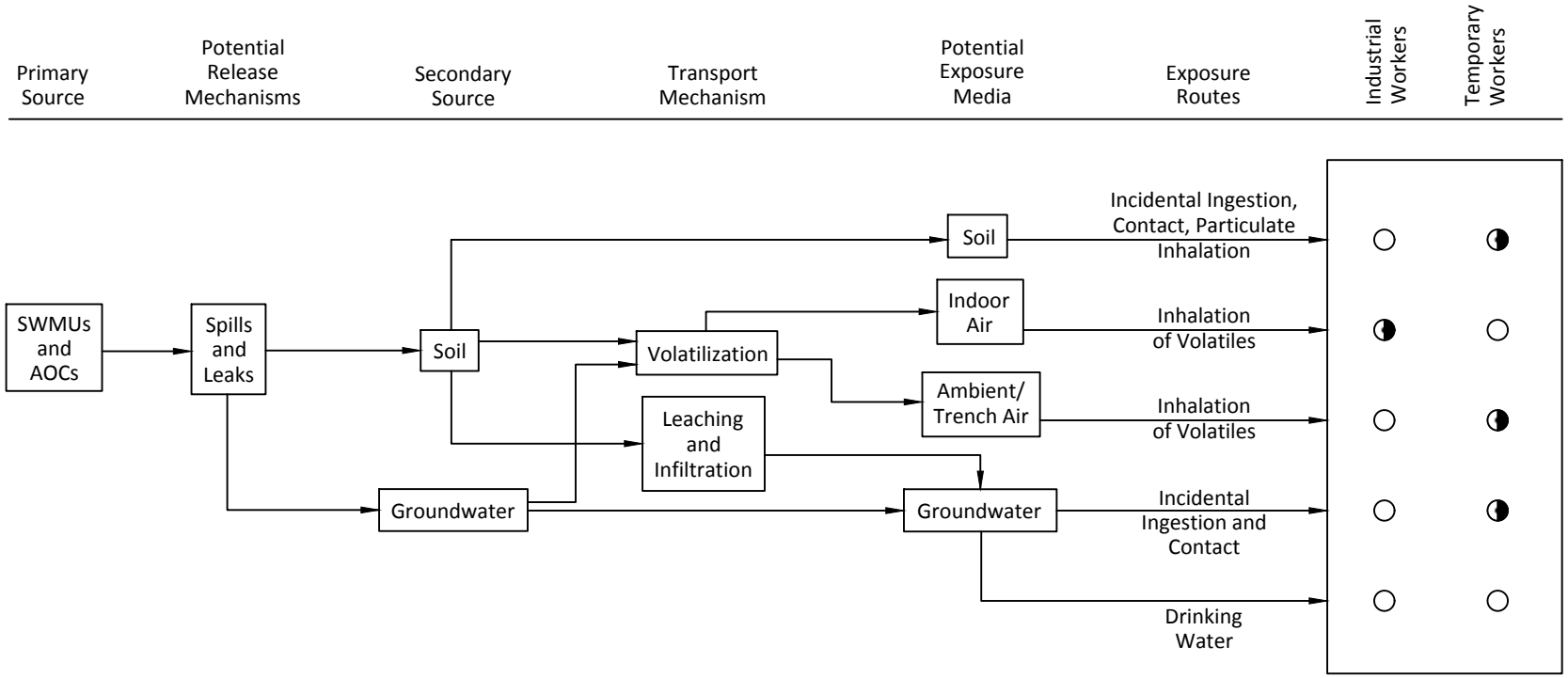
[46] Cis-1,2-DCE was evaluated as part of the RI vapor intrusion assessment but does not have indoor air screening levels due to a lack of inhalation toxicity values.

IHSs were selected by evaluating the contaminant data set for each media; requirements in WAC 173-340-703 were considered in the identification of IHSs. Contaminants that exceeded screening levels in more than 5 percent of samples for a given media were included as IHSs. No IHSs were selected for surface water because there were no exceedances of screening criteria in surface water. Additionally, no IHSs were selected for air because there was only one exceedance of a screening level in indoor air which was attributed to a background source.

For soil, the entire data set was evaluated. However, because most groundwater sample points (i.e., monitoring wells) are sampled over many years and concentrations change over time, the groundwater data set that was evaluated was selected as follows:

- For monitoring wells that have ongoing monitoring, all data for the last 3 years was included in the groundwater data set
- For currently sampled monitoring wells that previously were sampled for additional compounds that were discontinued (e.g. if a compound was previously removed from the analyte sampling list because it was not detected) and for monitoring wells that are no longer sampled, the most recent data for each compound sampled at that location was included in the groundwater data set
- For groundwater sampling locations that were sampled only once (borings and grab samples), all groundwater data from the location was included in the groundwater data set.

Tables 5-5 through 5-8 present summary statistics for soil, groundwater, surface water, and air, respectively. IHSs are listed on Table 5-9.



Legend

- ◑ Potentially complete exposure pathway
- ○ Incomplete exposure pathway
- ● Complete exposure pathway

Note

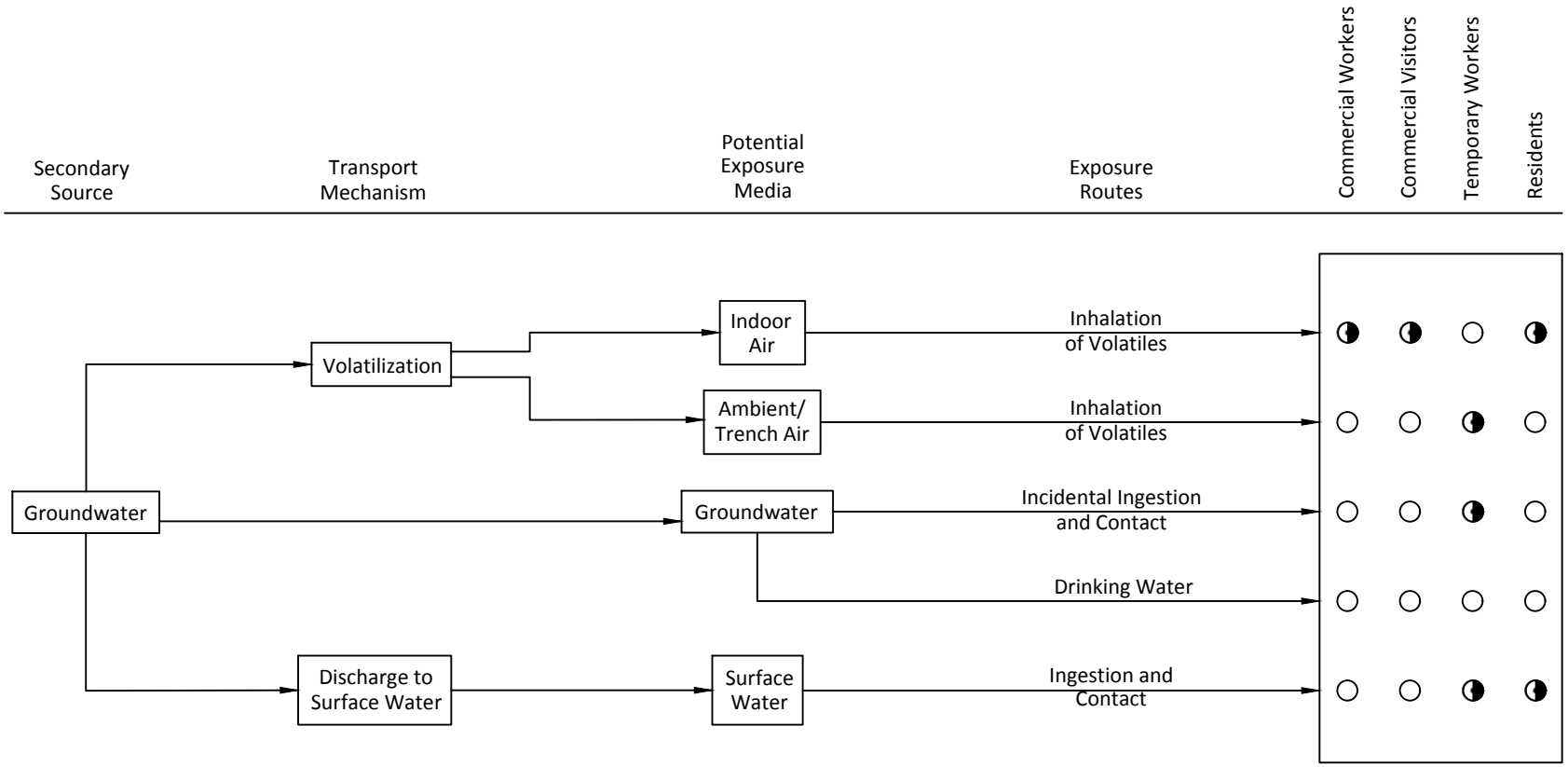
1. Temporary workers include remediation workers or construction workers engaged in subsurface excavation or exploration on short-term construction projects.

LANDAU ASSOCIATES

Boeing Auburn
Remedial Investigation
Auburn, Washington

Conceptual Site Model on Boeing Property

Figure 5-1



Legend

- ◑ Potentially complete exposure pathway
- ○ Incomplete exposure pathway
- ● Complete exposure pathway

Note

1. Temporary workers include remediation workers or construction workers engaged in subsurface excavation or exploration on short-term construction projects.

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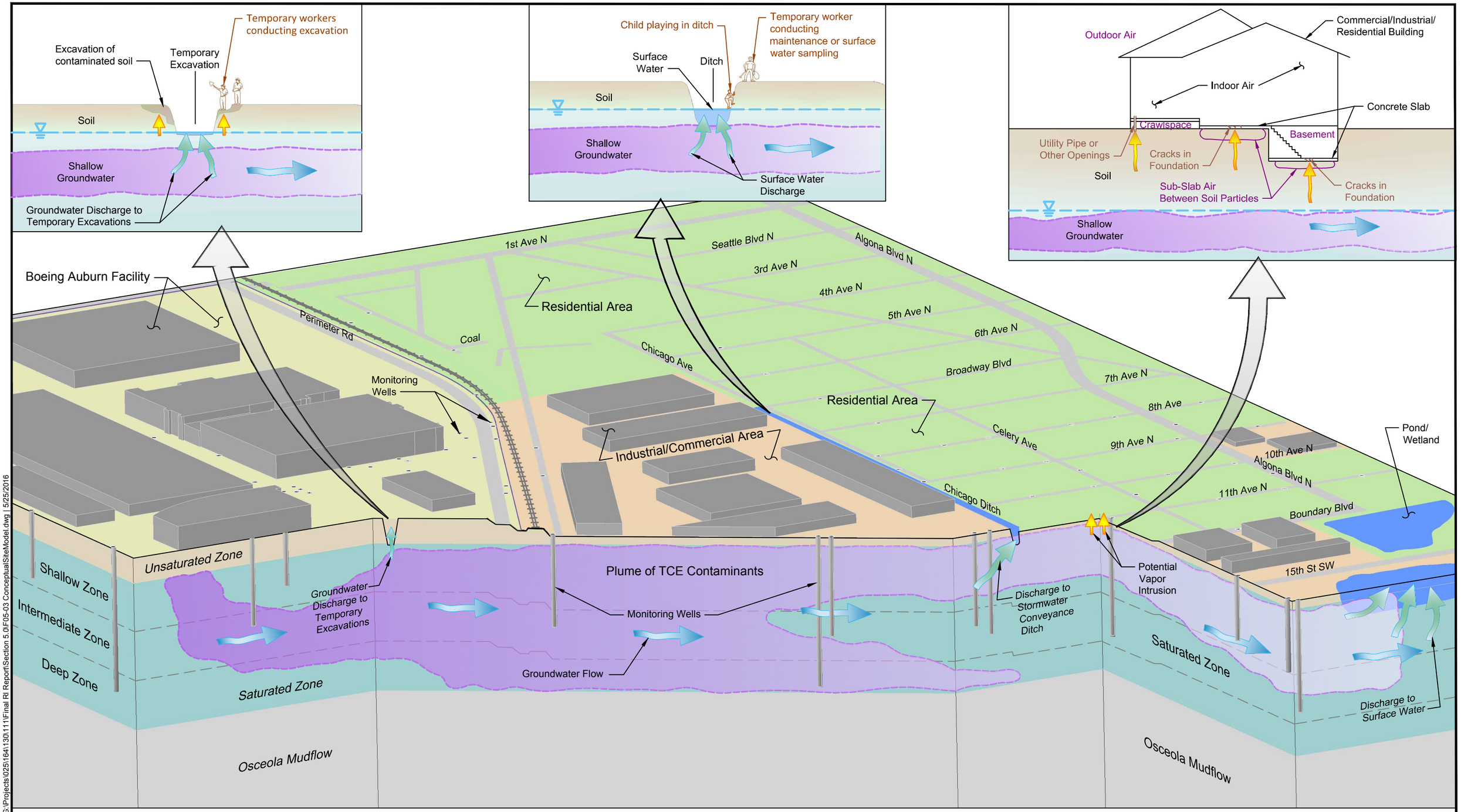
Boeing Auburn
Remedial Investigation
Auburn, Washington

Conceptual Site Model off Boeing Property

Figure 5-2



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Legend

- Groundwater Flow
- Surface Water Discharge
- Potential Vapor Intrusion

Not to scale

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Boeing Auburn Remedial Investigation Auburn, Washington	**Site-Wide Conceptual Site Model**	Figure 5-3

Notes

1. The locations of surface water features are approximate.
2. Screening levels shown include constituents of concern in surface water.
3. The health-based screening levels are used to evaluate potential health risk in the context of the RI. Final cleanup levels may differ from the screening levels shown for each area.
4. Health-based surface water screening levels for Areas C and D are based on incidental contact, inhalation, and ingestion. Surface water screening levels for Areas A and B are based on use as drinking water and/or the consumption of fish.
5. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

Legend

- Surface Water Sample
- Wetland Areas
- Open Waterways
- Piped Waterways
- City Limits
- Area A
- Area B
- Area C
- Area D

Screening Levels (µg/L)

	TCE	VC
Area A	0.3	0.02
Area B	0.7	0.18
Area C	58	98
Area D	58	15

N

0 800 1,600

Scale in Feet

Base Map Source: Geometrix 2003; Parcel Data Source: King County 2015; Aerial Photo Source: Esri World Imagery.

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Boeing Auburn Remedial Investigation Auburn, Washington	**Surface Water Screening Levels**	Figure 5-4

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Table 5-1
Soil Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	CAS	Soil Protective of Groundwater Vadose (mg/kg) (a)	Exceeds Screening Level in Groundwater	Direct Contact Pathway MTCA Method B: Unrestricted (b)		Laboratory LOQ (c)	Preliminary Screening Levels (mg/kg) (d)	Background Soil Metals Concentrations (mg/kg) (e)	Screening Levels (mg/kg)	Screening Levels in Final Units	Units
				carc. (mg/kg)	non-carc. (mg/kg)						
VOLATILES											
1,1,1-Trichloroethane	71-55-6	1.58E+00	X		1.60E+05		1.58E+00		1.58E+00	**1.58E+03**	µg/kg
1,1,2,2-Tetrachloroethane	79-34-5	1.23E-03	X	5.00E+00	1.60E+03		1.23E-03		1.23E-03	**1.23E+00**	µg/kg
1,1,2-Trichloroethane	79-00-5	4.27E-03	X	1.75E+01	3.20E+02		4.27E-03		4.27E-03	**4.27E+00**	µg/kg
1,1,2-Trichloro-1,2,2-Trifluoroethane	76-13-1	1.05E+04			2.40E+06		2.40E+06		2.40E+06	**2.40E+09**	µg/kg
1,1-Dichloroethane	75-34-3	4.19E-02	X	1.75E+02	1.60E+04		4.19E-02		4.19E-02	**4.19E+01**	µg/kg
1,1-Dichloroethene	75-35-4	5.01E-02	X		4.00E+03		5.01E-02		5.01E-02	**5.01E+01**	µg/kg
1,2,4-Trichlorobenzene	120-82-1	5.62E-02		3.45E+01	8.00E+02		3.45E+01		3.45E+01	**3.45E+04**	µg/kg
1,2,4-Trimethylbenzene	95-63-6	---		---	---		---		---	**---**	
1,2-Dichlorobenzene	95-50-1	7.03E+00			7.20E+03		7.20E+03		7.20E+03	**7.20E+06**	µg/kg
1,2-Dichloroethane	107-06-2	2.32E-03	X	1.10E+01	4.80E+02		2.32E-03		2.32E-03	**2.32E+00**	µg/kg
1,2-Dichloroethene (total)	540-59-0				7.20E+02		7.20E+02		7.20E+02	**7.20E+05**	µg/kg
1,2-Dichloropropane	78-87-5	6.25E-03		2.78E+01	7.20E+03		2.78E+01		2.78E+01	**2.78E+04**	µg/kg
1,3,5-Trimethylbenzene	108-67-8	---			8.00E+02		8.00E+02		8.00E+02	**8.00E+05**	µg/kg
1,3-Dichlorobenzene	541-73-1	---		---	---		---		---	**---**	
1,4-Dichlorobenzene	106-46-7	1.34E-01		1.85E+02	5.60E+03		1.85E+02		1.85E+02	**1.85E+05**	µg/kg
2-Butanone/MEK	78-93-3	1.96E+01			4.80E+04		4.80E+04		4.80E+04	**4.80E+07**	µg/kg
4-Isopropyltoluene	99-87-6	---		---	---		---		---	**---**	
4-Methyl-2-Pentanone (MIBK)	108-10-1	4.23E+00			6.40E+03		6.40E+03		6.40E+03	**6.40E+06**	µg/kg
Acetone	67-64-1	2.89E+01			7.20E+04		7.20E+04		7.20E+04	**7.20E+07**	µg/kg
Benzene	71-43-2	4.48E-03	X	1.82E+01	3.20E+02		4.48E-03		4.48E-03	**4.48E+00**	µg/kg
Bromodichloromethane	75-27-4	3.96E-03		1.61E+01	1.60E+03		1.61E+01		1.61E+01	**1.61E+04**	µg/kg
Bromoform	75-25-2	3.63E-02		1.27E+02	1.60E+03		1.27E+02		1.27E+02	**1.27E+05**	µg/kg
Bromomethane	74-83-9	5.18E-02			1.12E+02		1.12E+02		1.12E+02	**1.12E+05**	µg/kg
Carbon Disulfide	75-15-0	5.65E+00			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	µg/kg
Carbon Tetrachloride	56-23-5	5.75E-03		1.43E+01	3.20E+02		1.43E+01		1.43E+01	**1.43E+04**	µg/kg
Chlorobenzene	108-90-7	8.74E-01			1.60E+03		1.60E+03		1.60E+03	**1.60E+06**	µg/kg
Chloroform	67-66-3	7.51E-03	X	3.23E+01	8.00E+02		7.51E-03		7.51E-03	**7.51E+00**	µg/kg
Chloromethane	74-87-3	---									µg/kg
cis-1,2-Dichloroethene	156-59-2	8.00E-02	X		1.60E+02		8.00E-02		8.00E-02	**8.00E+01**	µg/kg
cis-1,3-Dichloropropene	10061-01-5	---		---	---		---		---	**---**	
Dibromochloromethane	124-48-1	2.77E-03		1.19E+01	1.60E+03		1.19E+01		1.19E+01	**1.19E+04**	µg/kg
Ethylbenzene	100-41-4	6.05E+00	X		8.00E+03		6.05E+00		6.05E+00	**6.05E+03**	µg/kg
Hexachlorobutadiene	87-68-3	6.05E-01		1.28E+01	8.00E+01		1.28E+01		1.28E+01	**1.28E+04**	µg/kg
Isopropylbenzene	98-82-8	---			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	µg/kg
m,p-Xylene	NA	1.46E+01					1.46E+01		1.46E+01	**1.46E+04**	µg/kg
Methylene Chloride	75-09-2	2.18E-02	X	5.00E+02	4.80E+02		2.18E-02		2.18E-02	**2.18E+01**	µg/kg
Naphthalene	91-20-3	4.46E+00			1.60E+03		1.60E+03		1.60E+03	**1.60E+06**	µg/kg
n-Butylbenzene	104-51-8	---			4.00E+03		4.00E+03		4.00E+03	**4.00E+06**	µg/kg
n-Propylbenzene	103-65-1	---			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	µg/kg
o-Xylene	95-47-6	1.46E+01	X		1.60E+04		1.46E+01		1.46E+01	**1.46E+04**	µg/kg
sec-Butylbenzene	135-98-8	---			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	µg/kg
Styrene	100-42-5	2.24E+00			1.60E+04		1.60E+04		1.60E+04	**1.60E+07**	µg/kg
Tetrachloroethene	127-18-4	5.30E-02		4.76E+02	4.80E+02		4.76E+02		4.76E+02	**4.76E+05**	µg/kg
Toluene	108-88-3	4.65E+00	X		6.40E+03		4.65E+00		4.65E+00	**4.65E+03**	µg/kg
trans-1,2-Dichloroethene	156-60-5	5.43E-01			1.60E+03		1.60E+03		1.60E+03	**1.60E+06**	µg/kg
trans-1,3-Dichloropropene	10061-02-6	---		---	---		---		---	**---**	
Trichloroethene	79-01-6	3.57E-03	X	1.20E+01	4.00E+01		3.57E-03		3.57E-03	**3.57E+00**	µg/kg
Trichlorofluoromethane	75-69-4	3.39E+01			2.40E+04		2.40E+04		2.40E+04	**2.40E+07**	µg/kg
Vinyl Acetate	108-05-4	3.31E+01			8.00E+04		8.00E+04		8.00E+04	**8.00E+07**	µg/kg
Vinyl Chloride	75-01-4	1.83E-04	X	6.70E-01	2.40E+02	1.00E-03	1.00E-03		1.00E-03	**1.00E+00**	µg/kg
Xylene	1330-20-7	1.46E+01	X		1.60E+04		1.46E+01		1.46E+01	**1.46E+04**	µg/kg
METALS											
Aluminum	7429-90-5	---			8.00E+04		8.00E+04	32,600	8.00E+04	**8.00E+04**	mg/kg
Antimony	7440-36-0	5.42E+00	X		3.20E+01		5.42E+00		5.42E+00	**5.42E+00**	mg/kg
Arsenic	7440-38-2	4.67E+00	X	6.67E-01	2.40E+01		6.67E-01	7	7.00E+00	**7.00E+00**	mg/kg
Barium	7440-39-3	1.65E+03			1.60E+04		1.60E+04		1.60E+04	**1.60E+04**	mg/kg
Beryllium	7440-41-7	6.32E+01			1.60E+02		1.60E+02	0.6	1.60E+02	**1.60E+02**	mg/kg
Cadmium	7440-43-9	6.90E-01	X		8.00E+01		6.90E-01	1	1.00E+00	**1.00E+00**	mg/kg

Table 5-1
Soil Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	CAS	Soil Protective of Groundwater Vadose (mg/kg) (a)	Exceeds Screening Level in Groundwater	Direct Contact Pathway MTCA Method B: Unrestricted (b)		Laboratory LOQ (c)	Preliminary Screening Levels (mg/kg) (d)	Background Soil Metals Concentrations (mg/kg) (e)	Screening Levels (mg/kg)	Screening Levels in Final Units	Units
				carc. (mg/kg)	non-carc. (mg/kg)						
Chromium III	16065-83-1	---			1.20E+05		1.20E+05	48	1.20E+05	**1.20E+05**	**mg/kg**
Cobalt	7440-48-4	---		---	---		---		---	**---**	
Copper	7440-50-8	2.84E+02	X		3.20E+03		2.84E+02	36	2.84E+02	**2.84E+02**	**mg/kg**
Chromium, Hexavalent	18540-29-9	1.84E+01	X		2.40E+02		1.84E+01		1.84E+01	**1.84E+01**	**mg/kg**
Iron	7439-89-6	5.64E+03			5.60E+04		5.60E+04	36,100	5.60E+04	**5.60E+04**	**mg/kg**
Lead	7439-92-1	3.00E+03			250 (f)		2.50E+02	24	2.50E+02	**2.50E+02**	**mg/kg**
Manganese	7439-96-5	---	X		1.12E+04		1.12E+04	1,200	1.12E+04	**1.12E+04**	**mg/kg**
Mercury	7439-97-6	2.09E+00			2 (f)		2	0.07	2	2	**mg/kg**
Nickel	7440-02-0	1.30E+02	X		1.60E+03		1.30E+02	48	1.30E+02	**1.30E+02**	**mg/kg**
Selenium	7782-49-2	5.20E+00			4.00E+02		4.00E+02		4.00E+02	**4.00E+02**	**mg/kg**
Silver	7440-22-4	1.36E+01			4.00E+02		4.00E+02		4.00E+02	**4.00E+02**	**mg/kg**
Thallium	7440-28-0	2.28E-01	X		8.00E-01		2.28E-01	1(g)	1.00E+00	**1.00E+00**	**mg/kg**
Titanium	7440-32-6	---		---	---		---		---	**---**	
Vanadium	7440-62-2	1.60E+03	X		4.00E+02		4.00E+02		4.00E+02	**4.00E+02**	**mg/kg**
Zinc	7440-66-6	5.97E+03			2.40E+04		2.40E+04	85	2.40E+04	**2.40E+04**	**mg/kg**
CYANIDE											
Cyanide	57-12-5		X		4.80E+01		4.80E+01		4.80E+01	**4.80E+01**	**mg/kg**
SEMI-VOLATILES											
1-Methylnaphthalene	90-12-0	---	X	3.45E+01	5.60E+03		3.45E+01		3.45E+01	**3.45E+04**	**µg/kg**
2,2'-Oxybis(1-Chloropropane)	108-60-1	3.27E-03		1.43E+01	3.20E+03		1.43E+01		1.43E+01	**1.43E+04**	**µg/kg**
2,4,5-Trichlorophenol	95-95-4	2.88E+01			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	**µg/kg**
2,4,6-Trichlorophenol	88-06-2	4.62E-02		9.09E+01	8.00E+01		8.00E+01		8.00E+01	**8.00E+04**	**µg/kg**
2,4-Dichlorophenol	120-83-2	1.67E-01			2.40E+02		2.40E+02		2.40E+02	**2.40E+05**	**µg/kg**
2,4-Dimethylphenol	105-67-9	1.31E+00			1.60E+03		1.60E+03		1.60E+03	**1.60E+06**	**µg/kg**
2,4-Dinitrophenol	51-28-5	1.28E-01			1.60E+02		1.60E+02		1.60E+02	**1.60E+05**	**µg/kg**
2,4-Dinitrotoluene	121-14-2	1.67E-03		3.23E+00	1.60E+02		3.23E+00		3.23E+00	**3.23E+03**	**µg/kg**
2,6-Dinitrotoluene	606-20-2	3.14E-04		6.67E-01	2.40E+01		6.67E-01		6.67E-01	**6.67E+02**	**µg/kg**
2-Chloronaphthalene	91-58-7	2.31E+01			6.40E+03		6.40E+03		6.40E+03	**6.40E+06**	**µg/kg**
2-Chlorophenol	95-57-8	4.72E-01			4.00E+02		4.00E+02		4.00E+02	**4.00E+05**	**µg/kg**
2-Methylnaphthalene	91-57-6	---			3.20E+02		3.20E+02		3.20E+02	**3.20E+05**	**µg/kg**
2-Methylphenol	95-48-7	2.33E+00			4.00E+03		4.00E+03		4.00E+03	**4.00E+06**	**µg/kg**
3,3'-Dichlorobenzidine	91-94-1	3.59E-03		2.22E+00			2.22E+00		2.22E+00	**2.22E+03**	**µg/kg**
4-Chloroaniline	106-47-8	1.16E-03		5.00E+00	3.20E+02		5.00E+00		5.00E+00	**5.00E+03**	**µg/kg**
4-Methylphenol	106-44-5	3.94E+00			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	**µg/kg**
Acenaphthene	83-32-9	9.79E+01			4.80E+03		4.80E+03		4.80E+03	**4.80E+06**	**µg/kg**
Anthracene	120-12-7	2.27E+03			2.40E+04		2.40E+04		2.40E+04	**2.40E+07**	**µg/kg**
Benzo(a)anthracene	56-55-3	---		1.37E+00			(h)		(h)	**(h)**	**µg/kg**
Benzo(a)pyrene	50-32-8	2.33E-01		1.37E-01			1.37E-01		1.37E-01	**1.37E+02**	**µg/kg**
Benzo(b)fluoranthene	205-99-2	---		1.37E+00			(h)		(h)	**(h)**	**µg/kg**
Benzo(g,h,i)perylene	191-24-2	---					---		---	**---**	
Benzo(k)fluoranthene	207-08-9	---		1.37E+01			(h)		(h)	**(h)**	**µg/kg**
Benzoic Acid	65-85-0	2.57E+02			3.20E+05		3.20E+05		3.20E+05	**3.20E+08**	**µg/kg**
Benzyl Alcohol	100-51-6	3.36E+00			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	**µg/kg**
Bis-(2-Chloroethyl) Ether	111-44-4	2.20E-04		9.09E-01			9.09E-01		9.09E-01	**9.09E+02**	**µg/kg**
bis(2-Ethylhexyl)phthalate	117-81-7	1.34E+01	X	7.14E+01	1.60E+03		1.34E+01		1.34E+01	**1.34E+04**	**µg/kg**
Butylbenzylphthalate	85-68-7	1.28E+01		5.26E+02	1.60E+04		5.26E+02		5.26E+02	**5.26E+05**	**µg/kg**
Carbazole	86-74-8	---									**µg/kg**
Chrysene	218-01-9	---		1.37E+02			(h)		(h)	**(h)**	**µg/kg**
Dibenz(a,h)anthracene	53-70-3	---		1.37E-01			(h)		(h)	**(h)**	**µg/kg**
Diethylphthalate	84-66-2	7.22E+01			6.40E+04		6.40E+04		6.40E+04	**6.40E+07**	**µg/kg**
Dimethylphthalate	131-11-3	---									
Di-n-Butylphthalate	84-74-2	5.65E+01			8.00E+03		8.00E+03		8.00E+03	**8.00E+06**	**µg/kg**
Di-n-Octyl phthalate	117-84-0	2.66E+05			8.00E+02		8.00E+02		8.00E+02	**8.00E+05**	**µg/kg**
Fluoranthene	206-44-0	6.31E+02			3.20E+03		3.20E+03		3.20E+03	**3.20E+06**	**µg/kg**
Fluorene	86-73-7	1.01E+02			3.20E+03		3.20E+03		3.20E+03	**3.20E+06**	**µg/kg**
Hexachlorobenzene	118-74-1	8.77E-02		6.25E-01	6.40E+01		6.25E-01		6.25E-01	**6.25E+02**	**µg/kg**
Hexachlorocyclopentadiene	77-47-4	1.92E+02			4.80E+02		4.80E+02		4.80E+02	**4.80E+05**	**µg/kg**
Hexachloroethane	67-72-1	4.36E-02		2.50E+01	5.60E+01		2.50E+01		2.50E+01	**2.50E+04**	**µg/kg**
Indeno(1,2,3-cd)pyrene	193-39-5	---		1.37E+00			(h)		(h)	**(h)**	**µg/kg**

Table 5-1
Soil Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	CAS	Soil Protective of Groundwater Vadose (mg/kg) (a)	Exceeds Screening Level in Groundwater	Direct Contact Pathway MTCA Method B: Unrestricted (b)		Laboratory LOQ (c)	Preliminary Screening Levels (mg/kg) (d)	Background Soil Metals Concentrations (mg/kg) (e)	Screening Levels (mg/kg)	Screening Levels in Final Units	Units
				carc. (mg/kg)	non-carc. (mg/kg)						
Isophorone	78-59-1	2.27E-01		1.05E+03	1.60E+04		1.05E+03		1.05E+03	**1.05E+06**	µg/kg
Nitrobenzene	98-95-3	1.02E-01			1.60E+02		1.60E+02		1.60E+02	**1.60E+05**	µg/kg
N-Nitroso-Di-N-Propylamine	621-64-7	5.60E-05	X	1.43E-01		3.30E-02	3.30E-02		3.30E-02	**3.30E+01**	µg/kg
N-Nitrosodiphenylamine	86-30-6	5.32E-01		2.04E+02			2.04E+02		2.04E+02	**2.04E+05**	µg/kg
Pentachlorophenol	87-86-5	3.47E-03		2.50E+00	4.00E+02		2.50E+00		2.50E+00	**2.50E+03**	µg/kg
Phenanthrene	85-01-8	---		---	---		---		---	**---**	
Phenol	108-95-2	1.10E+01			2.40E+04		2.40E+04		2.40E+04	**2.40E+04**	µg/kg
Pyrene	129-00-0	6.55E+02			2.40E+03		2.40E+03		2.40E+03	**2.40E+03**	µg/kg
PETROLEUM HYDROCARBONS											
Diesel-Range Organics	DRO		X		2,000 (f)		2,000 (f)		2,000 (f)	**2,000 (f)**	mg/kg
Gasoline-Range Organics	GRO		X		100 (f,i)		100 (f,i)		100 (f,i)	**100 (f,i)**	mg/kg
Oil-Range Organics	ORO		X		2,000 (f)		2,000 (f)		2,000 (f)	**2,000 (f)**	mg/kg
PESTICIDES											
Aroclor 1016	12674-11-2			1.43E+01	5.60E+00		5.60E+00		5.60E+00	**5.60E+03**	µg/kg
Aroclor 1221	11104-28-2						(j)		(j)	**(j)**	
Aroclor 1232	11141-16-5						(j)		(j)	**(j)**	
Aroclor 1242	53469-21-9						(j)		(j)	**(j)**	
Aroclor 1248	12672-29-6						(j)		(j)	**(j)**	
Aroclor 1254	11097-69-1			5.00E-01	1.60E+00		5.00E-01		5.00E-01	**5.00E+02**	µg/kg
Aroclor 1260	11096-82-5			5.00E-01			5.00E-01		5.00E-01	**5.00E+02**	µg/kg
Total PCBs	1336-36-3	2.71E-01		0.5 (k)			5.00E-01		5.00E-01	**5.00E+02**	µg/kg
DDD	72-54-8			4.17E+00			4.17E+00		4.17E+00	**4.17E+03**	µg/kg
DDT	50-29-3	3.49E+00		2.94E+00	4.00E+01		2.94E+00		2.94E+00	**2.94E+03**	µg/kg
Methoxychlor	72-43-5				4.00E+02		4.00E+02		4.00E+02	**4.00E+05**	µg/kg

Notes:

(a) Soil protective of groundwater vadose @ 25 degrees Celsius; see guidance equation 747-1.
(b) Direct contact pathway (ingestion only) MTCA Method B: Unrestricted Land Use Standard Formula Value
(c) Where LOQ is not listed, the LOQ is less than the groundwater screening level.
(d) Before adjustment for background.
(e) Puget Sound Region 90th percentile value (Ecology. 1994. Natural Background Soil Metals Concentrations in Washington State. Publication #94-115.)
(f) MTCA Method A soil cleanup levels for unrestricted land uses are used for lead, mercury, and petroleum hydrocarbons.
(g) Kabata-Pendias, A. 2001. Trace Elements in Soils and Plants, Third Edition. 2001.
'Bradford, G.R. et al. 1996. Background concentrations of Trace and Major Elements in California Soils. March.
(h) Evaluated using toxic equivalent concentration based on benzo(a)pyrene.
(i) For gasoline mixtures without benzene and the total of ethylbenzene, toluene and xylene is less than 1 percent of the gasoline mixture.
(j) Evaluated using screening level for total polychlorinated biphenyls.
(k) Toxic Substances Control Act soil cleanup level for high occupancy areas is 1 mg/kg.

1. If the analyte exceeded screening levels in groundwater, the soil screening level is based on the lowest of soil cleanup level for protection of groundwater and protection of human direct contact (Method B standard formula values for carcinogens and non-carcinogens). If the analyte did not exceed screening levels in groundwater, the soil screening level is based on direct contact.
2. Where applicable, laboratory quantitation limits and natural background concentrations were considered.
3. Screening levels are developed for all constituents detected in soil.

Abbreviations/Acronyms:

--- = no screening levels available
carc. = carcinogen
CAS = Chemical Abstract Service
DDD = Dichlorodiphenyldichloroethane
DDT = Dichlorodiphenyltrichloroethane
DRO = diesel-range organics
GRO = gasoline-range organics
LOQ = limit of quantitation
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram
MTCA = Model Toxics Control Act
NA = not applicable
non-carc. = non-carcinogen
ORO = oil-range organics
PCB = polychlorinated biphenyl

Table 5-2
Groundwater Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	CAS	ARARs MCL		MTCA Method B Standard Formula Values		Preliminary Screening Levels (a) µg/L	Background Water (b) µg/L	Screening Levels in µg/L	Screening Levels in Final Units	Units
		Federal MCL µg/L	WA State MCL µg/L	carc. µg/L	non-carc. µg/L					
VOLATILES										
1,1,1-Trichloroethane	71-55-6	200	200		16,000	200		2.00E+02	2.00E+02	µg/L
1,1,2,2-Tetrachloroethane	79-34-5			0.219	160	0.219		2.19E-01	2.19E-01	µg/L
1,1,2-Trichloroethane	79-00-5	5	5	0.768	32	0.768		7.68E-01	7.68E-01	µg/L
1,1,2-Trichlorotrifluoroethane	76-13-1				240,000	240,000		2.40E+05	2.40E+05	µg/L
1,1-Dichloroethane	75-34-3			7.68	1,600	7.68		7.68E+00	7.68E+00	µg/L
1,1-Dichloroethene	75-35-4	7	7		400	7		7.00E+00	7.00E+00	µg/L
1,2,4-Trichlorobenzene	120-82-1	70	70	1.51	80	1.51		1.51E+00	1.51E+00	µg/L
1,2-Dichlorobenzene	95-50-1	600	600		720	600		6.00E+02	6.00E+02	µg/L
1,2-Dichloroethane	107-06-2	5	5	0.481	48	0.481		4.81E-01	4.81E-01	µg/L
1,2-Dichloropropane	78-87-5	5	5	1.22	720	1.22		1.22E+00	1.22E+00	µg/L
1,4-Dichlorobenzene	106-46-7	75	75	8.10	560	8.10		8.10E+00	8.10E+00	µg/L
2-Butanone/MEK	78-93-3				4,800	4,800		4.80E+03	4.80E+03	µg/L
2-Chlorotoluene	95-49-8				160	160		1.60E+02	1.60E+02	µg/L
2-Hexanone	591-78-6	---	---	---	---	---		---	---	
4-Methyl-2-Pentanone (MIBK)	108-10-1				640	640		6.40E+02	6.40E+02	µg/L
Acetone	67-64-1				7,200	7,200		7.20E+03	7.20E+03	µg/L
Benzene	71-43-2	5	5	0.795	32	0.795		7.95E-01	7.95E-01	µg/L
Bromodichloromethane	75-27-4	80	80	0.706	160	0.706		7.06E-01	7.06E-01	µg/L
Bromoform	75-25-2	80	80	5.54	160	5.54		5.54E+00	5.54E+00	µg/L
Bromomethane	74-83-9				11.2	11.2		1.12E+01	1.12E+01	µg/L
Carbon Disulfide	75-15-0				800	800		8.00E+02	8.00E+02	µg/L
Carbon Tetrachloride	56-23-5	5	5	0.625	32	0.625		6.25E-01	6.25E-01	µg/L
Chlorobenzene	108-90-7	100	100		160	100		1.00E+02	1.00E+02	µg/L
Chloroethane	75-00-3	---	---	---	---	---		---	---	µg/L
Chloroform	67-66-3	80	80	1.41	80	1.41		1.41E+00	1.41E+00	µg/L
Chloromethane	74-87-3	---	---	---	---	---		---	---	µg/L
cis-1,2-Dichloroethene	156-59-2	70	70		16	16		1.60E+01	1.60E+01	µg/L
cis-1,3-Dichloropropene	10061-01-5	---	---	---	---	---		---	---	
Dibromochloromethane	124-48-1	80	80	0.521	160	0.521		5.21E-01	5.21E-01	µg/L
Ethylbenzene	100-41-4	700	700		800	700		7.00E+02	7.00E+02	µg/L
Hexachlorobutadiene	87-68-3			0.561	8	0.561		5.61E-01	5.61E-01	µg/L
m,p-Xylene	NA				1600 (c)	1600 (c)		1.60E+03	1600 (c)	µg/L
Methylene Chloride	75-09-2	5	5	21.9	48	5		5.00E+00	5.00E+00	µg/L
Naphthalene	91-20-3				160	160		1.60E+02	1.60E+02	µg/L
o-Xylene	95-47-6				1,600	1,600		1.60E+03	1.60E+03	µg/L
Styrene	100-42-5	100	100		1,600	100		1.00E+02	1.00E+02	µg/L
Tetrachloroethene	127-18-4	5	5	20.83	48	5		5.00E+00	5.00E+00	µg/L
Toluene	108-88-3	1,000	1,000		640	640		6.40E+02	6.40E+02	µg/L
trans-1,2-Dichloroethene	156-60-5	100	100		160	100		1.00E+02	1.00E+02	µg/L
trans-1,3-Dichloropropene	10061-02-6	---	---	---	---	---		---	---	
Trichloroethene	79-01-6	5	5	0.54	4	0.54		5.40E-01	5.40E-01	µg/L
Trichlorofluoromethane	75-69-4				2,400	2,400		2.40E+03	2.40E+03	µg/L
Vinyl Acetate	108-05-4				8,000	8,000		8.00E+03	8.00E+03	µg/L
Vinyl Chloride	75-01-4	2	2	0.029	24	0.029		2.90E-02	2.90E-02	µg/L
Total Xylene (c)	1330-20-7	10,000	10,000		1,600	1,600		1.60E+03	1.60E+03	µg/L
METALS										
Aluminum	7429-90-5				16,000	16,000		1.60E+04	1.60E+01	mg/L
Antimony	7440-36-0	6	6		6.4	6		6.00E+00	6.00E-03	mg/L
Arsenic	7440-38-2	10	10	0.0583	4.8	0.06	8	8.00E+00	8.00E-03	mg/L
Barium	7440-39-3	2,000	2,000		3,200	2,000		2.00E+03	2.00E+00	mg/L
Beryllium	7440-41-7	4	4		32	4		4.00E+00	4.00E-03	mg/L
Cadmium	7440-43-9	5	5		8	5	2.0	5.00E+00	5.00E-03	mg/L
Chromium (total)	7440-47-3	100	100			100	10	1.00E+02	1.00E-01	mg/L
Chromium (hexavalent)	18540-29-9				48	48		4.80E+01	4.80E-02	mg/L
Cobalt	7440-48-4	---	---	---	---	---		---	---	

Table 5-2
Groundwater Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	CAS	ARARs MCL		MTCA Method B Standard Formula Values		Preliminary Screening Levels (a) µg/L	Background Water (b) µg/L	Screening Levels in µg/L	Screening Levels in Final Units	Units
		Federal MCL µg/L	WA State MCL µg/L	carc. µg/L	non-carc. µg/L					
Copper	7440-50-8	1,300	1,300		640	640	20	6.40E+02	6.40E-01	mg/L
Hexavalent Chromium	18540-29-9				48	48		4.80E+01	4.80E-02	mg/L
Iron	7439-89-6				11,200	11,200		1.12E+04	1.12E+01	mg/L
Lead	7439-92-1	15	15			15	10	1.50E+01	1.50E-02	mg/L
Manganese	7439-96-5				2,240	2,240		2.24E+03	2.24E+00	mg/L
Mercury	7439-97-6	2	2			2		2.00E+00	2.00E-03	mg/L
Nickel	7440-02-0		100		320	100		1.00E+02	1.00E-01	mg/L
Selenium	7782-49-2	50	50		80	50		5.00E+01	5.00E-02	mg/L
Silver	7440-22-4				80	80		8.00E+01	8.00E-02	mg/L
Thallium	7440-28-0	2	2		0.16	0.16		1.60E-01	1.60E-04	mg/L
Titanium	7440-32-6	---	---	---	---	---		---	---	
Vanadium	7440-62-2				80	80		8.00E+01	8.00E-02	mg/L
Zinc	7440-66-6				4,800	4,800	160	4.80E+03	4.80E+00	mg/L
CYANIDE										
Cyanide	57-12-5	200	200		9.6	9.6		9.60E+00	9.60E-03	mg/L
SEMI-VOLATILES										
1-Methylnaphthalene	90-12-0			1.51	560	1.51		1.51E+00	1.51E+00	µg/L
2,2'-Oxybis(1-Chloropropane)	108-60-1			0.625	320	0.625		6.25E-01	6.25E-01	µg/L
2,4,5-Trichlorophenol	95-95-4				800	800		8.00E+02	8.00E+02	µg/L
2,4,6-Trichlorophenol	88-06-2			3.98	8	3.98		3.98E+00	3.98E+00	µg/L
2,4-Dichlorophenol	120-83-2				24	24		2.40E+01	2.40E+01	µg/L
2,4-Dimethylphenol	105-67-9				160	160		1.60E+02	1.60E+02	µg/L
2,4-Dinitrophenol	51-28-5				32	32		3.20E+01	3.20E+01	µg/L
2,4-Dinitrotoluene	121-14-2			0.282	32	0.282		2.82E-01	2.82E-01	µg/L
2,6-Dinitrotoluene	606-20-2			0.0583	4.8	0.0583		5.83E-02	5.83E-02	µg/L
2-Chloronaphthalene	91-58-7				640	640		6.40E+02	6.40E+02	µg/L
2-Chlorophenol	95-57-8				40	40		4.00E+01	4.00E+01	µg/L
2-Methylnaphthalene	91-57-6				32	32		3.20E+01	3.20E+01	µg/L
2-Methylphenol	95-48-7				400	400		4.00E+02	4.00E+02	µg/L
3,3'-Dichlorobenzidine	91-94-1			0.194		0.194		1.94E-01	1.94E-01	µg/L
4-Chloroaniline	106-47-8			0.219	32	0.219		2.19E-01	2.19E-01	µg/L
4-Methylphenol (p-cresol)	106-44-5				800	800		8.00E+02	8.00E+02	µg/L
Acenaphthene	83-32-9				960	960		9.60E+02	9.60E+02	µg/L
Anthracene	120-12-7				4,800	4,800		4.80E+03	4.80E+03	µg/L
Benzo(a)anthracene	56-55-3			0.120		0.120		(d)	(d)	µg/L
Benzo(a)pyrene	50-32-8	0.2		0.012		0.012		0.012 (d)	0.012 (d)	µg/L
Benzo(b)fluoranthene	205-99-2			0.120		0.120		(d)	(d)	µg/L
Benzo(k)fluoranthene	207-08-9			1.20		1.20		(d)	(d)	µg/L
Benzoic Acid	65-85-0				64,000	64,000		6.40E+04	6.40E+04	µg/L
Benzyl Alcohol	100-51-6				800	800		8.00E+02	8.00E+02	µg/L
Bis-(2-Chloroethyl) Ether	111-44-4			0.0398		0.0398		3.98E-02	3.98E-02	µg/L
bis(2-Ethylhexyl)phthalate	117-81-7	6		6.25	320	6		6.00E+00	6.00E+00	µg/L
Butylbenzylphthalate	85-68-7			46.1	3,200	46.1		4.61E+01	4.61E+01	µg/L
Carbazole	86-74-8	---	---	---	---	---		---	---	
Chrysene	218-01-9			12.0		12.0		(d)	(d)	µg/L
Dibenz(a,h)anthracene	53-70-3			0.0120		0.0120		(d)	(d)	µg/L
Dibenzofuran	132-64-9				16	16		1.60E+01	1.60E+01	µg/L
Diethylphthalate	84-66-2				12,800	12,800		1.28E+04	1.28E+04	µg/L
Dimethylphthalate	131-11-3	---	---	---	---	---		---	---	µg/L
Di-n-Butylphthalate	84-74-2				1,600	1,600		1.60E+03	1.60E+03	µg/L
Di-n-Octyl phthalate	117-84-0				160	160		1.60E+02	1.60E+02	µg/L
Fluoranthene	206-44-0				640	640		6.40E+02	6.40E+02	µg/L
Fluorene	86-73-7				640	640		6.40E+02	6.40E+02	µg/L
Hexachlorobenzene	118-74-1	1	1	0.0547	12.8	0.0547		5.47E-02	5.47E-02	µg/L
Hexachlorocyclopentadiene	77-47-4	50	50		48	48		4.80E+01	4.80E+01	µg/L
Hexachloroethane	67-72-1			1.09	5.6	1.09		1.09E+00	1.09E+00	µg/L

Table 5-2
Groundwater Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	CAS	ARARs MCL		MTCA Method B Standard Formula Values		Preliminary Screening Levels (a) µg/L	Background Water (b) µg/L	Screening Levels in µg/L	Screening Levels in Final Units	Units
		Federal MCL µg/L	WA State MCL µg/L	carc. µg/L	non-carc. µg/L					
Indeno(1,2,3-cd)pyrene	193-39-5			0.120		0.120		(d)	(d)	µg/L
Isophorone	78-59-1			46.1	1600	46.1		4.61E+01	4.61E+01	µg/L
Nitrobenzene	98-95-3				16	16		1.60E+01	1.60E+01	µg/L
N-Nitroso-Di-N-Propylamine	621-64-7			0.0125		0.0125		1.25E-02	1.25E-02	µg/L
N-Nitrosodiphenylamine	86-30-6			17.9		17.9		1.79E+01	1.79E+01	µg/L
Pentachlorophenol	87-86-5	1		0.219	80	0.219		2.19E-01	2.19E-01	µg/L
Phenanthrene	85-01-8	---	---	---	---	---		---	---	
Phenol	108-95-2				2,400	2,400		2.40E+03	2.40E+03	µg/L
Pyrene	129-00-0				480	480		4.80E+02	4.80E+02	µg/L
PETROLEUM HYDROCARBONS										
Diesel-Range Organics	DRO				500 (e)	500 (e)		500 (e)	0.5 (e)	mg/L
Gasoline-Range Organics	GRO				800 (e) (f)	800 (e) (f)		800 (e) (f)	0.8 (e) (f)	mg/L
Oil-Range Organics	ORO				500 (e)	500 (e)		500 (e)	0.5 (e)	mg/L
POLYCHLORINATED BIPHENYLS/ PESTICIDES										
Aroclor 1016	12674-11-2			1.25	1.12	1.12		1.12E+00	1.12E+00	µg/L
Aroclor 1221	11104-28-2					(g)		(g)	(g)	
Aroclor 1232	11141-16-5					(g)		(g)	(g)	
Aroclor 1242	53469-21-9					(g)		(g)	(g)	
Aroclor 1248	12672-29-6					(g)		(g)	(g)	
Aroclor 1254	11097-69-1			0.0438	0.32	0.0438		4.38E-02	4.38E-02	µg/L
Aroclor 1260	11096-82-5			0.0438		0.0438		4.38E-02	4.38E-02	µg/L
Total PCBs	1336-36-3	0.5	0.5	0.0438		0.0438		4.38E-02	4.38E-02	µg/L
Dieldrin	60-57-1			0.00547	0.8	0.00547		5.47E-03	5.47E-03	µg/L
Toxaphene	8001-35-2	3.00	3.00	0.0795		0.0795		7.95E-02	7.95E-02	µg/L
DDT	50-29-3			0.257	8	0.257		2.57E-01	2.57E-01	µg/L
DDE	72-55-9			0.257		0.257		2.57E-01	2.57E-01	µg/L

Notes:

(a) Before adjustment for background.
(b) Draft report from PTI 1989 90th percentile value.
(c) Screening level for total xylene is for the sum of the isomers.
(d) Evaluated using benzo(a)pyrene toxic equivalent concentration [benzo(a)pyrene toxicity equivalency quotient].
(e) MTCA Method A groundwater cleanup levels are used for petroleum hydrocarbons.
(f) For gasoline mixtures, if benzene is present. If benzene is not present, screening level is 1,000 µg/L (1.0 mg/L).
(g) Evaluated as part of total PCB calculation.

1. Screening level is based on lowest of federal or state MCL, and Method B standard formula values.
2. Screening levels are developed for all constituents detected in groundwater or soil.

Abbreviations/Acronyms:

--- = No screening levels available for this analyte
ARARs = applicable or relevant and appropriate requirements
carc. = carcinogenic
CAS = Chemical Abstracts Service
DRO = diesel-range organics
GRO = gasoline-range organics
MCL = maximum contaminant level
MTCA = Model Toxics Control Act
µg/L = micrograms per liter
mg/L = milligrams per liter
NA = not applicable
non-carc. = non-carcinogenic
ORO = oil-range organics

Table 5-3
Surface Water Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Surface Water Area Designation			Screening Level (µg/L)							
Area	Area Description	Screening Level Criteria	Acetone	Chloroform	Carbon Disulfide	PCE	TCE	Toluene	cDCE	VC
Area A	Mill Creek - West of SR 167, North of SR 18, East of West Valley Hwy	Criteria for potable surface water (based on consumption of drinking water and aquatic organisms)	ND	ND	ND	ND	ND 0.3 (a)	57(g)	ND	ND 0.02 (a)
Area B	Wetlands - West of SR 167, South of SR 18, East of West Valley Hwy, North of 15th Street SW	Criteria for non-potable surface water (based on consumption of aquatic organisms only)	7200 (b)	ND	ND	ND	ND 0.7 (c)	130 (c)	16 (b)	0.18 (c)
Area C	Stormwater ponds and infrastructure east of SR 167, South of SR 18, North of Boundary Blvd	Where calculated, health risk-based screening levels are based on a worker exposure scenario	7200 (b)	ND	ND	2.9 (c)	58 (d)	130 (c)	16 (b)	98 (d)
Area D	Algona ditches and standing water south of Boundary Blvd to 7th Ave North, East of SR 167 to Chicago Ave	Where calculated, health risk-based screening levels are based on child and worker exposure scenarios	7200 (b)	55 (f)	800 (b)	2.9 (c)	58 (e)	130 (c)	16 (b)	15 (e)

Notes:

(a) Surface water criteria promulgated in WAC 173-201A and 40CFR 131.45 for protection of human health for surface water used as drinking water (drinking water plus organisms).

(b) MTCA Method B standard formula value for groundwater as drinking water is provided for reference only, this is not a screening level. No surface water criteria available.

(c) Surface water criteria promulgated in WAC 173-201A and 40CFR 131.45 for protection of human health for surface water not used as drinking water (organisms only).

(d) Health risk screening level based on reasonable maximum, site-specific exposure for workers.

(e) Health risk screening level based on reasonable maximum, site-specific exposure; both child and worker exposure scenarios are applicable, the most conservative value was selected for screening levels. Worker exposure scenarios (TCE = 58 µg/L; VC = 98 µg/L); child exposure scenarios (TCE = 77 µg/L; VC = 15 µg/L).

(f) Method B standard formula value for surface water.

(g) National Recommended Water Quality Criteria published under Clean Water Act Section 304(a) (drinking water plus organisms).

1. No federal criteria for protection of aquatic organisms are available for the listed analytes.
2. Numeric criteria are provided for surface water constituents of concern (TCE and VC) in all areas; numeric criteria are provided for non-COC constituents only where detected.

Abbreviations/Acronyms:

-- = No criteria available; no screening level established
cDCE = cis-1,2-dichloroethene
COC = constituent of concern
ND = Constituent was not detected in surface water in the specified area
µg/L = micrograms per liter
MTCA = Modtel Toxics Control Act
PCE = tetrachloroethene
SR = State Route
TCE = trichloroethene
VC = vinyl chloride

Table 5-4
Vapor Intrusion Screening Levels
Boeing Auburn Remedial Investigation
Auburn, Washington

Industrial

Constituent of Concern	Air (µg/m³) (a)			Screening Levels Calculated Using MTCA Method C			
	MTCA Method C		EPA Region 10 Value (c) IAAL Sub-Chronic (non-carc.)	Soil Gas (µg/m³)		Groundwater (µg/L) (d)	
	carc.	non-carc.		carc.	non-carc.	carc.	non-carc.
Tetrachloroethene	96	40	--	3200	1300	240	100
Trichloroethene	6.3	2.0	8.4	210	67	26	8.4
Vinyl Chloride	2.8	100	--	95	3300	3.5	120

Commercial

Constituent of Concern	Air (µg/m³) (a)			Screening Levels Calculated Using MTCA Method B			
	Modified MTCA Method B (b)		EPA Region 10 Value IAAL Sub-Chronic (non-carc.) (c)	Soil Gas (µg/m³)		Groundwater (µg/L) (d)	
	carc.	non-carc.		carc.	non-carc.	carc.	non-carc.
Tetrachloroethene	29	120	--	960	4000	73	305
Trichloroethene	1.9	6.0	8.4	63	200	7.9	25
Vinyl Chloride	0.85	300	--	28	10000	1.0	370

Residential

Constituent of Concern	Air (µg/m³) (a)			Screening Levels Calculated Using MTCA Method B			
	MTCA Method B		EPA Region 10 Value IAAL Sub-Chronic (non-carc.) (c)	Soil Gas (µg/m³)		Groundwater (µg/L) (d)	
	carc.	non-carc.		carc.	non-carc.	carc.	non-carc.
Tetrachloroethene	9.6	18	--	320	610	24	47
Trichloroethene	0.37	0.91	2.0	12	30	1.6	3.8
Vinyl Chloride	0.28	46	--	9.5	1500	0.35	56
trans-1,2-Dichloroethene	--	27.4	--	--	907	--	46

Notes:

(a) Air screening criteria applies to indoor air samples, crawl space and basement air samples, and ambient air samples.

(b) Method for calculating modified Method B air screening levels for commercial land use was defined by Ecology in Ecology response comments to the draft vapor intrusion data report (Ecology 2012a).

(c) Ecology has requested that Boeing apply the sub-chronic non-carcinogenic indoor air action level from EPA Region 10 (EPA. 2012. Memorandum: OEA Recommendations Regarding Trichloroethylene Toxicity in Human health Risk Assessments. US EPA Region 10. December 13) value as an IAAL when air sampling is conducted where a woman of child bearing age resides.

(d) The Henry's Law constant used to calculate the shallow groundwater screening level assumes a temperature of 13 degrees Celsius per the U.S. temperature map provided by EPA Online Tools for Site Assessment Calculation for Henry's Law Constants.

1. Tan shading inidcates the most conservative screening level.

Abreviations/Acronyms:

-- = not applicable
carc. = carcinogenic
EPA = U.S. Environmental Protection Agency
IAALs = indoor air action levels
µg/L = micrograms per liter
µg/m³ = micrograms per cubic meter
MTCA = Model Toxics Control Act
non-carc. = non-carcinogenic

Table 5-5
Soil Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
VOLATILES (µg/kg)							
1,1,1,2-Tetrachloroethane	--	0	20	0		**0%**	**0%**
1,1,1-Trichloroethane	1.58E+03	0	113	2	35	**2%**	**0%**
1,1,2,2-Tetrachloroethane	1.23E+00	0	112	0		**0%**	**0%**
1,1,2-Trichloro-1,2,2-Trifluoroethane	2.40E+09	0	107	2	7.6	**2%**	**0%**
1,1,2-Trichloroethane	4.27E+00	0	112	0		**0%**	**0%**
1,1-Dichloroethane	4.19E+01	0	123	1	2.6	**1%**	**0%**
1,1-Dichloroethene	5.01E+01	0	112	0		**0%**	**0%**
1,1-Dichloropropene	--	0	13	0		**0%**	**0%**
1,2,3-Trichlorobenzene	--	0	13	0		**0%**	**0%**
1,2,3-Trichloropropane	--	0	13	0		**0%**	**0%**
1,2,4-Trichlorobenzene	3.45E+04	0	17	0		**0%**	**0%**
1,2,4-Trimethylbenzene	--	0	24	1	1300	**4%**	**0%**
1,2-Dibromo-3-chloropropane	--	0	13	0		**0%**	**0%**
1,2-Dibromoethane	--	0	13	0		**0%**	**0%**
1,2-Dichlorobenzene	7.20E+06	0	32	15	235000	**47%**	**0%**
1,2-Dichloroethane	2.32E+00	0	112	0		**0%**	**0%**
1,2-Dichloroethene	7.20E+05	0	8	8	4500	**100%**	**0%**
1,2-Dichloropropane	2.78E+04	0	105	0		**0%**	**0%**
1,3,5-Trimethylbenzene	8.00E+05	0	18	1	370	**6%**	**0%**
1,3-Dichlorobenzene	--	0	20	7	30510	**35%**	**0%**
1,3-Dichloropropane	--	0	13	0		**0%**	**0%**
1,4-Dichlorobenzene	1.85E+05	1	34	17	260000	**50%**	**3%**
2,2-Dichloropropane	--	0	13	0		**0%**	**0%**
2-Butanone/MEK	4.80E+07	0	121	51	130	**42%**	**0%**
2-Chloroethyl vinyl ether	--	0	105	0		**0%**	**0%**
2-Chlorotoluene	--	0	13	0		**0%**	**0%**
2-Hexanone	--	0	105	0		**0%**	**0%**
4-Chlorotoluene	--	0	13	0		**0%**	**0%**
4-Isopropyltoluene	--	0	18	1	100	**6%**	**0%**
4-Methyl-2-pentanone	6.40E+06	0	116	4	6200	**3%**	**0%**
Acetone	7.20E+07	0	129	106	7300	**82%**	**0%**
Acrolein	--	0	13	0		**0%**	**0%**
Acrylonitrile	--	0	13	0		**0%**	**0%**
Benzene	4.48E+00	3	120	19	860	**16%**	**3%**
Bromobenzene	--	0	13	0		**0%**	**0%**
Bromochloromethane	--	0	13	0		**0%**	**0%**
Bromodichloromethane	1.61E+04	0	105	0		**0%**	**0%**
Bromoform	1.27E+05	0	105	0		**0%**	**0%**
Bromomethane	1.12E+05	0	105	0		**0%**	**0%**
Carbon Disulfide	8.00E+06	0	111	7	2.5	**6%**	**0%**
Carbon Tetrachloride	1.43E+04	0	112	0		**0%**	**0%**
Chlorobenzene	1.60E+06	0	111	6	21480	**5%**	**0%**
Chloroethane	--	0	105	0		**0%**	**0%**
Chloroform	7.51E+00	0	112	0		**0%**	**0%**
Chloromethane	--	0	105	1	1.9	**1%**	**0%**
cis-1,2-Dichloroethene	8.00E+01	0	112	0		**0%**	**0%**

Table 5-5
Soil Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
cis-1,3-Dichloropropene	--	0	105	0		0%	0%
Dibromochloromethane	1.19E+04	0	105	0		0%	0%
Dibromomethane	--	0	13	0		0%	0%
Ethylbenzene	6.05E+03	1	132	17	9400	13%	1%
Hexachlorobutadiene	1.28E+04	0	17	0		0%	0%
Iodomethane	--	0	13	0		0%	0%
Isopropylbenzene	8.00E+06	0	18	1	34	6%	0%
Methylene Chloride	2.18E+01	4	132	41	810	31%	3%
Methyl-tert-butyl ether	--	0	5	0		0%	0%
Naphthalene	1.60E+06	0	66	6	87	9%	0%
n-Butylbenzene	4.00E+06	0	18	1	130	6%	0%
n-Propylbenzene	8.00E+06	0	18	1	110	6%	0%
sec-Butylbenzene	8.00E+06	0	18	1	110	6%	0%
Styrene	1.60E+07	0	105	1	12	1%	0%
tert-Butylbenzene	--	0	13	0		0%	0%
Tetrachloroethene	4.76E+05	0	115	12	1000	10%	0%
Toluene	4.65E+03	2	136	34	11650	25%	1%
trans-1,2-Dichloroethene	1.60E+06	0	112	0		0%	0%
trans-1,3-Dichloropropene	--	0	105	0		0%	0%
trans-1,4-Dichloro-2-butene	--	0	13	0		0%	0%
Trichloroethene	3.57E+00	10	119	15	6400	13%	8%
Trichlorofluoromethane	2.40E+07	0	105	0		0%	0%
Vinyl Acetate	8.00E+07	0	105	0		0%	0%
Vinyl Chloride	1.00E+00	0	112	0		0%	0%
Xylenes, Total	1.46E+04	3	250	45	64000	18%	1%
POLYCYCLIC AROMATIC HYDROCARBONS (µg/kg)							
Benzo(a)anthracene	(b)	0	55	3	200	5%	0%
Benzo(a)pyrene	1.37E+02	0	54	3	80	6%	0%
Benzo(b)fluoranthene	(b)	0	54	6	570	11%	0%
Benzo(g,h,i)perylene	--	0	44	1	38	2%	0%
Benzo(k)fluoranthene	(b)	0	55	5	100	9%	0%
Chrysene	(b)	0	55	6	240	11%	0%
Dibenzo(a,h)anthracene	(b)	0	48	0		0%	0%
Fluoranthene	3.20E+06	0	45	3	470	7%	0%
Indeno(1,2,3-cd)pyrene	(b)	0	54	2	25	4%	0%
Phenanthrene	--	0	44	4	180	9%	0%
Pyrene	2.40E+03	0	45	4	280	9%	0%
TOTAL METALS (mg/kg)							
Aluminum	8.00E+04	0	69	69	25100	100%	0%
Antimony	5.42E+00	9	78	10	9	13%	12%
Arsenic	7.00E+00	0	107	32	6	30%	0%
Barium	1.60E+04	0	67	67	2100	100%	0%
Beryllium	1.60E+02	0	85	76	0.31	89%	0%
Cadmium	1.00E+00	16	154	56	642	36%	10%
Calcium	--	0	33	33	22200	100%	0%
Chromium, Hexavalent	1.84E+01	0	47	3	0.49	6%	0%
Chromium, Total	1.20E+05	0	157	157	92	100%	0%

Table 5-5
Soil Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
Cobalt	--	0	33	33	35.2	**100%**	**0%**
Copper	2.84E+02	3	129	129	619	**100%**	**2%**
Iron	5.60E+04	0	33	33	24700	**100%**	**0%**
Lead	250 (a)	1	156	142	615	**91%**	**1%**
Magnesium	--	0	33	33	5900	**100%**	**0%**
Manganese	1.12E+04	0	69	69	1140	**100%**	**0%**
Mercury	2 (a)	0	116	7	0.18	**6%**	**0%**
Nickel	1.30E+02	0	129	129	101	**100%**	**0%**
Potassium	--	0	33	33	1150	**100%**	**0%**
Selenium	4.00E+02	0	111	5	8	**5%**	**0%**
Silver	4.00E+02	0	111	10	0.6	**9%**	**0%**
Sodium	--	0	33	33	1510	**100%**	**0%**
Thallium	1.00E+00	3	71	15	11	**21%**	**4%**
Titanium	--	0	36	36	1370	**100%**	**0%**
Vanadium	4.00E+02	0	33	33	61.6	**100%**	**0%**
Zinc	2.40E+04	0	129	129	391	**100%**	**0%**
CYANIDE (mg/kg)							
Cyanide	4.80E+01	8	47	35	350	**74%**	**17%**
SEMI-VOLATILES (µg/kg)							
1,3-Dichlorobenzene	--	0	4	0		**0%**	**0%**
1-Methylnaphthalene	3.45E+04	0	32	0		**0%**	**0%**
2,2'-Oxybis(1-Chloropropane)	1.43E+04	0	2	0		**0%**	**0%**
2,4,5-Trichlorophenol	8.00E+06	0	4	0		**0%**	**0%**
2,4,6-Trichlorophenol	8.00E+04	0	4	0		**0%**	**0%**
2,4-Dichlorophenol	2.40E+05	0	4	0		**0%**	**0%**
2,4-Dimethylphenol	1.60E+06	0	4	0		**0%**	**0%**
2,4-Dinitrophenol	1.60E+05	0	4	0		**0%**	**0%**
2,4-Dinitrotoluene	3.23E+03	0	4	0		**0%**	**0%**
2,6-Dinitrotoluene	6.67E+02	0	4	0		**0%**	**0%**
2-Chloronaphthalene	6.40E+06	0	4	0		**0%**	**0%**
2-Chlorophenol	4.00E+05	0	4	0		**0%**	**0%**
2-Methylnaphthalene	3.20E+05	0	39	2	180	**5%**	**0%**
2-Methylphenol	4.00E+06	0	4	0		**0%**	**0%**
2-Nitroaniline	--	0	4	0		**0%**	**0%**
2-Nitrophenol	--	0	4	0		**0%**	**0%**
3,3'-Dichlorobenzidine	2.22E+03	0	4	0		**0%**	**0%**
3-Nitroaniline	--	0	4	0		**0%**	**0%**
4,6-Dinitro-2-methylphenol	--	0	4	0		**0%**	**0%**
4-Bromophenyl phenyl ether	--	0	4	0		**0%**	**0%**
4-Chloro-3-methylphenol	--	0	4	0		**0%**	**0%**
4-Chloroaniline	5.00E+03	0	4	0		**0%**	**0%**
4-Chlorophenyl phenyl ether	--	0	4	0		**0%**	**0%**
4-Methylphenol	8.00E+06	0	4	0		**0%**	**0%**
4-Nitroaniline	--	0	4	0		**0%**	**0%**
4-Nitrophenol	--	0	4	0		**0%**	**0%**
Acenaphthene	4.80E+06	0	44	1	5.2	**2%**	**0%**
Acenaphthylene	--	0	44	0		**0%**	**0%**

Table 5-5
Soil Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
Anthracene	2.40E+07	0	44	1	15	**2%**	**0%**
Benzoic Acid	3.20E+08	0	4	0		**0%**	**0%**
Benzyl Alcohol	8.00E+06	0	4	0		**0%**	**0%**
bis(2-Chloro-1-Methylethyl) Ether	--	0	2	0		**0%**	**0%**
bis(2-Chloroethoxy) Methane	--	0	4	0		**0%**	**0%**
bis(2-Chloroethyl) Ether	9.09E+02	0	4	0		**0%**	**0%**
bis(2-Ethylhexyl) Phthalate	1.34E+04	0	6	4	89	**67%**	**0%**
Butyl Benzyl Phthalate	5.26E+05	0	4	0		**0%**	**0%**
Carbazole	--	0	4	0		**0%**	**0%**
Dibenzofuran	--	0	12	0		**0%**	**0%**
Diethyl Phthalate	6.40E+07	0	4	2	82	**50%**	**0%**
Dimethyl Phthalate	--	0	4	0		**0%**	**0%**
Di-N-Butyl Phthalate	8.00E+06	0	4	0		**0%**	**0%**
Di-n-octyl Phthalate	8.00E+05	0	4	0		**0%**	**0%**
Fluorene	3.20E+06	0	44	2	9.4	**5%**	**0%**
Hexachlorobenzene	6.25E+02	0	4	0		**0%**	**0%**
Hexachlorocyclopentadiene	4.80E+05	0	4	0		**0%**	**0%**
Hexachloroethane	2.50E+04	0	4	0		**0%**	**0%**
Isophorone	1.05E+06	0	4	0		**0%**	**0%**
Nitrobenzene	1.60E+05	0	4	0		**0%**	**0%**
N-Nitrosodi-n-propylamine	3.30E+01	0	4	0		**0%**	**0%**
N-Nitrosodiphenylamine	2.04E+05	0	4	0		**0%**	**0%**
Pentachlorophenol	2.50E+03	0	4	0		**0%**	**0%**
Phenol	2.40E+04	0	4	0		**0%**	**0%**
PETROLEUM HYDROCARBONS (mg/kg)							
Diesel-Range Organics	2000 (a)	17	154	64	9889	**42%**	**11%**
Gasoline-Range Organics	100 (a,c)	6	54	13	1300	**24%**	**11%**
Oil-Range Organics	2000 (a)	28	129	69	32000	**53%**	**22%**
Petroleum Hydrocarbons as Hydraulic Fluid	--	0	4	4	8800	**100%**	**0%**
Petroleum Hydrocarbons, Blazo-Cut Range	--	0	37	1	14	**3%**	**0%**
Petroleum Hydrocarbons, Unax Oil Range	--	0	37	2	23900	**5%**	**0%**
Petroleum Hydrocarbons, Way Oil Range	--	0	34	5	430	**15%**	**0%**
Total Petroleum Hydrocarbons	--	0	47	33	2000	**70%**	**0%**
VOLATILE PETROLEUM HYDROCARBONS							
Aliphatic Hydrocarbons C5-C6	--	0	5	0		**0%**	**0%**
Aliphatic Hydrocarbons C6-C8	--	0	5	0		**0%**	**0%**
Aliphatic Hydrocarbons C8-C10	--	0	15	0		**0%**	**0%**
Aliphatic Hydrocarbons C10-C12	--	0	24	1	13000	**4%**	**0%**
EXTRACTABLE PETROLEUM HYDROCARBONS							
Aliphatic Hydrocarbons C12-C16	--	0	19	2	18000	**11%**	**0%**
Aliphatic Hydrocarbons C16-C18	--	0	5	1	54000	**20%**	**0%**
Aliphatic Hydrocarbons C16-C21	--	0	14	6	570000	**43%**	**0%**
Aliphatic Hydrocarbons C18-C21	--	0	5	1	280000	**20%**	**0%**
Aliphatic Hydrocarbons C21-C28	--	0	5	2	3400000	**40%**	**0%**
Aliphatic Hydrocarbons C21-C34	--	0	14	8	15000000	**57%**	**0%**
Aliphatic Hydrocarbons C28-C36	--	0	5	1	6200000	**20%**	**0%**
Aliphatic Hydrocarbons, Total	--	0	3	3	10000000	**100%**	**0%**

Table 5-5
Soil Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
Aromatic Hydrocarbons C8-C10	--	0	15	3	9600	**20%**	**0%**
Aromatic Hydrocarbons C10-C12	--	0	24	3	430	**13%**	**0%**
Aromatic Hydrocarbons C12-C13	--	0	5	0		**0%**	**0%**
Aromatic Hydrocarbons C12-C16	--	0	19	4	1700	**21%**	**0%**
Aromatic Hydrocarbons C16-C18	--	0	5	1	20000	**20%**	**0%**
Aromatic Hydrocarbons C16-C21	--	0	14	8	170000	**57%**	**0%**
Aromatic Hydrocarbons C18-C21	--	0	5	1	60000	**20%**	**0%**
Aromatic Hydrocarbons C21-C28	--	0	5	1	430000	**20%**	**0%**
Aromatic Hydrocarbons C21-C34	--	0	14	6	1900000	**43%**	**0%**
Aromatic Hydrocarbons C28-C36	--	0	5	1	290000	**20%**	**0%**
Aromatic Hydrocarbons, Total	--	0	2	2	810000	**100%**	**0%**
POLYCHLORINATED BIPHENYLS/ PESTICIDES (µg/kg)							
DDD	4.17E+03	0	1	1	2.8	**100%**	**0%**
DDT	2.94E+03	0	4	4	8.6	**100%**	**0%**
Aroclor 1016	5.60E+03	0	58	0		**0%**	**0%**
Aroclor 1221	(d)	0	47	0		**0%**	**0%**
Aroclor 1232	(d)	0	47	0		**0%**	**0%**
Aroclor 1242	(d)	0	58	4	300	**7%**	**0%**
Aroclor 1248	(d)	0	61	6	429	**10%**	**0%**
Aroclor 1254	5.00E+02	0	60	7	180	**12%**	**0%**
Aroclor 1260	5.00E+02	0	60	10	100	**17%**	**0%**
Total Polychlorinated Biphenyls	5.00E+02	0	4	1	100	**25%**	**0%**

Notes:

(a) MTCA Method A soil cleanup levels for unrestricted land uses are used for lead, mercury, and petroleum hydrocarbons.
(b) Evaluated using benzo(a)pyrene toxic equivalent concentration [benzo(a)pyrene toxicity equivalency quotient].
(c) For gasoline mixtures without benzene and the total of ethyl benzene, toluene and xylene are less than 1% of the gasoline mixture.
(d) Evaluated using screening level for total polychlorinated biphenyls.

1. Orange shading: indicator hazardous substances; constituents that have exceedances in more than 5 percent of samples.

Abbreviations/Acronyms:

-- = no screening criteria available
µg/kg = micrograms per kilogram
mg/kg = milligrams per kilogram

Table 5-6
Groundwater Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Detected Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
VOLATILES (µg/L)							
1,1,1-Trichloroethane	2.00E+02	1	2863	35	250	**1%**	**0.03%**
1,1,2,2-Tetrachloroethane	2.19E-01	12	2860	24	0.5	**1%**	**0.42%**
1,1,2-Trichloroethane	7.68E-01	0	666	1	0.3	**0.2%**	**0.0%**
1,1-Dichloroethane	7.68E+00	5	2862	131	16	**5%**	**0.17%**
1,1-Dichloroethene	7.00E+00	1	2860	228	8	**8%**	**0.03%**
1,2-Dichloroethane	4.81E-01	2	2861	52	1.6	**2%**	**0.07%**
1,4-Dichlorobenzene	8.10E+00	0	71	2	0.13	**3%**	**0.0%**
4-Methyl-2-pentanone	6.40E+02	0	666	2	79	**0.3%**	**0.0%**
Acetone	7.20E+03	0	2870	176	530	**6%**	**0.0%**
Benzene	7.95E-01	13	2878	55	1700	**2%**	**0.45%**
Bromodichloromethane	7.06E-01	0	2860	3	0.7	**0.1%**	**0.00%**
Bromoform	5.54E+00	0	666	1	0.3	**0.2%**	**0.0%**
Carbon Disulfide	8.00E+02	0	2860	27	4.2	**1%**	**0.0%**
Chloroform	1.41E+00	16	2860	45	12	**2%**	**0.56%**
cis-1,2-Dichloroethene	1.60E+01	7	2861	1522	75	**53%**	**0.24%**
Dibromochloromethane	5.21E-01	0	666	1	0.2	**0%**	**0.0%**
Ethylbenzene	7.00E+02	5	2876	16	1200	**1%**	**0.17%**
Methyl Ethyl Ketone	4.80E+03	0	2865	56	750	**2%**	**0.0%**
Methylene Chloride	5.00E+00	4	2864	22	19	**1%**	**0.14%**
Naphthalene	1.60E+02	0	113	2	0.24	**2%**	**0.0%**
Styrene	1.00E+02	0	666	3	34	**0%**	**0.0%**
Tetrachloroethene	5.00E+00	0	2860	706	1.6	**25%**	**0.0%**
Toluene	6.40E+02	1	2879	139	3000	**5%**	**0.03%**
trans-1,2-Dichloroethene	1.00E+02	0	2860	416	2.4	**15%**	**0.0%**
Trichloroethene	5.40E-01	1314	2861	1570	230	**55%**	**46%**
Trichlorofluoromethane	2.40E+03	0	2860	9	2.1	**0%**	**0.0%**
Vinyl Acetate	8.00E+03	0	667	1	30	**0%**	**0.0%**
Vinyl Chloride	2.90E-02	1136	2860	1312	11	**46%**	**40%**
Xylenes, Total (a)	1.60E+03	4	5763	57	12000	**1%**	**0.1%**
DISSOLVED METALS (mg/L)							
Aluminum	1.60E+01	0	56	8	0.26	**14%**	**0.0%**
Antimony	6.00E-03	1	76	3	0.0167	**4%**	**1.3%**
Arsenic	8.00E-03	2	102	36	0.014	**35%**	**2.0%**
Barium	2.00E+00	0	63	51	0.0575	**81%**	**0.0%**
Cadmium	5.00E-03	10	114	20	0.0755	**18%**	**8.8%**
Chromium, Hexavalent	4.80E-02	0	61	11	0.034	**18%**	**0.0%**
Chromium, Total	1.00E-01	0	99	3	0.01	**3%**	**0.0%**
Copper	6.40E-01	1	78	18	1.47	**23%**	**1.3%**
Lead	1.50E-02	0	99	2	0.006	**2%**	**0.0%**
Manganese	2.24E+00	1	60	48	4.22	**80%**	**1.7%**
Mercury	2.00E-04	0	97	1	0.0002	**1%**	**0.0%**

Table 5-6
Groundwater Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Detected Analyte	Screening Level	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection	Percent Detected	Percent Exceedances
Nickel	1.00E-01	2	98	22	0.207	**22%**	**2.0%**
Silver	8.00E-02	0	78	1	0.006	**1%**	**0.0%**
Thallium	1.60E-04	1	74	1	0.001	**1%**	**1.4%**
Vanadium	8.00E-02	0	57	19	0.043	**33%**	**0.0%**
Zinc	4.80E+00	0	83	13	1.07	**16%**	**0.0%**
CYANIDE (mg/L)							
Cyanide	9.60E-03	0	30	9	0.6	**30%**	**0.0%**
SEMI-VOLATILES (µg/L)							
1-Methylnaphthalene	1.51E+00	1	31	2	4.8	**6%**	**3.2%**
2-Methylnaphthalene	3.20E+01	0	82	2	0.82	**2%**	**0.0%**
4-Methylphenol	8.00E+02	0	51	1	1	**2%**	**0.0%**
Acenaphthene	9.60E+02	0	82	1	1.3	**1%**	**0.0%**
bis(2-Ethylhexyl) Phthalate	6.00E+00	1	53	14	48	**26%**	**1.9%**
Diethyl Phthalate	1.28E+04	0	51	1	1.6	**2%**	**0.0%**
Di-N-Butyl Phthalate	1.60E+03	0	53	2	0.5	**4%**	**0.0%**
Di-n-octyl Phthalate	1.60E+02	0	52	1	2	**2%**	**0.0%**
Fluorene	6.40E+02	0	82	1	1.8	**1%**	**0.0%**
Pentachlorophenol	2.19E-01	2	52	2	180	**4%**	**3.8%**
Phenol	2.40E+03	0	51	2	5.8	**4%**	**0.0%**
Pyrene	4.80E+02	0	83	1	12	**1%**	**0.0%**
PETROLEUM HYDROCARBONS (mg/L)							
Diesel-Range Organics	0.5 (b)	40	230	53	5.4	**23%**	**17%**
Gasoline-Range Organics	0.8 (b) (c)	10	41	12	34	**29%**	**24%**
Oil-Range Organics	0.5 (b)	25	177	28	16	**16%**	**14%**

Notes:

(a) Total xylenes include m, p, and o isomers, which were analyzed separately.

(b) Model Toxics Control Act Method A groundwater cleanup levels are used for petroleum hydrocarbons.

(c) For gasoline mixtures, if benzene is present. If benzene is not present, screening level is 1,000 µg/L (1.0 mg/L).

1. For monitoring wells that have ongoing monitoring, the complete data set for the last 3 years was evaluated. For wells that are no longer sampled or for sampling locations only sampled once (borings and grab samples), the most recent data for each analyte sampled at that location was evaluated.
2. Orange shading : indicator hazardous substances; constituents that have exceedances in more than 5 percent of samples.

Abbreviations/Acronyms:

µg/L = micrograms per liter

mg/L = milligrams per liter

Table 5-7
Surface Water Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

Detected Analyte	Surface Water SL (µg/L)	Number of Results	Number of Detections	Maximum Detection (µg/L)	Percent Detections	Maximum Detection Exceeds SL?
VOLATILES (µg/L)						
Acetone (a)	7200 (b)	86	19	18	22%	No
Carbon Disulfide (a)	800	86	1	1.2	1%	No
Chloroform (a)	55	86	1	0.4	1%	No
cis-1,2-Dichloroethene	16 (b)	98	34	1.5	35%	No
Toluene (a)	57/130 (c)	86	37	19	43%	No
Tetrachloroethene (a)	2.9	86	9	0.15	10%	No
Trichloroethene - Area A	0.3	9	0	NA	0%	No
Trichloroethene - Area B	0.70	15	0	NA	0%	No
Trichloroethene - Area C	58	21	8	1.1	38%	No
Trichloroethene - Area D	58	53	21	1.7	40%	No
Vinyl Chloride - Area A	0.02	9	0	NA	0%	No
Vinyl Chloride - Area B	0.18	15	2	0.063	13%	No
Vinyl Chloride - Area C	98	21	10	0.32	48%	No
Vinyl Chloride - Area D	15	53	30	0.54	57%	No

Note:

(a) Constituent is not attributed to the plumes because it is understood to be naturally occurring or attributed to other anthropogenic sources and is not found in groundwater either near or upgradient of the surface water bodies.

(b) MTCA Method B standard formula value for groundwater as drinking water is provided for reference only, this is not a screening level.

(c) SL of 57 µg/L is applicable to Area A; SL of 130 µg/L is applicable to areas B, C, and D.

Abbreviations/Acronyms:

-- = No criteria available; no screening level established.
µg/L = micrograms per liter
SL = screening level
NA = not applicable

Table 5-8
Air Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

	Screening Level ($\mu g/m^3$)	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection ($\mu g/m^3$)	Percent Detected	Percent Exceedances (overall/VI related)
COMMERCIAL							
Ambient Air							
cis-1,2-Dichloroethene	--	NA	7	0	NA	0%	NA
Tetrachloroethene	2.88E+01	0	4	0	NA	0%	0%
Trichloroethene	1.88E+00	0	9	0	NA	0%	0%
Vinyl Chloride	8.52E-01	0	10	0	NA	0%	0%
Indoor Air							
cis-1,2-Dichloroethene	--	NA	15	0	NA	0%	NA
Tetrachloroethene	2.88E+01	1(a)	5	2	918	40%	20%/0%
Trichloroethene	1.88E+00	0(b)	21	3	11(b)	14%	0%
Vinyl Chloride	8.52E-01	0	23	4	0.38	17%	0%
Soil Vapor (Sub-slab and Borings)							
cis-1,2-Dichloroethene	--	NA	39	3	30	8%	NA
Tetrachloroethene	9.60E+02	0	10	0	NA	0%	0%
Trichloroethene	6.25E+01	0	42	5	14	12%	0%
Vinyl Chloride	2.84E+01	1	42	2	30	5%	3%
INDUSTRIAL							
Ambient Air							
cis-1,2-Dichloroethene	--	NA	2	0	NA	0%	NA
Tetrachloroethene	4.00E+01	0	2	0	NA	0%	0%
Trichloroethene	2.00E+00	0	2	0	NA	0%	0%
Vinyl Chloride	2.84E+00	0	2	0	NA	0%	0%
Indoor Air							
cis-1,2-Dichloroethene	--	NA	7	0	NA	0%	NA
Tetrachloroethene	4.00E+01	0	7	0	NA	0%	0%
Trichloroethene	2.00E+00	0	7	0	NA	0%	0%
Vinyl Chloride	2.84E+00	0	7	0	NA	0%	0%
Sub-Slab Soil Vapor							
1,1,1-Trichloroethane	--	NA	39	23	216	59%	NA
1,1,2,2-Tetrachloroethane	--	NA	27	2	5	7%	NA
1,1,2-Trichloroethane	--	NA	12	0	NA	0%	NA
1,1-Dichloroethane	--	NA	39	12	185	31%	NA
1,1-Dichloroethene	--	NA	39	4	47	10%	NA
cis-1,2-Dichloroethene	--	NA	39	9	310	23%	NA
Tetrachloroethene	1.30E+03	0	39	20	220	51%	0%
trans-1,2-Dichloroethene	--	NA	39	27	180	69%	NA
Trichloroethene	6.67E+01	5	39	19	1010	49%	13%/0%
Vinyl Chloride	9.47E+01	2	39	3	350	8%	5%/0%
RESIDENTIAL							
Ambient Air							
cis-1,2-Dichloroethene	--	NA	24	0	NA	0%	NA
trans-1,2-Dichloroethene	2.74E+01	0	24	0	NA	0%	0%
Trichloroethene	3.68E-01	1(a)	27	1	1.1	4%	4%/0%
Vinyl Chloride	2.84E-01	0	27	0	NA	0%	0%

Table 5-8
Air Statistics
Boeing Auburn Remedial Investigation
Auburn, Washington

	Screening Level ($\mu g/m^3$)	Number of Screening Level Exceedances	Number of Results	Number of Detections	Maximum Detection ($\mu g/m^3$)	Percent Detected	Percent Exceedances (overall/VI related)
Indoor Air							
cis-1,2-Dichloroethene	--	NA	68	0	NA	0%	NA
trans-1,2-Dichloroethene	2.74E+01	0	68	0	NA	0%	0%
Trichloroethene	3.68E-01	3(a)	74	7	1.2	9%	4%/0%
Vinyl Chloride	2.84E-01	0	71	0	NA	0%	0%
Sub-Slab Soil Vapor							
cis-1,2-Dichloroethene	--	NA	18	0	NA	0%	NA
trans-1,2-Dichloroethene	9.07E+02	0	18	0	NA	0%	0%
Trichloroethene	1.23E+01	0	18	1	0.43	6%	0%
Vinyl Chloride	9.47E+00	0	18	0	NA	0%	0%

Notes:

(a) Detections were determined to be the result of a background souce and are not attributed to vapor intrusion.

(b) One detection exceeded the screening level for continuously occupied work areas but was collected in an infrequently occupied area. The concentrations was determined to be less than a modified health risk-based screening level calculated for a typical exposure scenario in an infrequently occupied area.

1. Data set includes all Site-wide air data collected 2011 and later.

Abbreviations/Acronyms:

-- = No criteria available; no screening level established.

$\mu g/m^3$ = micrograms per cubic meter

NA = not applicable

Table 5-9
Indicator Hazardous Substances
Boeing Auburn Remedial Investigation
Auburn, Washington

Media	Indicator Hazardous Substance	Carcinogen/ Non-Carcinogen
Soil	Trichloroethene	Carcinogen and Non-Carcinogen
	Antimony	Non-Carcinogen
	Cadmium	Non-Carcinogen
	Cyanide	Non-Carcinogen
	Diesel-Range Organics	(a)
	Oil-Range Organics	(a)
	Gasoline-Range Organics	(a)
Groundwater	Trichloroethene	Carcinogen and Non-Carcinogen
	Vinyl Chloride	Carcinogen and Non-Carcinogen
	Cadmium	Non-Carcinogen
	Diesel-Range Organics	(a)
	Oil-Range Organics	(a)
	Gasoline-Range Organics	(a)

Note:

(a) Model Toxics Control Act Method A cleanup level is used because insufficient toxicity data is available for evaluation of either carcinogenic or non-carcinogenic effects of petroleum hydrocarbons.