Lower Duwamish Waterway
RM 4.3 to 4.9 East
(Boeing Developmental Center)

Summary of Existing Information and Identification of Data Gaps

Prepared for

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September 2010

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Acronyms and Abbreviations

AOC	Area of Concern
BDC	Boeing Developmental Center
bgs	below ground surface
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	chemical of concern
CSCSL	Confirmed or Suspected Contaminated Sites List
CSL	Cleanup Screening Level
CSO	combined sewer overflow
DW	dry weight
E&E	Ecology & Environment, Inc.
EAA	Early Action Area
ECHO	Enforcement and Compliance History Online
Ecology	Washington State Department of Ecology
EOF	emergency overflow
EPA	U.S. Environmental Protection Agency
GIS	Geographic Information Systems
HAP	Hazardous Air Pollutant
HazMat	Hazardous Materials
ISIS	Integrated Site Information System
KCIA	King County International Airport
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
LUST	leaking underground storage tank
mg/kg	milligrams per kilogram
MFC	Military Flight Center
MOF	Museum of Flight
MOU	Memorandum of Understanding
MTCA	Model Toxics Control Act
NOAA	National Oceanic and Atmospheric Administration
NOV	Notice of Violation
NPDES	National Pollutant Discharge Elimination System
NWRO	Northwest Regional Office
OC	organic carbon
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCE	tetrachloroethene
PSCAA	Puget Sound Clean Air Agency
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
RM	River Mile
SAIC	Science Applications International Corporation
SCAP	Source Control Action Plan
SCL	Seattle City Light
SD	storm drain

SIC	Standard Industrial Classification
SMS	Sediment Management Standards
SPU	Seattle Public Utilities
SQS	Sediment Quality Standard
SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWPPP	Stormwater Pollution Prevention Plan
TCE	trichloroethene
TOC	total organic carbon
TPH	total petroleum hydrocarbons
TSS	total suspended solids
UST	underground storage tank
VCP	Voluntary Cleanup Program
VOC	volatile organic compound
WAC	Washington Administrative Code
WWTP	wastewater treatment plant
μg/L	micrograms per liter

1.0 Introduction

1.1 Background and Purpose

This *Summary of Existing Information and Identification of Data Gaps* report (Data Gaps Report) pertains to River Mile (RM) 4.3-4.9 East[1] (Boeing Developmental Center), one of 24 source control areas identified as part of the overall cleanup process for the Lower Duwamish Waterway (LDW) Superfund Site (Figure 1). It summarizes readily available information regarding properties in the Boeing Developmental Center (BDC) source control area. Part of the northern portion of the BDC was included in the Data Gaps Report (E&E 2008) and Source Control Action Plan (SCAP) (Ecology 2008b) for the RM 3.9 to 4.3 East (Slip 6) source control area. Part of the southern portion of the BDC was included in the Data Gaps Report (E&E 2007) and SCAP (Ecology 2007b) for the RM 4.9 East (Norfolk Combined Sewer Overflow [CSO]/storm drain [SD])[2] source control area.

The purpose of this Data Gaps Report is to:

- Identify chemicals of potential concern in sediments associated with the BDC source control area;
- Evaluate potential contaminant migration pathways to LDW sediments;
- Identify and describe potential adjacent or upland sources of contaminants that could be transported to sediments;
- Identify critical data gaps that should be addressed to assess the potential for recontamination of sediments and the need for source control; and
- Determine what, if any, effective source control is already in place.

The LDW consists of 5.5 miles of the Duwamish Waterway, as measured from the southern tip of Harbor Island to just south of the Norfolk CSO. The LDW flows into Elliott Bay in Seattle, Washington. The LDW was added to the U.S. Environmental Protection Agency (USEPA or EPA) National Priorities List in September 2001 due to the presence of chemical contaminants in sediment. The key parties involved in the LDW site are EPA, the Washington State Department of Ecology (Ecology), and the Lower Duwamish Waterway Group (LDWG), which is composed of the City of Seattle, King County, the Port of Seattle, and The Boeing Company. In December 2000, EPA and Ecology signed an agreement with the LDWG to conduct a Remedial Investigation/Feasibility Study (RI/FS) for the LDW site.

EPA is leading the effort to determine the most effective cleanup strategies for the LDW through the RI/FS process. Ecology is leading the effort to investigate upland sources of contamination and to develop plans to reduce contaminant migration to waterway sediments.[3] The LDWG collected data during a Phase 1 Remedial Investigation (RI) (Windward 2003) that were used to

[1] River miles as defined in this report are measured from the southern tip of Harbor Island.
[2] The RM 4.9 East (Norfolk CSO/SD) source control area is also referred to as Early Action Area 7 (EAA-7).
[3] EPA and Ecology signed an interagency Memorandum of Understanding (MOU) in April 2002 and updated the MOU in April 2004. The MOU divides responsibilities for the site. EPA is the lead agency for the sediment RI/FS, while Ecology is the lead agency for source control issues (EPA and Ecology 2002, 2004).

identify candidate locations for early cleanup action. Seven candidate early action sites (or Tier 1 sites) were identified. Part of the BDC is located within one of these Tier 1 sites (Norfolk CSO/SD). Ecology's *Lower Duwamish Waterway Source Control Status Report, 2003 to June 2007* (Ecology 2007a) and *Lower Duwamish Waterway Source Control Status Report, July 2007 to March 2008* (Ecology 2008a) identified another 16 areas where source control actions may be necessary[4]. The BDC source control area was identified as one of these areas. Subsequently, Ecology and EPA redefined the boundaries of the source control areas, generally defined by stormwater drainage basins.

Ecology is the lead agency for source control for the LDW site. Source control is the process of finding and eliminating or reducing releases of contaminants to LDW sediments, to the extent practicable. The goal of source control is to prevent sediments from being recontaminated after cleanup has been undertaken.

The LDW Source Control Strategy (Ecology 2004) describes the process for identifying source control issues and implementing effective controls for the LDW. The plan is to identify and manage potential sources of sediment recontamination in coordination with sediment cleanups. Source control will be achieved by using existing administrative and legal authorities to perform inspections and require necessary source control actions.

The strategy is based primarily on the principles of source control for sediment sites described in EPA's *Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites* (EPA 2002), and the Washington State Sediment Management Standards (SMS) (Washington Administrative Code [WAC] 173-340-370[7] and WAC 173-204-400). The Source Control Strategy involves developing and implementing a series of detailed, area-specific SCAPs.

Before developing a SCAP, Ecology prepares a Data Gaps Report for the source control area. Findings from the Data Gaps Report are reviewed by LDW stakeholders and are incorporated into the SCAP. This process helps to ensure that the action items identified in the SCAP will be effective, implementable, and enforceable. As part of the source control efforts for the BDC source control area, Ecology requested Science Applications International Corporation (SAIC) to prepare this Data Gaps Report.

1.2 Report Organization

Section 2 of this report provides background information on the BDC source control area, including location, physical characteristics, chemicals of concern (COCs), and pathways by which contaminants may reach sediments. Sections 3 and 4 describe potential sources of contaminants and data gaps that must be addressed in order to minimize the potential for LDW sediment recontamination. Section 5 provides a summary of data gaps, and Section 6 lists the documents reviewed during preparation of this report.

Information presented in this report was obtained from the following sources:

- Ecology Northwest Regional Office (NWRO) Central Records;

[4] One additional source control area was added by Ecology in 2010, for a total of 24 source control areas.

- Washington State Archives;
- Ecology Underground Storage Tank (UST) and Leaking Underground Storage Tank (LUST) lists;
- Ecology Facility/Site Database;
- Ecology Integrated Site Information System (ISIS) Database;
- Washington Confirmed and Suspected Contaminated Sites List (CSCSL);
- EPA Enforcement and Compliance History Online (ECHO);
- EPA Envirofacts Warehouse;
- King County Geographic Information Systems (GIS) Center Parcel Viewer, Property Tax Records, and iMap; and
- Historical aerial photographs.

Information collected from the Facility/Site Database, ISIS, ECHO, EPA Envirofacts Warehouse, and King County property tax records was current as of June 2010. Recent updates to these databases may not be reflected in this report.

1.3 Scope of Report

This report documents readily available information relevant to potential sources of contaminants to sediments associated with the BDC source control area, including outfalls and adjacent properties, not assessed as part of the previously completed Data Gaps Reports and SCAPs.

Information presented in this report is limited to the BDC source control area, direct discharges to the sediments associated with the source control area, and potential adjacent and upland contaminant sources. Source control with regard to any contaminated sediments removed or left in place during cleanup in this portion of the LDW will need to be addressed as part of the remedial action decision and design for this area.

Chemical data have been compared to relevant regulatory criteria and guidelines, as appropriate. The level of assessment conducted for the data reviewed in this report is determined by the source control objectives. The scope of this Data Gaps Report does not include data validation or analysis that exceeds what is required to reasonably achieve source control.

Air pollution is a potential source of sediment contamination with origins outside of the BDC source control area. Although limited discussion of atmospheric deposition is provided in Section 2, the scope of this report does not include an assessment of data gaps pertaining to the effects of air pollution on the sediments associated with the source control area. Because air pollution is a concern for the wider LDW region, Ecology will review work being conducted by the Washington State Department of Health and planned by the Puget Sound Partnership regarding atmospheric deposition.

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2.0 BDC Source Control Area

The BDC source control area (also referred to as the RM 4.3-4.9 East source control area) is located along the eastern side of the LDW Site between RM 4.3 and 4.9, as measured from the southern end of Harbor Island (Figure 1). In this source control area (Figure 2), only one facility (BDC) is located directly adjacent to the LDW. Stormwater from the BDC property drains to one of three areas: Slip 6, RM 4.3 East to the Boeing Pedestrian Bridge, and the area around RM 4.9 East. The area draining to Slip 6 and the area around RM 4.9 East were addressed in earlier source control reports, as described in Section 2.1 below. For purposes of this report, “BDC source control area” refers to the portions of the BDC facility that drain to the area between RM 4.3 East and the Boeing Pedestrian Bridge, as shown in Figures 2 and 3. This is different than “BDC property” which refers to the entire facility, including those portions evaluated in other source control reports.

To the east of the BDC source control area are the King County Museum of Flight (MOF), King County International Airport (KCIA), and the Boeing Military Flight Center (MFC).

To the north of the BDC source control area are portions of the BDC property from which stormwater drains to Slip 6, and the former Rhone-Poulenc property, which is now owned by Container Properties, LLC. These facilities were discussed in the Data Gaps Report and SCAP for the Slip 6 (RM 3.9-4.3 East) source control area (E&E 2008; Ecology 2008b).

To the south of the BDC source control area are portions of the BDC property from which stormwater drains to the area near RM 4.9 East (including the BDC south storm drain) and a vacant lot, identified as “Strick Lease Storage Yard” in King County property records. Aerial photos indicate that the lot may be used to store truck/train trailers. This portion of the BDC property was discussed in the Data Gaps Report and SCAP for the Norfolk CSO/SD (RM 4.9 East) source control area (E&E 2007; Ecology 2007b). The vacant lot was not discussed in the Norfolk CSO/SD source control reports.

2.1 Summary of Previous Data Gaps Reports

Portions of the BDC property have been included in earlier Data Gaps Reports and SCAPs. At the time that the Data Gaps Report for the Norfolk CSO/SD (RM 4.9 East) was prepared, seven candidate EAAs had been identified, and the area around the Norfolk CSO/SD was identified as EAA-7. Since then, early actions have been planned or undertaken for only five of those original seven areas. When citing the Data Gaps Report for the Norfolk CSO/SD, it will be referred to by its original report name (EAA-7 Data Gaps Report).

Relevant information from previous Data Gaps Reports is summarized below; these areas of the BDC are not addressed further in the current Data Gaps Report, except as they directly relate to the BDC source control area (Figure 2).

2.1.1 EAA-7 (Norfolk CSO/SD) Data Gaps Report and SCAP

The EAA-7 Data Gaps Report summarized available information about the area of the property that drains to the following five SD outfalls, located between S 102nd Street Bridge and the Boeing pedestrian bridge (Figure 2):

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]
2095	DC1	Stormwater from parking areas and roadways in the southernmost portion of the BDC property; discharges through an oil/water separator to the 84-inch King County/SPU Norfolk CSO/SD at a point just upstream of the outfall. This outfall also includes drainage from the 769-acre Norfolk SD basin and the 4,900-acre Norfolk CSO basin.	84-inch (6 ft x 6 ft)	Very Large
2093	DC2	Also referred to as the South SD; collects stormwater runoff from the roof of Building 9-110 and a portion of the roof of Building 9-101, and from parking areas and roadways adjacent to these buildings. Stormwater is collected into a primary SD line, which runs through part of the south end of the BDC property before it discharges via a 24-inch concrete pipe to the LDW. A sediment trap / oil/water separator was installed in this drain upstream of manhole MH2 in 2003.	24-inch concrete	Large
2096	DC3	Drains a portion of the roofs of Buildings 9-140 and 9-130, plus the pavement and planted areas around this part of the building, and a small landscaped area for employee use.	6-inch iron	Small
BDC-5	DC16	Drains the southwest corner of the Building 9-140 roof and the pavement and planted areas around this part of the building.	No information	Very Small
2097	DC4	Also drains a small portion of the Building 9-140 roof and pavement/plantings near this building.	8-inch steel	Very Small
2092	DC17	Drains the southwest corner of the Building 9-101 roof, and approximately half of the roof areas of Buildings 9-140 and 9-130, plus the parking and roadway areas around portions of these buildings.	18-inch iron	Small

1. Outfall number as listed in Windward 2010, Appendix H.
2. Sources: Ecology 2007b; Windward 2010; Boeing 2003; Bet 2009; Herrera 2004
3. Outfall discharge volumes are presented as listed in Boeing 2010a; no definitions are provided.

In addition, an unidentified 12-inch concrete outfall pipe (Outfall 2094) was observed during surveys conducted in support of the LDW Phase 2 RI (Windward 2010). This outfall is not shown on Boeing drainage maps and was not discussed in the EAA-7 Data Gaps Report or SCAP. According to Boeing, this outfall is closed and there is no discharge from this outfall; it was approximately half full with sand in 2003, and this sand currently remains in place (Boeing 2010b).

In 2001, polychlorinated biphenyls (PCBs) were detected in the South SD line at concentrations up to 16,700 mg/kg dry weight (DW). Boeing conducted pressure cleaning of approximately 500 meters of the South SD piping in 2002 to remove PCBs from the interior of the SD piping. High levels of PCBs were found in the sidewall scum/organic material found on pipe interiors along the older SD segments. In 2003, Boeing installed a sediment trap / oil/water separator (Vortechnics 9000 unit) in the South SD line as a source control measure to help prevent stormwater solids from reaching the LDW. Subsequently, in September 2003, Boeing removed sediment in the LDW immediately offshore of the South SD line outfall and approximately 130 feet downstream of the Norfolk CSO/SD outfall (DC1), under Ecology's Voluntary Cleanup Program (VCP). A permeable carbon fabric was then placed in the excavation, and the excavation was backfilled with clean sand.

As described in the August 2009 Source Control Status Report (Ecology 2009a), Boeing's contractor (Calibre Systems) published a *Summary of Storm Drain Line Cleanout Work and 2008 Annual Sampling Report, South Storm Drain System, Boeing Developmental Center* (Calibre 2009), which presented results of the post-removal monitoring associated with the South SD system and documents additional cleaning performed in a segment of the SD system beneath Building 9-101 during 2008.

Additional information is provided in the EAA-7 Data Gaps Report and SCAP, and in the LDW Source Control Status Reports (Ecology 2007a; Ecology 2008a; Ecology 2008c; Ecology 2009a; and subsequent updates).

2.1.2 Slip 6 Data Gaps Report and SCAP

The Slip 6 (RM 3.9-4.3 East) Data Gaps Report includes the northern portion of the BDC property, and a parcel to the north/northeast that was formerly part of the BDC property and is currently owned by the MOF. Groundwater investigations at the MOF (former BDC) parcel (Parcel 1034 as shown on Figure 3) found diesel-range and gasoline-range petroleum hydrocarbons; however, the source and extent of groundwater contamination is unknown. This was identified as a data gap for the Slip 6 source control area. Recommended source control actions included continued monitoring of stormwater and/or SD solids at the MOF (former BDC) parcel in the vicinity of USTs and groundwater contamination; development of a plan to remove the USTs and associated soil and groundwater contamination; identify the source and extent of groundwater contamination on the parcel; and conduct remedial actions, if necessary (Ecology 2008b).

The areas of the BDC property with stormwater and surface drainage north to Slip 6 were also included in the Slip 6 Data Gaps Report and SCAP. Two stormwater outfalls currently discharge from the BDC to Slip 6:

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]
2081	DC15	Drains most of the roof of Buildings 9-77, 9-05, and 9-07; a large water storage tank; and extensive parking and paved storage areas. Runoff collected in this SD line passes through an oil/water separator prior to discharge. Also discharges stormwater drainage from the MOF (former BDC) parcel.	36-inch concrete	Medium
2082	DC14	Drains the roof of the northern half of Building 9-08, large paved parking and roadway areas around the building; planted areas; and a greenbelt corridor on the western property boundary, adjacent to the LDW. Runoff	24-inch steel	Medium

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]
		collected in this SD line passes through an oil/water separator prior to discharge.		

1. Outfall number as listed in Windward 2010, Appendix H.
2. Sources: Ecology 2007b; Windward 2010; Boeing 2003; Bet 2009; Herrera 2004.
3. Outfall discharge volumes are presented as listed in Boeing 2010a; no definitions are provided.

Two additional pipes were observed in this area during an outfall survey conducted by Seattle Public Utilities (SPU) in 2003 (Herrera 2004). These are shown as abandoned outfalls 2083 and 2084 in Figure 2. An investigation conducted by Boeing identified these as hydraulic pressure relief pipes which drain infiltrated tidal waters from behind the bulkhead. They are therefore part of the original bulkhead design, and are not outfalls.

The Slip 6 Data Gaps Report (E&E 2008) indicated that stormwater from Building 9-04 at the MOF property appeared to discharge to Outfall DC9 (2090). However, the most recent stormwater drainage map (Boeing 2009c) shows that stormwater drainage from the portion of the MOF property that includes Building 9-04, and the parking areas to the northwest, is discharged via Outfall DC15 to Slip 6 (Figure 5).

According to the Slip 6 SCAP (Ecology 2008b), no sampling of stormwater in this drainage area has been conducted, and it not known whether stormwater or SD solids may represent a potential source of sediment recontamination. In addition, no information was available regarding the potential presence of USTs in this area. These were identified as data gaps. Recommended source control actions included stormwater and/or SD solids sampling in the DC14/DC15 drainage area, and investigation of any USTs that may be located within this area.

Additional information is provided in the Slip 6 Data Gaps Report and SCAP (E&E 2008; Ecology 2008b), and updates will be provided in future LDW Source Control Status Reports.

2.2 Site Description

General background information on the LDW is provided in the Phase 1 RI Report (Windward 2003), which describes the history of dredging/filling and industrialization of the Duwamish River and its environs, as well as the physiography, physical characteristics, hydrogeology, and hydrology of the area.

The upland areas adjacent to the LDW have been industrialized for many decades; historical and current commercial and industrial operations in the vicinity of BDC include a commercial airport, chemical manufacturing, a military flight center, a museum, and an auto wrecking storage yard.

In the late 1800s and early 1900s, extensive topographic modifications were made to the Duwamish River to create a straightened channel; many of the current side slips are remnants of old river meanders. Slip 6, which is immediately north of the BDC property, is one of these remnants.

Groundwater in the Duwamish Valley alluvium is typically encountered within about 3 meters (10 feet) of the ground surface and under unconfined conditions (Windward 2003). The general direction of groundwater flow is toward the LDW, although the direction may vary locally depending on the nature of the subsurface material, and temporally, based on proximity to the LDW and the influence of tidal action. High tides can cause temporary groundwater flow reversals, generally within 100 to 150 meters (300 to 500 feet) of the LDW (Booth and Herman 1998). Groundwater flow in the vicinity of the BDC source control area is generally to the southwest, toward the LDW.

Bottom sediment composition is variable throughout the LDW, ranging from sands to mud. Typically, the sediment consists of slightly sandy silt with varying amounts of organic detritus. Coarser sediments are present in nearshore areas adjacent to SD discharges (Weston 1999); finer-grained sediments are typically located in remnant mudflats and along channel side slopes. LDW sediments in the vicinity of the BDC source control area range from >80 percent fines near Slip 6 to 40 to 60 percent fines at the upstream end of the source control area, with isolated patches of finer and coarser material (Windward 2003).

Ten active private outfalls, one abandoned outfall, and four seeps are present along the shoreline in the BDC source control area (Figure 2).

2.3 Chemicals of Concern in Sediment

In 1999, King County dredged sediments in the area offshore of the Norfolk CSO/SD outfall (located around RM 4.9 East), and backfilled the dredged area with clean sand. Following the cleanup, King County initiated a 5-year sampling program to monitor the sediment cap for potential recontamination by metals and organic contaminants. Sediment data associated with monitoring of the cap, and data from other studies associated with the RM 4.9 East source control area, are described in the EAA-7 Data Gaps Report (E&E 2007).

Chemicals detected in LDW sediment samples collected in the river segment near the BDC source control area (i.e., between RM 4.3 and 4.9 East) are listed in Appendix A. Surface sediment sample locations within this area are summarized in Table 1. No subsurface sediment samples have been collected in this area (except in the LDW navigation channel). Chemical detections exceeding the Washington State SMS are summarized in Table 2. Sampling locations and SMS exceedances are shown in Figure 4.

Laboratory detection limits exceeded the Sediment Quality Standards (SQS) for three chemicals that were not detected in any of the sediment samples collected near RM 4.3-4.9 East: hexachlorobutadiene, 1,2,4-trichlorobenzene, and N-nitrosodiphenylamine. These chemicals may or may not be present in sediment at concentrations exceeding the SQS.

2.3.1 Sediment Investigations

Sediment samples have been collected from the area near RM 4.3-4.9 East as part of the following investigations.

- **Boeing Site Characterization (October 1997)**

  Twenty-two surface sediment samples were collected by Boeing in the vicinity of the BDC source control area in October 1997. Samples were analyzed for polycyclic aromatic hydrocarbons (PAHs), PCBs, metals and trace elements, phthalates, and semivolatile organic compounds (SVOCs) including chlorinated benzenes and phenols (Exponent 1998, as cited in Windward 2003). Chemicals detected at these sample locations are listed in Appendix A.

- **Duwamish Waterway (NOAA) Sediment Characterization Study (September-November 1997)**

  Twenty-four surface sediment samples were collected near the BDC source control area. These samples were analyzed for PCBs (NOAA 1998). PCBs were detected in all samples, with concentrations ranging from 0.002 to 0.087 mg/kg DW.

- **EPA Site Inspection, Lower Duwamish River (August 1998)**

  Twelve surface sediment samples were collected in the vicinity of the BDC source control area in August 1998. Samples were analyzed for volatile organic compounds (VOCs), SVOCs, metals, PCBs as Aroclors and congeners, dioxins/furans, and total organic carbon (TOC) (Weston 1999). Chemicals detected at these sample locations are listed in Appendix A. No subsurface samples were collected in this area.

- **LDW Remedial Investigation Benthic Sampling (August 2004)**

  One surface sediment sample (B9a) was collected by Windward in the vicinity of RM 4.5 East (Figure 4) in August 2004. The sample was analyzed for total PCBs, PAHs, pesticides, metals, and SVOCs (Windward 2006). Chemicals detected at this sample location are listed in Appendix A.

- **LDW Phase 2 Remedial Investigation, Round 1 and 2 Surface Sediment Sampling (January to March 2005)**

  Four surface sediment samples were collected by Windward near the BDC source control area during Rounds 1 and 2 of the LDW Phase 2 RI during January to March 2005. All samples were analyzed for the SMS list of chemicals, SVOCs, and PCBs as Aroclors and congeners (Windward 2005a, 2005b). A subset of samples was also analyzed for polychlorinated dioxins and furans. Chemicals detected at these sampling locations are listed in Appendix A.

2.3.2 Identification of Chemicals of Concern

A chemical of concern (COC) is defined in this report as a chemical that is present in RM 4.3-4.9 East sediments at concentrations above regulatory criteria, and is therefore of particular interest with respect to source control. These COCs are the initial focus of the evaluation of potential contaminant sources.

The Washington SMS (Chapter 173-204 WAC) establish marine Sediment Quality Standard (SQS) and Cleanup Screening Level (CSL) values for some chemicals that may be present in sediments. The SQS values correspond to a sediment quality level that will result in no adverse effects on biological resources and no significant human health risk. CSLs represent minor adverse effects levels and are used as an upper regulatory threshold for making decisions about source control and cleanup.

A chemical was identified as a COC for RM 4.3-4.9 East if it was detected in sediment at concentrations above the SQS. A comparison of sample results to the SQS and CSL values is provided in Appendix A, and those chemicals that were detected at concentrations above their respective SQS/CSL values are listed in Table 2. For non-polar organics, the dry weight concentrations were organic carbon (OC) normalized to allow comparison to the SQS/CSL.

Chemicals detected in sediment for which no SQS/CSL values are available may be identified as COCs on a case-by-case basis. Additional contaminants may be present in soil, groundwater, stormwater, or stormwater solids at concentrations above regulatory criteria and/or soil-to-sediment or groundwater-to-sediment screening levels (SAIC 2006). These screening levels were developed to assist in the identification of upland properties that may pose a risk of recontamination of sediments at Slip 4. The screening levels incorporate a number of conservative assumptions, including the absence of contaminant dilution and ample time for contaminant concentrations in soil, sediment, and groundwater to achieve equilibrium. In addition, the screening levels do not address issues of contaminant mass flux from upland to sediments, nor do they address the area or volume of sediment that might be affected by upland contaminants. Because of these assumptions and uncertainties, these screening levels are most appropriately used for one-sided comparisons. If contaminant concentrations in upland soil or groundwater are below these screening levels, then it is unlikely that they will lead to exceedances of the SMS. However, upland concentrations that exceed these screening levels *may or may not* pose a threat to marine sediments; additional site-specific information must be considered in order to make such an assessment. While not currently considered COCs in sediment, these chemicals may warrant further investigation, depending on site-specific conditions, to evaluate the likelihood that they will lead to exceedances of the SMS criteria. Potential upland COCs are discussed as appropriate in Section 4.

2.3.3 COCs in RM 4.3-4.9 East Sediments

COCs were identified based on the results of sediment sampling conducted between 1997 and 2005, as described above. Chemicals that exceeded the SQS in at least one sediment sample near the BDC source control area (as shown on Figure 4) are considered COCs.

A total of 63 surface sediment samples have been analyzed. Of the 63 samples analyzed, five contained chemicals that exceed the SQS criteria (Table 2). No subsurface samples have been collected in this area.

The following chemicals are considered to be COCs in sediment for the BDC source control area[5]:

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[5] Hexachlorobutadiene, 1,2,4-trichlorobenzene, and N-nitrosodiphenylamine were not detected in any samples, however laboratory detection limits for these analytes exceeded the SQS in all samples.

Chemicals Detected at Concentrations above the SQS/CSL	>SQS	>CSL
Metals		
Lead	●	●
PAHs		
Acenaphthene	●	
Benzo(g,h,i)perylene	●	
Dibenzo(a,h)anthracene	●	
Fluoranthene	●	
Indeno(1,2,3-cd)pyrene	●	
PCBs		
Total PCBs	●	

Exceedance factors, which are a measure of the degree to which maximum detected concentrations exceed the SQS/CSL values, are listed in Table 2.
Chemicals listed in this table are based on results of surface sediment sampling; no subsurface sediment samples have been collected in the BDC source control area.

Results for these chemicals are discussed in more detail below.

Metals

Lead is the only metal with a detected concentration above the SQS. Lead was detected at one location (DR254), just downstream of the Boeing pedestrian bridge, at a concentration of 620 mg/kg DW. This slightly exceeds the both the SQS (450 mg/kg DW) and the CSL (530 mg/kg DW).

PAHs

PAH concentrations exceeding the SQS were detected in two surface samples, R79 and R63. The concentration of acenaphthene (0.22 mg/kg DW, 20 mg/kg OC) exceeded the SQS in sample R79, located west of the Boeing pedestrian bridge near the upstream side of the BDC source control area (Figure 4).

At R63, benzo(g,h,i)perylene, dibenzo(a,h)anthracene, fluoranthene, and indeno(1,2,3-cd)pyrene exceeded the SQS, with concentrations ranging from 19 mg/kg OC (dibenzo(a,h)anthracene) to 170 mg/kg OC (fluoranthene). None of these chemicals exceeded the CSL. R63 is located on the downstream end of the BDC source control area, near Outfall DC-13 and offshore of Building 9-12.

PCBs

PCB concentrations slightly exceeded the SQS in two sediment samples (R75 and B9a). These two samples, with concentrations from (0.26 to 0.27 mg/kg DW, 13 to 14 mg/kg OC) were collected near Outfall DC9, offshore of Building 9-96 (Figures 4 and 5).

2.3.4 Summary of Chemicals of Concern in Sediments

As described above, COCs were identified based on the results of sediment sampling conducted between 1997 and 2005. Chemicals that exceeded the SQS in at least one surface sediment sample offshore of the BDC source control area are considered COCs. No subsurface samples have been collected in this area.

In summary, the following chemicals are considered to be COCs in surface sediment near the BDC source control area:

- PCBs
- PAHs
- Lead

2.4 Potential Pathways to Sediment

Potential sources of sediment recontamination to RM 4.3-4.9 East include storm drains, adjacent properties, and contaminants transported along the LDW from upstream. No CSO outfalls are located within the BDC source control area. The Norfolk CSO/SD outfall is located upstream of the BDC source control area (Figure 2) and is discussed in detail in the EAA-7 Data Gaps Report and SCAP. There are no upland properties with stormwater drainage to the RM 4.3-4.9 area; other potential contaminant transport pathways to the LDW from upland properties are addressed as part of the EAA-7 and Slip 6 Data Gaps Reports and SCAPs.

Transport pathways that could contribute to the recontamination of sediments near the BDC source control area following remedial activities include direct discharges via outfalls, surface runoff (sheet flow) from the adjacent BDC property, bank erosion, groundwater discharges, air deposition, and spills directly to the LDW. These pathways are described below and are discussed in more specific detail in Sections 3 and 4.

2.4.1 Direct Discharges via Outfalls

Direct discharges may occur from public or private SD systems, CSOs, and emergency overflows (EOFs).

Some areas of the LDW are served by combined sewer systems, which carry both stormwater and municipal/industrial wastewater in a single pipe. These systems were generally constructed before about 1970 because it was less expensive to install a single pipe rather than separate storm and sanitary systems. Under normal rainfall conditions, wastewater and stormwater are conveyed through this combined sewer pipe to a wastewater treatment facility. During large storm events, however, the total volume of wastewater and stormwater can sometimes exceed the conveyance and treatment capacity of the combined sewer system. When this occurs, the combined sewer system is designed to overflow through relief points, called CSOs. The CSOs prevent the combined sewer system from backing up and creating flooding problems.

Untreated municipal/industrial wastewater and stormwater can potentially be discharged through CSOs to the LDW during these storm events. The City of Seattle owns and operates the local sanitary sewer collectors and trunk lines, while King County owns and operates the larger interceptor lines that transport flow from the local systems to the West Point Wastewater Treatment Plant (WWTP). The city's CSO network has its own National Pollutant Discharge

Elimination System (NPDES) permit; the county's CSOs are administered under the NPDES permit established for the West Point WWTP.

An EOF is a discharge that can occur from either the combined or sanitary sewer systems that is not necessarily related to storm conditions and/or system capacity limitations. EOF discharges typically occur as a result of mechanical issues (e.g., pump station failures) or when transport lines are blocked; pump stations are operated by both the city and county. Pressure relief points are provided in the drainage network to discharge flow to an existing storm drain or CSO pipe under emergency conditions to prevent sewer backups. EOF events are not covered under the city's or county's existing CSO wastewater permits.

When preparing a Data Gaps Report for a source control area, all properties that potentially discharge to that source control area (whether through a CSO/EOF or a separated storm drain) are identified to the extent that the boundaries of the drainage basin are known. However, for areas where drainage basins overlap, a property review is performed only if the property has not already been included in a previously published Data Gaps Report. Exceptions include situations where contaminants may be transported to the current source control area via a transport pathway that was not applicable for the earlier evaluation.

As noted above, ten active private outfalls and one abandoned outfall are present within the RM 4.3-4.9 East source control area (Figure 2). Contaminants discharged via these outfalls could directly affect waterway sediments. There are no CSO or EOF outfalls within the RM 4.3-4.9 East source control area.[6]

2.4.2 Surface Runoff (Sheet Flow)

In areas lacking collection systems, spills or leaks on properties adjacent to the LDW could flow directly over impervious surfaces or through creeks and ditches to the waterway. Current operational practices at adjacent properties could potentially contribute to the movement of contaminants to the LDW via runoff. The BDC property has an extensive stormwater collection system, as shown in Figure 5, and surface runoff to the LDW from this property is not considered a significant transport pathway to sediments associated with the BDC source control area.

2.4.3 Spills to the LDW

Near-water and over-water activities have the potential to impact adjacent sediment from spills of material containing COCs. There are no docks or waterfront activities at the BDC property bordering the RM 4.3-4.9 source control area; therefore, spills directly to the LDW from this property are not considered a significant transport pathway to sediments associated with the BDC source control area.

2.4.4 Groundwater Discharges

Contaminants in soil resulting from spills and releases to adjacent properties may be transported to groundwater and subsequently be released to the LDW. Contaminated groundwater and flow

[6] The Norfolk CSO is located to the south near RM 5.0.

directions toward the LDW have been documented at the BDC; however, none of the sediment COCs listed in Section 2.3.4 above were identified as groundwater contaminants at the BDC (see Section 4.1.5 for more information). The southern portion of the RM 4.3-4.9 East shoreline was identified as an area with higher general seepage, as indicated by numerous rivulets flowing along the shore. Four seeps have been identified along the shoreline of the BDC source control area, as shown on Figure 2 (Windward 2004). None of these seeps has been sampled. Transport of contaminants to the LDW via groundwater discharge is considered a potential transport pathway to sediments associated with the BDC source control area.

2.4.5 Bank Erosion

The banks of the LDW shoreline are susceptible to erosion by wind and surface water, particularly in areas where banks are steep. Shoreline armoring and the presence of vegetation reduce the potential for bank erosion. Much of the bank along RM 4.3-4.9 East is riprapped with up to 12 vertical feet of rock. There is a narrow strip of vegetation along most of the shoreline in this area. Aerial photographs appear to show short (<100-foot) lengths of bulkhead in three locations. Contaminants in soils along the banks of the LDW, if present, could be released directly to sediments via erosion.

2.4.6 Atmospheric Deposition

Atmospheric deposition occurs when air pollutants enter the LDW directly or through stormwater. Air pollutants may be generated from point or non-point sources. Point sources include industrial facilities, and air pollutants may be generated from painting, sandblasting, loading/unloading of raw materials, and other activities, or through industrial smokestacks. Non-point sources include dispersed sources such as vehicle emissions, aircraft exhaust, and off-gassing from common materials such as plastics. Air pollutants may be transported over long distances by wind, and can be deposited to land and water surfaces by precipitation or particle deposition.

Contaminants originating from nearby properties and streets may be transported through the air and deposited at RM 4.3-4.9 East or in areas that drain to the LDW. Although chemical deposition from air directly to the LDW probably occurs, this mechanism is not likely to result in sediment concentrations above local background levels. The BDC facility has a Synthetic Minor Air Operating Permit issued by the Puget Sound Clean Air Agency (PSCAA). The permit limits annual air emissions by the following amounts: less than 99 tons of VOCs, less than 9.5 tons of any single Hazardous Air Pollutant (HAP), and less than 24 tons of any combination of HAPs. The air permits are assumed to protect sediments from the impact of air deposition via stormwater discharge to the river. However, the connection between atmospheric deposition and sediments for specific COCs needs to be studied before informed conclusions are possible.

Additional information on recent and ongoing atmospheric deposition studies in the LDW area is summarized in the LDW Source Control Status Report (Ecology 2007a and subsequent updates). Ecology will continue to monitor these efforts.

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3.0 Potential for Sediment Recontamination from Outfalls

3.1 Public Outfalls

No public outfalls are located within the BDC source control area. As noted previously, the Norfolk CSO/SD is described in the 2007 EAA-7 Data Gaps Report (E&E 2007) and SCAP (Ecology 2007b). Boeing discharge point DC1 drains into the municipal SD system, which discharges into the LDW via the Norfolk CSO/SD outfall (E&E 2007).

3.2 Private Outfalls

According to the 2010 BDC Stormwater Pollution Prevention Plan (SWPPP) (Boeing 2010a), there are 18 active outfalls on the BDC property that discharge directly to the LDW; 10 of these outfalls are located within the BDC source control area (Figure 2). Except where noted, the following descriptions are based on descriptions in the 2010 SWPPP.

The following outfalls discharge to the BDC source control area (listed from north to south):

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]
2089	DC13	Drains the roof of Building 9-12 (cafeteria, now closed); the southern half of Building 9-08; a small portion of the south end of Building 9-77; paved areas around these buildings; and a greenbelt corridor next to the river. Runoff collected in this drain line system discharges via an oil/water separator.	24-inch concrete	Medium
2088	DC12	Drains a large narrow portion of the facility from the east to west boundaries of the property, including half of the roof areas of Buildings 9-53 and 9-55; all of the roof areas of Buildings 9-43, 9-48, 9-49, 9-51, 9-52, and 9-54; the paved areas around those buildings (parking, driving, storage, a gas station); and a planted pedestrian corridor, which follows the center length of this area. Runoff is collected into a centralized drain system and four oil/water separators before discharging to the LDW (Bet 2009).	36-inch concrete	Large
BDC-1	DC18	Drains a single line from a catch basin in the parking lot northwest of Building 9-99.	Unknown	Very Small
2087	DC11	Drains long and narrow portion running across the middle of the property from the east to west boundaries, including half of the roof areas of Buildings 9-99, 9-53, 9-42, and 9-55; extensive parking and driving areas; and the main driving entry to the property. Runoff is collected into a centralized drain line and discharges via an oil/water separator to the LDW.	36-inch	Large
2086	NA	Outfall is bricked shut, but discharge was observed during the outfall survey (Windward 2010).	48-inch riveted CMP	Low

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]
2085	DC10	Drains half of the roofs of Building 9-98 and 9-99, plus paved areas (parking, driving, storage) around portions of those buildings. Runoff is collected into a centralized drain line and discharges via an oil/water separator to the LDW.	36-inch concrete	Medium
2090	DC9	Drains nearly one quarter of the BDC property, including half of the roof areas from Buildings 9-98, 9-101, and 9-120; all of the roof areas of Buildings 9-59, 9-60, 9-61, 9-62, 9-66, 9-67, 9-90, and 9-96; the paved areas (parking, driving, storage) around all of these buildings; and some small planted areas. Runoff is collected into an extensive SD system and discharges via an oil/water separator to the LDW.	36-inch concrete	Very large
BDC-2	DC8	Drains a portion of the paved area west of Building 9-120 into a series of catch basins; runoff is collected into a single drain line that discharges to the LDW.	Unknown	Small
BDC-3	DC7	Drains a portion of the paved area west of Building 9-120 into one catch basin; runoff is collected into a single drain line that discharges to the LDW.	Unknown	Very Small
BDC-4	DC6	Drains a portion of the paved area west of Building 9-120 into one catch basin; runoff is collected into a single drain line that discharges to the LDW.	Unknown	Very Small
2091	DC5	Drains the southwest corner of Building 9-101; all of Buildings 9-80, 9-85, and 9-102; and the paved areas (parking, driving, storage) around these buildings. Runoff is collected into a SD system and discharges via an oil/water separator to the LDW.	36-inch CMP	Small

1. Outfall number as listed in Windward 2010, Appendix H.
2. Sources: Ecology 2007b; Windward 2010; Boeing 2003; Bet 2009; Herrera 2004
3. Outfall discharge volumes are presented as listed in Boeing 2010a; no definitions are provided.

The Slip 6 Data Gaps Report (E&E 2008) indicated that stormwater from Building 9-04 at the MOF property appeared to discharge to Outfall DC9 (2090). However, the most recent BDC stormwater drainage map (Boeing 2009c) shows that stormwater drainage from the portion of the MOF property that includes Building 9-04, and the parking areas to the northwest, is discharged via Outfall DC15 to Slip 6 (Figure 5).

The BDC has 13 oil/water separators, including 12 baffle-type oil/water separators and one venturi-style sediment separator that also acts as an oil/water separator (Bet 2009); locations are shown in Figure 6. Nine of these oil/water separators are located within the BDC source control area, on storm drain lines that discharge to the LDW through outfalls DC13, DC12 (four oil/water separators), DC11, DC10, DC9, and DC5. Much of the stormwater from the BDC source control area passes through these oil/water separators prior to being discharged to the LDW. Small drainage areas, with small surface area and relatively low activity, are not serviced with oil/water separators and discharge directly from the BDC source control area to the LDW via outfalls DC18, DC8, DC7, and DC6.

Sampling of water and sludge/sediment from oil/water separators was conducted in 2002; results identified total PCBs at concentrations up to 4.4 µg/L in water and 30.9 mg/kg DW in sediment/sludge (PPC 2003). Additional information about storm drain system sampling is provided in Section 4.1.5.

3.3 Data Gaps

Outfall 2086 appears to be abandoned; however, discharge has been observed. The status of this outfall needs to be confirmed.

Based on the available data, stormwater may represent a potential source of PCBs to LDW sediments. While PCBs are present in the BDC SD system, PCB concentrations in LDW surface sediment samples collected near the BDC outfalls exceeded the SQS in only two of 63 surface sediment samples, both located near outfall DC9. No subsurface sediment samples have been collected in the BDC area.

Additional data on concentrations of PCBs in sediment near the outfalls as well as in stormwater and SD solids in the stormwater system at the BDC are needed to determine whether current discharges may adversely impact LDW sediments.

Additional data gaps associated with stormwater discharges are discussed in Section 4.1.6.

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4.0 Potential for Sediment Recontamination from Adjacent Properties

Property and facility-specific details regarding the parcels located within the BDC source control area are presented in this section. Tax parcels in the vicinity of the BDC source control area are shown in Figure 3, identified by the last four digits of the King County tax identification number.

Aerial photographs of the source control area for the years 1936, 1946, 1956, 1960, 1969, 1977, 1980, 1990, 1999, and 2004 are provided in Appendix B. A summary of the aerial photographs and changes observed over time is also included in Appendix B. An oblique aerial photograph of the source control area shoreline, taken in 2006, is provided in Figure 7.

Only one facility is located within the BDC source control area, as described below.

4.1 Boeing Developmental Center (BDC)

In this report, the term "BDC property" refers to any of The Boeing Company's taxable land parcels in this area, including land parcels in the BDC (RM 4.3-4.9 East), Norfolk CSO/SD (RM 4.9 East), and Slip 6 (RM 3.9-4.3 East) source control areas. "BDC facility" is used to describe only the portions of The Boeing Company's taxable land parcels that are located within the BDC source control area.

The BDC property consists of Parcels 1038, 1036, 1032, 0990, 0018, 0028, 0026, 0048, 9016, and 9183, as shown in Figure 3. Parcel 1038 and portions of Parcels 1032 and 1036 are within the stormwater drainage basin of the Slip 6 source control area, and were included in the Slip 6 Data Gaps Report and SCAP. Groundwater in these parcels also is believed to flow toward Slip 6 (E&E 2008).

Parcels 0028, 0026, 0048, 9016, and 9183, located in the southeastern portion of the BDC property, are within the stormwater drainage basin of the Norfolk CSO/SD (RM 4.9 East) source control area, and were included in the EAA-7 Data Gaps Report and SCAP. This southern portion of the BDC property includes the area within the stormwater drainage basin of the BDC South SD (Outfall DC1), as well as Outfalls DC2, DC3, DC16, DC4, and DC17 (see Section 2.1 for additional information).

Parcel 0992 is a Seattle City Light (SCL) right-of-way that runs through the BDC property (Figure 3). Information listed in the table below is for the entire BDC property, including areas within the BDC source control area, the Slip 6 (RM 3.9-4.3 East) source control area, and the Norfolk CSO/SD (RM 4.9 East) source control area.

Facility Summary: Boeing Developmental Center	
Tax Parcel No.	BDC source control area: 5624200990, 0003400018, 5624200992, portions of 5624201032 and 5624201036 Slip 6 source control area: 5624201038, portions of 5624201032 and 5624201036 Norfolk CSO/SD source control area: 0003400028,

Facility Summary: Boeing Developmental Center	
	0003400026, 0003400048, 0423049016, 0423049183
Address	9725 East Marginal Way S, Tukwila 9806 East Marginal Way S, Tukwila 9501 East Marginal Way S, Tukwila
Property Owner*	0018, 0028, 1032, 1036, 1038, 9183: The Boeing Company 0026, 0048, & 9016: East Marginal Way Associates 0990: Mellon Trust of Washington et al. 0992: Seattle City Light
Parcel Size*	0990: 14.21 acres 0018: 61.44 acres 0992: 2.8 acres 1032: 25.74 acres 1036: 3.25 acres 1038: 3.78 acres 0028: 2.25 acres 0026: 3.88 acres 0048: 1.38 acres 9106: 3.17 acres 9183: 0.79 acre
Facility/Site ID	2101 (Boeing A&M Developmental Center; Boeing BAS Development Ctr; Boeing Developmental Center; Developmental Center) 4581384 (Boeing Development Center Norfolk) Slip 6 source control area: 95718589 (Boeing Drum; 9725 East Marginal Way Gate J28; currently part of MOF)
SIC Code(s)	3721 – Aircraft
NAICS Code/Description	336411 – Aircraft Manufacturing
EPA ID No.	WAD093639946
NPDES Permit No.	SO3000146
KCIW Discharge Authorization No.	526-04
UST/LUST ID No.	UST: 10408 (Boeing Develop Center BLDG 9-52)
VCP Site No.	NW0324; NW1083

*Listed by last four digits of King County tax parcel number.

The BDC property is bordered to the north by Container Properties LLC (9229 East Marginal Way S, Parcel 0010); to the northeast by a parcel owned by the King County MOF (no listed address, Parcel 1034); to the east by the Museum of Flight (9494 East Marginal Way S, Parcel 9019); to the southeast by the Boeing MFC (10002 East Marginal Way S, Parcel 0021) and several small industrial parcels owned by Michigan Properties, 3301 South Norfolk LLC, Buty LP/Martin Burton, and 10230 East Marginal LLC; to the south by the Strick Lease Storage yard (no street address, Parcel 9002); and to the west by the LDW. Facility information and data gaps for the MFC were described in the EAA-7 Data Gaps Report (E&E 2007).

According to King County tax assessor records there are 39 buildings on the BDC property. There are none listed for Parcels 0026, 0028, 0048, 0992, 1036, 9016, and 9138. All of those parcels are parking lots, with the exception of 0992 and 9183, which are rights-of-way. Parcel 9016 is listed as vacant but aerial photographs show it is used for parking. King County tax assessor records indicated the following information about buildings on the other parcels:

Parcel	Bldg. No.	Year Built	Square Footage	Predominant Use
0018	9-42	1985	1,414	Office Building
	9-50	1957	47,874	Storage Warehouse
	9-59	1962	1,295	Office Building
	9-60	1961	3,458	Storage Warehouse
	9-61	1968	2,903	Office Building
	9-64	1970	2,020	Industrial Light Manufacturing
	9-65	1957	1,134	Industrial Engineering Building
	9-66	1975	2,220	Retail Store
	9-67	1985	3,812	Industrial Light Manufacturing
	9-69/9-70	1980	1,900	Storage Warehouse
	9-80	1957	4,704	Industrial Engineering Building
	9-85	1962	2,289	Industrial Engineering Building
	9-90	1961	143,575	Office Building
	9-94	1961	18,594	Cafeteria
	9-96	1961	217,537	Office Building
	9-98	1962	145,382	Office Building
	9-101	1957	1,112,432	Industrial Heavy Manufacturing
	9-102	1983	13,110	Industrial Engineering Building
	9-103	1985	4,736	Industrial Light Manufacturing
	9-110	1963	10,393	Office Building
	9-120	1957	177,470	Industrial Light Manufacturing
	9-130	1957	3,051	Office Building
	9-140	1957	17,110	Office Building
	17-62	1967	2,068	Storage Warehouse
0990	9-43	1961	1,425	Industrial Light Manufacturing
	9-48	1961	2,284	Storage Warehouse
	9-49	1962	4,840	Storage Warehouse
	9-52	1986	7,930	Storage Warehouse
	9-53	1987	140,045	Industrial Engineering
	9-54	1980	9,365	Storage Warehouse
	9-55	1987	1,344	Office Building
	9-57	1986	858	Storage Warehouse
	9-99	1969	70,235	Industrial Light Manufacturing
1032	9-08	1990	244,121	Office Building
	9-12	1991	9,022	Cafeteria
	9-35	1967	455	Storage Warehouse
	9-51	1986	76,744	Garage, Service Repair
	9-77	1986	70,964	Industrial Engineering Building

4.1.1 Physical Setting

The Boeing SWPPP for the BDC estimates that this facility is developed with 100 percent impervious surfaces, with very little natural vegetation or landscaping present (Boeing 2009a) (Figure 2). The facility sits on the Duwamish River floodplain on the inside of an old meander loop that was filled in 1918 with dredge spoils (SAIC 1994). A characterization of the soils at Building 9-50 indicated that fill is present to depths of approximately 6 to 10 feet below ground surface (bgs) (Landau 1993). Duwamish River alluvium below the fill consists of primarily fine to medium sand.

A characterization of conditions at Building 9-50 indicated that shallow groundwater exists under apparently unconfined conditions at seasonal depths of 12 to 14 feet bgs (Landau 1993). The 1994 Resource, Conservation, and Recovery Act (RCRA) Facility Assessment indicated a 50-foot thick aquifer that is primarily unconfined except where a local, 1- to 3-foot silty aquitard produces a semi-confined condition (SAIC 1994). Flow within the aquifer is primarily horizontal with little vertical mixing. The uppermost aquifer rests upon a 20-foot thick marine silt unit that acts as an aquitard, separating a confined aquifer within sandy silts and silty sands beneath it. The confined aquifer is tidally influenced. There are no known municipal or domestic water wells within at least ½ mile of the facility (Landau 1993).

A groundwater elevation contour map is provided in Figure 8.

4.1.2 Historical Operations

In an effort to more thoroughly understand and evaluate historical facility operations and development in the BDC source control area, SAIC reviewed historical aerial photographs from 1936 to 2002. These photographs represent conditions during roughly each decade. The aerial photographs and complete descriptions for the years 1936, 1946, 1956, 1960, 1969, 1977, 1980, 1990, 1999, and 2004 are provided in Appendix B.

The BDC source control area was farmland until 1918 when the U.S. Army Corps of Engineers channelized the LDW. The earliest known commercial operations at the property began in 1927. The BDC property has been used as a meat packing facility (in the 1930s); a horse riding and training track; railroad tracks under various owner/lease agreements; and Pankrantz Lumber Company, which operated on portions of the property from 1943 to 1950. Boeing lease/ ownership began on various parcels in the mid-1950s.

The Boeing Developmental Center began operations in 1959. The facility was home to some of Boeing's most important research and development programs, including the Bomarc missile, Minuteman Intercontinental Ballistic Missile, Supersonic Transport, YC-14 short takeoff/landing transport, YF-22 fighter prototype, and the Boeing Joint Strike Fighter candidate. It has also been home to military production and modification programs including significant portions of the B-2 stealth bomber and military variants of Boeing commercial jets. The remains of a nonoperational Minuteman missile silo are still located in one corner of the site (Boeing 2009d).

Since the mid-1980s, the BDC has been the primary research and development center for carbon fiber structures on programs such as the B-2, 777 empennage, F-22, 787, and various proprietary programs. The BDC programs are also responsible for the modification of advanced aircraft such as E-3A Airborne Warning and Control System, 737 Airborne Early Warning and Control, C-40 transport, and P-8A Poseidon maritime patrol platform, and is the home for Boeing production work on the F-22 fighter (Boeing 2009d).

Given the historical use of the BDC property and the LDW bed composition, which is subject to high sediment loading from upstream deposits, it is possible that previous releases to sediments from the BDC property have been buried due to sedimentation. Core sediment samples from offshore of the BDC would provide a better understanding of subsurface sediment chemistry in this area.

4.1.3 Current Operations

The BDC is primarily an aircraft and aerospace research and development complex. Operations include manufacturing of airplanes and missiles, which involves machining of metal aircraft hardware, electroplating, chemical milling, conversion coating, painting, parts cleaning, and assembly (Landau 2002). The BDC currently builds the wing and aft fuselage of the F-22 fighter.

The portion of the BDC property within the BDC source control area comprises approximately 86 acres of the 174-acre BDC property. Buildings include offices as well as those that house aerospace manufacturing and support operations such as fabrication, composite material assembly, painting, and other activities.

The facility has been issued a Wastewater Discharge Authorization No. 526-04 from the King County Industrial Waste Program to discharge wastewater generated from the vactor decant station operations, composite parts wash stall operations, photo processing, water jet cutting operations, and groundwater remediation activities. This authorization is effective November 17, 2005, through November 16, 2010 (E&E 2007).

Although the BDC has maintained an Individual Wastewater Discharge permit in the past, according to Ecology's online NPDES and State Waste Discharge Permit database[7], this facility currently operates under the Industrial Stormwater General Permit (SO3000146). A new Industrial Stormwater General Permit went into effect on January 1, 2010.

On Ecology's ISIS database, the BDC (Boeing Development Center Norfolk, Facility ID No. 4581384) is listed as having PCB concentrations in soil below the Model Toxics Cleanup Act (MTCA) cleanup level for PCBs (Ecology 2009b). The Boeing A&M Developmental Center, Facility Site ID No. 2101, is also listed as having confirmed groundwater and soil contamination and suspected surface water, air, and sediment contamination (Ecology 2009c). The contaminants are listed as base/neutral/acid organics, priority pollutant metals, petroleum products, and non-halogenated solvents. In addition to these contaminants, chlorinated solvents, including tetrachloroethene, cis-1,2-dichloroethene, and vinyl chloride, were identified as contaminants of concern in groundwater as part of the EPA RCRA investigations and corrective actions (Landau 2004b). RCRA corrective actions are discussed further below.

Ecology's online Regulated UST database lists eleven USTs for the BDC (identified as the Developmental Center). Six of these USTs are listed as having been removed, one as closed in place, one as exempt, and three as operational and containing diesel fuel or unleaded gasoline. The listed exempt tank, DCU-15, has a capacity of 300 gallons; it is part of an oil/water separator system and contains stormwater. Operational USTs listed on ISIS include: DCU-16 (1,000

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[7] Online NPDES and State Waste Discharge Permit Database (accessed on 11/16/2009): http://www.ecy.wa.gov/programs/wq/permits/northwest_permits.html

gallons diesel); DCU-18 (550 gallons diesel); and DCU-19 (1,100 gallons unleaded gasoline). The BDC SWPPP lists a total of five operational USTs at the facility:

BDC Operational Underground Storage Tanks						
Tank ID Number	**Building**	**Location**	**Volume (gallons)**	**Content**	**Purpose**	**Containment**
DCU-16	9-101	South	1,000	Diesel	Emergency generator	Double-walled
DCU-18	9-52	North	550	Diesel	Vehicle Fuel	Double-walled
DCU-19	9-52	North	1,100	Unleaded gasoline	Vehicle Fuel	Double-walled
DCU-20 (Exempt)	9-72	West	20,000	Low sulfur diesel	Boiler	Double-walled
DCU-21 (Exempt)	9-72	West	20,000	Low sulfur diesel	Boiler	Double-walled

Information on aboveground tanks is provided in Appendix D.

The BDC is listed on Ecology's LUST database with release ID 1476. The status as of October 23, 2009, was "cleanup started" with a status date of June 1, 1995. Affected media was listed as soil and groundwater. Contaminated soil was removed when tanks DC-13 and DC-14 were replaced in 1990, and monitoring wells were installed. The two tank areas were later identified as AOC-01 and AOC-02. In November 2002, Ecology suspended groundwater monitoring requirements for AOC-01/02 based on data and information submitted by Boeing (Ecology 2002).

An inventory of air emission sources is provided in Appendix E.

Stormwater Discharges

According to the Boeing SWPPP (Boeing 2010a), stormwater from the BDC property is collected in catch basins and pipes and nearly all of it is discharged through those pipes to the LDW. There are 18 stormwater outfalls to the LDW from the BDC property; 10 of these are located within the BDC source control area. Approximate stormwater drainage areas for each of these 10 outfalls are shown in Figure 5. Six of the 10 stormwater discharge lines within the BDC source control area have in-line oil/water separators prior to discharge. There are a total of nine oil/water separators on these six lines, on storm drain lines that discharge to the LDW through outfalls DC13, DC12 (four oil/water separators), DC11, DC10, DC9, and DC5.[8] Much of the stormwater from the BDC property passes through these oil/water separators prior to being discharged to the LDW. Small drainage areas, with small surface area and relatively low activity,

[8] Additional oil/water separators are located on storm drain lines that discharge through outfalls DC14 and DC15 (within the RM 3.9-4.3 East [Slip 6] source control area) and outfalls DC2 and DC1 (within the RM 4.9 East ([Norfolk CSO/SD]) source control area.

are not serviced with oil/water separators and discharge directly from the BDC source control area to the LDW via outfalls DC18, DC8, DC7, and DC6.[9]

Under the Industrial Stormwater General Permit, Boeing is required to conduct monthly site inspections at outfalls that discharge from areas of industrial activity. Inspections include the following parameters: floating materials, visible oil sheen, discoloration, turbidity, and odor. The inspections also include observations to identify illicit discharges. Under the 2010 industrial stormwater general permit, Outfall DC9 was selected as the representative sampling point for the site. This outfall carries about one-fourth of the stormwater volume from the BDC property. Outfall monitoring will include quarterly samples collected at the outflow from the oil/water separator (DC9S) for the following parameters: total suspended solids (TSS), total zinc, total copper, oil sheen, turbidity, and pH (Boeing 2010a).

Potential stormwater pollution sources associated with the BDC source control area, as described in the 2010 SWPPP update, are listed below (Boeing 2010a).

Boeing Developmental Center Stormwater Pollution Risks

Low Risk	Minor Risk	Moderate Risk
• Outdoor storage of metal chips and concrete slurry • Portable tanks	• Storage of material and equipment • Roof contamination • Accumulation and storage of hazardous wastes • Tank and drum storage of hazardous materials • Storage of chemical materials and products • Fueling stations • Vehicle maintenance and cleaning • Dust and particulate generation • Non-stormwater discharges • Decant station • Construction activities (depending on project specifics)	• Solid waste disposal practices • Material handling activities • Handling of hazardous waste • Transportation of material and wastes • Surplus tub-skid, test weight, huge-haul, and dumpster storage • Oil and gas tanks (7 above ground outdoors, 5 below ground) • Construction activities (depending on project specifics)

Materials Handling

According to the 2009 SWPPP (Boeing 2009a), numerous solvents, adhesives, coatings, and lubricants are used in various processes and are transported and stored on the property. Chemicals include acids, alkalis, paints, water treatment chemicals, gasoline, diesel fuel, propane, coolants, and lubricants. Materials used, treated, or stored in significant quantities include hydrofluoric acid, nitrogen, light catalytic petroleum, hydrotreated petroleum, and diesel fuel No. 2. Boeing maintains Hazardous Materials (HazMat) response teams at all major

[9] In addition, stormwater drainage through outfalls DC17, DC4, DC16, and DC3, located within the RM 4.9 (Norfolk CSO/SD) source control area, is not serviced by oil/water separators.

facilities, including the BDC. The Developmental Center/Military Flight Center Spill Prevention Control and Countermeasures Plan was updated in August 2009 (Boeing 2009b).

Boeing prepared and submitted Pollution Prevention Progress Reports to Ecology during the years 1992 through 2002. More recent reports, if they were prepared, were not available in the files reviewed for this assessment.

4.1.4 Regulatory History

The BDC is a regulated facility under RCRA. Investigative activities have been conducted to determine if soil contamination and a historical gasoline leak have impacted groundwater. Under its RCRA corrective action authority, EPA conducted a RCRA Facility Assessment in 1994, and identified 157 Solid Waste Management Units (SWMUs) and five Areas of Concern (AOCs) at the BDC (SAIC 1994). Subsequent investigation determined that most of these do not pose a threat to human health or the environment. RCRA corrective actions were taken at several units. Ecology has authority delegated from EPA to implement RCRA corrective action through the MTCA regulations (WAC 173-340) and oversees remedial activities conducted under the Ecology VCP. Additional information is provided in Section 4.1.5 below.

The files reviewed for this Data Gaps Report contained facility inspections by Ecology and/or EPA dating back to December 1981. Reports and letters in the files indicate that the following inspections and/or site visits were conducted at the BDC (responses from Boeing are indicated in the references column):

Boeing Developmental Center Inspections/Site Visits			
Date	**Type of Inspection**	**Corrective Actions Identified**	**Reference(s)**
December 1981	Dangerous Waste Compliance	None	Ecology 1981
February 1984	Dangerous Waste Compliance	None	Ecology 1984
October 1984	Dangerous Waste Compliance	Unknown – inspection report not found in files	SAIC 1985
April 1986	Stormwater/ Dangerous Waste	Required clearance with METRO for sanitary sewer discharges; oil/water separator maintenance; waste storage practices	Ecology 1986
March 1988	Dangerous Waste Compliance	Display appropriate signage, employee training, communication with local agencies, improve closure plans, properly label waste	EPA 1988
August 1989	Dangerous Waste Compliance	Proper certification of dangerous waste manifests; continuous inspection records	Ecology 1989, 1990a, 1990b; Boeing 1990
August 1991	Dangerous Waste Compliance	Revise employee training plan	Ecology 1991a, 1991b; Boeing 1991a, 1991b
July 1993	Dangerous Waste Compliance	Develop a written schedule for inspecting monitoring equipment, safety and emergency equipment, security devices, and operating and structural equipment	Ecology 1993a, 1994a, 1994b; Boeing 1994b

Boeing Developmental Center Inspections/Site Visits			
Date	**Type of Inspection**	**Corrective Actions Identified**	**Reference(s)**
November 1993	Dangerous Waste Compliance	None	Ecology 1993b
February 1995	NPDES permit application	None	Ecology 1995a
March 1995	Dangerous Waste Compliance	Properly label waste; properly maintain fire protection equipment; provide adequate secondary containment; correct errors in Waste Analysis Plan	Ecology 1995b. 1995c; Boeing 1995a, 1995b
October 1996	Water Compliance	Correct reporting of flows	Ecology 1996
December 1996	Dangerous Waste Compliance	General recordkeeping requirements; secondary containment requirements; update Waste Analysis Plan for the facility	Ecology 1997a; Boeing 1997
June 1998	Water Compliance / Stormwater	Remove obsolete dumpster	Ecology 1998a
April 2001	Dangerous Waste Compliance	None	Ecology 2001
March 2006	Stormwater Compliance	Quarterly monitoring required	Ecology 2006
March 2007	Underground Storage Tank	Provide documentation that overfill alarm for tank DCU-16 is activated when energized.	EPA 2007
June 2009	Dangerous Waste Compliance	Properly label waste, properly store waste	EPA 2009
March 2010	Underground Storage Tank	None	Ecology 2010

EPA filed a Notice of Violation (NOV) and Compliance Schedule for the BDC in August 1988 as a result of violations discovered during a dangerous waste compliance inspection in March 1988 (EPA 1988). Violations described in the NOV included missing warning signs in the Main Storage Area; inadequate training of personnel engaged in hazardous waste handling; failure to notify local police, fire departments, and emergency response teams regarding the layout of the facility and associated hazards; and observation of a hazardous waste container at the facility with no accumulation date. According to the NOV, Boeing first filed a Notification of Hazardous Waste Activity for the BDC in November 1980. Boeing responded to the NOV in September 1988 and addressed each issue identified by EPA (Boeing 1988). In particular, Boeing took issue with being cited for failing to notify local agencies as they have had long-standing working relationships with the local facilities (police, fire, etc.) and had provided back up support during local emergencies.

Boeing filed a revised Notification of Dangerous Waste Activities with Ecology in February 1994 (Boeing 1994a). The form indicated 15 different waste streams for the facility including paints, inks, barium, chromium, lead, mixed oils, petroleum distillates, waste photographic fixers and developers, and others.

Ecology conducted a water compliance inspection of the BDC in October 1996 for NPDES permit SO3000148-8 (Ecology 1996). (Note: a letter from Ecology in April 2003 indicates this permit was cancelled as of April 25, 2003 [Ecology 2003].) The inspector reviewed the facility's discharge monitoring reports and met with Boeing representatives to discuss operational questions and concerns relating to the upcoming permit renewal. The inspector's notes indicated that Boeing had been underestimating their average daily flow by averaging over calendar days rather than operational days. The inspector also noted that Boeing's request to increase flow volume to improve efficiency of the ground water remediation process would be granted if requested flow volumes were within the systems' operational capacity. No compliance concerns were noted.

In September 1997, Ecology accepted the final facility closure certification for the BDC (Weston 1997), indicating the facility could no longer store (> 90 days), treat, or dispose of dangerous wastes at the facility (Ecology 1997c). The BDC would maintain interim status as a dangerous waste storage facility until all requirements of RCRA corrective actions were completed to Ecology's satisfaction. Earlier in the year, Boeing was cited for not reporting flow as required in late December 1996 (Ecology 1997b).

Ecology conducted a water compliance inspection of the BDC in June 1998 for NPDES permit SO3000146B (Ecology 1998a). The inspector's notes indicated only one concern for stormwater at this facility: an old large dumpster near Building 9-64 that may have contained residual contamination and or/hydraulic leaks that could contaminate stormwater. The inspector recommended disposal of that large surplus dumpster.

A July 1998 letter from Ecology to EPA indicated that the BDC was operating as a small quantity generator and all dangerous waste storage units had been clean closed (Ecology 1998b). Ecology indicated they did not want to continue RCRA inspections of the BDC because of the facility's history and track record and because the agency had other high priority facilities needing inspections.

Ecology conducted an unannounced dangerous waste compliance inspection at the BDC in April 2001. The inspector noted that "dangerous waste compliance issues have been well addressed" and she did not observe any areas of non-compliance at the facility (Ecology 2001). Ecology files reviewed for this report included no other records of RCRA inspections until June 2009 (described below).

In November 2002, Ecology suspended groundwater monitoring requirements for AOC-01/02 based on data and information submitted by Boeing (Ecology 2002).

Ecology conducted a stormwater compliance inspection of the BDC in March 2006 for NPDES permit SO3000146D (Ecology 2006). The inspector's notes indicate the following information about this facility:

- hundreds of catch basins collect stormwater on the site and these are cleaned annually;
- equipment/vehicle washing occurs on the property and wash water is conveyed to the sanitary sewer;

- outside storage and parking areas are swept monthly;
- the stationary fueling area is not covered and stormwater is discharged to an oil/water separator before entering the stormwater system;
- some repair and maintenance of vehicles occurs outside; and
- oil/water separators are cleaned annually.

The inspector indicated that only one quarterly monitoring sample had been collected during 2005, in violation of conditions stipulated by the Industrial Stormwater General Permit. No stormwater inspection has been conducted at this facility since March 2006.

EPA inspected the three regulated USTs (DCU-16, DCU-18, and DCU-19) at the BDC in March 2007 (EPA 2007). The inspector noted that release detection systems appeared to be operating correctly; cathodic protection was performing adequately based on test results; and spill prevention and overfill protection was evident for all tanks. As a follow-up item, the inspector requested that Boeing provide documentation that the audible overfill alarm of DCU-16 would activate when energized. Boeing provided this documentation after the inspection (Boeing 2007).

An EPA RCRA inspection performed June 30, 2009, found two violations that resulted in a Notice of Violation being issued on July 27, 2009 (EPA 2009). According to the NOV, partially full boxes of universal waste lamps in Building 9-35 were left open instead of being closed per WAC 173-303-573 (9)(c)(ii). The second violation involved a 55-gallon drum of paint-related wastes in Building 9-140 that was unlabeled, in violation of WAC 173-303-630(3).

Ecology inspected the three regulated USTs (DCU-16, DCU-18, and DCU-19) at BDC in March 2010. All systems were in good order. There were no violations and no follow-up items (Ecology 2010).

A list of spills between mid-2004 and mid-2009 at the BDC property is provided in Appendix F.

4.1.5 Environmental Investigations and Cleanups

Several environmental investigations and cleanups have been conducted at the BDC, as described below.

RCRA Investigations and Cleanup Actions

As noted above under Regulatory History, RCRA corrective actions have been taken at several AOCs and SWMUs at the BDC facility. Locations of these units are shown on Figure 9. Investigations and cleanup actions for all of the defined AOCs and SWMUs were described in the RCRA Facility Assessment Report prepared in 1994 (SAIC 1994). A Boeing Corrective Action Report prepared in 2002 indicated that no further action was needed for SWMUs 15, 16, and 23–25 (Landau 2002). These SWMUs are not discussed further in this Data Gaps Report.

More recently, investigations and cleanup actions for AOC-05, and SWMUs 17 and 20 were described in the EAA-7 Data Gaps Report (RM 4.9 East, Norfolk CSO/SD) for data available through mid-2007 (E&E 2007). The most recent information available for these areas is summarized below. Appendix C provides excerpts (summary figures and selected data tables) from reports related to the RCRA cleanup actions at BDC for the period 2007 through 2010.

AOC-03/04

AOC-03/04 is the former location of USTs DC-03 and DC-04, which were used to store No. 5 fuel oil from 1957 until a leak was discovered in 1991 (Landau 2002). Both USTs were removed and replaced with DC-20 and DC-21 (see also Section 4.1.3 above). During excavation, approximately 250 cubic yards of petroleum hydrocarbon contaminated soil and 200 to 500 gallons of free phase hydrocarbon were removed. In 1992, a monitoring well (MW-21A) was installed to sample soil and groundwater for TPH. Since 1997, the well has been sampled biannually and analyzed for VOCs and diesel-range petroleum hydrocarbons. In June 2001, MW-21C was installed to monitor VOCs and diesel-range petroleum hydrocarbons. In December 2000, diesel-range petroleum hydrocarbon was detected at a concentration above groundwater screening levels in MW-21A. Concentrations of diesel-range petroleum hydrocarbons were non-detect in both wells in December 2001. At the time of the report in 2002, the two monitoring wells were to be sampled semi-annually until four consecutive groundwater samples were non-detect for diesel-range petroleum hydrocarbons. No additional documents information regarding the continued sampling of AOC-03/04 were available at the time this Data Gaps Report was prepared.

AOC-05

AOC-05 was the location of a former unleaded gasoline UST and includes Buildings 9-60 and 9-61 (Landau 2002). Pilot testing of anaerobic bioremediation was completed in 2007 (Landau 2007a, 2009a). Four months of monitoring showed that a one-time addition of ammonium nitrate resulted in the decrease of petroleum hydrocarbon concentrations by 50 percent and a decrease in benzene, toluene, ethylbenzene, and xylenes (BTEX) concentrations by as much as 98 percent. Contaminant concentrations rebounded, however, upon depletion of the injected nitrate as groundwater returned to equilibrium with sorbed mass and non-aqueous phase liquid mass remaining in the aquifer.

A second injection well was installed in February 2008 upgradient of the first well, and baseline groundwater monitoring was conducted (Landau 2009a). Baseline monitoring indicated that gasoline-range total petroleum hydrocarbons (TPH) and benzene concentrations were in excess of preliminary screening levels in the two injection wells (source zone wells) but not at downgradient wells. Ammonium nitrate solutions were injected into the two wells in February, June, and October 2008 to stimulate anaerobic degradation of gasoline contamination. Performance monitoring was conducted every other month beginning the first month after injection. Injected nitrate is depleted between injection events by the degradation process. Contaminant reductions of between 83 and 98 percent for gasoline-range TPH and benzene were achieved in the source area.

Monitoring performed after the October 2008 nitrate injection indicated a diminished rate of degradation, which was attributed to an inadequate availability of phosphorus (Landau 2009d). In June 2009, ammonium phosphate was injected with the ammonium nitrate solution. Data from the July 2009 monitoring event suggests that biotreatment of the contaminants and consumption of the nitrate by the microorganisms has improved. Maximum contaminant concentrations were 410 µg/L for benzene, 280 µg/L for toluene, 32 µg/L for ethylbenzene, 1,630 µg/L for total xylenes, and 19 mg/L for gasoline-range TPH. Nitrate concentrations, however, exceeded a set threshold of 10 mg/L in downgradient wells.

A rebound of TPH-G and BTEX, but a depletion of nitrate to less than the reporting limit (<0.1 mg/L) was observed during the September 2009 monitoring event. This was indicative of contaminant reduction through the addition of ammonium phosphate to the injection solution (Landau 2010a). Building upon the June 2009 injection, the October 2009 injection also included ammonium phosphate. During the November 2009 monitoring event, maximum contaminant concentrations were 340 µg/L for benzene, 140 µg/L for toluene, 27 µg/L for ethylbenzene, 3,000 µg/L for total xylenes, and 24 mg/L for gasoline-range TPH. Nitrate concentrations remained above a set threshold of 10 mg/L in downgradient wells. During a February 2010 monitoring event, all contaminant concentrations were below screening levels, suggesting that bioremediation is providing effective treatment of contaminants. However, nitrate continued to exceed action levels and monitoring will continue at additional downgradient wells until nitrate concentrations no longer exceed the threshold. An injection event is expected in 2010, but results from the February 2010 monitoring event suggested that an additional injection was not needed (Landau 2010a). Quarterly monitoring was to be performed in order to determine the need for additional injection events.

Additional information is provided in Appendix C1.

SWMU-17

SWMU-17 consists of a former 67-gallon sump and associated 4,000-gallon steel UST (DC-05), which were used to store waste hydraulic and engine oil. The sump and UST were closed and removed in early 1986. Although Ecology stated in 1988 that no further groundwater monitoring was required of the wells in this SWMU, five wells (BDC05-2A, BDC05-3, BDC05-4, BDC05-5, and BDC05-7) have been sampled from this area semi-annually. Samples were analyzed for VOCs, TPH, and metals (Landau 2002). A Pilot Test Work Plan to evaluate enhanced anaerobic bioremediation as a remedy for tetrachloroethene (PCE) and copper in the groundwater aquifer was prepared by Landau Associates in October 2008 (Landau 2008b) (Appendix C2). The plan included installation of an additional groundwater monitoring well at this SWMU, and performance monitoring.

After implementation of the work plan during October 2008 through February 2010, it was concluded that bioremediation stimulated by electro-donor injection resulted in reduction of PCE and trichloroethene (TCE) to below detection limits at the injection well and a 25 percent reduction at a downgradient monitoring well. Due to a smaller than anticipated radius of influence and very slow downgradient transport, relatively close spacing of injection points was recommended. Further analysis of chlorinated VOC groundwater impacts will be conducted to better define the area addressed by full scale treatment. According to Boeing’s Pilot Test Report, no substantial effect of bioremediation of arsenic and copper was observed and no further action was to be performed due to natural background levels of these metals (Landau 2010b). Groundwater monitoring data for this SWMU can be found in the SWMU-17 Pilot Test Report (Landau 2010b).

SWMU-20

SWMU-20 is a former degreaser pit located in the northwest corner of Building 9-101. Trichloroethene (TCE) and PCE were released at this SWMU (Landau 2008a). Vinyl chloride, a TCE breakdown product, is also present in groundwater at this SWMU. A groundwater treatment system was operated at this SWMU between fall 1993 and December 2001. Monitoring was conducted for 2 years after the system was shut down to evaluate natural attenuation as a remedial alternative. When monitoring showed VOC concentrations had rebounded, Boeing proposed active remediation by enhanced *in situ* reductive dechlorination through electron donor amendment. The first injection treatment occurred in June 2004 and consisted of sodium lactate and a vegetable oil emulsion. Additional injections were performed in December 2004 and March 2005. The first two injections targeted the source zone while the third targeted elevated vinyl chloride concentrations at one of the downgradient wells.

A total of seven wells have been injected one or more times. The most recent monitoring information available (May 2008 data in Landau 2008a) indicate the electron donor injections successfully decreased TCE and breakdown products with no substantial rebound in the majority of wells in the treatment area. The observed rebound of vinyl chloride in some wells was attributed to slowing treatment of residual source material due to an inadequate amount of electron donor; additional substrate would be required to continue treatment. A fourth electron donor injection was performed in August 2008 (Landau 2009b, 2009c). Monitoring conducted in May 2009 indicated that treatment was enhanced at injection wells and other nearby wells. Maximum contaminant concentrations were 7.7 µg/L for PCE, 5.6 µg/L for TCE, 26 µg/L for cis-1,2-dichloroethene, and 6.3 µg/L for vinyl chloride (see also Appendix C3). Semiannual monitoring was scheduled to continue at this SWMU.

Storm Drain System Sampling and Cleanup

In 2002, Boeing collected samples of sludge/sediment and water from oil/water separators within the BDC source control area, and analyzed them for PCBs (PPC 2003). Results are listed below. It should be noted that there are some discrepancies between the sample locations listed in data tables in PPC (2003), the map of sampling locations in that same document, the list of oil/water separators and locations in the 2003 SWPPP (Boeing 2003), and the oil/water separators and locations in the 2010 SWPPP (Boeing 2010a). Figure 6 shows current oil/water separators and locations (Bet 2009).

Sample Location	Sample Location Notes	Date Sampled	Total PCBs in Water (µg/L)	Total PCBs in Sludge/Sediment (mg/kg)
DC5S		8/28/2002	1.0 E	
DC9S1	Not shown on sample location map in PPC 2003.	8/26/2002	<0.2 E	1.4 E
DC10S2	Sample location in PPC 2003 appears to be current location of DC9S.	8/26/2002 9/19/2002	4.4 E <1.4 E	
DC10S1		9/19/2002		30.9 5.5 (split sample)
DC10S(1)	Not clear if this is the same as DC10S1.	9/28/2002		9.7 D
DC10S(2)	Not clear if this is the same as DC10S2.	9/28/2002		7.4 D
DC10S(3)	Not shown on sample location map in	9/28/2002		5.9 D

Sample Location	Sample Location Notes	Date Sampled	Total PCBs in Water (µg/L)	Total PCBs in Sludge/Sediment (mg/kg)
	PPC 2003.			
DC10S(4)	Not shown on sample location map in PPC 2003.	9/28/2002		9.4 D
DC12S1/DC12S1		8/26/2002	<0.2 E	0.34 E
DC12S2		8/26/2002	0.4 E	
DC13S		9/19/2002	<1.4 E	
DC9-60 (D2116-S)	Waste characterization sample from Vactor Decant Bay, which drains to the sanitary sewer. Not shown on sample location map in PPC 2003.	9/30/2002		12.4 YD
DC9-60 (D2117-A)		9/30/2002	8.6 Y	
DC9-60 (D2118-A)		9/30/2002	<1.0	

E – Estimated; holding times were exceeded for these samples
D – Dilution
Y – Raised reporting limit due to matrix interference

The data quality review for the 2002 samples identified several issues, including holding time exceedances and sampling methodology problems. When collecting a sample from an oil/water separator, a solids sample was collected first, followed by a water sample. This resulted in increased turbidity in the water sample and likely affected the resulting water sample concentration. Despite the data quality issues, results indicate that PCBs are present in the BDC SD system. No information on more recent sampling of oil/water separators or other SD structures was available at the time this Data Gaps Report was prepared.

Storm Drain and Sediment Sampling Related to Outfall DC2

South SD Line: In the RM 4.9 East (Norfolk CSO/SD) source control area, the South SD line leading to Outfall DC2 has been extensively sampled for PCB contamination and has been cleaned on multiple occasions. A Vortechs 9000 sediment trap / oil/water separator vault was installed in this line in 2003 (Landau 2004a). Sampling and cleanup activities in this drainage system, through mid-2005, were described in the EAA-7 Data Gaps Report (E&E 2007). While the South SD line is not within the BDC source control area, outfall DC2 is located directly upstream of the BDC source control area. Recent information related to the South SD line is therefore summarized briefly below.

Boeing conducts annual maintenance and removal of accumulated solids from the sediment trap and oil/water separator in the South SD line. The May 2008 LDW Source Control Status Report (Ecology 2008a) described South SD line sampling conducted in 2006. SD solids collected in the line had PCB concentrations ranging from 5.9 to 38 mg/kg DW.

Solids from filter bags at Manhole 2 and 3 and from the sediment trap / oil/water separator were analyzed for PCBs in September 2007 (Calibre 2008). Total PCBs ranged from 1.67 to 2.28 mg/kg DW downstream from the separator (MH 2), 3.200 mg/kg DW upstream from the separator (MH 3), and 14.7 mg/kg DW in solids from the separator.

The August 2009 LDW Source Control Status Report (Ecology 2009a) described South SD line cleaning and sampling and sampling of the sediment trap / oil/water separator conducted in 2008. Aroclors 1248, 1254, and 1260 were detected in the Manhole 3 sample, with the higher concentrations predominantly 1248 and 1254. The total PCB concentration in this sample was 1.44 mg/kg DW (Calibre 2009). Total PCBs in the two solids samples collected from the sediment trap / oil/water separator were 13 and 32 mg/kg DW (Calibre 2009). Annual sampling has shown a steady decline in PCB concentrations since the initial cleanout in 2002, but concentrations remain elevated.

LDW Sediments: In September 2003, Boeing excavated approximately 60 cubic yards of PCB-contaminated sediment in front of Outfall DC2 and placed a permeable carbon fabric beneath a layer of clean sand. Results of sampling of the backfilled sand for recontamination with PCBs through 2005 were described in the EAA-7 Data Gaps Report (E&E 2007). The May 2008 LDW Source Control Status Report (Ecology 2008a) described sampling of the sediment conducted in 2006. Samples collected from the backfill material had PCB concentrations ranging from <0.02 to 0.28 mg/kg DW (approximately 16 mg/kg OC).

Three stations at the removal area were sampled in September 2007 (Calibre 2008). PCBs were not detected in two of the three locations. The total PCB concentrations at location S1 were 0.14 and 0.20 mg/kg DW in two splits of the same sample. Three stations at the removal area were sampled in February 2009; PCBs were not detected in any of the samples (Calibre 2009). Performance monitoring suggests that source control measures have been effective.

4.1.6 Potential for Sediment Recontamination

Historical operations at the BDC facility resulted in releases of petroleum hydrocarbons, VOCs, SVOCs, total PCBs, and metals to soil and groundwater beneath the property (Landau 2002). The potential for sediment contamination associated with the BDC source control area is summarized below by transport pathway.[10]

Stormwater Discharge

The BDC source control area contains 10 active outfalls and one abandoned outfall. The majority of the stormwater drainage area of the facility is serviced by oil/water separators prior to discharge to the LDW (Boeing 2009a). Samples of water and sludge/sediment in the oil/water separators in 2002 indicated PCBs at concentrations to up 4.4 µg/L in water and 30.9 mg/kg DW in solids (PPC 2003). However, as indicated in Section 3.2, when collecting samples from the oil/water separators, the solids sample was collected first, followed by the water sample. This resulted in increased turbidity in the water sample and likely increased the resulting water sample concentration. There is a potential for sediment contamination associated with the stormwater discharge pathway.

Surface Runoff/Spills

Due to the property's location adjacent to the LDW shoreline, contaminants (if any) suspended in surface runoff have the potential to reach the BDC source control area. However, the facility is almost entirely paved and contains an extensive network of catch basins that direct stormwater and spills to storm drains that discharge to the LDW. There are no commercial marine operations

[10] Data gaps associated with the RM 3.9-4.3 East (Slip 6) source control area and the RM 4.9 East (Norfolk CSO/SD; EAA-7) source control area are summarized in the Data Gaps Reports for these areas.

occurring at the BDC. Therefore, contamination from surface runoff or spills directly to the LDW at this location is considered unlikely.

Groundwater Discharge

Areas within the BDC source control area with known groundwater contamination include AOC-05, and SWMUs 17 and 20. Excavations were performed to remove contaminated soils at each of these locations (GeoEngineers 2000; Landau 2002). Groundwater contaminants include petroleum hydrocarbons and VOCs, including BTEX and chlorinated hydrocarbons; none of the sediment COCs listed in Section 2.3.4 have been identified as groundwater contaminants at the BDC. Bioremediation activities are ongoing at AOC-05 and SWMUs 17 and 20. Flow directions toward the LDW have been documented; however, based on monitoring data, Boeing has concluded that the extent of groundwater contamination in each of these areas is bounded by downgradient wells (Landau 2004b).

Four seeps were identified near the BDC source control area during a 2004 seep survey (Windward 2004); none of these seeps was sampled. Contaminants in stormwater and/or SD solids could be transported to groundwater through leaks and breaks in SD piping and structures. The potential for sediment recontamination associated with groundwater discharges is therefore unknown.

Groundwater samples at the MOF property (parcel 1034 in Figure 3) have detected petroleum hydrocarbons, and groundwater flow is to the west-southwest toward the LDW (Landau 2004c). MOF has filed a restrictive covenant with King County due to groundwater contamination at the southeast corner of the property. There is a low probability that petroleum-contaminated groundwater from the MOF area could impact the BDC source control area. Additional information is provided in the Data Gaps Report for Slip 6 (E&E 2008).

Bank Erosion

A portion of the BDC property is located along the embankment of the LDW. Contaminants in soils along the banks of the LDW, if present, could be released directly to sediments via erosion. No information is available regarding contaminants in bank soils. The potential for recontamination of LDW sediments through bank erosion is unknown; however, much of the river bank in this area is riprapped.

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5.0 Summary of Data Gaps

No subsurface sediment samples have been collected in the LDW near the BDC source control area. This lack of LDW subsurface sediment data is considered a data gap. In surface sediment samples, detection limits for three chemicals (hexachlorobutadiene, 1,2,4-trichlorobenzene, and N-nitrosodiphenylamine) were above the SQS. Additional sediment data are needed to adequately assess the potential for historical sediment contamination associated with the BDC source control area.

Additional data gaps are summarized below, listed by potential sediment recontamination pathway.

5.1 Stormwater Discharges

The BDC source control area contains 10 active outfalls and one abandoned outfall. PCBs have been detected in oil/water separator samples collected in 2002 at concentrations of potential concern. No other information on sampling conducted within the SD lines that discharge to these outfalls was found in the files reviewed during preparation of this Data Gaps Report.

The following information is needed to assess the potential for sediment contamination associated with the stormwater pathway:

- Sampling data for PCBs and other COCs in SD solids are needed, particularly for SD lines associated with Outfalls DC3, DC12, DC11, DC10, DC9, and DC5, which are listed as having medium to high flow. Given the data quality issues associated with the 2002 oil/water separator samples, additional sampling of these units may be warranted.
- Verification is needed that Outfall 2086 is in fact abandoned, and that no flow discharges to the LDW from this location. Dye testing may be appropriate to verify that stormwater drainage lines are consistent with those shown in Figure 5.
- The most recent stormwater compliance inspection in the files reviewed during preparation of this Data Gaps Report was conducted in March 2006. A current stormwater compliance inspection is needed to verify compliance with applicable regulations and BMPs to prevent the release of contaminants to the LDW.
- Additional assessment of BDC’s air emissions and air permit is needed to evaluate the potential for deposition on impervious surfaces and transport to the storm drain system.

5.2 Groundwater Discharge

Continued monitoring of RCRA cleanup activities within this source control area will minimize the potential for contaminants present in groundwater to enter the LDW. Updated information regarding the status of groundwater monitoring at AOC-03/04 is needed.

Groundwater seeps to the LDW have been documented in this area; however, no samples have been collected. Contaminants in stormwater, if present, could be transported to groundwater through leaking or broken pipes. Information on contaminant concentrations in seeps is needed if contaminants are detected at concentrations of concern in the storm drain system.

5.3 Bank Erosion/Leaching

Additional information about soil conditions along the bank of the LDW is needed to determine whether or not soil erosion is a potential source of sediment recontamination.

6.0 Documents Cited

Bet. 2009. Email from James Bet, The Boeing Company, to Jennifer Wallin, Science Applications International Corporation. Re: oil/water separators at the BDC site. November 25, 2009.

Boeing. 1988. Letter from James Johnstone, Boeing, to Charles Findley, U.S. Environmental Protection Agency. Re: Notice of Violation, HW-112. September 27, 1988.

Boeing. 1990. Letter from, Boeing, to Laurence Ashley, Ecology. Re: Compliance Issues Noted in Letter. March 8, 1990.

Boeing. 1991a. Letter from A.E. Whitson, Boeing, to Dean Yasuda, Ecology. Re: information requested during the August 14, 1991 inspection of the Developmental Center. September 19, 1991.

Boeing. 1991b. Letter from Laurence Weinberg, Boeing, to Josh Chaitin, Ecology. Re: August 14, 1991 Dangerous Waste Inspection of Boeing Developmental Center – Compliance with Washington State Dangerous Waste Regulations (WAC 173-303). November 25, 1991.

Boeing. 1994a. Form: Notification of Dangerous Waste Activities. Signed February 11, 1994. Submitted to Ecology.

Boeing. 1994b. Letter from Arthur Whitson, Jr., Boeing, to Jeannie Summerhays, Ecology. Re: Dangerous Waste Compliance Inspection, Developmental Center WAD 093 639 946 – Letter Dated January 18, 1994. March 2, 1994.

Boeing. 1995a. Letter from Andro Wipplinger, Boeing, to David Hohmann, Ecology. Re: March 9, 1995 Dangerous Waste Compliance Inspection, Boeing Developmental Center Facility, WAD 009262171. May 2, 1995.

Boeing. 1995b. Letter from J.T. Johnstone, Boeing, to Julie Sellick, Ecology. Re: Operation of Developmental Center Dangerous Waste Accumulation Tank. July 27, 1995.

Boeing. 1997. Letter from Andro Wipplinger, Boeing, to David Hovik, Ecology. Re: Dangerous Waste Compliance Evaluation Inspection, Boeing Developmental Center, WAD 096 639 946. February 21, 1997.

Boeing. 2003. Storm Water Pollution Prevention Plan, Boeing Developmental Center, Washington Department of Ecology Permit # SO3-000146. Prepared by The Boeing Company. December 2003 Revision. Certified April 13, 2006.

Boeing. 2007. Letter from Stephen Ryan, Boeing, to Todd Bender, EPA. Re: Confirmation of the Overfill Alarm of UST DC-16 at the Boeing Developmental Center, Tukwila, WA. April 6, 2007

Boeing. 2009a. Storm Water Pollution Prevention Plan, Boeing Developmental Center, Washington Department of Ecology Permit # SO3-000146. Prepared by The Boeing Company. August 31, 2009.

Boeing. 2009b. Developmental Center/Military Flight Center Spill Prevention Control and Countermeasures Plan. Prepared by Boeing Puget Sound Integrated Defense Systems Environment, Safety and Health. August 31, 2009.

Boeing. 2009c. Facility drainage map. November 13, 2009. Provided by Mr. James Bet, Boeing Environment, Health and Safety.

Boeing. 2009d. "Historical Perspective: 50 years at the leading edge; Developmental Center keeps proving 'it *can* be done'." *Boeing Frontiers*. August 2009.

Boeing. 2010a. Storm Water Pollution Prevention Plan, Boeing Developmental Center, PSEHS-WC-07 Rev B, Washington Department of Ecology Permit # WAR-000146. Prepared by The Boeing Company. July 13, 2010

Boeing. 2010b. Review Comments: Draft Lower Duwamish Waterway RM 4.3 to 4.9 East (Boeing Developmental Center), Summary of Existing Information and Identification of Data Gaps. July 2010.

Booth and Herman. 1998. Duwamish Coalition: Duwamish basin groundwater pathways conceptual model report. City of Seattle Office of Economic Development and King County Office of Budget and Strategic Planning, Seattle, WA. As cited in Windward 2003.

Calibre. 2008. 2007 Annual Sampling Report – South Storm Drain System, Boeing Developmental Center. Prepared for the Boeing Company Shared Services Group. May 20, 2008.

Calibre. 2009. Summary of Storm Drain Line Cleanout Work and 2008 Annual Sampling Report South Storm Drain System Boeing Developmental Center. Prepared for The Boeing Company. April 2009.

E&E (Ecology & Environment, Inc.). 2007. Lower Duwamish Waterway Early Action Area 7 Final Summary of Existing Information and Identification of Data Gaps Report. September 2007. Prepared for Washington Department of Ecology.

E&E. 2008. Lower Duwamish Waterway RM 3.9-4.4 East (Slip 6), Summary of Existing Information and Identification of Data Gaps, Final Report. February 2008. Prepared for Washington Department of Ecology.

Ecology. 1981. Interim Status Standards Notification – Boeing Developmental Center. Inspection by Julie Sellick, Ecology. December 14, 1981.

Ecology. 1984. Dangerous Waste Compliance Checklist/Questionnaire – Boeing Developmental Center. February 24, 1984.

Ecology. 1986. Letter from Kyle Cook, Ecology, to Douglas Weeks, Boeing Military Airplane Company. Re: Inspection of Boeing's Developmental Center and Airborne Warning and Control System (AWACS) Facility, Seattle, Washington, King County. May 1, 1986.

Ecology. 1989. Memo from D. Hideo Fujita, Ecology, to Julie Sellick and Laurence Ashley, Ecology. Re: Dangerous Waste Inspection – 23 August, 1989, Boeing Advanced Systems Development Center.

Ecology. 1990a. Letter from Laurence Ashley, Ecology, to J.T. Johnstone, Boeing Advanced Systems. Re: Hazardous Waste Compliance Inspection conducted on August 23, 1989. March 1, 1990.

Ecology. 1990b. Letter or memo from Laurence Ashley, Ecology, to Richard Mattrass, unspecified affiliation. Re: RCRA Inspection report for Boeing Advanced Systems Development Center conducted August 23, 1989. June 8, 1990.

Ecology. 1991a. Solid and Hazardous Waste Program Inspection Report – Boeing Advanced Systems Development Center. Inspection August 14, 1991. September 6, 1991.

Ecology. 1991b. Letter from Josh Chaitin, Ecology, to Art Whitson, Boeing Defense and Space Group. Re: Compliance with Washington State Dangerous Waste Regulations (WAC 173-303). October 29, 1991.

Ecology. 1993a. Dangerous Waste Inspection Checklist – Boeing Developmental Center. Inspector Jeannie Summerhays. July 28, 1993.

Ecology. 1993b. Waste Reduction, Recycling, and Litter Control Program – Site/Visit Contact Report. November 2, 1993.

Ecology. 1994a. Hazardous Waste and Toxics Reduction Program Inspection Report – Developmental Center WAD093639946. Inspector Julie Sellick. January 13, 1994.

Ecology. 1994b. Letter from Jeannie Summerhays, Ecology, to Mary Jo Donelly, Boeing Defense and Space Group. Re: Dangerous Waste Compliance Inspection Developmental Center WAD093639946. January 18, 1994.

Ecology. 1995a. Department of Ecology Inspection Report – Permit Application Boeing Developmental Center. Inspector Pam Elardo. February 23, 1995.

Ecology. 1995b. Hazardous Waste Inspection Report – Boeing Developmental Center. March 9, 1995.

Ecology. 1995c. Letter from J. David Hohmann, Ecology, to David Dornbush, Boeing. Re: 3/09/95 Dangerous Waste Compliance Inspection Boeing Developmental Center Facility WAD 009262171. April 12, 1995.

Ecology. 1996. Water Compliance Inspection Report – Boeing Developmental Center. Inspection October 31, 1996. Inspector Pam Elardo. November 7, 1996.

Ecology. 1997a. Letter from Dean Yasuda, Ecology, to Andy Wipplinger, Boeing Defense and Space Group. Re: Dangerous Waste Compliance Evaluation Inspection at the Boeing Developmental Center (WAD 093639946). January 15, 1997.

Ecology. 1997b. Letter from Kenneth White, Ecology, to Denis Bourcier, Boeing Developmental Control. Re: Monthly Discharge Monitoring Report violations, October 1, 1996 through December 31, 1996. March 4, 1997.

Ecology. 1997c. Letter from Julie Sellick, Ecology, to Andro Wipplinger, Boeing Defense and Space Group. Re: Ecology's Acceptance of Certification for Final Facility Clean Closure of the Boeing Developmental Center. September 3, 1997.

Ecology. 1998a. Water Compliance Inspection Report – Stormwater – Boeing Developmental Center. Ron Devitt, Inspector. Inspection on June 29, 1998. Report prepared July 6, 1998.

Ecology. 1998b. Letter from Erin Guthrie, Ecology, to Jack Boller, USEPA/WOO. Re: TSD Inspections for Boeing Plant 2 and Boeing Developmental Center. July 9, 1998.

Ecology. 2001. Letter from Tiffany Yelton, Ecology, to Thomas Gallacher, The Boeing Company. Re: Dangerous Waste Compliance Inspection at Boeing A&M Developmental Center RCRA ID WAD093639946 on April 24, 2001. May 4, 2001.

Ecology. 2002. Letter from Byung Maeng, Ecology, to James Bet, The Boeing Company. Re: Completion of Groundwater Monitoring at AOC-01/02 Boeing Developmental Center (WAD 093 639 946). November 25, 2002.

Ecology. 2003. Letter from Ecology to Tom Gallacher, The Boeing Company. Re: Cancellation of NPDES Permit No. WA-003148-8 Boeing Developmental Center. April 25, 2003.

Ecology. 2004. Lower Duwamish Source Control Strategy. Publication No. 04-09-043. January 2004.

Ecology. 2006. Stormwater Compliance Inspection Report: Boeing Developmental Center. March 16, 2006.

Ecology. 2007a. Lower Duwamish Waterway Source Control Status Report, 2003 to June 2007. Publication No. 07-09-064. Prepared by Washington State Department of Ecology, Northwest Regional Office, Toxics Cleanup Program. July 2007.

Ecology. 2007b. Lower Duwamish Waterway Source Control Action Plan for Early Action Area 7. Produced by Washington State Department of Ecology, Northwest Regional Office, Toxics Cleanup Program and Ecology and Environment, Inc. Publication No. 07-09-003. September 2007.

Ecology. 2008a. Lower Duwamish Waterway Source Control Status Report, July 2007 to March 2008. Publication No. 08-09-063. Prepared by Washington State Department of Ecology, Northwest Regional Office, Toxics Cleanup Program. May 2008.

Ecology. 2008b. Lower Duwamish Waterway River Mile 3.9-4.3 East (Slip 6) Source Control Action Plan. Produced by Washington State Department of Ecology, Northwest Regional Office, Toxics Cleanup Program and Ecology and Environment, Inc. Publication No. 08-09-001. September 2008.

Ecology. 2008c. Lower Duwamish Waterway Source Control Status Report April 2008 through August 2008. Publication No. 08-09-086. Prepared by Washington State Department of Ecology, Northwest Regional Office, Toxics Cleanup Program. October 2008.

Ecology. 2009a. Lower Duwamish Waterway Source Control Status Report September 2008 through June 2009. Publication No. 09-09-183. Prepared by Washington State Department of Ecology, Northwest Regional Office, Toxics Cleanup Program. August 2009.

Ecology. 2009b. Integrated Site Information System: Cleanup Site Details Report for Boeing Development Center Norfolk Site ID 4581384. Created October 19, 2009.

Ecology. 2009c. Integrated Site Information System: Cleanup Site Details Report for Boeing A & M Developmental Center Site ID 2101. Created October 23, 2009.

Ecology. 2010. Underground Storage Tank Inspection – Boeing Developmental Center. March 31, 2010.

EPA (U.S. Environmental Protection Agency). 1988. Notice of Violation and Compliance Schedule, in the matter of the Environmental Protection Agency, Region 10 vs. Boeing Developmental Center. August 29, 1988.

EPA. 2002. Principles for Managing Contaminated Sediment Risks at Hazardous Waste Sites. OSWER Directive 9285.6-08. U.S. Environmental Protection Agency. February 12, 2002.

EPA. 2007. Underground Storage Tank Inspection - Boeing Developmental Center. March 29, 2007.

EPA. 2009. Letter from Edward Kawalski, EPA, to Stephen Ryan, Boeing A & M Developmental Center. Re: Notice of Violation, Boeing A & M Developmental Center, EPA ID Number: WAD 09363 9946. July 27, 2009.

EPA and Ecology. 2002. Lower Duwamish Waterway Site Memorandum of Understanding between the United States Environmental Protection Agency and the Washington State Department of Ecology. April 2002.

EPA and Ecology. 2004. Lower Duwamish Waterway Site Memorandum of Understanding between the United States Environmental Protection Agency and the Washington State Department of Ecology. April 2004.

GeoEngineers. 2000. Phase I Environmental Site Assessment, 9725 East Marginal Way South, Seattle, Washington. Prepared for Museum of Flight. May 22, 2000.

Herrera. 2004. Summary Report: Lower Duwamish Waterway Outfall Survey. Prepared for Seattle Public Utilities by Herrera Environmental Consultants, Inc., Seattle, WA. January 2004.

Landau (Landau Associates Inc.). 1993. Site Characterization Building 9-50 Underground Boiler Fuel tank Replacement Project, Boeing Developmental Center Facility, Tukwila, Washington. Prepared for The Boeing Company Defense and Space Group. February 26, 1993.

Landau. 2002. Summary report: Corrective Action Boeing Developmental Center. Prepared for the Boeing Company, Seattle, Washington by Landau Associates, Edmonds, WA. February 27, 2002.

Landau. 2004a. Construction Completion Report Stormwater Treatment Vault Installation, Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company. February 26, 2004.

Landau. 2004b. Evaluation Report SWMU-17, SWMU-20, and AOC-05, Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company. March 10, 2004.

Landau. 2004c. Report: 2004 Annual Groundwater Monitoring Gate J-28/Museum of Flight, Tukwila, Washington. Prepared for The Boeing Company, Seattle, Washington. July 23, 2004.

Landau. 2007a. Technical Memorandum: AOC-05 Pilot Test Results, Enhanced Anaerobic Biodegradation of Petroleum Hydrocarbons, Boeing Developmental Center, Tukwila, WA. From Clint Jacob and Benni Jonsson to Jim Bet, The Boeing Company. October 3, 2007.

Landau. 2007b. Work Plan: AOC-05 Remedial Action Plan, Enhanced Anaerobic Biodegradation of Gasoline-Range Petroleum Hydrocarbons, Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company by Landau Associates. November 16, 2007.

Landau. 2008a. Technical Memorandum: SWMU-20 Work Plan Addendum Fourth Electron Donor Injection, Boeing Developmental Center, Tukwila, WA. From Benni Jonsson and Clint Jacob to Jim Bet, The Boeing Company. July 30, 2008.

Landau. 2008b. Work Plan SWMU-17 Pilot Test, Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company. October 2, 2008.

Landau. 2009a. 2008 Annual Report AOC-05 Remedial Action, Enhanced Anaerobic Biodegradation of Gasoline-Range Petroleum Hydrocarbons, Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company. March 13, 2009.

Landau. 2009b. May 2009 Semiannual Groundwater Monitoring Results, Boeing Developmental Center, Tukwila, Washington. Letter to Byung Maeng, Ecology, from Clinton Jacob, Landau Associates. July 16, 2009.

Landau. 2009c. May 2009 Semiannual Groundwater Monitoring Results, Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company by Landau Associates. July 16, 2009.

Landau. 2009d. Technical Memorandum: Update on AOC-05 Full-Scale Bioremediation Results, Enhanced Anaerobic Biodegradation of Petroleum Hydrocarbons, Boeing Developmental Center, 9725 East Marginal Way South, Tukwila, WA. From Clint Jacob and David Buser to James Bet, The Boeing Company. September 17, 2009.

Landau. 2010a. 2009 Annual Report: AOC-05 Remedial Action Enhanced Anaerobic Biodegradation of Gasoline-Range Petroleum Hydrocarbons, Boeing Developmental Center, Tukwila, Washington. April 9, 2010.

Landau. 2010b. SWMU-17 Pilot Test Report, Boeing Developmental Center, Tukwila, Washington. May 14, 2010.

NOAA (National Oceanic and Atmospheric Administration). 1998. Duwamish Waterway Sediment Characterization Study Report. National Oceanic and Atmospheric Administration, Seattle, WA. As cited in Windward 2003.

PPC (Project Performance Corporation). 2003. Data Quality Review/Assessment: Sampling and Analysis for PCBs in Storm Water System Oil/Water Separators, Developmental Center. Prepared for The Boeing Company. January 17, 2003.

SAIC (Science Applications International Corporation). 1985. Potential Hazardous Waste Site Preliminary Assessment. Summary Memorandum – Boeing Developmental Center. March 12, 1985.

SAIC. 1994. RCRA Facility Assessment Report for Boeing Developmental Center, Tukwila, Washington EPA I.D. No. WAD 09363 9946 and Boeing Military Flight Center, Seattle Washington, EPA I.D. No. WAS 98847 5943. Prepared for U.S. Environmental Protection Agency. September 1994.

SAIC. 2006. Soil and Groundwater Screening Criteria, Source Control Action Plan, Slip 4, Lower Duwamish Waterway. Prepared for Washington State Department of Ecology by SAIC, Bothell, WA. August 2006.

Weston (Roy F. Weston, Inc.). 1997. Closure Certification Building 9-50, 9-60 and 9-69/70 Container Storage Areas. Boeing Developmental Center, Tukwila, Washington. Prepared for The Boeing Company. April 1997.

Weston. 1999. Site inspection report: Lower Duwamish River. RM 2.5-11.5. Volume 1 – Report and appendices. Prepared by Roy F. Weston, Inc. for U.S. Environmental Protection Agency Region 10, Seattle, WA.

Windward (Windward Environmental LLC). 2003. Phase 1 Remedial Investigation Report, Final. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. July 3, 2003.

Windward. 2004. Data Report: Survey and Sampling of Lower Duwamish Waterway Seeps, Final. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. November 18, 2004.

Windward. 2005a. Data Report: Round 1 Surface Sediment Sampling for Chemical Analyses and Toxicity Testing. Final. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. October 21, 2005.

Windward. 2005b. Data Report: Round 2 Surface Sediment Sampling for Chemical Analyses and Toxicity Testing. Final. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. December 9, 2005.

Windward. 2006. Technical Memorandum: Criteria for Defining the Baseline Surface Sediment Dataset for Use in the Lower Duwamish Waterway Phase 2 RI/FS. Final. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. April 5, 2006.

Windward. 2007a. Data Report: Subsurface Sediment Sampling for Chemical Analyses. Final. Prepared by Windward Environmental LLC and RETEC for the Lower Duwamish Waterway Group. January 29, 2007.

Windward. 2007b. Data Report: Round 3 Surface Sediment Sampling for Chemical Analyses. Final. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. March 12, 2007.

Windward. 2008. Lower Duwamish Waterway Remedial Investigation Report. Draft Final. Prepared by Windward Environmental for the Lower Duwamish Waterway Group. October 30, 2008.

Windward. 2010. Phase 2 Remedial Investigation Report. Prepared by Windward Environmental LLC for the Lower Duwamish Waterway Group. July 9, 2010.

Tables

Table 1
LDW Surface Sediment Samples Collected Between RM 4.3 and 4.9 East*

Event Name	Location Name	Date Collected	Collection Depth
NOAA Site Characterization	EST118	9/26/1997	Surface
NOAA Site Characterization	EST120	9/26/1997	Surface
NOAA Site Characterization	EIT051	9/29/1997	Surface
NOAA Site Characterization	EST121	9/29/1997	Surface
NOAA Site Characterization	EST125	9/29/1997	Surface
NOAA Site Characterization	EST111	9/30/1997	Surface
NOAA Site Characterization	EST113	9/30/1997	Surface
NOAA Site Characterization	EST114	9/30/1997	Surface
NOAA Site Characterization	EST116	9/30/1997	Surface
NOAA Site Characterization	EST124	9/30/1997	Surface
NOAA Site Characterization	EST127	9/30/1997	Surface
NOAA Site Characterization	EST112	10/8/1997	Surface
Boeing Site Characterization	R60	10/13/1997	Surface
Boeing Site Characterization	R61	10/13/1997	Surface
Boeing Site Characterization	R62	10/13/1997	Surface
Boeing Site Characterization	R63	10/13/1997	Surface
Boeing Site Characterization	R64	10/13/1997	Surface
Boeing Site Characterization	R65	10/14/1997	Surface
Boeing Site Characterization	R66	10/14/1997	Surface
Boeing Site Characterization	R67	10/14/1997	Surface
Boeing Site Characterization	R68	10/14/1997	Surface
Boeing Site Characterization	R69	10/14/1997	Surface
Boeing Site Characterization	R70	10/14/1997	Surface
Boeing Site Characterization	R71	10/14/1997	Surface
Boeing Site Characterization	R72	10/14/1997	Surface
Boeing Site Characterization	R73	10/14/1997	Surface
Boeing Site Characterization	R74	10/14/1997	Surface
Boeing Site Characterization	R78	10/14/1997	Surface
Boeing Site Characterization	R75	10/15/1997	Surface
Boeing Site Characterization	R76	10/15/1997	Surface
Boeing Site Characterization	R77	10/15/1997	Surface
Boeing Site Characterization	R79	10/15/1997	Surface
Boeing Site Characterization	R80	10/15/1997	Surface
Boeing Site Characterization	R81	10/15/1997	Surface
NOAA Site Characterization	EIT056	10/16/1997	Surface
NOAA Site Characterization	CH0001	10/20/1997	Surface
NOAA Site Characterization	EST122	10/21/1997	Surface
NOAA Site Characterization	EST106	10/23/1997	Surface
NOAA Site Characterization	EST110	11/12/1997	Surface
NOAA Site Characterization	EST115	11/12/1997	Surface
NOAA Site Characterization	EST117	11/12/1997	Surface

Table 1
LDW Surface Sediment Samples Collected Between RM 4.3 and 4.9 East*

Event Name	Location Name	Date Collected	Collection Depth
NOAA Site Characterization	EST123	11/12/1997	Surface
NOAA Site Characterization	EIT049	11/13/1997	Surface
NOAA Site Characterization	EIT052	11/13/1997	Surface
NOAA Site Characterization	EIT054	11/13/1997	Surface
NOAA Site Characterization	EIT055	11/13/1997	Surface
EPA Site Inspection	DR247	8/26/1998	Surface
EPA Site Inspection	DR248	8/26/1998	Surface
EPA Site Inspection	DR249	8/26/1998	Surface
EPA Site Inspection	DR250	8/26/1998	Surface
EPA Site Inspection	DR251	8/26/1998	Surface
EPA Site Inspection	DR252	8/26/1998	Surface
EPA Site Inspection	DR253	8/26/1998	Surface
EPA Site Inspection	DR254	8/26/1998	Surface
EPA Site Inspection	DR272	8/26/1998	Surface
EPA Site Inspection	DR280	8/26/1998	Surface
EPA Site Inspection	DR281	8/26/1998	Surface
EPA Site Inspection	DR289	8/26/1998	Surface
LDWRI-Benthic Sampling	B9a	8/27/2004	Surface
LDWRI-Surface Sediment Round 1	LDW-SS142	1/24/2005	Surface
LDWRI-Surface Sediment Round 2	LDW-SS137	3/9/2005	Surface
LDWRI-Surface Sediment Round 2	LDW-SS138	3/9/2005	Surface
LDWRI-Surface Sediment Round 2	LDW-SSB9a	3/15/2005	Surface

*Note: Includes samples collected in the LDW between Slip 6 and the Boeing pedestrian bridge (see Figure 4). LDW sediment samples collected between the Boeing pedestrian bridge and the S 102nd Street Bridge are presented and discussed in the EAA-7 Data Gaps Report.

Source: LDW Baseline Surface Sediment Dataset (Windward 2006)

Table 2
Chemicals Above Screening Levels in Surface Sediment
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor	CSL Exceedance Factor
Metals and Trace Elements										
EPA SI	DR254	Lead	6.2E+02	NA	NA	450	530	mg/kg DW	1.4	1.2
Polycyclic Aromatic Hydrocarbons (PAHs)										
Boeing SiteChar	R79	Acenaphthene	2.2E-01	1.1	2.0E+01	16	57	mg/kg OC	1.3	0.35
Boeing SiteChar	R63	Benzo(g,h,i)perylene	7.4E-01	1.5	4.9E+01	31	78	mg/kg OC	1.6	0.63
Boeing SiteChar	R63	Dibenzo(a,h)anthracene	2.8E-01	1.5	1.9E+01	12	33	mg/kg OC	1.6	0.58
Boeing SiteChar	R63	Fluoranthene	2.6E+00	1.5	1.7E+02	160	1200	mg/kg OC	1.1	0.14
Boeing SiteChar	R63	Indeno(1,2,3-cd)pyrene	7.5E-01	1.5	5.0E+01	34	88	mg/kg OC	1.5	0.57
Polychlorinated Biphenyls (PCBs)										
Boeing SiteChar	R75	PCBs (total calc'd)	2.6E-01	1.8	1.4E+01	12	65	mg/kg OC	1.2	0.22
LDWRI-Benthic	B9a	PCBs (total calc'd)	2.7E-01	2.1	1.3E+01	12	65	mg/kg OC	1.1	0.20

DW - Dry weight
TOC - Total organic carbon
OC - Organic carbon normalized

NA - Not applicable
SQS - Sediment Quality Standard
CSL - Cleanup Screening Level

No subsurface sediment data have been collected in this area.
Exceedance factors are the ratio of the detected concentration to the CSL or SQS
Hexachlorobutadiene, 1,2,4-trichlorobenzene, and N-nitrosodipheynylamine were not detected, however detection limits exceeded the SQS

Figures

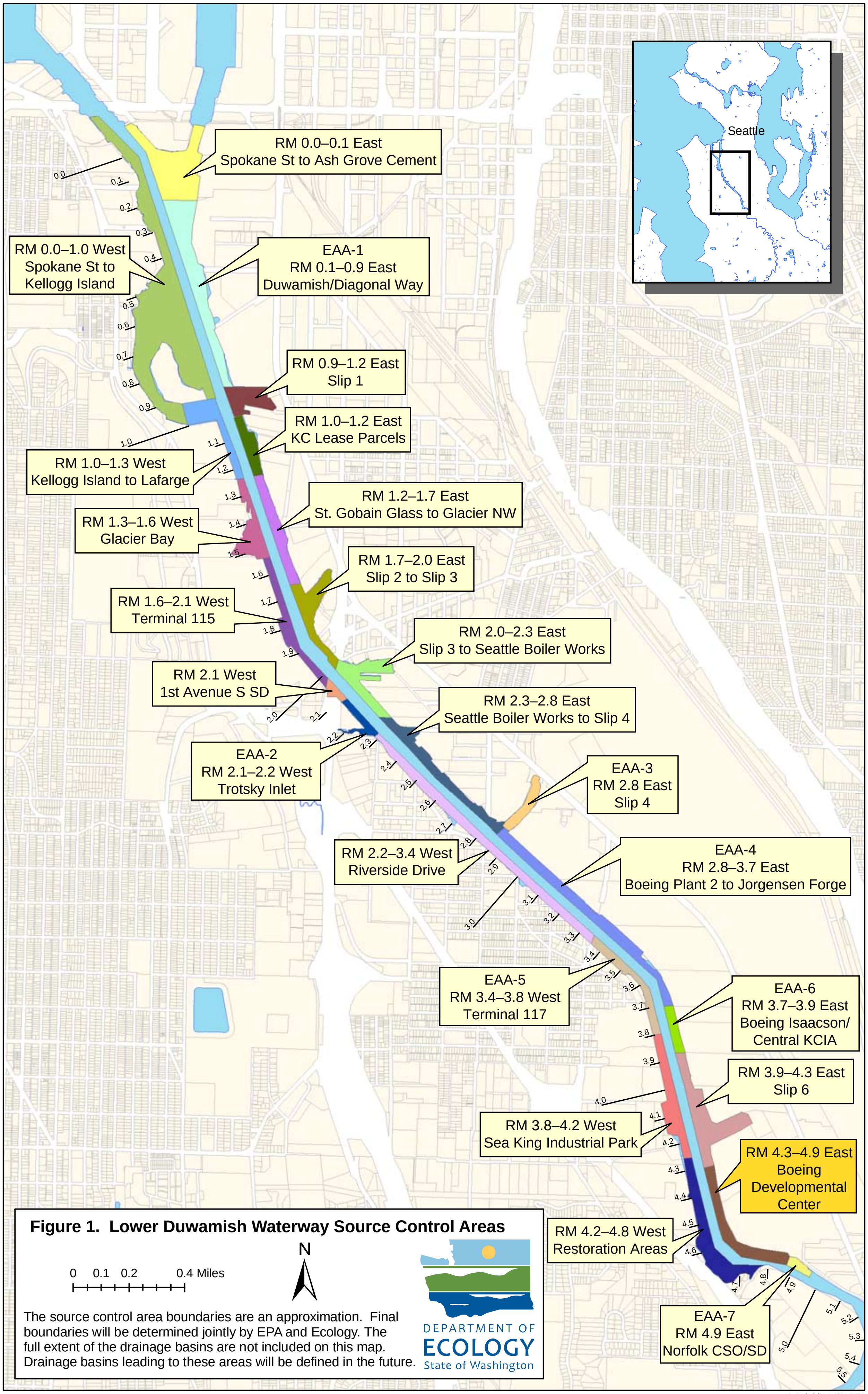

Figure 1. Lower Duwamish Waterway Source Control Areas

The source control area boundaries are an approximation. Final boundaries will be determined jointly by EPA and Ecology. The full extent of the drainage basins are not included on this map. Drainage basins leading to these areas will be defined in the future.

L. Delwiche SAIC, 2010

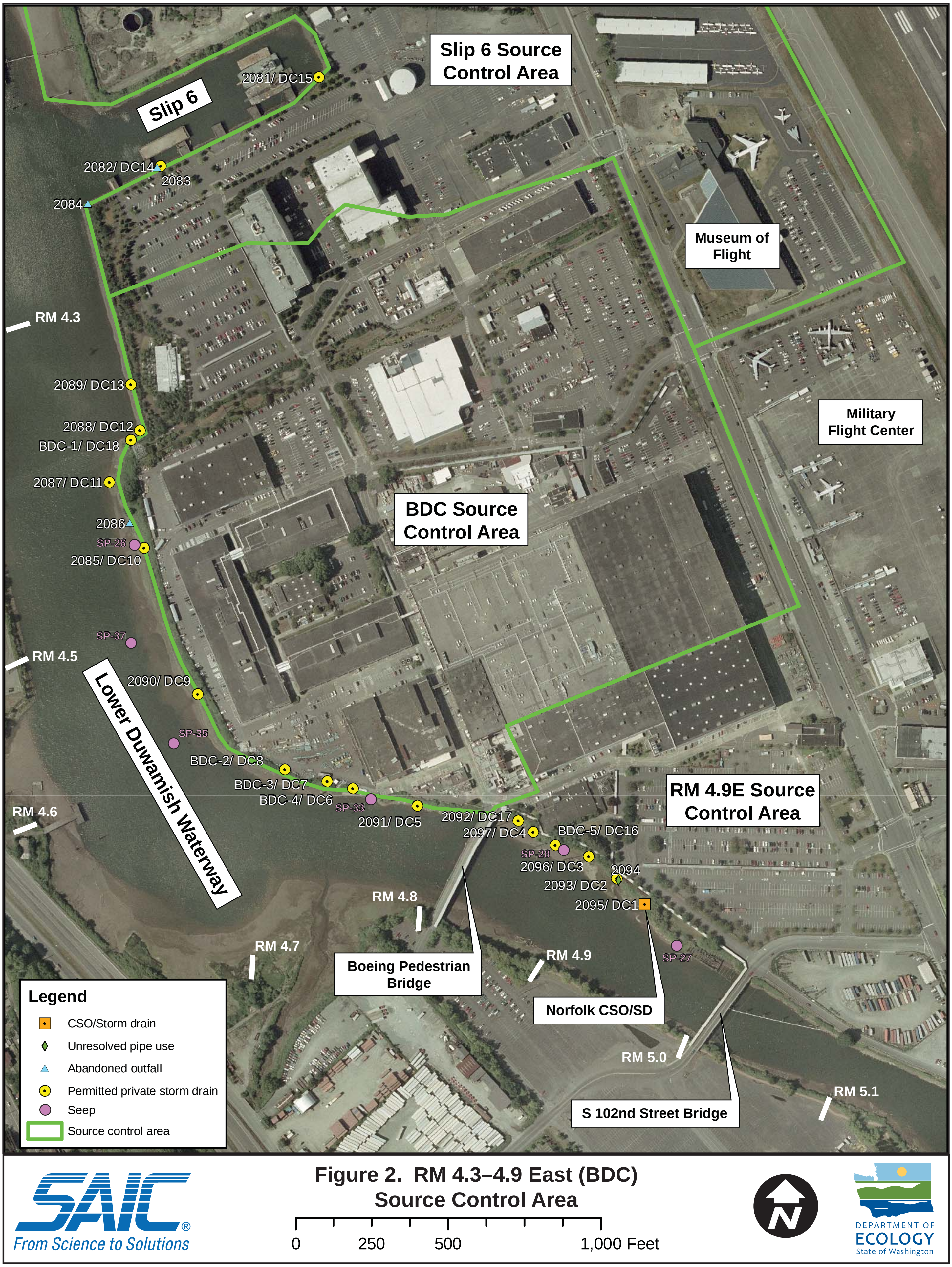

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Figure 2. RM 4.3–4.9 East (BDC) Source Control Area

DEPARTMENT OF ECOLOGY State of Washington

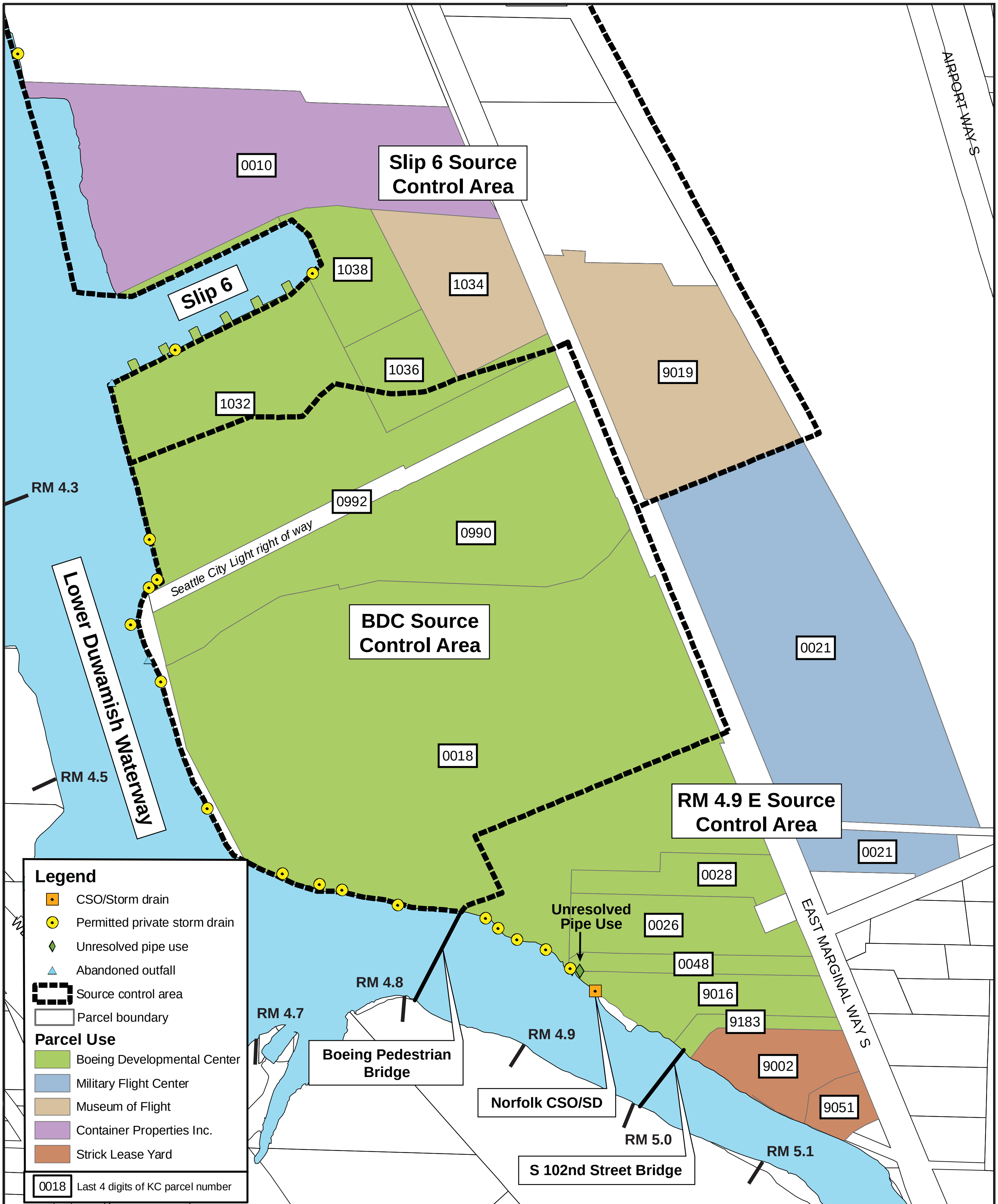

Figure 3. RM 4.3–4.9 East (BDC) Parcel Use

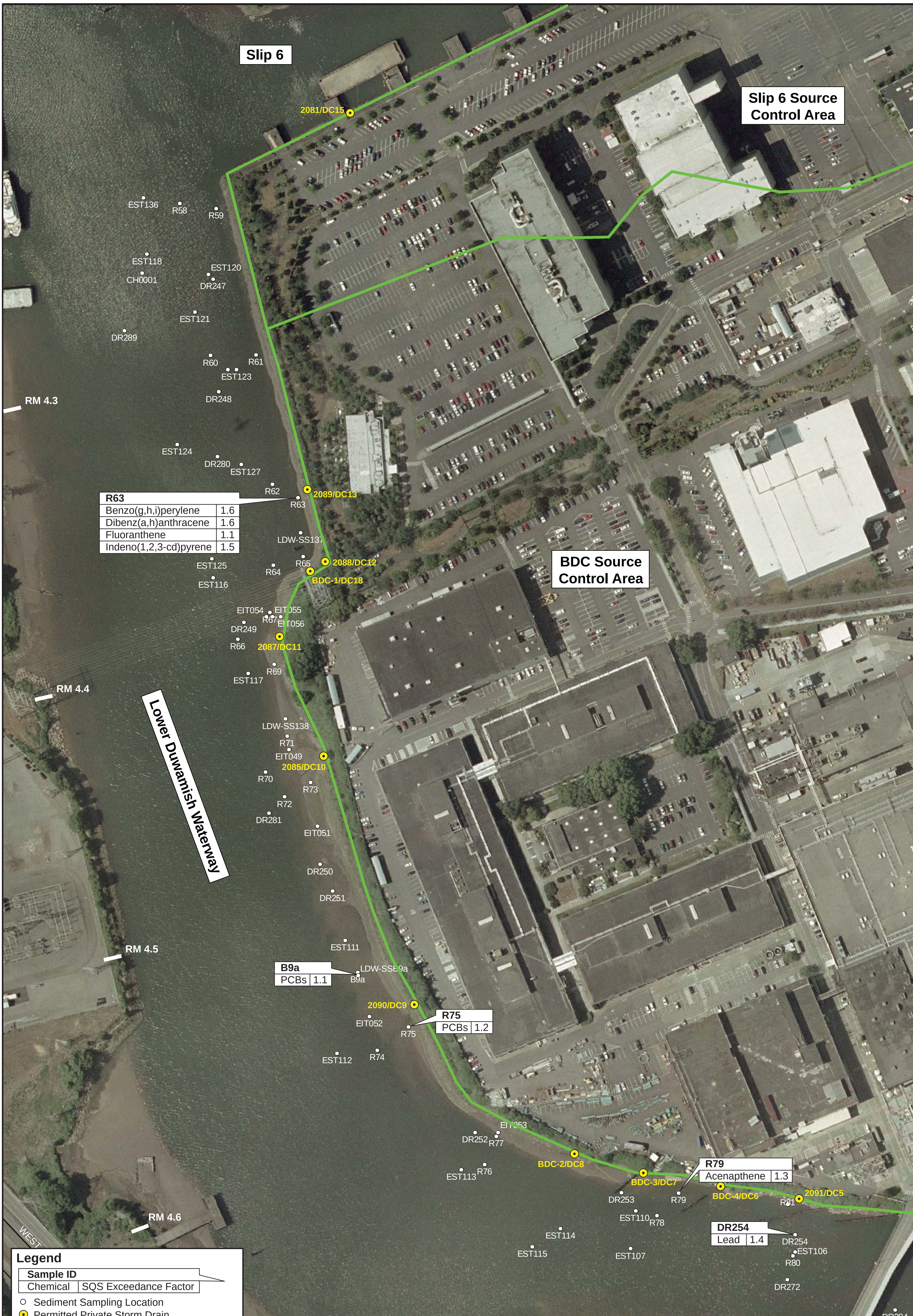

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Figure 4. RM 4.3–4.9 East (BDC) Sediment Sampling Locations

0 100 200 400 Feet

DEPARTMENT OF ECOLOGY State of Washington

Source: Adapted from Bet 2009

Figure 5. Boeing Developmental Center Stormwater Drainage Map

0 400 800 1,600 Feet

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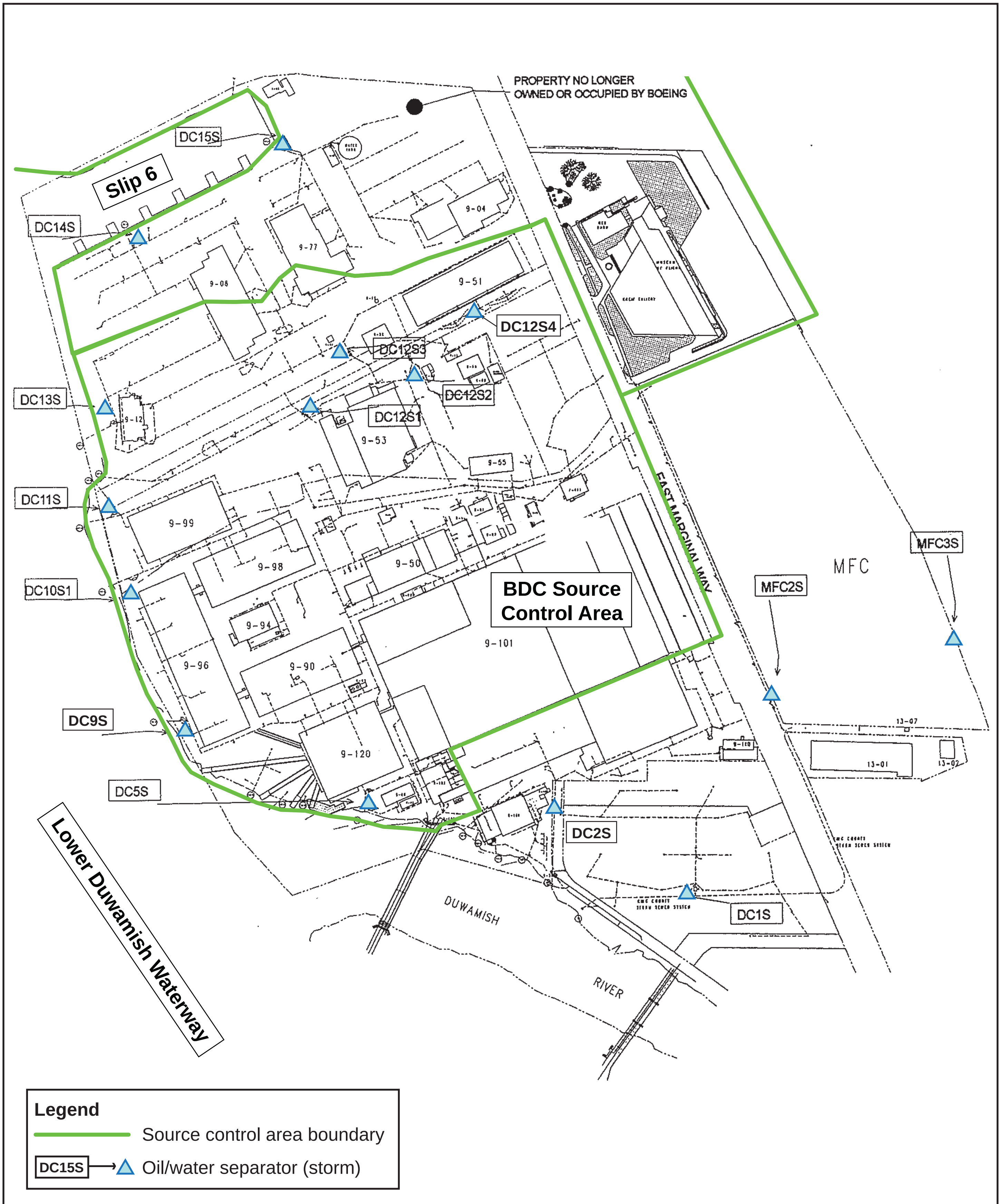

Source: PPC 2003

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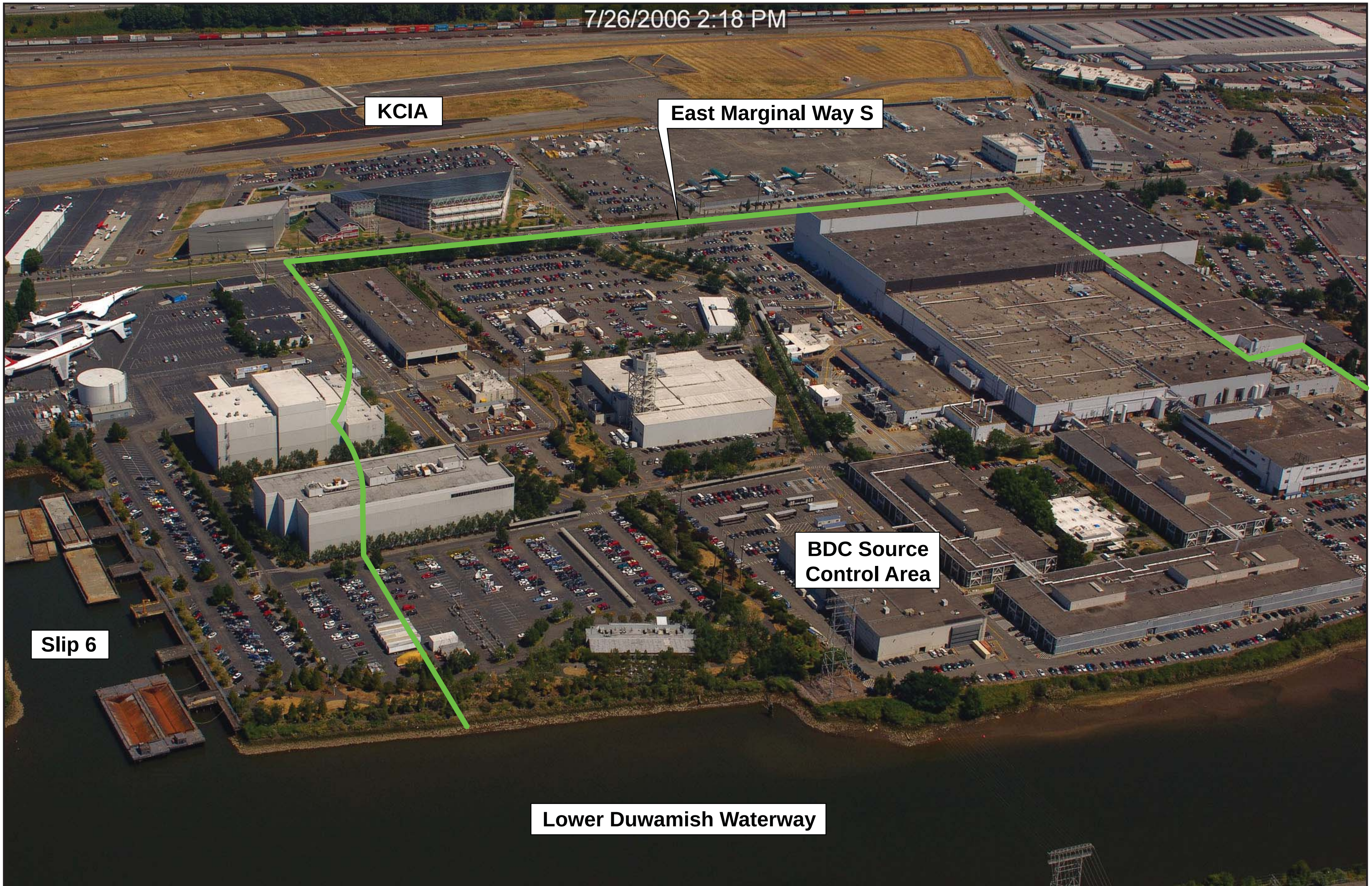
Figure 6. BDC Oil/Water Separator Locations

DEPARTMENT OF ECOLOGY
State of Washington



Source: Ecology Coastal Atlas, http://www.ecy.wa.gov/programs/sea/sma/atlas_home.html

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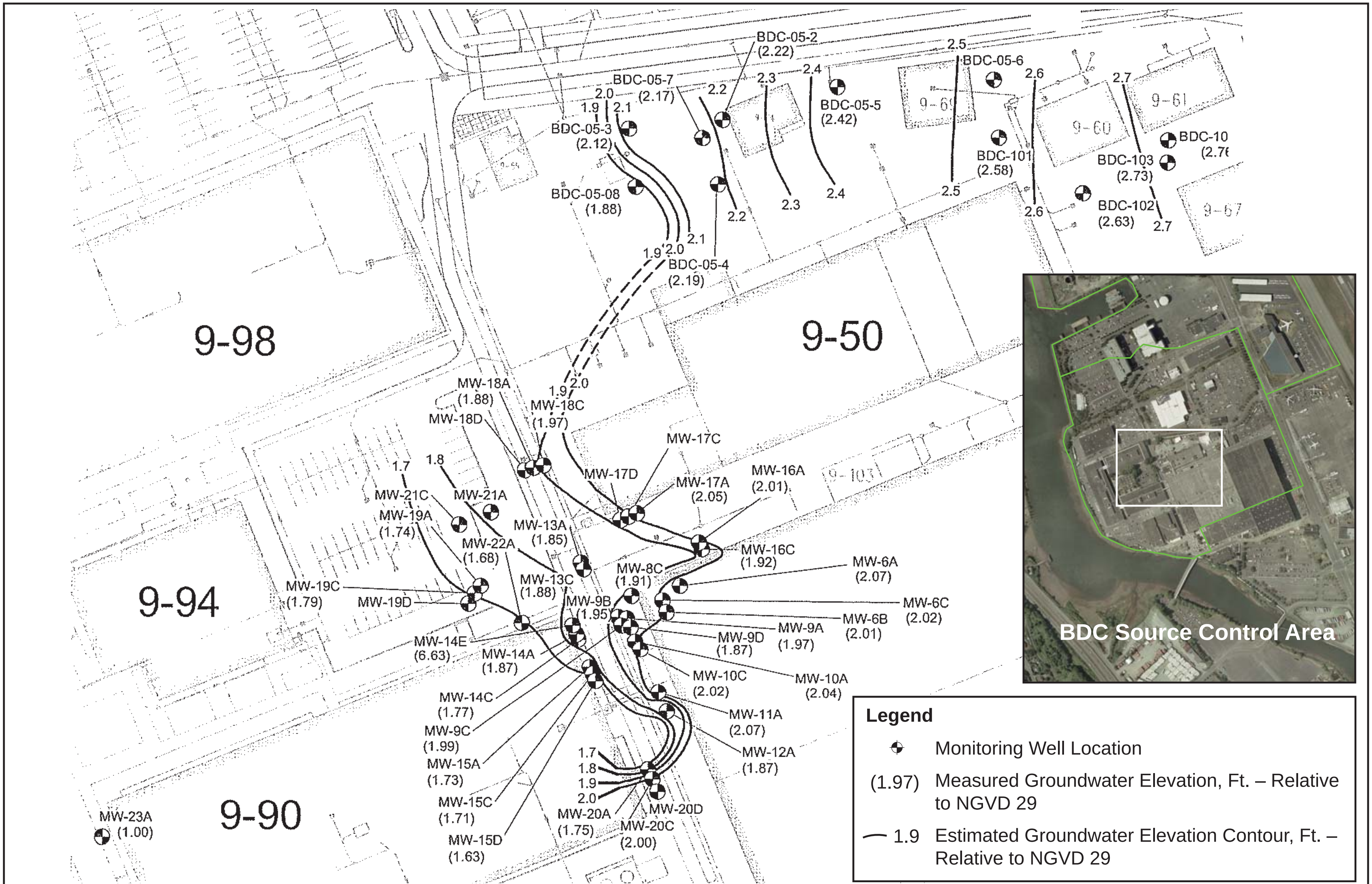
Figure 7. Oblique Aerial Photograph, BDC Source Control Area

DEPARTMENT OF ECOLOGY
State of Washington



Source: Landau 2009c

Figure 8. BDC Facility-Wide Groundwater Elevation Contours, May 2009

Source: Landau 2002

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Figure 9. Boeing Developmental Center AOC and SWMU Locations

DEPARTMENT OF ECOLOGY
State of Washington

Appendix A

Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)

Surface Sediment Sampling Results

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
LDWRI-Benthic	B9a	1-Methylnaphthalene	3.7E-03 J	2.1						
LDWRI-Benthic	B9a	2,4'-DDT	3.9E-03 JN	2.1						
LDWRI-Benthic	B9a	2-Methylnaphthalene	4.2E-03 J	2.1	2.0E-01	38	64	mg/kg OC	0.01	0.003
LDWRI-Benthic	B9a	4,4'-DDD	7.9E-04 JN	2.1						
LDWRI-Benthic	B9a	4,4'-DDT	5.4E-03 JN	2.1						
Boeing SiteChar	R62	4-Methylphenol	2.5E-02	1.8		670	670	ug/kg dw	0.04	0.04
Boeing SiteChar	R79	Acenaphthene	2.2E-01	1.1	2.0E+01	16	57	mg/kg OC	1.3	0.35
LDWRI-SurfaceSedimentRound1	LDW-SS142	Acenaphthene	1.6E-01	2.0	8.2E+00	16	57	mg/kg OC	0.51	0.14
Boeing SiteChar	R81	Acenaphthene	1.0E-01	1.3	7.7E+00	16	57	mg/kg OC	0.48	0.14
Boeing SiteChar	R77	Acenaphthene	7.7E-02	1.4	5.5E+00	16	57	mg/kg OC	0.34	0.10
Boeing SiteChar	R63	Acenaphthene	5.4E-02	1.5	3.6E+00	16	57	mg/kg OC	0.23	0.06
Boeing SiteChar	R62	Acenaphthene	2.7E-02	1.8	1.5E+00	16	57	mg/kg OC	0.09	0.03
Boeing SiteChar	R65	Acenaphthene	2.0E-02	1.6	1.3E+00	16	57	mg/kg OC	0.08	0.02
Boeing SiteChar	R75	Acenaphthene	2.0E-02	1.8	1.1E+00	16	57	mg/kg OC	0.07	0.02
EPA SI	DR253	Acenaphthene	2.0E-02	1.6	1.3E+00	16	57	mg/kg OC	0.08	0.02
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Acenaphthene	2.0E-02	2.4	8.2E-01	16	57	mg/kg OC	0.05	0.01
LDWRI-Benthic	B9a	Acenaphthene	7.9E-03	2.1	3.7E-01	16	57	mg/kg OC	0.02	0.01
LDWRI-Benthic	B9a	Acenaphthylene	2.8E-03 J	2.1	1.3E-01	66	66	mg/kg OC	0.002	0.002
EPA SI	DR289	Aluminum	2.3E+04	3.6						
EPA SI	DR250	Aluminum	2.2E+04	1.9						
EPA SI	DR281	Aluminum	2.1E+04	3.6						
EPA SI	DR248	Aluminum	2.0E+04	2.3						
EPA SI	DR247	Aluminum	2.0E+04	2.0						
EPA SI	DR280	Aluminum	2.0E+04	2.5						
EPA SI	DR251	Aluminum	2.0E+04	1.9						
EPA SI	DR253	Aluminum	2.0E+04	1.6						
EPA SI	DR272	Aluminum	1.9E+04	0.1						
EPA SI	DR249	Aluminum	1.8E+04	1.5						
EPA SI	DR252	Aluminum	1.4E+04	1.7						
EPA SI	DR254	Aluminum	8.2E+03	1.9						
Boeing SiteChar	R77	Anthracene	2.5E-01	1.4	1.8E+01	220	1200	mg/kg OC	0.08	0.02
Boeing SiteChar	R63	Anthracene	1.8E-01	1.5	1.2E+01	220	1200	mg/kg OC	0.06	0.01
Boeing SiteChar	R62	Anthracene	8.9E-02	1.8	4.9E+00	220	1200	mg/kg OC	0.02	0.004
EPA SI	DR253	Anthracene	6.0E-02	1.6	3.8E+00	220	1200	mg/kg OC	0.02	0.003
LDWRI-SurfaceSedimentRound2	LDW-SS137	Anthracene	4.5E-02	3.0	1.5E+00	220	1200	mg/kg OC	0.01	0.001
Boeing SiteChar	R65	Anthracene	4.4E-02	1.6	2.8E+00	220	1200	mg/kg OC	0.01	0.002
Boeing SiteChar	R75	Anthracene	4.2E-02	1.8	2.3E+00	220	1200	mg/kg OC	0.01	0.002
Boeing SiteChar	R79	Anthracene	2.7E-02	1.1	2.5E+00	220	1200	mg/kg OC	0.01	0.002

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
LDWRI-Benthic	B9a	Anthracene	2.7E-02	2.1	1.3E+00	220	1200	mg/kg OC	0.01	0.001
Boeing SiteChar	R73	Anthracene	2.5E-02	2.4	1.0E+00	220	1200	mg/kg OC	0.005	0.001
Boeing SiteChar	R81	Anthracene	2.0E-02	1.3	1.5E+00	220	1200	mg/kg OC	0.01	0.001
EPA SI	DR281	Anthracene	2.0E-02	3.6	5.5E-01	220	1200	mg/kg OC	0.003	0.000
EPA SI	DR289	Anthracene	2.0E-02	3.6	5.5E-01	220	1200	mg/kg OC	0.003	0.000
EPA SI	DR249	Antimony	5.0E+00 J	1.5				mg/kg dw		
LDWRI-Benthic	B9a	Antimony	2.0E-01 J	2.1				mg/kg dw		
LDWRI-Benthic	B9a	Aroclor-1242	1.8E-01	2.1						
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Aroclor-1242	1.0E-01	2.4						
EPA SI	DR281	Aroclor-1242	2.8E-02	3.6						
Boeing SiteChar	R81	Aroclor-1242	2.7E-02	1.3						
Boeing SiteChar	R77	Aroclor-1242	1.5E-02 J	1.4						
Boeing SiteChar	R74	Aroclor-1242	1.4E-02 J	1.5						
Boeing SiteChar	R63	Aroclor-1242	9.7E-03 J	1.5						
Boeing SiteChar	R64	Aroclor-1242	9.4E-03 J	2.2						
Boeing SiteChar	R62	Aroclor-1242	9.3E-03 J	1.8						
Boeing SiteChar	R65	Aroclor-1242	9.2E-03 J	1.6						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Aroclor-1248	2.9E-02	2.0						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Aroclor-1248	2.3E-02 J	3.0						
Boeing SiteChar	R75	Aroclor-1254	1.1E-01	1.8						
EPA SI	DR281	Aroclor-1254	9.7E-02	3.6						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Aroclor-1254	9.3E-02	2.0						
LDWRI-Benthic	B9a	Aroclor-1254	8.5E-02	2.1						
Boeing SiteChar	R73	Aroclor-1254	5.4E-02	2.4						
Boeing SiteChar	R74	Aroclor-1254	5.4E-02	1.5						
Boeing SiteChar	R67	Aroclor-1254	5.3E-02	1.9						
Boeing SiteChar	R77	Aroclor-1254	5.2E-02	1.4						
EPA SI	DR272	Aroclor-1254	5.2E-02	0.1						
Boeing SiteChar	R68	Aroclor-1254	4.7E-02	2.0						
Boeing SiteChar	R63	Aroclor-1254	4.6E-02	1.5						
Boeing SiteChar	R81	Aroclor-1254	4.4E-02	1.3						
Boeing SiteChar	R65	Aroclor-1254	4.2E-02	1.6						
EPA SI	DR248	Aroclor-1254	3.9E-02	2.3						
EPA SI	DR280	Aroclor-1254	3.9E-02	2.5						
EPA SI	DR251	Aroclor-1254	3.6E-02	1.9						
EPA SI	DR289	Aroclor-1254	3.4E-02	3.6						
EPA SI	DR247	Aroclor-1254	3.2E-02	2.0						
Boeing SiteChar	R69	Aroclor-1254	3.1E-02	1.4						

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R66	Aroclor-1254	3.0E-02	1.2						
EPA SI	DR253	Aroclor-1254	3.0E-02	1.6						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Aroclor-1254	3.0E-02	3.0						
Boeing SiteChar	R62	Aroclor-1254	2.9E-02	1.8						
Boeing SiteChar	R64	Aroclor-1254	2.9E-02	2.2						
Boeing SiteChar	R79	Aroclor-1254	2.8E-02	1.1						
Boeing SiteChar	R76	Aroclor-1254	2.3E-02	2.0						
Boeing SiteChar	R78	Aroclor-1254	2.2E-02	1.6						
Boeing SiteChar	R60	Aroclor-1254	2.0E-02	1.2						
Boeing SiteChar	R71	Aroclor-1254	2.0E-02	2.0						
Boeing SiteChar	R70	Aroclor-1254	1.7E-02 J	1.1						
Boeing SiteChar	R61	Aroclor-1254	1.4E-02 J	1.4						
Boeing SiteChar	R72	Aroclor-1254	1.4E-02 J	1.0						
Boeing SiteChar	R75	Aroclor-1260	1.5E-01	1.8						
EPA SI	DR281	Aroclor-1260	6.8E-02	3.6						
Boeing SiteChar	R74	Aroclor-1260	5.4E-02	1.5						
Boeing SiteChar	R63	Aroclor-1260	4.9E-02	1.5						
Boeing SiteChar	R73	Aroclor-1260	4.6E-02	2.4						
Boeing SiteChar	R68	Aroclor-1260	4.1E-02	2.0						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Aroclor-1260	4.0E-02 J	2.0						
Boeing SiteChar	R77	Aroclor-1260	3.6E-02	1.4						
EPA SI	DR251	Aroclor-1260	3.5E-02	1.9						
EPA SI	DR248	Aroclor-1260	3.3E-02	2.3						
EPA SI	DR280	Aroclor-1260	3.3E-02	2.5						
EPA SI	DR247	Aroclor-1260	3.1E-02	2.0						
Boeing SiteChar	R65	Aroclor-1260	2.9E-02	1.6						
Boeing SiteChar	R64	Aroclor-1260	2.5E-02	2.2						
Boeing SiteChar	R66	Aroclor-1260	2.5E-02	1.2						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Aroclor-1260	2.5E-02	3.0						
EPA SI	DR289	Aroclor-1260	2.4E-02	3.6						
EPA SI	DR253	Aroclor-1260	2.3E-02	1.6						
Boeing SiteChar	R62	Aroclor-1260	2.2E-02	1.8						
Boeing SiteChar	R67	Aroclor-1260	2.1E-02	1.9						
Boeing SiteChar	R81	Aroclor-1260	1.9E-02	1.3						
Boeing SiteChar	R79	Aroclor-1260	1.8E-02 J	1.1						
LDWRI-SurfaceSedimentRound2	LDW-SS138	Aroclor-1260	1.7E-02 J	1.8						
Boeing SiteChar	R64	Arsenic	1.7E+01	2.2		57	93	mg/kg dw	0.29	0.18
EPA SI	DR281	Arsenic	1.5E+01	3.6		57	93	mg/kg dw	0.27	0.17

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR253	Arsenic	1.4E+01	1.6		57	93	mg/kg dw	0.25	0.15
LDWRI-SurfaceSedimentRound2	LDW-SS137	Arsenic	1.3E+01	3.0		57	93	mg/kg dw	0.23	0.14
EPA SI	DR280	Arsenic	1.3E+01	2.5		57	93	mg/kg dw	0.23	0.14
EPA SI	DR289	Arsenic	1.3E+01	3.6		57	93	mg/kg dw	0.22	0.14
EPA SI	DR248	Arsenic	1.2E+01	2.3		57	93	mg/kg dw	0.20	0.12
Boeing SiteChar	R62	Arsenic	1.2E+01	1.8		57	93	mg/kg dw	0.20	0.12
Boeing SiteChar	R68	Arsenic	1.1E+01	2.0		57	93	mg/kg dw	0.20	0.12
EPA SI	DR247	Arsenic	1.1E+01	2.0		57	93	mg/kg dw	0.20	0.12
Boeing SiteChar	R75	Arsenic	1.1E+01	1.8		57	93	mg/kg dw	0.19	0.12
EPA SI	DR252	Arsenic	1.1E+01	1.7		57	93	mg/kg dw	0.19	0.12
Boeing SiteChar	R63	Arsenic	1.1E+01	1.5		57	93	mg/kg dw	0.18	0.11
Boeing SiteChar	R65	Arsenic	1.1E+01	1.6		57	93	mg/kg dw	0.18	0.11
LDWRI-SurfaceSedimentRound1	LDW-SS142	Arsenic	1.1E+01	2.0		57	93	mg/kg dw	0.18	0.11
EPA SI	DR272	Arsenic	1.0E+01	0.1		57	93	mg/kg dw	0.18	0.11
Boeing SiteChar	R73	Arsenic	1.0E+01	2.4		57	93	mg/kg dw	0.18	0.11
Boeing SiteChar	R76	Arsenic	1.0E+01	2.0		57	93	mg/kg dw	0.18	0.11
Boeing SiteChar	R61	Arsenic	9.7E+00	1.4		57	93	mg/kg dw	0.17	0.10
Boeing SiteChar	R66	Arsenic	9.4E+00	1.2		57	93	mg/kg dw	0.16	0.10
Boeing SiteChar	R74	Arsenic	9.1E+00	1.5		57	93	mg/kg dw	0.16	0.10
Boeing SiteChar	R60	Arsenic	9.0E+00	1.2		57	93	mg/kg dw	0.16	0.10
EPA SI	DR250	Arsenic	9.0E+00	1.9		57	93	mg/kg dw	0.16	0.10
Boeing SiteChar	R80	Arsenic	8.9E+00	1.2		57	93	mg/kg dw	0.16	0.10
Boeing SiteChar	R77	Arsenic	8.7E+00	1.4		57	93	mg/kg dw	0.15	0.09
Boeing SiteChar	R67	Arsenic	8.5E+00	1.9		57	93	mg/kg dw	0.15	0.09
Boeing SiteChar	R79	Arsenic	8.2E+00	1.1		57	93	mg/kg dw	0.14	0.09
Boeing SiteChar	R70	Arsenic	8.1E+00	1.1		57	93	mg/kg dw	0.14	0.09
Boeing SiteChar	R71	Arsenic	7.8E+00	2.0		57	93	mg/kg dw	0.14	0.08
EPA SI	DR249	Arsenic	7.7E+00	1.5		57	93	mg/kg dw	0.14	0.08
LDWRI-SurfaceSedimentRound2	LDW-SS138	Arsenic	7.5E+00	1.8		57	93	mg/kg dw	0.13	0.08
Boeing SiteChar	R69	Arsenic	7.4E+00	1.4		57	93	mg/kg dw	0.13	0.08
Boeing SiteChar	R72	Arsenic	7.3E+00	1.0		57	93	mg/kg dw	0.13	0.08
Boeing SiteChar	R78	Arsenic	7.0E+00	1.6		57	93	mg/kg dw	0.12	0.08
EPA SI	DR251	Arsenic	6.9E+00	1.9		57	93	mg/kg dw	0.12	0.07
LDWRI-Benthic	B9a	Arsenic	6.6E+00 J	2.1		57	93	mg/kg dw	0.12	0.07
EPA SI	DR254	Arsenic	6.1E+00	1.9		57	93	mg/kg dw	0.11	0.07
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Arsenic	5.9E+00	2.4		57	93	mg/kg dw	0.10	0.06
Boeing SiteChar	R81	Arsenic	1.9E+00	1.3		57	93	mg/kg dw	0.03	0.02
EPA SI	DR250	Barium	7.7E+01	1.9						

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR280	Barium	7.4E+01	2.5						
EPA SI	DR289	Barium	7.3E+01	3.6						
EPA SI	DR248	Barium	7.0E+01	2.3						
EPA SI	DR247	Barium	6.9E+01	2.0						
EPA SI	DR281	Barium	6.8E+01	3.6						
EPA SI	DR249	Barium	6.7E+01	1.5						
EPA SI	DR253	Barium	6.4E+01	1.6						
EPA SI	DR272	Barium	6.2E+01	0.1						
EPA SI	DR251	Barium	5.9E+01	1.9						
EPA SI	DR252	Barium	3.9E+01	1.7						
EPA SI	DR254	Barium	3.1E+01	1.9						
Boeing SiteChar	R63	Benzo(a)anthracene	8.1E-01	1.5	5.4E+01	110	270	mg/kg OC	0.49	0.20
Boeing SiteChar	R77	Benzo(a)anthracene	7.0E-01	1.4	5.0E+01	110	270	mg/kg OC	0.45	0.19
Boeing SiteChar	R62	Benzo(a)anthracene	4.3E-01	1.8	2.4E+01	110	270	mg/kg OC	0.22	0.09
Boeing SiteChar	R65	Benzo(a)anthracene	2.1E-01	1.6	1.3E+01	110	270	mg/kg OC	0.12	0.05
EPA SI	DR253	Benzo(a)anthracene	1.8E-01	1.6	1.2E+01	110	270	mg/kg OC	0.11	0.04
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzo(a)anthracene	1.8E-01	3.0	6.1E+00	110	270	mg/kg OC	0.06	0.02
Boeing SiteChar	R75	Benzo(a)anthracene	1.6E-01	1.8	8.9E+00	110	270	mg/kg OC	0.08	0.03
EPA SI	DR281	Benzo(a)anthracene	1.4E-01	3.6	3.8E+00	110	270	mg/kg OC	0.04	0.01
Boeing SiteChar	R64	Benzo(a)anthracene	1.0E-01	2.2	4.5E+00	110	270	mg/kg OC	0.04	0.02
Boeing SiteChar	R73	Benzo(a)anthracene	1.0E-01	2.4	4.2E+00	110	270	mg/kg OC	0.04	0.02
EPA SI	DR248	Benzo(a)anthracene	1.0E-01	2.3	4.4E+00	110	270	mg/kg OC	0.04	0.02
EPA SI	DR280	Benzo(a)anthracene	1.0E-01	2.5	4.0E+00	110	270	mg/kg OC	0.04	0.02
EPA SI	DR289	Benzo(a)anthracene	9.0E-02	3.6	2.5E+00	110	270	mg/kg OC	0.02	0.01
Boeing SiteChar	R67	Benzo(a)anthracene	8.2E-02	1.9	4.3E+00	110	270	mg/kg OC	0.04	0.02
Boeing SiteChar	R79	Benzo(a)anthracene	8.0E-02	1.1	7.3E+00	110	270	mg/kg OC	0.07	0.03
EPA SI	DR272	Benzo(a)anthracene	8.0E-02	0.1		1300	1600	ug/kg dw	0.06	0.05
Boeing SiteChar	R76	Benzo(a)anthracene	7.8E-02	2.0	3.9E+00	110	270	mg/kg OC	0.04	0.01
Boeing SiteChar	R68	Benzo(a)anthracene	7.6E-02	2.0	3.8E+00	110	270	mg/kg OC	0.04	0.01
LDWRI-Benthic	B9a	Benzo(a)anthracene	7.6E-02	2.1	3.6E+00	110	270	mg/kg OC	0.03	0.01
EPA SI	DR247	Benzo(a)anthracene	7.0E-02	2.0	3.5E+00	110	270	mg/kg OC	0.03	0.01
Boeing SiteChar	R74	Benzo(a)anthracene	6.8E-02	1.5	4.5E+00	110	270	mg/kg OC	0.04	0.02
Boeing SiteChar	R81	Benzo(a)anthracene	6.5E-02	1.3	5.0E+00	110	270	mg/kg OC	0.05	0.02
EPA SI	DR251	Benzo(a)anthracene	6.0E-02	1.9	3.2E+00	110	270	mg/kg OC	0.03	0.01
EPA SI	DR252	Benzo(a)anthracene	6.0E-02	1.7	3.6E+00	110	270	mg/kg OC	0.03	0.01
Boeing SiteChar	R69	Benzo(a)anthracene	5.7E-02	1.4	4.1E+00	110	270	mg/kg OC	0.04	0.02
Boeing SiteChar	R66	Benzo(a)anthracene	5.4E-02	1.2	4.5E+00	110	270	mg/kg OC	0.04	0.02
Boeing SiteChar	R70	Benzo(a)anthracene	5.4E-02	1.1	4.9E+00	110	270	mg/kg OC	0.05	0.02

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
LDWRI-SurfaceSedimentRound2	LDW-SS138	Benzo(a)anthracene	5.0E-02	1.8	2.8E+00	110	270	mg/kg OC	0.03	0.01
Boeing SiteChar	R60	Benzo(a)anthracene	4.2E-02	1.2	3.5E+00	110	270	mg/kg OC	0.03	0.01
Boeing SiteChar	R71	Benzo(a)anthracene	4.1E-02	2.0	2.1E+00	110	270	mg/kg OC	0.02	0.01
Boeing SiteChar	R72	Benzo(a)anthracene	4.1E-02	1.0	4.2E+00	110	270	mg/kg OC	0.04	0.02
EPA SI	DR249	Benzo(a)anthracene	4.0E-02	1.5	2.7E+00	110	270	mg/kg OC	0.03	0.01
EPA SI	DR250	Benzo(a)anthracene	4.0E-02	1.9	2.1E+00	110	270	mg/kg OC	0.02	0.01
Boeing SiteChar	R61	Benzo(a)anthracene	3.0E-02	1.4	2.1E+00	110	270	mg/kg OC	0.02	0.01
Boeing SiteChar	R78	Benzo(a)anthracene	2.5E-02	1.6	1.6E+00	110	270	mg/kg OC	0.02	0.01
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Benzo(a)anthracene	2.2E-02	2.4	9.0E-01	110	270	mg/kg OC	0.01	0.003
LDWRI-SurfaceSedimentRound1	LDW-SS142	Benzo(a)anthracene	1.4E-02	2.0	7.2E-01	110	270	mg/kg OC	0.01	0.00
Boeing SiteChar	R63	Benzo(a)pyrene	9.4E-01	1.5	6.3E+01	99	210	mg/kg OC	0.64	0.30
Boeing SiteChar	R77	Benzo(a)pyrene	6.2E-01	1.4	4.4E+01	99	210	mg/kg OC	0.44	0.21
Boeing SiteChar	R62	Benzo(a)pyrene	5.2E-01	1.8	2.9E+01	99	210	mg/kg OC	0.29	0.14
Boeing SiteChar	R65	Benzo(a)pyrene	2.6E-01	1.6	1.6E+01	99	210	mg/kg OC	0.16	0.08
EPA SI	DR253	Benzo(a)pyrene	2.0E-01	1.6	1.3E+01	99	210	mg/kg OC	0.13	0.06
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzo(a)pyrene	2.0E-01	3.0	6.8E+00	99	210	mg/kg OC	0.07	0.03
EPA SI	DR280	Benzo(a)pyrene	1.3E-01	2.5	5.1E+00	99	210	mg/kg OC	0.05	0.02
EPA SI	DR281	Benzo(a)pyrene	1.3E-01	3.6	3.6E+00	99	210	mg/kg OC	0.04	0.02
Boeing SiteChar	R64	Benzo(a)pyrene	1.2E-01	2.2	5.5E+00	99	210	mg/kg OC	0.06	0.03
EPA SI	DR248	Benzo(a)pyrene	1.2E-01	2.3	5.3E+00	99	210	mg/kg OC	0.05	0.03
EPA SI	DR289	Benzo(a)pyrene	1.2E-01	3.6	3.3E+00	99	210	mg/kg OC	0.03	0.02
Boeing SiteChar	R73	Benzo(a)pyrene	1.1E-01	2.4	4.6E+00	99	210	mg/kg OC	0.05	0.02
EPA SI	DR272	Benzo(a)pyrene	1.1E-01	0.1		1600	3000	ug/kg dw	0.07	0.04
Boeing SiteChar	R67	Benzo(a)pyrene	9.7E-02	1.9	5.1E+00	99	210	mg/kg OC	0.05	0.02
Boeing SiteChar	R76	Benzo(a)pyrene	8.9E-02	2.0	4.5E+00	99	210	mg/kg OC	0.05	0.02
Boeing SiteChar	R74	Benzo(a)pyrene	8.4E-02	1.5	5.6E+00	99	210	mg/kg OC	0.06	0.03
Boeing SiteChar	R68	Benzo(a)pyrene	8.2E-02	2.0	4.1E+00	99	210	mg/kg OC	0.04	0.02
EPA SI	DR247	Benzo(a)pyrene	8.0E-02	2.0	4.0E+00	99	210	mg/kg OC	0.04	0.02
EPA SI	DR252	Benzo(a)pyrene	8.0E-02	1.7	4.8E+00	99	210	mg/kg OC	0.05	0.02
LDWRI-Benthic	B9a	Benzo(a)pyrene	8.0E-02	2.1	3.7E+00	99	210	mg/kg OC	0.04	0.02
Boeing SiteChar	R79	Benzo(a)pyrene	7.6E-02	1.1	6.9E+00	99	210	mg/kg OC	0.07	0.03
Boeing SiteChar	R81	Benzo(a)pyrene	7.5E-02	1.3	5.8E+00	99	210	mg/kg OC	0.06	0.03
Boeing SiteChar	R69	Benzo(a)pyrene	7.4E-02	1.4	5.3E+00	99	210	mg/kg OC	0.05	0.03
EPA SI	DR251	Benzo(a)pyrene	7.0E-02	1.9	3.7E+00	99	210	mg/kg OC	0.04	0.02
Boeing SiteChar	R66	Benzo(a)pyrene	6.6E-02	1.2	5.5E+00	99	210	mg/kg OC	0.06	0.03
LDWRI-SurfaceSedimentRound2	LDW-SS138	Benzo(a)pyrene	6.0E-02	1.8	3.4E+00	99	210	mg/kg OC	0.03	0.02
Boeing SiteChar	R70	Benzo(a)pyrene	5.6E-02	1.1	5.1E+00	99	210	mg/kg OC	0.05	0.02
Boeing SiteChar	R60	Benzo(a)pyrene	5.1E-02	1.2	4.3E+00	99	210	mg/kg OC	0.04	0.02

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R71	Benzo(a)pyrene	4.9E-02	2.0	2.5E+00	99	210	mg/kg OC	0.03	0.01
EPA SI	DR249	Benzo(a)pyrene	4.0E-02	1.5	2.7E+00	99	210	mg/kg OC	0.03	0.01
EPA SI	DR250	Benzo(a)pyrene	4.0E-02	1.9	2.1E+00	99	210	mg/kg OC	0.02	0.01
Boeing SiteChar	R61	Benzo(a)pyrene	3.9E-02	1.4	2.8E+00	99	210	mg/kg OC	0.03	0.01
Boeing SiteChar	R72	Benzo(a)pyrene	3.5E-02	1.0	3.6E+00	99	210	mg/kg OC	0.04	0.02
Boeing SiteChar	R78	Benzo(a)pyrene	2.8E-02	1.6	1.8E+00	99	210	mg/kg OC	0.02	0.01
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Benzo(a)pyrene	2.7E-02	2.4	1.1E+00	99	210	mg/kg OC	0.01	0.01
LDWRI-SurfaceSedimentRound1	LDW-SS142	Benzo(a)pyrene	1.6E-02	2.0	8.2E-01	99	210	mg/kg OC	0.01	0.004
Boeing SiteChar	R63	Benzo(b)fluoranthene	9.9E-01	1.5						
Boeing SiteChar	R77	Benzo(b)fluoranthene	6.5E-01	1.4						
Boeing SiteChar	R62	Benzo(b)fluoranthene	6.4E-01	1.8						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzo(b)fluoranthene	2.9E-01	3.0						
Boeing SiteChar	R65	Benzo(b)fluoranthene	2.8E-01	1.6						
EPA SI	DR253	Benzo(b)fluoranthene	2.1E-01	1.6						
EPA SI	DR281	Benzo(b)fluoranthene	1.8E-01	3.6						
Boeing SiteChar	R73	Benzo(b)fluoranthene	1.6E-01	2.4						
EPA SI	DR280	Benzo(b)fluoranthene	1.6E-01	2.5						
EPA SI	DR248	Benzo(b)fluoranthene	1.5E-01	2.3						
EPA SI	DR289	Benzo(b)fluoranthene	1.5E-01	3.6						
Boeing SiteChar	R64	Benzo(b)fluoranthene	1.4E-01	2.2						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Benzo(b)fluoranthene	1.4E-01	2.0						
Boeing SiteChar	R76	Benzo(b)fluoranthene	1.3E-01	2.0						
Boeing SiteChar	R67	Benzo(b)fluoranthene	1.2E-01	1.9						
Boeing SiteChar	R68	Benzo(b)fluoranthene	1.2E-01	2.0						
EPA SI	DR247	Benzo(b)fluoranthene	1.1E-01	2.0						
EPA SI	DR272	Benzo(b)fluoranthene	1.1E-01	0.1						
Boeing SiteChar	R75	Benzo(b)fluoranthene	1.0E-01	1.8						
Boeing SiteChar	R66	Benzo(b)fluoranthene	9.9E-02	1.2						
Boeing SiteChar	R74	Benzo(b)fluoranthene	9.4E-02	1.5						
Boeing SiteChar	R79	Benzo(b)fluoranthene	9.4E-02	1.1						
EPA SI	DR251	Benzo(b)fluoranthene	9.0E-02	1.9						
EPA SI	DR252	Benzo(b)fluoranthene	9.0E-02	1.7						
Boeing SiteChar	R70	Benzo(b)fluoranthene	7.9E-02	1.1						
Boeing SiteChar	R81	Benzo(b)fluoranthene	7.9E-02 J	1.3						
LDWRI-Benthic	B9a	Benzo(b)fluoranthene	7.4E-02	2.1						
Boeing SiteChar	R69	Benzo(b)fluoranthene	7.2E-02	1.4						
LDWRI-SurfaceSedimentRound2	LDW-SS138	Benzo(b)fluoranthene	7.1E-02	1.8						
Boeing SiteChar	R60	Benzo(b)fluoranthene	6.4E-02	1.2						

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R71	Benzo(b)fluoranthene	5.1E-02	2.0						
EPA SI	DR249	Benzo(b)fluoranthene	5.0E-02	1.5						
EPA SI	DR250	Benzo(b)fluoranthene	5.0E-02	1.9						
Boeing SiteChar	R61	Benzo(b)fluoranthene	4.6E-02	1.4						
Boeing SiteChar	R72	Benzo(b)fluoranthene	4.2E-02	1.0						
Boeing SiteChar	R78	Benzo(b)fluoranthene	4.1E-02 J	1.6						
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Benzo(b)fluoranthene	3.5E-02	2.4						
LDWRI-Benthic	B9a	Benzo(e)pyrene	6.5E-02	2.1						
Boeing SiteChar	R63	Benzo(g,h,i)perylene	7.4E-01	1.5	4.9E+01	31	78	mg/kg OC	1.6	0.63
Boeing SiteChar	R62	Benzo(g,h,i)perylene	3.6E-01	1.8	2.0E+01	31	78	mg/kg OC	0.65	0.26
Boeing SiteChar	R77	Benzo(g,h,i)perylene	2.8E-01	1.4	2.0E+01	31	78	mg/kg OC	0.65	0.26
Boeing SiteChar	R65	Benzo(g,h,i)perylene	2.1E-01	1.6	1.3E+01	31	78	mg/kg OC	0.42	0.17
EPA SI	DR253	Benzo(g,h,i)perylene	1.5E-01	1.6	9.6E+00	31	78	mg/kg OC	0.31	0.12
Boeing SiteChar	R73	Benzo(g,h,i)perylene	1.2E-01	2.4	5.0E+00	31	78	mg/kg OC	0.16	0.06
EPA SI	DR280	Benzo(g,h,i)perylene	1.0E-01	2.5	4.0E+00	31	78	mg/kg OC	0.13	0.05
Boeing SiteChar	R64	Benzo(g,h,i)perylene	9.7E-02	2.2	4.4E+00	31	78	mg/kg OC	0.14	0.06
EPA SI	DR248	Benzo(g,h,i)perylene	9.0E-02	2.3	3.9E+00	31	78	mg/kg OC	0.13	0.05
EPA SI	DR281	Benzo(g,h,i)perylene	9.0E-02	3.6	2.5E+00	31	78	mg/kg OC	0.08	0.03
EPA SI	DR289	Benzo(g,h,i)perylene	9.0E-02	3.6	2.5E+00	31	78	mg/kg OC	0.08	0.03
Boeing SiteChar	R67	Benzo(g,h,i)perylene	8.6E-02	1.9	4.5E+00	31	78	mg/kg OC	0.15	0.06
Boeing SiteChar	R76	Benzo(g,h,i)perylene	8.6E-02 J	2.0	4.3E+00	31	78	mg/kg OC	0.14	0.06
Boeing SiteChar	R69	Benzo(g,h,i)perylene	7.4E-02	1.4	5.3E+00	31	78	mg/kg OC	0.17	0.07
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzo(g,h,i)perylene	7.2E-02	3.0	2.4E+00	31	78	mg/kg OC	0.08	0.03
EPA SI	DR272	Benzo(g,h,i)perylene	7.0E-02	0.1		670	720	ug/kg dw	0.10	0.10
Boeing SiteChar	R68	Benzo(g,h,i)perylene	6.8E-02	2.0	3.4E+00	31	78	mg/kg OC	0.11	0.04
Boeing SiteChar	R74	Benzo(g,h,i)perylene	6.3E-02	1.5	4.2E+00	31	78	mg/kg OC	0.14	0.05
Boeing SiteChar	R81	Benzo(g,h,i)perylene	6.2E-02	1.3	4.8E+00	31	78	mg/kg OC	0.15	0.06
LDWRI-Benthic	B9a	Benzo(g,h,i)perylene	6.1E-02	2.1	2.9E+00	31	78	mg/kg OC	0.09	0.04
EPA SI	DR247	Benzo(g,h,i)perylene	6.0E-02	2.0	3.0E+00	31	78	mg/kg OC	0.10	0.04
EPA SI	DR251	Benzo(g,h,i)perylene	6.0E-02	1.9	3.2E+00	31	78	mg/kg OC	0.10	0.04
EPA SI	DR252	Benzo(g,h,i)perylene	6.0E-02	1.7	3.6E+00	31	78	mg/kg OC	0.12	0.05
Boeing SiteChar	R79	Benzo(g,h,i)perylene	5.7E-02	1.1	5.2E+00	31	78	mg/kg OC	0.17	0.07
Boeing SiteChar	R66	Benzo(g,h,i)perylene	5.2E-02	1.2	4.3E+00	31	78	mg/kg OC	0.14	0.06
EPA SI	DR250	Benzo(g,h,i)perylene	5.0E-02	1.9	2.6E+00	31	78	mg/kg OC	0.08	0.03
Boeing SiteChar	R60	Benzo(g,h,i)perylene	4.8E-02	1.2	4.0E+00	31	78	mg/kg OC	0.13	0.05
Boeing SiteChar	R71	Benzo(g,h,i)perylene	4.8E-02	2.0	2.4E+00	31	78	mg/kg OC	0.08	0.03
Boeing SiteChar	R70	Benzo(g,h,i)perylene	4.4E-02 J	1.1	4.0E+00	31	78	mg/kg OC	0.13	0.05
EPA SI	DR249	Benzo(g,h,i)perylene	4.0E-02	1.5	2.7E+00	31	78	mg/kg OC	0.09	0.04

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R61	Benzo(g,h,i)perylene	3.8E-02	1.4	2.7E+00	31	78	mg/kg OC	0.09	0.04
Boeing SiteChar	R72	Benzo(g,h,i)perylene	3.2E-02 J	1.0	3.3E+00	31	78	mg/kg OC	0.11	0.04
Boeing SiteChar	R78	Benzo(g,h,i)perylene	3.0E-02 J	1.6	1.9E+00	31	78	mg/kg OC	0.06	0.02
LDWRI-SurfaceSedimentRound2	LDW-SS138	Benzo(g,h,i)perylene	2.1E-02	1.8	1.2E+00	31	78	mg/kg OC	0.04	0.02
Boeing SiteChar	R63	Benzo(k)fluoranthene	8.4E-01	1.5						
Boeing SiteChar	R77	Benzo(k)fluoranthene	6.5E-01	1.4						
Boeing SiteChar	R62	Benzo(k)fluoranthene	4.8E-01	1.8						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzo(k)fluoranthene	3.8E-01	3.0						
Boeing SiteChar	R65	Benzo(k)fluoranthene	3.0E-01	1.6						
EPA SI	DR253	Benzo(k)fluoranthene	2.2E-01	1.6						
EPA SI	DR281	Benzo(k)fluoranthene	1.9E-01	3.6						
Boeing SiteChar	R64	Benzo(k)fluoranthene	1.5E-01	2.2						
Boeing SiteChar	R73	Benzo(k)fluoranthene	1.5E-01	2.4						
EPA SI	DR280	Benzo(k)fluoranthene	1.5E-01	2.5						
EPA SI	DR289	Benzo(k)fluoranthene	1.5E-01	3.6						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Benzo(k)fluoranthene	1.5E-01	2.0						
EPA SI	DR248	Benzo(k)fluoranthene	1.4E-01	2.3						
Boeing SiteChar	R76	Benzo(k)fluoranthene	1.2E-01 J	2.0						
EPA SI	DR272	Benzo(k)fluoranthene	1.2E-01	0.1						
Boeing SiteChar	R67	Benzo(k)fluoranthene	1.1E-01	1.9						
Boeing SiteChar	R74	Benzo(k)fluoranthene	1.0E-01 J	1.5						
Boeing SiteChar	R75	Benzo(k)fluoranthene	1.0E-01	1.8						
Boeing SiteChar	R79	Benzo(k)fluoranthene	9.7E-02	1.1						
Boeing SiteChar	R68	Benzo(k)fluoranthene	9.6E-02 J	2.0						
Boeing SiteChar	R69	Benzo(k)fluoranthene	9.4E-02	1.4						
Boeing SiteChar	R81	Benzo(k)fluoranthene	9.2E-02 J	1.3						
EPA SI	DR247	Benzo(k)fluoranthene	9.0E-02	2.0						
EPA SI	DR252	Benzo(k)fluoranthene	9.0E-02	1.7						
LDWRI-SurfaceSedimentRound2	LDW-SS138	Benzo(k)fluoranthene	8.6E-02	1.8						
LDWRI-Benthic	B9a	Benzo(k)fluoranthene	8.4E-02	2.1						
EPA SI	DR251	Benzo(k)fluoranthene	8.0E-02	1.9						
Boeing SiteChar	R71	Benzo(k)fluoranthene	7.1E-02	2.0						
Boeing SiteChar	R70	Benzo(k)fluoranthene	6.9E-02 J	1.1						
Boeing SiteChar	R60	Benzo(k)fluoranthene	6.4E-02	1.2						
Boeing SiteChar	R66	Benzo(k)fluoranthene	6.4E-02	1.2						
EPA SI	DR249	Benzo(k)fluoranthene	6.0E-02	1.5						
EPA SI	DR250	Benzo(k)fluoranthene	5.0E-02	1.9						
Boeing SiteChar	R72	Benzo(k)fluoranthene	4.9E-02	1.0						

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R61	Benzo(k)fluoranthene	4.6E-02	1.4						
Boeing SiteChar	R78	Benzo(k)fluoranthene	3.5E-02	1.6						
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Benzo(k)fluoranthene	2.9E-02	2.4						
Boeing SiteChar	R63	Benzofluoranthenes (total-calc'd)	1.8E+00	1.5	1.2E+02	230	450	mg/kg OC	0.52	0.27
Boeing SiteChar	R77	Benzofluoranthenes (total-calc'd)	1.3E+00	1.4	9.3E+01	230	450	mg/kg OC	0.40	0.21
Boeing SiteChar	R62	Benzofluoranthenes (total-calc'd)	1.1E+00	1.8	6.2E+01	230	450	mg/kg OC	0.27	0.14
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzofluoranthenes (total-calc'd)	6.7E-01	3.0	2.3E+01	230	450	mg/kg OC	0.10	0.05
Boeing SiteChar	R65	Benzofluoranthenes (total-calc'd)	5.8E-01	1.6	3.6E+01	230	450	mg/kg OC	0.16	0.08
EPA SI	DR253	Benzofluoranthenes (total-calc'd)	4.3E-01	1.6	2.8E+01	230	450	mg/kg OC	0.12	0.06
EPA SI	DR281	Benzofluoranthenes (total-calc'd)	3.7E-01	3.6	1.0E+01	230	450	mg/kg OC	0.04	0.02
Boeing SiteChar	R73	Benzofluoranthenes (total-calc'd)	3.1E-01	2.4	1.3E+01	230	450	mg/kg OC	0.06	0.03
EPA SI	DR280	Benzofluoranthenes (total-calc'd)	3.1E-01	2.5	1.2E+01	230	450	mg/kg OC	0.05	0.03
EPA SI	DR289	Benzofluoranthenes (total-calc'd)	3.0E-01	3.6	8.3E+00	230	450	mg/kg OC	0.04	0.02
Boeing SiteChar	R64	Benzofluoranthenes (total-calc'd)	2.9E-01	2.2	1.3E+01	230	450	mg/kg OC	0.06	0.03
EPA SI	DR248	Benzofluoranthenes (total-calc'd)	2.9E-01	2.3	1.3E+01	230	450	mg/kg OC	0.06	0.03
LDWRI-SurfaceSedimentRound1	LDW-SS142	Benzofluoranthenes (total-calc'd)	2.9E-01	2.0	1.5E+01	230	450	mg/kg OC	0.07	0.03
Boeing SiteChar	R76	Benzofluoranthenes (total-calc'd)	2.5E-01 J	2.0	1.3E+01	230	450	mg/kg OC	0.06	0.03
Boeing SiteChar	R67	Benzofluoranthenes (total-calc'd)	2.3E-01	1.9	1.2E+01	230	450	mg/kg OC	0.05	0.03
EPA SI	DR272	Benzofluoranthenes (total-calc'd)	2.3E-01	0.1		3200	3600	ug/kg dw	0.07	0.06
Boeing SiteChar	R68	Benzofluoranthenes (total-calc'd)	2.2E-01 J	2.0	1.1E+01	230	450	mg/kg OC	0.05	0.02
Boeing SiteChar	R75	Benzofluoranthenes (total-calc'd)	2.0E-01	1.8	1.1E+01	230	450	mg/kg OC	0.05	0.02
EPA SI	DR247	Benzofluoranthenes (total-calc'd)	2.0E-01	2.0	1.0E+01	230	450	mg/kg OC	0.04	0.02
Boeing SiteChar	R79	Benzofluoranthenes (total-calc'd)	1.9E-01	1.1	1.7E+01	230	450	mg/kg OC	0.07	0.04
Boeing SiteChar	R74	Benzofluoranthenes (total-calc'd)	1.9E-01 J	1.5	1.3E+01	230	450	mg/kg OC	0.06	0.03
EPA SI	DR252	Benzofluoranthenes (total-calc'd)	1.8E-01	1.7	1.1E+01	230	450	mg/kg OC	0.05	0.02
Boeing SiteChar	R81	Benzofluoranthenes (total-calc'd)	1.7E-01 J	1.3	1.3E+01	230	450	mg/kg OC	0.06	0.03
EPA SI	DR251	Benzofluoranthenes (total-calc'd)	1.7E-01	1.9	9.0E+00	230	450	mg/kg OC	0.04	0.02
Boeing SiteChar	R69	Benzofluoranthenes (total-calc'd)	1.7E-01	1.4	1.2E+01	230	450	mg/kg OC	0.05	0.03
Boeing SiteChar	R66	Benzofluoranthenes (total-calc'd)	1.6E-01	1.2	1.4E+01	230	450	mg/kg OC	0.06	0.03
LDWRI-Benthic	B9a	Benzofluoranthenes (total-calc'd)	1.6E-01	2.1	7.4E+00	230	450	mg/kg OC	0.03	0.02
LDWRI-SurfaceSedimentRound2	LDW-SS138	Benzofluoranthenes (total-calc'd)	1.6E-01	1.8	8.8E+00	230	450	mg/kg OC	0.04	0.02
Boeing SiteChar	R70	Benzofluoranthenes (total-calc'd)	1.5E-01 J	1.1	1.3E+01	230	450	mg/kg OC	0.06	0.03
Boeing SiteChar	R60	Benzofluoranthenes (total-calc'd)	1.3E-01	1.2	1.1E+01	230	450	mg/kg OC	0.05	0.02
Boeing SiteChar	R71	Benzofluoranthenes (total-calc'd)	1.2E-01	2.0	6.1E+00	230	450	mg/kg OC	0.03	0.01
EPA SI	DR249	Benzofluoranthenes (total-calc'd)	1.1E-01	1.5	7.4E+00	230	450	mg/kg OC	0.03	0.02
EPA SI	DR250	Benzofluoranthenes (total-calc'd)	1.0E-01	1.9	5.3E+00	230	450	mg/kg OC	0.02	0.01
Boeing SiteChar	R61	Benzofluoranthenes (total-calc'd)	9.2E-02	1.4	6.6E+00	230	450	mg/kg OC	0.03	0.02
Boeing SiteChar	R72	Benzofluoranthenes (total-calc'd)	9.1E-02	1.0	9.4E+00	230	450	mg/kg OC	0.04	0.02

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R78	Benzofluoranthenes (total-calc'd)	7.6E-02 J	1.6	4.8E+00	230	450	mg/kg OC	0.02	0.01
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Benzofluoranthenes (total-calc'd)	6.4E-02	2.4	2.6E+00	230	450	mg/kg OC	0.01	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzoic acid	9.9E-02	3.0		650	650	ug/kg dw	0.15	0.15
LDWRI-Benthic	B9a	Benzoic acid	5.4E-02 J	2.1		650	650	ug/kg dw	0.08	0.08
LDWRI-SurfaceSedimentRound2	LDW-SS137	Benzyl alcohol	2.3E-02	3.0		57	73	ug/kg dw	0.40	0.32
EPA SI	DR250	Beryllium	4.4E-01	1.9						
EPA SI	DR281	Beryllium	4.2E-01	3.6						
EPA SI	DR289	Beryllium	4.2E-01	3.6						
EPA SI	DR251	Beryllium	4.0E-01	1.9						
EPA SI	DR280	Beryllium	4.0E-01	2.5						
EPA SI	DR247	Beryllium	3.9E-01	2.0						
EPA SI	DR248	Beryllium	3.8E-01	2.3						
EPA SI	DR249	Beryllium	3.8E-01	1.5						
EPA SI	DR272	Beryllium	3.5E-01	0.1						
EPA SI	DR253	Beryllium	3.3E-01	1.6						
EPA SI	DR252	Beryllium	2.7E-01	1.7						
EPA SI	DR254	Beryllium	1.7E-01	1.9						
LDWRI-Benthic	B9a	Biphenyl	1.5E-03 J	2.1						
EPA SI	DR281	Bis(2-ethylhexyl)phthalate	5.3E-01	3.6	1.5E+01	47	78	mg/kg OC	0.32	0.19
EPA SI	DR289	Bis(2-ethylhexyl)phthalate	4.5E-01	3.6	1.2E+01	47	78	mg/kg OC	0.26	0.15
Boeing SiteChar	R75	Bis(2-ethylhexyl)phthalate	4.3E-01	1.8	2.4E+01	47	78	mg/kg OC	0.51	0.31
Boeing SiteChar	R65	Bis(2-ethylhexyl)phthalate	4.2E-01	1.6	2.6E+01	47	78	mg/kg OC	0.55	0.33
EPA SI	DR280	Bis(2-ethylhexyl)phthalate	4.1E-01	2.5	1.6E+01	47	78	mg/kg OC	0.34	0.21
Boeing SiteChar	R76	Bis(2-ethylhexyl)phthalate	3.6E-01	2.0	1.8E+01	47	78	mg/kg OC	0.38	0.23
Boeing SiteChar	R62	Bis(2-ethylhexyl)phthalate	3.4E-01	1.8	1.9E+01	47	78	mg/kg OC	0.40	0.24
Boeing SiteChar	R63	Bis(2-ethylhexyl)phthalate	3.4E-01	1.5	2.3E+01	47	78	mg/kg OC	0.49	0.29
Boeing SiteChar	R73	Bis(2-ethylhexyl)phthalate	3.3E-01	2.4	1.4E+01	47	78	mg/kg OC	0.30	0.18
Boeing SiteChar	R64	Bis(2-ethylhexyl)phthalate	3.0E-01	2.2	1.4E+01	47	78	mg/kg OC	0.30	0.18
Boeing SiteChar	R74	Bis(2-ethylhexyl)phthalate	3.0E-01	1.5	2.0E+01	47	78	mg/kg OC	0.43	0.26
Boeing SiteChar	R68	Bis(2-ethylhexyl)phthalate	2.8E-01	2.0	1.4E+01	47	78	mg/kg OC	0.30	0.18
EPA SI	DR253	Bis(2-ethylhexyl)phthalate	2.8E-01	1.6	1.8E+01	47	78	mg/kg OC	0.38	0.23
EPA SI	DR252	Bis(2-ethylhexyl)phthalate	2.6E-01	1.7	1.6E+01	47	78	mg/kg OC	0.34	0.21
Boeing SiteChar	R77	Bis(2-ethylhexyl)phthalate	2.5E-01	1.4	1.8E+01	47	78	mg/kg OC	0.38	0.23
Boeing SiteChar	R67	Bis(2-ethylhexyl)phthalate	2.4E-01	1.9	1.3E+01	47	78	mg/kg OC	0.28	0.17
LDWRI-SurfaceSedimentRound1	LDW-SS142	Bis(2-ethylhexyl)phthalate	2.4E-01	2.0	1.2E+01	47	78	mg/kg OC	0.26	0.15
LDWRI-Benthic	B9a	Bis(2-ethylhexyl)phthalate	2.1E-01 J	2.1	9.8E+00	47	78	mg/kg OC	0.21	0.13
Boeing SiteChar	R69	Bis(2-ethylhexyl)phthalate	2.0E-01	1.4	1.4E+01	47	78	mg/kg OC	0.30	0.18
Boeing SiteChar	R60	Bis(2-ethylhexyl)phthalate	1.9E-01	1.2	1.6E+01	47	78	mg/kg OC	0.34	0.21

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R81	Bis(2-ethylhexyl)phthalate	1.8E-01	1.3	1.4E+01	47	78	mg/kg OC	0.30	0.18
Boeing SiteChar	R61	Bis(2-ethylhexyl)phthalate	1.6E-01 J	1.4	1.1E+01	47	78	mg/kg OC	0.23	0.14
Boeing SiteChar	R71	Bis(2-ethylhexyl)phthalate	1.6E-01 J	2.0	8.0E+00	47	78	mg/kg OC	0.17	0.10
Boeing SiteChar	R70	Bis(2-ethylhexyl)phthalate	1.4E-01 J	1.1	1.3E+01	47	78	mg/kg OC	0.28	0.17
Boeing SiteChar	R79	Bis(2-ethylhexyl)phthalate	1.4E-01 J	1.1	1.3E+01	47	78	mg/kg OC	0.28	0.17
Boeing SiteChar	R66	Bis(2-ethylhexyl)phthalate	1.2E-01 J	1.2	1.0E+01	47	78	mg/kg OC	0.21	0.13
Boeing SiteChar	R72	Bis(2-ethylhexyl)phthalate	9.9E-02 J	1.0	1.0E+01	47	78	mg/kg OC	0.21	0.13
Boeing SiteChar	R78	Bis(2-ethylhexyl)phthalate	8.6E-02 J	1.6	5.4E+00	47	78	mg/kg OC	0.11	0.07
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Bis(2-ethylhexyl)phthalate	8.4E-02	2.4	3.4E+00	47	78	mg/kg OC	0.07	0.04
EPA SI	DR272	Bis(2-ethylhexyl)phthalate	8.0E-02	0.1		1300	1900	ug/kg dw	0.06	0.04
Boeing SiteChar	R75	Butyl benzyl phthalate	5.5E-02 J	1.8	3.1E+00	4.9	64	mg/kg OC	0.63	0.05
EPA SI	DR280	Butyl benzyl phthalate	5.0E-02	2.5	2.0E+00	4.9	64	mg/kg OC	0.41	0.03
EPA SI	DR281	Butyl benzyl phthalate	5.0E-02	3.6	1.4E+00	4.9	64	mg/kg OC	0.29	0.02
LDWRI-SurfaceSedimentRound2	LDW-SS137	Butyl benzyl phthalate	4.4E-02	3.0	1.5E+00	4.9	64	mg/kg OC	0.31	0.02
EPA SI	DR289	Butyl benzyl phthalate	4.0E-02	3.6	1.1E+00	4.9	64	mg/kg OC	0.22	0.02
Boeing SiteChar	R73	Butyl benzyl phthalate	3.0E-02 J	2.4	1.3E+00	4.9	64	mg/kg OC	0.27	0.02
EPA SI	DR247	Butyl benzyl phthalate	3.0E-02	2.0	1.5E+00	4.9	64	mg/kg OC	0.31	0.02
EPA SI	DR248	Butyl benzyl phthalate	3.0E-02	2.3	1.3E+00	4.9	64	mg/kg OC	0.27	0.02
Boeing SiteChar	R65	Butyl benzyl phthalate	2.9E-02 J	1.6	1.8E+00	4.9	64	mg/kg OC	0.37	0.03
Boeing SiteChar	R76	Butyl benzyl phthalate	2.5E-02 J	2.0	1.3E+00	4.9	64	mg/kg OC	0.27	0.02
Boeing SiteChar	R81	Butyl benzyl phthalate	2.2E-02 J	1.3	1.7E+00	4.9	64	mg/kg OC	0.35	0.03
Boeing SiteChar	R74	Butyl benzyl phthalate	2.1E-02 J	1.5	1.4E+00	4.9	64	mg/kg OC	0.29	0.02
Boeing SiteChar	R68	Butyl benzyl phthalate	2.0E-02 J	2.0	1.0E+00	4.9	64	mg/kg OC	0.20	0.02
Boeing SiteChar	R77	Butyl benzyl phthalate	2.0E-02 J	1.4	1.4E+00	4.9	64	mg/kg OC	0.29	0.02
EPA SI	DR253	Butyl benzyl phthalate	2.0E-02	1.6	1.3E+00	4.9	64	mg/kg OC	0.27	0.02
LDWRI-Benthic	B9a	Butyl benzyl phthalate	1.7E-02 J	2.1	7.9E-01	4.9	64	mg/kg OC	0.16	0.01
EPA SI	DR289	Cadmium	4.0E-01	3.6		5.1	6.7	mg/kg dw	0.08	0.06
EPA SI	DR281	Cadmium	3.6E-01	3.6		5.1	6.7	mg/kg dw	0.07	0.05
EPA SI	DR251	Cadmium	2.8E-01	1.9		5.1	6.7	mg/kg dw	0.06	0.04
EPA SI	DR249	Cadmium	2.3E-01	1.5		5.1	6.7	mg/kg dw	0.05	0.03
EPA SI	DR250	Cadmium	2.3E-01	1.9		5.1	6.7	mg/kg dw	0.05	0.03
EPA SI	DR248	Cadmium	2.1E-01	2.3		5.1	6.7	mg/kg dw	0.04	0.03
LDWRI-Benthic	B9a	Cadmium	2.1E-01	2.1		5.1	6.7	mg/kg dw	0.04	0.03
EPA SI	DR272	Cadmium	2.0E-01	0.1		5.1	6.7	mg/kg dw	0.04	0.03
EPA SI	DR247	Cadmium	1.9E-01	2.0		5.1	6.7	mg/kg dw	0.04	0.03
EPA SI	DR280	Cadmium	1.8E-01	2.5		5.1	6.7	mg/kg dw	0.04	0.03
EPA SI	DR252	Cadmium	1.7E-01	1.7		5.1	6.7	mg/kg dw	0.03	0.03
EPA SI	DR253	Cadmium	1.7E-01	1.6		5.1	6.7	mg/kg dw	0.03	0.03

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR254	Cadmium	1.6E-01	1.9		5.1	6.7	mg/kg dw	0.03	0.02
Boeing SiteChar	R63	Carbazole	3.5E-01	1.5						
Boeing SiteChar	R62	Carbazole	1.6E-01	1.8						
Boeing SiteChar	R65	Carbazole	8.8E-02	1.6						
Boeing SiteChar	R77	Carbazole	6.4E-02 J	1.4						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Carbazole	5.3E-02	3.0						
Boeing SiteChar	R73	Carbazole	5.2E-02	2.4						
EPA SI	DR253	Carbazole	4.0E-02	1.6						
Boeing SiteChar	R64	Carbazole	3.6E-02	2.2						
Boeing SiteChar	R75	Carbazole	3.5E-02	1.8						
Boeing SiteChar	R79	Carbazole	3.3E-02	1.1						
EPA SI	DR281	Carbazole	3.0E-02	3.6						
Boeing SiteChar	R67	Carbazole	2.6E-02	1.9						
Boeing SiteChar	R69	Carbazole	2.2E-02	1.4						
Boeing SiteChar	R81	Carbazole	2.1E-02	1.3						
Boeing SiteChar	R76	Carbazole	2.0E-02 J	2.0						
EPA SI	DR248	Carbazole	2.0E-02	2.3						
EPA SI	DR272	Carbazole	2.0E-02	0.1						
EPA SI	DR280	Carbazole	2.0E-02	2.5						
EPA SI	DR289	Carbazole	2.0E-02	3.6						
LDWRI-Benthic	B9a	Carbazole	1.9E-02 J	2.1						
Boeing SiteChar	R68	Chromium	2.9E+01	2.0		260	270	mg/kg dw	0.11	0.11
Boeing SiteChar	R75	Chromium	2.8E+01	1.8		260	270	mg/kg dw	0.11	0.10
LDWRI-SurfaceSedimentRound2	LDW-SS137	Chromium	2.8E+01	3.0		260	270	mg/kg dw	0.11	0.10
Boeing SiteChar	R62	Chromium	2.7E+01	1.8		260	270	mg/kg dw	0.10	0.10
Boeing SiteChar	R63	Chromium	2.7E+01	1.5		260	270	mg/kg dw	0.10	0.10
Boeing SiteChar	R64	Chromium	2.7E+01	2.2		260	270	mg/kg dw	0.10	0.10
EPA SI	DR250	Chromium	2.7E+01	1.9		260	270	mg/kg dw	0.10	0.10
EPA SI	DR289	Chromium	2.7E+01	3.6		260	270	mg/kg dw	0.10	0.10
Boeing SiteChar	R65	Chromium	2.6E+01	1.6		260	270	mg/kg dw	0.10	0.10
EPA SI	DR251	Chromium	2.6E+01	1.9		260	270	mg/kg dw	0.10	0.10
EPA SI	DR272	Chromium	2.6E+01	0.1		260	270	mg/kg dw	0.10	0.10
EPA SI	DR281	Chromium	2.6E+01	3.6		260	270	mg/kg dw	0.10	0.10
Boeing SiteChar	R61	Chromium	2.5E+01	1.4		260	270	mg/kg dw	0.10	0.09
Boeing SiteChar	R71	Chromium	2.5E+01	2.0		260	270	mg/kg dw	0.10	0.09
Boeing SiteChar	R73	Chromium	2.5E+01	2.4		260	270	mg/kg dw	0.10	0.09
LDWRI-SurfaceSedimentRound2	LDW-SS138	Chromium	2.5E+01	1.8		260	270	mg/kg dw	0.10	0.09
Boeing SiteChar	R60	Chromium	2.4E+01	1.2		260	270	mg/kg dw	0.09	0.09

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R66	Chromium	2.4E+01	1.2		260	270	mg/kg dw	0.09	0.09
Boeing SiteChar	R67	Chromium	2.4E+01	1.9		260	270	mg/kg dw	0.09	0.09
Boeing SiteChar	R74	Chromium	2.4E+01	1.5		260	270	mg/kg dw	0.09	0.09
LDWRI-SurfaceSedimentRound1	LDW-SS142	Chromium	2.4E+01	2.0		260	270	mg/kg dw	0.09	0.09
Boeing SiteChar	R70	Chromium	2.3E+01	1.1		260	270	mg/kg dw	0.09	0.09
EPA SI	DR247	Chromium	2.3E+01	2.0		260	270	mg/kg dw	0.09	0.09
EPA SI	DR248	Chromium	2.3E+01	2.3		260	270	mg/kg dw	0.09	0.09
EPA SI	DR253	Chromium	2.3E+01	1.6		260	270	mg/kg dw	0.09	0.09
EPA SI	DR280	Chromium	2.3E+01	2.5		260	270	mg/kg dw	0.09	0.09
Boeing SiteChar	R77	Chromium	2.2E+01	1.4		260	270	mg/kg dw	0.09	0.08
EPA SI	DR249	Chromium	2.2E+01	1.5		260	270	mg/kg dw	0.09	0.08
Boeing SiteChar	R72	Chromium	2.1E+01	1.0		260	270	mg/kg dw	0.08	0.08
Boeing SiteChar	R79	Chromium	2.1E+01	1.1		260	270	mg/kg dw	0.08	0.08
LDWRI-Benthic	B9a	Chromium	2.1E+01	2.1		260	270	mg/kg dw	0.08	0.08
Boeing SiteChar	R69	Chromium	2.0E+01	1.4		260	270	mg/kg dw	0.08	0.07
Boeing SiteChar	R80	Chromium	2.0E+01	1.2		260	270	mg/kg dw	0.08	0.07
Boeing SiteChar	R76	Chromium	1.7E+01	2.0		260	270	mg/kg dw	0.07	0.06
EPA SI	DR252	Chromium	1.7E+01	1.7		260	270	mg/kg dw	0.07	0.06
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Chromium	1.4E+01	2.4		260	270	mg/kg dw	0.06	0.05
Boeing SiteChar	R78	Chromium	1.3E+01	1.6		260	270	mg/kg dw	0.05	0.05
EPA SI	DR254	Chromium	1.2E+01	1.9		260	270	mg/kg dw	0.05	0.04
Boeing SiteChar	R81	Chromium	5.0E+00	1.3		260	270	mg/kg dw	0.02	0.02
Boeing SiteChar	R63	Chrysene	1.0E+00	1.5	6.7E+01	110	460	mg/kg OC	0.61	0.15
Boeing SiteChar	R77	Chrysene	7.4E-01	1.4	5.3E+01	110	460	mg/kg OC	0.48	0.12
Boeing SiteChar	R62	Chrysene	6.3E-01	1.8	3.5E+01	110	460	mg/kg OC	0.32	0.08
LDWRI-SurfaceSedimentRound2	LDW-SS137	Chrysene	3.6E-01	3.0	1.2E+01	110	460	mg/kg OC	0.11	0.03
Boeing SiteChar	R65	Chrysene	3.4E-01	1.6	2.1E+01	110	460	mg/kg OC	0.19	0.05
EPA SI	DR253	Chrysene	3.1E-01	1.6	2.0E+01	110	460	mg/kg OC	0.18	0.04
EPA SI	DR281	Chrysene	2.3E-01	3.6	6.3E+00	110	460	mg/kg OC	0.06	0.01
Boeing SiteChar	R73	Chrysene	1.8E-01	2.4	7.5E+00	110	460	mg/kg OC	0.07	0.02
Boeing SiteChar	R64	Chrysene	1.7E-01	2.2	7.7E+00	110	460	mg/kg OC	0.07	0.02
Boeing SiteChar	R75	Chrysene	1.7E-01 J	1.8	9.4E+00	110	460	mg/kg OC	0.09	0.02
EPA SI	DR280	Chrysene	1.7E-01	2.5	6.7E+00	110	460	mg/kg OC	0.06	0.02
EPA SI	DR289	Chrysene	1.7E-01	3.6	4.7E+00	110	460	mg/kg OC	0.04	0.01
EPA SI	DR248	Chrysene	1.6E-01	2.3	7.0E+00	110	460	mg/kg OC	0.06	0.02
Boeing SiteChar	R67	Chrysene	1.4E-01	1.9	7.4E+00	110	460	mg/kg OC	0.07	0.02
Boeing SiteChar	R79	Chrysene	1.4E-01	1.1	1.3E+01	110	460	mg/kg OC	0.12	0.03
Boeing SiteChar	R68	Chrysene	1.3E-01	2.0	6.5E+00	110	460	mg/kg OC	0.06	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R76	Chrysene	1.3E-01	2.0	6.5E+00	110	460	mg/kg OC	0.06	0.01
EPA SI	DR272	Chrysene	1.3E-01	0.1		1400	2800	ug/kg dw	0.09	0.05
LDWRI-SurfaceSedimentRound1	LDW-SS142	Chrysene	1.3E-01	2.0	6.7E+00	110	460	mg/kg OC	0.06	0.02
EPA SI	DR247	Chrysene	1.1E-01	2.0	5.5E+00	110	460	mg/kg OC	0.05	0.01
EPA SI	DR252	Chrysene	1.1E-01	1.7	6.6E+00	110	460	mg/kg OC	0.06	0.01
Boeing SiteChar	R66	Chrysene	1.0E-01	1.2	8.3E+00	110	460	mg/kg OC	0.08	0.02
Boeing SiteChar	R69	Chrysene	1.0E-01	1.4	7.1E+00	110	460	mg/kg OC	0.07	0.02
EPA SI	DR251	Chrysene	1.0E-01	1.9	5.3E+00	110	460	mg/kg OC	0.05	0.01
LDWRI-Benthic	B9a	Chrysene	1.0E-01	2.1	4.7E+00	110	460	mg/kg OC	0.04	0.01
Boeing SiteChar	R81	Chrysene	9.9E-02	1.3	7.6E+00	110	460	mg/kg OC	0.07	0.02
Boeing SiteChar	R74	Chrysene	9.0E-02	1.5	6.0E+00	110	460	mg/kg OC	0.06	0.01
Boeing SiteChar	R72	Chrysene	8.9E-02	1.0	9.2E+00	110	460	mg/kg OC	0.08	0.02
Boeing SiteChar	R70	Chrysene	8.3E-02	1.1	7.5E+00	110	460	mg/kg OC	0.07	0.02
Boeing SiteChar	R60	Chrysene	7.9E-02	1.2	6.6E+00	110	460	mg/kg OC	0.06	0.01
Boeing SiteChar	R71	Chrysene	7.9E-02	2.0	4.0E+00	110	460	mg/kg OC	0.04	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS138	Chrysene	7.9E-02	1.8	4.4E+00	110	460	mg/kg OC	0.04	0.01
EPA SI	DR249	Chrysene	7.0E-02	1.5	4.7E+00	110	460	mg/kg OC	0.04	0.01
EPA SI	DR250	Chrysene	6.0E-02	1.9	3.2E+00	110	460	mg/kg OC	0.03	0.01
Boeing SiteChar	R61	Chrysene	5.6E-02	1.4	4.0E+00	110	460	mg/kg OC	0.04	0.01
Boeing SiteChar	R78	Chrysene	4.7E-02	1.6	2.9E+00	110	460	mg/kg OC	0.03	0.01
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Chrysene	3.6E-02	2.4	1.5E+00	110	460	mg/kg OC	0.01	0.003
EPA SI	DR250	Cobalt	1.1E+01	1.9						
EPA SI	DR247	Cobalt	1.0E+01	2.0						
EPA SI	DR248	Cobalt	1.0E+01	2.3						
EPA SI	DR249	Cobalt	1.0E+01	1.5						
EPA SI	DR251	Cobalt	1.0E+01	1.9						
EPA SI	DR280	Cobalt	1.0E+01	2.5						
EPA SI	DR281	Cobalt	1.0E+01	3.6						
EPA SI	DR289	Cobalt	1.0E+01	3.6						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Cobalt	9.7E+00	3.0						
LDWRI-Benthic	B9a	Cobalt	9.5E+00	2.1						
LDWRI-SurfaceSedimentRound2	LDW-SS138	Cobalt	9.3E+00	1.8						
EPA SI	DR253	Cobalt	9.0E+00	1.6						
EPA SI	DR272	Cobalt	9.0E+00	0.1						
EPA SI	DR252	Cobalt	8.0E+00	1.7						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Cobalt	7.9E+00	2.0						
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Cobalt	6.2E+00	2.4						
EPA SI	DR254	Cobalt	4.0E+00	1.9						

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
LDWRI-SurfaceSedimentRound2	LDW-SS137	Copper	4.9E+01	3.0		390	390	mg/kg dw	0.13	0.13
Boeing SiteChar	R75	Copper	4.4E+01	1.8		390	390	mg/kg dw	0.11	0.11
EPA SI	DR281	Copper	4.4E+01	3.6		390	390	mg/kg dw	0.11	0.11
EPA SI	DR289	Copper	4.4E+01	3.6		390	390	mg/kg dw	0.11	0.11
Boeing SiteChar	R64	Copper	4.3E+01	2.2		390	390	mg/kg dw	0.11	0.11
Boeing SiteChar	R62	Copper	4.1E+01	1.8		390	390	mg/kg dw	0.11	0.11
Boeing SiteChar	R65	Copper	4.1E+01	1.6		390	390	mg/kg dw	0.11	0.11
Boeing SiteChar	R68	Copper	4.1E+01	2.0		390	390	mg/kg dw	0.11	0.11
Boeing SiteChar	R63	Copper	3.9E+01	1.5		390	390	mg/kg dw	0.10	0.10
Boeing SiteChar	R73	Copper	3.7E+01	2.4		390	390	mg/kg dw	0.10	0.10
Boeing SiteChar	R74	Copper	3.7E+01	1.5		390	390	mg/kg dw	0.10	0.10
EPA SI	DR280	Copper	3.7E+01	2.5		390	390	mg/kg dw	0.10	0.10
Boeing SiteChar	R71	Copper	3.6E+01	2.0		390	390	mg/kg dw	0.09	0.09
EPA SI	DR247	Copper	3.6E+01	2.0		390	390	mg/kg dw	0.09	0.09
EPA SI	DR248	Copper	3.6E+01	2.3		390	390	mg/kg dw	0.09	0.09
Boeing SiteChar	R61	Copper	3.5E+01	1.4		390	390	mg/kg dw	0.09	0.09
Boeing SiteChar	R67	Copper	3.5E+01	1.9		390	390	mg/kg dw	0.09	0.09
EPA SI	DR250	Copper	3.4E+01	1.9		390	390	mg/kg dw	0.09	0.09
LDWRI-SurfaceSedimentRound2	LDW-SS138	Copper	3.4E+01	1.8		390	390	mg/kg dw	0.09	0.09
LDWRI-SurfaceSedimentRound1	LDW-SS142	Copper	3.4E+01	2.0		390	390	mg/kg dw	0.09	0.09
EPA SI	DR251	Copper	3.3E+01	1.9		390	390	mg/kg dw	0.09	0.09
Boeing SiteChar	R60	Copper	3.2E+01	1.2		390	390	mg/kg dw	0.08	0.08
Boeing SiteChar	R66	Copper	3.1E+01	1.2		390	390	mg/kg dw	0.08	0.08
Boeing SiteChar	R77	Copper	3.0E+01	1.4		390	390	mg/kg dw	0.08	0.08
EPA SI	DR249	Copper	3.0E+01	1.5		390	390	mg/kg dw	0.08	0.08
EPA SI	DR253	Copper	3.0E+01	1.6		390	390	mg/kg dw	0.08	0.08
Boeing SiteChar	R69	Copper	2.9E+01	1.4		390	390	mg/kg dw	0.07	0.07
Boeing SiteChar	R70	Copper	2.9E+01	1.1		390	390	mg/kg dw	0.07	0.07
EPA SI	DR254	Copper	2.9E+01	1.9		390	390	mg/kg dw	0.07	0.07
EPA SI	DR272	Copper	2.9E+01	0.1		390	390	mg/kg dw	0.07	0.07
Boeing SiteChar	R72	Copper	2.7E+01	1.0		390	390	mg/kg dw	0.07	0.07
Boeing SiteChar	R76	Copper	2.7E+01	2.0		390	390	mg/kg dw	0.07	0.07
EPA SI	DR252	Copper	2.7E+01	1.7		390	390	mg/kg dw	0.07	0.07
Boeing SiteChar	R80	Copper	2.5E+01	1.2		390	390	mg/kg dw	0.06	0.06
LDWRI-Benthic	B9a	Copper	2.5E+01	2.1		390	390	mg/kg dw	0.06	0.06
Boeing SiteChar	R79	Copper	2.3E+01	1.1		390	390	mg/kg dw	0.06	0.06
Boeing SiteChar	R78	Copper	1.9E+01	1.6		390	390	mg/kg dw	0.05	0.05
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Copper	1.9E+01	2.4		390	390	mg/kg dw	0.05	0.05

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R81	Copper	5.0E+00	1.3		390	390	mg/kg dw	0.01	0.01
LDWRI-Benthic	B9a	DDTs (total-calc'd)	1.0E-02 JN	2.1						
Boeing SiteChar	R63	Dibenzo(a,h)anthracene	2.8E-01	1.5	1.9E+01	12	33	mg/kg OC	1.6	0.58
Boeing SiteChar	R62	Dibenzo(a,h)anthracene	1.7E-01	1.8	9.4E+00	12	33	mg/kg OC	0.78	0.28
Boeing SiteChar	R77	Dibenzo(a,h)anthracene	1.3E-01 J	1.4	9.3E+00	12	33	mg/kg OC	0.78	0.28
Boeing SiteChar	R65	Dibenzo(a,h)anthracene	7.7E-02	1.6	4.8E+00	12	33	mg/kg OC	0.40	0.15
Boeing SiteChar	R64	Dibenzo(a,h)anthracene	4.4E-02	2.2	2.0E+00	12	33	mg/kg OC	0.17	0.06
Boeing SiteChar	R73	Dibenzo(a,h)anthracene	3.8E-02	2.4	1.6E+00	12	33	mg/kg OC	0.13	0.05
EPA SI	DR253	Dibenzo(a,h)anthracene	3.0E-02	1.6	1.9E+00	12	33	mg/kg OC	0.16	0.06
Boeing SiteChar	R67	Dibenzo(a,h)anthracene	2.9E-02	1.9	1.5E+00	12	33	mg/kg OC	0.13	0.05
Boeing SiteChar	R75	Dibenzo(a,h)anthracene	2.8E-02 J	1.8	1.6E+00	12	33	mg/kg OC	0.13	0.05
LDWRI-SurfaceSedimentRound2	LDW-SS137	Dibenzo(a,h)anthracene	2.7E-02	3.0	9.1E-01	12	33	mg/kg OC	0.08	0.03
Boeing SiteChar	R76	Dibenzo(a,h)anthracene	2.4E-02	2.0	1.2E+00	12	33	mg/kg OC	0.10	0.04
Boeing SiteChar	R81	Dibenzo(a,h)anthracene	2.0E-02 J	1.3	1.5E+00	12	33	mg/kg OC	0.13	0.05
EPA SI	DR248	Dibenzo(a,h)anthracene	2.0E-02	2.3	8.8E-01	12	33	mg/kg OC	0.07	0.03
EPA SI	DR280	Dibenzo(a,h)anthracene	2.0E-02	2.5	7.9E-01	12	33	mg/kg OC	0.07	0.02
EPA SI	DR281	Dibenzo(a,h)anthracene	2.0E-02	3.6	5.5E-01	12	33	mg/kg OC	0.05	0.02
EPA SI	DR289	Dibenzo(a,h)anthracene	2.0E-02	3.6	5.5E-01	12	33	mg/kg OC	0.05	0.02
LDWRI-Benthic	B9a	Dibenzo(a,h)anthracene	1.3E-02	2.1	6.1E-01	12	33	mg/kg OC	0.05	0.02
Boeing SiteChar	R63	Dibenzofuran	4.7E-02	1.5	3.1E+00	15	58	mg/kg OC	0.21	0.05
Boeing SiteChar	R77	Dibenzofuran	3.4E-02	1.4	2.4E+00	15	58	mg/kg OC	0.16	0.04
Boeing SiteChar	R62	Dibenzofuran	2.8E-02	1.8	1.6E+00	15	58	mg/kg OC	0.11	0.03
Boeing SiteChar	R75	Dibenzofuran	2.3E-02	1.8	1.3E+00	15	58	mg/kg OC	0.09	0.02
Boeing SiteChar	R65	Dibenzofuran	2.0E-02	1.6	1.3E+00	15	58	mg/kg OC	0.09	0.02
LDWRI-Benthic	B9a	Dibenzofuran	4.4E-03 J	2.1	2.1E-01	15	58	mg/kg OC	0.01	0.004
LDWRI-Benthic	B9a	Dibenzothiophene	4.6E-03 J	2.1						
EPA SI	DR289	Dibutyltin as ion	8.0E-03 J	3.6						
EPA SI	DR253	Dibutyltin as ion	3.0E-03 J	1.6						
EPA SI	DR249	Dibutyltin as ion	2.0E-03 J	1.5						
LDWRI-Benthic	B9a	Dibutyltin as ion	2.0E-03	2.1						
EPA SI	DR281	Dimethyl phthalate	2.0E-02	3.6	5.5E-01	53	53	mg/kg OC	0.01	0.01
Boeing SiteChar	R77	Di-n-butyl phthalate	1.0E-01	1.4	7.1E+00	220	1700	mg/kg OC	0.03	0.004
Boeing SiteChar	R75	Di-n-butyl phthalate	8.1E-02	1.8	4.5E+00	220	1700	mg/kg OC	0.02	0.003
Boeing SiteChar	R73	Di-n-butyl phthalate	2.8E-02	2.4	1.2E+00	220	1700	mg/kg OC	0.01	0.001
LDWRI-SurfaceSedimentRound2	LDW-SS137	Di-n-butyl phthalate	2.4E-02	3.0	8.1E-01	220	1700	mg/kg OC	0.004	0.0005
LDWRI-Benthic	B9a	Di-n-butyl phthalate	1.3E-02 J	2.1	6.1E-01	220	1700	mg/kg OC	0.003	0.0004
Boeing SiteChar	R75	Di-n-octyl phthalate	3.4E-02	1.8	1.9E+00	58	4500	mg/kg OC	0.03	0.0004
Boeing SiteChar	R65	Di-n-octyl phthalate	3.1E-02	1.6	1.9E+00	58	4500	mg/kg OC	0.03	0.0004

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R73	Di-n-octyl phthalate	2.4E-02	2.4	1.0E+00	58	4500	mg/kg OC	0.02	0.0002
EPA SI	DR248	Di-n-octyl phthalate	2.0E-02	2.3	8.8E-01	58	4500	mg/kg OC	0.02	0.0002
EPA SI	DR280	Di-n-octyl phthalate	2.0E-02	2.5	7.9E-01	58	4500	mg/kg OC	0.01	0.0002
EPA SI	DR281	Di-n-octyl phthalate	2.0E-02	3.6	5.5E-01	58	4500	mg/kg OC	0.01	0.0001
EPA SI	DR289	Di-n-octyl phthalate	2.0E-02	3.6	5.5E-01	58	4500	mg/kg OC	0.01	0.0001
LDWRI-Benthic	B9a	Endrin ketone	1.2E-03 JN	2.1						
Boeing SiteChar	R63	Fluoranthene	2.6E+00	1.5	1.7E+02	160	1200	mg/kg OC	1.1	0.14
Boeing SiteChar	R77	Fluoranthene	1.2E+00	1.4	8.6E+01	160	1200	mg/kg OC	0.54	0.07
Boeing SiteChar	R62	Fluoranthene	1.0E+00	1.8	5.6E+01	160	1200	mg/kg OC	0.35	0.05
LDWRI-SurfaceSedimentRound2	LDW-SS137	Fluoranthene	8.3E-01	3.0	2.8E+01	160	1200	mg/kg OC	0.18	0.02
Boeing SiteChar	R65	Fluoranthene	6.9E-01	1.6	4.3E+01	160	1200	mg/kg OC	0.27	0.04
EPA SI	DR253	Fluoranthene	6.2E-01	1.6	4.0E+01	160	1200	mg/kg OC	0.25	0.03
EPA SI	DR281	Fluoranthene	4.4E-01	3.6	1.2E+01	160	1200	mg/kg OC	0.08	0.01
Boeing SiteChar	R75	Fluoranthene	4.0E-01	1.8	2.2E+01	160	1200	mg/kg OC	0.14	0.02
EPA SI	DR289	Fluoranthene	3.3E-01	3.6	9.1E+00	160	1200	mg/kg OC	0.06	0.01
Boeing SiteChar	R79	Fluoranthene	3.2E-01	1.1	2.9E+01	160	1200	mg/kg OC	0.18	0.02
Boeing SiteChar	R73	Fluoranthene	3.1E-01	2.4	1.3E+01	160	1200	mg/kg OC	0.08	0.01
EPA SI	DR280	Fluoranthene	3.1E-01	2.5	1.2E+01	160	1200	mg/kg OC	0.08	0.01
Boeing SiteChar	R64	Fluoranthene	3.0E-01	2.2	1.4E+01	160	1200	mg/kg OC	0.09	0.01
EPA SI	DR248	Fluoranthene	2.8E-01	2.3	1.2E+01	160	1200	mg/kg OC	0.08	0.01
EPA SI	DR272	Fluoranthene	2.8E-01	0.1	0.0E+00	1700	2500	ug/kg dw	0.16	0.11
LDWRI-SurfaceSedimentRound1	LDW-SS142	Fluoranthene	2.7E-01	2.0	1.4E+01	160	1200	mg/kg OC	0.09	0.01
Boeing SiteChar	R67	Fluoranthene	2.4E-01	1.9	1.3E+01	160	1200	mg/kg OC	0.08	0.01
Boeing SiteChar	R68	Fluoranthene	2.3E-01	2.0	1.2E+01	160	1200	mg/kg OC	0.08	0.01
Boeing SiteChar	R76	Fluoranthene	2.3E-01	2.0	1.2E+01	160	1200	mg/kg OC	0.08	0.01
Boeing SiteChar	R81	Fluoranthene	2.3E-01	1.3	1.8E+01	160	1200	mg/kg OC	0.11	0.02
EPA SI	DR247	Fluoranthene	2.1E-01	2.0	1.1E+01	160	1200	mg/kg OC	0.07	0.01
EPA SI	DR252	Fluoranthene	2.0E-01	1.7	1.2E+01	160	1200	mg/kg OC	0.08	0.01
LDWRI-Benthic	B9a	Fluoranthene	2.0E-01	2.1	9.3E+00	160	1200	mg/kg OC	0.06	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS138	Fluoranthene	1.9E-01	1.8	1.1E+01	160	1200	mg/kg OC	0.07	0.01
Boeing SiteChar	R66	Fluoranthene	1.8E-01	1.2	1.5E+01	160	1200	mg/kg OC	0.09	0.01
EPA SI	DR251	Fluoranthene	1.7E-01	1.9	9.0E+00	160	1200	mg/kg OC	0.06	0.01
Boeing SiteChar	R69	Fluoranthene	1.6E-01	1.4	1.1E+01	160	1200	mg/kg OC	0.07	0.01
Boeing SiteChar	R70	Fluoranthene	1.5E-01	1.1	1.4E+01	160	1200	mg/kg OC	0.09	0.01
Boeing SiteChar	R74	Fluoranthene	1.5E-01	1.5	1.0E+01	160	1200	mg/kg OC	0.06	0.01
Boeing SiteChar	R60	Fluoranthene	1.2E-01	1.2	1.0E+01	160	1200	mg/kg OC	0.06	0.01
Boeing SiteChar	R71	Fluoranthene	1.2E-01	2.0	6.0E+00	160	1200	mg/kg OC	0.04	0.01
EPA SI	DR249	Fluoranthene	1.2E-01	1.5	8.1E+00	160	1200	mg/kg OC	0.05	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR250	Fluoranthene	1.0E-01	1.9	5.3E+00	160	1200	mg/kg OC	0.03	0.004
Boeing SiteChar	R72	Fluoranthene	9.4E-02	1.0	9.7E+00	160	1200	mg/kg OC	0.06	0.01
Boeing SiteChar	R61	Fluoranthene	9.1E-02	1.4	6.5E+00	160	1200	mg/kg OC	0.04	0.01
Boeing SiteChar	R78	Fluoranthene	8.9E-02	1.6	5.6E+00	160	1200	mg/kg OC	0.04	0.00
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Fluoranthene	5.4E-02	2.4	2.2E+00	160	1200	mg/kg OC	0.01	0.002
Boeing SiteChar	R80	Fluoranthene	2.8E-02	1.2	2.3E+00	160	1200	mg/kg OC	0.01	0.002
Boeing SiteChar	R63	Fluorene	8.5E-02	1.5	5.7E+00	23	79	mg/kg OC	0.25	0.07
Boeing SiteChar	R77	Fluorene	7.8E-02	1.4	5.6E+00	23	79	mg/kg OC	0.24	0.07
Boeing SiteChar	R75	Fluorene	4.6E-02	1.8	2.6E+00	23	79	mg/kg OC	0.11	0.03
Boeing SiteChar	R62	Fluorene	4.1E-02	1.8	2.3E+00	23	79	mg/kg OC	0.10	0.03
Boeing SiteChar	R65	Fluorene	2.3E-02	1.6	1.4E+00	23	79	mg/kg OC	0.06	0.02
EPA SI	DR253	Fluorene	2.0E-02	1.6	1.3E+00	23	79	mg/kg OC	0.06	0.02
LDWRI-Benthic	B9a	Fluorene	8.4E-03	2.1	3.9E-01	23	79	mg/kg OC	0.02	0.005
LDWRI-Benthic	B9a	gamma-BHC	1.2E-03 JN	2.1						
Boeing SiteChar	R68	Hexachlorobenzene	2.7E-03	2.0	1.4E-01	0.38	2.3	mg/kg OC	0.37	0.06
Boeing SiteChar	R76	Hexachlorobenzene	1.6E-03	2.0	8.0E-02	0.38	2.3	mg/kg OC	0.21	0.04
Boeing SiteChar	R77	Hexachlorobenzene	1.4E-03	1.4	1.0E-01	0.38	2.3	mg/kg OC	0.26	0.04
LDWRI-Benthic	B9a	Hexachlorobenzene	1.4E-03 JN	2.1	6.5E-02	0.38	2.3	mg/kg OC	0.17	0.03
Boeing SiteChar	R64	Hexachlorobenzene	1.2E-03	2.2	5.5E-02	0.38	2.3	mg/kg OC	0.14	0.02
Boeing SiteChar	R63	Indeno(1,2,3-cd)pyrene	7.5E-01	1.5	5.0E+01	34	88	mg/kg OC	1.5	0.57
Boeing SiteChar	R77	Indeno(1,2,3-cd)pyrene	4.0E-01	1.4	2.9E+01	34	88	mg/kg OC	0.85	0.33
Boeing SiteChar	R62	Indeno(1,2,3-cd)pyrene	3.9E-01	1.8	2.2E+01	34	88	mg/kg OC	0.65	0.25
Boeing SiteChar	R65	Indeno(1,2,3-cd)pyrene	2.1E-01	1.6	1.3E+01	34	88	mg/kg OC	0.38	0.15
EPA SI	DR253	Indeno(1,2,3-cd)pyrene	1.6E-01	1.6	1.0E+01	34	88	mg/kg OC	0.29	0.11
Boeing SiteChar	R73	Indeno(1,2,3-cd)pyrene	1.1E-01	2.4	4.6E+00	34	88	mg/kg OC	0.14	0.05
EPA SI	DR248	Indeno(1,2,3-cd)pyrene	1.0E-01	2.3	4.4E+00	34	88	mg/kg OC	0.13	0.05
EPA SI	DR280	Indeno(1,2,3-cd)pyrene	1.0E-01	2.5	4.0E+00	34	88	mg/kg OC	0.12	0.05
Boeing SiteChar	R64	Indeno(1,2,3-cd)pyrene	9.9E-02	2.2	4.5E+00	34	88	mg/kg OC	0.13	0.05
LDWRI-SurfaceSedimentRound2	LDW-SS137	Indeno(1,2,3-cd)pyrene	9.5E-02	3.0	3.2E+00	34	88	mg/kg OC	0.09	0.04
Boeing SiteChar	R76	Indeno(1,2,3-cd)pyrene	9.3E-02	2.0	4.7E+00	34	88	mg/kg OC	0.14	0.05
EPA SI	DR281	Indeno(1,2,3-cd)pyrene	9.0E-02	3.6	2.5E+00	34	88	mg/kg OC	0.07	0.03
EPA SI	DR289	Indeno(1,2,3-cd)pyrene	9.0E-02	3.6	2.5E+00	34	88	mg/kg OC	0.07	0.03
Boeing SiteChar	R67	Indeno(1,2,3-cd)pyrene	8.6E-02	1.9	4.5E+00	34	88	mg/kg OC	0.13	0.05
Boeing SiteChar	R81	Indeno(1,2,3-cd)pyrene	8.2E-02	1.3	6.3E+00	34	88	mg/kg OC	0.19	0.07
EPA SI	DR272	Indeno(1,2,3-cd)pyrene	8.0E-02	0.1		600	690	ug/kg dw	0.13	0.12
Boeing SiteChar	R68	Indeno(1,2,3-cd)pyrene	7.8E-02	2.0	3.9E+00	34	88	mg/kg OC	0.11	0.04
Boeing SiteChar	R74	Indeno(1,2,3-cd)pyrene	7.3E-02	1.5	4.9E+00	34	88	mg/kg OC	0.14	0.06
LDWRI-Benthic	B9a	Indeno(1,2,3-cd)pyrene	6.3E-02	2.1	2.9E+00	34	88	mg/kg OC	0.09	0.03

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R79	Indeno(1,2,3-cd)pyrene	6.1E-02	1.1	5.5E+00	34	88	mg/kg OC	0.16	0.06
EPA SI	DR247	Indeno(1,2,3-cd)pyrene	6.0E-02	2.0	3.0E+00	34	88	mg/kg OC	0.09	0.03
EPA SI	DR251	Indeno(1,2,3-cd)pyrene	6.0E-02	1.9	3.2E+00	34	88	mg/kg OC	0.09	0.04
EPA SI	DR252	Indeno(1,2,3-cd)pyrene	6.0E-02	1.7	3.6E+00	34	88	mg/kg OC	0.11	0.04
Boeing SiteChar	R69	Indeno(1,2,3-cd)pyrene	5.8E-02	1.4	4.1E+00	34	88	mg/kg OC	0.12	0.05
Boeing SiteChar	R66	Indeno(1,2,3-cd)pyrene	5.5E-02	1.2	4.6E+00	34	88	mg/kg OC	0.14	0.05
Boeing SiteChar	R70	Indeno(1,2,3-cd)pyrene	4.8E-02	1.1	4.4E+00	34	88	mg/kg OC	0.13	0.05
Boeing SiteChar	R60	Indeno(1,2,3-cd)pyrene	4.3E-02	1.2	3.6E+00	34	88	mg/kg OC	0.11	0.04
Boeing SiteChar	R71	Indeno(1,2,3-cd)pyrene	4.2E-02	2.0	2.1E+00	34	88	mg/kg OC	0.06	0.02
Boeing SiteChar	R72	Indeno(1,2,3-cd)pyrene	4.0E-02	1.0	4.1E+00	34	88	mg/kg OC	0.12	0.05
EPA SI	DR249	Indeno(1,2,3-cd)pyrene	4.0E-02	1.5	2.7E+00	34	88	mg/kg OC	0.08	0.03
EPA SI	DR250	Indeno(1,2,3-cd)pyrene	4.0E-02	1.9	2.1E+00	34	88	mg/kg OC	0.06	0.02
Boeing SiteChar	R61	Indeno(1,2,3-cd)pyrene	3.4E-02	1.4	2.4E+00	34	88	mg/kg OC	0.07	0.03
Boeing SiteChar	R75	Indeno(1,2,3-cd)pyrene	3.0E-02 J	1.8	1.7E+00	34	88	mg/kg OC	0.05	0.02
LDWRI-SurfaceSedimentRound2	LDW-SS138	Indeno(1,2,3-cd)pyrene	2.7E-02	1.8	1.5E+00	34	88	mg/kg OC	0.04	0.02
Boeing SiteChar	R78	Indeno(1,2,3-cd)pyrene	2.6E-02	1.6	1.6E+00	34	88	mg/kg OC	0.05	0.02
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Indeno(1,2,3-cd)pyrene	2.1E-02	2.4	8.6E-01	34	88	mg/kg OC	0.03	0.01
LDWRI-SurfaceSedimentRound1	LDW-SS142	Indeno(1,2,3-cd)pyrene	1.2E-02	2.0	6.2E-01	34	88	mg/kg OC	0.02	0.01
EPA SI	DR281	Iron	3.3E+04	3.6						
EPA SI	DR289	Iron	3.3E+04	3.6						
EPA SI	DR253	Iron	2.9E+04	1.6						
EPA SI	DR280	Iron	2.9E+04	2.5						
EPA SI	DR248	Iron	2.8E+04	2.3						
EPA SI	DR250	Iron	2.8E+04	1.9						
EPA SI	DR247	Iron	2.7E+04	2.0						
EPA SI	DR272	Iron	2.7E+04	0.1						
EPA SI	DR252	Iron	2.5E+04	1.7						
EPA SI	DR251	Iron	2.5E+04	1.9						
EPA SI	DR249	Iron	2.3E+04	1.5						
EPA SI	DR254	Iron	2.2E+04	1.9						
EPA SI	DR254	Lead	6.2E+02	1.9		450	530	mg/kg dw	1.4	1.2
EPA SI	DR281	Lead	2.2E+01 J	3.6		450	530	mg/kg dw	0.05	0.04
Boeing SiteChar	R74	Lead	2.2E+01	1.5		450	530	mg/kg dw	0.05	0.04
Boeing SiteChar	R75	Lead	2.2E+01	1.8		450	530	mg/kg dw	0.05	0.04
EPA SI	DR289	Lead	2.2E+01	3.6		450	530	mg/kg dw	0.05	0.04
LDWRI-SurfaceSedimentRound2	LDW-SS137	Lead	2.1E+01	3.0		450	530	mg/kg dw	0.05	0.04
Boeing SiteChar	R68	Lead	1.8E+01	2.0		450	530	mg/kg dw	0.04	0.03
Boeing SiteChar	R64	Lead	1.7E+01	2.2		450	530	mg/kg dw	0.04	0.03

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R65	Lead	1.7E+01	1.6		450	530	mg/kg dw	0.04	0.03
Boeing SiteChar	R73	Lead	1.7E+01	2.4		450	530	mg/kg dw	0.04	0.03
LDWRI-SurfaceSedimentRound1	LDW-SS142	Lead	1.7E+01	2.0		450	530	mg/kg dw	0.04	0.03
EPA SI	DR272	Lead	1.6E+01	0.1		450	530	mg/kg dw	0.04	0.03
Boeing SiteChar	R76	Lead	1.6E+01	2.0		450	530	mg/kg dw	0.04	0.03
EPA SI	DR253	Lead	1.6E+01	1.6		450	530	mg/kg dw	0.04	0.03
EPA SI	DR280	Lead	1.6E+01 J	2.5		450	530	mg/kg dw	0.04	0.03
EPA SI	DR248	Lead	1.5E+01 J	2.3		450	530	mg/kg dw	0.03	0.03
Boeing SiteChar	R62	Lead	1.5E+01	1.8		450	530	mg/kg dw	0.03	0.03
Boeing SiteChar	R63	Lead	1.5E+01	1.5		450	530	mg/kg dw	0.03	0.03
Boeing SiteChar	R67	Lead	1.5E+01	1.9		450	530	mg/kg dw	0.03	0.03
Boeing SiteChar	R77	Lead	1.5E+01	1.4		450	530	mg/kg dw	0.03	0.03
LDWRI-SurfaceSedimentRound2	LDW-SS138	Lead	1.4E+01	1.8		450	530	mg/kg dw	0.03	0.03
EPA SI	DR247	Lead	1.4E+01 J	2.0		450	530	mg/kg dw	0.03	0.03
LDWRI-Benthic	B9a	Lead	1.4E+01	2.1		450	530	mg/kg dw	0.03	0.03
Boeing SiteChar	R69	Lead	1.3E+01	1.4		450	530	mg/kg dw	0.03	0.03
EPA SI	DR251	Lead	1.3E+01 J	1.9		450	530	mg/kg dw	0.03	0.02
Boeing SiteChar	R71	Lead	1.2E+01	2.0		450	530	mg/kg dw	0.03	0.02
EPA SI	DR252	Lead	1.2E+01	1.7		450	530	mg/kg dw	0.03	0.02
Boeing SiteChar	R61	Lead	1.1E+01	1.4		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R66	Lead	1.1E+01	1.2		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R79	Lead	1.1E+01	1.1		450	530	mg/kg dw	0.02	0.02
EPA SI	DR250	Lead	1.1E+01 J	1.9		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R60	Lead	1.0E+01	1.2		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R70	Lead	1.0E+01	1.1		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R80	Lead	1.0E+01	1.2		450	530	mg/kg dw	0.02	0.02
EPA SI	DR249	Lead	9.9E+00 J	1.5		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R72	Lead	8.0E+00	1.0		450	530	mg/kg dw	0.02	0.02
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Lead	8.0E+00	2.4		450	530	mg/kg dw	0.02	0.02
Boeing SiteChar	R78	Lead	7.0E+00	1.6		450	530	mg/kg dw	0.02	0.01
Boeing SiteChar	R81	Lead	2.0E+00	1.3		450	530	mg/kg dw	0.00	0.00
EPA SI	DR247	Mercury	2.2E-01	2.0		0.41	0.59	mg/kg dw	0.54	0.37
EPA SI	DR289	Mercury	2.1E-01	3.6		0.41	0.59	mg/kg dw	0.51	0.36
Boeing SiteChar	R63	Mercury	1.2E-01	1.5		0.41	0.59	mg/kg dw	0.29	0.20
EPA SI	DR250	Mercury	1.2E-01	1.9		0.41	0.59	mg/kg dw	0.29	0.20
EPA SI	DR281	Mercury	1.2E-01	3.6		0.41	0.59	mg/kg dw	0.29	0.20
Boeing SiteChar	R64	Mercury	1.1E-01	2.2		0.41	0.59	mg/kg dw	0.27	0.19
Boeing SiteChar	R74	Mercury	1.1E-01	1.5		0.41	0.59	mg/kg dw	0.27	0.19

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR280	Mercury	1.1E-01	2.5		0.41	0.59	mg/kg dw	0.27	0.19
LDWRI-Benthic	B9a	Mercury	1.1E-01	2.1		0.41	0.59	mg/kg dw	0.27	0.19
Boeing SiteChar	R62	Mercury	1.0E-01	1.8		0.41	0.59	mg/kg dw	0.24	0.17
Boeing SiteChar	R73	Mercury	1.0E-01	2.4		0.41	0.59	mg/kg dw	0.24	0.17
Boeing SiteChar	R75	Mercury	1.0E-01	1.8		0.41	0.59	mg/kg dw	0.24	0.17
LDWRI-SurfaceSedimentRound1	LDW-SS142	Mercury	1.0E-01	2.0		0.41	0.59	mg/kg dw	0.24	0.20
LDWRI-SurfaceSedimentRound2	LDW-SS138	Mercury	1.0E-01	1.8		0.41	0.59	mg/kg dw	0.24	0.17
EPA SI	DR248	Mercury	9.0E-02	2.3		0.41	0.59	mg/kg dw	0.22	0.20
EPA SI	DR249	Mercury	9.0E-02	1.5		0.41	0.59	mg/kg dw	0.22	0.20
EPA SI	DR251	Mercury	9.0E-02	1.9		0.41	0.59	mg/kg dw	0.22	0.20
EPA SI	DR253	Mercury	7.0E-02	1.6		0.41	0.59	mg/kg dw	0.17	0.10
EPA SI	DR272	Mercury	7.0E-02	0.1		0.41	0.59	mg/kg dw	0.17	0.10
EPA SI	DR252	Mercury	6.0E-02	1.7		0.41	0.59	mg/kg dw	0.15	0.10
EPA SI	DR254	Mercury	5.0E-02	1.9		0.41	0.59	mg/kg dw	0.12	0.08
EPA SI	DR253	Monobutyltin as ion	2.0E-03 J	1.6						
LDWRI-Benthic	B9a	Monobutyltin as ion	1.2E-03 J	2.1						
EPA SI	DR251	Monobutyltin as ion	1.0E-03 J	1.9						
LDWRI-Benthic	B9a	Naphthalene	3.6E-03 J	2.1	1.7E-01	99	170	mg/kg OC	0.002	0.001
EPA SI	DR251	Nickel	3.0E+01 J	1.9				mg/kg dw		
Boeing SiteChar	R75	Nickel	2.9E+01	1.8				mg/kg dw		
Boeing SiteChar	R62	Nickel	2.8E+01	1.8				mg/kg dw		
Boeing SiteChar	R63	Nickel	2.8E+01	1.5				mg/kg dw		
Boeing SiteChar	R64	Nickel	2.8E+01	2.2				mg/kg dw		
Boeing SiteChar	R65	Nickel	2.8E+01	1.6				mg/kg dw		
Boeing SiteChar	R68	Nickel	2.7E+01	2.0				mg/kg dw		
Boeing SiteChar	R71	Nickel	2.7E+01	2.0				mg/kg dw		
Boeing SiteChar	R61	Nickel	2.6E+01	1.4				mg/kg dw		
Boeing SiteChar	R60	Nickel	2.5E+01	1.2				mg/kg dw		
Boeing SiteChar	R67	Nickel	2.5E+01	1.9				mg/kg dw		
Boeing SiteChar	R73	Nickel	2.5E+01	2.4				mg/kg dw		
Boeing SiteChar	R66	Nickel	2.3E+01	1.2				mg/kg dw		
Boeing SiteChar	R70	Nickel	2.3E+01	1.1				mg/kg dw		
Boeing SiteChar	R74	Nickel	2.3E+01	1.5				mg/kg dw		
Boeing SiteChar	R80	Nickel	2.3E+01	1.2				mg/kg dw		
EPA SI	DR250	Nickel	2.2E+01 J	1.9				mg/kg dw		
Boeing SiteChar	R69	Nickel	2.1E+01	1.4				mg/kg dw		
Boeing SiteChar	R72	Nickel	2.1E+01	1.0				mg/kg dw		
Boeing SiteChar	R77	Nickel	2.1E+01	1.4				mg/kg dw		

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR289	Nickel	2.0E+01	3.6				mg/kg dw		
LDWRI-SurfaceSedimentRound2	LDW-SS137	Nickel	2.0E+01	3.0				mg/kg dw		
Boeing SiteChar	R79	Nickel	1.9E+01	1.1				mg/kg dw		
EPA SI	DR249	Nickel	1.9E+01 J	1.5				mg/kg dw		
LDWRI-SurfaceSedimentRound2	LDW-SS138	Nickel	1.9E+01	1.8				mg/kg dw		
EPA SI	DR281	Nickel	1.8E+01 J	3.6				mg/kg dw		
Boeing SiteChar	R76	Nickel	1.8E+01	2.0				mg/kg dw		
EPA SI	DR253	Nickel	1.8E+01	1.6				mg/kg dw		
EPA SI	DR247	Nickel	1.7E+01 J	2.0				mg/kg dw		
EPA SI	DR252	Nickel	1.7E+01	1.7				mg/kg dw		
EPA SI	DR280	Nickel	1.7E+01 J	2.5				mg/kg dw		
Boeing SiteChar	R78	Nickel	1.7E+01	1.6				mg/kg dw		
LDWRI-Benthic	B9a	Nickel	1.7E+01	2.1				mg/kg dw		
LDWRI-SurfaceSedimentRound1	LDW-SS142	Nickel	1.7E+01	2.0				mg/kg dw		
EPA SI	DR248	Nickel	1.7E+01 J	2.3				mg/kg dw		
EPA SI	DR254	Nickel	1.5E+01	1.9				mg/kg dw		
EPA SI	DR272	Nickel	1.5E+01	0.1				mg/kg dw		
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Nickel	1.2E+01	2.4				mg/kg dw		
Boeing SiteChar	R81	Nickel	5.0E+00	1.3				mg/kg dw		
LDWRI-SurfaceSedimentRound1	LDW-SS142	PCB TEQ - Mammal WHO 2005 - Half DL	3.5E-06							
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	PCB TEQ - Mammal WHO 2005 - Half DL	9.7E-07							
LDWRI-Benthic	B9a	PCBs (total calc'd)	2.7E-01	2.1	1.3E+01	12	65	mg/kg OC	1.1	0.20
Boeing SiteChar	R75	PCBs (total calc'd)	2.6E-01	1.8	1.4E+01	12	65	mg/kg OC	1.2	0.22
EPA SI	DR281	PCBs (total calc'd)	1.9E-01	3.6	5.3E+00	12	65	mg/kg OC	0.44	0.08
LDWRI-SurfaceSedimentRound1	LDW-SS142	PCBs (total calc'd)	1.6E-01 J	2.0	8.3E+00	12	65	mg/kg OC	0.69	0.13
Boeing SiteChar	R74	PCBs (total calc'd)	1.2E-01 J	1.5	8.1E+00	12	65	mg/kg OC	0.68	0.12
Boeing SiteChar	R63	PCBs (total calc'd)	1.1E-01 J	1.5	7.0E+00	12	65	mg/kg OC	0.58	0.11
Boeing SiteChar	R77	PCBs (total calc'd)	1.0E-01 J	1.4	7.4E+00	12	65	mg/kg OC	0.62	0.11
Boeing SiteChar	R73	PCBs (total calc'd)	1.0E-01	2.4	4.2E+00	12	65	mg/kg OC	0.35	0.07
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	PCBs (total calc'd)	1.0E-01	2.4	4.1E+00	12	65	mg/kg OC	0.34	0.06
Boeing SiteChar	R81	PCBs (total calc'd)	9.0E-02	1.3	6.9E+00	12	65	mg/kg OC	0.58	0.11
Boeing SiteChar	R68	PCBs (total calc'd)	8.8E-02	2.0	4.4E+00	12	65	mg/kg OC	0.37	0.07
NOAA SiteChar	EST110	PCBs (total calc'd)	8.7E-02 J	0.5		130	1000	ug/kg dw	0.67	0.09
Boeing SiteChar	R65	PCBs (total calc'd)	8.0E-02 J	1.6	5.0E+00	12	65	mg/kg OC	0.42	0.08
LDWRI-SurfaceSedimentRound2	LDW-SS137	PCBs (total calc'd)	7.8E-02 J	3.0	2.6E+00	12	65	mg/kg OC	0.22	0.04
Boeing SiteChar	R67	PCBs (total calc'd)	7.4E-02	1.9	3.9E+00	12	65	mg/kg OC	0.33	0.06

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR248	PCBs (total calc'd)	7.2E-02	2.3	3.2E+00	12	65	mg/kg OC	0.27	0.05
EPA SI	DR280	PCBs (total calc'd)	7.2E-02	2.5	2.8E+00	12	65	mg/kg OC	0.23	0.04
EPA SI	DR251	PCBs (total calc'd)	7.1E-02	1.9	3.8E+00	12	65	mg/kg OC	0.32	0.06
NOAA SiteChar	EIT056	PCBs (total calc'd)	6.5E-02 J	1.9	3.5E+00	12	65	mg/kg OC	0.29	0.05
Boeing SiteChar	R64	PCBs (total calc'd)	6.3E-02 J	2.2	2.9E+00	12	65	mg/kg OC	0.24	0.05
EPA SI	DR247	PCBs (total calc'd)	6.3E-02	2.0	3.2E+00	12	65	mg/kg OC	0.27	0.05
Boeing SiteChar	R62	PCBs (total calc'd)	6.0E-02 J	1.8	3.3E+00	12	65	mg/kg OC	0.28	0.05
EPA SI	DR289	PCBs (total calc'd)	5.8E-02	3.6	1.6E+00	12	65	mg/kg OC	0.13	0.03
Boeing SiteChar	R66	PCBs (total calc'd)	5.5E-02	1.2	4.6E+00	12	65	mg/kg OC	0.38	0.07
EPA SI	DR253	PCBs (total calc'd)	5.3E-02	1.6	3.4E+00	12	65	mg/kg OC	0.28	0.05
NOAA SiteChar	EIT052	PCBs (total calc'd)	5.3E-02 J	2.0	2.7E+00	12	65	mg/kg OC	0.23	0.04
EPA SI	DR272	PCBs (total calc'd)	5.2E-02	0.1		130	1000	ug/kg dw	0.40	0.05
Boeing SiteChar	R79	PCBs (total calc'd)	4.6E-02 J	1.1	4.2E+00	12	65	mg/kg OC	0.35	0.07
NOAA SiteChar	EIT055	PCBs (total calc'd)	4.1E-02 J	1.4	2.9E+00	12	65	mg/kg OC	0.24	0.05
NOAA SiteChar	EST124	PCBs (total calc'd)	4.0E-02 J	1.3	3.0E+00	12	65	mg/kg OC	0.25	0.05
Boeing SiteChar	R69	PCBs (total calc'd)	3.1E-02	1.4	2.2E+00	12	65	mg/kg OC	0.18	0.03
NOAA SiteChar	CH0001	PCBs (total calc'd)	2.6E-02 J	1.9	1.3E+00	12	65	mg/kg OC	0.11	0.02
NOAA SiteChar	EIT054	PCBs (total calc'd)	2.4E-02 J	0.5		130	1000	ug/kg dw	0.18	0.02
Boeing SiteChar	R76	PCBs (total calc'd)	2.3E-02	2.0	1.2E+00	12	65	mg/kg OC	0.10	0.02
Boeing SiteChar	R78	PCBs (total calc'd)	2.2E-02	1.6	1.4E+00	12	65	mg/kg OC	0.12	0.02
Boeing SiteChar	R60	PCBs (total calc'd)	2.0E-02	1.2	1.7E+00	12	65	mg/kg OC	0.14	0.03
Boeing SiteChar	R71	PCBs (total calc'd)	2.0E-02	2.0	1.0E+00	12	65	mg/kg OC	0.08	0.02
NOAA SiteChar	EST111	PCBs (total calc'd)	1.9E-02 J	1.4	1.3E+00	12	65	mg/kg OC	0.11	0.02
Boeing SiteChar	R70	PCBs (total calc'd)	1.7E-02 J	1.1	1.5E+00	12	65	mg/kg OC	0.13	0.02
LDWRI-SurfaceSedimentRound2	LDW-SS138	PCBs (total calc'd)	1.7E-02 J	1.8	9.6E-01	12	65	mg/kg OC	0.08	0.02
NOAA SiteChar	EST112	PCBs (total calc'd)	1.5E-02 J	0.6	2.5E+00	12	65	mg/kg OC	0.21	0.04
Boeing SiteChar	R61	PCBs (total calc'd)	1.4E-02 J	1.4	1.0E+00	12	65	mg/kg OC	0.08	0.02
Boeing SiteChar	R72	PCBs (total calc'd)	1.4E-02 J	1.0	1.4E+00	12	65	mg/kg OC	0.12	0.02
NOAA SiteChar	EIT051	PCBs (total calc'd)	1.4E-02 J	1.1	1.2E+00	12	65	mg/kg OC	0.10	0.02
NOAA SiteChar	EST125	PCBs (total calc'd)	1.4E-02 J	1.4	1.0E+00	12	65	mg/kg OC	0.08	0.02
NOAA SiteChar	EST120	PCBs (total calc'd)	1.1E-02 J	1.7	6.3E-01	12	65	mg/kg OC	0.05	0.01
NOAA SiteChar	EST127	PCBs (total calc'd)	1.1E-02 J	1.5	7.2E-01	12	65	mg/kg OC	0.06	0.01
NOAA SiteChar	EST118	PCBs (total calc'd)	1.0E-02 J	1.4	7.4E-01	12	65	mg/kg OC	0.06	0.01
NOAA SiteChar	EST117	PCBs (total calc'd)	9.6E-03 J	1.6	6.1E-01	12	65	mg/kg OC	0.05	0.01
NOAA SiteChar	EST116	PCBs (total calc'd)	9.5E-03 J	1.3	7.3E-01	12	65	mg/kg OC	0.06	0.01
NOAA SiteChar	EIT049	PCBs (total calc'd)	9.3E-03 J	2.3	4.0E-01	12	65	mg/kg OC	0.03	0.01
NOAA SiteChar	EST113	PCBs (total calc'd)	6.0E-03 J	0.1		130	1000	ug/kg dw	0.05	0.01
NOAA SiteChar	EST114	PCBs (total calc'd)	5.7E-03 J	0.4		130	1000	ug/kg dw	0.04	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
NOAA SiteChar	EST121	PCBs (total calc'd)	4.1E-03 J	1.3	3.2E-01	12	65	mg/kg OC	0.03	0.005
NOAA SiteChar	EST122	PCBs (total calc'd)	3.7E-03 J	1.6	2.3E-01	12	65	mg/kg OC	0.02	0.004
NOAA SiteChar	EST123	PCBs (total calc'd)	3.0E-03 J	1.8	2.0E-01	12	65	mg/kg OC	0.02	0.003
NOAA SiteChar	EST106	PCBs (total calc'd)	2.6E-03 J	0.1		130	1000	ug/kg dw	0.02	0.003
NOAA SiteChar	EST115	PCBs (total calc'd)	2.3E-03 J	0.1		130	1000	ug/kg dw	0.02	0.002
LDWRI-Benthic	B9a	Perylene	4.3E-02	2.1						
Boeing SiteChar	R63	Phenanthrene	1.4E+00	1.5	9.3E+01	100	480	mg/kg OC	0.93	0.19
Boeing SiteChar	R77	Phenanthrene	8.8E-01	1.4	6.3E+01	100	480	mg/kg OC	0.63	0.13
Boeing SiteChar	R62	Phenanthrene	6.8E-01	1.8	3.8E+01	100	480	mg/kg OC	0.38	0.08
Boeing SiteChar	R75	Phenanthrene	3.2E-01	1.8	1.8E+01	100	480	mg/kg OC	0.18	0.04
Boeing SiteChar	R65	Phenanthrene	3.1E-01	1.6	1.9E+01	100	480	mg/kg OC	0.19	0.04
EPA SI	DR253	Phenanthrene	2.9E-01	1.6	1.9E+01	100	480	mg/kg OC	0.19	0.04
LDWRI-SurfaceSedimentRound2	LDW-SS137	Phenanthrene	2.3E-01	3.0	7.8E+00	100	480	mg/kg OC	0.08	0.02
EPA SI	DR281	Phenanthrene	1.6E-01	3.6	4.4E+00	100	480	mg/kg OC	0.04	0.01
Boeing SiteChar	R73	Phenanthrene	1.5E-01	2.4	6.3E+00	100	480	mg/kg OC	0.06	0.01
Boeing SiteChar	R79	Phenanthrene	1.5E-01	1.1	1.4E+01	100	480	mg/kg OC	0.14	0.03
Boeing SiteChar	R64	Phenanthrene	1.4E-01	2.2	6.4E+00	100	480	mg/kg OC	0.06	0.01
EPA SI	DR248	Phenanthrene	1.2E-01	2.3	5.3E+00	100	480	mg/kg OC	0.05	0.01
EPA SI	DR272	Phenanthrene	1.2E-01	0.1		1500	5400	ug/kg dw	0.08	0.02
EPA SI	DR280	Phenanthrene	1.2E-01	2.5	4.7E+00	100	480	mg/kg OC	0.05	0.01
EPA SI	DR289	Phenanthrene	1.2E-01	3.6	3.3E+00	100	480	mg/kg OC	0.03	0.01
LDWRI-SurfaceSedimentRound1	LDW-SS142	Phenanthrene	1.2E-01	2.0	6.2E+00	100	480	mg/kg OC	0.06	0.01
Boeing SiteChar	R76	Phenanthrene	1.1E-01	2.0	5.5E+00	100	480	mg/kg OC	0.06	0.01
Boeing SiteChar	R68	Phenanthrene	1.0E-01	2.0	5.0E+00	100	480	mg/kg OC	0.05	0.01
LDWRI-Benthic	B9a	Phenanthrene	9.4E-02	2.1	4.4E+00	100	480	mg/kg OC	0.04	0.01
Boeing SiteChar	R81	Phenanthrene	9.1E-02	1.3	7.0E+00	100	480	mg/kg OC	0.07	0.02
Boeing SiteChar	R67	Phenanthrene	9.0E-02	1.9	4.7E+00	100	480	mg/kg OC	0.05	0.01
EPA SI	DR247	Phenanthrene	9.0E-02	2.0	4.5E+00	100	480	mg/kg OC	0.05	0.01
Boeing SiteChar	R70	Phenanthrene	8.4E-02	1.1	7.6E+00	100	480	mg/kg OC	0.08	0.02
Boeing SiteChar	R66	Phenanthrene	8.3E-02	1.2	6.9E+00	100	480	mg/kg OC	0.07	0.01
EPA SI	DR252	Phenanthrene	8.0E-02	1.7	4.8E+00	100	480	mg/kg OC	0.05	0.01
Boeing SiteChar	R69	Phenanthrene	7.6E-02	1.4	5.4E+00	100	480	mg/kg OC	0.05	0.01
EPA SI	DR251	Phenanthrene	7.0E-02	1.9	3.7E+00	100	480	mg/kg OC	0.04	0.01
Boeing SiteChar	R74	Phenanthrene	6.9E-02	1.5	4.6E+00	100	480	mg/kg OC	0.05	0.01
Boeing SiteChar	R72	Phenanthrene	6.6E-02	1.0	6.8E+00	100	480	mg/kg OC	0.07	0.01
EPA SI	DR249	Phenanthrene	6.0E-02	1.5	4.1E+00	100	480	mg/kg OC	0.04	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS138	Phenanthrene	6.0E-02	1.8	3.4E+00	100	480	mg/kg OC	0.03	0.01
Boeing SiteChar	R71	Phenanthrene	5.7E-02	2.0	2.9E+00	100	480	mg/kg OC	0.03	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R60	Phenanthrene	5.6E-02	1.2	4.7E+00	100	480	mg/kg OC	0.05	0.01
EPA SI	DR250	Phenanthrene	5.0E-02	1.9	2.6E+00	100	480	mg/kg OC	0.03	0.01
Boeing SiteChar	R78	Phenanthrene	4.6E-02	1.6	2.9E+00	100	480	mg/kg OC	0.03	0.01
Boeing SiteChar	R61	Phenanthrene	4.5E-02	1.4	3.2E+00	100	480	mg/kg OC	0.03	0.01
Boeing SiteChar	R80	Phenanthrene	4.3E-02	1.2	3.6E+00	100	480	mg/kg OC	0.04	0.01
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Phenanthrene	3.7E-02	2.4	1.5E+00	100	480	mg/kg OC	0.02	0.003
EPA SI	DR254	Phenol	6.0E-02 J	1.9		420	1200	ug/kg dw	0.14	0.05
Boeing SiteChar	R81	Phenol	3.7E-02 J	1.3		420	1200	ug/kg dw	0.09	0.03
EPA SI	DR249	Phenol	3.0E-02	1.5		420	1200	ug/kg dw	0.07	0.03
Boeing SiteChar	R62	Phenol	2.9E-02	1.8		420	1200	ug/kg dw	0.07	0.02
Boeing SiteChar	R71	Phenol	2.9E-02	2.0		420	1200	ug/kg dw	0.07	0.02
Boeing SiteChar	R72	Phenol	2.2E-02 J	1.0		420	1200	ug/kg dw	0.05	0.02
Boeing SiteChar	R76	Phenol	2.1E-02 J	2.0		420	1200	ug/kg dw	0.05	0.02
Boeing SiteChar	R63	Pyrene	2.1E+00	1.5	1.4E+02	1000	1400	mg/kg OC	0.14	0.10
Boeing SiteChar	R62	Pyrene	1.2E+00	1.8	6.7E+01	1000	1400	mg/kg OC	0.07	0.05
Boeing SiteChar	R77	Pyrene	1.2E+00	1.4	8.6E+01	1000	1400	mg/kg OC	0.09	0.06
Boeing SiteChar	R65	Pyrene	5.8E-01	1.6	3.6E+01	1000	1400	mg/kg OC	0.04	0.03
LDWRI-SurfaceSedimentRound2	LDW-SS137	Pyrene	5.7E-01	3.0	1.9E+01	1000	1400	mg/kg OC	0.02	0.01
EPA SI	DR253	Pyrene	5.3E-01	1.6	3.4E+01	1000	1400	mg/kg OC	0.03	0.02
EPA SI	DR281	Pyrene	4.1E-01	3.6	1.1E+01	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R64	Pyrene	3.1E-01	2.2	1.4E+01	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R73	Pyrene	3.1E-01	2.4	1.3E+01	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR280	Pyrene	2.8E-01	2.5	1.1E+01	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR248	Pyrene	2.6E-01	2.3	1.1E+01	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR289	Pyrene	2.6E-01	3.6	7.2E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R79	Pyrene	2.3E-01	1.1	2.1E+01	1000	1400	mg/kg OC	0.02	0.02
LDWRI-SurfaceSedimentRound1	LDW-SS142	Pyrene	2.3E-01	2.0	1.2E+01	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR272	Pyrene	2.1E-01	0.1		2600	3300	ug/kg dw	0.08	0.06
Boeing SiteChar	R67	Pyrene	2.0E-01	1.9	1.1E+01	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R76	Pyrene	1.9E-01	2.0	9.5E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R74	Pyrene	1.8E-01	1.5	1.2E+01	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR247	Pyrene	1.8E-01	2.0	9.0E+00	1000	1400	mg/kg OC	0.01	0.01
LDWRI-Benthic	B9a	Pyrene	1.8E-01	2.1	8.4E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R68	Pyrene	1.7E-01	2.0	8.5E+00	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR252	Pyrene	1.6E-01	1.7	9.6E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R69	Pyrene	1.5E-01	1.4	1.1E+01	1000	1400	mg/kg OC	0.01	0.01
EPA SI	DR251	Pyrene	1.5E-01	1.9	8.0E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R60	Pyrene	1.2E-01	1.2	1.0E+01	1000	1400	mg/kg OC	0.01	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R66	Pyrene	1.2E-01	1.2	1.0E+01	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R70	Pyrene	1.2E-01	1.1	1.1E+01	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R81	Pyrene	1.2E-01	1.3	9.2E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R71	Pyrene	1.1E-01	2.0	5.5E+00	1000	1400	mg/kg OC	0.01	0.00
EPA SI	DR249	Pyrene	1.1E-01	1.5	7.4E+00	1000	1400	mg/kg OC	0.01	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS138	Pyrene	1.1E-01	1.8	6.2E+00	1000	1400	mg/kg OC	0.01	0.00
Boeing SiteChar	R61	Pyrene	9.0E-02	1.4	6.4E+00	1000	1400	mg/kg OC	0.01	0.005
EPA SI	DR250	Pyrene	9.0E-02	1.9	4.8E+00	1000	1400	mg/kg OC	0.005	0.003
Boeing SiteChar	R72	Pyrene	7.0E-02	1.0	7.2E+00	1000	1400	mg/kg OC	0.01	0.01
Boeing SiteChar	R78	Pyrene	6.0E-02	1.6	3.8E+00	1000	1400	mg/kg OC	0.004	0.003
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Pyrene	6.0E-02	2.4	2.5E+00	1000	1400	mg/kg OC	0.003	0.002
Boeing SiteChar	R75	Pyrene	5.5E-02 J	1.8	3.1E+00	1000	1400	mg/kg OC	0.003	0.002
Boeing SiteChar	R80	Pyrene	2.4E-02	1.2	2.0E+00	1000	1400	mg/kg OC	0.002	0.001
EPA SI	DR280	Selenium	1.4E+01	2.5						
EPA SI	DR281	Selenium	1.4E+01	3.6						
EPA SI	DR289	Selenium	1.3E+01	3.6						
EPA SI	DR248	Selenium	1.3E+01	2.3						
EPA SI	DR250	Selenium	1.3E+01	1.9						
EPA SI	DR247	Selenium	1.2E+01	2.0						
EPA SI	DR251	Selenium	1.2E+01	1.9						
EPA SI	DR249	Selenium	1.1E+01	1.5						
EPA SI	DR252	Selenium	9.0E+00 J	1.7						
EPA SI	DR253	Selenium	9.0E+00 J	1.6						
EPA SI	DR272	Selenium	9.0E+00 J	0.1						
EPA SI	DR254	Selenium	6.0E+00 J	1.9						
LDWRI-Benthic	B9a	Selenium	7.0E-01	2.1						
Boeing SiteChar	R80	Silver	3.0E-01 J	1.2		6.1	6.1	mg/kg dw	0.05	0.05
EPA SI	DR254	Silver	2.5E-01	1.9		6.1	6.1	mg/kg dw	0.04	0.04
EPA SI	DR281	Silver	2.2E-01	3.6		6.1	6.1	mg/kg dw	0.04	0.04
EPA SI	DR272	Silver	1.9E-01	0.1		6.1	6.1	mg/kg dw	0.03	0.03
EPA SI	DR289	Silver	1.9E-01	3.6		6.1	6.1	mg/kg dw	0.03	0.03
EPA SI	DR253	Silver	1.8E-01	1.6		6.1	6.1	mg/kg dw	0.03	0.03
EPA SI	DR250	Silver	1.3E-01	1.9		6.1	6.1	mg/kg dw	0.02	0.02
EPA SI	DR252	Silver	1.3E-01	1.7		6.1	6.1	mg/kg dw	0.02	0.02
LDWRI-Benthic	B9a	Silver	1.2E-01	2.1		6.1	6.1	mg/kg dw	0.02	0.02
EPA SI	DR251	Silver	1.2E-01	1.9		6.1	6.1	mg/kg dw	0.02	0.02
EPA SI	DR280	Silver	1.2E-01	2.5		6.1	6.1	mg/kg dw	0.02	0.02
EPA SI	DR247	Silver	9.0E-02	2.0		6.1	6.1	mg/kg dw	0.02	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR248	Silver	9.0E-02	2.3		6.1	6.1	mg/kg dw	0.02	0.01
EPA SI	DR249	Silver	9.0E-02	1.5		6.1	6.1	mg/kg dw	0.02	0.01
EPA SI	DR253	Tetrabutyltin as ion	2.0E-03 J	1.6						
EPA SI	DR289	Thallium	1.2E-01	3.6						
EPA SI	DR281	Thallium	1.1E-01	3.6						
EPA SI	DR251	Thallium	9.0E-02	1.9						
EPA SI	DR250	Thallium	8.0E-02	1.9						
LDWRI-Benthic	B9a	Thallium	7.6E-02	2.1						
EPA SI	DR247	Thallium	7.0E-02	2.0						
EPA SI	DR280	Thallium	7.0E-02	2.5						
EPA SI	DR248	Thallium	6.0E-02	2.3						
EPA SI	DR249	Thallium	6.0E-02	1.5						
EPA SI	DR252	Thallium	5.0E-02	1.7						
EPA SI	DR253	Thallium	5.0E-02	1.6						
EPA SI	DR254	Thallium	5.0E-02	1.9						
EPA SI	DR272	Thallium	5.0E-02	0.1						
EPA SI	DR254	Tin	3.5E+02	1.9						
EPA SI	DR253	Tin	4.0E+00	1.6						
Boeing SiteChar	R63	Total HPAH (calc'd)	1.1E+01	1.5	7.4E+02	960	5300	mg/kg OC	0.77	0.14
Boeing SiteChar	R77	Total HPAH (calc'd)	6.6E+00 J	1.4	4.7E+02	960	5300	mg/kg OC	0.49	0.09
Boeing SiteChar	R62	Total HPAH (calc'd)	5.8E+00	1.8	3.2E+02	960	5300	mg/kg OC	0.33	0.06
Boeing SiteChar	R65	Total HPAH (calc'd)	3.2E+00	1.6	2.0E+02	960	5300	mg/kg OC	0.21	0.04
LDWRI-SurfaceSedimentRound2	LDW-SS137	Total HPAH (calc'd)	3.0E+00	3.0	1.0E+02	960	5300	mg/kg OC	0.11	0.02
EPA SI	DR253	Total HPAH (calc'd)	2.6E+00	1.6	1.7E+02	960	5300	mg/kg OC	0.17	0.03
EPA SI	DR281	Total HPAH (calc'd)	1.9E+00	3.6	5.3E+01	960	5300	mg/kg OC	0.06	0.01
Boeing SiteChar	R73	Total HPAH (calc'd)	1.6E+00	2.4	6.6E+01	960	5300	mg/kg OC	0.07	0.01
Boeing SiteChar	R64	Total HPAH (calc'd)	1.5E+00	2.2	7.0E+01	960	5300	mg/kg OC	0.07	0.01
EPA SI	DR280	Total HPAH (calc'd)	1.5E+00	2.5	6.0E+01	960	5300	mg/kg OC	0.06	0.01
EPA SI	DR289	Total HPAH (calc'd)	1.5E+00	3.6	4.1E+01	960	5300	mg/kg OC	0.04	0.01
EPA SI	DR248	Total HPAH (calc'd)	1.4E+00	2.3	6.2E+01	960	5300	mg/kg OC	0.07	0.01
Boeing SiteChar	R67	Total HPAH (calc'd)	1.2E+00	1.9	6.3E+01	960	5300	mg/kg OC	0.07	0.01
EPA SI	DR272	Total HPAH (calc'd)	1.2E+00	0.1		12000	17000	ug/kg dw	0.10	0.07
Boeing SiteChar	R76	Total HPAH (calc'd)	1.2E+00 J	2.0	5.9E+01	960	5300	mg/kg OC	0.06	0.01
Boeing SiteChar	R79	Total HPAH (calc'd)	1.2E+00	1.1	1.1E+02	960	5300	mg/kg OC	0.11	0.02
Boeing SiteChar	R68	Total HPAH (calc'd)	1.1E+00 J	2.0	5.3E+01	960	5300	mg/kg OC	0.06	0.01
Boeing SiteChar	R75	Total HPAH (calc'd)	1.0E+00 J	1.8	5.8E+01	960	5300	mg/kg OC	0.06	0.01
EPA SI	DR247	Total HPAH (calc'd)	9.7E-01	2.0	4.9E+01	960	5300	mg/kg OC	0.05	0.01
LDWRI-SurfaceSedimentRound1	LDW-SS142	Total HPAH (calc'd)	9.6E-01	2.0	4.9E+01	960	5300	mg/kg OC	0.05	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
LDWRI-Benthic	B9a	Total HPAH (calc'd)	9.3E-01	2.1	4.3E+01	960	5300	mg/kg OC	0.05	0.01
Boeing SiteChar	R81	Total HPAH (calc'd)	9.2E-01 J	1.3	7.1E+01	960	5300	mg/kg OC	0.07	0.01
EPA SI	DR252	Total HPAH (calc'd)	9.1E-01	1.7	5.4E+01	960	5300	mg/kg OC	0.06	0.01
Boeing SiteChar	R74	Total HPAH (calc'd)	9.0E-01 J	1.5	6.0E+01	960	5300	mg/kg OC	0.06	0.01
Boeing SiteChar	R69	Total HPAH (calc'd)	8.4E-01	1.4	6.0E+01	960	5300	mg/kg OC	0.06	0.01
EPA SI	DR251	Total HPAH (calc'd)	8.4E-01	1.9	4.5E+01	960	5300	mg/kg OC	0.05	0.01
Boeing SiteChar	R66	Total HPAH (calc'd)	7.9E-01	1.2	6.6E+01	960	5300	mg/kg OC	0.07	0.01
Boeing SiteChar	R70	Total HPAH (calc'd)	7.0E-01 J	1.1	6.4E+01	960	5300	mg/kg OC	0.07	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS138	Total HPAH (calc'd)	6.9E-01	1.8	3.9E+01	960	5300	mg/kg OC	0.04	0.01
Boeing SiteChar	R60	Total HPAH (calc'd)	6.3E-01	1.2	5.3E+01	960	5300	mg/kg OC	0.06	0.01
Boeing SiteChar	R71	Total HPAH (calc'd)	6.1E-01	2.0	3.1E+01	960	5300	mg/kg OC	0.03	0.01
EPA SI	DR249	Total HPAH (calc'd)	5.7E-01	1.5	3.9E+01	960	5300	mg/kg OC	0.04	0.01
EPA SI	DR250	Total HPAH (calc'd)	5.2E-01	1.9	2.8E+01	960	5300	mg/kg OC	0.03	0.01
Boeing SiteChar	R72	Total HPAH (calc'd)	4.9E-01 J	1.0	5.1E+01	960	5300	mg/kg OC	0.05	0.01
Boeing SiteChar	R61	Total HPAH (calc'd)	4.7E-01	1.4	3.4E+01	960	5300	mg/kg OC	0.04	0.01
Boeing SiteChar	R78	Total HPAH (calc'd)	3.8E-01 J	1.6	2.4E+01	960	5300	mg/kg OC	0.03	0.005
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Total HPAH (calc'd)	2.8E-01	2.4	1.2E+01	960	5300	mg/kg OC	0.01	0.002
Boeing SiteChar	R80	Total HPAH (calc'd)	5.2E-02	1.2	4.3E+00	960	5300	mg/kg OC	0.005	0.001
Boeing SiteChar	R63	Total LPAH (calc'd)	1.7E+00	1.5	1.1E+02	370	780	mg/kg OC	0.30	0.14
Boeing SiteChar	R77	Total LPAH (calc'd)	1.3E+00	1.4	9.2E+01	370	780	mg/kg OC	0.25	0.12
Boeing SiteChar	R62	Total LPAH (calc'd)	8.4E-01	1.8	4.7E+01	370	780	mg/kg OC	0.13	0.06
Boeing SiteChar	R75	Total LPAH (calc'd)	4.3E-01	1.8	2.4E+01	370	780	mg/kg OC	0.07	0.03
Boeing SiteChar	R65	Total LPAH (calc'd)	4.0E-01	1.6	2.5E+01	370	780	mg/kg OC	0.07	0.03
Boeing SiteChar	R79	Total LPAH (calc'd)	4.0E-01	1.1	3.6E+01	370	780	mg/kg OC	0.10	0.05
EPA SI	DR253	Total LPAH (calc'd)	3.9E-01	1.6	2.5E+01	370	780	mg/kg OC	0.07	0.03
LDWRI-SurfaceSedimentRound1	LDW-SS142	Total LPAH (calc'd)	2.8E-01	2.0	1.4E+01	370	780	mg/kg OC	0.04	0.02
LDWRI-SurfaceSedimentRound2	LDW-SS137	Total LPAH (calc'd)	2.8E-01	3.0	9.5E+00	370	780	mg/kg OC	0.03	0.01
Boeing SiteChar	R81	Total LPAH (calc'd)	2.1E-01	1.3	1.6E+01	370	780	mg/kg OC	0.04	0.02
Boeing SiteChar	R73	Total LPAH (calc'd)	1.8E-01	2.4	7.5E+00	370	780	mg/kg OC	0.02	0.01
EPA SI	DR281	Total LPAH (calc'd)	1.8E-01	3.6	4.9E+00	370	780	mg/kg OC	0.01	0.01
LDWRI-Benthic	B9a	Total LPAH (calc'd)	1.4E-01 J	2.1	6.7E+00	370	780	mg/kg OC	0.02	0.01
Boeing SiteChar	R64	Total LPAH (calc'd)	1.4E-01	2.2	6.4E+00	370	780	mg/kg OC	0.02	0.01
EPA SI	DR289	Total LPAH (calc'd)	1.4E-01	3.6	3.9E+00	370	780	mg/kg OC	0.01	0.01
EPA SI	DR248	Total LPAH (calc'd)	1.2E-01	2.3	5.3E+00	370	780	mg/kg OC	0.01	0.01
EPA SI	DR272	Total LPAH (calc'd)	1.2E-01	0.1		5200	13000	ug/kg dw	0.02	0.01
EPA SI	DR280	Total LPAH (calc'd)	1.2E-01	2.5	4.7E+00	370	780	mg/kg OC	0.01	0.01
Boeing SiteChar	R76	Total LPAH (calc'd)	1.1E-01	2.0	5.5E+00	370	780	mg/kg OC	0.02	0.01
Boeing SiteChar	R68	Total LPAH (calc'd)	1.0E-01	2.0	5.0E+00	370	780	mg/kg OC	0.01	0.01

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
Boeing SiteChar	R67	Total LPAH (calc'd)	9.0E-02	1.9	4.7E+00	370	780	mg/kg OC	0.01	0.01
EPA SI	DR247	Total LPAH (calc'd)	9.0E-02	2.0	4.5E+00	370	780	mg/kg OC	0.01	0.01
Boeing SiteChar	R70	Total LPAH (calc'd)	8.4E-02	1.1	7.6E+00	370	780	mg/kg OC	0.02	0.01
Boeing SiteChar	R66	Total LPAH (calc'd)	8.3E-02	1.2	6.9E+00	370	780	mg/kg OC	0.02	0.01
EPA SI	DR252	Total LPAH (calc'd)	8.0E-02	1.7	4.8E+00	370	780	mg/kg OC	0.01	0.01
Boeing SiteChar	R69	Total LPAH (calc'd)	7.6E-02	1.4	5.4E+00	370	780	mg/kg OC	0.02	0.01
EPA SI	DR251	Total LPAH (calc'd)	7.0E-02	1.9	3.7E+00	370	780	mg/kg OC	0.01	0.005
Boeing SiteChar	R74	Total LPAH (calc'd)	6.9E-02	1.5	4.6E+00	370	780	mg/kg OC	0.01	0.01
Boeing SiteChar	R72	Total LPAH (calc'd)	6.6E-02	1.0	6.8E+00	370	780	mg/kg OC	0.02	0.01
EPA SI	DR249	Total LPAH (calc'd)	6.0E-02	1.5	4.1E+00	370	780	mg/kg OC	0.01	0.01
LDWRI-SurfaceSedimentRound2	LDW-SS138	Total LPAH (calc'd)	6.0E-02	1.8	3.4E+00	370	780	mg/kg OC	0.01	0.004
Boeing SiteChar	R71	Total LPAH (calc'd)	5.7E-02	2.0	2.9E+00	370	780	mg/kg OC	0.01	0.004
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Total LPAH (calc'd)	5.7E-02	2.4	2.3E+00	370	780	mg/kg OC	0.01	0.003
Boeing SiteChar	R60	Total LPAH (calc'd)	5.6E-02	1.2	4.7E+00	370	780	mg/kg OC	0.01	0.01
EPA SI	DR250	Total LPAH (calc'd)	5.0E-02	1.9	2.6E+00	370	780	mg/kg OC	0.01	0.003
Boeing SiteChar	R78	Total LPAH (calc'd)	4.6E-02	1.6	2.9E+00	370	780	mg/kg OC	0.01	0.004
Boeing SiteChar	R61	Total LPAH (calc'd)	4.5E-02	1.4	3.2E+00	370	780	mg/kg OC	0.01	0.004
Boeing SiteChar	R80	Total LPAH (calc'd)	4.3E-02	1.2	3.6E+00	370	780	mg/kg OC	0.01	0.005
EPA SI	DR289	Tributyltin as ion	1.1E-02 J	3.6						
EPA SI	DR253	Tributyltin as ion	4.0E-03 J	1.6						
LDWRI-Benthic	B9a	Tributyltin as ion	1.6E-03 J	2.1						
EPA SI	DR249	Tributyltin as ion	1.0E-03 J	1.5						
EPA SI	DR251	Tributyltin as ion	1.0E-03 J	1.9						
LDWRI-SurfaceSedimentRound2	LDW-SS137	Vanadium	7.3E+01	3.0						
LDWRI-SurfaceSedimentRound1	LDW-SS142	Vanadium	7.1E+01	2.0						
EPA SI	DR289	Vanadium	7.0E+01	3.6						
EPA SI	DR281	Vanadium	6.7E+01	3.6						
EPA SI	DR272	Vanadium	6.6E+01	0.1						
EPA SI	DR250	Vanadium	6.5E+01	1.9						
LDWRI-SurfaceSedimentRound2	LDW-SS138	Vanadium	6.4E+01	1.8						
EPA SI	DR251	Vanadium	6.3E+01	1.9						
EPA SI	DR253	Vanadium	6.3E+01	1.6						
EPA SI	DR248	Vanadium	5.6E+01	2.3						
EPA SI	DR280	Vanadium	5.6E+01	2.5						
EPA SI	DR247	Vanadium	5.5E+01	2.0						
LDWRI-Benthic	B9a	Vanadium	5.4E+01	2.1						
EPA SI	DR249	Vanadium	5.3E+01	1.5						
EPA SI	DR252	Vanadium	5.1E+01	1.7						

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Vanadium	4.3E+01	2.4						
EPA SI	DR254	Vanadium	3.8E+01	1.9						
Boeing SiteChar	R75	Zinc	1.2E+02	1.8		410	960	mg/kg dw	0.28	0.12
EPA SI	DR281	Zinc	1.0E+02	3.6		410	960	mg/kg dw	0.25	0.11
EPA SI	DR289	Zinc	9.7E+01	3.6		410	960	mg/kg dw	0.24	0.10
LDWRI-SurfaceSedimentRound2	LDW-SS137	Zinc	9.6E+01	3.0		410	960	mg/kg dw	0.23	0.10
Boeing SiteChar	R64	Zinc	9.1E+01	2.2		410	960	mg/kg dw	0.22	0.10
Boeing SiteChar	R68	Zinc	9.1E+01	2.0		410	960	mg/kg dw	0.22	0.10
Boeing SiteChar	R65	Zinc	9.0E+01	1.6		410	960	mg/kg dw	0.22	0.09
Boeing SiteChar	R74	Zinc	8.9E+01	1.5		410	960	mg/kg dw	0.22	0.09
LDWRI-SurfaceSedimentRound1	LDW-SS142	Zinc	8.8E+01	2.0		410	960	mg/kg dw	0.21	0.09
Boeing SiteChar	R63	Zinc	8.7E+01	1.5		410	960	mg/kg dw	0.21	0.09
Boeing SiteChar	R73	Zinc	8.7E+01	2.4		410	960	mg/kg dw	0.21	0.09
Boeing SiteChar	R62	Zinc	8.4E+01	1.8		410	960	mg/kg dw	0.20	0.09
EPA SI	DR280	Zinc	8.1E+01	2.5		410	960	mg/kg dw	0.20	0.08
EPA SI	DR248	Zinc	8.0E+01	2.3		410	960	mg/kg dw	0.20	0.08
Boeing SiteChar	R67	Zinc	7.9E+01	1.9		410	960	mg/kg dw	0.19	0.08
Boeing SiteChar	R71	Zinc	7.9E+01	2.0		410	960	mg/kg dw	0.19	0.08
EPA SI	DR253	Zinc	7.8E+01	1.6		410	960	mg/kg dw	0.19	0.08
LDWRI-SurfaceSedimentRound2	LDW-SS138	Zinc	7.7E+01	1.8		410	960	mg/kg dw	0.19	0.08
Boeing SiteChar	R80	Zinc	7.6E+01	1.2		410	960	mg/kg dw	0.19	0.08
Boeing SiteChar	R61	Zinc	7.5E+01	1.4		410	960	mg/kg dw	0.18	0.08
EPA SI	DR251	Zinc	7.5E+01	1.9		410	960	mg/kg dw	0.18	0.08
EPA SI	DR250	Zinc	7.4E+01	1.9		410	960	mg/kg dw	0.18	0.08
Boeing SiteChar	R76	Zinc	7.3E+01	2.0		410	960	mg/kg dw	0.18	0.08
EPA SI	DR272	Zinc	7.3E+01	0.1		410	960	mg/kg dw	0.18	0.08
EPA SI	DR247	Zinc	7.2E+01	2.0		410	960	mg/kg dw	0.18	0.08
Boeing SiteChar	R60	Zinc	7.1E+01	1.2		410	960	mg/kg dw	0.17	0.07
Boeing SiteChar	R77	Zinc	7.1E+01	1.4		410	960	mg/kg dw	0.17	0.07
EPA SI	DR252	Zinc	7.1E+01	1.7		410	960	mg/kg dw	0.17	0.07
LDWRI-Benthic	B9a	Zinc	7.1E+01	2.1		410	960	mg/kg dw	0.17	0.07
Boeing SiteChar	R66	Zinc	6.9E+01	1.2		410	960	mg/kg dw	0.17	0.07
Boeing SiteChar	R69	Zinc	6.8E+01	1.4		410	960	mg/kg dw	0.17	0.07
Boeing SiteChar	R70	Zinc	6.7E+01	1.1		410	960	mg/kg dw	0.16	0.07
EPA SI	DR249	Zinc	6.3E+01	1.5		410	960	mg/kg dw	0.15	0.07
Boeing SiteChar	R72	Zinc	6.1E+01	1.0		410	960	mg/kg dw	0.15	0.06
Boeing SiteChar	R79	Zinc	6.0E+01	1.1		410	960	mg/kg dw	0.15	0.06
Boeing SiteChar	R78	Zinc	5.8E+01	1.6		410	960	mg/kg dw	0.14	0.06

Table A-1
Surface Sediment Sampling Results
RM 4.3-4.9 East (BDC)

Sampling Event	Sample Location	Chemical	Conc'n (mg/kg DW)	TOC %	Conc'n (mg/kg OC)	SQS	CSL	Units	SQS Exceedance Factor[a]	CSL Exceedance Factor[a]
EPA SI	DR254	Zinc	5.4E+01	1.9		410	960	mg/kg dw	0.13	0.06
LDWRI-SurfaceSedimentRound2	LDW-SSB9a	Zinc	5.0E+01	2.4		410	960	mg/kg dw	0.12	0.05
Boeing SiteChar	R81	Zinc	1.6E+01	1.3		410	960	mg/kg dw	0.04	0.02

Table presents detections only.

DW - Dry weight
OC - Organic carbon normalized
TOC - Total organic carbon
SQS - Sediment Quality Standard
CSL - Cleanup Screening Level
J - The analyte was positively identified, the associated numerical value is the approximate concentration of the analyte in the sample
JN - The analyte was tentatively identified, the associated numerical value is the approximate concentration of the analyte in the sample

No subsurface sediment data have been collected in this area.
a - Exceedance factors are the ratio of the detected concentration to the CSL or SQS; an exceedance factor greater than 1 indicates that the measured concentration is higher than the corresponding CSL or SQS.

Appendix B

Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)

Historical Aerial Photograph Review

Appendix B
Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)
Historical Aerial Photograph Review

In an effort to more thoroughly understand and evaluate historical facility operations and development in the RM 4.3-4.9 East (Boeing Developmental Center) source control area, SAIC reviewed historical aerial photographs from 1936 to 2004. At a minimum, these photographs represent conditions of roughly each decade. Additional photographs are available; however, if during a cursory assessment there were no apparent changes, photographs less than a decade apart were not included in this summary. The aerial photographs for the years 1936, 1946, 1956, 1960, 1969, 1977, 1980, 1990, 1999, and 2004 are described below.

1936

Slip 6 is already well defined and appears similar to the current size and shape although it is narrower at its entrance due to the presence of mudflats on the north side. There are logs floating in the slip adjacent to the lumber mill. No piers are in the slip at this time. The area immediately to the north of Slip 6 (Container Properties LLC) appears cleared but undeveloped.

The area south of Slip 6 was occupied by a lumber mill, as evidenced by the logs floating in the slip and what appear to be upwards of 100 stacks of milled lumber. One or two large buildings and possibly some smaller buildings comprised the lumber mill. The land immediately south of the lumber mill was cleared and vacant. To the northeast of the vacant land, adjacent to what is now Marginal Way and at the northern boundary of the Museum of Flight, were what appear to be four or five small structures and possibly a circular tank. Just south were two more buildings and some unidentified structures. These buildings were in the area approximately where Building 9-04 (the Museum of Flight) exists today and may have been the former location of Washington Compressed Gas or the American Winegrower's Association winery described in the RCRA assessment document (SAIC 1994). What appear to be four round tanks can be seen behind the buildings. Further to the south, a large building fronted Marginal Way where the current large parking lot north of S 96th Place is today. The purpose of this building is unknown.

To the south of S 96th Place were a collection of buildings and cleared land that may have been the stockyard and meat packing plant described in the RCRA assessment (SAIC 1994). Although no railroad tracks can be seen in the photo, there appears to be a line of railroad cars between the buildings and Marginal Way. The BDC RCRA assessment indicated that railroads once occupied part of the property, although the time period and location was not known. Further south of S 96th Place, at about where Building 9-110 and the eastern portion of Building 9-101 are today, was a large complex of buildings including at least one warehouse-sized structure. These buildings may have been associated with the stockyard and slaughterhouse as they appear to have been connected to the stockyard. A cluster of buildings, three residence-sized and one larger, fronted Marginal Way to the south in the area that is now the eastern portion of the south parking lots. One of those residences still exists at 10035 East Marginal Way South and is owned by East Marginal Associates; this residence is not a part of the BDC facility. This cluster of buildings likely included the grocery store and gas station described in the RCRA assessment because the assessment mentions that the grocery/warehouse building burned down in the 1940s and the larger of the buildings appears razed and the ground blackened in the 1946 photograph.

South of the vacant area to the south of the lumber mill were two more buildings in the approximate location of the current Building 9-99, and another small slip with floating logs. South of the small former Slip 7 there was at least one large building and possibly two or three smaller buildings. This area also contained stacks of logs and/or milled lumber. East of Slip 7 the land appears to have been cultivated. Three buildings are clearly visible at the northern edge of the farmed land. Another building, potentially a residence, was located just off the LDW at the southern edge of the farmed land approximately in the area of the current Building 9-120. The in-water structures that can be seen south of Buildings 9-120 and 9-80 in current aerial photos are visible in the view from 1936.

With the exception of the structures mentioned above, and a possible small dock at the southern end of the northernmost lumber mill, there appears to be relatively little use of the LDW for moorage or waterway. A possible wall or riprap structure is visible along the LDW shoreline for almost the entire length of what is now S 104th Street. In 1936 there were multiple structures fronting the north side of that road with more cultivated land behind them to the north. Those buildings would have occupied the land where the southern parking lots now lie.

The area to the south, currently referred to as the Strick Lease Storage Yard, was primarily cultivated with two or three possibly residential buildings along the road that is known as S 104th Street.

1946

This photograph documents the increased development taking place along the LDW. The eastern half of Slip 6 appeared to have silted in. Several of the buildings from the lumber mill on the southwest side of Slip 6 had been razed and the piles of milled lumber were no longer present on that portion of the property. A large shadow indicates the presence of some kind of tower or stack at this location.

One of the buildings and the possible tank structure in the northeast corner are no longer visible in 1946. To the south, the four tanks seen in the 1936 photograph cannot be seen in the one taken in 1946. However, additional structures were constructed in that area and 12 tanks (4 large and 8 smaller) were constructed farther back from Marginal Way.

The two buildings to the south seen in the 1936 photograph were razed some time before 1946 and more structures were present just south of that area. Additional structures are also visible in the area where the stockyard and slaughterhouse appeared to be in 1936. A line of train cars were also present between the buildings and Marginal Way.

To the south of the stockyard the large grocery/warehouse building visible along Marginal Way in the 1936 photograph appears razed and the ground blackened in the 1946 photograph. The area that today is the south parking lots and Strick Lease Storage Yard appeared largely cultivated or vacant in 1946, with the exception of the portions of the property directly adjacent to the roads.

The smaller of the two buildings north of Slip 7 had been razed and the slip itself appeared to be largely filling in with the only water being in a creek with small branches. Three additional structures were built to the east of the lumber piles at this slip and a cluster of small structures were built across the road to the northeast of the mill. To the north of Slip 7 a ladder or stair type structure had been built out into the LDW and four or five boats were moored along the shore.

The small structure (a residence?) visible southeast of the lumber yard on Slip 7 in the 1936 photograph appears to have been razed by the time the 1946 photograph was taken. The adjacent land to the west also appears to have been cultivated.

1956

The interior portion of Slip 6 appears to have silted in, with water entering the slip from the north side. The land across Slip 6 at the current Container Properties location was developed with multiple buildings and 2 large and 12 smaller storage tanks. The area on the south side of Slip 6 that was occupied by the lumber yard appears to have been covered in debris. Only one of the buildings seen in the 1936 photograph was still present in 1956. There also appears to be multiple railroad tracks crossing this area with two lines of cars going right up to the LDW shoreline. Two ships were tied up along the LDW shoreline just south of Slip 6. The 77,000-square foot granary was built south of the lumber mill within the last decade and can be seen in this photograph.

East of the granary, an additional large building was constructed and the four large and eight smaller storage tanks were more clearly visible. Additional structures were constructed to the south, in approximately the area that is currently the south side of Building 9-51. More structures were also constructed along the south side of what is now S 96th Place.

The area that was likely the stockyard seen in the photographs from 1936 and 1946 was almost entirely cleared by 1956. No train cars appear in that area of the property in 1956. Clearing of land in the central southern portion of the property was begun for construction of what are now Buildings 9-101, 9-50, 9-65, 9-80, 9-120, 9-130, and 9-140.

The lumber yard at Slip 7 was still apparent in 1956, with multiple buildings, log booms, and stacks of milled lumber.

The auto wrecking yard is clearly visible in the area that is currently the south parking lots and the Strick Lease Storage Yard. There appears to be one large possible warehouse structure immediately north of the wrecking yard with an additional large building north of that. It is unclear if those buildings are associated with the wrecking yard or were a separate entity. Approximately nine structures appeared to be within the wrecking yard lot.

1960

A large building appears to be either under construction or demolition on the south shore of Slip 6 at the former location of the lumber mill. The ground appears to be covered in debris in several places in this area. There were multiple lines of train cars in this area, with some stopped right by the LDW shoreline. No boats or barges, however, were tied up along the shore in this area. At least one of the train lines serviced the granary. Southeast of the granary, the eight smaller storage tanks were removed, with the four larger tanks remaining.

Slip 7 in the central portion of the property was still being used to float lumber in 1960. Slip 7 was in the area now occupied by the northern portion of Building 9-96 and the western portion of Building 9-98. The building on the north side of Slip 7 was either partially or totally demolished; in the photograph taken in 1960 a small building or portion of the larger building was still standing. At least one dozen structures associated with the lumber mill as well as dozens of stacks of milled lumber can be seen on the land south of the slip.

The two buildings seen in the 1956 photograph in the approximate location of the current Building 9-55 were demolished and the land cleared in the 1960 photograph.

The following buildings were constructed on the southern half of the property by Boeing: 9-101 (smaller in 1960 than it is today), 9-50, 9-65, 9-80, 9-120, 9-130, and 9-140. There is also a structure in the 1960 aerial photograph in the approximate location of what is now Building 9-94 or the adjacent parking lot; however, that structure does not appear to have the size and shape, and it may have been completely or partially torn down prior to construction of Building 9-94 in 1961. Most of the southern half of the property was converted to impermeable surfaces during the period between the photographs taken in 1956 and 1960. A large circular storage tank was present at the north edge of the paved Boeing property, south of S 96th Place.

The large building complex that was just southwest of the stockyard in the earlier photographs was still present in 1960, surrounded by Boeing operations and buildings to the north and west. The two warehouse-sized buildings on the north side of the auto wrecking yard were replaced by what appears to be a dirt parking lot with some grassy or cleared space in the middle. It is unclear if the parking area was part of Boeing at that time. The wrecked cars as well as two of the 6 structures fronting Marginal Way had been removed. The bridge across the LDW at S 102nd Street was constructed.

The northern half of the Strick Lease Storage Yard to the south of the BDC was still vacant at the time the photograph was taken in 1960. A large swath of land to the east across Marginal Way was paved to create the Military Flight Center.

1969

In 1969, Slip 6 was dredged and was in the shape and size it is today although the shoreline still appeared soft. Traces of the old lumber mill, including what appeared to be debris piles in the photographs from 1956 and 1960, were no longer apparent in 1969. Land at the head of the slip was a storage yard for what appear to be either train cars or trucks. No train cars are visible in the area of the former lumber mill or by the granary. A structure was built out into the LDW at the end of one of the rail lines southwest of the granary. The relatively tall shadow cast by the structure indicates it may have been a covered loading dock.

The cluster of approximately 10 buildings that were north of S 96th Place were demolished and replaced with a parking lot.

Buildings constructed during the previous period included: 9-35, 9-43, 9-48, 9-49, 9-59, 9-60, 9-61, 9-85, 9-90, 9-94, 9-96, and 9-98. Building 9-101 was expanded onto the parking lots to the east and south. Slip 7 was completely filled in and Building 9-99 and a large parking area were constructed in its place.

The building complex south of Building 9-101 that was formerly adjacent to the stockyard was demolished and replaced with part of the new building and a parking lot. Three structures were constructed on the very southern portion of the property north of S 102nd Street and it appeared to be used for storage of some kind. The Strick Lease Storage Yard property was cleared at the time the 1969 photograph was taken.

The sunken structure visible along the shoreline just downstream of the S 102nd Street bridge in current photographs can be seen in the photograph taken in 1969. It is possible this may have been a barge tied up along the shore or a ramp.

1977

The six dock structures on the southern shoreline of Slip 6 were constructed and the shoreline appears hardened in the photograph taken in 1977. The area to the north of the granary appears to have been entirely paved and used for material transfers at the docks. The overwater structure that had been southwest of the granary was demolished or removed and the shoreline straightened and hardened or rip rapped from Slip 6 south to the Seattle City Light right-of-way.

The building that had been immediately south of the granary, and which may have been associated with the winery, had been demolished along with the four round storage tanks. Two new structures are visible immediately adjacent to the granary building on the southeast side.

A line of rail cars is clearly visible at the northeastern part of the property and the three buildings that had been in that area in 1969 were razed. The Port of Seattle bought this property in 1976 (SAIC 1994) and leased the land to Kenworth Truck Company and Transport Pool International for parking and storage.

Apart from the occasional tree, the strip of land that is currently the Seattle City Light right-of-way is the only area on the property in 1977 that appears to have had any vegetation. The right-of-way was clearly defined in this photograph although the overhead power lines were not yet visible.

Buildings 9-64 and 9-66 were constructed in 1970 and 1975, respectively.

More materials appear to be stored in the southernmost portion of the property that later became part of the south parking lots.

1980

A small watercraft can be seen moored in Slip 6. The northeast portion of the property is clearly entirely paved in the photograph. Truck trailers can be seen stored in this area. No rail cars are evident, and it is unknown if the railroad tracks were still in existence in this area. To the south, the operations of Dallas-Mavis, a commercial trucking company (SAIC 1994), can be seen where upwards of one hundred big-rigs are parked.

Most of the structures and materials surrounding the granary building, including its loading/unloading structure, had been removed. A large debris pile can be seen adjacent to the LDW southwest of the granary. To the south, the power lines can be seen crossing the LDW from the Seattle City Light right-of-way.

Building 9-69/70 was constructed in 1980. However, a recent map of the BDC (Boeing 2009c) does not label this building and it is unclear from earlier maps (e.g., Figure 16 in EAA-7 Data Gaps Report by E&E 2007) if it is visible in the photograph taken in 1980. Building 9-54 was also constructed in 1980 but it does not appear to have been completed before the aerial photo was taken.

Rusty metal colored materials appear to be stored in the southernmost portion of the property that later became part of the south parking lots. What appear to be very large tires (tractor or trailer-sized?) can also be seen in this area in the 1980 photograph.

What might be a barge can be seen along the shoreline just north of the S 102nd Street bridge at the ramp-like structure. There appears to be one or two cranes onshore northwest of the structure in the water.

1990

Several buildings were constructed at the BDC during the 1980s and the property began to look largely the way it does today. Buildings 9-05 and 9-07 can be seen in the northern part of the property as well as a large circular tank and Building 9-403, which is now part of the Museum of Flight. The Dallas-Mavis building can be seen but it does not appear as though that company was still operating on the property as the commercial trucks are gone and there were only a few trailers. The rest of that area was converted to parking.

The granary was demolished and Buildings 9-08 and 9-77 built in its location in 1990 and 1986, respectively. Large parking lots and small amounts of landscaping surrounded those buildings. To the south, a walking path and landscaping can be seen in the Seattle City Light right-of-way. To the east, the buildings that may have comprised the winery were demolished and replaced with Building 9-51, which was constructed in 1986. Building 9-52 was constructed west of 9-51 in that same year. A large parking lot was constructed southeast of Building 9-51. In 1987, the large Building 9-53 was constructed to the south of Building 9-52, between the right-of-way and S 96th Place.

Buildings 9-42 and 9-67 were constructed east of Building 9-50 in 1985. Building 9-103, directly adjacent to the north wall of 9-101, was also constructed in 1985. Four new structures that no longer exist can be seen in the photograph to the north and east of the northeast corner of Building 9-101. Building 9-102 was constructed to the southwest corner of Building 9-101 in 1983. A bridge was constructed over the LDW at the intersection of Francis Street and S 98th Street. What appears to be multiple above ground storage tanks (ASTs) can be seen on the perimeter of Building 9-101 on the southeast and southwest sides. Another structure that may have been a large AST can be seen just west of the bridge at S 98th Street by Building 9-85.

The south parking lots appeared in the 1990 photograph as they do today; all storage operations of truck trailers and unknown materials ceased. The crane(s) that had been along the shore northwest of the S 102nd Street bridge in the 1980 photograph was removed by the time the 1990 photograph was taken.

1999

On the northwest section of the site, a portion of the parking lot closest to the LDW was reclaimed as natural area and Building 9-112 (the cafeteria) was constructed in 1991. According to King County tax records, this was the last building constructed on the BDC property. An unknown structure or structures can be seen on the north side of S 94th Place between the MOF and Building 9-77.

2004

The only notable change between the 1999 and 2004 photographs is the addition of what might be three air venting structures on the north side of Building 9-50. All other structures and the shoreline appear similar.

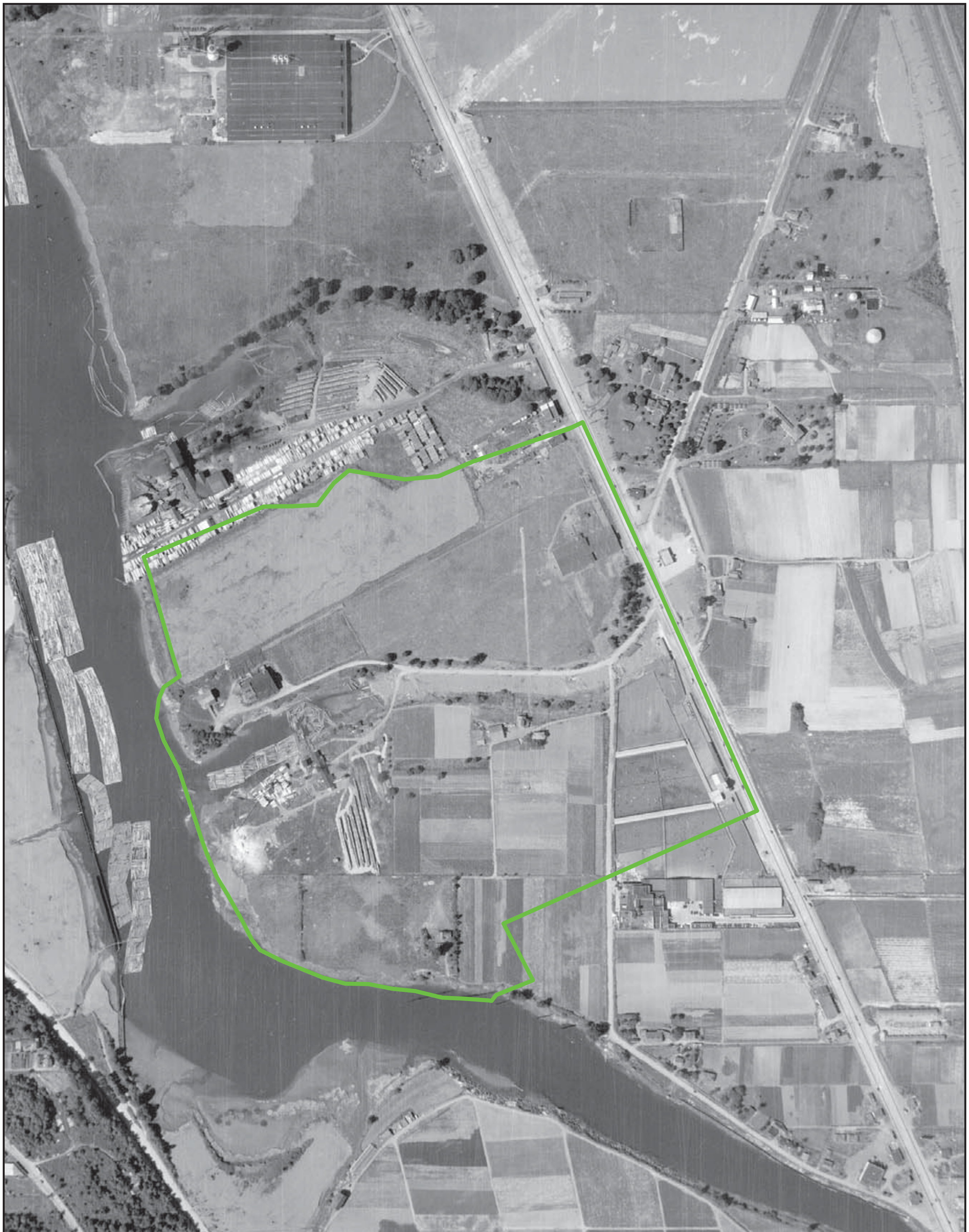

Figure B–1. RM 4.3–4.9 East (Boeing Developmental Center): 1936

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Figure B–2. RM 4.3–4.9 East (Boeing Developmental Center): 1946

Figure B–3. RM 4.3–4.9 East (Boeing Developmental Center): 1956

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Figure B–4. RM 4.3–4.9 East
(Boeing Developmental Center): 1960

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Figure B–5. RM 4.3–4.9 East
(Boeing Developmental Center): 1969

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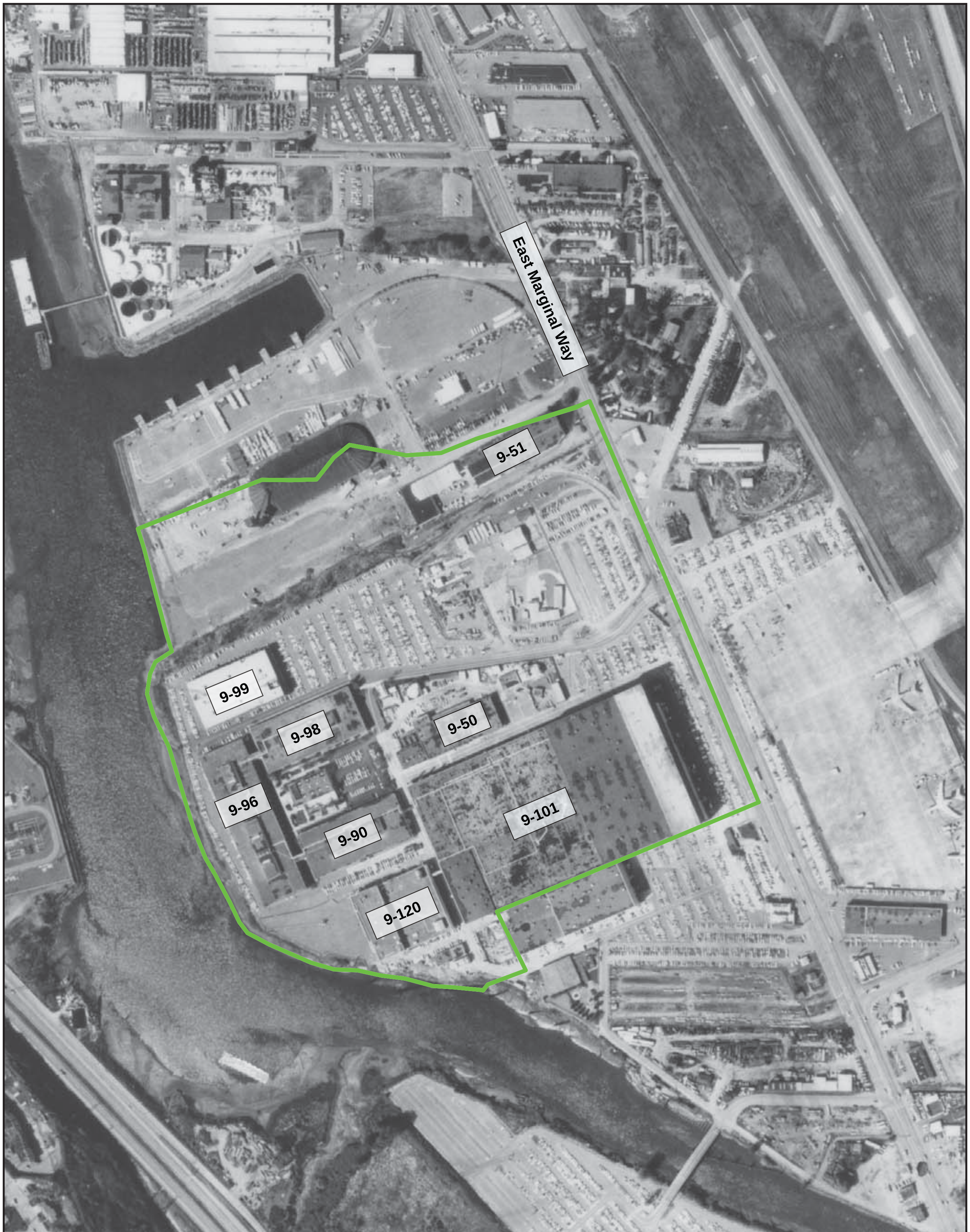

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Figure B–6. RM 4.3–4.9 East (Boeing Developmental Center): 1977

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Figure B–7. RM 4.3–4.9 East (Boeing Developmental Center): 1980

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Figure B–8. RM 4.3–4.9 East (Boeing Developmental Center): 1990

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Figure B–9. RM 4.3–4.9 East (Boeing Developmental Center): 1999

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Figure B–10. RM 4.3–4.9 East (Boeing Developmental Center): 2004

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Appendix C

Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)

Excerpts from BDC RCRA Reports, 2007–2009

Appendix C1 – AOC-05

AOC-05 Remedial Action Plan, November 16, 2007 (Landau 2007b)

Developmental Center Groundwater Monitoring, AOC-05 Data, May 2009 (Landau 2009c)

Technical Memorandum, Update on AOC-05 Full-Scale Bioremediation Results, September 17, 2009 (Landau 2009d)

Work Plan
AOC-05 Remedial Action Plan
Enhanced Anaerobic Biodegradation of Gasoline-Range Petroleum Hydrocarbons
Boeing Developmental Center
Tukwila, Washington

November 16, 2007

Prepared for

The Boeing Company
Seattle, Washington

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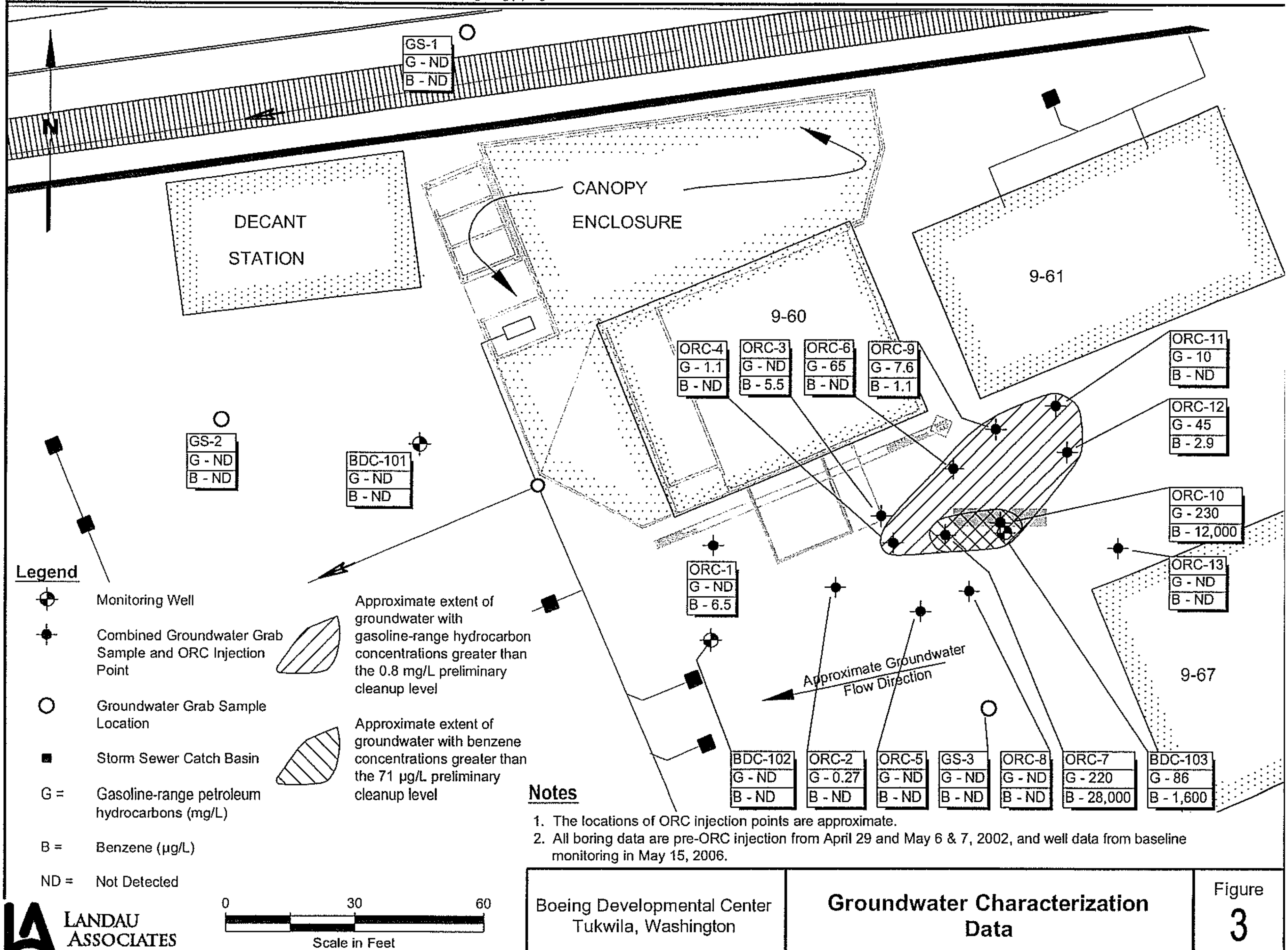
Boeing/Developmental Center | V:\025\093\040\D\AOC-05 Nitrate Full Scale Work Plan\Fig3.dwg (A) "Figure 3" 9/26/2007



Notes

1. The locations of ORC injection points are approximate.
2. All boring data are pre-ORC injection from April 29 and May 6 & 7, 2002, and well data from baseline monitoring in May 15, 2006.

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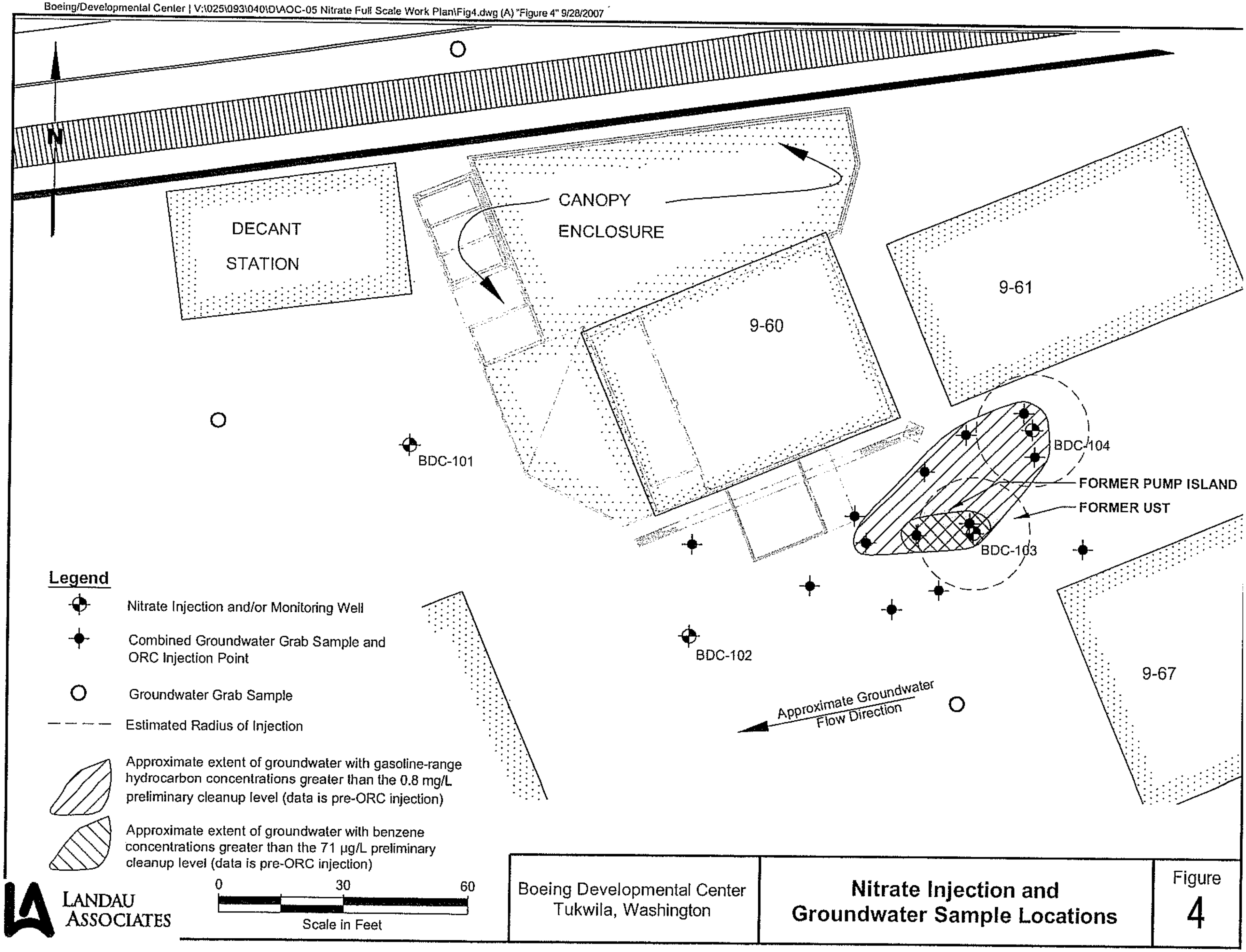
Boeing Developmental Center
Tukwila, Washington

Groundwater Characterization Data

Figure 3


N
DECANT
STATION
CANOPY
ENCLOSURE
9-60
9-61
9-67
BDC-101
BDC-102
BDC-103
BDC-104
FORMER PUMP ISLAND
FORMER UST
Approximate Groundwater
Flow Direction
Legend
Nitrate Injection and/or Monitoring Well
Combined Groundwater Grab Sample and ORC Injection Point
Groundwater Grab Sample
Estimated Radius of Injection
Approximate extent of groundwater with gasoline-range hydrocarbon concentrations greater than the 0.8 mg/L preliminary cleanup level (data is pre-ORC injection)
Approximate extent of groundwater with benzene concentrations greater than the 71 µg/L preliminary cleanup level (data is pre-ORC injection)
0
30
60
Scale in Feet
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Tukwila, Washington
Nitrate Injection and Groundwater Sample Locations
Figure
4

TABLE 1
GROUNDWATER CONTAMINANT DATA
AOC-05
BOEING DEVELOPMENTAL CENTER

	Preliminary Groundwater Levels (a) Screening	Pre-ORC Injection (b) BDC-101 06/11/01	BDC-101 09/04/01	BDC-101 12/03/01	BDC-101 03/13/02	BDC-101 EH92A 04/29/02	Post ORC Injection (b) BDC-101 EK68A 06/03/02	BDC-101 EN04A 07/01/02	BDC-101 EP36A 08/01/02	BDC-101 FA41A 12/02/02
Total Petroleum Hydrocarbons (mg/L)										
Gasoline	0.8	3	5	6.5	0.25 U	0.25 U	0.25 U	0.25 U	0.25 U	0.61
BTEX (µg/L)										
Benzene	71	11.9	7.13 J	95	1.4	1 U	1	1 U	3.1	4.3
Toluene	200,000	1 U	10.7	1.6	1 U	1 U	1 U	1 U	1 U	1 U
Ethylbenzene	29,000	113.1	50.4	750	4.4	2.2	1 U	1 U	2.4	21
m,p-Xylene	NA					1 U	1 U	1 U	1 U	27
o-Xylene	NA					1 U	1 U	1 U	1 U	6.4
Total Xylenes	NA	109.2	53.8	650	2 U	1 U	1 U	1 U	1 U	33.4

	BDC-101 FH27A 03/10/03	BDC-101 FN40A 06/03/03	BDC-101 GB17B 11/19/03	BDC-101 GO82A 04/28/04	BDC-101 HF76A 10/18/04	BDC-101 IA83A 05/10/05	BDC-101 IS89A 11/10/05	BDC-101 JJ26B 05/15/06	BDC-101 KG20B 11/20/06
Total Petroleum Hydrocarbons (mg/L)									
Gasoline	0.25 U	0.25 U	0.42 J	0.25 U	0.64	0.25 U	0.25	0.25 U	1.1
BTEX (µg/L)									
Benzene	1	1 U	13 J	1 U	10	1 U	7.6	1.0 U	10
Toluene	1 U	1 U	1 UJ	1 U	1 U	1 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	4.5	1 U	15 J	1 U	15	1 U	2.6	1.0 U	15
m,p-Xylene	3.2	1 U	35 J	1 U	43	1 U	42	1.0 U	72.0
o-Xylene	1 U	1 U	1 UJ	1 U	1 U	1 U	1.0 U	1.0 U	1.0 U
Total Xylenes	3.2	1 U	35 J	1 U	43	1 U	42	1.0 U	72

	Preliminary Groundwater Levels (a) Screening	Post-Nitrate Injection (c) BDC-101 KO95A 02/20/07	BDC-101 KR82A 03/19/07	BDC-101 KV95A 04/24/07	BDC-101 KZ41A 05/17/07
Total Petroleum Hydrocarbons (mg/L)					
Gasoline	0.8	0.25 U	0.25 U	0.25 U	0.25 U
BTEX (µg/L)					
Benzene	71	1.0 U	1.0 U	1.0 U	1.0 U
Toluene	200,000	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	29,000	1.0 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	NA	1.0 U	1.0 U	1.0 U	1.0 U
o-Xylene	NA	1.0 U	1.0 U	1.0 U	1.0 U
Total Xylenes	NA	1.0 U	1.0 U	1.0 U	1.0 U

TABLE 1
GROUNDWATER CONTAMINANT DATA
AOC-05
BOEING DEVELOPMENTAL CENTER

	Preliminary Groundwater Levels (a) Screening	Pre-ORC Injection (b)					Post ORC Injection (b)												
		BDC-102 06/11/01	BDC-102 09/04/01	BDC-102 12/03/01	BDC-102 03/13/02	BDC-102 EH92B 04/29/02	BDC-102 EK68B 06/03/02	BDC-102 EN04B 07/01/02	BDC-102 EP36B 08/01/02	BDC-102 FA41B 12/02/02	BDC-102 FH27B 03/10/03	BDC-102 FN40B 06/03/03	BDC-102 GB17C 11/19/03	BDC-102 GO82B 04/28/04	BDC-102 HF76B 10/18/04	BDC-102 IA83B 05/10/05	BDC-102 IS89B 11/10/05	BDC-102 JJ26A 05/15/06	BDC-102 KG20A 11/20/06
Total Petroleum Hydrocarbons (mg/L)																			
Gasoline	0.8	0.55	0.38	1.6	0.5	0.33	0.25 U	0.25	0.25 U	0.25 U	0.26	0.25 U	0.99 J	0.40	0.33	0.25 U	0.25 U	0.25 U	0.25 U
BTEX (µg/L)																			
Benzene	71	5.33 J	1.61 J	3.7	1.3	2.6	4.4	1 U	1 U	1 U	1 U	1 U	120 J	10	1 U	1 U	1.0 U	1.0 U	1.0 U
Toluene	200,000	1 U	1.89 J	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	29,000	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 U	8.5 J	1 U	1 U	1 U	1.0 U	1.0 U	1.0 U
m,p-Xylene	NA					1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	3	1 U	1 U	1.0 U	1.0 U	1.0 U
o-Xylene	NA					1 U	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	1 U	1 U	1 U	1.0 U	1.0 U	1.0 U
Total Xylenes	NA	2 U	1.87 J	3.49 J	1 U	1.1	1 U	1 U	1 U	1 U	1 U	1 U	1 UJ	3	1 U	1 U	1.0 U	1.0 U	1.0 U

	Preliminary Groundwater Levels (a) Screening	Post-Nitrate Injection (c)			
		BDC-102 K095B 02/20/07	BDC-102 KR82B 03/19/07	BDC-102 KV95B 04/24/07	BDC-102 KZ41B 05/17/07
Total Petroleum Hydrocarbons (mg/L)					
Gasoline	0.8	0.25 U	0.25 U	0.53	0.25 U
BTEX (µg/L)					
Benzene	71	5.8	18	6.1	1.8
Toluene	200,000	1.0 U	1.0 U	1.0 U	1.0 U
Ethylbenzene	29,000	1.0 U	1.0 U	3.1	1.0 U
m,p-Xylene	NA	1.0 U	32	100	7.4
o-Xylene	NA	1.0 U	1.0 U	1.0 U	1.0 U
Total Xylenes	NA	1.0 U	32	100	7.4

TABLE 1
GROUNDWATER CONTAMINANT DATA
AOC-05
BOEING DEVELOPMENTAL CENTER

	Preliminary Groundwater Levels (a) Screening	Pre-ORC Injection (b) BDC-103 06/11/01	BDC-103 09/04/01	BDC-103 (d) 12/03/01	BDC-103 03/13/02	BDC-103 EH92C 04/29/02	Post ORC Injection (b) BDC-103 EK68C 06/03/02	BDC-103 EN04C 07/01/02	BDC-103 EP36C 08/01/02	BDC-103 FA41C 12/02/02	BDC-103 FH27C 03/10/03	BDC-103 FN40C 06/03/03	BDC-103 GB17D 11/19/03
Total Petroleum Hydrocarbons (mg/L)													
Gasoline	0.8	177	123	120	200	200	200	240	270	250	180	220	180
BTEX (µg/L)													
Benzene	71	875 J	494 J	5,100	1,700	980	960	1,300	4,600	1,400	780	900	850 J
Toluene	200,000	12,010	3,760	2,300,000	17,000	16,000	17,000	16,000	18,000	15,000	13,000	10,000	8,300 J
Ethylbenzene	29,000	1,985 J	419 J	10,000	4,900	5,400	5,100	5,200	5,200	5,000	5,200	5,000	4,500 J
m,p-Xylene	NA					20,000	20,000	20,000	19,000	22,000	20,000	20,000	18,000 J
o-Xylene	NA					7,000	7,100	6,800	6,600	6,900	6,700	6,600	5,500 J
Total Xylenes	NA	11,430	2,636	3,400,000	26,400	27,000	27,100	26,800	25,600	28,900	26,700	26,600	23,500 J

	BDC-103 GO82C 04/28/04	BDC-103 HF76C 10/18/04	BDC-103 IA83C 05/10/05	BDC-103 IS89C 11/10/05	BDC-103 JJ26C 05/15/06	BDC-103 JJ26H 05/15/06	BDC-103 KG20C 11/20/06
Total Petroleum Hydrocarbons (mg/L)							
Gasoline	160	140	110	90	84	86	51
BTEX (µg/L)							
Benzene	1,600	2,100	2,200	2,200	1,600	1,600	2,000
Toluene	6,600	5,500	5,500	3,500	3,800	3,800	730
Ethylbenzene	3,900	3,700	3,800	3,700	3,100	3,100	2,200
m,p-Xylene	16,000	15,000	14,000	12,000	10,000	10,000	3,900
o-Xylene	5,100	4,400	3,200	2,500	2,200	2,200	1,000
Total Xylenes	21,100	19,400	17,200	15,000	12,000	12,000	4,900

	Preliminary Groundwater Levels (a) Screening	Post-Nitrate Injection (c) BDC-103 KO95C 02/20/07	BDC-103 KR82C 03/19/07	BDC-103 KV95C 04/24/07	BDC-103 KZ41C 05/17/07
Total Petroleum Hydrocarbons (mg/L)					
Gasoline	0.8	26	30	36	77
BTEX (µg/L)					
Benzene	71	460	490	820	1,400
Toluene	200,000	420	88	440	4,300
Ethylbenzene	29,000	140	130	220	1,100
m,p-Xylene	NA	3,600	3,500	3500	8,300
o-Xylene	NA	1,600	1,700	1800	3,200
Total Xylenes	NA	5,200	5,200	5300	11,500

NA = no preliminary cleanup level available.
U = compound was not detected at given reporting limit.
J = indicates the analyte was positively identified, and the concentration listed is an estimate.
UJ = The analyte was not detected in the sample; the reported sample reporting limit is an estimate.

-- = Not Measured.
Boxed value indicates concentration above preliminary cleanup level.

(a) Landau Associates 2002.
(b) ORC injection in April and May 2002.
(c) Ammonium nitrate solution injected to well on 1/17-18/07.
(d) BTEX data questionable for this event. Concentrations inconsistent with TPH-G data for indicated event and BTEX data from other events.

DEVELOPMENTAL CENTER

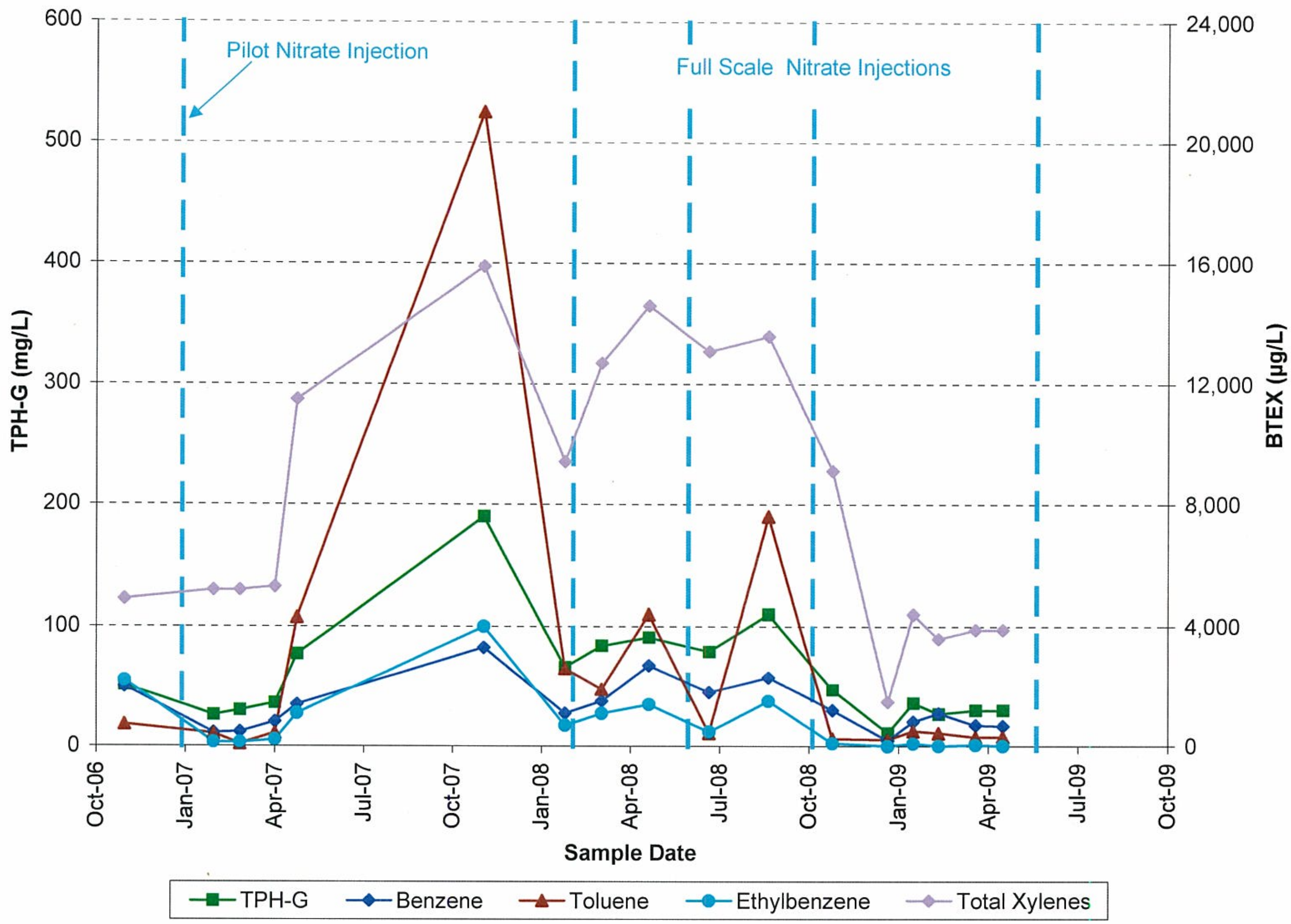
GROUNDWATER MONITORING

MAY 2009

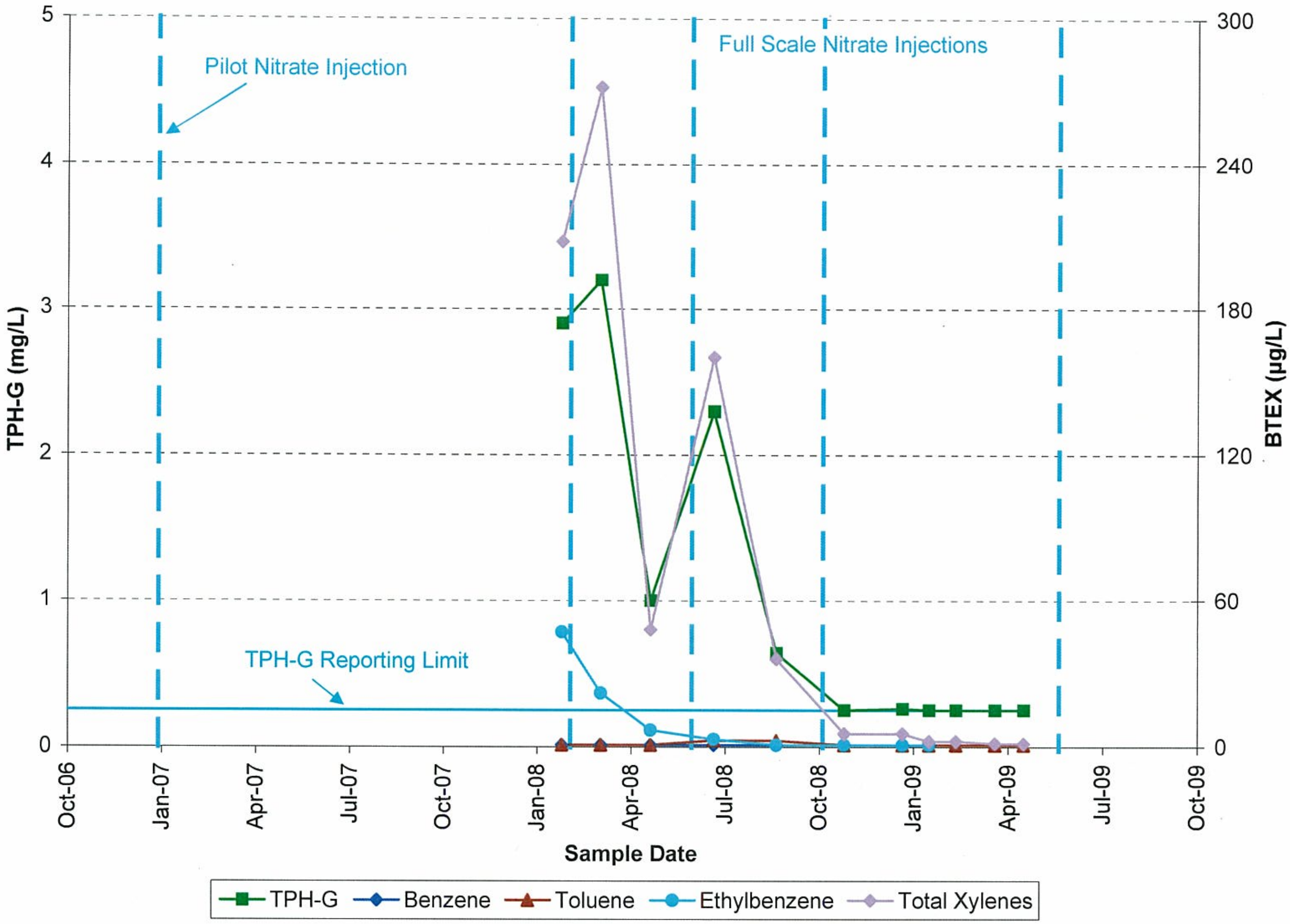
AOC-05 DATA

- **AOC-05 Data Table**
- **AOC-05 TPH-G and Benzene Concentration Trend Charts (June 2001 through Present)**

BDC-103
TPH-G and BTEX Concentrations Beginning with 2007 Pilot Testing

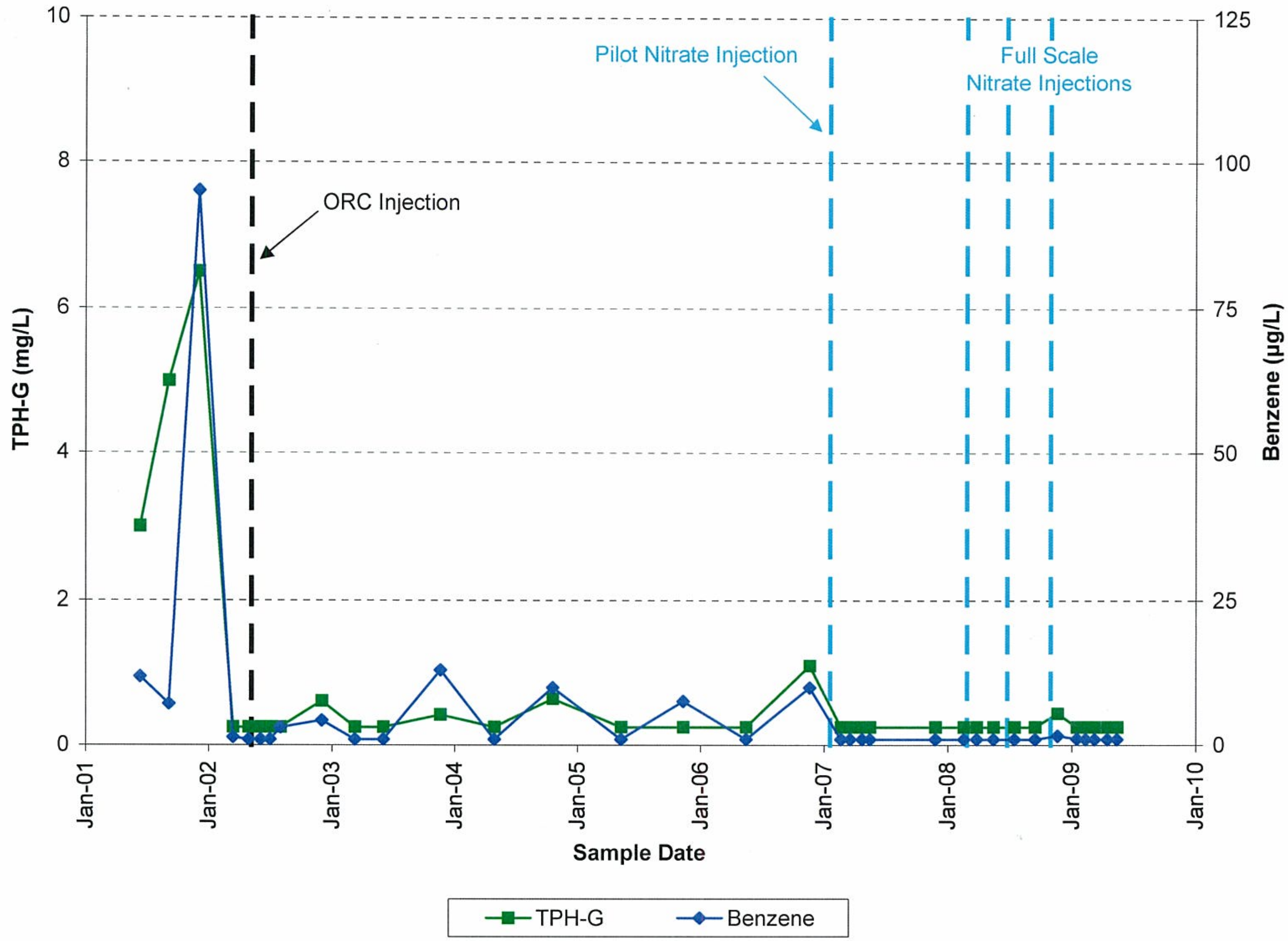


BDC-104
TPH-G and BTEX Concentrations Beginning with 2007 Pilot Testing



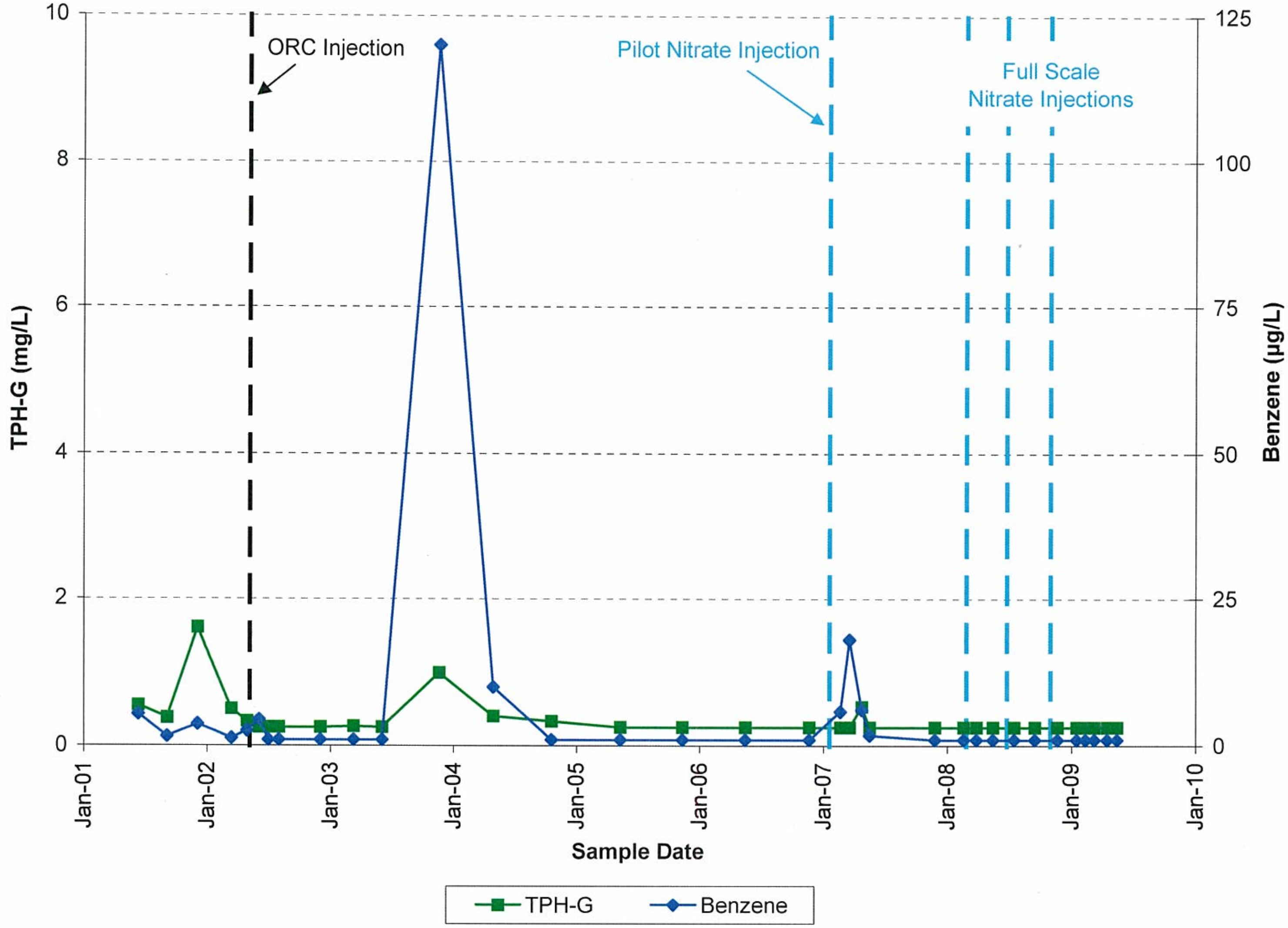
7/8/2009\\Edmdata\projects\025\093\FileRm\R\Semiann\May 09 semiann\09 May Semiann AOC-5 Summary Tb Fig 4 - BDC-104 plot during rem

BDC-101
TPH-G and Benzene Concentrations Since 2001



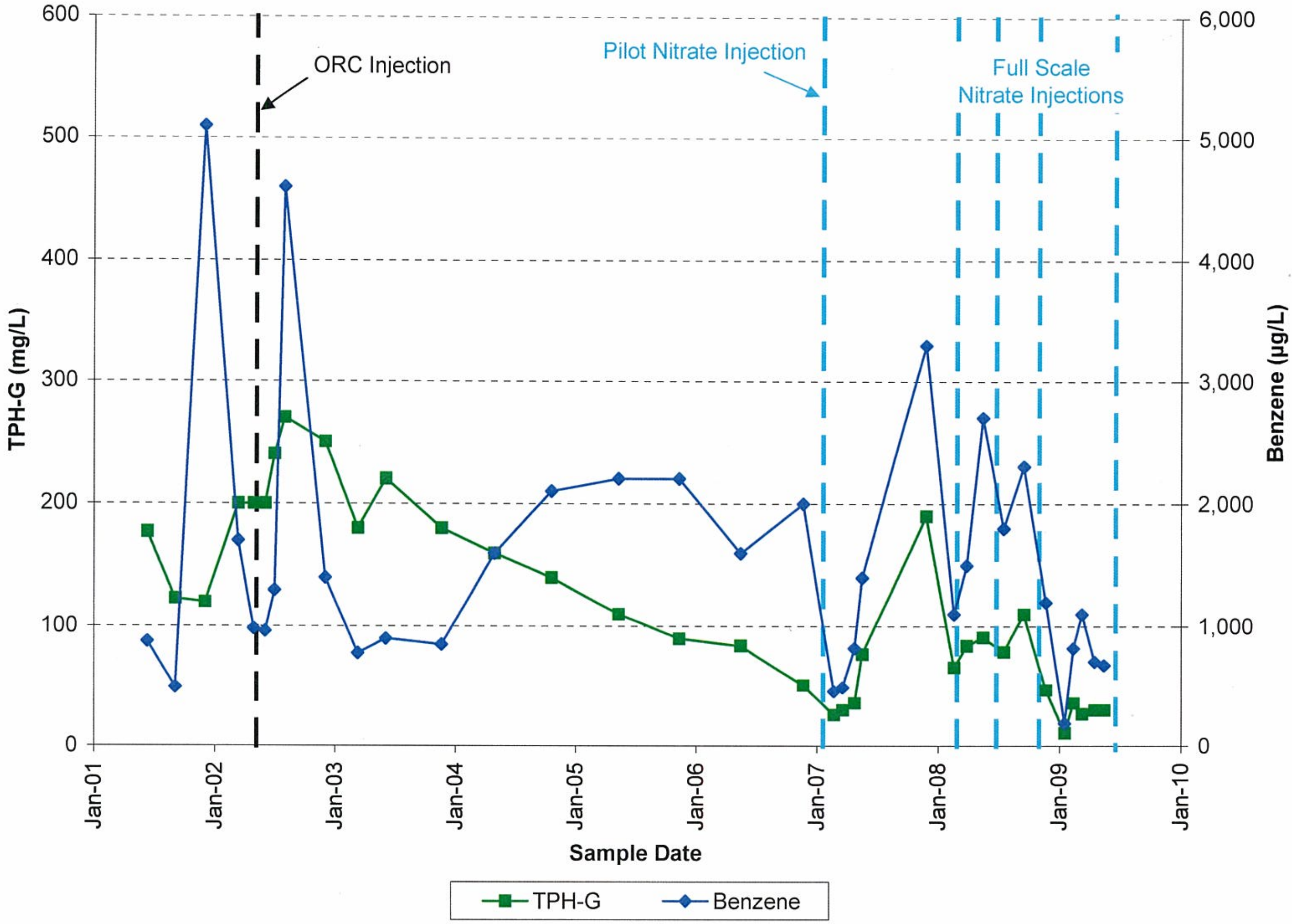
7/8/2009\\Edmdata\projects\025\093\FileRm\R\Semiann\May 09 semiann\09 May Semiann AOC-5 Summary Tb Fig 5 - BDC-101 plot

BDC-102
TPH-G and Benzene Concentrations Since 2001



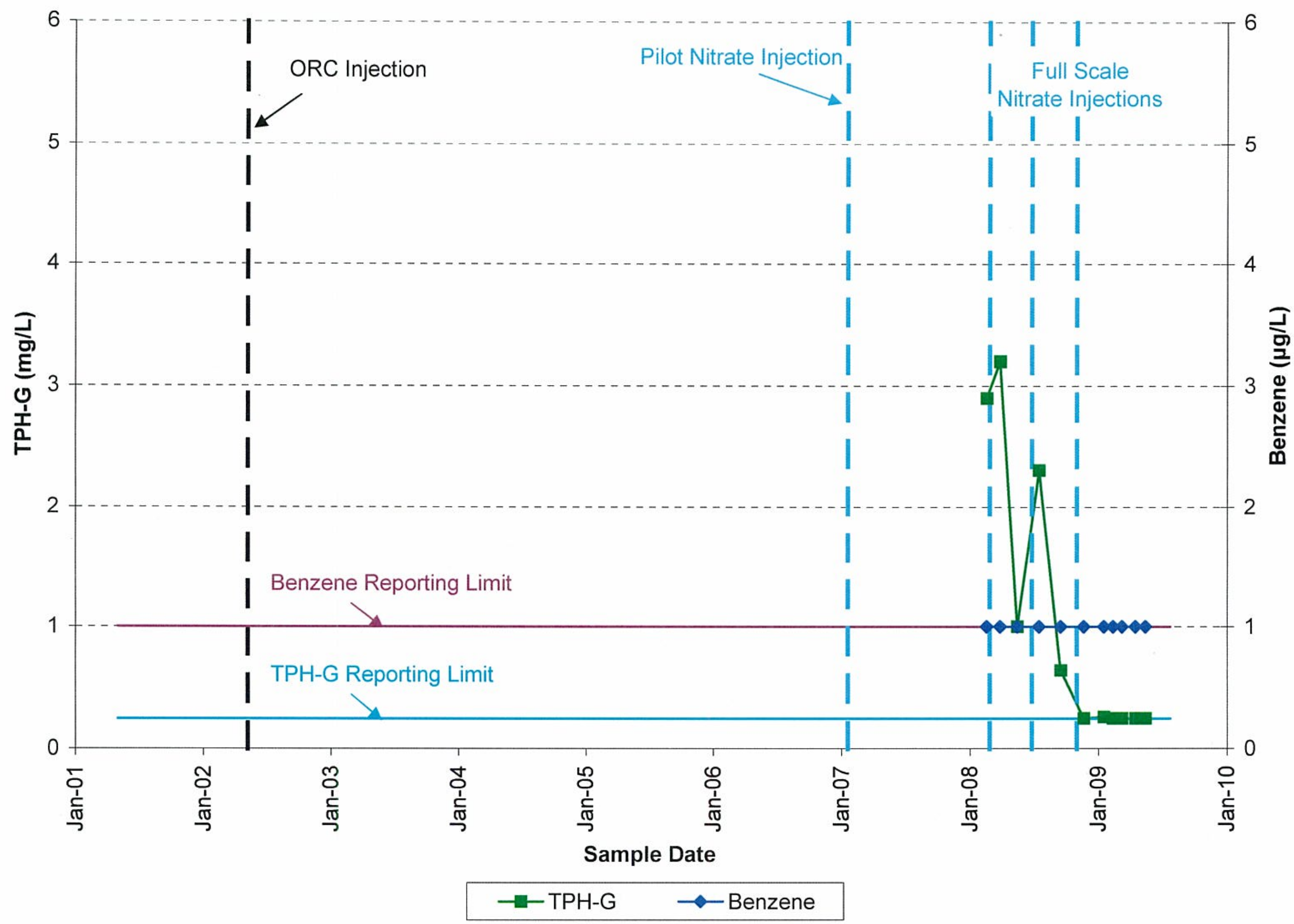
7/8/2009\\Edmdata\projects\025\093\FileRm\R\Semiann\May 09 semiann\09 May Semiann AOC-5 Summary Tb Fig 6 - BDC-102 plot

BDC-103
TPH-G and Benzene Concentrations Since 2001

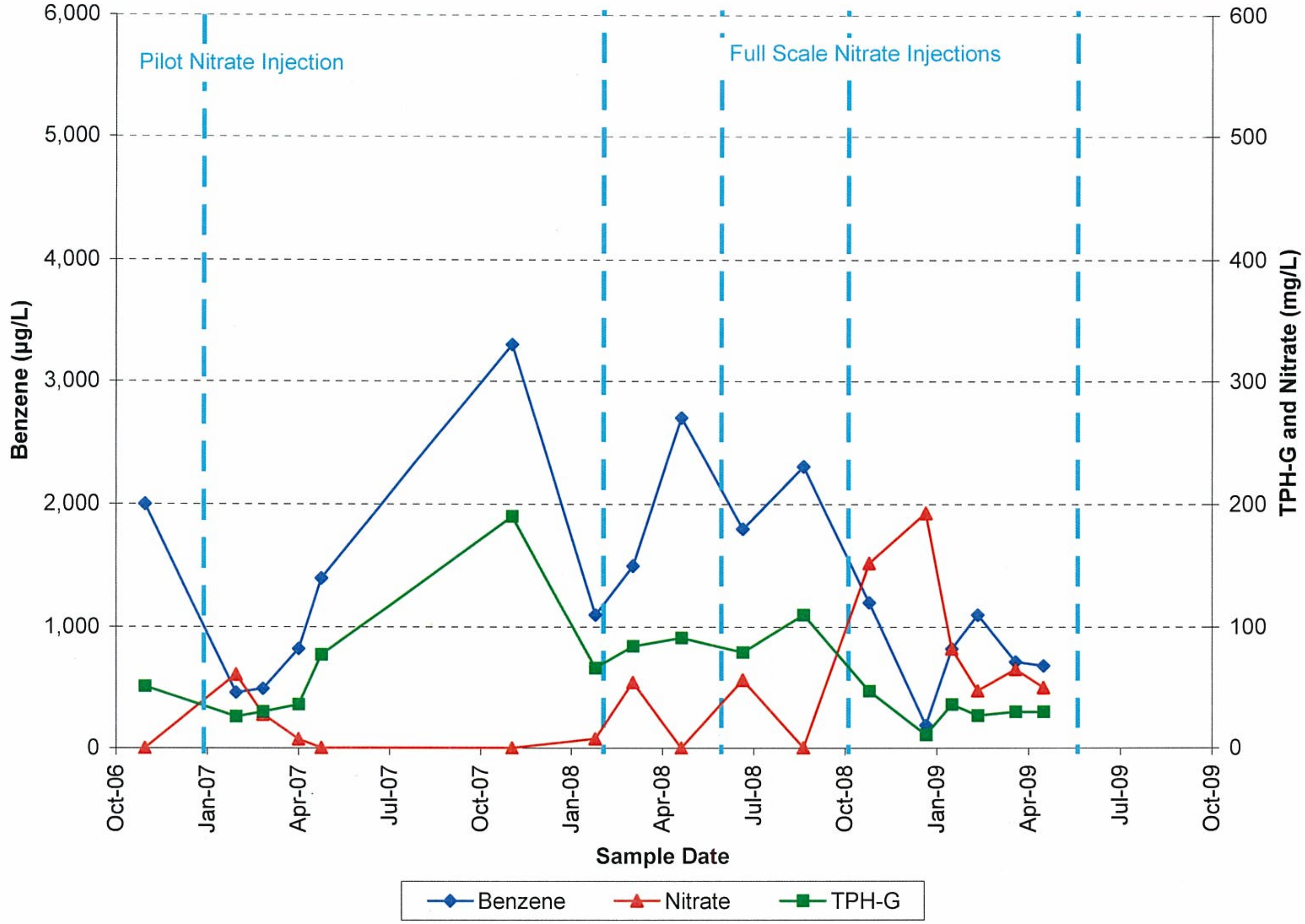


7/8/2009\\Edmdata\projects\025\093\FileRm\R\Semiann\May 09 semiann\09 May Semiann AOC-5 Summary Tb Fig 7 - BDC-103 plot

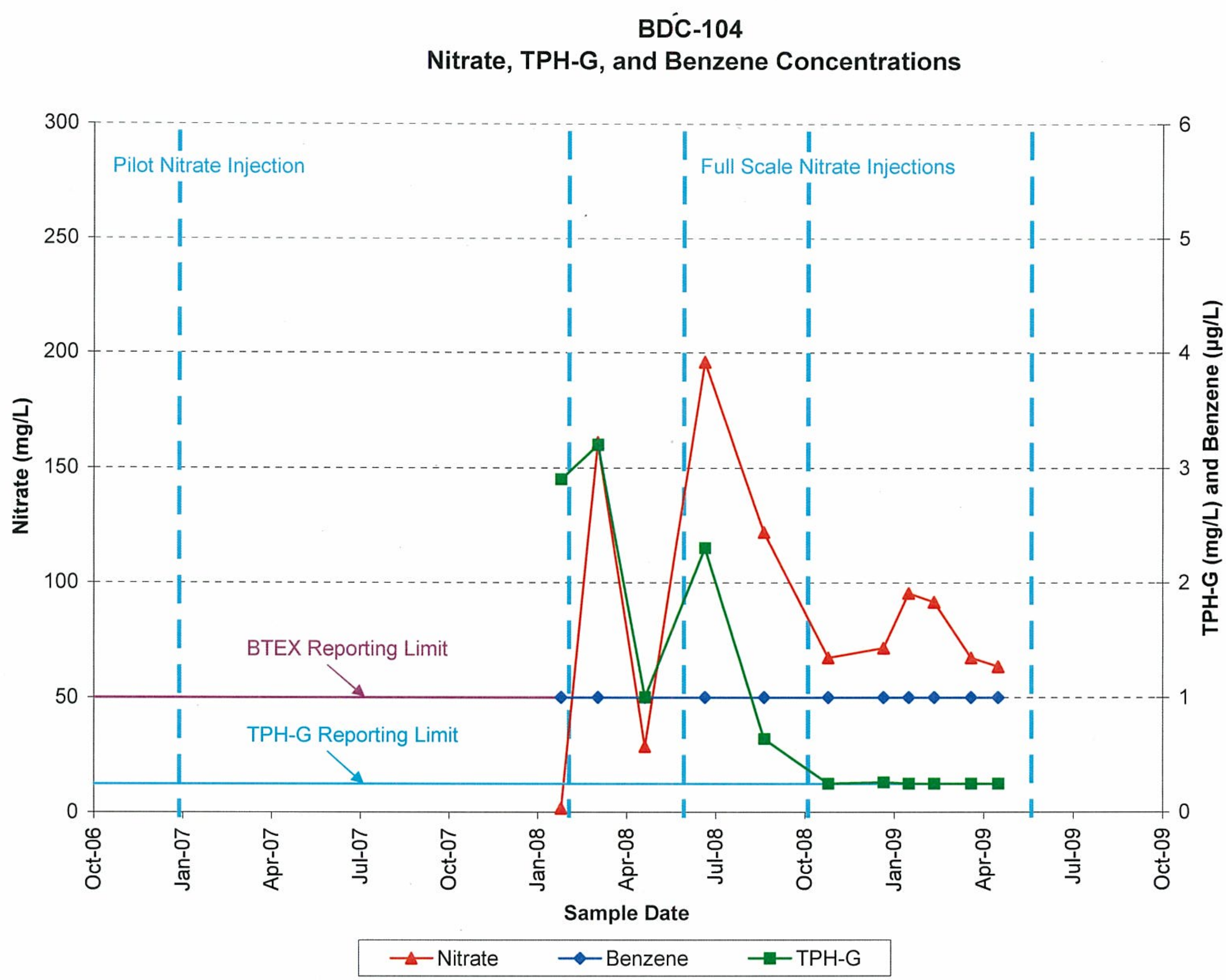
BDC-104
TPH-G and Benzene Concentrations Since 2001



BDC-103
Nitrate, TPH-G, and Benzene Concentrations



7/8/2009\\Edmdata\projects\025\093\FileRm\R\Semiann\May 09 semiann\09 May Semiann AOC-5 Summary Tb Fig 9 - BDC-103 plot nitrate



BDC-104
Nitrate, TPH-G, and Benzene Concentrations
Pilot Nitrate Injection
Full Scale Nitrate Injections
BTEX Reporting Limit
TPH-G Reporting Limit
Nitrate (mg/L)
TPH-G (mg/L) and Benzene (µg/L)
300
250
200
150
100
50
0
6
5
4
3
2
1
0
Oct-06
Jan-07
Apr-07
Jul-07
Oct-07
Jan-08
Apr-08
Jul-08
Oct-08
Jan-09
Apr-09
Jul-09
Oct-09
Sample Date
Nitrate
Benzene
TPH-G

TECHNICAL MEMORANDUM

LANDAU ASSOCIATES
ENVIRONMENTAL | GEOTECHNICAL | NATURAL RESOURCES

TO: James Bet, The Boeing Company

FROM: Clint Jacob, P.E., L.G., and David M. Buser, L.G.

DATE: September 17, 2009

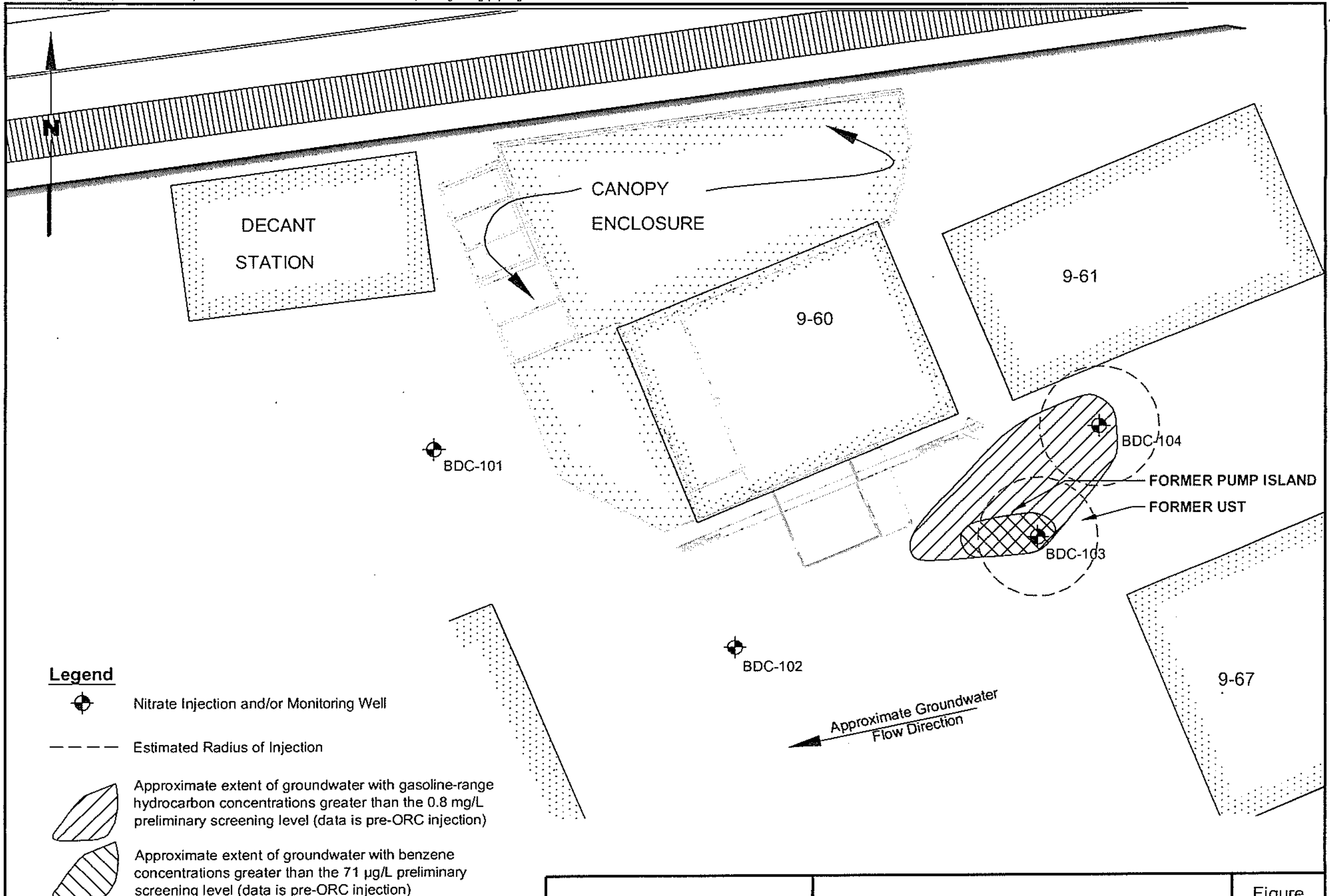
RE: UPDATE ON AOC-05 FULL-SCALE BIOREMEDIATION RESULTS ENHANCED ANAEROBIC BIODEGRADATION OF PETROLEUM HYDROCARBONS BOEING DEVELOPMENTAL CENTER 9725 EAST MARGINAL WAY SOUTH TUKWILA, WASHINGTON

This technical memorandum summarizes the results of recent bioremediation performance monitoring performed at Area of Concern (AOC)-05 of The Boeing Company (Boeing) Developmental Center (DC) in Tukwila, Washington (Figure 1). This work is being performed in accordance with the *Work Plan, AOC-05 Remedial Action Plan, Enhanced Anaerobic Biodegradation of Gasoline-Range Petroleum Hydrocarbons, Boeing Developmental Center, Tukwila, Washington* prepared by Landau Associates, Inc. (Landau) and dated November 16, 2007 (Work Plan). Enhanced bioremediation is being implemented to address concentrations of total petroleum hydrocarbons as gasoline (TPH-G) as well as benzene, toluene, ethylbenzene, and total xylenes (BTEX) released from a former underground storage tank (UST) in 1985 located near monitoring well BDC-103. As explained in the Work Plan, AOC-05 corresponds to the former UST location. Full-scale anaerobic bioremediation at AOC-05 involves aquifer amendment using electron acceptors (e.g., nitrate) as well as performance groundwater monitoring.

NUTRIENT INJECTIONS

The nitrate injections have been successful in remediating TPH-G and BTEX concentrations in groundwater at monitoring wells BDC-103 and BDC-104; however, a diminished rate of degradation was observed during monitoring performed following the October 2008 injection (third full-scale injection event). Observations, including slower depletion of injected nitrate and partial rebound in the concentrations of petroleum hydrocarbons, suggest that biodegradation in AOC-05 had become nutrient-limited to some degree. It has been concluded at other sites using a similar treatment approach that biotreatment has been inhibited by the inadequate availability of phosphorous, a macronutrient that is required along with nitrogen for microorganisms to proliferate.

Boeing notified the Washington State Department of Ecology (Ecology) of the intent to include ammonium phosphate (in addition to the ammonium nitrate specified in the Work Plan) as part of the fourth aquifer amendment (Bet 2009). On June 16-17, 2009, both mono-ammonium phosphate and ammonium nitrate were injected in monitoring wells BDC-103 and BDC-104. In accordance with the

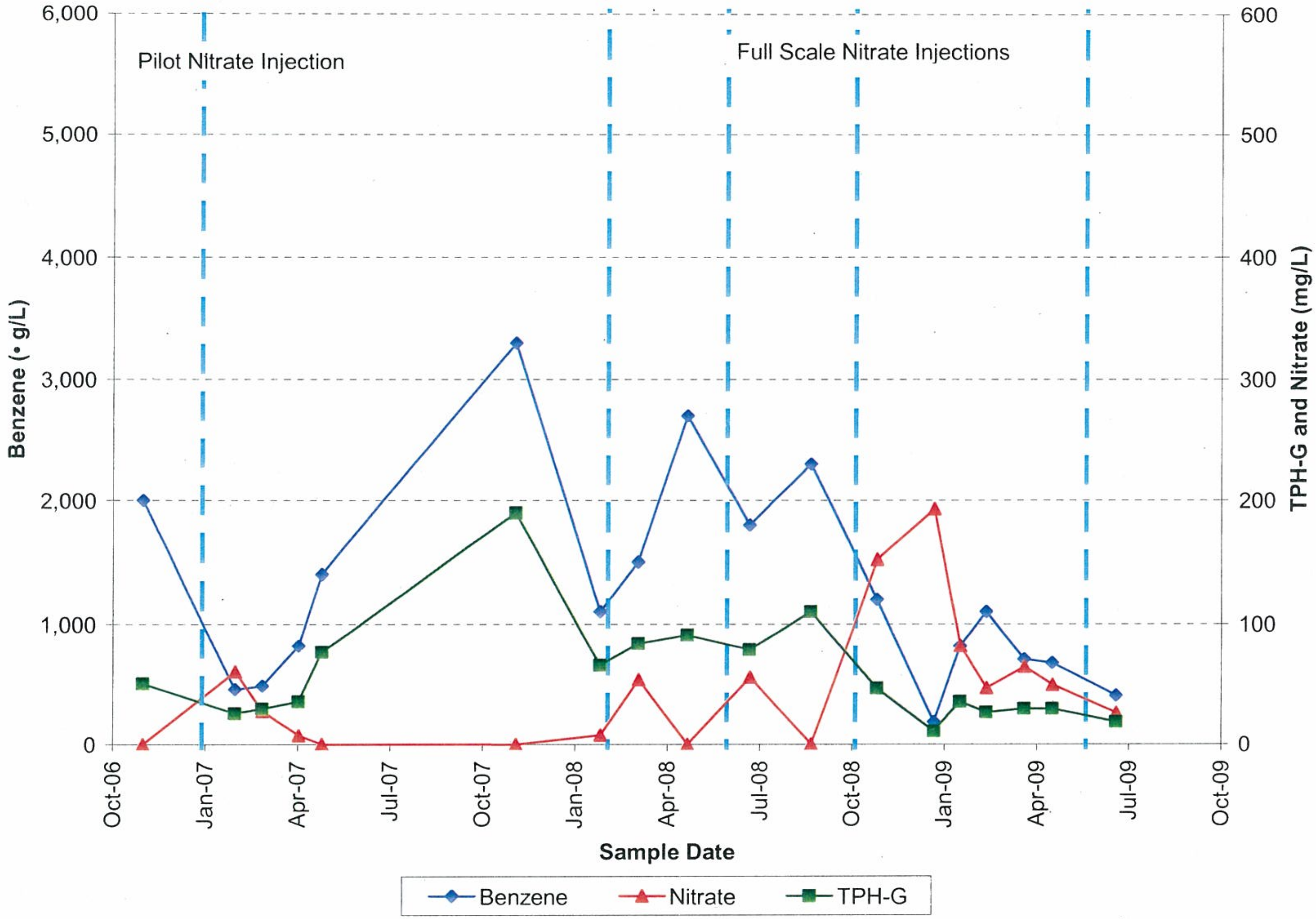


LANDAU ASSOCIATES

Boeing Developmental Center
Tukwila, Washington

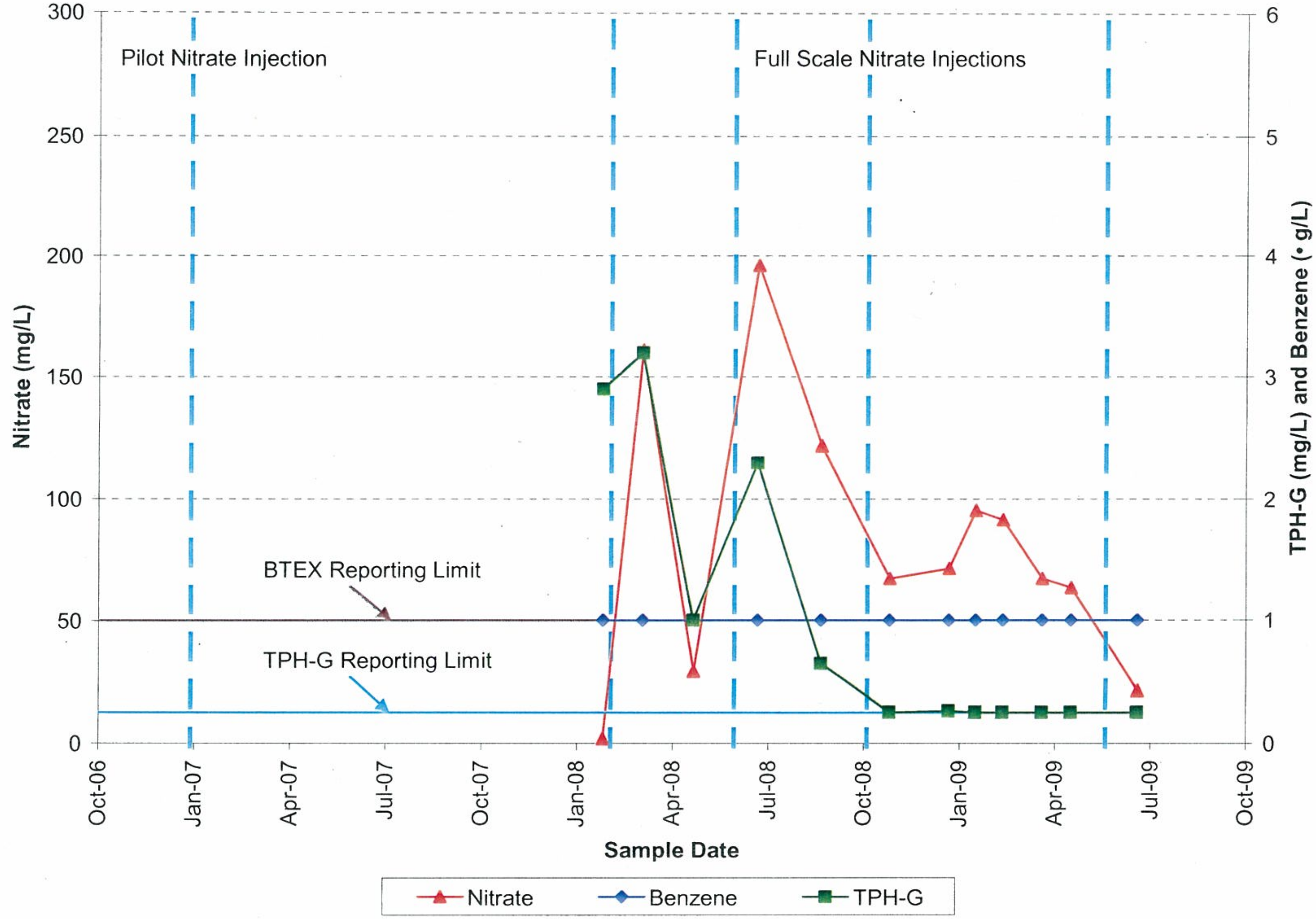
Nitrate Injection and Groundwater Sample Locations

Figure 2



LANDAU ASSOCIATES

Boeing Developmental Center Tukwila, Washington	BDC-103: Nitrate, TPH-G, and Benzene Concentrations	Figure 3



LANDAU ASSOCIATES

Boeing Developmental Center Tukwila, Washington	BDC-104: Nitrate, TPH-G, and Benzene Concentrations	Figure 4

TABLE 1
DATA SUMMARY TABLE
AOC-05 ANAEROBIC BIOREMEDIATION REMEDIAL ACTION
BOEING DEVELOPMENTAL CENTER

		ORC Injection	Pilot Injection	Full Scale Injection 1	Full Scale Injection 2	Full Scale Injection 3	Full Scale Injection 4	Volatile Organic Compounds (all units in ug/L)							Aquifer Redox Conditions							Donor Indicators		
		Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	TPH-G (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	m,p-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylenes (µg/L)	DO (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (µg/L)	ORP (mV)	TOC (mg/L)	pH	
Preliminary Groundwater Screening Levels (a)								0.8	71	200,000	29,000	NA (b)	NA (b)	NA (b)										
Well	Date																							Comments
BDC-101	6/11/2001							3.0	11.9	<1.0	113.1			109.2										
BDC-101	9/4/2001							5.0	7.13	10.7	50.4			53.8										
BDC-101	12/3/2001							6.5	95	1.6	750			650										
BDC-101	3/13/2002							<0.25	1.4	<1.0	4.4			<1.0										
BDC-101	4/29/2002							<0.25	<1.0	<1.0	2.2	<1.0	<1.0	<1.0										
BDC-101	6/3/2002	27						<0.25	1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-101	7/1/2002	55						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-101	8/1/2002	86						<0.25	3.1	<1.0	2.4	<1.0	<1.0	<1.0										
BDC-101	12/2/2002	209						0.61	4.3	<1.0	21	27	6.4	33.4										
BDC-101	3/10/2003	307						<0.25	1.0	<1.0	4.5	3.2	<1.0	3.2										
BDC-101	6/3/2003	392						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-101	11/19/2003	561						0.42	13	<1.0	15	35	<1.0	35	0.36	1.1	0.010	0.2	16	240	120.3			
BDC-101	4/28/2004	722						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-101	10/18/2004	895						0.64	10	<1.0	15	43	<1.0	43										
BDC-101	5/10/2005	1099						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-101	11/10/2005	1283						0.25	7.6	<1.0	2.6	42	<1.0	42	0.96	4.4			34.3		259	2.05		
BDC-101	5/15/2006	1469						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.78	17.8	0.059	0	64.1		80			
BDC-101	11/20/2006	1658						1.1	10	<1.0	15	72.0	<1.0	72	0.92	0.122	0.016	2.4	8.7		174			
BDC-101	2/20/2007	1750	33					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.39	15.0	0.047	0.2	50.0		277		6.63	
BDC-101	3/19/2007	1777	60					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	5.97	8.83	0.037	0.5	38.5		213		6.60	
BDC-101	4/24/2007	1813	96					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.09	9.59	0.041	0.5	34.1		136		6.46	
BDC-101	5/17/2007	1836	119					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.35	9.95	0.046	0.4	35.7		297		6.55	
BDC-101	11/26/2007	2029	312					<0.25	<1.0	<1.0	2.1	6.5	<1.0	6.5	2.30	5.88	0.032	0	26.8		287			
BDC-101	2/18/2008	2113	396					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.55	8.10	0.040	0	31.5		341		6.29	
BDC-101	3/27/2008	2151	434	30				<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.19	9.3	<0.10	0.2	40.0		506			
BDC-101	5/15/2008	2200	483	79				<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.57	6.8	<0.10	0	24.6		176		6.44	
BDC-101	7/16/2008	2262	545	141	22			<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.34	5.3	<0.10	0	21.8		-232		6.52	
BDC-101	9/15/2008	2323	606	202	83			<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.22	5.33	0.023	0	28.7		153			
BDC-101	11/20/2008	2389	672	268	149	21		0.44	1.6	<1.0	<1.0	<1.0	<1.0	<1.0	1.45	2.9	0.1	0.8	17.1		-22		6.65	
BDC-101	1/16/2009	2446	729	325	206	78		<0.25	1.1	<1.0	<1.0	<1.0	<1.0	<1.0	0	4.40	0.042	0.4	29.5		-245		6.50	
BDC-101	2/11/2009	2472	755	351	232	104		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.62	8.5	<0.1	0.4	39.6		-16		6.43	
BDC-101	3/9/2009	2498	781	377	258	130		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.93	9.4	<0.1	0	46.8		54		6.54	
BDC-101	4/16/2009	2536	819	415	296	168		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.69	9.0	<0.1	0	36.0		131		6.61	
BDC-101	5/14/2009	2564	847	443	324	196	-34	<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.00	13.0	<0.1	0	44.4		68		6.81	
BDC-101	7/17/2009	2628	911	507	388	260	30	<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.80	12.6	<0.1	0	49.0		19		7.17	
BDC-102	6/11/2001							0.55	5.33	<1.0	<1.0			<1.0										
BDC-102	9/4/2001							0.38	1.61	1.89	<1.0			1.87										
BDC-102	12/3/2001							1.6	3.7	<1.0	<1.0			3.49										
BDC-102	3/13/2002							0.50	1.3	<1.0	<1.0			<1.0										
BDC-102	4/29/2002							0.33	2.6	<1.0	<1.0	1.1	<1.0	1.1										
BDC-102	6/3/2002	27						<0.25	4.4	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	7/1/2002	55						0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	8/1/2002	86						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	12/2/2002	209						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	3/10/2003	307						0.26	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	6/3/2003	392						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	11/19/2003	561						0.99	120	<1.0	8.5	<1.0	<1.0	<1.0	0.38	0.19	0.011	5.5	46	1100	122.2			
BDC-102	4/28/2004	722						0.40	10	<1.0	<1.0	3.0	<1.0	3.0										
BDC-102	10/18/2004	895						0.33	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	5/10/2005	1099						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0										
BDC-102	11/10/2005	1283						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.82	4.4			34.0		122	18.4		
BDC-102	5/15/2006	1469						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.21	4.72	0.175	2.2	35.7		-11			
BDC-102	11/20/2006	1658						<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.25	<0.250	<0.250	2.2	9.2		163			

TABLE 1
DATA SUMMARY TABLE
AOC-05 ANAEROBIC BIOREMEDIATION REMEDIAL ACTION
BOEING DEVELOPMENTAL CENTER

		ORC Injection	Pilot Injection	Full Scale Injection 1	Full Scale Injection 2	Full Scale Injection 3	Full Scale Injection 4	Volatile Organic Compounds (all units in ug/L)							Aquifer Redox Conditions							Donor Indicators		
		Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	Elapsed Time from Injection (a) (days)	TPH-G (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	m,p-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylenes (µg/L)	DO (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (µg/L)	ORP (mV)	TOC (mg/L)	pH	
Preliminary Groundwater Screening Levels (a)								0.8	71	200,000	29,000	NA (b)	NA (b)	NA (b)										
Well	Date																							Comments
BDC-102	2/20/2007	1750	33					<0.25	5.8	<1.0	<1.0	<1.0	<1.0	<1.0	0.47	0.749	0.027	3.0	25.3		-145		6.54	
BDC-102	3/19/2007	1777	60					<0.25	18	<1.0	<1.0	32	<1.0	32	0.88	0.938	0.072	3.0	31.0		-98		6.67	
BDC-102	4/24/2007	1813	96					0.53	6.1	<1.0	3.1	100	<1.0	100	1.20	1.94	0.051	2.8	40.4		-93		6.51	
BDC-102	5/17/2007	1836	119					<0.25	1.8	<1.0	<1.0	7.4	<1.0	7.4	0.84	2.78	0.108	2.6	33.9		286		6.52	
BDC-102	11/26/2007	2029	312					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	3.29	1.03	0.247	3.0	55.7		46			
BDC-102	2/18/2008	2113	396					<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.51	3.91	0.054	2.8	42.8		431		5.97	
BDC-102	3/27/2008	2151	434	30				<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.85	1.3	<0.10	2.5	17.9		233			
BDC-102	5/15/2008	2200	483	79				<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.40	3.0	<0.10	3.5	19.2		-115		6.56	
BDC-102	7/16/2008	2262	545	141	22			<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	2.46	2.5	<0.10	3.2	13.7		-312		6.67	
BDC-102	9/15/2008	2323	606	202	83			<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.22	4.28	0.056	3.0	31.6		191			
BDC-102	11/20/2008	2389	672	268	149	21		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.70	0.40	<0.10	2.0	5.6		-70		6.69	
BDC-102	1/16/2009	2446	729	325	206	78		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.00	<0.100	0.200	2.5	8.3		-235		6.70	
BDC-102	2/11/2009	2472	755	351	232	104		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.65	2.4	<0.1	3.0	20.4		-70		6.61	
BDC-102	3/9/2009	2498	781	377	258	130		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.00	0.9	<0.1	3.0	8.7		-46		6.65	
BDC-102	4/16/2009	2536	819	415	296	168		<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.30	0.6	<0.1	3.0	8.3		-7		6.66	
BDC-102	5/14/2009	2564	847	443	324	196	-34	<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.29	0.9	<0.1	3.4	9.8		-35		6.78	
BDC-102	7/17/2009	2628	911	507	388	260	30	<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	0.66	4.9	<0.1	2.2	28.6		-11		6.46	
BDC-103	6/11/2001							177	875	12,010	1,985			11,430										
BDC-103	9/4/2001							123	494	3,760	419			2,636										
BDC-103 (c)	12/3/2001							120	5,100	2,300,000	10,000			3,400,000										
BDC-103	3/13/2002							200	1,700	17,000	4,900			26,400										
BDC-103	4/29/2002							200	980	16,000	5,400	20,000	7,000	27,000										
BDC-103	6/3/2002	27						200	960	17,000	5,100	20,000	7,100	27,100										
BDC-103	7/1/2002	55						240	1,300	16,000	5,200	20,000	6,800	26,800										
BDC-103	8/1/2002	86						270	4,600	18,000	5,200	19,000	6,600	25,600										
BDC-103	12/2/2002	209						250	1,400	15,000	5,000	22,000	6,900	28,900										
BDC-103	3/10/2003	307						180	780	13,000	5,200	20,000	6,700	26,700										
BDC-103	6/3/2003	392						220	900	10,000	5,000	20,000	6,600	26,600										
BDC-103	11/19/2003	561						180	850	8,300	4,500	18,000	5,500	23,500	0.38	0.012	0.011	5.5	53	630	-75.9			
BDC-103	4/28/2004	722						160	1,600	6,600	3,900	16,000	5,100	21,100										
BDC-103	10/18/2004	895						140	2,100	5,500	3,700	15,000	4,400	19,400										
BDC-103	5/10/2005	1099						110	2,200	5,500	3,800	14,000	3,200	17,200										
BDC-103	11/10/2005	1283						90	2,200	3,500	3,700	12,000	2,500	15,000	0.72	<1.0			11.9		147	15.4		
BDC-103	5/15/2006	1469						84	1,600	3,800	3,100	10,000	2,200	12,000	0.92	<0.010	0.054	3.5	15.2		106			
BDC-103	11/20/2006	1658						51	2,000	730	2,200	3,900	1,000	4,900	1.23	<0.10	<0.10	2.4	28.3		202			
BDC-103	2/20/2007	1750	33					26	460	420	140	3,600	1,600	5,200	0.31	60.8	11.1	0.5	99.2		109		6.54	
BDC-103	3/19/2007	1777	60					30	490	88	130	3,500	1,700	5,200	0.63	27.9	8.28	0.4	141		4		6.79	
BDC-103	4/24/2007	1813	96					36	820	440	220	3500	1800	5300	0.84	7.54	3.56	2.4	59.2		-14		6.70	
BDC-103	5/17/2007	1836	119					77	1,400	4,300	1,100	8,300	3,200	11,500	0.61	0.138	0.079	3.6	169		244		6.82	
BDC-103	11/26/2007	2029	312					190	3,300	21,000	4,000	11,000	4,900	15,900	3.37	0.063	0.049	3.6	49.1		-118			
BDC-103	2/18/2008	2113	396					66	1,100	2,600	700	7,500	1,900	9,400	2.06	7.75	0.134	2.8	163		552		5.97	
BDC-103	3/27/2008	2151	434	30				84	1,500	1,900	1,100	9,700	3,000	12,700	1.60	54.1	18	4.0	115.0		182			
BDC-103	5/15/2008	2200	483	79				91	2,700	4,400	1,400	11,000	3,600	14,600	1.38	<0.10	<0.10	3.2	192		-138		7.11	
BDC-103	7/16/2008	2262	545	141	22			79	1,800	440	490	10,000	3,100	13,100	1.61	56.1	16.6	2.8	149		-226		6.72	
BDC-103	9/15/2008	2323	606	202	83			110	2,300	7,600	1,500	10,000	3,600	13,600	0.48	0.330	0.218	3.2	218		189			
BDC-103	11/20/2008	2389	672	268	149	21		47	1,200	260	110	7,000	2,100	9,100	0.21	152	12.5	2.0	120		-1.2		6.66	
BDC-103	1/16/2009	2446	729	325	206	78		11	190	220	12	1,000	480	1,480	0.24	193	2.32	0.6	62.5		-181		6.19	
BDC-103	2/11/2009	2472	755	351	232	104		36	820	510	<100	2,900	1,500	4,400	1.66	82.0	6.7	0.8	178		-65		6.69	
BDC-103	3/9/2009	2498	781	377	258	130		27	1100	440	18 J	2,400	1,200	3,600	0	47.3	2.4	0.4	192		17		6.80	
BDC-103	4/16/2009	2536	819	415	296	168		30	710	310	<50	2,700	1,200	3,900	0.95	64.8	5.6	0.2-0.4	194		62		6.77	
BDC-103	5/14/2009	2564	847	443	324	196	-34	30	680	320	20	2,400	1,500	3,900	0.48	49.8	4.8	0.8	222		20		6.85	
BDC-103	7/17/2009	2628	911	507	388	260	30	19	410	280	32	630	1,000	1,630	2.60	26.6	2.0	1.0	104		29		6.98	

9/17/2009 \\Edmdata\projects\025\093\FileRm\R\AOC-05\AOC-05 Full Scale TM\AOC-05 Full Scale PT Nitrate TM_Tb 1 Table 1 Summary Table to update
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T\AOC-5\temp Summary table_080409 Table 1 Summary Table to update

TABLE 1
DATA SUMMARY TABLE
AOC-05 ANAEROBIC BIOREMEDIATION REMEDIAL ACTION
BOEING DEVELOPMENTAL CENTER

Well	Date	ORC Injection Elapsed Time from Injection (a) (days)	Pilot Injection Elapsed Time from Injection (a) (days)	Full Scale Injection 1 Elapsed Time from Injection (a) (days)	Full Scale Injection 2 Elapsed Time from Injection (a) (days)	Full Scale Injection 3 Elapsed Time from Injection (a) (days)	Full Scale Injection 4 Elapsed Time from Injection (a) (days)	Volatile Organic Compounds (all units in ug/L) TPH-G (mg/L)	Benzene (µg/L)	Toluene (µg/L)	Ethylbenzene (µg/L)	m,p-Xylene (µg/L)	o-Xylene (µg/L)	Total Xylenes (µg/L)	Aquifer Redox Conditions DO (mg/L)	Nitrate (mg/L)	Nitrite (mg/L)	Iron II (mg/L)	Sulfate (mg/L)	Methane (µg/L)	ORP (mV)	Donor Indicators TOC (mg/L)	pH	Comments
Preliminary Groundwater Screening Levels (a								0.8	71	200,000	29,000	NA (b)	NA (b)	NA (b)										
BDC-104	2/18/2008	2113	396					2.9	<1.0	<1.0	47	180	28	208	2.09	1.63	0.072	3.0	18.7		598			
BDC-104	3/27/2008	2151	434	30				3.2	<1.0	<1.0	22	220	52	272	1.34	161	0.1	0.5	52.2		259			
BDC-104	5/15/2008	2200	483	79				1.0	<1.0	<1.0	7.0	26	22	48	1.24	28.7	0.7	0.4	26.6		94		6.69	
BDC-104	7/16/2008	2262	545	141	22			2.3	<1.0	2.9	3.3	110	50	160	1.56	196	0.4	0	74.7		-221		7.17	
BDC-104	9/15/2008	2323	606	202	83			0.64	<1.0	2.6	<1.0	20	16	36	0.06	122	0.729	0	38.4		191			
BDC-104	11/20/2008	2389	672	268	149	21		<0.25	<1.0	<1.0	<1.0	1.4	4.1	5.5	0.98	67.2	<0.10	0.2	24.3		-27		7.46	
BDC-104	1/16/2009	2446	729	325	206	78		0.26	<1.0	<1.0	<1.0	<1.0	5.5	5.5	0.05	71.4	0.204	0.6	34.6		-164		6.86	
BDC-104	2/11/2009	2472	755	351	232	104		<0.25	<1.0	<1.0	<1.0	1.3	1.1	2.4	1.78	95.4 J	0.1	0.2	20.1		-75		6.68	
BDC-104	3/9/2009	2498	781	377	258	130		<0.25	<1.0	<1.0	<1.0	1.3	1.1	2.4	0	91.5	<0.1	0	19.2		20		6.67	
BDC-104	4/16/2009	2536	819	415	296	168		<0.25	<1.0	<1.0	<1.0	<1.0	1.6	1.6	0.34	67.2	<0.1	0	21.6		67		6.63	
BDC-104	5/14/2009	2564	847	443	324	196	-34	<0.25	<1.0	<1.0	<1.0	<1.0	1.4	1.4	0.51	63.4	<0.1	0	20.1		6		6.70	
BDC-104	7/17/2009	2628	911	507	388	260	30	<0.25	<1.0	<1.0	<1.0	<1.0	<1.0	<1.0	1.41	21.0	0.5	1.0	30.8		-3		7.30	

Notes:

(a) Landau Associates 2002a.

(b) NA = no preliminary cleanup level available.

(c) BTEX data questionable for this event. Concentrations inconsistent with TPH-G data for indicated event and BTEX data from other events.

Injection dates

5/7/2002	ORC
1/18/2007	Pilot -scale nitrate
2/26/2008	Full-scale nitrate
6/24/2008	Full-scale nitrate
10/30/2008	Full-scale nitrate
6/17/2009	4th full scale injdection

Appendix C2 – SWMU-17

Work Plan, SWMU-17 Pilot Test, October 2, 2008 (Landau 2008b)

Work Plan
SWMU-17 Pilot Test
Boeing Developmental Center
Tukwila, Washington

October 2, 2008

Prepared for

The Boeing Company
Seattle, WA

LANDAU ASSOCIATES
130 2nd Avenue South
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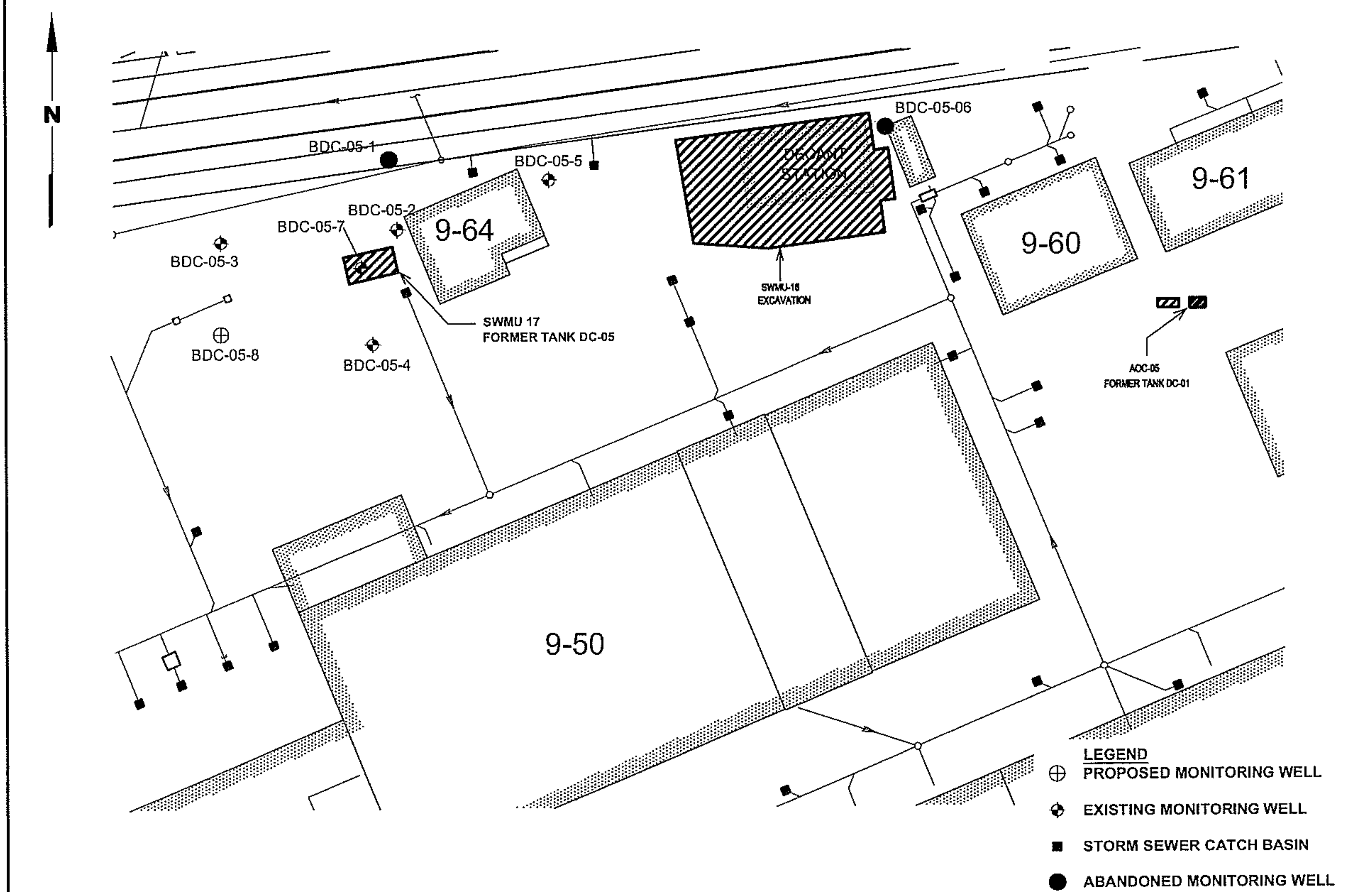
(425) 778-0907



LANDAU ASSOCIATES

Boeing Developmental Center Tukwila, Washington	SWMU-17	Figure 2

TABLE 1
CUMULATIVE DATA SUMMARY
SWMU-17
BOEING DEVELOPMENTAL CENTER

	Method B Preliminary Screening Level Marine Surface Water	Method B Preliminary Screening Level Fresh Surface Water	Jun-02	Dec-02	Jun-03	Nov-03	Apr-04	Oct-04	May-05	Nov-05	May-06	Nov-06	May-07	Nov-07	May-08
TOTAL ARSENIC (mg/L)	0.005	0.005													
BDC-05-2			0.05 U	0.05 U	0.001 U	0.001 U	0.002	0.002	0.001	0.002	0.001	0.002	0.003	0.001	0.002
BDC-05-3			0.05 U	0.05 U	0.004	0.001 U	0.002	0.002	0.001 U	0.002	0.007	0.002	0.003	0.002	0.002
BDC-05-4			0.05 U	0.05 U	0.011	0.018	0.019	0.016	0.008	0.018	0.018	0.002	0.018	0.009	0.018
BDC-05-5			0.05 U	0.05 U	0.002	0.001	0.003	0.007	0.003	0.006	0.009	0.001	0.002	0.001 U	0.002
BDC-05-7			0.05 U	0.05 U	0.002	0.001 U	0.001	0.001	0.001	0.002	0.002	0.001	0.003	0.001 U	0.002
DISSOLVED ARSENIC (mg/L)	0.005	0.005													
BDC-05-2			0.05 U	0.05 U	0.001 U	0.001 U	0.001	0.001 U	0.001	0.001	0.001	0.001	0.003	0.001 U	0.002
BDC-05-3			0.05 U	0.05 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002	0.001 U	0.001
BDC-05-4			0.05 U	0.05 U	0.001 U	0.001	0.001	0.001 U	0.001 U	0.001	0.001 U	0.001 U	0.002	0.001 U	0.001 U
BDC-05-5			0.05 U	0.05 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.001	0.001 U	0.001 U
BDC-05-7			0.05 U	0.05 U	0.001 U	0.001 U	0.001	0.001 U	0.001 U	0.001 U	0.001 U	0.001 U	0.002	0.001 U	0.001 U
TOTAL COPPER (mg/L)	0.0034	0.0089													
BDC-05-2			0.002 U	0.002	0.002	0.002 U	0.003	0.002	0.003	0.003	0.004	0.002 U	0.006	0.002 U	0.004
BDC-05-3			0.002 U	0.003	0.004	0.002	0.003	0.003	0.003	0.004	0.010	0.002	0.004	0.002	0.002
BDC-05-4			0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.004	0.002 U	0.002	0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-5			0.003	0.004	0.004	0.003	0.004	0.006	0.005	0.007	0.014	0.002 U	0.003	0.002 U	0.003
BDC-05-7			0.004	0.007	0.008	0.011	0.008	0.010	0.012	0.012	0.018	0.008	0.016	0.014	0.016
DISSOLVED COPPER (mg/L)	0.0034	0.0089 (a)													
BDC-05-2			0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002	0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-3			0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.003	0.003	0.002 U	0.002 U	0.002 U
BDC-05-4			0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U	0.002 U
BDC-05-5			0.002 U	0.002	0.007	0.002 U	0.002 U	0.002 U	0.002 U	0.004	0.002	0.002	0.002 U	0.002 U	0.003
BDC-05-7			0.003	0.004	0.004	0.005	0.006	0.007	0.007	0.008	0.009	0.009	0.012	0.009	0.010
TETRACHLOROETHENE (μg/L)	9	9													
BDC-05-2			23	4.7	17	6.5	32	9.2	22	10	30	6.2	20	12	14
BDC-05-3			4.1	4.4	3.3	4.5	3.4	5.1	2.3	3.8	3.2	1.7	3.5	2.3	3.8
BDC-05-4			1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.4	1.0 U	1.0 U	1.5
BDC-05-5			1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	0.8	1.0 U	1.0 U	0.3
BDC-05-7			13	12	15	20	23	27	25	31	29	24	30	28	33
TRICHLOROETHENE (μg/L)	81														
BDC-05-2			38	7.2	30	10	45	15	28	16	31	8.2	24	14	20
BDC-05-3			11	11	9.9	12	8.6	11	5.3	6.7	6.4	2.4	8.1	4.4	8.5
BDC-05-4			1.2	1.1	1.0 U	1.0	1.0 U	1.0 U	1.0 U	1.0 U	1.0 U	1.0	1.0 U	1.0 U	0.9
BDC-05-5			1.6	1.4	1.7	1.5	1.5	1.3	1.4	1.5	1.4	1.1	1.0 U	1.0 U	0.8
BDC-05-7			28	26	29	41	31	37	31	34	23	29	22	25	32

U = Indicates compound was analyzed for, but was not detected at the reported sample detection limit.
Bold indicates detected compound.
Box indicates exceedance of screening level.

Appendix C3 – SWMU-20

Developmental Center Groundwater Monitoring, AOC-05 Data, May 2009 (Landau 2009c)

DEVELOPMENTAL CENTER

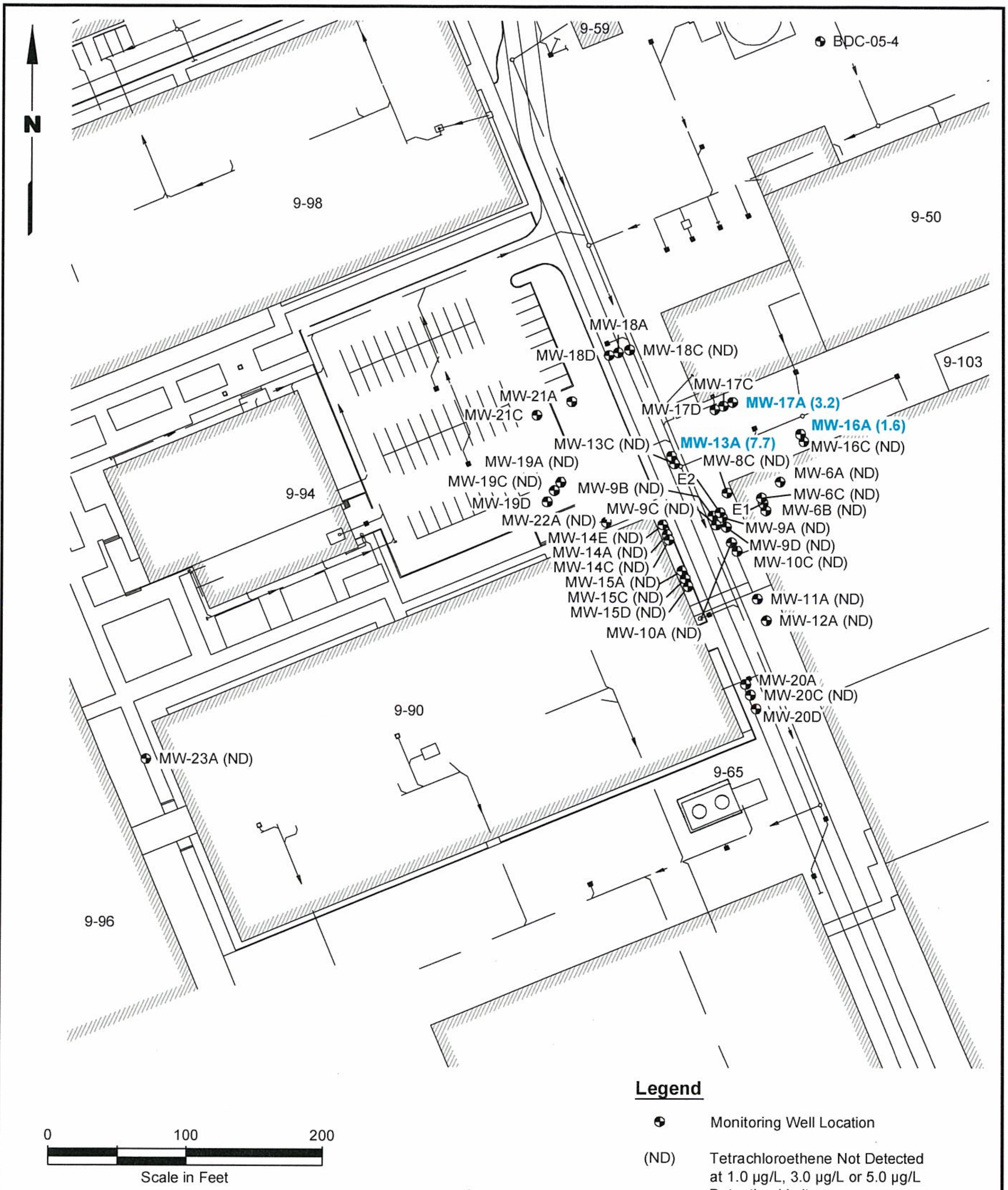
GROUNDWATER MONITORING

MAY 2009

SWMU-20 VOA/CONVENTIONALS DATA TABLES

SWMU-20 SUMMARY DATA

- **SWMU-20 VOC SUMMARY MAPS**
- **SWMU-20 ANALYTICAL RESULTS SUMMARY (January 1994 through Present)**
- **SWMU-20 VOC CONCENTRATION TREND CHARTS (January 1994 through Present)**
- **SWMU-20 CLEANUP ACTION SUMMARY – SOURCE ZONE**
- **SWMU-20 CLEANUP ACTION SUMMARY – NON-SOURCE ZONE**

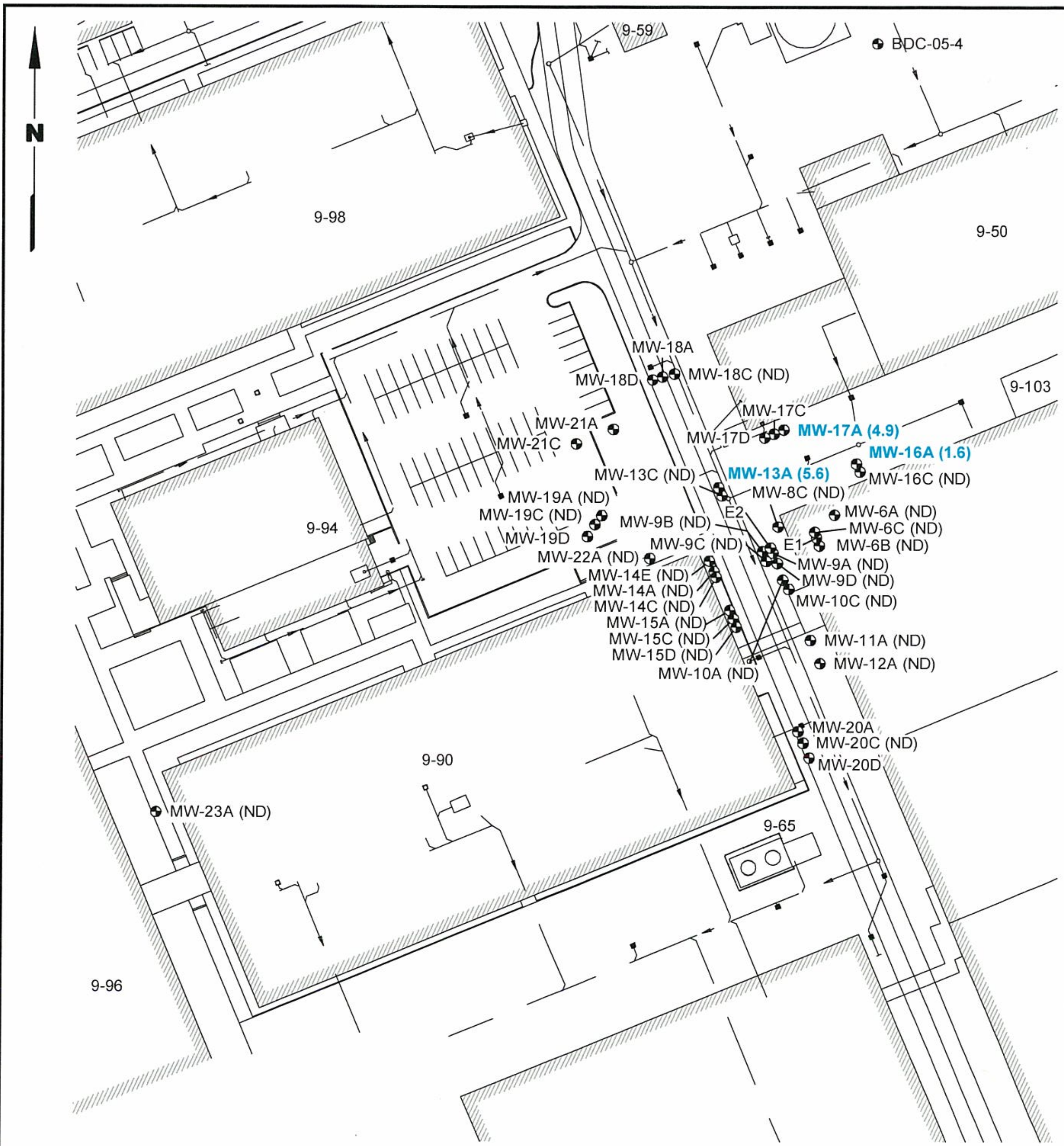


Legend

⊕	Monitoring Well Location
(ND)	Tetrachloroethene Not Detected at 1.0 µg/L, 3.0 µg/L or 5.0 µg/L Detection Limit
(1.5)	Tetrachloroethene Groundwater Concentration in µg/L

Boeing/Developmental Center/Summary Report | V:\025\093\020\Semiannual GW Report May 2009\Figs1-6.dwg (A) "Figure 1" 6/29/2009

Landau Associates	Boeing Developmental Center Tukwila, Washington	**SWMU-20 Tetrachloroethene May 2009 Groundwater Concentrations**	Figure 1



0 100 200

Scale in Feet

Legend

⊕	Monitoring Well Location
(ND)	Trichloroethene Not Detected at 1.0 µg/L or 5.0 µg/L Detection Limit
(1.4)	Trichloroethene Groundwater Concentration in µg/L

Boeing/Developmental Center/Summary Report | V:\025\093\020\Semiannual GW Report May 2009\Figs1-6.dwg (A) "Figure 2" 6/29/2009

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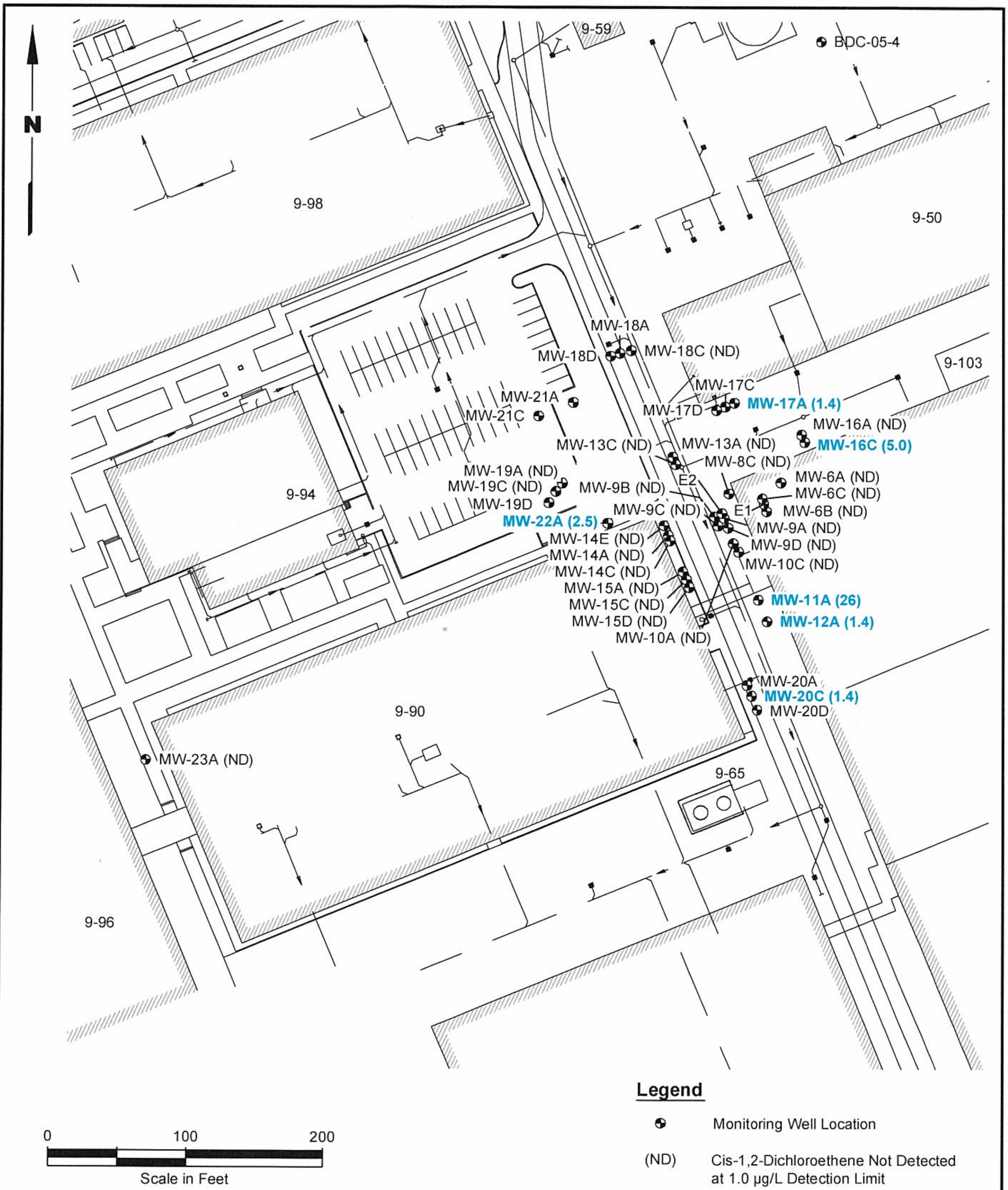
Boeing Developmental Center
Tukwila, Washington

SWMU-20 Trichloroethene May 2009 Groundwater Concentrations

Figure 2



Legend

Monitoring Well Location

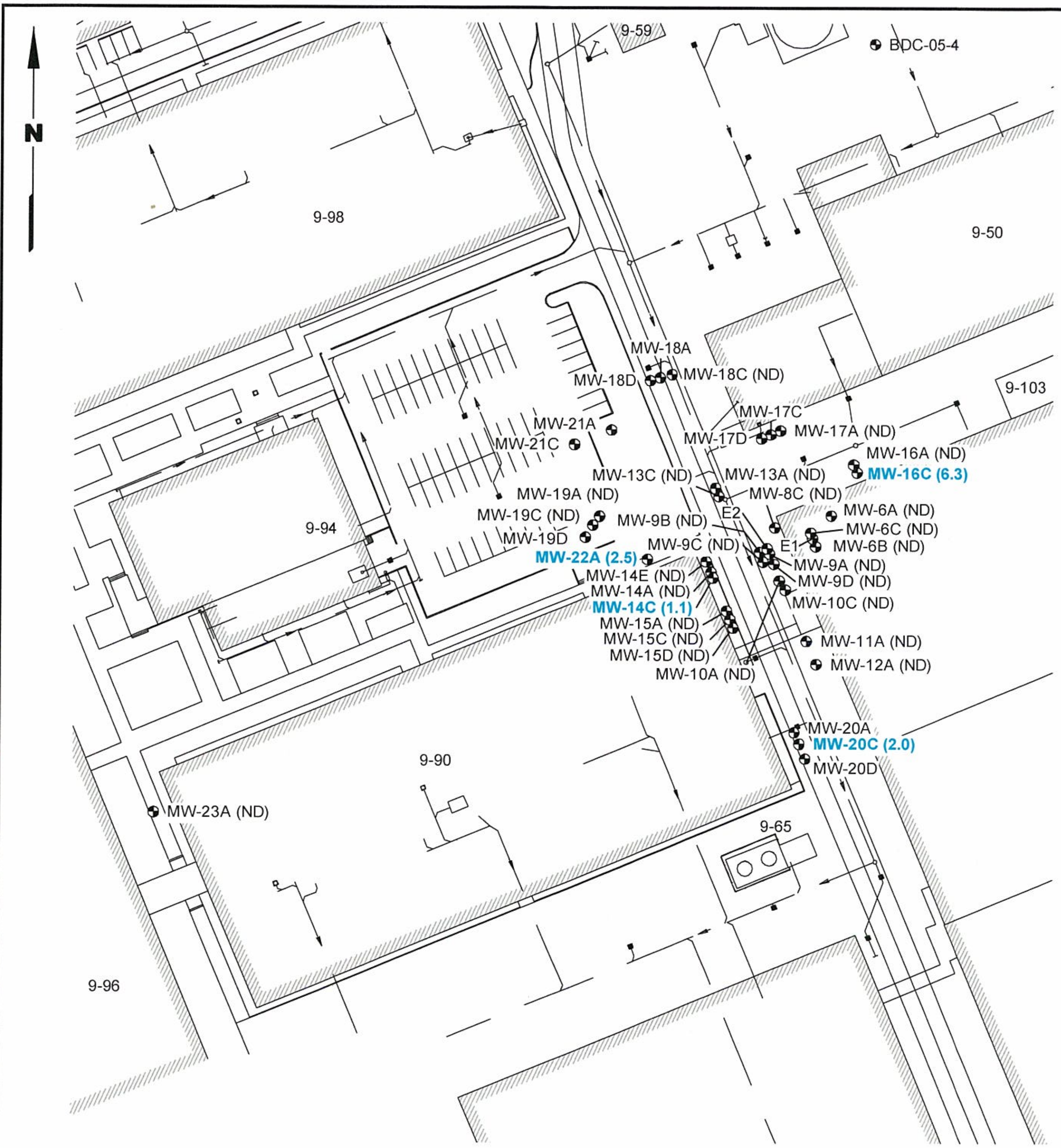
(ND) Cis-1,2-Dichloroethene Not Detected at 1.0 µg/L Detection Limit

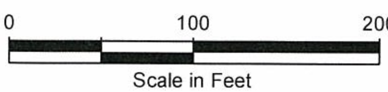
(1.0) Cis-1,2-Dichloroethene Groundwater Concentration in µg/L

Boeing/Developmental Center/Summary Report | V:\025\093\020\Semiannual GW Report May 2009\Figs1-6.dwg (A) "Figure 3" 6/29/2009

Landau Associates

Boeing Developmental Center Tukwila, Washington	**SWMU-20 Cis-1,2-Dichloroethene May 2009 Groundwater Concentrations**	Figure 3

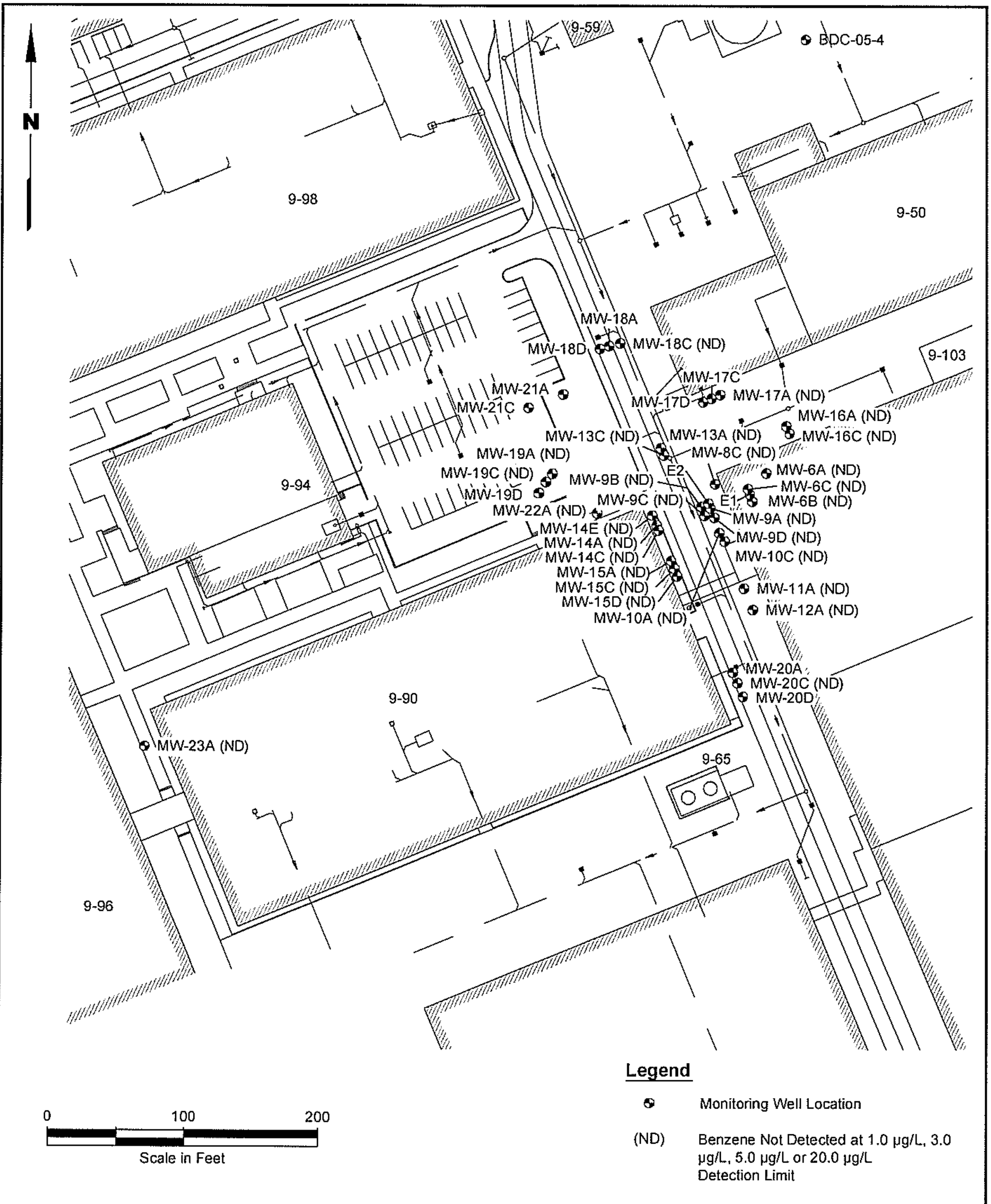




Legend

⊕	Monitoring Well Location
(ND)	Vinyl Chloride Not Detected at 1.0 µg/L, 3.0 µg/L or 5.0 µg/L Detection Limit
(2.2)	Vinyl Chloride Groundwater Concentration in µg/L

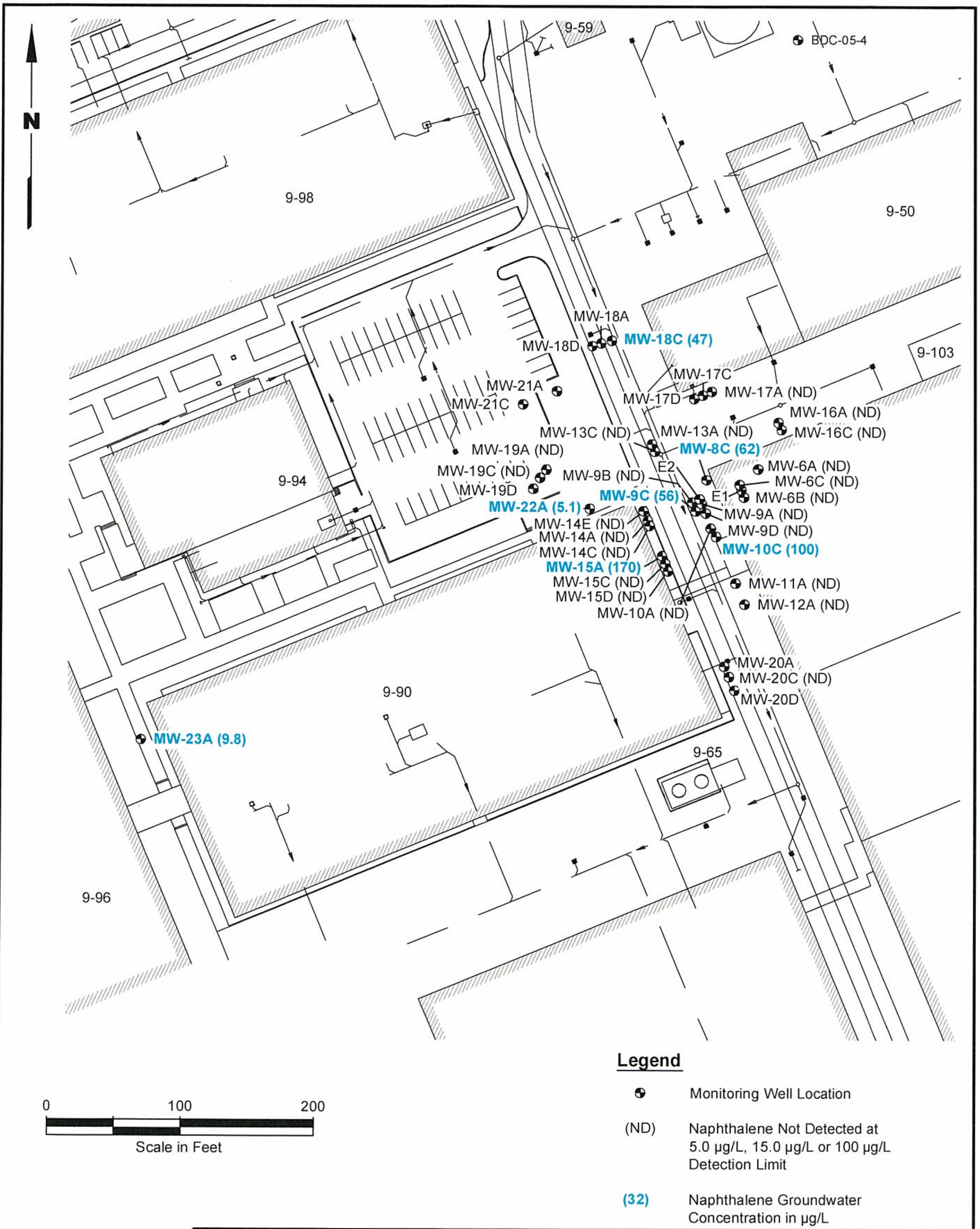
LANDAU ASSOCIATES	Boeing Developmental Center Tukwila, Washington	**SWMU-20 Vinyl Chloride May 2009 Groundwater Concentrations**	Figure 4



Boeing/Developmental Center/Summary Report | V:\025\093\020\Semiannual GW Report May 2009\Figs1-6.dwg (A) "Figure 5" 6/29/2009

LANDAU ASSOCIATES

Boeing Developmental Center Tukwila, Washington	**SWMU-20 Benzene May 2009 Groundwater Concentrations**	Figure 5



LANDAU ASSOCIATES

Boeing Developmental Center
Tukwila, Washington

SWMU-20 Naphthalene
May 2009
Groundwater Concentrations

Figure
6

Boeing/Developmental Center/Summary Report | V:\025\093\020\Semiannual GW Report May 2009\Figs1-6.dwg (A) "Figure 6" 6/29/2009

Appendix D

Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)

Tank Inventory

(from Boeing 2009a)

TANK INVENTORY

(List of storage tanks at the Developmental Center)

Underground Oil and Gas Tanks

TANK ID NUMBER	BUILDING	LOCATION	VOLUME (gallons)	CONTENT	PURPOSE	CONTAINMENT
DC16	9-101	South	1000	Diesel	Emergency generator	Double-walled
DC18	9-52	North	550	Diesel	Vehicle Fuel	Double-walled
DC19	9-52	North	1100	Unleaded gasoline	Vehicle Fuel	Double-walled
DC20	9-72	West	20000	Fuel oil	Boiler	Double-walled
DC21	9-72	West	20000	Fuel oil	Boiler	Double-walled

TANK ID NUMBER	BUILDING	LOCATION	VOLUME (gallons)	CONTENT	PURPOSE	CONTAINMENT
DC16	9-101	South	1000	Diesel	Emergency generator	Double-walled
DC18	9-52	North	550	Diesel	Vehicle Fuel	Double-walled
DC19	9-52	North	1100	Unleaded gasoline	Vehicle Fuel	Double-walled
DC20	9-72	West	20000	Fuel oil	Boiler	Double-walled
DC21	9-72	West	20000	Fuel oil	Boiler	Double-walled

Aboveground Tanks

TANK ID NUMBER	BUILDING	LOCATION	VOLUME (gallons)	CONTENT	PURPOSE	CONTAIN MENT
BMA004	9-60	West side, Canopy	550	Recyclable oil	Recycle used oil	Double-walled
BMA027	9-72	Exterior, DR N-1	1000	Diesel	Backup generator	Dike tank
BMA029	9-52	North-yard	1000	Propane	Dispensing	Not apllicable
BMA030	9-51	West canopy	3000	DW Oily water	Steam clean H2O.	Dike tank
BMA031	9-07	Inside building	280	Diesel	Emergency fire pump fuel	Building sump
BMA032	9-07	Inside building	180	Diesel	Emergency fire pump fuel	Building sump
BMA033	907	Inside building	180	Diesel	Emergency fire pump fuel	Building sump
BMA034	9-07	Inside building	180	Diesel	Emergency fire pump fuel	Building sump
BMA035	9-07	Inside building	180	Diesel	Emergency fire pump fuel	Building sump
BMA036	9-07	Inside building	60	Diesel	Emergency fire pump fuel	Building sump
BMA039	9-53	Exterior, DR N-2	275	Diesel	Backup generator	Steel box contain.
BMA040	9-64	Exterior, DR E-1	675	Diesel	Emergency generator	Dike tank
BMA041	9-99	South Dr. S-1	350	Diesel	Emergency generator	Dike tank
BMA048	9-101	D-10	2000	Hydraulic oil	Hydraulic test	Building/ trench
BMA058	9-102	Interior-2nd Floor Mezz.	120	Diesel	Fuel distribution	Building
BMA059	9-102	Exterior, DR E-1	500	Diesel	Backup generator	Dike tank
BMA065	9-08	Exterior, DR E-3	1100	Diesel	Emergency generator	Dike tank
BMA070	9-102	South-yard	4000	Diesel	Emergency generator	Dike tank
BMA072	9-51	West canopy	190	Diesel	Emergency generator	Berm

Appendix E

Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)

Air Emission Inventory

(from Boeing 2009a)

AIR EMISSION INVENTORY

BLDG	AREA	COLUMN	SOURCE	MAKE	CONTROL	EMISSION	INSTL
9-101	Blue Streak	Dr N10	Dust Collector	Sternvent	Baghouse	Aluminum dust	1994
9-101	Paint	C-2	Spray Booth	Devilbiss/Boe	Dry Filter	VOC, CO, NOx	1984
9-101	Outside, N.	D N11	Dust Collector	Spencer	Baghouse	Composite dust	1995
9-101	Autoclave	D-22	Compos Cure	United McGill	N/A	Resin off gas	1983
9-101	Blue Streak	Dr N10	Dust Collector	Spencer	Baghouse	Composite dust	1984
9-101	Trim	N-16	Dust Collector	Spencer	Baghouse	Composite dust	1987
9-101	Trim	R-15	Dust Collector	Donaldson Ind	Baghouse	Composite dust	1989
9-101	Autoclave	D-20	Compos Cure	Thermal Equip.	N/A	Resin off gas	1988
9-101	Parts Fab.	Dr N1	Dust Collector	Torit 98-X	Baghouse	Aluminum dust	1999
9-101	Pump/Treat	A2	Groundwater	Carbonair	N/A	Tetrachlor	1993
9-101	Parts Fab.	Dr N1	Dust Collector	Torit VS-2400	Cartridge	Aluminum dust	1999
9-101	F-22	Dr E3	Dust Collector	Spencer	Cartridge	Compos/Graph	1996
9-101	F-22	Dr E3	Dust Collector	Torit-Donaldson	Cartridge	Compos/Graph	1996
9-101	F-22	Dr N17	Dust Collector	Torit-Donaldson	Cartridge	Compos/Graph	1996
9-101	F-22	Dr N17	Dust Collector	Spencer	Cartridge	Compos/Graph	1996
9-101	F-22	Dr E2	Dust Collector	Torit	Filter/Cartr	Titanium/Compo s	1996
9-101	F-22	Dr E2	Dust Collector	Torit	Filter/Cartr	Titanium/Compo s	1996
9-101	F-22	Dr N17	Dust Collector	Torit	Filter/Cartr	Composite	1996
9-101	Sea Launch	Z-23	Dust Collector	Torit 90-5	Filter Pads	AL dust/chips	2000
9-101	Trim	R-18	Dust Collector	Hoffman	Baghouse	Composite dust	1983
9-101	MDL	P-16	Spray Booths	Bleeker Bros.	Dry Filter	VOC, CO, NOx	2001
9-120	Eng Mdl Lab	Dr E4	Dust Collector	Torit	Baghouse	Plastic	1991
9-120	Mech.Rm	J-1	Dust Collector	Spencer	Baghouse	Wood Dust	1992
9-120	Room 116	E-2	Spray Booth	Devilbiss	Dry Filter	VOC, CO, NOx	1988
9-120	Eng Mdl Lab	J-3	Spray Booth	Devilbiss	Dry Filter	VOC, CO, NOx	1988
9-120	Eng Mdl Lab	Dr E4	Dust Collector	Torit-Donaldson	Baghouse	Plastic/metal/wd	1990
9-120	Mech.Room	J-1	Dust Collector	Spencer	Baghouse	Wood Dust	1992
9-140	ADL	D-1	Spray Booth	Binks/JBI	Dry Filter	VOC, CO, NOx	2001
9-50	Outside, W	West	UST 20000	DC 20	N/A	Fuel oil	1992
9-50	Outside, W	West	UST 20000	DC 21	N/A	Fuel oil	1992
9-50	Boiler Rm	B-2.5	Boiler #1	Foster Wheeler	N/A	CO, NOx, Sox	1957
9-50	Boiler Rm	C-2.5	Boiler #2	Foster Wheeler	N/A	CO, NOx, Sox	1957

9-50	Boiler Rm	D-2.5	Boiler #3	Foster Wheeler	N/A	CO, NOx, Sox	1957
9-50	Boiler Rm	E-2.5	Boiler #4	Keeler	N/A	CO, NOx, Sox	1957
9-51	Carp.Shp	L-6	Dust Collector	Spencer	Baghouse	Wood Dust	1992
9-51	Carp.Shp	A-1	Dust Collector	Donaldson/Cart.	Filter/Cartr	Wood Dust	1997
9-51	Carp.Shp	A-1	Dust Collector	DCE/Farr	Filter/Cartr	Wood Dust	1997
9-52	Outside, N	North	UST 1100	DC 19	N/A	VOC (gasoline)	1990
9-52	Paint Shp	A/B-1	Spray Booth	Bleeker Bros.	Dry Filter	VOC, CO, NOx	1985
9-67	Data Destr	Roof	Dust Collector	Mikropul	Baghouse	Paper Dust	1988
9-67	Data Destr	N/A	Incinerator	Ecolaire Comb.	2nd Chamber	CO NOx HCL	1988
9-77	Classified	H-16	Dust Collector	Sternvent	Filter/Cartr	Wood/metal dust	1988
9-99	Sea Launch	G-2	Paint Area	Boeing	Dry Filter	VOC, CO, NOx	1998
9-99	Model	Dr S-1	Dust Collector	Torit	Dry Filter	Wood Dust	2009
9-120	Model	Dr E-4	Dust Collector	Torit	Dry Filter	Aluminum	1997
9-120	Rapid Proto	J-2	Dust Collector	Torit	Dry Filter	Nylon Powder	2003
9-101	Composites	Dr S-18	Dust Collector	Spencer	Bag House	Composite Dust	1996
9-101	Tool Grind	Dr N-7	Dust Collector	Amer. Air Filter	Wet Rotocl	Metal Dust/Shav	2002
9-101	Tooling	J-13	Dust Collector	Sternvent	Dry Filter	wd/plast/graph	1995
9-101	Tooling	J-13	Dust Collector	Sternvent	Dry Filter	steel	1995
9-101	Trim	R-18	Dust Collector	Torit	Dry Filter	Composite dust	
9-101	CFAC Repair	M-17	Sanding Booth	Torit	Dry Filter	Composite dust	2002
9-101	MR&D	E-2	Sanding Booth	Torit	Dry Filter		
9-101	MR&D	E-2	Sanding Booth	JBI	Dry Filter		2002
9-101	General	D-5	Sanding Booth	Torit	Dry Filter		2007
9-101	CFAC Trim	P-16	Sanding Booth	Torit	Dry Filter	Composite dust	
9-101	Paint	C-4	Sanding Booth	Torit	Dry Filter		2007
9-101	Tool/Plast	K-2	Grinding Booth	AirWall StripT	Dry Filter	Composite dust	
9-101	General	H-17	Dust Collector	ERBO	Dry Filter	Compos/Graph	2008

Appendix F

Lower Duwamish Waterway
RM 4.3-4.9 East (Boeing Developmental Center)

Five-Year Spill History

(from Boeing 2009a)

FIVE-YEAR SPILL HISTORY

Spills to the Environment mid-2004 to mid-2009. Complete spill history is available on the EHS website, EHS Toolbox, Spill Reports

Date	Location (outside)	Material	Quantity	% Recovered
7/27/04	N of 9-67	Latex concrete bond	4 gal	100
8/01/04	9-04 roof	Water - lightly treated	20,000 gal	0
8/14/04	E of 9-101	Water	300 gal	100
8/30/04	9-61, Dr E 1	Water	5 gal	100
10/0804	9-101 outside	Latex paint dust	blowing	0
12/28/04	9-101, Dr N5	Diesel	1 pt	100
1/27/05	Oxbow parking lot	Oil/gas	1 qt	90
3/24/05	9-140 breezeway	Oil	1 cup	99
4/25/05	9-101 S parking	Capacitor oil	1 pt	100
6/30/05	NE of 9-101	Liquid cleaner	1 cup	100
6/15/05	9-96, Dr W7	Antifreeze	1 qt	95
8/08/05	9-50, Dr N2	Water	500 gal	0
8/23/05	9-101, Dr E12	Motor oil	2 qts	100
8/26/05	Oxbow parking lot	Antifreeze	1 gal	100
9/21/05	9-55 SE parking	Diesel #2	3 gal	75
11/02/05	9-101, Dr W1	Motor oil	2 qts	98
11/13/05	9-90 outside	Water/floor stripper	7 gal	95
11/21/05	9-52, W yard	Water/ethylene glycol	6 gal	20
12/09/05	9-101, SE parking	Ethylene glycol	1 pt	100
12/16/09	9-101 to 9-51 outside	Ethylene glycol	2 qt	100
1/13/06	9-101, Dr N9	Cooking oil	2 gal	95
1/16/06	9-98, E parking	Dry chemical	7 lbs	5
1/24/06	9-101, N side	Motor oil	2 qts	98
2/22/06	9-94, E side	Cooking grease	5 gal	50
5/03/06	9-51, Dr S1	Oily waste water	20 gal	99
5/15/09	9-51, Dr N1	Hydraulic oil	1/2 gal	0
5/25/09	9-52, N side	Gasoline	1 qt	95
6/05/05	9-51, Dr S1	Soapy water	40 gal	99
6/23/06	9-60, Dr W3	Photo developer/water	4 gal	95
7/19/06	DC Gate J5 area	Engine oil	1 qt	100
7/27/06	9-98, Dr N1	Diesel fuel	4 oz	0
8/24/06	DC Gate J5 area	Motor oil	1 gal	98
8/30/06	9-60 W side	Hydraulic fluid	3 cups	99
	continues next page			

Date	Location (outside)	Material	Quantity	% Recovered
9/10/06	9-101, Dr N15	Carpet cleaner	1 gal	100
9/12/06	9-101, S parking	Ethylene glycol	2 gal	95
10/05/06	9-60, W side	Hydraulic fluid	1 pt	0
11/06/06	9-51, E side	Oil	Drops	0
11/17/06	9-101, SE area	Hydraulic fluid	1 gal	90
12/14/06	9-52, gas pump area	Gasoline	1 cup	100
12/15/06	9-102 roof	Antifreeze/water	2 gal	0
12/21/06	9-65, Dr S1	Cooling water	100 gal`	100
1/02/07	9-98, Dr N3	Hydraulic fluid	2 qt	99
2/28/07	9-98, NW corner	Diesel fuel	Unknown	0
3/27/07	9-53, Dr E1	Motor oil	6 oz	95
4/12/07	9-101, Dr E8	Gasoline	16 oz	98
4/22/07	9-110, N area	Motor oil	2 gals	98
5/02/07	9-51, S side	Landscape bark effluent	3 gals	0
6/15/07	Oxbow parking	Petroleum	1 pt	90
6/18/07	9-101, Dr N9	Fire suppression water	2500 gal	0
7/05/07	9-50, Dr E1	Water/Ethylene glycol	45 liters	98
7/10/07	9-50, Dr. N12	Hydraulic fluid	1 pt	95
9/15/07	9-101, E side	Hot water	200 gal	0
10/03/07	9-51, canopy	Coolant	1 gal	95
10/09/07	9-120, NE area	Chiller water	200 gal	0
10/31/07	9-101, SE corner	Oil	1 gal	0
4/14/08	9-52, Dr N1	Unleaded gas	1/2 gal	95
4/28/08	9-55, N side	Liquid hand soap	2 liters	95
5/24/08	9-50, N side	Water/biocide	Unknown	0
6/02/08	9-52, Dr. N1	Unleaded gas	1/2 gal	95
6/19/08	9-101, Dr N1	Hydraulic oil	1/2 gal	95
9/04/08	9-98, Dr S1	Hydraulic fluid	1 qt	95
10/07/08	9-110 outside area	Water/lavatory cleaner	2 gal	75
12/04/08	DC Gate J26 area	Transmission fluid	1/2 gal	90
1/26/09	9-12 parking	Sanitary sewer overflow	2,000 gal	0
2/06/09	9-52, Dr N2	Sprinkler water	300 gal	0
2/17/09	9-52, N side	Gasoline	1 qt	100
3/09/09	9-103, Dr N1	Chiller water/oil	500 gal	100
3/20/09	9-140, W side	Fuel	5 oz	95
6/29/09	9-101, Dr N9	Antifreeze	1 qt	95