DEPARTMENT OF ECOLOGY
State of Washington

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

Source Control Action Plan

December 2010

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RM 4.3 to 4.9 East
(Boeing Developmental Center)

Source Control Action Plan

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Executive Summary

The purpose of this Source Control Action Plan (SCAP) is to describe potential sources of contaminants to sediments along the Lower Duwamish Waterway (LDW) River Mile (RM) 4.3 to 4.9 East, and to identify actions necessary to prevent recontamination of sediment after cleanup. This SCAP is based on a thorough review of information pertinent to sediment recontamination, as documented in *Summary of Existing Information and Identification of Data Gaps* (SAIC 2010).

The LDW, located in Seattle, Washington, was added to the National Priorities List (Superfund) by the U.S. Environmental Protection Agency (EPA) on September 13, 2001. Chemicals of concern (COCs) found in waterway sediments include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), metals, bis(2-ethylhexyl)phthalate (BEHP), dioxins/furans, and organo-tin compounds. These COCs may pose threats to people, fish, and wildlife.

In December 2000, EPA and the Washington State Department of Ecology (Ecology) entered into an order with King County, the Port of Seattle, the City of Seattle, and The Boeing Company to perform a Remedial Investigation (RI) and Feasibility Study (FS) of sediment contamination in the waterway. EPA is the lead agency for the RI/FS. Ecology is the lead agency for controlling current sources of pollution to the site, in cooperation with the City of Seattle, King County, the Port of Seattle, the City of Tukwila, and EPA.

The RI Report (Windward 2010) used a combination of existing and newly collected data to identify potential human health and ecological risks, information needs, and high priority areas for cleanup. Seven candidate early action areas were initially identified (Windward 2003b). 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.[1] The Boeing Developmental Center (BDC) source control area was identified as one of these areas.

As part of source control efforts in the LDW, Ecology works with other members of the Source Control Work Group (SCWG) to develop SCAPs for terrestrial source control areas that are potential sources of contaminants to sediments that will or may require cleanup. The SCAP for each of these source control areas describes potential sources of sediment contaminants and the actions needed to control them, and evaluates whether ongoing sources are present that could recontaminate sediments after cleanup. In addition, the SCAPs describe source control actions that are planned or currently underway, and sampling and monitoring activities that will be conducted to identify additional sources.

Sections 1 and 2 of this SCAP provide background information about the LDW site and the sediments associated with the BDC source control area. PCBs, PAHs, and lead are considered to be the major COCs in sediments associated with the source control area. While this SCAP focuses on these COCs, other chemicals that could result in sediment recontamination will be addressed as sources are identified.

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

Section 3 contains the following: a description of potential sources of contaminants that may affect sediments associated with the BDC source control area, including stormwater discharges and other potential releases from the adjacent property; an evaluation of the significance of these potential sources; and an identification of the actions that are planned or underway to control potential contaminant sources. Section 4 discusses monitoring activities that will be conducted to identify additional sources and assess progress, and Section 5 describes how source control efforts will be tracked and reported. Section 6 lists documents reviewed during preparation of this SCAP.

Table ES-1 lists the source control actions that have been identified for the BDC source control area. This table includes a brief description of the potential contaminant sources for each property, source control activities to be conducted, parties involved in source control actions for each property or task, and milestone/target dates for completion of the identified action items. The milestones and targets are best-case scenarios based on consultation with the identified agencies or facilities. They reflect reasonably achievable schedules, and include the time required for planning, contracting, field work, laboratory analysis, and activities dependent on weather.

A removal action for sediment associated with the BDC source control area was not scheduled at the time this SCAP was prepared.

Table ES-1. Source Control Actions –Boeing Developmental Center Source Control Area

Potential Sources	Action Items	Priority	Responsible Party(ies)	Status	Target Date
Boeing Developmental Center Outfalls					
Stormwater from the BDC is discharged to the LDW via 10 private outfalls. Much of the stormwater flow is directed through one of nine oil/water separators prior to discharge. Water and sludge/sediment samples collected from some of the oil/water separators in 2002 indicated elevated PCB concentrations. LDW surface sediments near outfall DC9 slightly exceeded the SQS but were below the CSL. No subsurface sediment samples have been collected.	Request Boeing to investigate the status of Outfall 2086, which appears to be abandoned.	Medium	Ecology/Boeing	Planned	TBD
	Request Boeing to prepare a work plan for collection of subsurface sediment samples in the area of the LDW adjacent to the BDC outfalls.	Medium	Ecology/Boeing	Planned	TBD
	Request Boeing to collect grab solids samples from the BDC SD system. Priority should be given to SD lines with medium to high flows and SD lines serving areas with significant industrial activities. Samples should be analyzed for PCBs, PAHs, and metals.	High	Ecology/Boeing	Planned	TBD
	If COCs are detected in the SD system at concentrations above the SQS, request Boeing to conduct source tracing and control as needed to reduce the potential for sediment recontamination.	High	Ecology/Boeing	Planned	TBD
Boeing Developmental Center (9725 East Marginal Way S, Tukwila)					
Historical operations at this location have resulted in releases of petroleum hydrocarbons, VOCs (including chlorinated compounds), SVOCs, total PCBs, and metals to soil and groundwater beneath the property. Investigation and cleanup of contamination at two SWMUs and one AOC is being conducted under Ecology's Voluntary Cleanup Program. The most recent Ecology stormwater inspection was conducted in 2006. Although changes to operations at this facility are planned, the new operations will likely be a continuation of past activities involving development and testing of composite materials. .	Review response to EPA's Request for Information 104(e) letters sent to Boeing.	Medium	Ecology	Planned	TBD
	Continue to monitor RCRA cleanup activities to ensure contaminants present in groundwater as a result of historical releases are not entering the LDW.	Low	Ecology	Planned	TBD
	Conduct a stormwater compliance inspection to ensure that current and planned operations are consistent with stormwater regulations and best management practices. Review changes to industrial activities at BDC to assess potential for sediment recontamination associated with new operations.	Medium	Ecology	Planned	TBD
	Request additional information about the nature of BDC's emissions and air permit as they relate to deposition on impervious surfaces and the stormwater pathway to the LDW.	Low	Ecology	Planned	TBD
	Request Boeing to collect at least one round of seep samples from the four known seepage locations (see Figure 2) to confirm that no contaminants are being discharged to the LDW via this transport pathway.	Medium	Ecology/Boeing	Planned	TBD

Priority:

High priority action item – to be completed prior to sediment cleanup
Medium priority action item – to be completed prior to or concurrent with sediment cleanup
Low priority action item – ongoing actions or actions to be completed as resources become available

AOC = Area of Concern
BDC = Boeing Development Center
COC = chemical of concern
CSL = Cleanup Screening Level
EPA = Environmental Protection Agency
LDW = Lower Duwamish Waterway
MTCA = Model Toxics Control Act
PAH = polycyclic aromatic hydrocarbon
PCB = polychlorinated biphenyl
RCRA = Resource Conservation and Recovery Act
SD = storm drain
SQS = Sediment Quality Standard
SVOC = semivolatile organic compound
SWMU = solid waste management unit
VOC = volatile organic compound

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Acronyms/Abbreviations

AOC	Area of Concern
AOPC	Area of Potential Concern
BDC	Boeing Developmental Center
BEHP	bis(2-ethylhexyl)phthalate
BTEX	benzene, toluene, ethylbenzene, and xylenes
COC	chemical of concern
CSL	Cleanup Screening Level
CSO	combined sewer overflow
DW	dry weight
E&E	Ecology & Environment, Inc.
EAA	Early Action Area
Ecology	Washington State Department of Ecology
EOF	emergency overflow
EPA	United States Environmental Protection Agency
FS	Feasibility Study
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
μg/L	micrograms per liter
mg/kg	milligrams per kilogram
mg/L	milligrams/liter
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
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	Remedial Investigation
RM	river mile
ROD	Record of Decision
SAIC	Science Applications International Corporation
SCAP	Source Control Action Plan
SCWG	Source Control Work Group
SD	storm drain
SMS	Sediment Management Standards
SQS	Sediment Quality Standard

Acronyms/Abbreviations (continued)

SVOC	semivolatile organic compound
SWMU	solid waste management unit
SWPPP	Stormwater Pollution Prevention Plan
TCE	trichloroethylene
TPH	total petroleum hydrocarbons
TSS	total suspended solids
UST	underground storage tank
VOC	volatile organic compound
WAC	Washington Administrative Code

1.0 Introduction

This Source Control Action Plan (SCAP) describes potential sources of contaminants that may affect sediments in and adjacent to the River Mile (RM) 4.3 to 4.9 East[2] (Boeing Developmental Center) Source Control Area.[3] The purpose of this plan is to evaluate the significance of these sources and to determine if actions are needed to minimize the potential for recontamination of sediment associated with the Boeing Developmental Center (BDC) source control area after cleanup[4]. In addition, this SCAP describes:

- Source control actions/programs that are planned or currently underway,
- Sampling and monitoring activities that will be conducted to identify additional sources and assess progress, and
- How these source control efforts will be tracked and reported.

The information in this document was obtained from various sources, including the following documents:

- *Lower Duwamish Waterway, RM 4.3 to 4.9 East (Boeing Developmental Center) – Summary of Existing Information and Identification of Data Gaps,* Science Applications International Corporation (SAIC), September 2010, located on Ecology's website: http://www.ecy.wa.gov/programs/tcp/sites/lower_duwamish/sites/RM_43-49_E/boeingDevCtr.html
- *Lower Duwamish Waterway Source Control Strategy, Washington State Department of Ecology*, January 2004, located on Ecology's website: http://www.ecy.wa.gov/pubs/0409043.pdf

1.1 Organization of Document

Section 1 of this SCAP describes the Lower Duwamish Waterway (LDW) site, the strategy for source control, and the responsibilities of the public agencies involved in source control for the LDW. Section 2 provides background information on the BDC source control area, including a description of the chemicals of concern (COCs) for sediments. Section 3 provides an overview of potential sources of contaminants that may affect sediments associated with the BDC source control area, including stormwater discharges and other potential releases from the BDC property. Section 3 also describes actions planned or currently underway to control potential sources of contaminants, while Sections 4 and 5 describe monitoring and tracking/reporting activities, respectively. References are listed in Section 6, and figures and tables are presented at the end of the document.

[2] River miles as defined in this report are measured from the southern tip of Harbor Island.
[3] This SCAP incorporates data published through August 2010. Section 5, Tracking and Reporting of Source Control Activities, describes how newer data will be disseminated.
[4] Cleanup options for the LDW are currently being developed as part of the FS. No sediment cleanup action has been identified for the RM 4.3 to 4.9 East at this time.

As new information about the sites and potential sources discussed in this document becomes available and as source control progress is made, Ecology will update the information in this SCAP as needed. The status of source control actions is summarized in the LDW Source Control Status Reports (Ecology 2007a, 2008a, 2008b, 2009a and as updated).

1.2 Lower Duwamish Waterway Site

The LDW is the downstream portion of the Duwamish River, extending from the southern tip of Harbor Island to just south of Turning Basin 3 (Figure 1). It is a major shipping route for bulk and containerized cargo. Most of the upland areas adjacent to the LDW have been developed for industrial and commercial operations. These include cargo handling and storage, marine construction, boat manufacturing, marina operations, concrete manufacturing, paper and metals fabrication, food processing, and aerospace manufacturing. In addition to industry, the river is used for fishing, recreation, and wildlife habitat. Residential areas near the waterway include the South Park and Georgetown neighborhoods.

Beginning in 1913, this portion of the Duwamish River was dredged and straightened to promote navigation and industrial development, resulting in the river's current form. Shoreline features within the waterway include constructed bulkheads, piers, wharves, buildings extending over the water, and steeply sloped banks armored with riprap or other fill materials (Weston 1999). This development left intertidal habitats dispersed in relatively small patches, with the exception of Kellogg Island, which is the largest contiguous area of intertidal habitat remaining in the Duwamish River (Tanner 1991). Over the past 20 years, public agencies and volunteer organizations have worked to restore intertidal and subtidal habitat to the river. Some of the largest restoration projects are at Herring House Park/Terminal 107, Turning Basin 3, Hamm Creek, and Terminal 105.

The presence of chemical contamination in the LDW has been recognized since the 1970s (Windward 2003a). In 1988, the United States Environmental Protection Agency (EPA) investigated sediments in the LDW as part of the Elliott Bay Action Program. Problem chemicals identified by the EPA study included metals, polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), phthalates, and other organic compounds. In 1999, EPA completed a study of approximately 6 miles of the waterway, from the southern tip of Harbor Island to just south of the turning basin near the Norfolk combined sewer overflow (CSO) (Weston 1999). This study confirmed the presence of PCBs, PAHs, phthalates, mercury, and other metals. These contaminants may pose threats to people, fish, and wildlife.

In December 2000, EPA and the Washington State Department of Ecology (Ecology) signed an agreement with King County, the Port of Seattle, the City of Seattle, and The Boeing Company, collectively known as the Lower Duwamish Waterway Group (LDWG). Under the agreement, the LDWG is conducting a Remedial Investigation (RI) and Feasibility Study (FS) of the LDW to assess risks to human health and the environment and to evaluate cleanup alternatives. The RI for the site was done in two phases. Results of Phase 1 were published in July 2003 (Windward 2003a). The Phase 1 RI used existing data to characterize the nature and extent of chemical distributions in LDW sediments, develop preliminary risk estimates, and identify candidate sites for early cleanup action. The final RI was published in July 2010, and presents the results of investigations conducted for the LDW study area between 2003 and 2009, including studies to assess sediment dynamics, the nature and extent of contamination in the LDW, preliminary background concentrations, ecological and human health risks, and potential chemical sources (Windward 2010). An FS, which will address cleanup options for contaminated sediments in the LDW, is currently in progress.

On September 13, 2001, EPA added the LDW to its National Priorities List. This is EPA's list of hazardous waste sites that warrant further investigation and cleanup under Superfund. Ecology added the site to the Washington State Hazardous Sites List on February 26, 2002.

An interagency Memorandum of Understanding (MOU), signed by EPA and Ecology in April 2002 and updated in April 2004, divides responsibilities for the site (EPA and Ecology 2002; EPA and Ecology 2004). EPA is the lead agency for the RI/FS, while Ecology is the lead agency for source control issues.

In June 2003, the *Technical Memorandum: Data Analysis and Candidate Site Identification* (Windward 2003b) was issued. Seven candidate sites for early action (Early Action Areas [EAAs]) were initially identified (Figure 1). The sites are:

- Area 1: Duwamish/Diagonal CSO and storm drain (SD),
- Area 2: West side of the waterway, just south of the First Avenue S Bridge, approximately 2.2 miles from the south end of Harbor Island,
- Area 3: Slip 4, approximately 2.8 miles from the south end of Harbor Island,
- Area 4: South of Slip 4, on the east side of the waterway, just offshore of the Boeing Plant 2 and Jorgensen Forge properties, approximately 2.9 to 3.7 miles from the south end of Harbor Island,
- Area 5: Terminal 117 and adjacent properties, approximately 3.6 miles from the south end of Harbor Island, on the west side of the waterway,
- Area 6: East side of the waterway, approximately 3.8 miles from the south end of Harbor Island, and
- Area 7: Norfolk CSO/SD, on the east side of the waterway, approximately 4.9 to 5.5 miles from the south end of Harbor Island.

Of the seven candidate EAAs, five either had sponsors to begin investigations or were already under investigation by a member or group of members of the LDWG. These five sites are: Slip 4, Terminal 117, Boeing Plant 2, Duwamish/Diagonal CSO/SD, and Norfolk CSO/SD[5]. EPA is the lead agency for managing cleanup at Terminal 117 and Slip 4. The other three early action cleanup projects were started before the current LDW RI/FS was initiated. Cleanup at Boeing Plant 2, under EPA Resource Conservation and Recovery Act (RCRA) management, is currently in the planning stage. The Duwamish/Diagonal CSO/SD and Norfolk CSO/SD cleanups are under King County management as part of the Elliott Bay-Duwamish Restoration Program. Cleanup at Duwamish/Diagonal was partially completed in March 2004; a partial sediment cleanup was conducted at Norfolk CSO/SD in 1999. An additional sediment removal action was

[5] These five sites are identified as EAAs in the Draft Final FS for the Lower Duwamish Waterway, published on October 15, 2010 (AECOM 2010). The two candidate EAAs without sponsors are identified in the Draft Final FS as Areas of Potential Concern (AOPCs).

completed by Boeing inshore of the Norfolk CSO/SD area in September 2003. Early action cleanups may involve members of the LDWG or other parties as appropriate. Planning and implementation of early action cleanups is being conducted concurrently with the RI/FS.

In 2007, Ecology, in consultation with EPA, identified eight additional source control areas based on available sediment data, size of the upland basin draining to the source control area, and general knowledge about facilities operating in the basin. In February 2008, Ecology identified the areas of the LDW not covered by a SCAP or planned SCAP. Using the same criteria as in 2007, eight additional potential source control areas were added to the list (Ecology 2008a). One additional source control area was added by Ecology in 2010, for a total of 24 source control areas. The seven candidate EAAs and 17 additional source control areas are shown in Figure 1.

Further information about the LDW can be found at:
http://yosemite.epa.gov/r10/cleanup.nsf/sites/lduwamish and
http://www.ecy.wa.gov/programs/tcp/sites/lower_duwamish/lower_duwamish_hp.html.

1.3 LDW Source Control Strategy

The LDW Source Control Strategy (Ecology 2004) describes the process for identifying source control issues and implementing effective source controls for the LDW. The plan is to identify and manage sources of potential contamination and recontamination in coordination with sediment cleanups. The goal of the strategy is to minimize the potential for recontamination of sediments to levels exceeding the LDW sediment cleanup goals and the Washington State Sediment Management Standards (SMS).[6] Existing administrative and legal authorities will be used to perform inspections and require necessary source control actions.

The strategy is being implemented through the development of a series of detailed, area-specific SCAPs that will be coordinated with sediment cleanups, beginning with the EAAs. Each SCAP will document what is known about the area, the potential sources of recontamination, actions taken to address them, and how to determine when adequate source control is achieved for an area. Because the scope of source control for each site will vary, it is necessary to adapt each plan to the specific situation at that site. The success of this strategy depends on the coordination and cooperation of all public agencies with responsibility for source control in the LDW area, as well as prompt compliance by the businesses that must make necessary changes to control releases from their properties.

The source control strategy focuses on controlling contamination that affects LDW sediments. It is based 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 Ecology's SMS. The first principle is to control sources early, starting with identifying all ongoing sources of contaminants to the site. EPA's Record of Decision (ROD) for the LDW will require that sources of sediment contamination to the entire LDW be evaluated, investigated, and controlled as necessary. Dividing source control work into specific SCAPs and prioritizing those plans to coordinate with sediment cleanups will address the guidance and regulations and will be consistent with the selected remedial actions in the EPA ROD.

[6] Washington Administrative Code 173-204

Source control priorities are divided into four tiers. Tier 1 consists of source control actions associated with EAA sediment cleanups. Tier 2 consists of source control actions associated with cleanup areas identified in Phase 2 of the RI/FS and EPA's ROD. Tier 3 consists of source control actions necessary to prevent future sediment contamination from basins that may not drain directly to an identified sediment cleanup area. Tier 4 consists of source control actions necessary to address any recontamination identified by post-cleanup sediment monitoring (Ecology 2008a). This document is a SCAP for a Tier 3 Source Control Area.

Further information about the LDW Source Control Strategy can be found at: http://www.ecy.wa.gov/biblio/0409052.html and http://www.ecy.wa.gov/programs/tcp/sites/lower_duwamish/lower_duwamish_hp.html.

1.4 Source Control Work Group

The primary public agencies responsible for source control for the LDW are Ecology, the City of Seattle, King County, Port of Seattle, City of Tukwila, and EPA. Ecology and EPA are involved in the source control activities for the BDC source control area.

In order to coordinate among these agencies, Ecology formed the Source Control Work Group (SCWG) in January 2002. The purpose of the SCWG is to share information, discuss strategy, actively participate in developing SCAPs, jointly implement source control measures, and share progress reports on source control activities for the LDW area. The monthly SCWG meetings are chaired by Ecology. All final decisions on source control actions and completeness will be made by Ecology, in consultation with EPA, as outlined in the April 2004 Ecology/EPA LDW Memorandum of Understanding (EPA and Ecology 2004).

Other public agencies with relevant source control responsibilities include the Washington State Department of Transportation, Puget Sound Clean Air Agency, and the Seattle/King County Department of Public Health. These agencies are invited to participate in source control with the SCWG as appropriate (Ecology 2004).

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2.0 River Mile 4.3 to 4.9 East (Boeing Developmental Center)

The BDC source control area is located along the eastern side of the LDW Superfund Site between 4.3 and 4.9 miles from the southern tip of Harbor Island (Figure 1). The BDC is the only facility located directly adjacent to the LDW within this source control area (Figure 2). 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. 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 complex, 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 SCAP for the Slip 6 (RM 3.9-4.3 East) source control area (E&E 2008; Ecology 2008c).

To the south of the BDC source control area are portions of the BDC property from which stormwater drains to the RM 4.9 East source control area (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/rail trailers. This portion of the BDC property was discussed in the SCAP for the Norfolk CSO/SD (RM 4.9 East/EAA-7) source control area (E&E 2007; Ecology 2007b). The vacant lot was not discussed in the Norfolk CSO/SD source control reports.

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 owned by Boeing and is at the north end 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 2010). 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.

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 2003a).

Ten active private outfalls, one abandoned outfall, and four seeps were identified along the shoreline within the BDC source control area (Figure 2) (Windward 2010).

2.1 Chemicals of Concern in Sediment

Several environmental investigations have included the collection of sediment associated with the BDC source control area (Figure 4), within and directly downstream (north) of RM 4.3 to 4.9 East. These include:

- Twenty-two surface sediment samples were collected by Boeing in the vicinity of the BDC source control area as part of a Boeing Site Characterization in October 1997 (Exponent 1998, as cited in Windward 2003a);
- Twenty-four surface samples were collected as part of a National Oceanic and Atmospheric Administration (NOAA) sediment characterization of the Duwamish River in 1997 (NOAA 1998);
- Twelve surface sediment samples were collected during an EPA Site Inspection in 1998 (Weston 1999);
- One surface sediment sample was collected by Windward in the vicinity of RM 4.5 East (Figure 4) in August 2004 (Windward 2006);
- Four surface sediment samples were collected by Windward during Rounds 1 and 2 of the LDW Phase 2 RI during January to March 2005 (Windward 2005a, 2005b).

Sediment data associated with the BDC source control area are detailed in *Summary of Existing Information and Identification of Data Gaps* (SAIC 2010), referred to in this document as the BDC Data Gaps Report. Chemical data were compared to the SMS, which include both the Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSLs) criteria of the SMS (WAC 173-204). Sediments with chemical concentrations below the SQS criteria have a low likelihood of adverse effects on sediment-dwelling biological resources. However, an exceedance of the SQS numerical criteria does not necessarily indicate adverse effects or toxicity, and the degree of SQS exceedance does not correspond to the level of sediment toxicity. The CSL criteria are greater than or equal to the SQS criteria and represents a higher level of risk to benthic organisms than the SQS. The SQS and CSL criteria provide a basis for identifying sediments that may pose a risk to some ecological receptors. The SMS for most organic chemicals are based on total organic carbon (OC)-normalized concentrations.

As described above, COCs were identified based on the results of surface sediment sampling conducted between 1997 and 2005 in the vicinity of the BDC source control area. Chemicals that exceeded the SQS in at least one surface sediment sample are considered COCs for the BDC source control area. There was one sample location just downstream of the Boeing pedestrian bridge where lead (620 mg/kg dry weight [DW]) exceeded the SQS and CSL. PAHs exceeded the SQS in two surface samples west of the Boeing pedestrian bridge near the upstream side of the BDC source control area. At sample location R79, acenaphthene was detected at 20 mg/kg OC, while at location R63, benzo(g,h,i)perylene, dibenz(a,h)anthracene, fluoranthene, and indeno(1,2,3-cd)pyrene were detected at 49, 19, 170, and 50 mg/kg OC, respectively. Total PCBs exceeded the SQS in two samples near Outfall DC9 (Figure 4), with concentrations of 13 and 14 mg/kg OC. Additional information on SQS/CSL exceedances is provided in the BDC Data Gaps Report (SAIC 2010).

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

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

2.2 Potential Pathways to Sediment

Potential sources of COCs to sediments near the RM 4.3-4.9 East source control area include storm drain discharges, atmospheric deposition, historical soil and groundwater contamination, and sediment transport from upstream sources. No CSO or public 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 RM 4.9 East/EAA-7 Data Gaps Report and SCAP. There are no other properties with stormwater drainage to the RM 4.3-4.9 East 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 potentially contribute to the recontamination of sediments near the BDC source control area following remedial activities (if any) include direct discharges via outfalls, surface runoff (sheet flow), groundwater discharge, bank erosion, atmospheric deposition, and spills directly to the LDW. These pathways are described below and are discussed in more specific detail in Section 3.

2.2.1 Direct Discharges from Outfalls

Storm drains entering the LDW carry runoff generated by rain and snow. A wide range of chemicals may become dissolved or suspended in runoff as rainwater flows over the land. Urban areas may accumulate particulates, dust, oil, asphalt, rust, rubber, metals, pesticides, detergents, or other materials as a result of urban activities. These can be flushed into storm drains during wet weather. Storm drains can also convey materials from businesses with permitted discharges (i.e., National Pollutant Discharge Elimination System [NPDES] industrial stormwater permits), vehicle washing, runoff from landscaped areas, erosion of contaminated soil, groundwater infiltration, and materials illegally dumped into the storm drain system.

Direct discharges may occur from public or private SD systems, CSOs, and emergency overflows (EOFs). As noted above, 10 active private outfalls and one abandoned outfall are present in the RM 4.3-4.9 East area (Figure 2) and are discussed in Section 3. The existing sediment sampling locations near and around these outfalls are shown in Figure 4. Contaminants discharged via these outfalls could directly affect waterway sediments. There are no CSO, EOF, or public outfalls within the RM 4.3-4.9 East source control area.[7]

2.2.2 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 surface 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.

2.2.3 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 directions toward the LDW have been documented at the BDC; however, none of the sediment COCs were identified as groundwater contaminants at the BDC. 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 have been sampled. Although transport of contaminants to the LDW via groundwater discharge is considered a potential transport pathway to sediments associated with the BDC source control area, but is a relatively low priority due to upland controls and monitoring that are in place under RCRA (see page 27).

2.2.4 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. Contaminants in soils along the banks of the LDW, if present, could be released directly to sediments via erosion.

2.2.5 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-

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

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. The BDC facility has a Synthetic Minor Air Operating Permit issued by the Puget Sound Clean Air Agency (PSCAA). Although air permits are assumed to protect sediments from the impact of air deposition via stormwater discharge to the river, 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 involving other facilities in the LDW area is summarized in the LDW Source Control Status Report (Ecology 2007a, 2008a, 2008b, 2009a and subsequent updates); Ecology will continue to monitor these efforts.

2.2.6 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 within the RM 4.3-4.9 East 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.

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3.0 Potential Sources of Sediment Recontamination

Potential sources of sediment recontamination are described in detail in the BDC Data Gaps Report (SAIC 2010). This section summarizes the information on private outfalls (Section 3.1) and the BDC facility (Section 3.2).

3.1 Outfalls

Storm drains convey stormwater runoff collected from streets, parking lots, roof drains, and residential, commercial, and industrial properties to the LDW. Storm drains entering the LDW carry runoff generated by rain and snow. A wide range of chemicals may become dissolved or suspended in runoff as rainwater flows over the land. Urban areas generally accumulate particulates, dust, oil, asphalt, rust, rubber, metals, pesticides, detergents, or other materials as a result of human activities throughout the drainage basin.

Human activities include landscaping, spills, illegal dumping, vehicle maintenance (fueling, washing), and vehicle use (wear on roads, tires, brakes, fluid leaks, and emissions). These materials can be flushed into storm drains during wet weather and are then conveyed to the waterway, mainly through the stormwater system. In addition, contaminants in soil or groundwater could enter the storm drain system through cracks or gaps in the stormwater piping.

There are no public outfalls located within the BDC source control area. 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 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]	Oil/Water Separator?
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	Yes

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]	Oil/Water Separator?
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, and storage areas, as well as a vehicle refueling station near Building 9-52); 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	Yes (4 units)
BDC-1	DC18	Drains a single line from a catch basin in the parking lot northwest of Building 9-99.	Unknown	Very Small	No
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	Yes
2086	NA	Outfall is bricked shut, but discharge was observed during the outfall survey (Windward 2010).	48-inch riveted CMP	Low	No
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	Yes
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	Yes
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	No
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	No

LDW RI Outfall No.[1]	Boeing Outfall No.	Description[2]	Pipe Diameter/ Material	Outfall Discharge Volume[3]	Oil/Water Separator?
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	No
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	Yes

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 2010; 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 of up to 4.4 µg/L in water and 30.9 mg/kg DW in sediment/sludge (PPC 2003). A data quality review identified 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. Additional information about oil/water separator sampling is provided in the Data Gaps Report (SAIC 2010).

3.1.1 Potential for Future Releases to LDW Sediments

Based on limited available data, stormwater discharges from outfalls may represent a potential source of PCBs to LDW sediments. PCBs were detected in the BDC SD system during the 2002 sampling described above; however, 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.

It should be noted that the BDC source control area is immediately downstream of the Norfolk CSO/SD removal area, which is known to have had high PCB concentrations prior to a sediment removal action in 1999. Most of the sediment samples along the BDC shoreline were collected prior to 1999, and therefore could have been affected by transport of contaminants from the vicinity of the Norfolk CSO/SD. Sediment samples collected after the removal action could also have been affected, because the dredging at the Norfolk CSO/SD location created highly turbid conditions throughout this area. It is possible that sediments that were resuspended during that removal action have resettled offshore of the BDC.

Upstream sediments from the Green/Duwamish River that settle along the BDC may mask the presence of any COCs that may be released to the LDW from BDC outfalls. Sediment transport modeling conducted for the LDW RI/FS estimated that net sedimentation rates within the nearshore area along the BDC generally range from 10 to 36 cm/year.

No subsurface sediment samples have been collected in the BDC source control area. Given the relatively high sedimentation rates in this area, subsurface sediment samples are needed to identify potential historical or ongoing sources of contaminants associated with storm drain outfalls at the BDC facility.

3.1.2 Source Control Actions

Information needed to assess the potential for sediment recontamination associated with the 10 private outfalls was summarized in the BDC Data Gaps Report. The following source control actions will be conducted to fill the identified data gaps and reduce the potential for recontamination of sediments associated with the BDC source control area:

- Outfall 2086 is believed to be abandoned; however, discharge was observed during a 2003 outfall survey (Herrera 2004). Ecology will request that Boeing investigate the status of this outfall.
- Ecology will request Boeing to prepare a work plan for collection of subsurface sediment samples in the area of the LDW adjacent to the BDC outfalls.
- Ecology will request Boeing to collect grab samples of solids from the BDC storm drain system. Priority should be given to SD lines with medium to high flows, and SD lines that serve areas with significant industrial activity. At a minimum, samples should be collected from the SD lines associated with Outfalls DC13, DC12, DC11, DC10, DC9, and DC5, which are listed as having medium to high flow, and should be analyzed for PCBs, PAHs, and metals. Given the data quality issues associated with the 2002 oil/water separator samples, additional sampling of these units may be warranted.
- If COCs are detected in the SD system at concentrations above the SQS, Ecology will request that Boeing conduct source tracing and control, as needed to reduce the potential for sediment recontamination.

3.2 Boeing Developmental Center (BDC)

Current Operations	Aircraft and aerospace research and development
Historical Operations	Farmland, meat packing, railroad tracks; Boeing operations since 1959
Address	9725 East Marginal Way S, Tukwila 9806 East Marginal Way S, Tukwila 9501 East Marginal Way S, Tukwila
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)
Chemicals of Concern	PCBs, PAHs, lead
Media Affected	Soil, stormwater, groundwater

In this report, the term BDC "property" refers to any of The Boeing Company's taxable land parcels including land areas in the BDC, Norfolk CSO/SD (RM 4.9 East), and Slip 6 (RM 3.7 to 3.9 East) source control areas. BDC "facility" is used to describe only The Boeing Company's taxable land parcel within the BDC source control area.

Portions of the BDC property have been included in earlier Data Gaps Reports and SCAPs (i.e. Slip 6 and Norfolk CSO/SD). Relevant information from previous Data Gaps Reports is summarized in the BDC Data Gaps Report; these areas of the BDC are not addressed further in the current SCAP, except as they directly relate to the BDC source control area (Figure 2).

The BDC facility consists of parking lots and 39 buildings. The Boeing SWPPP for the BDC estimates that this facility is developed with 100 percent impervious surfaces, and very little natural vegetation or landscaping is 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). There are no known municipal or domestic water wells within at least ½ mile of the facility (Landau 1993).

3.2.1 Historical Operations

Prior to the start of operations by Boeing in 1959, the land was used for farming, meat packing, and railroad tracks (Foster 1945; SAIC 1994). The BDC facility was home to some of Boeing's most important research and development programs, including commercial jet production, along with military aircraft and missile production. 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 proprietary and military aircraft 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).

3.2.2 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 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).

On September 9, 2010, the Seattle Times reported that Boeing's commercial airplane division will convert space at the BDC facility into an Advanced Developmental Composites Facility. Operations at the facility will include the development of new advanced composites manufacturing technologies and the fabrication of major parts in significant quantities (Gates 2010). Operations associated with the Advanced Developmental Composites Facility will likely be similar to existing operations.

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[8], this facility currently operates under the Industrial Stormwater General Permit (SO3000146). A new Industrial Stormwater General Permit went into effect on January 1, 2010.

Underground Storage Tanks

Ecology's online Regulated underground storage tank (UST) database lists 11 USTs at 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 the Integrated Site Information System (ISIS) include: DCU-16 (1,000 gallons diesel); DCU-18 (550 gallons diesel); and DCU-19 (1,100 gallons unleaded gasoline). The BDC SWPPP (Boeing 2010a) 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

[8] Online NPDES and State Waste Discharge Permit Database: http://www.ecy.wa.gov/programs/wq/permits/northwest_permits.html

BDC Operational Underground Storage Tanks						
Tank ID Number	**Building**	**Location**	**Volume (gallons)**	**Content**	**Purpose**	**Containment**
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

The BDC is listed on Ecology's leaking underground storage tank (LUST) database with Release ID 1476. The status as of September 24, 2010 was listed as "cleanup started" with a status date of June 1, 1995. Affected media were 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 the finding that gasoline-range, diesel-range, and motor-oil range petroleum hydrocarbons and benzene, toluene, ethylbenzene, and total xylenes (BTEX) were not detected in two consecutive monitoring events (Ecology 2002).

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.[9] 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, 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.[10]

Under the 2010 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

[9] 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.

[10] 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.

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 includes 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)

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

3.2.3 Regulatory History

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 BDC, recorded on ISIS as 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.

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. Facility inspections by Ecology and/or EPA date back to December 1981.

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 backup support during local emergencies.

Boeing filed a revised Notification of Dangerous Waste Activities with Ecology in February 1994 (Boeing 1994). The form indicated 15 different wastes 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 that 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 groundwater remediation process would be granted if requested flow volumes were within the system's 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 would no longer store (> 90 days), treat, or dispose of dangerous wastes at the facility (Ecology 1997b). 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 1997a).

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 positive 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 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 the finding that gasoline-range, diesel-range, and motor-oil range petroleum hydrocarbons and BTEX were not detected in two consecutive monitoring events (Ecology 2002). Boeing has performed semiannual groundwater sampling at monitoring wells in AOC-01/02 since 2000, and periodic groundwater sampling since 1995.

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 appeared to have been collected during 2005, in violation of conditions stipulated by the Industrial Stormwater General Permit. No stormwater inspection has been conducted by Ecology 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 on June 30, 2009, found two violations that resulted in issuance of an NOV 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).

3.2.4 Environmental Investigations and Cleanups

As noted above, RCRA corrective actions have been undertaken at several Areas of Concern (AOCs) and solid waste management units (SWMUs) at the BDC facility. 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). In a 2002 Boeing Corrective Action Report, cleanup and subsequent investigations recommended that no further action was necessary for SWMUs 15, 16, and 23-25 (Landau 2002). In a 2004 Boeing Evaluation Report, cleanup and subsequent investigations recommended that no further action was necessary for AOC 03/04 (Landau 2004a). More recently, investigations and cleanup actions for AOC-05, and SWMUs 17 and 20 were described in the EAA-7 Data Gaps Report for data available through mid-2007 (E&E 2007). The most recent information available for these areas is summarized below.

AOC-03/04

AOC-03/04 is the former location of USTs DC-03 and DC-04 used to store No. 5 fuel oil from 1957 until a leak was discovered in 1991 (Landau 2002). Both USTs were removed and were replaced with USTs DC-20 and DC-21. 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 total petroleum hydrocarbons (TPH). Since 1997, the well has been sampled biannually and analyzed for volatile organic compounds (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 hydrocarbons were 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 and motor-oil range petroleum hydrocarbons. In 2003, monitoring was discontinued following four consecutive quarters during which contaminants of concern were below detection limits (Landau 2004b). No further remedial action is required.

AOC-5

AOC-5 was the location of a former unleaded gasoline UST in the vicinity of Buildings 9-60 and 9-61 (Landau 2002). Pilot testing of anaerobic bioremediation was completed in 2007 (Landau 2007, 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 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.

In response, 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 petroleum hydrocarbons 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 petroleum hydrocarbons 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 2009b). In June 2009, ammonium phosphate was injected with the ammonium nitrate solution. Data from the July 2009 monitoring event suggest that biotreatment of the contaminants and consumption of nitrate by the microorganisms had 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, leading to additional downgradient monitoring, described as a contingency in the work plan (Landau 2009a).

A rebound of gasoline range petroleum hydrocarbons (TPH-G) and BTEX coincident with 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 improved 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 was planned for early 2010, but results from the February 2010 monitoring event suggested that an additional injection was not needed (Landau 2010a).

Subsequent monitoring performed in May and August 2010 showed decreasing concentrations and near depletion of nitrate at source well BDC-103 (2.4 mg/L), with persistent nitrate remaining at source well BDC-104 (38 mg/L). As a result, a sixth full-scale injection of ammonium nitrate and ammonium phosphate solution was performed at well BDC-103 in September 2010. No additional injection was performed at well BDC-104 because the remaining nitrate was adequate for continued treatment. Monitoring in May 2010 indicated that nitrate remained above the threshold at the nearest downgradient wells, but was below the threshold at the additional downgradient wells (Boeing 2010b). Quarterly monitoring continues to be performed to determine the need for additional injection events.

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) are sampled from this area semi-annually. Samples have been 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 groundwater was prepared by Landau Associates in October 2008 (Landau 2008b). The plan included installation of an additional groundwater monitoring well and performance monitoring at this SWMU.

After implementation of the work plan from October 2008 through February 2010, it was concluded that bioremediation stimulated by electro donor injection resulted in reduction of PCE and trichloroethylene (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 for full-scale treatment. 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.TCE and PCE have been detected in groundwater 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 two 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). 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. Semi-annual monitoring was scheduled to continue at this SWMU.

3.2.5 Storm Drain System Sampling and Cleanup

No information on sampling of the SD system in the BDC source control area, with the exception of the oil/water separator sampling discussed in Section 3.1, was identified in the documents reviewed during the preparation of this SCAP.

In the RM 4.9 East 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 and 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 Data Gaps Report for RM 4.9 East (E&E 2007). Information obtained since that time is summarized in the BDC Data Gaps Report.

3.2.6 Potential for Sediment Recontamination

The potential for sediment contamination associated with the BDC source control area is summarized below:

- Stormwater from the BDC is collected and discharged to the LDW via 10 private outfalls. Much of the stormwater from the BDC source control area passes through oil/water separators prior to being discharged; however, PCBs were detected in water and sludge/sediment samples collected from the BDC storm drain system in 2002. Two LDW sediment samples collected near Outfall DC9 slightly exceeded the SQS for total PCBs. Additional data on concentrations of PCBs in stormwater and SD solids at the BDC are needed to provide verification that current discharges do not have an adverse impact on sediments in the LDW. The potential for sediment recontamination associated with stormwater discharges is believed to be moderate.
- The BDC is almost entirely paved and has an extensive stormwater collection system that limits the likelihood that recontamination will occur through surface runoff or spills directly to the LDW.
- Petroleum hydrocarbons, VOCs, semivolatile organic compounds (SVOCs), total PCBs, and metals have been detected in soil and/or groundwater beneath the BDC property (Landau 2002). Boeing has conducted excavations and ongoing bioremediation in areas with known groundwater contamination (AOC-05, SWMU-17, SWMU-20); operations

are ongoing. Boeing has characterized the lateral extent of groundwater contamination, and none of the groundwater contaminants at the BDC have been identified as COCs in the LDW sediments offshore of the BDC. The potential for sediment recontamination associated with this soil and groundwater contamination is believed to be low.

- 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 under sedimentation. Therefore, core samples are needed from offshore of the BDC in order to better understand subsurface chemistry and to identify potential historical and ongoing sources of contaminants to the LDW.
- Four seeps were identified near the BDC source control area during a 2004 seep survey (Windward 2004). None of these seeps were sampled. Contaminants in stormwater and/or SD solids, if present, could be transported to soil and groundwater through leaks and breaks in SD piping and structures. The potential for sediment recontamination via this pathway is therefore unknown.

3.2.7 Source Control Actions

Information needed to assess the potential for sediment recontamination associated with current or historical operations at the BDC was summarized in the RM 4.3 to 4.9 East Data Gaps Report (SAIC 2010). The following source control actions will be conducted to fill the identified data gaps and reduce the potential for recontamination of sediments:

- Ecology will review responses to EPA's Request for Information 104(e) letters sent to Boeing.
- Ecology will continue to monitor RCRA cleanup activities within this source control area, to ensure that contaminants present in groundwater as a result of historical releases are not entering the LDW.
- Ecology will conduct a stormwater compliance inspection to ensure that current and planned operations are consistent with stormwater regulations and best management practices. In conjunction with this inspection, Ecology will review any recent or planned changes to industrial activities at the BDC, and how these changes may affect potential contaminant pathways to the LDW.
- Ecology will request additional information about the nature of BDC's emissions and air permit as they relate to deposition on impervious surfaces and the stormwater pathway to the LDW.
- Ecology will request Boeing to collect at least one round of seep samples from the four known seepage locations (see Figure 2) to confirm that no contaminants are being discharged to the LDW via this transport pathway.

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4.0 Monitoring

Monitoring efforts by Ecology and Boeing will continue to assist in identifying and tracing ongoing sources of COCs present in LDW sediments or in upland media. This information will be used to focus source control efforts on specific problem areas within the BDC source control area and to track the progress of the source control program. The following types of samples may be collected:

- In-line sediment trap samples from storm drain systems,
- Onsite catch basin sediment samples,
- Seep samples, and
- Soil and groundwater samples as necessary.

If monitoring data indicate the presence of additional sources that could result in recontamination of sediments associated with the BDC source control area, then Ecology will identify source control activities as appropriate.

Because source control is an iterative process, monitoring is necessary to identify trends in concentrations of COCs. Monitoring is anticipated to continue for some years. Any decisions to discontinue monitoring will be made jointly by Ecology and EPA, based on the best available information. At this time, Ecology plans to review the progress and data associated with source control action items for each SCAP at least annually, and to summarize this information in the LDW Source Control Status Reports, which are scheduled for publication twice a year. In addition, Ecology may prepare Technical Memoranda to update the Data Gaps reports and SCAPs, as needed.

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5.0 Tracking and Reporting of Source Control Activities

Ecology is the lead for tracking, documenting, and reporting the status of source control to EPA and the public. Each agency involved in source control will document its source control activities and provide regular updates to Ecology. Ecology will prepare semiannual LDW Source Control Status Reports that summarize recent activities for each source control area and the overall status of source control in the LDW.

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Figures

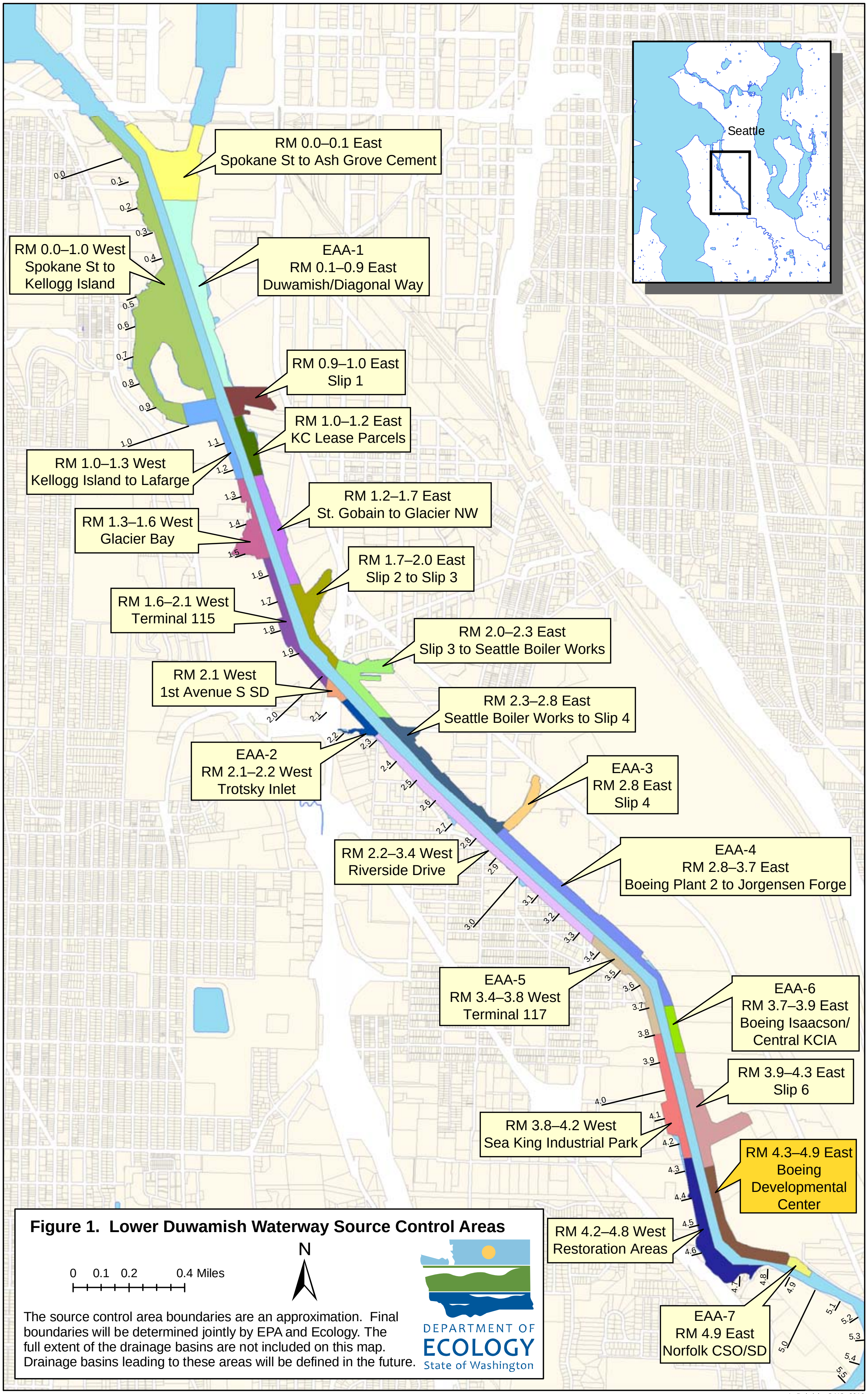

Figure 1. Lower Duwamish Waterway Source Control Areas

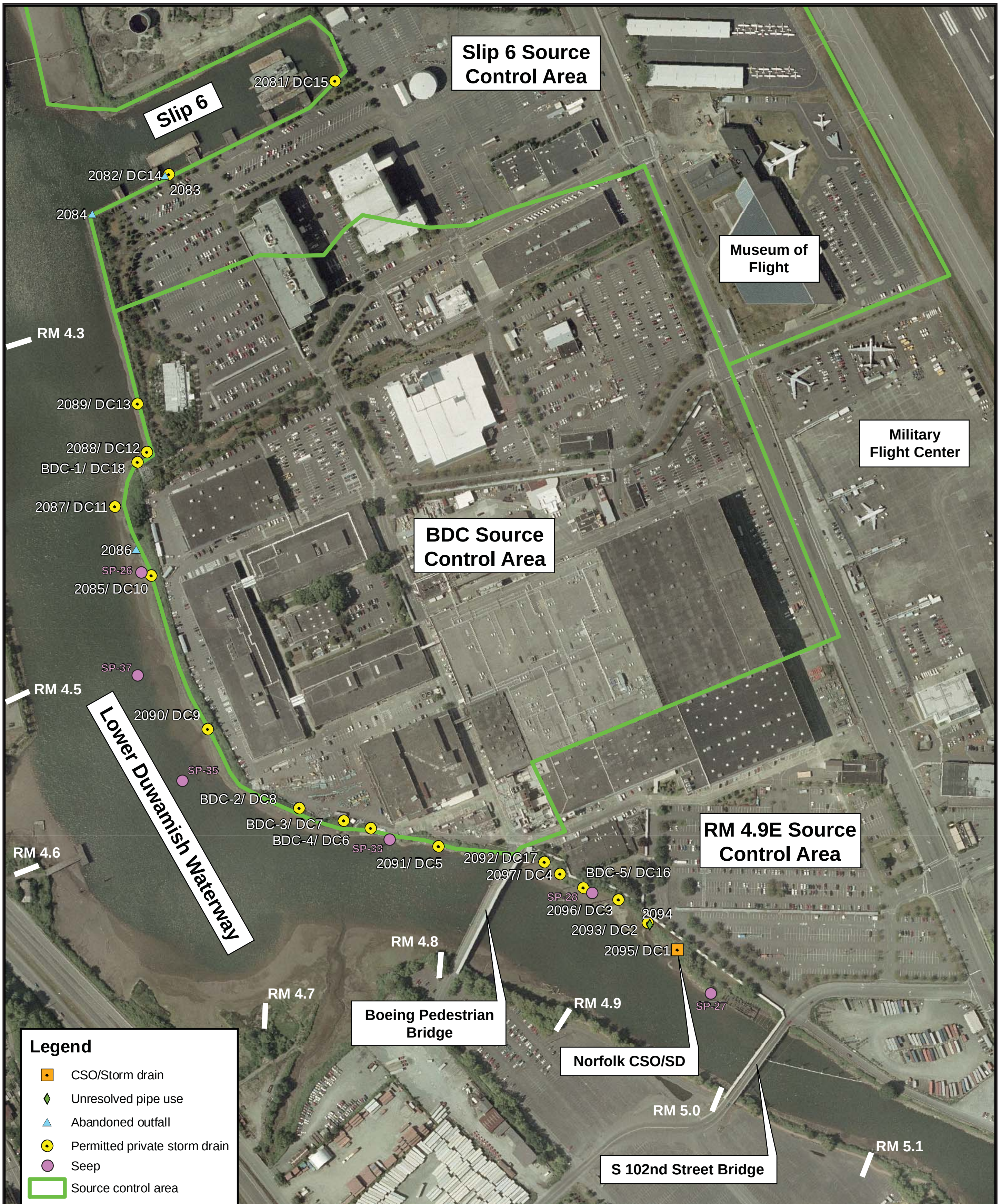

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Figure 2. RM 4.3–4.9 East (BDC) Source Control Area

0 250 500 1,000 Feet

DEPARTMENT OF ECOLOGY State of Washington

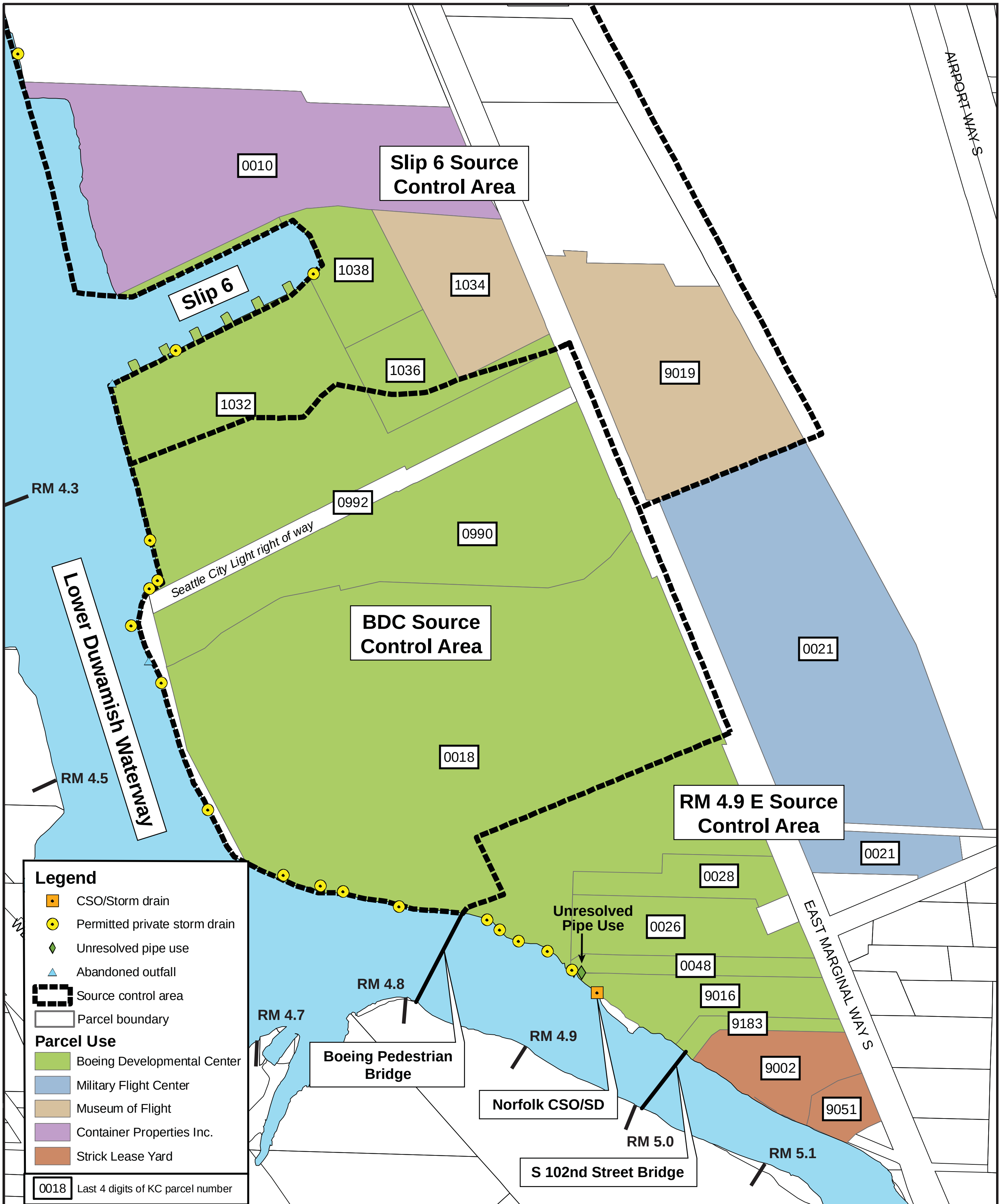

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Figure 3. RM 4.3–4.9 East (BDC) Parcel Use

0 250 500 1,000 Feet

DEPARTMENT OF ECOLOGY State of Washington

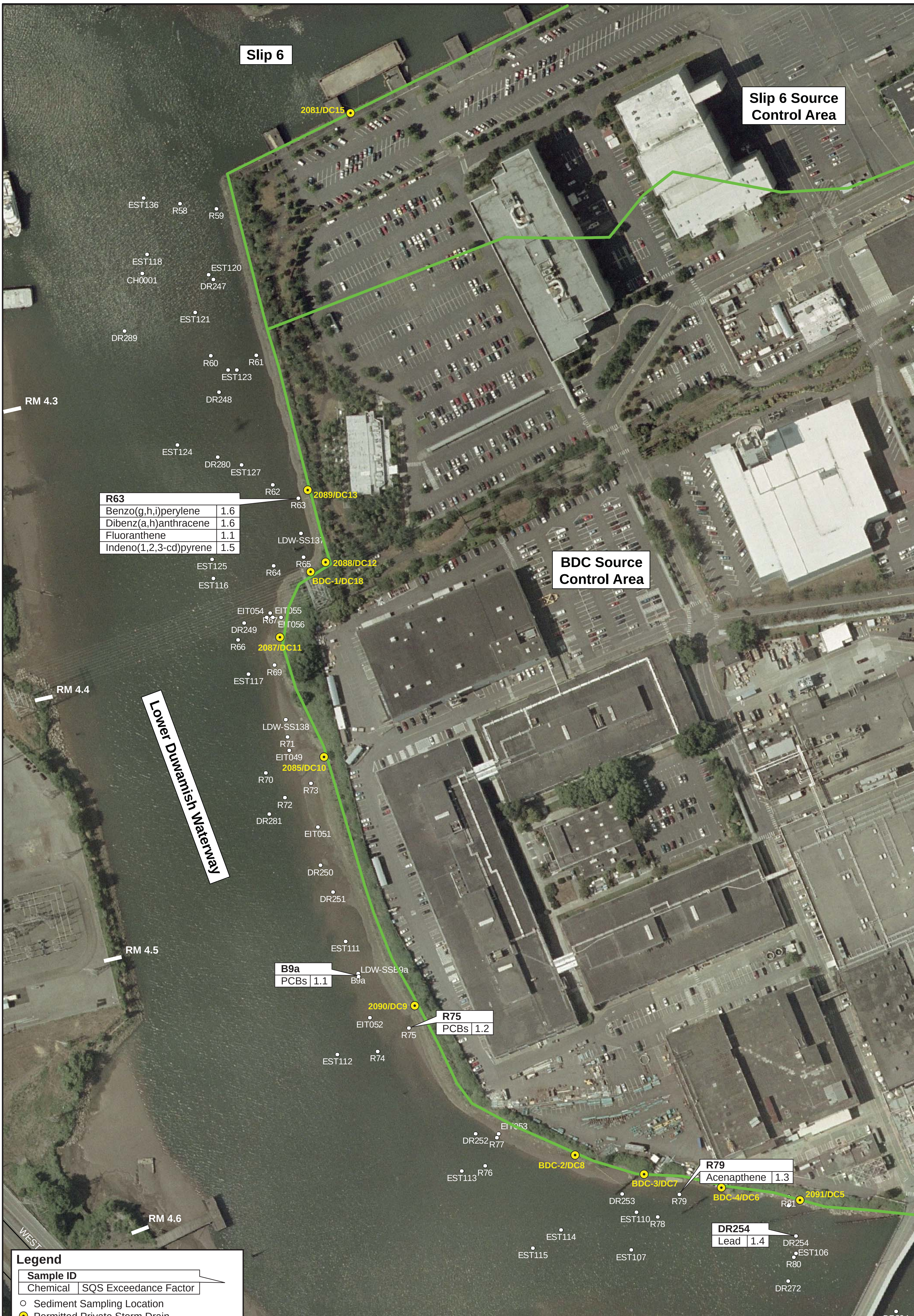

Figure 4. RM 4.3–4.9 East (BDC) Sediment Sampling Locations

0 100 200 400 Feet

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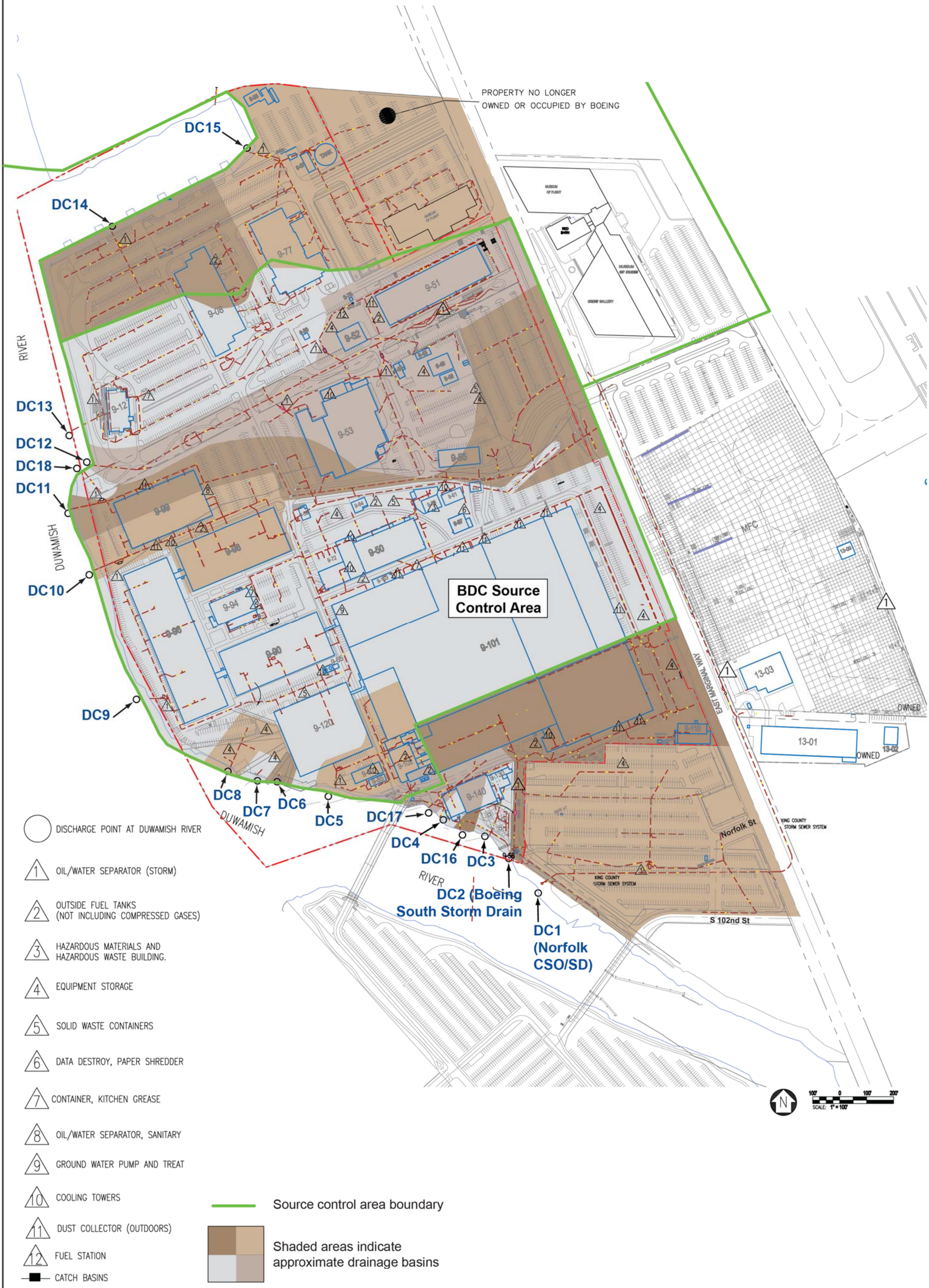
DEPARTMENT OF ECOLOGY State of Washington



Source: Adapted from Bet 2009

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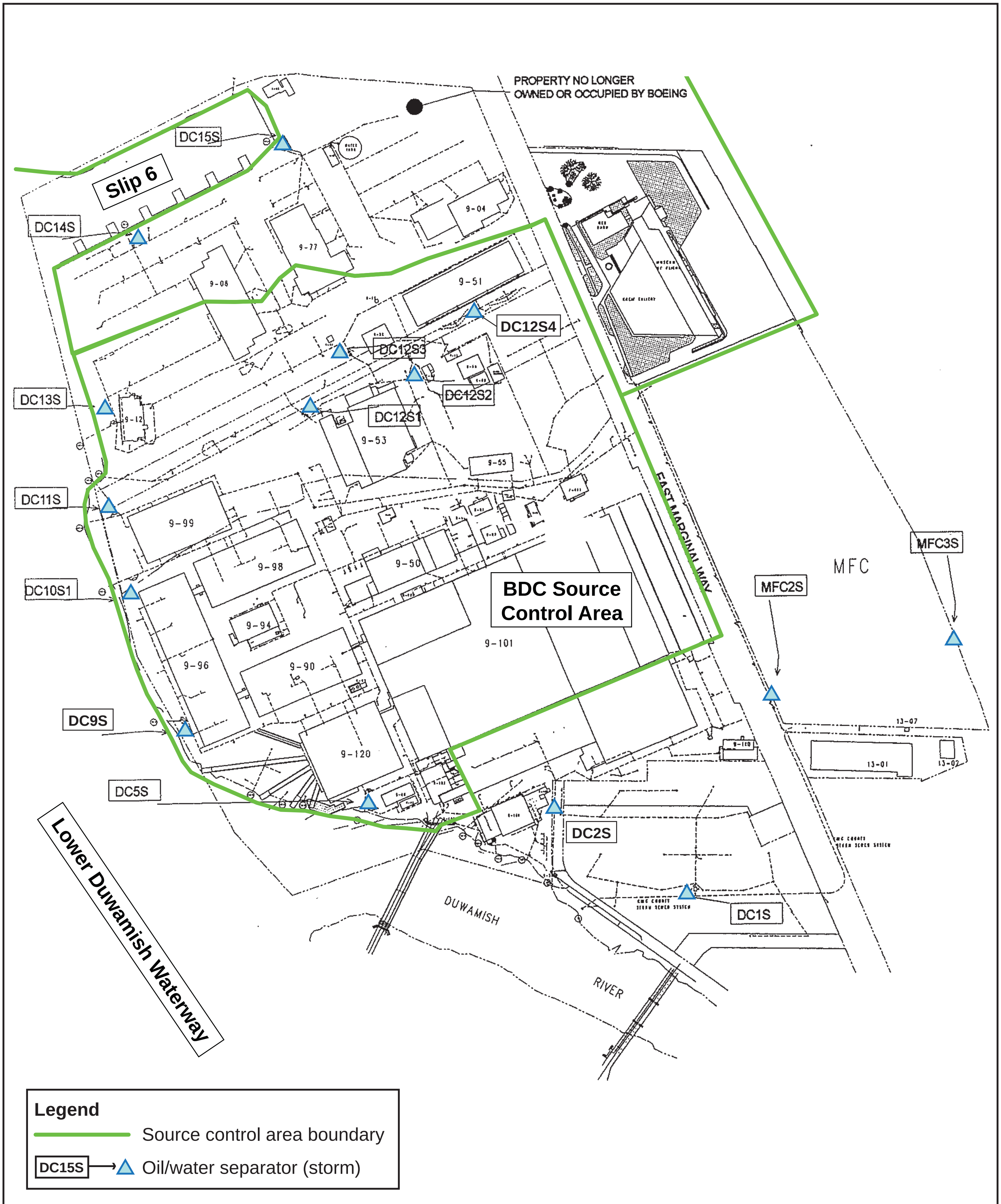
Figure 5. Boeing Developmental Center Stormwater Drainage Map

0 400 800 1,600 Feet

DEPARTMENT OF ECOLOGY
State of Washington



Source: PPC 2003

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Figure 6. BDC Oil/Water Separator Locations

DEPARTMENT OF ECOLOGY
State of Washington