WASHINGTON STATE
DEPARTMENT OF
ECOLOGY

Lower Duwamish Waterway Source Control Action Plan for the Slip 4 Early Action Area

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Lower Duwamish Waterway Source Control Action Plan for the Slip 4 Early Action Area

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Executive Summary

The Lower Duwamish Waterway, 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 found in waterway sediments include polychlorinated biphenyls (PCBs), polycyclic aromatic hydrocarbons (PAHs), mercury and other metals, and phthalates. These chemicals of concern 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.

Phase 1 of the RI/FS used existing data to identify potential human health and ecological risks, information needs, and high priority areas for cleanup ("early action areas"). The Slip 4 Early Action Area (EAA) is one of seven EAAs identified by EPA and Ecology.

Sections 1 and 2 of this Source Control Action Plan (Action Plan) provide background information about the Lower Duwamish Waterway site and the Slip 4 EAA. Polychlorinated biphenyls (PCBs) and bis(2-ethylhexyl)phthalate (BEHP) are considered the major contaminants of concern in Slip 4 sediments. While this Action Plan focuses on PCBs and BEHP, other chemicals that could result in sediment recontamination will be addressed as sources are identified.

Section 3 describes potential sources of contamination that may affect sediments in Slip 4, including piped outfalls, spills, adjacent properties, and upland properties, and evaluates the significance of those potential sources. Section 4 identifies the actions that are planned or underway to control these potential sources. Section 5 discusses monitoring activities that will be conducted to identify additional sources and assess progress. Section 6 describes how source control efforts will be tracked and reported.

Table ES-1 lists the source control actions that have been identified for the Slip 4 Early Action 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.

Table ES-2 lists these source control actions by priority. High priority actions are related to known or probable sources of contaminants of concern with high recontamination potential. Medium priority actions are associated with potential sources of contaminants of concern and/or low to moderate recontamination potential. Low priority actions include confirmation of storm drain connections, review of groundwater data, and other activities intended to identify additional potential sources.

The Slip 4 removal action is scheduled to occur during the summer 2007 / winter 2008 construction season. Dredging and other in-water work cannot occur during identified “fish window” closure periods. It is currently anticipated that in-water dredging or capping of contaminated material will be allowed only between October 1, 2007, and February 15, 2008.

Some source control actions may not be complete before late 2007. Ecology and EPA are continuing to evaluate the status of source control; in this same timeframe, the City is proceeding with the removal action design for Slip 4. Based on this analysis, cleanup might be delayed.

Table ES-1. Slip 4 Source Control Actions

Potential Sources	Action Items	Milestones and Parties Involved
North Boeing Field (NBF); KC Airport SD#3/PS44 EOF		
Ongoing source: SPU installed in-line sediment traps at NBF and surrounding area in March 2005. August 2005 data show PCB contamination in the I-5 / residential area (see below), KCIA (see below), and Boeing-leased property storm drain lines. SPU, Ecology, EPA, King County, and Boeing are currently evaluating available data and collecting additional samples to identify possible source areas or activities and controls. Boeing is removing PCB-contaminated caulk from parking areas and taxiways.	Review results of Ecology's TCP, Waste and Water programs, and King County/Hazardous Waste inspections of NBF (Nov–Dec 2005) (results pending).	Ecology, EPA — June 2006
	Distribute 2005/2006 in-line sediment trap data for winter wet season.	SPU — May 2006
	Reinstall sediment traps.	SPU, Boeing — Sept. 2006
	Remove last 1,400 linear feet of PCB joint sealant (conducted under TSCA).	Boeing, EPA — May 2006
	Conduct comprehensive analyses of sediment trap and catch basin data.	Ecology — Apr.–Aug. 2006
	Revise Stormwater Management Plan; conduct additional inspections of the NBF facility as necessary.	Boeing, Ecology — Dec.2006
	Clean oil/water separator 640 and catch basins.	Boeing, June — Sept. 2006
	Complete source evaluation at north drain line and complete clean-out.	Boeing, — June 2006
	Evaluate existing NPDES industrial stormwater permits for potential Slip 4 sediment impacts.	See below — NPDES
King County International Airport (KCIA); KC Airport SD#3/PS44 EOF		
Ongoing source: SPU installed in-line sediment traps at NBF and surrounding area in March 2005. August 2005 data show PCB contamination in the I-5 / residential area (see below), KCIA, and Boeing-leased property (see above) storm drain lines. SPU, Ecology, EPA, King County, and Boeing are currently evaluating available data and collecting additional samples to identify possible source areas or activities and controls.	Conduct comprehensive analyses of sediment trap and catch basin data.	Ecology — Apr.–Aug. 2006
	Test concrete joint sealant for PCBs; remove material as necessary.	KCIA — Oct. 2006
	Clean lines and structures of contamination.	KCIA, city of Seattle — Aug.–Nov. 2006
	Complete source tracing; sample sediment in 7 oil/water separators for PCBs.	SPU, KCIA — June–Sept. 2006
	Distribute 2005/2006 in-line sediment trap data for winter wet season.	SPU — May 2006
	Reinstall sediment traps.	SPU — Sept. 2006
	Evaluate existing NPDES industrial stormwater permits for potential Slip 4 sediment impacts.	See below — NPDES

Table ES-1. Slip 4 Source Control Actions (Continued)

Potential Sources	Action Items	Milestones and Parties Involved
I-5 and Residential Drainage; I-5 Storm Drain		
Potential ongoing source: Based on August 2005 sediment trap data (see NBF & KCIA above), this drainage may be a source of PCBs to Slip 4. SPU is conducting source tracing in the small commercial/industrial business strip along I-5 to determine if there are any obvious sources and will involve WSDOT as necessary.	Complete source tracing.	SPU, WSDOT — 2006
	Reinstall sediment trap.	SPU — Sept. 2006
	Clean lines and structures of contamination.	SPU, WSDOT — 2007
Georgetown Flume		
Potential ongoing source: SPU resurveyed and sampled the entire flume in 2005. Illicit connections to businesses along Myrtle Street were located; one of these has been corrected while others continue to discharge to the flume. August 2005 inline sediment samples show PCB contamination in the flume.	Investigate connection toward North Boeing Field as a possible source of PCBs (see GTSP below).	SPU, Boeing — Jun 2006
	Close connections to flume and remove contaminated sediments.	City of Seattle — Oct. 2007
Georgetown Steam Plant (GTSP)		
Potential ongoing source: 2002 Site Assessment ranked GTSP as “5” on State contaminated sites list. Historically, the pathways of contamination from GTSP to Slip 4 were the Georgetown Flume and KC Airport SD#3. Recent data indicate an area along the west fence with NBF (soils contained behind ecology blocks) may be a source of PCBs to stormwater lines on NBF and KC Airport SD#3/PS44 EOF.	Remove PCB contaminated soils; implement erosion or other source control as needed.	SCL — May 2006
	Conduct additional site characterization to assess need for additional soil removal.	SCL — 2006
Crowley Marine, Alaska Logistics (Parcels D and F), Private Drainage**		
Potential ongoing source: The current tenant, Alaska Logistics, transfers containers for shipment to/from Alaska and was subject to joint Ecology/SPU inspections during 2005 and early 2006.	Conduct physical site inspection confirming outfalls and what they drain(ed). (Done)	Ecology, SPU — 2005 to early 2006 (Done)
	Collect stormwater runoff and in-line solids to assess recontamination potential from any ongoing operations.	Ecology, SPU — Sept. 2006
	Evaluate site with respect to NPDES permit (see below).	See below — NPDES

Table ES-1. Slip 4 Source Control Actions (Continued)

Potential Sources	Action Items	Milestones and Parties Involved
Crowley Marine, Alaska Logistics (Parcels D and F)**		
Evaluate potential historic sources: Evaluate whether upland spills or contamination could be a source to Slip 4. Historic sources indicate wood treating operation, pipe dipping, log storage, and aluminum window manufacture. Portions of the site were unpaved for much of history with large equipment use; soil and groundwater contamination has been associated with USTs (see Appendix A).	Compile and evaluate historic groundwater quality data; complete historic use investigation to identify data gaps in existing soil and groundwater data to assess potential for sediment recontamination.	Ecology — 2006
	Determine means to fill data gap(s).	Ecology — late 2006
	Conduct any necessary sampling and evaluate data.	Ecology — 2007
First South Properties, Emerald Services (Parcel E), Private Drainage		
Potential ongoing source: Ecology and SPU conducted joint inspections at Emerald Services throughout 2005 and early 2006 and found potential stormwater issues for source control which are being addressed. Ecology conducted an upland soil investigation in the vicinity of a drainage swale at the top of the bank adjacent to Slip 4, near the old asphalt plant, and determined that this was not a potential recontamination source for PCBs. Elevated concentrations of phthalates have been detected in catch basins and drainage structures.	Collect stormwater runoff and in-line solids to assess sediment recontamination potential from any ongoing operations.	Ecology, SPU — Aug. 2006
	Evaluate site data with respect to NPDES permit (see below).	See below — NPDES
	Clean catch basins and drain lines.	Emerald Services – June 2006
	Investigate two 4- to 6-inch outfalls located on the bank of First South Properties. Determine if the outfalls are still functioning and their drainage areas.	Ecology, SPU – Aug. 2006
	Reassess drainage swale for erosion and recontamination potential for phthalates.	Ecology — Aug. 2006
First South Properties (Parcel E)		
Evaluate potential historic sources: Tenants have included Emerald Services/Webster, Cedar Grove Composting, Evergreen Marine Leasing, an asphalt plant, and lumber/log industries. See Appendix A for history of this parcel.	Compile and evaluate historic groundwater quality data; complete historic use investigation to identify data gaps for recontamination potential (soil and groundwater).	Ecology — 2006
	Determine means to fill data gaps.	Ecology — Oct. 2006
	Conduct necessary sampling and evaluate data.	Ecology — 2007
Boeing Plant 2**		
Evaluate potential historic sources: The upland history of the 17 acres of Plant 2 draining to Slip 4 is summarized in Appendix A. Soil remediation completed in area near Slip 4. Stormwater permit and SWPPP in place. Data gaps relevant to sediment recontamination are: groundwater data, effluent data from two NPDES permitted outfalls to outer Slip 4.	Assess existing groundwater data in the area — additional groundwater monitoring may be required to address recontamination concerns.	EPA, Ecology — 2006–2007
	Reevaluate NPDES coverage.	See below — NPDES
	Inspect Bldg. 2-122 area, sample onsite storm drain solids.	Ecology — Fall 2006
	Clean onsite storm drain system as necessary.	Boeing — 2006–2007

Table ES-1. Slip 4 Source Control Actions (Continued)

Potential Sources	Action Items	Milestones and Parties Involved
Other Upland Properties		
Potential ongoing sources: Several upland properties may contain contaminants of concern and are potential sources of sediment recontamination via the stormwater drainage system. These include: Marine Vacuum Service, North Coast Chemical Company, American Avionics/KC Airport, Arco Station #5218, KC Airport Maintenance, American Avionics, and Rainier Ice & Cold Storage.	Review data to determine if there are contaminants of concern or pathways to Slip 4 from these seven upland properties.	Ecology — June 2006
	Reinspect KC Surplus Storage, NE T-Hangars, and Schultz Distributing, Inc. as necessary to achieve compliance with BMPs.	SPU, Ecology — Aug. 2006–Nov. 2006
NPDES Stormwater Permits		
NPDES permit conditions for stormwater discharges to Slip 4 will be reviewed with respect to COCs found in sediments. This will include both municipal and industrial permits. Permittees affected for Slip 4 include Boeing (NBF), Boeing Plant 2, Emerald Services, Alaska Logistics, KCIA, WSDOT, and SPU.		Ecology, EPA — 2007
Business Inspections		
Repeat business inspections in Slip 4 drainage for pollution prevention practices and source control, as needed.		SPU — 2006–2008
Upland Spills		
Depending on the nature of the spill, track origin of the spill and cleanup activities to identify any post-spill source control that may be needed.		Ongoing/as needed

** These parcels span the Slip 4 Early Action Area and other areas of the slip and Duwamish Waterway. Sites that are not determined to be sources for the Slip 4 Early Action Area will be evaluated as potential sources for these other areas.

COC – Contaminant of Concern
Ecology – Washington State Department of Ecology
EOF – Emergency Overflow
EPA – U.S. Environmental Protection Agency
GTSP – Georgetown Steam Plant
KC – King County
KCIA – King County International Airport
NBF – North Boeing Field
NFA – No Further Action
NPDES – National Pollutant Discharge Elimination System
PCB – Polychlorinated biphenyl
SD – Storm drain
SCL – Seattle City Light
SPU – Seattle Public Utilities
SWPPP – Stormwater Pollution Prevention Plan
TCP – Toxics Cleanup Program (Ecology)
TSCA – Toxic Substances Control Act
UST – Underground Storage Tank
VCP – Voluntary Cleanup Program (Ecology)
WSDOT – Washington State Department of Transportation

Table ES-2. Slip 4 Source Control Action Priorities

High Priority Source Control Actions[1]:

Source Control Action Item	Responsible Party	Estimated Completion Date
NBF: Remove PCB joint sealant.	Boeing	May 2006 (Done)
NBF/KCIA/I-5: Distribute 2005/2006 in-line sediment trap data for winter wet season.	SPU	May 2006 (Done)
GTSP: Remove PCB contaminated soils; implement erosion or other source control as needed.	SCL	May 2006
NBF: Complete source evaluation at north drain line and complete clean-out.	Boeing	Jun. 2006
NBF/KCIA/I-5: Conduct comprehensive analyses of sediment trap and catch basin data	Ecology	Jun. 2006
NBF: Clean oil/water separator 640.	Boeing	Jun. 2006 – Aug. 2006
I-5/Residential Drainage: Complete source tracing.	SPU	Aug. 2006
KCIA: Complete source tracing; sample seven oil/water separators.	KCIA	Jun. 2006 – Sept. 2006
NBF: Clean out catch basins.	Boeing	Aug. 2006 – Sept. 2006
NBF/KCIA/I-5: Reinstall sediment traps.	SPU, Boeing	Sept. 2006
KCIA: Test for PCB joint sealant (~1acre); remove as necessary.	KCIA	Oct. 2006
KCIA: Clean out catch basins and lines (if required).	KCIA	Aug. 2006 – Nov. 2006
I-5/Residential Drainage: Clean out catch basins and lines (pending results of sediment trap analysis round 3, due 9/2006).	Ecology, SPU, WSDOT	Summer 2007
Georgetown Flume: Investigate connection toward North Boeing Field as a possible source of PCBs.	SPU, Boeing	Jun. 2006
Georgetown Flume: Close connections to flume, remove contaminated sediments.	SCL, SPU	Oct. 2007

Medium Priority Source Control Actions[2]:

Source Control Action Item	Responsible Party	Estimated Completion Date
Crowley Marine/Alaska Logistics: Conduct physical site inspection confirming outfalls and what they drain(ed).	Ecology, SPU,	2005/ 2006 (Done)
Crowley Marine/Alaska Logistics: Collect stormwater runoff and in-line solids to assess recontamination potential of current operations.	Ecology, SPU	Sept. 2006
Crowley Marine/Alaska Logistics: Clean catch basins and drain lines.	Crowley	Sept. 2006
First South Properties/Emerald Services: Collect stormwater runoff and in-line solids to assess sediment recontamination potential from any ongoing operations.	Ecology, SPU	Aug. 2006
First South Properties/Emerald Services: Investigate three 4- to 6-inch outfalls located on the bank of First South Properties. Determine if the outfalls are still functioning and their drainage areas.	Ecology, SPU	Aug. 2006
First South Properties/Emerald Services: Clean catch basins and drain lines.	Emerald Services	Jun. 2006
First South Properties/Emerald Services: Reassess drainage swale for erosion and recontamination potential for phthalates.	Ecology	Sept. 2006
KCIA: Reinspect KC Surplus Storage, NE T-Hangars, and Schultz Distributing, Inc. as necessary to achieve compliance with BMPs.	SPU, Ecology	Aug. 2006 – Nov. 2006
NBF: Review results of Ecology's TCP, Waste and Water programs, and King County/Hazardous Waste inspections of NBF (Nov–Dec 2005)	Ecology, EPA	Jun. 2006

[1] High Priority: PCBs present or suspected, with potential for release to Slip 4
[2] Medium Priority: No PCBs present or suspected, but potential for release of other contaminants to Slip 4

NBF: Revise Stormwater Management Plan; conduct additional inspections of the NBF facility as necessary.	Ecology Boeing	Dec. 2006
GTSP: Conduct additional site characterization to assess need for additional soil removal.	SCL	2006
Boeing Plant 2: Inspect Bldg. 2-122 area, sample onsite storm drain solids.	Ecology	Fall 2006
Boeing Plant 2: Clean onsite storm drain system as necessary.	Boeing	2006 – 2007

Low Priority Source Control Actions[3]:

Source Control Action Item	Responsible Party	Estimated Completion Date
Crowley Marine/Alaska Logistics: Compile and evaluate historic groundwater quality data; complete historic use investigation to identify data gaps for recontamination potential (soil and groundwater).	Ecology/SAIC	Jun. 2006
Crowley Marine/Alaska Logistics: Determine means to fill data gaps.	Ecology	Oct. 2006
Crowley Marine/Alaska Logistics: Conduct sampling if necessary and evaluate data.	Ecology	Spring 2007
First South Properties/Emerald Services: Compile and evaluate historic groundwater quality data; complete historic use investigation to identify data gaps for recontamination potential (soil and groundwater).	Ecology/SAIC	Jun. 2006
First South Properties/Emerald Services: Determine means to fill data gaps.	Ecology	Oct. 2006
First South Properties/Emerald Services: Conduct sampling if necessary and evaluate data.	Ecology	Spring 2007
KCIA: Conduct follow-up inspections at Shultz Distributing, Inc. until compliance achieved. Evaluate potential contaminants of concern and pathways.	SPU, Ecology	Dec. 2006
Boeing Plant 2: Assess existing groundwater data in the area.	Ecology, EPA	Dec. 2006
Other Upland Properties: Review data for contaminants of concern or pathways to Slip 4 for North Coast Chemical Company, Marine Vacuum Service, Inc. American Avionics/KC Airport, Arco Station #5218, KC Airport Maintenance, American Avionics, and Rainier Ice & Cold Storage.	Ecology/SAIC	Jun. 2006
Review NPDES permits: Review permits for COCs found in sediments. This will include both municipal and industrial permits. Permittees affected for Slip 4 include Boeing (NBF), Boeing Plant 2, Emerald Services, Alaska Logistics, KCIA, WSDOT, and SPU.	Ecology, EPA	2007

COC – Contaminant of Concern
Ecology – Washington State Department of Ecology
EOF – Emergency Overflow
EPA – U.S. Environmental Protection Agency
GTSP – Georgetown Steam Plant
KC – King County
KCIA – King County International Airport
NBF – North Boeing Field
NFA – No Further Action
NPDES – National Pollutant Discharge Elimination System
PCB – Polychlorinated biphenyl
SD – Storm drain
SCL – Seattle City Light
SPU – Seattle Public Utilities
SWPPP – Stormwater Pollution Prevention Plan
TCP – Toxics Cleanup Program (Ecology)
TSCA – Toxic Substances Control Act
UST – Underground Storage Tank
VCP – Voluntary Cleanup Program (Ecology)
WSDOT – Washington State Department of Transportation

[3] Low Priority: Release of contaminants possible but unlikely, based on location, current/past operations, or results of investigations

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Richard Thomas, Washington State Department of Ecology, Toxics Cleanup Program

Integral Consulting, Inc. (formerly Striplin Environmental Associates)

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Acronyms/Abbreviations

BEHP	Bis(2-ethylhexyl)phthalate
bgs	Below ground surface
BMP	Best Management Practice
CDWAA	Central Dangerous Waste Accumulation Area
COC	Contaminant of Concern
cPAH	Carcinogenic Polycyclic Aromatic Hydrocarbon
CSL	Cleanup Screening Level
CSO	Combined Sewer Overflow
DNRP	King County Department of Natural Resources and Parks
DSOA	Duwamish Sediment Other Area
DW	Dry Weight
EAA	Early Action Area
Ecology	Washington State Department of Ecology
EE/CA	Engineering Evaluation/Cost Analysis
EOF	Emergency Overflow
EPA	United States Environmental Protection Agency
ERM	Environmental Resources Management
ERTS	Environmental Report Tracking System
FS	Feasibility Study
GTSP	Georgetown Steam Plant
KC	King County
KCIA	King County International Airport
LDW	Lower Duwamish Waterway
LDWG	Lower Duwamish Waterway Group
MLLW	Mean Lower Low Water
MTCA	Washington State Model Toxics Control Act
NBF	North Boeing Field
NFA	No Further Action
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
OC	Organic Carbon
PAH	Polycyclic Aromatic Hydrocarbon
PCB	Polychlorinated Biphenyl
PCE	Tetrachloroethene
PSDDA	Puget Sound Dredged Disposal Analysis
RCRA	Resource Conservation and Recovery Act
RI	Remedial Investigation
RM	River Mile

Acronyms/Abbreviations (Continued)

ROD	Record of Decision
SCL	Seattle City Light
SCWG	Source Control Work Group
SD	Storm Drain
SEA	Striplin Environmental Associates
SMS	Sediment Management Standards
SPU	Seattle Public Utilities
SQS	Sediment Quality Standards
SWPPP	Stormwater Pollution Prevention Plan
TCE	Trichloroethylene
TCP	Toxics Cleanup Program (Ecology)
TOC	Total Organic Carbon
TPH	Total Petroleum Hydrocarbons
TSCA	Toxic Substances Control Act
USCG	United States Coast Guard
UST	Underground Storage Tank
VCP	Voluntary Cleanup Program (Ecology)
WSDOT	Washington State Department of Transportation

1.0 Introduction

This Source Control Action Plan (Action Plan) describes potential sources of contamination that may affect sediments in and adjacent to Slip 4.[4] 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 Slip 4 sediments. In addition, this Action Plan 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 a variety of sources, including the following documents:

- *Summary of Existing Information and Identification of Data Gaps*, Striplin Environmental Associates, 2004
- *Lower Duwamish Waterway Slip 4 Early Action Area Engineering Evaluation/Cost Analysis*, Integral Consulting, Inc., 2006
- *Source Control Program for the Lower Duwamish Waterway*, June 2004, January 2005, and June 2005 Progress Reports, Seattle Public Utilities and King County Industrial Waste, Seattle, WA

1.1 Organization of Document

Section 1 of this Action Plan describes the Lower Duwamish Waterway site, the strategy for source control, and the responsibilities of the public agencies involved in source control for the Lower Duwamish Waterway. Section 2 provides background information on the Slip 4 Early Action Area (EAA), including a description of the chemicals of concern for Slip 4 sediments. Section 3 provides an overview of potential sources of contaminants that may affect Slip 4 sediments, including piped outfalls, spills, properties adjacent to Slip 4, and upland properties. Actions planned or currently underway to control potential sources of contaminants are described in Section 4, while Sections 5 and 6 describe monitoring and tracking/reporting activities, respectively. Appendix A summarizes historical uses of adjacent and upland properties.

1.2 Lower Duwamish Waterway Site

The Lower Duwamish Waterway 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 Lower Duwamish Waterway 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 airplane parts

[4] This Action Plan incorporates data published through March 31, 2006. Section 8, Reporting, describes how newer data will be disseminated.

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 1999a). 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 Lower Duwamish Waterway has been recognized since the 1970s (Windward 2003a). In 1988, the U.S. Environmental Protection Agency (EPA) investigated sediments in the Lower Duwamish Waterway 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 (Weston 1999a). This study confirmed the presence of PCBs, PAHs, phthalates, mercury, and other metals. These chemicals 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 Lower Duwamish Waterway to assess potential risks to human health and the environment and to evaluate cleanup alternatives. The Remedial Investigation for the site is being done in two phases. Results of Phase 1 were published in July 2003 (Windward 2003a). The Phase 1 RI used existing data to provide an understanding of the nature and extent of chemical distributions in Lower Duwamish Waterway sediments, develop preliminary risk estimates, and identify candidates for early cleanup action. The Phase 2 RI is currently underway and is designed to fill critical data gaps identified in Phase 1. Based on the results of the Phase 2 RI, additional areas for cleanup may be identified. During Phase 2, a Feasibility Study will be completed that will address cleanup options for contaminated sediments in the Lower Duwamish Waterway.

On September 13, 2001, EPA added the Lower Duwamish Waterway to the 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, 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 for the RI/FS, while Ecology is the lead 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 were recommended (Figure 2). The sites are:

- Area 1: Duwamish/Diagonal combined sewer overflow (CSO) and storm drain
- Area 2: River mile (RM) 2.2, on the west side of the waterway, just south of the 1st Avenue South Bridge
- Area 3: Slip 4 (RM 2.8)
- Area 4: South of Slip 4, on the east side of the waterway, just offshore of the Boeing Plant 2 and Jorgensen Forge properties (RM 2.9 to 3.7)
- Area 5: Terminal 117 and adjacent properties, located at approximately RM 3.6, on the west side of the waterway
- Area 6: RM 3.8, on the east side of the waterway
- Area 7: Norfolk CSO (RM 4.9 to 5.5), on the east side of the waterway

Of the seven recommended Early Action Areas (EAAs), four either had sponsors to begin investigations or were already under investigation by a member or group of members of the LDWG. These four sites are: Slip 4 (the subject of this Action Plan), Terminal 117, Boeing Plant 2, and Duwamish/Diagonal. EPA is the lead for managing cleanup at Terminal 117 and Slip 4. The other two early action cleanup projects were begun before the current Lower Duwamish Waterway 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 cleanup, under King County management as part of the Elliott Bay-Duwamish Restoration Program, was partially completed in March 2004. 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 Phase 2 investigation.

Further information about the Lower Duwamish Waterway 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 Lower Duwamish Waterway Source Control Strategy

The Lower Duwamish Waterway Source Control Strategy (Ecology 2004) describes the process for identifying source control issues and implementing effective source controls for the Lower Duwamish Waterway. The basic 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 Lower Duwamish Waterway sediment cleanup goals and the Sediment Management Standards (WAC 173-204). 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 Action Plans that will be coordinated with sediment cleanups, beginning with the EAAs. Each Action Plan 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 will be 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 Lower Duwamish Waterway area, as well as prompt compliance by the businesses that must make necessary changes to control releases from their properties.

The focus of the strategy is on controlling contamination that affects Lower Duwamish Waterway 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; February 12, 2002* (EPA 2002), and Ecology's Sediment Management Standards (WAC 173-204). 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 site will require that sources of sediment contamination to the entire site be evaluated, investigated, and controlled as necessary. Dividing source control work into specific Action Plans 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.

Source control priorities are divided into four tiers. Tier One consists of source control actions associated with the EAAs identified to date. Tier Two consists of source control actions associated with any final, long-term sediment cleanup actions identified through the Phase 2 RI and the EPA ROD. Tier Three consists of source identification and potential source control actions in areas of the waterway that are not identified for cleanup, but where source control may be needed to prevent future contamination. Tier Four consists of source control work identified by post-cleanup sediment monitoring (Ecology 2004). This document is a Tier One Source Control Action Plan for an early action sediment cleanup.

Further information about the Lower Duwamish Waterway 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 Lower Duwamish Waterway are Ecology, the city of Seattle, King County, Port of Seattle, city of Tukwila, and EPA.

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 Action Plans, jointly implement source control measures, and share progress reports on source control activities for the Lower Duwamish Waterway 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 Lower Duwamish Waterway Memorandum of Understanding (EPA and Ecology 2004).

Because the city of Tukwila and the Port of Seattle have no jurisdiction over the areas that drain to the Slip 4 EAA, they are not included in this Action Plan. 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 have been invited to participate as appropriate (Ecology 2004).

2.0 Slip 4 Early Action Area

The city of Seattle and King County are planning a sediment removal action for early cleanup of contaminated sediments in the Slip 4 EAA. Sediments in Slip 4 have accumulated chemical contaminants from numerous sources, both historical and potentially ongoing. These chemicals entered the slip through direct discharges, spills, bank erosion, groundwater discharges, surface water runoff, atmospheric deposition, or other non-point discharges.

Slip 4 is located on the east bank of the Lower Duwamish Waterway, approximately 2.8 miles from the southern end of Harbor Island. The slip is approximately 1,400 feet long, with an average width of 200 feet, and encompasses about 6.4 acres (Integral 2006). Properties immediately adjacent to Slip 4 are currently owned by: Crowley Marine Services, First South Properties, King County, and The Boeing Company. Crowley owns the majority of the submerged land within the Slip 4 EAA.

Slip 4 is relatively shallow with bed elevations ranging from +5.0 feet mean lower low water (MLLW) at the head of the slip to approximately –20 feet MLLW at the mouth. The shallowest depths occur at the head and along the eastern shoreline where the bottom gradually slopes to the current and historical dredging boundary, located approximately halfway across the slip. At low tide, bottom sediments are exposed at the head and along the eastern shoreline. In areas of historical dredging along the western shoreline half of the slip, water depths range from –5 to –15 feet MLLW. In 1996, Crowley dredged a portion of the slip to a uniform depth of –17 feet MLLW (PTI 1995).

The proposed removal area identified in the Engineering Evaluation/Cost Analysis (EE/CA) for Slip 4 includes about 3.6 acres of the northern (inner) half of the slip (Integral 2006; Figure 3). This includes all areas where surface sediments have chemical concentrations greater than the sediment quality standards (SQS) except for one isolated station with minor SQS exceedances. Sediments outside the proposed removal area will continue to be evaluated by the LDWG, EPA, and Ecology pursuant to the Lower Duwamish Waterway (LDW) RI/FS.

2.1 Chemicals of Concern

Numerous environmental investigations have included the collection of sediment data in Slip 4. Four sediment investigations were conducted between 1990 and 1999 in Slip 4, including an EPA site investigation (Weston 1999a), a National Oceanic and Atmospheric Administration (NOAA) sediment characterization of the Duwamish River (NOAA 1998), a site assessment (Landau 1990), and a dredged material characterization (Exponent 1998). Additional sediment characterization data were collected in 2004 (Integral 2004), including surface and subsurface sediment samples and bank samples. Additional bank samples were collected in 2005 by Ecology (Parametrix 2005), Boeing (Boeing 2005b) and First South Properties (CH2M Hill 2005a and 2005b). Sediment data are detailed in *Summary of Existing Information and Identification of Data Gaps* (SEA 2004) and *Engineering Evaluation/Cost Analysis* (EE/CA; Integral 2006).

Chemical data are compared to the Washington State Sediment Management Standards (SMS), which include both the Sediment Quality Standards (SQS) and Cleanup Screening Levels (CSLs) (WAC 173-204). Sediments that meet 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 is defined as the maximum allowed chemical concentration and level of biological effects permissible at a cleanup site, to be achieved by year 10 after cleanup has been completed. The CSL is greater than or equal to the SQS and represents a higher level of risk to benthic organisms than SQS levels. The SQS and CSL values 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 (TOC)-normalized concentrations.

2.1.1 Historical Slip 4 Sediment Sampling

As detailed in the Slip 4 EE/CA (Integral 2006), surveys conducted between 1990 and 1999 included collection of surface sediment samples at 41 sampling locations and subsurface sediment cores (up to 10 feet deep) at 12 locations in Slip 4. The data from these samples (detailed in SEA 2004) indicate that PCBs are the contaminant of primary concern in Slip 4 surface sediments due to their areal extent and concentration. PCBs exceeded the SQS at nearly all surface sampling locations, and exceeded the CSL at over half of the surface sampling locations. The highest PCB concentrations were found at the head of the slip, with concentrations decreasing toward the mouth. Bis(2-ethylhexyl)phthalate (BEHP) also exceeded the SQS and the CSL at several stations.

Other chemicals exceeding the SQS or CSL in surface sediments included metals and PAHs in samples located in the vicinity of the outfalls at the head of the slip.

In subsurface sediments, PCBs were also the contaminant with the most frequent SQS exceedances. Only two other chemicals (acenaphthene and fluoranthene) exceeded the SQS in subsurface sediments.

2.1.2 Recent Slip 4 Sediment Sampling

Additional sediment samples were collected in 2004. These included surface sediment samples at 29 locations and sediment cores (to a depth of 12 feet) at 11 locations. In addition, one intertidal sample was collected along the eastern shore of Slip 4, and bank samples were collected at six locations.

PCB concentrations in the 2004 surface sediment samples exceeded the SQS at six stations. CSL exceedances were confined to three stations at the head of the slip and the intertidal area located along the eastern bank of the slip. Total PCBs at the remaining 20 surface sediment stations were below the SQS. A subset of 2004 surface sediment samples was analyzed for other SMS analytes. At Station SG16, BEHP and phenol were slightly above the SQS in surface sediments; PCBs also exceeded the SQS at this location. No other SQS exceedances were observed in surface sediment samples.

In subsurface sediment, PCBs in exceeded the CSL in six of the nine cores that were submitted for chemical analysis (two cores were archived), with exceedances most commonly occurring to a depth of 4 to 6 feet. Other detected chemicals that exceeded the SQS or CSL in subsurface sediment included mercury and silver. Other than PCBs, there were no detected organic chemicals in subsurface sediment samples that exceeded the SQS or CSL (Integral 2004).

When the surface PCB concentrations from 2004 are compared with historical data collected between 1990 and 1998, it is apparent that PCB concentrations in surface sediments in many areas of the slip are lower in 2004 than they were between 1990 and 1998. In all cases, total PCBs in the surface sample are lower than the concentrations in the top interval (0 to 2 feet) of the collocated core (Integral 2006).

In general, two PCB mixtures (known as Aroclors) have been detected in sediment samples collected in and around Slip 4: Aroclor 1254 and Aroclor 1260. Isolated detections of Aroclor 1242 and 1248 have also been reported.

The sediment chemistry data are discussed in more detail in the Slip 4 EE/CA (Integral 2006). Although PAHs and metals were detected in some surface or subsurface sediment samples, they are generally collocated with PCBs. Remediation of PCB-contaminated sediment will also result in the cleanup of areas where PAHs and metals exceed the SQS or CSL. For these reasons, and because PCBs and BEHP are the most common problem chemicals in waterway sediment, PCBs and BEHP are considered the contaminants of concern in Slip 4 sediments and are the primary focus of this Action Plan. While source control efforts will focus on PCBs and BEHP, any other chemicals that could result in sediment recontamination will be addressed as needed.

Further information about Slip 4 can be found at:
http://yosemite.epa.gov/R10/CLEANUP.NSF/ldw/slip+4

3.0 Potential Sources of Sediment Recontamination

Sediments in Slip 4 contain chemical contaminants from numerous historical and potentially ongoing sources. These chemicals entered the slip through direct discharges, bank erosion, groundwater discharges, surface water runoff, spills, and other non-point discharges. This section discusses current and historical land uses and the results of environmental investigations on properties adjacent to or discharging to the slip. Potential sources of sediment recontamination are depicted on Figure 4 (Slip 4 Outfalls), Figure 5 (Slip 4 Drainage Basin), and Figure 6 (Slip 4 Adjacent and Upland Properties).

3.1 Piped Outfalls

The Lower Duwamish Waterway area is served by a combination of storm drain (SD), sanitary sewer, and combined sewer systems. Storm drains convey stormwater runoff collected from streets, parking lots, roof drains, and residential, commercial, and industrial properties to the waterway. In the Lower Duwamish Waterway, there are both public and private storm drain systems. Most of the waterfront properties are served by privately owned systems that discharge directly to the waterway. The other upland areas are served by a combination of private and publicly owned systems.

Storm drains entering the Lower Duwamish Waterway 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. Impervious surfaces may accumulate particulates, dust, oil, asphalt, rust, rubber, metals, pesticides, detergents, or other materials as a result of urban activities. These are flushed into storm drains during wet weather. Storm drains can also convey materials from businesses with permitted discharges (i.e., NPDES industrial stormwater permits), vehicle washing, runoff from landscaped areas, erosion of contaminated soil, groundwater infiltration, and materials illegally dumped into the system.

Prior to formation of the Municipality of Metropolitan Seattle (Metro, now part of King County) in 1958, Seattle and other surrounding communities operated small treatment plants that discharged to Lake Washington, the Duwamish River, and Puget Sound. One of these treatment plants, the Diagonal treatment plant, located at Diagonal Avenue S. and E. Marginal Way S., was constructed in about 1939. The Duwamish interceptor, which conveyed stormwater and municipal/industrial wastewater along E. Marginal Way S. to the treatment plant, was constructed in about 1940 (Brown and Caldwell 1958). A pump station, equipped with a 36-inch emergency overflow and stormwater bypass at the head of Slip 4, was included as part of this system.

The current sanitary sewer system collects municipal and industrial wastewater from throughout the Lower Duwamish Waterway area and conveys it to the West Point wastewater treatment plant, where it is treated before being discharged to Puget Sound. The smaller trunk sewer lines, which collect wastewater from individual properties, are owned and operated by the individual municipalities (e.g., Cities of Seattle and Tukwila) and local sewer districts. The large interceptor system that collects wastewater from the trunk lines is owned and operated by King County. The

Elliott Bay Interceptor was constructed along the east side of the Duwamish River and Elliott Bay in 1964 to convey wastewater to the West Point plant.

Pump stations lift sewage to a location where it can continue to flow downhill to the treatment plant. If there is an equipment or power failure, an overflow route is needed to protect conveyance pipes and pumps from damage. These are called emergency overflows (EOFs) and only occur in the event of a serious system malfunction such as a pump failure or a blocked pipe. Pump stations are equipped with an emergency generator to ensure operation during power failures.

Some areas of the Lower Duwamish Waterway are also 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 system rather than separate storm and sanitary systems.

During large storm events, the volume of stormwater can sometimes exceed the capacity of the combined sewer system. The collection system designed for the West Point treatment plant contains relief points called combined sewer overflows (CSOs) to control the amount of combined sewage and storm water that could enter the system and especially the Elliott Bay Interceptor. The CSOs prevent the combined system from backing up and creating flooding problems. During large storm events, these CSOs release a mixture of stormwater and sanitary sewage to the waterway. There are no CSOs discharging to Slip 4.

There are five public and numerous private outfalls to Slip 4 (Figure 4). The public outfalls are listed below:

- King County (KC) Airport SD #3/PS44 EOF – 60 inches; previously called Slip 4 SD (117)
- North Boeing Field SD – 24 inches; previously called Slip 4 EOF/SD
- I-5 SD – 72 inches
- Georgetown flume – 72 inches
- E. Marginal Way EOF – 36 inches

Potential sources that may contribute pollutants to these outfalls include:

- Chemicals carried by stormwater runoff (e.g., street dust, atmospheric deposition, automobile emissions, fertilizers, household pesticides, etc.)
- Industrial and municipal wastewater discharged during emergency overflow conditions at sewer system pump stations
- Contaminated groundwater that may have infiltrated into the system through breaks in conveyance lines
- Materials improperly disposed of in the storm drain and/or combined/sanitary systems

The combined sewer service area in the Slip 4 basin encompasses about 6,200 acres and the storm drain basin covers about 467 acres (Figure 5). Land use in the basin is primarily industrial and commercial, with a small amount of residential property east of I-5. There are currently no storm-related combined sewer overflows that discharge to Slip 4. The City and King County both maintain EOFs on pump stations that discharge to Slip 4, but overflows occur infrequently.

City and County source control activities focus on reducing the amount of chemicals discharged to publicly-owned storm drains and sanitary/combined sewers through business inspections and source identification/tracing activities. Because there are no CSOs discharging into Slip 4 and pump station EOFs occur infrequently, source control activities have focused on stormwater discharges. The City and County provide progress reports to Ecology and EPA every 6 months. Detailed information is available in the June 2004, January 2005, and June 2005 reports (SPU and King County 2004, 2005a, 2005b).

The small private outfalls that discharge to Slip 4 serve approximately 50 acres of mostly industrial and commercial land adjacent to the slip. Non-point discharges to Slip 4 include stormwater runoff that is not collected in a piped system and discharges directly to the slip as sheet flow.

3.1.1 I-5 Storm Drain Outfall

The I-5 storm drain collects runoff from approximately 1.5 miles of I-5 (75 acres), 44 acres of single family residential property located east of I-5, and 1 to 2 acres on the north end of the King County airport.

3.1.2 KC Airport SD #3/PS44 EOF

The 60-inch KC Airport SD #3/PS44 EOF is owned by King County. This line drains the northern portion of the King County International Airport and encompasses 290 acres of the Slip 4 drainage area. The airport drainage system has been modified numerous times. In about 1985, runoff from approximately 120 acres at the north end of the airport that formerly discharged to the 24-inch North Boeing Field SD and 1.5 acres that formerly discharged to the Georgetown Flume was diverted to the 60-inch KC Airport SD #3/PS44 EOF (SEA 2004).

The emergency overflow from City pump station #44 was also diverted from the 24-inch North Boeing Field SD to the KC Airport SD #3/PS44 EOF. Consequently the KC Airport SD #3/PS44 EOF now functions as a City emergency pump station overflow. City pump station #44 has not overflowed in the past 5 years, when the City started maintaining pump station records (Schmoyer 2004).

A North Boeing Field industrial water discharge survey in 1994 discovered that process water and condensate water (including pump leaks to floor drains and condensate from room heaters and process heat exchangers) were discharging to the KC Airport SD #3/PS44 EOF (Babich 1994).

On June 11, 2004, King County staff observed white foam discharging in pulses from one of the storm drains at the head of Slip 4, later identified as KC Airport SD #3/PS44 EOF (SPU and King County 2005a). King County Industrial Waste found that Boeing had been conducting an annual test of the fire suppression system for the Fuel Test Facility in Building 3-335. The foam was an aqueous film-forming foam released when a valve was inadvertently left open by a new fire inspector conducting the testing. Boeing estimated that less than 3 gallons of foam were discharged into the storm system with up to 300 gallons of water. Surface water samples collected in Slip 4 contained BEHP at 0.609 µg/L, and low levels of barium, boron, calcium, iron, magnesium, and sodium. Except for BEHP, which was present at levels consistent with or lower than levels found in stormwater, the discharge contained no chemicals of concern. Boeing has modified its procedures to prevent recurrence (SPU and King County 2005a).

3.1.3 North Boeing Field SD

The 24-inch North Boeing Field SD now drains about 1 acre on the north end of the King County International Airport (KCIA) and no longer functions as an emergency pump station overflow. Until about 1976, this system was referred to as the Greeley Street sewer and functioned as a raw sewage outfall for the industrial area at the far north end of the KCIA/Boeing Field and parts of the Georgetown neighborhood. The Greeley Street sewer was constructed in 1934 (King County 1933a). It was separated in 1976 and converted to a storm drain. At that time, the drain collected runoff from about 120 acres on the north end of the airport and also functioned as an emergency overflow for City sewer pump station #44, located on Airport Way S. Pump station #44 is currently connected to the 60-inch KC Airport SD #3/PS44 EOF and has not overflowed in the past 5 years, when the City began maintaining pump station records.

3.1.4 E. Marginal Way EOF

King County's E. Marginal Way pump station is connected to the E. Marginal Way EOF. There has not been a recorded overflow from this pump station since recordkeeping began in the 1970s.

In January 2005, Emerald Services reported that flow from a manhole downstream of this pump station was entering their property and discharging to Slip 4 (Smith 2005). An investigation determined that the interceptor downstream of the E. Marginal Way Pump Station was at capacity. The surcharge was backing up and coming out of a manhole at the force main discharge structure. It appeared that most of the surcharge was contained within the parking area at the pump station (Hulsizer 2005, Zimmer 2005). King County is investigating the situation to determine if operational changes resulted in this release and whether there is a potential for repeated releases by this pathway (Stern 2006).

Because discharges from the combined sewer service area are infrequent, source control work in Slip 4 is focused on the separated drainage system. However, historically the E. Marginal Way combined sewer system discharged directly to Slip 4. The combined sewer was constructed in about 1934 and conveyed wastewater from properties along E. Marginal Way extending from Slip 4 southward into what was then unincorporated King County (King County 1933b). After the Diagonal wastewater treatment plant was constructed in 1940, the outfall to Slip 4 became an overflow structure. It is estimated that because of limited capacity in the interceptor sewer, up to 90 percent of the wet weather flow was bypassed to the Duwamish Waterway via several overflow structures (including Slip 4) constructed along the waterway (Brown and Caldwell 1958). By 1958, the E. Marginal Way sewer system served an area of about 7,120 acres.

Overflows to Slip 4 were greatly reduced after about 1969 when King County (formerly Metro) constructed the regional sewer system and conveyed flow to the West Point wastewater treatment plant.

3.1.5 Georgetown Flume

The Georgetown Flume was originally constructed to discharge cooling water from the Georgetown Steam Plant (GTSP) after the river was straightened in 1916 into the Duwamish Waterway. The 6.5-foot-wide flume is located on property owned by the city of Seattle that varies between 20 and 45 feet in width. The flume consists of concrete and wooden sections, as well as piped sections, and extends approximately 2,500 feet across the north end of the King County International Airport from the GTSP to the head of Slip 4 (Figure 7).

The head or upstream end of the flume (referred to as the tunnel section) is a closed pipe that extends approximately 250 feet from the steam plant to a 90-foot long section of open, concrete-lined flume. The concrete-lined flume connects to twin 42-inch diameter pipes approximately 400 feet long. These pipes are connected to a short section of open, concrete-lined flume, which in turn is connected to an open wooden flume that extends to E. Marginal Way S. This open portion is approximately 1,240 feet long and meets a concrete header at the edge of E. Marginal Way S. From here, a culvert passes under E. Marginal Way S. to the outfall at the head of Slip 4.

Except for annual test runs, routine cooling water discharges were discontinued in the 1960s when the steam plant was shut down (SEA 2004). At one time, the flume was a conduit for industrial wastewater discharges and runoff from an estimated 11.5 acres of the north end of the airport. The flume now receives stormwater runoff from an estimated 10 acres.

City-owned property adjacent to the flume has been leased to Boeing. As industrial development occurred in the area, discharge pipes from nearby properties and facilities were connected to the flume at numerous locations along its length. These included both permitted and unpermitted connections for stormwater, cooling water, and industrial wastewater discharges. During a 2005 field inspection, six unplugged pipes were observed entering the flume (Integral 2006). Some documented examples of connections and uses of the flume are discussed in Appendix A.

Sections of the flume remain uncovered and continue to collect stormwater discharge from rainwater falling in the flume and runoff from adjacent upland areas. In addition to Boeing, adjacent upland properties without direct connections to the flume but with possible overland runoff include storage areas, the Willow Street substation, and a former substation site (Ellis Street). Boeing uses paved areas near S. Myrtle Street and overlying the tunnel to stage materials and equipment.

Seattle Public Utilities (SPU) has used an undeveloped area west of the flume and north of S. Myrtle Street to stage stockpiles of gravel, sand, and mixed soil and asphalt (Bridgewater Group 2000). Surface soil samples collected at the SPU yard contained PCBs at 1.2 mg/kg and less than 1 mg/kg near the center of the property (Bridgewater Group 2000). The Washington State Model Toxics Control Act (MTCA) Method A soil cleanup level for unrestricted use is 1 mg/kg PCBs. In 2001, the City installed an underground vault and regraded and bermed the storage area to contain runoff onsite. Site runoff is currently collected in the underground vault. The vault is periodically pumped to remove stormwater and silt. Material is disposed offsite. The City intends to close this storage area in 2006.

The Willow Street Substation is unpaved and slopes toward the flume. During a site visit in 2000, Bridgewater Group (2000) observed no staining or other evidence of release around the perimeter of the substation or between the substation and the flume.

The former Ellis Substation, located on the east side of the flume, just south of S. Myrtle Street, was decommissioned in 1990. A composite soil sample consisting of 10 subsamples, collected between the substation and the flume in 1984, contained 0.071 mg/kg PCBs (Raven Services Corporation 1991). Additional samples were collected in 1991 from onsite soil and concrete equipment pads. PCBs were detected in two of the three soil samples (<0.1 to 0.5 mg/kg DW) and one of the four concrete samples (<0.1 to 0.2 mg/kg DW) (Bridgewater 2000).

Samples collected by SPU in 2005 found PCBs in sediment collected from the upper end of the flume, ranging from 0.38 to 92 mg/kg DW (see Section 3.1.6 below). The city is working to clean the flume and identify offsite drainage and potential erosion entering the flume that may represent potential sources (see Section 4.3).

3.1.6 Sediment Trap and Inline Sediment Samples

In March 2005, SPU installed sediment traps at the following 10 stations in the publicly owned storm drains that discharge to Slip 4 (Figure 8):

- SL4-T1 (MH422): 60-inch KC Airport SD #3/PS44 EOF at the downstream end of the north and central laterals.
- SL4-T2 and SL4-T2A (MH356 and MH482): 60-inch KC Airport SD #3/PS44 EOF, south lateral (downstream and upstream of the Boeing leased property).
- SL4-T3 and SL4-T3A (MH364 and MH19C): 60-inch KC Airport SD #3/PS44 EOF, central lateral#1 (downstream and upstream of the Boeing leased property).
- SL4-T4 and SL4-T4A (MH221A and MH229A): 60-inch KC Airport SD #3/PS44 EOF, central lateral #2 (downstream and upstream of the Boeing lease property).
- SL4-T5 and SL4-T5A (MH363 and MH178): KC Airport SD #3/PS44 EOF, north lateral (downstream and upstream of the Boeing lease property).
- SL4-T6: 72-inch I-5 SD at the intersection of S. Hardy Street and Airport Way S.

Station locations were selected to isolate individual storm drains and subbasins within the larger Slip 4 drainage basin. Traps are installed for a 4- to 6-month period to passively collect samples of suspended sediment present in the stormwater runoff. In August 2005, SPU and Boeing removed and redeployed the traps for the winter wet season.

Results from the first round of samples are provided in Tables 1 and 2. Chemicals that exceeded SMS include mercury, zinc, BEHP, and PCBs. Mercury concentrations (0.1–1.12 mg/kg dry weight [DW]) exceeded the CSL in three traps (SL4-T1, SL4-T5, and SL4-T5A) and zinc (220–553 mg/kg DW) exceeded the SQS in 3 traps (SL4-T4A, SL4-T5, and SL4-T6). TOC was not analyzed in all samples because of low sample volumes and so comparisons with SMS for organic compounds could only be performed on three of the sediment trap samples (SL4-T1, SL4-T4A, and SL4-T6). BEHP (49–189 mg/kg organic carbon [OC]) exceeded the SMS in all three samples (two SQS exceedances and one CSL exceedance).

PCBs were detected in all 10 traps at concentrations ranging from 0.04 to 24 mg/kg DW and exceeded the MTCA Method A cleanup level for residential soil of 1 mg/kg DW in five traps. As described above, TOC analysis was performed for only three samples, and therefore only these samples could be compared to the SMS. Two of the three samples (SL4-T1 and SL4-T6, 233 and 246 mg/kg OC PCBs, respectively) exceeded the CSL for PCBs.

In addition to the sediment trap samples, SPU collected inline sediment samples at four of the stations where traps were deployed and one additional maintenance hole at the downstream end of the flume (MH100). Duplicate samples were collected at each site and split with Boeing. Inline samples are grab samples collected from sediment that has deposited in the storm drain line, typically at maintenance holes or other areas where sediment accumulates. Inline sediment data are provided in Tables 3 (DW) and 4 (TOC-normalized). Sampling locations are shown on Figure 8.

Chemicals exceeding SMS included mercury, zinc, acenaphthene, fluorene, phenanthrene, benzo[b+k]fluoranthene, benzo[g,h,i]perylene, fluoranthene, indeno[1,2,3-c,d]pyrene, BEHP, and PCBs (Table 4). Mercury (0.48 and 0.7 mg/kg DW) exceeded the CSL in split samples at MH363, while zinc (411 and 572 mg/kg DW) exceeded the SQS at MH100 and MH221A and the CSL (699 and 1,130 mg/kg DW) in split samples at MH229A (Table 3). Concentrations of PAH compounds exceeded the SQS at MH229A and in one of the two split samples at MH221A (Table 4).

BEHP concentrations in the Slip 4 inline sediment samples shown in Table 3 (180–2,200 µg/kg DW) were relatively low compared to other source sediment samples collected in the Lower Duwamish Waterway (<20–26,000 µg/kg DW)(Integral 2006). However, samples from three of the five locations (MH221A, MH363, and MH229A) exceeded the SQS.

PCBs were detected at four of the five inline sample locations (0.31–31 mg/kg DW, 7-2,793 mg/kg OC), exceeding the SQS at one location (MH100) and the CSL at three locations (MH221A, MH363, and MH229A). MH363 contained the highest concentration of PCBs (31 mg/kg DW or 2,793 mg/kg OC). PCB concentrations in the other three locations where they were detected ranged from 0.31 to 56 mg/kg DW (7 to 921 mg/kg OC).

Additional inline sediment samples were collected from various locations along the Georgetown Flume (Tables 3 and 4). Chemicals exceeding SMS included lead, mercury, zinc, acenaphthene, fluorene, phenanthrene, benzo[b+k]fluoranthene, fluoranthene, BEHP, and PCBs. Total petroleum hydrocarbons exceeded MTCA Method A cleanup levels. Concentrations of PCBs ranged from 0.04 to 92 mg/kg DW (5 to 1,746 mg/kg OC); they exceeded the SQS in seven of 11 samples, and exceeded the CSL in two samples. The highest PCB concentration was found at location P3.

3.2 Spills

The U.S. Coast Guard (USGS) and Ecology were contacted regarding information on oil or chemical spills to Slip 4 (SEA 2003a, 2003b). Records prior to the 1990s at both agencies are not centralized and consist primarily of individual incident reports. One very minor spill (one gallon of hydraulic oil) occurred at Crowley Marine Services in 1997 due to an equipment malfunction (SEA 2004). No other reports of spills from facilities adjacent to Slip 4 were found during a review of Ecology files. The U.S. Coast Guard provided information of spills on record occurring in the Duwamish River from 1992 to 2003, but, based on available information, none appear to have occurred in the vicinity of Slip 4 (USCG 2003).

3.3 Properties Adjacent to Slip 4

In addition to discharges via the outfalls described above, adjacent properties may contribute contamination to Slip 4 through a private stormwater system that discharges to the slip, or by direct discharge of contaminated groundwater to the slip. Another potential source of contamination is soil erosion from the riverbank. If chemicals of concern from an adjacent site reach the waterway, they could recontaminate the Slip 4 sediments.

Properties adjacent to Slip 4 are currently owned by: Crowley Marine Services (Crowley), First South Properties, King County, and The Boeing Company (Boeing Plant 2) (Figure 9). These are discussed in Section 3.3.1 through 3.3.4 below.

The banks of Slip 4 are armored by a sheet-piling wall with rip rap along the northwest (Crowley) shoreline and by riprap along the Boeing Plant 2 shoreline. Portions of the shoreline along the northeast Crowley shoreline, First South Properties parcel, and the head of the slip are lined with discontinuous segments of wooden or cinderblock bulkheads or are only partially armored with pavement debris such as concrete, asphalt, and brick or coarse gravel and cobbles.

The wooden bulkhead along the southwestern shoreline of the First South Properties is estimated from aerial photos to be approximately 50 years old. Erosion of the slope along this bulkhead has been observed. Other evidence of bank erosion includes a minor amount of eroded vegetation observed on the Crowley shoreline and a small drainage gully from the upland portion of First South Properties to the slip (Integral 2006).

In September 2004, six soil samples were collected from various locations along the banks of Slip 4 by the city of Seattle. Five of these samples, BK02 through BK06, were collected from the banks of the First South/Emerald Services property. The banks and this portion of the slip are owned by Crowley. BK06 is located near the junction of the property lines of First South Properties, Crowley and Boeing Plant 2. The samples were collected from the intertidal zone at elevations of approximately 10 feet above MLLW. The data found sample BK06 exceeded the CSL for PCBs (Integral 2004).

Additional bank sampling was conducted in 2005 by Ecology (Parametrix 2005), Boeing (Boeing 2005b) and First South Properties (CH2M Hill 2005a and 2005b). Bank surface and subsurface soil/sediment sample results showed that some PCB concentrations exceed the SQS and the CSL. Removal of these bank soils and intertidal sediments during the cleanup will eliminate this recontamination source. Ecology will work with the city of Seattle and EPA to address the surface and subsurface bank soil/sediment PCB contamination as part of the sediment cleanup in Slip 4 (Ecology 2005a).

3.3.1 Crowley Marine Services

Crowley Marine Services (Crowley) owns the property on the northwest side of the slip. Previous tenants include Northland Services (Northland) and Samson Tug and Barge Company, Inc. (Samson). The site is currently leased to Alaska Logistics. The upland area is used for cargo container storage, and a berthing facility occupies the northwestern shoreline of the slip. Most of the facility is paved, with only the area adjacent to E. Marginal Way S. remaining unpaved. Some minor vehicle maintenance occurs on the site. Equipment and vehicles being transported occasionally leak oils and other fluids. During a recent inspection, spill control materials were available onsite, but no spill response plan was available (SPU 2004). The facility does not have an industrial stormwater NPDES permit or a Stormwater Pollution Prevention Plan (SWPPP). Alaska Logistics and Crowley have been notified that they need to apply for a NPDES permit.

Current Storm Drainage

Surface drainage for this property discharges to six 8-inch outfalls located along the north side of Slip 4 (Figure 10) (Northland 2002). During a joint SPU/Ecology inspection of the Crowley property in June 2004, a sediment sample was collected from one of the onsite catch basins. The catch basin contained zinc (1,220 mg/kg DW) at levels above the SQS. PCBs were below the detection limit of 20 µg/kg DW and BEHP was measured at 1,600 µg/kg DW, but did not exceed the SQS when the data were TOC-normalized.

Past Use

The Crowley property is made up of two parcels, as shown on Figure 9. Parcel D is the southern two-thirds and Parcel F forms the northern one-third of the Crowley property (SEA 2004). Past uses of these two parcels are summarized in Appendix A.

Environmental Sampling/Cleanup

Parcel D. Several investigations to assess conditions resulting from past site uses have been conducted at Parcel D (SEA 2004). Soil samples collected in 1988 through 1990 detected several contaminants in soil at concentrations above cleanup levels: arsenic (up to 2,800 mg/kg), total petroleum hydrocarbons (TPH; up to 29,000 mg/kg), carcinogenic PAHs (cPAH; up to 1,396 mg/kg), and PCBs (up to 2.5 mg/kg). The elevated arsenic appeared to be localized in the vicinity of a former pole-dipping facility. Hart Crowser estimated that approximately 9,000 cubic yards of soil exceeded cleanup levels (Hart Crowser 1989a). Monitoring wells installed and sampled during 1988 through 1990 detected arsenic, copper, and cPAHs above surface water quality criteria (SEA 2004). Additional information about environmental sampling at Parcel D is provided in Appendix A. There is no record of soil or groundwater remediation on Parcel D.

Parcel F. Several investigations to assess conditions resulting from past site use have been conducted at Parcel F (SEA 2004). Soil samples collected in 1989 and 1990 detected several contaminants including PCBs, but only TPH was detected above MTCA cleanup levels (Hart Crowser 1989b). Copper and BEHP were detected above surface water quality criteria in groundwater samples (Hart Crowser 1989b, 1991). PCBs were not detected in groundwater. Additional information about environmental sampling at Parcel F is provided in Appendix A. Except for the removal of two underground storage tanks, there are no records of soil or groundwater remediation on Parcel F.

Potential for Future Releases to Slip 4

Spills that may occur at the property could enter the onsite storm drain system and be discharged to Slip 4 through the outfalls located on the north side of the slip or via sheet flow. Alaska Logistics, the current occupant, does not have an NPDES industrial stormwater permit or SWPPP.

Available soil and groundwater data indicate arsenic, TPH, cPAHs, and PCBs are present in soil at concentrations greater than MTCA Method A industrial cleanup levels. The property is paved, except for the area adjacent to E. Marginal Way S., reducing the likelihood of soil being carried into the slip by stormwater.

Groundwater near the slip does not exceed surface water criteria; however, groundwater from other portions of the property exceeds surface water criteria for arsenic, copper, cPAHs, and BEHP; these contaminants could reach the Duwamish Waterway. The historical groundwater data should be reexamined to evaluate the potential for contaminated groundwater to reach Slip 4.

3.3.2 First South Properties/Emerald Services

First South Properties is the owner of the land northeast of Slip 4 (Figure 9; also called Parcel E). The property is currently occupied by Emerald Services and is being used to store portable toilets, storage tanks and containers, dumpsters, and large construction hauling/recycling containers. The property is partially paved (see "edge of asphalt" on Figure 11). There is an office trailer and one small building used for equipment storage located along the southern fence line with Boeing.

SPU and Ecology conducted a joint inspection of Emerald Services on October 28, 2005. During the inspection, Ecology determined that the transfer of the NPDES permit from the prior tenant, Cedar Grove Composting, to Emerald Services was invalid. Emerald Services has a SWPPP and conducts the inspections and monitoring required by the NPDES Industrial Stormwater General Permit. Emerald Services is working to submit a new application for coverage.

Emerald Services is currently working to make the recommended modifications to improve stormwater quality at the site (Uzonow 2005):

- Replumb catch basin from portable toilet area to the sanitary sewer
- Clean catch basin, oil/water separator, and storm drain lines
- Clean up oil-stained material and replant the drainage swale on the west side of the property
- Post spill prevention and cleanup information at key locations around the site.

An inspection of the facility by SPU and Ecology on January 18, 2006 found that Emerald Services needs to clean the catch basins and oil/water separator, and should address some localized oily sheens on the ground (Ecology 2006). There did not appear to be any significant sheet flow to the slip.

Current Storm Drainage

Four outfalls are located on the southeast side of Slip 4 between about 700 and 1,000 feet from the mouth of the slip. Two 4- to 6-inch concrete pipes and one drainage swale serve the western portion of the property (Figure 11). The source and function of the other two pipes needs to be investigated. The eastern portion of the site drains to the King County interceptor located on E. Marginal Way S., which discharges to the King County Metro Wastewater Treatment Plant at West Point.

Past Use

The site was previously occupied by Washington Machinery and Storage Company and J.A. Jack & Son Lime Plant and Northwest Precote. These past uses are summarized in Appendix A.

Environmental Sampling/Cleanup

Several investigations were conducted from 1988 through 1996 to assess site conditions at this parcel. The initial investigation identified chemical contamination in soils. A number of cleanup actions followed, including soil removal and groundwater monitoring. Ecology ultimately determined that no further action was required at this property. Additional information is provided in Appendix A.

In April 2005, Emerald Services collected soil samples for PCB analysis (CH2M Hill 2005a, b). Seven surface soil samples were collected approximately 10 to 20 feet inland from the top of the bank; concentrations of PCBs in these samples ranged from undetected to 6.2 mg/kg OC (143 ug/kg DW), all less than the SQS. In addition, Emerald Services collected two samples (plus duplicates) from the drainage swale where stormwater from the property could transport upland surface soil to Slip 4 (Figure 11). PCB concentrations in the drainage swale samples ranged from 22 to 810 mg/kg OC (which exceed the sediment SQS and CSL, respectively). A subsurface soil sample was collected near the center of the site; no PCBs were detected.

Also in 2005, Ecology collected soil samples at 10 upland boring locations and at the drainage swale (Parametrix 2005). PCBs were detected in four of the 10 borings, located near the Slip 4 shoreline. PCB concentrations were detected in three samples at depths from 2 to 11.5 feet bgs, and in one shallow subsurface sample (SB-11; 14.2 mg/kg OC) in the southern portion of the site. All dry weight concentrations were below MTCA Method A criteria for industrial soil. Ecology also collected a surface soil sample from the drainage swale; PCBs were detected at 6.1 mg/kg OC (197 ug/kg DW), below the SQS.

A surface soil sample collected by SPU from the drainage swale detected no PCBs, but did find BEHP at 177 mg/kg OC (5,500 ug/kg DW), above the CSL for BEHP of 78 mg/kg OC (Integral 2006).

In November 2005, SPU collected sediment samples were collected from an oil/water separator located at the southwest corner of the property (Integral 2006). Sediment in the oil/water separator contained elevated concentrations of zinc (758 mg/kg DW), BEHP (120,000 µg/kg DW, 1,869 mg/kg OC), and di-n-octylphthalate (4,000 mg/kg DW, 62 mg/kg OC). Zinc and di-n-octylphthalate exceeded the SQS, and BEHP exceeded the CSL.

Samples were also collected by SPU from two catch basins on the southeast corner of the property (one on S. Webster Street) that drain to the combined sewer on E. Marginal Way S. (Integral 2006). Sampling stations are shown on Figure 8, and results are provided in Tables 5 and 6. Of the two catch basins, the onsite catch basin contained elevated concentrations of BEHP (38,000 µg/kg DW, 1,418 mg/kg OC), butylbenzylphthalate (1,800 µg/kg DW, 67 mg/kg OC), dimethylphthalate (1,900 µg/kg DW, 71 mg/kg OC), and di-n-octylphthalate (1,800 µg/kg DW, 67 mg/kg OC). The catch basin on S. Webster Street did not contain contaminants above SQS or MTCA cleanup levels (Integral 2006).

Potential for Future Releases to Slip 4

Spills and other releases that may occur at the property could enter the storm drain system and be discharged to the slip through the two outfalls or the drainage swale. The facility does not have an industrial stormwater permit. Two other pipes have been observed in the bank of the property. It is not known if these are active, and if so, what discharges to them.

Based on results of upland soil sampling, including sampling in the vicinity of the drainage swale at the top of the bank adjacent to Slip 4, Ecology concluded that active cleanup is not necessary at this time. Ecology will work with the city of Seattle to address the surface and subsurface bank soil/sediment PCB and BEHP contamination at the time when the City is conducting sediment cleanup in Slip 4 (Ecology 2005c).

Soil and groundwater data from upland areas of the property indicate that TPH, cPAHs, cadmium, and lead may be present in exposed soil at concentrations above the MTCA Method A industrial soil cleanup level. Arsenic, copper, zinc, and 2-methylnaphthalene may be present in groundwater at concentrations greater than surface water criteria at the property. The historical groundwater data will be reexamined to evaluate groundwater as a potential source of recontamination. Available sediment data do not indicate that groundwater is a current source of contamination.

If contaminated soil is present in unpaved areas of the property, contaminants may enter the slip through soil transport in stormwater (sheet flow).

3.3.3 King County Pump Station

King County owns a small property and building northeast of First South Properties on E. Marginal Way S. The building is a pump station associated with the Elliott Bay Interceptor, and is connected to the E. Marginal Way EOF. The pump station was built in 1966 and has operated since that time.

Storm Drains

All drainage from this parcel goes to the combined sewer system.

Past Use

No specific information was found to address this specific parcel. Given its location, it was likely used as part of the Washington Machinery and Storage Company operations.

Environmental Sampling/Cleanup

No environmental sampling or cleanups are known to have occurred at this site. There has not been a recorded overflow from this pump station since recordkeeping began in the 1970s.

As described in Section 3.1.4, in January 2005, flow from a manhole downstream of this pump station overflowed to the First Properties/Emerald Services property and discharged to Slip 4. An investigation determined that the interceptor downstream of the E. Marginal Way Pump Station was at capacity; the surcharge was backing up and coming out of a manhole at the force main discharge structure. Apparently, most of the surcharge was contained within the parking area at the pump station (Hulsizer 2005, Zimmer 2005).

Potential for Future Releases to Slip 4

Given the small size of the parcel and the nature of operations at the facility, and since all drainage goes to the combined sewer system, the potential for sediment recontamination from this property is believed to be low, except during extreme high flow conditions. King County is currently investigating the potential for recurrence of the January 2005 release.

3.3.4 Boeing Plant 2

The entire Boeing Plant 2 facility occupies 109 acres between E. Marginal Way S. and the Duwamish River on the southeastern side of Slip 4. The facility is used for storage as well as for the manufacturing of metal parts for airplanes (Weston 1998). About 17.5 acres of this property drains to Slip 4 (Figure 12). Building 2-122 is located adjacent to Slip 4 and was built in the early 1990s to house the Integrated Aircraft Systems Laboratory (Boeing 1993). The facility is used to test sensor systems developed by Boeing. No production-scale manufacturing is performed at this facility. The site is paved with small landscaped areas. The grounds between the parking area and Slip 4 include public walking trails and trees. A single-family residence is located on Webster Street northeast of Building 2-122 (Weston 1998). Boeing Plant 2 building numbers and locations are shown on Figure 13.

Current Storm Drains

Two 30-inch storm drains are located on the south side of the slip approximately 170 feet from the mouth. These collect parking area stormwater, which flows through bioswales before discharge, as well as roof drainage. Boeing has an Industrial Stormwater NPDES Permit (#SO3000482D) for Plant 2, which became effective September 2002. The facility has a SWPPP. The plan includes a facility description, potential pollutant source inventory, and best management practices (BMPs). Both drains are covered under the facility's industrial stormwater permit and are managed under the facility SWPPP. The stormwater from this outfall is monitored as required under the permit for copper, hardness, oil & grease, pH, turbidity, and zinc.

Past Use

Boeing has manufactured airplane parts at Plant 2 since 1936 (SEA 2004). Past use is summarized in Appendix A.

Environmental Sampling/Cleanup

There have been a number of investigations at the north end of Boeing Plant 2 from 1990 through 1994 to assess conditions resulting from past site uses and to document soil removal and cleanup actions (SEA 2004). These include:

- Phase II Subsurface Environmental Assessment, Proposed Integrated Aircraft Systems Laboratory Building, Seattle, Washington (Weston, October 1990)
- Supporting Documentation for Engineer's Certification of Closure, Boeing Plant II, 2-01 Building Dangerous Waste Sump (CH2M Hill, December 1991)

- Leaking Underground Storage Tank Investigation, Proposed Integrated Aircraft System Laboratory Construction Site, Plant II, Seattle, Washington (Weston, January 1992)
- Release Assessment, Boeing—Plant 2, Seattle/Tukwila, Washington (Weston, March 1994)

In 1990, Weston performed a pre-construction environmental assessment of soil and groundwater around the perimeter of the former Building 2-01, which was located at the north end of Plant 2 adjacent to Slip 4 to the north and the Duwamish Waterway to the west. One composite surface soil sample collected adjacent to electrical transformers near the southeast corner of the former Building 2-01 contained 14 mg/kg PCBs (Weston 1990). This exceeded the MTCA Method A industrial soil cleanup level of 10 mg/kg.

In subsurface soil, naphthalene and several cPAHs in one sample located in the parking lot south of the former Building 2-01 exceeded MTCA cleanup levels. PCBs were not detected in any of the subsurface soil samples.

In groundwater, chromium (up to 11 mg/L), copper (2.7 mg/L), lead (0.7 mg/L), nickel (3.8 mg/L), and zinc (2.4 mg/L) were detected at concentrations that exceeded their respective marine chronic water quality criteria in one or more samples. However, because the groundwater samples were collected using push-probe sampling methods and were typically turbid, metals concentrations were not considered representative of ambient metals concentrations in groundwater (Weston 1990). Remediation in these areas was completed as part of the 2-122 building construction (Boeing 2006a).

The dangerous waste sump (an RCRA Treatment, Storage, or Disposal unit) in the former Building 2-01 was removed and closed in 1991 (CH2M Hill 1991). Soils were not analyzed for PCBs during closure activities. Following demolition of Building 2-01, the sump was demolished, and 343 tons of concrete and associated soil were disposed of at the hazardous waste landfill in Arlington, Oregon. Ecology approved interim status closure of the former Building 2-01 dangerous waste sump in July 1992 (Ecology 1992). The closure of the sump is not referred to as “final closure,” since other dangerous waste management units remain in operation at Plant 2 (CH2M Hill 1991 and Ecology 1992).

Boeing performed a Release Assessment under an Administrative Order on Consent for a 3008(h) RCRA corrective action (Weston 1994). The assessment included an evaluation of groundwater quality data from the north end of Plant 2 in the vicinity of Slip 4, but did not include an evaluation of soil chemical data from this area. In addition to the analytical results for the push-probe groundwater samples collected from the perimeter of the former Building 2-01, the Release Assessment included data from three monitoring wells that were temporarily installed in the parking lot east of the building in the area now occupied by Building 2-122. The full suite of groundwater analytes is not known. Arsenic (up to 30 mg/L) and chromium (up to 60 mg/L) were detected in unfiltered groundwater samples collected from the wells (Weston 1994). The maximum detected metals concentrations exceeded their respective marine chronic water quality criteria.

A leaking underground storage tank (UST) was removed in 1991 from an area just outside of the southeast corner of the former Building 2-01 (Weston 1992). One soil sample from the excavation was analyzed for PCBs; no PCBs were detected. There is no information in Ecology files that TPH impacts to groundwater were investigated (SEA 2004).

Additional information on environmental sampling and cleanup is provided in Appendix A.

Recent Actions

Boeing is currently conducting an RCRA corrective action investigation at Plant 2. All of the RCRA corrective action investigation units are located south of Building 2-122 and do not include the redeveloped north end adjacent to Slip 4, since this north end area was extensively remediated as part of Building 2-122 construction. The corrective action includes sediments in the Duwamish Waterway west of Plant 2, known as the Duwamish Sediment Other Area (DSOA), but does not include sediments in Slip 4.

Potential for Future Releases to Slip 4

Spills at the north portion of the property (near Building 2-122) may enter the storm drain system and be discharged into the slip; however, activities that might cause releases are controlled in accordance with an industrial stormwater permit and SWPPP, and stormwater runoff flows through bioswales prior to discharge. Operations at this building are not likely to result in spills.

Available data indicate that remediation has been completed and the property is paved; therefore, the likelihood for contaminated soil to be carried by stormwater into the slip is small. The original groundwater data from various studies needs to be reevaluated. More current groundwater data may be needed to assess this area as a potential groundwater source to the slip, although sediment data do not suggest that there are impacts from groundwater.

3.4 Upland Properties

Upland sites may contribute contamination to Slip 4 through stormwater and other discharges to piped outfalls and through contaminated groundwater that may infiltrate into a stormwater system that discharges to the slip. If chemicals of concern from an upland site reach the waterway, they could recontaminate the sediments. Upland properties are shown in Figure 6.

Upland properties not directly adjacent to Slip 4 include the Georgetown Steam Plant (Section 3.4.1), North Boeing Field (Section 3.4.2), and King County International Airport (Section 3.4.3). Other potential upland contaminant sources are discussed in Section 3.4.4.

The Georgetown Steam Plant (GTSP), owned by Seattle City Light, is included because the facility once discharged cooling water to Slip 4 and has been identified as a potential source of contamination of the slip. North Boeing Field is discussed because of past releases at the site and recent information that it may be a potential source of recontamination.

3.4.1 Georgetown Steam Plant

The Seattle City Light GTSP property is located on the northwest corner of King County International Airport/Boeing Field. The property contains the old powerhouse, which currently houses the Georgetown Power Plant Museum. The condenser pit in the powerhouse is connected to the GTSP flume and, until the 1960s, discharged cooling water from the steam plant to the flume.

Current Storm Drainage

There are currently no storm drains present at the GTSP. The roof of the steam plant building drains to the Georgetown Flume. . Stormwater at the GTSP infiltrates into the ground or flows into catch basins at North Being Field, to the south or west.

Past Use

The powerhouse was built in 1906 by Seattle Electric Light Company. It contained three turbo-generators: a 3,000 kW unit, an 8,000 kW unit, and a 10,000 kW unit installed, in 1907, 1908, and 1917, respectively (Bridgewater Group 2000). When the plant was constructed, it was located along an oxbow of the Duwamish River. Past use of this site is summarized in Appendix A; Figure 14 identifies historic site features and shows the current GTSP boundary..

Environmental Sampling/Cleanup

A number of environmental investigations have been conducted at the GTSP. Areas of chemical contamination were identified on the property, in sediments of the flume, and in Boeing storm drains connected to the flume. PCBs were detected in three USTs located adjacent to the southwest corner of the GTSP in 1980 at concentrations from 7 to 20 mg/kg. Samples collected in 1984 found PCBs at concentrations up to 91,000 mg/kg on a low-lying area of the GTSP property (Figure 14), in a drainage ditch leading from the north part of KCIA (up to 8.9 mg/kg), and in adjacent areas of the airport and North Boeing Field (up to 223 mg/kg). Cleanup of the unpaved low-lying areas, some drains into the flume, and the flume was conducted in 1985. Subsequent sampling through 1991 continued to detect PCBs in the drainage and the flume.

Oil in the transformers at the former Ellis substation, located adjacent to the flume at S. Myrtle Street, contained PCBs at concentrations to 12.1 mg/kg. The substation was decomissioned and transformers removed in 1990. Additional information on environmental sampling and cleanup conducted during the 1980s and 1990s is provided in Appendix A.

In September 1999, the GTSP site was added to Ecology's list of confirmed and suspected sites. Ecology and Public Health-Seattle & King County conducted a site hazard assessment at GTSP in 2001. The site was assigned a Washington Ranking Method ranking of 5 out of 5 (lowest level of concern for risk to human health and the environment).

In 2001, the Bridgewater Group conducted a Phase II environmental assessment of the GTSP on behalf of Seattle City Light. Wipe samples were taken at multiple locations in the building beneath electrical equipment and beneath an oil pump. No PCBs were found except in one sample where they were detected at 1.1 µg/100 cm^2 (SEA 2004). Forty soil samples were collected from the property and analyzed for TPH-Dx, PCBs, PAHs, and heavy metals. All of the results for PCBs, PAHs, and metals were below the MTCA method A cleanup levels. One sample collected near an old oil tank contained diesel at 4,200 mg/kg and heavy oil at 2,200 mg/kg (cleanup levels are at 2,000 mg/kg).

During November 2005, Boeing collected soil samples from the gaps in the retaining wall along the fence line that runs northwest to southeast between the GTSP and NBF. The highest PCB concentration in these soil samples was 2,400 mg/kg (Boeing 2005g).

In January 2006, Seattle City Light collected additional soil samples from this same area. The data should be available by March 2006[5] (Goldberg 2006a).

Potential for Future Releases

Contaminated soil may be transported by stormwater to catch basins at NBF and discharged into Slip 4. There are currently no known uses of chemicals at the GTSP; therefore, the potential for spills from this area to reach the slip is small.

Available soil data indicate that PCBs are present in soil at the GTSP at concentrations greater than MTCA Method A industrial soil cleanup levels. The property is unpaved and during high rainfall events stormwater may flow into catch basins on North Boeing Field.

This property is a potential source of contaminants to the slip. The source of the PCBs in the upper part of the flume is being investigated.

3.4.2 North Boeing Field

North Boeing Field (NBF) is leased by Boeing from KCIA with the exception of a few acres on either side of the GTSP flume which is leased from the city of Seattle, and the 3-390 building and an adjacent parcel used for parking which are owned by Boeing. The 130-acre site is located between E. Marginal Way S. to the west and KCIA to the east (Figure 6). Ellis Avenue S. forms the northern border and the Federal Aviation Administration Tower marks the southern extent of the site. The head of Slip 4 is approximately 150 feet from the northwestern boundary of NBF.

The entire area within the NBF property boundaries is developed. Land use at the site includes office and industrial buildings, aircraft parking and related facilities. The remaining portion of the site is almost entirely paved. Automobile parking areas comprise approximately 36 acres, while flight line positions and taxiways comprise approximately 42 acres. Less than 1 percent of the site is pervious, including landscaped areas adjacent to some of the buildings.

Primary activities at the site include aircraft finishing and testing; research and development of Boeing military and commercial aircraft; and support services. Aircraft finishing activities involve wet sanding, cleaning, and painting of airplanes. Testing of airplane parts, both assembled and unassembled, occurs throughout the site.

Research and development groups at NBF have separate specialized testing operations. Support operations include metalworking, woodworking, and a wastewater treatment plant.

Current Site Drainage

Boeing has an Industrial General Stormwater Permit (#S03000226C) for NBF, which became effective September 2002. The latest revision of the NBF SWPPP is dated September 2001. The plan includes a facility description, potential pollutant source inventory, and BMPs. Under the permit, annual dry weather inspections are performed to identify unpermitted non-stormwater discharges, such as domestic wastewater, non-contact cooling water, or process wastewater. Quarterly discharge visual inspections and discharge monitoring are performed to look for evidence of pollution in the storm drain system, and to ensure that BMPs are being implemented.

[5] This Action Plan includes data current as of March 31, 2006. Section 8 describes how new data will be reported.

The stormwater for this facility is monitored as required under the permit for copper, hardness, lead, oil & grease, pH, turbidity, and zinc.

Drainage patterns at NBF are generally defined by the slopes of paved areas, building locations, and the storm drainage system. The storm drainage system consists of a network of catch basins, manholes, and pipes ranging from 8 inches to 48 inches in diameter. There are 23 drainage areas at this site. Nine of these cover approximately 41 acres that do not discharge to Slip 4. NBF drainage is shown on Figure 15.

Drainage from NBF is currently conveyed to Slip 4 via the KC Airport SD #3/PS44 EOF, which runs across NBF. Runoff from the offsite area upgradient of NBF (approximately 171 acres of KCIA) commingles with the runoff from NBF as the drain crosses NBF and is currently conveyed to Slip 4 via the KC Airport SD #3/PS44 EOF.

The offsite areas that discharge to the KC Airport SD #3/PS44 EOF upstream of NBF include the Air National Guard buildings, the King County Airport Maintenance Shop, and parts of KCIA located west, north, and northeast of the Seattle City Light building.

The airport area upgradient of NBF includes the north ends of the runways; a portion of northeastern King County International Airport; the hangars located adjacent to East Perimeter Road, and a KCIA fuel station. This portion of the KC Airport SD #3/PS44 EOF crosses NBF near stall A-6 on the flight line.

Drainage from approximately 190 feet of the north end of the 13R-13L runway, and the small airplane parking areas and hangars adjacent to the East Perimeter Road connect to the NBF storm drainage system near stall B-8 on the flight line.

About 750 feet of runway 13R-13L; 900 feet of runway I3L-31R; east taxiway areas and loading aprons; and the terminal, north annex, and administration buildings discharge into the NBF site storm drainage system stall B-11 on the flight line.

Potential Industrial Pollutant Sources

Activities occur at NBF in the seven industrial activities cited in the General Permit for inclusion in the SWPPP. All of these activities occur in one or more of the site drainage basins. These activities are indicated on the site maps in Appendix D of the SWPPP, which is currently being updated (Boeing 2001).

Loading and Unloading

Except for bulk liquid material, there are several authorized areas for the loading and unloading of both hazardous and non-hazardous new materials that are received from offsite. Spent hazardous and non-hazardous materials are shipped off site. Bulk liquid material is delivered by the vendor directly to the holding tanks. Most of these areas represent a potential source of pollutants as there are only a few covered and permanently contained loading and unloading areas. Few reported spills have occurred in these areas.

Outdoor Storage

There are 13 storage stations that contain hazardous or liquid chemical materials that could come into contact with stormwater at NBF. Outside material areas, other than aboveground or underground storage tanks, are roofed and are equipped with secondary containment. Tank storage areas comply with all regulatory requirements, including secondary containment and fail-safe controls.

The Central Dangerous Waste Accumulation Area (CDWAA) is located in Building 3-3 13 and is used for less than 90-day accumulation of dangerous waste from satellite areas within the plant. The CDWAA is roofed and the loading area is covered. Dangerous waste is segregated by waste type in separate dedicated accumulation cells. Floors in each cell are sloped to separate dead end sumps.

Container accumulation areas are roofed or have stormwater protection such as berms or plastic tarping. Hazardous material storage areas have secondary containment.

Airplane and fuselage sections are temporarily stored in the area adjacent to Building 3-369 (Paint Hangar). Transportation personnel and hazardous waste handlers are trained on proper handling procedures for packaging of hazardous materials and hazardous waste. Most non-bulk new material is stored indoors, either in the receiving areas, enclosed storage sheds, or in the using shops. Stockpile areas are covered with tarps or plastic.

Industrial activities such as engine component testing, aircraft painting, and research and development activities take place inside buildings or within contained areas.

All of the aboveground waste storage tanks are provided with secondary containment and are inspected daily. These tanks are equipped with overfill alarms (visual and/or audible), interstitial detection systems, and most are electrically connected to the site emergency monitoring and control system. The rest of the tanks (underground and aboveground) are inspected weekly. The adjacent storm drains either have emergency shut-off valves or drain covers. The potential pollution risks associated with these operations are posed by vendors that deliver products to or remove wastes from these tanks and do not follow the instructions posted at the tanks for drain coverage, or leave the tanker unattended during operations.

Outdoor Manufacturing Processes

Outdoor manufacturing processes consist of fueling and defueling aircraft, deicing at the wash stall (C-13), and performing engine preflight and avionics testing. Minor processes consist of cosmetic work such as touch-up painting, chemical cleaning, and interior work. Potential pollutants from the outdoor manufacturing processes that are susceptible to stormwater runoff are fats, oils, grease, and organics.

Onsite Treatment, Storage, and Disposal

NBF has a wastewater pretreatment system that is used to treat process wastewaters and other treatable hazardous waste. Stormwater drainage from the treatment plant, including the loading area, is processed through the treatment plant and discharged to the sanitary sewer.

Vehicle/Equipment Washing and Steam Cleaning

Aircraft deicing, and large vehicle and equipment washing occur at the C-13 Wash Stall. The wash stall discharges to the sanitary sewer unless it is determined that the water would fail the King County Department of Natural Resources discharge standards.

There is a protected wash area at the 3-354 Building, which is located adjacent to the automotive maintenance shop for vehicle and equipment steam cleaning. The wastewater pumped into Above Ground Tank ABF-160 is regularly shipped to an approved hazardous waste facility for proper disposal.

A fuel truck maintenance and washing area is located on a specially constructed concrete pad at the south side of Building 3-822. The water passes through an oil-water separator before discharging into the sanitary sewer.

Environmental Sampling/Cleanup

There have been numerous investigations and cleanups on the NBF property. Much of the work is the result of environmental investigations done prior to new construction or facility modification. The following is a list of reports filed with the Department of Ecology since the mid-1990s. Earlier reports are identified in Appendix A.

- Independent Soil Cleanup Action Report Proposed 3-333 Building Location (Seacor 1996)
- Remedial Action Report, Proposed West Wing 3-333 Building Fuel Test Laboratory (AGI 1998a)
- Site Investigation Oil/Water Separator UBF-55 (AGI 1998b)
- Sampling and Analysis Report, Concrete Joint Material (Landau 2001b)
- April 2001 Sampling Investigation Draft Report, Concrete Expansion Joint Material (Landau 2001c)

Building 3-333

Investigations conducted by Boeing in preparation for construction of Building 3-333 (fuel test laboratory), near the original location of the flume (Boeing 2006c), found PCBs in soil samples up to 5,100 mg/kg at 3.5 feet below ground surface (bgs) (Bridgewater Group 2000). In 1997, a supplemental investigation and cleanup were conducted as part of the construction of the west wing of Building 3-333. PCBs were detected at concentrations up to 1,600 mg/kg at a depth of 0.7 to 1.7 feet bgs. Later in 1997, Boeing excavated the soils to a depth of 5 feet bgs. During soil removal, a broken section of 8-inch ductile iron pipe was discovered and found to contain a black oily substance that contained 25,300 mg/kg PCBs (AGI 1998a, Bridgewater Group 2000). Remedial actions taken to facilitate construction of the building included soil removal and confirmation sampling. AGI Technologies reported that PCBs and TPH were below MTCA Method A cleanup levels on three sides of the building; however, elevated levels remained on the east side of the building (AGI 1998a). These areas were reported to be isolated and no further action was taken (SEA 2004, AGI 1998a). TPHs were found in samples as diesel and gasoline at concentrations of 7,600 and 7,800 mg/kg respectively (Bridgewater Group 2000).

Oil/Water Separator UBF-55

In 1997, AGI Technologies conducted a site investigation for the oil/water separator designated as UBF-55 (Figure 16). This oil/water separator was located in the northwest portion of North Boeing Field on property that Boeing leases from King County. The area is bounded to the north by the Georgetown Steam Plant and a gas meter, to the west by the air-gas dryer area, and to the southeast by the 3-326 Building.

The oil/water separator was installed in 1976 and was constructed of steel with a 5,000-gallon capacity. An adjacent 3,000-gallon fuel oil underground storage tank (UBF-22) was removed in May 1986. Analytical results of soil samples collected during verification sampling of the UBF-22 indicated the presence of PCBs at concentrations above cleanup levels (up to 1000 mg/kg).

Maximum TPH (gasoline, diesel, and motor oil range) concentrations were detected in samples collected from the lower sampling intervals (4.1–7.1 feet bgs) of two borings. Maximum gasoline, diesel, and motor oil concentrations detected were 150, 1,900, and 550 mg/kg, respectively. Of the 18 lower interval samples, five exceeded 1997 cleanup levels. One sample contained gasoline-range petroleum hydrocarbons at a concentration above the current MTCA Method A soil cleanup level (AGI 1998b).

Maximum PCB concentrations were detected in samples collected from north and south of the oil/water separator. Analytical results indicate maximum PCB concentrations in soil collected from the upper and lower sampling intervals were 260 and 1,540 mg/kg, respectively. Of the 18 lower interval samples analyzed, six exceeded cleanup levels. Two of the four upper interval samples analyzed exceeded cleanup levels. No operational source for this PCB contamination has been identified; it may be the result of a historical release. Upon completion of sample collection activities, sampling locations were backfilled with bentonite chips and sealed at the surface with concrete patch (AGI 1998b).

Joint Caulk Removal

In a survey of concrete joint caulk conducted in 2001, Boeing identified 57,900 linear feet of primary caulk, or residual caulking material from prior removals, that contained PCBs. In a report summarizing joint caulk removal for 2005, Boeing estimated that the total project involved the removal of approximately 89,000 linear feet of joint material. Boeing has been removing caulk containing PCBs from the North Field area that drains to Slip 4 under EPA oversight since 2002 (Boeing 2005a, c). Caulk that was removed had concentrations of PCBs up to 79,000 mg/kg. There is approximately 1,400 linear feet of residual joint sealant material left to be removed at NBF, most of which is located between Stall C-3 and Stall C-4. Removal of this remaining material is scheduled to be completed by the summer of 2006 (Boeing 2005h).

2005/2006 Storm Drain Solids Sampling

Boeing has conducted extensive sampling of solids from storm drain structures including catch basins, manhole access locations, and oil/water separators throughout the Boeing-leased property. During May and June 2005, 13 of these storm drain structures were sampled for PCBs. Twelve of these structures were identified for sampling due to elevated PCB detections discovered during prior sampling events. Sample results for the 12 structures from July and August 1991 to August 2000 had PCB detections ranging from 17 to 342 mg/kg (Boeing 2005d). Results from May and June 2005 ranged from 3.5 to 50 mg/kg DW (Landau 2005).

During September 2005 through November 2005, Boeing conducted an investigation to determine the source of PCBs in the north storm drain line where PCBs were detected in the sediment at 24 mg/kg DW. Samples were obtained from nine catch basins and PCBs were detected from 0.07 mg/kg to 1,310 mg/kg DW (Boeing 2005e).

In order to determine whether infiltration of PCB-contaminated soil to storm drains from breaks or gaps in the piping system is occurring in the vicinity of CB 173 (the catch basin with 1,310 mg/kg DW PCB), Boeing removed accumulated sediment from the lines leading to this catch basin and conducted a video inspection. The system appeared to be in good condition with no visual gaps or breaks in the piping. The line was last cleaned in 1992 (Boeing 2005g).

In November 2005, Boeing collected soil samples from the gaps in the concrete retaining wall that parallels the storm drain line and the fence line between the GTSP and NBF. Concentrations were highest in the six samples collected along the southeast end of the property (5.1 to 2,400 mg/kg DW). PCB concentrations in the soil samples collected just south of the Steam Plant building were generally below 1 mg/kg DW. PCBs in these soils were predominantly Aroclor 1254. Boeing believes that this soil may be the source of the elevated PCBs in the NBF north end storm drain line (Boeing 2005g).

Catch basin filters were installed on two catch basins along the storm drain line bordering the GTSP and NBF properties to limit potential soil infiltration into the catch basins during rainfall events. During March 2006, samples of the filter material were analyzed and found to contain 14 mg/kg and 5.5 mg/kg of PCBs. CB173 was re-sampled and PCBs were detected at 110 mg/kg. Boeing is conducting additional sampling and investigation work at CB173 to further evaluate PCBs at this location.

During May 2006, Seattle City Light is planning to conduct an interim measure at the GTSP and NBF fence line area to prevent PCB-contaminated soil from entering NBF storm drains.

Potential for Future Releases to Slip 4

Spills at North Boeing Field may enter the storm drain system and be discharged to the slip. However, activities that could potentially cause spills are controlled by the facility industrial stormwater permit and SWPPP.

Available soil and groundwater data from North Boeing Field indicate that PCBs are present in soil at concentrations above the MTCA Method A industrial cleanup level. However, the facility is almost entirely paved, making transport of subsurface contaminated soil into the storm drain system unlikely, except in the northeast corner where contaminated soil from the GTSP may be entering catch basins at North Boeing Field. Seattle City Light collected additional soil samples from this area in late January 2006 (Goldberg 2006a).

PCBs are also present in residual joint sealant material in one area of the facility. This residual material is planned for removal in 2006.

Boeing conducts regular sweeping of the flight line at North Boeing Field. Water is separated from the solid material, then treated and discharged in accordance with an industrial wastewater permit from King County Department of Natural Resources and Parks (DNRP). The solids are placed in roll-off containers and this material is sampled for waste characterization purposes.

PCBs were detected in the sample collected in December 2005 at a concentration of 2.5 mg/kg (Boeing 2006d).

Storm drain sediment traps and catch basin samples indicate the presence of PCBs in the storm drain system. Storm drains at the property are a likely future source of PCBs to the slip unless the origin of PCBs in the storm drains is identified and controlled.

3.4.3 King County International Airport

King County International Airport (KCIA) is a general aviation airport owned and operated by King County as a public utility. The site covers about 615 acres, of which 435 acres are impervious surface covered by buildings and paved areas. The remaining 180 acres consist of grass and landscape areas (King County 2003).

Current Site Drainage

There are about 15 miles of pipe in the airport storm drainage system. All stormwater discharges into the Duwamish Waterway. There are two pumping stations, which lift the water and pump it out at two outfalls. The north pump station discharges to Slip 4. The southern pump station drains the central portion of the airport through a 48-inch pipe that runs under Boeing property and discharges to the Duwamish Waterway at river mile 3.8. There are two gravity lines that drain the south end of the airport. One discharges into Slip 6 and the other discharges into the storm drain portion of the Norfolk CSO/SD located at river mile 4.9. Between one and two acres of the north airport drainage are connected to the I-5 Storm Drain (King County 2003).

Approximately 171 acres of King County International Airport discharge to Slip 4 via KC Airport SD#3/PS44 EOF. This drainage includes portions of the Air National Guard facility, the KCIA maintenance shop, areas at the northern end of the airport including parts of the runways and taxiways; a KCIA fuel station, the small airplane parking areas and hangars adjacent to the East Perimeter Road, the terminal, north annex, and administration buildings (King County 2003).

The airport has an NPDES Industrial Stormwater Permit (SO 3000343D), effective September 20, 2002 and expiring on September 20, 2007. The airport has a SWPPP, which addresses the airport maintenance facilities and the paved areas (runways and taxiways). Other businesses at the airport are covered under individual permits. The areas draining to Slip 4 are shown in Figure 5.

The airport maintenance shop is located at the northwest corner of the airport. A portion of this area drains into the I-5 storm drain after passing through an oil/water separator. The remainder of the site drains to the northwest pump house and is discharged to Slip 4. Each oil/water separator is inspected weekly (King County 2003).

Sampling for the maintenance shop facility is performed quarterly. The sampling location represents the maintenance facility and includes the runoff from the bulk storage and equipment storage areas (King County 2003).

Almost all of the stormwater runoff generated on the airport (excluding the Boeing leased area) is treated in gravity oil/water separators. Two of the separators also contain two coalescing plate oil separators. In addition, in the more recent site development, the airport has installed advanced treatment systems including vortex treatment and a storm filter system utilizing compost filtration canisters. Each oil/water separator is inspected weekly (King County 2003).

Potential Industrial Pollutant Sources

Airport Maintenance Shop

The activities at the airport maintenance shop include: storage and handling of various maintenance-related materials; fuel storage and vehicle fueling; vehicle and equipment maintenance; and repair and storage of vehicles and equipment.

Most vehicle and equipment maintenance and repair work is performed inside the auto shop. However, some of the larger equipment is occasionally worked on outdoors.

The two 1,000-gallon aboveground fuel storage tanks (unleaded gasoline and diesel) are uncovered. The tanks have a 7-gallon overfill containment feature for spill protection during filling. The tanks are double lined with a monitoring tube to detect if the primary tank has leaked.

All liquid wastes are stored in a covered and contained area. Any spills associated with fueling would be contained according to the airport's spill procedures.

Deicing Activities

Deicing and anti-icing are performed on aircraft to minimize the ice buildup on the wings and plane body during cold weather conditions. A limited amount of deicing materials is used at the airport. Several tenants perform limited aircraft deicing. The airport has constructed dedicated areas for aircraft deicing. The runoff from these areas is diverted to the sanitary sewer system and is conveyed to the local municipal treatment facilities. All tenants are required to deice aircraft in the specified locations to prevent deicing fluids from entering the airport's stormwater system.

The airport's principal runway and Alpha Taxiway are occasionally deiced with potassium acetate during snow and ice events. A maximum of 81 acres may be deiced.

Airport Tenants

The activities of airport tenants include fuel storage and maintenance of aircraft, vehicles, and equipment, and repair and storage of vehicles and equipment. Most vehicle and equipment maintenance and repair work is performed inside hangars, however some is performed outside.

Beginning in June 2004, 28 airport tenants (not including Boeing facilities) were screened as potential sources of contamination by SPU (Table 8). SPU found the operations at eight facilities were not potential sources of contaminants. The remaining 20 were inspected for compliance with stormwater, industrial waste, and hazardous waste handling requirements. As of December 2005, all but three of the facilities were in compliance. SPU is continuing to work to bring these facilities into compliance (SPU and King County 2004, 2005a, 2005b).

Galvin Flying Service is the only airport tenant in the Slip 4 drainage with an NPDES industrial stormwater permit (SO3000607D), effective September 20, 2002 and expiring on September 20,

2007. The facility has a SWPPP. Galvin Flying Service was inspected in 2004 and is currently in compliance.

Past Use

The airport is the site of the homes of the original settlers who arrived in King County. In the early 1900s, the winding course of the Duwamish River, which ran through much of the airport property, was straightened and filled.

Construction of the airport began in 1928. The airport served as the community's aviation center until December 6, 1941, when the U.S. Army took over the airport for strategic and production reasons. The airport remained under military jurisdiction through the end of World War II.

In the late 1940s, the airport was reopened for passenger and other commercial traffic. Usage evolved to general aviation, serving industrial, business, and recreational purposes with the opening of Sea-Tac International Airport in 1947 (Global Security 2006).

Environmental Sampling/Cleanup

The airport has been cleaning out accumulated solids from each catch basin on the airport semi-annually. Each oil/water separator is cleaned annually, or more frequently if there are any accumulations noted during the weekly inspections.

KCIA video-inspected the majority of the airport's stormwater drainage system in 2001. The intent was to inventory the conditions of the system and to identify illicit sanitary connections to the stormwater drainage system. One sink discharge was identified and was subsequently diverted to the sanitary sewer system (King County 2006a).

Two contaminated site cleanups have been conducted within the area of the airport that drains to Slip 4: American Avionics (located at 7023 Perimeter Rd. S.) and King County Airport Maintenance (located at 6518 Ellis Ave. S.).

All of the tenants at the King County International Airport with operations that pose a threat of a release to Slip 4 have been inspected. SPU is working to bring the last three of 20 facilities into compliance (Table 8).

Potential for Future Releases to Slip 4

Spills at KCIA may enter the storm drain system and be discharged to the slip. Activities that could potentially cause spills are controlled by the facility industrial stormwater permit and SWPPP. As of 2005, 25 of 28 airport tenants were in compliance with stormwater, industrial waste, and hazardous waste handling requirements. Efforts to bring the remaining three facilities into compliance are ongoing.

Available data indicate that PCB concentrations are elevated in storm drains discharging to Slip 4 from KCIA. Sampling of the King County International Airport storm drain system has been limited; further investigation is needed to determine whether catch basin cleaning and/or pressure washing of the drainage system are needed to control PCBs to Slip 4. In addition, investigation is needed to determine whether PCBs are present in joint sealant material at KCIA.

3.4.4 Other Upland Sites

Potential upland contaminant sources include: Marine Vacuum Service, North Coast Chemical Company, Aviation Fuel Storage/Schultz Distributing, American Avionics/King County Airport, Arco Station #5218, and King County Airport Maintenance. The files for these sites will be reviewed to determine whether there are any chemicals of concern present and if the sites are a historic or potential source of sediment contamination or recontamination. Target chemicals include PCBs, phthalates, and other chemicals that may partition into or affect the sediments.

At several sites, source control effectiveness has been assessed and controlled (Table 9). These facilities include Boeing Electronic Manufacturing, Puget Sound Energy, and the Washington Air National Guard.

The Washington Air National Guard site, which is adjacent to the Georgetown Flume, is a formerly contaminated site that has recently completed cleanup (Ecology 2005b). Activities at the site (including motor vehicle maintenance, paint storage, and equipment storage) generate waste oils, cleaning solvents, paint wastes, and thinners. In recent years, hazardous wastes have typically been collected and disposed of by a contractor or through the Defense Reutilization and Marketing Office at Fort Lewis, Washington. Drainage from the north portion of the site enters North Boeing Field near the 3-325 building through a 24-inch line. Drainage in the southern portion of the site discharges to the I-5 storm drain. A Phase II RI conducted in 1998 and 1999 detected trichloroethylene (TCE), tetrachloroethene (PCE), and benzene in shallow groundwater at concentrations above cleanup standards (ERM 1999). The RI suggested that groundwater contamination was likely caused by minor releases or incidental spills of TCE during historical station operations. The contaminated groundwater was treated, and based on the results of post-treatment monitoring, Ecology issued a "no further action" determination on October 18, 2005 (Ecology 2005b). Currently, the ground surface at the Air National Guard site is covered by buildings and pavement, with the exception of landscaped planters around the perimeter. Additional information on past use and environmental sampling at this site is presented in Appendix A.

4.0 Source Control Actions Specific to Slip 4

This section describes source control actions that will be taken to reduce the potential for recontamination of Slip 4 sediments from ongoing sources. Potential ongoing sources of sediment recontamination include: North Boeing Field, King County International Airport, the I-5 Storm Drain outfall, the Georgetown Steam Plant and flume, and storm drains on properties adjacent to Slip 4. Table 9 identifies sites where source control effectiveness has previously been assessed and controlled.

The following sections briefly summarize the available information about chemicals from these drainage systems that discharge to Slip 4. The summary focuses on the chemicals of greatest concern for sediment recontamination at Slip 4, namely PCBs and BEHP. As shown below and based on data in Tables 1 through 7, these two chemicals are also commonly found in the sediment samples collected from the drainage systems that discharge to Slip 4.

PCBs in Source Sediment Samples

	PCBs (mg/kg DW)	PCBs (mg/kg OC)	Exceedance Frequency (percent)			
			MTCA Method A (soil - unrestricted use)	MTCA Method A (industrial soil)	CSL (sediment)	n
Sediment traps[a]	0.038 – 24	8.4 – 246	50	20	67	10
Catch basins[b]	0.066 – 1,310	NA	91	67	NA	33
In line sediment[c]	0.31 – 31	7 – 2,793	75	12	62	8
Georgetown flume[d]	0.038 – 92	5 – 1,746	33	8	17	12
Catch basin and other sediment[e]	<0.02 – 0.3	<0.4 – 4.7	0	0	0	4

MTCA Method A soil cleanup level for unrestricted use: 1 mg/kg DW
MTCA Method A soil cleanup level for industrial use: 10 mg/kg DW
CSL (cleanup screening level): 65 mg/kg OC
n = number of samples
NA = not applicable

a. Traps installed by SPU in KC Airport SD #3/PS44 EOF and I-5 SD (Tables 1 and 2)
b. Catch basins sampled on North Boeing Field by Boeing in 2005 (Table 7)
c. Inline sediment samples (4 splits) collected in the KC Airport SD #3/PS 44 EOF by SPU in 2005 (Tables 3 and 4)
d. Sediment samples from flume and 2 samples from pipe/ditch that discharge to flume (Tables 3 and 4)
e. Catch basin and/or ditch samples from properties immediately adjacent to Slip 4 (Tables 5 and 6)

BEHP in Source Sediment Samples

	BEHP (mg/kg DW)	BEHP (mg/kg OC)	Exceedance Frequency (percent)		n
			SQS	CSL	
Sediment traps[a]	1.8– 6	49– 189	100	33	3
Catch basins[b]	NA	NA	NA	NA	NA
In line sediment[c]	0.18– 2.2	24– 76	50	0	8
Georgetown flume[d]	0.12– 3.8	2– 75	25	0	12
Catch basin and other sediment[e]	1.6– 120	3.4– 1,400	80	60	4

SQS (sediment quality standards): 47 mg/kg OC
CSL (cleanup screening level): 78 mg/kg OC
n = number of samples
NA = not applicable

a. Traps installed by SPU in KC Airport SD #3/PS44 EOF and I-5 SD (Tables 1 and 2)
b. Catch basins sampled on North Boeing Field by Boeing in 2005 (Table 7)
c. Inline sediment samples (4 splits) collected in the KC Airport SD #3/PS 44 EOF by SPU in 2005 (Tables 3 and 4)
d. Sediment samples from flume and 2 samples from pipe/ditch that discharge to flume (Tables 3 and 4)
e. Catch basin and/or ditch samples from properties immediately adjacent to Slip 4 (Tables 5 and 6)

4.1 North Boeing Field and King County International Airport

Sediment samples collected by Boeing, the city of Seattle, and King County (inline sediment traps, catch basin sediment, and sediment collected from maintenance holes on the storm drain system) indicate that PCB concentrations are elevated in many of the storm drains discharging to Slip 4 from North Boeing Field and KCIA.

The Boeing Company has been investigating potential sources of PCBs around North Boeing Field (Boeing 2005e) and has identified concrete joint material (caulk) present in the pavement on NBF as one potential source of PCBs in the catch basin sediments (Landau 2001a). Samples of caulk material contain <1 to 79,000 mg/kg DW PCBs. The highest concentrations of PCBs are generally found in three types of caulk (Type A, G, and H).

In addition, Boeing found elevated concentrations of PCBs (0.049 to 2,400 mg/kg DW) in soil samples collected along the west edge of the Georgetown Steam Plant property. This area may drain to the Slip 4 SD during high intensity storm events.

BEHP concentrations in the Slip 4 inline sediment samples (180 to 2,200 µg/kg DW) and sediment traps (1,800 to 6,000 µg/kg DW) were relatively low compared to other source sediment samples collected in the Lower Duwamish Waterway (<20 to 26,000 µg/kg DW). However, 50 percent of the inline samples and 100 percent of the sediment trap samples that contained sufficient sample volume to analyze TOC content to allow comparisons with the SMS, exceeded the SQS. Only one sediment trap sample exceeded the CSL.

4.1.1 Storm Drains

Residual sediment in storm drain structures (e.g., catch basins, inlets, maintenance holes, and other associated structures, like oil/water separators) as well as the sediment that has accumulated in the storm drain pipes that contain elevated concentrations of PCBs should be removed to prevent these materials from reaching Slip 4. Based on available data, several of the storm drain catch basins and manholes on North Boeing Field are contaminated with PCBs. However, it is unclear whether the contaminated sediments extend beyond the structures and into the pipes. Further evaluation is needed to determine whether the entire line needs to be pressure washed or whether simple cleaning of the associated structures will be adequate to control PCBs in these systems.

The storm drains serving KCIA generally contain lower concentrations of PCBs (0.038 to 0.45 mg/kg DW in sediment traps and 0.31 to 5.6 mg/kg DW in the inline samples) than the concentrations found on North Boeing Field (0.84 to 24 mg/kg DW in sediment traps and 1.8 to 31 mg/kg DW in the inline samples). However, sampling of the KCIA system has been limited. Further investigation is needed to determine whether catch basin cleaning and pressure washing of the drainage system are needed to control PCBs to Slip 4.

4.1.2 Caulk Removal

Boeing has been working to remove PCB-contaminated joint material from the paved areas on North Boeing Field. As of 2005, approximately 80,000 linear feet of caulk material has been removed (Boeing 2006b). An estimated 1,400 linear feet of caulk is scheduled to be removed in 2006.

Further investigation is needed to determine whether other areas at KCIA contain PCB-contaminated caulk that could reach Slip 4 via nearby storm drains.

4.1.3 Source Control Actions

The following source control actions are currently underway or will be conducted:

- SPU installed in-line sediment traps across North Boeing Field and the surrounding area in March 2005. Data collected in August 2005 show PCBs in sediment samples collected from the Georgetown Flume, I-5/residential area, and King County International Airport and Boeing-leased properties at the airport.
- SPU, Ecology, EPA, King County, and Boeing are currently evaluating available data and collecting additional data to identify possible source areas or activities for source control.
- Boeing will remove the remaining 1,400 linear feet of PCB-containing caulk material from runways, under EPA Toxic Substances Control Act (TSCA) supervision (end of 2006).
- Ecology’s TCP, Waste and Water programs and King County/Hazardous Waste inspected North Boeing Field in November/December 2005; reports are pending (May 2006).

- Ecology will conduct a comprehensive data analysis of the North Boeing Field property (April – August 2006).
- Ecology will require Boeing to revise the SWPPP to address PCBs in the storm drain system and may conduct additional inspections of the NBF facility (late 2006).
- Data from in-line sediment traps that have been re-installed for the 2005/2006 winter wet season will be available in May 2006; SPU will distribute and evaluate these data.
- SPU, Boeing, and KCIA will complete source tracing (late 2006).
- KCIA will review catch basin and sediment trap data collected by SPU and identify lines that are satisfactory and those where additional source tracing is needed before cleanout. Where additional source tracing is needed, KCIA will work to identify and correct continuing sources (end 2006 through 2007). King County is currently exploring options for funding this work.
- After existing data and sources have been evaluated, Ecology will work with King County, Boeing, and the City to clean drain lines and contaminated structures as needed (fall 2006 or 2007).
- Boeing and SPU will resample sediment traps to evaluate source control effectiveness (2008).
- Ecology and EPA will evaluate NBF's NPDES permits with respect to Slip 4 sediment impacts (2007).
- SPU will conduct soil removal actions and/or implement containment measures at the area between the NBF and GTSP fence line to prevent soil from entering NBF storm drain systems (second quarter 2006).

4.2 I-5 Storm Drain and Residential Drainage

PCB (7.8 mg/kg DW, 246 mg/kg OC) and BEHP (6 mg/kg DW, 189 mg/kg OC) concentrations in the one sediment trap sample collected to date in the I-5 storm drain exceeded the CSL. The following source control actions are currently underway or will be conducted:

- SPU will complete source tracing (including inspections and catch basin sampling) in the small commercial/industrial business strip along I-5 to determine if there are any obvious sources; Washington State Department of Transportation (WSDOT) will be involved as necessary (2006).
- SPU and WSDOT will clean lines and structures of contamination (2007).
- SPU and WSDOT will resample drain lines and structures of contamination for effectiveness of source control actions (2007–2008).

Ecology will review for completeness and source control adequacy.

4.3 Georgetown Flume

PCB concentrations exceed the SMS at multiple locations along the flume, ranging from 0.038 to 92 mg/kg DW. Concentrations are generally higher at the upper end of the flume (0.78 to 92 mg/kg DW above S. Willow Street) compared to the downstream end (0.065-0.4 mg/kg DW). The highest concentration (92 mg/kg DW/1,746 mg/kg OC) was measured in the flume adjacent to the 15-inch storm drain (P3) that drained part of the NBF and entered just downstream of the GTSP tunnel section. This storm drain is now plugged.

PCB-contaminated sediment found by the City in the upper end of the flume in 2005 needs to be removed. In 2006, the City will evaluate options for removing PCB-contaminated sediment and closing the flume.

The following source control actions are currently underway or will be conducted:

- SPU and Boeing will investigate a possible drain connection from North Boeing Field to the flume (see Georgetown Steam Plant below) (November 2005 – March 2006).
- City of Seattle will remove contaminated sediments (2007).
- SPU and/or Seattle City Light will evaluate the future use and potential modification or closure of the flume (2007).

Ecology will review for completeness and source control adequacy.

4.4 Georgetown Steam Plant

Historically, the drainage pathway from the Georgetown Steam Plant property to Slip 4 was the Georgetown Flume. Recent data indicate that an area along the west fenceline with NBF (soils contained behind ecology blocks) may be a source of PCBs to both the Flume and storm drain lines on NBF.

Additional investigation is needed to determine the source of the PCBs that were found in the soil/sediment samples collected adjacent to the west property line at the Steam Plant by Boeing in November 2005. City Light collected additional soil samples in January 2006 to test for the presence of PCBs in soil on the Steam Plant property. Depending on the results, further sampling and cleanup may be necessary.

The following source control actions are currently underway or will be conducted:

- Seattle City Light will complete the soil investigation of the area adjacent to the west property line at the Steam Plant and conduct a cleanup, if needed (2006).
- Seattle City Light, Ecology, and EPA will revisit past site determinations relative to ongoing sediment contamination and SPU decisions regarding the flume (2007).

4.5 Storm Drains on Properties Adjacent to Slip 4

None of the five samples collected from the drainage systems located on properties adjacent to Slip 4 that drain directly to the slip contain elevated concentrations (<0.02 to 0.62 mg/kg DW) of PCBs. However, all three of the drainage structures sampled on the First South property exceed the CSL for BEHP (177 to 1,869 mg/kg OC, 5,500 to 120,000 µg/kg DW). Di-n-octylphthalate (4,000 µg/kg DW, 62 mg/kg OC) also exceeded the SQS in the oil/water separator at the southwest corner of the property (which drains to Slip 4). The catch basin located on the southeast corner of the property, which drains to the combined sewer on E. Marginal Way S., contained elevated concentrations of butylbenzylphthalate (1,800 µg/kg DW, 67 mg/kg OC), dimethylphthalate (1,900 µg/kg DW, 71 mg/kg OC), and di-n-octylphthalate (1,800 µg/kg DW, 67 mg/kg OC).

Residual sediment in storm drain structures (e.g., catch basins, inlets, maintenance holes, and other associated structures, like oil/water separators) as well as the sediment that has accumulated in the storm drain pipes that contain elevated concentrations of phthalates should be removed to prevent these materials from reaching Slip 4.

4.5.1 Crowley Marine (Parcels D & F)

Historic spills or contamination on this property may be a source of contaminants to Slip 4. Historic sources indicate a wood treating operation, pipe dipping, log storage, and aluminum window manufacture were conducted at this site. Portions of the site were unpaved for much of its history, with large equipment use, and soil and groundwater contamination associated with USTs at the site. The current tenant, Alaska Logistics, transfers containers for shipment to/from Alaska and was subject to joint Ecology/SPU inspections during 2005; during this site visit, outfalls and drainage destination were identified. The following source control actions are currently underway or will be conducted:

- Ecology will compile and evaluate historic groundwater quality data (2006).
- Ecology will identify data gaps for recontamination potential associated with soil and groundwater (2006).
- Ecology will determine how to fill the data gaps identified above (late 2006).
- Ecology will collect effluent/runoff and in-line solids to assess recontamination potential from any ongoing sources (2006–2007).
- Ecology will conduct additional sampling and evaluation as necessary (2007).
- Ecology and EPA will evaluate NPDES permits with respect to Slip 4 sediment impacts (2007).

4.5.2 First South Properties (Parcel E)

Past tenants at this site have included Cedar Grove Composting, Evergreen Marine Leasing, an asphalt plant, and lumber/log industries. See Appendix A for history of this parcel.

Ecology and SPU conducted joint inspections at Emerald Services throughout 2005 and early 2006 and found potential stormwater issues for source control. Ecology conducted an upland soil investigation in the vicinity of a drainage swale at the top of the bank adjacent to Slip 4, near the old asphalt plant, and determined that this was not a potential recontamination source for PCBs.

Elevated concentrations of phthalates (BEHP, butylbenzylphthalate, di-n-octylphthalate, and dimethylphthalate) have been found in sediment samples collected from catch basins and other drainage structures on the Emerald Services site. Phthalates appear to be unique to the Emerald Services site, since other drains in the Slip 4 area generally contain lower concentrations of phthalates. Further investigation is needed to determine whether phthalates are associated with specific products used by Emerald Services and how they can be controlled.

The following source control actions are currently underway or will be conducted:

- Ecology will compile and evaluate historic groundwater quality data (2006).
- Ecology will identify data gaps for recontamination potential associated with soil and groundwater (2006).
- Ecology will reevaluate past no further action (NFA) determinations for sediment protection (2006).
- Ecology will reassess the drainage swale for erosion and recontamination potential for phthalates and will work with the City during the design process for dredging and capping of the bank area (2006).
- Ecology will determine how to fill the data gaps identified above (late 2006).
- Ecology will conduct necessary sampling and evaluate the data (2007).
- Ecology will collect effluent/runoff and in-line solids to verify the conclusions of the 2005/2006 inspections and to assess the recontamination potential from any ongoing source (2006/2007).
- Ecology and EPA will evaluate NPDES permits with respect to Slip 4 sediment impacts (2007).

4.6 Boeing Plant 2

The upland history of the 17 acres of Plant 2 draining to Slip 4 is summarized in Appendix A. Data gaps relevant to sediment recontamination include groundwater data/information, and effluent data from two outfalls to outer Slip 4. The following source control actions are currently underway or will be conducted:

- EPA and Ecology will assess existing groundwater data in the area, and determine whether additional groundwater monitoring is required to address recontamination concerns (2006–2007).
- Ecology and EPA will evaluate NPDES permits with respect to Slip 4 sediment impacts (2007).
- Ecology will conduct an inspection of the Boeing property (2006).
- Boeing will inspect and sample the onsite storm drain system, and clean as necessary (2006).

4.7 NPDES Stormwater Permits

Ecology and EPA will review NPDES permit conditions for stormwater discharges to Slip with respect to the contaminants of concern found in sediments. This will include municipal and industrial permits. The following permittees and facilities will be affected: Boeing (NBF), Boeing Plant 2, Emerald Services, Alaska Logistics, King County International Airport, WSDOT, and SPU. Reviews will be completed by 2007.

4.8 In-Water Spills

U.S. Coast Guard records were reviewed and show no apparent spills in, or in the vicinity of, Slip 4 from 1992 to 2003. The Coast Guard's responsibility for spill response ends at the First Avenue South Bridge. Ecology and EPA are responsible for spill response south of the bridge, including Slip 4. Ecology's Environmental Report Tracking System (ERTS) Database will be checked quarterly for any pertinent information.

4.9 Business Inspections

SPU and King County Industrial Waste are leading the joint King County/Seattle business inspection program in the LDW. Inspections are conducted under existing code authorities. Since June 2004, a total of 55 businesses (all of the airport tenants and waterfront facilities, except Boeing-owned or leased facilities) have been inspected in the Slip 4 drainage basin (46 full inspections and nine screening inspections). Boeing facilities were inspected in December 2005 by Ecology rather than the city of Seattle and King County.

Of the 46 sites receiving full inspections, 35 (64 percent) required some type of corrective action. Most of the problems found in the Slip 4 drainage were related to spill prevention and cleanup (e.g., lack of proper spill prevention and cleanup plans or inadequate employee training in spill prevention and cleanup practices). Other common problems included lack of adequate spill control materials on site and need for cleaning of onsite drainage facilities. Inspectors requested a total of 103 corrective actions in the Slip 4 basin.

As of December 2005, 88 percent of the sites that were requested to make corrective actions have completed the required changes (SPU and King County 2005b). Inspectors are working with the three remaining facilities to obtain compliance.

Business inspections in the Slip 4 drainage will be repeated as needed to evaluate pollution prevention practices and source control.

4.10 Upland Spills

Upland spills will be monitored as needed on an ongoing basis by King County, Ecology, SPU, and EPA. Depending on the nature of the spill, the origin of the spill will be identified and cleanup activities to determine appropriate post-spill source control activities that may be required will be evaluated.

4.11 Other Source Control Activities

Phthalates, particularly bis(2-ethylhexyl)phthalate (BEHP), are contaminants of concern in the Lower Duwamish Waterway. Phthalates are a class of industrial compounds commonly used as softeners in plastics, as solvents, as oil in vacuum pumps and electric capacitors, and as carriers for fragrances and pesticides. They are also often used in personal care products. These contaminants are not only found in waterway sediments, but also in stormwater and catch basin samples, and in the sanitary sewers.

In 2003, King County and SPU joined the City of Tacoma in testing various materials and commonly used products to help identify controllable sources of phthalates. To date, the materials tested include brake pads and automotive belts, tires, packing peanuts, cigarette butts, soaps, sealants, detergents, and common household products. Atmospheric sampling in Duwamish sub-basins was recently added to the local study based on a literature review and dust samples from the Tacoma Dome roof, which indicate that atmospheric deposition may also be a source of phthalates. The municipalities will continue to investigate phthalates and possible sources to better understand phthalate loading to the waterway sediments, and possible methods of controlling those loads.

5.0 Monitoring

Monitoring efforts by SPU, Boeing, and King County are intended to assist in identifying and tracing ongoing sources of the chemicals of concern present in the waterway sediments. This information is being used to focus source control efforts on specific problem areas within the Slip 4 drainage basin and to track the progress of the source control program. The following types of samples will continue to be collected:

- In-line sediment trap samples from the storm drain systems
- Onsite catch basin sediment samples
- Soil and groundwater sampling as necessary

If monitoring data indicate that additional sources of sediment recontamination are present, then Ecology will identify additional source control activities as appropriate.

Because source control is an iterative process, monitoring is necessary to identify trends in concentrations of contaminants of concern. In-water sediment monitoring is anticipated to continue for some years. Any decisions to discontinue monitoring will be made jointly by Ecology and EPA, based on the weight of evidence.

6.0 Tracking and Reporting of Source Control Activities

Ecology is the lead agency for tracking, documenting, and reporting the status of source control to EPA. The agency performing the source control work will document their activities and provide reports to Ecology. Ecology will prepare waterway-wide and basin-specific reports for EPA and the public. Please refer to the Lower Duwamish Source Control Strategy for further details (Ecology 2004).

Ecology is developing a database for tracking known or potential sources of recontamination. The database will be used to track all sources identified in this Action Plan as well as past and future source control action plans. Ecology will use the database to prepare semi-annual reports documenting source control actions. Ecology will submit the reports to EPA; the first report will be prepared in September 2006.

Ecology will add all new sources of contamination not covered by this Action Plan to the database. The status of actions in this plan and any new sources will be discussed in the semi-annual reports. Ecology will not publish a revised Slip 4 Source Control Action Plan.

Ecology will submit a Technical Memorandum to EPA in September 2006. The memorandum will summarize the status of the source control actions listed in Tables ES-1 and ES-2 and any new sources identified. The memorandum will describe any issues that may adversely affect source control for the Slip 4 sediment cleanup.

Ecology will submit a Technical Memorandum to EPA in January 2007. The memorandum will summarize the status of the source control actions listed in Tables ES-1 and ES-2 and any new sources identified. This memorandum will include a recommendation on whether sources are controlled adequately to allow construction of the Slip 4 removal action with minimal potential for recontamination of Slip 4 sediments. The memorandum may include a discussion of the uncertainties associated with the recommendation and may identify requirements for ongoing monitoring or control as appropriate. EPA will review and concur with this recommendation before implementation of the Slip 4 sediment cleanup.

Following EPA and Ecology's assessment and before implementing cleanup actions, the city of Seattle and King County will also consider whether or not source control action is adequate.

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Figures

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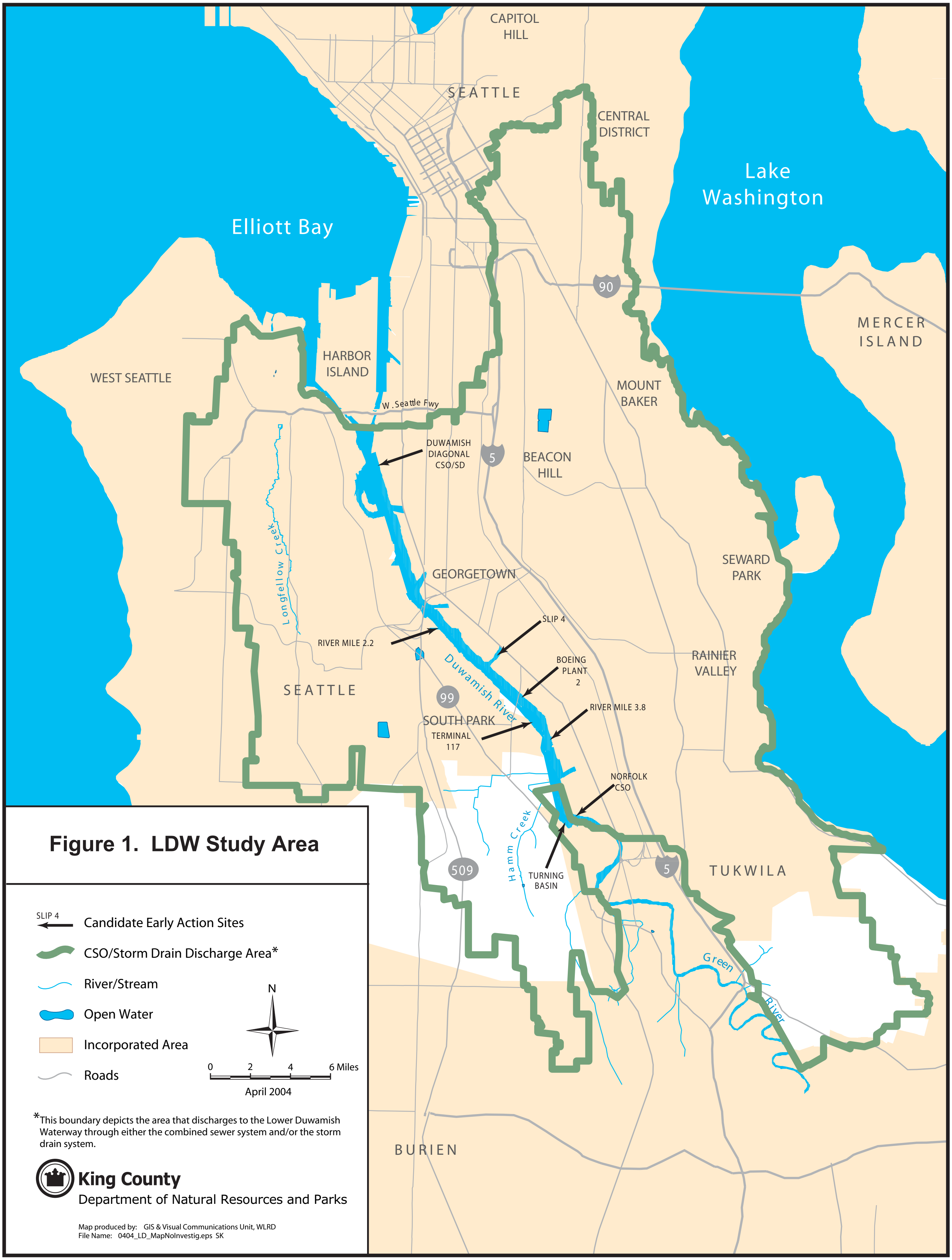


Figure 1. LDW Study Area

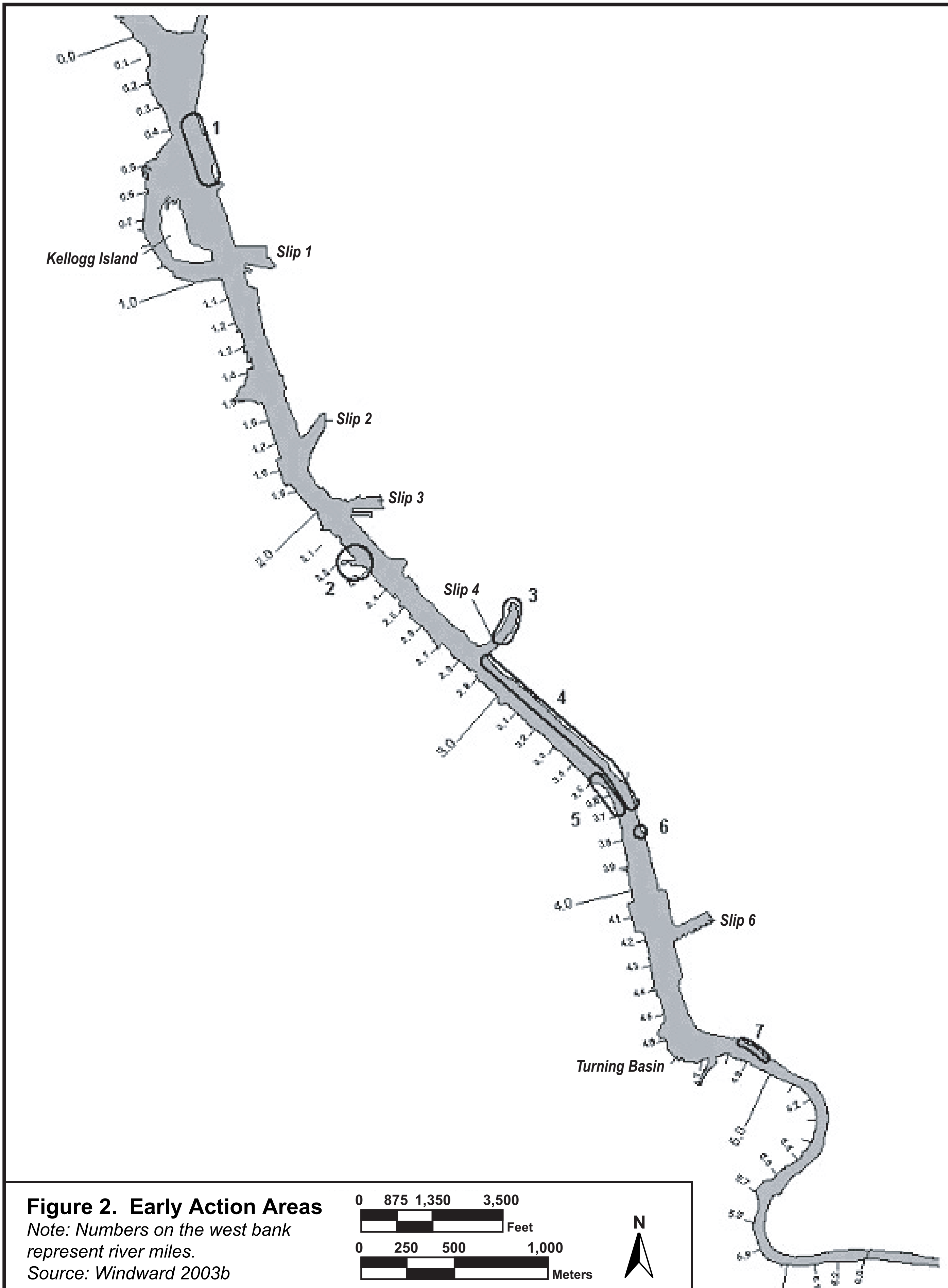


Figure 2. Early Action Areas
Note: Numbers on the west bank represent river miles.
Source: Windward 2003b

integral consulting inc

Map Feature Sources:
King County GIS, Seattle Public Utilities
USACE, Ecology, Windward Environmental,
David Evans, Inc., and others.
Sediment Chemistry:
Lower Duwamish Project Database and 2004
Slip 4 Survey PCB analysis results.

Figure 3. Slip 4 Proposed Removal Action Boundary
Source: Integral 2006

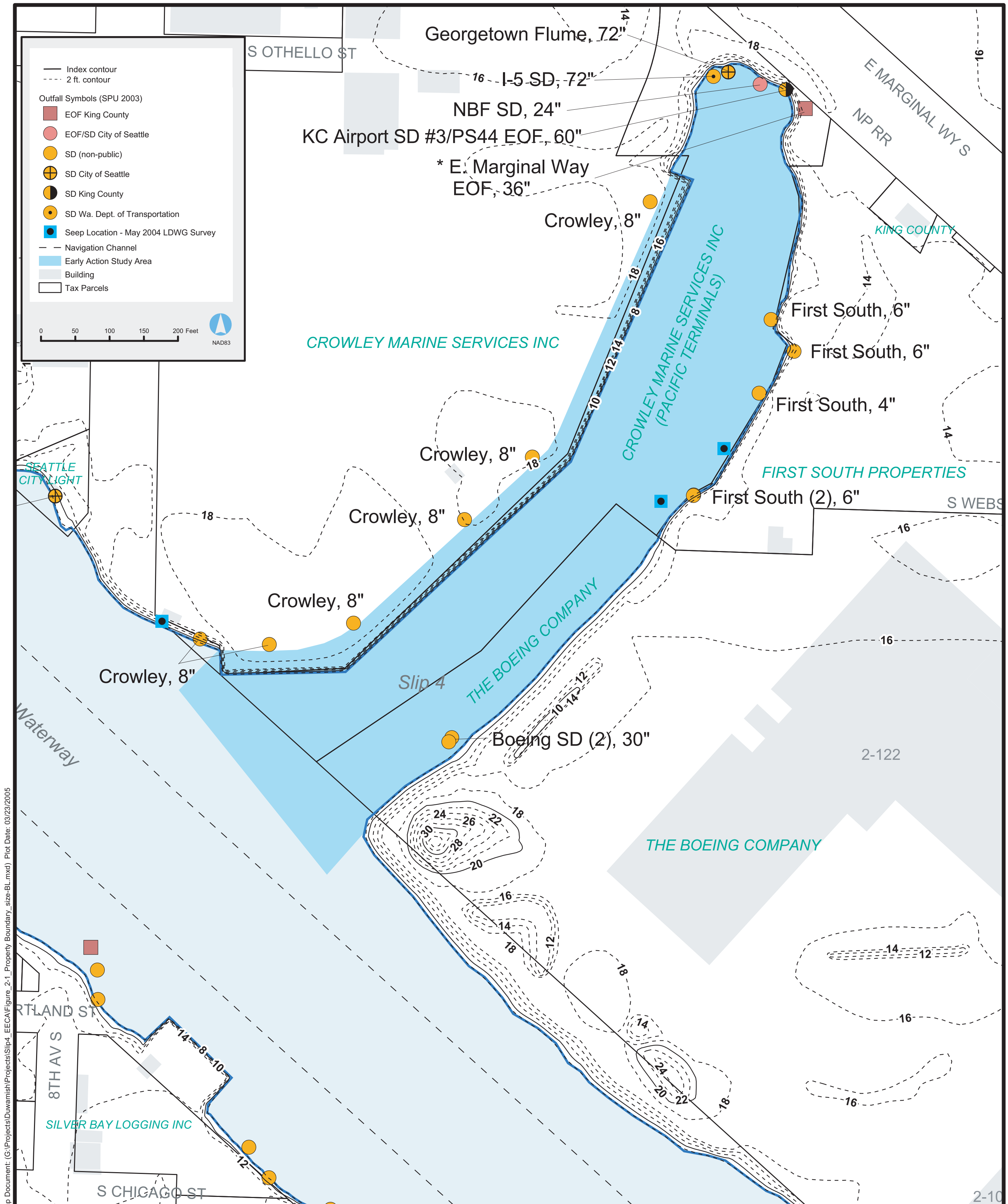


Figure 4. Slip 4 Outfalls
Adapted from: Integral 2006

* East Marginal Way EOF not observed during SPU (2003) survey: location based on King County coordinates.

Map Feature Sources: King County GIS, Seattle Public Utilities, USACE, Ecology, Windward Environmental, and others.

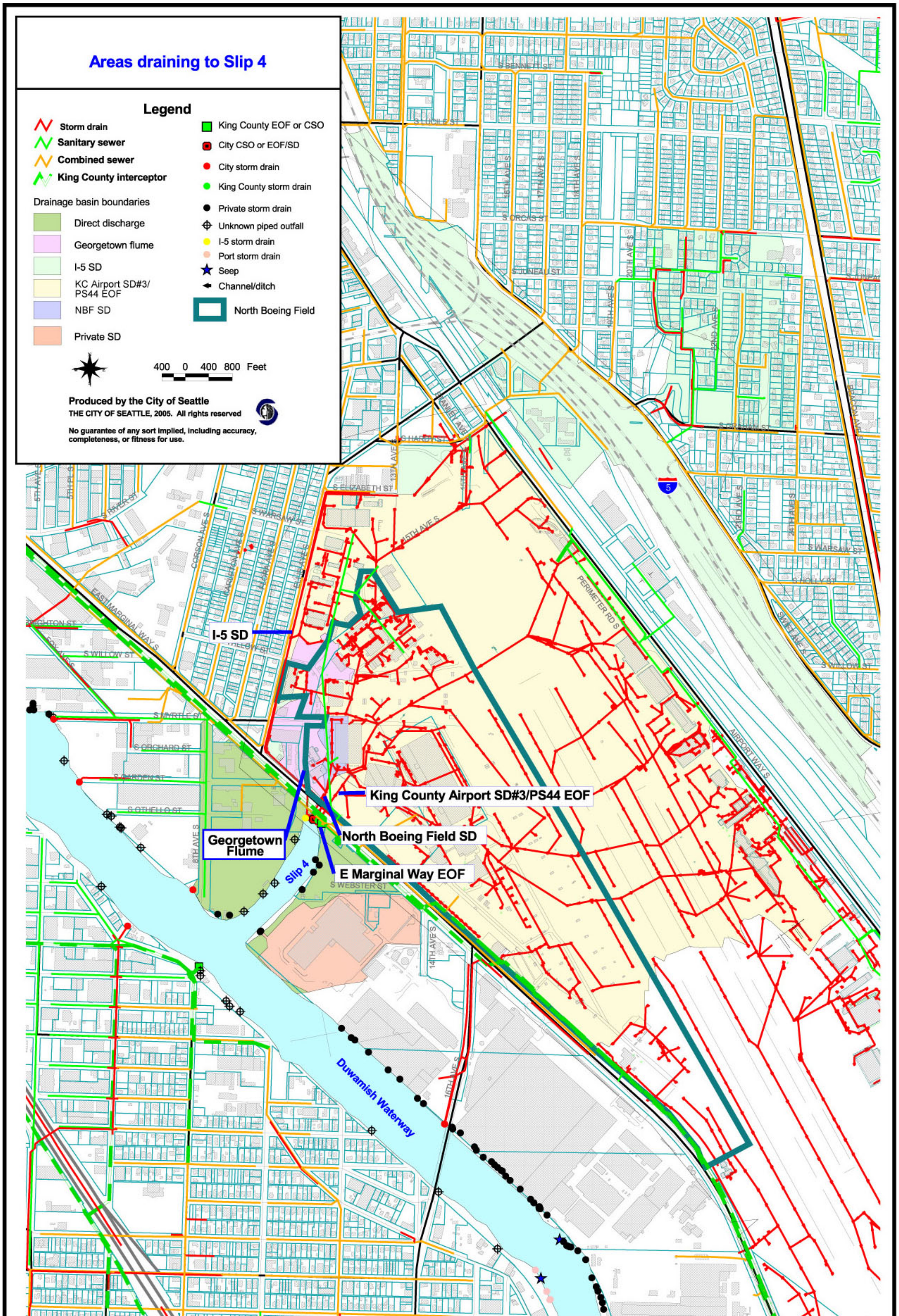


Figure 5. Slip 4 Drainage Basin

Adapted from: City of Seattle 2006

Figure 6. Slip 4 Adjacent and Upland Properties

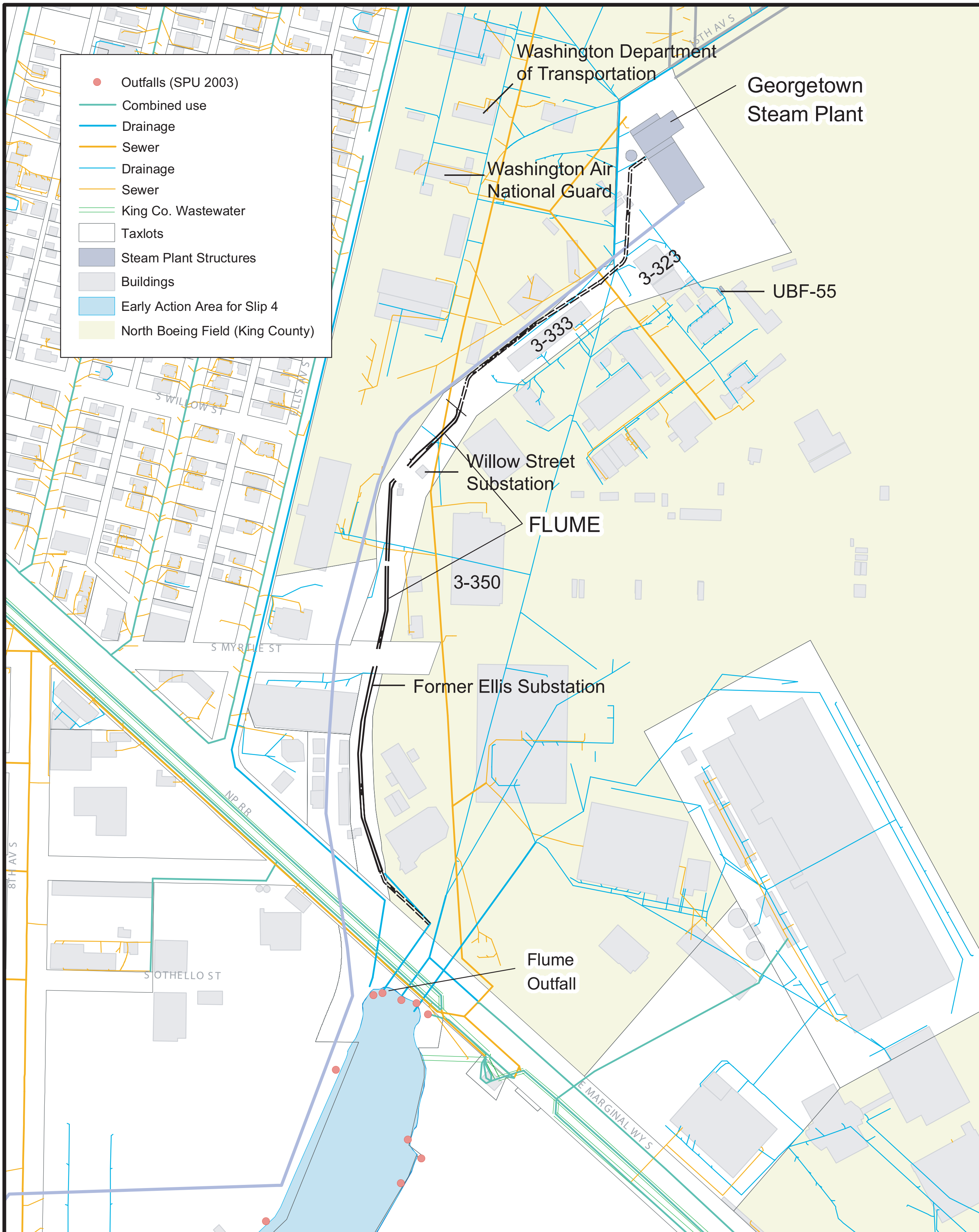


Figure 7. Georgetown Steam Plant Flume
Adapted from: SEA 2004

Map Feature Sources: King County GIS, Seattle Public Utilities, USACE, Ecology, and others.

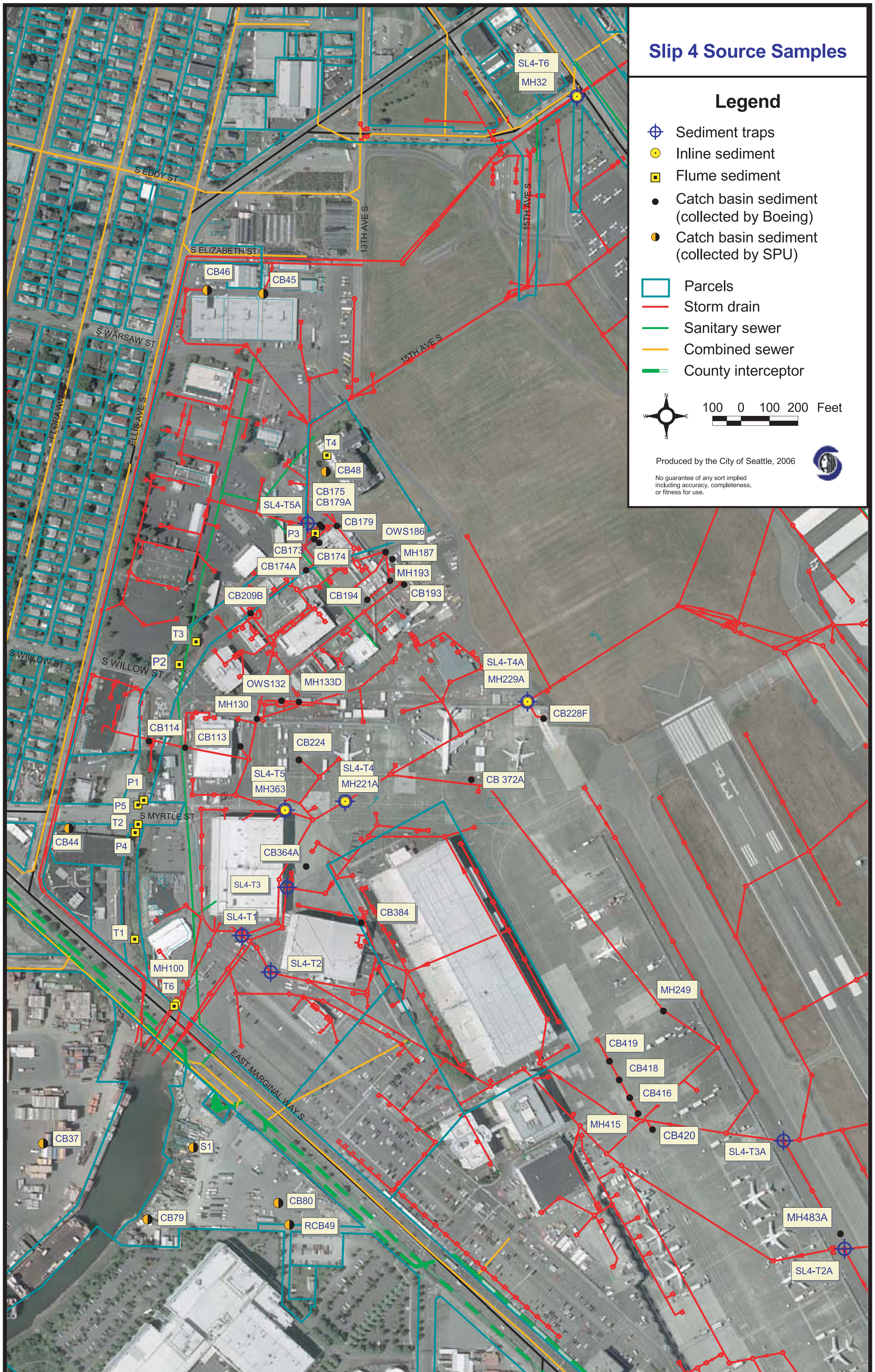


Figure 8. Slip 4 Source Samples
Adapted from: Integral 2006

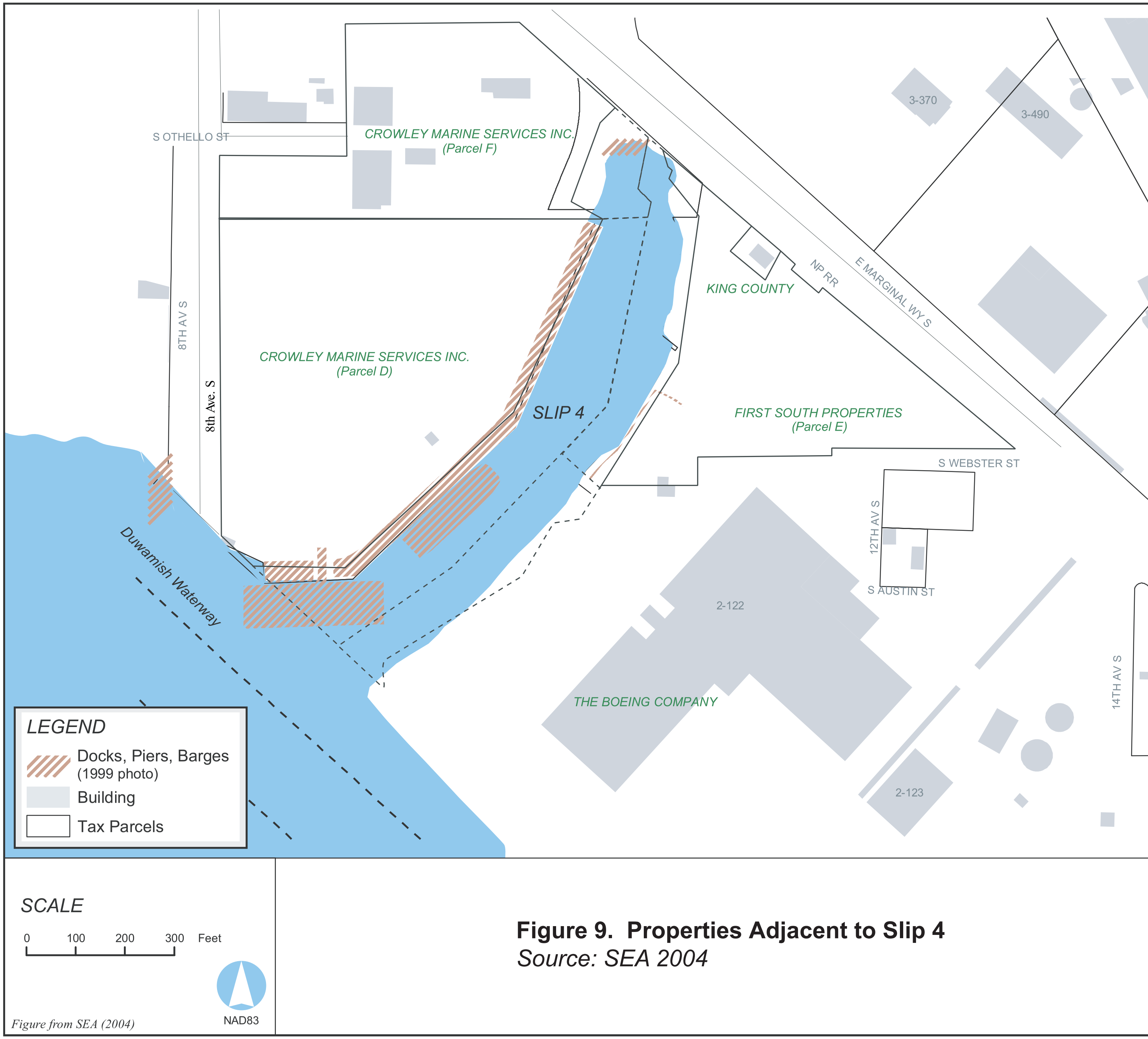


Figure 9. Properties Adjacent to Slip 4
Source: SEA 2004

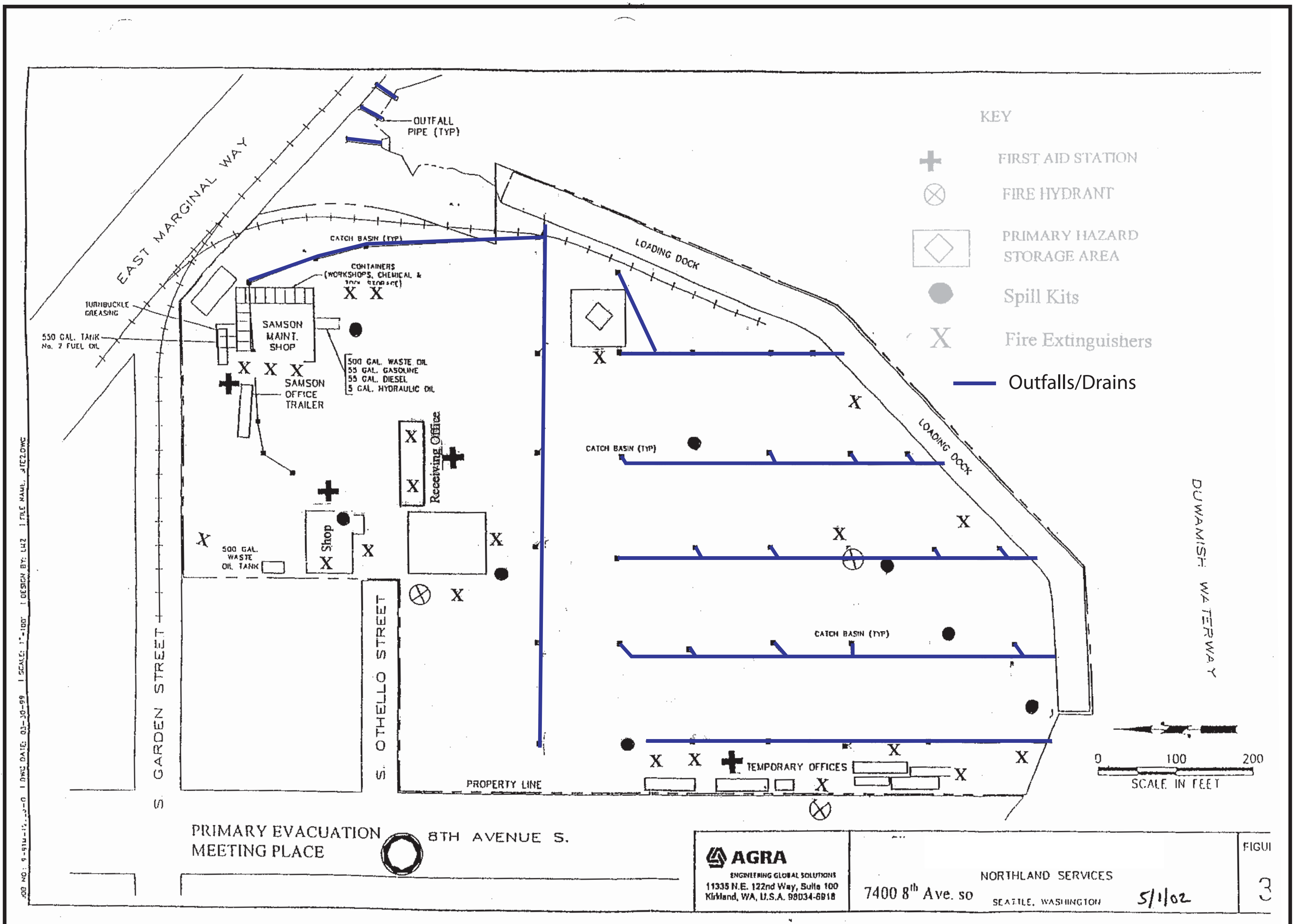


Figure 10. Drainage Map for Crowley Marine Services Property
Adapted from: Northland 2002

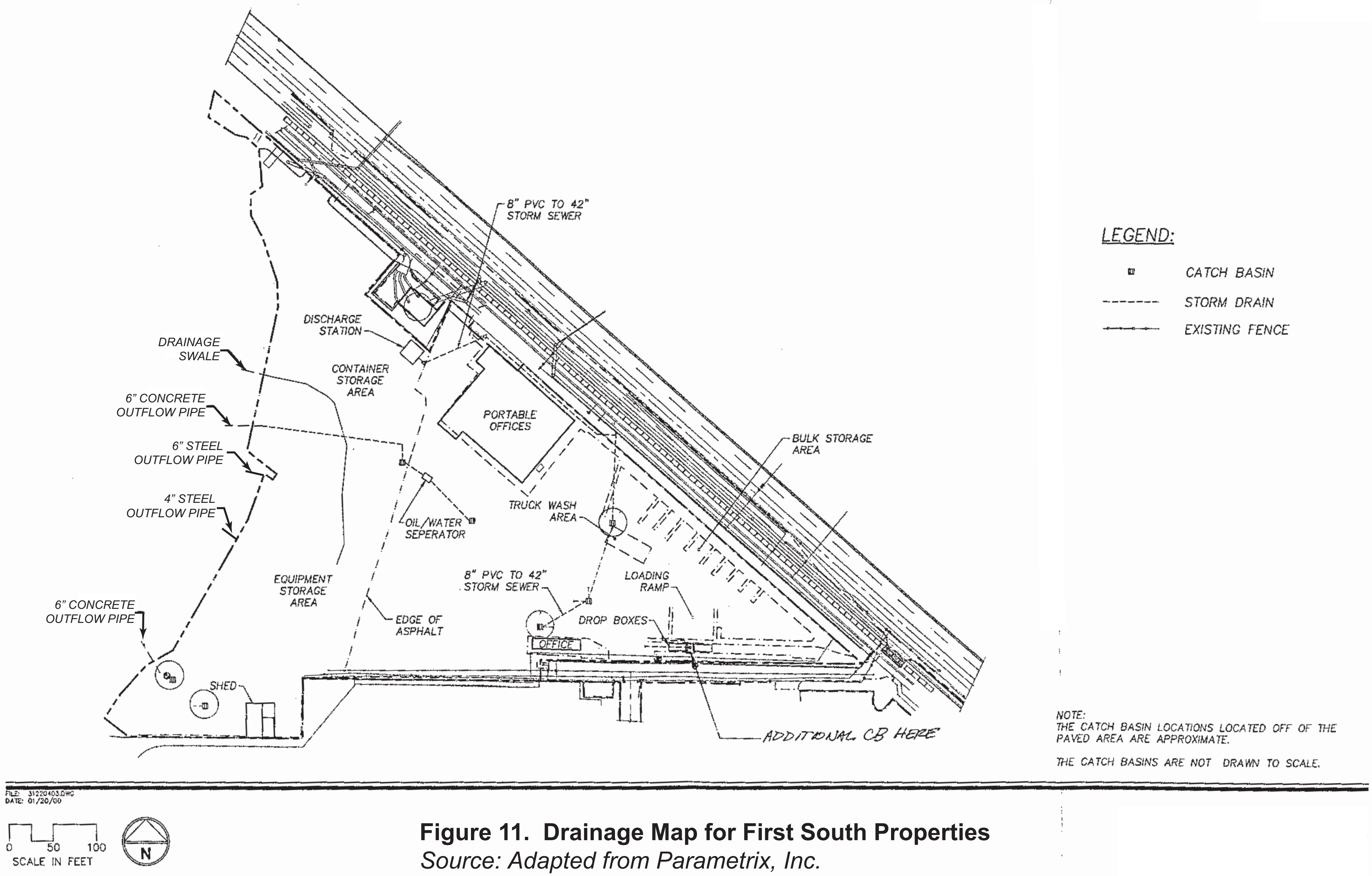


Figure 11. Drainage Map for First South Properties
Source: Adapted from Parametrix, Inc.

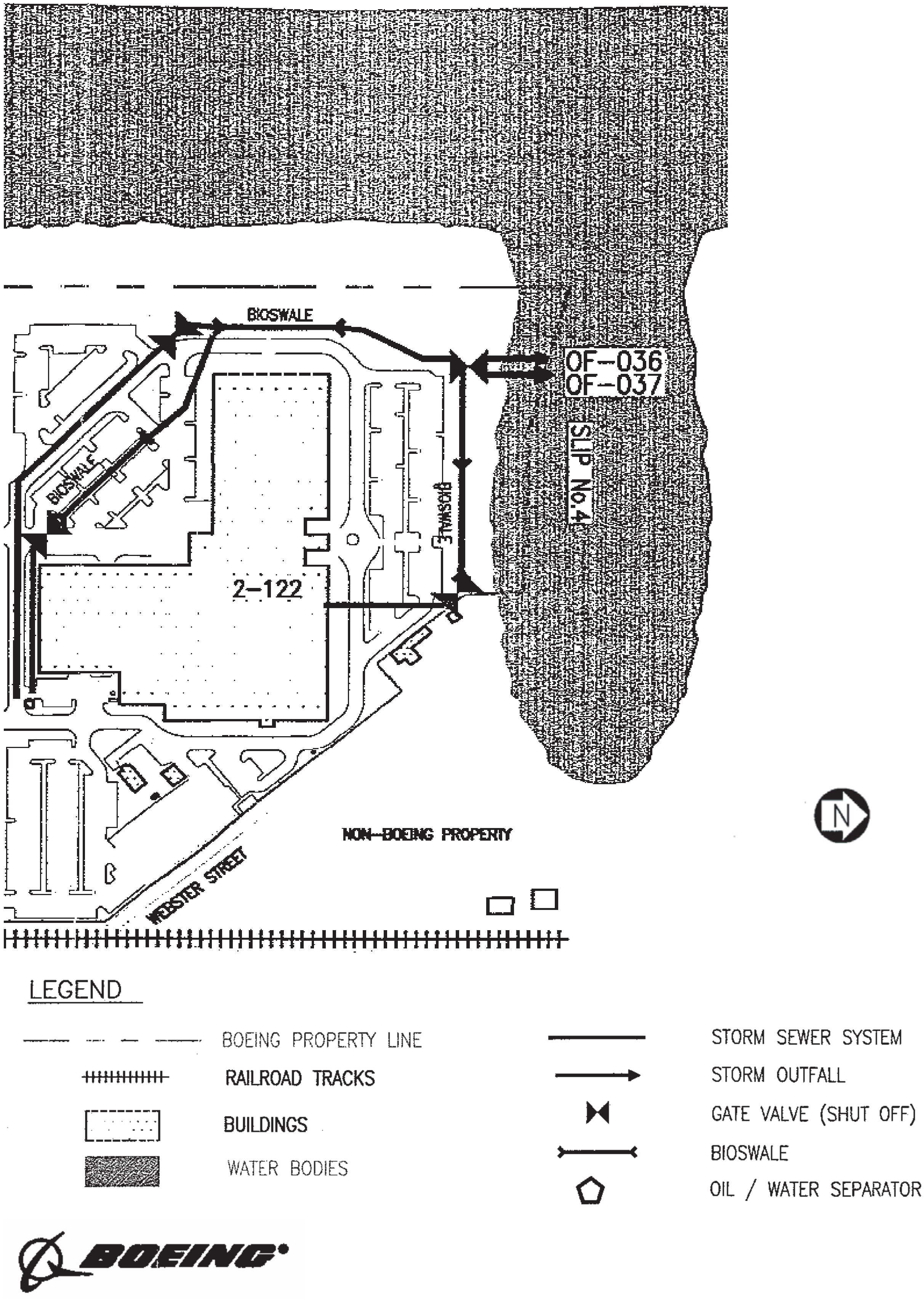


Figure 12. Boeing Plant 2 Drainage to Slip 4
Source: Boeing 2001

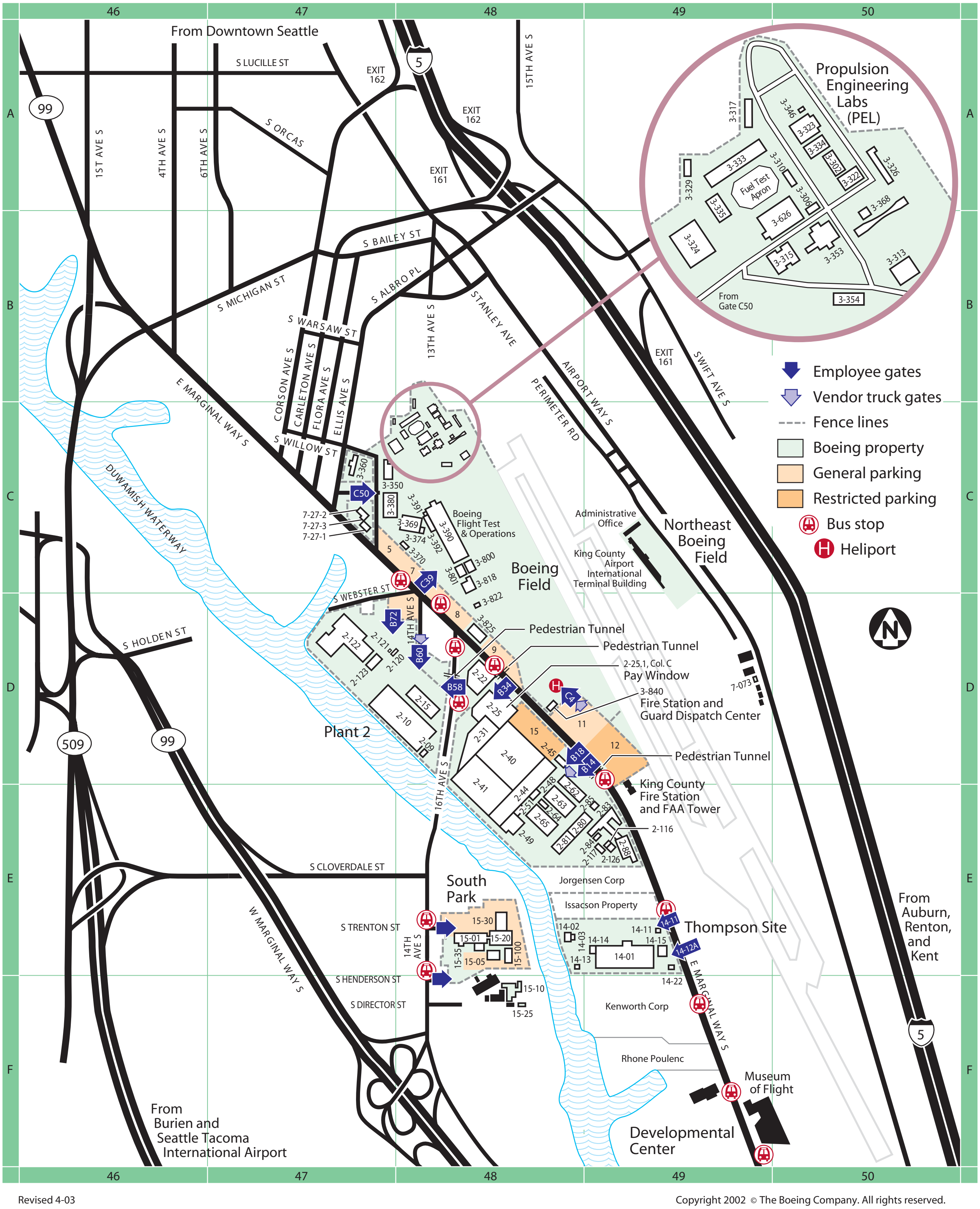
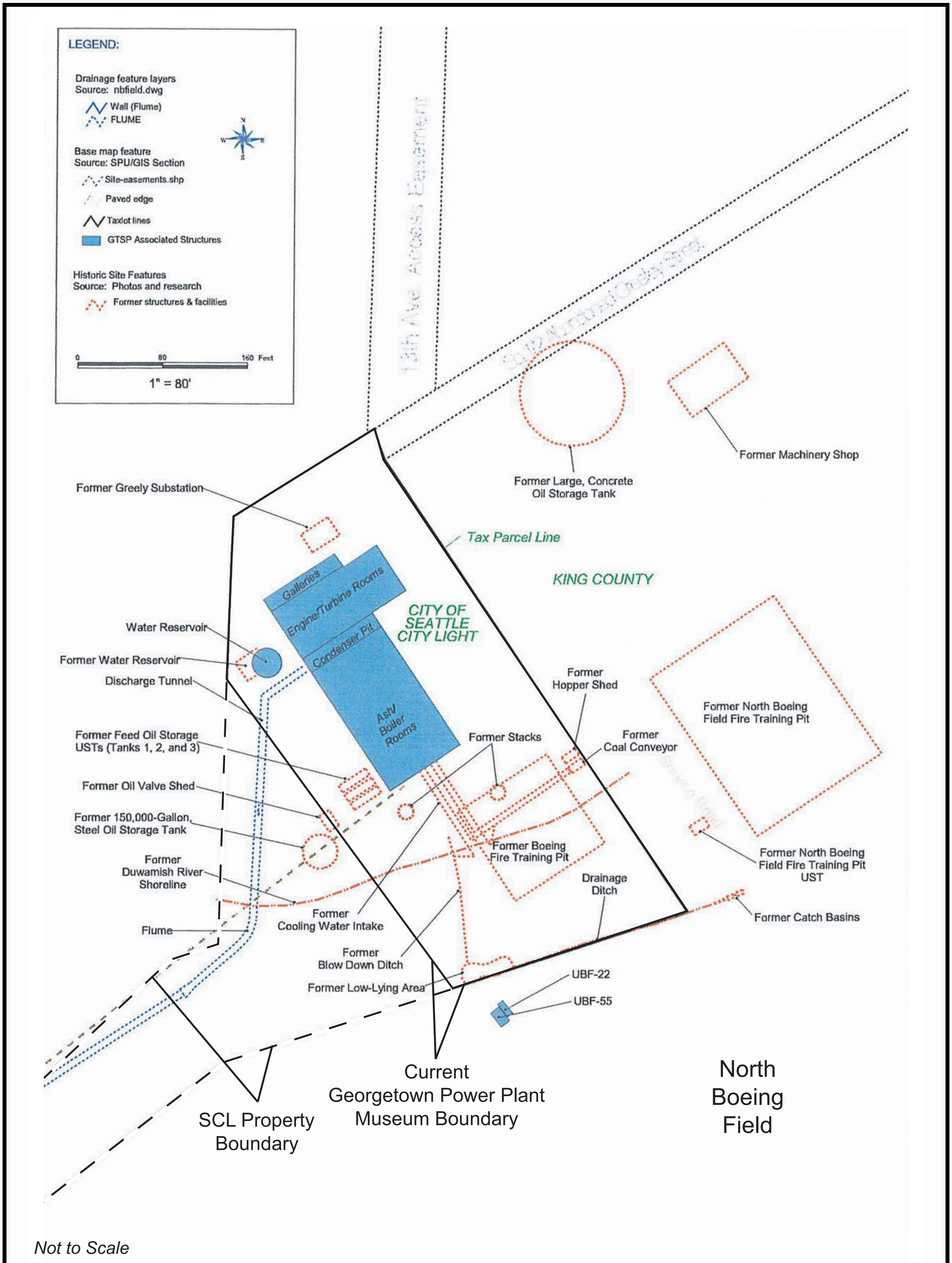


Figure 13. North Boeing Field and Boeing Plant 2 Building Layout
Source: Boeing 2003

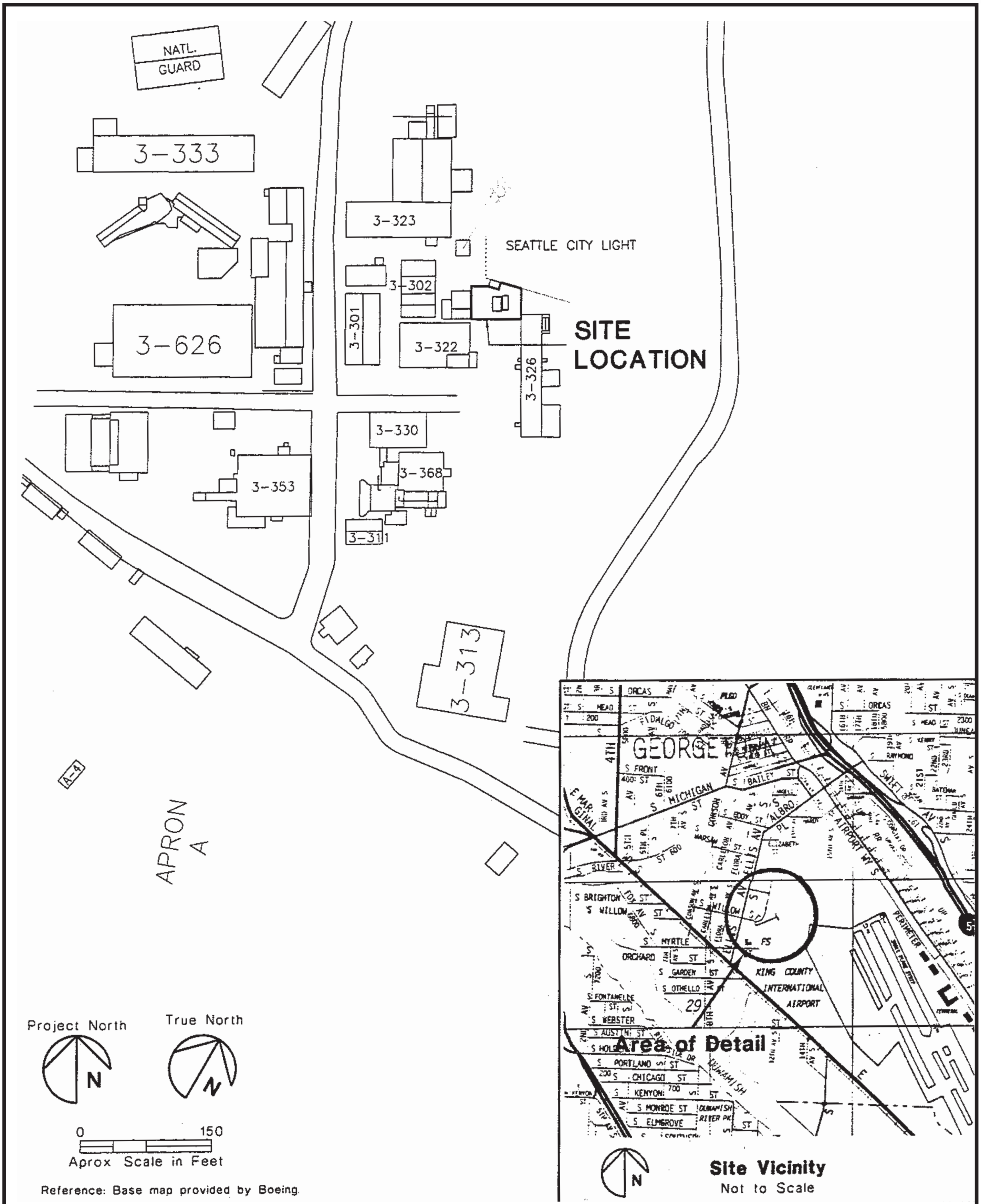


BRIDGEWATER GROUP, INC
in association with

Figure 14. Georgetown Steam Plant Historic Site Features
Source: Adapted from Bridgewater Group 2000

Duwamish Waterway Slip 4
December 14, 2000
...\SCL-slip4\Map
Projects\scl-proj-1.apr

Figure 15. NBF Drainage and Slip 4 Sediment Traps
Source: Integral 2006



AGI TECHNOLOGIES

Figure 16. Location of Oil/Water Separator UBF-55
Source: AGI 1998b

Tables

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Table 1. Slip 4 Drainage Basin Sediment Trap Results (DW) *(Source: Integral 2006)*

Seattle Public Utilities ID King County/Boeing MH#	SL4-T1 MH422 KC Airport SD, north + central #1 lat	SL4-T2A MH482 KC Airport SD, south lat, d/s runway	SL4-T2 MW356 KC Airport SD, south lat, d/s Boeing Field	SL4-T3A MH19C KC Airport SD, central lat #2, d/s runway	SL4-T3 MH364 KC Airport SD, central lat #2, d/s Boeing Field	SL4-T4A MH229A KC Airport SD, central lat #1, d/s runway	SL4-T4 MH221A KC Airport SD, central lat #1, d/s Boeing Field	SL4-T5A MH178 KC Airport SD, north lat, d/s Steamplant	SL4-T5 MH363 KC Airport SD, north lat, d/s Boeing Field	SL4-T6 NA I-5 SD at Airport Way S
	Round 1	**Round1**	**Round 1**	**Round 1**	**Round 1**	**Round 1**	**Round 1**	**Round 1**	**Round 1**	**Round 1**
Date deployed		03/10/05	03/07/05	03/10/05	03/07/05	03/08/05	03/08/05	03/08/05	03/07/05	
Date removed	08/11/05	08/11/05	08/11/05	08/11/05	08/11/05	08/11/05	08/11/05	08/11/05	08/11/05	08/11/05
Sample collected by	Boeing	SPU	Boeing	SPU	Boeing	Boeing	Boeing	Boeing	Boeing	SPU
TOC (percent)	4.29	NA	NA	NA	NA	5.35	NA	NA	NA	3.17
Metals (mg/kg DW)										
As	**11**	NA	NA	NA	NA	**16**	NA	**14**	**21**	**11**
Cu	**83.6**	NA	NA	NA	NA	**94.3**	NA	**113**	**148**	**84.5**
Pb	**140**	NA	NA	NA	NA	**144**	NA	**962**	**109**	**110**
Hg	**1.10**	NA	NA	NA	NA	**0.19**	NA	**0.86**	**1.12**	**0.10**
Zn	**368**	NA	NA	NA	NA	**460**	NA	**220**	**553**	**422**
LPAH (ug/kg DW)										
Acenaphthene	**210**	NA	NA	NA	NA	160 U	**1,300**	110 U	130 U	79 U
Acenaphthylene	100 U	NA	NA	NA	NA	160 U	210 U	110 U	130 U	79 U
Anthracene	**360**	NA	NA	NA	NA	**180**	**1,500**	**150**	**210**	**98**
Fluorene	**190**	NA	NA	NA	NA	160 U	**1,000**	110 U	130 U	79 U
Naphthalene	100 U	NA	NA	NA	NA	160 U	**670**	110 U	130 U	79 U
Phenanthrene	**2,800**	NA	NA	NA	NA	**1,700**	**8,600**	**1,300**	**1,600**	**570**
HPAH (ug/kg DW)										
Benzo(a)anthracene	**1,400**	NA	NA	NA	NA	**860**	**3,000**	**840**	**940**	**270**
Benzo(a)pyrene	**1,700**	NA	NA	NA	NA	**1,400**	**3,400**	**1,100**	**1,200**	**250**
Benzo(b)fluoranthene	**2,400**	NA	NA	NA	NA	**2,100**	**4,600**	**1,600**	**1,700**	**380**
Benzo(k)fluoranthene	**1,300**	NA	NA	NA	NA	**1,300**	**2,600**	**800**	**970**	**220**
Benzo(g,h,i)perylene	**720**	NA	NA	NA	NA	**710**	**1,600**	**450**	**600**	79 U
Chrysene	**1,900**	NA	NA	NA	NA	**1,700**	**4,100**	**1,200**	**1,400**	**370**
Dibenzo(a,h)anthracene	**260**	NA	NA	NA	NA	160 U	**730**	110 U	130 U	79 U
Fluoranthene	**4,100**	NA	NA	NA	NA	**3,100**	**8,900**	**2,400**	**2,900**	**880**
Indeno(1,2,3-c,d)pyrene	**810**	NA	NA	NA	NA	**780**	**1,900**	**520**	**680**	**84**
Pyrene	**3,000**	NA	NA	NA	NA	**2,100**	**6,800**	**1,700**	**2,000**	**630**
Phthalates (ug/kg DW)										
Bis(2-ethylhexyl)phthalate	**2,400**	NA	NA	NA	NA	**2,600**	**6,000**	**1,800**	**2,700**	**6,000**
Butylbenzylphthalate	**120**	NA	NA	NA	NA	160 U	210 U	110 U	**140**	**420**
Diethylphthalate	100 U	NA	NA	NA	NA	160 U	210 U	110 U	130 U	79 U
Dimethylphthalate	100 U	NA	NA	NA	NA	160 U	210 U	110 U	130 U	79 U
Di-n-butylphthalate	**130**	NA	NA	NA	NA	**350**	**260**	**150**	130 U	**460**
Di-n-octylphthalate	**440**	NA	NA	NA	NA	**4,300**	**3,700**	**220**	**1,200**	**430**
PCBs (ug/kg DW)										
Aroclor 1016	29 U	48 U	21 U	34 U	20 U	9.8 U	9.8 U	9.6 U	49 U	1,800 U
Aroclor 1242	29 U	48 U	21 U	34 U	20 U	9.8 U	9.8 U	9.6 U	49 U	1,800 U
Aroclor 1248	29 U	48 U	21 U	34 U	20 U	9.8 U	9.8 U	9.6 U	49 U	1,800 U
Aroclor 1254	**10,000**	**67**	**500** P	**38** JP	**1,400**	**290** P	**1,900** P	**72**	**24,000**	1,800 U
Aroclor 1260	1,200 U	**110**	**340**	34 U	380 U	**160**	**850**	**34**	2,400 U	**7,800**
Aroclor 1221	29 U	48 U	21 U	34 U	20 U	9.8 U	9.8 U	9.6 U	49 U	1,800 U
Aroclor 1232	29 U	48 U	21 U	34 U	20 U	9.8 U	9.8 U	9.6 U	49 U	1,800 U
Total PCBs	**10,000**	**177**	**840** P	**38** JP	**1,400**	**450** P	**2,750** P	**106**	**24,000**	**7,800**
TPH (mg/kg)										
Diesel	**230**	NA	NA	NA	NA	**100**	NA	**160**	**390**	**310**
Motor Oil	**970**	NA	NA	NA	NA	**410**	NA	**570**	**1,400**	**800**

Detected values shown in bold type.
NA = not analyzed
U = Chemical not detected at reported concentration
J = Chemical concentration is reported as estimate.
P = Chemical detected on both chromatographic columns, but values differ by >40% RPD with no obvious interference.
(grey shading) Exceeds SQS (0.41 mg/kg mercury, 410 mg/kg zinc) or MTCA Method A soil cleanup level for unrestricted use (1 mg/kg PCBs)
(black shading) Exceeds CSL (0.59 mg/kg mercury) or MTCA Method A soil cleanup level for industrial use (10 mg/kg PCBs)

Table 2. Slip 4 Drainage Basin Sediment Trap Results Compared to Sediment Management Standards *(Source: Integral 2006)*

Seattle Public Utilities ID King County/Boeing MH#	SQS	CSL	SL4-T1 MH422 KC Airport SD, north + central #1 lat	SL4-T4A MH229A KC Airport SD, central lat #1, d/s runway	Slip4-T6 NA I-5 SD at Airport Way S
			Round 1	**Round1**	**Round 1**
Date deployed				03/08/05	
Date removed			08/11/05	08/11/05	08/11/05
Sampled by			Boeing	Boeing	SPU
TOC (percent)			4.29	5.35	3.17
Metals (mg/kg DW)					
As	57	93	**11**	**16**	**11**
Cu	390	390	**83.6**	**94.3**	**84.5**
Pb	450	530	**140**	**144**	**110**
Hg	0.41	0.59	**1.10**	**0.19**	**0.1**
Zn	410	960	**368**	**460**	**422**
LPAH (mg/kg OC)					
Acenaphthene	16	57	**5**	3 U	2.5 U
Acenaphthylene	66	66	2 U	3 U	2.5 U
Anthracene	220	1,200	**8**	**3**	**3.1**
Fluorene	23	79	**4**	3 U	2.5 U
Naphthalene	99	170	2 U	3 U	2.5 U
Phenanthrene	100	480	**65**	**32**	**18**
HPAH (mg/kg OC)					
Benzo(a)anthracene	110	270	**33**	**16**	**8.5**
Benzo(a)pyrene	99	210	**40**	**26**	**7.9**
Benzo(b+k)fluoranthene	230	450	**86**	**64**	**12.0**
Benzo(g,h,i)perylene	31	78	**17**	**13**	**6.9**
Chrysene	110	460	**44**	**32**	**11.7**
Dibenzo(a,h)anthracene	12	33	**6**	3 U	2.5 U
Fluoranthene	160	1,200	**96**	**58**	**27.8**
Indeno(1,2,3-c,d)pyrene	34	88	**19**	**15**	**2.6**
Pyrene	1,000	1,400	**70**	**39**	**19.9**
Phthalates (mg/kg OC)					
Bis(2-ethylhexyl)phthalate	47	78	**56**	**49**	**189**
Butylbenzylphthalate	4.9	64	**3**	3 U	**13**
Diethylphthalate	61	110	2 U	3 U	2 U
Dimethylphthalate	53	53	2 U	3 U	2 U
Di-n-butylphthalate	220	1,700	**3**	**7**	**15**
Di-n-octylphthalate	58	4,500	**10**	**80**	**14**
PCBs (mg/kg OC)					
Aroclor 1016			1 U	0.2 U	57 U
Aroclor 1242			1 U	0.2 U	57 U
Aroclor 1248			1 U	0.2 U	57 U
Aroclor 1254			**233**	**5.4** P	57 U
Aroclor 1260			28 U	**3.0**	**246**
Aroclor 1221			1 U	0.2 U	57 U
Aroclor 1232			1 U	0.2 U	57 U
Total PCBs	12	65	**233**	**8.4** P	**246**
TPH (mg/kg)					
Diesel		2000[a]		**100**	**310**
Motor Oil		2000[a]		**410**	**800**

Detected values shown in bold type.

[a]MTCA Method A soil cleanup level for unrestricted and industrial use.

U = Chemical not detected at reported concentration

P = Chemical detected on both chromatographic columns, but values differ by >40% RPD with no obvious interference

Exceeds SQS (grey shading): Zn 460 and 422; Bis(2-ethylhexyl)phthalate 56 and 49

Exceeds CSL or MTCA Method A soil cleanup level (black shading): Hg 1.10; Bis(2-ethylhexyl)phthalate 189; Total PCBs 233 and 246

Table 3. Slip 4 Drainage Basin Inline Sediment Sample Results (DW) *(Source: Integral 2006)*

	Slip 4 Storm Drains								
	MH100 North+ central lat #2	MH100 North+ central lat #2	MH221A Central lat #1, d/s Boeing Field	MH221A Central lat #1, d/s Boeing Field	MH363 North lat, d/s Steamplt	MH363 North lat, d/s Steamplt	MH229A Central lat #1, d/s runway	MH229A Central lat #1, d/s runway	MH32 I-5 SD at Airport Wy
Date	2/16/05 S	2/16/05 B	2/16/05 S	2/16/05 B	2/16/05 S	2/16/05 B	2/16/05 S	2/16/05 B	8/11/05 S
TOC (percent)	6.11	6.6	1.09	1	1.11	0.76	4.34	3.88	0.739
Metals (mg/kg DW)									
As	**20**	**20**	**40**	**12**	**9**	**8**	**30**	**30**	10 U
Cu	88.9	**102**	**126**	**38.5**	**64.1**	**45.1**	**69.7**	**85.5**	**61.2**
Pb	134	**142**	**94**	**50**	**51**	**110**	**120**	**155**	**207**
Hg	0.2	**0.2**	**0.09**	**0.09**	**0.48**	**0.7**	**0.07**	**0.07**	0.05 U
Zn	377	**411**	**572**	**332**	**208**	**272**	**699**	**1,130**	**186**
LPAH (ug/kg DW)									
Acenaphthene	100 U	59 U	180 U	58 U	59 U	59 U	**800**	**930**	20 U
Acenaphthylene	100 U	59 U	180 U	58 U	59 U	59 U	**86**	220 U	20 U
Anthracene	100 U	**140**	180 U	**71**	**65**	59 U	**770**	**1,200**	20 U
Fluorene	100 U	59 U	180 U	**73**	59 U	59 U	**810**	**1,100**	20 U
Naphthalene	100 U	59 U	59 U	58 U	59 U	59 U	**76**	220 U	22 U
Phenanthrene	**500**	**250**	**440**	**300**	**400**	**260**	**6,100**	**8,900**	**22**
HPAH (ug/kg DW)									
Benzo(a)anthracene	**320**	**380**	**330**	**280**	**340**	**280**	**1,900**	**3,000**	20 U
Benzo(a)pyrene	**290**	**480**	**470**	**400**	**330**	**300**	**2,000**	**3,400**	**26**
Benzo(b)fluoranthene	**500**	**760**	**740**	**710**	**520**	**450**	**3,300**	**5,400**	**34**
Benzo(g,h,i)perylene	**210**	**200**	**310**	**230**	**170**	**170**	**840**	**1,300**	20 U
Benzo(k)fluoranthene	**280**	**460**	**370**	**400**	**280**	**310**	**2,000**	**3,600**	20 U
Chrysene	**570**	**620**	**600**	**490**	**500**	**400**	**2,600**	**4,200**	**31**
Dibenzo(a,h)anthracene	100 U	59 U	180 U	58 U	59 U	59 U	**370**	220 U	20 U
Fluoranthene	**980**	**880**	**1,100**	**920**	**840**	**750**	**6,700**	**11,000**	**44**
Indeno(1,2,3-c,d)pyrene	**240**	**180**	**380**	**260**	**190**	**180**	**980**	**1,500**	20 U
Pyrene	**750**	**810**	**800**	**870**	**630**	**660**	**4,900**	**7,600**	**50**
Phthalates (ug/kg DW)									
Bis(2-ethylhexyl)phthalate	**1,500**	**2,000**	**800**	**760**	**430**	**500**	**1,200**	**2,200**	**180**
Butylbenzylphthalate	**140**	**86**	180 U	58 U	59 U	59 U	**62**	220 U	20 U
Diethylphthalate	100 U	59 U	180 U	58 U	59 U	59 U	61 U	220 U	20 U
Dimethylphthalate	100 U	59 U	180 U	58 U	59 U	59 U	61 U	220 U	20 U
Di-n-butylphthalate	100 U	59 U	180 U	58 U	59 U	59 U	**110**	220 U	20 U
Di-n-octylphthalate	100 U	**71**	180 U	**120**	**59**	**69**	**130**	**240**	20 U
PCBs (ug/kg DW)									
Aroclor 1016	220 U	95 U	120 U	120 U	1,200 Y	950 U	19 U	140 U	19 U
Aroclor 1242	220 U	95 U	120 U	120 U	940 Y	950 U	19 U	140 U	19 U
Aroclor 1248	220 U	95 U	120 U	120 U	2,400 Y	1,900 U	19 U	140 U	19 U
Aroclor 1254	**1,000**	**1,600**	**590**	**960**	**31,000**	**7,000**	**150**	**3,700**	19 U
Aroclor 1260	**820** P	**380** P	**410**	**530**	3,800 Y	950 U	**160** P	**1,900**	19 U
Aroclor 1221	220 U	95 U	120 U	120 U	470 U	480 U	19 U	140 U	19 U
Aroclor 1232	220 U	95 U	120 U	120 U	1,400 Y	1,400 U	19 U	140 U	19 U
Total PCBs	**1,820** P	**1,980** P	**1,000**	**1,490**	**31,000**	**7,000**	**310** P	**5,600**	19 U
TPH (mg/kg)									
Diesel	**88**	**40**	**120**	**120**	**120**	**47**	**110**	**200**	120 U
Motor Oil	**380**	**190**	**270**	**210**	**680**	**190**	**380**	**1,000**	**290**

Detected values shown in bold type.
U = Chemical not detected at reported concentration
Y = Chemical not detected at the reported concentration. Reporting limit raised due to chromatographic interference.
P = Chemical detected on both chromatographic columns, but values differ by >40% RPD with no obvious interference.
J = Chemical concentration is reported as estimate.
Exceeds SQS (450 mg/kg lead, 0.41 mg/kg mercury, 410 mg/kg zinc) or MTCA Method A soil cleanup level for unrestricted use (1 mg/kg PCBs)
Exceeds CSL (530 mg/kg lead, 0.59 mg/kg mercury, 960 mg/kg zinc) or MTCA Method A soil cleanup level for industrial use (10 mg/kg PCBs)

Table 3. Slip 4 Drainage Basin Inline Sediment Sample Results (DW) *(Source: Integral 2006)*

	Georgetown Flume Samples										
	T1 Flume 15' u/s of box culvert	T2 Flume at S Myrtle St	T5[1] Flume at S Myrtle St	T3 Flume upstream of S Willow St	T4 Head of flume	T6 MH100 u/s of E Marginal Wy S	P1 Flume off of 8" plugged pipe	P2 Flume off of 8" pipe near S Willow St	P3 Flume off of 15" plugged pipe	P4 Flume off of 8" pipe at S Myrtle St	P5 Ditch at S Myrtle St
Date	3/24/05 S	3/24/05 S	3/24/05 S	3/25/05 S	3/24/05 S	3/25/05 S	3/25/05 S	3/25/05 S	3/25/05 S	3/24/05 S	3/24/05 S
TOC (percent)	3.92	1.43	1.17	2.25	8.71	2.68	0.711	2.47	5.27	0.773	6.86
Metals (mg/kg DW)											
As	11	7 U	7 U	7 U	40	7 U	7 U	13	20	6 U	10 U
Cu	63.2	18.5	20.2	54.6	314 J	79.6	18	56.6	133	12.8	95.1
Pb	99	14	15	263	590 J	61	16	69	501	10	73
Hg	0.1	0.05 U	0.05 U	0.41	1.7	0.08	0.05 U	0.18	1	0.06 U	0.08
Zn	218	53.8	61.3	180	1,130	240	60.8	238	766	52.7	195
LPAH (ug/kg DW)											
Acenaphthene	270	20 U	24	380	660	67	20 U	58 U	120 U	19 U	1,600 U
Acenaphthylene	150	20 U	21	230	2,700	34 J	28	92	120 U	19	1,600 U
Anthracene	640	53	91	590	2,500	220	97	270	130	69	1,600 U
Fluorene	240	20 U	20 U	530	1,900	66	20 U	42 J	120 U	19 U	1,600 U
Naphthalene	310	20 U	20 U	97	2,400	59 U	20 U	58 U	120 U	19 U	1,600 U
Phenanthrene	4,500	44	67	6,200	11,000	740	96	250	510	140	1,600 U
HPAH (ug/kg DW)											
Benzo(a)anthracene	1,300	100	150	1,400	7,900	520	150	370	370	73	1,600 U
Benzo(a)pyrene	1,300	240	310	490	8,600	560	130	290	450	83	1,600 U
Benzo(b)fluoranthene	1,600	240	350	850	11,000	640	140	520	640	100	1,600 U
Benzo(g,h,i)perylene	570	92	130	200	2,500	210	52	120	190	33	1,600 U
Benzo(k)fluoranthene	1,600	270	290	1,000	9,400	790	230	540	500	140	1,600 U
Chrysene	2,300	160	210	1,500	8,400	750	230	650	540	160	810 J
Dibenzo(a,h)anthracene	230	34	41	45 J	1,000	54 J	20 U	33 J	120 U	19 U	1,600 U
Fluoranthene	6,300	200	260	6,100	18,000	1,600	530	1,200	1,100	490	1,000
Indeno(1,2,3-c,d)pyrene	660	91	120	220	3,000	210	57	120	210	32	1,600 U
Pyrene	3,200	130	180	3,300	14,000	1,200	300	850	960	230	1,200
Phthalates (ug/kg DW)											
Bis(2-ethylhexyl)phthalate	2,000	140	140	580	210	2,000	120	560	2,100	140	3,800
Butylbenzylphthalate	110	20 U	20 U	59 U	200 U	100	20 U	58 U	160	19 U	1,600 U
Diethylphthalate	60 U	20 U	20 U	59 U	200 U	59 U	20 U	58 U	120 U	19 U	1,600 U
Dimethylphthalate	60 U	20 U	20 U	59 U	200 U	59 U	20 U	58 U	120 U	19 U	1,600 U
Di-n-butylphthalate	87	20 U	20 U	60	200 U	59 U	24	69	140	19 U	1,600 U
Di-n-octylphthalate	60 U	20 U	20 U	59 U	200 U	64	20 U	230	140	19 U	1,600 U
PCBs (ug/kg DW)											
Aroclor 1016	59 U	7.8 U	4.0 U	2,800 U	240 U	40 U	12 U	79 U	26,000 U	3.9 U	240 U
Aroclor 1242	59 U	7.8 U	4.0 U	2,800 U	240 U	40 U	12 U	79 U	26,000 U	3.9 U	240 U
Aroclor 1248	59 U	12	12 J	2,800 U	1,500 J	79 U	28	210	26,000 U	6.3	240 U
Aroclor 1254	190	26 J	29 J	3,900	1,700	240	56 J	450	92,000	14 J	470 U
Aroclor 1260	140	28	24	2,800 U	540	160	36	120	26,000 U	18	1,500
Aroclor 1221	59 U	7.8 U	4.0 U	2,800 U	240 U	40 U	12 U	79 U	26,000 U	7.8 U	240 U
Aroclor 1232	59 U	16 U	4.0 U	2,800 U	240 U	40 U	12 U	79 U	26,000 U	7.8 U	240 U
Total PCBs	330	66 J	65 J	3,900	3,740 J	400	120 J	780	92,000	38.3 J	1,500
TPH (mg/kg)											
Diesel	36	21	19	84	2,300	120	14	63	250	8.9	1,600
Motor Oil	140	99	70	460	9,700	670	66	360	1,100	61	3,000

[1] T5 is duplicate of T2.

S = Seattle field split

B = Boeing field split

Table 4. Slip 4 Drainage Basin Inline Sediment Sample Results Compared to Sediment Management Standards
(Source: Integral 2006)

	SQS	CSL	Slip 4 Storm Drains MH100 North+ central lat #2	MH100 North+ central lat #2	MH221A Central lat #1, d/s Boeing Field	MH221A Central lat #1, d/s Boeing Field	MH363 North lat, d/s Steamplt	MH363 North lat, d/s Steamplt	MH229A Central lat #1, d/s runway	MH229A Central lat #1, d/s runway	MH32 I-5 SD at Airport Wy
Date			2/16/05 S	2/16/05 B	2/16/05 S	2/16/05 B	2/16/05 S	2/16/05 B	2/16/05 S	2/16/05 B	8/11/05 S
TOC (percent)			6.11	6.6	1.09	1	1.11	0.76	4.34	3.88	0.739
Metals (mg/kg DW)											
As	57	93	**20**	**20**	**40**	**12**	**9**	**8**	**30**	**30**	10 U
Cu	390	390	88.9	**102**	**126**	**38.5**	**64.1**	**45.1**	**69.7**	**85.5**	**61.2**
Pb	450	530	134	**142**	**94**	**50**	**51**	**110**	**120**	**155**	**207**
Hg	0.41	0.59	0.2	**0.2**	**0.09**	**0.09**	**0.48**	**0.7**	**0.07**	**0.07**	0.05 U
Zn	410	960	377	**411**	**572**	**332**	**208**	**272**	**699**	**1,130**	**186**
LPAH (mg/kg OC)											
Acenaphthene	16	57	2 U	2.7 U	17 U	6 U	5 U	8 U	**18**	**24**	3 U
Acenaphthylene	66	66	2 U	2.7 U	17 U	6 U	5 U	8 U	**2**	**6** U	3 U
Anthracene	220	1,200	2 U	**2.7**	17 U	**7**	**6**	8 U	**18**	**31**	3 U
Fluorene	23	79	2 U	2.7 U	**17**	**7**	5 U	8 U	**19**	**28**	3 U
Naphthalene	99	170	2 U	0.9 U	5 U	6 U	5 U	8 U	**2**	**6** U	**3**
Phenanthrene	100	480	**8**	**6.7**	**40**	**30**	**36**	**34**	**141**	**229**	3 U
HPAH (mg/kg OC)											
Benzo(a)anthracene	110	270	**5**	**6**	**30**	**28**	**31**	**37**	**44**	**77**	3 U
Benzo(a)pyrene	99	210	**5**	**7**	**43**	**40**	**30**	**39**	**46**	**88**	**4**
Benzo (b+k)fluoranthene	230	450	**13**	**18**	**102**	**111**	**72**	**100**	**122**	**232**	**7**
Benzo(g,h,i)perylene	31	78	**3**	**3**	**28**	**23**	**15**	**22**	**19**	**34**	3 U
Chrysene	110	460	**9**	**9**	**55**	**49**	**45**	**53**	**60**	**108**	**4**
Dibenzo(a,h)anthracene	12	33	2 U	1 U	17 U	6 U	5 U	8 U	**9**	6 U	3 U
Fluoranthene	160	1,200	**16**	**13**	**101**	**92**	**76**	**99**	**154**	**284**	**6**
Indeno(1,2,3-c,d)pyrene	34	88	**4**	**3**	**35**	**26**	**17**	**24**	**23**	**39**	3 U
Pyrene	1,000	1,400	**12**	**12**	**73**	**87**	**57**	**87**	**113**	**196**	**7**
Phthalates (mg/kg OC)											
Bis(2-ethylhexyl)phthalate	47	78	**25**	**30**	**73**	**76**	**39**	**66**	**28**	**57**	**24**
Butylbenzylphthalate	4.9	64	**2**	**1.3**	17 U	6 U	5 U	8 U	**1**	6 U	3 U
Diethylphthalate	61	110	2 U	0.9 U	17 U	6 U	5 U	8 U	1 U	6 U	3 U
Dimethylphthalate	53	53	2 U	0.9 U	17 U	6 U	5 U	8 U	1 U	6 U	3 U
Di-n-butylphthalate	220	1,700	2 U	0.9 U	17 U	6 U	5 U	8 U	**3**	6 U	3 U
Di-n-octylphthalate	58	4,500	2 U	**1.1**	**17**	**12**	**5**	**9**	**3**	**6**	3 U
PCBs (mg/kg OC)											
Aroclor 1016			4 U	1.4 U	11 U	12 U	108 Y	125 U	0.4 U	3.6 U	3 U
Aroclor 1242			4 U	1.4 U	11 U	12 U	85 Y	125 U	0.4 U	3.6 U	3 U
Aroclor 1248			4 U	1.4 U	11 U	12 U	216 Y	250 U	0.4 U	3.6 U	3 U
Aroclor 1254			**16**	**24**	**54**	**96**	**2,793**	**921**	**3**	**95**	3 U
Aroclor 1260			**13** P	**6** P	**38**	**53**	342 Y	125 U	**4** P	**49**	3 U
Aroclor 1221			4 U	1.4 U	11 U	12 U	42 U	63 U	0.4 U	3.6 U	3 U
Aroclor 1232			4 U	1.4 U	11 U	12 U	126 Y	184 U	0.4 U	3.6 U	3 U
Total PCBs	12	65	**30** P	**30** P	**92**	**149**	**2,793**	**921**	**7** P	**144**	3 U
TPH (mg/kg)											
Diesel		2,000[a]	**88**	**40**	**120**	**120**	**120**	**47**	**110**	**200**	120 U
Motor Oil		2,000[a]	**380**	**190**	**270**	**210**	**680**	**190**	**380**	**1,000**	**290**

Detected values shown in bold type.
[a]MTCA Method A soil cleanup level for industrial use.
U = Chemical not detected at reported concentration
Y = Chemical not detected at the reported concentration. Reporting limit raised due to chromatographic interference.
J = Chemical concentration is reported as estimate.
P = Chemical detected on both chromatographic columns, but values differ by >40% RPD with no obvious interference.
Exceeds SQS
Exceeds CSL or MTCA Method A soil cleanup level for industrial use.

Table 4. Slip 4 Drainage Basin Inline Sediment Sample Results Compared to Sediment Management Standards

(Source: Integral 2006)

			Georgetown Flume Samples										
	SQS	CSL	T1 Flume 15' u/s of box culvert	T2 Flume at S Myrtle St	T5[1] Flume at S Myrtle St	T3 Flume upstream of S Willow St	T4 Head of flume	T6 MH100 u/s of E Marginal Wy S	P1 Flume off of 8" plugged pipe	P2 Flume off of 8" pipe near S Willow St	P3 Flume off of 15" plugged pipe	P4 Flume off of 8" pipe at S Myrtle St	P5 Ditch at S Myrtle St
Date			3/24/05 S	3/24/05 S	3/24/05 S	3/25/05 S	3/24/05 S	3/25/05 S	3/25/05 S	3/25/05 S	3/25/05 S	3/24/05 S	3/24/05 S
TOC (percent)			3.92	1.43	1.17	2.25	8.71	2.68	0.711	2.47	5.27	0.773	6.86
Metals (mg/kg DW)													
As	57	93	11	7 U	7 U	7 U	40	7 U	7 U	13	20	6 U	10 U
Cu	390	390	63.2	18.5	20.2	54.6	314 J	79.6	18	56.6	133	12.8	95.1
Pb	450	530	99	14	15	263	590 J	61	16	69	501	10	73
Hg	0.41	0.59	0.1	0.05 U	0.05 U	0.41	1.7	0.08	0.05 U	0.18	1	0.06 U	0.08
Zn	410	960	218	53.8	61.3	180	1,130	240	60.8	238	766	52.7	195
LPAH (mg/kg OC)													
Acenaphthene	16	57	7	1 U	2	17	8	3	3 U	2 U	2 U	2 U	23 U
Acenaphthylene	66	66	4	1 U	2	10	31	1 J	4	4	2 U	2	23 U
Anthracene	220	1,200	16	4	8	26	29	8	14	11	2	9	23 U
Fluorene	23	79	6	1 U	2 U	24	22	2	3 U	2 J	2 U	2 U	23 U
Naphthalene	99	170	8	1 U	2 U	4	28	2 U	3 U	2 U	2 U	2 U	23 U
Phenanthrene	100	480	115	3	6	276	126	28	14	10	10	18	23 U
HPAH (mg/kg OC)													
Benzo(a)anthracene	110	270	33	7	13	62	91	19	21	15	7	9	23 U
Benzo(a)pyrene	99	210	33	17	26	22	99	21	18	12	9	11	23 U
Benzo (b+k)fluoranthene	230	450	82	36	55	82	234	53	52	43	22	31	47 U
Benzo(g,h,i)perylene	31	78	15	6	11	9	29	8	7	5	4	4	23 U
Chrysene	110	460	59	11	18	67	96	28	32	26	10	21	12 J
Dibenzo(a,h)anthracene	12	33	6	2	4	2 J	11	2 J	3 U	1 J	2 U	2 U	23 U
Fluoranthene	160	1,200	161	14	22	271	207	60	75	49	21	63	15
Indeno(1,2,3-c,d)pyrene	34	88	17	6	10	10	34	8	8	5	4	4	23 U
Pyrene	1,000	1,400	82	9	15	147	161	45	42	34	18	30	17
Phthalates (mg/kg OC)													
Bis(2-ethylhexyl)phthalate	47	78	51	10	12	26	2	75	17	23	40	18	55
Butylbenzylphthalate	4.9	64	3	1 U	2 U	3 U	2 U	4	3 U	2 U	3	2 U	23 U
Diethylphthalate	61	110	2 U	1 U	2 U	3 U	2 U	2 U	3 U	2 U	2 U	2 U	23 U
Dimethylphthalate	53	53	2 U	1 U	2 U	3 U	2 U	2 U	3 U	2 U	2 U	2 U	23 U
Di-n-butylphthalate	220	1,700	2	1 U	2 U	3	2 U	2 U	3	3	3	2 U	23 U
Di-n-octylphthalate	58	4,500	2 U	1 U	2 U	3 U	2 U	2	3 U	9	3	2 U	23 U
PCBs (mg/kg OC)													
Aroclor 1016			2 U	1 U	0 U	124 U	3 U	1 U	2 U	3 U	493 U	1 U	3 U
Aroclor 1242			2 U	1 U	0 U	124 U	3 U	1 U	2 U	3 U	493 U	1 U	3 U
Aroclor 1248			2 U	1	1 J	124 U	17 J	3 U	4	9	493 U	1	3 U
Aroclor 1254			5	2 J	2 J	173	20	9	8 J	18	1,746	2 J	7 U
Aroclor 1260			4	2	2	124 U	6	6	5	5	493 U	2	22
Aroclor 1221			2 U	1 U	0 U	124 U	3 U	1 U	2 U	3 U	493 U	1 U	3 U
Aroclor 1232			2 U	1 U	0 U	124 U	3 U	1 U	2 U	3 U	493 U	1 U	3 U
Total PCBs	12	65	8	5	6	173	43	15	17	32	1,746	5	22
TPH (mg/kg)													
Diesel		2,000[a]	36	21	19	84	2,300	120	14	63	250	8.9	1,600
Motor Oil		2,000[a]	140	99	70	460	9,700	670	66	360	1,100	61	3,000

[1]T5 is duplicate of T2.

S = Seattle field split

B = Boeing field split

Table 5. Slip 4 Drainage Basin Catch Basin and Sediment Sample Results (DW) *(Source: Integral 2006)*

	SQS	CSL	CB37	CB44	CB45	CB46	CB48	CB79	CB80	RCB49	S1
Date			6/22/04	12/8/04	12/22/04	12/22/04	2/20/05	11/9/05	11/9/05	11/8/05	11/9/05
TOC (percent)			4.74	24.6	9.74	10.4	1.57	6.42	2.68	4.06	3.1
Metals (mg/kg DW)											
As	57	93	20 U	**12**	**20**	**20**	**12**	**30**	6 U	20 U	**11**
Cu	390	390	**173**	**142**	**6,320**	**5,660**	**51.5**	**207**	**85.2**	**85**	**69.9**
Pb	450	530	**250**	**123**	**481**	**396**	**343**	**114**	**29**	**79**	**73**
Hg	0.41	0.59	**0.08**	**0.12**	**0.30**	**0.20**	**0.32**	**0.2**	0.05 U	0.05 U	**0.14**
Zn	410	960	**1,220**	**524**	**3,420**	**3,530**	**657**	**758**	**268**	**357**	**172**
LPAH (ug/kg DW)											
Acenaphthene			**170**	140 U	**760**	1,600 U	**130**	90 U	**66**	20 U	35 U
Acenaphthylene			140 U	140 U	390 U	1,600 U	59 U	90 U	42 U	20 U	35 U
Anthracene			**820**	140 U	**2,100**	**5,000**	**110**	**6,400**	**67** M	**16** J	**21** J
Fluorene			**350**	140 U	**1,300**	**3,000**	**130**	**1,300**	**340**	20 U	35 U
Naphthalene			140 U	140 U	390 U	1,600 U	**470**	**160**	**89**	20 U	35 U
Phenanthrene			**3,000**	**220**	**17,000**	**35,000**	**3,100**	**1,700**	**1,100**	**68**	**78**
HPAH (ug/kg DW)											
Benzo(a)anthracene			**610**	140 U	**13,000**	**27,000**	**1,300**	**730**	**160**	**60**	**81**
Benzo(a)pyrene			**200**	140 U	**15,000**	**32,000**	**1,400**	**830**	**170**	**120**	**140**
Benzo(b)fluoranthene			**480**	**180**	**15,000**	**34,000**	**3,100**	**1,200**	**250** M	**200**	**250**
Benzo(k)fluoranthene			**320**	**180**	**15,000**	**34,000**	**1,500**	**1,300**	**240** M	**170**	**190**
Benzofluoranthenes			**800**	**360**	**30,000**	**68,000**	**4,600**	**2,500**	**490** M	**370**	**440**
Benzo(g,h,i)perylene			140 U	140 U	**7,300**	**16,000**	**660**	**570**	**140**	**110**	**87**
Chrysene			**1,000**	**290**	**20,000**	**43,000**	**2,100**	**1,800**	**400**	**120**	**160**
Dibenzo(a,h)anthracene			140 U	140 U	**2,700**	**5,400**	**99**	**150**	42 U	**14** J	**35**
Fluoranthene			**3,600**	**410**	**31,000**	**85,000**	**4,700**	**1,700**	**360**	**180**	**190**
Indeno(1,2,3-c,d)pyrene			140 U	140 U	**8,600**	**19,000**	**940**	**410**	**62**	**41**	**61**
Pyrene			2,600	**290**	**23,000**	**49,000**	**3,100**	**5,300**	**1,000**	**180**	**290**
Phthalates (ug/kg DW)											
Bis(2-ethylhexyl)phthalate			**1,600**	**3,910**	**8,800**	**30,000**	**88**	**120,000**	**38,000**	**1,400**	**5,500**
Butylbenzylphthalate			**1,300**	**430**	**490**	1,600 U	59 U	90 U	**1,800**	**1,100**	**140**
Diethylphthalate			140 U	140 U	390 U	1,600 U	59 U	90 U	42 U	20 U	35 U
Dimethylphthalate			**280**	**850**	**620**	1,600 U	59 U	90 U	**1,900**	**44**	35 U
Di-n-butylphthalate			140 U	140 U	**1,200**	1,600 U	59 U	90 U	360 B	54 B	63 B
Di-n-octylphthalate			140 U	140 U	1,200	1,600 U	59 U	**4,000**	**1,800**	**79**	35 U
PCBs (ug/kg DW)											
Aroclor 1016			20 U	20 U	58 U	47 U	19 U	99 U	98 U	98 U	99 U
Aroclor 1242			20 U	20 U	58 U	47 U	19 U	99 U	98 U	98 U	99 U
Aroclor 1248			20 U	20 U	58 U	47 U	19 U	99 U	98 U	98 U	99 U
Aroclor 1254			20 U	49 Y	**170**	**250**	**250**	**160**	98 U	98 U	99 U
Aroclor 1260			20 U	**180**	**300**	**430**	77 Y	**140**	98 U	98 U	99 U
Aroclor 1221			20 U	20 U	58 U	47 U	19 U	99 U	98 U	98 U	99 U
Aroclor 1232			20 U	20 U	58 U	47 U	19 U	99 U	98 U	98 U	99 U
Total PCBs			20 U	**180**	**470**	**680**	**250**	**300**	98 U	98 U	99 U
TPH (mg/kg)											
Diesel			**180**	**85**	**950**	**1,900**	**98**	**6,000**	**1,200**	**68**	**280**
Motor Oil			**650**	**790**	**4,700**	**4,600**	**210**	**13,000**	**2,300**	**450**	**1,500**

Detected values shown in bold type.
U = Chemical not detected at reported concentration
Y = Chemical not detected at the reported concentration. Reporting limit raised due to chromatograhic interference.
P = Chemical detected on both chromatographic columns, but values differ by >40% RPD with no obvious interference.
M = Estimated value. Analyte detected and confirmed by analyst, but spectral match patterns are low.
J = Chemical concentration is reported as estimate.
B = Chemical detected in laboratory blank.

Exceeds SQS (grey shading)
Exceeds CSL or MTCA Method A soil cleanup level (black shading)

Table 6. Slip 4 Drainage Basin Catch Basin and Sediment Samples Compared to Sediment Management Standards

(Source: Integral 2006)

	SQS	CSL	CB37	CB44	CB45	CB46	CB48	CB79	CB80	RCB49	S1
Date			6/22/04	12/8/04	12/22/04	12/22/04	2/20/05	11/9/05	11/9/05	11/8/05	11/9/05
TOC (percent)			4.74	24.6	9.74	10.4	1.57	6.42	2.68	4.06	3.1
Metals (mg/kg DW)											
As	57	93	20 U	**12**	**20**	**20**	**12**	**30**	6 U	20 U	**11**
Cu	390	390	**173**	**142**	**6,320**	**5,660**	**52**	**207**	**85.2**	**85**	**69.9**
Pb	450	530	**250**	**123**	**481**	**396**	**343**	**114**	**29**	**79**	**73**
Hg	0.41	0.59	**0.08**	**0.12**	**0.30**	**0.20**	**0.32**	**0.2**	0.05 U	0.05 U	**0.14**
Zn	410	960	**1,220**	**524**	**3,420**	**3,530**	**657**	**758**	**268**	**357**	**172**
LPAH (mg/kg OC)											
Acenaphthene	16	57	**4**	1 U	**8**	15 U	**8**	1 U	**2**	0.5 U	1 U
Acenaphthylene	66	66	**3** U	1 U	4 U	15 U	4 U	1 U	2 U	0.5 U	1 U
Anthracene	220	1,200	**17**	1 U	**22**	**48**	**7**	**100**	**3** M	**0.4** J	**1** J
Fluorene	23	79	**7**	1 U	**13**	**29**	**8**	**20**	**13**	0.5 U	1 U
Naphthalene	99	170	3 U	1 U	4 U	15 U	**30**	**2**	**3**	0.5 U	1 U
Phenanthrene	100	480	**63**	**1**	**175**	**337**	**197**	**26**	**41**	**2**	**3**
HPAH (mg/kg OC)											
Benzo(a)anthracene	110	270	**13**	1 U	**133**	**260**	**83**	**11**	**6**	**1**	**3**
Benzo(a)pyrene	99	210	**4**	1 U	**154**	**308**	**89**	**13**	**6**	**3**	**5**
Benzo(b)fluoranthene	---	---	**10**	**1**	**154**	**327**	**197**	**19**	**9** M	**5**	**8**
Benzo(k)fluoranthene	---	---	**7**	**1**	**154**	**327**	**96**	**20**	**9** M	**4**	**6**
Benzo(b+k)fluoranthenes	230	450	**17**	**1**	**308**	**654**	**293**	**39**	**18** M	**9**	**14**
Benzo(g,h,i)perylene	31	78	3 U	1 U	**75**	**154**	**42**	**9**	**5**	**3**	**3**
Chrysene	110	460	**21**	**1**	**205**	**413**	**134**	**28**	**15**	**3**	**5**
Dibenzo(a,h)anthracene	12	33	3 U	1 U	**28**	**52**	**6**	**2**	2 U	**0** J	**1**
Fluoranthene	160	1,200	**76**	**2**	**318**	**817**	**299**	**26**	**13**	**4**	**6**
Indeno(1,2,3-c,d)pyrene	34	88	3 U	1 U	**88**	**183**	**60**	**6**	**2**	**1**	**2**
Pyrene	1,000	1,400	**55**	**1**	**236**	**471**	**197**	**83**	**37**	**4**	**9**
Phthalates (mg/kg OC)											
Bis(2-ethylhexyl)phthalat	47	78	**34**	**16**	**90**	**288**	**6**	**1,869**	**1,418**	**34**	**177**
Butylbenzylphthalate	5	64	**27**	**2**	**5**	15 U	4 U	1 U	**67**	**27**	**5**
Diethylphthalate	61	110	3 U	1 U	4 U	15 U	4 U	1 U	2 U	0.5 U	1 U
Dimethylphthalate	53	53	**6**	**3**	**6**	15 U	4 U	1 U	**71**	**1**	1 U
Di-n-butylphthalate	220	1,700	3 U	1 U	**12**	15 U	4 U	1 U	13 B	1 B	2 B
Di-n-octylphthalate	58	4,500	**3**	**1**	**12**	**15**	**4**	**62**	**67**	**2**	1 U
PCBs (mg/kg OC)											
Aroclor 1016			0.4 U	0.1 U	0.6 U	0.5 U	1.2 U	1.5 U	3.7 U	2.4 U	3.2 U
Aroclor 1242			0.4 U	0.1 U	0.6 U	0.5 U	1.2 U	1.5 U	3.7 U	2.4 U	3.2 U
Aroclor 1248			0.4 U	0.1 U	0.6 U	0.5 U	1.2 U	1.5 U	3.7 U	2.4 U	3.2 U
Aroclor 1254			0.4 U	0.2 Y	**1.7**	**2.4**	**15.9**	**2.5**	3.7 U	2.4 U	3.2 U
Aroclor 1260			0.4 U	**0.7**	**3.1**	**4.1**	4.9 Y	**2.2**	3.7 U	2.4 U	3.2 U
Aroclor 1221			0.4 U	0.1 U	0.6 U	0.5 U	1.2 U	1.5 U	3.7 U	2.4 U	3.2 U
Aroclor 1232			0.4 U	0.1 U	0.6 U	0.5 U	1.2 U	1.5 U	3.7 U	2.4 U	3.2 U
Total Aroclor	12	65	0.4 U	**0.7**	**4.8**	**6.5**	**15.9**	**4.7**	3.7 U	2.4 U	3.2 U
TPH (mg/kg)											
Diesel	2,000[a]		**180**	**85**	**950**	**1,900**	**98**	**6,000**	**1,200**	**68**	**280**
Motor Oil	2,000[a]		**650**	**790**	**4,700**	**4,600**	**210**	**13,000**	**2,300**	**450**	**1,500**

Detected values shown in bold type.

[a]MTCA Method A soil cleanup level for unrestricted use.

U = Chemical not detected at reported concentration

Y = Chemical not detected at the reported concentration. Reporting limit raised due to chromatograhic interference.

M = Estimated value. Analyte detected and confirmed by analyst, but spectral match patterns are low.

J = Chemical concentration is reported as estimate.

B = Chemical detected in laboratory blank.

Exceeds SQS

Exceeds CSL or MTCA Method A soil cleanup level

Table 7. Storm Drain Solid Material: September–October Sampling (DW)
North Boeing Field
(Source: Boeing 2005)

PCBs (ug/kg DW)	CB113 9/26/2005 IO61I	CB114 9/26/2005 IO61J	CB173 9/26/2005 IO61A	CB173 10/24/2005 IR18A	CB173 10/24/2005 IR18B	CB174 10/24/2005 IR18D	CB175 10/24/2005 IR18C	CB174A 10/24/2005 IR18F	CB193 10/27/2005 IR42A	CB194 20/24/2005 IR18E	CB209B 9/26/2005 IO61K
Aroclor 1016	4 U	0.16 U	27 U	5.4 U	5.1 U	0.8 U	0.23 U	0.36 U	0.77 U	0.67 U	0.033 U
Aroclor 1221	4 U	0.16 U	27 U	54 U	20 U	0.8 U	0.23 U	0.36 U	0.77 U	0.67 U	0.033 U
Aroclor 1232	4 U	0.16 U	27 U	270 U	100 U	9.6 U	2.1 U	0.36 U	3.8 U	0.67 U	0.033 U
Aroclor 1242	4 U	0.16 U	570	5.4 U	5.1 U	0.8 U	0.23 U	0.36 U	0.77 U	0.67 U	0.033 U
Aroclor 1248	4 U	0.16 U	27 U	**200 J**	**87**	**5.8**	**1.2**	1.1 U	0.77 U	**3.0**	0.033 U
Aroclor 1254	**16**	**0.26**	**740**	**200 J**	**160**	**6.0**	**1.3**	**7.2**	**14**	**8.8**	**0.066**
Aroclor 1260	**12**	**0.61**	27 U	5.4 U	5.1 U	**1.9**	**0.38**	0.71 U	**2.5**	**2.3**	0.033 U
PCB, Total	**28**	**0.87**	**1,310**	**400**	**247**	**13.7**	**2.88**	**7.2**	**16.5**	**14.1**	**0.07**

U - Compound was undetected at the reported concentration.
J - Analytes were positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Table 7. Storm Drain Solid Material: September–October Sampling (DW)
North Boeing Field
(Source: Boeing 2005)

PCBs (ug/kg DW)	MH130 9/26/2005 IO61G	MH133D 9/26/2005 IO61F	MH179 9/26/2005 IO61C	MH179A 9/26/2005 IO61B	MH187 10/4/2005 IP31A	MH193 9/26/2005 IO61E	OWS132 9/26/2005 IO61H	OWS186 9/26/2005 IO61D
Aroclor 1016	0.26 U	0.031 U	0.4 U	0.26 U	0.41 U	6.4 U	4.2 U	4.8 U
Aroclor 1221	0.26 U	0.031 U	0.4 U	0.26 U	0.41 U	6.4 U	4.2 U	4.8 U
Aroclor 1232	0.26 U	0.031 U	0.4 U	0.26 U	0.41 U	6.4 U	4.2 U	4.8 U
Aroclor 1242	0.26 U	0.031 U	0.4 U	0.26 U	0.41 U	6.4 U	4.2 U	**38**
Aroclor 1248	**1.0**	0.031 U	**6.9**	**2.2**	0.41 U	**36**	4.2 U	4.8 U
Aroclor 1254	**1.3**	**0.05**	**8.4**	**1.5**	**8.1**	**48**	**12**	**11**
Aroclor 1260	0.26 U	**0.061**	0.4 U	0.26 U	**1.1**	6.4 U	4.2 U	4.8 U
PCB, Total	**2.3**	**0.111**	**15.3**	**3.7**	**9.2**	**84**	**12**	**49**

U - Compound was undetected at the reported concentration.
J - Analytes were positively identified; the associated numerical value is the approximate concentration of the analyte in the sample.

Table 8. King County International Airport Tenant Inspections

Tenant	Address	Initial Screening: Potential Source of Contaminants	Inspection Conducted	In Compliance (as of 12/31/05)**
American Avionics, Inc.	7023 Perimeter Rd S	NO	N/A	N/A
Helijet	7277 Perimeter Rd. S.	NO	N/A	N/A
Kenmore Air		NO	N/A	N/A
King County Public Health – Asthma	7300 Perimeter Rd. S.	NO	N/A	N/A
King County Sheriff's Office – Special Operations, Office of Emergency Management	7300 Perimeter Rd. S.	NO	N/A	N/A
Opportunity Skyway	6524 Ellis Ave. S.	NO	N/A	N/A
San Juan Airlines	7277 Perimeter Rd. S.	NO	N/A	N/A
Air Lift Northwest	6987 Perimeter Rd. S.	YES	YES	YES
Airpac Airlines	7001 Perimeter Rd. S.	YES	YES	YES
Classic Helicopters	6505 Perimeter Rd. S.	YES	YES	YES
Federal Aviation Administration	6526 Ellis Ave. S.	YES	YES	YES
Galvin Flying Service, Inc.	7001 Perimeter Rd. S.	YES	YES	YES
Galvin Flying Service, Inc.	7023 Perimeter Rd. S.	YES	YES	YES
Galvin Flying Service, Inc.	7149 Perimeter Rd. S.	YES	YES	YES
Galvin Flying Service, Inc.	7201 Perimeter Rd. S.	YES	YES	YES
Galvin Flying Service, Inc.	6987 Perimeter Rd. S.	YES	YES	YES
Georgetown Management	6801 Perimeter Rd. S.	YES	YES	YES
King County Maintenance Facility	6518 Ellis Ave. S.	YES	YES	YES
King County Surplus Storage	6530 Ellis Ave. S.	YES	YES	NO
Mente LLC	6771 Perimeter Rd. S.	YES	YES	YES
National Aviation	7170 Perimeter Rd. S.	YES	YES	YES
NE T-Hangars	6300 Perimeter Rd. S.	YES	YES	NO
Olde Thyme Aviation	6505 Perimeter Rd. S.	YES	YES	YES
Shultz Distributing Inc.	1495 S. Hardy St.	YES	YES	NO
Starbucks Coffee Company – Corporate Aviation	6771 Perimeter Rd. S.	YES	YES	YES
WA Air National Guard	6736 Ellis Ave S	YES	YES	YES

** Facility is in compliance with applicable stormwater, industrial waste, and hazardous waste handling requirements.

Table 9. Sites Where Source Control Effectiveness Has Been Assessed or Controlled

Name	Address	Status
Boeing Electronic Manufacturing	7300 Perimeter Rd S	Cleanup of chlorinated VOCs under VCP, groundwater not a source to Slip 4
Puget Sound Energy	6349 18th Ave S	Gasoline UST removed. Clean closure. All contamination removed.
WA Air National Guard	6736 Ellis Ave S	Remediation of chlorinated solvents complete. NFA after assessment, VCP.

Appendix A

Information on Historic Uses:
Adjacent and Upland Properties

Slip 4

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The purpose of this appendix is to document the available information on past uses of the properties adjacent to and upgradient of Slip 4. In addition, environmental sampling and cleanup activities prior to the mid-1990s are described and summarized. Properties adjacent to and upgradient of Slip 4 are shown in Figure A1.

A1. Georgetown Steam Plant and Flume

A1.1 Georgetown Steam Plant (GTSP)

The Seattle City Light Georgetown Steam Plant (GTSP) property is located on the northwest corner of King County International Airport/Boeing Field. The property contains the old powerhouse, which currently houses the Georgetown Power Plant Museum. The condenser pit in the powerhouse is connected to the GTSP flume and, until the 1960s, discharged cooling water from the steam plant to the flume. Figure A2 depicts the historic site features discussed below.

Past Use

The powerhouse was built in 1906 by Seattle Electric Company. It contained three turbo-generators: a 3,000 kW unit, an 8,000 kW unit, and a 10,000 kW unit installed in 1907, 1908, and 1917, respectively (Bridgewater Group 2000). When the plant was constructed, it was located along an oxbow of the Duwamish River. The following is a brief history of the property:

- Puget Sound Traction Power and Light Company (later Puget Sound Power and Light, now Puget Sound Energy) purchased Seattle Electric Company in 1912. After the purchase, the use of the steam plant declined. For a period of time, the plant was only used to supply steam to the company's car barns (Bridgewater Group 2000).
- In 1917, the oxbow near the plant was filled during the construction of the Duwamish Waterway. At that time, a pump house was built northwest of Slip 4 to supply feed water to the steam plant boilers, and the GTSP flume was constructed to carry the cooling water back to the waterway. A third turbine generator was installed. Steam to operate the plant was supplied by 16 boilers, which were fired with fuel oil or coal. From 1925 to 1945, the boilers were fired with coal (Bridgewater Group 2000).
- In 1951, the City of Seattle Department of Lighting (now Seattle City Light) purchased the property. The plant produced power for the area until the winter of 1964 (SEA 2004).
- In 1952, The Boeing Company leased part of the property. This included the area where the flume is located and areas adjacent to the flume. A facility drawing indicates that an oil-filled sump and transformers were present on the property (Boeing 1965). Boeing constructed buildings in the leased area, including a fuel laboratory. A portion of the flume was rerouted prior to building construction (Boeing 2005d, Boeing 2006c). Storage tanks for fuel and other materials were installed, as well as storm drains and water pipes (SEA 2004). In 1954, the City of Seattle allowed Boeing to connect a catch basin to a 24-inch City of Seattle sewer line located west of the steam plant building (Bridgewater Group 2000, City of Seattle 1954).

- In 1961, Boeing was allowed to use an area at the north end of the King County International Airport for fire drill training (located east of the steam plant property). This area is referred to as the North Boeing Field Fire Training Pit. In 1967, the City of Seattle gave Boeing a temporary permit to conduct fire training in an area approximately 50 feet southeast of the GTSP. This area is referred to as the former Boeing Fire Training Pit, although there is no indication that it was ever a "pit." Aerial photographs show an airplane fuselage was present at the time in this location. The permit expired in 1974 (SEA 2004).
- In 1963, a portion of the original GTSP property, including a large concrete oil storage tank, a warehouse, and a machinery shop, was sold to King County (Bridgewater Group 2000).
- The last production run of the steam plant was in the winter of 1964. From 1971 to 1977, the plant was maintained on "cold standby" (SEA 2004).
- In 1977, the plant was officially retired.
- In 1978, it was listed on the National Register of Historic Places.
- In 1980, the site was designated a national Historic Mechanical Engineering Landmark.
- In 1984, the plant became a City of Seattle Landmark (SEA 2004), and a National Historic Landmark.
- Since 1987, the plant has been a museum (Goldberg 2006a).
- During 1995 and 1996, King County expanded its operations onto the site. This included placement of soil piles on GTSP property (Bridgewater Group 2000).

Environmental Sampling/Cleanup

A number of environmental investigations have been conducted at the GTSP. Areas of chemical contamination were identified on the property, in sediments of the flume, and in Boeing storm drains connected to the flume. Contaminated soils and sediments have been removed from the site and flume in the past.

In 1978, Ecology inspected the site and noted that the large concrete oil storage tank was leaking. Replacement of the tank and lining of two sumps in front of the tank was recommended. Oil in the tank contained polychlorinated biphenyls (PCBs) at concentrations up to 3.4 mg/kg. The tank was demolished in approximately 1988. No PCBs were detected in any of the soil or concrete samples collected in the vicinity of the concrete oil storage tank (Bridgewater Group 2000).

Oil samples collected by Seattle City Light in 1980 from three oil feed underground storage tanks (USTs) located adjacent to the southwest corner of the Steam Plant were analyzed for PCBs. Results showed 10, 7, and 20 mg/kg respectively, in Tanks 1, 2, and 3. Soil samples collected at depths ranging from 0 to 15 inches and 120 to 126 inches did not show PCBs at a detection limit of 1 mg/kg (Bridgewater Group 2000).

In 1982, Environmental Protection Agency (EPA) investigations found metals, polynuclear aromatic hydrocarbons (PAHs), and PCBs in Duwamish waterway sediments in Slip 4 (Raven Systems & Research 1988). Sampling by Metro confirmed the presence of PCBs in the flume and in a Boeing storm drain (SEA 2004). Samples collected in 1984 confirmed PCB in soils on low-lying areas of the GTSP property, ranging from less than 0.1 to 91,000 mg/kg (Raven Systems and Research 1988). PCBs were also found in a drainage ditch leading from the northern part of King County International Airport (0.2 to 8.9 mg/kg) and in adjacent areas of the airport and Boeing-leased property under paved areas (190 to 223 mg/kg) (Raven 1988).

Overflow from the low-lying area flowed into the storm drain system at North Boeing Field which discharged to the head of the flume (Raven 1988). This drainage system also received runoff from North Boeing Field, the former Boeing Fire Training Pit, and the North Boeing Field Fire Training Pit. In 1984, based on the presence of PCBs, Seattle City Light covered the drainage ditch and low-lying area with plastic, and King County diverted surface runoff from northern Boeing Field in order to minimize flow into the ditch and low-lying area (SEA 2004).

In 1985, Ecology performed a preliminary site assessment and identified North Boeing Field and the Georgetown Steam Plant as a potential source of PCBs, lead, and petroleum products (Ecology 1985).

During the late fall of 1985, Seattle City Light performed a cleanup of the unpaved low-lying areas, some drains into the flume, and the flume. Contaminated soils and sediments were removed and unpermitted connections into the flume were sealed. Subsequent sampling of the cleaned areas indicated that PCB concentrations were reduced to 11 mg/kg or less (Raven 1988, SEA 2004).

After the cleanup and the sealing of unpermitted drains, the flume continued to operate as a point of discharge for two permitted cooling water discharges from Boeing facilities. Overflow from low-lying areas at GTSP continued to enter the flume through a Boeing storm drain connected to the head of the flume (Raven 1988).

In 1986, Seattle City Light collected additional samples from the drainage ditch and flume. PCBs as Aroclor 1254 were detected in drainage ditch sediments at concentrations ranging from 4 to 15 mg/kg and in flume samples ranging from 1 to 123 mg/kg. The highest concentration was immediately downstream of where the discharge tunnel connects to the flume. Based on the renewed detection of PCBs, Boeing was notified by Seattle City Light of the need to terminate the two permitted cooling water connections to the flume. Samples collected in 1988 between the head of the flume and S. Myrtle Street showed concentrations of PCBs ranging from 0.25 to 14.26 mg/kg with highest concentrations found again at the head of the flume (Bridgewater Group 2000).

From 1989 to 1991, Seattle City Light continued to test the flume for PCBs. PCB concentrations ranged from 103 to 1.6 mg/kg, with concentrations decreasing with distance from the GTSP to less than 1 mg/kg at the Myrtle Street culvert. The same decrease in concentrations away from the GTSP was seen in the results from the 1998 sampling of the flume (Bridgewater Group 2002 and 2000, Raven Services Corporation 1989-1991).

Seattle City Light collected water and oil samples from the GTSP underground water tank in 1987. This tank was located south of the large, concrete oil storage tank (Figure A2). There were no PCBs above laboratory detection limits; however, oil and grease were detected in one sample at 20 mg/L. Copper and zinc were detected at 0.036 and 0.047 mg/L respectively in another sample. After emptying the tank, analysis showed the sludges in the tank contained PCBs as Aroclor 1260 at concentrations ranging from 1.3 to 2 mg/kg (Bridgewater Group 2000).

During 1988 and 1989, three feed oil USTs that formerly supplied oil to the boilers of the steam plant, the large concrete oil storage tank north of the site, and the steam plant diesel tank were all removed. No PCBs were found in soil samples collected when these tanks were removed (SEA 2004, Bridgewater Group 2000). A series of soil samples from these locations were also tested for petroleum hydrocarbons. Oil and grease, thin layer chromatography (TLC) PAHs, and TLC hydrocarbons were detected at 3,660, 200, and 250 mg/kg respectively in one soil sample collected at a depth of 14 feet near the large concrete storage tank. Another sample in this area had 60,000 mg/kg of TLC PAHs at a depth of 21 feet. Oil and grease were detected in a 0- to 1.2-foot-deep sample collected near the north feed oil UST at a concentration of 35,690 mg/kg. TPH concentrations in samples from the excavation of the three feed oil USTs ranged from 8.6 to 67,600 mg/kg (Bridgewater Group 2000).

In 1989, Seattle City Light collected soil, water, and surface wipe samples at the pump house that supplied water to the steam plant, located north of Slip 4 on the Duwamish Waterway. None of these samples showed PCBs at levels above the detection limits (Raven Services Corporation 1989–1991, Bridgewater Group 2000).

In September 1999, the GTSP site was added to Ecology's list of confirmed and suspected sites. Ecology and Public Health – Seattle and King County conducted a site hazard assessment at GTSP in 2001. The site was assigned a Washington Ranking Method ranking of 5 out of 5 (lowest level of concern for risk to human health and the environment.)

Environmental sampling conducted after 1999 is discussed in Section 3.4.1 of this Action Plan.

A1.2 Georgetown Flume

Current configuration and uses of the Georgetown Flume are described in Section 3.1.5 of this Action Plan. The Georgetown Flume (Figure A-3) was originally constructed to discharge cooling water from the GTSP into the Duwamish Waterway after the river was straightened in 1916. Except for annual test runs, routine cooling water discharges were discontinued in the 1960s when the steam plant was shut down (SEA 2004). At one time, the flume was a conduit for industrial wastewater discharges and runoff from an estimated 11.5 acres of the north end of the airport.

City-owned property adjacent to the flume has been leased to Boeing. As industrial development occurred in the area, discharge pipes from nearby properties and facilities were connected to the flume at numerous locations along its length. These included both permitted and unpermitted connections for stormwater, cooling water, and industrial wastewater discharges. Some documented examples of connections and uses of the flume are listed below:

- In 1962, overflow from an oil yard drain pit on the Boeing property was discharged to the flume via a 6-inch iron pipe (Bridgewater Group 2000).

- In 1964, Seattle City Light issued a permit (Permit No. 6-6131-202) to Boeing for the discharge of 600 gallons per minute (gpm) of cooling water into the flume near S. Myrtle Street (Van Hollebeke 1968).

- In 1969, Boeing was allowed to discharge an additional 100 gpm of cooling water from the hydraulic system of a testing machine and received a replacement permit to discharge a total of 700 gpm of cooling water into the flume. Both discharges were combined under a single temporary permit (6-6003-11-122) in 1969 (Henry 1969, Scarvie 1969, Bridgewater Group 2000)

- In 1965, a storm drain (distinct from the permit discharges described above) from the Boeing property was connected to the flume at the downstream end of the tunnel section and discharged to the flume until at least the mid-1980s. Sampling of this storm drain in 1984 found PCBs up to 520 mg/kg, and the drain was subsequently cleaned (Raven 1988, Bridgewater Group 2000). Based on Boeing facility plans (drawings 10-000-4504/SH M-1 and C3.YD-C100, dated 1985 and 1988, respectively), it appears that this drain was re-plumbed to King County (KC) Airport SD #3 sometime between 1985 and 1988. A City survey of the flume conducted in 2005 confirmed that this drain no longer connects to the flume (Herrera 2005).

- The flume was used by Boeing as a containment area for a 10,000-gallon methylene chloride tank beginning in 1982 (SCL 1982, Bridgewater Group 2000).

- Compressor cooling water from Boeing's Building 3-302 was discharged to the flume until 1987, when it was rerouted to the public storm drain (Cherberg 1987).

- A 1984–1985 survey mapped connections to the flume downstream of the two 42-inch concrete pipes (Geissinger 2003). Twenty-nine undocumented drains into the flume were located and closed. (The Seattle Engineering Department was notified, and City-side information cards stating "City Light Flume - Allow No Connections" were installed as a measure to prevent further connections to the flume.) Most were re-plumbed to the King County International Airport drainage system (KC Airport SD #3/PS44 EOF).

- In 1986, lubricating oil (maximum 10 gallons) was spilled to the flume from North Boeing Field (Wooten 1986).

- Boeing permits for cooling water discharge and use of the flume for containment of methylene chloride spills were discontinued in 1987.

The Willow Street Substation is unpaved and slopes toward the flume. Transformers were reportedly installed at this location in the 1960s, and were replaced in 1996 and 1998 with non-PCB transformers (Goldberg 2006b). No sampling has been conducted at this location.

The former Ellis Substation, located on the east side of the flume, just south of S. Myrtle Street, was decommissioned in 1990. A composite soil sample consisting of 10 subsamples, collected between the substation and the flume in 1984, contained 0.071 mg/kg PCBs (Raven 1991). In November of 1990, Seattle City Light sampled two transformer tap changers. PCBs were detected at concentrations of 12.1 and 9.2 mg/kg. The four concrete and four soil samples detected PCBs in one of the concrete samples at 0.2 mg/kg and in two of the soil samples at 0.1 and 0.5 mg/kg (Raven 1991). Additional samples were collected in 1991 from onsite soil and concrete equipment pads. PCBs were detected in two of the three soil samples (<0.1 to 0.5 mg/kg Aroclor 1254) and one of the four concrete samples (<0.1 to 0.2 mg/kg Aroclor 1254) (Raven 1991).

In February 1985 the U.S. Coast Guard investigated and Ecology cleaned up approximately 50 gallons of oil spilled into Slip 4 (Brugger 1985, Croll 1985). The spill was determined to be from the GTSP flume. Despite searching the entire length of the flume, no source was identified. Two oil samples contained 67 and 80 mg/L of PCBs (Brugger 1985).

A2. Crowley Marine Services

Past Use

The Crowley property (Tax Parcel 2136200641) is made up of two parcels. Parcel D is the southern two-thirds and Parcel F forms the northern one-third of the Crowley property (SEA 2004) (Figure A1). Past uses of these two parcels are summarized below (SEA 2004):

Parcel D, Southern Portion

- In 1904, this area was vacant.
- By 1929, the area was occupied by the Hydraulic Supply Manufacturing Company, a manufacturer of pipes, tanks, and perhaps hydraulic parts or equipment. At the time, the factory consisted of a main manufacturing building and a pipe-dipping vat located between this building and Slip 4, and a furnace located on the north end of the building apparently used to heat the vat located inside.
- By 1949, the Hydraulic Supply Manufacturing Company constructed a chain-manufacturing building between the pipe-dipping building and the Duwamish River. From this time until 1971, the buildings associated with this facility changed very little.
- By 1980, all structures were demolished, leaving uncovered soil.
- Between 1980 and 1985, what appears to be a loading ramp existed near the Crowley dock on the northern side of Slip 4.
- By 1985, the area was paved, the loading ramp was gone, and the dock that currently occupies the northwestern shoreline of Slip 4 was constructed.

Parcel D, Northern Portion

- In 1904, this area was vacant.

- By 1929, the Pankrantz Lumber Company occupied the site, including a large lumberyard, sawmill, refuse burner, boiler, and planer.
- In 1936, the lumber operation still existed. Logs were rafted in Slip 4 awaiting processing at the lumber mill. Milled lumber was stacked west of the buildings. A rail system with a working crane transported lumber between the storage area and the slip, and a rail spur extended from E. Marginal Way S. into the northern end of the facility.
- By 1946, all buildings once associated with Pankrantz Lumber were demolished and the site was being used as a pole yard.
- By 1949, two buildings had been constructed on the site and a pole-dipping tank had been installed at the terminus of the rail spur.
- By 1960, the pole-dipping tank had been removed and a building occupied the site. Logs were still bundled and rafted along the northwestern shoreline of Slip 4.
- By 1966, a steel-culvert manufacturing company occupied part of the site.
- By 1969, the area was almost vacant and remained so until at least 1980.
- By 1985, the area had been paved and was being operated as part of the Crowley container storage facility.

Parcel F

- In 1904, this area was vacant.
- Prior to 1929, the area was developed for residential use.
- By 1929, the area was occupied by the Washington Excelsior and Manufacturing Company, which manufactured excelsior (wood shaved into long, curly, straw-like pieces) for packing material.
- By 1950, part of the area of the former excelsior manufacturing operation was occupied by a manufacturer of aluminum windows and sashes.
- By 1985, the buildings that once housed the Washington Excelsior and Manufacturing Company had been demolished and much of the area was being used for shipping container storage.

Environmental Sampling/Cleanup

Parcel D

Several investigations to assess conditions resulting from past site uses have been conducted at Parcel D (SEA 2004; Hart Crowser 1989a).

In 1988, samples from soil borings at two locations in Parcel D were analyzed for arsenic, phenols, pesticides, PCBs, and volatile organic compounds (VOCs). Arsenic detected at up to 1,600 mg/kg exceeds Washington State Model Toxics Control Act (MTCA) Method A soil cleanup levels (SEA 2004). Monitoring wells installed in these borings were used to sample groundwater for metals, VOCs, semi-volatile organic compounds (SVOCs), pesticides, and PCBs. Arsenic and copper were found to exceed marine chronic surface water quality criteria.

In 1989, 33 additional soil samples were collected and two additional monitoring wells were installed and sampled to delineate the extent of arsenic contamination. Soil results indicated that elevated arsenic concentrations, up to 2,800 mg/kg, were limited to four hot spots in a 1-foot-thick layer of soil approximately 2.5 feet below ground surface (SEA 2004). The elevated arsenic was attributed to arsenic-containing wood preservatives used in the former pole-dipping facility. Arsenic concentrations in the additional monitoring wells did not exceed surface water quality criteria. This investigation concluded that migration of arsenic to the Duwamish River was not significant.

In early 1990, soil samples were collected from 14 additional soil borings throughout the site and analyzed for VOCs, SVOCs, PCBs, total petroleum hydrocarbons (TPH), chlorinated phenolics, and metals. Arsenic up to 1,760 mg/kg, TPH up to 29,000 mg/kg, carcinogenic PAHs (cPAHs) up to 1,396 mg/kg, and PCBs up to 2.5 mg/kg exceeded soil cleanup levels. These samples confirmed the localized zone of elevated arsenic found during previous investigations and identified additional areas of arsenic contamination in the vicinity of the former pole-dipping facility and an upland sediment disposal area located in the south-central portion of the site (SEA 2004). These soil samples identified additional areas of PAH contamination. Three additional monitoring wells were installed in the southwestern portion of the site and analyzed for VOCs, SVOCs, TPHs, chlorinated phenolics, and metals. Although several chemicals were detected in groundwater, only chrysene was detected—in a single sample—at a level (1.4 µg/L) exceeding water quality criteria. Based on a comparison of these results to nearby sediment data, Hart Crowser concluded that groundwater discharges from the site did not represent a threat to sediment quality (SEA 2004).

In late 1990, soil samples were collected from ten additional soil borings in the southwestern portion of the site and analyzed for arsenic, PAHs, and TPH. Arsenic and PAHs exceeded cleanup levels in a number of samples. Hart Crowser estimated that approximately 9,000 cubic yards of soil exceeded cleanup levels. Additional groundwater samples were also collected from seven existing wells and were analyzed for arsenic and PAHs. Carcinogenic PAHs exceeded water quality criteria for human consumption of aquatic organisms in four wells on the site.

There is no record of soil or groundwater remediation on Parcel D.

Parcel F

Several investigations to assess conditions resulting from past site use have been conducted at Parcel F, as described in SEA 2004.

In 1988, an 8,000-gallon diesel UST and a 2,000-gallon gasoline UST were removed from the northeastern portion of the property. Confirmation samples from both tank excavations indicated contaminant concentrations in remaining soil were below applicable cleanup levels.

In 1989, soil samples from the central and eastern portions of the parcel were collected and analyzed for pesticides, PCBs, and VOCs (Hart Crowser 1989b). PCBs were detected in samples collected beneath two storage sheds at concentrations of 120 µg/kg and 890 µg/kg, and endosulfan I was detected at a concentration of 17.7 µg/kg, which is well below the MTCA Method B cleanup level (21,000 mg/kg). In addition, methylene chloride (8 µg/kg), ethylbenzene (up to a maximum of 96 µg/kg), toluene (up to 120 µg/kg), and total xylenes (640 µg/kg) were detected. However, none of the contaminants detected exceeded MTCA Method A soil cleanup levels for industrial sites. Two monitoring wells were installed; one in the diesel UST excavation and the other in one of the soil borings. Groundwater was sampled for metals, VOCs, SVOCs, pesticides, and PCBs. Few chemicals were detected, and only copper was detected above the marine chronic surface water criterion in one of the monitoring wells.

In 1990, soil samples were collected from five borings and analyzed for PCBs, TPH, VOCs, SVOCs, and metals. TPH exceeded cleanup levels in two surface samples collected in areas of visible soil staining. Several VOCs, SVOCs, and metals were detected in subsurface samples; however, none exceeded MTCA cleanup levels for industrial soils. PCBs were not detected. Three monitoring wells were installed and sampled for VOCs, SVOCs, PCBs, TPH, and metals. Bis(2-ethylhexyl)phthalate (BEHP) was detected above the surface-water quality criterion for the human consumption of aquatic organisms. Copper exceeded the marine chronic surface water quality criterion in one well. PCBs and TPH were not detected.

Except for the UST removals there are no records of soil or groundwater remediation on Parcel F.

In 1997 an equipment malfunction at Crowley resulted in a spill of 1 gallon of hydraulic oil (Ecology 2001).

A3. First South Properties

Past Use

The site was previously occupied by Washington Machinery and Storage Company, J.A. Jack & Son Lime Plant, and Northwest Precote. This property is also known as Parcel E. These past uses are summarized below (SEA 2004):

Washington Machinery and Storage Company

- In 1929, the Washington Machinery and Storage Company occupied a portion of the site. Facilities included a machine shop, and a railroad spur extended from E. Marginal Way S. into the property.
- By 1949, the facility expanded to include a separate building that housed an office and a laboratory. Grounds surrounding the machine shop were used to store machinery.
- In 1969, the Washington Machinery and Storage Company still appeared to be in operation, and the same buildings were present.
- By 1985, the office and laboratory building still existed, but the machine shop was gone.
- By 1990, all buildings associated with the Washington Machinery and Storage Company were gone.

J.A. Jack & Son Lime Plant and Northwest Precote

- In 1946, there was a lime plant between the Washington Machinery and Storage Company office and Slip 4. The plant was operated by J.A. Jack & Son. An aerial photograph shows a barge located in Slip 4 near the lime plant, tied to a wooden bulkhead along the southeastern shore. A crane-operated bucket loader appears to be moving sand or lime between the barge and adjacent uplands.
- By 1960, a portion of shoreline north of the loading facility shown in the 1946 photograph appears to have been filled and contained by a retaining wall. Lime plant operations appear to have continued into the 1960s but had ceased by 1969.
- By 1946, Northwest Precote, Inc., an asphalt plant, was established south of the lime plant and adjacent to Webster Street.
- By 1969, four new tanks, apparently associated with the asphalt plant, had been constructed along the waterfront.
- In 1980, the asphalt plant appeared to be operating.
- By 1990, the asphalt plant had been demolished.

Environmental Sampling/Cleanup

The following information is from a site summary prepared by SEA (2004).

Several investigations were conducted at Parcel E from 1988 through 1996 to assess site conditions. The initial investigation identified chemical contamination in soils. A number of cleanup actions followed, including soil removal and groundwater monitoring. Ecology ultimately determined that no further action was required at this property.

Following a preliminary groundwater and subsurface soil investigation performed at the parcel by Hart Crowser in March 1989, Landau conducted a more extensive investigation in June 1990 (Hart Crowser 1991). This investigation included the collection of 33 soil samples from 10 of 12 borings and groundwater samples from the three wells, which were analyzed for VOCs, SVOCs, PCBs, TPH, and metals analyses. The borings were primarily located in the vicinity of two identified USTs (Landau 1990).

Most locations sampled during the Landau investigation were excavated during later remedial activities (Hart Crowser 1991, 1996). In the remaining locations, the maximum detected TPH concentration of 2,600 mg/kg exceeded the MTCA Method A soil cleanup level for industrial properties and detection limits were above MTCA cleanup levels of 2,000 µg/kg for cPAHs. The maximum concentrations of cadmium (2.7 mg/kg) and lead (1,190 mg/kg) were slightly above the Method A soil cleanup level (2.0 mg/kg and 1,000 mg/kg, respectively). The maximum total chromium concentration (20.7 mg/kg) exceeded the MTCA cleanup level for hexavalent chromium (19.0 mg/kg) but is below the level for trivalent chromium (2,000 mg/kg). No PCBs were detected in the soil samples (Landau 1990).

Maximum concentrations of arsenic (0.093 mg/L), copper (0.132 mg/L), and zinc (0.211 mg/L) detected in groundwater samples exceeded marine chronic surface water quality criteria for dissolved metals (0.036 mg/L, 0.0037 mg/L, and 0.085 mg/L, respectively). Detected concentrations of VOCs and low molecular weight polycyclic aromatic hydrocarbons (LPAHs) were below surface water quality criteria for human consumption of aquatic organisms. No TPH or PCBs were detected in the groundwater samples (Landau 1990).

In 1991, five USTs were excavated and removed from the site, four additional monitoring wells were installed, and 22 test pits were excavated (Hart Crowser 1991). The five USTs removed from the parcel included:

- 8,000-gallon diesel tank
- 12,500-gallon buried railroad tank car containing heavy oil
- 1,000-gallon tank thought to contain stove oil
- 2,500-gallon diesel tank
- 1,000-gallon tank containing a soil/oil mixture (possibly a previous attempt to close the tank in place)

Approximately 1,500 cubic yards of visibly stained soil and rubble associated with the USTs were excavated from the site and disposed of at permitted offsite facilities (Hart Crowser 1991). The test pits were excavated to assess the horizontal and vertical extent of the petroleum contaminated soils associated with the USTs and the area of the former asphalt plant. Concentrations of TPH ranged from less than 10 to 25,000 mg/kg. The MTCA Method A cleanup level is 2,000 mg/kg. Hart Crowser (1991) attributed these concentrations to the use of oil for dust control and roadway stabilization.

Groundwater was sampled in October 1990, January 1991, and April 1991 from four monitoring wells, and was analyzed for VOCs, SVOCs, and TPHs. Analytical results indicated decreasing concentrations of TPHs and LPAHs and no detected VOC or cPAH concentrations. Hart Crowser (1991) analyzed the maximum constituent concentrations detected in groundwater to evaluate potential impacts to Slip 4. They compared all groundwater concentrations from the UST excavation area to calculated worst-case criteria based on MTCA surface water protection and sediment quality criteria. They did not consider attenuation, dispersion, or dilution during transport. Hart Crowser determined that TPH and 2-methylnaphthalene concentrations in groundwater exceeded the worst-case criteria. One former well sample exceeded the criterion for 2-methylnapthalene. TPH concentrations were declining and 2- methylnaphthalene in the downgradient well nearest Slip 4 was below the worst-case criterion (Hart Crowser 1991).

Evergreen Marine Leasing applied to Ecology for a No Further Action (NFA) determination for the site in the fall of 1994. Ecology determined further remedial action was required (Marten & Brown 1997). Beginning in 1996 more TPH-contaminated soil was removed based on Ecology's recommendations (Marten & Brown 1997; Hart Crowser 1996). Ecology issued a NFA determination for the TPH-diesel release in 1997. The NFA was conditioned on conducting groundwater monitoring for TPH and filing of a Restrictive Covenant for the site (Ecology

1997). Monitoring documented compliance with the NFA and monitoring was terminated by Ecology in 1998 (Ecology 1998).

A4. Boeing Plant 2

Past Use

Boeing has manufactured airplane parts at Plant 2 since 1936 (SEA 2004). The entire Boeing Plant 2 facility occupies 109 acres between E. Marginal Way S. and the Duwamish River on the southeastern side of Slip 4. About 17.5 acres of this property drains to Slip 4. Building 2-122 is located adjacent to Slip 4 and was built in the early 1990s to house the Integrated Aircraft Systems Laboratory (Boeing 1993). The facility is paved with small landscaped areas. The grounds between the parking area and Slip 4 include public walking trails and trees. A single-family residence is located on Webster Street northeast of Building 2-122 (Weston 1998).

Past use of the property is summarized in below:

- Prior to 1936, the area was agricultural and residential, with some homes having small orchards and gardens. One home had been built on the Slip 4 shoreline.
- By 1946, the one home on Slip 4 had been removed and the shoreline was not otherwise developed.
- By 1960, all homes within the Plant 2 boundaries had been removed and Building 2-01 had been constructed adjacent to Slip 4 and the Duwamish Waterway. Parking lots occupied the remainder of the property.
- By the early 1990s, Building 2-01 had been removed and Building 2-122 was built within its footprint and that of the previous parking area. Landscaped parking and grounds incorporating stormwater controls currently surround Building 2-122.

Environmental Sampling/Cleanup

There have been a number of investigations at the north end of Boeing Plant 2 from 1990 through 1994 to assess conditions resulting from past site uses and to document soil removal and cleanup actions (SEA 2004). These include:

- Phase II Subsurface Environmental Assessment, Proposed Integrated Aircraft Systems Laboratory Building, Seattle, Washington (Weston, October 1990)
- Supporting Documentation for Engineer’s Certification of Closure, Boeing Plant II, 2-01 Building Dangerous Waste Sump (CH2M Hill, December 1991)
- Leaking Underground Storage Tank Investigation, Proposed Integrated Aircraft System Laboratory Construction Site, Plant II, Seattle, Washington (Weston, January 1992)
- Release Assessment, Boeing—Plant 2, Seattle/Tukwila, Washington (Weston, March 1994)

In 1990, Weston performed a preconstruction environmental assessment of soil and groundwater around the perimeter of the former Building 2-01 at the north end of Plant 2 adjacent to Slip 4. One surface soil sample, 36 subsurface soil samples from 21 soil borings, and groundwater samples were collected from six push-probe borings.

Soil Sampling

The soil samples were analyzed for VOCs, PAHs, SVOCs, pesticides/PCBs, TPH, and Resource Conservation and Recovery Act (RCRA) metals; groundwater samples were analyzed for VOCs, unfiltered metals, and oil and grease. Four of the soil borings and three of the push-probe groundwater stations were located along the north side of the former building along the shoreline of Slip 4. One composite surface soil sample collected adjacent to electrical transformers near the southeast corner of Building 2-01 contained 14 mg/kg PCBs (Weston 1990). This exceeds the MTCA Method A soil cleanup level of 10 mg/kg.

In subsurface soil, acetone up to 190 µg/kg; 2-butanone up to 34 µg/kg; 1,1,1-trichloroethane up to 6 µg/kg; and trichloroethene up to 9 µg/kg were the only VOCs detected. All were below their MTCA Method A cleanup levels. Several PAHs were detected in subsurface soil at individual concentrations ranging from 71 to 28,000 µg/kg. In the seven subsurface soil samples analyzed for base neutral extractable acids (BNAs), di-n-octylphthalate up to 200 µg/kg; naphthalene at 28,000 µg/kg; and methylnaphthalene at 8,800 µg/kg were detected. Only naphthalene and several cPAHs in sample B-24, located in the parking lot south of the former 2-01 building, exceeded the MTCA cleanup levels. PCBs were not detected in any of the subsurface soil samples. TPHs were detected in two subsurface soil samples at concentrations up to 103 mg/kg, below MTCA cleanup levels. Metals were detected in subsurface soil at concentrations near background, except for copper (310 mg/kg), lead (160 mg/kg), and zinc (220 mg/kg) in one sample. Cadmium in sample B-36, near the southeast corner of the former 2-01 building, was the only metal that exceeded the MTCA Method A soil cleanup level for industrial properties (Weston 1990).

Remediation in these areas was completed as part of the 2-122 building construction.

Groundwater Sampling

Vinyl chloride at 2.0 µg/L was the only VOC detected in groundwater. This is below the water quality criterion for human consumption of aquatic organisms (530 µg/L). Chromium (up to 11 mg/L), copper (2.7 mg/L), lead (0.7 mg/L), nickel (3.8 mg/L), and zinc (2.4 mg/L) were the only metals detected in groundwater. All of these metals were detected in one or more samples at concentrations that exceeded their respective marine chronic water quality criteria. However, because the groundwater samples collected using push-probe sampling methods were typically turbid, metals concentrations were not considered representative of ambient metals concentrations in groundwater. Oil and grease were detected in several groundwater samples at concentrations ranging from 0.8 to 12 mg/L (Weston 1990).

The dangerous waste sump (an RCRA Treatment, Storage, or Disposal unit) in Building 2-01 was removed and closed in 1991 (CH2M Hill 1991). The sump was constructed of reinforced concrete and handled materials containing acetone, 2-butanone, toluene, and petroleum hydrocarbons. During closure activities, the dangerous waste sump was steam-cleaned with a detergent solution. Concrete and underlying soils were then sampled for comparison to closure performance standards. PCBs were not analyzed during closure activities. Following demolition of Building 2-01, the sump was demolished, and 343 tons of concrete and associated soil were disposed of at the hazardous waste landfill in Arlington, Oregon. An additional 270 tons of soil were excavated and disposed of at Arlington during three additional rounds of sampling and excavation. The maximum constituent concentrations detected prior to closure were 700 µg/kg for acetone, 31 µg/kg for 2-butanone, 8.3 µg/kg for toluene, and 100 mg/kg for TPH. The final excavation sidewall and floor soil samples were below performance standards: 100 µg/kg for acetone, 100 µg/kg for 2-butanone, 5 µg/kg for toluene, and 25 mg/kg for TPH. Soil and groundwater sampling results from the 1990 preconstruction environmental assessment around Building 2-01 were also used in the closure certification to document clean closure of the sump (CH2M Hill 1991). Ecology approved interim status closure of the Building 2-01 dangerous waste sump in July 1992 (Ecology 1992). The closure of the sump is not referred to as "final closure," since other dangerous waste management units remain in operation at Plant 2 (CH2M Hill 1991).

In 1994, Boeing performed a Release Assessment under an Administrative Order on Consent for a 3008(h) RCRA corrective action (Weston 1994). The assessment included an evaluation of groundwater quality data from the north end of Plant 2 in the vicinity of Slip 4, but did not include an evaluation of soil chemical data from this area. In addition to the analytical results for the push-probe groundwater samples collected from the perimeter of the former 2-01 building, the Release Assessment included data from three monitoring wells that were temporarily installed in the parking lot east of the building in the area now occupied by Building 2-122. The full suite of groundwater analytes is not known. Arsenic (up to 30 mg/L) and chromium (up to 60 mg/L) were detected in unfiltered groundwater samples collected from the wells (Weston 1994). The maximum detected metals concentrations exceeded their respective marine chronic water quality criteria.

Underground Storage Tanks

A leaking UST was removed in 1991 from an area just outside of the southeast corner of the former 2-01 building (Weston 1992). The 10,000-gallon Tank PL-3 was installed in 1954 to hold bunker C fuel oil. A total of 541 tons of petroleum-contaminated soil were removed from the vicinity of the former UST. The maximum soil TPH concentration measured from the removed material was 16,000 mg/kg of TPH (Method WTPH-418.1). Following soil removal, the bottom of the excavation contained soil with a TPH concentration of 420 mg/kg of diesel (method 8015). Additional soil was not removed due to the presence of 1 to 2 feet of groundwater in the excavation bottom. One soil sample from the excavation was also analyzed for PCBs; no PCBs were detected. There is no information in Ecology files that TPH impacts to groundwater were subsequently investigated (SEA 2004).

A5. North Boeing Field

North Boeing Field (NBF) is leased by Boeing from King County International Airport, with the exception of a few acres on either side of the GTSP flume which is leased from the City of Seattle. The 130-acre site is located between E. Marginal Way S. to the west and King County

International Airport to the east (see Figure 5 of this Action Plan). Ellis Avenue S. forms the northern border, as does the Federal Aviation Administration Tower for the southern extent of the site. The head of Slip 4 is approximately 150 feet from the northwestern boundary of NBF. Stormwater from the southern portion of NBF does not discharge to Slip 4.

Environmental Sampling/Cleanup

There have been numerous investigations and cleanups on the NBF property. Much of the work is the result of environmental investigations done prior to new construction or facility modification. The following is a list of reports filed with the Department of Ecology. There may be other reports that have been archived or filed under other facility names that are not on this list.

- Field and Laboratory Services Utilidor Project North Boeing Field (Groundwater Technology 1990a)
- Soil Sampling and Analyses Inlet Development Facility (Groundwater Technology 1990b)
- Supplemental Pre-Construction Environmental Investigation Proposed 3-801 Building Site (Seacor 1991)
- Building 3-354 Preconstruction Environmental Assessment (Groundwater Technology 1991a)
- Preconstruction Environmental Assessment Building 3-840 Expansion (Groundwater Technology 1991b)
- Pre-Construction Environmental Investigation Proposed 7-027-1/2/3 and 3-360/361/365 Building Sites (Seacor 1992a)
- Independent Cleanup Action report, Flight Line Utilities Project Concourse C (Seacor 1992b)
- Site Assessment Main Fuel Farm (Seacor 1992e)
- Soil and Groundwater Investigation, Fire Training Center - North Boeing Field (Landau 1992a)
- Cleanup Action Program North Boeing Field Fire Training Center, King County Airport (Landau 1992b)
- Independent Soil Remedial Action Report, Flight Test Engineering Laboratory 3-801 Building Location (Seacor 1992c)
- Site Assessment Investigation 3-800 Building (Seacor 1992d)
- North Boeing Field Storm Drain System PCB sampling (Landau 1993a)
- Storm Drain System Cleanout North Boeing Field (Landau 1993b)
- Report of Permanent Closure Former Underground Storage Tank near Fire training Center (Landau 1993c)

- Remedial Action North Boeing Field Fire Training Center, King County Airport (Landau 1993d)
- Pre-Closure Site Assessment Investigation F&G Facility (Seacor 1994a)
- Supplemental Site Assessment Investigation Green Hornet Area (Seacor 1994b)
- Independent Soil Remedial Action Green Hornet Area (Seacor 1994c)
- Report For UST Decommissioning Site Assessment And Monitoring Well Abandonment F&G Facility (Seacor 1994d)
- Site Assessment And Independent Soil Cleanup Action During the Decommissioning of an Oil/Water Separator, Main Fuel Farm, North Boeing Field (Seacor 1994e)
- Site Assessment During The Decommissioning Of Underground Storage Tanks BF-22 and BF-23, 3-374 Building (Seacor 1994f)
- Independent Soil Cleanup Action Report Proposed 3-333 Building Location (Seacor 1996)
- Remedial Action Report, Proposed West Wing 3-333 Building Fuel Test Laboratory (AGI 1998a)
- Site Investigation Oil/Water Separator UBF-55 (AGI 1998b)

Metro asked Boeing to provide information about a number of oil/water separators at North Boeing Field that were identified during a 1985 inspection as possibly discharging to the storm drain. Of particular concern was the Building 3-315 drum storage/oil separator facility which appeared to collect drainage from drums of various fuels, oils, and solvents, as well as an electrical transformer/capacitor station (Lampe 1985). Boeing has indicated that these units do not currently discharge to the storm drain (Boeing 2005d).

Environmental investigations have been conducted by Boeing in preparation for construction of Building 3-333. These investigations, as well as sampling related to oil/water separator UBF-55, are described in Section 3.4.2 of this Action Plan.

A6. Washington Air National Guard

The Seattle Air National Guard Station (ANGS) property is located at 6736 Ellis Avenue South. The station consists of 7.5 acres and four buildings (34,698 total square feet). The property is leased from King County by the U.S. Air Force, who in turn licenses the property to the Washington State Military Department for Air National Guard use. The current mission of the 143rd Communications Squadron is to provide mobile communication support and telephone/teletype support for airports and airfields.

Seattle ANGS consists of a Communications/Administration Building, an Aerospace Ground Equipment motor vehicle building, a paint storage building, and Mobility Storage. Seattle ANGS activities that generate waste oils, cleaning solvents, paint wastes, and thinners are conducted at the following locations: Aerospace Ground Equipment Motor Vehicle Maintenance, Power Production, and Communications/Administration. In the past, small amounts of hazardous materials have been spilled or released into the environment at the station. However, during recent years, hazardous wastes have typically been collected and disposed of by a contractor or through the Defense Reutilization and Marketing Office at Fort Lewis, Washington.

Past Use

Seattle ANGS was built during World War II by the War Department and was used by the Army Air Force as the “Aircraft Factory School” during the war. In 1948, the property was given to King County as surplus property and was subsequently leased to the Washington Air National Guard. In 1948, the station consisted of 17 acres of land, including an aircraft parking ramp, leased from King County. At that time, the property contained 15 buildings (including a number of small shed structures), all of which were subsequently demolished. No site plans or photographs depicting these buildings or the general station layout have been located.

In 1951, a new property lease decreased the size of the station from 17 acres to its present size of 7.5 acres, and buildings were constructed for headquarters, mess hall, warehouse, and vehicle service requirements. Replacement of all buildings was begun in 1980 and completed in 1984, with the exception of the Mobility Warehouse, which was completed in 1988.

The Preliminary Assessment/Site Inspection report (OpTech 1995) noted that except for an aerial photograph of very poor resolution of the general area taken in 1940, no site plans or photographs depicting the station layout and its activities during the World War II period were found.

Solid wastes generated from the 1950s through 1968 at the Station were reportedly burned and/or buried in the northeastern comer of the site, or disposed of off site. Wastes generated during this period included radio tubes, solvents, used motor oils, kerosene, batteries, brake fluid, spray paints, and paint thinners/removers. Additionally, interviews with site workers indicate that chlorinated solvents may have been used at the Station in the 1970s and 1980s. In particular, workers recalled using solvents in the former paint shop that existed in the southern portion of the site prior to 1984 (ERM 2001). Based on the worker interviews, it is possible that small quantities of solvents leaked or spilled during storage and use. As a result of the Preliminary Assessment (PA)/Site Investigation (SI), an area approximately 175 feet long by 175 feet wide in the northeastern corner of the Station was designated as ERP Site 1 – Burial Site.

The Burial Site Air Operations Center (AOC) is located in the northeast corner of Seattle ANGS, approximately 70 feet east of Building 202, the AGE Vehicle Maintenance Building. From the early 1950s to 1968, various waste items were burned and buried in the area northeast of the old gravel parking lot. The probable wastes associated with this site include radio tubes, solvents, waste motor oils, kerosene, batteries, brake fluid, spray paints, paint thinners and removers, methyl ethyl ketone, xylene, and naphtha.

The Station previously had a wash rack in the southern portion of the site, as well as several USTs. According to a station plan dated 1982, there were four USTs previously located at the station: a 4,000-gallon motor gasoline UST, a 2,000-gallon diesel fuel UST, a 2,000-gallon UST (contents unknown), and a fourth UST (size and contents unknown).

The former washrack and underground storage tanks were removed in the 1980s and 1990s during station remodeling and prior to the Remedial Investigation (RI). A building that contained a paint shop and a battery shop also existed in the southern portion of the site; this building was demolished in the mid-1980s during Station remodeling. Finally, a waste burial site (ERP Site 1) reportedly existed in the northeastern corner of the Station from the 1950s through 1968. However, no conclusive evidence of historical waste burial or burning activity was discovered in this area during the PA/SI or RI.

Environmental Sampling/Cleanup

The Phase II RI, conducted in 1998 and 1999, detected trichloroethylene (TCE), tetrachloroethene (PCE), and benzene in shallow groundwater at concentrations above cleanup standards. Other constituents investigated in soil and groundwater (semivolatile organic compounds, TPH, radionuclides, and metals) were either not detected, were detected at concentrations below cleanup standards, or were consistent with area or regional background concentrations. The TCE detected in groundwater beneath the southern portion of the Station was the only contaminant considered to present a potential risk to human health or the environment, due to its persistence at concentrations above the MTCA Method A Cleanup Level (ERM 1999). The results suggested that the groundwater contamination in the southern portion of the Station was most likely caused by minor releases or incidental spills of TCE during historical Station operations. No evidence of TCE migration beneath the site from offsite sources was identified.

There is no evidence of residual dense non-aqueous phase liquid (i.e., liquid TCE) at the site. The highest TCE concentration detected in groundwater (83 µg/L) was well below the 10,000 µg/L level considered to be indicative of potential dense non-aqueous phase liquid.

The groundwater was treated with potassium permanganate in 2004. The treatment area was in the southern portion of the station, and was approximately 150 feet wide and 200 feet long. The treatment area corresponded to the area identified previously as having dissolved TCE concentrations above 5 µg/L. Based on the results of post-treatment monitoring, Ecology issued a “no further action” determination on October 18, 2005 (Ecology 2005b).

References

References are listed in Section 7.0 of this Action Plan.

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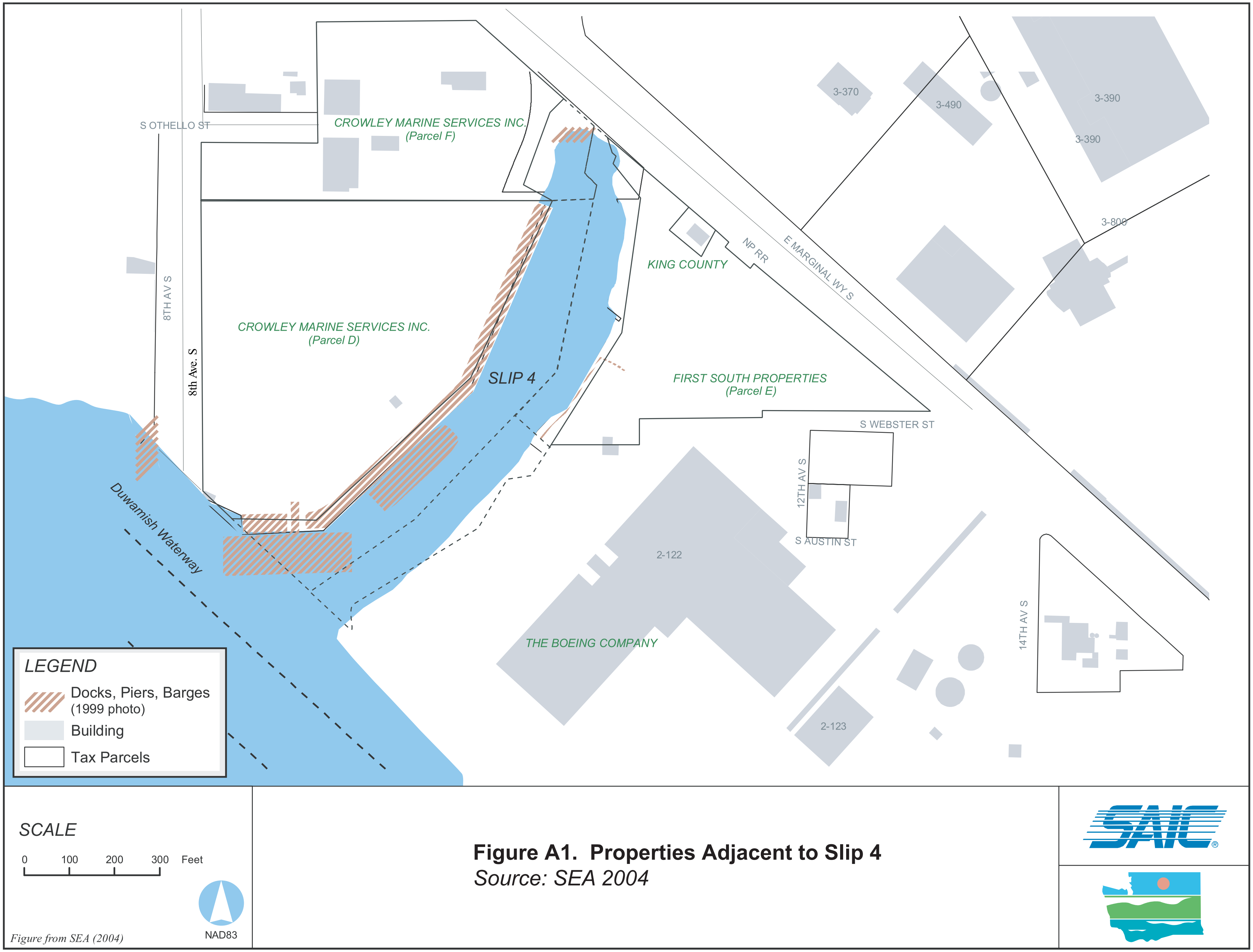

Figure A1. Properties Adjacent to Slip 4
Source: SEA 2004

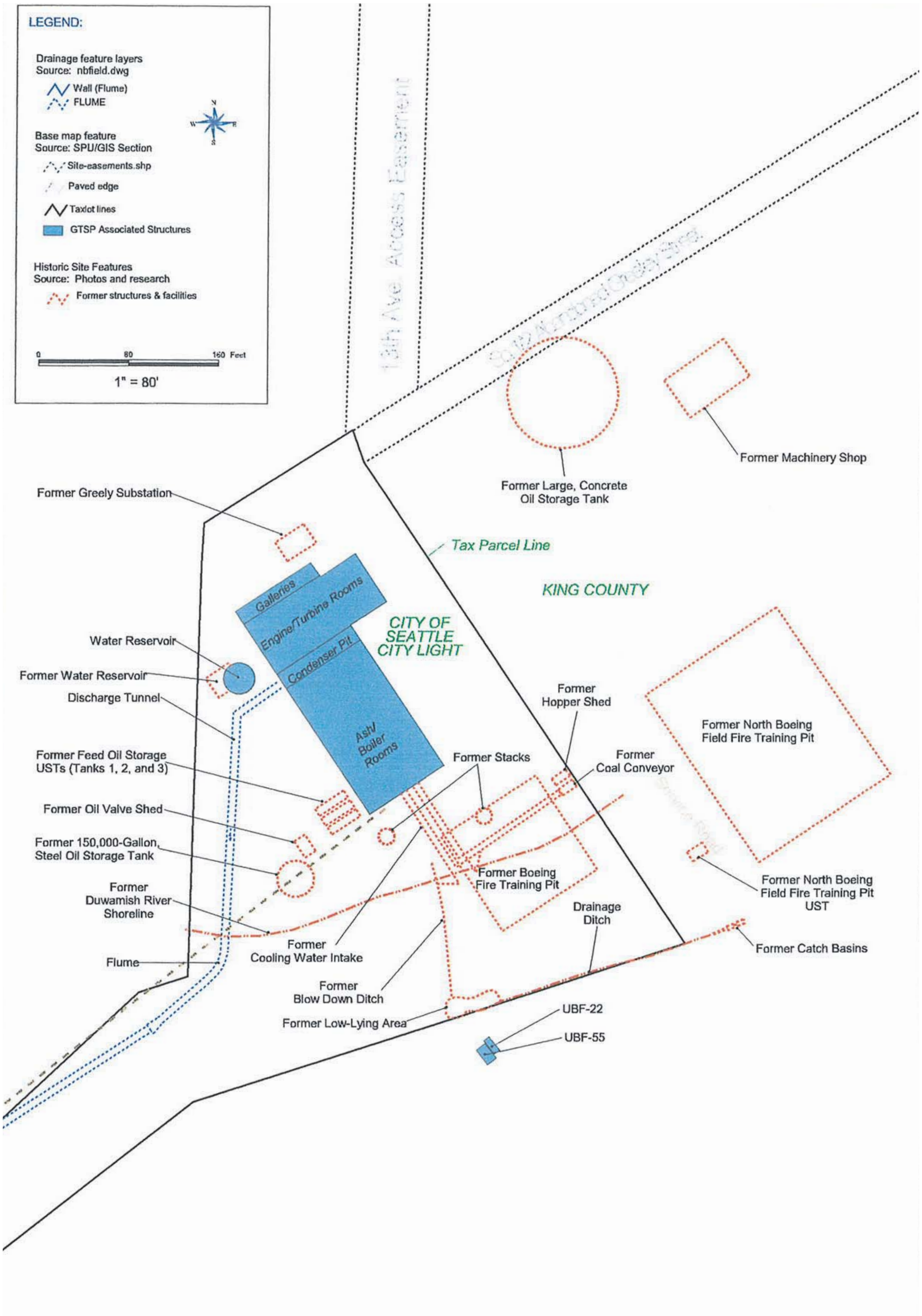

Figure A2. Georgetown Steam Plant Historic Site Features
Source: Bridgewater Group 2000

Duwamish Waterway Slip 4
December 14, 2000
...\SCL-slip4\Map Projects\scl-proj-1.apr

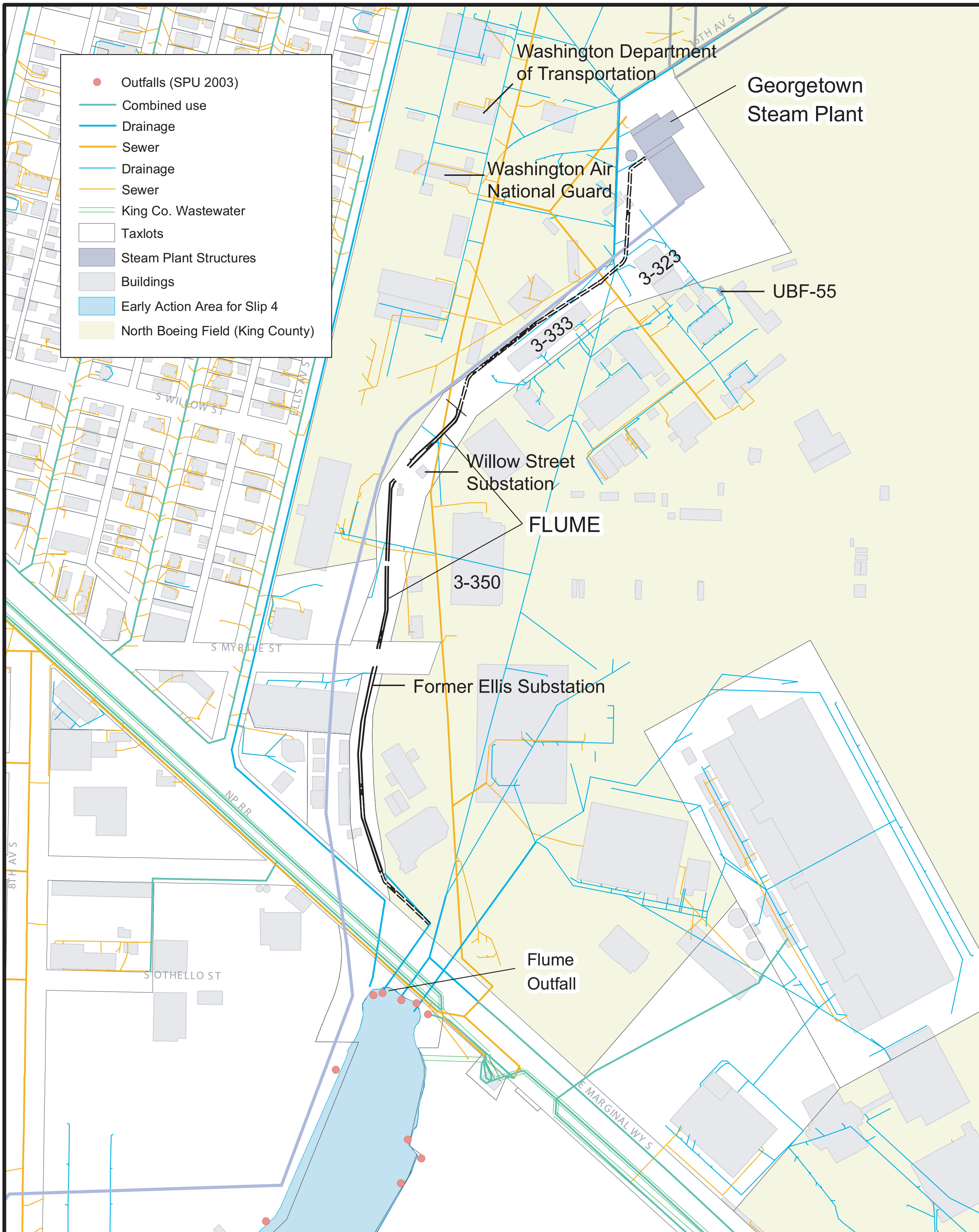

Figure A3. Georgetown Steam Plant Flume

Adapted from: SEA 2004

Map Feature Sources: King County GIS, Seattle Public Utilities, USACE, Ecology, and others.