North Boeing Field/ Georgetown Steam Plant Site Remedial Investigation/Feasibility Study

Assessment of Infiltration and Inflow to North Boeing Field Storm Drain System

VOLUME I

Prepared for

Toxics Cleanup Program
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List of Acronyms

AET	Apparent Effects Threshold
ASAOC	Administrative Settlement Agreement and Order on Consent
AST	aboveground storage tank
ATSDR	Agency for Toxic Substances and Disease Registry
BBP	butylbenzylphthalate
BEHP	bis(2-ethylhexyl)phthalate
bgs	below ground surface
CB	catch basin
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CJM	concrete joint material
COPC	chemical of potential concern
CSL	Contaminant Screening Level
CSM	conceptual site model
D	drain
DL	detection limit
DW	dry weight
Ecology	Washington State Department of Ecology
EOF	emergency overflow
FTC	Fire Training Center
GIS	Geographic Information System
gpm	gallons per minute
GPS	global positioning system
GTSP	Georgetown Steam Plant
HHO	human health – consumption of organisms
HHRA	human health risk assessment
HPAH	high molecular weight polycyclic aromatic hydrocarbon
I-5	Interstate 5
I&I	infiltration and inflow
IN	inlet
KC	King County
KCIA	King County International Airport
LAET	lowest AET
2LAET	second lowest AET
LDW	Lower Duwamish Waterway
LPAH	low molecular weight polycyclic aromatic hydrocarbon
LTST	long-term stormwater treatment
MDL	method detection limit
MFF	Main Fuel Farm
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MH	manhole or maintenance hole

MTCA	Model Toxics Control Act
NA	not available
NBF	North Boeing Field
ng/L	nanograms per liter
OC	organic carbon
OWS	oil-water separator
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PCT	polychlorinated terphenyl
PEL	Propulsion Engineering Laboratory
pg/g	picograms per gram
pg/L	picograms per liter
PLP	Potentially Liable Party
ppb	parts per billion
ppq	parts per quadrillion
ppt	parts per trillion
PS	pump station
PVC	polyvinyl chloride
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation/Feasibility Study
SAIC	Science Applications International Corporation
SD	storm drain
SMS	Washington State Sediment Management Standards
SQS	Sediment Quality Standard
STST	short-term stormwater treatment
SWPPP	Stormwater Pollution Prevention Plan
TCLP	Toxicity Characteristic Leaching Procedure
TEQ	toxic equivalent
TOC	total organic carbon
TSCA	Toxic Substances Control Act
TSS	total suspended solids
ug/kg, µg/kg	micrograms per kilogram
ug/L, µg/L	micrograms per liter
USEPA	U.S. Environmental Protection Agency
WAC	Washington Administrative Code
WQC	Water Quality Criteria
WQS	Water Quality Standard

Executive Summary

ES.1 Introduction

Cleanup of contaminated sediments in Slip 4 of the Lower Duwamish Waterway (LDW) has been delayed because of potential recontamination that might result through releases of contaminants from the North Boeing Field/Georgetown Steam Plant (NBF-GTSP) Site. A Remedial Investigation/Feasibility Study (RI/FS) and cleanup of the Site to reduce the potential for recontamination of Slip 4 sediments is in progress. The Washington State Department of Ecology (Ecology) has expedited RI/FS activities, including this Infiltration and Inflow (I&I) Assessment, that support implementation of interim actions that may allow cleanup of Slip 4 to commence as scheduled in late 2011.

Stormwater with suspended and dissolved contaminants at the NBF-GTSP Site (the Site) has been identified as a potential pathway for sources leading to Slip 4 (Figure 1-1; all figures are located in Volume II). In order to control sources of contaminants to the NBF storm drain (SD) system, it is necessary to locate and mitigate these sources. This report presents results of an assessment to accomplish the following:

- Identify potential sources of contaminants, primarily polychlorinated biphenyls (PCBs), to the NBF SD system.
- Evaluate the potential for transport of contaminants from surface sources (inflow) and groundwater/soil sources (infiltration).
- Provide recommendations leading to development of interim actions or other measures to minimize the potential for sediment recontamination in Slip 4.
- Describe additional characterization activities that need to be conducted in order to address these pathways.

A number of interim actions and characterization efforts at the NBF-GTSP Site have been performed since early 2010 or are currently in the planning stages. The completed actions include characterization of a large number of source media, including soil and groundwater; potential source evaluation; soil excavation; removal/replacement of asphalt, paint, and concrete joint material (CJM); cleaning and inspection of SD lines; replacement of SD lines; and initiation of a short-term stormwater treatment facility. The recommendations from this I&I Assessment are intended to complement these other actions.

Significant concentrations of PCBs and other contaminants have been detected in stormwater and solids found in SD structures on the Site. Based on these sampling results, the primary sources of PCB contamination appear to be within the north lateral drainage basin.

For this I&I Assessment, *inflow* at NBF-GTSP includes transport of contaminated materials to the SD system by surface runoff along the ground surface; on, in, or through buildings or other structures; or by airborne transport. *Infiltration* involves entry into the SD system by groundwater or subsurface soil, through gaps in the SD infrastructure.

This I&I Assessment incorporated all identified, available data from a large number of investigations up to January 2011. Media sampled and/or evaluated include stormwater and SD base flow water (whole water), SD solids, SD filtered suspended solids, soil, groundwater, CJM, and a variety of building materials (paint, caulk, siding, roofing, pavement).

Contaminants of Potential Concern

In this I&I Assessment, a contaminant of potential concern (COPC) in the NBF SD system is defined as a chemical that has been detected in Slip 4 sediments at concentrations above the Sediment Management Standards (SMS) or other relevant criteria. In addition, chemicals detected in stormwater discharges from NBF at concentrations above water quality criteria (WQC) are considered COPCs. Although PCBs may be the primary contaminant of concern in Slip 4 and the LDW, other COPCs at the NBF-GTSP Site are also of concern due to exceedances of these various criteria.

In this report, screening levels are applied to chemical concentrations to identify levels protective of sediment recontamination. For many sampling media, organic contaminants are screened against the Lowest Apparent Effects Threshold (LAET) and the Second Lowest Apparent Effects Threshold (2LAET) values, while metals are screened against the SMS Sediment Quality Standard (SQS) and Cleanup Screening Level (CSL) values. Other screening levels are applied for certain cases, such as the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sediment screening level, established for the Terminal 117 Site on the west side of the LDW.

A chemical was specifically identified as a COPC for the NBF SD system if it met at least two of the following three criteria: detection at concentrations above the SQS or LAET in at least one 2010 sediment sample from Slip 4, detection at concentrations above the marine or freshwater chronic WQC in SD whole water samples collected at the King County lift station in 2009 or 2010, or detection above the SQS or LAET in at least one filtered suspended solids sample at the lift station in 2009 or 2010. Chemicals exceeding only one criterion were considered on a case-by-case basis. The full list of screening levels protective of sediment recontamination for all media is included in Table 1-2. The following chemicals are considered to be COPCs in the NBF SD system and are carried forward in this I&I Assessment:

- PCBs
- Metals (mercury, cadmium, copper, lead, zinc)
- High molecular weight PAHs (HPAHs)
- Bis(2-ethylhexyl)phthalate (BEHP)
- Dioxins/furans

ES.2 NBF Storm Drain System

The NBF-GTSP Site is drained by four main lateral SD lines and two minor lines: the north lateral, north-central lateral, south-central lateral, south lateral, Building 3-380 area, and parking lot area (Figures 2-1 and 2-2). All but the latter SD line are directed to a trunk line that passes through the King County lift station, under East Marginal Way S, and finally discharges through the King County International Airport (KCIA) SD#3/PS44 EOF outfall at Slip 4. The NBF parking lot area downstream of the lift station also drains to Slip 4 via this KCIA outfall. The SD system drains an area of approximately 132 acres on the NBF facility. The four NBF lateral drainage lines also receive stormwater from the northern and central portions of KCIA (approximately 171 acres), located upstream and offsite of the NBF-GTSP Site.

SD system piping ranges from 8 to 48 inches in diameter, and comprises over 600 SD structures, including catch basins, manholes, trench drains, inlets, and oil-water separators (OWS). Most of these are made of concrete, but some older structures have wooden or clay floors. The total length of the SD system is estimated to be 7 to 8 miles.

To identify potential inflow and infiltration sources around each SD structure, a series of Thiessen polygons were developed to depict an approximate drainage area or “capture zone” for each SD structure at NBF-GTSP (Figure 2-9). These polygons are used as the basis for comparison between SD solids collected at many SD structures and other sampled media located within the polygon areas.

Chemicals with concentrations that exceed screening level criteria for SD solids were identified as COPCs. The classes of known and suspected COPCs for SD solids are listed in Table ES-1, distinguished by locations within each drainage area. Known COPCs for SD solids (grab samples, sediment traps, or filtered solids) in each drainage area are summarized in the following table, based on analytical exceedances of screening level criteria:

Drainage Area	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
North Lateral	●	●	●	●	●	●	●	●	●
North-Central Lateral	●	●	●	●	●	●	●	●	●
South-Central Lateral	●	--	●	●	●	●	●	●	●
South Lateral	●	●	●	●	●	●	●	●	●
Building 3-380 Area	●	--	●	--	●	●	●	●	●
Parking Lot Area	●	--	●	--	●	●	●	●	●

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the appropriate criteria.

The most recent SD solids data for each structure, including grab samples or sediment traps collected between 2004 and 2010 (Figure 2-10), yields the following range of total PCB concentrations for both the main lateral line and the entire area of each drainage basin:

Drainage Area	Main Lateral Line Total PCBs (mg/kg DW)		Full Drainage Area Total PCBs (mg/kg DW)		Sub-Drainage with Maximum Concentration (Figures 2-3 to 2-8)
	Min.	Max.	Min.	Max.	
North Lateral	0.28	57	0.090	180	N11
North-Central Lateral	0.11	4.0	0.11	34	NC2 and NC3
South-Central Lateral	0.02U	3.0	0.02U	6.8	SC6
South Lateral	0.18	0.58	0.14	19	S2
Building 3-380 Area	0.041	1.8	0.041	1.8	B1
Parking Lot Area	0.41	2.1	0.24	2.1	PL1

Recommendations for source control actions pertaining to the SD system are summarized in Table ES-2.

ES.3 Conceptual Site Model

A conceptual site model was developed for the NBF-GTSP Site. This model includes information on fate and transport for each of the COPCs in the environmental media at the Site. Site uses included the following primary industrial activities at NBF: aircraft finishing (including wet sanding, cleaning, painting), aircraft testing (including parts testing, fuel system testing, aircraft systems testing, and fire suppression system testing), delivery of completed aircraft to customers, aircraft research and development, and support services.

A number of transport pathways allow contaminants to enter the NBF SD system at the Site and eventually reach Slip 4. A schematic representation of the conceptual site model is included as Figure 3-1. Inflow to the SD system may include the following transport mechanisms:

- Weathering/erosion of contaminated surface solid materials located outdoors, such as asphalt, concrete, CJM, and soil particles. This causes fragmentation and movement of material along the ground surface, eventually washing into SD structures. Surface soil from the GTSP could possibly reach the NBF SD system during extreme weather events.
- Weathering of a variety of solid materials from buildings (e.g., paint, caulk, window glazing, siding), various structures (tanks, utility materials), and vehicles/aircraft (including paint, brake pads/lining, tires). This causes erosion and/or fragmentation, with material reaching the ground surface and eventually the SD system. Contaminated material may reach the surface directly through gravity or may be conveyed via piping (such as downspouts), or may reach the SD system more directly (floor drains illicitly connected to the SD system, downspouts plumbed into SD system).
- Illicit liquid releases from buildings, various structures (e.g., transformers, hoses) and vehicles/aircraft, may be inadvertently washed into the SD system. Contaminants may reach the surface and be washed to SD structures, or be conveyed directly into the SD system.

- Materials deposited via atmospheric transport on building rooftops, paved surfaces, and other outdoor surfaces (including SD structures), from both on and offsite sources, which are then washed into the SD system.

Infiltration to the NBF SD system may include the following transport mechanisms:

- Contaminated soil may directly enter an adjacent opening in a SD structure or piping. This may take place directly or be aided by movement of groundwater or by water percolating through the vadose zone.
- In addition, contaminated water may also directly enter an opening in a SD structure or piping; groundwater infiltration is considered likely in areas where the highest water table elevation is at or above any given SD structure or piping elevation. Conversely, exfiltration may locally occur where contaminated stormwater exits the SD system into the subsurface.

ES.4 Inflow Assessment

Sources of contaminant inflow to the SD system include known sources (such as CJM) and potential sources (such as paint or roofing materials). The inflow assessment included a broad literature review to compile information on contaminants related to industrial activities at the NBF-GTSP Site. Environmental reports and other documents were reviewed and site visits were conducted to evaluate and photograph buildings, storm drains, and other structures.

The focus of the inflow assessment is on contaminant sources that are likely to be most significant with respect to inflow to the SD system. Emphasis is placed on exterior sources of PCBs and other contaminants, such as CJM, paint, roofing material, and building caulk. It is recognized that many other activities and structures currently or historically present at NBF may act as sources of COPCs, including interior sources. The following sections summarize findings by sampling media located at NBF.

Concrete Joint Material

CJM (or caulk) is present within large areas of concrete surfaces at NBF, but not within the Building 3-380 drainage area. Although CJM may include other COPCs (metals, PAHs, phthalates), it has only been analyzed for PCBs at the Site. Sampling of CJM in 2000 to 2001 revealed significantly elevated concentrations of total PCBs (as high as 79,000 mg/kg). Removal and replacement of CJM with identified concentrations of total PCBs greater than 50 mg/kg took place from 2002 to 2006, primarily in the flightline areas. CJM was further removed throughout the PEL area in 2010, regardless of concentration. Sampling of in-situ CJM following 2006 removal/replacement has identified concentrations of PCBs as high as 1,200 mg/kg, and up to 2,200 mg/kg for thin remnants of unreplaced caulk. All but six samples collected since 2006 (out of 141) have contained less than 50 mg/kg total PCBs. These six samples were located in the central flightline area and the area northwest of Building 3-390.

Some of the newer CJM that was installed from 2002 to 2006 has become recontaminated with PCBs, with concentrations up to 370 mg/kg total PCBs in five samples collected in 2006. It appears that PCBs from the former contaminated CJM had previously migrated into the concrete panels in the immediate area of the joints, and recent desorption of PCBs from this contaminated concrete into the new CJM has resulted in detections in the new caulk.

Investigation documents concerning CJM material at NBF have suggested or assumed that caulk material is a source of PCBs to the SD system and may be a component of PCBs in sediments of Slip 4. A 2010 investigation of the flightline area suggests that a moderate correlation exists between PCB concentrations in CJM and co-located SD inlet filter solids sampling. Recent sampling supports the concept that CJM contaminated with PCBs at levels of concern still remains in areas of NBF, and this material is an ongoing source to the SD system and may potentially recontaminate Slip 4 sediments.

In this I&I Assessment, PCB concentrations in removed and current CJM were compared to SD solids concentrations for the Thiessen polygons where the CJM samples were located (Figure 4-1). Concentrations of removed CJM were included in this comparison because these locations may include caulk left behind in the removal process or may be an indicator of PCB recontamination due to the concrete desorption process. Thus, very high concentrations in the past may correspond to high concentrations now. The comparison between CJM and nearby SD solids data produced mixed results. Some CJM with elevated PCB concentrations corresponds to nearby SD solids with elevated concentrations. This is seen to a certain extent in the north lateral and north-central lateral drainage areas. But the south-central lateral and south lateral drainage areas do not have enough available recent SD solids data to be able to properly compare.

The classes of known and suspected COPCs for CJM are listed in Table ES-1, distinguished by locations within each drainage area. Recommendations for source control actions pertaining to CJM are summarized in Table ES-2.

Building Materials and Components

Building materials and components that may contain COPCs include caulking materials (excluding CJM), paint, rooftop and downspout solids, plastics and rubber, building sidings and a variety of other materials. The I&I Assessment included an evaluation of NBF buildings and other structures built prior to 1980 (when PCBs were presumably no longer in use), in combination with a site visit, to determine if these structures may represent sources of PCBs to the SD system. For other COPCs, a review of chemical use information from the literature was performed and compared to present-day building materials and components observed at NBF. In combination with recent analytical data, individual buildings and other structures were identified as known or suspected potential sources of contaminants to the SD system.

Boeing conducted limited sampling of building materials within the north lateral drainage area in 2010. Of all building materials, paint was found to cause the most concern for both PCBs and metals, in terms of number of exceedances of screening level criteria selected to be protective of Slip 4 sediments. Of all paint samples, painted bollards (traffic security posts) contained the highest concentrations of PCBs (Figures 4-4, 4-10, 4-16). Some paint and caulk samples collected from buildings renovated after 1980 were found to contain PCBs.

In the 2010 investigation, caulking material samples results for PCBs exceeded the screening level in 2 of 13 samples, with a maximum concentration of 14,000 mg/kg total PCBs (on a window seal). Results for paint samples showed PCB exceedances in 34 of 77 samples, with a maximum concentration of 2,300 mg/kg total PCBs (on a yellow bollard). Results for roofing material samples showed one PCB exceedance in four samples, with a maximum concentration of 0.92 mg/kg total PCBs. Results for samples of a variety of “other materials” (foam, rubber, insulation, coating material, downspout solids, siding, etc.) showed PCB exceedances in 5 of 21 samples, with a maximum concentration of 15,800 mg/kg total PCBs (foam squares). The highest concentration of mercury was identified in a sample of peeling paint from a building siding (130 mg/kg). No potential sources of contamination could be eliminated as a result of these findings.

The classes of known and suspected COPCs for building materials are listed in Table ES-1, distinguished by locations within each drainage area. The following table summarizes known COPCs for building materials, based on analytical exceedances of screening level criteria:

Building Material	PCBs	Mercury	Cadmium	Copper	Lead	Zinc
Caulking Materials	●	●	●	--	--	●
Paint	●	●	●	●	●	●
Roofing Materials		--	●	--	●	●
Downspouts	●	●	●	●	●	●
Plastic/Rubber	●	--	●	--	--	●
Building Siding/ Other Materials	●	--	●	●	--	●

● = Chemical detected above the SQS/2LAET in one or more samples.
-- = Not detected above the appropriate criteria.
Blank = Not analyzed or DL was above appropriate criteria.

Building materials in other drainage areas of the Site do not have comparable analytical results. Boeing performed paint abatement activities in October 2010 to remove paint from yellow bollards in the north lateral drainage area. Recommendations for source control actions pertaining to building materials and components are summarized in Table ES-2.

Additional Outdoor Sources

Other outdoor sources that may contain COPCs include surface materials (asphalt, concrete, surface debris), pavement sweeper debris, outdoor mobile sources (solid, liquid, and exhaust released from vehicles and aircraft), and atmospheric deposition. These outdoor sources and pathways either are known to occur or to potentially occur at NBF. Analytical data for the I&I Assessment was not available for outdoor mobile sources or atmospheric deposition.

Asphalt samples were collected in the PEL area, particularly near Building 3-322. Figure 4-28 shows asphalt sampling locations as triangle symbols, and a black dot inside the shape indicates that asphalt material at that location has been removed and replaced. Total PCB concentrations ranged up to 380 mg/kg PCBs, highest near the northwest portion of Building 3-322 (Figure 4-28). This area drains to nearby former catch basin CB191, which had the highest concentration of PCBs in SD solids at NBF. The surface and subsurface in the area of this building has since been removed as a source control action.

A limited number of concrete samples were collected in the PEL area. Total PCB concentrations ranged up to 0.55 mg/kg (Figure 4-28).

Boeing collected 76 samples of surface solids debris in 2009 and 2010 in the north lateral drainage area. Total PCB concentrations from these samples ranged up to 557 mg/kg, with the most contaminated material located near the northwest portion of Building 3-322 (Figure 4-28). As mentioned for asphalt, this area drains to nearby former catch basin CB191, which had the highest concentration of PCBs in SD solids at NBF. The pavement and soil in the area of this building has since been removed. Elevated concentrations of total PCBs were also identified in adjacent areas within the PEL area, including near the fence line corner at the GTSP property boundary. These locations generally correlate with elevated PCB concentrations in nearby SD structures. With the exception of copper, metals were identified above their screening levels throughout the north lateral drainage area.

SAIC collected six samples of surface solids debris from the parking lot drainage area in 2010. Total PCB concentrations in these samples ranged up to 0.34 mg/kg.

Mechanical pavement sweeping takes place regularly in the flightline area. Sweeper debris likely originates as fragments of CJM, concrete, asphalt, vehicle and aircraft debris, paint chips, roof debris from downspouts, coatings, and other substances. Material that is swept is then handled at the sweeper decant station and treatment area. Sample results for total PCBs in composite sweeper debris solids from 2005 to 2010 (about once per year) ranged from 0.46U to 2.5 mg/kg DW, generally decreasing through time. These analytical results represent large-scale composite samples of solid debris material in the flightline areas and what is anticipated to enter the SD system. However, some flightline debris material is likely not being removed by the sweeping activity, and some solids may be further distributed by dust emanating from the sweeper vehicles or by improper handling at the decant station.

The classes of known and suspected COPCs for outdoor sources are listed in Table ES-1, distinguished by locations within each drainage area. The following table summarizes known COPCs for outdoor sources, based on analytical exceedances of screening level criteria:

Surface Material	PCBs	Mercury	Cadmium	Copper	Lead	Zinc
Asphalt	●	●	●	--	●	--
Concrete	●	--	●	●	--	●
Surface Debris	●	●	●	●	●	●
Pavement Sweeper Debris	●					

● = Chemical detected above the SQS/LAET in one or more samples.
-- = Not detected above the appropriate criteria.
Blank = Not analyzed.

Recommendations for source control actions or investigations pertaining to these outdoor surface material sources are summarized in Table ES-2.

Interior Contaminant Sources

This general category includes indoor sources such as PCB-bearing caulk on pipe flanges, building sealants and other PCB-bearing materials, air compressor oils, inadvertent tracking by employees of PCB-bearing dust, and floor drains that are not fully plugged. Little analytical data correspond to these sources/pathways and only minor evaluation has been performed to determine the likelihood of indoor sources reaching the SD system via these pathways.

Recommendations for source control actions pertaining to these interior contaminant sources are summarized in Table ES-2.

ES.5 Infiltration Assessment

Infiltration involves entry into the SD system by groundwater or subsurface soil, through openings in the SD system. The infiltration assessment involved: reviewing available information including SD video inspections, repair/replacement of SD piping and structures, and contaminant data for soil/groundwater and the SD system; determination of potential groundwater infiltration by comparing SD system depths to high groundwater levels; and evaluation of the pathway of contaminated material into damaged SD lines.

Soil and groundwater sample locations are concentrated on the GTSP property and in four main areas of NBF: PEL area, Building 3-380 and former Building 3-360, Buildings 3-800 and 3-801, and the Main Fuel Farm (MFF) area. The locations of soil and groundwater samples that have been analyzed for one or more of the COPCs are shown on Figure 5-1. Soil samples collected within areas that were subsequently excavated are not included on the I&I figures.

Soil-to-sediment screening levels were developed using both the SQS and CSL values for sediments, and all data comparisons apply the soil screening levels for the saturated zone. Concentrations of dioxins/furans were compared to Ecology's natural background and urban background levels. Groundwater screening levels are based on the Washington State WQS for Surface Water, using the most conservative of the marine and freshwater criteria. The soil-to-sediment and groundwater screening levels for the SD COPCs are listed in Table 1-2.

Soil Contamination

The classes of known and suspected COPCs for soil are listed in Table ES-1, distinguished by locations within each drainage area. Known COPCs for soil in each investigation area are summarized in the following table, based on analytical exceedances of screening level criteria:

Site Area	Depth	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
GTSP/Fence Line Area	S	⬆	⬆	⬆	⬆	⬆	⬆	⬆	⬆	⬆
	D	⬇		--	⬇	⬇	⬇	⬇	⬇	
PEL Area	S	⬆	⬆		⬆	⬆	⬆	⬆		
	D	⬇	⬇		⬇	⬇	⬇	⬇		
Bldg. 3-380/ 3-360 Area	S			--				⬆		
	D		⬇	--	--	--	⬇			

Site Area	Depth	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
Bldg. 3-800/	S		--	⬆		--		--		
3-801 Area	D	--	--	⬇	--	--	--	--		
Main Fuel	S							⬆		
Farm Area	D							⬇		

⬆ = Chemical detected above the Soil-to-Sediment SQS or background levels in one or more shallow soil samples.
⬇ = Chemical detected above the Soil-to-Sediment SQS or background levels in one or more deep soil samples.
-- = Not detected above appropriate criteria.
Blank = Not analyzed or DL was above appropriate criteria.
S = Shallow soil (0-4 feet bgs)
D = Deep soil (4-8 feet bgs)

PEL Area and GTSP Property

Most of the soil samples on the Site have been collected in the NBF PEL area and at the GTSP facility, especially along the fence line area between these properties. Soil on both sides of the fence and extending toward NBF Buildings 3-302 and 3-322 is heavily contaminated with PCBs and coincides with an area containing relatively elevated concentrations of PCBs in SD solids (Figures 5-2 and 5-3). In recent sampling (2010), total PCBs in soil were detected at up to 2,300 mg/kg along the NBF side of the fence and 530 mg/kg on the GTSP side. Historical PCB concentrations have been as high as 91,000 mg/kg near the fence line. Most deep soil sample results (4 to 8 feet bgs) in this vicinity were non-detected for PCBs, although method detection limits (MDLs) typically exceeded the screening level. Boeing and the City of Seattle plan to excavate a significant portion of contaminated soil in this fence line/GTSP area in summer 2011. Soils in the vicinity of Buildings 3-302 and 3-322 were excavated by Boeing in 2010 down to 1 to 2 feet below the water table, with some PCB-contaminated soil remaining in place.

In the area northwest and southeast of Building 3-335, two clusters of samples show significant exceedances for PCBs (red and orange on figures). Boeing plans to excavate soil northwest of Building 3-335 in 2011. Concentrations of SD solids in this general area are lower than for the area near the fence line.

Another area of concern for PCBs is near the north end of Building 3-333, where previous contaminated soil removal took place, but deeper confirmation to the north was incomplete. A few isolated areas in the central PEL area also have significant concentrations of PCBs in soil, although elevated MDLs are common among the results (Figures 5-2 and 5-3).

As shown in the table above, all other COPCs in soil have exceeded applicable criteria in the general PEL/GTSP area, at least at shallow depths. In particular, mercury and HPAHs show significant exceedances in the eastern portion of the PEL area and the GTSP property. In addition, areas along the GTSP side of the fence line will be excavated for petroleum hydrocarbons during the 2011 excavation (not a COPC for the SD system).

Other Areas of NBF

Other areas of identified soil contamination are located near Building 3-380, former Building 3-360, and Building 7-27-1. PCBs are not a concern at these locations, and metals and HPAHs are the COPCs of concern.

The Building 3-800 and 3-801 areas are similarly not of concern for PCBs, but metals are the COPCs of concern.

The Main Fuel Farm (MFF) area contains petroleum contamination in soil (not a COPC for the SD system), and HPAH concentrations are also of concern.

Other locations at NBF have localized exceedances of COPCs. These include the Green Hornet Area near Building 3-313 (BEHP, HPAHs), Concourses A and B (BEHP), and former Building 3-830 (PCBs).

Groundwater Contamination

The classes of known and suspected COPCs for groundwater and SD base flow (which is essentially groundwater) are listed in Table ES-1, distinguished by locations within each drainage area. Known COPCs are summarized in the following table for the GTSP and NBF facilities, based on analytical exceedances of screening level criteria:

Facility	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
GTSP Facility	●	--	--	●	--	--	--	--	
NBF Facility	●	●	●	●	●	●	●	●	

● = Chemical detected above the WQS/HHO/RCRA-MTCA in one or more samples.
-- = Not detected above the appropriate criteria.
Blank = Not analyzed or DL was above appropriate criteria.

The majority of the groundwater investigations performed at NBF have focused on petroleum hydrocarbons. Limited information regarding the occurrence of COPCs in groundwater is available.

PCBs in groundwater have been analyzed at the GTSP facility, at the former NBF Fire Training Center (FTC) area upgradient of GTSP, the PEL area, along the former Georgetown Flume, along the NBF-GTSP fence line, and in the Building 3-800 area. PCB concentrations for the most recent groundwater sample from each well, and base flow locations, where PCBs were analyzed are presented on Figure 5-21. This does not include wells recently installed by Boeing in the PEL area. PCB concentrations in five well samples exceeded the WQS screening level, located mainly in the fence line area and the northern PEL area. The total PCB concentration in the most recent whole water sample collected from MH108 (in the north lateral area) also exceeds the WQS screening level.

Groundwater samples collected from a broader area of the Site have been analyzed for metals. Metals concentrations for the most recent groundwater sample from each NBF well include screening level exceedances for mercury, cadmium, copper, lead, and zinc. In addition, copper exceeded also at one GTSP well. Significant mercury exceedances in groundwater (red and orange symbols on Figure 5-22) are found in the flightline areas and in the vicinity of Building 3-380.

Similarly, wells in a broader area of NBF have been analyzed for HPAHs and BEHP, with localized exceedances. Limited groundwater samples have been analyzed for dioxins/furans, and all results have been non-detected.

Groundwater Setting and Infiltration

Groundwater at the Site occurs at shallow depths within alluvium and fill material, under unconfined conditions. Site groundwater flow direction averages toward the south-southwest (Figure 5-29), at hydraulic gradients of 0.0010 to 0.0025. Depth to the water table varies seasonally and with local tidal fluctuations, ranging from 2.6 to 11.3 feet below the well casing for all onsite wells. Approximately 81 percent of all groundwater depths were measured between 5 and 9 feet, and the average depth for the entire Site is 7.4 feet below the well casing.

To determine if SD lines are submerged by groundwater during high-water periods, water table elevations were compared to the bottom elevations of SD lines and structures. Two sets of wet-season data were used: January 1988 and March 1996. Figure 5-30 presents a map of the NBF facility outlining SD lines that would be submerged at these high groundwater levels.

SD video inspections conducted in 2007, 2008, and 2010 of the NBF SD system provided information on SD lines within portions of all six drainage areas. Figures 5-31 to 5-33 document locations of gaps, breaks, or other problems and they identify structures that have been repaired. The submergence of lines with gaps or breaks could result in infiltration of contaminants to the SD system. A number of identified locations of soil and groundwater contamination are present in the vicinity of damaged and submerged SD lines, presenting the possibility for infiltration. The following is a summary of findings for damage and submergence in each drainage area.

North lateral area: Of the 107 segments inspected, 33 indicated signs of cracks, fractures, breaks, or other defects. Signs of soil and groundwater infiltration were confirmed in 10 segments within the following lines: N4, N5, N7, N10, and a branch of N11. Of these, generally only N7 and probably N10 are submerged by groundwater during high water-table conditions. In addition, 54 presumed inactive tap connections were observed to be unplugged or uncapped.

North-central lateral area: Data containing results of the cleaning and video inspection of segments of lines NC1, NC2, NC3, and NC5 were lost due to a malfunction. Signs of soil infiltration were confirmed in line NC3, but this line is not submerged by groundwater. Five segments indicated cracks, fractures, or separated joints but showed no signs of infiltration. In addition, seven tap connections were observed to be unplugged or uncapped.

South-central lateral area: Of the 17 line segments inspected, 9 indicated signs of soil and/or groundwater infiltration; all were located in the main line, which is entirely submerged in groundwater. The majority of the main line, SC1, indicated signs of infiltration. In addition, four tap connections were observed to be unplugged or uncapped.

South lateral area: Eight line segments inspected indicated signs of soil or groundwater infiltration. Cracks, fractures, or separations were identified in approximately a third of the line segments inspected. In some areas where the SD system has been compromised, the system is submerged in groundwater. In addition, 26 tap connections were observed unplugged or uncapped.

Building 3-380 area: One SD line segment had minor cracks but it is shallow and not submerged, and thus not subject to groundwater infiltration.

Parking lot area: SD structures and lines are shallow and cannot be submerged by groundwater (although tidal flooding may occur inside the SD line). Video inspection reported cracks or fractures in the SD lines PL1 and PL3. Intruding roots were observed in PL1; there is a potential for infiltration of soil.

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1.0 Introduction

Cleanup of contaminated sediment in Slip 4 of the Lower Duwamish Waterway (LDW) has been delayed because of potential recontamination that might result through releases of contaminants from the North Boeing Field/Georgetown Steam Plant (NBF-GTSP) Site (Figure 1-1). A Remedial Investigation/Feasibility Study (RI/FS) and cleanup of the Site to reduce the potential for recontamination of Slip 4 sediments is in progress. Due to the long time frame associated with the RI/FS process, the Washington State Department of Ecology (Ecology) has expedited RI/FS activities that support implementation of interim actions and that may allow cleanup of Slip 4 to commence as scheduled in late 2011. This Infiltration and Inflow (I&I) Assessment is one of these expedited activities, focusing on contaminant sources contributing to storm drain discharge to Slip 4.

Stormwater with suspended and dissolved contaminants at the NBF-GTSP Site (the Site) has been identified as a potential pathway for sources leading to Slip 4, in addition to other potential pathways leading to the slip. Virtually all storm drain (SD) lines in the NBF-GTSP SD system are located on the NBF facility, with upstream laterals extending onto the adjacent King County International Airport (KCIA) facility. In order to control sources of contaminants to the NBF SD system, it is necessary to locate and mitigate these sources. This report presents results of a study conducted to identify potential areas of contaminated surface inflow and groundwater/soil infiltration at the Site, such that appropriate recommendations leading to interim actions or other measures can be implemented prior to Slip 4 sediment cleanup, and thereby minimize the potential for sediment recontamination. The objectives of this I&I Assessment are to accomplish the following:

- Identify potential sources of contaminants, primarily polychlorinated biphenyls (PCBs), to the NBF SD system.
- Evaluate the potential for transport of contaminants to the NBF SD system from surface sources (inflow) and subsurface sources (infiltration).
- Provide recommendations leading to development of interim actions to mitigate and/or eliminate transport of contaminants to the SD system via these pathways.
- Describe additional characterization activities that need to be conducted in order to evaluate and address these pathways.

As this I&I Assessment has been developed (draft and final reports), a number of interim actions and characterization efforts at the NBF-GTSP Site have been performed or are currently in the planning stages. As a result, a portion of the recommendations from the I&I Assessment have already begun, although additional work in these areas is included as further recommendations in this report.

The I&I Assessment report is organized into the following sections. Section 1.0 provides background information on the NBF-GTSP Site, discusses the approach and methodology for the I&I Assessment, discusses the selection of contaminants of potential concern (COPC) for the NBF SD system, and discusses the investigation activities and source control interim actions taking place at the Site. Section 2.0 provides a description of the NBF SD system and the contaminants identified within the system. Section 3.0 presents a conceptual site model (CSM) that describes sources, release mechanisms, and exposure pathways to the SD system. Sections 4.0 and 5.0 comprise the detailed inflow and infiltration assessments, respectively, which include the means by which contaminant sources reach the SD system. Section 6.0 lists references cited in this report.

1.1 Background

Most areas of NBF drain to one of four major lateral SD lines: the north, north-central, south-central, and south lateral SD lines. The lateral lines and the smaller Building 3-380 area SD line are directed to a trunk line that passes through the King County (KC) lift station, under East Marginal Way S, and then discharges to the 60-inch KCIA SD#3/PS44 emergency overflow (EOF) outfall at Slip 4. Other potentially contaminated stormwater leading to Slip 4 includes the Interstate 5 (I-5) SD and the former Georgetown Flume. The NBF lateral drainage lines also receive stormwater from the northern and central portions of KCIA, located upstream and offsite of the Boeing-leased property (see Section 2.0). NBF stormwater from a small area near a parking area downstream of the lift station also drain to Slip 4 via the KCIA SD#3/PS44 EOF outfall.

Significant concentrations of PCBs and other contaminants have been detected in stormwater and SD solids found in manholes, catch basins, and sediment traps on the Site (in this report, all SD "sediments" are referred to as "solids"). Whole water samples have been collected at a number of NBF locations, during storm events and base flow periods from 2009 to 2011. In addition to samples of SD settled solids, filtered suspended solids have recently been collected at a number of locations. Based on SD whole water and solids sampling results, the primary sources of PCB contamination appear to be within the north lateral drainage basin.

The United States Environmental Protection Agency (USEPA) has notified Ecology that the USEPA will proceed with cleanup of sediments in the upper portion of Slip 4 during the fall/winter of 2011/2012, and has indicated that the contaminant sources to Slip 4 from the NBF SD system must be controlled prior to cleanup of Slip 4. The USEPA is requiring both short-term and long-term stormwater treatment facilities to be constructed and operated, in order to reduce the impact of contaminants in the NBF SD system. A short-term stormwater treatment facility was installed in the north lateral drainage area and became operational by September 15, 2010. Plans to design and implement a long-term stormwater treatment facility at NBF will be submitted to the USEPA in March 2011. USEPA, Ecology, and the potentially liable parties (PLPs) have agreed to accelerate work on the stormwater and source control portions of the NBF-GTSP RI/FS. These portions of the RI are being accelerated in an attempt to identify and control contaminant sources prior to cleanup of Slip 4.

Science Applications International Corporation (SAIC) prepared the *Supplemental Report: Summary of Existing Information and Identification of Data Gaps* for the NBF-GTSP Site in 2009. This Supplemental Data Gaps Report (SAIC 2009) described and summarized potential contaminant sources at NBF, including areas of contaminated soil and groundwater, concrete joint material (CJM) containing PCBs, and use of building materials (roofing, grout, paint, and other materials) that may contain PCBs or other chemicals of potential concern. The

Supplemental Data Gaps Report identified the following data gaps that are relevant to and are addressed in this I&I Assessment:

- A set of Geographic Information System (GIS) maps is needed to document the current status of the SD system, including the current system configuration (showing newly constructed lines and segments that have been plugged or removed), dates of most recent cleanout, locations of upgrades and repairs, and locations of cracks or breaks in the lines as identified during video inspections of the north lateral drain line.
- Sample data from the SD system need to be mapped to evaluate the geographic distribution of contaminants (especially PCBs and mercury) in the system. This information should be combined with available data on soil and groundwater contamination and PCB concentrations in CJM to identify correlations, if any.
- Results from recent particle size analysis of CJM should be evaluated.
- Additional investigation is needed to assess whether residual CJM is a source of PCBs to the KCIA SD#3/PS44 EOF storm drain.
- Additional investigation is needed to assess the concentration, fate, and transport of PCBs in recently installed CJM and other building materials at NBF. This assessment should include additional caulk sampling and sampling of roofing, grout, paint, and other materials.

A number of these data gaps have been filled and other activities performed since 2009. These include characterization investigations and source control interim actions. The PLPs have also proposed a number of additional activities to identify and mitigate PCBs and other sources at NBF-GTSP (as discussed in Section 1.4).

1.2 Approach and Methodology for I&I Assessment

For purposes of this I&I Assessment, *inflow* at NBF-GTSP includes transport of contaminated materials to the SD system by surface runoff along the ground surface; on, in, or through buildings or other structures; or by airborne transport. Inflow is distinct from infiltration in that the contaminants enter the SD system via catch basins, manholes, drains, or direct pipe connections, rather than by external subsurface mechanisms. *Infiltration* involves entry into the SD system by groundwater or subsurface soil, through breaks or other gaps in the SD infrastructure. Once source contaminants have reached the SD system, the transport of water and solids is the pathway leading to discharge to Slip 4.

This I&I Assessment is aimed at identifying potential sources of contamination to the SD system. A portion of this assessment involved historical and general research, and a portion involved the use of analytical data. The assessment incorporated all identified and available Site data through December 2010. This information includes pertinent analytical and other data from a large number of previous investigations, including those recently conducted by the PLPs and those by Ecology/SAIC. In particular, samples collected recently (2009–2010) at the NBF facility served to identify sources of SD contaminants, and to evaluate the potential for transport of contaminants to and through the NBF SD system, eventually discharging to Slip 4. Media sampled include stormwater (whole water), SD base flow water, SD solids, SD filtered suspended solids, soil, groundwater, CJM, and a variety of building materials. Descriptions of sample collection methods, data evaluation, and results from these investigations can be found in their corresponding work plans, reports, and data tables/figures (for PLP activities, see Section 1.4).

Information included in the I&I Assessment was compiled from technical documents drafted as late as January 31, 2011. However, analytical data from recently completed documents include only validated data that were available for incorporation into SAIC's database as of December 31, 2010. Although relatively older results have been entered into this database (extending back to 1982), the older data were selectively used in this I&I Assessment. The following list summarizes the sample data types used in this report:

- SD solids sampling results include the most recently collected data for any given location and COPC, but only extending back to 2004.
- SD whole water (storm event or base flow) sampling results include the maximum concentration detected for any given location and COPC, from 2009 to 2010.
- Groundwater sampling results include only the most recent data for any given location and COPC.
- Soil sampling results include the highest concentration for each COPC at each location, distinguished within two depth ranges (0 to 4 feet and 4 to 8 feet).
- CJM sampling results include the highest concentration at each location.
- Surface and building materials sampling results include all available, validated data.

1.3 Contaminants of Potential Concern

A COPC in the NBF SD system is defined in this report as a chemical that has been detected in Slip 4 sediments at concentrations above the Washington State Sediment Management Standards (SMS) or other relevant criteria. In addition, chemicals detected in stormwater discharges from NBF at concentrations above marine and/or freshwater water quality criteria (WQC) are considered COPCs. Although PCBs may be the primary contaminant of concern in Slip 4 and the LDW, other COPCs at the NBF-GTSP Site are of concern due to exceedances of the SMS and WQC values for samples collected from the NBF SD system. The I&I Assessment focuses on all COPCs identified for Slip 4 and at the KC lift station.

The SMS (Chapter 173-204 of the Washington Administrative Code [WAC]) establish marine Sediment Quality Standard (SQS) and Cleanup Screening Level (CSL) values for some chemicals that may be present in sediments. Sediments with chemical concentrations that do not exceed 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. For any given chemical, the CSL is greater than or equal to the SQS and it represents a higher level of risk to benthic organisms than the SQS level. The SQS and CSL values provide a basis for identifying sediments that may pose a risk to some ecological receptors.

Many of the SQS and CSL values are normalized to the organic carbon (OC) content of the sediment sample (reported as milligrams per kilogram [mg/kg] OC). Total organic carbon (TOC) values are increased by the presence of significant organic contamination and can be problematic when normalizing OC. Furthermore, OC normalization is not considered to be appropriate for TOC concentrations less than 0.5 percent or greater than 4.0 percent (Michelsen and Bragdon-Cook 1993, as cited in Windward 2008). Because many of the SD solids samples that have been collected at NBF either have TOC values outside these limits, or do not have associated TOC data, and to facilitate comparisons between sample media, dry weight (DW) chemical concentrations (non-OC normalized, reported as mg/kg DW) have been compared to the Apparent Effects Threshold (AET) values for these chemicals. AET values represent the concentrations of specific chemicals in sediment above which a significant adverse biological effect occurs (Ecology 1996). The AET values form the basis for both the Puget Sound Dredged Disposal Analysis program guidelines and the criteria contained in the SMS rule. The SQS and CSL values are based on the Lowest Apparent Effects Threshold (LAET) and Second Lowest Apparent Effects Threshold (2LAET).

Slip 4 sediment samples, whole water stormwater and SD base flow water, along with filtered suspended solids samples, were collected in order to identify COPCs for the NBF SD system, as these media are directly and rapidly transported through the SD system and discharged to Slip 4. A chemical was identified as a COPC for the NBF SD system if it met at least two of the following three criteria:

- Detection at concentrations above the SQS or LAET in at least one sediment sample from Slip 4 (based on Slip 4 surface sediment samples collected by SAIC on May 5, 2010),
- Detection at concentrations above the marine or freshwater chronic WQC in whole water stormwater or base flow samples collected at the KC lift station (sample location LS431) during 12 stormwater or base flow sampling events conducted between October 2009 and June 2010, or
- Detection above the SQS or LAET in at least one filtered suspended solids sample collected at the lift station during this same interval.

Chemicals exceeding only one criterion were considered on a case-by-case basis. Chemicals with concentrations in one or more samples that exceed the SQS/LAET or WQC are listed in Table 1-1. A listing of COPCs and the criteria used as screening levels for the various sampling media are presented as Table 1-2.

A review of the data used to identify COPCs indicates the following chemical-specific conclusions about determining COPCs.

- Copper did not exceed the SQS in Slip 4 sediments or filtered suspended solids. However, copper exceeded the Washington State Water Quality Standard (WQS) in 12 of the 24 stormwater samples, with a maximum concentration significantly higher than the WQS of 3.1 micrograms per liter (µg/L). As a result, copper was identified as a COPC for the NBF SD system.

- Selenium was detected sporadically in whole water samples, and the two observed exceedances were only 10 to 20 percent greater than the freshwater chronic WQS. There is no SQS/LAET value for selenium. Therefore, selenium is not considered as a COPC in this I&I Assessment.
- All polycyclic aromatic hydrocarbons (PAHs) reported in whole water samples were high molecular weight PAHs (HPAHs). Laboratory analysis of environmental samples can isolate individual PAHs; however, the individual PAHs are not discernable in potential sources of PAHs at NBF. In this report, the term total HPAHs is used as an indicator for all HPAHs and will collectively represent those HPAHs that have been detected in whole water samples above regulatory criteria. Total HPAHs were calculated as the sum of benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene.
- Exceedances of the low molecular weight PAH (LPAH) phenanthrene were detected in only two filtered suspended solids samples as estimated low values. Phenanthrene was detected in only one Slip 4 sediment sample at a concentration exceeding the LAET by less than 7 percent and was non-detected in stormwater samples. Therefore, phenanthrene is not considered as a COPC in this I&I Assessment.
- For purposes of the I&I Assessment, bis(2-ethylhexyl)phthalate (BEHP) is used as a representative phthalate compound. As such, butylbenzylphthalate (BBP), which was detected above the LAET in only four Slip 4 sediment samples at concentrations below the 2LAET criterion, is not considered as a COPC in this I&I Assessment.
- Analytical results for dioxins/furans indicate that these are also COPCs with respect to potential sediment contamination in Slip 4. The toxic equivalent (TEQ) values are applied for this chemical class (Table 1-2). Dioxins/furans concentrations do not have numerical criteria for comparison under SMS. The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) sediment screening level (4.5 picograms per gram [pg/g]), which was established for the Terminal 117 Site on the west side of the LDW (see Ecology 2011), is being applied for this I&I Assessment. Several sample results have concentrations exceeding this criterion from both the Slip 4 sediments (up to TEQ 41 pg/g DW) and NBF filtered suspended solids (up to TEQ 157 pg/g DW in the north lateral line). These data indicate it is likely that stormwater in the NBF SD system is a transport pathway for contamination of Slip 4 sediments by dioxins/furans. Dioxins/furans have not been tested for in other (non-NBF) SD lines leading to Slip 4 or in upstream SD lines (on KCIA property).

In summary, the following chemicals are considered to be COPCs in the NBF SD system and are carried forward in this I&I Assessment:

- PCBs
- Metals (mercury, cadmium, copper, lead, zinc)
- Total HPAHs
- BEHP
- Dioxins/furans

Additional chemicals have been detected in SD solids collected from numerous sampling locations within the NBF SD system, but are not found in Slip 4 sediments or NBF stormwater at concentrations above appropriate regulatory criteria. These chemicals are not considered COPCs for purposes of this I&I Assessment.

Contributions from other discharges, including the Georgetown Flume and the I-5 storm drain, to Slip 4 were considered in the evaluation of Slip 4 sediments for COPCs, but are not included as part of this NBF-GTSP I&I Assessment.

1.4 Recent Source Control Investigations and Interim Actions

The following is a list of activities and interim actions performed or reported since early 2010 at the NBF-GTSP Site.

- March and April 2010: Boeing excavated PCB-impacted asphalt and soil, conducted surface cleaning, as well as inspected, cleaned, and abandoned or replaced selected SD structures in the north lateral drainage area.
- June and July 2010: City of Seattle performed soil and groundwater sampling at the GTSP facility, focusing on the Low-Lying Area and the former fuel tank area.
- July and August 2010: Boeing conducted a focused soil and groundwater investigation in the PEL area, adjacent to the NBF-GTSP fence line and near Building 3-302.
- July and August 2010: Boeing conducted an evaluation of potential sources of contamination in the north lateral drainage area.
- August 2010: Boeing conducted jet-cleaning and video inspection of north lateral SD lines.
- August to October 2010: Boeing removed CJM in the Propulsion Engineering Laboratory (PEL) area.
- August to December 2010: Boeing jet-cleaned and video inspected SD lines in the north-central lateral, south-central lateral, south lateral, Building 3-380, and parking lot area drainage areas.
- September 2010: Boeing initiated the startup of the onsite short-term stormwater treatment facility designed to handle stormwater in the north lateral drainage area.
- September 2010: Boeing collected soil samples from borings in the PEL area.
- October 2010: Boeing performed abatement of yellow paint on bollards (traffic security posts) and support structures in the north Lateral drainage area.
- October and November 2010: Boeing replaced components of the SD system and excavated PCB-impacted soil in the PEL area.

In addition to the above activities, Boeing recently completed a human health risk assessment (HHRA) and transport evaluation for PCBs related to CJM in the flightline area. Sampling included SD inlet filter solids and CJM, as well as HHRA concrete wipe sampling. Information from this draft report was received too late for incorporation into this I&I Assessment report.

Boeing has also recently installed and sampled 15 new monitoring wells in the PEL area. Results have not yet been made available.

Boeing has recently conducted a salinity survey of Slip 4 to determine the nature of the Slip water and the habitat, to aid in understanding receptors and applicable regulatory criteria.

Boeing and the City of Seattle are planning excavations to remove contaminated soil with PCBs and petroleum hydrocarbons in summer 2011. Planned areas of excavation include the GTSP Low-Lying Area, the GTSP former fuel tank area, the NBF fence line area and surrounding areas, and near NBF Building 3-335.

Boeing is planning to sample additional CJM material and SD inlet filter solids in the flightline area of NBF during 2011. In addition, Boeing is planning to sample paint and remove contaminated paint from areas of the NBF facility outside of the PEL area.

Boeing will submit plans to USEPA in March 2011 for design and implementation of a long-term stormwater treatment facility at NBF.

Some of these Site activities, already completed and those planned, overlap with and/or will complement the activities and recommendations presented in this I&I Assessment report.

2.0 NBF Storm Drain System

The layout of the NBF SD drainage areas, including upstream drainages on KCIA, is presented in Figure 2-1. This figure depicts approximate acreages of the drainage areas for both the NBF-GTSP Site and for offsite. A detailed layout of the NBF SD system is presented in Figure 2-2. Large format base maps for the entire Site and for the northern portion of the NBF-GTSP Site, which include an aerial photo background, SD structures and piping, structure type, and structure numbers, are provided electronically in Appendix A. Section 2.1 presents an overview of the NBF SD system, and Sections 2.2 through 2.7 provide additional information for each of the six main drainage areas at NBF. Section 2.8 discusses depths below ground surface of SD structures and pipelines, and Section 2.9 summarizes Boeing's SD system upgrade and replacement activities.

2.1 Overview of NBF Storm Drain System

Most areas of NBF drain to one of four lateral SD lines (the north, north-central, south-central, and south lateral SD lines), which are directed to a trunk line that passes through the KC lift station, under East Marginal Way S, and finally discharges to the 60-inch KCIA SD#3/PS44 EOF outfall at Slip 4. The lift station (Building 3-395) was built in 1941, according to KCIA maintenance engineers (as cited in Landau 1993a). According to the KCIA engineers, the construction of the lift station prevents tidal backwash from flowing into the SD system.

Stormwater from a smaller area near Building 3-380 (which previously discharged to Slip 4 via a separate SD line) and an area downstream of the lift station, which includes a large automobile parking lot, also drain to Slip 4.

The NBF SD system drains an area of approximately 132 acres of the NBF facility:

SD Line	Area (sq ft)	Area (acres)	Percent of Total
North lateral	947,110	21.74	16.5 %
North-central lateral	924,174	21.22	16.1 %
South-central lateral	1,119,133	25.69	19.5 %
South lateral	2,276,360	52.26	39.6 %
Building 3-380 area	171,396	3.94	3.0 %
Parking lot area (downstream of KC lift station)	308,593	7.08	5.4 %
Lift station junction area	3,418	0.079	0.06 %
Total stormwater drainage area	5,750,185	132.01	100 %

SD system piping ranges from 8 to 48 inches in diameter (Boeing 2010a), and includes over 600 SD structures, including catch basins, manholes, trench drains, inlets, and oil-water separators (OWS). The catch basins and manholes are circular and/or rectangular structures of various sizes and ages, mostly constructed of concrete. Some of the older structures have wooden or clay floors. The total length of the system is estimated to be 7 to 8 miles, of which approximately 17 percent is greater than 24 inches in diameter (Landau 1993b). According to the May 2010 NBF Stormwater Pollution Prevention Plan (SWPPP) (Boeing 2010a), the SD system includes 16

OWSs and one lift station, as well as channel drains and roof drains from numerous buildings (Boeing 2010a).

Automobile parking areas comprise approximately 36 acres, or 28 percent of the Site area; flightline positions and taxiways comprise about 42 acres, or 33 percent of the Site area (Boeing 2010a). Less than one percent of the Site is pervious, including landscaped areas next to some of the buildings.

Stormwater from the northern portion of KCIA (approximately 171 acres) also drains to the four lateral SD lines, upstream of the Boeing-leased property[1] (Figure 2-1). According to the 2010 Boeing SWPPP (Boeing 2010a), the offsite areas that discharge to the KCIA SD#3/PS44 EOF upstream of NBF include:

- Offsite Drainage 1: An area consisting of the Air National Guard buildings, the KCIA Maintenance Shop, and parts of KCIA located west, north, and northeast of the GTSP. Drainage from this area enters the north lateral SD line at two locations upstream of MH178. King County and Boeing are working to more accurately define offsite drainage. Efforts will include dye testing to determine points of entry into the storm drain system.
- Offsite Drainage 2: An area consisting of clear zones at the northern end of the airport, the northern side of the runways, a portion of northeastern KCIA (including a fuel station), and the T-hangars adjacent to East Perimeter Road. Drainage from this area enters the north-central lateral SD line through an 18-inch diameter conduit near stall A-6 on the flightline, upstream of CB229A.
- Offsite Drainage 3: An area consisting of 190 feet along the northern end of the 13R-13L runway, small airplane parking areas, and the hangars adjacent to East Perimeter Road. These connect to the south-central lateral SD line through a 36-inch diameter pipe near stall B-8 on the flightline, upstream of MH19C.
- Offsite Drainage 4: An area consisting of 750 feet of runway 13R-13L, 900 feet of runway 13L-31R, east taxiway areas and loading aprons, the KCIA terminal, the north annex, and administration buildings. Drainage from this area enters the south lateral SD line through a 36-inch diameter pipe near stall B-11 on the flightline, upstream of MH492.

Potential contaminant sources in offsite drainage to the NBF SD system have not been evaluated as part of this I&I Assessment. Recommendations for further actions, if any, associated with offsite sources are presented in the Executive Summary.

For this I&I Assessment, the NBF SD system has been divided into the following six drainage areas (Figure 2-2):

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[1] KCIA is served by three storm drain outfalls: KCIA SD#3/PS44 EOF at Slip 4, KCIA SD#2/PS78 EOF at the former location of Slip 5, and KCIA SD#1 at Slip 6. KCIA SD#3 generally serves the northern portion of the airport. KCIA SD#2 serves the central portion of the airport, and KCIA SD#1 serves the southern portion of the airport.

- North lateral
- North-central lateral
- South-central lateral
- South lateral
- Building 3-380 area
- Parking lot area

SAIC and Landau Associates have been working to update storm drain structure coordinates and pipe configurations on site maps. During Boeing's 2010 SD solids sampling program, a mobile global positioning system (GPS) device was used to determine coordinates in the field for a subset of SD structures. These data have been incorporated into the maps included with this report. In some cases structure coordinates changed slightly, but the general configuration did not change. New structures identified during the Boeing sampling effort have been added and are shown on figures in this report and on the base maps in Appendix A; however, in some cases, SD lines associated with the new structures have not been defined.

The six drainage areas are shown in Figures 2-3 through 2-8. To simplify the discussion of each drainage area, sub-areas (identified as "tributary lines" on Figures 2-3 through 2-8) have been identified for each of the six main drainage areas.

Surface runoff drainage patterns at NBF are generally defined by the slopes of paved areas, building locations, and the locations of SD structures (Boeing 2010a). For this I&I Assessment, a simplified approach has been developed to identify surface areas that may be contributing runoff to specific SD structures. A series of Thiessen polygons[2] were developed to depict a drainage area for each SD structure that has been sampled at NBF (Figure 2-9). These polygons represent, as a rough approximation, an "area of influence" around each SD structure. Under ideal circumstances, a detailed surface elevation survey would be performed to accurately identify surface drainage pathways at the Site. However, the Site is generally flat and, given the nature of activities and the many buildings/structures/vehicles present at the Site, the information obtained during such a survey would still represent a significant uncertainty. This effort would not be cost-effective, particularly given the expedited nature of this I&I Assessment. As an approximation, the Thiessen polygons provide an indication of where to look for sources of contaminants to a given SD structure. It is recognized that SD solids within any given structure represents a composite of material reaching this point from nearby surfaces as well as material transported from upstream in the SD system.

The maps in this section and throughout the report present sample data as both colored symbols and as shaded polygons. The shaded polygons represent the most recent SD solids concentration at each sampling location, while the colored symbols represent specific sample locations and media (CJM, soil, groundwater, etc.). For consistency, the following color scale is used to represent SD solids for all maps in this report:

[2] Thiessen polygons contain one data point, and any location within a polygon is closer to its associated point than to the point of any other polygon.

Map Color	General Description	SD Solids
(light blue)	No exceedances	Less than SQS/LAET/CERCLA T-117 screening levels
(light green)	Concentrations exceed lowest criterion	Above SQS/LAET/CERCLA T-117
(yellow)	Concentrations exceed second lowest criterion, where applicable	Above CSL/2LAET or more than 10x CERCLA T-117
(orange)	Concentrations exceed 10x lowest criterion	More than 10x the SQS/LAET or 100x CERCLA T-117
(red)	Concentrations exceed 100x lowest criterion	More than 100x the SQS/LAET or 1,000x CERCLA T-117
(purple)	Concentrations exceed 1,000x lowest criterion	More than 1,000x the SQS/LAET or 10,000x CERCLA T-117

Sections 2.2 through 2.7 summarize the most recent SD solids sampling data for each drainage area at NBF as of June 2010; these data are depicted in Figures 2-10 through 2-18. Historical data collected prior to 2004 were not included. These data form the basis for the inflow and infiltration assessments presented in Sections 4.0 and 5.0. The presence of COPCs in the SD system at concentrations above screening levels triggers the search for a surface (inflow) or subsurface (infiltration) contaminant source. Results of 2009/2010 stormwater filtered suspended solids sampling activities are also discussed below.

2.2 North Lateral Drainage Area

The north lateral SD line drains most of the PEL area. The north lateral is represented by the green SD lines in Figure 2-2, and is shown in more detail in Figure 2-3. In general, the highest PCB concentrations detected in SD solids at NBF have been in the north lateral SD line and structures. The most recent COPC concentrations in SD solids are shown in Figures 2-10 through 2-18. Descriptions and data below are presented from the downstream end of the north lateral SD line to the upstream location where it enters the property from offsite. As contaminants in the SD system are cumulative, this approach attempts to trace the source of contaminants upstream.

The north lateral main line (N1 in Figure 2-3) intersects with the north-central lateral SD line at a location downstream of CB363. From CB363, the north lateral passes through CB108A, MH108, MH112, MH130, MH152, MH158, MH163, MH169, MH170, MH172, and MH178. It enters NBF near the GTSP property, upstream of MH178. An additional drainage area (shown on Figure 2-1) intersects with the main line from the west-northwest at a point just upstream of MH178. Twelve tributary lines, or "sub-drainages," identified as N2 through N12, are shown in Figure 2-3.

Table 2-1 lists the most recent SD solids data (filtered solids samples, grab samples, and sediment trap samples), the most recent sample date for a given SD structure between January 2004 and June 2010, and the sub-drainage for each structure. All of the SD COPCs have been detected at concentrations above the SQS/LAET/CERCLA T-117 screening level in the north lateral drainage area.

In addition to the grab samples and sediment trap sampling summarized in Table 2-1, SAIC has collected filtered suspended solids samples in stormwater at several locations along the north lateral SD line. PCBs, metals, HPAHs, BEHP, and dioxins/furans were detected at concentrations above their respective screening levels in these samples. PCB results are summarized below[3]:

SD Structure	Sub-Drainage	Sample Date(s)	Total PCB Conc'n (mg/kg DW)
MH108	N1 (Main Line)	10/17/09 – 6/30/10	1.3 – 22
MH133D	N5	5/20/10 – 6/2/10	0.27 – 1.3
MH138	N7	5/20/10 – 6/2/10	0.77 – 13
MH152	N1 (Main Line)	4/27/10 – 6/2/10	0.99 – 3.7
CB165	N10	4/27/10 – 6/2/10	1.3 – 7.5
CB173	N11	4/27/10 – 6/30/10	10 – 43
MH178	N1 (Main Line)	4/27/10 – 6/2/10	0.12 – 1.3

The most recent PCB concentrations in grab samples and sediment traps in the north lateral main line range from 0.28 to 57 mg/kg DW; three SD structures in the main line contained total PCBs above 10 mg/kg DW. It should be noted that the three highest PCB concentrations were found in samples collected in 2007 and 2009; these structures were not sampled during Boeing's SD sampling program in 2010 because insufficient solid material was present. PCB concentrations in stormwater filtered suspended solids collected by SAIC in the north lateral main line ranged from 1.3 to 22 mg/kg DW in 2010 samples.

BEHP analyses have been conducted only for sediment trap samples. Total HPAH analyses have been conducted only for sediment trap and filtered suspended solids samples. Dioxin/furan analyses have been conducted only for filtered suspended solids samples. The table below summarizes COPC detections above their respective screening levels in each sub-drainage based on the grab sample and sediment trap data (Table 2-1) and SAIC's stormwater filtered suspended solids data:

North Lateral Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
N1 – Main Line	●	●	●	●	●	●	●	●	●
N2 – Drainage to CB363	●	--	●	--	--	●	NA	NA	NA
N3 – Drainage to MH108	●	--	●	--	--	●	NA	NA	NA
N4 – Drainage to MH112	●	●	●	●	--	●	NA	NA	NA
N5 – Drainage to MH112-MH130 Segment	●	●	●	--	--	●	●	NA	●

[3] Complete filtered suspended solids data are presented in the *North Boeing Field/Georgetown Steam Plant Site Remedial Investigation/Feasibility Study, Expanded Stormwater Sampling Interim Data Report (Updated)* (SAIC 2011).

North Lateral Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
N6 – Drainage to MH130	●	●	●	●	--	●	NA	NA	NA
N7 – Drainage to MH130-MH152 Segment	●	●	●	●	●	●	●	NA	●
N8 – Drainage to MH152 (Fuel Test Area)	●	●	●	●	--	●	NA	NA	NA
N9 – Drainage to MH158-MH163 Segment	●	●	●	●	●	●	NA	NA	NA
N10 – Drainage to MH163-MH169 Segment	●	●	●	--	●	●	NA	NA	●
N11 – Drainage to MH172	●	●	●	●	--	●	NA	NA	●
N12 – Drainage to MH178	●	--	●	--	●	●	NA	NA	NA

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the SQS/LAET/CERCLA T-117.
NA = Not analyzed.

2.3 North-Central Lateral Drainage Area

The north-central lateral SD line drains the Concourse A flightline and portions of the Concourse B flightline, plus the area around Building 3-313 (Regulated Waste Storage). The north-central lateral is represented by the yellow SD lines in Figure 2-2, and is shown in more detail in Figure 2-4. The most recent COPC concentrations in SD solids as of June 2010 are shown in Figures 2-10 through 2-18. Descriptions and data below are presented from the downstream end of the north-central lateral SD line to the upstream location where it enters the property from offsite.

The north-central lateral main line (NC1 in Figure 2-4) intersects the Building 3-380 area SD line at MH422, just upstream of the KC lift station. MH422 is the location of sediment trap T1, and represents drainage from the north lateral, north-central lateral, and Building 3-380 area. From MH422, the north-central lateral passes through MH358, MH362, the junction with the north lateral SD line and sub-drainage NC2, MH219, MH221A, MH226, MH228, UNKMH19, MH228C, and CB229A. It enters NBF near the north end of KCIA, upstream of CB229A. Four tributary lines, or "sub-drainages," identified as NC2 through NC5, are shown in Figure 2-4.

Table 2-1 lists the most recent SD solids data (filtered solids samples, grab samples, and sediment trap samples), the most recent sample date for a given SD structure between January 2004 and June 2010, and the sub-drainage for each structure. All of the SD COPCs have been detected in at least one sample at concentrations above the SQS/LAET/CERCLA T-117 screening level in the north-central lateral.

In addition to the grab samples and sediment trap sampling summarized in Table 2-1, SAIC has collected filtered suspended solids samples in stormwater at one location (MH226) along the north-central lateral SD line. Samples were collected between April 27 and June 2, 2010. Total PCBs ranged from 0.34 to 0.54 mg/kg DW. Cadmium, copper, zinc, HPAHs, and dioxins/furans were also detected above their respective screening levels in one or more of these samples.

The most recent PCB concentrations in grab samples and sediment traps in the north-central lateral main line range from 0.11 to 4.0 mg/kg DW. The lowest concentration (0.11 mg/kg DW) was at CB229A and MH228C, both at the upstream end of the north-central main line. The highest concentration was at MH422-T1 (4.0 mg/kg); this sample was collected during Boeing's SD sampling program in 2010. The most recent filtered suspended solids sample collected from the north-central main line contained 0.5 mg/kg DW total PCBs in June 2010.

BEHP analyses have been conducted only for sediment trap samples. Total HPAH analyses have been conducted only for sediment trap and filtered suspended solids samples. An analysis of dioxins/furans has been conducted for only one filtered suspended solids sample. The table below summarizes COPC detections above their respective screening levels in each sub-drainage:

North-Central Lateral Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
NC1 – Main Line	●	--	●	●	--	●	●	●	●
NC2 – Drainage to MH422-MH221A Segment	●	●	●	●	--	●	NA	NA	NA
NC3 – Drainage to MH226	●	--	●	--	--	●	NA	NA	NA
NC4 – Drainage to MH228	●	●	●	--	--	●	NA	NA	NA
NC5 – Drainage to MH228-CB229A Segment	●	●	●	--	●	●	NA	NA	NA

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the SQS/LAET/CERCLA T-117.
NA = Not analyzed.

2.4 South-Central Lateral Drainage Area

The south-central lateral SD line drains the area around the east side of Building 3-390 (Flight Test Hangar) plus portions of the Concourse B flightline area. The south-central lateral is represented by the orange SD lines in Figure 2-2, and is shown in more detail in Figure 2-5. The most recent COPC concentrations in SD solids are shown in Figures 2-10 through 2-18. Descriptions and data below are presented from the downstream end of the south-central lateral SD line to the upstream location where it enters the property from offsite.

The south-central lateral main line (SC1 in Figure 2-5) intersects the other main NBF drainage areas at OWS421 at the KC lift station, just upstream of the lift station pumps. The south-central lateral main line then passes through MHPRD, MH361, CB364, MH368, MH369, MH373, CB409, MH410, CB455, MH413, MH414, MH461, UNKMH14, MH19C, and MH478, where it crosses the NBF boundary into the north-central portion of KCIA. Six tributary lines, or “sub-drainages,” identified as SC2 through SC7, are shown in Figure 2-5.

Table 2-1 lists the most recent SD solids data (filtered solids samples, grab samples, and sediment trap samples), the most recent sample date for a given SD structure between January 2004 and June 2010, and the sub-drainage for each structure. PCBs, cadmium, copper, lead, zinc, HPAHs, BEHP, and dioxins/furans have been detected in at least one sample at concentrations above the SQS/LAET/CERCLA T-117 screening level in the south-central lateral.

In addition to the grab samples and sediment trap sampling summarized in Table 2-1, SAIC has collected filtered suspended solids samples in stormwater at one location (MH369) along the south-central lateral SD line. Samples were collected between April 27 and June 2, 2010. Total PCBs ranged from 0.23 to 1.1 mg/kg DW. Cadmium, zinc, and dioxins/furans were also detected above their respective screening levels in one or more of these samples.

The most recent PCB concentrations in grab samples and sediment traps in the south-central lateral main line range from non-detect (detection limit 0.02 mg/kg DW) to 3.0 mg/kg DW. PCBs were not detected at MH19C, near the upstream end of the south-central main line. The highest concentration was at OWS421 (3.0 mg/kg DW); this sample was collected in 2006. This structure was not sampled during Boeing’s SD sampling program in 2010 because insufficient solid material was present. The most recent filtered suspended solids sample collected from the south-central main line contained 0.69 mg/kg DW total PCBs in June 2010. BEHP analyses have been conducted only for sediment trap samples. Total HPAH analyses have been conducted only for sediment trap and filtered suspended solids samples. An analysis of dioxins/furans has been conducted for only one filtered suspended solids sample. The table below summarizes COPC detections above their respective screening levels in each sub-drainage:

South-Central Lateral Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
SC1 – Main Line	●	--	--	--	--	--	●	●	●
SC2 – Drainage to OWS421-MH361 Segment	●	NA	NA	NA	NA	NA	NA	NA	NA
SC3 – Drainage to MH369-MH413 Segment	●	NA	NA	NA	NA	NA	NA	NA	NA
SC4 – Drainage to MH414	●	--	--	--	--	●	NA	NA	NA
SC5 – Drainage to MH461	●	--	●	--	--	●	NA	NA	NA

South-Central Lateral Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
SC6 – Drainage to MH461-MH19C Segment (through OWS 472A)	●	--	●	●	●	●	NA	NA	NA
SC7 – Drainage to MH19C	NA	NA	NA	NA	NA	NA	NA	NA	NA

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the SQS/LAET/CERCLA T-117.
NA = Not analyzed.

2.5 South Lateral Drainage Area

The south lateral SD line drains a large area in the southwestern portion of the Site, including the southern portion of Concourse B, all of Concourse C, and areas around the tent hangars (Buildings 3-811 and 3-812), Building 3-800 (Flight Test Engineering), 3-801 (Flight Test Engineering Lab), and 3-818 (Quick Change Building/Wire Shop), the southern parking lot area, the west side of Building 3-390 (Flight Test Hangar), plus the area around Buildings 3-369 (Paint Hangar/Wastewater Treatment Plant) and 3-374 (Boiler House). The south lateral is represented by the blue SD lines in Figure 2-2, and is shown in more detail in Figure 2-6. The most recent COPC concentrations in SD solids as of June 2010 are shown in Figures 2-10 through 2-18. Descriptions and data below are presented from the downstream end of the south lateral SD line to the upstream location where it enters the property from offsite.

The south lateral main line (S1 in Figure 2-6) intersects the other main NBF drainage areas at OWS421 at the KC lift station, just upstream of the lift station pumps. The south lateral main line then passes through MH443, MH356, MH353, MH281, MH271B, MH266A, MH263, MH642, MH482, OWS483F, and MH492, where it crosses the NBF boundary into the north-central portion of KCIA. Nine tributary lines, or “sub-drainages,” identified as S2 through S10, are shown in Figure 2-6.

Table 2-1 lists the most recent SD solids data (filtered solids samples, grab samples, and sediment trap samples), the most recent sample date for a given SD structure between January 2004 and June 2010, and the sub-drainage for each structure. All SD COPCs have been detected in at least one sample at concentrations above the SQS/LAET/CERCLA T-117 in the south lateral.

In addition to the grab samples and sediment trap sampling summarized in Table 2-1, SAIC has collected filtered suspended solids samples in stormwater at one location (MH356) along the south lateral SD line. Samples were collected between April 27 and June 2, 2010. Total PCBs ranged from 0.26 to 0.82 mg/kg DW. Cadmium, zinc, HPAHs, and dioxins/furans were also detected above their respective screening levels in one or more of these samples.

The most recent PCB concentrations in grab samples and sediment traps in the south lateral main line range from 0.18 to 0.58 mg/kg DW. The PCB concentration at the upstream end of the south lateral main line was 0.18 mg/kg DW in October 2009. The most recent filtered suspended solids sample collected from the south lateral main line contained 0.47 mg/kg DW total PCBs in June 2010.

BEHP analyses have been conducted only for sediment trap samples. Total HPAH analyses have been conducted only for sediment trap and filtered suspended solids samples. An analysis of dioxins/furans has been conducted for only one filtered suspended solids sample. The table below summarizes COPC detections above their respective screening levels in each sub-drainage:

South Lateral Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
S1 – Main Line	●	--	●	--	--	●	●	●	●
S2 – Drainage to MH353	●	●	●	●	--	●	NA	NA	NA
S3 – Drainage to MH281	●	--	--	--	--	●	NA	NA	NA
S4 – Drainage to MH271B	NA	NA	NA	NA	NA	NA	NA	NA	NA
S5 – Drainage to MH266A	●	NA	NA	NA	NA	NA	NA	NA	NA
S6 – Drainage to MH263	●	●	●	●	●	●	●	●	NA
S7 – Drainage to MH642	●	--	●	●	●	●	●	●	NA
S8 – Drainage to MH453	●	●	●	●	--	●	NA	NA	NA
S9 – Drainage to MH482-MH492 Segment	●	●	●	●	--	●	●	--	NA
S10 – Drainage to MH492	NA	NA	NA	NA	NA	NA	NA	NA	NA

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the SQS/LAET/CERCLA T-117.
NA = Not analyzed.

2.6 Building 3-380 Drainage Area

The Building 3-380 SD line drains a small area in the northwestern portion of the NBF facility around Building 3-380 (Paint Hangar). Most of this area formerly drained to Slip 4 through a separate outfall. The Building 3-380 SD line is represented by the red SD lines in Figure 2-1, and is shown in more detail in Figure 2-7. The most recent COPC concentrations in SD solids are shown in Figures 2-10 through 2-18. Descriptions and data below are presented from the downstream end of the Building 3-380 SD line to its upstream terminus.

The Building 3-380 SD line (B1 in Figure 2-7) intersects the north-central lateral at MH422, just upstream of the KC lift station. MH422 is the location of sediment trap T1, and represents drainage from the north lateral, north-central lateral, and Building 3-380 area. The Building 3-380 main line then passes through CB423, CB423A, MH104, MH105, CB427, MH427A, MH428, MH428A, CB429, CB107A, and CB109C. Two tributary lines, or "sub-drainages," identified as B2 and B3, are shown in Figure 2-7.

Table 2-1 lists the most recent SD solids data (filtered solids samples, grab samples, and sediment trap samples), the most recent sample date for a given SD structure between January 2004 and June 2010, and the sub-drainage for each structure. PCBs, cadmium, lead, zinc, HPAHs, BEHP, and dioxins/furans have been detected in at least one sample at concentrations above the SQS/LAET/CERCLA T-117 in the Building 3-380 SD line.

In addition to the grab samples and sediment trap sampling summarized in Table 2-1, SAIC has collected filtered suspended solids samples in stormwater at one location (CB423) along the Building 3-380 SD line. Samples were collected between April 27 and June 2, 2010. Total PCBs ranged from 0.18 to 1.8 mg/kg DW. Zinc and dioxins/furans were also detected above their respective screening levels in one or more of these samples.

The most recent PCB concentrations in grab samples and sediment traps in the Building 3-380 main line range from 0.041 to 1.3 mg/kg DW. The highest concentration (1.3 mg/kg DW) was found in MH105 in a grab sample collected in June 2009. The most recent filtered suspended solids sample collected from the Building 3-380 area main line contained 1.8 mg/kg DW total PCBs in June 2010.

BEHP and dioxin/furan analyses have been conducted for one sample. Total HPAH analyses have been conducted for one grab sample and filtered suspended solids samples only. The table below summarizes COPC detections above their respective screening levels in each sub-drainage:

Bldg 3-380 Area Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
B1 – Main Line	●	--	●	--	●	●	●	●	●
B2 – Drainage to MH105	●	--	●	--	●	●	NA	NA	NA
B3 – Drainage to MH428A	●	--	●	--	--	●	NA	NA	NA

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the SQS/LAET/CERCLA T-117.
NA = Not analyzed.

2.7 Parking Lot Drainage Area

The parking lot area SD line drains the large parking lot on the northwestern portion of the NBF facility and the area around Building 3-370. The parking lot area SD line is represented by the pink SD lines in Figure 2-2, and is shown in more detail in Figure 2-8. The most recent COPC concentrations in SD solids as of June 2010 are shown in Figures 2-10 through 2-18.

The parking lot area SD line (B1 in Figure 2-8) intersects the KCIA SD#3/PS44 EOF downstream of the KC lift station at CB433. The parking lot main line then passes through MH434, CB633, MH632, CB631, CB630, and CB436. Upstream of CB436, this line consists of two long, rectangular channel drains (D436A and D283A) through the parking lot.

Two tributary lines, or “sub-drainages,” identified as PL2 and PL3, are shown in Figure 2-8. These are two long, rectangular channel drains (D434A and D435B) that run the length of the parking lot in this area.

Table 2-1 lists the most recent SD solids data (filtered solids samples, grab samples, and sediment trap samples), the most recent sample date for a given SD structure between January 2004 and June 2010, and the sub-drainage for each structure. PCBs, cadmium, lead, zinc, HPAHs, BEHP, and dioxins/furans have been detected in at least one sample at concentrations above the SQS/LAET/CERCLA T-117 in the parking lot area SD line.

In addition to the grab samples and sediment trap sampling summarized in Table 2-1, SAIC has collected filtered suspended solids samples in stormwater at one location (MH434) along the parking lot SD line. Samples were collected between April 27 and June 2, 2010. Total PCBs ranged from 0.57 to 0.76 mg/kg DW. Zinc, HPAHs, and dioxins/furans were also detected above their respective screening levels in one or more of these samples.

The most recent PCB concentrations in grab samples and sediment traps in the parking lot area main line range from 0.41 to 2.1 mg/kg DW. The highest concentration (2.1 mg/kg DW) was found in CB633, located near Building 3-370, in a grab sample collected in April 2010. The most recent filtered suspended solids sample collected from the parking lot area main line contained 0.61 mg/kg DW total PCBs in June 2010.

Also included in the parking lot drainage area are several other tributaries to the KCIA SD#3/PS44 EOF line downstream of the KC lift station. These are shown in Figure 2-8 and include inputs from CB432, inlet 433A, CB433A (and upstream structures CB102, CB102A, CB102B, CB102C, and CB102D), and CB435A. PCBs in these structures ranged from 0.25 to 0.57 mg/kg DW during Boeing’s 2010 SD sampling program. In addition, cadmium (CB432), lead (CB102, CB432), and zinc (all locations) exceeded the SQS.

BEHP analyses have been conducted for one grab sample. Total HPAH analyses have been conducted for one grab sample and filtered suspended solids samples only. Dioxins/furans analyses have been conducted for only one filtered suspended solids sample. The table below summarizes COPC detections above their respective screening levels in each sub-drainage:

Parking Lot Area Sub-Drainage	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	HPAHs	BEHP	Dioxins/ Furans
PL1 – Main Line	●	--	●	--	●	●	●	NA	●
PL2 – Channel Drain 434A	●	NA	NA	NA	NA	NA	NA	NA	NA
PL3 – Channel Drain 435B	●	--	--	--	--	●	NA	●	NA
Other Drainage Downstream of KC Lift Station	●	--	●	--	●	●	NA	NA	NA

● = Chemical detected above the SQS/LAET/CERCLA T-117 in one or more grab samples, sediment trap samples, or stormwater filtered suspended solids samples.
-- = Not detected above the SQS/LAET/CERCLA T-117.
NA = Not analyzed.

2.8 Stormwater Treatment Facilities

In accordance with Administrative Settlement Agreement and Order on Consent (ASAOC) with the USEPA, Boeing installed a short-term stormwater treatment (STST) facility in the area of the north lateral drainage basin. The temporary chitosan enhanced sand filtration system is designed to remove PCBs and other COPCs in stormwater from the portion of the north lateral drainage area with historically the highest concentrations of PCBs.

Installation of the STST facility incorporated new SD structures, MH130A, MH130B, and MH130C. The STST facility, which began operations as of September 15, 2010, is capable of treating approximately 485 gallons per minute (gpm). As of November 13, 2010, the STST has treated approximately 3.73 million gallons of stormwater. It is estimated that 36.6 percent of stormwater has bypassed the system, which meets the intended system design of 61 percent treated and 39 percent untreated (bypassed) total stormwater (Landau 2010j).

Under the ASAOC, effluent from the STST facility must meet the following criteria: total PCB concentrations in discharged stormwater must be below Aquatic Life – Fresh Water/Chronic WQS of 0.014 µg/L and total suspended solids (TSS) in stormwater must be below a daily maximum of 10 milligrams per liter (mg/L) and a monthly average of 5 mg/L. Total PCB concentration must be below 0.420 mg/kg DW for TSS.

Only two samples of discharged water were collected as a result of issues with the installation of the effluent sampling port. The samples were non-detect for PCBs; however, the method detection limits (MDLs) exceeded the Aquatic Life – Fresh Water/Chronic WQS. Totals suspended solids in effluent whole water samples were non-detect (1.1U mg/L). As requested by the USEPA, an effluent filter was installed on October 15, 2010, in order to collect effluent filtered solids. As of November 17, 2010, an amount of filtered solids insufficient for analysis has been collected.

A long-term stormwater treatment (LTST) facility will be designed and implemented, as required by the ASAOC (USEPA 2010). Pending review of STST facility monitoring data, an alternative system type and location may be recommended for the LTST facility. LTST facility details will be outlined in the Pre-Design Technical Memorandum to be submitted to the USEPA in March 2011. The LTST facility is scheduled to be installed and operational by September 2011 (Geosyntec 2010).

2.9 Depth of SD System Components

This section describes the depths of SD system components at NBF. This information is used in conjunction with groundwater elevation data in Section 5.0 (Infiltration Assessment) to evaluate the potential for infiltration of groundwater to the SD system. Two types of system components are discussed in this section:

- SD structures, including catch basins, manholes, drains, inlets, vaults, and OWSs; and
- SD lines (conveyance piping) between these structures.

In any given location, the bottom depths of the SD structures may be the same or deeper than bottom depths of the adjacent SD lines. Information on depths for both categories of SD system components was largely obtained from elevations on Boeing AutoCAD drawings, as shown in Figure 2-19 (from Bach 2010b). These drawings and the evaluation presented in this Section extend south as far as stalls B-10 and C-8, within the southern portion of the south lateral SD basin.

The depths below ground surface (bgs) of these SD system components vary considerably within any drainage area. Table 2-2 presents the range of maximum depths of SD structures and SD lines for all major segments of the SD system, excluding short tributaries or side branches. SD system components are listed by drainage area and generally from downstream to upstream, including major tributaries. To determine SD line depths, either the flow line elevations (level of bottom main pipe in manhole) or selected invert elevations (base of tributary pipes) were utilized. Depths for oil-water separators in Table 2-2 are sometimes listed separately from other SD structures because they are typically deeper than surrounding structures and are located on a side branch to the main lateral lines. The following sections briefly highlight the general depth ranges of the SD structures and lines, arranged by drainage area.

2.9.1 North Lateral Drainage Area

Table 2-2 summarizes the depths of SD structures and SD lines for all major segments of the north lateral SD. This SD is considered to terminate at manhole MH363A, where it merges into the north-central SD line (see below). MH363A has a flow line depth of 8.6 feet bgs. The next two upstream structures on the main lateral line (CB363 and CB108A) have deeper invert depths of 11.4 and 10.8 feet bgs, respectively. Storm water flowing along this segment is apparently shunted upward to more shallow SD lines before reaching MH363A.

Moving in the upstream direction, beyond CB108A the SD line depth decreases to 7.1 feet bgs, which further decreases upstream to a depth of 6.8 feet at MH108, and to 6.1 feet at MH112. For a distance upstream from this location, the main lateral line maintains a depth of 5.5 to 6.5 feet bgs, increasing in depth again to 7 feet bgs at MH172 and MH178.

Overall, the SD lines in this drainage area are relatively shallow compared to the other large drainage areas. Aside from the deeper lines downstream of CB108A, all other portions of these pipes have depths less than 7 feet bgs. Most of the SD lines in sub-drainage N11, and continuing east of Building 3-626, have depths between 4 and 5.5 feet bgs, with a few short segments less than 4 feet. Most of the SD lines inside this loop and small branches outside the loop are also less than 4 feet bgs. SD lines in the vicinity of the Test Building (sub-drainage N8, N9, N10) range in depth to 5.5 feet bgs. The SD lines immediately surrounding Building 3-324 (sub-drainage N6) have depths between 4.4 and 6.5 feet bgs. SD lines in sub-drainage N5 extending northwest from the sweeper decant station (Building 3-341) are mostly shallow, but in the downstream direction they become deeper than 4 feet bgs near Building 3-343. Lastly, the SD lines in sub-drainage N4 are less than 4 feet bgs to the west of the former Georgetown Flume location and between 4 and 5.5 feet bgs to the east of the flume.

2.9.2 North-Central Lateral Drainage Area

Table 2-2 summarizes the depths of SD structures and SD lines for all major segments of the north-central lateral SD. At its downstream end, this SD passes through manhole MH358, which has a flow line depth of 10.3 feet bgs, and continues to MH422, which reaches 12.0 feet bgs. SD water then flows to OWS421 (depth of 18.2 feet bgs), which forms part of the KC lift station.

Most of this drainage area includes SD lines that range in depth from 4 to 8 feet bgs. Locations where SD lines are greater than 8 feet bgs include only the length downstream of CB221A, continuing to the lift station. Locations where SD lines are less than 4 feet bgs include: the upstream branches of sub-drainage NC2, upstream portions of sub-drainage NC4, the tributary line to sub-drainage NC3 along the eastern margin of stalls B-1 to B-3, and a few very short laterals draining catch basins.

2.9.3 South-Central Lateral Drainage Area

Table 2-2 summarizes the depths of SD structures and SD lines for all major segments of the south-central lateral SD. At its downstream end, this SD passes through manhole MH361, which reaches to a depth of 14.1 feet bgs, and continues to manhole MH-PRD (no depth information). Adjacent to MH-PRD is MH360, which reaches 8.6 feet bgs on a branch loop of the main lateral. Stormwater from both of these manholes then flows to OWS421 (18.2 feet bgs) and the KC lift station.

The main lateral SD line of this drainage area is deeper than 9 feet bgs for virtually the entire length at NBF. The large majority of this drainage area includes SD lines with depths greater than 4 feet bgs. Locations where SD lines are less than 4 feet bgs include sub-drainage SC5, sub-drainage SC7, most of sub-drainage SC4, and a few very short laterals draining catch basins.

2.9.4 South Lateral Drainage Area

Table 2-2 summarizes the depths of SD structures and SD lines for all major segments of the south lateral SD. At its downstream end, this SD through manhole MH356, which extends to a depth of 14.4 feet bgs, continuing to MH443, which reaches to only 10.4 feet bgs. SD water then flows to OWS421 (18.2 feet bgs) and the KC lift station.

This large drainage area has wide-ranging depths for SD structures and lines. The main lateral SD line of this drainage area is deeper than 7 feet bgs (mostly more than 9 feet) for virtually the entire length at NBF. Other SD lines deeper than 8 feet bgs include some in the area between Buildings 3-369 and 3-390, as well as on the south side of Building 3-369 (deeper than 12.5 feet), and under the middle of Building 3-390. The large parking lot areas along East Marginal Way S include SD lines more shallow than 4 feet bgs on the southeast and northwest portions of the lot, and between 4 and 6 feet bgs in the central area of the lot. Similar depth distributions (less than 4 to about 6 feet) are present in the airplane stall areas and other small branches and tributaries, with an average SD line depth of approximately 4 feet bgs in these areas.

2.9.5 Building 3-380 Drainage Area

Table 2-2 summarizes the depths of SD structures and SD lines for all segments of the Building 3-380 drainage area. At its downstream end, this SD passes through catch basins CB423A (outlet depth of 9 feet bgs) and CB423 (outlet depth of 9 feet bgs), before merging with the north-central SD at MH422 (depth of 12 feet bgs), prior to reaching the KC lift station.

This small drainage area includes SD lines that have depths greater than 8.5 feet bgs in the main lateral line downstream of MH105, between 5 and 8.5 feet bgs in the main line upstream of MH105 and in sub-basin B3, and 3 to 4 feet bgs in sub-basin B2.

2.9.6 Parking Lot Drainage Area

Table 2-2 summarizes the depths of SD structures and SD lines for all segments of the parking lot drainage area. This SD merges with stormwater from the other NBF drainage areas downstream of the KC lift station (LS431) at CB433 (depth information not available). The discharge line from the lift station exits at a depth of 6.9 feet bgs and is then gravity fed to Slip 4.

The two western channel drains in the parking lot (sub-drainage PL2 and PL3) have depths of approximately 3.4 feet bgs, and the two eastern drains (PL1) have depths of approximately 2.3 feet bgs. Downstream (northwest) of drains D283A and D436A, the SD lines become as deep as 6.3 feet and merge together through a single manhole (MH434) at an invert depth of 6.3 feet bgs before reaching CB433. A short distance downstream (southwest) from CB433, a small SD line merges with the main lateral from the northwest at a depth greater than about 4 feet bgs, before all combined stormwater drains to Slip 4.

2.10 Summary of Storm Drain System Upgrades and Replacement

Boeing has conducted numerous SD system upgrades and improvements since 2010. The results of the 2010 SD cleaning and video inspections, which were conducted in all six drainage areas, are discussed further in Section 5.0. Storm drain system upgrades and replacements are summarized below:

Dates	Activity	Sub-Drainage	Description
Aug-Oct 2006	SD Cleaning	N1, N3, N7, N11, and NC1	After the City of Seattle conducted an interim action to remove PCB-contaminated soil along the NBF-GTSP fence line, Boeing jet-cleaned SD lines between the PEL area and the lift station.
Jan 2007	Video Inspection	N1, N3, N7, N9, N10, and N11	Boeing performed a video investigation in the PEL area to assess the condition of the SD piping. Results are described in Section 5.0.
Jun-Sep 2007	SD Line Replacement	N11	Boeing replaced approximately 300 linear feet of SD lines near the NBF-GTSP fence line. The former OWS vault (OWS186), located adjacent to the NBF-GTSP fence line, was decommissioned after groundwater was found to be leaking into the vault.
Nov 2007	SD Line Upgrades	N1 and N11	An additional 500 linear feet of SD lines near the NBF-GTSP fence line were cleaned and upgraded with a cured-in-place plastic lining system.
Oct-Dec 2007	SD Line Cleaning	N1, N2, N7, N11, NC1-NC5	The main SD trunk lines in the PEL area and in the flightline area (north lateral and north-central lateral SD lines) were jet cleaned.
Apr 2008	Video Inspection and SD Cleaning	NC1 and NC3	Additional SD trunk lines in the north-central lateral were jet-cleaned. Video inspection of lines indicated the need for SD repairs.
Jun-Jul 2008	SD Line Installation	NA	Approximately 950 linear feet of new SD lines were installed at the north end of the NBF property to support the Georgetown Flume closure project.
Nov-Dec 2008	SD Line Upgrades	NC1 and NC3	Approximately 700 linear feet of SD piping in the north-central lateral was upgraded. A small portion of the piping was replaced, and the remaining piping was re-lined with cured-in-place plastic piping. Prior SD piping in this area consisted of corrugated metal pipes that could not be sufficiently cleaned and were corroding. Noticeable reductions of PCBs in the north-central lateral were observed following this cleanout and upgrade work.
May-Sep 2009	SD Investigation and Cleanout	NA	Based on results of SD structure sampling throughout NBF, Boeing conducted cleanout of selected manhole, catch basin, and OWS structures.
Mar-Apr 2010	Surface Cleaning, SD Structure Cleaning, and Soil Removal	N1, N7, N11, and NC1	Boeing conducted pressure cleaning of surface areas around Buildings 3-323, 3-302, and 3-322 to remove residual PCBs from surface debris; in addition, Boeing removed asphalt and underlying soil along the north side of Building 3-322 and on the west side of Building 3-302. Catch basin filters were installed in SD structures in the vicinity of these buildings. Seven catch basins with PCB concentrations greater than 50 mg/kg DW were cleaned.
Mar-Apr 2010	SD Structure Grouting	NA	Boeing identified 13 catch basin and/or manhole locations with observed or potential for groundwater infiltration. These were sealed with polyurethane grout.
Aug 2010	SD Cleaning and Video Inspection	N1-N12	Boeing jet cleaned SD lines and conducted a video inspection of north lateral lines which indicated SD structures in need of repair.

Dates	Activity	Sub-Drainage	Description
Aug-Dec 2010	SD Cleaning and Video Inspection	NC1-NC5, SC1, SC3, SC5, SC6, S1-S10, B1-B3, PL1-PL3	Boeing jet-cleaned SD trunk lines in the north-central, south-central, south, Building 3-380, and parking lot area laterals. Video inspection of lines indicated the need for SD repairs.
Oct-Nov 2010	SD Structure and Line Replacement	N10 and N11	Boeing replaced approximately 270 linear feet of north lateral SD line, abandoned former CB184 and former CB184B, and installed CB184C, CB184D, and CB174B

NA = Not available

SD system pipe cleaning, slip-lining activities, abandonments and replacements, are shown on Figures 2-19 through 2-22. Catch basins, manholes, and OWSs that have been cleaned between 2005 and 2009 are listed in Appendix C. The majority of SD structures and line segments in all six drainage areas were cleaned in 2010 (Figure 2-20).

3.0 Conceptual Site Model

Two of the objectives of the I&I Assessment are to identify potential sources of SD COPCs at the NBF-GTSP Site, and to evaluate the potential for transport of contaminants to the SD system from surface sources (inflow) and subsurface sources (infiltration).

As an initial step, a brief literature review was performed to identify historical and present-day uses of the SD COPCs in commercial and industrial settings. The general relevance of these uses to activities at NBF was assessed where applicable. In some cases, such as PAHs and dioxins/furans, the SD COPCs are also byproducts of widespread, non-industrial activities. Potential uses and sources of COPCs that may be applicable to activities at NBF are listed in Table 3-1, and are described in the following sections.

During the literature review, information was also obtained regarding the fate and transport of the COPCs in environmental media such as air, soil, and groundwater. Relevant fate and transport mechanisms for each COPC are summarized in the following section to facilitate a better understanding of the potential pathways for COPCs to enter the SD system at NBF. This conceptual site model incorporates general uses for each COPC class. An evaluation of concentrations of these COPCs in surrounding industrial areas was not performed as part of the I&I Assessment.

3.1 General Sources and Pathways for SD COPCs

3.1.1 Polychlorinated Biphenyls

PCBs are a group of synthetic chemicals created by adding chlorine to biphenyl. PCBs were manufactured and sold as complex mixtures of various congeners, primarily from 1929 to the late 1970s. PCBs were used in hundreds of industrial and commercial applications because they do not burn easily, have a high heat capacity, do not explode, are chemically stable, have high boiling points, and have electrical insulating properties (USEPA 1980; Fiedler 1997). In 1998, USEPA identified a number of non-liquid PCBs, which included paint, Galbestos siding, ceiling tiles, adhesive tape, fiberglass insulation, foam rubber, coal tar enamel coatings, processed cork ventilation system gasket material and other roofing and siding materials (M.L. Press 2007). Additional information regarding sources of PCBs in industrial settings is included in Appendix D.

Manufacture of PCBs was banned in the United States in 1979. Modern PCB releases to the environment can occur from illegal or improper dumping of waste materials that contain PCBs; leaks or releases from electrical transformers; vaporization from PCB-containing coatings and materials; disposal of PCB-containing consumer products into municipal or other landfills not designed to handle hazardous wastes; burning of wastes in municipal and industrial incinerators; leaching and/or weathering of PCB-containing building materials; and erosion of PCB-contaminated soil (Agency for Toxic Substances and Disease Registry [ATSDR] 2000, Herrick et al. 2007, and Marsalek 2006).

In air, lower-chlorinated PCBs are found preferentially in the gas phase and are not typically washed out with rainwater from the atmosphere due to their low water solubilities. Higher-chlorinated PCBs completely adsorb to particulates and can be removed from the atmosphere by capture of aerosols in rain drops (Fiedler 1997). A review of 140 articles on urban stormwater quality indicated that PCB concentrations in urban stormwater ranged from 0.027 to 1.1 μg/L (ATSDR 2000).

PCBs released to water are strongly adsorbed to sediment and organic matter (Rice et al. 2003). The organic carbon in soils and sediments acts as a sink for PCBs, which bind tightly and become immobilized (Fiedler 1997). Re-dissolution into the water column from sediments, although unlikely under most conditions, has been shown to occur (Hoffman et al. 2003).

If leaching of PCBs from soil and sediment were to occur, it would be greatest for the least-chlorinated PCB congeners and for soils with low organic carbon (Rice et al. 2003). PCBs are highly mobile in soils when leached with organic solvents (CCME 1999).

3.1.2 Mercury

Mercury is used in many electrical applications including batteries, wiring devices and switches, measuring and control instruments (e.g., thermostats), and lighting. Phenylmercuric acetate is used in inks, adhesives, and caulking compounds. Use of phenylmercuric acetate in exterior paints and fungicides was banned by 1991. The use of phenylmercuric acetate was banned in interior paints in 1990 (ATSDR 1999). Mercury is no longer used in paint in the U.S. (USGS 2010a).

Mercury is present in the atmosphere as a result of natural and anthropogenic emissions. Natural emissions include degassing of mineral mercury from the lithosphere and hydrosphere. Anthropogenic emissions include industrial processes such as chloralkali manufacturing, combustion of fossil fuels, cement production, incineration of medical and municipal wastes, and boilers, both commercial and industrial. Other sources of anthropogenic mercury include the application of fungicides, fertilizers, and municipal solid waste to land and the disposal of solid and industrial waste products to landfills. Mercury is deposited on the land and surface waters through wet and dry processes.

Wet deposition (i.e., precipitation) is the primary method of mercury removal from the atmosphere (ATSDR 1999). Concentrations of mercury in rain water are generally below 100 nanograms per liter (ng/L) in areas not influenced by an emissions source (including urban areas). Mercury concentrations in excess of 1,000 ng/L have been reported in areas downwind of anthropogenic mercury sources (USEPA 1997).

Mercury is present in surface water due to weathering of mercury-bearing minerals in rocks; atmospheric deposition of elemental mercury, such as dust emissions from industrial operations; and spills from industrial equipment and erosion of mercury-contaminated soil. Mercury present in soil can be washed to surface waters during rain events. Elemental mercury deposited to the ground surface may be conveyed to the SD system during rain events. Mercury then sorbs to sediments with little dissolution to the water column. Mercury in rainwater sorbs to soil and does not generally leach to groundwater. The average range of mercury concentrations in soil ranges from 20 to 625 micrograms per kilogram (µg/kg), with the highest concentrations generally found in urban locations (ATSDR 1999).

3.1.3 Cadmium

The major use of cadmium is in batteries, followed by pigments, coatings and plating, stabilizers for plastics, nonferrous alloys, and specialized uses such as photovoltaic devices (USGS 2008, 2010b). Cadmium pigments are durable and withstand exposure to light, high temperatures, and harsh weathering conditions. Over 85 percent of the cadmium pigments produced are used to color plastics due to their ability to withstand high temperatures. Cadmium pigments are also used to color glass and ceramics. Glass traffic light lenses and hazard lights are colored with cadmium pigments (USGS 2008).

Cadmium provides corrosion resistance in most environments and is commonly used to coat aluminum, brass, iron, steel, and titanium. Cadmium-based coatings are used on plate fasteners for aircraft landing gear and parachutes, automotive brake parts, other fasteners such as nuts and bolts, and springs. Cadmium is used as a stabilizer in polyvinyl chloride (PVC) though its use has decreased since 1980 (USGS 2002).

Cadmium is released to the air through fossil fuel combustion and other industrial activities such as metal production and waste incineration. It can travel long distances in the atmosphere and be deposited on surface soils and water through wet or dry deposition. Atmospheric deposition is the major source of cadmium to soil and surface water, followed by direct applications (e.g., phosphate fertilizer use), and accidental or fugitive contamination. In areas of atmospheric emissions, such as incinerators and vehicular traffic (which may emit cadmium from burned fuel and worn tires), cadmium deposition levels are greater. Cadmium tends to bond strongly with organic material and is immobile in most soils, though it may leach into groundwater, especially under acidic conditions (ATSDR 2008).

3.1.4 Copper

Copper is a widely used metal due to its durability, ductility, malleability, and electrical and thermal conductivity. The top industrial and commercial users of copper are in the construction industry, electrical and electrical products, transportation equipment, and industrial machinery and equipment. Some common uses of copper and copper alloys are used in plumbing, building wire, power utilities, air conditioning, business electronics, and valves and fittings (ATSDR 2004).

Sources of copper in the air of urban areas include coal combustion, soil, brake wear, and automobile emissions. Copper is released to the atmosphere in the form of particulate matter or adsorbed to particulate matter. It is removed by gravitational settling (bulk deposition), dry deposition, and wet deposition (ATSDR 2004).

Copper is released to water as a result of natural weathering of soil and discharges from industries and sewage treatment plants. Copper compounds may also be intentionally applied to water to kill algae. Urban runoff is another source of copper to waterways. Copper originates on building rooftops and sidings and in vehicle emissions. Much of the copper discharged into waterways is in the form of particulate matter that has settled out. In the water column and in sediments, copper adsorbs to organic matter, hydrous iron and manganese oxides, and clay. Sediment is an important sink and reservoir for copper. The median concentration of copper in U.S. surface water is 10 μg/L (ATSDR 2004).

The major sources of anthropogenic copper releases to land are mining operations, agriculture, sludge from publicly owned treatment works, and municipal and industrial solid waste. Copper generally adsorbs to organic matter, carbonate minerals, clay minerals, or hydrous iron and manganese oxides in soils. Sandy soils with low pH have the greatest potential for leaching. In the U.S., copper concentrations in soil range from 1 to 300 mg/kg with a mean ranging from 14 to 41 mg/kg, depending on soil type (ATSDR 2004).

3.1.5 Lead

Lead is a comparatively rare metal but is ubiquitous in urban environments and is a trace constituent in rocks, soils, water, plants, animals, and air. The amount of lead released to the environment from natural sources (volcanoes, windblown dust, and erosion) is minor compared to anthropogenic sources (smelting, coal and oil combustion, lead based paint, etc.). Lead and lead compounds are used in a wide variety of applications including batteries, caulk, plastic stabilizers, glass and ceramic products, pigments, electrical machinery and equipment, and vehicles and equipment (ATSDR 2007). Lead was used in paint as a pigment and to extend life of the paint until this use was banned for consumer products in 1978. Paint containing lead may continue to be used in industrial settings (CPSC 2001).

Lead occurs in the air in particles and is removed by wet and dry deposition. Atmospheric deposition is the largest source of lead to soils. Lead sorbs strongly to soil and does not readily leach to subsoils or groundwater except under acidic conditions. In water, lead is most soluble under conditions of low pH, low organic content, low concentrations of suspended sediments, and low concentrations of the salts of calcium, iron, manganese, zinc, and cadmium (Eisler 2000). Lead in surface waters is generally sorbed to suspended solids and sediments. Soils and sediments act as sinks for lead, as lead released to air and water is ultimately deposited in soil or sediment. Lead is mobilized and released from sediments when pH decreases suddenly or ionic composition changes (ATSDR 2007).

Although lead concentrations have declined dramatically since the ban of its use as a gasoline additive, urban runoff is a potential source of lead to waterways. Lead is present in many building materials (brick, concrete, painted and unpainted wood, roofing and vinyl) and automotive sources (brakes, used oil). In the U.S., lead concentrations in groundwater and surface water range from 5 to 30 μg/L (ATSDR 2007).

3.1.6 Zinc

Zinc is released to the environment through natural and anthropogenic sources (WHO 2001). Zinc is used in many applications, including protective coatings, dye-casting, electrical goods, tires, and paint (ATSDR 2005). Major anthropogenic sources of zinc to the environment include electroplaters, domestic and industrial sewage, combustion of fossil fuels and solid wastes, tire debris in road surface runoff, and corrosion of zinc alloys and galvanized surfaces (Eisler 2000).

Anthropogenic sources of zinc emissions to air include dust and fumes from mining, zinc production facilities, smelting, brass works, coal and fuel combustion, refuse incineration, and iron and steel production. Zinc concentrations in air are relatively low except near industrial sources such as smelters. Zinc is removed from the air by dry and wet deposition. Zinc particles with small diameters and low densities suspended in the atmosphere can travel long distances from emission sources (ATSDR 2005).

Atmospheric deposition is a significant source of zinc to surface waters. Urban runoff (buildings and automobiles contributed 95% of zinc loading in one study), municipal effluents, and effluents from the following industries: iron and steel, zinc smelting, plastics, and electroplating are significant sources of zinc to surface waters. Zinc oxide (the compound most commonly used in industry) has a low solubility in most solvents. Zinc does not volatilize from water but is deposited to sediments through adsorption and precipitation. Zinc concentrations are generally greater in sediments than in the water column (ATSDR 2005).

Significant sources of zinc releases to soil include mining, manufacturing, processing, and electrical power generation industries. Metallic zinc may yield soluble zinc compounds under acidic conditions; it is washed off slowly and forms a diffuse source of zinc to soils. Tire debris contains significant quantities of zinc which may contaminate soils near roads (ATSDR 2005). Zinc does not volatilize from soil and although it usually remains adsorbed to soil, leaching has been reported at waste disposal sites. Movement toward groundwater is expected to be slow unless zinc is applied to soil in soluble form (such as in agricultural applications) or accompanied by corrosive substances (such as in mine tailings). Clay and metal oxides are capable of sorbing zinc and tend to retard its mobility in soil. The mean zinc concentration in uncultivated soil is 51 mg/kg (ATSDR 2005).

3.1.7 Polycyclic Aromatic Hydrocarbons

PAHs are a ubiquitous product of combustion from natural sources (volcanoes, forest fires) and anthropogenic sources (motor vehicles and other gas and diesel-burning engines, cigarette smoke, etc.). Burning of wood in homes is the single largest anthropogenic source. Other natural sources include crude oil and shale oil. Commercial production of PAHs is not a significant source of these compounds to the environment. Only three PAHs are produced commercially in the U.S. in quantities greater than research level: acenaphthene, acenaphthylene, and anthracene (ATSDR 1995).

PAHs in the atmosphere are sorbed to particulates or occur as gases. PAHs exist in both the vapor and particulate phase in air. Particle-bound PAHs are removed from the atmosphere by precipitation and dry deposition (ATSDR 1995).

PAHs enter aquatic environments in atmospheric deposition, industrial and domestic sewage effluents, surface runoff from land, and spills of petroleum and petroleum products. In surface water, PAHs can volatilize, photolyze, oxidize, or biodegrade to the atmosphere, bind to suspended particles or sediments, or accumulate in aquatic organisms. HPAHs can volatilize from water only to a limited extent. HPAHs are hydrophobic and have extremely low solubilities (ATSDR 1995).

Most of the PAHs in soil are believed to result from atmospheric deposition. PAHs in soil can volatilize, undergo abiotic degradation, biodegrade, accumulate in plants, or be transported to groundwater. Sorption of PAHs in soils and sediments increases as the organic carbon content increases. HPAHs have extremely low volatilities (ATSDR 1995).

3.1.8 Phthalates

Phthalates are anthropogenic chemicals used to make plastics more flexible; they are also used in applications such as glues, cosmetics, rocket fuels, carpet backings, and paints (ATSDR 2001, 2002).

Phthalates are released to air from plastic products containing phthalate esters. Phthalate-containing materials continually off-gas until most of the phthalate is released and the product becomes brittle. Air with higher concentrations of fine particulates draws more phthalates out of plasticized PVC (Sediment Phthalates Work Group 2007). Phthalates are present in vapor phase and associated with particulates. Phthalates are removed from the atmosphere from wet (rain and snow) and dry (wind and settling) deposition (ATSDR 2002).

Phthalates are released to water by plastic containers or tubing containing phthalate esters. Phthalates sorb to suspended particulates and sediments and do not appreciably dissolve in water (Sediment Phthalates Work Group 2007). Phthalates in groundwater will adsorb strongly to soil. Sources of phthalates to soil include the disposal of plastics containing phthalate esters to landfills, and contaminated groundwater. Common organic solvents may increase solubility of phthalates, which increases the potential for phthalates to leach from soil into groundwater. Concentrations of BEHP range between 0.6 to 2,400 μg/L in U.S. surface waters (ATSDR 2002).

Phthalates travel to sediments primarily along an air to stormwater to sediment pathway. Phthalate loading to sediments increases with air particulate concentration and urbanization (Sediment Phthalates Work Group 2007). In the Commencement Bay watershed in the City of Tacoma, newly paved surfaces of brushed/rolled asphalt sealer were associated with exceptionally high BEHP sediment concentrations (340 and 580 mg/kg) (Foss et al. 2006). Other locations with elevated phthalate concentrations appeared to be linked to brake pads, serpentine belts, tire wear, cars, and high traffic businesses and areas (Foss et al. 2006).

3.1.9 Dioxins/Furans

Chlorinated dioxins, commonly referred to as dioxins, and chlorinated dibenzofurans, commonly referred to as furans, are two families of over 100 congeners with varying harmful effects to human health and the environment. Dioxins/furans typically occur in the environment in ash, soil, and surfaces with high organic content (e.g., plants) and are frequently co-located (ATSDR 1994, 1998).

Dioxins/furans are created as byproducts from the production, use, and disposal of certain chemicals and products (e.g., PCBs, chlorinated benzenes, chlorinated pesticides and herbicides, pentachlorophenol and other wood treatment products, PVC). Production and use of chlorinated pesticides and herbicides and pentachlorophenol has been discontinued or heavily restricted in the U.S. Waste water sludge from bleached kraft pulp and paper mills is a significant source of dioxins/furans. Small amounts of dioxins/furans are currently manufactured for chemical and toxicological research (ATSDR 1994, 1998).

Incineration and combustion processes currently produce the largest amounts of dioxins/furans and largest releases to the environment. Dioxins/furans are released to the atmosphere through waste incineration; fossil fuel and wood combustion; metal production and recycling (including iron, steel magnesium, nickel, lead, and aluminum); and cement kilns. Natural combustion processes such as forest fires or volcanoes may release dioxins/furans to the atmosphere, but these releases are relatively small amounts when compared to the anthropogenic incineration and combustion processes. Background levels of dioxins in air, water, soil, and sediments range are in parts per trillion (ppt) or parts per quadrillion (ppq), though in industrial areas concentrations in soil are present in the parts per billion (ppb) range (ATSDR 1994, 1998).

In the air, dioxins/furans are associated with ash and other particulates. Larger particles are typically deposited near the emission source, while smaller particles are transported long distances by wind. Lower-chlorinated dioxins/furans can vaporize from particles, soil, and surface water and be transported globally through the atmosphere. Sunlight breaks down a small portion of the dioxins/furans in the atmosphere. Dioxins/furans are removed from the atmosphere through wet and dry deposition. The compounds may be deposited directly to soil and surface waters (ATSDR 1994, 1998).

Dioxins/furans have contaminated soil and surface waters through a variety of processes, including wet and dry deposition of contaminated particles from the atmosphere, historical applications of chlorinated pesticides and herbicides; disposal of industrial wastes; and chemical leaching from chlorophenol-treated railway ties and utility poles. Additionally, surface waters may become contaminated with dioxins/furans through direct discharges from industrial sources and publicly owned treatment works; urban runoff released to water bodies through stormwater outfalls and CSO discharges; and erosion of contaminated soils (ATSDR 1994, 1998).

Dioxins/furans are not water soluble; the less-chlorinated congeners slowly vaporize out of the water column and the more-chlorinated congeners attach strongly to particles of soil and other organic matter. Dioxins/furans are biologically and environmentally stable and generally immobile in soil and sediments. Groundwater can become contaminated with dioxins/furans due to the presence of other contaminants in soil, such as petroleum hydrocarbons. Petroleum hydrocarbons may dissolve dioxins/furans, allowing the compounds to migrate from soil to groundwater. Dioxins have been detected in groundwater at concentrations up to 3,900 ppt near some industrial sites (ATSDR 1994, 1998).

3.2 Site-Specific Pathways

Primary industrial activities at NBF include:

- Aircraft finishing (including wet sanding, cleaning, painting);
- Aircraft testing (including parts testing, fuel system testing, aircraft systems testing, and fire suppression system testing);
- Delivery of completed aircraft to customers;

- Aircraft research and development; and
- Support services.

PCBs and other COPCs may enter the SD system and eventually reach Slip 4 through a number of pathways. Contaminants may reach the NBF SD system via either inflow or infiltration. Inflow pathways are means of transport along the ground surface, or on/in/through buildings or structures, or via an airborne pathway, and which result in contaminated materials reaching the SD system. These transport processes are typically facilitated by stormwater, but may also include direct spills and dry deposition to SD structures. Infiltration pathways are subsurface transport processes that allow contaminants to enter the SD system through gaps or breaks in underground SD structures. This process takes place through transport of contaminants found in soil or groundwater, which may directly infiltrate into the SD system. The following sections describe in more detail the various pathways for inflow and infiltration processes. A conceptual site model that illustrates these pathways is provided in Figure 3-1.

Contaminants reaching the SD system through *inflow* processes may follow a number of pathways. These pathways are not exclusive of each other, and contaminants may follow more than one pathway before reaching the SD system. These pathways include the following:

- Contaminants in solid materials originating on the outdoor ground surface may be fragmented and washed to SD structures.
- Contaminants (solids or liquids) on or in buildings, structures, or vehicles/aircraft may reach the SD system through weathering, fragmentation, washing, and/or conveyance through piping.
- Contaminants may become airborne from any source (onsite or offsite) via volatilization, off-gassing, wind, and/or exhaust, and may then be transported via atmospheric deposition to the ground surface and into the SD system.

Contaminants reaching the SD system through *infiltration* processes may follow one of two pathways. These pathways include the following:

- Contaminated groundwater (with or without suspended solids) may enter the SD system through gaps or breaks in underground structures or piping.
- Contaminated soil may enter the SD system through gaps or breaks in underground structures or piping.

A variety of individual processes at NBF may result in contaminants following one or more of the above pathways via inflow and infiltration to the SD system. Specific mechanisms of transport that are known to occur in industrial and other settings, and which may occur at NBF, are listed below.

<u>Inflow to NBF SD System</u>

- Weathering/erosion of contaminated surface solid materials located outdoors, such as asphalt, concrete, CJM, and soil particles. This causes fragmentation and movement of material along the ground surface, eventually washing into SD structures. Surface soil from the GTSP could possibly reach the NBF SD system during extreme weather events; however, it is not likely to occur during normal weather conditions.
- Weathering of a variety of solid materials from buildings (e.g., paint, caulk, window glazing, siding), various structures (tanks, utility materials), and vehicles/aircraft (including paint, brake pads/lining, tires). This causes erosion and/or fragmentation, with material reaching the ground surface and eventually the SD system. Contaminated material may reach the surface directly through gravity or may be conveyed via piping (such as downspouts), or may reach the SD system more directly (floor drains illicitly connected to the SD system, downspouts plumbed into SD system).
- Illicit liquid releases from buildings, various structures (e.g., transformers, hoses) and vehicles/aircraft, may be inadvertently washed into the SD system. Contaminants may reach the surface and be washed to SD structures, or be conveyed directly into the SD system.
- Materials deposited via atmospheric transport on building rooftops, paved surfaces, and other outdoor surfaces (including storm drain structures), from both on and offsite sources, which are then washed into the SD system.

<u>Infiltration to the NBF SD System</u>

- Contaminated soil may directly enter an adjacent opening in a SD structure or piping. This may take place directly or be aided by movement of groundwater or by water percolating through the vadose zone.
- In addition, contaminated water may also directly enter an opening in a SD structure or piping; groundwater infiltration is considered likely in areas where the highest water table elevation is at or above any given SD structure or piping elevation. Conversely, exfiltration may locally occur where contaminated stormwater exits the SD system.

An example of the transport of individual contaminated source material along multiple pathways to the SD system involves painted surfaces. Some exterior paints used at NBF contain COPCs (Landau 2010d). Paint on buildings, structures, and vehicles/aircraft can weather and flake off to the ground surface and migrate as solid particles that reach SD structures. Paint components can also off-gas during application and drying, adsorb onto airborne particulates, and settle out through atmospheric deposition.

The following table lists various potential processes and sources of contaminants at NBF, and it summarizes the possible pathways that these contaminated materials may take in reaching the SD system and eventually Slip 4. These processes and pathways are not certain to be currently taking place at NBF; however, this list includes potential or likely conditions sources, some of which are addressed under the NBF SWPPP (Boeing 2010a).

Source Material	Pathway[1]	Transport Mechanisms[1]
Adhesives	atmospheric deposition	volatilization, adsorption on particulates, airborne deposition, drains to SD
Asphalt	surface solid	erosion, fragmentation, drains to SD
Aviation and vehicle fuel/exhaust	atmospheric deposition	exhaust material from combustion, settles through airborne deposition, drains to SD
	liquid release to surface	liquid material drains to SD
Battery cart	liquid/solid release to surface	liquid/solid material released to ground surface, drains to SD
Brake pads/linings	solid release to surface	wearing of pads/lining, reaches ground surface and drains to SD
Cable/wire coverings	atmospheric deposition	off-gas during weathering, adsorption on particulates, airborne deposition, drains to SD
	solid release to surface	weathering, fragmentation, release to surface or subsurface utility vault
Caulk/grout/sealant	surface solid (concrete joint material, caulk)	erosion, fragmentation, drains to SD
	solid release to surface (building material)	weathering, fragmentation, reaches ground surface, drains to SD
	atmospheric deposition	off-gas during weathering, adsorption on particulates, airborne deposition, drains to SD
Concrete/cement	surface solid	potential adsorption or application of contaminants, erosion, fragmentation, drains to SD
Fertilizers, Herbicides, Insecticides	solid/liquid release to surface	released during application to ground surface or other areas, drains to SD
Floor tiles (Remaining after building demolition)	atmospheric deposition	volatilization, adsorption on particulates, airborne deposition, drains to SD
	solid release to surface	wearing of tiles, fragmentation, release to surface
Hydraulic fluid, lubricants, and other industrial fluids	liquid release to surface	liquid material released to ground surface, drains to SD
Paints/pigments	solid release to surface	weathering, fragmentation, reaches ground surface, drains to SD
	atmospheric deposition	off-gas during application/drying, adsorption on particulates, airborne deposition, drains to SD
Plastics, plasticizers, PVC	solid release to surface	weathering, fragmentation, reaches ground surface, drains to SD
	atmospheric deposition	off-gas during weathering, adsorption on particulates, airborne deposition, drains to SD
Plumbing/Welding/Soldering metals	solid release to surface	weathering and wear cause release to ground surface, drains to SD
Rubber (door seams, vehicle tires)	solid release to surface	weathering, fragmentation, reaches ground surface, drains to SD
	atmospheric deposition	off-gas during weathering, adsorption on particulates, airborne deposition, drains to SD

Source Material	Pathway[1]	Transport Mechanisms[1]
Solvents	liquid release to surface	liquid material released to ground surface, drains to SD
	atmospheric deposition	volatilization, adsorption on particulates, airborne deposition, drains to SD
Wood preservatives	solid/liquid release to surface	weathering and wear, fragmentation, reaches ground surface, drains to SD

1. Release to surface indicates a pathway contributing to surface runoff.

4.0 Inflow Assessment

Inflow to the storm drain system at NBF includes transport of contaminated materials to the SD system by surface runoff along the ground surface; on, in, or through buildings or structures; or by airborne transport. The inflow assessment included the following activities:

- Available information was collected and reviewed, including literature information on potential PCB sources from industrial activities pertinent to NBF; sampling data for CJM, asphalt, surface materials and pavement sweepings; building construction information; inspection reports; and other available information.
- Site visits were conducted to identify potential contaminant sources at NBF, particularly with regard to building materials.
- Maps were prepared to document locations where residual CJM or other sources of contaminants may be present in proximity to COPCs in the NBF SD system.
- Additional data needed to assess inflow potential and relative importance of transport pathways were identified.
- Recommendations for interim actions or additional data collection were developed, as appropriate, for each potential source of contaminants to the SD system.

Section 4.1 of this report summarizes potential inflow sources examined in this assessment. Section 4.2 consists of a detailed evaluation of CJM, with comparison of PCB sampling data in CJM to nearby SD solids data. Section 4.3 consists of a detailed evaluation of known or suspected building/equipment materials at NBF, including results of the April 15 site visit and comparisons to literature information on specific COPCs. Section 4.4 consists of an evaluation of surface materials at NBF, including review of sampling data for asphalt and loose surface debris near SDs in the PEL area, and a general review of the airborne deposition pathway. Recommendations are made for further actions regarding CJM, SD solids, surface debris, and building/equipment materials.

4.1 Potential Inflow Sources

Sources of contaminant inflow to the SD system include known sources (such as CJM) and potential sources (such as paint or roofing materials). As part of this inflow assessment, the following activities and evaluation of information were performed to reach conclusions on known or potential sources of PCBs and other contaminants reaching the SD system at NBF.

A broad literature review was conducted to compile information on contaminants related to industrial activities that are known or are likely to have occurred or continue to occur at the NBF-GTSP Site. This included activity-specific documents from published literature, including documents from the ATSDR and expert witness reports submitted in July 2009 by Boeing and the City of Seattle. In addition, site-specific environmental reports and other documents concerning contaminant evaluations, remedial actions, building information, a recent Ecology inspection report, and other information were reviewed, including the results from the 2010 north lateral SD potential source evaluation (Landau 2010d). Site visits were conducted to evaluate and photograph buildings, storm drains, and other structures, including a site visit with an SAIC building materials expert on April 15, 2010. Some photographs from these site visits are included in Appendix E.

The focus of the inflow assessment is on contaminant sources that are likely to be most significant with respect to inflow to the SD system. Emphasis has been placed on exterior sources of PCBs and other contaminants, such as CJM, pipe flanges, paint, and building caulk. It is recognized that many other activities and structures currently or historically present at NBF may act as sources of COPCs, including interior sources. Very little information on interior sources at NBF was provided by Boeing, but has been included during preparation of this report to the extent that it was available. A number of these potential sources are identified and summarized in Table 3-1.

4.2 Concrete Joint Material

CJM, also referred to as concrete expansion joint material, joint caulk material, joint caulk sealant, or simply caulk, has been identified as a potential source of PCBs to the NBF SD system. Primary or residual CJM and associated concrete/asphalt may represent a significant source of PCBs to the SD system and ultimately to Slip 4 sediments. Although caulk is known elsewhere to contain polychlorinated terphenyls (PCTs), phthalates, PAHs, mercury, lead, and zinc, these chemicals have never been analyzed for in NBF CJM samples (Chrostowski 2009).

Several environmental investigations and previous cleanups of CJM have taken place at NBF, as summarized below. During these investigations and CJM removals, concentrations of PCBs in caulk material and surface pavement have been detected at concentrations exceeding the applicable cleanup or interim screening levels in various areas of the site.

4.2.1 Summary of CJM Characterization and Removal at NBF

In September 2001, Boeing notified the PCB Coordinator in the USEPA’s Toxic Substances Control Act (TSCA) Program that they had recently determined that concrete joint sealant (caulk) manufactured with PCBs had been used at NBF. Boeing estimated that approximately 500 linear feet of concrete joints contained sealant with PCBs at concentrations greater than 50 mg/kg, which is the TSCA action level for total PCBs (discussed below). This material is referred to as “primary” CJM. Boeing also indicated that an additional 57,000 linear feet of concrete joints with “residual” CJM of the same type (i.e., containing PCBs above 50 mg/kg) were identified. Residual CJM consists of fragments of caulk material not removed during any episode of past maintenance or re-caulking activities. According to Boeing, this residual material did not show any signs of decay nor evidence that breakdown of the material would enter stormwater runoff. Boeing planned to remove and replace the primary CJM immediately, and to remove/replace the residual CJM as part of ongoing joint maintenance activities.

In 2000 and 2001, Boeing and Landau Associates mapped the distribution of CJM types and collected samples for PCB analysis (Landau 2001a). Mapping activities identified a number of CJM general types, based on visual observations, which were designated with alphabetical labels from A to K, with various subtypes distinguished. Samples were collected in November 2000, April 2001, and June–July 2001 (Landau 2001b, 2001c); ARI 2001a, 2001b). Results showed total PCB concentrations ranging up to 79,000 mg/kg, with Types A and G containing maximum PCBs greater than 60,000 mg/kg; Type H was the only other CJM type exceeding 50 mg/kg (see Table 4-1). The principal PCB Aroclor found in these CJM samples was Aroclor 1254, and to a lesser extent Aroclor 1260, and rarely Aroclor 1248.

In November 2001, Boeing prepared a work plan for the removal of both primary and residual CJM (Boeing 2001). According to this document, 900 linear feet of primary joint material with PCB concentrations above 50 mg/kg had been identified, in addition to the 57,000 linear feet of residual material. Removal of PCB-containing joint material was conducted in phases between 2002 and 2006, as follows (Landau 2007a):

- 2002 (August): 900 linear feet of primary CJM and some residual CJM
- 2003 (July to September): 16,225 linear feet of residual CJM
- 2004 (June to October): 30,500 linear feet of residual CJM
- 2005 (June to October): 36,650 linear feet of residual CJM, plus 4,000 linear feet of joint material used to fill cracks in the concrete
- 2006 (May): 1,450 linear feet of primary and residual CJM

Removal activities were conducted by Boeing Maintenance employees, with periodic observation and inspection by Landau Associates. Removal and replacement of caulk extended to a depth of approximately ¾ inch (Boeing 2001), below which is a joint spacer that is (in some places) made of plastic. The last of the residual CJM with PCB concentrations identified above 50 mg/kg was removed by Boeing in 2006. Altogether, an estimated 89,000 linear feet of CJM were removed and replaced at NBF between 2002 and 2006.

However, recent testing at the Boeing Everett facility after replacement of PCB-containing CJM found that the new joint material had been recontaminated with PCBs (SAIC 2009). As a result, in December 2006, Boeing collected five samples of CJM that had recently replaced the former PCB-containing caulk at NBF. Based on these limited data, Boeing recognized that the new joint sealant material had been found to contain PCBs at concentrations ranging from <1 mg/kg to 370 mg/kg (Bach 2007; Landau 2007a).

Based on similar conditions investigated at the Everett facility, it is believed that PCBs originating from the former contaminated CJM had previously migrated into portions of the concrete panels in the immediate area of the joints, and recent desorption of PCBs from this contaminated concrete into the new CJM has resulted in detections of PCBs in the new sealant (SAIC 2009; Landau 2011c). Based on the limited available data, the extent or severity of this problem is unknown. It may be limited to areas of concrete previously contaminated with significant concentrations of PCBs in CJM, and concentrations may depend on the timing of CJM removal and replacement.

In addition to the samples collected by Boeing, the City of Seattle (with Integral Consulting, Inc.) sampled remnant CJM at NBF in September 2008. Samples were collected from five locations where thin zones of caulk remained on the margins of CJM seams due to previously incomplete caulk removal at those locations. These samples thus were not representative of the full seam width, but only material along the margins of the seam. Total PCB concentrations in these five samples ranged from 0.67 to 2,200 mg/kg (Exponent 2009; Thomas 2010).

Additional sampling of CJM for PCB analysis was conducted by Landau for Boeing in 2010 (Landau 2011c). Results were not available in time to incorporate into the project database and present in this I&I Assessment report. However, the preliminary key findings are summarized here. A total of 131 CJM samples were collected throughout the NBF flightline area in September and October 2010. Detected concentrations were identified in 49 samples, ranging from 0.88 to 1,200 mg/kg total PCBs, but caulk types were not presented. The two anomalously high values (730 and 1,200 mg/kg) were located in the east-central flightline area, to the east and northeast of Building 3-800. The third highest concentration was 45 mg/kg. As part of this investigation, Landau also collected co-located samples of CJM and SD inlet filter solids (180-micron filter fabric), to compare PCB concentrations. A moderate correlation trend is apparent, suggesting that CJM may form at least a moderate component of PCBs in storm drain solids, although other unidentified sources cannot be ruled out.

CJM removal at NBF has primarily focused on the TSCA cleanup level of 50 mg/kg for total PCBs. The concern for any remaining contaminated CJM, including potential recontamination of recently installed caulk, has resulted in the need to perform further removal actions. Ecology does not consider the USEPA TSCA action level of 50 mg/kg for removal of PCBs to be adequate to prevent Slip 4 recontamination, due to the potential transport of contaminated solid materials (including CJM) through the SD system to Slip 4. Ecology initially proposed a cleanup level of 0.5 mg/kg for total PCBs in CJM. However, the lowest reliably attainable reporting limit (which is essentially the same as the detection limit) for PCBs in caulk and some other building materials is approximately 0.8 mg/kg, due to preparation and interference concerns, and thus a CJM cleanup level of 1.0 mg/kg has been applied (Landau 2010g).

In June 2010, Boeing proposed to further remove all CJM in the PEL area, regardless of concentration, that was not removed during the 2002 to 2006 episodes of CJM removal at NBF. This excluded all concrete areas documented to have been installed after 1980. Between August and October 2010, CJM removal activities were conducted in the PEL area of the north lateral drainage basin. All CJM material was removed as proposed, although no samples of CJM were collected prior to or after CJM removal. Approximately 3,900 linear feet of CJM were removed from the PEL area during this event (Landau 2010g).

In July 2009, expert witness evaluations of sources to the SD system and Slip 4 were completed for Boeing and the City of Seattle. Using detailed analysis of PCB congeners and homologues from limited samples, one of the Boeing expert witness reports (Exponent 2009) concluded that PCB fingerprints in old CJM residue at NBF (from two of five samples collected in September 2008) closely matched PCB fingerprints in solid materials from NBF catch basins and manholes (eight samples collected in September 2008). However, these two sets of similar fingerprints did not match PCB fingerprints in Slip 4 sediments; instead, samples collected at the GTSP show more PCB similarities to the Slip 4 sediment PCBs. The composition of PCBs in Slip 4 sediments is constant with depth (to 18 inches), implying similar sources through time.

Another expert witness for Boeing (Scott 2009) concluded that PCBs in caulk were likely reaching Slip 4 sediments through the SD system, but that caulk was not likely to be a significant contributor to sediments as compared to other sources.

One of the City's expert witness reports (Chrostowski 2009) concluded that joint sealant (elastomeric caulk) and industrial operations at NBF formed significant sources of PCB contamination to Slip 4 sediments. According to Chrostowski, residual caulk appears to be an ongoing source of contamination to Slip 4. PCBs in caulk may be transported through the air (vapor and particulates), in surface water via overland flow, and through the NBF SD system. The predominance of Aroclor 1254 in caulk (and likely in other NBF materials but not in GTSP materials) as well as in Slip 4 sediments is strong evidence toward NBF as the source of PCBs in sediment. PCTs are pervasive throughout Slip 4, the Georgetown Flume, and related areas; PCTs and Aroclor 1254 are associated with industrial fluids, precision casting, and elastomers that are present at NBF but not GTSP. According to Chrostowski, Boeing's congener analysis results (discussed above) are probably due to differential weathering or variability in caulks.

Another expert witness for the City (Werner 2009) identified two main sources of PCBs at NBF: CJM and various aviation-related operations. He concluded that deteriorating caulk could have eroded and rapidly reached the SD system and Slip 4 in reasonably large quantities over the decades. This included a pathway through pavement sweeping and placement in sweeper dumps, which in turn drained to the SD system and the Georgetown Flume (Werner 2009).

In conclusion, all four of these expert witness reports identified caulk as a component of PCB contamination reaching the SD system, and three of the four reports concluded that caulk material was ultimately reaching Slip 4, in varying amounts. A microscopy study of two samples of NBF catch basin solids also show what appear to be CJM fragments, but they are visually difficult to distinguish from other rubber or pitch-like materials (Ghosh 2008). Because various lines of evidence point to PCB-contaminated CJM being present in the SD system, it follows that PCBs from CJM may be present downstream in measurable quantities in Slip 4 sediments.

The following sections discuss the geographic distribution of CJM and its potential correlation to PCB-contaminated solids at various locations in the SD system at NBF. One of the inherent difficulties in making such a comparison is the lack of significant numbers of samples for SD solids, and the different dates for such sampling events. For example, CJM samples were collected largely in 2000 to 2001, and some of this sampled caulk was subsequently removed and replaced with new caulk (in 2002 to 2006, and again in 2010). Between 2001 and 2009, only five samples of new CJM and five samples of residual CJM along joint margins were collected and analyzed. As noted, the 2010 sample results in the flightline area are not fully incorporated into this I&I Assessment, other than summarizing key findings.

The areas where CJM was previously removed consist of a corridor extending generally northward through the middle of the flightline area northeast of Buildings 3-825, 3-818, 3-800 and 3-390, then turning westward and extending to Building 3-350. Other small removal areas are located on the northwest sides of Buildings 3-390 and 3-322. According to Boeing reports, virtually all CJM within these broad removal zones was removed and replaced, regardless of concentration or field designation (Types A to K) (Landau 2007a). In addition, CJM older than 1980 was recently removed throughout the PEL area (Landau 2010g).

Figure 4-1 depicts sample locations and color-coded ranges of PCB concentrations for CJM at NBF (no CJM in pavement is known at the GTSP property). In this figure, the shaded polygons represent the most recent concentration of total PCBs in SD solids (grab samples and sediment traps) at each sampling location, based on the Thiessen polygon approach described in Section 2.1. The individual colored circle symbols in Figure 4-1 correspond to CJM sample locations. Locations with a small open circle inside the symbol indicate that the PCB result was non-detected (highest nondetect value for Aroclors in sample used for color). Sample locations with a small black dot inside the symbol indicate that the caulk at those locations has been subsequently removed and replaced (including most PCB values greater than 50 mg/kg).

The data from locations where CJM has been replaced are included in Figure 4-1 to provide historical information regarding relative concentrations formerly present in CJM, which may have previously eroded, entered the SD system, and reached Slip 4. Areas of residual contaminated CJM may currently remain in these areas along the margins of joints. Furthermore, this information provides an indication of areas that might be expected to produce recontamination of new CJM due to desorption of PCBs from concrete located adjacent to highly contaminated former CJM. Thus, areas of historical significantly elevated concentrations of PCBs in CJM may be an indicator of possible elevated concentrations in existing CJM and adjacent concrete. Due to these factors, historical CJM data are included and discussed below.

In the draft I&I Assessment report, many older sample results of SD solids were included and compared to CJM results, most of which were also older (2000 to 2001). For this final I&I Assessment report, it was agreed to remove any SD data older than 2004, because many SD segments have been cleaned in recent years, and because portions of CJM and other sources have been removed. For the flightline area, many of the SD structures recently have not contained enough volume of solids to sample, and no recent SD solids data exist. Thiessen polygons for much of this area are thus blank (white) in Figure 4-1. Nonetheless, recent sampling supports the concept that CJM contaminated with PCBs at levels of concern is still present in areas of NBF (Landau 2011c), and this material is an ongoing source to the SD system and may potentially recontaminate Slip 4 sediments.

The color ranges used to categorize PCB concentrations in CJM and SD solids samples in Figure 4-1 are presented below. For CJM, the lowest screening level is 1.0 mg/kg, which is the interim screening level that is applied because it is slightly higher than the laboratory detection limit (see Table 1-2). Above this level, concentration ranges increase by an order of magnitude, except that the TSCA action level of 50 mg/kg is substituted for 100 mg/kg.

Map Color	SD Solids	Concrete Joint Material
(light blue)	Less than LAET screening level	Less than interim screening levels (1.0 mg/kg, equivalent to 2LAET)
(light green)	Above LAET screening level	Above interim screening level
(yellow)	Above 2LAET screening level	More than 10x the interim screening level
(orange)	More than 10x the LAET screening level	More than the TSCA action level (50 mg/kg)
(red)	More than 100x the LAET screening level	More than 1000x the interim screening level
(purple)	More than 1,000x the LAET screening level	---

The following sections summarize the salient features of CJM concentrations, in both former and present caulk, and the apparent relationship to concentrations in SD solids. For CJM sample results, higher concentrations (greater than 1.0 mg/kg PCBs) are discussed below for each stormwater drainage area, and the highest concentrations (greater than 50 mg/kg PCBs) are discussed in greater detail with regard to location and relationship to the SD system solids samples. Detailed maps presenting the drainage areas and labeled SD structures are provided in Figures 2-3 through 2-9, and in Appendix A.

4.2.2 North Lateral Drainage Area

As seen in Figure 4-1, four CJM samples with PCB concentrations greater than 50 mg/kg (SP01, SP49, SP57, and SP58, shown as red and orange symbols) are located within the north lateral SD area. CJM in these areas has been removed because PCB concentrations were greater than the TSCA action level of 50 mg/kg. In addition, four samples (SP08, SP09, SP50, and SP56, shown in yellow) have concentrations ranging from 19.9 to 49 mg/kg; caulk in the area of two of these four samples has been removed (those near Building 3-350 remain). Six CJM samples have concentrations between 1.0 and 10 mg/kg and are shown as green symbols; of these six, CJM in three of the four sample areas within the PEL area have been removed. All other CJM samples within the north lateral SD area (three locations in blue) have PCB concentrations of less than 1.0 mg/kg.

The two samples shown in red (SP33 and SP58) are located on the east side of Building 3-350 and consist of Type G caulk that has been removed, with concentrations of 35,000 and 50,000 mg/kg. These two locations likely drain to CB113, which has moderate concentrations of PCBs in SD solids (between 1.3 and 13 mg/kg DW). CB113 drains downstream to MH108. A nearby sample of Type A caulk (SP56, shown in yellow), located near the southeast corner of Building 3-350, has a concentration of 49 mg/kg. Because this result is less than 50 mg/kg, the Type A caulk at this location was left in place. This location drains to the area of MH108, where SD solids contain moderately high PCB concentrations (between 13 and 130 mg/kg DW). Although caulk corresponding to the two CJM samples shown in red was previously removed, it is possible that high-concentration residual caulk material and/or desorption of PCBs from concrete into the new caulk may form an ongoing source of contamination to CB113. In addition, the remaining Type A material may form an ongoing source of contaminated material to MH108 and vicinity.

The two CJM samples of Type H shown in orange (SP01 and SP49) are located on the northwest side of Building 3-322, with concentrations of 164 and 270 mg/kg, and this material has been removed. These two samples are located within sub-drainage N11, which is the sub-drainage at

NBF with the highest concentration of total PCBs in SD solids samples (to 173 mg/kg DW). Although caulk corresponding to the two CJM samples shown in orange were previously removed, it is possible that residual caulk material and/or desorption of PCBs from pavement material into new caulk may form an ongoing source of contamination to SD structures in this area.

In conclusion, CJM samples within the north lateral SD area are limited in number, thus making it difficult to draw a correlation between concentrations of PCBs in CJM and concentrations in nearby storm drain solids. Based on general patterns of occurrences in Figure 4-1, the relatively higher concentrations of PCBs in CJM (now present or removed) generally appear to occur in areas with higher concentrations of PCBs in storm drain solids. However, many exceptions are noted, and limited CJM sampling makes this relationship uncertain.

The recent removal of CJM in the PEL area is expected to reduce PCB contamination from reaching the nearby SD structures. In addition, the area to the north and west of Building 3-322 has recently been excavated and covered with new asphalt, which should act to reduce PCB contamination in CJM and other sources from reaching nearby SD structures. Because the PEL area undergoes pavement sweeping on a limited basis, eroded contaminated material may continue to linger and be available to reach the SD system. A large number of potential sources of PCBs to SD structures exist within this complex drainage area, and a number of samples of SD solids have moderate to high concentrations of PCBs.

Recommendations for North Lateral Drainage Area

Implementation of Boeing’s plan to remove all CJM in the PEL area with no additional characterization precluded the identification of additional locations within the PEL area where elevated levels of PCBs in CJM may have contaminated the adjacent concrete, and may be likely locations for caulk recontamination in the future. Representative concrete samples should be collected near areas known or suspected to have relatively elevated PCB concentrations in CJM, in order to determine the potential for desorption of PCBs from concrete to CJM. These sample locations should be selected based on previous caulk type and past sampling results for those types. One or more additional samples of Type A caulk should be collected near Building 3-350. Type G caulk that was previously replaced near Building 3-350 should be resampled to determine if any residual CJM is present or if desorption of PCBs from adjacent concrete into CJM has taken place.

Catch basins on the NBF facility continue to become recontaminated with PCBs from CJM or other sources after multiple SD cleaning episodes. CJM should be sampled, where present, in all sub-drainages containing moderate to high concentrations of PCBs in SD solids (e.g., greater than 1.0 mg/kg DW); samples would be best located closer to catch basins to assure a known transport relationship of CJM fragments. Because CJM samples at the NBF facility have been analyzed only for PCBs, a portion of future analysis of caulk should include additional COPCs (phthalates, PAHs, mercury, lead, and zinc). Consideration should be given to conducting selected PCB congener analysis on SD solids and on nearby CJM (and other potential source material) having relatively high concentrations of SD solids. In addition, PCB analyses should be conducted on grain size fractions of SD solids or SD inlet filter solids to determine if a particular grain size range of source materials is the main contributor of PCBs to the SD system.

These recommendations are generally considered a high priority activity because: (a) although most CJM in the PEL area (not the whole drainage) has been removed, little CJM or concrete characterization has taken place in this area, and (b) PCB concentrations in the SD system in this area are relatively high.

4.2.3 North-Central Lateral Drainage Area

CJM in the north-central lateral drainage area has the highest concentrations of PCBs compared to other drainages. As seen in Figure 4-1, nine samples of CJM in the north-central lateral area contain total PCB concentrations greater than 50 mg/kg (shown as red symbols; there are no orange symbols in this area). CJM in these areas has been removed because PCB concentrations were greater than 50 mg/kg. Three samples (SP22, SP60, and SP68, shown in yellow) have concentrations ranging from 11.6 to 42 mg/kg; caulk in the area of two of these three samples has been removed. In addition, seven samples shown in green have concentrations between 1.0 and 10 mg/kg; three of these CJM sample areas have been removed. The remaining one CJM sample within the north-central lateral SD basin has a PCB concentration of less than 1.0 mg/kg (shown in blue).

The following text summarizes conditions at the nine stations with CJM samples shown in red, in areas where caulk has been removed. Three clustered samples (SP14, SP65, and SP66) located near the west corner of Building 3-390 consist of Type A caulk, with total PCB concentrations of 23,000, 68,000, and 79,000 mg/kg. These locations drain to CB364A, which has moderate concentrations of PCBs in SD solids (4.5 mg/kg DW). To the northwest of this location is a sample of Type Residual-G caulk (SP59), with a PCB concentration of 20,000 mg/kg. It is located in sub-drainage NC2 near MH223 and MH220, where SD solids have high concentrations of PCBs (16.5 to 34 mg/kg DW, although recent results are not available for MH223). Upstream of this sample location, to the north and northwest, are two samples of Type Residual-G caulk (SP61 and SP67), with PCB concentrations of 19,900 and 25,700 mg/kg. These two samples are also located in sub-drainage NC2 near CB224 and CB225, which both have moderate concentrations of PCBs in SD solids (2.5 to 4.9 mg/kg DW). To the north of Building 3-390 are two adjacent sample locations (SP69 and SP70); one is Type Residual-H caulk with a PCB concentration of 2,240 mg/kg and draining to MH247 and/or CB372; the other is Type Residual-G caulk with a PCB concentration of 16,100 mg/kg and draining to MH247. SD solids in MH247 have high concentrations of PCBs (34 mg/kg DW), while CB372 solids contain moderate concentrations of PCBs (1.1 mg/kg DW). Lastly, to the northeast of Building 3-390 is a sample of Type Residual-G caulk (SP76) with a PCB concentration of 17,200 mg/kg; it drains to MH248 (which drains directly to MH247), where no recent SD solids data exist (but formerly had high concentrations of PCBs at 17.5 mg/kg DW).

Caulk corresponding to the nine CJM sample locations shown in red was previously removed and replaced. However, it is possible that high-concentration residual caulk material and/or desorption of PCBs from concrete into new caulk may form an ongoing source of contamination to catch basins and manholes listed above and others in this drainage area with relatively high PCB concentrations in SD solids. Results from the 2010 CJM sampling are not included in this report, other than noting that the highest PCB concentration (1,200 mg/kg) of these sample results is located in this drainage area, in the vicinity of SP35 (Landau 2011c). Some areas of relatively high concentrations of PCBs in CJM still remain at the Site.

In conclusion, CJM samples within the north-central lateral drainage area are limited in number; however, sub-drainages are also fewer in number compared to the north lateral drainage area. The correlation between concentrations of PCBs in CJM and in nearby SD solids is not as strong as noted in the draft I&I Assessment report, which applied older SD solids data. But there still remain local areas in the north-central lateral area that show a spatial correlation between high concentrations of CJM and SD solids data, despite the fact that much caulk was removed and replaced. This local correlation suggests that some areas of PCB-contaminated CJM or adjacent concrete may continue to form ongoing sources to the SD system. Much of the north-central lateral drainage area undergoes pavement sweeping on a regular basis. This mechanical sweeping activity may cause erosion of surface materials, but it should also remove much of the loose surface debris before it reaches the SD system. Regardless of mechanisms, there are few identified sources aside from CJM that would be expected to contribute significant quantities of PCB-contaminated material to the SD system in this area of the flightline.

Recommendations for North-Central Lateral Drainage Area

Additional sampling of caulk has recently been undertaken in this drainage area, and additional sampling is planned by Boeing. This information should be used to identify current sources of PCBs and to determine if any additional CJM removal is necessary. CJM should be sampled in all sub-drainages containing moderate to high concentrations of PCBs in SD solids (e.g., greater than 1.0 mg/kg). CJM in areas with previously high concentrations of PCBs (Types A, Residual-G, Residual-H) should also be resampled to determine if any residual CJM is present or if desorption of PCBs from adjacent concrete into CJM has taken place. Representative concrete samples should be collected near joints with previously identified elevated concentrations.

Because CJM samples at the NBF facility have been analyzed only for PCBs, a portion of future analysis of caulk should include additional COPCs (phthalates, PAHs, mercury, lead, and zinc). Consideration should be given to conducting PCB congener analysis on SD solids and on nearby CJM (and other potential source material) at selected locations with relatively high concentrations of SD solids. In addition, PCB analyses should be conducted on grain size fractions of SD solids or SD inlet filter solids to determine if a particular grain size range of source materials is the main contributor of PCBs to the SD system.

These recommendations are considered a medium priority activity due to the moderate to high concentrations of PCBs in the SD system in this area, and the fact that sampling was recently conducted in this drainage.

4.2.4 South-Central Lateral Drainage Area

CJM in the south-central lateral drainage area has relatively high concentrations of PCBs. As seen in Figure 4-1, seven CJM samples collected in the south-central lateral drainage area contain total PCB concentrations greater than 50 mg/kg (shown as red and orange symbols). CJM in five of these seven sample areas has been previously removed because PCB concentrations were greater than 50 mg/kg. The one red and one orange sample locations in this drainage where CJM was not removed (without black dot in symbol) represent samples collected from a thin margin of remnant caulk left behind. In addition, five samples (SP62, SP75, SP77, SP83, and NBF-JM08-01, shown in yellow) have concentrations ranging from 13.7 to 43 mg/kg;

CJM in one of these five sample areas has been previously removed. Seven samples shown in green have concentrations between 1.0 and 10 mg/kg; CJM in four of these sample areas have been removed. The remaining four CJM samples within the south-central lateral drainage area have PCB concentrations of less than 1.0 mg/kg (shown in blue).

The following text summarizes conditions at the six stations with CJM samples shown in red. The sample station located southeast of Building 3-390 (SP78) is located where the CJM was previously removed. This sample and a duplicate consist of Type G caulk, with total PCB concentrations of 39,300 and 59,000 mg/kg. This location is within sub-drainage SC1 and stormwater drains to CB412, which has moderate concentrations of PCBs in SD solids (1.5 mg/kg DW). The adjacent sample of marginal remnant caulk (NBF-JM08-02, red symbol, not removed) has a PCB concentration of 2,200 mg/kg. This location is within sub-drainage SC4 and drains to CB418, which has a moderate concentration of PCBs in SD solids (1.2 mg/kg DW).

To the southeast of this location is a sample of Type Residual-G caulk (SP80) that has been removed, with a PCB concentration of 57,000 mg/kg. This location is close to the margin of this drainage area and it appears to drain to MH/CB415 in sub-drainage SC4, where SD solids have a moderately low concentration of PCBs (0.3 mg/kg DW). To the southeast of this location are two very proximal samples of Type G caulk (SP30 and SP82), with the caulk at this location removed (shown on map as a single red symbol), with PCB concentrations of 35,300 and 60,000 mg/kg. This location (within sub-drainage SC1) drains to MH461, where SD solids have a low concentration of PCBs (0.04 mg/kg DW). Southwest of this station is a sample of Type Residual-G caulk (SP85) that has been removed, with a PCB concentration of 4,200 mg/kg. This location apparently drains to CB420, where SD solids have a moderately low concentration of PCBs (0.52 mg/kg DW).

The one sample location depicted in orange (NBF-JM08-03), with a concentration of 51 mg/kg, represents marginal residual caulk. This location drains to CB463, which has a moderately low concentration of PCBs in SD solids (0.61 mg/kg DW).

Most of the caulk corresponding to the six CJM stations shown in red and the one in orange were previously removed and replaced (only small residual caulk areas remain). However, it is possible that other areas of high-concentration caulk material and/or desorption of PCBs from concrete into new caulk may form an ongoing source of contamination to SD structures listed above and others in this drainage area with relatively high concentrations of PCBs in SD solids. Results from the 2010 CJM sampling are not included in this report, other than noting that the highest PCB concentration from samples in this drainage area is approximately 14 mg/kg (Landau 2011c).

In conclusion, CJM samples within the south-central lateral drainage area are limited in number, and SD solids in some sub-drainages have not been sampled. The spatial correlation between concentrations of PCBs in CJM and concentrations in nearby SD solids appears to be modest to weak in the south-central lateral area. This pattern suggests that areas of PCB-contaminated CJM or adjacent concrete may not represent a significant ongoing source of material to the SD system in this area. However, the lack of SD sample data in this drainage area may be affecting the interpretation of this pattern. Much of the south-central lateral area undergoes pavement sweeping on a regular basis. This may cause erosion of surface materials, but it should also remove much of the loose surface debris before it reaches the SD system. Regardless of mechanisms, CJM probably contributes a significant portion of the SD PCBs in this area.

Recommendations for South-Central Lateral Drainage Area

Additional sampling of caulk has recently been undertaken in this drainage area, and additional sampling is planned by Boeing. This information should be used to identify current sources of PCBs and to determine if any additional CJM removal is necessary. Some additional sampling for PCBs in SD solids where data do not currently exist would also assist in focusing on problem areas in this drainage. CJM should be sampled in all sub-drainages containing moderate to high concentrations of PCBs in storm drain solids (e.g., greater than 1.0 mg/kg DW). CJM with previously high concentrations of PCBs (Types G, Residual-G, H) should be resampled to determine if any residual CJM is present or if desorption of PCBs from adjacent concrete into CJM has taken place. Representative concrete samples should be collected near joints with previously identified elevated concentrations. This is considered a medium priority activity due to the moderate concentrations of PCBs in the SD system in this area, but also the lack of data. Because CJM samples at the NBF facility have been analyzed only for PCBs, a portion of future analysis of caulk should include additional COPCs (phthalates, PAHs, mercury, lead, and zinc).

4.2.5 South Lateral Drainage Area

As seen in Figure 4-1, only one CJM sample in the south lateral drainage area contains total PCB concentrations greater than 50 mg/kg (shown as orange symbol; there are no red symbols in this drainage basin). However, two other samples with red symbols were collected near the margins of this drainage area in the south-central area. In addition, three samples (SP72, SP81, and SP84, shown in yellow) have concentrations ranging from 13 to 50 mg/kg; CJM in one of these three sample areas has been removed. Very little caulk removal was performed in this drainage area because sample concentrations were relatively low, with almost all results below 50 mg/kg. In addition, 15 CJM samples have concentrations of total PCBs ranging between 1.0 and 10 mg/kg (shown in green) and have not been removed. All other CJM samples within the south-lateral drainage area have PCB concentrations of less than 1.0 mg/kg (shown in blue).

The one sample station with a CJM sample shown in orange (SP39) is located near the southern end of the Site. This sample result for Type C1 caulk is shown in orange because it contains a relatively high non-detected value of 270U mg/kg for the principal PCB Aroclor, 1254 (other Aroclors are 20U and 40U mg/kg). The next highest Type C caulk sample at NBF has a concentration of 13 mg/kg (SP72). The SP39 sample location drains to CB491, which has a moderately low concentration of PCBs in storm drain solids (0.19 mg/kg DW). The SP39 sample likely has an anomalously elevated detection limit that is not reflective of the absolute concentration.

Results from the 2010 CJM sampling are not included in this report, other than noting that the second-highest PCB concentration (730 mg/kg) of these sample results is located in this drainage area, in the outlier area near SP81 (Landau 2011c). Some areas of relatively high concentrations of PCBs in CJM still remain at the Site. Thus most of the CJM sample concentrations in this drainage area are low to moderate, with only this one new sample detection in the orange coded range. However, this drainage area also suffers from a dearth of collected samples of CJM and SD solids.

Correlation between PCB concentrations of CJM and SD solids is not possible in this drainage area due to low numbers of samples. Concentrations of PCBs in SD solids within this drainage area appear to increase toward the northwest, although the density of sampling is so low that this may not be the true condition. The highest concentrations of PCBs in SD solids are on the north side of Building 3-369 (sub-drainage S2), with moderate to high concentrations (1.1 to 27 mg/kg DW). It is possible that some high-concentration caulk material may form an ongoing source of contamination to the SD system in this drainage area.

Recommendations for South Lateral Drainage Area

Additional sampling of caulk has recently been undertaken in this drainage area, and additional sampling is planned by Boeing. This information should be used to identify current sources of PCBs and to determine if any additional CJM removal is necessary. Additional sampling of SD solids should be undertaken in this large drainage area, due to the dearth of number of samples previously collected. This additional sampling for PCBs would assist in identifying potential problem areas. CJM should be sampled in all sub-drainages containing moderate to high concentrations of PCBs in SD solids (e.g., greater than 1.0 mg/kg DW), as well as in general areas where few SD solids samples have been collected, such as the parking areas and the southern flightline area. This is considered a medium priority activity due to the large drainage size and small number of samples already collected, although existing samples have yielded mostly low to moderate concentrations of PCBs in CJM and SD solids. Because CJM samples at the NBF facility have been analyzed only for PCBs, a portion of future analysis of caulk should include additional COPCs (phthalates, PAHs, mercury, lead, and zinc).

4.2.6 Building 3-380 Drainage Area

As seen in Figure 4-1 within the Building 3-380 drainage area, no samples of CJM have been collected, due to little or no caulk identified in this area (Landau 2001a). Most samples of SD solids in this small drainage area have low to moderately low concentrations of PCBs (0.041 to 0.43 mg/kg DW), with PCBs in one SD sample (MH105) at 1.3 mg/kg DW.

Recommendations for Building 3-380 Drainage Area

No additional sampling of CJM in this drainage area is recommended because caulk is likely not present here.

4.2.7 Parking Lot Drainage Area

As seen in Figure 4-1, only two samples of CJM have been collected within the parking lot drainage area near Building 3-370 (SP05 and SP07, shown in green symbols), with concentrations of 2U and 3.1 mg/kg. Most samples of SD solids in this small drainage area have low to moderate PCB concentrations (0.24 to 2.1 mg/kg DW). Correlation between PCB concentrations of CJM and SD solids is not possible in this drainage area due to low numbers of CJM samples and generally low concentrations in both media.

Recommendations for Parking Lot Drainage Area

Additional sampling of caulk at a few locations should be undertaken in this area, due to the low number of samples previously collected. This additional sampling for PCBs would assist in identifiying potential problem areas. This information would be used to identify current sources of PCBs and to determine if any additional CJM removal is necessary. CJM should be sampled in sub-drainages containing moderate to high concentrations of PCBs in storm drain solids (e.g., greater than 1.0 mg/kg DW), as well as the southeast portion of this drainage area where no samples of CJM or SD solids have been collected. This is considered a low priority activity due to the low concentrations of PCBs in existing samples of CJM and SD solids, and the small drainage size of this parking lot area. Because CJM samples at the NBF facility have been analyzed only for PCBs, a portion of future analysis of caulk should include additional COPCs (phthalates, PAHs, mercury, lead, and zinc).

4.3 Building Materials and Components

In order to evaluate potential sources of PCBs in building materials at NBF, the age of NBF buildings was determined from historical Boeing maps and building lists and from King County parcel information. Structures constructed prior to 1980 were identified as potential PCB sources, and a list of these buildings was compiled. A site visit was conducted by SAIC on April 15, 2010, with Boeing personnel knowledgeable of the site buildings and history. Pre-1980 building exteriors were examined for the presence of worn and peeling paint, caulk expansion joints, caulk and glazing on windows, and caulk around doors and vents. Sidewalks with visible caulk or expansion joints were also noted, although the focus of the site visit was on structures. Observations and recommendations associated with the site visit are provided in Appendix B. Figure 4-2 shows locations of potential historical PCB sources at NBF. For non-PCB COPCs, SAIC reviewed chemical use information in ATSDR reports and evaluated this information with respect to the present-day building materials and components observed at NBF.

An investigation was conducted in July 2010 by Boeing to evaluate potential sources of contamination to the SD system in the area of the north lateral drainage basin. As part of this investigation, samples of various media were collected including asphalt, building caulk, concrete, paint, roof materials, surface solids, and other materials. Buildings determined to be constructed prior to 1980 and areas in close proximity to SD structures with elevated levels of PCBs and metals were identified for sampling. Samples were collected as described in the *North Lateral Storm Drain System Evaluation of Potential Sources Report, North Boeing Field, Seattle, Washington* (Landau 2010d). Descriptions of each sample are included in Appendix F.

The results of this investigation are incorporated into Section 4.3.1, which describes potential sources of COPCs in building materials at NBF, and in Section 4.3.2, which describes specific sources within the north lateral drainage area. Asphalt, surface solids, and concrete sampling results are discussed in Section 4.4.1. Figure 4-3 provides an overview of all building caulk, paint, and other building materials sample locations from the evaluation. Figures 4-4 through 4-21 present analytical results for the building materials samples collected during the investigation, along with the most recent analytical results for SD solids. A total of 17 wipe samples were collected as part of the investigation; results from these samples are discussed in Section 4.3.2. Figure 4-22 provides an overview of all wipe samples collected, and Figures 4-23 through 4-27 present the analytical results for the wipe samples along with the most recent analytical results for SD solids.

The color ranges used to categorize PCB and metals concentrations in building materials and SD solids samples in Figures 4-4 through 4-21 are presented below. The lower limit screening level for total PCBs, LAET (0.13 mg/kg), is below the analytical method detection limits for building caulk, paint, and roofing materials; therefore, any exceedances of the LAET cannot be determined (see Table 1-2). For the purposes of the I&I Assessment, total PCBs concentrations for building materials samples are compared to the 2LAET (1.0 mg/kg). Above this level, concentration ranges increase by an order of magnitude, except that the TSCA action level of 50 mg/kg is substituted for 100 mg/kg. No regulatory criteria apply to wipe sample results; therefore, the lowest color range was set to include all the non-detect values (using the detection limit as the upper boundary). The lower boundary for the subsequent color ranges is set at multiples of 10 of the detection limit for each COPC.

Map Color	SD Solids	Building Materials (Total PCBs Concentrations)	Building Materials (Metals Concentrations)	Building Materials (Wipe Sample Results)
	Less than SQS/LAET screening levels	Less than the 2LAET screening level	Less than SQS screening levels	Not detected
	Above SQS/LAET screening levels	Above the 2LAET screening level	Above SQS screening level	Detected
	Above CSL/2LAET screening levels	More than 10x the 2LAET screening level	Above CSL screening level	More than 10x greater than the detection limit
	More than 10x the SQS/LAET screening levels	Greater than the TSCA Action Level of 50 mg/kg	More than 10x the SQS screening level	More than 100x greater than the detection limit
	More than 100x the SQS/LAET screening levels	More than 1,000x the 2LAET screening level	More than 100x the SQS screening level	--
	More than 1,000x the SQS/LAET screening levels	More than 10,000x the 2LAET screening level	--	--

Note: For copper, the SQS and CSL screening levels are both 390 mg/kg. On maps showing copper concentrations in sample media, the light green map color is not used, as any copper concentration above 390 mg/kg exceeds both the SQS and CSL screening levels.

4.3.1 COPCs in Building Materials and Components

Building materials and components, such as caulking materials and downspouts, are potential sources of COPCs to the NBF SD system. These sources and others are described below. Potential COPC sources in building materials and components related to specific buildings or structures are described for each drainage area in Sections 4.3.2 through 4.3.7.

Caulking Materials

CJM is a known source of PCBs at NBF. In addition to use as concrete expansion joint sealant on the flightline, caulk is used to create a seal around doors, vents, and windows of NBF buildings. Recent studies have identified building materials, particularly caulking materials around windows and doors, as potential sources of PCBs to the environment. A 2004 study of 24 buildings in the Greater Boston area found that 8 of 24 buildings sampled contained caulking materials with >50 mg/kg PCBs (Herrick et al. 2007). Similar results have been observed by investigators in Germany, Finland, Sweden, and Switzerland, with PCB concentrations as high as 550,000 mg/kg. Herrick et al. (2007) measured PCB concentrations in walls where the caulking had apparently never been disturbed. Results of Toxic Characteristic Leaching Procedure (TCLP) testing demonstrated that PCBs are readily mobilized from the caulking material.

PCB-bearing caulk is more likely to be present on buildings constructed prior to 1980 (e.g., Building 3-365); however, during the 2010 building materials investigation, total PCBs concentrations exceeding the 2LAET screening level were reported in building caulk samples collected from Buildings 3-326 and 3-350 (Landau 2010d). These two buildings were constructed before 1980 and were extensively renovated after 1980.

In addition to PCBs, caulk may also be a source of cadmium, lead, mercury, zinc, phthalates, and PAHs (Table 3-1). These COPCs may be present in caulk material currently used for door, vent, and window caulking at NBF. Caulk is also used on some buildings (e.g., Building 3-323, Appendix E, Photo 24) to seal the seams between dissimilar building materials such as masonry and metal siding.

Concentrations of cadmium, copper, lead, mercury, and/or zinc were detected in all the building caulk samples collected in July 2010. Mercury, cadmium, and/or zinc concentrations exceeded the SQS in six caulk samples, including the two caulk samples from Building 3-326 and 3-350 described above, a window caulk sample from Building 3-368, and three concrete joint seam samples from Buildings 3-315, 3-326, and 3-368. Copper and lead were detected at concentrations below the SQS (Landau 2010d).

Paint

PCBs, cadmium, copper, lead, mercury, and zinc are present in the exterior paints used at NBF. PCBs and lead were historically used to extend the life of the paint by increasing its durability. The use of lead-based paint was banned in 1977 for consumer products; however, it may continue to be used in industrial applications. Mercury was used as an anti-fungal agent and as pigment in exterior paints until this use was banned in 1991 (ATSDR 1999). Copper is currently used as an anti-fouling agent. Metals are typically used as pigments for paints. Exterior paint colors commonly observed on building materials and components are listed below, with the metal COPC that may be present in the paint.

	Paint Color							
Metal	**Black**	**Blue**	**Green**	**Orange**	**Purple**	**Red**	**White**	**Yellow**
Cadmium			●	●		●		●
Copper		●	●		●			
Lead	●					●	●	●
Mercury						●		
Zinc							●	

Yellow and orange paints are ubiquitous throughout NBF on roadways, walkways, bollards (traffic security posts), and outdoor equipment. Chipped and/or peeling yellow paint was observed on many bollards. Most buildings at NBF are painted beige on the exterior walls with gray- or green-painted doors. The exterior wall paint is peeling on several buildings (Appendix E, Photos 32 through 49). Older paint may contain mercury and may be a persistent source of PCBs and mercury even though the paint may be encapsulated by newer paint. As the paint chips, flakes, and peels, layers of older paint may be contained in the chips or become exposed to further weathering. Newer paint that is chipped, flaking, or peeling may be a source of contamination if COPCs were used in the paint formulation.

Peeling paint has the potential to enter the SD system. At NBF, flakes of zinc-bearing paint apparently entered CB181B (north lateral SD area, sub-drainage N11), which resulted in a zinc concentration of 21,000 mg/kg in a SD solids sample collected in March 2010. The zinc-bearing paint had been applied to cooling towers on Building 3-331, but the paint did not adhere to the galvanized surface, which is also a source of zinc. The Boeing Site Services group has removed the peeling paint from the cooling towers (Bach 2010d). Optical microscopy analysis of two SD solids samples from CB372A in the north-central SD area (sub-drainage NC3) revealed the presence of layered blue and pink paint in the sample collected from CB372A (Ghosh 2008).

A 2006 study of old paint layers on a building at the former Rainier Brewery in Seattle found PCB concentrations as high as 2,300 mg/kg (Vernon 2006). It is not known whether this type of paint was used in or on buildings at NBF. According to Boeing staff, Boeing does not maintain painting records, and no information is available regarding when buildings were most recently painted or what type of paint was used (SAIC 2010c).

In July 2010, Boeing collected paint samples from bollards, buildings, piping, outdoor equipment, containers, flood lights, cinder blocks, wood doors, aboveground storage tanks (ASTs), support beams, and various metal structures in the north lateral drainage area. Samples were collected in areas where paint was peeling or chipped. A total of 78 paint samples were analyzed for PCBs; 65 of these samples were also analyzed for metals. Total PCBs concentrations exceeded the 2LAET in 35 of the 78 paint samples (note that the detection limit for all samples exceeded the LAET). Concentrations of chromium, copper, lead, mercury, and/or zinc exceeded the SQS screening levels in 59 of the 65 paint samples analyzed for metals (Landau 2010d).

Rooftops and Downspouts

Rooftops at NBF appear to be constructed primarily of painted and/or galvanized metal or asphalt materials. The asphalt materials may be a source of PCBs (depending on date of construction), phthalates, and HPAHs. The metal roofing materials may be a source of zinc to the SD system via building downspouts, which are also made primarily of galvanized metal. The rooftops and downspouts may also serve as a pathway for air-deposited COPCs to reach the SD system. Many downspouts at NBF are connected directly to the SD system (Appendix E, Photos 57, 60, and 61). SAIC personnel observed some damaged connections, which may allow for stormwater to unintentionally discharge to the ground surface (Appendix E, Photo 63). Some downspouts discharge to the ground surface and are subsequently conveyed to a catch basin or manhole. These downspouts appear to drain smaller rooftop areas, such as door awnings (Appendix E, Photos 50 through 56 and 58).

Approximately 12 percent of the impervious surface at NBF consists of rooftops. Air emissions from the site, including paint hangars, paint booths, and shops in Building 3-818, or from offsite sources, may settle on rooftops and be conveyed by stormwater to the SD system (SAIC 2010c).

Based on the results of a study to identify sources of four metals to urban runoff (Davis et al. 2001), runoff quality from asphalt roofs is generally of better quality than galvanized metal roofs. Lead, copper, and zinc concentrations were highest in runoff samples collected from galvanized metal roofs. Cadmium concentrations were highest in the samples collected from commercial buildings (Davis et al. 2001).

Recent samples collected from roofing materials at NBF contained PCBs, copper, and mercury concentrations below the LAET/SQS, and concentrations of copper, lead, and zinc above the SQS screening levels. Solids samples were collected from two downspouts; total PCBs and the metal COPCs concentrations exceeded the LAET/SQS in one sample (collected between Buildings 3-322 and 3-332). In the other downspout solids sample (collected from Building 3-368), mercury exceeded the SQS and cadmium, copper, lead, and zinc concentrations were below the SQS. PCBs were not detected in the sample; however, the detection limit exceeded the LAET screening level (Landau 2010d).

Plastics and Rubber

Plastics (including PVC) and rubber materials are present throughout NBF. These materials are potential sources of PCBs, cadmium, copper, lead, mercury, zinc, and phthalates to the SD system, particularly when used on building exteriors (e.g., vinyl siding) and when stored or used outdoors (e.g., cable or wire covers). Rubber materials were observed on door seals/gaskets (Appendix E, Photos 66 and 67), a loading dock (Building 3-353), and on wheels attached to some structures (e.g., Building 3-342). Plastic and rubber materials are present on a variety of components and equipment such as dumpster lids, tires, equipment cases and hoses, slats in chain link fences, signs, and numerous other applications.

A sample of the rubber door seal at Building 3-315, collected in July 2010, contained concentrations of PCBs, cadmium, and zinc which exceeded the LAET/SQS screening levels. Copper, lead, and mercury were also detected at concentrations below the SQS screening levels (Landau 2010d).

Building Siding

Davis et al. (2001) studied sources of lead, copper, cadmium, and zinc in urban runoff. Building siding materials were found to be a significant source of these metals to urban runoff. Brick, concrete, and painted wood structures exhibited the highest zinc concentrations. Zinc concentrations were one to two orders of magnitude higher than the concentrations of lead, copper, and cadmium for all siding material types. The greatest lead concentrations were in brick and painted wood siding (which was attributed to lead-based paint). Copper concentrations were highest in both painted and unpainted wood siding, which may be attributed to use of chromate copper arsenate preservative. Samples collected from brick and painted wood siding had the highest cadmium concentrations. Samples collected from vinyl siding had the lowest concentrations of lead, cadmium, and zinc. The lowest copper concentrations were observed in samples collected from metal siding (Davis et al. 2001).

Metal siding and concrete walls, and possibly Galbestos (see description below), are the primary building exteriors observed at NBF. These materials may represent a significant source of zinc, lead, and copper to the SD system. A few buildings have small areas of painted wood siding (e.g., Building 3-350 and 7-27-1), which may be a localized source of lead and copper to the SD system. However, concentrations of these metals have not exceeded the SQS in SD solids samples collected from the SD structures adjacent to these buildings. Vinyl siding is present on Building 3-350 (Appendix E, Photo 70), which may be a localized source of lead and copper to the SD system. These metals were not detected above the SQS in the adjacent SD structures.

A concrete sample was collected from a stained area of the south wall of Building 3-353 in July 2010. Copper, cadmium, lead, and zinc were detected in the sample at concentrations below the SQS screening level. PCBs and mercury were not detected (Landau 2010d).

Galbestos siding is known to be present on the exterior of Building 3-626 and may be present on other buildings at the NBF facility. Galbestos is a generic term for a building material used as exterior sheeting primarily at industrial and commercial facilities. Galbestos consists of a sheet of steel galvanized by molten lead and zinc, pressed with asbestos, and sprayed with an asphaltic coating (Baker 2006). In 1998, the USEPA categorized Galbestos as a non-liquid PCB (M.L. Press 2007). A sample of paint from the Galbestos siding of Building 3-626 indicated detections of total PCBs, mercury, cadmium, and zinc above their respective LAET/SQS screening levels. Lead was detected at a concentration approximately 1 percent below its SQS screening level (Landau 2010d). Total PCBs, mercury, cadmium, and zinc were also detected above the LAET/SQS screening levels in nearby catch basin CB162.

4.3.2 North Lateral Drainage Area

Table 4-2 summarizes potential contaminant sources from exterior building materials to the north lateral drainage area, based on information gathered for the CSM (Section 3.0), the April 15, 2010, site visit and subsequent visits to NBF, and the sample results from the July 2010 potential source evaluation. A summary of the overall analytical results for building materials samples is provided in Table 4-3.

Potential Sources of PCBs

Potential sources of PCBs from building materials in the north lateral drainage area include paint, window caulk and glazing, door caulk, expansion joints, wood preservatives, concrete contaminated from historical PCB leaks and spills, insulation materials, building siding and sealants.

Although a number of buildings and other structures were sampled for building materials by Boeing in 2010, the sampling density was relatively low and a number of locations have not yet been sampled. Therefore, none of the buildings in the north lateral drainage area can be ruled out as potential sources of PCBs. Structures in this area that were constructed before the ban on PCB use include Buildings 3-315, 3-322, 3-323, 3-365, 3-368, and 3-626. These are discussed below. Buildings that have been renovated or reconstructed after 1980 include Buildings 3-302, 3-310, 3-326, 3-334, 3-350, and 3-357. These buildings are less likely to be sources of PCBs from exterior building materials and components; however, some building materials may still contain PCBs. For example, the July 2010 caulk and paint samples collected from Buildings 3-326 and 3-350 contained total PCBs concentrations which exceeded the 2LAET value (Table 4-3).

Building 3-315 was constructed in 1979 and is located near storm drains with high PCB concentrations (UNKMH9, UNKMH10, MH139). This structure has some peeling paint on its thick concrete walls (Appendix E, Photos 36 and 37). Glaze material appears to be present on the windows. Total PCBs concentrations in the SD structures around Building 3-315 exceed the SQS and/or the CSL (Figure 4-10).

Boeing collected caulk, paint, roofing material, and rubber weather stripping samples from this building in July 2010 (Landau 2010d). The total PCBs concentration in the rubber weather stripping sample exceeded the 2LAET value for total PCBs (Figure 4-10). PCBs were not detected in the caulk, paint, and roof materials samples (Table 4-3, note that the detection limit exceeded the LAET value).

Building 3-322 was constructed in 1955. It has peeling paint and previously had PCB-contaminated asphalt removed in the area beneath the peeling paint. Flanges with PCB-bearing caulk were identified inside the building in 2010. Nearby storm drains with high PCB concentrations include former CB184, CB191, and CB194 (Figure 4-4).

Boeing collected caulk, paint, and roof material samples from this building in July 2010 (Landau 2010d). Total PCBs concentrations in the paint samples exceeded the 2LAET value (Figure 4-4). PCBs were not detected in the caulk and roofing materials samples (Table 4-3, note that the detection limit exceeded the LAET value).

Building 3-323 was constructed in 1954. It has paint in fair condition and has caulk around vents (Appendix E, Photo 24), pipes, and door frames. Adjacent sidewalk joints are brown and fibrous (Appendix E, Photo 4). This building is near storm drains that have had high PCB concentrations including MH166A, CB182, former MH179, CB173, and MH181A (Figure 4-4).

In July 2010, Boeing collected caulk, paint, and insulation samples from Building 3-323. Paint samples were collected from the building and from the ASTs located on the western side of the building (Landau 2010d). Total PCBs concentrations in five of the six paint samples exceeded the 2LAET value (Figure 4-4). PCBs were not detected in the caulk and insulation samples (Table 4-3, note that the detection limit exceeded the LAET value).

Building 3-326 was originally constructed in between 1969 and 1980 and renovated in approximately 1984. The footprint of the renovated building appears to have encompassed the original building. Caulk is present around the building windows and doors. The paint is in generally poor condition. Total PCBs concentrations in the SD structures surrounding the building exceed the LAET value, with the highest concentrations present in MH187 and MH193 (Figure 4-4).

Boeing collected window caulk, paint, and roofing materials samples, and a pipe wrap sample from the building in July 2010 (Landau 2010d). Total PCBs were detected at a concentration of 14,000 mg/kg DW in the window caulk sample (identified by the red triangle on Figure 4-4). The building caulk from the window seal was removed along with similar caulk from a nearby window. Comparable caulk was not found on any other building in the north lateral drainage area. Total PCBs concentrations in the paint and pipe wrap samples also exceeded the 2LAET value. PCBs were not detected in the roofing material sample (Table 4-3, note that the detection limit exceeded the LAET value).

Building 3-332 is constructed of concrete blocks. Caulk is present on the door jambs. PCBs concentrations exceed the 2LAET value in SD solids samples from all SD structures surrounding the building. The greatest exceedances are observed in CB185 and MH166A (Figure 4-4).

Boeing collected a sample of caulk around a vent on the east side of the building in July 2010 (Landau 2010d). PCBs were not detected in the sample (Figure 4-4); however, the detection limit exceeded the LAET value (Table 4-3).

Building 3-334 was constructed in 1997. The building is painted beige. Caulk is present around the door jambs (Appendix E, Photo 25). Total PCBs concentrations in the SD structures surrounding the building exceed the LAET value, with the highest concentration present in MH166A (Figure 4-4).

Boeing collected paint samples from this building in July 2010 (Landau 2010d). Total PCBs concentrations exceeded the 2LAET value in the samples (Table 4-3, Figure 4-4).

Building 3-350 was constructed in 1945 and renovated in 2008. The building siding is mainly vinyl siding, although there are some small areas with painted wood siding. Paint on the hangar doors is in fair to good condition, with some peeling paint. Almost all SD solids samples from the SD structures surrounding the building contain elevated total PCBs concentrations. The highest concentrations are observed in CB113, CB117, and MH108.

In July 2010, Boeing collected building caulk, paint, and roof material samples from this structure. Concentrations of total PCBs in some caulk and paint samples exceeded the 2LAET value (Figure 4-16). PCBs were not detected in the roofing materials samples (Table 4-3, note that the detection limit exceeded the LAET value).

Building 3-365 was constructed some time before 1956 (it is not included in King County parcel records and is visible on the 1955 Boeing facility map). This building was recently repainted, but the glazing on the windows is worn out and peeling off (Appendix E, Photo 22). PCB concentrations in nearby catch basins CB118D were greater than 1 mg/kg DW (Figure 4-16). Boeing collected caulk and paint samples from this building in July 2010. PCBs were not detected in the samples (Table 4-3, Figure 4-16); however, the detection limit exceeded the LAET value (Landau 2010d).

Building 3-368 was constructed in 1969 and has peeling paint. Nearby SD structures with high PCB concentrations include CB147 and former CB193 (Figure 4-4). Boeing collected caulk, paint, and roofing materials samples from this building in July 2010. Total PCBs were detected in the paint samples at concentrations that exceeded the 2LAET (Figure 4-14). PCBs were not detected in the caulk and roofing material samples; however, the detection limit exceeded the LAET value (Table 4-3) (Landau 2010d).

Building 3-626 was constructed in 1966. Paint and caulk on the doors and vents appeared to be in satisfactory condition. Stained concrete beneath the outdoor compressor was observed during the April 2010 site visit (Appendix E, Photo 20). This building is known to have galbestos siding, a category of non-liquid PCB. This building is located near SD structures with high PCB concentrations, including MH138 and CB159 (Figure 4-10).

Boeing collected paint and foam samples from this building in July 2010. The paint and foam samples contained total PCBs concentrations exceeding the 2LAET value (Table 4-3). Boeing subsequently removed the foam material from the building (Figure 4-10).

Substation 87. A PCB-filled transformer was historically located at the North End-West Boeing Substation, which appears to be the current Substation No. 87 (Appendix E, Photo 15). Substation No. 87 is near the northwest corner of Building 3-324 (Figure 4-2). The former Transformer No. 88 had a volume of 177 gallons (Landau 2000). The substation is fenced, but is not covered.

Historical Transformers. A PCB-filled transformer (No. 87) was historically located at Building 3-350 at the northeast exterior. The volume of Transformer No. 87 was 177 gallons. Additionally, PCB-containing transformers or capacitors were historically located at Buildings 3-315, 3-326, 3-333, and 3-353 (Landau 2000). Locations are shown in Figure 4-2.

Other Potential PCB Sources. Air dryer oil and air compressor oil samples were collected from Building 3-333 and 3-302 in 2001 and 2002, respectively. PCBs were detected at elevated concentrations. As stated in the 2009 Chrostowski expert witness report:

> In 2002, Boeing undertook several tests of air compressor oils and found PCB concentrations up to 37 ppm. The only Aroclor reported for these data was A1254. Building 3-302, which housed the compressors, was designated as a source area based on the environmental data. This data is consistent with the use of this building. Aroclor 1254 was historically the primary PCB used in hydraulic fluids (Lowenbach 2002). As noted previously, A1254 is also the primary mixture of PCBs found in Slip 4.

Non-contact cooling water associated with operations at Building 3-302 and the buildings it served, former Building 3-301 and Buildings 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353 and 3-368, may have become contaminated with PCBs through leaky valves, flanges, joints, and seals or pipe erosion (Chrostowski 2009). Chrostowski states that:

> …a large volume of cooling water containing particulate matter flowing at high velocity can cause eroding of pipes. Electrochemical and chemical corrosion of pipes is also common. Thermal and mechanical stresses are also causes of leaks. PCB contamination of cooling water has been reported at other facilities.

This may be a historical and persistent source of PCBs; therefore, any piping, valves, flanges, joints, and seals associated with the above mentioned buildings should be evaluated for the presence of PCBs, if all components were not replaced following the 2001 and 2002 sampling activities. Buildings 3-326 and 3-353 are connected to Building 3-303 via overhead piping; therefore, these buildings may also be an ongoing source of PCBs.

Other structures. During the July 2010 potential source investigation, Boeing collected paint samples from several non-building structures such as bollards and ASTs. Concentrations of total PCBs in paint were greatest in samples collected from bollards near Buildings 3-323, 3-326 and 3-353. The samples were collected from bollards on the northwest corner of Building 3-323 (Figure 4-4), the west side of Building 3-326 (Figure 4-4), and the northwest corner of Building 3-353 (Figure 4-10). The highest total PCBs concentration detected was 2,300 mg/kg DW. Aroclor 1254 was dominant and followed by lesser concentrations of Aroclor 1260. Total PCBs in the SD structures nearest the sample locations (e.g., CB142, CB150, CB187A, CB192, MH172, MH173, MH187, and MH193) generally exceed the 2LAET screening level. Subsequent to this investigation, Boeing removed paint from the majority of bollards located in the north lateral drainage area at NBF (Landau 2010h). Paint abatement activities were performed for the support structures near CB187A (Figure 4-4) and in the areas of the ASTs and Buildings 3-303, 3-310, 3-315, 3-323, 3 -326, 3-350, 3-353, and 3-626. A figure showing the areas where paint abatement activities were performed is provided in Appendix F.

During the July 2010 potential source investigation, 17 wipe samples were collected from media including exterior walls, metal roofing, and metal and non-metal structures, equipment, siding, and piping (Figure 4-22). Total PCBs were not detected above the MDL of 1.0 microgram (µg) in any wipe sample collected. PCBs are known to be present in measurable quantities in some building materials in the north lateral drainage area; therefore, it is assumed that wipe sampling methodology was not sensitive enough to detect PCBs. One exception may be paint; in October 2010, Boeing collected wipe samples from three areas where paint was known to contain PCBs. PCBs were detected in the wipe samples (Landau 2010i). Additional co-located wipe and paint chip samples are needed to determine if wipe sampling methodology is suitable as a screening sample for PCBs in paint at NBF.

Potential Sources of Metals, HPAHs, and BEHP

All buildings in the north lateral drainage area contain materials which are potential sources of metals. Caulk used on door jambs, window frames, and flanges are potential sources of metals, phthalates, and PAHs. Exterior paint is a potential source of metals. Utility lines that are observed on most buildings are potential sources of metals and phthalates. The concrete used to construct the building foundations and walls may be a source of metals and phthalates.

Although a number of buildings were sampled for building materials by Boeing in 2010, the sampling density was relatively low and a number of buildings and structures have not yet been sampled. Additionally, the building materials samples were not analyzed for phthalates or PAHs. Therefore, the following buildings cannot be ruled out as potential sources of metals, phthalates, and PAHs.

Building 3-302 is constructed of a concrete pad and metal siding. The building appears to be freshly painted with beige paint. Chipped yellow paint is present on the door jamb adjacent to former CB184. There are several downspouts discharging to the ground surface. These downspouts appear to drain the roof of the building (Appendix E, Photos 50 through 52). A galvanized steel box is present on the exterior. A vinyl covered cable extends from the box and enters the building. This building historically housed the air compressors serving Buildings 3-322, 3-323, and 3-368. Mercury, cadmium, and zinc concentrations reported in grab SD solids samples collected from the catch basins surrounding Building 3-302 exceeded the CSL (Figures 4-5, 4-6, and 4-9).

Building 3-303 is a covered area that houses evaporators. The building area is surrounded by yellow-painted bollards connected by yellow-painted metal rods. The yellow paint is chipped and degraded by rust in many places. Galvanized metal piping is exposed to the elements. Some pieces of equipment are painted blue. Flanges are present on the exterior. Some piping is protected by PVC covers. Mercury and zinc concentrations reported in grab SD solids samples collected from the catch basins surrounding Building 3-303 exceeded the CSL (Figures 4-5 and 4-9). Cadmium concentrations in nearby SD structures exceeded the SQS (Figure 4-6).

Building 3-306 is constructed of concrete walls and some metal siding. The building is painted with beige paint, which is mostly in good condition with some peeling on the concrete. The doors are painted gray. Red staining is present at the juncture of a metal pipe near the roof and metal siding that extends to the ground. Yellow and orange paint are present on the ground on the east side of the building, and yellow-painted bollards are present in front of the building doors. Downspouts from this building discharge to the SD system. Some utilities are present on the exterior of the building. This building houses restrooms. Mercury, cadmium and zinc concentrations reported in grab SD solids samples collected from the catch basins surrounding Building 3-306 exceeded the SQS and/or CSL (Figures 4-11, 4-12, and 4-15).

Building 3-310 is constructed of concrete block walls and some metal siding. The building is painted with beige paint, which appears to be mostly in good condition. Door caulk is present around the door jambs. The doors are painted gray and green. A caulk seam appears to be present between door jamb and ground surface concrete and possibly at wall/ground interface. Downspouts from the building discharge to the ground surface and to the SD system (Appendix E, Photos 54 and 55). The windows are glazed and caulk is present around the window frames. Exterior piping, utilities, and flanges are present (Appendix E, Photos 18 and 19). A valve wheel on the exterior piping is painted blue. Indoor floor tiles used outdoors are present in the area immediately east of the building (Appendix E, Photo 65). Six ASTs are present on the northwest side of the building. These ASTs are painted white. Mercury, lead, and zinc concentrations reported in grab SD solids samples collected from the catch basins surrounding Building 3-310 exceeded the CSL (Figures 4-11, 4-14, and 4-15).

Building 3-315 is constructed with cement walls. As noted above, the gray and beige paint on the exterior is peeling. Yellow paint is present on the wall adjacent to the emergency shower and on bollards; this paint also appears to be peeling. Blue-painted metal beams are stored outdoors adjacent to the building. The blue paint is chipped. Some blue-painted items are present in the gap between sections of the building. Rubber gaskets are present around the doors (Appendix E, Photos 66 and 67). Downspouts appear to discharge to the ground and to the SD system (Appendix E, Photo 56). Exterior utilities are present and some of these are covered with PVC casings. Exterior flanges are present (Appendix E, Photo 73). This building is the Nozzle Test Facility. Mercury, cadmium, copper, and zinc concentrations have exceeded the SQS and/or CSL in at least one grab sample collected from the SD structures surrounding Building 3-315 (Figures 4-11, 4-12, 4-13, and 4-15).

In July 2010, Boeing collected caulk, paint, roofing materials, rubber gasket, and orange foam samples from this building (Table 4-3) (Landau 2010d). Mercury concentrations in one paint sample exceeded the CSL screening level. Mercury was detected in the roofing materials and rubber gasket samples at concentrations below the SQS (Figure 4-11). Cadmium concentrations in all types of building materials samples exceeded the CSL levels (Figures 4-12). Copper was detected in all the samples at concentrations below the SQS screening level (Figure 4-13). Lead was detected in paint samples at concentrations above the CSL screening level and in the roofing materials, rubber gasket, and orange foam samples at concentrations below the SQS screening level (Figure 4-14). Zinc concentrations in the paint, roofing materials, rubber gasket and orange foam samples exceeded the CSL screening levels (Figure 4-15).

<u>Building 3-317</u> is a storage building that is open on one side. The building is constructed of metal siding that is painted beige, with a concrete foundation. Exposed I-beams support the roof. These I-beams are painted yellow and white. The paint is chipped. New materials are stored on metal shelves. Green paint on shelves is chipped. The roof extends over the opening of the structure, but the interior is still exposed to the elements; however, it is generally well protected from rain. Cadmium, lead, and zinc concentrations exceed the SQS and/or CSL in SD structures near the southeast corner of Building 3-317 (Figures 4-12, 4-14 and 4-15).

<u>Building 3-322</u> is constructed of concrete walls and metal siding. The exterior walls are covered with beige paint, which is peeling. Some blue-painted equipment is stored outdoors adjacent to the building. A ladder attached to an exterior wall, its safety cage, and a vault lid is painted yellow. The yellow paint on the vault lid is chipped. Downspouts from the roof discharge to the SD system and to the ground. Extensive exterior piping and electrical utilities are present; much of the piping is galvanized or painted beige or white. Exterior flanges are present (Appendix E, Photos 74 and 75). Rubber gaskets are present on roll-up doors and caulk material is present around the doors. Mercury, cadmium, copper, and zinc concentrations exceed the SQS and/or CSL in SD solids samples collected from one or more SD structures adjacent to Building 3-322 (Figures 4-5, 4-6, 4-7, and 4-9).

In July 2010, Boeing collected caulk, paint and roofing materials samples from this building (Table 4-3) (Landau 2010d). Mercury and cadmium concentrations in paint samples exceeded the CSL screening limit and mercury was detected in caulk at a concentration below the SQS screening limit (Figures 4-5 and 4-6). Copper and lead were detected above the CSL screening limit in one paint sample and were detected in all other building materials samples (including other paint samples) at concentrations below the SQS screening limit (Figures 4-7 and 4-8), although lead was not detected in the caulk sample. Zinc was detected above the CSL in two paint samples and below the SQS screening level in all other building materials samples (Figure 4-9).

<u>Buildings 3-323 and 3-364</u> are constructed of concrete walls. <u>Building 3-323</u> is also constructed of concrete block and metal siding (Appendix E, Photo 71). The walls of Building 3-323 are painted beige. Outdoor ASTs associated with Building 3-323 are painted white. Door and vent caulk and caulk between metal siding and concrete wall seam are observed on Building 3-323(Appendix E,

Photo 24). A large wood panel is present above the door jamb at door E-2, and orange paint is on the ground at the door jamb at door S-3 (Appendix E, Photo 68). Downspouts from the building appear to discharge to the ground surface only. Exterior utility piping and flanges are present. Green and red paint is present on some of the outdoor piping. In some areas, yellow-painted bollards are present around exterior piping (Appendix E, Photo 76). The walls of <u>Building 3-364</u> are unpainted. Exterior electrical utilities are present. Mercury, cadmium, and zinc concentrations exceeded the CSL in one or more of the catch basins around Buildings 3-323 and 3-364 (Figures 4-5, 4-6, and 4-9).

In July 2010, Boeing collected caulk, paint, and pipe insulation samples from Building 3-323 (Table 4-3) (Landau 2010d). Mercury concentrations in paint samples exceeded the CSL screening limit and mercury was detected in the caulk sample at a concentration below the SQS screening level (Figure 4-5). Cadmium concentrations exceeded the CSL in paint sample. Cadmium was detected below the SQS screening level in the pipe insulation sample, and was not detected in the caulk sample (Figure 4-6). Copper, lead, and zinc were detected above the CSL screening level in paint samples and was detected below the SQS screening level in the other building materials samples (Figures 4-7, 4-8, and 4-9).

<u>Building 3-324</u> is an office building. The building has concrete walls that are painted beige. Hand rails for the outdoor stairs, the door awnings and the support structures are painted white. Caulk is present around the doors and windows. Red squares are painted in three of the parking spaces associated with the building. Downspouts from the door awnings drain to the SD system and to the ground surface. Mercury concentrations exceeded the SQS and cadmium, copper, and zinc concentrations exceeded the CSL in at least one SD solids sample collected from the catch basins around the building (Figures 4-17, 4-18, 4-19, and 4-21).

<u>Building 3-326</u> is primarily constructed of concrete blocks; portions of the eastern wall are constructed of plywood and metal siding (Appendix E, Photo 69). The walls are painted beige. The paint is in fair condition. The doors are painted gray. Caulk is present around the doors. Rubber gaskets are present on sliding doors on the eastern side of the building. All downspouts appear to be connected to the SD system. Exterior utilities with flanges are present. Valve wheels are painted red and gray (Appendix E, Photos 77 and 78). The building is connected to Building 3-322 by overhead piping (Appendix E, Photo 79). Mercury, cadmium, copper, and zinc exceeded the CSL in one or more SD solids samples collected from the catch basins in the vicinity of the building (Figures 4-5, 4-6, 4-7 and 4-9).

In July 2010, Boeing collected caulk, paint, roofing materials, and pipe wrap samples from this building (Table 4-3) (Landau 2010d). Mercury concentrations exceeded CSL screening level in one caulk sample (note that this caulk was subsequently removed due to the high PCB concentration in the sample), one paint sample and the pipe wrap sample (Figure 4-5). Cadmium was detected above the CSL screening level in caulk and below the SQS screening level in other building materials samples (Figure 4-6). Copper and lead were detected in the building materials samples at concentrations below the SQS screening level (Figures 4-7 and 4-8). Zinc was detected above the SQS screening level in caulk and roofing materials and above the CSL screening level in the paint and pipe wrap samples (Figure 4-9).

Building 3-329 is a storage building that is open on one side. The foundation of the building is concrete and the walls and roof are made of metal siding. I-beams support the building roof. The building is painted beige, white, and gray, and the paint appears to be in good condition. A chain link fence is present along the open side of the building. Vinyl privacy slats have been inserted in the chain link. A concrete apron at the open side of the building slopes to the southeast away from the opening. Metal shelving inside the storage area is painted white and green. A utility line is present on the western side of the building. Valve wheels on the utility line are painted red. A small addition is present on the southern side of the building. The addition is constructed of the same materials. A fire alarm and what appear to be connections for a fire suppression system are attached to the addition and are painted red. Cadmium, copper, and zinc concentrations have exceeded the CSL in at least one of the two catch basins that are near this building (Figures 4-12, 4-13, and 4-15).

Building 3-331 is part of the 3-323/3-332/3-334 complex. It has a concrete foundation with metal siding. The siding is painted beige. Multiple cooling towers are adjacent to the building. Exterior galvanized pipes are present. Mercury, cadmium, copper, and zinc concentrations exceeded the CSL in SD solids grab samples collected from catch basins immediately east of the building (Figure 4-5, 4-6, 4-7 and 4-9).

Zinc-bearing paint had been applied to cooling towers on Building 3-331, but the paint did not adhere to the galvanized surface, which is also a source of zinc. Flakes of the zinc-bearing paint apparently entered CB181B, which resulted in a zinc concentration of 21,000 mg/kg in a SD solids sample collected in March 2010. The Boeing Site Services group has removed the peeling paint from the cooling towers (Bach 2010d).

Building 3-332 is constructed of concrete blocks. The building is connected to Building 3-331 on the exterior. The walls are painted beige and the doors are painted gray; all paint appears to be in fair condition. Painted metal beams and poles extend from the roof of the building to the ground. The white paint on these surfaces is peeling and rust stains are visible. Caulk is present on the door jambs. Downspouts from the roof discharge to the ground. Mercury, cadmium, copper, mercury, and zinc concentrations exceeded the CSL in SD solids grab samples collected from catch basins in the vicinity of the building (Figures 4-5, 4-6, 4-7 and 4-9).

In July 2010, Boeing collected a caulk sample from this building (Table 4-3) (Landau 2010d). Copper and zinc were detected in the sample at concentrations below the SQS screening level (Figures 4-7 and 4-9).

Building 3-333 is constructed with concrete walls and metal siding. Orange paint is present on the ground and yellow-painted bollards are present near the building. Blue-painted equipment is present around the building and in the “breezeway”. Downspouts from the roof discharge to the SD system and to the ground. Door caulk and a rubber gasket were observed on one door. The downspouts and door awnings facing the test pad are made of galvanized metal. Exterior utilities are present both on the building walls and in the “breezeway” between building sections. Flanges are present on these utilities. Mercury, cadmium, copper, lead, and zinc concentrations exceeded the CSL in one or more SD solids grab samples collected from the catch basins in the immediate vicinity of the building (Figures 4-11 through 4-15).

Building 3-334 is constructed of concrete blocks. The building is painted beige. Caulk is present around the door jambs (Appendix E, Photo 25). A rubber gasket is present on the roll-up door on the southern side of the building. Two ASTs with peeling white paint and bollards with yellow peeling paint are also present on the southern exterior wall. An area enclosed by a chain link fence with vinyl privacy slats is present off the western side of the building. Electrical equipment appears to be present in this area. Mercury, cadmium, copper, and zinc concentrations exceeded the CSL in one or more SD solids samples collected from the catch basins in the immediate vicinity of the building (Figures 4-5, 4-6, 4-7 and 4-9).

In July 2010, Boeing collected one paint sample from this building (Table 4-3) (Landau 2010d). Mercury, cadmium, lead, and zinc concentrations exceeded the CSL screening levels (Figures 4-5, 4-6, 4-8 and 4-9).

Building 3-335 is constructed with concrete foundation and walls and metal siding. The building is painted beige and appears to be in good condition. Caulk may be present on a second story window. Galvanized downspouts and awnings are present. The downspouts from door awnings discharge to the ground surface. Exterior utilities are present (Appendix E, Photo 17). A rubber gasket is present on the roll-up door. Electrical and/or air conditioning equipment is housed at southern corner of building along with an AST. White paint on the AST is cracked and peeling. Exterior galvanized pipes are also present. This area is surrounded by yellow-painted bollards. Additional air conditioning equipment is stored at the northern corner of the building. This equipment is also surrounded by yellow-painted bollards. The air conditioning units are on concrete slabs. Sprinkler system valve wheels on the western wall are painted red. Cadmium, copper, and zinc concentrations exceeded the SQS and/or the CSL in several catch basins nearby the building (Figures 4-12, 4-13 and 4-15).

Building 3-341 consists of a concrete slab, four metal posts, and a metal roof. The building covers the prefilter and carbon filter equipment associated with the sweeper dump vault and settling tank (Appendix E, Photos 13 and 14). The building cover and discharge tanks ABF 232 and ABF 233 are painted white. The paint on the discharge tanks is peeling. Some galvanized piping from the settling tank, ABF 231, to the filter system is exposed to the elements. Yellow-painted bollards are adjacent to the structure near MH133; the paint is damaged and peeling. The sweeper dump vault is located off the northwestern end of the structure. Cadmium, mercury, and zinc concentrations exceeded the CSL in one or more SD solids samples collected from catch basins near the structure.

Building 3-342 consists of a concrete slab and a metal roof supported by eight extendable legs. The roof is corrugated metal that is painted gray or white. Roof drains which discharge to the ground are present along all four sides of the roof. The legs are also painted white and are on wheels padded with red rubber. The concrete pad is curbed around three sides and the north side is open and adjacent to a trench drain. The concrete pad is enclosed by a chain link fence. The structure is used as a storage area for oil drums, which are stored on wood pallets. The drums are painted green, red, light blue, dark blue, and white; the paint appears to be in good condition. Cadmium and mercury concentrations exceeded the SQS and CSL, respectively, in a SD solids sample collected from CB133, which is near Building 3-342. SD samples from catch basins in the immediate vicinity of the building were not collected or were of insufficient volume for chemical analysis.

Building 3-343 is identical to Building 3-342 in terms of building materials and design. The structure is a hazardous waste storage area. All waste is drummed and stored on wood pallets. The drums are painted gray. PVC piping is stored outdoors on metal shelving that surrounds the chain link fence. The shelving on the southern side of the structure is painted orange. Cadmium, mercury, and zinc concentrations exceeded the CSL in SD solids samples collected from two catch basins adjacent to the building.

Building 3-350 was reroofed, resided with vinyl siding (Appendix E, Photo 70), and new windows were installed in 2008. The roof appears to be made of asphalt. Plywood siding, painted white, is present adjacent to one of the roll up doors. Downspouts from the roof discharge to the SD system and the ground. Rubber gaskets and seams are present on the hangar doors and roll-up doors. Exterior ladders, utilities and flanges are present. Yellow-painted bollards are present around an outdoor storage area for equipment. A storage container adjacent to the building has peeling gray paint (Appendix E, Photo 41). Mercury, cadmium and zinc concentrations exceeded the CSL in SD solids samples collected from one or more catch basins adjacent to the building (Figures 4-17, 4-18, and 4-21).

In July 2010, Boeing collected caulk, paint, and roofing materials samples from this building (Table 4-3) (Landau 2010d). Mercury exceeded the CSL screening level in caulk and paint samples and was detected at concentrations below the SQS screening level in roofing materials (Figure 4-17). Cadmium exceeded the CSL screening level in paint samples and was detected below the SQS screening level in roofing materials samples (Figure 4-18). Copper was detected below the SQS screening level in all building materials samples (Figure 4-19). Lead was detected above the CSL paint and roofing materials samples (Figure 4-20). Zinc was detected above the CSL screening level in paint and roofing materials samples and below the SQS screening level in caulk samples (Figure 4-21).

Building 3-352 is a storage building constructed of metal siding that is painted gray, white, and red. The gray paint is in fair condition; however the red and white paints are chipped. The east side of building is open to the elements though it appears that the building is made to have some type of door. The roof is sloped and no downspouts were observed. Zinc concentrations exceeded the CSL in SD solids samples collected from two catch basins (CB118B and CB118C) in the vicinity of the building (Figure 4-21).

Building 3-353 is constructed with concrete walls and some metal siding. The concrete walls are painted beige. The metal siding, some downspouts, and door awnings are painted blue. All paint appears to be in fair condition. Caulk is present around the door jambs. Some damage to the building exterior was observed the western side of the building. A loading dock is present at door S2. Rubber bumpers and chipped yellow and orange paint are present on the loading dock. Exterior utilities, including air conditioning units, and galvanized piping are present. A substation is present on the north side of the building. Chain link fence with vinyl privacy slats surround the substation. This building is connected to Building 3-303 by overhead piping. Mercury, cadmium, copper, lead, and zinc concentrations exceeded the SQS and/or the CSL in several catch basins nearby the building (Figures 4-11 through 4-15).

In July 2010, Boeing collected a concrete sample from the south wall of this building (Landau 2010d). Cadmium, copper, lead, and zinc concentrations were below the SQS screening levels (Table 4-3).

Building 3-354 is constructed of concrete walls on a concrete foundation. The walls are painted beige; the paint is chipped. Doors to the building are painted gray. Caulk is present around the door jambs and a rubber gasket is present on the roll-up door. A curb by the roll-up door is painted yellow; the paint is in fair condition. Downspouts from the roof and door awnings discharge to the ground. The door awnings are galvanized metal. Exterior utilities, with flanges, are present (Appendix E, Photo 81). Exterior fire equipment valves are painted red paint. Exterior ladders and associated safety cages are painted white. Yellow-painted bollards are present at the building corners and some doors; the yellow paint is chipped. Cadmium, mercury, and zinc concentrations exceeded the CSL in the SD solids sample collected from CB134, the catch basin that is closest to the building.

In July 2010, Boeing collected a paint sample from this building (Landau 2010d). Cadmium, copper, lead, mercury, and zinc were detected at concentrations below the SQS screening level (Table 4-3).

Building 3-355 is a steam-cleaning building. It is constructed with a concrete foundation and concrete walls. The concrete walls are covered with metal siding. A covered storage area is present on the western side of the building. The north side of the cleaning area and the west side of the storage area are open to the elements. The concrete foundation in the cleaning area is sloped to a possible floor drain. White deposits are present on the concrete pad. Yellow-painted bollards are present at the entrance, paint is chipped. Downspouts from the roof discharge to the ground. Exterior utilities, with flanges, are present. Caulk may be present around an exterior vent. The storage area on the western side of the building contains two red fuel cans. Tank ABF-160 is adjacent to the building to the west. The tank is 5,000 gallons and holds waste steam cleaning water. Water was observed on the east side of the tank at the junction between the tank piping and the ground surface. Orange paint is present on a concrete block and metal post at the southern end of ABF-160. Yellow paint is present on curbs adjacent to the tank. Galvanized metal piping connects the cleaning area to ABF-160 and passes through the storage area. Cadmium, mercury, and zinc concentrations exceeded the CSL in the SD solids sample collected from CB134, the catch basin that is closest to the building.

Building 3-356 is a barrel-storage building. The building is constructed with concrete walls covered with metal siding. Downspouts from the roof discharge to the ground. Exterior utilities are present. Caulk was observed on one exterior flange (Appendix E, Photo 82). Cadmium, mercury, and zinc concentrations exceeded the CSL in the SD solids sample collected from CB134, the catch basin that is closest to the building. This building is at the boundary of the north-central lateral drainage area; therefore, these building materials may be a potential source of COPCs to that drainage area.

Building 3-357 was reconstructed after 1980. It has a concrete foundation with metal siding. The beige paint is in good condition. The building is open to the elements on the eastern side. I-beams supporting the roof are painted white; the paint is chipped. The building is used for forklift, gas cylinder, and drum storage. A metal shed on the western side of the building is used to store four to six 55-gallon drums which requiring grounding. Downspouts from the roof discharge to the ground. Cadmium, mercury, and zinc concentrations exceeded the CSL in the SD solids sample collected from CB134, the catch basin that is closest to the building.

<u>Building 3-365</u> appears to be constructed of wood with a concrete foundation. The roof appears to be made of asphalt materials. The building has recent beige paint. Glazing and caulk on the windows is peeling (Appendix E, Photo 22). Downspouts from the roof discharge to the ground. Some exterior utilities are present. Zinc concentrations exceeded the CSL in the SD solids samples collected from several catch basins near the building (Figure 4-21).

In July 2010, Boeing collected caulk and paint samples from this building (Table 4-3) (Landau 2010d). Mercury, cadmium, lead, and zinc concentrations exceeded the SQS and/or the CSL screening levels in the paint sample (Figures 4-17, 4-18, 4-20, and 4-21). Copper was also detected in the paint sample at a concentration below the SQS screening level (Figure 4-19). Mercury, copper, lead, and zinc concentrations were detected below the SQS screening level in the caulk sample (Figures 4-17, 4-19, 4-20, and 4-21).

<u>Building 3-368</u> is constructed with concrete walls and foundation. The walls are painted white and beige; both paints are peeling. Caulk is present on the door jambs and window frames. Glaze may be present on the windows. Downspouts from the roof discharge to ground. An air conditioning unit is present on the roof and other exterior utilities are present. Red paint is present on some exterior features. Mercury, cadmium, copper, lead, and zinc concentrations exceeded the CSL in one or more SD solids samples collected from the catch basins in the immediate vicinity of the building (Figures 4-5 through 4-9).

In July 2010, Boeing collected caulk, paint, roofing materials, and downspouts solids samples from this building (Table 4-3) (Landau 2010d). Mercury exceeded the CSL screening level in caulk and paint samples and in the downspout solids sample (Figure 4-5). Cadmium was detected above the CSL screening level in one paint sample and below the SQS screening level in the caulk, roofing materials, and downspout solids sample (Figure 4-6). Copper was detected at concentrations below the SQS screening level in all the building materials samples (Figure 4-7). Lead was detected above the CSL screening level in paint samples and below the SQS screening level in the roofing materials and downspouts solids samples (Figure 4-8). Zinc was detected above the CSL screening level in caulk and paint samples and below the SQS screening level in the roofing materials and downspout solids samples (Figure 4-9).

<u>Building 3-626</u> is constructed with concrete block walls and metal siding. The beige paint on the walls is in fair condition. Caulk on the door jambs and vents is also in fair condition. Downspouts from the roof discharge to the SD system and the ground. Rubber gaskets are present on the roll-up and sliding doors. An outdoor compressor on a stained concrete pad is present on the western side of the building (Appendix E, Photo 20). Exterior ladders and safety cages are painted white. Several yellow-painted on bollards are present near doors and building corners. Equipment that is painted orange, red, blue, and green is stored outside building. Exterior utilities with flanges and galvanized piping are present (Appendix E, Photo 80). Mercury, cadmium, copper, lead, and zinc concentrations exceeded the CSL in one or more SD solids samples collected from the catch basins in the immediate vicinity of the building (Figures 4-11 through 4-15).

In July 2010, Boeing collected paint and foam samples from this building (Table 4-3) (Landau 2010d). Concentrations of mercury, cadmium, copper, lead, and zinc exceeded the CSL screening level in the one or more of the paint samples (Figures 4-11 through 4-15). In the foam sample, zinc was detected at a concentration which exceeded the CSL screening level (Figure 4-15) and mercury, cadmium, copper and lead were detected in the sample at concentrations below the SQS screening level (Figures 4-11 through 4-14). Due to the presence of PCBs in the sample (which exceeded the SQS screening level) foam in the immediate vicinity of the sample was removed from the building (Landau 2010d).

Building 3-380 is primarily located in the Building 3-380 drainage area; however, approximately one-quarter of the building footprint is in the north lateral drainage area. Specific details regarding the building construction and components are provided under the Building 3-380 drainage area section. Cadmium and zinc concentrations exceeded the CSL in SD solids samples collected from CB108B, which is the closest catch basin to Building 3-380 in the north lateral drainage area.

Other Structures. In July 2010, Boeing collected paint samples from bollards, buildings, piping, outdoor equipment, containers, flood lights, cinder blocks, wood doors, ASTs, support beams, and various metal structures in the north lateral drainage area. Samples were collected in areas where paint was peeling or chipped. Sixty-five paint samples were analyzed for metals. Concentrations of chromium, copper, lead, mercury, and/or zinc exceeded the SQS screening levels in 59 of the 65 paint samples analyzed for metals (Landau 2010d). Due to the high PCB concentrations in many of these samples, Boeing removed paint from the majority of bollards located in the north lateral drainage area at NBF (Landau 2010h). Paint abatement activities were performed for the support structures near CB187A (Figure 4-4) and in the areas of the ASTs and Buildings 3-303, 3-310, 3-315, 3-323, 3 -326, 3-350, 3-353, and 3-626. A figure showing the areas where paint abatement activities were performed is provided in Appendix F. Paint samples with high metals concentrations that were collected from other structures (such as portable skids) have not been removed.

During the July 2010 potential source investigation, 17 wipe samples were collected from media including exterior walls, metal roofing, and metal and non-metal structures, equipment, siding, and piping. One or more of the metal COPCs were detected in 12 of the 17 wipe samples (Landau 2010d). The highest concentrations of cadmium, copper, lead, and zinc were detected in the wipe sample collected from a stained area of the east wall of Building 3-335 (Figure 4-22). The stain resulted from discharge from a vent pipe. Cadmium, copper, and zinc concentrations in the SD structure near this location exceed the CSL; lead concentrations in the SD structure did not exceed the SQS (Figures 4-24 through 4-27). The highest mercury concentration was detected in a wipe sample collected from black soot on the metal blast wall near the wind tunnel. Mercury concentrations in nearby SD structures are below the SQS (Figure 4-23). In general, the presence of metals in wipe samples does not appear to be a good indicator for the presence of mercury, cadmium, or copper in SD structures (Figures 4-23 through 4-25). Metals may be detected in wipe samples and not above the SQS in nearby SD structures; metals may be detected in wipe samples and above the SQS and/or CSL in nearby SD structures; or metals may not be detected in wipe samples but detected above the CSL in nearby SD structures.

Sampling Recommendations for the North Lateral Drainage Area

Although a number of buildings were sampled for building materials by Boeing in 2010, the sampling density was relatively low and a number of buildings and structures have not yet been sampled. Additionally, the building materials samples were not analyzed for phthalates or PAHs. Therefore, the following buildings cannot be ruled out as potential sources of PCBs, metals, phthalates, and PAHs. Additional data needs are described below. Building-specific action items and sampling recommendations for the north lateral drainage area are listed in Table 4-4.

PCBs:

- Piping, valves, flanges, joint, and seals in the Building 3-302 area may be a continuing source of PCBs. Additional information is needed to determine if these components, which were potentially exposed to non-contact cooling water that may have contained PCBs associated with operations at Buildings 3-302, 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, 3-364 and 3-368, were replaced following the identification of Building 3-302 as a PCB source in 2002.
- If these components have not been replaced, an evaluation of these components is needed to determine if they are contaminated with PCBs. If caulk is present on the exterior utilities, samples should be collected and analyzed for PCBs.
- The fate of the non-contact cooling water associated with operations at Buildings 3-302, 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, 3-364 and 3-368 needs to be determined. The non-contact cooling water should be sampled if determined to discharge to the NBF SD system.
- Paint and concrete on these buildings may have historically contained PCBs, or exterior painted surfaces may have become contaminated through contact with potentially PCB-contaminated non-contact cooling water. At 3 paint samples for each paint type or color should be collected from each side of each building.
- Paint samples should be collected from Buildings: 3-310 and 3-352 because these buildings were built prior to the ban on PCBs. At least 1 to 3 paint samples should be collected from each side of each building.
- Additional paint samples should be collected from Buildings 3-315, 3-322, 3-323, 3-326, 3-333, 3-350, 3-365, 3-368, and 3-626, and from other structures and equipment to supplement those collected by Landau in 2010.
- Boeing plans to implement a wipe sampling investigation to identify paints that may be sources of PCBs (Landau 2010i). Paint chip samples should be collected in addition to any wipe samples collected in order to provide supporting evidence for wipe sample reliability.

- Caulk samples should be collected from window frames, door frames, and around the exterior piping and vents at the following buildings: 3-302, 3-303, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-333, 3-334, 3-352, 3-353, 3-355, 3-364, 3-365, 3-368, and 3-626. Samples should be collected from each caulk type at each building.
- Window glaze samples should be collected from the following buildings: 3-302, 3-303, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-333, 3-334, 3-353, 3-352, 3-365, 3-368 and 3-626.
- Wood siding samples should be collected from buildings 3-323, 3-326, and 3-350.
- A review of building construction plans is needed to identify buildings completed with Galbestos siding in the drainage area.
- Collect samples of air-deposited dry materials from rooftops from all buildings and rain water discharged from downspouts not connected to the SD system.
- Additional characterization data are needed to determine if exterior walls or surfaces around Buildings 3-310, 3-315, 3-333, 3-350, and 3-353 are potential sources of PCBs due to age of the building and/or the historical presence of PCB-filled transformers and/or capacitors. This characterization should include concrete samples of the exterior surfaces of the buildings.
- Additional characterization data are needed to determine if Substation No. 87 is a potential source of PCBs due to the historical presence of a PCB-filled transformer. The concrete pad needs to be tested for PCBs. If present, stormwater may convey PCBs to the SD system. Wipe samples and concrete samples should be collected in stained areas of the pad to test for the presence of PCBs. Concrete core samples should be collected beneath the outdoor compressor at Building 3-626, where the concrete pad beneath the compressor is stained.
- Electrical utilities were observed on the northwest side of Building 3-353 and the west side of Building 3-334. Concrete pads beneath these utilities should be sampled for PCBs as well.
- Pipe wrap and foam samples collected from exterior utility lines and buildings in this drainage area contained PCBs and other COPCs. A visual survey is needed to determine if these materials are present on other buildings and structures in the drainage area to determine if additional abatement activities are needed. This may require additional sampling of materials such as pipe wrap, foam, insulation, and rubber door gaskets. Degraded remnants of these materials may have the potential to reach the SD system as the materials weather and age.

<u>Mercury</u>:

- Mercury concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several structures in the north lateral SD during 2010 sampling. Building materials may be a source of mercury to the SD system; therefore, buildings and equipment/utilities adjacent to SD structures with elevated mercury concentrations were examined for building materials that may be potential sources of mercury. The buildings listed in the

Table 4-4 are adjacent to SD structures where mercury concentrations are elevated or where mercury concentrations are unknown.

Metals, HPAHs, and BEHP:

- Cadmium, copper, lead, and zinc concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several structures in the north lateral SD during 2010. Building materials may be a source of these metals to the SD system; therefore, buildings and equipment/utilities adjacent to SD structures with elevated metals concentrations were examined for building materials that may be potential sources of metals.
- The buildings listed in Table 4-4 are adjacent to SD structures where metals concentrations are elevated or where metals concentrations are unknown. Only two structures in the north lateral SD have been sampled for BEHP and PAHs: sediment trap samples at CB363 and MH178. BEHP and total HPAH concentrations from April 2010 samples exceeded the 2LAET at both locations.

4.3.3 North-Central Lateral Drainage Area

Table 4-5 summarizes potential contaminant sources from exterior building materials to the north-central lateral drainage area.

Potential Sources of PCBs

PCB-containing transformers or capacitors were historically located near Buildings A-5, A-6, 3-125, and 3-126 (Landau 2006) (Figure 4-2).

Based on the available information, all structures present in the north-central lateral drainage area were built after 1980, except a portion of the Building 3-369 footprint. Therefore, most building materials in the drainage area are not likely to be a source of PCBs, although paint, caulk, and concrete on Building 3-369 may be a source of PCBs.

Potential Sources of Metals, Phthalates, and PAHs

All buildings in the north-central lateral drainage area contain materials which are potential sources of metals. Caulk used on door jambs, window frames, and flanges are potential sources of metals, phthalates, and PAHs. Exterior paint is a potential source of metals. Utility lines that are observed on most buildings are potential sources of metals and phthalates. The concrete used to construct the building foundations and walls may be a source of metals and phthalates.

Buildings A-1 through A-6, 3-106, 3-107, 3-125, 3-126, 3-127, and 3-128 are portable building units. The buildings have blue metal siding and white metal roofs. The doors are painted white. Exterior utilities, primarily air-conditioning units, are present. Caulk is present around exterior outlet boxes and possibly around door jambs and window frames. Roof drains discharge to the surface. Light poles adjacent to these buildings are painted red and white. Cadmium and zinc concentrations exceeded the CSL in SD solids samples collected from the catch basins in the vicinity of these structures. Additional crew shelters are present in the north-central lateral drainage area; these buildings may also represent a potential source of COPCs to the SD system.

Building 3-313 houses the regulated waste storage area. The building has concrete foundation and walls constructed of concrete and metal siding. Caulk may be present at seams between building material types. The irregular-shaped building is not fully enclosed; many sides are open to the elements. The roof is constructed of metal. The metal siding is painted blue and beige and some wear on the blue paint was observed near the building signage. Metal supports inside the structure are painted yellow and rest on large concrete supports that are also painted yellow. The yellow paint on the metal supports is chipped. Exterior utilities are present on the building. A chain link fence encloses an outdoor drum storage area. Drums inside and outside the building are stored on wood pallets. Yellow-painted bollards are present around a fire hydrant in the yard area. Downspouts from the roof drain to the ground surface. A rubber gasket is present on the roll-up door. ABF-105 is connected to the building. The AST holds nonhazardous waste. The tank and its associated components are painted white. Cadmium, lead, mercury, and zinc concentrations exceeded the CSL in one or more SD solids sample collected from the catch basins and manholes in the immediate vicinity of this building.

Building 3-356 is located at the boundary of the north lateral and north-central lateral drainage areas. As described above for the north lateral drainage area, the materials used in and on this building include caulk, paint, downspouts discharging to the ground, rubber gaskets, and concrete. Cadmium, mercury, and zinc concentrations exceeded the CSL in a SD solids sample collected from CB232, the catch basin in the north-central lateral drainage area that is closest to the building.

Building 3-369 is primarily located in the south lateral drainage area; however, COPCs related to building materials may conveyed to the north-central lateral drainage area by stormwater. Analytical data were not available for review from MH362, which is located on the east side of the building in front of the hangar doors, and is the SD structure in the north-central lateral drainage area that is associated with Building 3-369.

Building 3-380 is primarily located in the Building 3-380 drainage area; however, approximately one-third of the building footprint is in the north-central lateral drainage area. Specific details regarding the building construction and components are provided in Section 4.3.6 (Building 3-380 drainage area). No analytical data were available from MH362, which is located on the east side of the building in front of the hangar doors, and is the SD structure in the north-central lateral drainage area that is associated with Building 3-380.

Sampling Recommendations for the North-Central Lateral Drainage Area

Additional data needs are described below. Building-specific action items and sampling recommendations for the north-central lateral drainage area are listed in Table 4-6.

PCBs:

- Concrete core samples should be collected in the area where PCB-containing transformers or capacitors were historically located around Buildings A-5, A-6, 3-125, and 3-126. PCB concentrations exceed the LAET by up to 100 times in the SD structures adjacent to these buildings.

- Paint, caulk, and concrete wipe samples should be collected at Building 3-369. PCB concentrations exceed the LAET by up to 100 times in the north-central lateral SD structures adjacent to Building 3-369.
- Paint samples from bollards in the north lateral drainage area were determined to be a potentially significant source of PCBs to the SD system. Paint samples should be collected from any bollards in this drainage area to determine if paint abatement activities are necessary to remove PCB-bearing paint.
- Caulk samples should be collected from window frames, door frames, and around the exterior piping and vents at the following buildings: A-1, A-2, A-3, A-4, A-5, A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356, 3-369 and 3-380. Samples should be collected from each caulk type at each building.
- A review of building construction plans is needed to identify buildings completed with Galbestos siding in the drainage area. At least 1 to 3 paint samples should be collected from each side of each building that has Galbestos siding.
- Collect samples of air-deposited dry materials from rooftops from all buildings and rain water discharged from downspouts not connected to the SD system.
- Pipe wrap and foam samples collected from exterior utility lines and buildings in the north lateral drainage area contained PCBs and other COPCs. A visual survey is needed to determine if these materials are present on other buildings and structures in this drainage area to determine if additional abatement activities are needed. This may require additional sampling of materials such as pipe wrap, foam, insulation, and rubber door gaskets. Degraded remnants of these materials may have the potential to reach the SD system as the materials weather and age.

Mercury:

- Mercury concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several SD structures in the north-central lateral drainage area during spring 2010.
- Building materials may be a source of mercury in the SD system; therefore, buildings and equipment/utilities adjacent to SD structures with elevated mercury concentrations were examined for building materials that may be potential sources of mercury. The buildings listed in Table 4-6 are adjacent to SD structures where mercury concentrations are elevated or where mercury concentrations are unknown.

Metals, HPAHs, and BEHP:

- Cadmium, copper, lead, and zinc concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several structures in the north-central lateral SD during spring 2010.
- Building materials may be a source of these metals to the SD system; therefore, buildings and equipment/utilities adjacent to SD structures with elevated metals concentrations were examined for building materials that may be potential sources of metals. The

buildings listed in Table 4-6 are adjacent to SD structures where metals concentrations are elevated or where metals concentrations are unknown.

- Only three SD structures in the north-central lateral drainage area have been sampled for BEHP and PAHs: CB229A, MH219, and MH221. BEHP and total HPAH concentrations were below the LAET in MH219. In sediment trap samples from CB229A and MH219, BEHP and total HPAH concentrations exceeded the 2LAET.

4.3.4 South-Central Lateral Drainage Area

Table 4-7 summarizes potential contaminant sources from exterior building materials to the south-central lateral drainage area.

Potential Sources of PCBs

Two structures with partial footprints in the south-central lateral drainage area were built prior to 1980: Buildings 3-369 and 3-390. Building 3-369 occurs largely within the south lateral drainage area; only the northern side of the building is in the south-central lateral drainage area. The footprint of Building 3-390 straddles the south and south-central lateral drainage areas. The northern and eastern faces of Building 3-390 are in the south-central lateral drainage area.

Building 3-369 was constructed in 1966. This building has concrete block and metal siding walls in good condition. Caulk material is present around the door jambs (Appendix E, Photos 27 and 28). Historical PCB concentrations in SD structures near Building 3-369 have exceeded the LAET (CB359) the 2LAET (MH361).

Building 3-390 was constructed in 1953. Former Transformers Nos. 54 and 55 were historically located in the South and North Penthouses, respectively, of the building. The volume of these transformers was 375 gallons (Landau 2000). This massive structure has thick coats of red and white paint on the north side with large areas peeling (Appendix E, Photos 32 through 35). Caulk may be present on door jambs and window frames. PCB-bearing glaze may be present on the windows. Results from the spring 2010 sampling indicated that PCB concentrations exceeded the 2LAET in 10 of the 13 SD structures located within the south-central lateral drainage area and that are near the building.

Potential Sources of Metals, Phthalates, and PAHs

The buildings in the south-central lateral drainage area contain materials that are potential sources of metals. Caulk used on door jambs, window frames, and flanges are potential sources of metals, phthalates, and PAHs. Exterior paint is a potential source of metals. Utility lines that are observed on most buildings are potential sources of metals and phthalates. The concrete used to construct the building foundations and walls may be a source of metals and phthalates.

Building 3-369 is constructed of concrete block walls with metal siding. The metal siding is painted beige. Additional building materials and components for the portion of the building that is situated in the south-central lateral drainage area include exterior utilities (some components painted red); a roll-up door with a rubber gasket; downspouts from the roof discharging to the SD system; and a diesel fuel AST (also painted red) that is connected to a generator. The AST and generator are surrounded by yellow-painted bollards. No analytical data are available for the SD structures in the south-central lateral drainage area that are adjacent to Building 3-369.

Building 3-380 may be a source of COPCs in the south-central lateral drainage area due to its proximity to SD structures within the drainage area.

Building 3-390 is painted in a red and white checkerboard pattern on its northern face. This pattern has been on the building since at least 1968. Exterior utilities are present on the northern and eastern faces. SD structures near the northern and eastern sides of the building that have been sampled are MH368, CB374, and MH402. Zinc exceeded the SQS in CB374. No other metals exceeded the SQS. Phthalates and PAHs have not been analyzed in SD samples in this area. CB364, located slightly downstream of Building 3-390, contained BEHP at 4.0 mg/kg DW, above the LAET, in a sediment trap sample collected in April 2010.

Seven crew shelters are present in the south-central lateral drainage area. The buildings appear to be similar to Buildings A-1 through A-6, 3-125 and 3-126, which are portable building units. Light poles adjacent to these buildings are painted red and white. These buildings may also represent a potential source of COPCs to the SD system.

Sampling Recommendations for the South-Central Lateral Drainage Area

Additional data needs are described below. Building-specific action items and sampling recommendations for the south-central lateral drainage area are listed in Table 4-8.

PCBs:

- The two largest buildings in the south-central lateral drainage area were built prior to 1980; therefore, the building materials have a high potential to contain PCBs. PCB concentrations exceeded the LAET by 1,000 times in a SD structure near the north wall of Building 3-390. Generally elevated PCB concentrations were observed in the SD structures in the south-central lateral drainage area near the footprints of Buildings 3-369 and 3-390.
- Paint samples from bollards in the north lateral drainage area were determined to be a potentially significant source of PCBs to the SD system. Paint samples should be collected from any bollards in this drainage area to determine if paint abatement activities are necessary to remove PCB-bearing paint.
- Caulk and window glaze samples should be collected from Buildings 3-369 and 3-390.
- A review of building construction plans is needed to identify buildings completed with Galbestos siding in the drainage area. At least 1 to 3 paint samples should be collected from each side of each building that has Galbestos siding.
- Collect samples of air-deposited dry materials from rooftops from all buildings and rain water discharged from downspouts not connected to the SD system.
- Pipe wrap and foam samples collected from exterior utility lines and buildings in the north lateral drainage area contained PCBs and other COPCs. A visual survey is needed to determine if these materials are present on other buildings and structures in this

drainage area to determine if additional abatement activities are needed. This may require additional sampling of materials such as pipe wrap, foam, insulation, and rubber door gaskets. Degraded remnants of these materials may have the potential to reach the SD system as the materials weather and age.

Mercury:

- Mercury concentrations in SD solids samples have not exceeded the SQS or CSL in the SD structures that are near Buildings 3-369 and 3-390. Many of the south-central lateral drainage area structures have not been tested for mercury.
- Due to the age of the paint on Building 3-390, the paint may be a source of mercury. Old layers of paint are likely to contain mercury as an anti-fouling agent in the red and white paint and as a pigment in the red paint.
- Other building materials and components, such as caulk and utilities may be potential sources of mercury to the south-central lateral drainage area.

Metals, HPAHs, and BEHP:

- Zinc concentrations in SD solids samples have not exceeded the SQS in the SD structures that are near Buildings 3-369 and 3-390, with the exception of CB374. Concentrations of the remaining metal COPCs have not exceeded the SQS or CSL in SD solids samples collected near buildings in the south-central lateral drainage area. BEHP and PAHs have been tested for in only three SD structures within the south-central lateral drainage area; CB364, MH19C, and MH368. BEHP and total HPAH concentrations exceeded the 2LAET in the SD solids samples collected from MH19C. MH19C is located on the eastern side of Concourse B and southeast of Buildings 3-369 and 3-390; therefore, building materials may not be a source of phthalates and PAHs to this catch basin.

4.3.5 South Lateral Drainage Area

Table 4-9 summarizes potential contaminant sources from exterior building materials to the south lateral drainage area.

Potential Sources of PCBs

Potential sources of PCBs from building materials in the south lateral drainage area include paint, window caulk and glazing, door caulk, expansion joints, wood preservatives, concrete contaminated from previous PCB leaks and spills, and sealants. Structures in this area that were constructed before the ban on PCB use include buildings 3-369, 3-374, 3-390, 3-397, 3-818, 3-822, and 3-825.

Building 3-369 was constructed in 1966. This building has metal siding in good condition. Of the eight nearby structures in the south lateral SD, solids samples from seven of the structures contained PCB concentrations which exceeded the 2LAET.

Building 3-374 was constructed in 1974. The building has painted metal and possibly wood siding in fair condition (Appendix E, Photos 44and 45). One of the three ASTs adjacent to the building has layers of peeling paint (Appendix E, Photo 43). SD solids from three structures adjacent to the building were sampled for PCBs. PCB concentrations exceeded the 2LAET in all three samples.

Building 3-390 was constructed in 1953. The western and southern sides of the building are in the south lateral drainage area. Caulk and window glazing containing PCBs may be present on the windows. Four SD structures near the building were sampled for PCBs. PCB concentrations in three of the solids samples exceeded the LAET. The PCB concentration in the fourth sample exceeded the 2LAET.

Building 3-397 was constructed in 1953. The exterior walls and interior pump equipment were recently repainted. However, paint on the doors is in poor condition. The SD structures adjacent to the building have not been sampled.

Building 3-818 was constructed in 1966. It is has a concrete foundation and the walls are concrete brick and metal siding. The metal siding is in good condition. Dark and light brown caulk is present around the seams between building materials (Appendix E, Photos 46and 47). CJM is present at the ground connection (Appendix E, Photos 7 and 8). Former Transformer No. 94 was historically located at the west exterior of this building. The volume of the transformer was 655 gallons. A SCL-owned transformer, located southwest of Building 3-818, was also tested for PCBs, with a result of 213,000 μg/L (Landau 2000). Vault 94 is now present in this location. The concrete pad appears to be heavily stained (Appendix E, Photo 21). Two SD solids samples were collected from SD structures near the building; PCB concentrations in both samples exceeded the 2LAET.

Building 3-822 was constructed in 1954. Paint on this structure is worn and peeling. Door and window frame caulk appear to be in poor to fair condition (Appendix E, Photo 48). PCB concentrations exceeded the LAET and 2LAET in SD solids samples collected from structures in the vicinity of the building.

Building 3-825 was constructed 1966. The painted masonry is in good condition and there is caulk around door jambs and window frames. The SD structures near this building have not been sampled.

Former Buildings 3-830 and 3-831 were located in the south lateral drainage area. Building 3-830 was built prior to 1960 and demolished prior to 2008 (SAIC 2009). Two PCB-filled transformers were associated with this building. Transformers Nos. 89 and 90 were at the southwest exterior of the building and had volumes of 203 and 395 gallons, respectively (Landau 2000). A power substation was located near the northwest corner of Building 3-830 (Weston 1997). Former Building 3-831 was built prior to 1984 and demolished after 1997 (SAIC 2009) and former Transformer No. 91 was located on the roof at the northwest corner of the building (Landau 2000). PCB concentrations exceeded the LAET in all SD solids samples collected from SD structures near the footprint of the former buildings.

Other Sources. Thirty-six pole-mounted Boeing-owned capacitors, each containing 1.5 gallons of liquid PCBs were historically located in the parking lot north of Building 3-825 and three SCL-owned capacitors, each containing 5 gallons liquid PCBs, were present in the west parking lot south of former Building 2-35. In 1990, two SCL-owned transformers, P-840 and P-841, located east of former Building 2-35 were tested for PCBs. PCB concentrations were 155,000 and 245,000 µg/L, respectively (Landau 2000).

Potential Sources of Metals, HPAHs, and BEHP

The buildings in the south lateral drainage area contain materials which are potential sources of COPCs. Caulk used on door jambs, window frames, and flanges are potential sources of metals, phthalates, and PAHs. Exterior paint is a potential source of metals. Utility lines that are observed on most buildings are potential sources of metals and phthalates. The concrete used to construct the building foundations and walls may be a source of metals and phthalates.

Building 3-369 has a concrete foundation and walls constructed of concrete blocks and metal siding. The metal siding is painted beige and appears to be in good condition, although some areas of damaged paint are observed on the hangar doors. Caulk material is present around the door jambs (Appendix E, Photos 27 and 28). ABF-205, which contains sludge water, is present on the southern side of the building. Yellow-painted bollards are present near the AST. Exterior utilities are present on the building, including an air-conditioning unit and electrical wiring. Rubber gaskets are present on the roll-up and hangar doors. Downspouts from the roof discharge to the SD system and to the ground (Appendix E, Photo 58).

Four 25,000-gallon ASTs are present along the south side of the building. Two of these tanks contain untreated wash water and the other two tanks contain hangar waste water. The secondary containment areas for the tanks are made of concrete walls. A hazardous waste satellite accumulation area is located at the southern corner of the building. Remnants of blue, yellow, red, and orange paint are visible on the concrete pad in the accumulation area. Cadmium concentrations exceeded the CSL in SD solids samples collected from UNKCB4, which is located near the southwestern side of the building. BEHP was detected at a concentration exceeding the LAET in the SD solids sample collected from MH356, which is located at the western corner of the building.

Building 3-374 has a concrete foundation and walls with metal siding. The building is painted beige and the paint appears to be in good condition, except near door S1 where blistering and peeling paint is observed. Roof drains from the building appear to discharge to the SD system. Large-diameter galvanized piping, both painted and unpainted, is present on the building exterior. Yellow paint is present on the door jamb at door S1. Piping that appears to be associated with a former AST is present on the southwestern side of the building. Flanges are present. The pipes and flanges are painted red and gray (Appendix E, Photo 83). Two ASTs are present on the northeast side of the building; the tanks have white paint in fair condition. Galvanized piping, flanges, and some electrical lines are connected to the ASTs and associated secondary containment system. Large flakes of white paint are peeling off a boiler that is connected to the building through the northeastern wall (Appendix E, Photo 43). A flange is present at the exterior connection. Mercury exceeded the SQS and cadmium, copper, and zinc concentrations exceeded the CSL in a SD solids sample collected from OWS1-C, which is immediately south of the building.

Building 3-800 was constructed in 1990. The building is constructed of unpainted concrete panels. Light-brown caulking material is present between the concrete panels (Appendix E, Photo 30). Black caulk or rubber is present around the door jambs and window frames. No downspouts were observed on the building; therefore, it is assumed that all stormwater discharge from the roof is conveyed directly to the SD system. Several exterior lights are present on the walls and air conditioning units are on the roof. No other exterior utilities were observed. SD structures near the building have not been sampled for metals, phthalates, or PAHs; however, PCB concentrations exceeding SQS and CSL have been observed in MH266A and CB266B, which are near the eastern and southern sides of the building.

Building 3-801 was constructed in 1992. The building is constructed of concrete panels. The concrete panels are unpainted on the rectangular sections comprising the northern and southern wings of the building. The walls comprising the middle of the building are painted gray. The doors and concrete immediately adjacent to them are painted gray; the paint is in poor to fair condition. Door awning downspouts discharge to the ground (Appendix E, Photo 64) and roof downspouts appear to be connected to the SD system. Light-brown caulking material is present between the concrete panels and white caulk is present around the door jambs (Appendix E, Photo 29). Rubber gaskets are present on the roll-up doors. Several exterior lights are present on the walls and air conditioning units are on the roof. No other exterior utilities were observed. SD structures near the building have not been sampled.

Buildings 3-811 and 3-812 were constructed in 2008. The buildings are constructed of an interior framing structure which is covered by a fabric tarpaulin that appears to be coated with a plastic material. No roof drains were observed on the buildings. SD structures near these buildings have not been sampled have not been sampled for metals, phthalates, or PAHs.

Building 3-818 has a concrete foundation and the walls are concrete brick and metal siding. The metal siding is in good condition (Appendix E, Photo 72). Dark and light brown caulk is present around the seams between building materials (Appendix E, Photo 31). Caulk is also present on door jambs and window frames. Peeling gray paint is present on some concrete surfaces. Roof downspouts appear to discharge only to the SD system. One of the roll-up doors is painted blue. Yellow-painted bollards connected by yellow-painted boards are present in the parking area associated with the building. Rubber gaskets are present on the roll-doors. Exterior utilities, including lights, vents and electrical outlets, are present. Cadmium and zinc concentrations exceeded the CSL in the SD solids sample collected from CB448, which is near the southwest corner of the building.

Building 3-822 is constructed of concrete blocks. The walls are painted beige and the paint is in poor condition. The doors are painted gray and the paint is in fair to good condition. Caulk is present around the door jambs and window frames (Appendix E, Photo 48). Glaze may be present on the building windows. Exterior utilities are present on the building. Cadmium and zinc concentrations exceeded the CSL in SD solids samples collected from CB308 and CB451, which are located immediately west of the building.

Building 3-825 is constructed of a combination of concrete blocks and concrete walls. Most of the concrete walls are painted blue and the concrete walls appear to be largely unpainted. Caulk may be present on the building door jambs and window frames. Air conditioning units are on the roof of the building, no other exterior utilities appear to be present. Roof drains from the building appear to discharge only to the SD system. The SD structures near the building have not been sampled.

Building 3-834 is portable building unit that supports Buildings 3-811 and 3-812. The building exterior consists of metal siding and roofs. Exterior utilities are present. SD structures near these buildings have not been sampled have not been sampled for metals, phthalates, or PAHs.

Building 3-390 is partially located within the south lateral drainage area. The western and southern footprint of the building is in this drainage area. Roof drains on the western side of the building discharge only to the SD system (Appendix E, Photo 61). Rubber gaskets may be present on the roll-up door at the southern end of the building. Exterior utilities are present on the building. Red and white radio towers, antennas, and other equipment are present on the roof. Mercury exceeded the SQS and cadmium, copper, and zinc concentrations exceeded the CSL in a SD solids sample collected from OWS1-C, which is immediately west of the building.

Building 3-397 has a concrete foundation and walls with metal siding. The paint on the building exterior is in fair to good condition while the gray paint on the doors is peeling and in poor condition. Downspouts from the roof discharge only to the SD system; however, damage to one connection was observed and stormwater was released to the surface (Appendix E, Photos 62 and 63). Caulk and window glazing may be present on the door jambs, window frames, and windows. Exterior utilities are present including an electrical line and vents. The SD structures adjacent to the building have not been sampled.

Sampling Recommendations for the South Lateral Drainage Area

Additional data needs are described below. Building-specific action items and sampling recommendations for the south lateral drainage area are listed in Table 4-10.

PCBs:

- Concrete core samples should be collected in the area where PCB-containing transformers or capacitors were historically located around former Buildings 3-830 and 3-831, the former power substation near the northwest corner of former Building 3-830, in the employee parking lot north of Building 3-825, and around the footprint of former Building 2-35.
- Paint samples should be collected from the following buildings: 3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397 because these buildings were built prior to the ban on PCBs. At least 1 to 3 paint samples should be collected from each side of each building.
- Paint samples from bollards in the north lateral drainage area were determined to be a potentially significant source of PCBs to the SD system. Paint samples should be collected from any bollards in this drainage area to determine if paint abatement activities are necessary to remove PCB-bearing paint.
- Caulk samples should be collected from window frames, door frames, and around the exterior piping, flanges and vents at the following buildings: 3-369, 3-374, 3-818, 3-822,

3-825, 3-390, and 3-397. Samples should be collected from each caulk type at each building.

- Window glaze samples should be collected from the following buildings: 3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397.
- Additional characterization data are needed to determine if Vault No. 94 is a potential source of PCBs due to the historical presence of a PCB-filled transformer. The concrete pad needs to be tested for PCBs. If present, stormwater may convey PCBs to the SD system. Wipe samples and concrete samples should be collected in stained areas of the pad to test for the presence of PCBs.
- A review of building construction plans is needed to identify buildings completed with Galbestos siding in the drainage area. At least 1 to 3 paint samples should be collected from each side of each building that has Galbestos siding.
- Collect samples of air-deposited dry materials from rooftops from all buildings and rain water discharged from downspouts not connected to the SD system.
- Pipe wrap and foam samples collected from exterior utility lines and buildings in the north lateral drainage area contained PCBs and other COPCs. A visual survey is needed to determine if these materials are present on other buildings and structures in this drainage area to determine if additional abatement activities are needed. This may require additional sampling of materials such as pipe wrap, foam, insulation, and rubber door gaskets. Degraded remnants of these materials may have the potential to reach the SD system as the materials weather and age.

<u>Mercury</u>:

- Mercury concentrations in SD solids samples exceeded the SQS and CSL in SD structures that are between Buildings 3-369, 3-374 and 3-390 and south of Building 3-818. Many of the south lateral SD structures have not been tested for mercury. Due to the age of the paint on Buildings 3-369, 3-374, 3-390, and 3-818, the paint may be a source of mercury. Old layers of paint are likely to contain mercury as an anti-fouling agent. Other building materials and components, such as caulk and utilities, may be potential sources of mercury to the south lateral drainage area.

<u>Metals, HPAHs, and BEHP</u>:

- Cadmium, copper, and zinc concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several structures in the south lateral SD. Building materials may be a source of these metals to the SD system; therefore, buildings adjacent to SD structures with elevated metals concentrations were examined for building materials that may be potential sources of metals. The buildings listed in Table 4-10 are adjacent to SD structures where metals concentrations are elevated or where metals concentrations are unknown. Only eight SD structures in the south lateral drainage area have been sampled for BEHP and PAHs, and only four of these structures are adjacent to buildings: CB446, MH281, MH356 and MH445B. BEHP and total HPAH concentrations were below the LAET in MH281 and MH445B. In CB446 and MH356, BEHP and total HPAH concentrations exceeded the 2LAET.

4.3.6 Building 3-380 Drainage Area

The buildings in the Building 3-380 drainage area may contain materials that are potential sources of metals. Caulk used on door jambs, window frames, and flanges are potential sources of metals, phthalates, and PAHs. Exterior paint is a potential source of metals. Utility lines that are observed on most buildings are potential sources of metals and phthalates. The concrete used to construct the building foundations and walls may be a source of metals and phthalates.

Table 4-11 summarizes potential contaminant sources from exterior building materials to the Building 3-380 drainage area.

Potential Sources of PCBs

Building 3-380 was constructed in 1991 and therefore would not be considered a source of PCB-contaminated building materials. However, PCB concentrations exceeding the SQS were present in SD solids samples collected from the structures adjacent to the building.

The footprint of Building 7-27-1 is partially within the Building 3-380 drainage area. Its exact construction date is unknown but is prior to 1956 as it occurs on aerial photographs of the site from 1956. The south side of this building was painted in late 2009 but peeling paint is visible on the north side (Appendix E, Photos 38 through 40), which is within the Building 3-380 drainage area. Caulk is present around the vents, and door frame caulk may be present. Relatively low PCB concentrations exceeding the SQS were found in MH105, CB106, and CB107.

Potential Sources of Metals, HPAHs, and BEHP

Building 3-380 is primarily located in the Building 3-380 drainage area; however, approximately one quarter of the building footprint is located in the north lateral drainage area and approximately one third of the building footprint is located in the north-central lateral drainage area. The building has a concrete foundation. The walls are constructed of concrete and metal siding. Caulk or vinyl is present in the seam between the concrete and metal siding. Caulk material is present around the door jambs (Appendix E, Photo 26) and windows and may be present around ventilation fan housings. Gray and beige paint on the building walls is cracked and peeling in some areas. Exterior utilities are present on the building.

Downspouts from the roof appear to discharge to the SD system while downspouts from door and equipment awnings appear to discharge to the ground. A compressor on a concrete pad is present on the western side of the building. Yellow-painted bollards are located at the corners of the concrete pad and around a fire hydrant on the eastern side of the building. Rubber gaskets are present on the large hangar doors on the eastern side of the building. Two ASTs are present on the southern side of the building. The ASTs are painted white. Yellow-painted bollards are also present around these ASTs. Cadmium, lead, and zinc concentrations exceeded the SQS (cadmium) or CSL (lead and zinc) in SD solids samples collected from CB109C, CB427, and CB429, the SD structures adjacent to the building. BEHP exceeded the 2LAET in the SD solids samples collected from MH105 in 2009.

Building 7-27-1 has a concrete foundation. The exterior walls are a mix of beige-painted wood and metal siding. The paint is in good condition on the metal siding, but it is in poor condition on the wood siding. Caulk may be present around some door jambs and window frames. The downspouts appear to discharge only to the SD system. Exterior lights and piping are present. Roll-up doors on the building are likely to have rubber gaskets. Cadmium, lead, zinc, and phthalates concentrations exceeded the SQS (or 2LAET for phthalates) in one or more SD structures adjacent to the building.

Sampling Recommendations for the Building 3-380 Drainage Area

Additional data needs are described below. Building-specific action items and sampling recommendations for the Building 3-380 drainage area are listed in Table 4-12.

PCBs:

- Paint samples should be collected from Building 7-27-1 because this building was built prior to the ban on PCBs. At least 1 to 3 paint samples should be collected from each side of the building.
- Caulk samples should be collected from window frames, door frames, and around the exterior piping, flanges and vents at Building 7-27-1. Samples should be collected from each caulk type at each building.
- Paint samples from bollards in the north lateral drainage area were determined to be a potentially significant source of PCBs to the SD system. Paint samples should be collected from any bollards in this drainage area to determine if paint abatement activities are necessary to remove PCB-bearing paint.
- Caulk samples should be collected from window frames, door frames, and around the exterior piping and vents from Buildings 3-380 and 7-27-1. Samples should be collected from each caulk type at each building.
- Window glaze samples should be collected from Building 7-27-1.
- A review of building construction plans is needed to identify buildings completed with Galbestos siding in the drainage area. At least 1 to 3 paint samples should be collected from each side of each building that has Galbestos siding.
- Collect samples of air-deposited dry materials from rooftops from all buildings and rain water discharged from downspouts not connected to the SD system.
- Pipe wrap and foam samples collected from exterior utility lines and buildings in the north lateral drainage area contained PCBs and other COPCs. A visual survey is needed to determine if these materials are present on other buildings and structures in this drainage area to determine if additional abatement activities are needed. This may require additional sampling of materials such as pipe wrap, foam, insulation, and rubber door gaskets. Degraded remnants of these materials may have the potential to reach the SD system as the materials weather and age.

Metals, HPAHs, and BEHP:

- Cadmium, lead, and zinc concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several SD structures in the Building 3-380 drainage area. Building materials may be a source of these metals to the SD system; therefore, buildings adjacent to SD structures with elevated metals concentrations were examined for building materials that may be potential sources of metals. Only one SD structure in the Building 3-380 drainage area has been sampled for BEHP and PAHs: MH105. BEHP concentrations exceeded the LAET and total HPAH concentrations exceeded the 2LAET.

4.3.7 Parking Lot Drainage Area

The buildings in the parking lot drainage area contain materials that are potential sources of metals. Caulk used on door jambs, window frames, and flanges are potential sources of metals, phthalates, and PAHs. Exterior paint is a potential source of metals. Utility lines that are observed on most buildings are potential sources of metals and phthalates. The concrete used to construct the building foundations and walls may be a source of metals and phthalates.

Table 4-13 summarizes potential contaminant sources from exterior building materials to the parking lot drainage area.

Potential Sources of PCBs

Building 3-370 is located within the parking lot drainage area. Building 3-370 is believed to have been constructed in 1993 and would not be considered a source of PCB-contaminated building materials.

Building 7-27-1 was described previously under the Building 3-380 drainage area. A portion of this building is located in the area that drains to the KCIA SD#3 line downstream of the KC lift station and the junction with the parking lot drainage. The nearest drainage structures to this building (CB102 and MH102B) contained concentrations of PCBs that exceeded the LAET.

A PCB-containing transformer or capacitor was historically located west of former Building 3-490 (Landau 2000) (Figure 4-2). PCB concentrations in the nearby SD structures exceeded the LAET.

Potential Sources of Metals, Phthalates, and PAHs

Building 3-370 has a concrete foundation and walls with metal siding. Beige paint on the concrete walls is in fair condition. Paint on the metal siding is in good condition. Downspouts from the roof discharge only to the SD system (Appendix E, Photos 59 and 60). Exterior utilities on the building include vents and lights on the walls and air conditioning units on the roof. Rubber gaskets are likely to be present on the roll-up doors. Cadmium, lead, and zinc concentrations exceeded the SQS and CSL in SD solids samples collected from one or more SD structures immediately adjacent to the building.

Building 7-27-1 has a concrete foundation. The exterior walls are a mix of beige-painted wood and metal siding. The paint is in good condition on the metal siding, but it is in poor condition on the wood siding. Caulk may be present around some door jambs and window frames. The downspouts appear to discharge only to the SD system. Exterior lights and piping are present.

Roll-up doors on the building are likely to have rubber gaskets. Cadmium, lead, zinc, and phthalates concentrations exceeded the SQS (or 2LAET for phthalates) in one or more SD structures adjacent to the building.

Sampling Recommendations for the Parking Lot Drainage Area

Additional data needs are described below. Building-specific action items and sampling recommendations for the parking lot drainage area are listed in Table 4-14.

<u>PCBs</u>:

- Concrete core samples should be collected in the area where a PCB-containing transformer or capacitor was historically located west of former Building 3-490.
- Paint samples from bollards in the north lateral drainage area were determined to be a potentially significant source of PCBs to the SD system. Paint samples should be collected from any bollards in this drainage area to determine if paint abatement activities are necessary to remove PCB-bearing paint.
- Caulk samples should be collected from window frames, door frames, and around the exterior piping and vents from Buildings 3-380 and 7-27-1. Samples should be collected from each caulk type at each building.
- Window glaze samples should be collected from Building 7-27-1.
- A review of building construction plans is needed to identify buildings completed with Galbestos siding in the drainage area. At least 1 to 3 paint samples should be collected from each side of each building that has Galbestos siding.
- Collect samples of air-deposited dry materials from rooftops from all buildings and rain water discharged from downspouts not connected to the SD system.
- Pipe wrap and foam samples collected from exterior utility lines and buildings in the north lateral drainage area contained PCBs and other COPCs. A visual survey is needed to determine if these materials are present on other buildings and structures in this drainage area to determine if additional abatement activities are needed. This may require additional sampling of materials such as pipe wrap, foam, insulation, and rubber door gaskets. Degraded remnants of these materials may have the potential to reach the SD system as the materials weather and age.

<u>Metals, HPAHs, and BEHP</u>:

- Cadmium, chromium, lead, and zinc concentrations exceeded the SQS and/or the CSL in SD solids samples collected from several SD structures in the parking lot drainage area. Building materials may be a source of these metals to the SD system; therefore, buildings adjacent to SD structures with elevated metals concentrations were examined for building materials that may be potential sources of metals. Only one SD structure in the parking lot drainage area has been sampled for BEHP and PAHs: CB435. BEHP exceeded the LAET in CB435. Total HPAH concentrations were below the LAET.

4.4 Additional Outdoor Sources

In addition to sources described in Sections 4.2 (CJM) and 4.3 (Building Materials and Components), additional outdoor contaminant sources and pathways have been identified at NBF. These include asphalt, surface solid debris, pavement sweeper debris, liquid and solid releases from vehicles and aircraft or other mobile sources, utility lines, and sources related to airborne deposition. Specifically, the following sources are included in this category:

- Surface material, such as asphalt, concrete, and surface solid debris, in the area of north lateral drainage area and in the parking lot area;
- Pavement sweeper surface debris;
- Solid, liquid, and exhaust releases of contaminated materials from mobile sources such as vehicles and aircraft;
- Contaminants released from utility sources;
- Deposition of offsite airborne contaminants.

These outdoor sources and pathways either are known to occur or potentially occur at NBF. The following text briefly summarizes the known, suspected or potential occurrences of these sources and pathways.

4.4.1 Surface Materials

Surface materials, such as asphalt, concrete, or surface debris, may contribute to contamination in the SD system, and which may ultimately be transported to Slip 4. Limited sampling of asphalt, concrete, and loose surface debris has been conducted in the north lateral drainage area. In addition, limited sampling of surface debris has been conducted in the parking lot drainage area.

Surface contamination related to building/equipment components, such as leaking transformer oil or roof downspout deposition, is included in Section 4.3.

Samples of surface material collected from the north lateral drainage area have been analyzed for total PCBs and/or metals. Figures 4-28 through 4-33 present sample locations and analytical results for the sampling of asphalt, concrete, and surface debris material in the north lateral drainage area and parking lot drainage area, along with PCB and metals sampling results for SD solids.

The color ranges used to categorize PCBs and metals concentrations in surface materials and SD solids samples in Figures 4-28 through 4-33 are presented below.

Map Color	SD Solids	Surface Materials
(light blue)	Less than SQS/LAET screening levels	Less than SQS/LAET screening levels
(light green)	Above SQS/LAET screening levels	Above SQS/LAET screening levels
(yellow)	Above CSL/2LAET screening levels	Above CSL/2LAET screening levels
(orange)	More than 10x the SQS/LAET screening levels	More than 10x the SQS/LAET screening levels
(red)	More than 100x the SQS/LAET screening levels	More than 100x the SQS/LAET screening levels
(purple)	More than 1,000x the SQS/LAET screening levels	More than 1,000x the SQS/LAET screening levels

Note: For copper, the SQS and CSL screening levels are both 390 mg/kg. On maps showing copper concentrations in sample media, the light green map color is not used, as any copper concentration above 390 mg/kg exceeds both the SQS and CSL screening levels.

Asphalt Samples

Asphalt samples were collected using a drill, and consisted of asphalt dust and small fragments of asphalt. Sample locations are shown in Figures 4-28 through 4-33 as triangle symbols, and a black dot inside the symbol indicates that asphalt material at that location has been removed and replaced. Total PCB concentrations ranged from non-detect (0.031U mg/kg) to 380 mg/kg PCBs. Aroclor 1254 was predominant, followed by lesser concentrations of Aroclor 1248 and Aroclor 1260. The asphalt sample with the highest PCB concentration was identified a short distance northeast of the west corner of Building 3-322. The two samples located closest to and northeast of this corner had the highest PCB concentrations (34 and 380 mg/kg). This area drains to nearby former catch basin CB191, which had the highest concentration of PCBs in SD solids at NBF (Figure 4-28). Samples of asphalt collected from the area of former Building 3-360, Building 3-326, and the STST facility indicated concentrations of mercury, cadmium, and/or lead exceeding their respective screening levels in only one sample. SD solids in the Building 3-326 area had levels of mercury and cadmium exceeding the SQS screening levels. Samples of SD solids in the areas of former Building 3-360 and the STST facility have not been collected.

Concrete Samples

A limited number of concrete samples were collected as bulk material or dust samples. Bulk material samples were collected, where possible, using tools to loosen pieces of concrete. Dust samples were collected using a drill and consisted of concrete dust and small fragments of concrete. Sample locations are shown in Figures 4-28 through 4-33 as square symbols, and a black dot inside the symbol indicates that concrete material at that location has been removed and replaced. Total PCB concentrations ranged from non-detect (0.03U) to 0.55 mg/kg. One concrete sample located in the area of former Building 3-360 contained concentrations of PCBs, copper, and zinc exceeding their LAET/SQS screening levels. One concrete sample located west of Building 3-303 had PCBs and zinc concentrations in exceedance of LAET/SQS screening levels. In addition, cadmium and zinc were detected in exceedance of their respective CSL screening levels in the PEL area. Where data are available, SD solids samples in these areas indicate elevated levels of COPCs with the exception of copper, which was detected below the SQS screening level. SD sampling results varied in other areas where samples of concrete indicated COPCs below their respective screening levels.

Surface Debris Samples

In July and August 2009, Boeing collected 53 samples of surface solids material (surface debris), from the north lateral drainage area (Landau 2009, Landau 2010b). An additional 23 samples of surface solids material were collected in July 2010 from the north lateral drainage area, following the March and April 2010 surface cleaning activities near Buildings 3-302, 322, 3-323, 3-331, 3-332, and 3-334 of the PEL area (Landau 2010d). Six samples of surface solids debris were also collected by SAIC from the parking lot drainage area in July 2010. Samples were swept together from a large area, creating a composite sample at each location. Sample material included soil, gravel, fine particulate and organic debris; particles greater than about ¼ inch were removed from each sample. This material is believed to represent surface debris that would have eventually reached the nearby storm drain structures. Sample locations of surface debris are shown in Figures 4-28 through 4-33 as circle symbols; a black dot inside the symbol indicates that the surface debris at that location has since been removed during excavation and/or repaving.

In the north lateral drainage area, total PCB concentrations from samples of surface debris ranged from non-detect (0.03U mg/kg) to 557 mg/kg PCBs, with Aroclor 1254 being predominant, followed to a lesser extent by Aroclor 1260 and Aroclor 1248. The highest concentration sample also contained Aroclor 1242. Concentrations were detected below the LAET screening level at the four most northerly sample locations, along the GTSP fence line. Similar to asphalt sample results, the most contaminated surface solids were identified a short distance northeast of the west corner of Building 3-322. The two samples located closest to and northeast of this corner had the two highest PCB concentrations (290 and 557 mg/kg). Thus the most contaminated location for surface solids and asphalt was found about 25 feet northeast of the corner. This area drains to nearby former catch basin CB191, which had the highest concentration of PCBs in storm drain solids at NBF. The third highest sample result, 160 mg/kg, is located about 50 feet northeast of this corner; this area apparently drains to former CB184, which had moderate to high concentrations of PCBs in storm drain solids (1.3 to 13 mg/kg DW). With the exception of copper, metals were detected above their respective SQS screening levels throughout the north lateral drainage area; with multiple detections in the area of Building 3-330. Mercury and lead exceeded SQS screening level in only two samples, while cadmium and zinc were more prevalent. There was a general trend in exceedances between samples of surface debris and SD solids from nearby SD structures for metals, as shown in Figures 4-29 through 4-33.

In the parking lot drainage area, total PCB concentrations in surface solids material ranged from 0.12 to 0.34 mg/kg. Surface solids sample D283A (0.34 mg/kg) was collected in the area of nearby drain D283A, which has the second most elevated level of total PCBs in SD solids in the drainage area. Zinc was detected at concentrations exceeding the SQS screening level in all samples collected. Of the SD solids samples analyzed for zinc, all exceeded the SQS screening level and three exceeded the CSL screening level. Mercury, cadmium, copper, and lead were detected below their respective SQS screening level for the surface debris samples. Although limited data are available for metals in SD solids samples in the parking lot drainage area, there does appear to be a correlation between metals detected in surface material debris collected near PL3 and metals detected in SD solids collected from CB435 (Figures 4-20 through 4-33).

Summary

Total PCB concentrations in asphalt and total PCBs and metals concentrations in surface debris correlate well with data from SD solids (see Figures 4-28 through 4-33). Thus, these surface media likely form a PCBs and/or metals source to SD solids. For both asphalt and surface debris results, the original source of PCBs in this area is uncertain, and there does not appear to be a relationship or trend from the GTSP fence line area to the most contaminated locations. However, there appears to be a strong relationship to materials and activities in or near Building 3-322. This contaminated area has since been excavated and the pavement replaced; however, without knowing the specific source of contamination, it remains to be seen if concentrations in nearby SD solids will improve with time. Section 4.3 addresses building materials and related potential sources of COPCs. In addition to PCBs, asphalt is also known to contain PAHs, and some asphalt sealant is known to contain BEHP (see Section 3.0). Some asphalt surfaces at NBF are also coated with a variety of paints, primarily yellow, orange, and white. These pavement paints may contain a number of metal contaminants.

Sampling Recommendations for Surface Materials

Samples of surface solids should be collected in areas where SD solids sample results have identified relatively elevated concentrations of COPCs. Composite samples should be collected with a clean broom in a designated area around selected SD structures and suspected sources. Specific descriptions of location and type of material should be recorded, with notes on proximity to SD structures and likely source(s) of surface solids. Sample material should be split and archived so that those samples showing relatively high concentrations can then be visually closely examined to aid in potentially determining the specific source of the elevated levels. This might include recognition of paint debris, metallic material, debris from aging utilities and equipmentas well as CJM and other recognizable source materials. This investigation should be done in combination with CJM sampling. These are considered medium priority activities because of the moderate to moderately high concentrations of COPCs in most of these areas, and the number of existing SD samples for purposes of initial characterization of impact to the SD system.

In order to focus these investigations, emphasis should be placed on the areas of relatively high-concentration COPCs in SD solids, include the following:

- Cadmium along most of the flightline area, PEL area, and localized areas near Buildings 3-380, 7-27-1 and former Building 3-360.
- Copper in the southern flightline area, the PEL area, and isolated areas near Building 3-374, former Building 3-360, and MH220.
- Lead in isolated portions of the PEL area, the flightline, and near Buildings 3-370, 7-27-1, and the KC lift station.
- Mercury in the PEL area and isolated locations in the southern flightline area.
- Zinc in the PEL area, particularly near Buildings 3-315, 3-331, 3-333, 3-334, and 3-368; the flightline area; and isolated areas around Buildings 3-350, 3-369, 3-370, 3-374, 3-380

(particularly near MH109), 3-818, 3-822, 7-27-1, the KC Lift Station and former Building 3-360.

- BEHP and total HPAHs in isolated portions of the site, including the area northwest of Building 3-323, the area between buildings 3-380 and 7-27-1, the areas around MH221A and CB261. Since BEHP and HPAHs have not been well characterized yet in the SD system, surface solids samples collected for metals should also be analyzed for BEHP and PAHs if there is a sufficient sample volume.
- PCBs in the central and northern flightline areas, the PEL area, and isolated areas near Buildings 3-365, 3-369, 3-370, 3-374, 3-380, 3-800, 3-811, 3-818, 3-822 and the KC Lift Station, the parking lot north of Building 3-801, and the area around MH100 near East Marginal Way S.

4.4.2 Pavement Sweeper Debris

Surface debris regularly accumulates by a number of processes on the NBF flightline area, which is detrimental to aviation operations. As a result, Boeing conducts frequent mechanical sweeping of pavement in this area. Sweeping activity in the plane stalls occurs when stalls are not occupied by aircraft. Scheduling is arranged so that each stall is typically swept at least once per week. Other areas of NBF that are not used by aircraft, including the PEL area, are swept irregularly, such as weekly or less frequently, depending on need and access. Regenerative air-type street sweepers are used for pavement sweeping. It is assumed that sweeping removes a significant amount of surface debris from these paved areas, but also leaves some material behind.

The sweeper-collected material likely originated as fragments of CJM, concrete, asphalt, vehicle and aircraft debris (e.g., tire fragments, brake dust, fasteners), chipped paint, roof debris from downspouts, airborne deposition, soil debris, plant material, and other substances. The sweeping waste is collected, managed, and sampled as follows (Keller 2006a, 2006b; Landau 2010b):

- Water is separated from the solid material at the sweeper decant station (Building 3-341); the water is treated and discharged in accordance with Boeing's industrial wastewater permit with King County.
- Solids are placed in roll-off containers at the sweeper dump area, followed by appropriate disposal.
- Sweeper material in the roll-off containers at the sweeper decant station is occasionally sampled and analyzed for PCBs; this does not include solids generated from cleanout of the decant station treatment.

The sweeper decant station and treatment area is located at Building 3-341, southwest of Building 3-315. Boeing shipped three roll-off containers of sweeping waste in 2008, averaging approximately 11 tons each (SAIC 2010c). Some shipments of material have been sampled for waste characterization purposes. Five samples of the sweeping waste solids have been collected in recent years (Bach 2010a, Bach 2010c). Results are listed below:

Sample Date	Aroclor 1254 (mg/kg DW)	Aroclor 1260/1262 (mg/kg DW)	Total PCBs (mg/kg DW)
12/16/2005	2.5	<0.31	2.5
3/28/2007	0.38	0.89	1.3
6/11/2008	0.38	0.23	0.61
6/24/2009	<0.36	0.72	0.72
6/8/2010	<0.46	<0.46	ND

DW = dry weight ND = not detected

Older sampling identified higher concentrations of PCBs in sweeper dump material: up to 60 mg/kg DW in the solid phase and up to 6.9 µg/L in the aqueous phase (sampled in 2000).

These analytical results are presented for two purposes. First, they indicate what the approximate PCB concentrations have been for composite surface debris located mainly in the flightline areas, including remaining material that may have reached the SD system. Second, they indicate approximate mean concentrations of any material that may have been released from the sweeper dump area during handling and thus reached the SD system. Concentrations of PCBs in the recent sweeper dump samples (2005 to 2010) are relatively low to moderate, with the three most recent samples at less than 1.0 mg/kg DW total PCBs. However, these represent composite samples over large areas, and only one sample has been collected per year. All sample results (including the non-detect value) are lower than the LAET screening level for SD solids at NBF. Concentrations indicate that PCB-contaminated material has been typically present on or in the paved surfaces that are being swept regularly by Boeing. Surface materials that remain on the surface, which are not removed during sweeping, are potentially capable of reaching the SD system; in some localized areas these surface materials may have significantly greater PCB concentrations than identified in these composite samples.

Swept dust has been observed to spread out behind the mechanical sweeper on occasion. There is also the possibility that improper handling of sweeper dump waste, or mud on the roll-off dumpsters, could result in some swept materials reaching the ground surface and entering the SD system. It was noted during an inspection by Ecology's Water Quality Program that: "Solids on the ground around the dumpsters indicated that the solids handling allows some to get on the pavement which is tributary to the storm drainage system" (Wright 2010). Nearby catch basins include CB128 and CB131, located a short distance west and north of the sweeper dump station. CB128 is currently outfitted with a sediment filter to catch surface solids; however, it was observed in June 2010 that the filter was full and clogged. Total PCB sample results for SD solids in CB128 are moderately low (0.35 mg/kg DW). PCB results for the solids in CB131 are moderate (1.5 mg/kg DW total PCBs).

The area within the footprint of the sweeper dump station, and the adjacent sweeper decant station and water treatment system, drains to the sanitary sewer. The containment berms around the sweeper dump station have large drain holes in the concrete at the exterior ground level, which allow water from outside of the containment berms to drain into the decant water collection system. Stormwater around this area drains largely to the SD system, but may enter the decant water collection system as well.

4.4.3 Outdoor Mobile Sources

Potential solid releases from vehicles and aircraft at NBF include the presence of cadmium in fasteners on aircraft landing gear, copper and cadmium in brake system parts, as well as cadmium and zinc in a variety of metal, vehicles, and other sources. Zinc is used in metal belts within vehicle tires, and phthalates are released during tire wear. Lead used on tires (for balancing) and in lead-acid batteries in vehicles may also be released to the surface. Copper is used commonly in electrical wires and connections in vehicles (see Section 3.0). During wear and weathering of vehicle and aircraft parts at NBF, including during brake usage, cadmium, copper, lead, zinc and phthalates could be released to the surface at NBF in solid fine particles or they could become airborne and settle at more distal locations at the site.

Liquid spills in outdoor locations at NBF have and do occur occasionally. It is assumed that these spills in recent years are rapidly contained and absorbed, without significant drainage to the SD system. However, some exceptions may occur, although the scope of this document does not include documentation of recent releases. One recently suspected source of metals, apparently including lead and mercury, is from a battery cart used near Building 3-626. This may have released metal contamination to the SD system, although it is unclear if this would be in a liquid or solid form.

Contaminants are known to be present in exhaust emissions released from vehicles and aircraft. Burning of fuel may emit PAHs, dioxins/furans, cadmium and lead in the exhaust (see Section 3.0). Some of these SD contaminants at NBF may have originated in vehicle or aircraft exhaust and become transported via atmospheric deposition. No available analytical data correspond directly to these mobile outdoor potential sources.

4.4.4 Outdoor Utility Sources

Utility lines at NBF that may be a source of contamination include natural gas lines, which may contain PCBs, and some older electrical lines that may be insulated with PCB-impregnated paper. Natural gas lines may contain PCBs in gas-transport compressors and in condensate that forms in the lines due to PCB-contaminated lubricants. Burning of natural gas may also produce PCBs. A 4-inch diameter natural gas line is located along the NBF western side of the fence line with GTSP, as well as a gas-metering station north of Building 3-322 (Chrostowski 2009). Electrical lines with potential PCB insulation at NBF may be located overhead, underground, or within utility trenches. Insulation materials may also contain phthalates. Any PCB-contaminated utility material may be transported via weathering or wear directly to the ground surface, or as airborne particulates, or in shallow water present within trenches.

Several samples should be collected of older electric-line insulation material to assess PCB and phthalate concentrations and to determine whether this constitutes a transport concern. No available analytical data correspond directly to these outdoor utility potential sources.

4.4.5 Atmospheric Deposition

Another possible outdoor route of transport of COPCs to the SD system at NBF is through the atmospheric deposition pathway. This transport process at NBF is less certain than other pathways discussed, in terms of the extent or significance in accumulating contaminants. PCBs may be transported via this pathway and may exist in air as vapors, sorbed to particulates, or as aerosols. In particular, PCBs may volatilize from CJM, especially when heated by solar radiation (Chrostowski 2009). All other COPCs may also be transported via the airborne pathway. When atmospheric transport of contaminated material gives way to deposition on the surface, the particulates are then capable of being washed into the SD system. Whether this mode of transport is substantial enough to result in concentration levels of concern at NBF is not known.

A study was performed at NBF in September 2000 to attempt to determine the significance of aerial deposition of PCBs (Landau 2000). Four sample stations were staged for 22 days at widely scattered locations at NBF (only three stations were successful: near the fence line northwest of Building 3-326, on the roof of Building 3-324, on Concourse B near service shed B-13). Each location was set up to collect particulate PCBs through dry deposition on mineral oil and wet deposition by draining into water during rain events. In samples from the three stations, PCB analyses identified no detectable concentrations in these samples. Thus, Landau (2000) concluded that aerial deposition of PCBs at that time was not a substantial migration pathway. Whether this limited sampling is representative of PCB aerial deposition at NBF cannot be determined. No other available analytical data correspond directly to the atmospheric deposition potential sources.

4.5 Interior Contaminant Sources

The inflow study primarily addresses the potential COPC sources from exterior building materials and components. Due to the recent discovery of PCB-bearing caulk around the collars of flanges inside Building 3-322 and the results of air compressor oil samples collected in 2001 and 2002 (Chrostowski 2009), it would be prudent to perform a survey of all buildings at NBF that were built prior to 1980, regardless of subsequent remodeling, in order to identify potential sources of PCBs and the other COPCs. Indoor sources may reach the SD via many pathways:

- Employees may inadvertently track out PCB-bearing dust to other areas of NBF; this may mix with stormwater and thereby enter the SD system.
- Boeing blocked improper connections from interior drains to the SD system in the early to mid-1980s at NBF. If the materials used to block these interior drains have degraded over time, or if any improper connections remain, then these interior drains may serve as a pathway for PCBs to enter the SD system.
- PCB-bearing caulk or other PCB-bearing materials may continue to be a source of PCBs to indoor air. The air-exchange rate may be sufficient to allow the release of PCBs to outdoor air. This may result in aerial deposition of PCBs to the building and ground surfaces at NBF. During a storm event, these PCBs would be conveyed to the SD.

Building 3-302 was built prior to 1953 and renovated after 1980; however, the building was identified as a source of PCBs in 2001. Former catch basin CB184 is adjacent to the building at the east door. In a March 2010 grab SD solids sample, total PCBs concentration was reported at 11 mg/kg DW. If interior sources of PCBs persist inside Building 3-302, the PCB concentrations observed in former CB184 may result from track out of PCB-bearing dust or aerial deposition of PCBs.

Although Boeing contends it has either routed all indoor floor drains to the sanitary sewer system or plugged the drains, records documenting these actions have not been kept (personal communication with Carl Bach, 4/15/2010). It is possible that some interior drains may still drain to the SD system or that previous plugs in interior drains have deteriorated and are failing. Dye tests and/or camera tests are recommended to document that no interior drains discharge to the SD system.

4.6 Recommended Actions Related to Inflow

The following actions are recommended for implementation prior to completion of additional sampling as described in this section:

- Boeing should place filter socks in all SD structures in which the most recent SD solids sample contained PCB concentrations above 1.0 mg/kg DW (Figure 2-10).
- For filter socks, evaluate methods to collect more representative samples of solids entering the SD system (to span full grain-size range). This might be done by combining filter socks with collecting fine filtered solids samples.
- Boeing should perform building materials evaluations in each drainage area and perform abatement activities as appropriate.
- Boeing should conduct an interior building drain survey and documentation should be provided to Ecology to demonstrate that no interior floor drains at NBF discharge to the SD system. This may include dye testing or video inspection.
- Boeing should conduct a survey of potential indoor sources of PCBs and other contaminants. Emphasis should be placed on indoor caulk which may contain PCBs. Samples should be collected as appropriate and documentation should be provided to Ecology.
- Boeing should conduct pavement sweeping more frequently in areas with elevated levels of PCBs in the SD system. Sampling should be conducted quarterly and should be more geographically localized. More frequent local sampling would provide rapid composite sampling of large areas to aid in identification of source areas and reveal changes in concentrations through time.

5.0 Infiltration Assessment

Infiltration involves entry into the SD system by groundwater or subsurface soil, through breaks or other gaps in the SD infrastructure. Once source contaminants have reached the SD system, the transport of water and solids is the pathway leading to discharge to Slip 4. The infiltration assessment included the following activities:

- Available information (video inspections, repair/replacement of SD piping and structures, soil/groundwater and SD system contaminant data) was collected and reviewed.
- Maps to document locations where groundwater infiltration may be occurring near compromised infrastructure and key sources were prepared.
- Additional data needed to assess infiltration potential and relative importance of the groundwater transport pathway was identified.
- Interim actions are recommended, as appropriate.

In conjunction with RI/FS Task 3.2 (Data Management) and Task 3.3 (Geodatabase Development and GIS Mapping), SAIC has developed a set of maps to present known areas of soil and groundwater contamination at NBF, the most recent SD solids chemical concentrations at each structure sampled, and recent SD base flow chemical concentrations. Sample locations and concentrations of COPCs in the SD system (PCBs, mercury, cadmium, copper, lead, zinc, HPAHs, phthalates, and dioxins/furans) and sample locations and concentrations of the COPCs in soil and groundwater samples are presented on Figures 5-1 through 5-28. Groundwater flow and depth are presented in Figure 5-29. Data for BEHP was selected to represent all phthalates. For PAHs, total HPAH concentrations were calculated. Dioxin/furan concentrations are presented using a TEQ that applies 0.5 the detection limit for non-detect values. The following information sources were used:

- Historical soil and groundwater data as summarized in the Supplemental Data Gaps Report (SAIC 2009);
- Recent soil and groundwater data (i.e., from August 2009 to December 2010) provided by Boeing;
- Sediment trap and in-line filtered SD solids data; and
- SD base flow data collected from the KC Lift Station and MH108 in the north lateral SD line.

5.1 Potential Soil and Groundwater Source Areas

Soil and groundwater sample locations are concentrated on the GTSP property and in four areas of NBF: the PEL area, Building 3-380 and former Building 3-360, Buildings 3-800 and 3-801, and the Main Fuel Farm (MFF) area. Additional soil and groundwater investigations have been performed in isolated areas across NBF. The locations of soil and groundwater samples that have been analyzed for at least one of the COPCs are illustrated on Figure 5-1. Additional soil and groundwater samples have been collected, but have not been analyzed for the SD COPCs relevant to the I&I Assessment; therefore, these sample locations have not been included. Soil samples that were collected in areas that were subsequently excavated are also not included on the maps in this section.

Additional areas of potential soil and groundwater sources may be present at NBF. However, due to the limited amount of soil and groundwater data that are available for areas of the site, evaluation of the potential for infiltration to the SD system can only be evaluated for the above-mentioned areas.

Concentrations of dioxins/furans were compared to the Model Toxics Control Act (MTCA) natural background level and urban background level as found in the August 2010 Technical Memorandum #8 by Ecology (Ecology 2010). Concentrations of other chemicals in soil were compared to draft soil-to-sediment screening levels (SAIC 2006). These screening levels were initially developed to assist in the identification of upland properties that may pose a potential risk of recontamination of sediments at Slip 4. The screening levels incorporate a number of conservative assumptions, including the absence of contaminant dilution and ample time for contaminant concentrations in soil, sediment, and groundwater to achieve equilibrium. In addition, the screening levels do not address issues of contaminant mass flux from upland media to sediments, nor do they address the area or volume of sediment that might be affected by upland contaminants.

It is given that source control screening levels developed for the LDW Superfund site are only used for one-sided comparisons. If COPC concentration data in upland soils or groundwater are below the screening levels, then it is unlikely they will lead to SMS exceedances in the receiving environment. If COPC concentration data exceed source control screening levels, then the upland media *may or may not* pose a threat to marine sediments and additional site-specific information should be considered for further decisions about source control.

Correspondingly, when the MDL for a COPC exceeds a source control screening level, the upland media may or may not pose a threat to marine sediments. Additional site-specific information will need to be considered for source control and this may include additional data if lower MDLs are feasible and necessary given the extent of existing information about the specific site. If a lower MDL is not feasible then, per guidance issued for Washington MTCA and consistent with the LDW Source Control Strategy, source control will proceed with some degree of uncertainty and post-cleanup monitoring of the site and the receiving environment (i.e., LDW) will be used to evaluate the possible need for additional source control.

Soil-to-sediment screening levels were developed using both the SQS and CSL values for sediments. In this document, soil-to-sediment screening levels will be referred to as soil-to-sediment (SQS) or soil-to-sediment (CSL) screening levels (depending on whether they are based on the sediment SQS or CSL, respectively). Please note that a concentration in exceedance of the soil-to-sediment (CSL) also exceeds the soil-to-sediment (SQS). Groundwater screening levels are based on the Washington State WQS for Surface Water (WAC 173-201A) most conservative of the marine and freshwater criteria. The soil-to-sediment and groundwater screening levels for the SD COPCs are listed in Table 1-2.

Due to fluctuations in groundwater elevation, soil samples will be compared to the soil screening levels of the saturated zone as presented in Table 1-2, regardless of sample collection depth. This method provides for a more conservative approach to the protection of Slip 4. The majority of MDLs for total PCBs are within the soil-to-sediment (CSL) screening level (0.065 mg/kg); most exceed the soil-to-sediment (SQS) screening level (0.012 mg/kg).

Figures 5-2 through 5-19 present soil sample COPC concentrations (shown as colored dots on the maps) and SD solids COPC concentrations (shown as shaded polygons). Figures 5-21 through 5-28 present groundwater and SD base flow COPC concentrations (shown as colored symbols on the maps) and SD solids COPC concentrations (shown as shaded polygons). Using the shaded polygons (developed as described in Section 2.1) allows a visual comparison of soil and groundwater sampling results to areas with higher SD solids concentrations.

5.2 Soil Contamination

The bottom depth of most SD structures at NBF is less than approximately 8 feet bgs. For this reason, soil data were examined at two depth intervals within this range: “Shallow” or 0 to 4 feet bgs, and “Deep” or 4 to 8 feet bgs (based on top of soil depth). For any soil sample, the maximum concentration of a COPC for the shallow or deep depth interval was plotted on the site map. Where cracks or breaks in the SD structures or piping occur, the soil immediately adjacent to the structures may enter the SD system. Therefore, contaminated soil below 8 feet bgs has little opportunity to infiltrate the SD system; however, leaching of contaminants from soil to groundwater may be a pathway for contaminants in deeper soil to enter the SD system. The potential for contaminants to infiltrate the SD system through compromises in SD structures based on the video inspections is briefly discussed in Sections 5.2.1 through 5.2.5. Video inspection results are evaluated further in Section 5.5.

The maps in this section present sample data as both colored circles and as shaded polygons. The shaded polygons represent the most recent SD solids concentration at each sampling location, while the colored circles represent specific sample locations and concentrations of soil. For consistency, the following color scale is used for Figures 5-2 through 5-19:

Map Color	General Description	SD Solids	Soil
	No exceedances	Less than SQS/LAET/ CERCLA T-117 screening levels	Less than Soil-to-Sed (SQS)/ MTCA (Natural) screening levels
	Concentrations exceed lowest criterion	Above SQS/LAET/ CERCLA T-117	Above Soil-to-Sed (SQS)/ MTCA (Natural)
	Concentrations exceed second lowest criterion, where applicable	Above CSL/2LAET or more than 10x CERCLA T-117	Above Soil-to-Sed (CSL)/ MTCA (Urban)
	Concentrations exceed 10x lowest criterion	More than 10x the SQS/LAET or 100x CERCLA T-117	More than 10x the Soil-to-Sed (SQS)/MTCA (Natural)
	Concentrations exceed 100x lowest criterion	More than 100x the SQS/LAET or 1,000x CERCLA T-117	More than 100x the Soil-to-Sed (SQS)/MTCA (Natural)
	Concentrations exceed 1,000x lowest criterion	More than 1,000x the SQS/LAET or 10,000x CERCLA T-117	More than 1,000x the Soil-to-Sed (SQS)/MTCA (Natural)
	Concentrations exceed 10,000x lowest criterion	More than 10,000x the SQS/LAET or 100,000x CERCLA T-117	More than 10,000x the Soil-to-Sed (SQS)/MTCA (Natural)
	Concentrations exceed 100,000x lowest criterion	More than 100,000x the SQS/LAET or 1,000,000x CERCLA T-117	More than 100,000x the Soil-to-Sed (SQS)/MTCA (Natural)

5.2.1 Propulsion Engineering Lab Area and GTSP Facility

Most of the soil and groundwater data within the PEL area and the GTSP Facility come from several investigations that have been performed near the NBF-GTSP fence line, around Buildings 3-302 and 3-322, and near Buildings 3-333 and 3-335. A summary of screening level exceedances in this area is provided in Table 5-1. Sample locations and analytical results for COPCs in soil are presented in Figures 5-2 through 5-19.

PCBs

PCB concentrations in soil samples collected throughout the PEL area have exceeded the soil-to-sediment screening levels in shallow and deep soil. The historical maximum PCB concentration in soil at NBF was 4,150 mg/kg at 3.4 feet bgs (sample H1-10). The sample was collected near the western side of the current Building 3-333 in August 1997. The historical maximum PCB concentration in soil at GTSP was 91,000 mg/kg at 1 foot bgs in sample B18; collected near the NBF-GTSP fence line in March 1985. In July 2010, total PCBs were detected at 2,300 mg/kg in soil sample SB07(4-6), located along the NBF-GTSP fence line. Soil sample SB08-36 was collected at 5 feet bgs near H1-10 in September 2008; PCBs were reported at 270 mg/kg in the sample.

PCBs are prevalent in shallow soil along the northern and western sides of Building 3-333 and the area of Building 3-335, the area along the NBF-GTSP fence line north of Building 3-326, and the area between Buildings 3-302 and 3-322 and west of Building 3-322 (Figures 5-2 and 5-3). PCB concentrations in the majority of soil samples have exceeded both the soil-to-sediment (SQS) and (CSL) screening levels. Total PCBs in eleven shallow and two deep soil samples were detected at concentrations over 1,200 mg/kg. For shallow sample locations where PCBs were not detected, the MDL for most samples exceeded the soil-to-sediment (SQS) screening level. For the deep soil samples in the PEL area, there are more non-detect samples for PCBs; however, all of the MDLs exceed the soil-to-sediment (SQS) screening level and many also exceed the soil-to-sediment (CSL) screening level.

In the area northwest and southeast of Building 3-335, there are many shallow and deep soil samples with concentrations of total PCBs that exceed the soil-to-sediment (SQS) screening level by a factor of 1,000 or more. There were also numerous non-detect concentrations; however, MDLs for these samples exceed the soil-to-sediment (SQS) and (CSL) screening levels. Boeing plans to excavate soil northwest of Building 3-335 in 2011. The area southeast of Building 3-335 is not planned for any soil characterization or removal.

Another area of concern for PCBs is immediately northwest of the north end of Building 3-333, where previous soil removal (in the building footprint) took place, but deeper confirmation sampling within the footprint and to the north was incomplete. The extent of this soil contamination to the north of the building is not known.

The majority of soil samples collected near the NBF-GTSP fence line were collected during a SD line replacement and the 2010 Focused Soil Investigation (Landau 2010e). In addition, soil samples were collected from the GTSP property and the NBF-Fire Training Center (FTC) area (upgradient of GTSP). All detected PCB concentrations exceeded the soil-to-sediment (SQS) and

(CSL) screening levels, and the majority of concentrations exceeded the soil-to-sediment (SQS) screening level by a factor of 1,000 or more. Most deep soil samples were non-detect for PCBs, though all MDLs exceeded the soil-to-sediment (SQS) screening level.

Soil borings drilled northeast of Building 3-302 had concentrations of total PCBs above the soil-to-sediment (SQS) and (CSL) screening levels. Subsequently, Boeing excavated approximately 100 cubic yards of impacted soil and replaced compromised SD lines and structures from the area of Building 3-302 (Landau 2010l). In some areas, the excavation extended one to two feet below groundwater. Six confirmation soil samples were collected from the bottom of the excavation. Five of the confirmation samples indicated total PCBs ranging from 0.34 to 1.69 mg/kg, exceeding the soil-to-sediment (SQS) and (CSL) screening levels. A barrier of layered carbon and geofabric was installed along the bottom of the excavation area, separating in-place soil from clean fill material and providing treatment of fluctuating groundwater.

In March and April 2010, shallow excavations to remove PCB-contaminated soil were completed in the areas west of Buildings 3-302 and 3-322, between buildings 3-302 and 3-322, and between Buildings 3-322 and 3-323 (Landau 2010b). Approximately 344 cubic yards of impacted soil was removed. Total PCB concentrations from in-situ soil samples ranged from non-detect (0.031U) to 33 mg/kg; the most elevated concentrations were detected in shallow soil. PCBs were detected in three deep soil samples at concentrations exceeding the soil-to-sediment (SQS) screening level. Remaining deep soil samples in the area have been non-detect for PCBs; however, the MDL for all samples was greater than the soil-to-sediment (SQS) screening level. Storm drain lines and structures are generally submerged at high water levels and total PCB concentrations in SD solids samples exceed the LAET. Some SD structures were abandoned or replaced during excavation activities and are discussed further in Section 5.5.1.

Metals

Metals were indicated in soil throughout the PEL area and on the GTSP facility. Concentrations of mercury, cadmium, lead, and zinc ranged from non-detect to levels exceeding their respective soil-to-sediment (SQS) and (CSL) screening levels. Concentrations of copper in most soil samples were detected below the soil-to-sediment (SQS) screening level; however, concentrations of copper exceeding the soil-to-sediment (SQS) were detected in samples collected along the NBF-GTSP fence line and on the GTSP facility. Figures 5-4 through 5-19 depict concentrations of metals in shallow and deep soils at the NBF-GTSP Site.

A subsurface investigation in the area along the northern and western sides of Building 3-333 and the area north of Building 3-335 indicated concentrations of total PCBs, mercury, and zinc are indicated above their respective soil-to-sediment (SQS) screening level in both shallow and deep soils. Total HPAHs were detected above the soil-to-sediment (SQS) in only shallow soils in the area. Cadmium, copper, and BEHP concentrations were either non-detect or were detected below their respective screening levels; however, the MDLs of most non-detect samples exceeded respective soil-to-sediment (SQS) screening levels.

Recent excavations were conducted in the areas of Buildings 3-302 and 3-322; a total of approximately 444 cubic yards of PCB-impacted soils were removed (Landau 2010b, 2010l). Confirmation samples of in-situ soil were not analyzed for metals. Mercury and zinc were detected above their respective screening levels in soil samples collected south of Building 3-322 and near Buildings 3-302, 3-334, and 3-303. Cadmium and copper were detected below their respective screening levels. Lead was detected above the soil-to-sediment (SQS) and (CSL) in only one shallow soil sample near Building 3-303.

Exceedances of screening levels for metals are prevalent along the NBF-GTSP fence line. Analytical results, including those from the recent focused soil investigation (Landau 2010e), indicate concentrations of all metal COPCs exceeding the soil-to-sediment (SQS) and (CSL) screening levels in at least one shallow soil sample along the NBF-GTSP fence line. Mercury in several shallow soil samples was detected above the soil-to-sediment (SQS) by a factor of 10 or more. In deep soil, mercury was non-detect; however, the MDL for all samples exceeded the soil-to-sediment (SQS) and (CSL). Copper, lead, and zinc were detected above their respective screening levels in deep soil. Cadmium in soil samples along the NBF-GTSP fence line were either non-detect or detected below the soil-to-sediment (SQS) in deep soil. Mercury, cadmium, copper, lead, and zinc have been detected above both the soil-to-sediment (SQS) and (CSL) in several shallow and deep soil samples collected from the GTSP facility and the FTC area.

Lead and mercury concentrations from shallow soil samples collected near the eastern side of Building 3-626 exceeded the soil-to-sediment (SQS) and (CSL) screening levels. A single detection of copper was present in a soil sample collected in the footprint of Building 3-353. Zinc concentrations exceeded the soil-to-sediment (CSL) screening levels in four shallow soil samples collected from this area.

Mercury and zinc concentrations from shallow and deep soil samples collected near the eastern side of Building 3-626 and near Building 3-353 exceeded the soil-to-sediment (SQS) and (CSL) screening levels. Two detections of lead were present in a shallow soil sample collected from the eastern side of Building 3-626 above the soil-to-sediment (SQS) and (CSL). A single detection of cadmium in shallow soil, copper in shallow soil, and copper in deep soil were indicated above the soil-to-sediment (SQS) near Buildings 3-626, 3-353, and 3-315, respectively.

HPAHs, BEHP, and Dioxins/Furans

Total HPAHs in shallow and deep soil samples collected from within the PEL area and the GTSP facility are mostly non-detect; however, the MDLs exceed the soil-to-sediment (CSL). Detected concentrations of total HPAHs in soil samples ranged from levels just exceeding the soil-to-sediment (CSL) to levels exceeding the soil-to-sediment (SQS) by a factor of 100 or more. Samples with the most elevated levels of HPAHs appear to be concentrated at the GTSP facility and the eastern PEL area.

BEHP is non-detect in most soil samples collected from the PEL area and the GTSP facility; however, the MDLs exceed the soil-to-sediment (SQS) for all but twelve samples. Only four shallow soil samples and one deep soil sample collected from the PEL area had concentrations of BEHP exceeding the soil-to-sediment (CSL). These samples were collected along the NBF-GTSP fence line. Detections of BEHP in soil samples collected from the GTSP facility ranges from below 0.047 mg/kg to concentrations exceeding the soil-to-sediment (SQS) and (CSL). Soil samples collected from the former FTC area had elevated non-detects and detections of BEHP in shallow and deep soil.

Few soil samples in the PEL area and GTSP facility have been analyzed for dioxins/furans. Of the samples collected, the TEQ (0.5 detection limit [DL]) concentration of one soil sample exceeded the MTCA natural background level, while the TEQ (0.5 DL) concentrations of three soil samples exceeded the urban background level. These samples were collected from shallow soil at the GTSP facility. Dioxins/furans were detected below the MTCA natural background level in all soil samples collected from the NBF facility.

5.2.2 Building 3-380 and Former Building 3-360 Area

Soil and groundwater samples were collected in the footprint of the Building 3-380 area prior to construction of the building in 1991. Several shallow soil samples were collected during 2008 during storm drain line re-routing activities north of Building 3-380. Boeing performed several soil and groundwater investigations in the area of former Building 3-360, previously located northwest of Building 3-352, from the early 1990s to 2003 (SAIC 2009). Wells NGW201 through NGW212 were originally installed during these investigations and the wells continue to be used for groundwater monitoring. The area around Building 7-27-1 is included in this section. A summary of screening level exceedances in this area is provided in Table 5-2. Sample locations and analytical results for COPCs in soil are presented in Figures 5-2 through 5-19.

PCBs

PCBs have not been widely detected in shallow soil in this area; however, the MDLs for all non-detects have been greater than the soil-to-sediment (SQS) screening level. Where PCBs have been detected in shallow soil, the concentrations have exceeded the soil-to-sediment (SQS) screening level and two samples have exceeded the soil-to-sediment (CSL). Only three deep soil samples have been collected and analyzed for PCBs. The MDL for all three samples exceeded the soil-to-sediment (SQS) screening level.

Metals

Limited soil sampling data are available for metals in the Building 3-380 and former Building 3-360 areas. Soil samples analyzed for metals were collected from only deep soil. Exceedances of soil-to-sediment screening levels in deep soil in this area do not appear to be prevalent for all metals; however, mercury and zinc are detected above their respective soil-to-sediment (SQS) screening levels consistently throughout the area.

Four deep soil samples were analyzed for metals in the footprint of Building 3-380. Cadmium, copper, and lead were not detected or were detected below the soil-to-sediment (SQS) screening level. Zinc concentrations were detected in all four samples, but only one concentration exceeded the soil-to-sediment (SQS) screening level. Mercury was detected in all four samples above the soil-to-sediment (SQS) screening level, three of which also exceeded the soil-to-sediment (CSL).

In deep soil samples collected near Building 7-27-1, cadmium, copper, and lead were not detected or were detected at concentrations below the soil-to-sediment screening (SQS) level. Mercury was not detected; however, the MDL exceeded the soil-to-sediment (CSL) screening level. Zinc was detected in three samples above the soil-to-sediment (SQS) screening level and one sample was detected above the soil-to-sediment (CSL) screening level.

In deep soil samples collected near former Building 3-360, previously located northwest of Building 3-352, cadmium, copper, and lead were not detected or were detected at concentrations below the soil-to-sediment screening (SQS) level. Mercury and zinc were detected in samples above the soil-to-sediment (CSL) screening level in this area.

HPAHs, BEHP, and Dioxins/Furans

Shallow soil samples collected from the footprint of Building 3-380 were analyzed for total HPAHs and BEHP. Deep soil samples were not collected. BEHP was detected in only one of the 13 samples; however, the detected concentration, and the MDL for the non-detect samples, exceeded both the soil-to-sediment (SQS) and (CSL) screening levels. Dioxins/furans were not analyzed in soil samples from this area.

5.2.3 Building 3-800 and Building 3-801 Area

Soil samples in this area were collected prior to the construction of Buildings 3-800 and 3-801. Most soil samples were collected in the footprints of the buildings. Other soil samples were collected during well installation activities in the area north of Building 3-800. The SD structures at the northwest corner and east of Building 3-800 are the only SD structures adjacent to the building that have been sampled. Samples were analyzed only for PCBs. The SD structures adjacent to Building 3-801 have not been sampled. A summary of screening level exceedances in this area is provided in Table 5-3. Sample locations and analytical results for COPCs in soil are presented in Figures 5-2 through 5-19.

PCBs

Soil samples collected from the Building 3-800 and 3-801 area have not been analyzed for PCBs.

Metals

Shallow and deep soil samples collected from the Building 3-801 footprint were analyzed for metals, with the exception of mercury which was not included in the analyses. Cadmium concentrations exceeded the soil-to-sediment (SQS) screening level in two shallow and two deep soil samples. Copper concentrations exceeded the soil-to-sediment (SQS) screening level in two shallow and three deep soil samples. Lead concentrations did not exceed the soil-to-sediment screening levels in shallow or deep soil. Zinc concentrations exceeded the soil-to-sediment (SQS) in all soil samples; zinc exceeded the soil-to-sediment (CSL) in three shallow and three deep soil samples. The shallow and deep soil samples were not analyzed for mercury.

Three shallow soil samples collected during the installation of groundwater monitoring wells north of Building 3-800 were analyzed for mercury. Mercury was not detected in any of the samples; however, the MDL for all samples exceeded the soil-to-sediment (CSL) screening level based on the CSL. Deep soil samples were not analyzed for mercury.

HPAHs, BEHP, and Dioxins/Furans

Deep soil samples collected from the Building 3-800 and Building 3-801 area were analyzed for total HPAHs and BEHP. Shallow soil samples were not collected. BEHP and total HPAH were not detected; however, the MDL for all samples exceeded the soil-to-sediment (CSL) screening levels. Dioxins/furans were not analyzed in soil samples from this area

5.2.4 Main Fuel Farm

Several investigations have been performed at the MFF; however, most of these investigations have focused on petroleum-related chemicals and not the COPCs to the SD system. Limited soil data are available for PCBs, BEHP, and PAHs. The soil samples collected in this area have not been analyzed for metals or dioxins/furans. A summary of screening level exceedances in this area is provided in Table 5-4. Sample locations and analytical results for COPCs in soil are presented in Figures 5-2 through 5-19.

PCBs

PCBs have not been detected in shallow or deep soil at the MFF; however, the MDLs for all samples exceeded the soil-to-sediment (SQS) and (CSL) screening levels.

HPAHs, BEHP, and Dioxins/Furans

Total HPAHs have been detected in shallow and deep soil samples at concentrations that exceeded the soil-to-sediment (CSL) screening level. BEHP has not been detected in the soil samples collected from the MFF area; however, the MDLs for all samples exceeded the soil-to-sediment screening (SQS) level.

5.2.5 Other Areas

Soil samples have been analyzed for PCBs, HPAHs, and BEHP in some isolated areas including the Green Hornet Area (near Building 3-313), Concourses A and B, and former Building 3-830. The bottoms of SD structures in these areas are generally deeper than 4 feet bgs. Sample locations and analytical results for COPCs in soil are presented in Figures 5-2 through 5-19.

PCBs

Total PCBs were detected at a concentration in exceedance of the soil-to-sediment (SQS) screening level in a shallow soil sample collected near the west side of former Building 3-830. In the remaining areas, PCBs were not detected in soil; however, the MDL for all samples exceeded the soil-to-sediment (SQS) screening level and SD solids samples collected from the SD structures adjacent to the area have exceeded the LAET and/or the 2LAET.

HPAHs, BEHP, and Dioxins/Furans

Deep soil samples collected from the Green Hornet Area and Concourses A and B were analyzed for total HPAHs and BEHP. BEHP was detected at concentrations exceeding the soil-to-sediment screening (CSL) level. HPAHs were detected only in the Green Hornet area and the total HPAH concentrations exceeded the soil-to-sediment (CSL) screening level. HPAHs were not detected in the soil samples collected on the concourses; however, the MDL for all samples exceeded the soil-to-sediment (CSL) screening level. Dioxins/furans were not analyzed in soil samples from this area.

5.3 Groundwater Contamination

The majority of the groundwater investigations performed at NBF have been focused on petroleum hydrocarbons. Limited information regarding the occurrence of the COPCs in groundwater is available. Figure 5-20 depicts groundwater sampling locations.

COPC concentrations in groundwater and SD base flow (which is essentially groundwater) are compared to the WQS, as described in Section 5.1. The potential for contaminants to infiltrate the SD system through compromises in SD structures based on the 2010 video inspection is briefly discussed in Sections 5.3.1 through 5.3.4. Video inspection results are evaluated further in Section 5.5.

The maps in this section present sample data as colored circles, colored diamonds, and as shaded polygons. The shaded polygons represent the most recent SD solids concentration at each sampling location, while the colored circles represent specific sample locations and concentrations of groundwater and colored diamonds represent specific sample locations and concentrations of SD base flow. For consistency, the following color scale is used for Figures 5-21 through 5-28:

Map Color	General Description	SD Solids	Groundwater and SD Base Flow
	No exceedances	Less than SQS/LAET/ CERCLA T-117 screening levels	Less than WQS/HHO/RCRA-MTCA screening levels
	Concentrations exceed lowest criterion	Above SQS/LAET/ CERCLA T-117	Above WQS/HHO/RCRA-MTCA
	Concentrations exceed second lowest criterion, where applicable	Above CSL/2LAET or more than 10x CERCLA T-117	More than 10x the WQS/HHO/ RCRA-MTCA
	Concentrations exceed 10x lowest criterion	More than 10x the SQS/LAET or 100x CERCLA T-117	More than 100x the WQS/HHO/RCRA-MTCA
	Concentrations exceed 100x lowest criterion	More than 100x the SQS/LAET or 1,000x CERCLA T-117	More than 1,000x the WQS/HHO/RCRA-MTCA
	Concentrations exceed 1,000x lowest criterion	Not Applicable	Not Applicable

5.3.1 PCBs

PCBs have been analyzed in groundwater at the GTSP, at the former NBF-FTC area (upgradient of GTSP), the PEL area, along the former Georgetown Flume near the northwest property line, along the NBF-GTSP fence line, and in the Building 3-800 area. PCB concentrations for the most recent groundwater sample from each well where PCBs were analyzed are presented on Figure 5-21. This does not include wells recently installed by Boeing in the PEL and fence line areas. PCBs were detected in six of these samples, and concentrations in five samples exceeded the WQS screening level, located mainly in the fence line area and the northern PEL area. PCBs were not detected in any of the remaining samples; however, the MDLs exceeded the WQS screening levels for most samples.

The total PCB concentration in the most recent whole water sample collected from the KC Lift Station (LS431) exceeds the WQS screening level of 0.014 µg/L. The total PCB concentration in the most recent whole water sample collected from MH108 (in the north lateral main line) exceeds the WQS screening level by a factor of 10. In December 2009, Boeing observed water infiltrating into a catch basin (CB187A) located near the NBF-GTSP fence line (drainage sub-basin N11) during a period of no rainfall. This is believed to represent shallow groundwater in this area. A sample was collected by Landau Associates on December 2, 2009, and was analyzed for PCBs. The concentration of total PCBs in this sample was 0.74 µg/L, which is above the WQS screening level. A SD solids sample collected from this structure in July 2009 contained 7.5 mg/kg DW total PCBs.

5.3.2 Metals

Groundwater samples collected from a broader area of the site have been analyzed for metals. Metals concentrations for the most recent groundwater sample from each well for which metals were analyzed are presented on Figures 5-22 through 5-26.

Mercury concentrations in groundwater generally exceed the WQS screening levels (Figure 5-22). At Buildings 3-369 and 3-380, the mercury concentrations detected in all recent groundwater samples exceeded the WQS screening level by a factor of 100 or more. A single detection of mercury exceeding the WQS screening level by a factor of 1,000 or more was observed on Concourse B. A mix of mercury concentrations below and exceeding the WQS screening levels was observed at the GTSP facility and the NBF-GTSP fence line. The MDLs exceeded the screening levels for all samples collected from the NBF-FTC, Concourse A, Building 3-800, former Building 3-360, and Building 7-27-1 areas.

Mercury was detected in the SD base flow samples collected at LS431 and MH108 above the WQS screening level.

Cadmium concentrations in groundwater have exceeded the WQS screening level in the samples collected from the Building 3-369 area, Concourse A area, and Concourse B area (Figure 5-23).

Single groundwater samples collected from Concourse A and Building 3-369 contained cadmium concentrations that exceeded the WQS screening level. The remaining samples in these areas did not contain detectable cadmium; however, the MDLs for all samples exceeded the WQS screening level. Groundwater samples at the former Building 3-360 area and the GTSP facility were non-detect for cadmium (MDLs below the WQS screening level) or cadmium was detected at concentrations below the WQS screening level. Cadmium was not detected in groundwater samples collected from the area of Building 3-380; however, the MDLs for all samples exceeded the WQS screening level.

Total cadmium concentrations exceeded the WQS screening level in the SD base flow samples collected from LS431 and MH108.

Most copper concentrations exceeded the WQS screening level (Figure 5-24). Copper concentrations have exceeded the WQS screening levels in all areas for which it was analyzed, including one well at the GTSP facility. Concentrations at Concourse B, Concourse A, Building 3-800, Building 3-380, and Building 3-369 exceeded the WQS screening level by a factor of 100. The MDLs for non-detect samples do not exceed the WQS in only three samples.

Total copper in SD base flow samples exceeded the WQS screening levels at LS431 and MH108.

Lead concentrations exceeding the WQS screening levels were observed in the areas of former Building 3-360, Building 7-27-1, Building 3-369, Concourse A, and Concourse B (Figure 5-25). The MDLs for all samples at Building 3-380 and for two samples at Building 3-800 exceeded the WQS screening level.

Total lead concentrations in SD base flow samples did not exceed the WQS screening at LS431 and MH108.

Zinc concentrations exceeding the WQS screening levels were observed in the areas of Building 3-380, Building 3-369, Building 3-800, former Building 3-360, Concourse A, and Concourse B. Concentrations of zinc in Concourse A and Concourse B exceeded the WQS by a factor of 10 or more. All other samples indicated detections or MDLs below the WQS screening level.

Total zinc in SD base flow samples did not exceed the WQS screening levels at LS431 and MH108.

5.3.3 HPAHs and BEHP

Groundwater samples from the following areas were analyzed for total HPAHs (Figure 5-27): the GTSP facility area, the NBF-FTC area, near Building 3-353, a single well in the former Building 3-360 area, Building 3-800, and Concourses A and B. HPAHs were not detected in any of the groundwater samples; however, the MDL exceeded the WQS screening levels for all samples in all areas (except the samples collected from wells at GTSP).

Groundwater samples from the following areas were analyzed for BEHP (Figure 5-28): the GTSP facility area, the NBF-FTC area, near Building 3-353, Building 3-380, a single well in the former Building 3-360 area, Building 3-800, and Concourses A and B. Concentrations of BEHP exceeded the WQS screening level at Building 3-353, Building 3-800, and Concourses A and B. BEHP was not detected in the remaining areas; however, the MDLs exceeded the groundwater screening levels for some non-detect samples.

Total HPAHs exceeded the WQS in SD base flow samples collected from LS431 and MH108. BEHP was not analyzed in SD base flow samples collected from LS431 or MH108.

5.3.4 Dioxins/Furans

Dioxins/furans are not water soluble (ATSDR 1994, 1998). Only four samples of groundwater have been analyzed for dioxins/furans. The samples were collected in 1987 and 2010; concentrations were non-detect with MDLs ranging from 0.92 to 5,000,000 picograms per liter (pg/L) (TEQ 0.5 DL). In addition, samples of SD base flow have not been analyzed for dioxins/furans. Given the nature of dioxins/furans in liquid and the fact that data are limited and inconclusive, dioxins/furans in groundwater and SD base flow are not considered further in this report. A figure depicting dioxin/furan sampling locations and concentrations is not provided.

5.4 Groundwater Setting

5.4.1 Hydrogeologic Summary

The following hydrogeologic summary of this area is based on a large number of site investigations conducted in the vicinity of NBF-GTSP. The geologic units underlying the Duwamish Valley include bedrock, glacial deposits, marine embayment sediments, and river/floodplain deposits. The latter alluvial deposits consist of a lower zone of fine sand with silt, or silty sand; above a depth of about 30 to 60 feet is an upper zone consisting generally of fine to medium sand with minor silt or gravel. This is locally overlain by a thin layer of organic-rich silt at approximately 10 feet bgs. Fill material consisting of sand, silt and gravel occupies the upper 3 to 20 feet bgs (Landau 1990; Hart Crowser 1991; GeoMapNW 2009).

Groundwater at and near the Site occurs at shallow depths within the recent alluvium and fill material, under unconfined conditions. Figure 5-29 presents a summary of information on groundwater depths and flow directions, based on a large number of historical groundwater investigative results (and included in the SAIC/Ecology database). Groundwater studies across the NBF area indicate that the flow direction averages toward the south-southwest, at relatively low hydraulic gradients of 0.0010 to 0.0025 foot per foot (e.g., Landau 1990). In the central area of NBF, groundwater flows more in a southwesterly direction, whereas near the western end of NBF, in the vicinity of Buildings 7-27-1 and former Building 3-360, the flow is more southerly, toward Slip 4. Investigations in localized small areas at NBF exhibit a wider range of flow directions and gradients, as expected, with directions varying from westward to southward to eastward and rarely northeastward. Figure 5-29 presents both regional flow directions and more localized variable directions.

At the GTSP property and the adjacent NBF-FTC, groundwater flow is generally toward the south, varying from south-southeast to southwest, at an average gradient of 0.0040 foot per foot (Landau 1992; Integral 2010). In general, the southerly flow direction in this area then shifts toward the south-southwest in the adjacent PEL area, and continues downgradient across NBF and toward Boeing Plant 2 and Slip 4.

5.4.2 Groundwater Depths

Based on a large number of historical groundwater monitoring data and other site investigations at NBF-GTSP (primarily by SECOR and Landau), depth to the water table varies seasonally and with tidal fluctuations, ranging from 2.6 to 11.3 feet below the well casing for all onsite wells. Note that these water-level depth measurements (a total of 916) include only those made available to SAIC/Ecology and entered into the SAIC database. For the NBF facility, the large majority of water level data extend only up to 1996, while GTSP data extend up to 2007. The distribution of these groundwater depth measurements are summarized in the following table.

Summary of Groundwater Depth Measurements at NBF-GTSP		
Groundwater Depth Range (feet below well casing)	**Number of Water Level Measurements in Database**	**Percentage**
2 to <3	1	0.1%
3 to <4	7	0.8%
4 to <5	67	7.3%
5 to <6	117	12.8%
6 to <7	119	13.0%
7 to <8	219	23.9%
8 to <9	286	31.2%
9 to <10	79	8.6%
10 to <11	18	2.0%
11 to <12	3	0.3%

Approximately 55 percent of all groundwater depths were measured between 7 and 9 feet, while 81 percent were between 5 and 9 feet. The average depth measurement for the entire Site is 7.4 feet below the well casing. These depth values are presented to aid in understanding of the potential for groundwater infiltration at NBF.

Figure 5-29 presents ranges of groundwater depths around individual wells or clusters of wells (stated as depth bgs). The area of most uncertainty for groundwater levels at NBF-GTSP is along the concourses, particularly in the large Concourse B. Also there are no wells in the central PEL area. The following text summarizes groundwater depths at the Site.

The water table at the GTSP property is found at depths of 3.0 to 9.4 feet bgs, becoming generally deeper toward the south. The groundwater depth of 3.0 feet in well GTSP-3 is the shallowest identified throughout the entire NBF-GTSP area. Thus, the water table on both sides of the GTSP southern fence line is expected to be very shallow year-round. Most of the GTSP property upgradient of this fence line has deeper groundwater.

In the entire PEL area, which is located largely within the north lateral drainage area, the historical water levels range from 4.3 to 9.3 feet bgs. The shallow depth of 3.0 feet bgs at the GTSP fence line also applies to the northeastern portion of the PEL area. According to a recent summary of results for the PEL area, the observed water levels are stated as ranging from 3 to 12 feet bgs (Landau 2010a).

The deepest water levels at the Site were found in the Building 7-27-1 area (former Markov property), with depths of 10.0 to 11.6 feet bgs at this downgradient location. This range of water levels is similar to that for three other downgradient wells across East Marginal Way S at Boeing Plant 2 (see Figure 5-29), ranging from 10.5 to 11.8 feet bgs. Measurements made in May 2010 in the Building 7-27-1 area (Landau 2010a) indicate a much more extreme range of water levels. Between these downgradient areas and the upgradient PEL area is a zone of water depths ranging largely from 6.5 to 10.5 feet.

5.5 Potential Infiltration Areas

This section summarizes the water table levels compared to locations of SD components in the six drainage areas at NBF. It also discusses whether the SD structures and lines are expected to be submerged below the wet-season water table and thus potentially subject to infiltration in locations where breaks or gaps exist in the SD components. Information that has been made available to SAIC with regard to video inspections of SD lines is also discussed in this section, as relevant.

In order to determine if SD lines are submerged by groundwater during high-water periods, water table elevations were compared to the bottom elevations of SD lines. Much of the historical groundwater elevation data in the project database were not tied to a single surveyed datum (local relative elevations were applied), and many of these studies were focused on local areas, not site-wide investigations. In addition, various water level measurements in wells were collected at different dates and years for each area. Newer data (since 1996) from groundwater investigations were mostly unavailable during preparation of this report.

Two sets of data collected during high-water periods for the Site were evaluated and used to determine groundwater elevations for the submergence determination. One set is from a compilation in Landau (Landau 1990), including water level measurements taken each month for one year on a number of wells located across much of the Site and adjacent offsite (including wells no longer present). The measurement event with the highest elevation of water levels in the Landau report was January 1988, which was selected for use in this analysis. A second set of similarly high-water data from March 1996 were also used to cover much of the Site (with no offsite wells), including the western portion near Building 7-27-1 and former Building 3-360 (using five monitoring reports produced by SECOR in 1996). The two sources involved mostly different wells, yet the resultant groundwater contour maps were similar where they overlapped. Using both sources of groundwater data, the water table elevations were contoured across the entire Site and surrounding areas, using Boeing’s newer survey elevations.

A summary listing of which SD components are expected to be submerged at high water is included as Table 5-5. Figure 5-30 presents a map of the NBF facility outlining areas that would be submerged at high groundwater levels (based on January 1988 and March 1996 data). The following text discusses the segments of these components that are anticipated to be submerged below the water table. Specifically, if the water table during the high-water season reaches the level at the bottom of a SD line (based on flow line or invert levels in structures), the line is considered to be submerged at that location. It is recognized that there is some interpretation and approximation involved in this process, but this preliminary evaluation of potential infiltration in the NBF SD lines is expected to be generally representative of actual high-water site conditions.

Information on video inspections conducted in 2007, 2008, and 2010 of the NBF SD system have been provided to Ecology/SAIC; it is not known whether additional SD video inspections have been performed by Boeing. The areas surveyed include lines within portions of all six drainage areas (Bravo 2008, Landau 2007b, Landau 2010f, and Landau 2011b). Figures 5-31, 5-32, and 5-33 document locations where gaps, breaks, or other problems were noted by the field technicians and identify structures that have been repaired. The descriptions and approximate locations for identified problem areas are taken directly from the field notes provided with these inspection reports. These problem areas constitute known locations where infiltration of groundwater or soil could be occurring. The figures also show locations of SD lines that have been identified as situated below the water table during high water conditions. This submergence could result in infiltration of contaminants to the SD system. Section 5.2, Section 5.3 and Figures 5-2 through 5-28 provide detailed information regarding concentrations of COPCs in soil and groundwater. Other areas of the Site have not been inspected by video surveys, and there may be similar openings in the SD lines and structures that allow for infiltration to occur.

5.5.1 North Lateral Drainage Area

The maximum depth of a SD structure in this drainage area is 13.5 feet bgs near the downstream end, before it joins the north-central lateral SD. The minimum bottom-pipe depth along the line is 5.6 feet bgs. The main lateral SD line is entirely submerged by groundwater upstream to where the line enters the GTSP property. Other areas in this drainage system that are submerged at high water levels include: the northern tributary line as far upstream as CB188B, MH166A, and CB184C; the eastern tributary upstream to its origin at MH193 (marginal submergence, with pipe elevations close to high-water levels); in the Building 3-324 area upstream to CB626; southwest of the Test Building area upstream to CB209A and UNKCB9, as well as the area near UNKCB13 and UNKCB14; and the tributary in the area of the sweeper decant station upstream to MH133D.

Select SD lines and structures were pressure washed and video inspected during the March and April 2010 soil excavation (Landau 2010b). Catch basin CB191 and connecting SD lines were abandoned or removed from the excavated areas between Buildings 3-302 and 3-322.

During the August 2010 video inspection of the north lateral lines, it was indicated that several structures were in need of repair. Of the 107 segments inspected, cracks, fractures, breaks, or other defects were identified in 33 segments. Of these segments, two were identified to have been constructed of vitrified clay (MH158 to MH152 and MH152 to MH130). Signs of soil and groundwater infiltration were confirmed in 10 segments within the following lines: N4, N5, N7, N10, and a branch of N11. Of these, generally only N7 is submerged by groundwater during high water-table conditions. However, note that N10 is likely submerged from CB184 down to the main lateral, but the SD elevation data were not clear (Figure 5-33a).

Signs of infiltration were observed throughout the entire length of N4. Soil infiltration was confirmed in segments CB118A to CB114 and CB114 to MH112. The potential for soil infiltration in a segment from a blind connection downstream of CB120 to CB118A was detected as roots were observed intruding the SD line. PCBs, cadmium, and zinc were detected in SD solids at concentrations exceeding their respective screening levels in line N4. Mercury, copper, and lead were detected below their respective screening levels. Total HPAHs, BEHP, and dioxins/furans were not analyzed. One shallow soil sample was collected near CB118A and was analyzed for only PCBs. PCBs were non-detect, but the MDL exceeded the soil-to-sediment screening level. In addition, water was observed in segments of N4 (CB118A to CB114 and CB114 to MH112). Groundwater and SD base flow in this area has not been sampled.

In north lateral line, N5, soil and groundwater infiltration was observed in segments CB142B to CB141 and CB141 to MH133D, respectively. Concentrations of PCBs, mercury, cadmium, zinc, HPAHs, and dioxins/furans in SD solids were detected in exceedance of their respective screening levels. Lead was detected below the SQS screening level, and BEHP was not analyzed in SD solids samples collected at this location. Shallow soil samples collected near CB142B to MH133D indicated concentrations exceeding screening levels for the following COPCs: PCBs, mercury, and zinc. Cadmium and dioxins/furans were detected below their respective screening levels. Total HPAH was not analyzed in soil samples from this area. Groundwater and SD base flow samples have not been collected in the line N5 area.

In north lateral line, N7, groundwater infiltration was observed in the following segments: CB146 to UNKMH10, UNKCB23 to MH139, UNKMH9 to UNKCB23, MH139 to MH138. As stated above, N7 is generally submerged in groundwater during periods of high water-table elevation. Storm drain solids collected from at least one SD structure within these segments indicated concentrations of PCBs, cadmium, zinc, HPAHs, and dioxins/furans in exceedance of their respective screening levels. Mercury, copper, and lead were detected below their respective screening levels. BEHP was not analyzed in SD solids samples in this area. Groundwater samples collected near CB142C, a branch of N5, were analyzed for HPAHs and BEHP. The concentration of total HPAHs was non-detect; however, the MDL exceeded the Human Health Organisms (HHO) screening level. BEHP was detected at a concentration exceeding the HHO screening level by a factor of 10.

Groundwater infiltration was observed in one segment of line N10 (CB165 to a blind connection). The most recent storm drain solids sample collected from CB165 indicated concentrations of PCBs, mercury, cadmium, zinc, HPAHs, and dioxins/furans in exceedance of their respective screening levels. Copper and lead were detected below their respective screening levels. BEHP was not analyzed in the CB165 SD solids sample. Groundwater samples have not been collected in the N10 area.

In addition, 54 presumed inactive tap connections were observed to be unplugged or uncapped. Tap connections and areas where storm drain piping was identified as damaged during the August 2010 video inspection survey (Landau 2010f) are shown in Figure 5-33. Standing water was observed at multiple locations during the 2010 video inspection, although no signs of infiltrations were observed.

Following the August 2010 video inspection and discovery of compromised SD structures, Boeing replaced line segments between former CB184 downstream to CB165B and CB174A downstream to CB174 as these shallow segments were areas of potential soil infiltration. Concentrations of PCBs, mercury, cadmium lead, zinc, total HPAHs, and/or dioxins/furans in at least one SD solids sample from these structures were detected above their respective screening levels. Soil samples in these areas were not collected prior to replacement activities. Approximately 270 linear feet of SD line was replaced with 6- and 8-inch PVC (Landau 2010l). Former CB184 and CB184B were decommissioned and replaced with CB184C and CB184D in alternative locations for better drainage. Catch basin CB174B was installed in the area of CB174 and CB174A for additional drainage. In addition, soil was excavated from trench lines and in the area of former CB184 and former CB184B.

5.5.2 North-Central Lateral Drainage Area

The maximum depth of both SD structures and lines in this drainage area is 12 feet bgs at the downstream end, and the main lateral is submerged by groundwater upstream nearly to MH226. A tributary above MH363A is submerged upstream only to MH220, and four OWSs and associated lines are also submerged.

In September and October 2010, Boeing conducted a video inspection of the SD system in the north-central drainage area after jet cleaning of SD lines. Data containing results of the cleaning and video inspection of segments of lines NC1, NC2, NC3, and NC5 were lost due to a hard-drive malfunction. Based on remaining data, signs of soil infiltration were confirmed in line NC3 (VAULT258 to MH249). The severity of intruding soil and a change in pipe size resulted in the abandonment of the video inspection at this location. PCBs and zinc were detected in SD solids in this area at concentrations above their respective screening levels. Soil samples have not been collected in this area. Groundwater is not of concern as NC3 is not submerged at this location.

In addition, five line segments indicated cracks, fractures, or separated joints but showed no signs of infiltration. Seven tap connections were observed not plugged or capped. Standing water was observed at multiple locations during the 2010 video inspection, although no signs of infiltrations were observed. Little is known about soil and groundwater conditions in this area; therefore, it is difficult to determine the extent, if any, that stormwater is impacted by infiltration.

5.5.3 South-Central Lateral Drainage Area

The maximum depth of both SD structures and lines in this drainage area is more than 14 feet bgs near the downstream end, where the system is submerged by groundwater. The main lateral is entirely submerged by groundwater to a point upstream of the NBF-KCIA property boundary, with a minimum line depth of 8.4 feet bgs. One tributary upstream of MH461 is submerged upstream to beyond MH467. Another tributary upstream of MH477 is submerged to beyond MH479; OWS472A and associated lines are also submerged.

During the 2010 video inspection of the south-central drainage area, 9 of the 17 line segments inspected indicated signs of soil and/or groundwater infiltration; all were located in the main line, which is entirely submerged in groundwater as stated above. The majority of the main line, SC1, indicated signs of infiltration. Lines segments in SC1 that did not indicate signs of infiltration include those upgradient of MH461, MH414 to MH413, and MH360 to the Lift Station. PCBs, cadmium, copper, zinc, and BEHP were detected above their respective screening levels in samples of SD solids collected along SC1. One groundwater sample collected near a compromised line segment near Building 3-369 had a concentration of mercury exceeding its WQS screening level by a factor of 100.

In addition, four tap connections were observed not plugged or capped. Standing water was observed at multiple locations during the 2010 video inspection, although no signs of infiltrations were observed. Little is known about soil and groundwater conditions in the south-central lateral drainage area as data collected are limited; therefore it is difficult to determine the extent, if any, stormwater is impacted by infiltration.

5.5.4 South Lateral Drainage Area

The maximum depth of both SD structures and lines in this drainage area is 14.4 feet bgs near the downstream end, where the system is submerged by groundwater. The main lateral SD line is entirely submerged by groundwater upstream to OWS483 near the NBF-KCIA property boundary, with a minimum depth along the SD line of 7.3 feet bgs. The SW-NE diagonal line has an unknown depth, but it likely becomes deeper toward the southwest and probably is submerged. The SD line under the middle of Building 3-390 is deep and submerged at its western end and is likely submerged all or much of the distance under the building. From its western end, two branches of this SD line are submerged, and the branch that passes through OWS1-C is submerged and reaches a depth of 12.5 to 14 feet bgs.

Eight line segments inspected during the 2010 video inspection indicated signs of soil or groundwater infiltration (Landau 2011b). Two of these eight segments (MH482 to MH481 and MH281 to MH353) are located in the main line, S1. PCBs and zinc were detected above screening levels in SD solids collected in these areas. In addition, HPAHs and BEHP were detected above screening levels in SD solids collected from MH482. Copper, zinc, and BEHP were detected in groundwater samples at concentrations exceeding screening levels in near segment MH281 to MH353. All metals were detected in groundwater samples collected near segment MH482 to MH481. Soil samples have not been collected in this area.

Concentrations of PCBs, cadmium, copper, and/or zinc were detected above their respective screening levels in compromised segments in S8 (MH1314 to UNKMH3) and the S8 branch area (CB503 to MH501). Soil samples have not been collected in this area.

Samples of SD solids, groundwater, or soil have not been collected near damaged segments in S2 (MH378 to MH353) and the S3 branch area (IN327 to IN326 and UNK3 to CB324).

In addition, cracks, fractures, or separations were identified in approximately a third of the line segments inspected in the south lateral drainage area. Twenty-six tap connections were observed not plugged or capped. In some areas where the SD system has been compromised, the system is submerged in groundwater as shown in Figure 5-33. Standing water was observed at multiple locations during the 2010 video inspection, although no signs of infiltrations were observed. Groundwater, soil, and SD solids sample data are limited in the south lateral drainage area; therefore, it is difficult to assess the degree to which COPCs in soil and groundwater are infiltrating the NBF SD system.

5.5.5 Building 3-380 Drainage Area

The maximum depth of both SD structures and lines in the Building 3-380 drainage area is 12 feet bgs at the downstream end. Submergence of the SD lines extends upstream as far as MH105, including a short branch between CB423A and Building 3-380.

The 2010 video inspection of SD structures in the Building 3-380 drainage area confirmed that one SD line segment, CB109C to CB107A, presented minor cracks (Landau 2011b). This segment is shallow and is not submerged in groundwater during periods of high water-table elevation; therefore, this segment is not subject to potential groundwater infiltration. Standing water was observed at only two locations, though all SD lines and structures were observed to be free of visible signs of infiltration.

5.5.6 Parking Lot Drainage Area

The maximum depth of SD components in the parking lot drainage area is 18.2 feet bgs in the OWS at the lift station (Table 5-5). The floor of the lift station OWS likely is submerged (on the outside) by approximately 9 feet of groundwater during high water stage, although the lift station discharge point is above the high water level. At higher tidal levels, the water table in the vicinity of Slip 4 is likely influenced and may rise significantly, possibly submerging this SD discharge line through much of its length (in addition to tidal flooding inside the SD line).

SD structures and lines in the parking lot area near Building 3-370 and the tributary in the Building 7-27-1 area are quite shallow and cannot be submerged by groundwater. Therefore, most of this drainage area is not submerged and not subject to potential infiltration.

A video inspection of SD structures in the parking lot area conducted in August and September 2010 reported cracks or fractures in the SD lines from PL1 (the end of the line segment to D436A) and from PL3 (the end of the line segment to D435B) (Figure 5-33c). Intruding roots were observed in the line segment from PL1 (D283A to D436A). Although line segments leading to D435B and D436A are not subject to potential groundwater infiltration as discussed above, data are not available to discount the potential for the infiltration of soil at the line segment from D283A to D436A. Concentrations of COPCs in SD solids collected from D436A exceed the lower screening levels for PCBs, cadmium, lead, and zinc; total HPAH, BEHP, and dioxins/furans have not been analyzed. Mercury and copper were detected below their respective screening levels.

5.6 Action Items and Sampling Recommendations

- It is recommended that Boeing move forward with a request by Ecology to conduct an excavation of PCB impacted soils along the NBF-GTSP fence line. A subsurface investigation was conducted to determine the horizontal and vertical extents of the planned excavation. It was determined that PCB impacted soils were close to and deeper than active subsurface utilities. Boeing proposes to complete the excavation during the summer of 2011, so that utilities may be re-routed and to avoid the difficulties of a rainy season excavation.
- It is recommended that Boeing move forward with the planned excavation of PCB-impacted soil in the area northwest of Building 3-335 and west of Building 3-333.
- It is recommended that Boeing conduct further investigations of PCB-impacted soil in the area immediately southeast of Building 3-335 to determine if excavation is necessary, as limited soil sampling results are inconclusive.
- It is recommended that Boeing conduct further soil investigations in the area immediately north of the north portion of Building 3-333 to determine if PCB-impacted soils remain after a partial soil removal took place without full confirmational sampling.

- Areas of the SD system that are potentially submerged and in which significant problems were reported during the 2007, 2008, and 2010 video inspections (Figures 5-31, 5-32, and 5-33) should be repaired and/or replaced as soon as possible.
- Areas of the SD system that may not be submerged and show signs of soil infiltration as reported in the 2010 video inspection should be repaired and/or replaced as soon as possible.
- Areas of the SD system that were constructed of absorbent materials such as wood or clay should be replaced as soon as possible.
- Limited sampling data are available for SD solids, SD base flow, groundwater, and soil in many areas of compromised SD structures. As such, additional investigations are recommended for the following drainage areas where signs of infiltration were observed: north lateral (N4, N5, N7, N10, and N11), north-central lateral (NC3), south-central lateral (SC1), south lateral (S1, S2, S3 branches, S8, and S8 branches), and the parking lot area (PL1).
- Additional SD line video inspections should be conducted in the north-central drainage area where 2010 video inspection data were lost due to a hard-drive malfunction (NC1, NC2, NC3, and NC5).
- An evaluation should be made to attempt to trace the source of the numerous tap connections identified in the video surveys.
- Additional groundwater measurements throughout the Site are necessary to assist in this evaluation (data may be sufficient to assist in this evaluation, but have not been made available to Ecology/SAIC for recent years of measurements).
- To further identify the potential for infiltration at the Site, particularly in the north lateral drainage area, additional focused groundwater sampling is needed near or upgradient from those SD line locations identified as being submerged during at least high-water conditions.
- Also, a data gap identified in this assessment is the lack of detailed information (depths, elevations, structure types) regarding the SD components that have been replaced in the last few years.

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North Boeing Field/ Georgetown Steam Plant Site Remedial Investigation/Feasibility Study

Assessment of Infiltration and Inflow to North Boeing Field Storm Drain System

VOLUME II

FIGURES

Prepared for

DEPARTMENT OF ECOLOGY
State of Washington

Toxics Cleanup Program
Northwest Regional Office
Washington State Department of Ecology
Bellevue, Washington

Prepared by

SAIC
From Science to Solutions

Science Applications International Corporation
18912 North Creek Parkway, Suite 101
Bothell, Washington 98011

February 2011

Figures

Figures (continued)

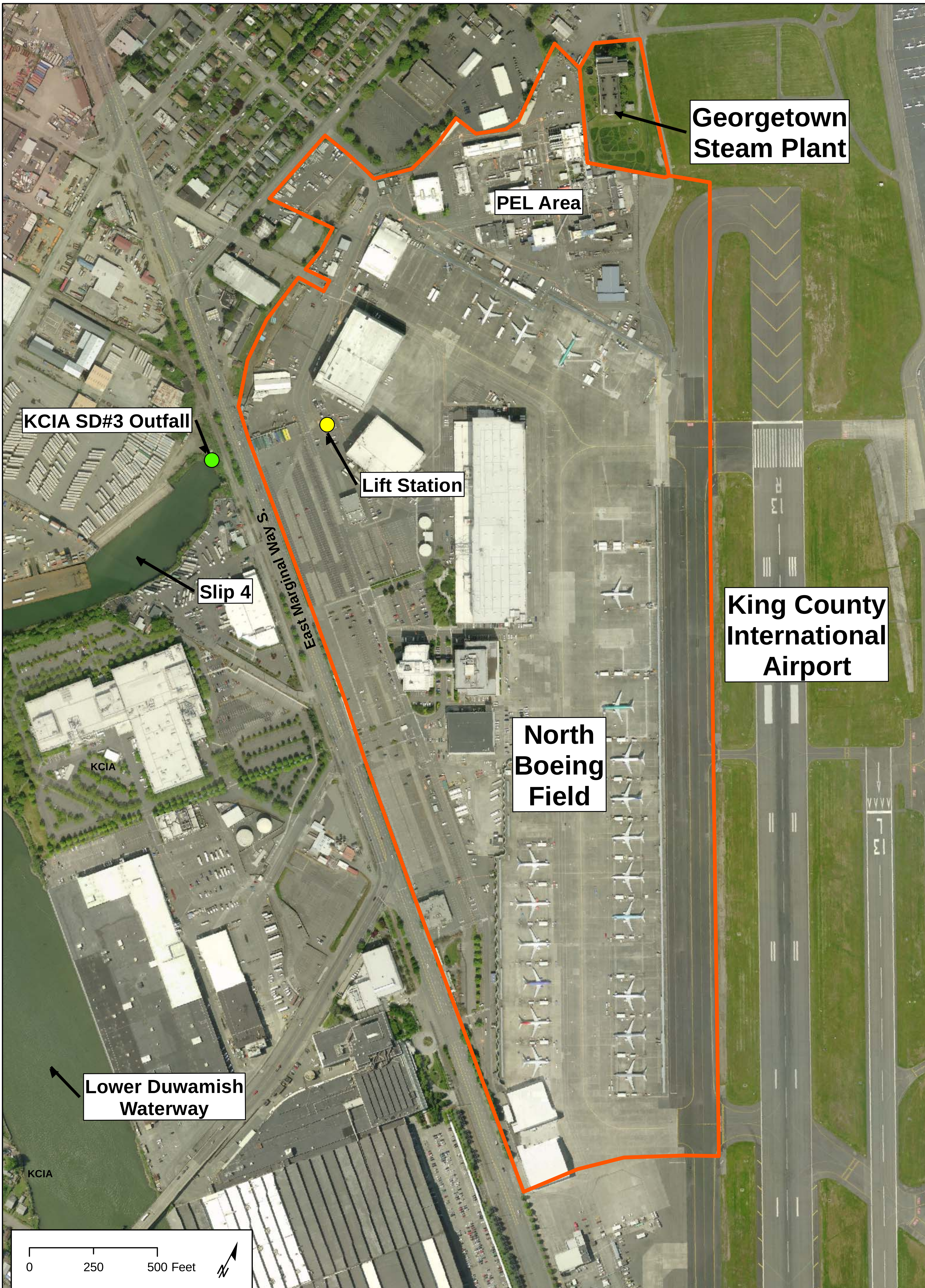

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Figure 1-1. NBF-GTSP Site and Vicinity

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 1-01_NBF_Site_Map.mxd
Illustrative purposes only.

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Figure 2-1. NBF-GTSP and KCIA Drainage Areas

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Figure 2-2. SD System Overview at NBF-GTSP Site

Coordinate System:
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Prepared By: apw
File: 2-02_SD_System_overview.mxd
Illustrative purposes only.

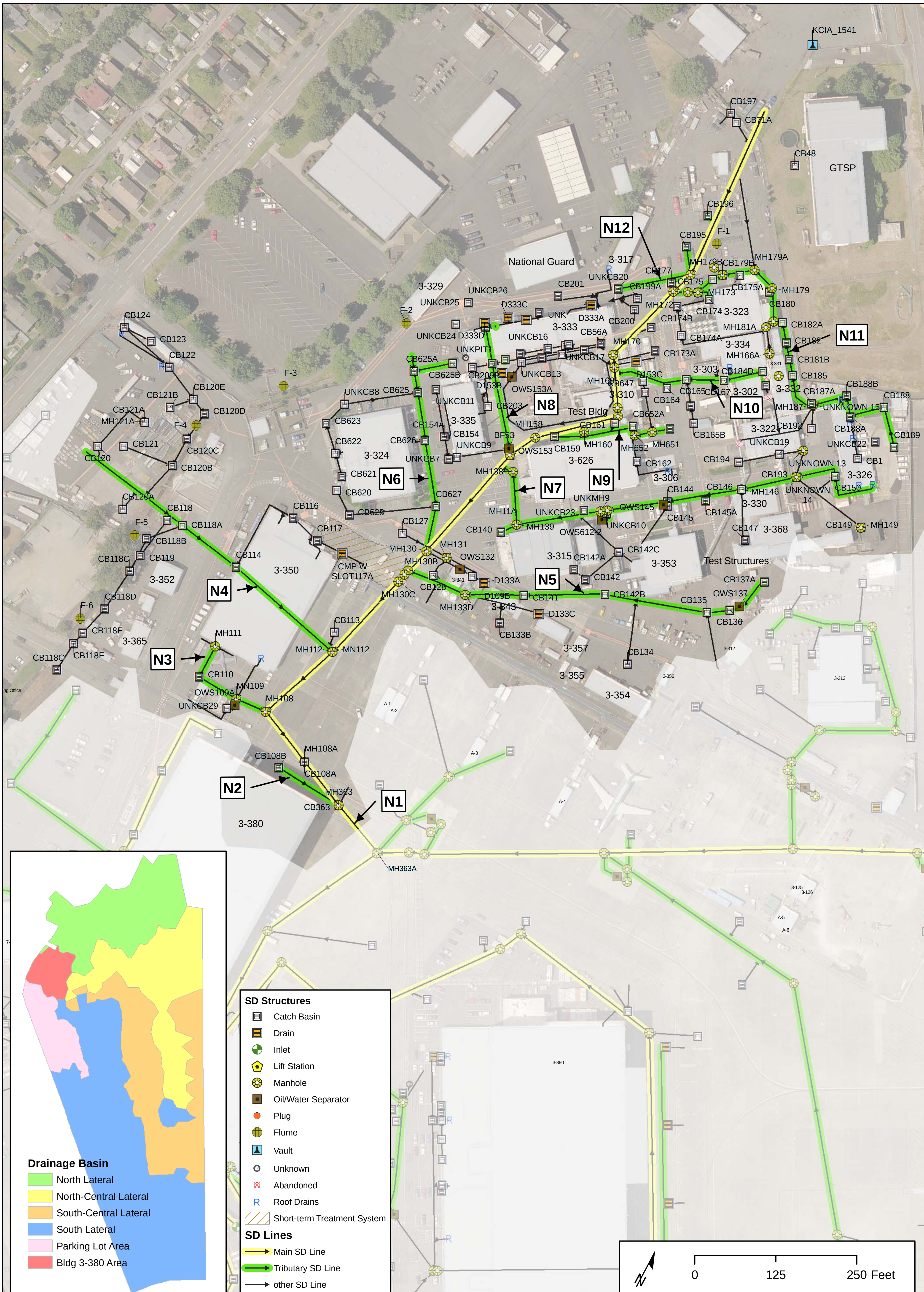

Figure 2-3. North Lateral SD Line at NBF-GTSP Site

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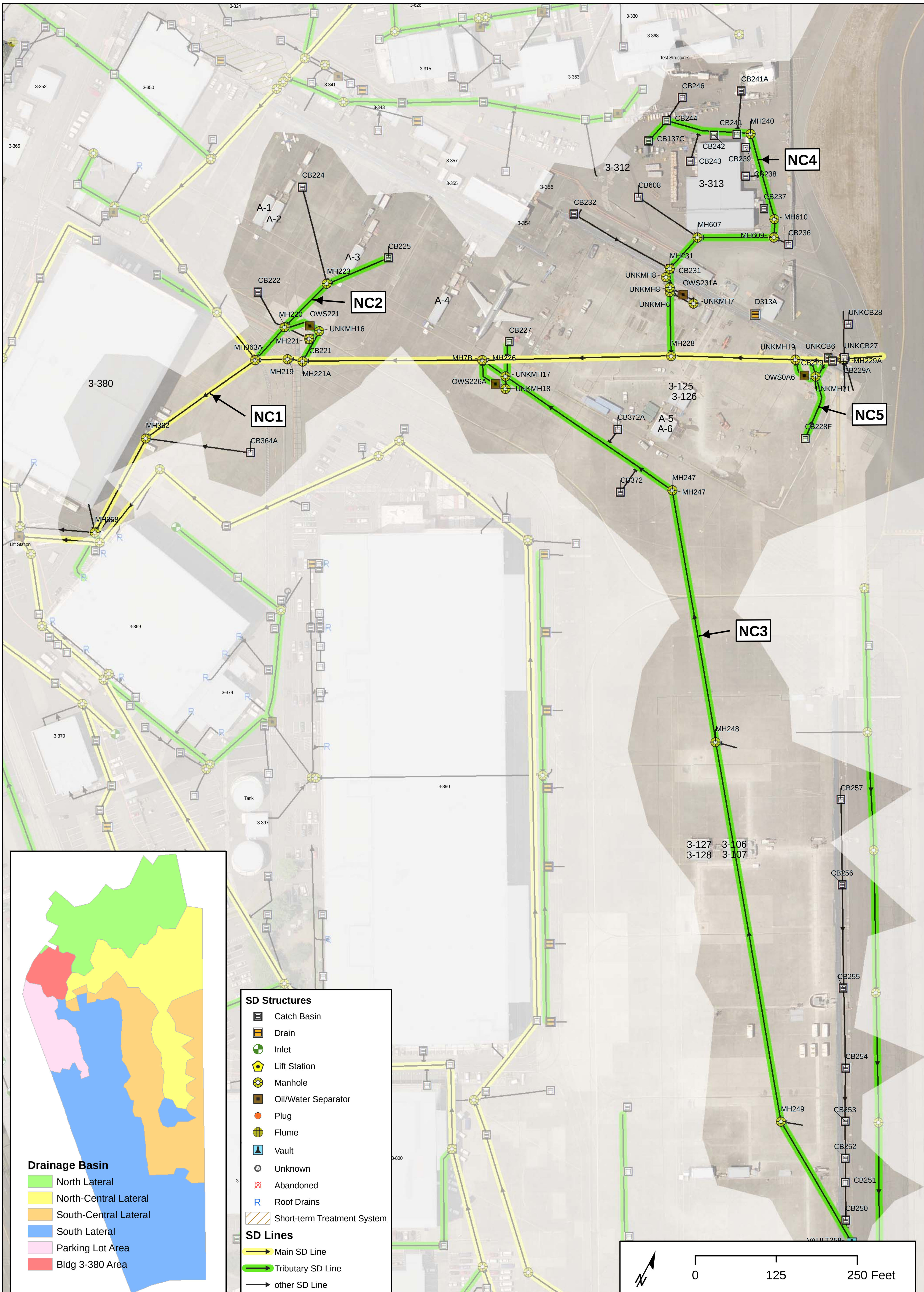

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Figure 2-4. North-Central Lateral SD Line at NBF-GTSP Site

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Prepared By: apw
File: 2-02_SD_System_overview.mxd
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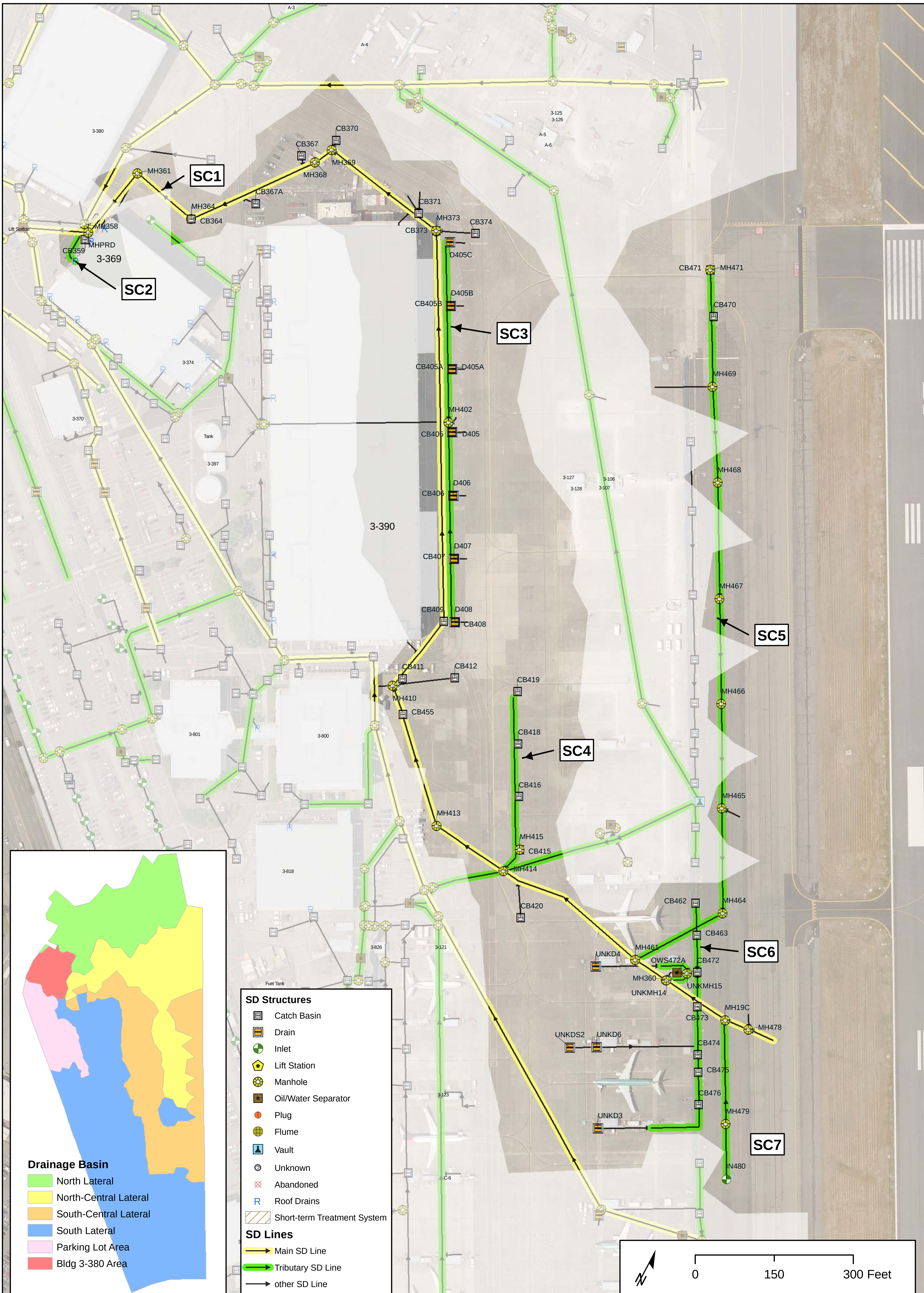

Figure 2-5. South-Central Lateral SD Line at NBF-GTSP Site

Coordinate System:
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Prepared By: apw
File: 2-02_SD_System_overview.mxd
Illustrative purposes only.

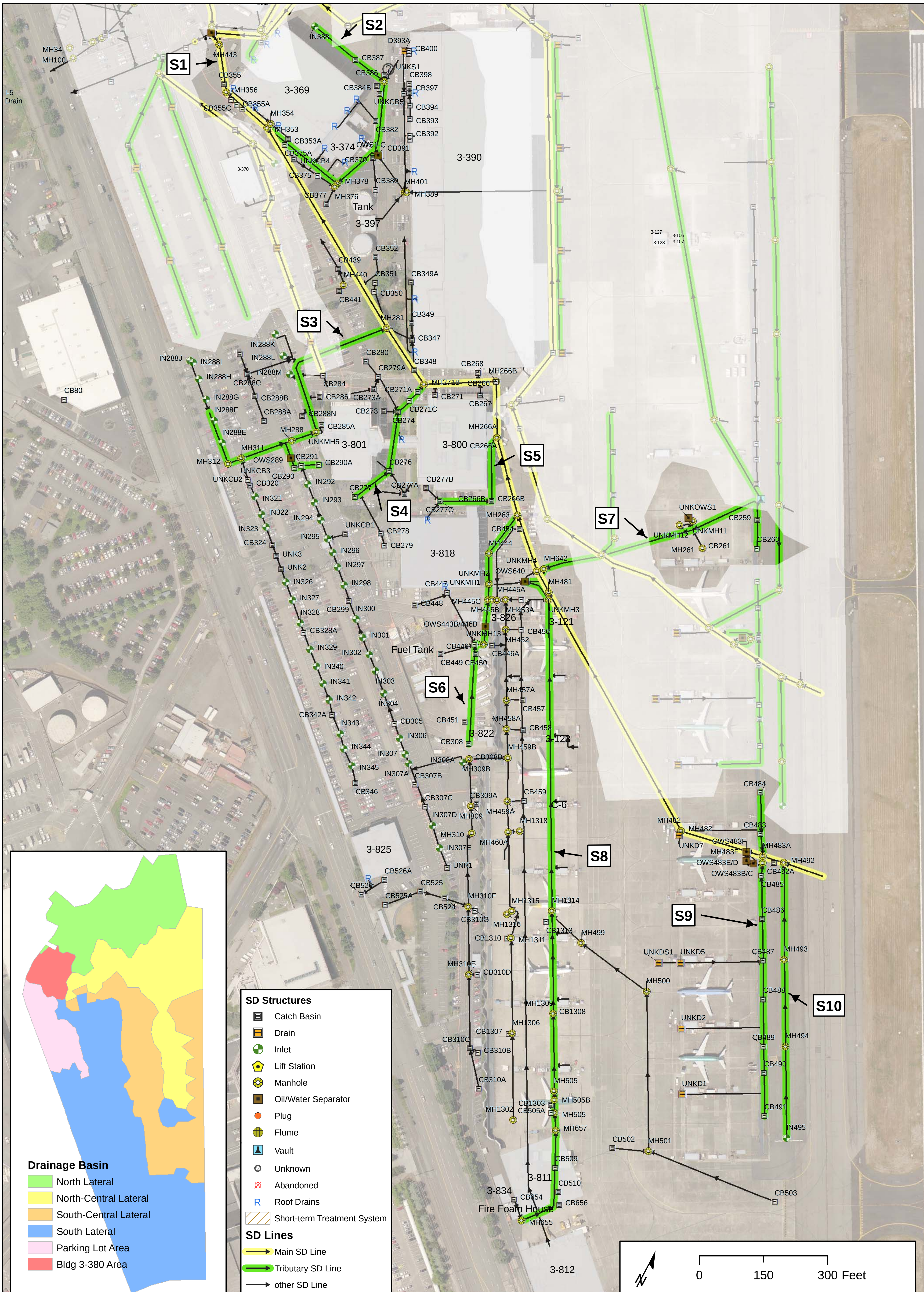

Figure 2-6. South Lateral SD Line at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 2-02_SD_System_overview.mxd
Illustrative purposes only.

Figure 2-7. Building 3-380 Area SD Line at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 2-02_SD_System_overview.mxd
Illustrative purposes only.

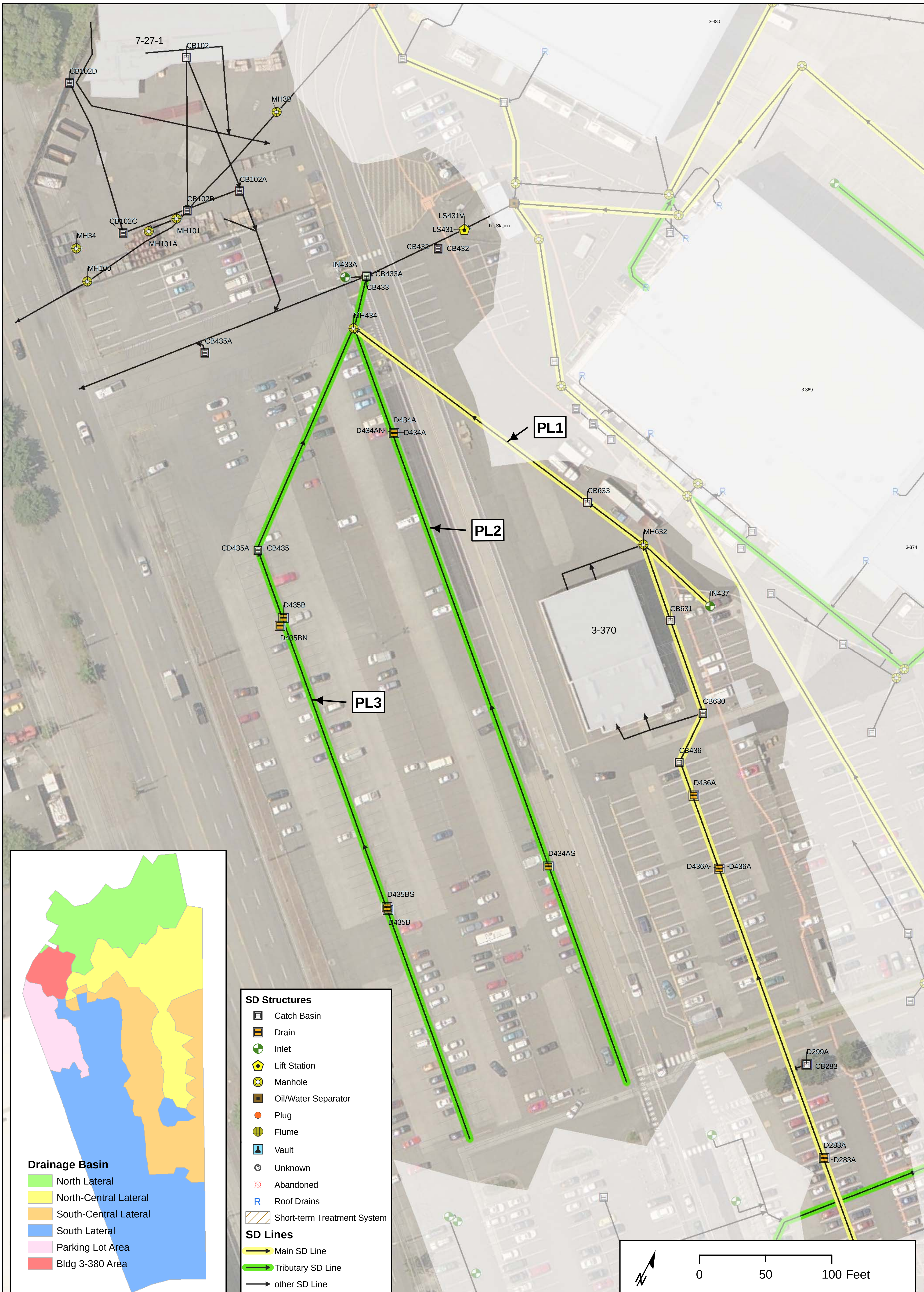

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Figure 2-8. Parking Lot Area SD Line at NBF-GTSP Site

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Prepared By: apw
File: 2-02_SD_System_overview.mxd
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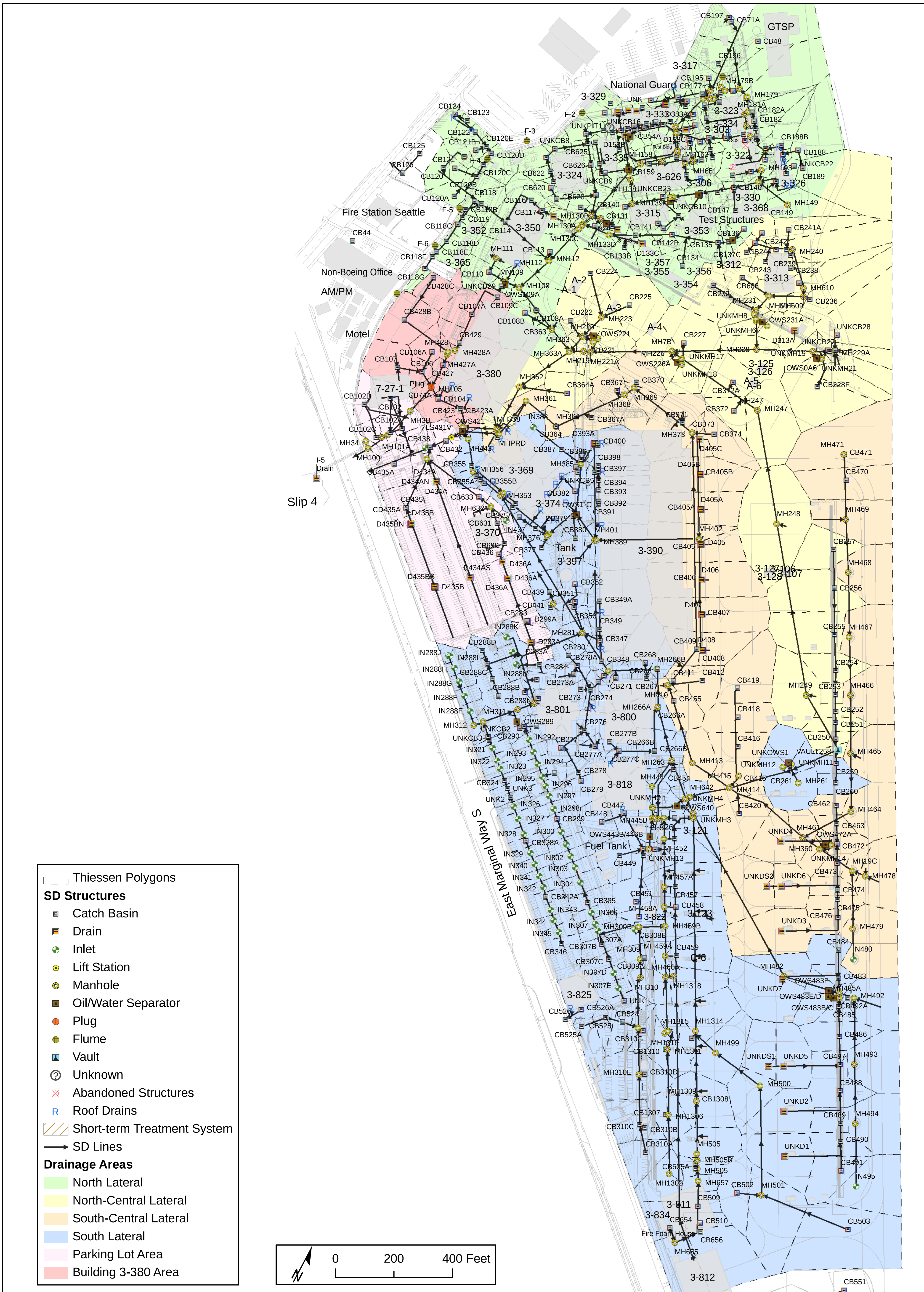

Figure 2-9. NBF SD System Overview and Thiessen Polygon Boundaries

Coordinate System:
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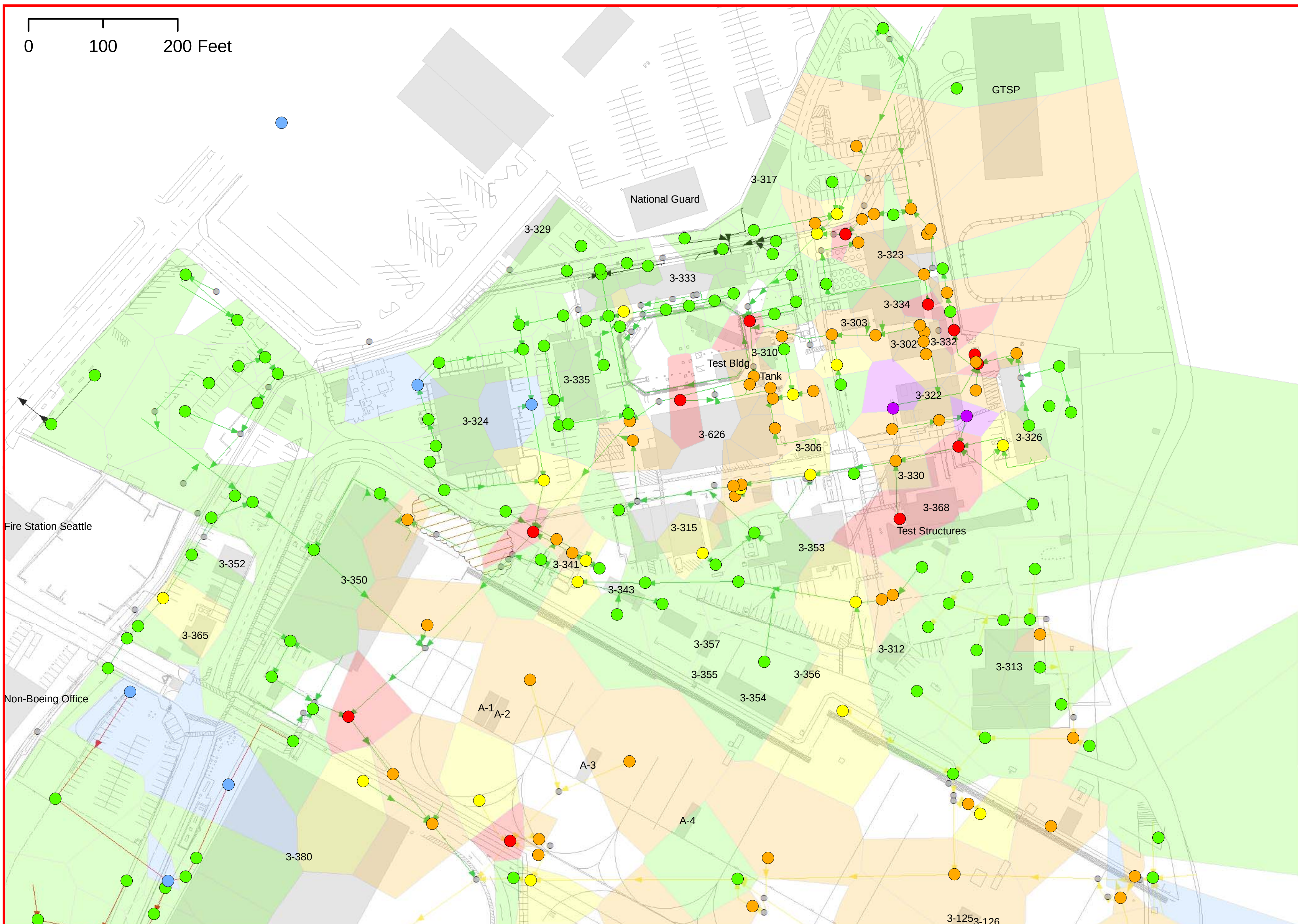
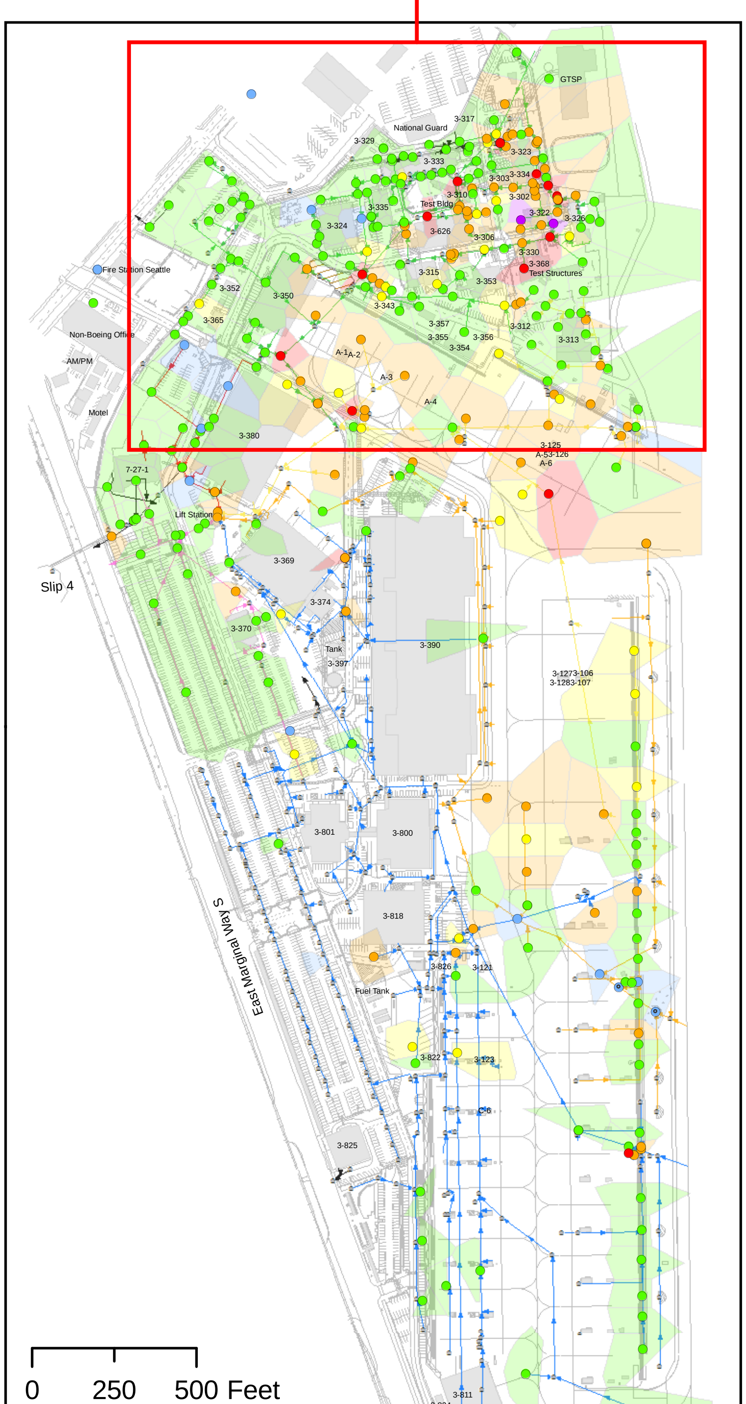
Prepared By: apw
File: 2-09_SD_System_Overview_Thiessen-PORTRAIT.mxd
Illustrative purposes only

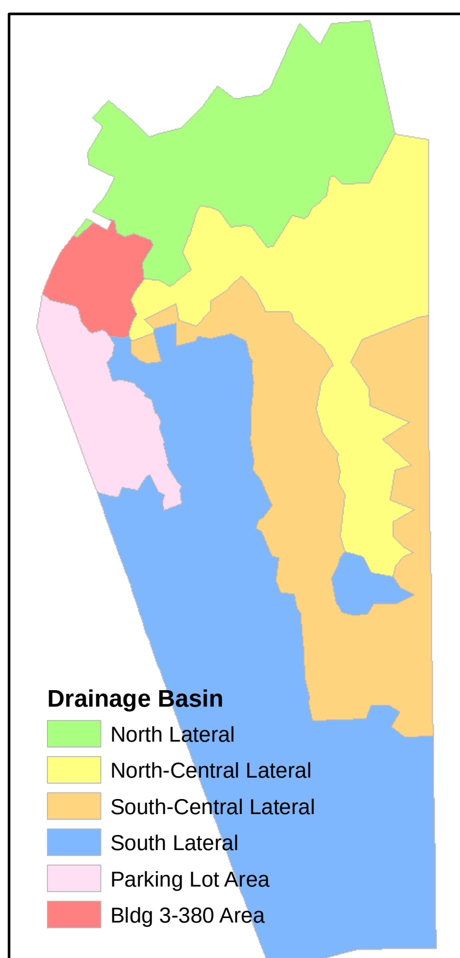




Total PCBs

SD Solids (mg/kg DW)
- 0 - 0.13
- >0.13 - 1.0
- >1.0 - 1.3
- >1.3 - 13
- >13 - 130
- >130 - 180
- non-detects

SD Solids (mg/kg DW)
- 0 - 0.13
- >0.13 - 1.0
- >1.0 - 1.3
- >1.3 - 13
- >13 - 130
- >130 - 180
- non-detect



Screening Levels: (mg/kg DW)
SD Solids:
LAET = 0.13
2LAET = 1.0

Most recent result at each location shown as of June 2010

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 2-10_PCB_SD-SOLIDS-PORTRAIT.mxd
Illustrative purposes only.

SD Structures
Structure Abandoned
Short-term Treatment System

SD Lines
North Lateral
North-Central Lateral
South-Central Lateral
South Lateral
Building 3-380 Area
Parking Lot Area
Other

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Figure 2-10. Total PCBs in SD Solids at NBF-GTSP Site

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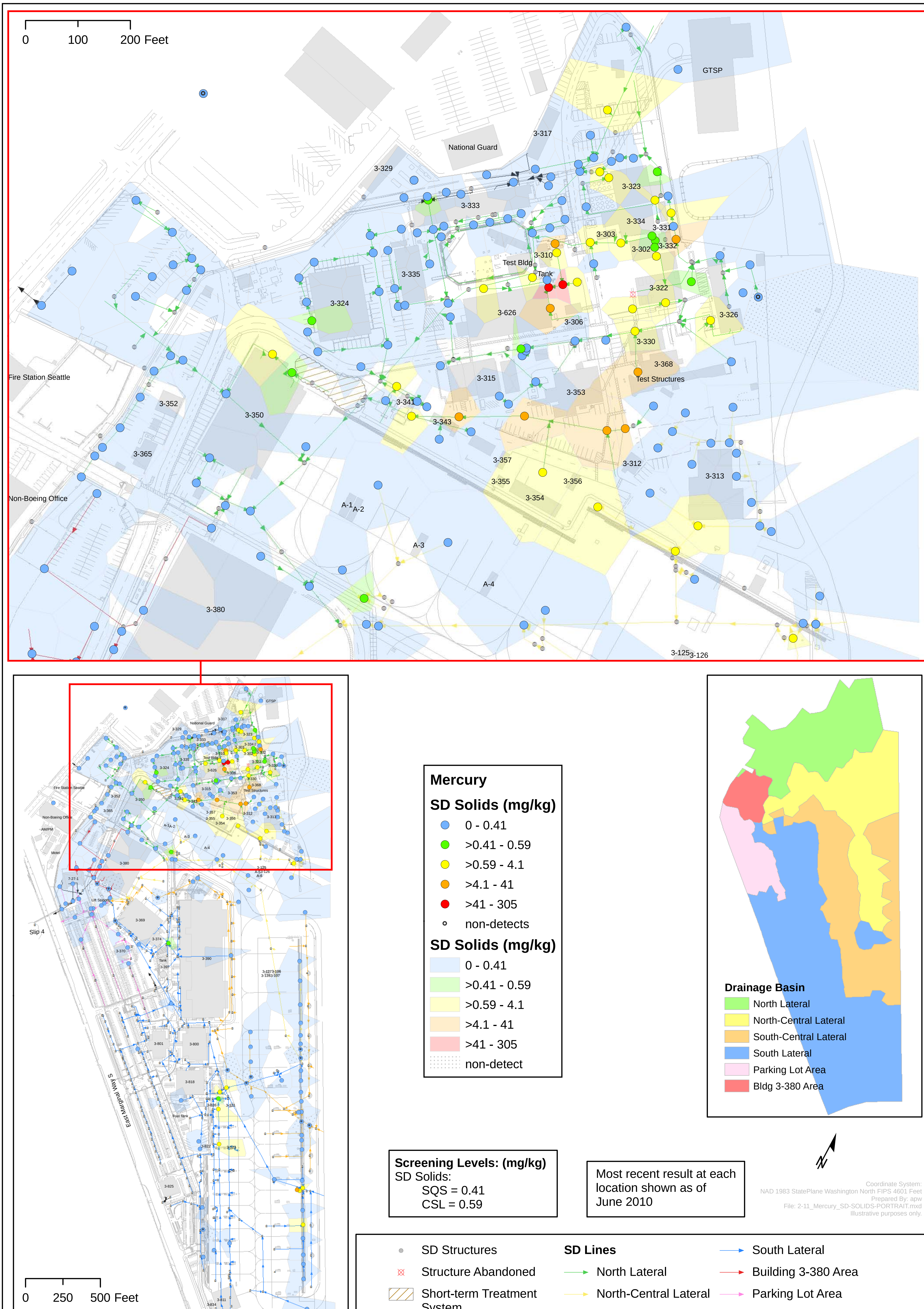

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Figure 2-11. Mercury in SD Solids at NBF-GTSP Site

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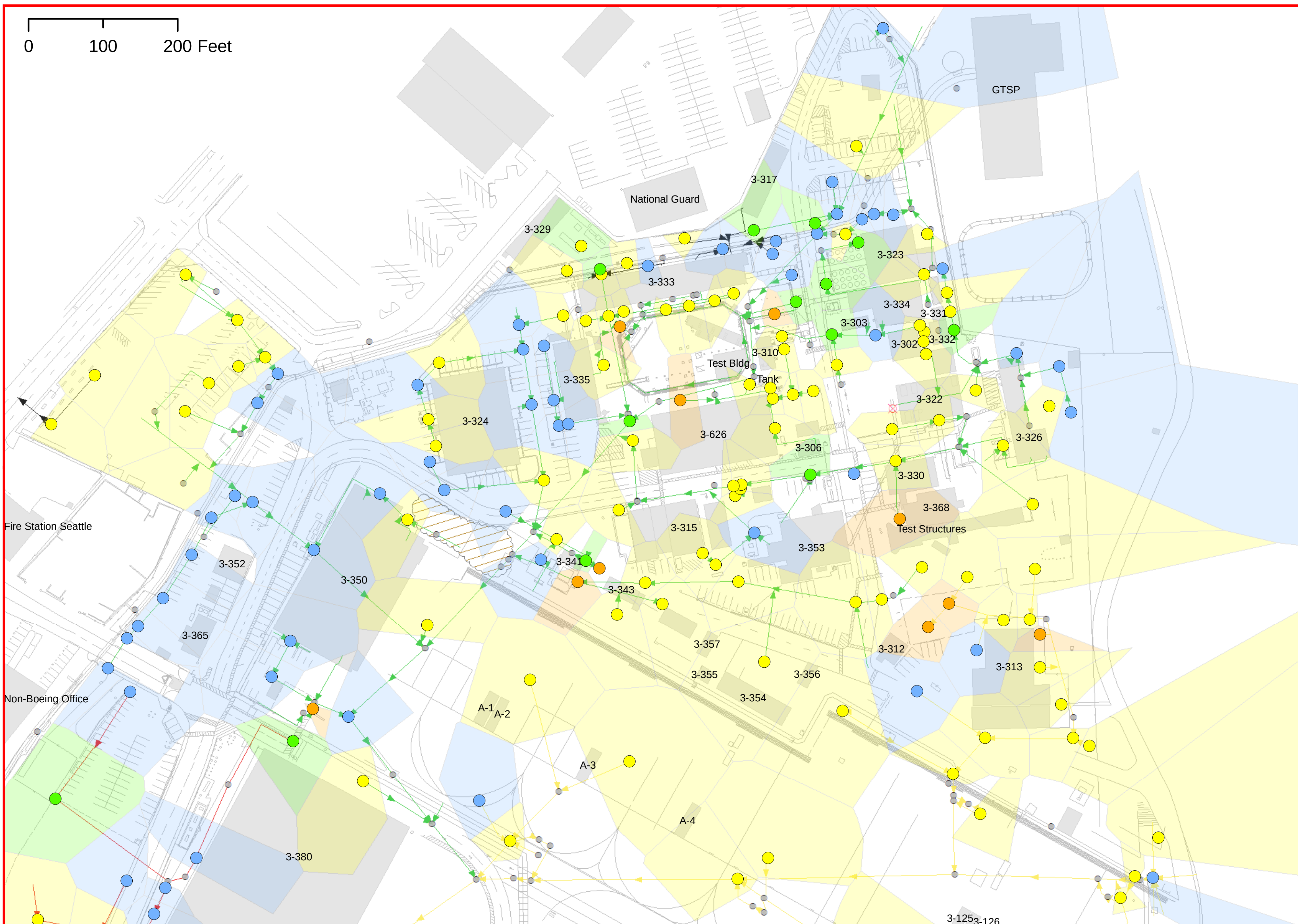

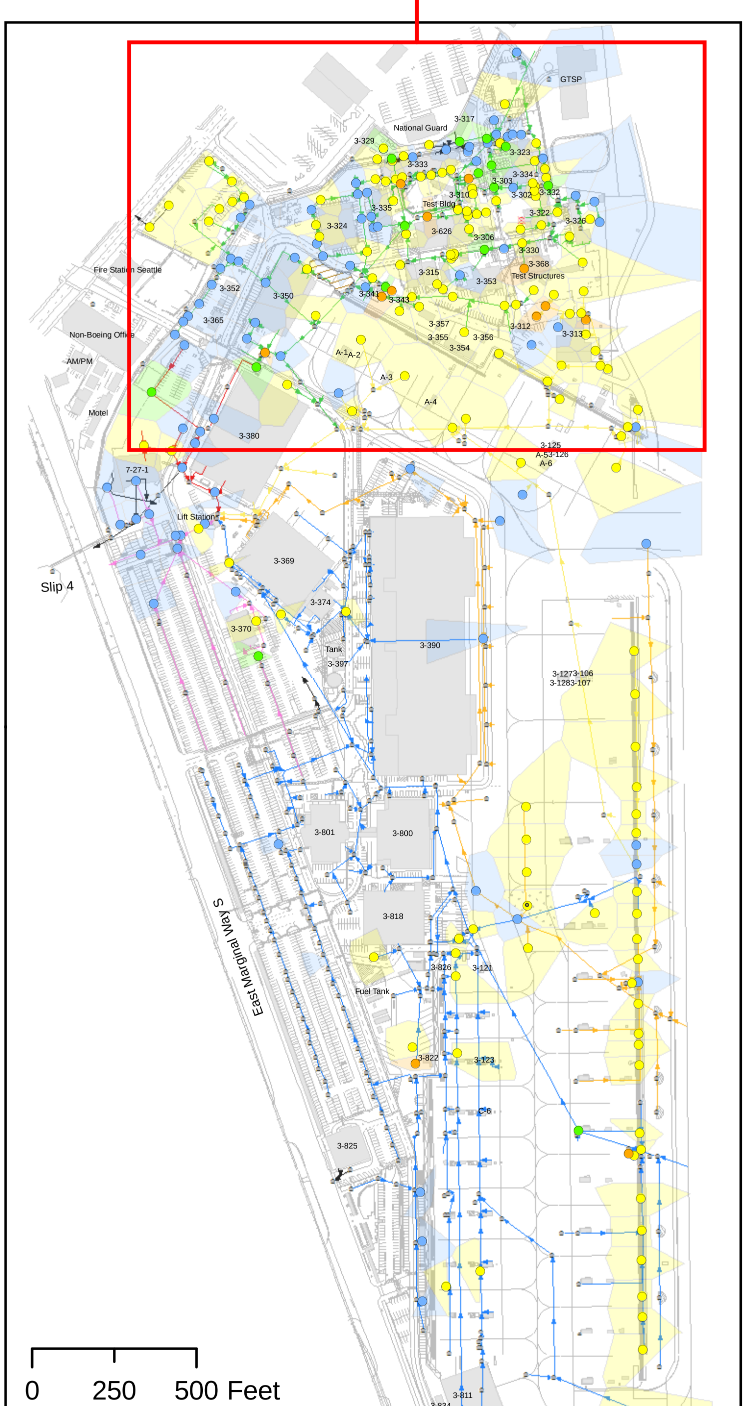

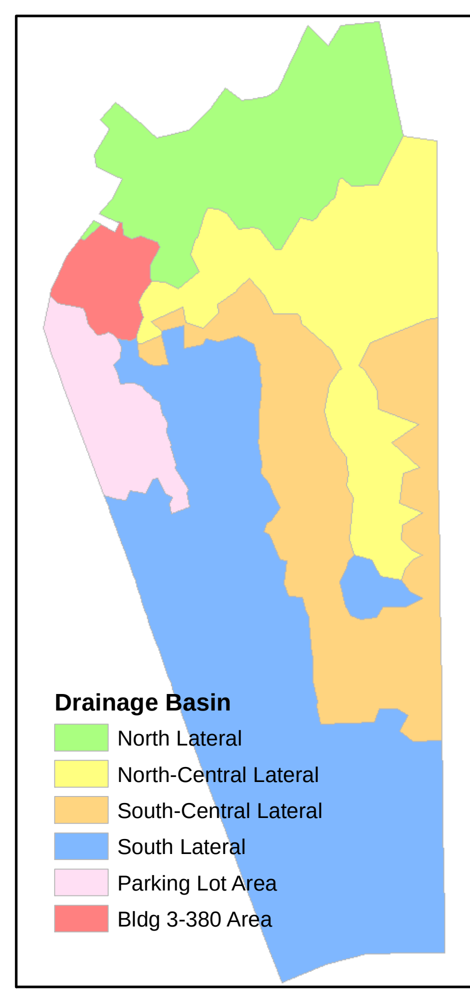

Cadmium

SD Solids (mg/kg)

- 0 - 5.1
- >5.1 - 6.7
- >6.7 - 51
- >51 - 510
- >510 - 5,100
- non-detects

SD Solids (mg/kg)

- 0 - 5.1
- >5.1 - 6.7
- >6.7 - 51
- >51 - 510
- >510 - 5,100
- non-detect

Screening Levels: (mg/kg)
SD Solids:
SQS = 5.1
CSL = 6.7

Most recent result at each location shown as of June 2010

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 2-12_Cadmium_SD-SOLIDS-PORTRAIT.mxd
Illustrative purposes only.

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 2-12. Cadmium in SD Solids at NBF-GTSP Site

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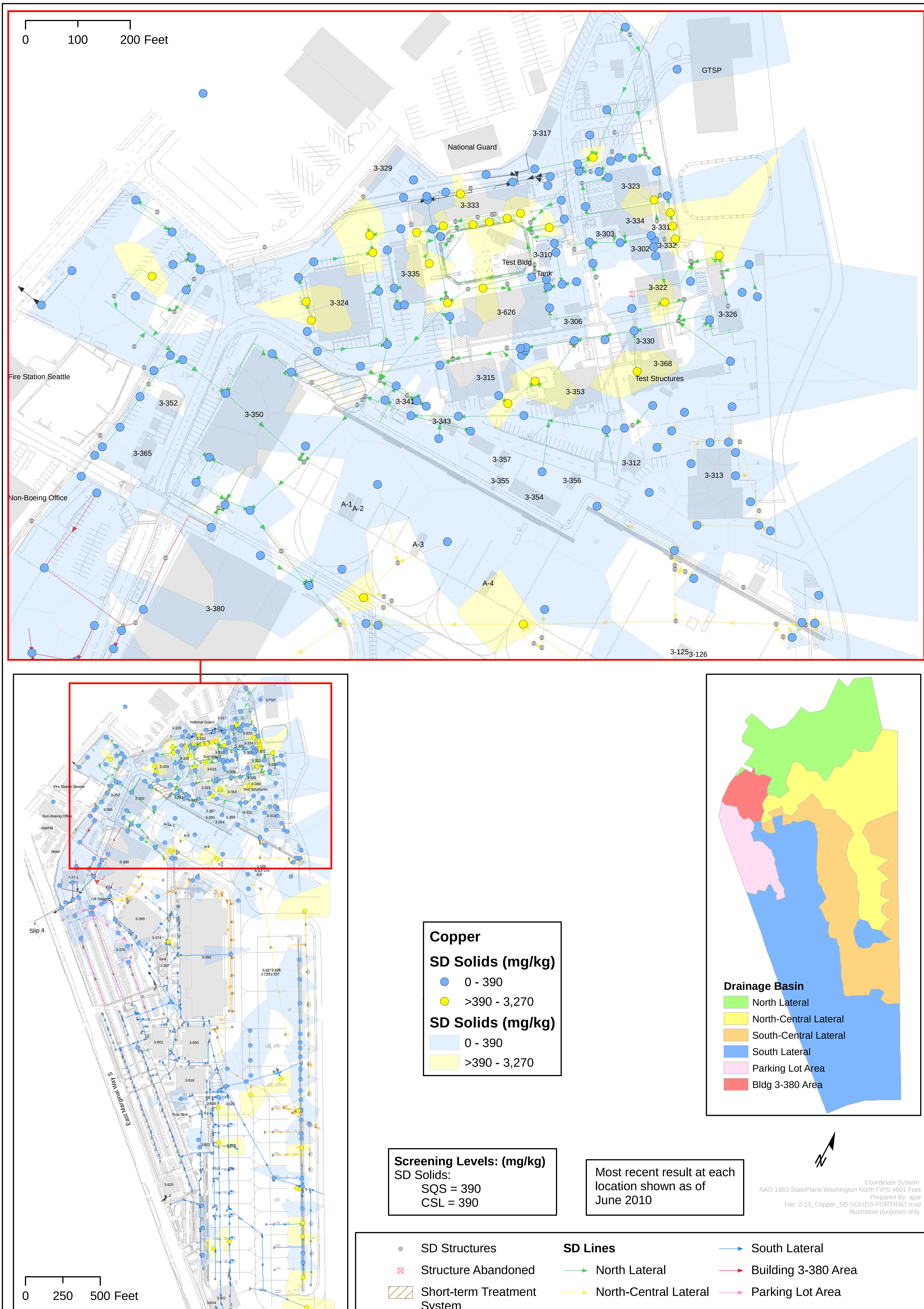

Figure 2-13. Copper in SD Solids at NBF-GTSP Site

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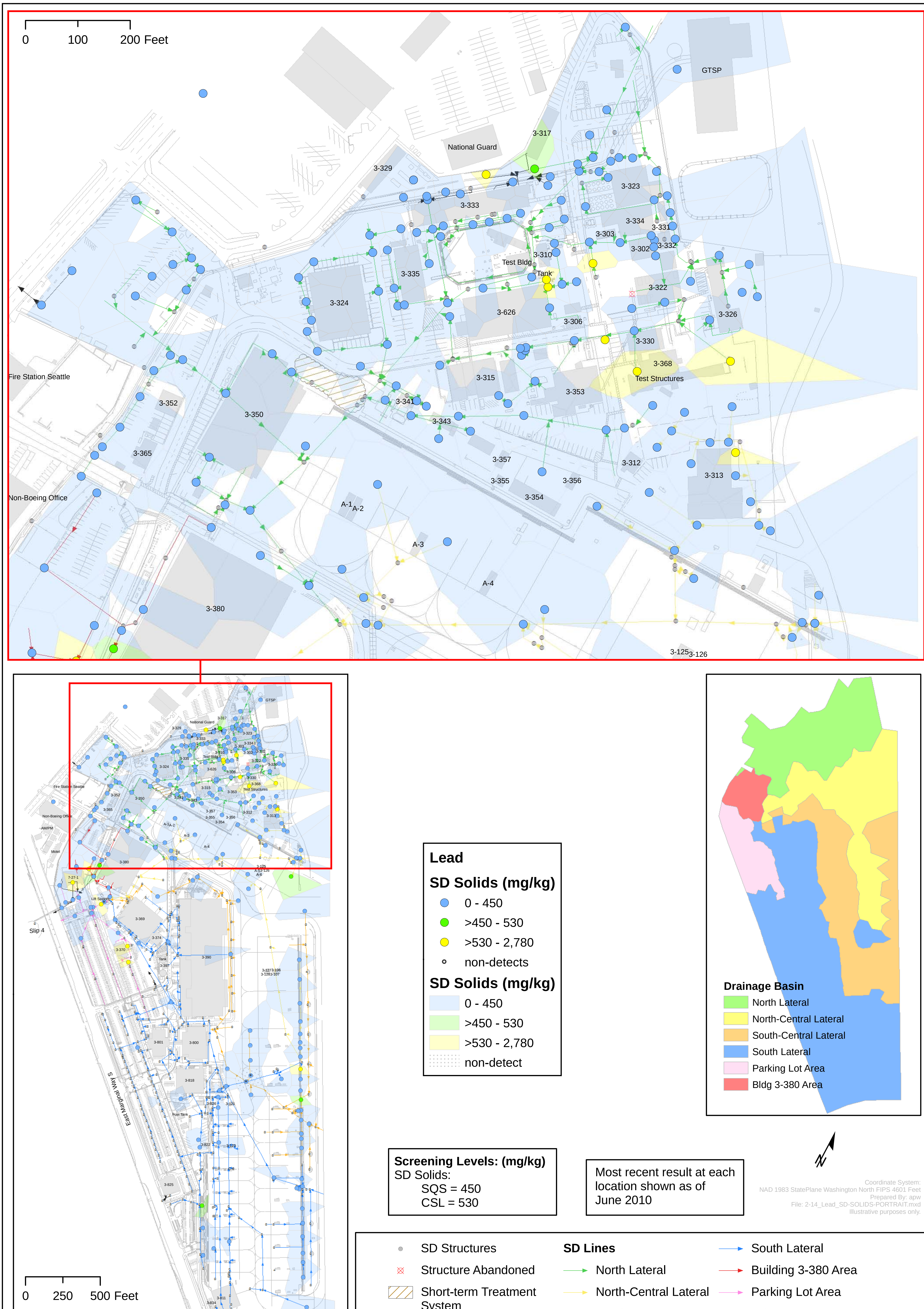

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Figure 2-14. Lead in SD Solids at NBF-GTSP Site

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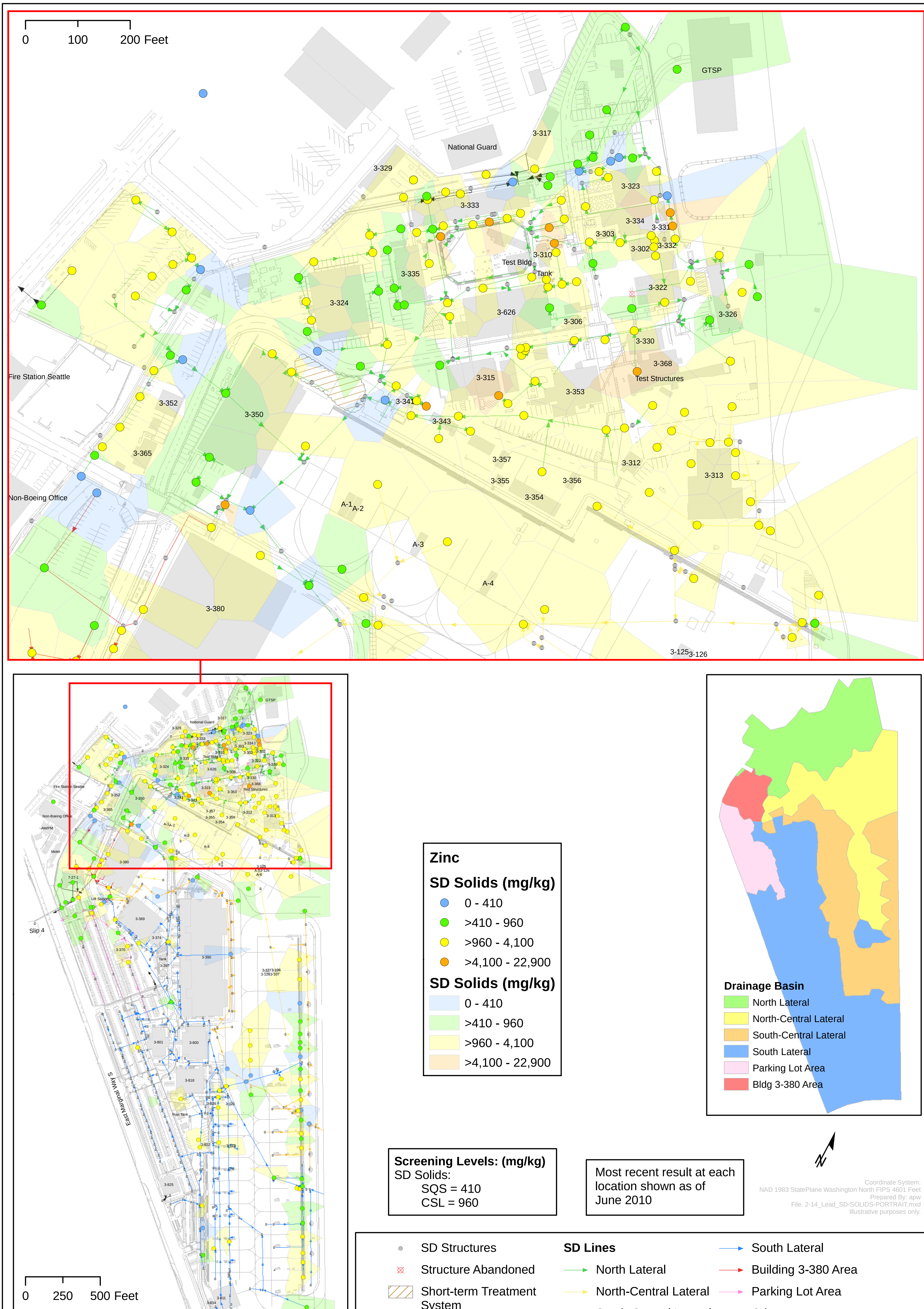
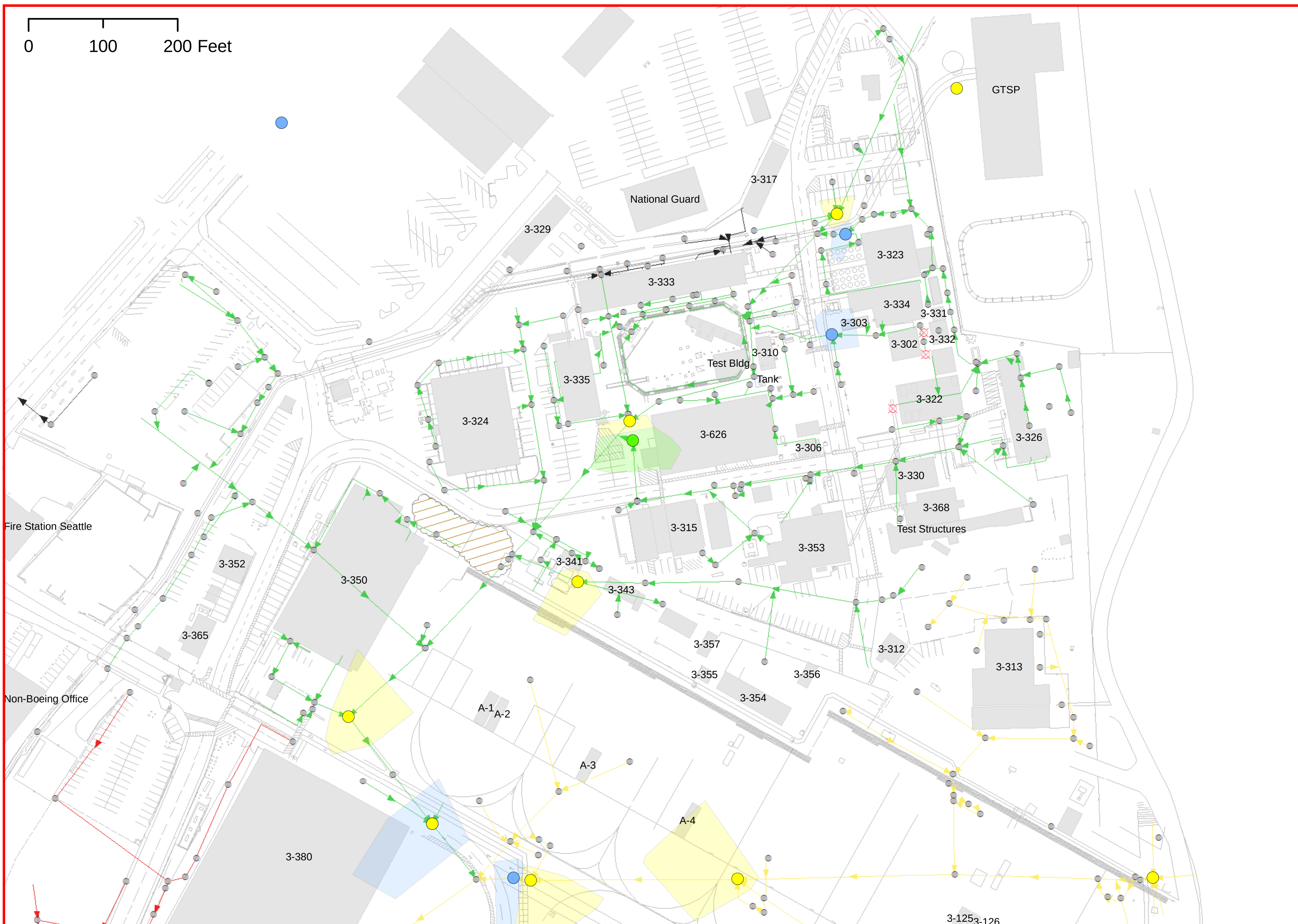
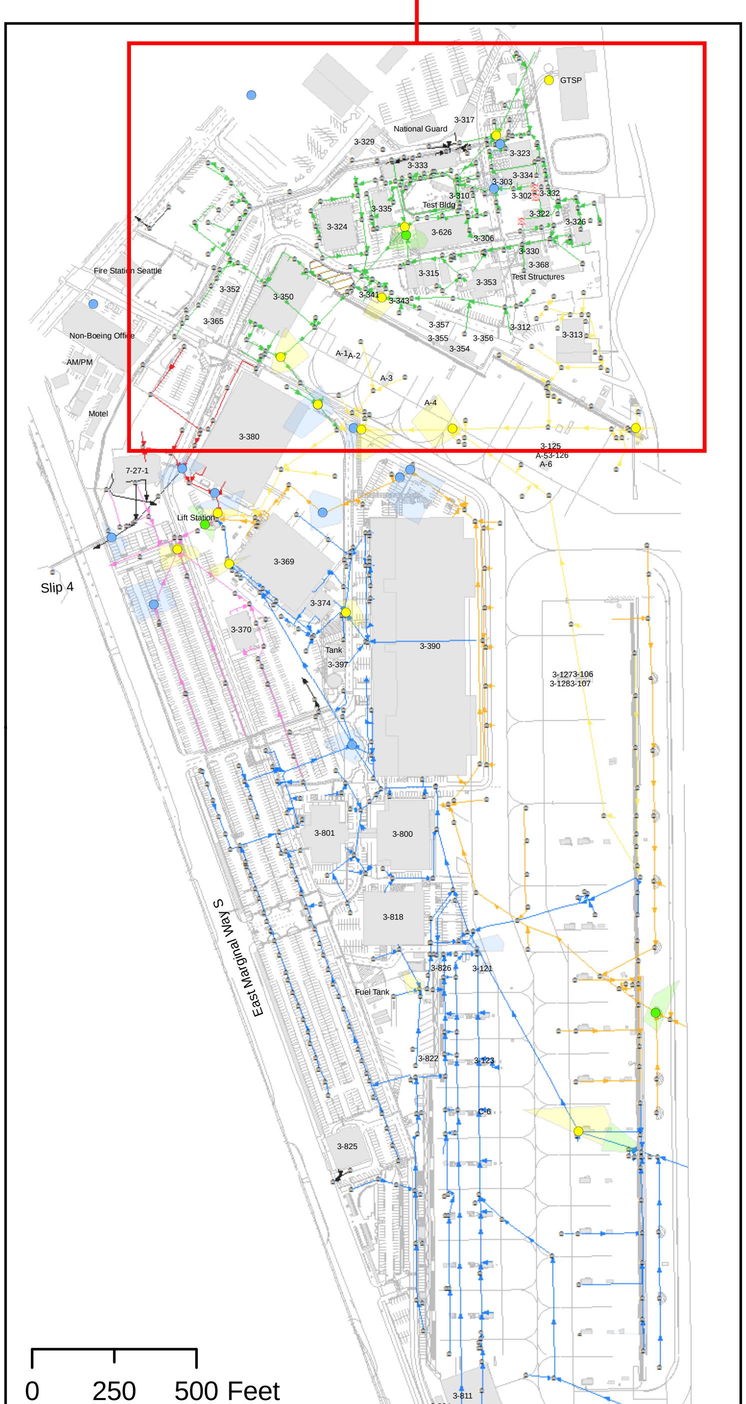


Figure 2-15. Zinc in SD Solids at NBF-GTSP Site

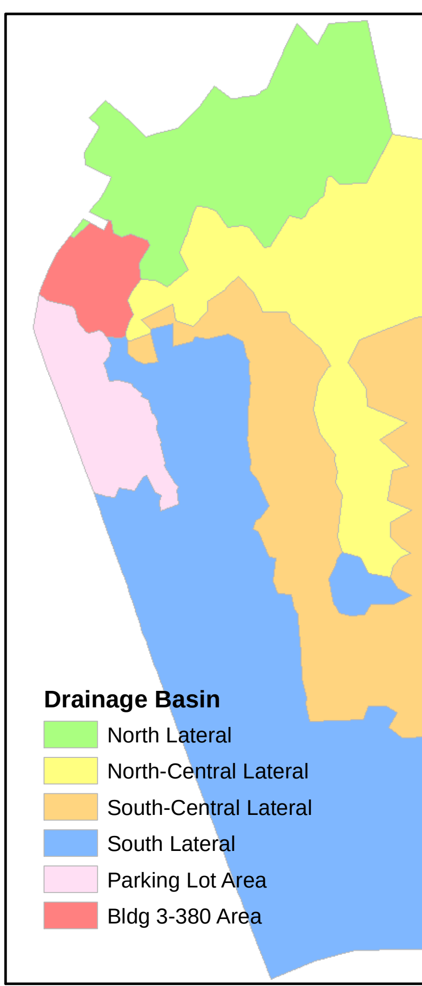




Total HPAHs

SD Solids (mg/kg DW)
- 0 - 12
- >12 - 17
- >17 - 170
- >170 - 1,700

SD Solids (mg/kg DW)
- 0 - 12
- >12 - 17
- >17 - 170
- >170 - 1,700



Screening Levels: (mg/kg DW)
SD Solids:
LAET = 12
2LAET = 17

Most recent result at each location shown as of June 2010

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 2-16_HPAH_SD-SOLIDS-PORTRAIT.mxd
Illustrative purposes only.

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines
- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 2-16. Total HPAHs in SD Solids at NBF-GTSP Site

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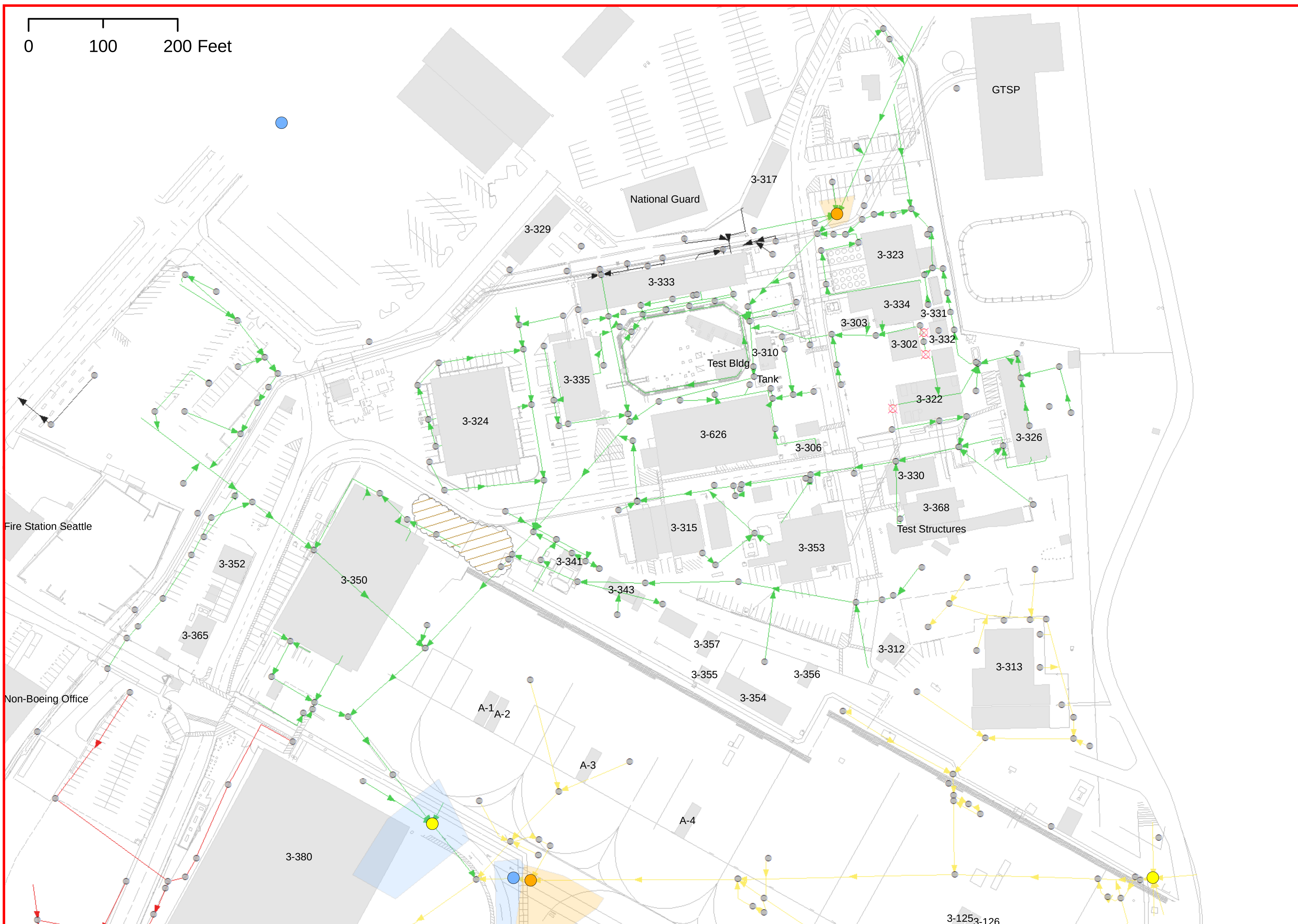

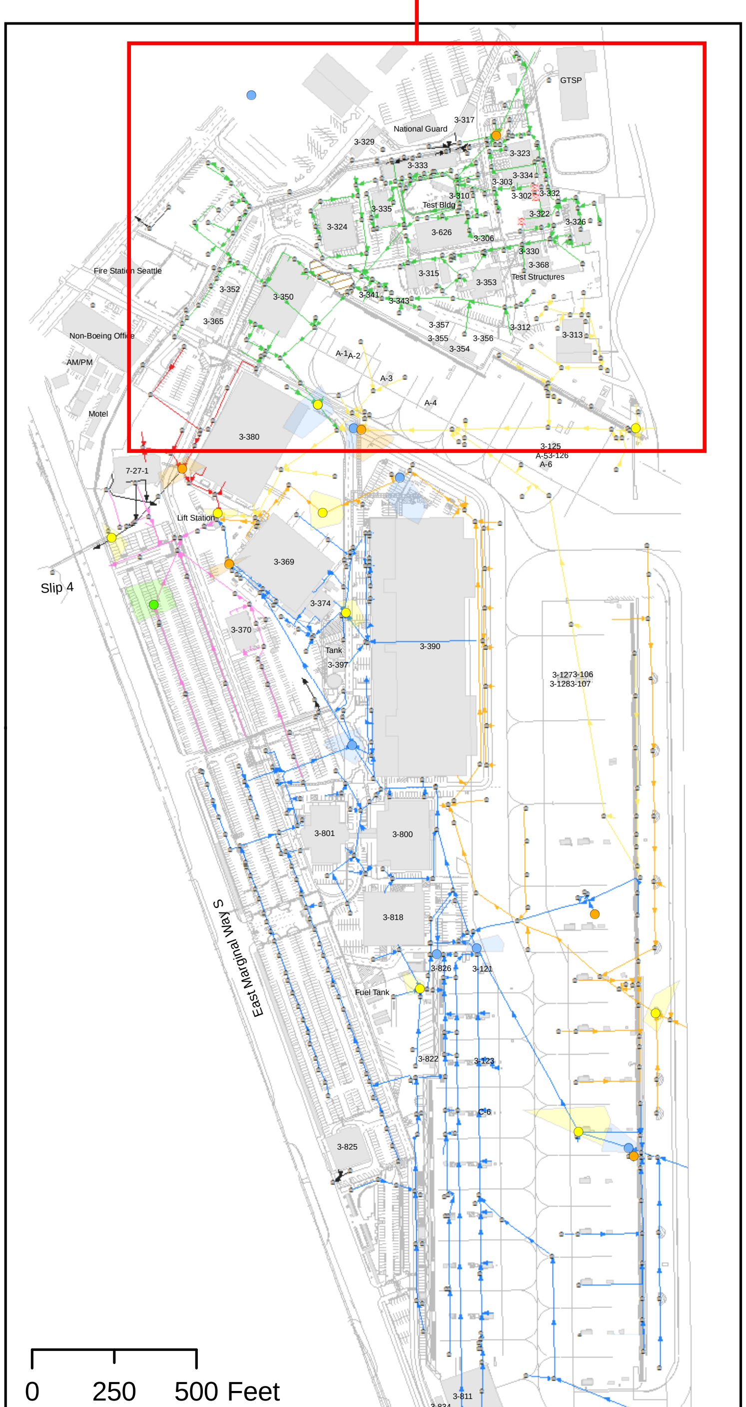

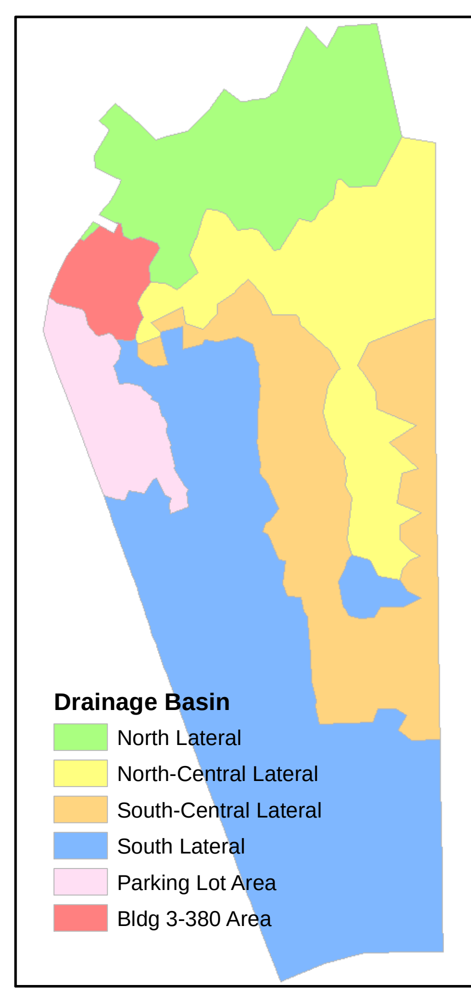

BEHP

SD Solids (mg/kg DW)

- 0 - 1.3
- >1.3 - 1.9
- >1.9 - 13
- >13 - 232

SD Solids (mg/kg DW)

- 0 - 1.3
- >1.3 - 1.9
- >1.9 - 13
- >13 - 232

Drainage Basin

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Parking Lot Area
- Bldg 3-380 Area

Screening Levels: (mg/kg DW)
SD Solids:
LAET = 1.3
2LAET = 1.9

Most recent result at each location shown as of June 2010

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 2-17_BEHP_SD-SOLIDS-PORTRAIT.mxd
Illustrative purposes only.

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 2-17. BEHP in SD Solids at NBF-GTSP Site

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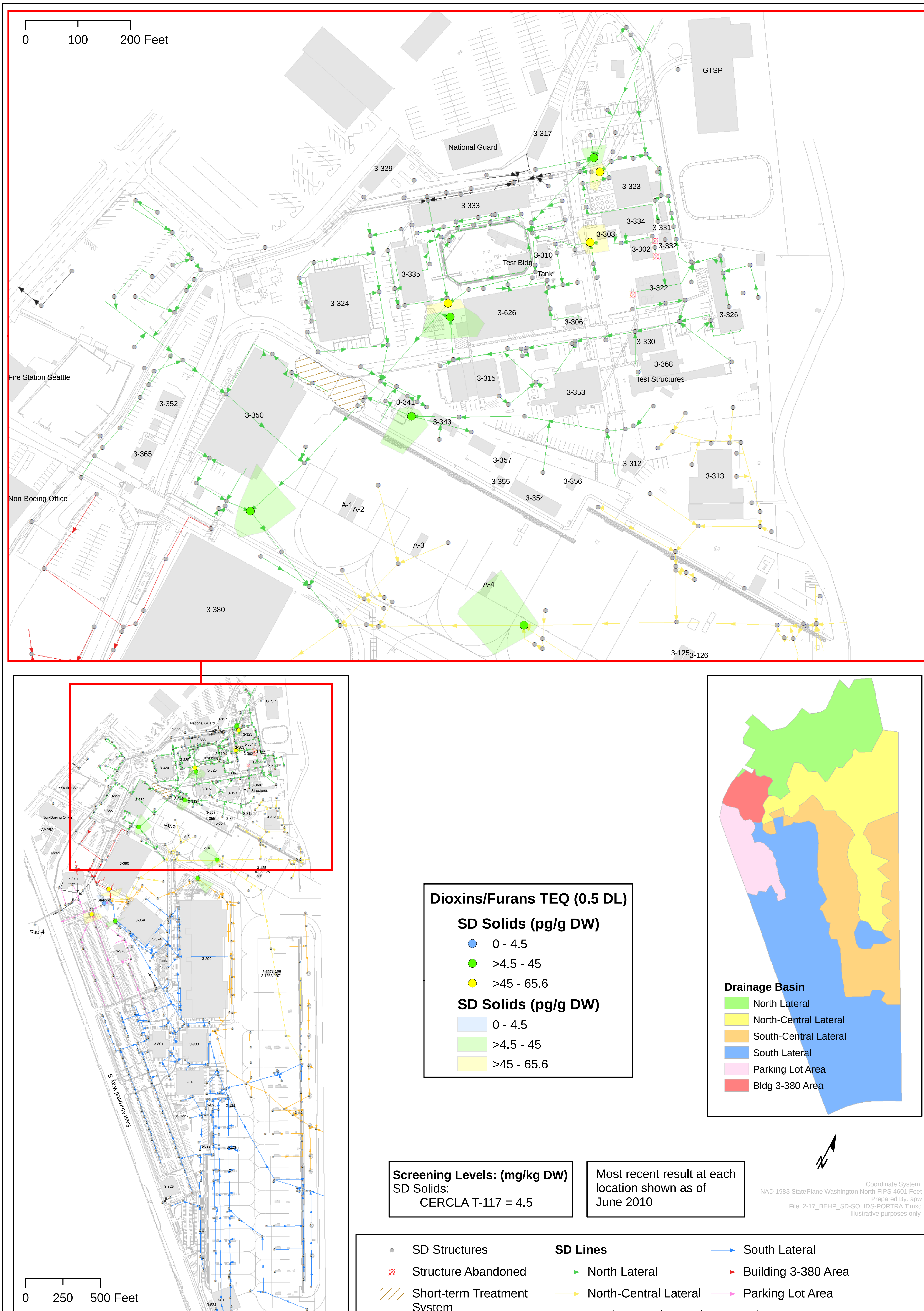

Figure 2-18. Dioxins/Furans TEQ (0.5 DL) in SD Solids at NBF-GTSP Site

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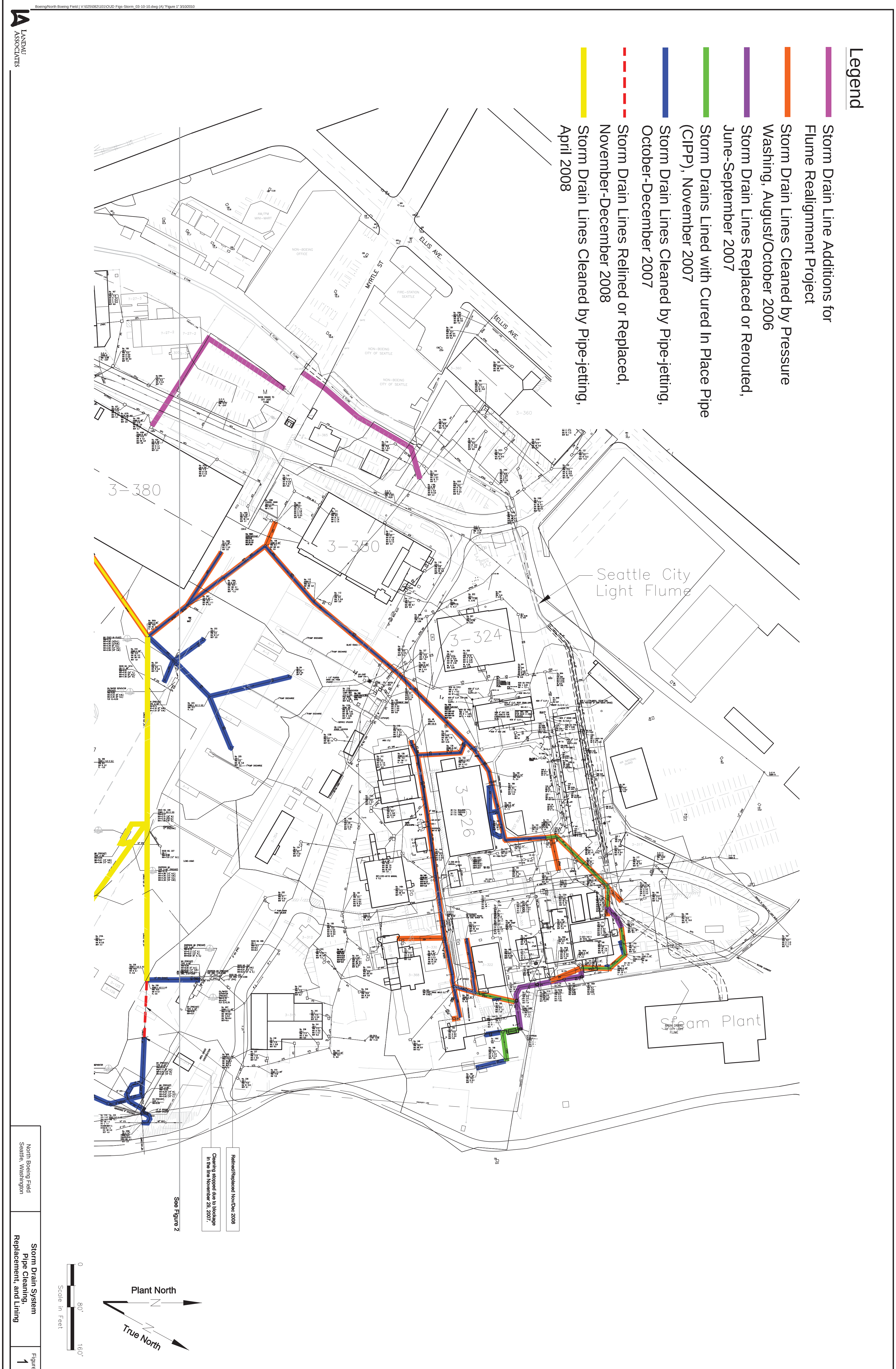
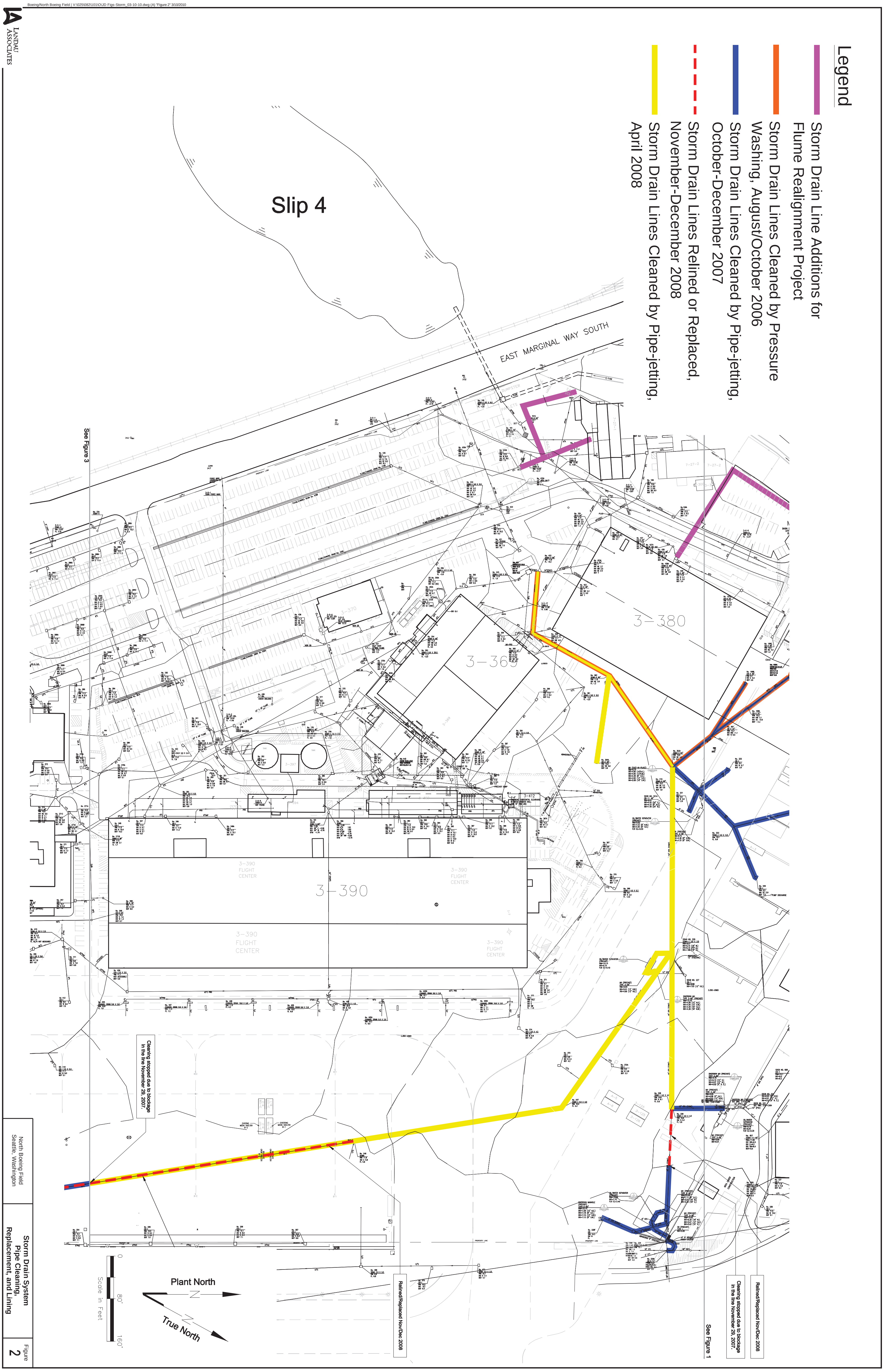


Source: Bach 2010b

Figure 2-19a. NBF SD System Pipe Cleaning, Replacement and Lining, 2006–2008



Source: Bach 2010b

Figure 2-19b. NBF SD System Pipe Cleaning, Replacement and Lining, 2006–2008

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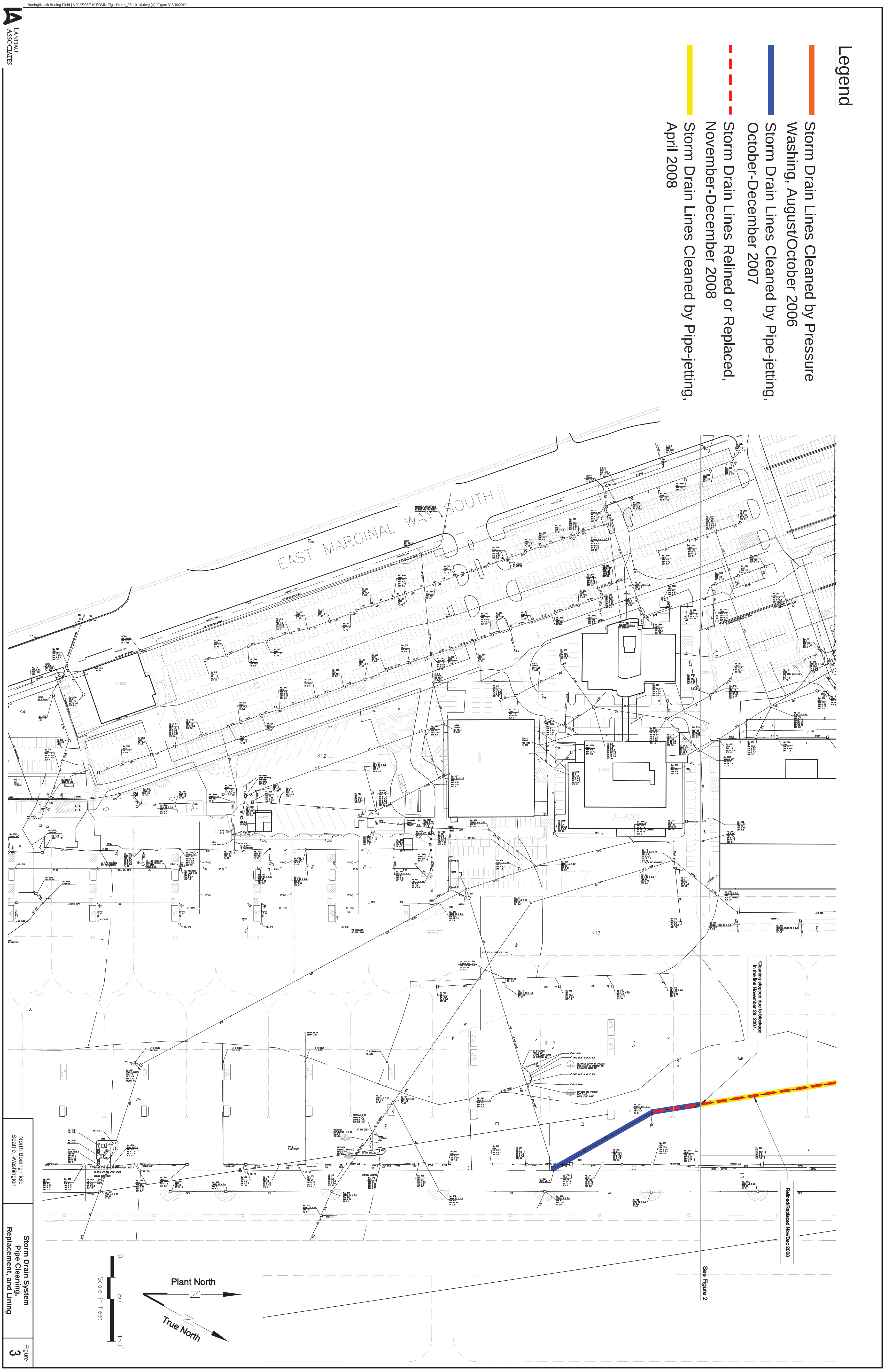

Source: Bach 2010b

Figure 2-19c. NBF SD System Pipe Cleaning, Replacement and Lining, 2006–2008

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Source: Landau 2011b

Figure 2-20. NBF SD System Pipe Cleaning and Video Inspection, 2010

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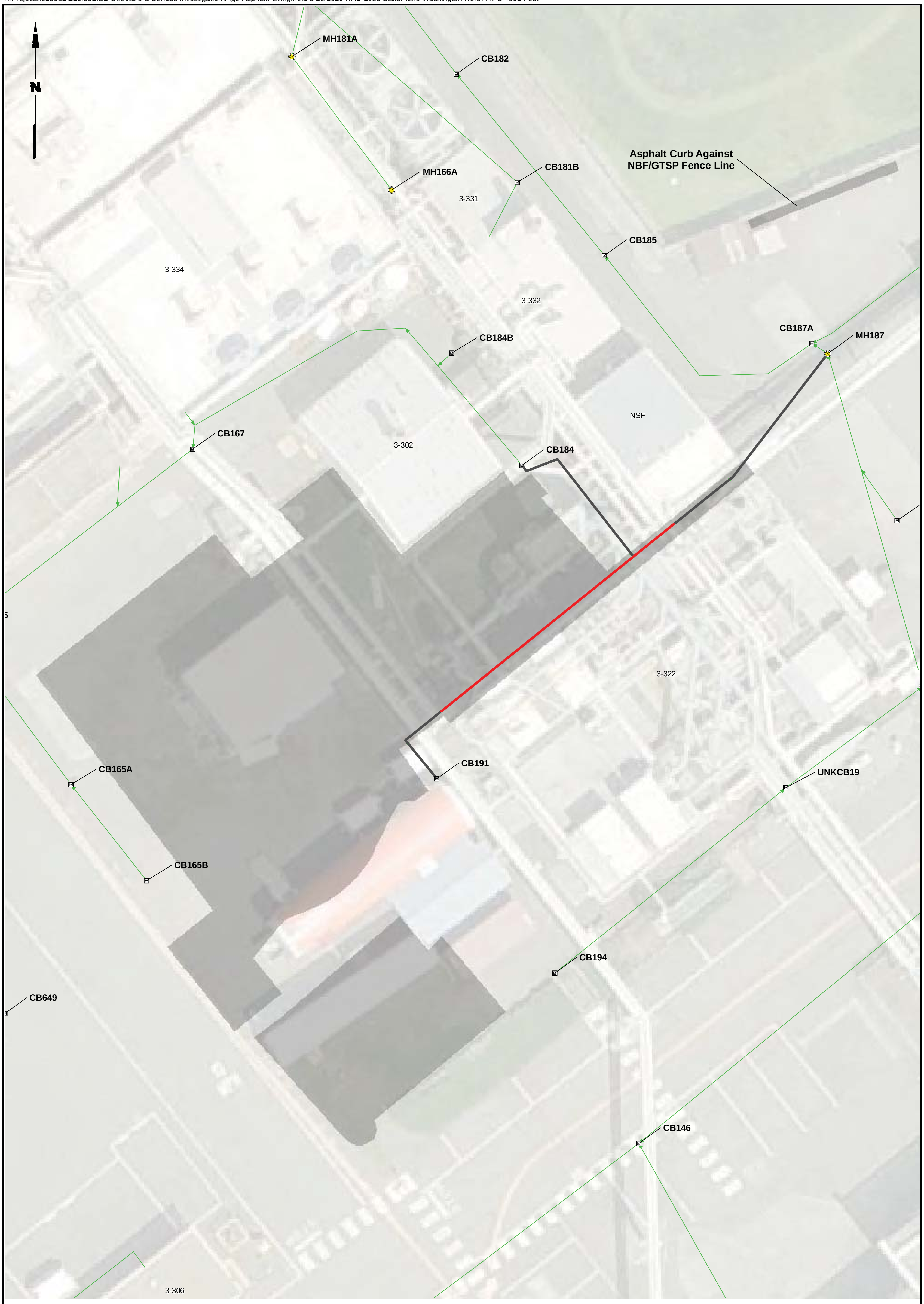
Y:\Projects\025082\210.001\SD Structure & Surface Investigation\Fig9-AsphaltPaving.mxd 6/16/2010 NAD 1983 StatePlane Washington North FIPS 4601 Feet



Legend

Asphalt Paving Area
Manhole
Storm Drain Piping Abbandoned/Not in Use
Catch Basin
North Lateral
Storm Drain Piping Removed

0 20 40
Scale in Feet

LANDAU ASSOCIATES

Note
1. Black and white reproduction of this color original may reduce its effectiveness and lead to incorrect interpretation.

North Boeing Field
Seattle, Washington

Asphalt Paving Areas

Figure
9

Source: Landau 2010b

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Figure 2-21. NBF SD System Abandonments, 2010

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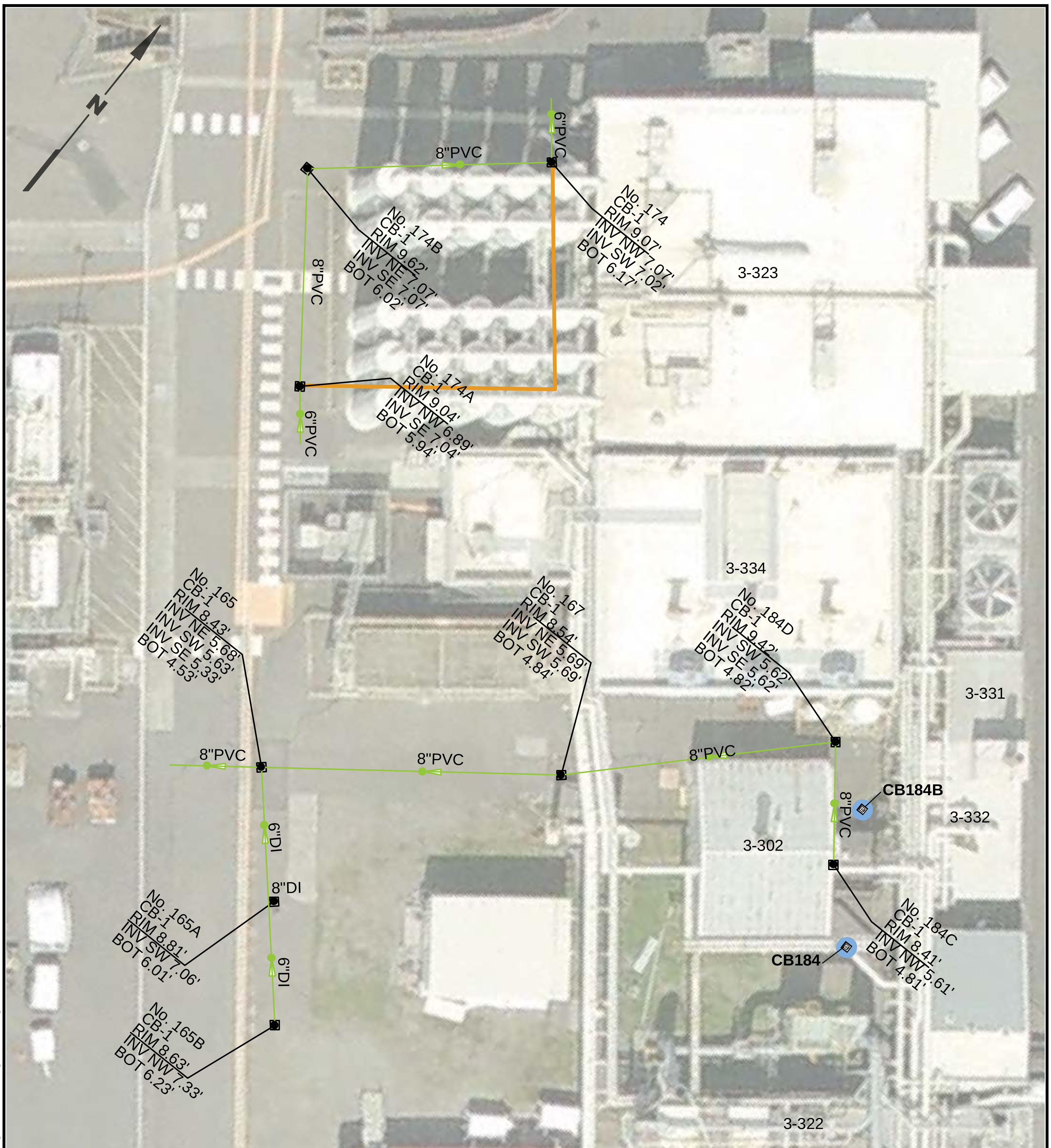

Legend

- Storm Drain Structure Abandoned
- Existing Storm Drain Structure
- Storm Drain Line Abandoned In-place

0 30 60

Scale in Feet

Y:\Projects\025082\MapDocs\Focused Investigation\Building 3-302\Fig4-SD.mxd 12/14/2010 NAD 1983 StatePlane Washington North FIPS 4601 Feet

Landau Associates

North Boeing Field Seattle, Washington	**Survey Data from Storm Drain Line Replacement and Reroutes**	Figure 4

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Source: Landau 2010 L

Figure 2-22. NBF SD System Line Replacement and Reroutes, 2010

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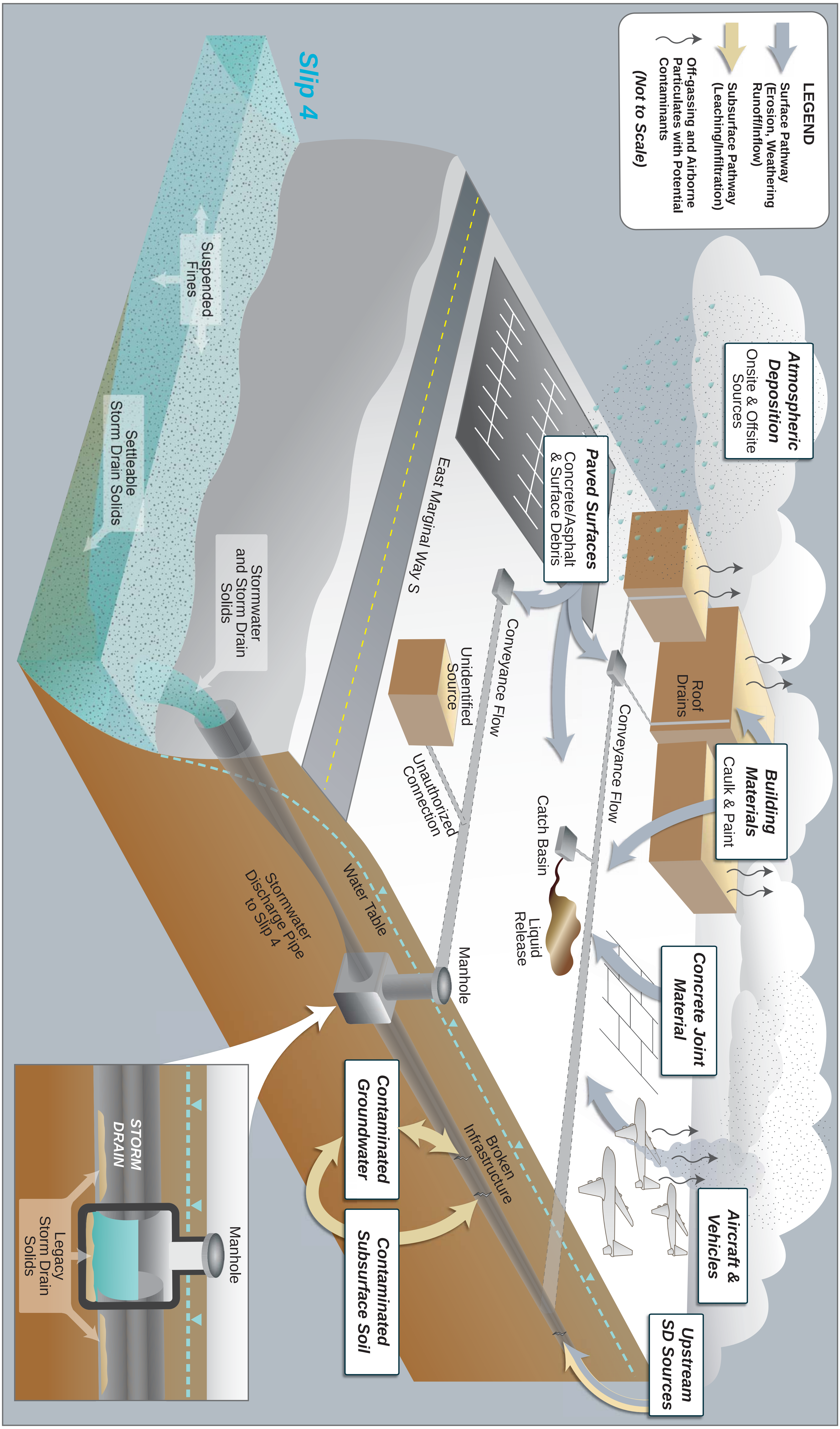

Figure 3-1. Schematic Representation of Conceptual Site Model for Stormwater, NBF-GTSP Site

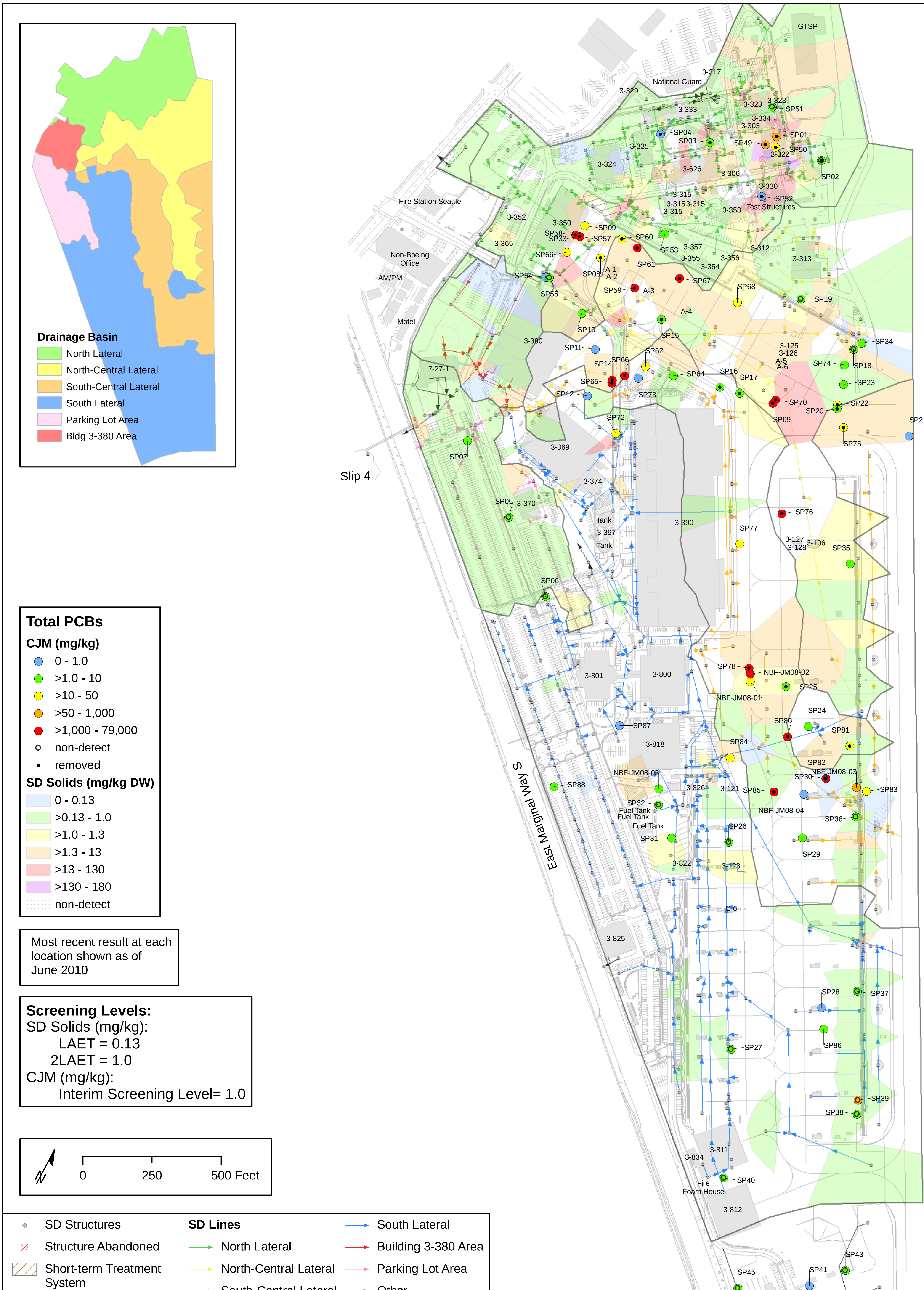

Figure 4-1. Total PCBs in Concrete Joint Material Samples at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-01_PCB_CJM-Materials-PORTRAIT.mxd
Illustrative purposes only.

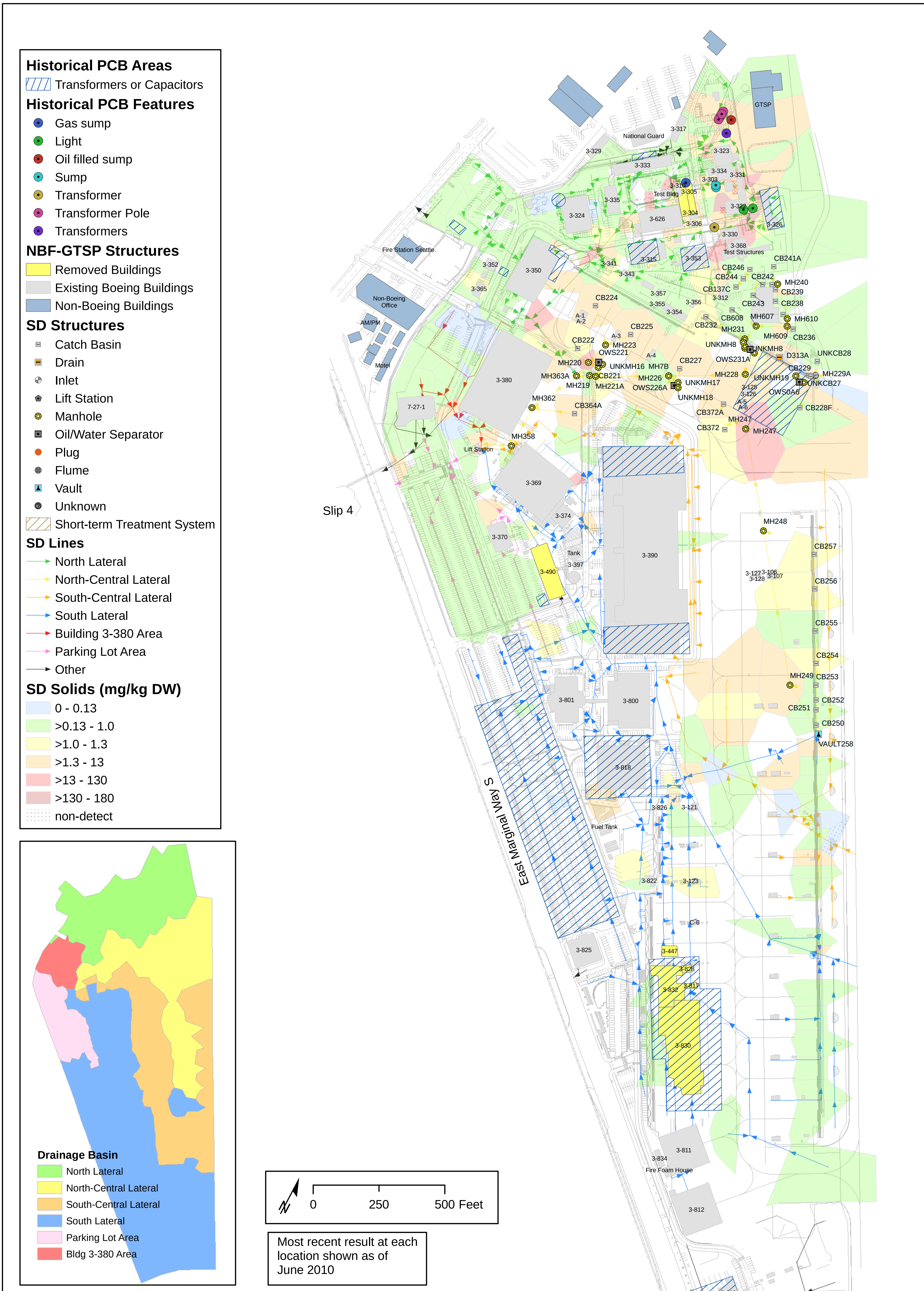

Figure 4-2. NBF-GTSP Areas with Potential Historical PCB Sources

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-02_PCB_Potential_Historic-PORTRAIT.mxd
Illustrative purposes only.

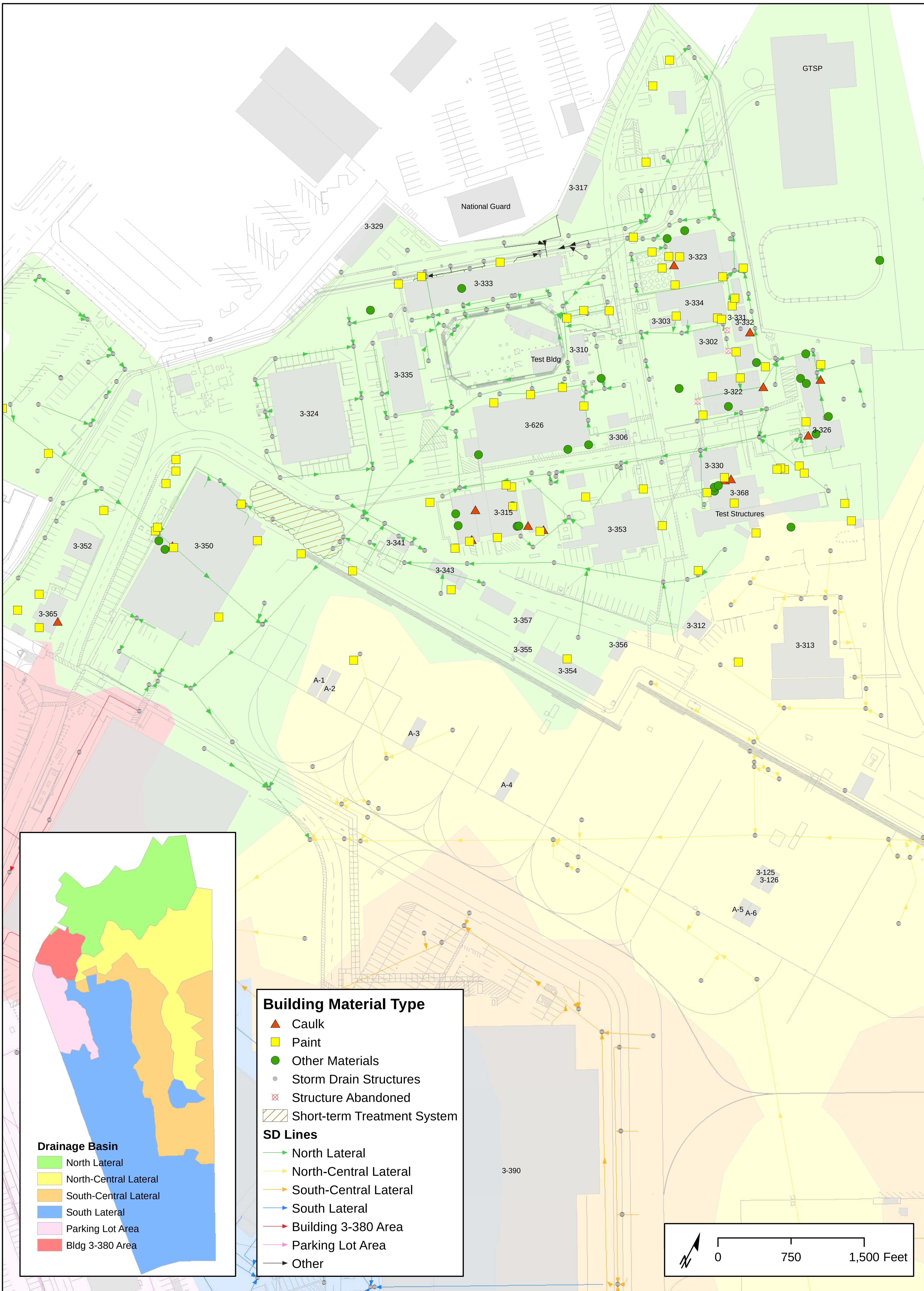

Figure 4-3. Building Material Sampling Locations at PEL Area at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-16_PCBs_GroundWater-PORTRAIT.mxd
Illustrative purposes only.

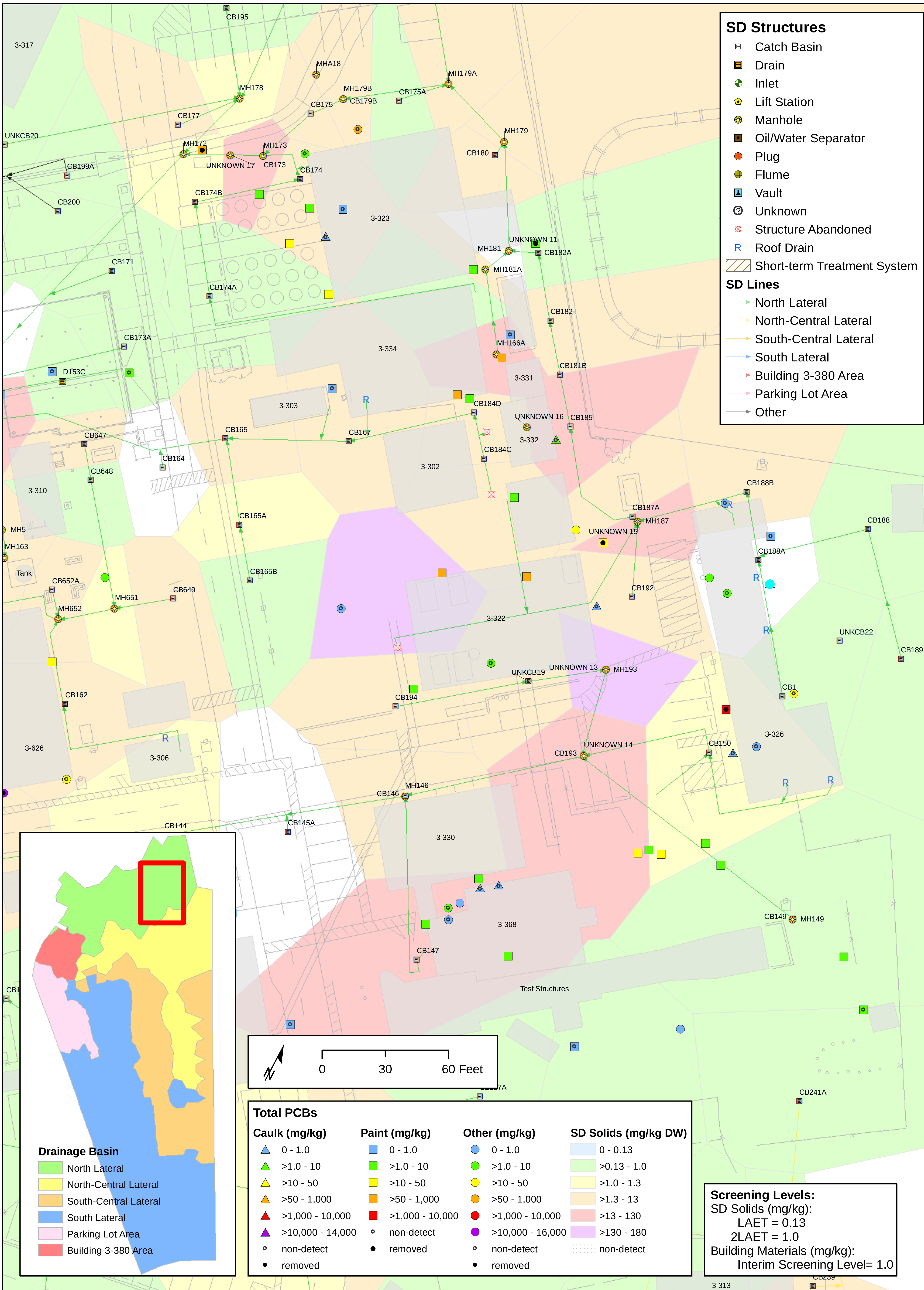

Figure 4-4. Total PCBs in Building Materials Near Building 3-322 at NBF-GTSP Site

Coordinate System:
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Prepared By: apw
File: 5-16_PCBs_GroundWater-PORTRAIT.mxd
Illustrative purposes only.

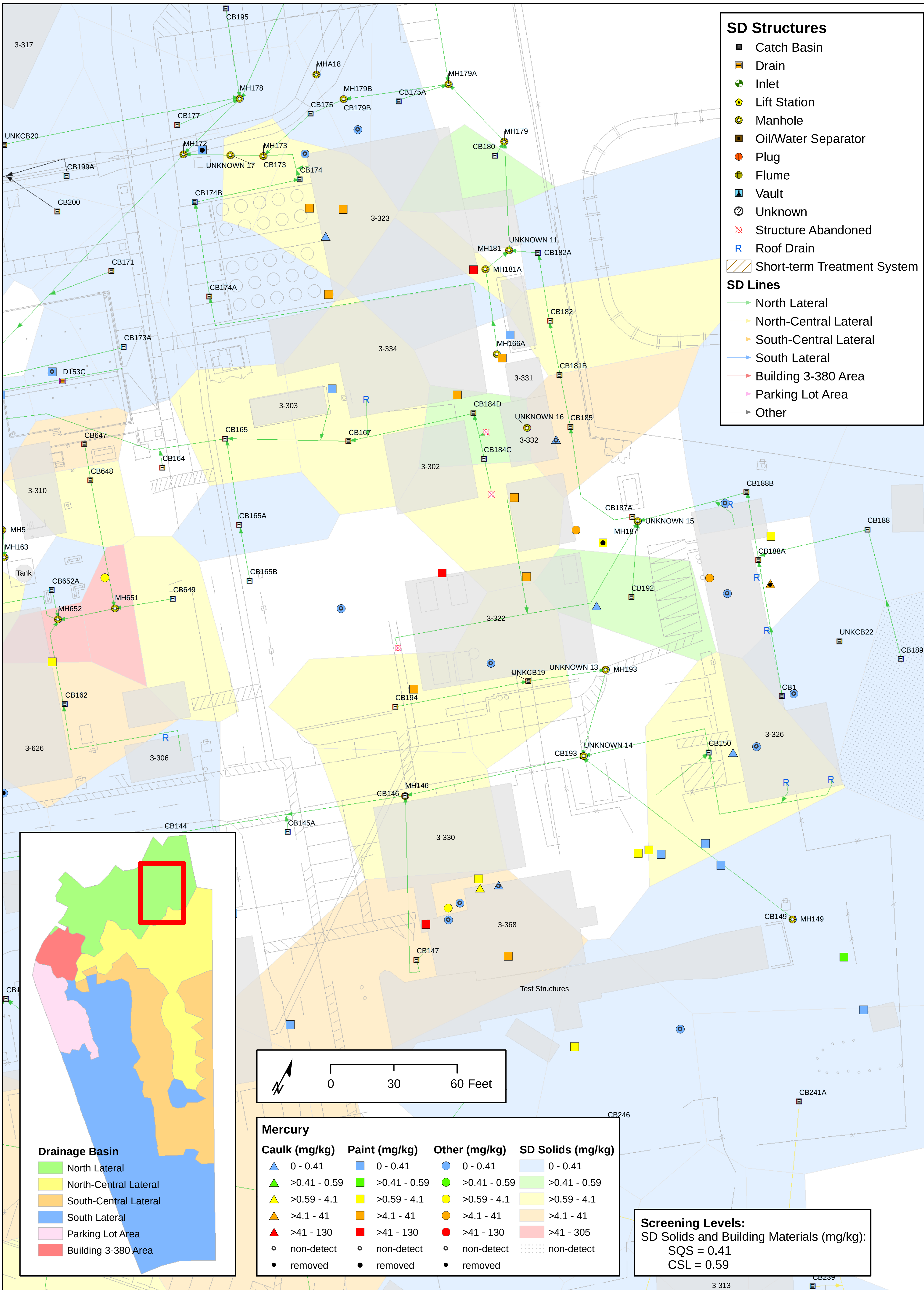

Figure 4-5. Mercury in Building Materials Near Building 3-322 at NBF-GTSP Site

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-16_PCBs_GroundWater-PORTRAIT.mxd
Illustrative purposes only.

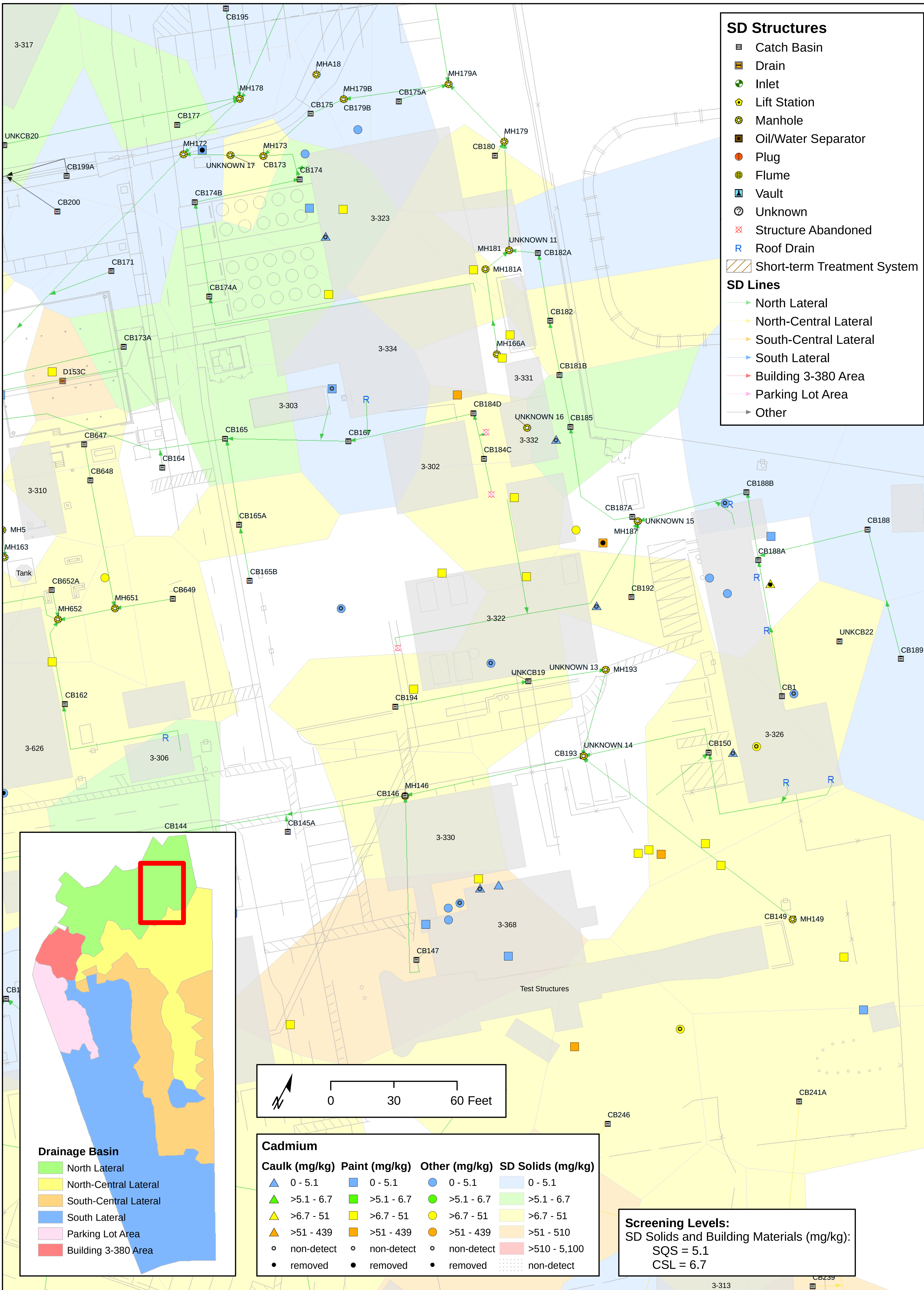

Figure 4-6. Cadmium in Building Materials Near Building 3-322 at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-06_Cadmium_BuildingMaterial-PORTRAIT_near_3-322.mxd
Illustrative purposes only.

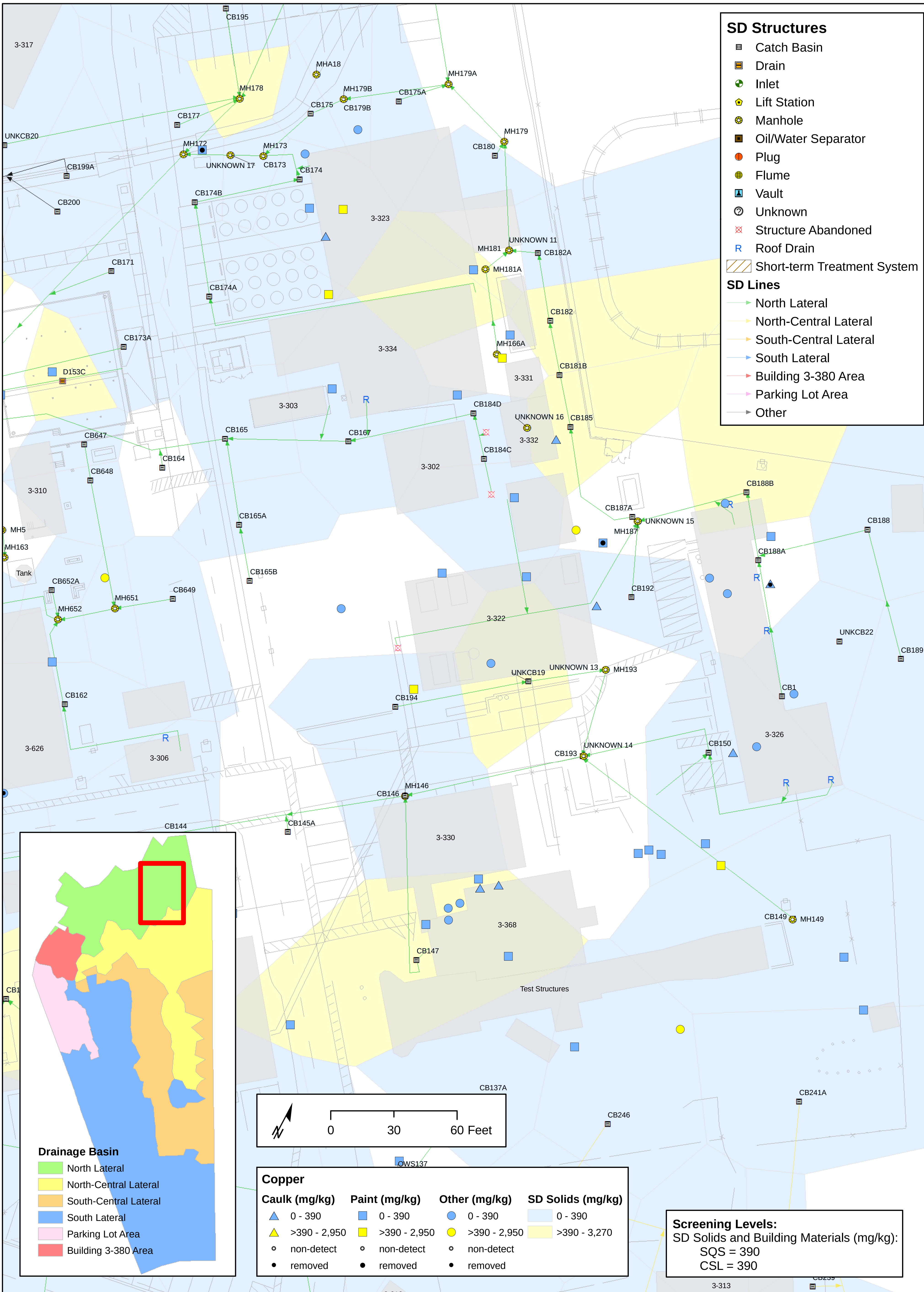

Figure 4-7. Copper in Building Materials Near Building 3-322 at NBF-GTSP Site

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Coordinate System:
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Prepared By: apw
File: 4-07_Copper_BuildingMaterial-PORTRAIT_near_3-322.mxd
Illustrative purposes only.

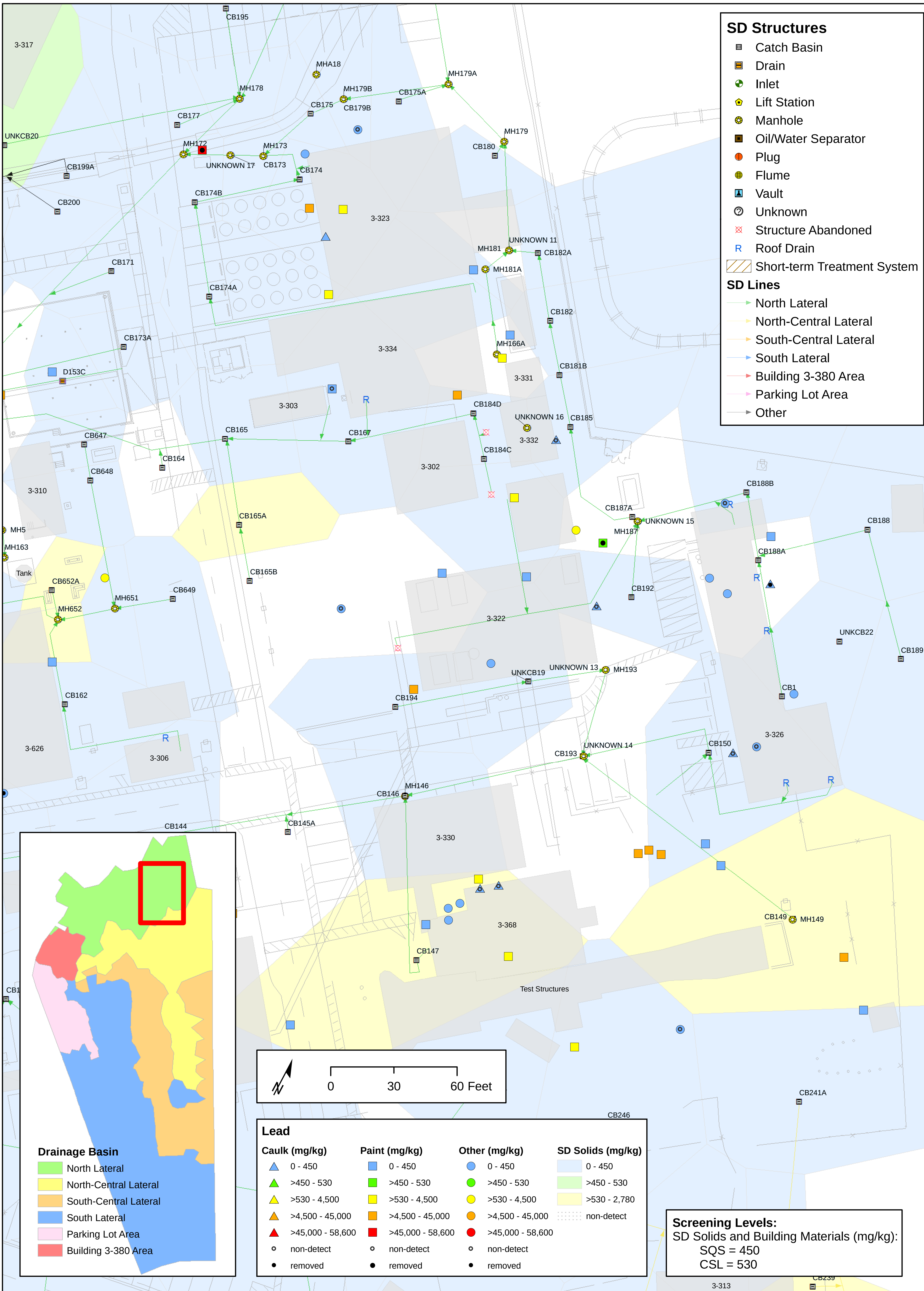

Figure 4-8. Lead in Building Materials Near Building 3-322 at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-08_Lead_BuildingMaterial-PORTRAIT_near_3-322.mxd
Illustrative purposes only.

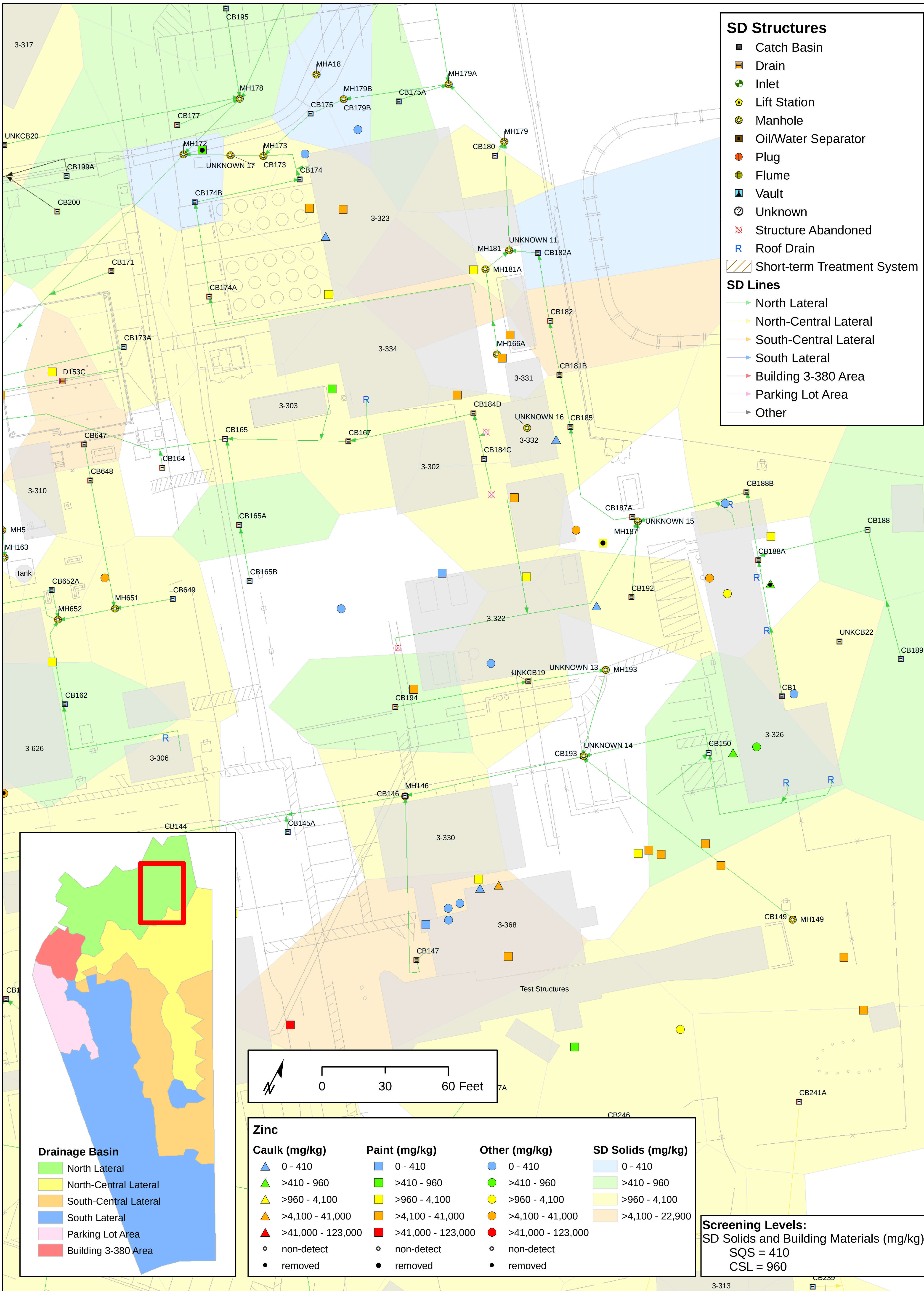

Figure 4-9. Zinc in Building Materials Near Building 3-322 at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-09_Zinc_BuildingMaterial-PORTRAIT_near_3-322.mxd
Illustrative purposes only.

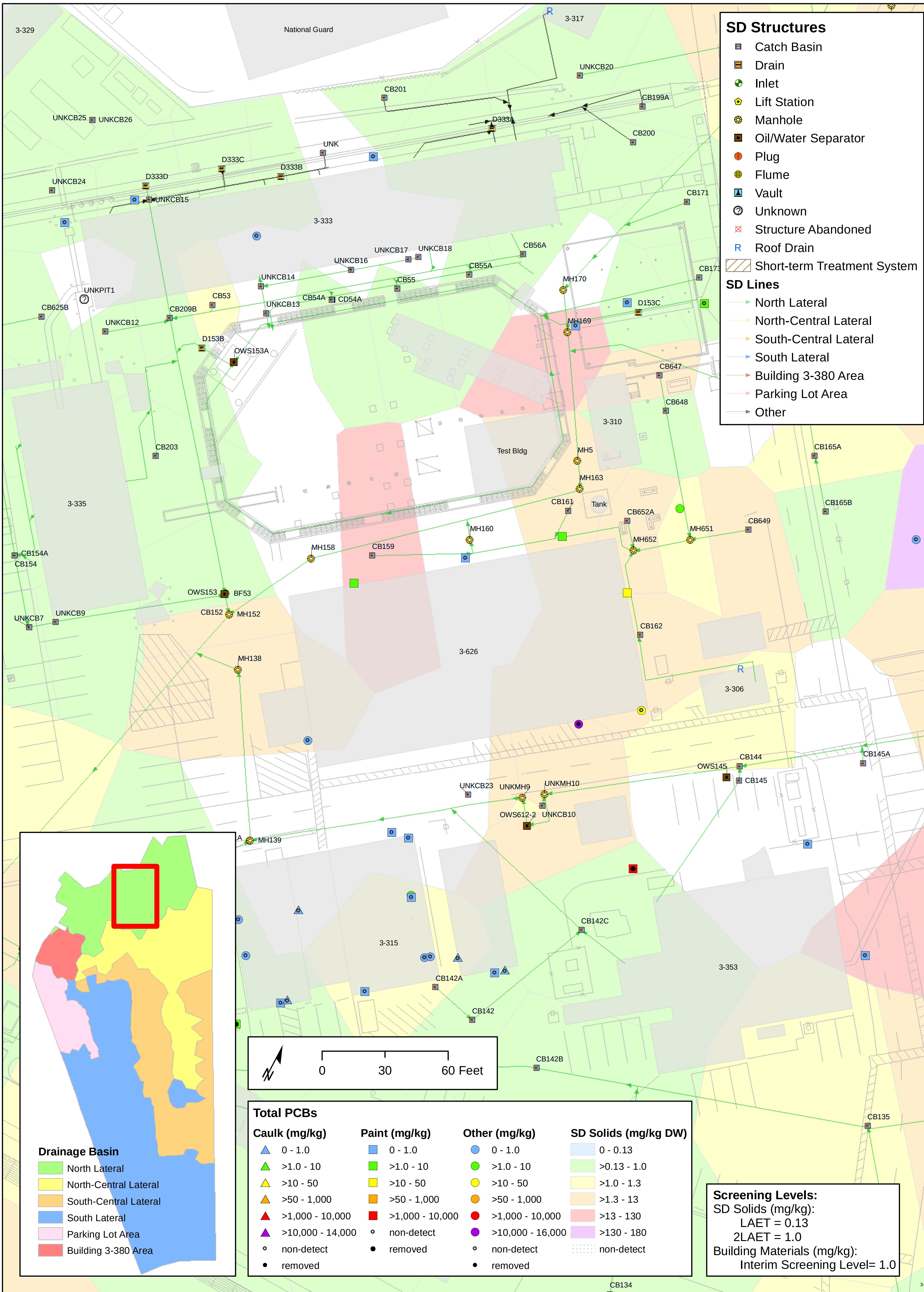

Figure 4-10. Total PCBs in Building Materials Near Building 3-626 at NBF-GTSP Site

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-10_PCB_BuildingMaterial_near_3-626-PORTRAIT.mxd
Illustrative purposes only.

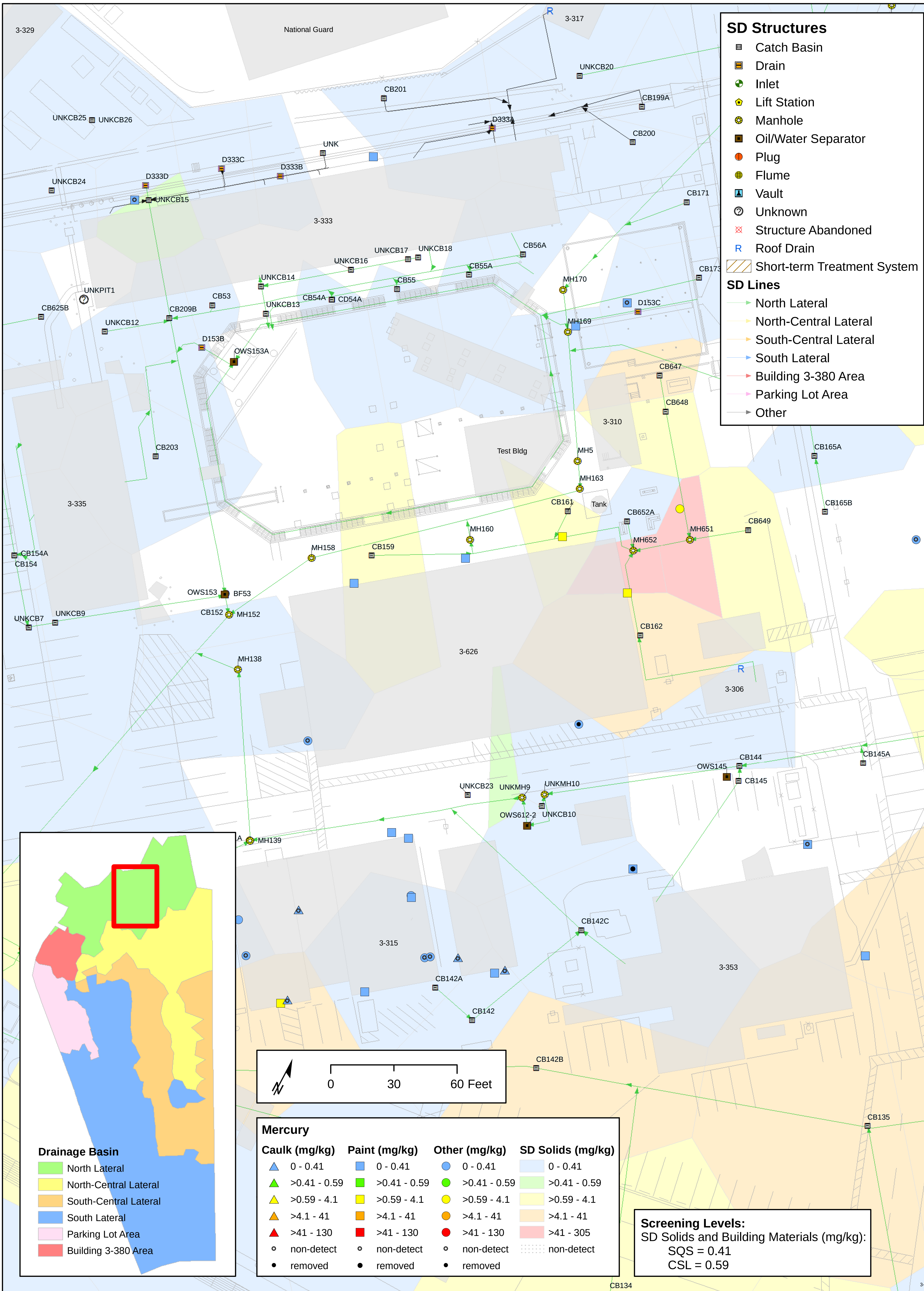

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Figure 4-11. Mercury in Building Materials Near Building 3-626 at NBF-GTSP Site

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-11_Mercury_BuildingMaterial_near_3-626-PORTRAIT.mxd
Illustrative purposes only.

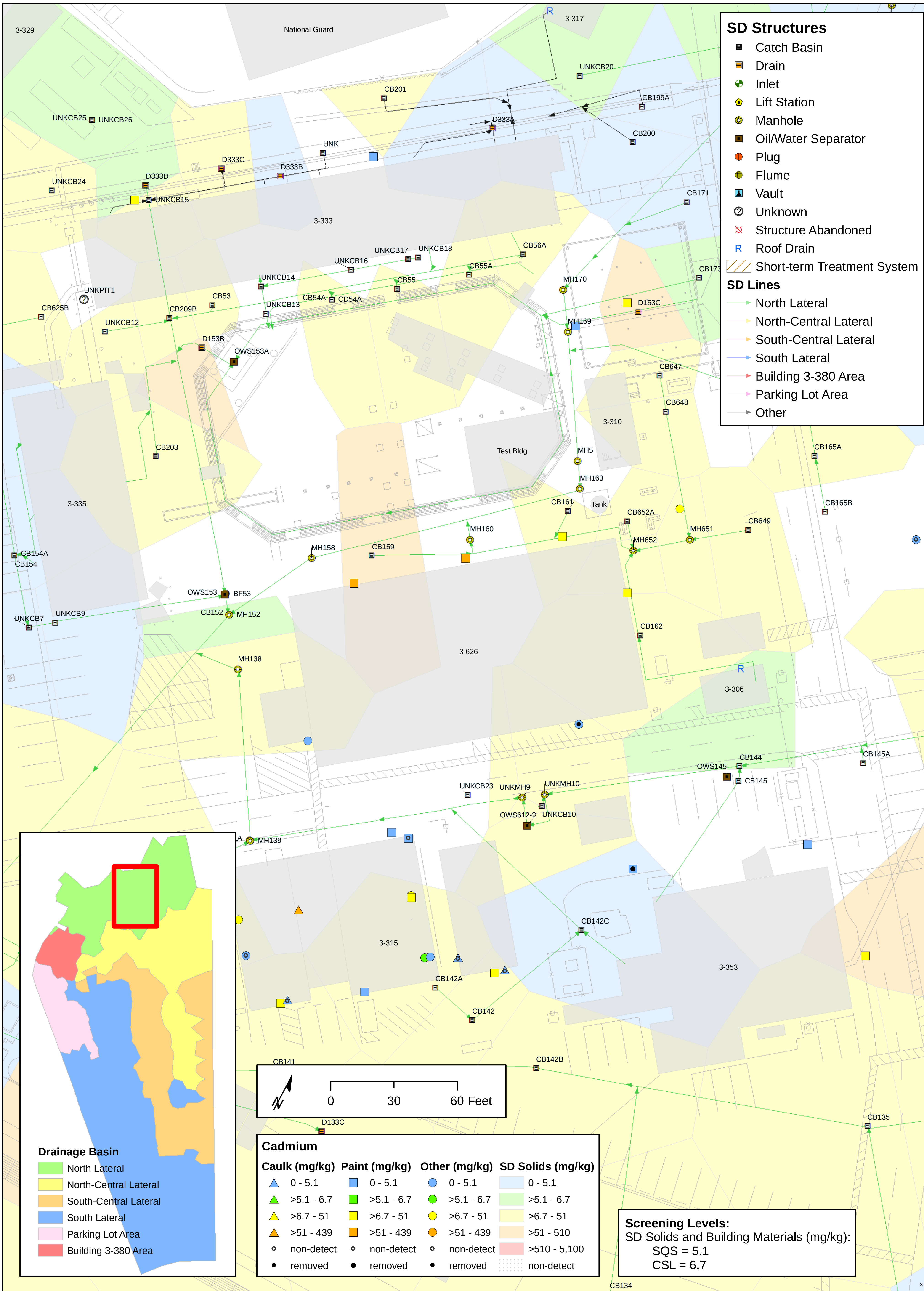

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Figure 4-12. Cadmium in Building Materials Near Building 3-626 at NBF-GTSP Site

SAIC
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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-12_Cadmium_BuildingMaterial_near_3-626-PORTRAIT.mxd
Illustrative purposes only.

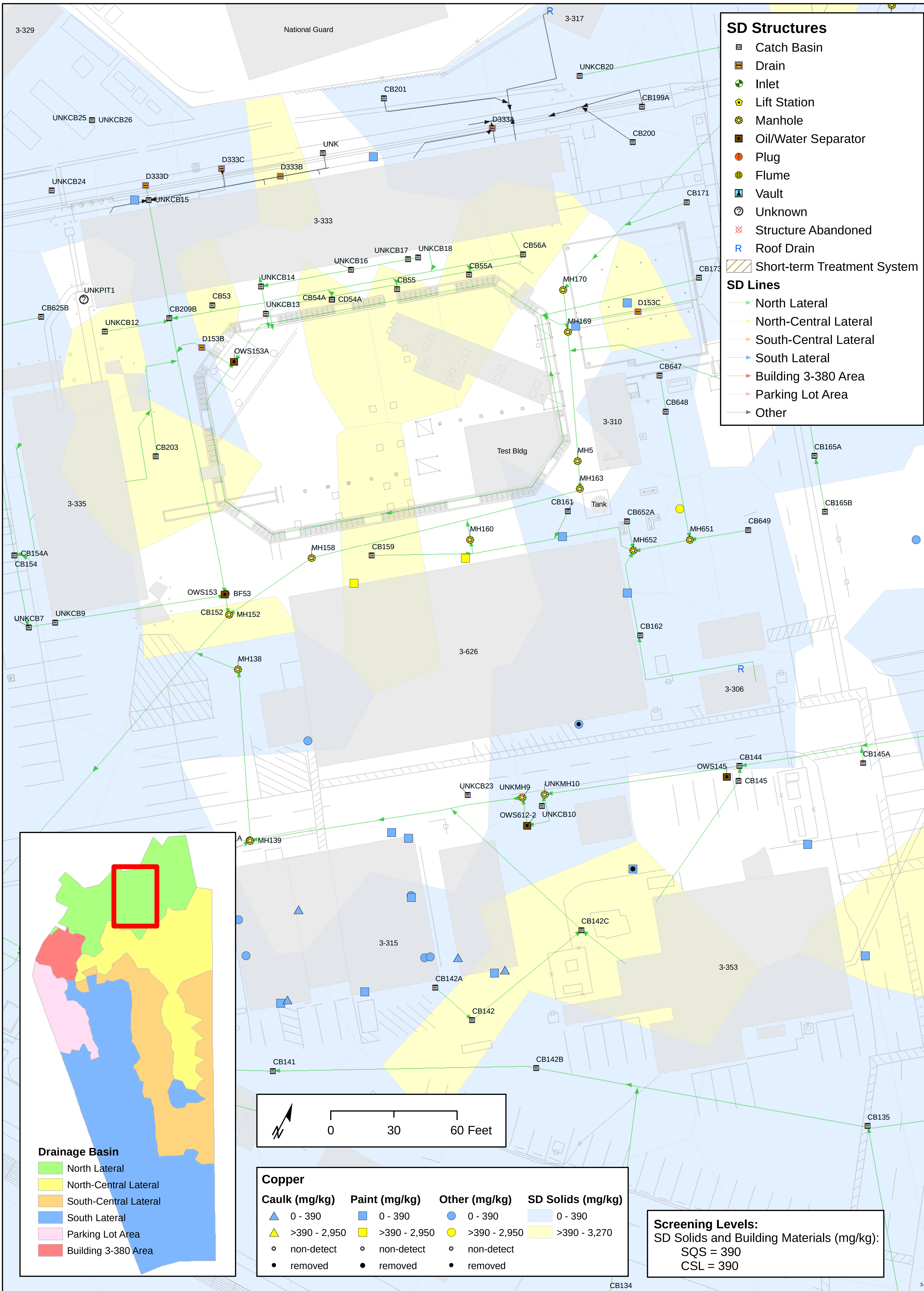

Figure 4-13. Copper in Building Materials Near Building 3-626 at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-13_Copper_BuildingMaterial_near_3-626-PORTRAIT.mxd
Illustrative purposes only.

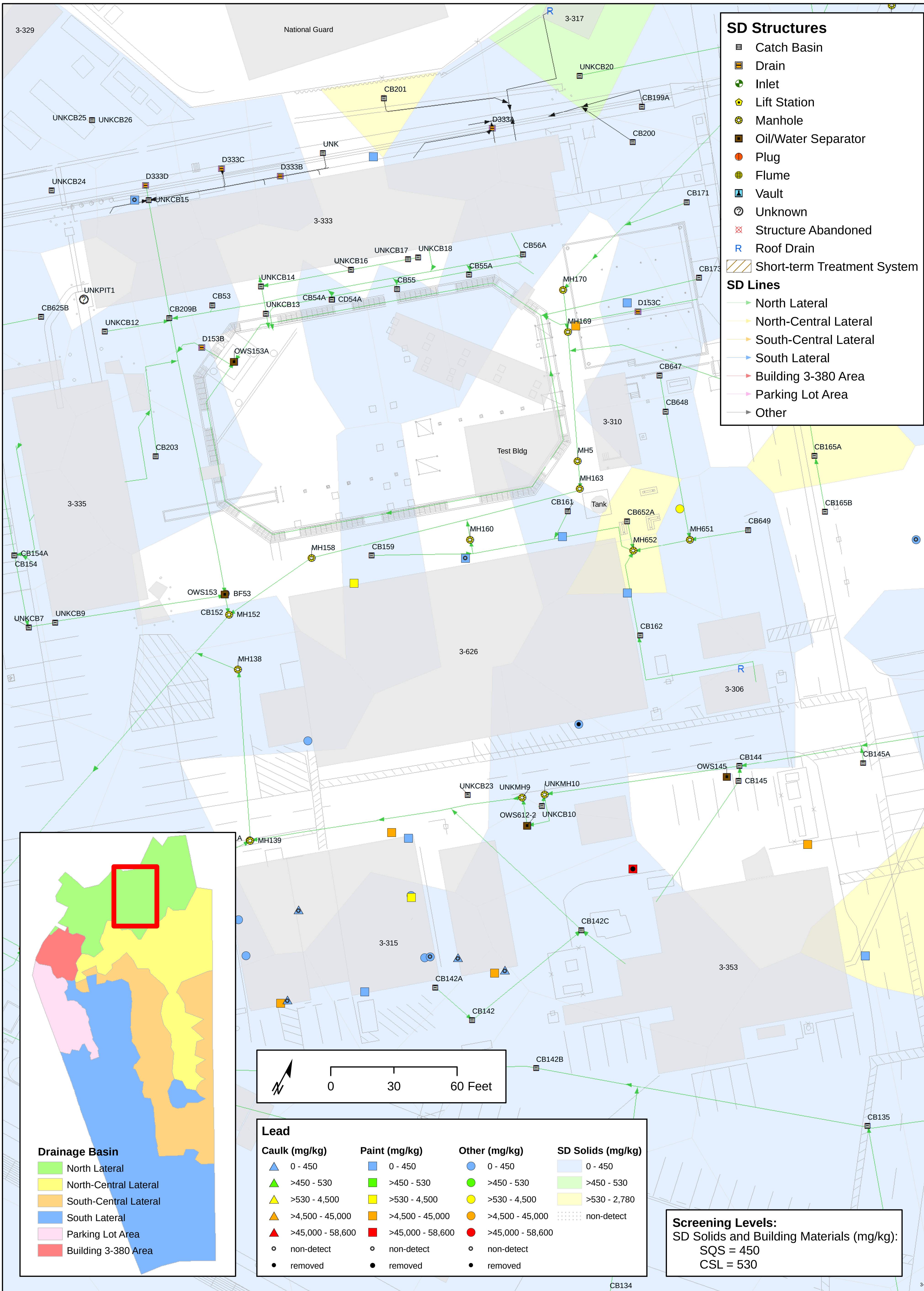

Figure 4-14. Lead in Building Materials Near Building 3-626 at NBF-GTSP Site

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SAIC From Science to Solutions

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-14_Lead_BuildingMaterial_near_3-626-PORTRAIT.mxd
Illustrative purposes only.

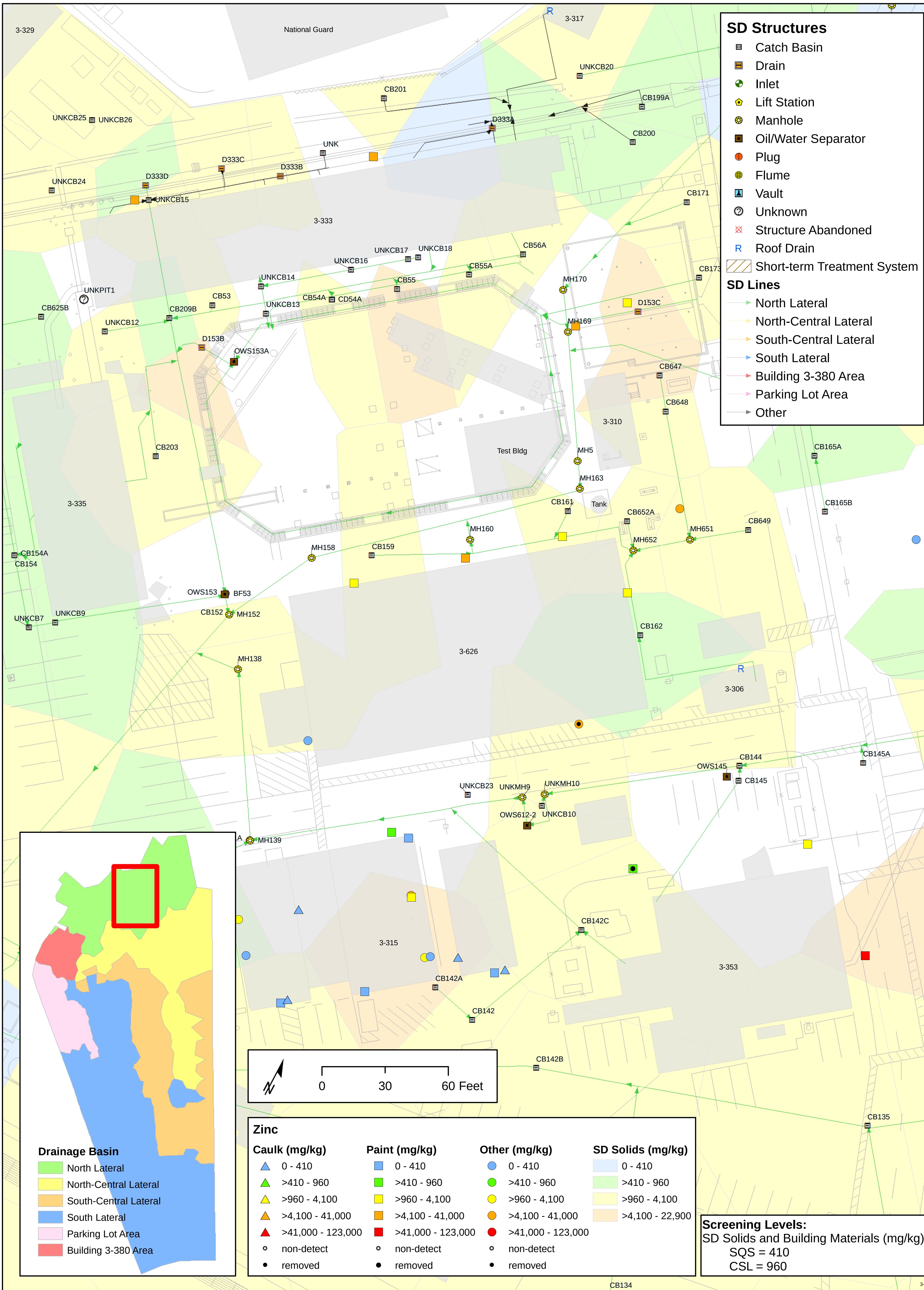

Figure 4-15. Zinc in Building Materials Near Building 3-626 at NBF-GTSP Site

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-15_Zinc_BuildingMaterial_near_3-626-PORTRAIT.mxd
Illustrative purposes only.

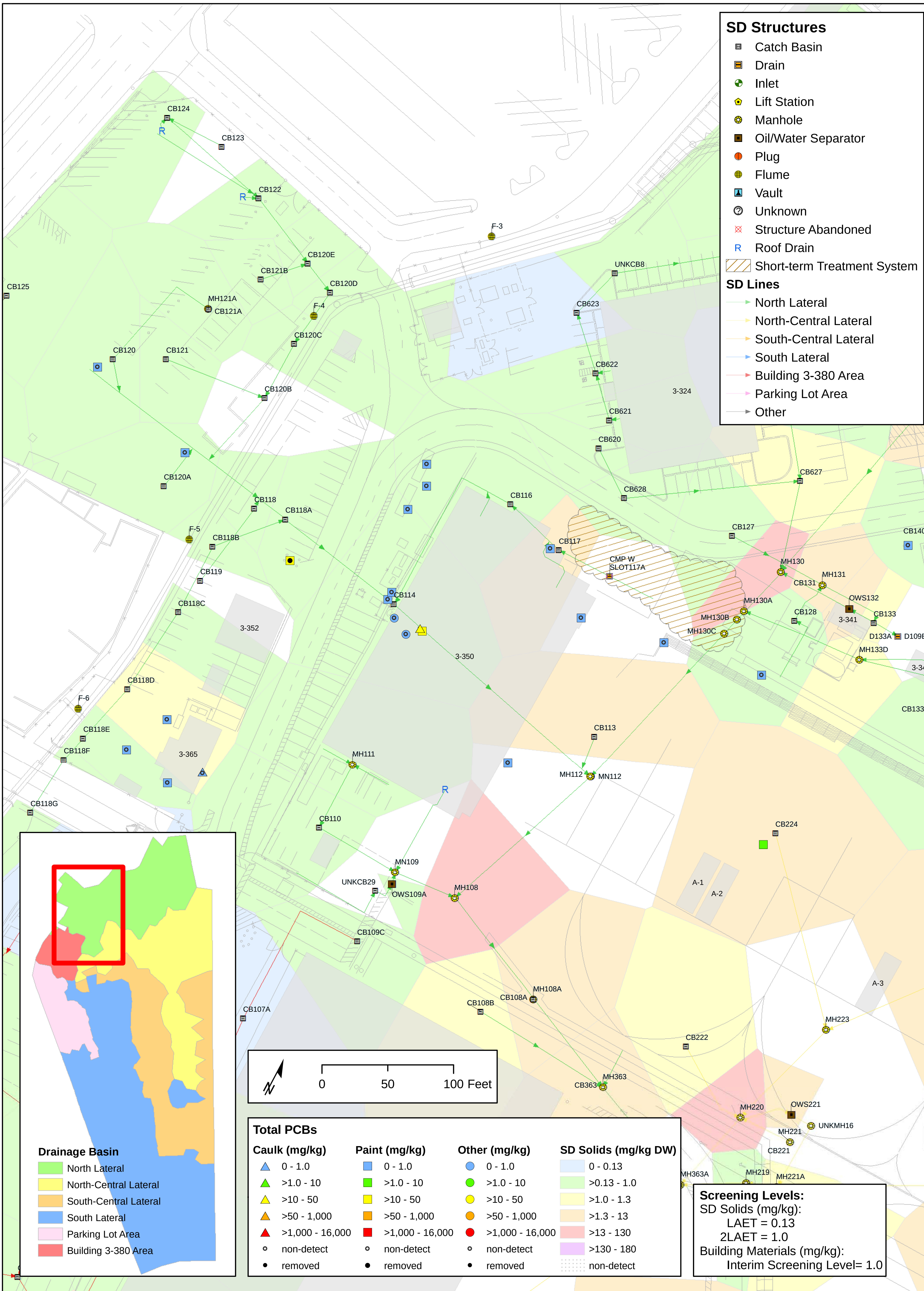

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Figure 4-16. Total PCBs in Building Materials Near Building 3-350 at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-16_PCB_BuildingMaterial_near_3-380-PORTRAIT.mxd
Illustrative purposes only.

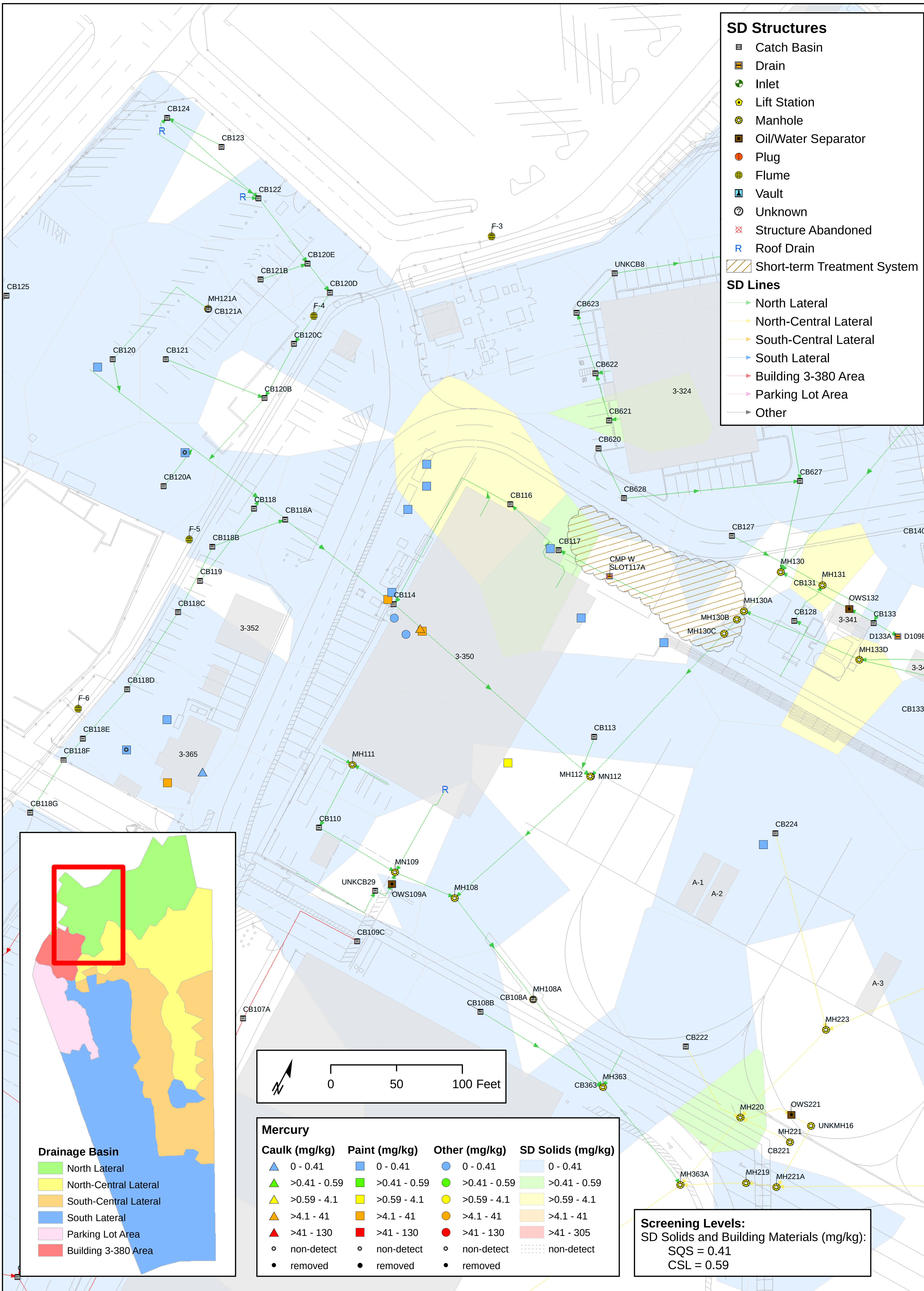

Figure 4-17. Mercury in Building Materials Near Building 3-350 at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-17_Mercury_BuildingMaterial_near_3-380-PORTRAIT.mxd
Illustrative purposes only.

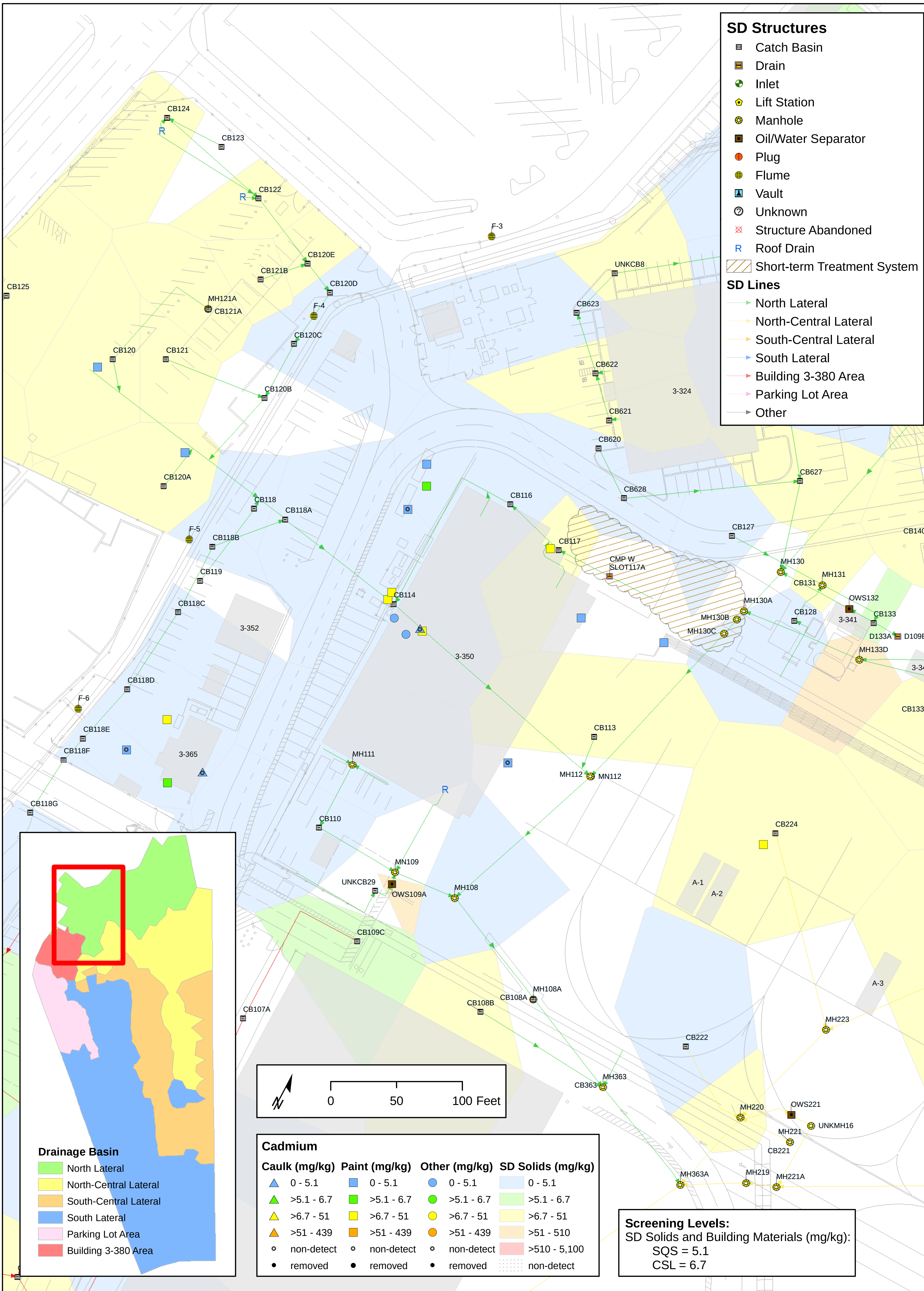

Figure 4-18. Cadmium in Building Materials Near Building 3-350 at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-18_Cadmium_BuildingMaterial_near_3-380-PORTRAIT.mxd
Illustrative purposes only.

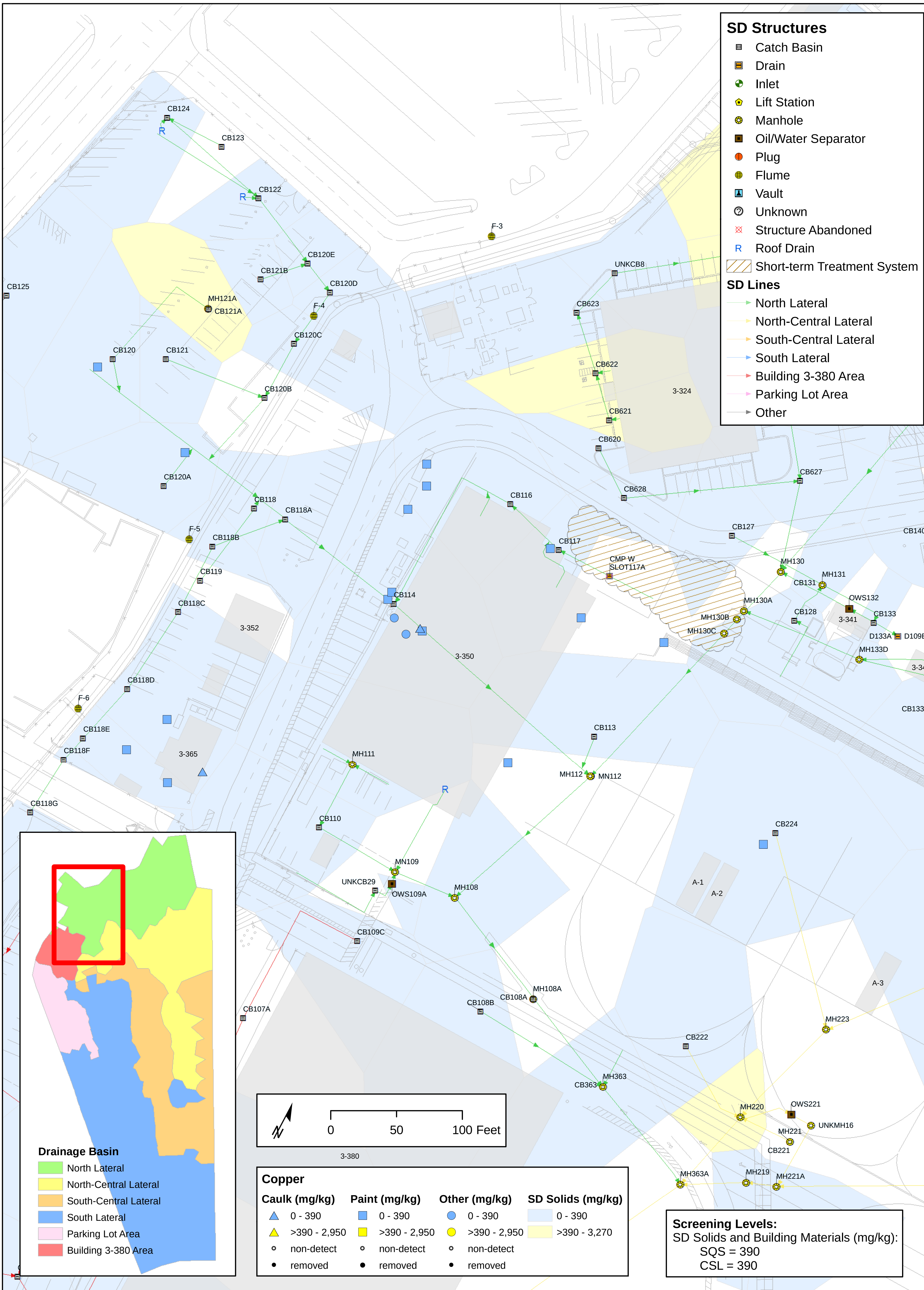

Figure 4-19. Copper in Building Materials Near Building 3-350 at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-19_Copper_BuildingMaterial_near_3-380-PORTRAIT.mxd
Illustrative purposes only.

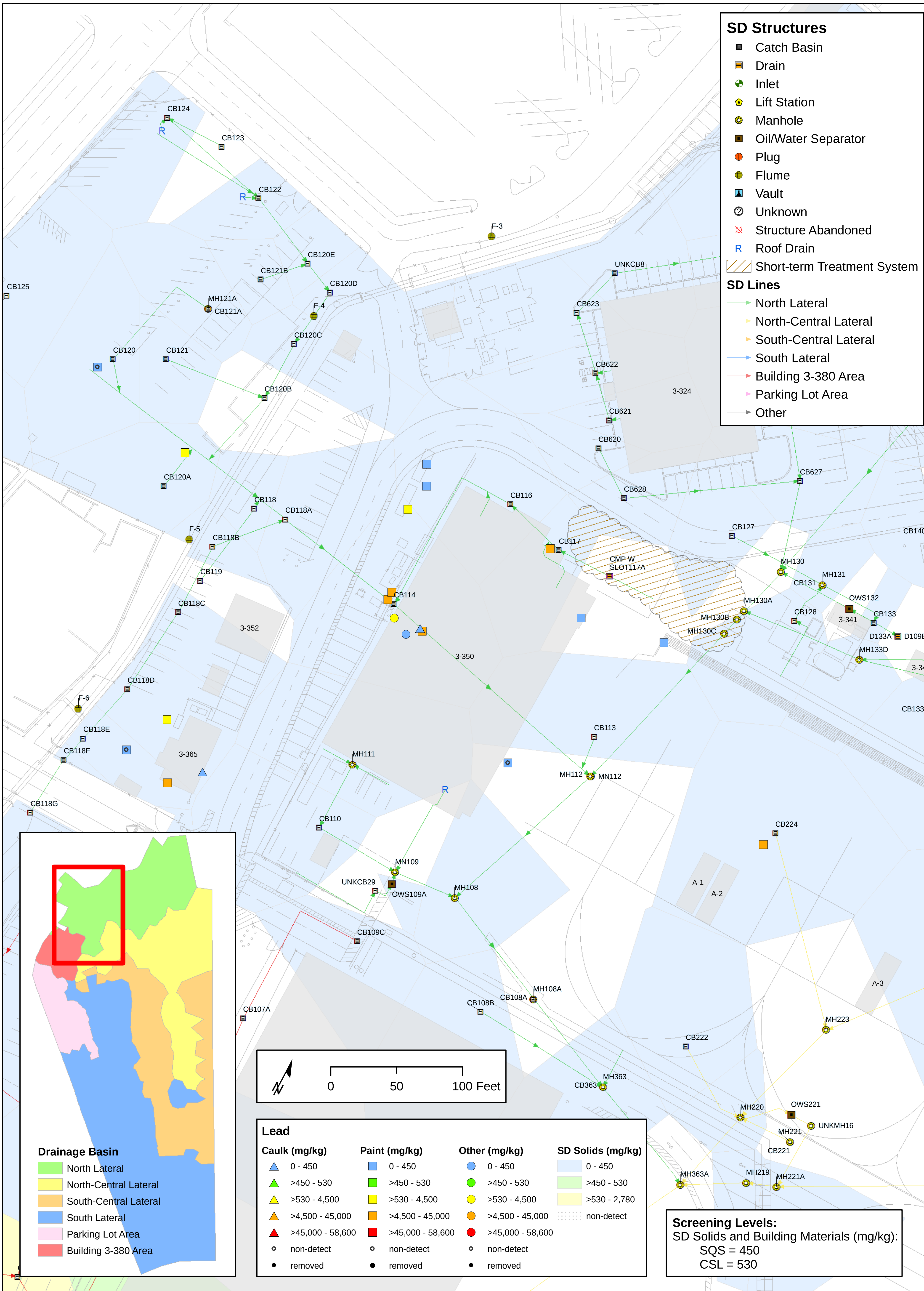

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Figure 4-20. Lead in Building Materials Near Building 3-350 at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-20_Lead_BuildingMaterial_near_3-380-PORTRAIT.mxd
Illustrative purposes only.

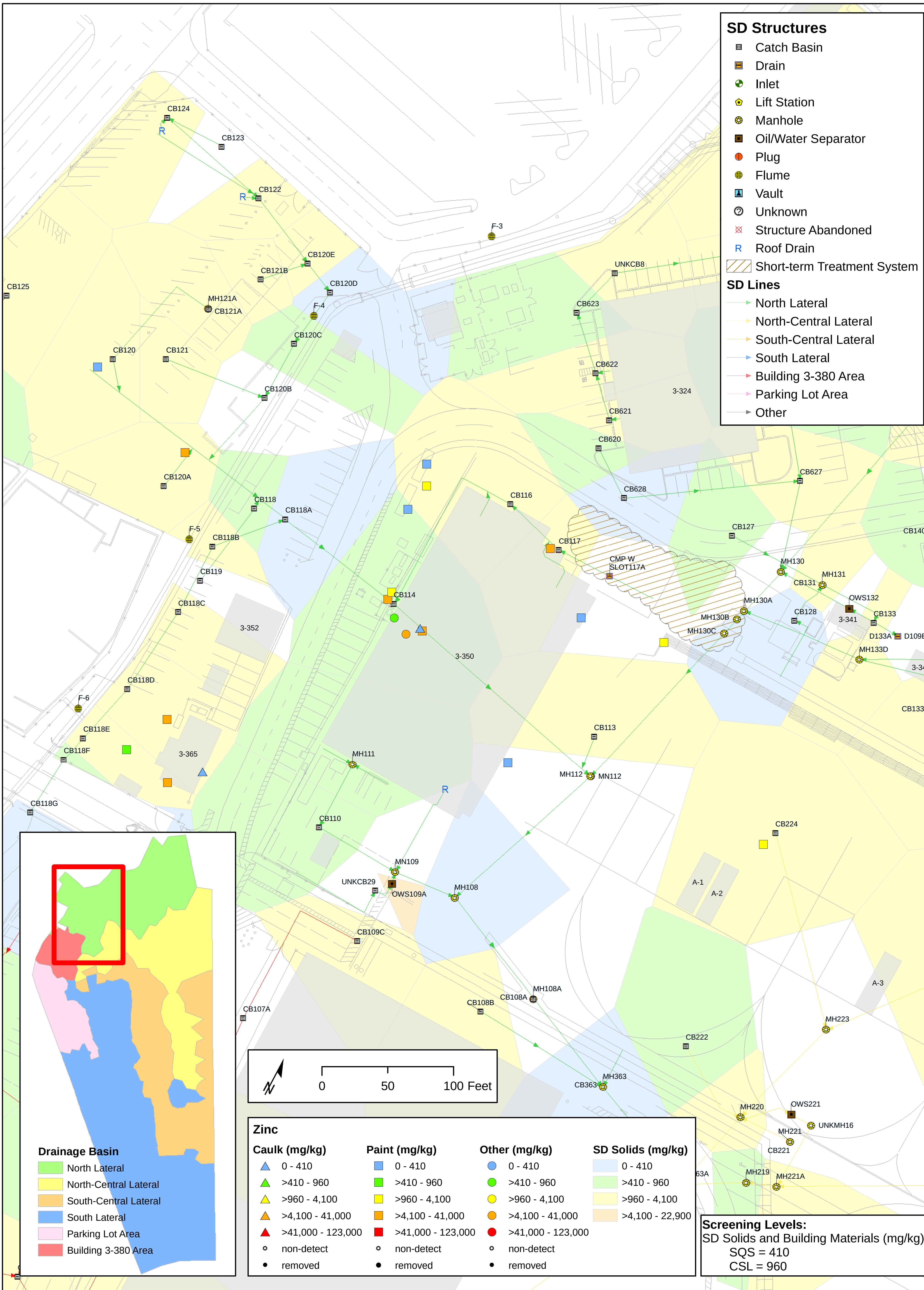

Figure 4-21. Zinc in Building Materials Near Building 3-350 at NBF-GTSP Site

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-21_Zinc_BuildingMaterial_near_3-380-PORTRAIT.mxd
Illustrative purposes only.

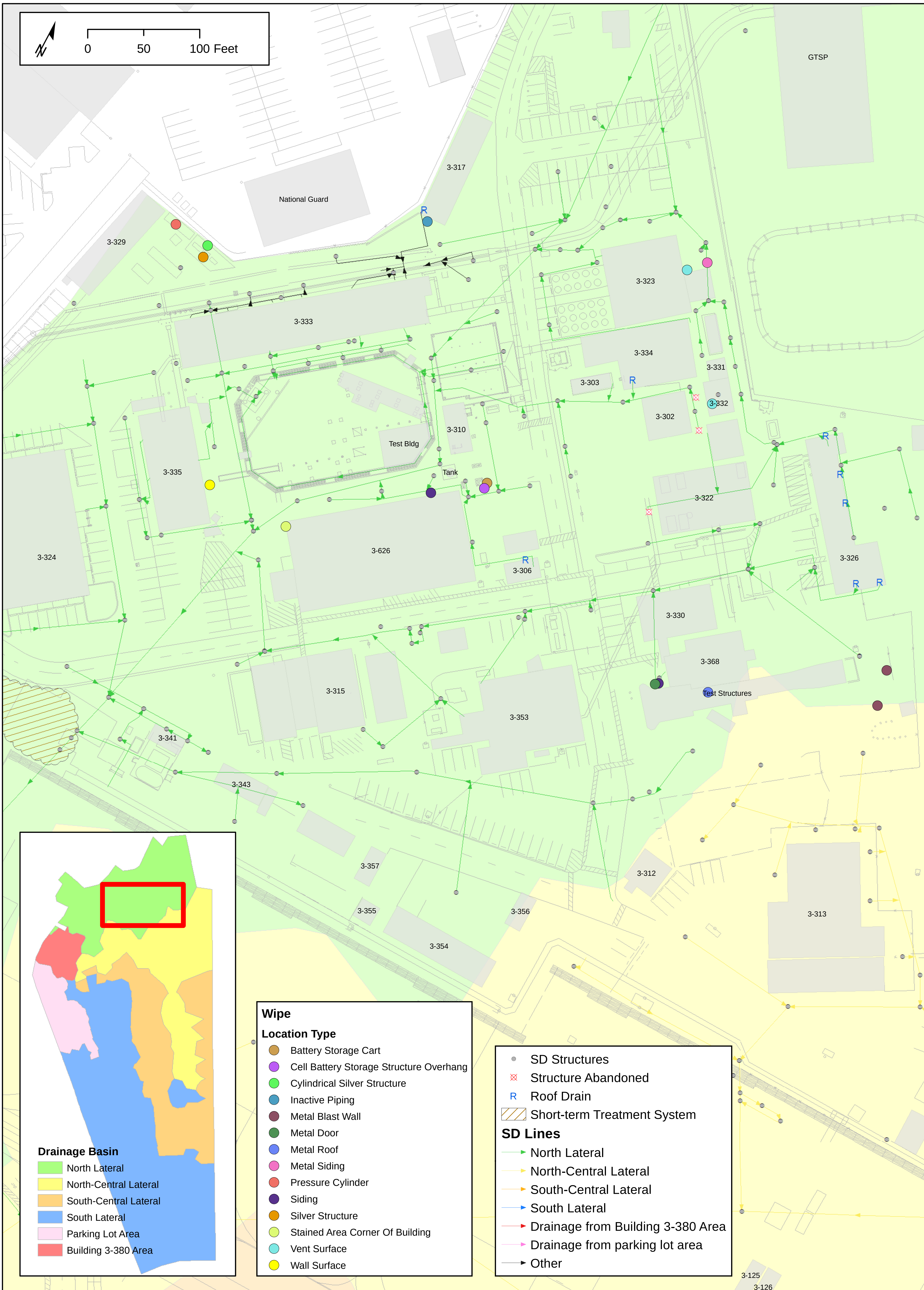

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Figure 4-22. Wipe Sampling Locations at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-22_Wipe_sampling_overview-PORTRAIT.mxd
Illustrative purposes only.

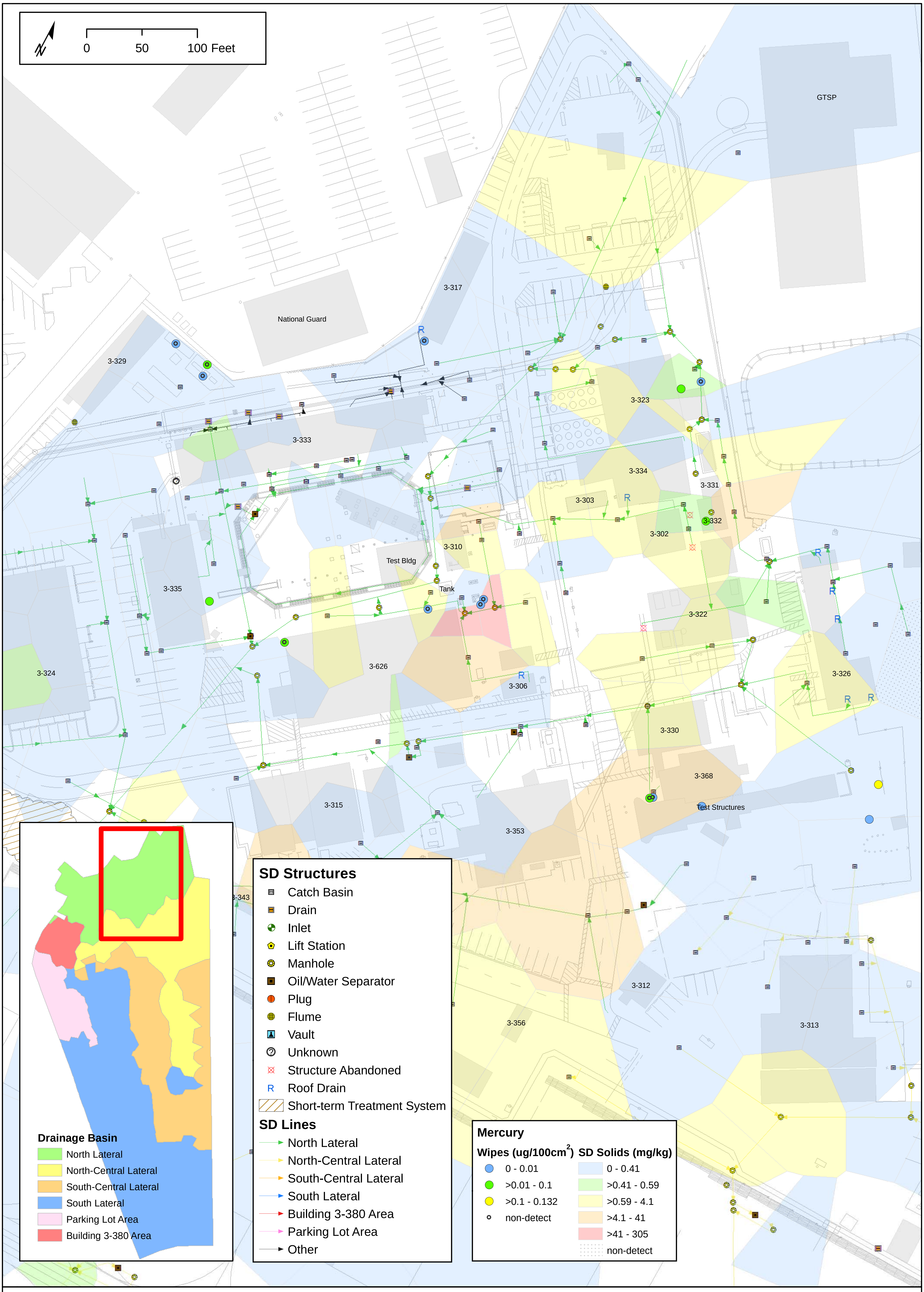

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Figure 4-23. Mercury in Wipe Samples at NBF-GTSP Site

SAIC From Science to Solutions

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-23_Mercury_Wipe_sampling-PORTRAIT.mxd
Illustrative purposes only.

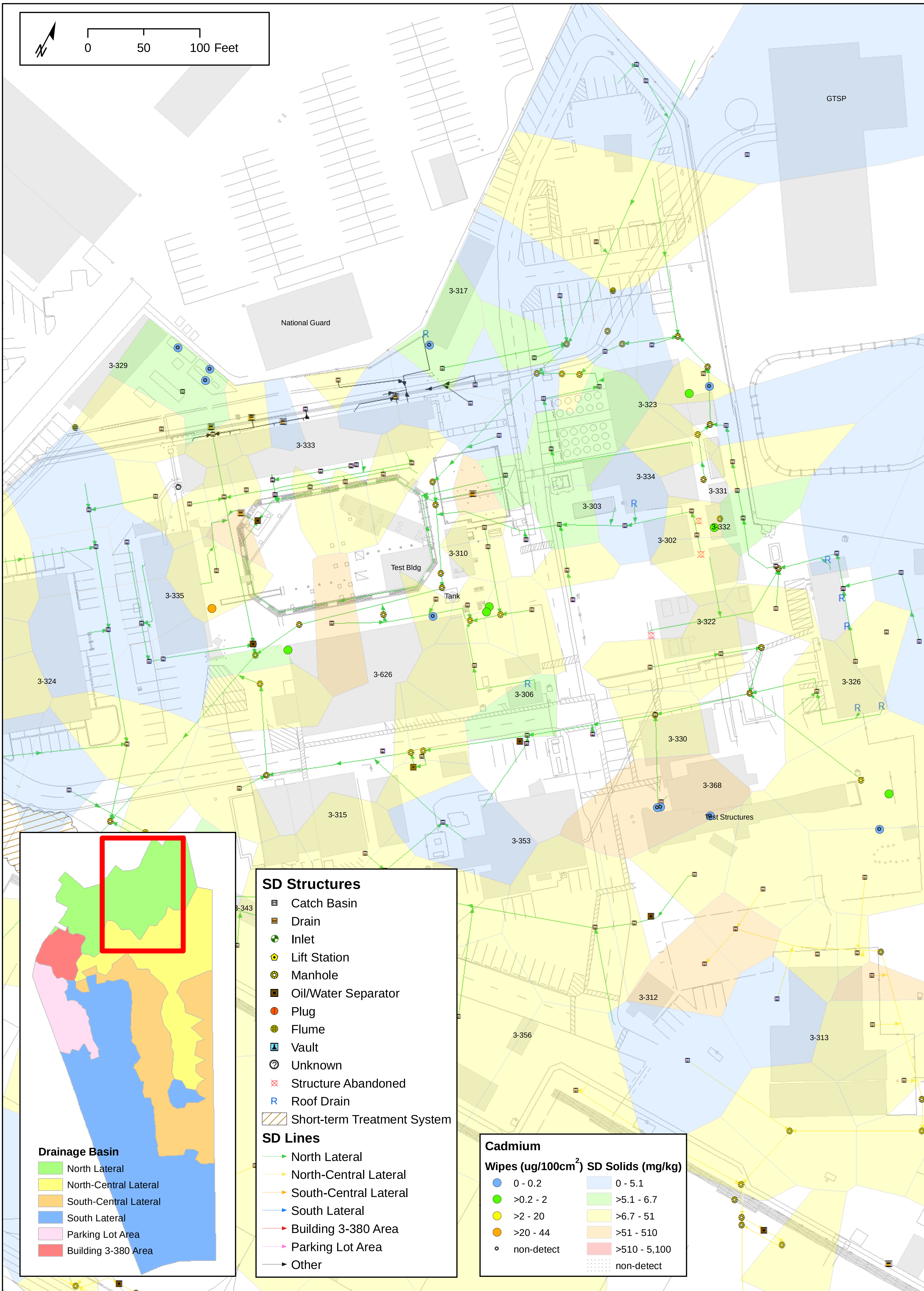

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Figure 4-24. Cadmium in Wipe Samples at NBF-GTSP Site

SAIC® From Science to Solutions

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-23_Mercury_Wipe_sampling-PORTRAIT.mxd
Illustrative purposes only.

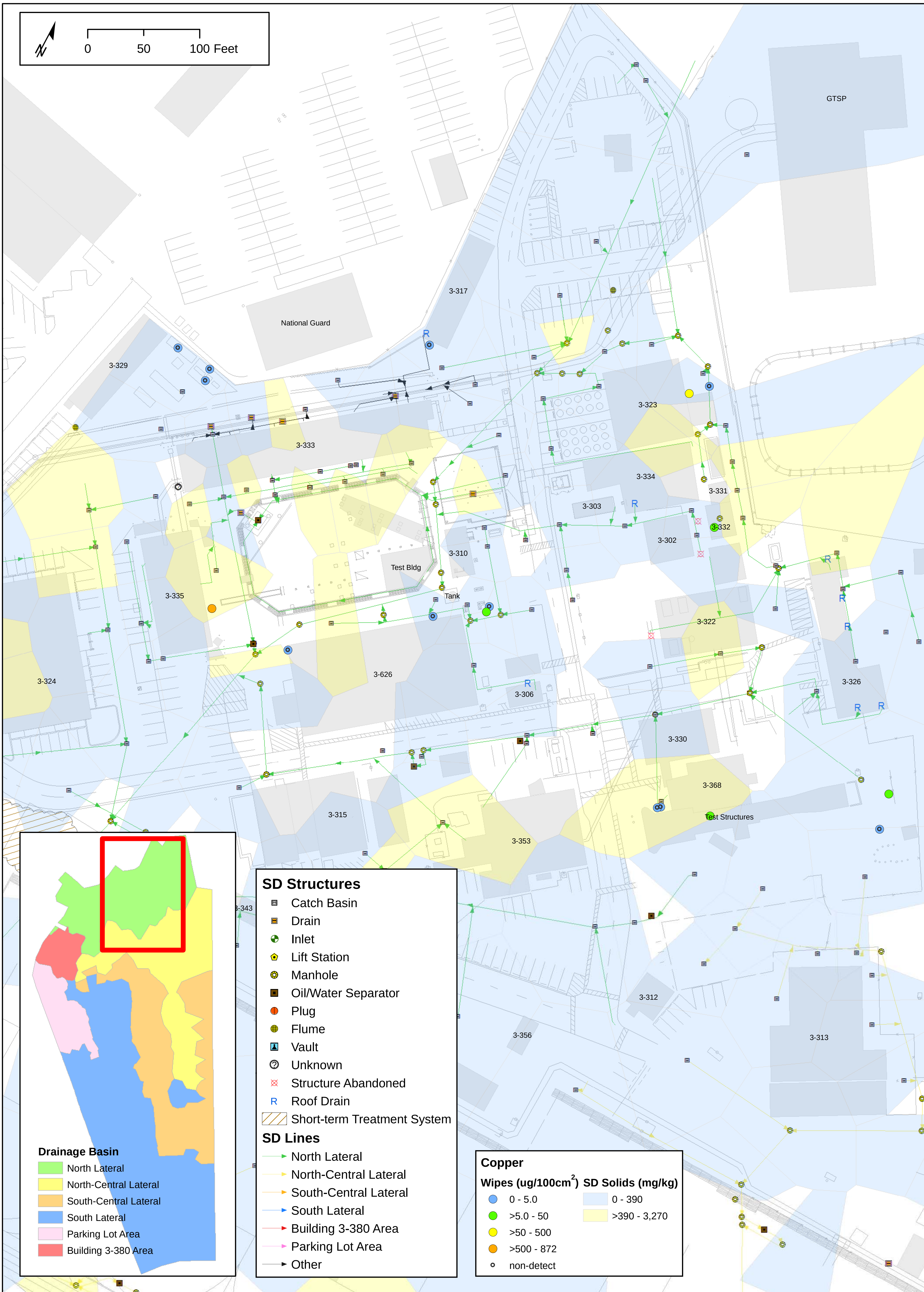

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Figure 4-25. Copper in Wipe Samples at NBF-GTSP Site

SAIC From Science to Solutions

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-24_Cadmium_Wipe_sampling-PORTRAIT.mxd
Illustrative purposes only.

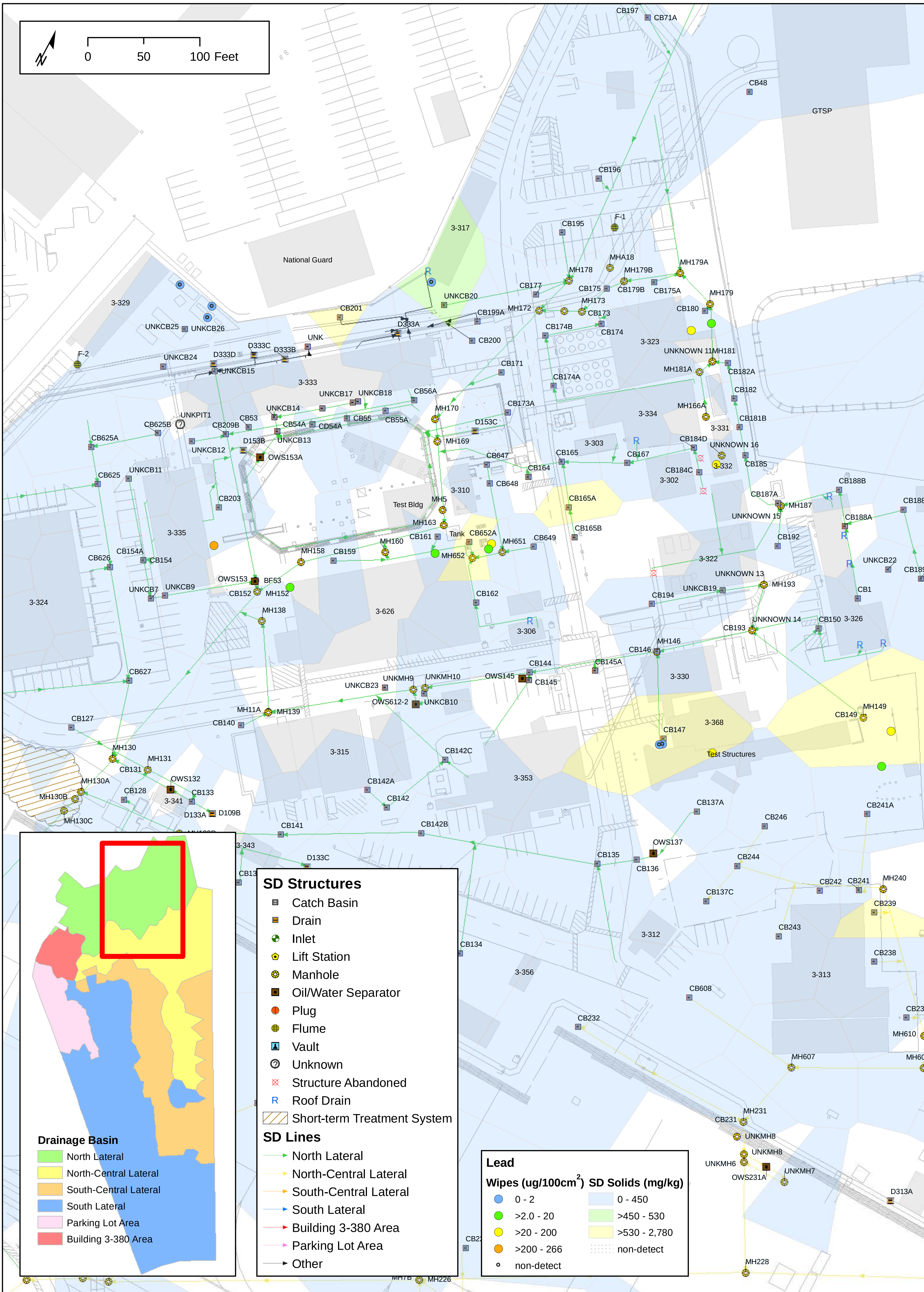

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Figure 4-26. Lead in Wipe Samples at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-26_Lead_Wipe_sampling-PORTRAIT.mxd
Illustrative purposes only.

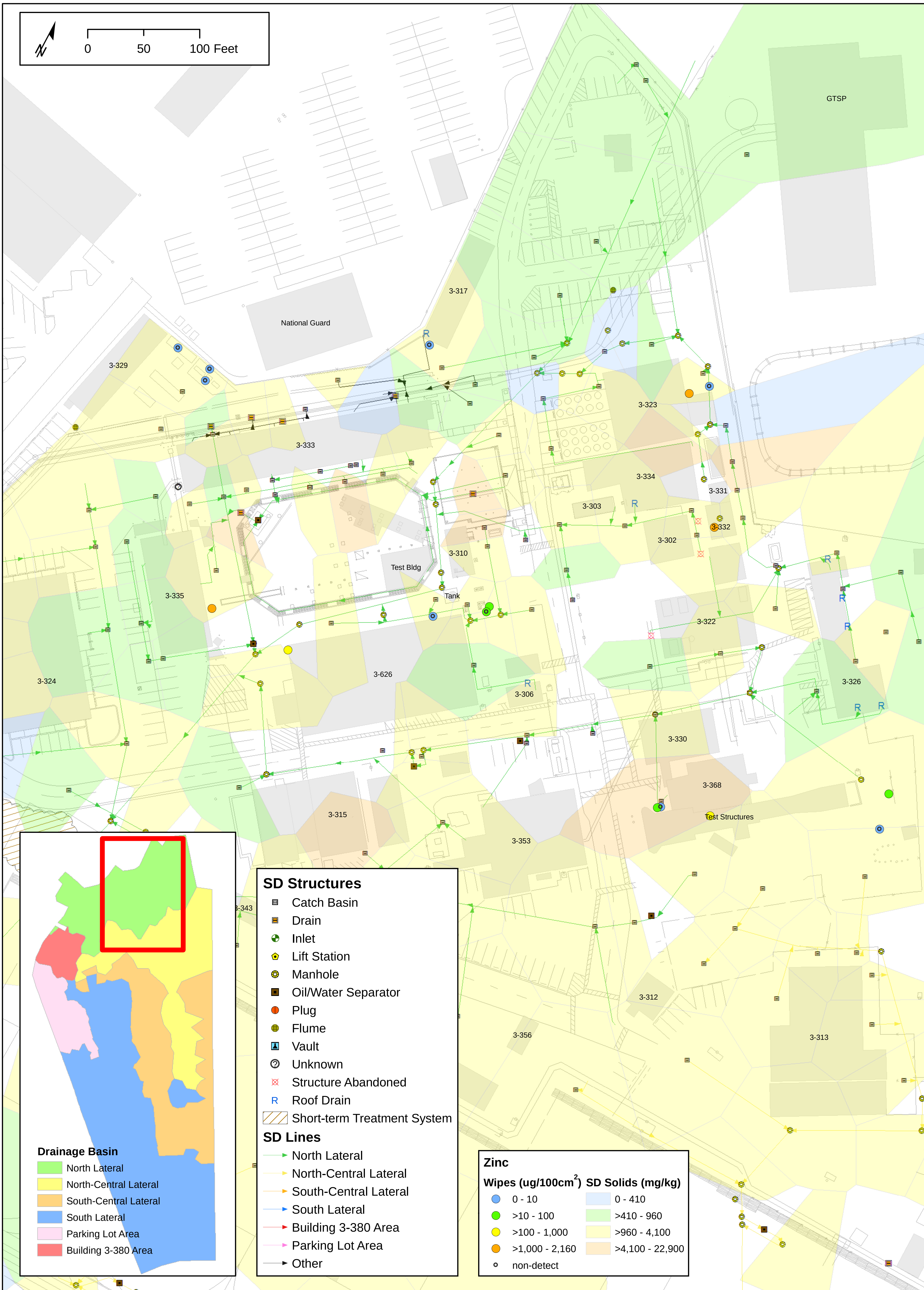

Figure 4-27. Zinc in Wipe Samples at NBF-GTSP Site

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SAIC From Science to Solutions

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-27_Zinc_Wipe_sampling-PORTRAIT.mxd
Illustrative purposes only.

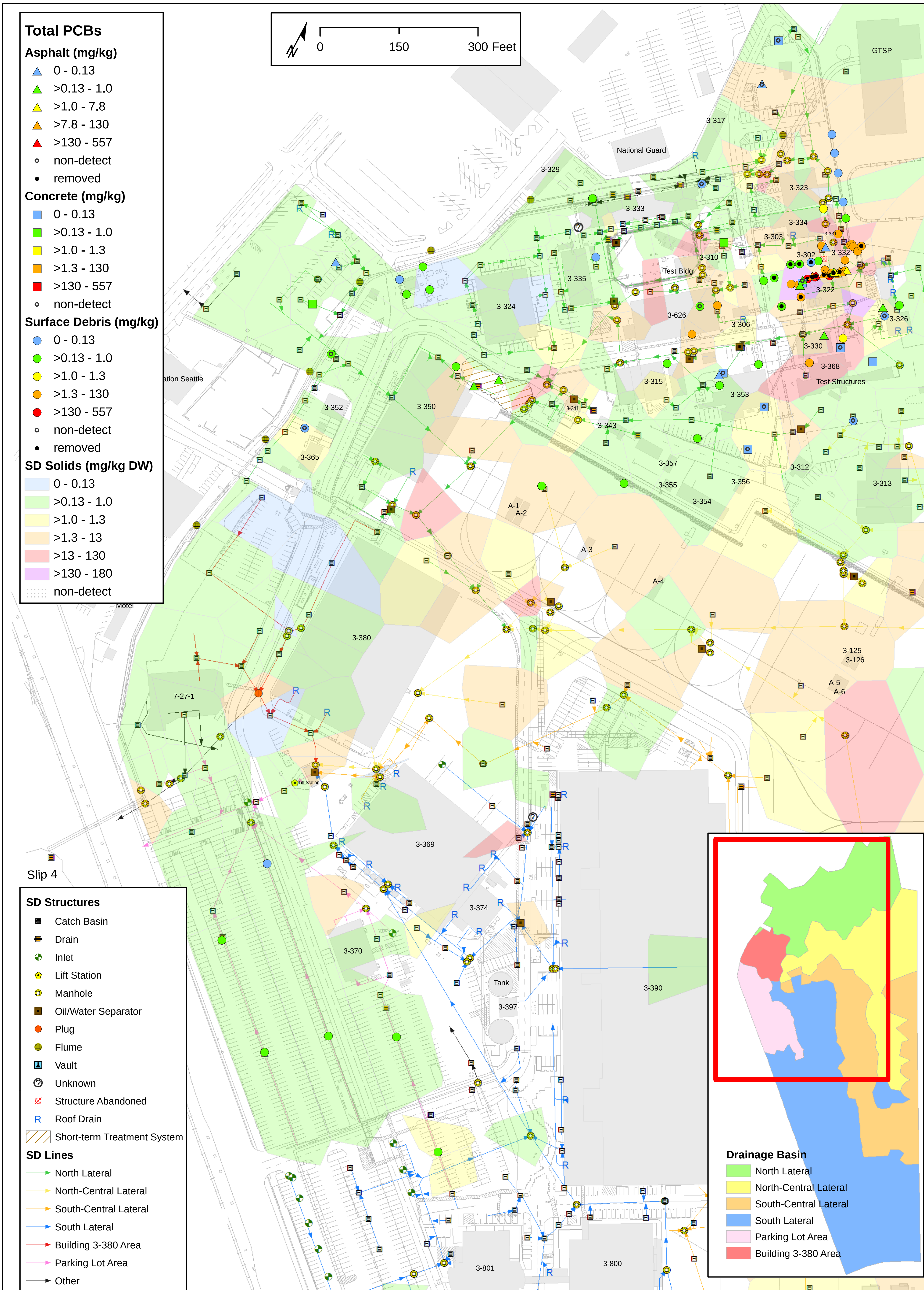

Figure 4-28. Total PCBs in Asphalt, Concrete, and Surface Debris at NBF-GTSP Site

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-31_PCB_Surface_Materials-PORTRAIT.mxd
Illustrative purposes only.

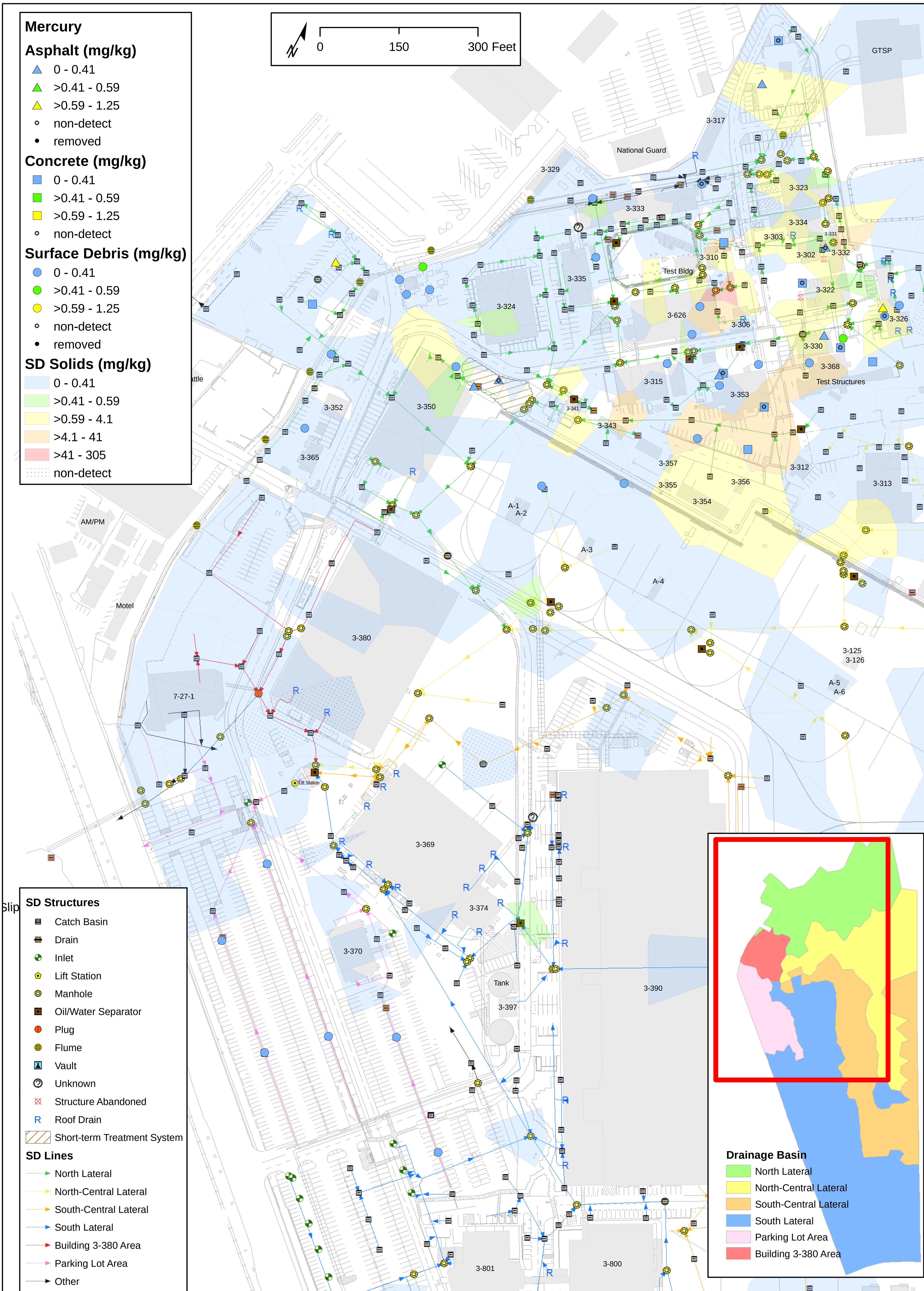

Figure 4-29. Mercury in Asphalt, Concrete, and Surface Debris at NBF-GTSP Site

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-29_Mercury_Surface_Materials-PORTRAIT.mxd
Illustrative purposes only.

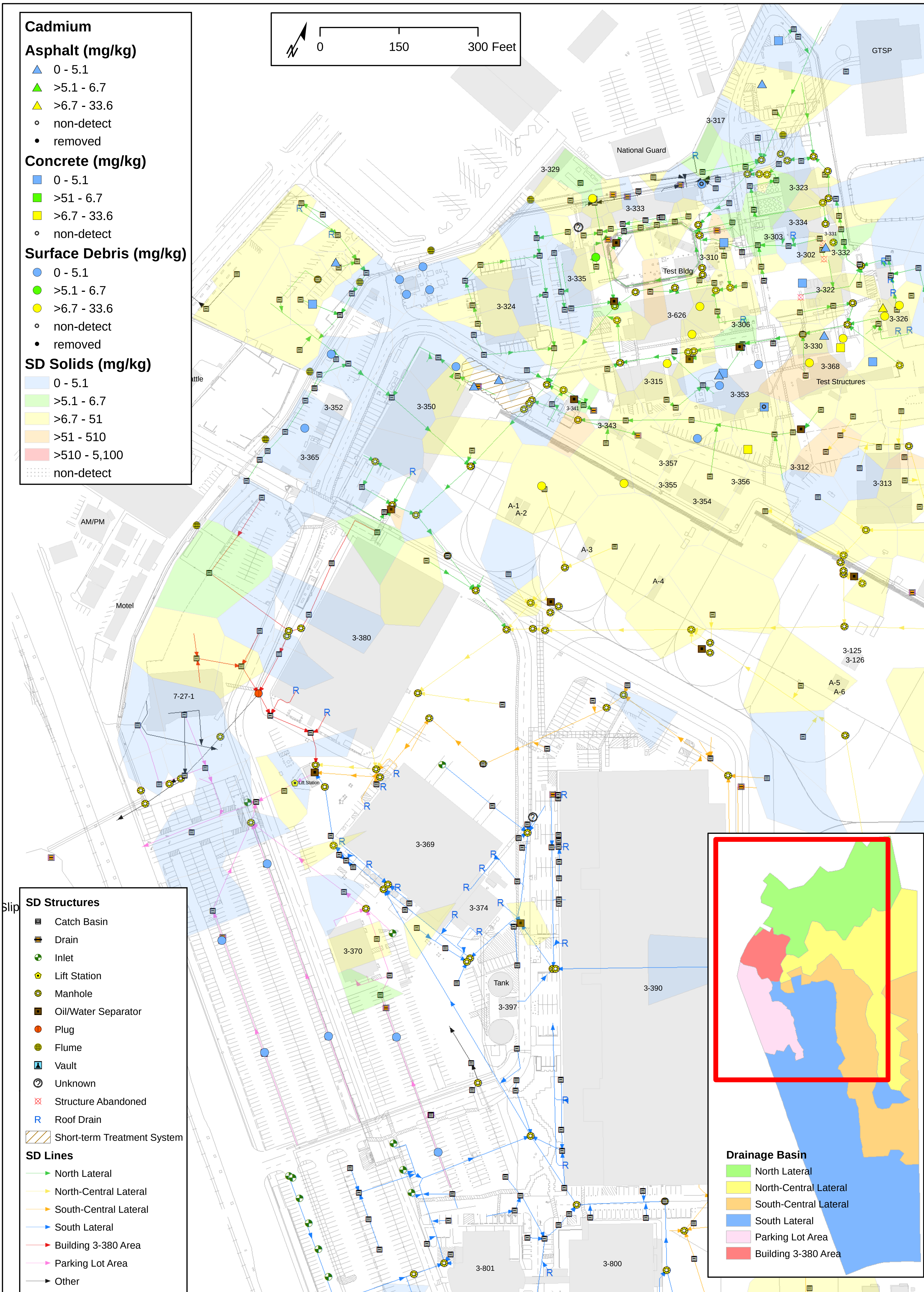

Figure 4-30. Cadmium in Asphalt, Concrete, and Surface Debris at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-30_Cadmium_Surface_Materials-PORTRAIT.mxd
Illustrative purposes only.

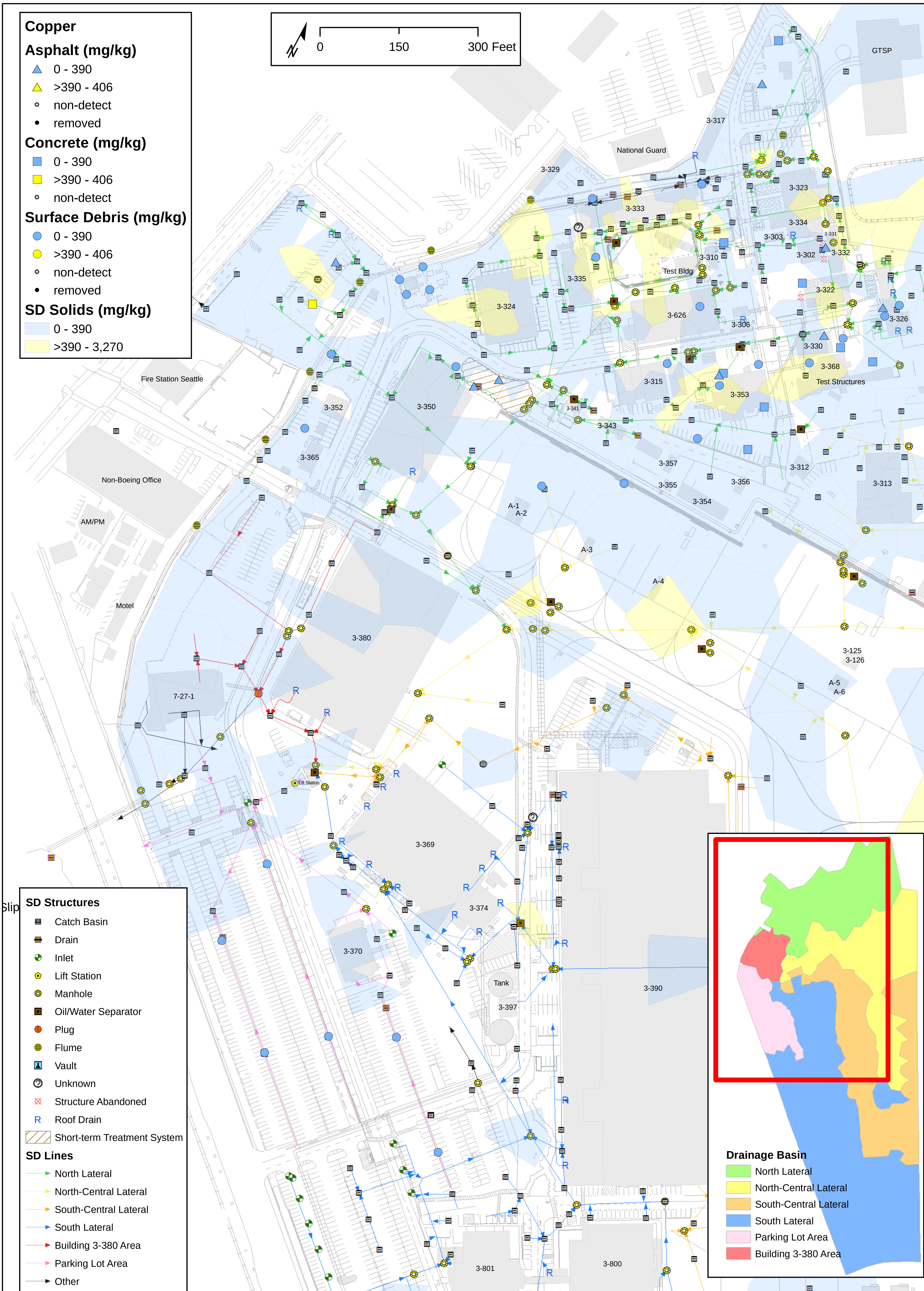

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Figure 4-31. Copper in Asphalt, Concrete, and Surface Debris at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-31_Copper_Surface_Materials-PORTRAIT.mxd
Illustrative purposes only.

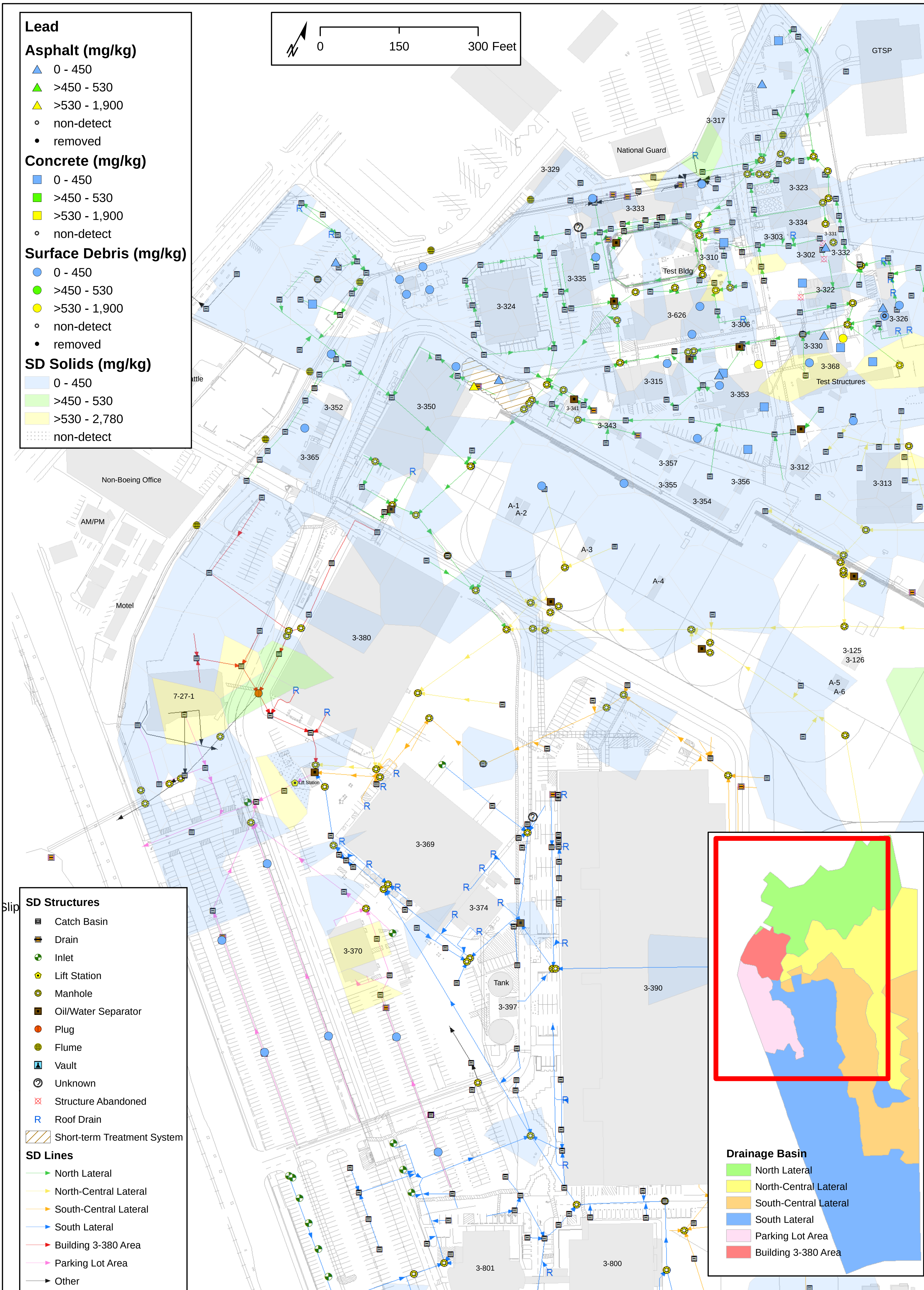

Figure 4-32. Lead in Asphalt, Concrete, and Surface Debris at NBF-GTSP Site

DEPARTMENT OF ECOLOGY State of Washington

SAIC From Science to Solutions

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-32_Lead_Surface_Materials-PORTRAIT.mxd
Illustrative purposes only.

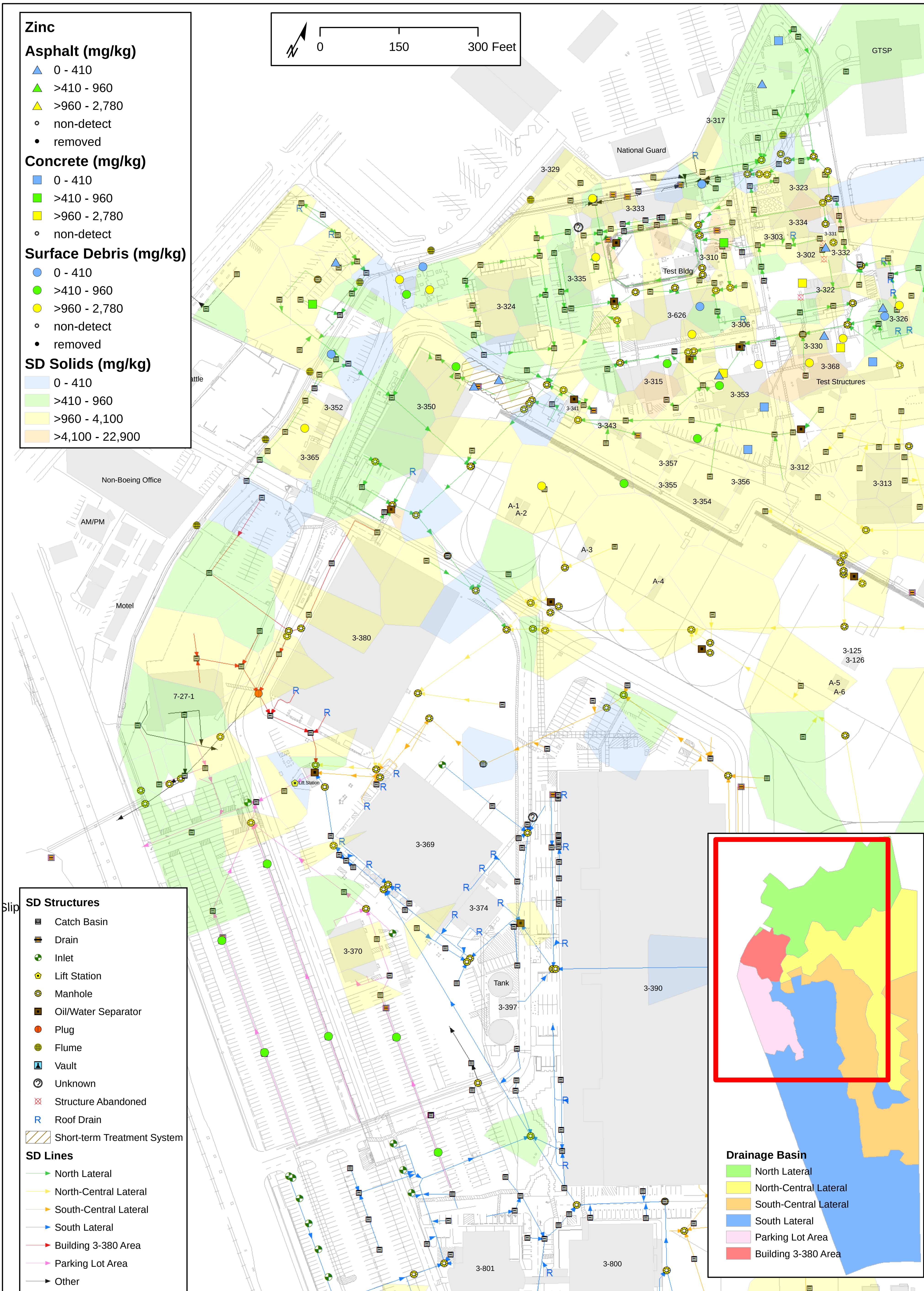

Figure 4-33. Zinc in Asphalt, Concrete, and Surface Debris at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 4-33_Zinc_Surface_Materials-PORTRAIT.mxd
Illustrative purposes only.

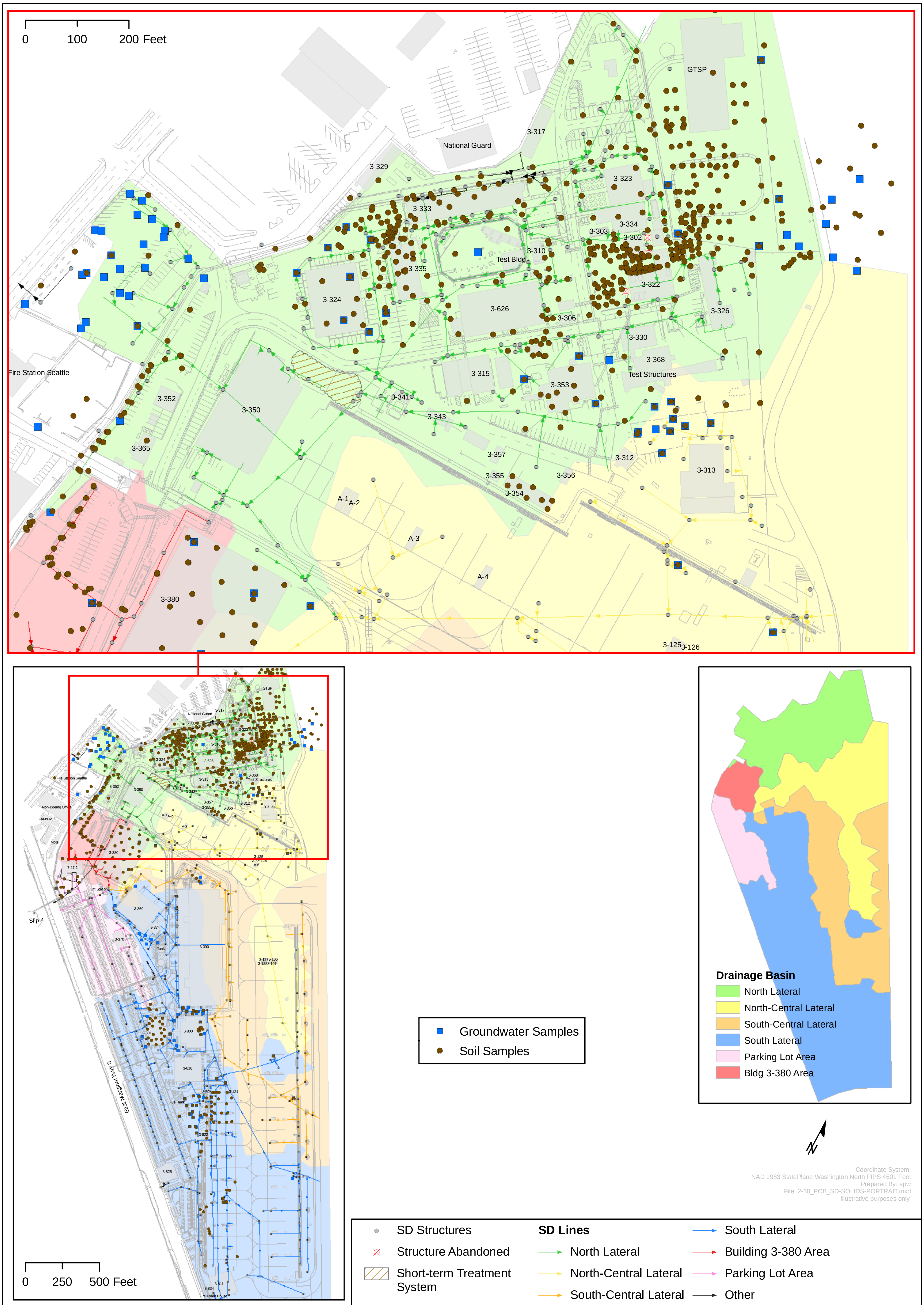

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Figure 5-1. Soil and Groundwater Sampling Locations at NBF-GTSP Site

SAIC From Science to Solutions

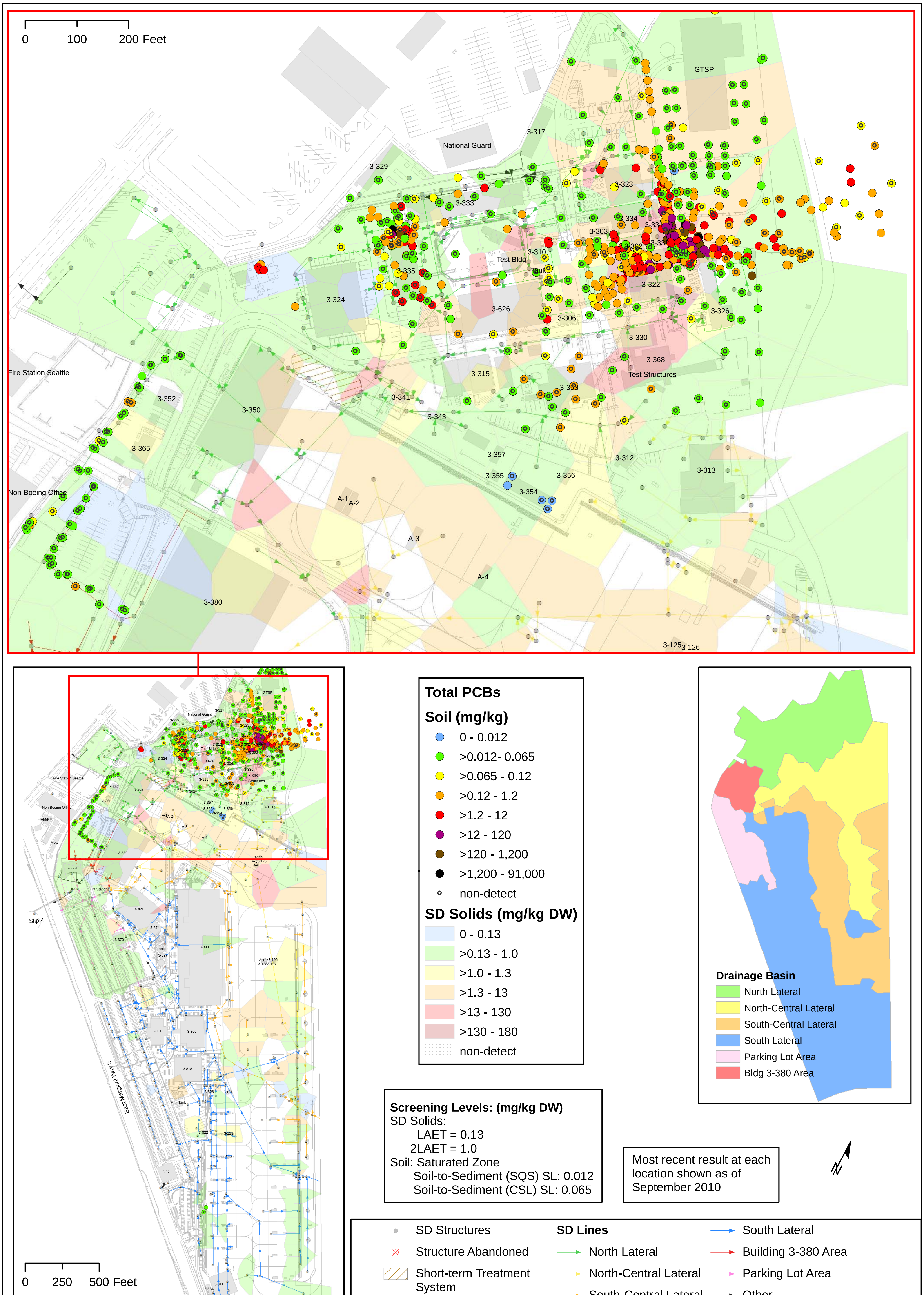

Figure 5-2. Total PCBs in Shallow (0-4 ft) Soil at NBF-GTSP Site

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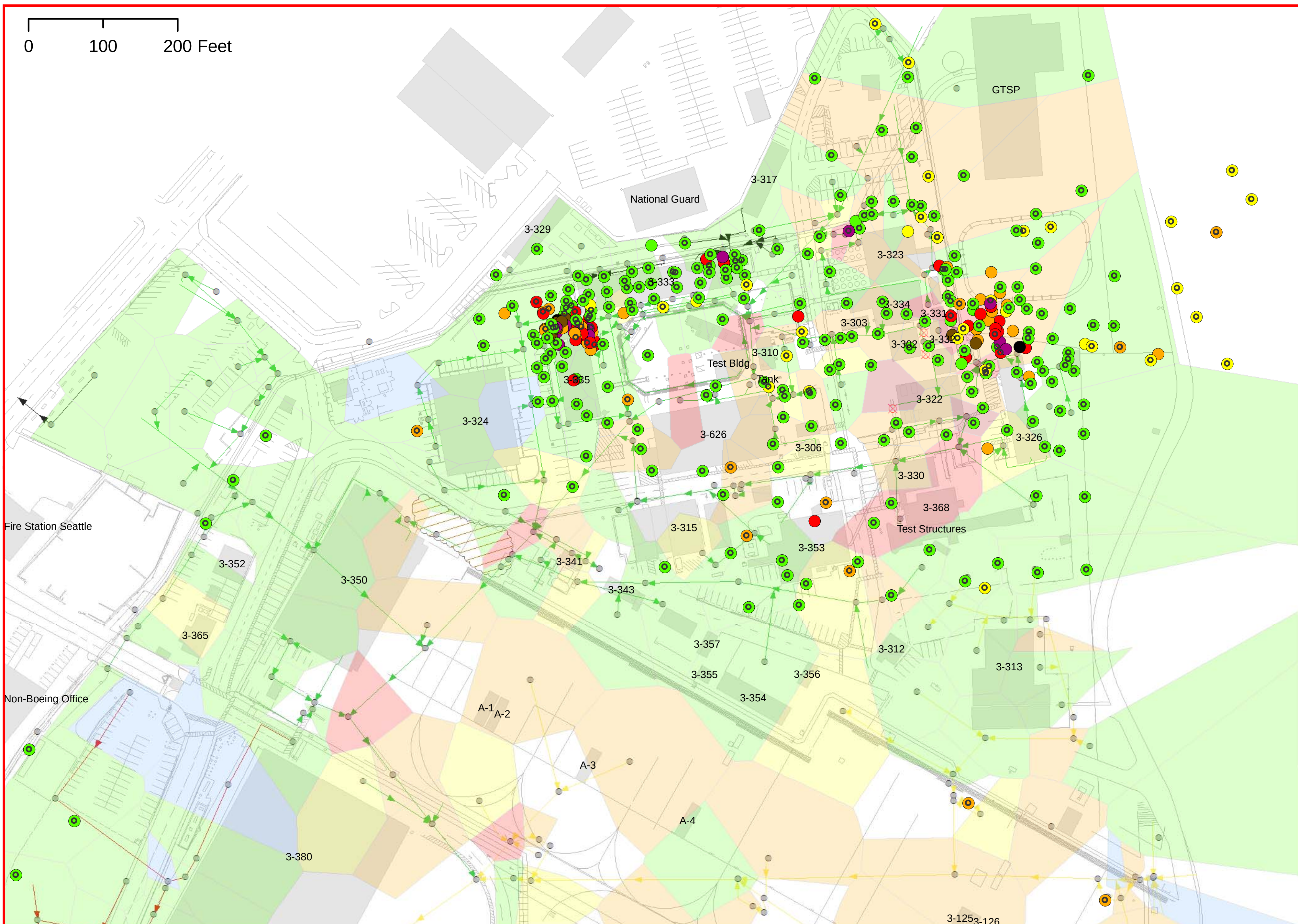
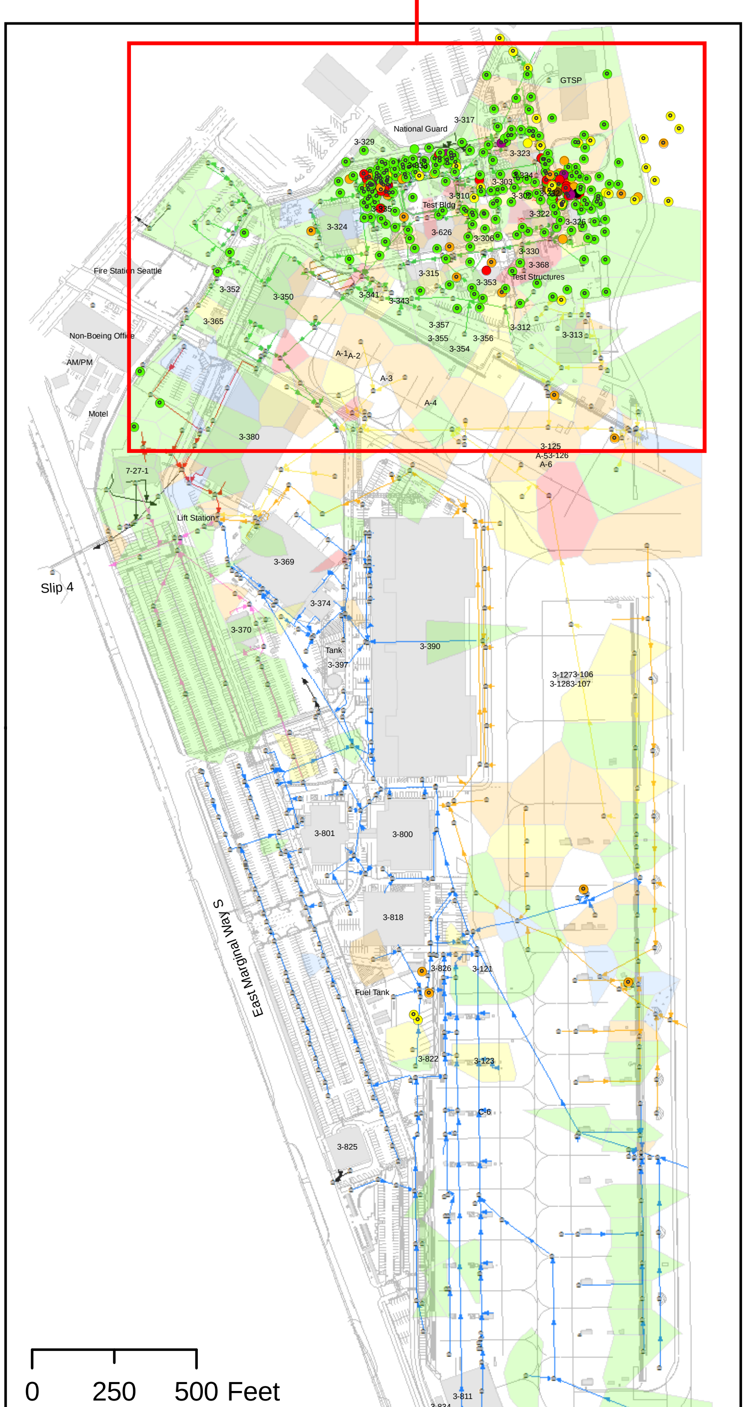
Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-02b_PCB_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

SAIC From Science to Solutions





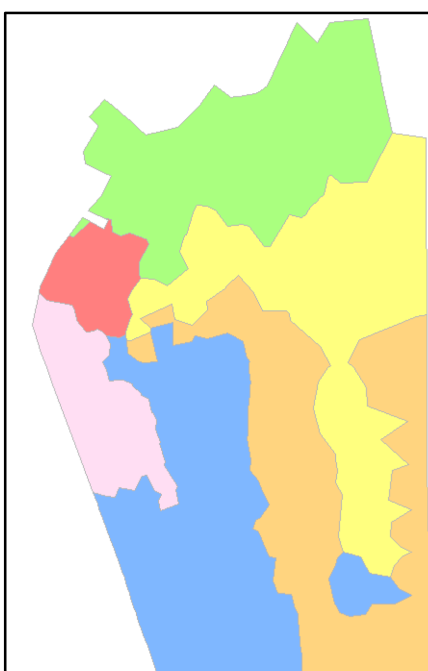
Total PCBs

Soil (mg/kg)

- 0 - 0.012
- >0.012 - 0.065
- >0.065 - 0.12
- >0.12 - 1.2
- >1.2 - 12
- >12 - 120
- >120 - 1,200
- >1,200 - 2,300
- non-detect

SD Solids (mg/kg DW)

- 0 - 0.13
- >0.13 - 1.0
- >1.0 - 1.3
- >1.3 - 13
- >13 - 130
- >130 - 180
- non-detect



Screening Levels: (mg/kg DW)
SD Solids:
LAET = 0.13
2LAET = 1.0
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 0.012
Soil-to-Sediment (CSL) SL: 0.065

Most recent result at each location shown as of September 2010

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 5-3. Total PCBs in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-03_PCB_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.

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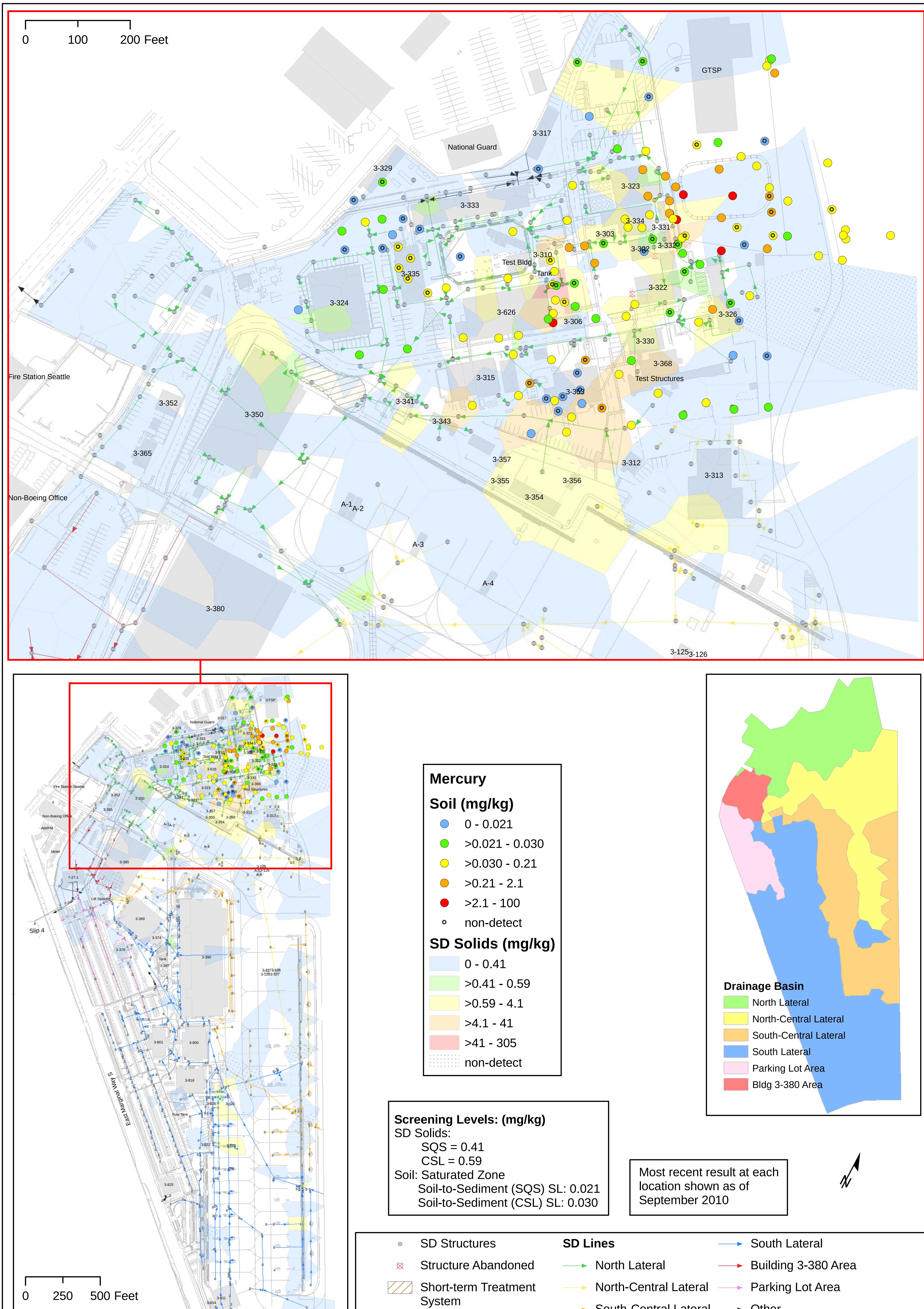

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Figure 5-4. Mercury in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-04_Mercury_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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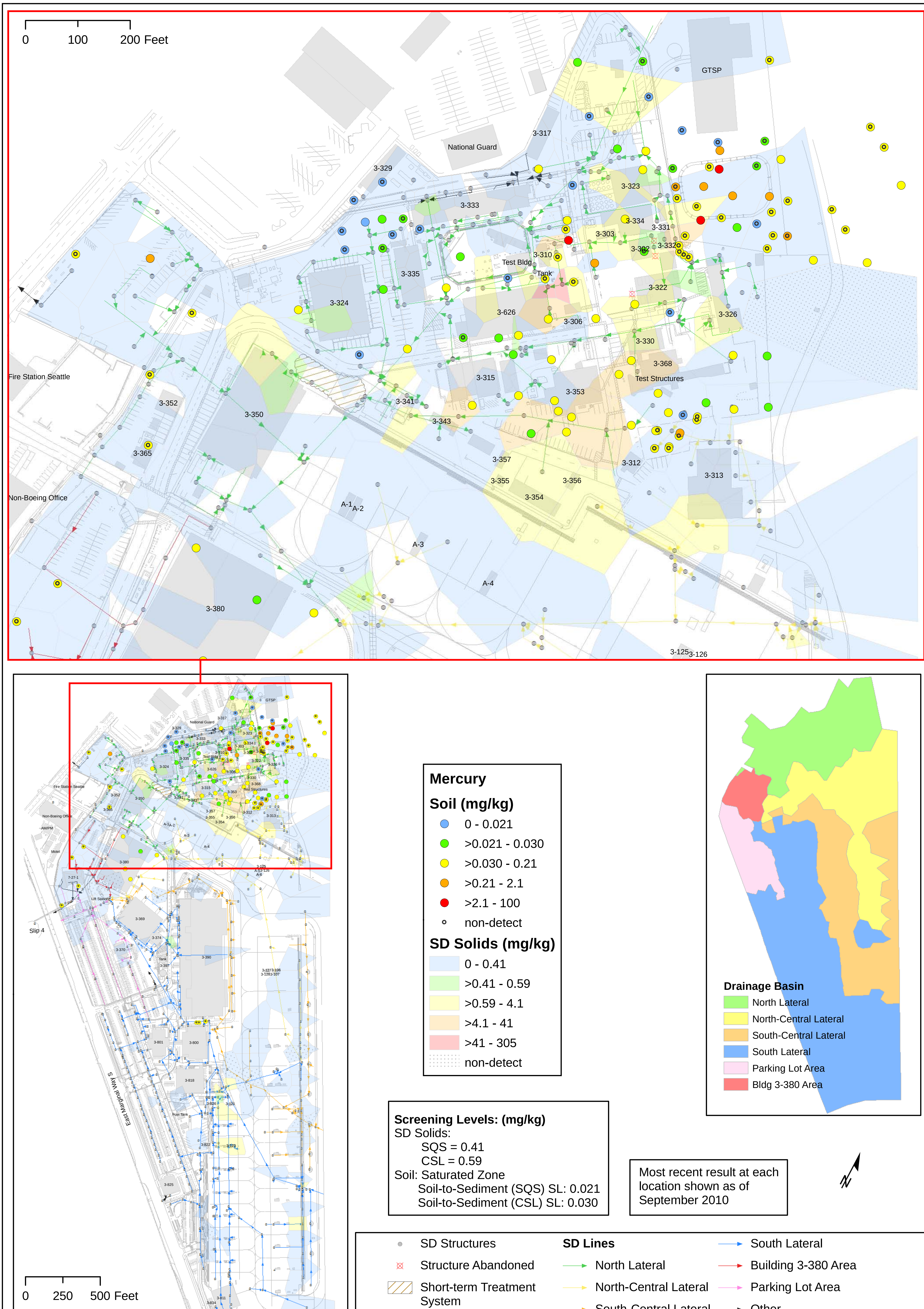
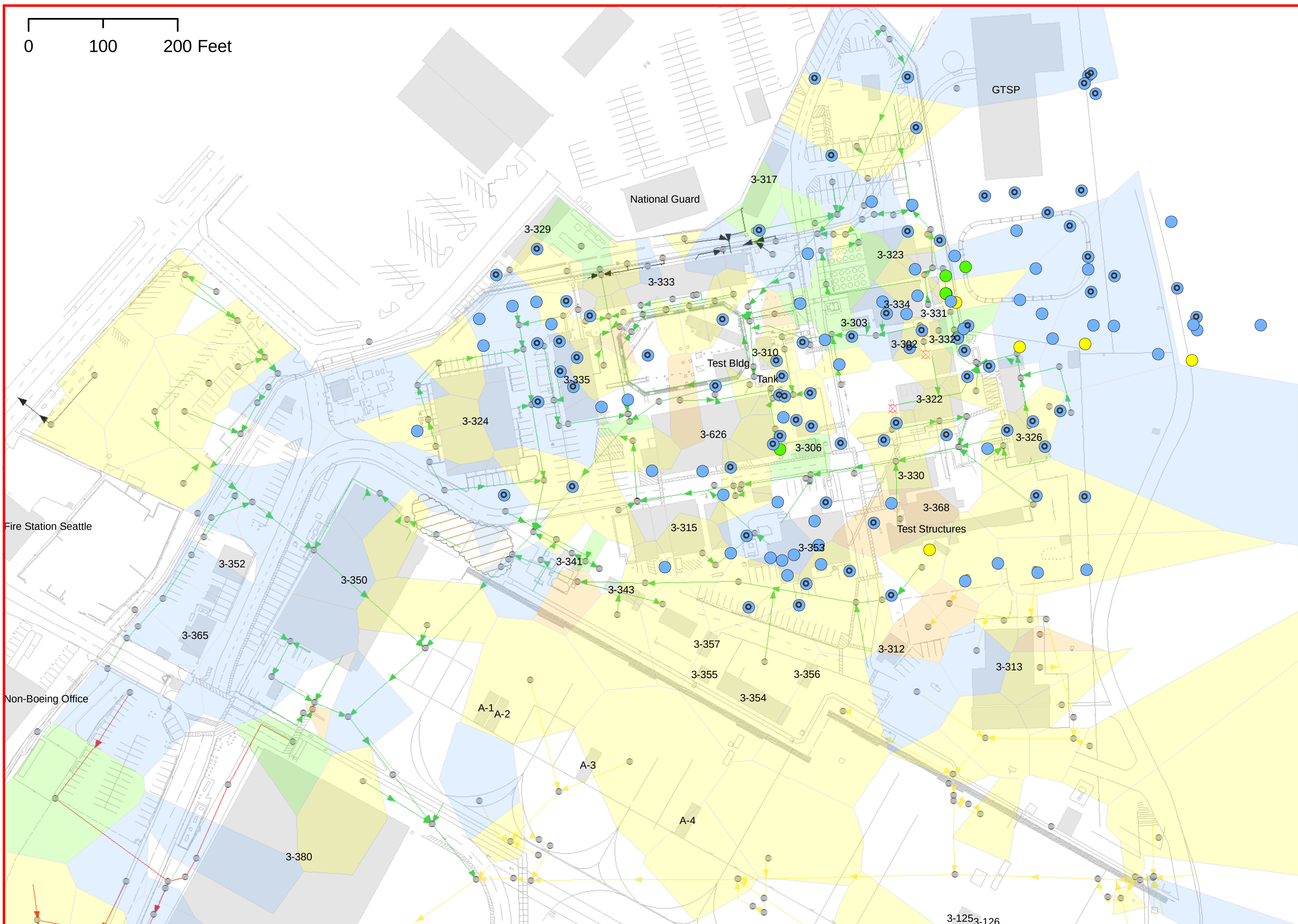
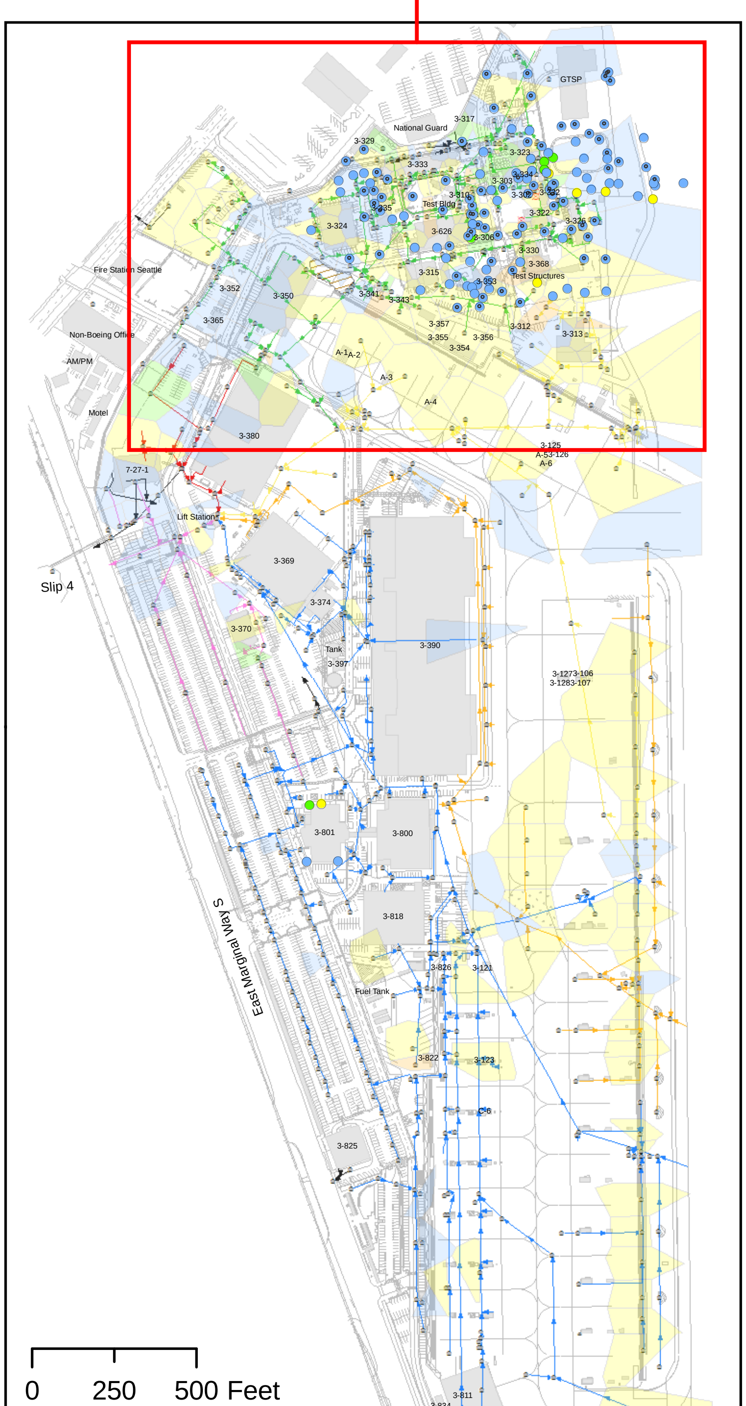


Figure 5-5. Mercury in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-05_Mercury_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.





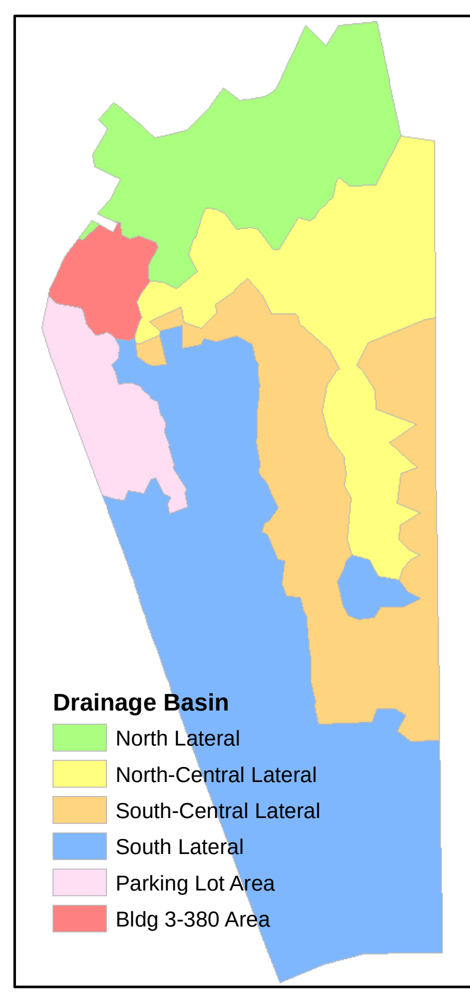
Cadmium

Soil (mg/kg)

- 0 - 1.3
- >1.3 - 1.7
- >1.7 - 12
- non-detect

SD Solids (mg/kg)

- 0 - 5.1
- >5.1 - 6.7
- >6.7 - 51
- >51 - 110
- non-detect



Screening Levels: (mg/kg)
SD Solids:
SQS = 5.1
CSL = 6.7
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 1.3
Soil-to-Sediment (CSL) SL: 1.7

Most recent result at each location shown as of September 2010

SD Structures	**SD Lines**	South Lateral
Structure Abandoned	North Lateral	Building 3-380 Area
Short-term Treatment System	North-Central Lateral	Parking Lot Area
	South-Central Lateral	Other

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Figure 5-6. Cadmium in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-06_Cadmium_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

SAIC From Science to Solutions

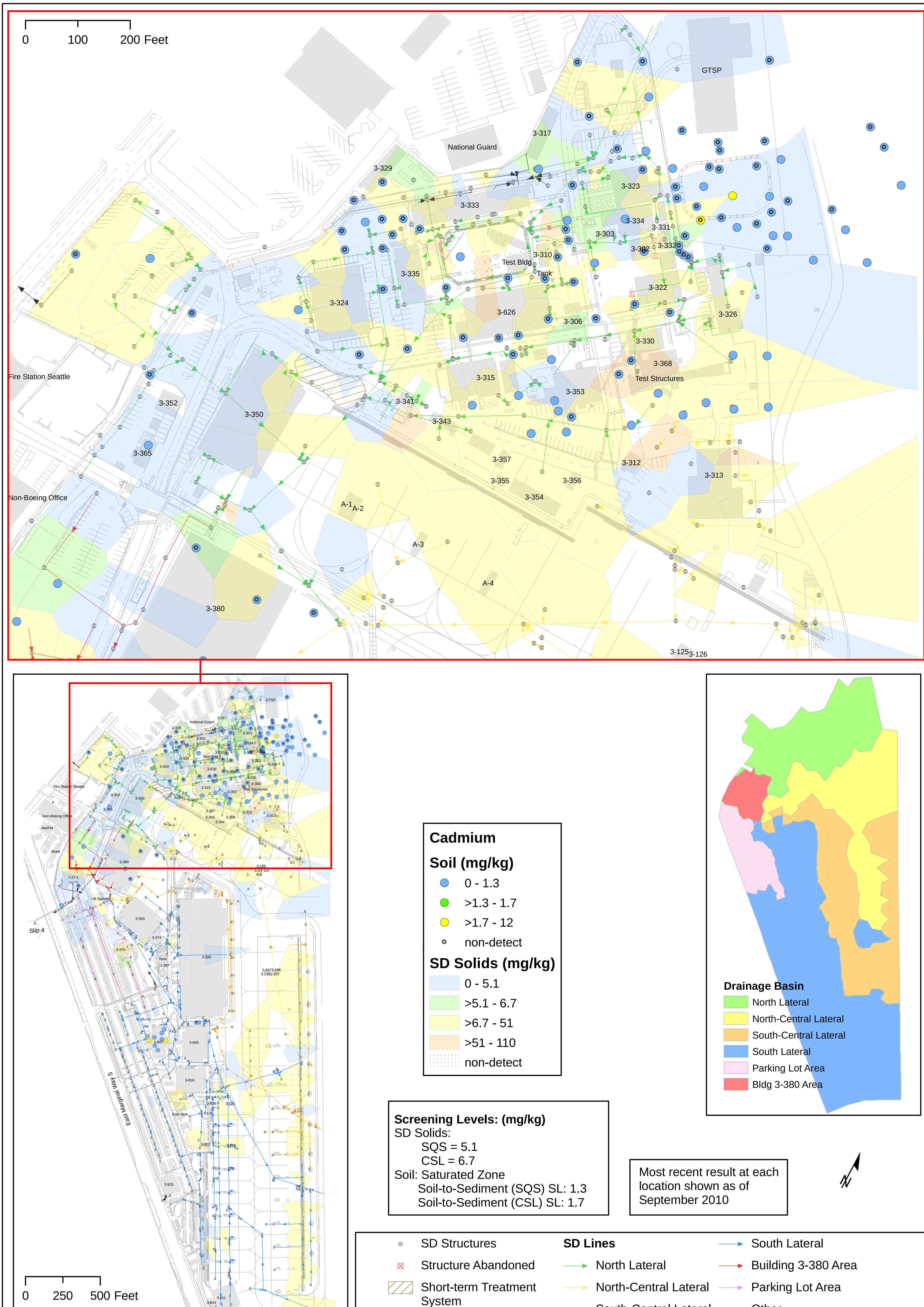

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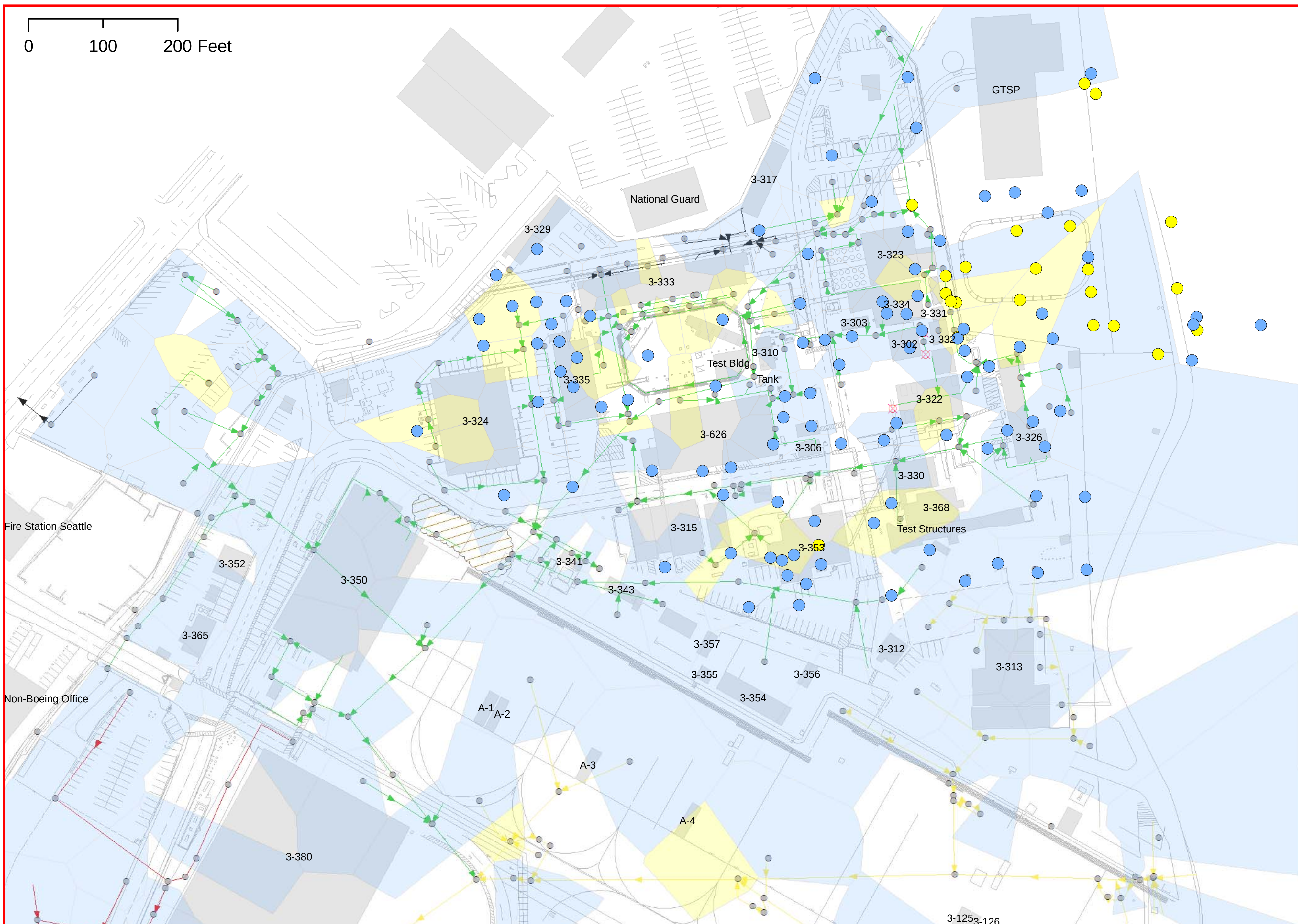
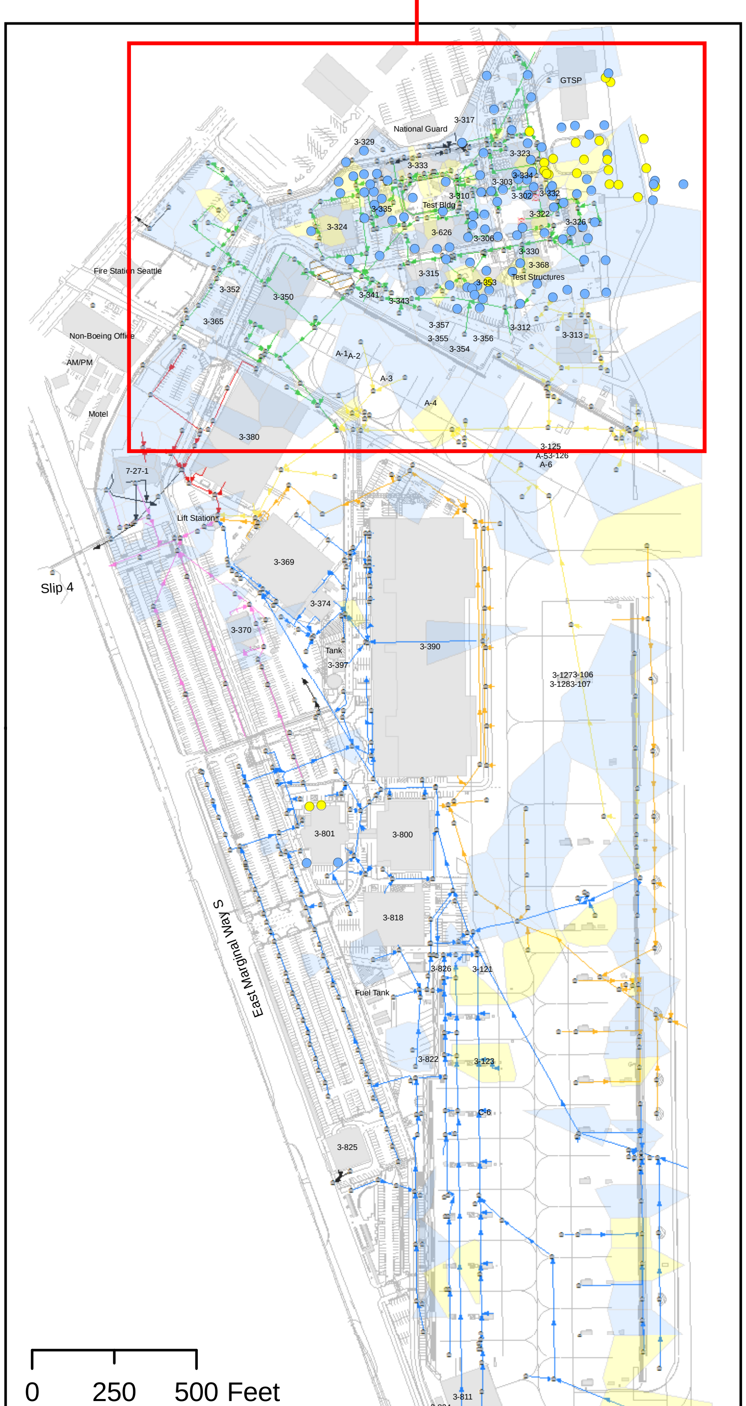
Figure 5-7. Cadmium in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-07_Cadmium_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.

SAIC From Science to Solutions





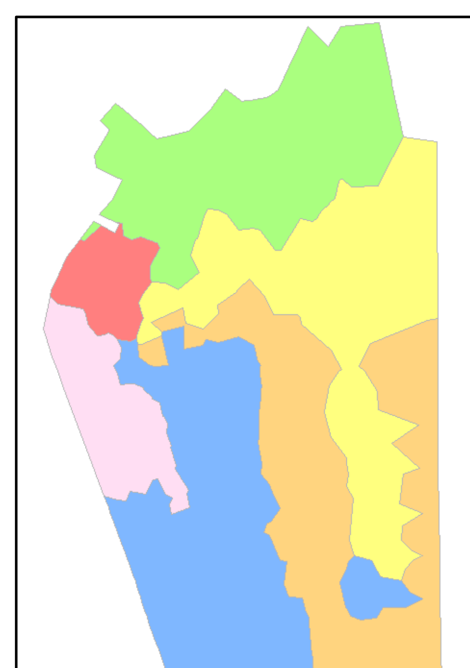
Copper

Soil (mg/kg)

- 0 - 39
- >39 - 230
- non-detect

SD Solids (mg/kg)

- 0 - 390
- >390 - 3,270



Screening Levels: (mg/kg)
SD Solids:
SQS = 390
CSL = 390
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 39
Soil-to-Sediment (CSL) SL: 39

Most recent result at each location shown as of September 2010

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 5-8. Copper in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-08_Copper_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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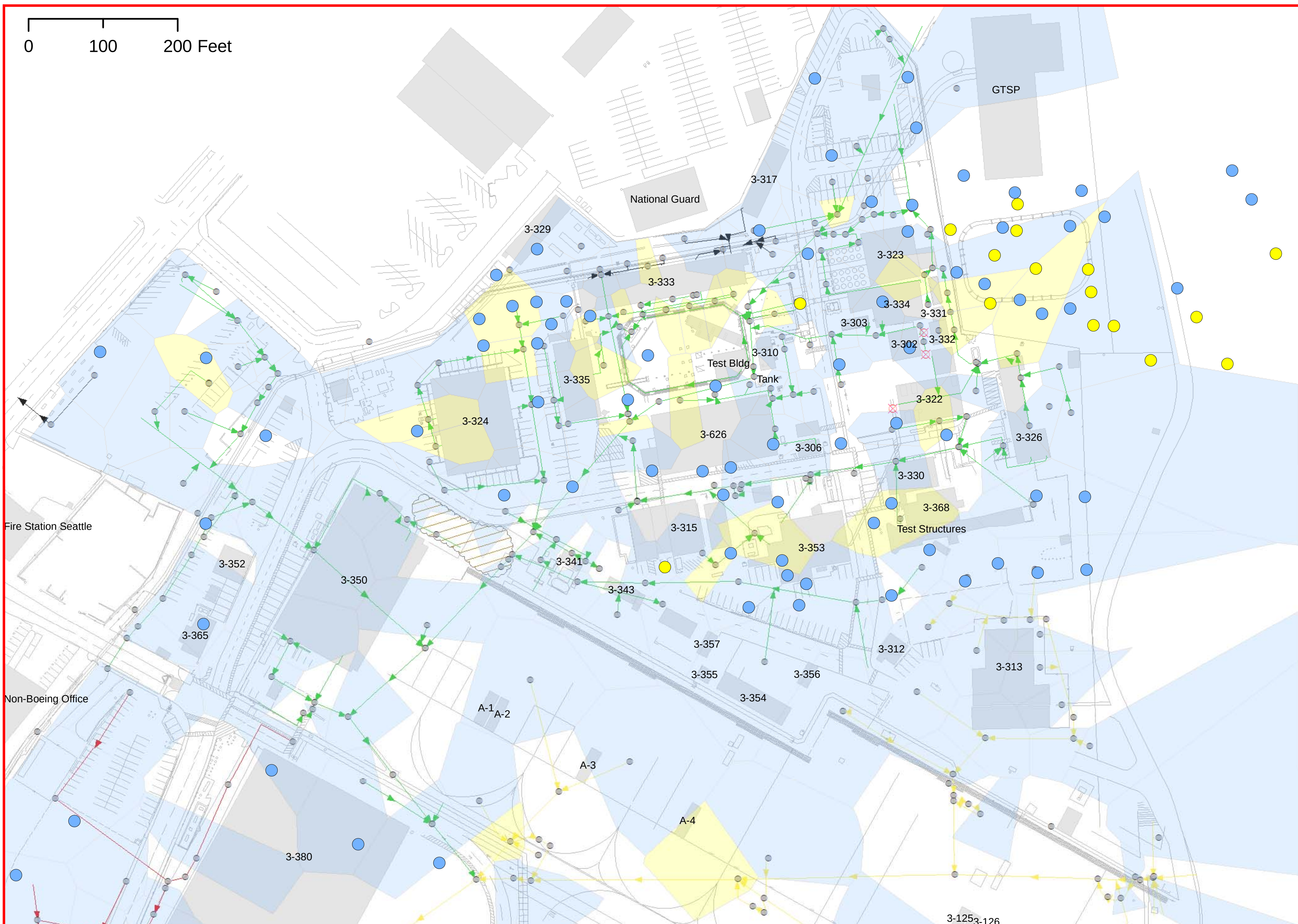

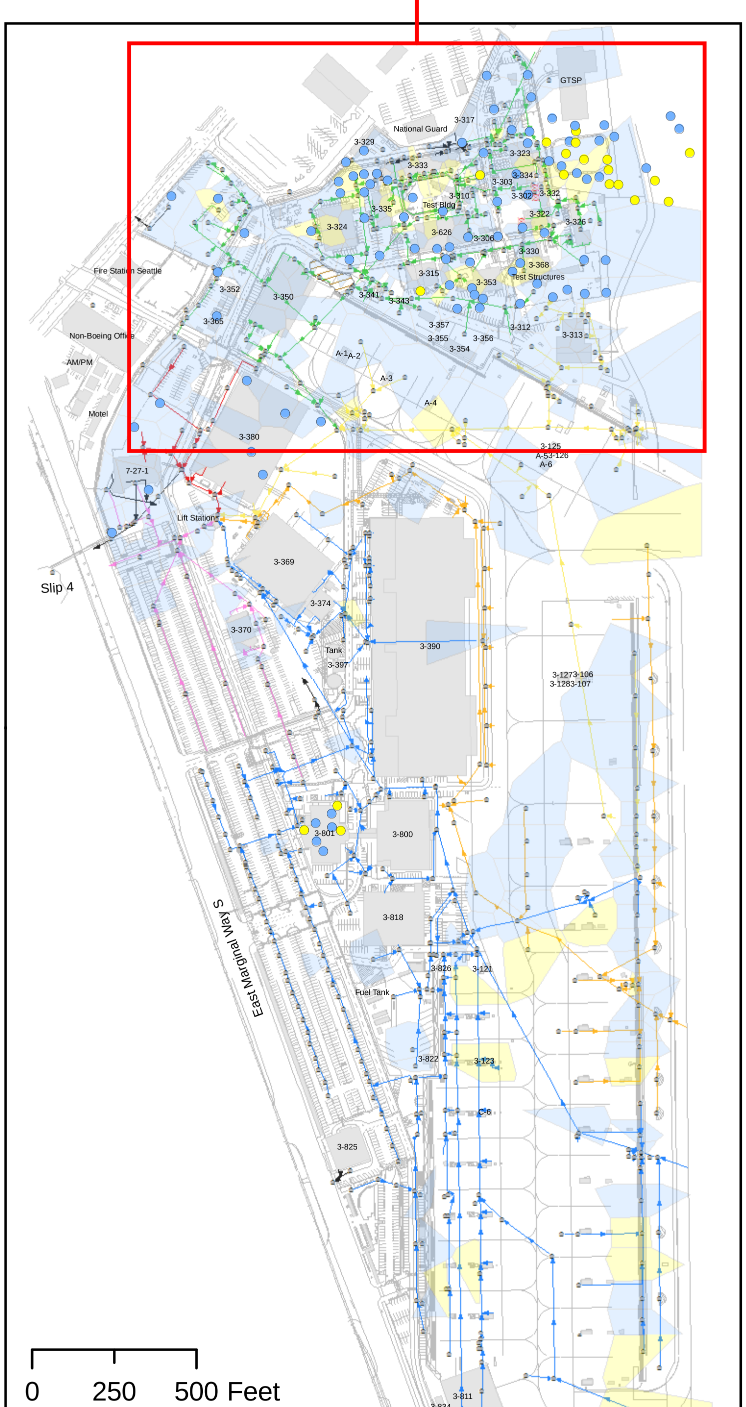

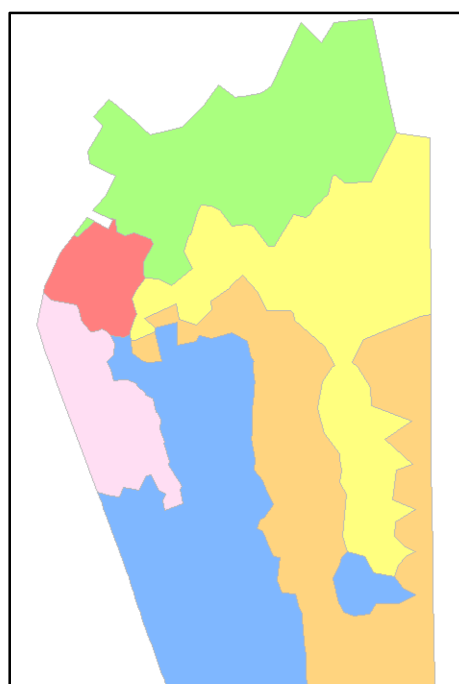

Copper

Soil (mg/kg)
- 0 - 39
- >39 - 236
- non-detect

SD Solids (mg/kg)
- 0 - 390
- >390 - 3,270

Screening Levels: (mg/kg)
SD Solids:
SQS = 390
CSL = 390
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 39
Soil-to-Sediment (CSL) SL: 39

Most recent result at each location shown as of September 2010

SD Structures	**SD Lines**	South Lateral
Structure Abandoned	North Lateral	Building 3-380 Area
Short-term Treatment System	North-Central Lateral	Parking Lot Area
	South-Central Lateral	Other

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Figure 5-9. Copper in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-09_Copper_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.

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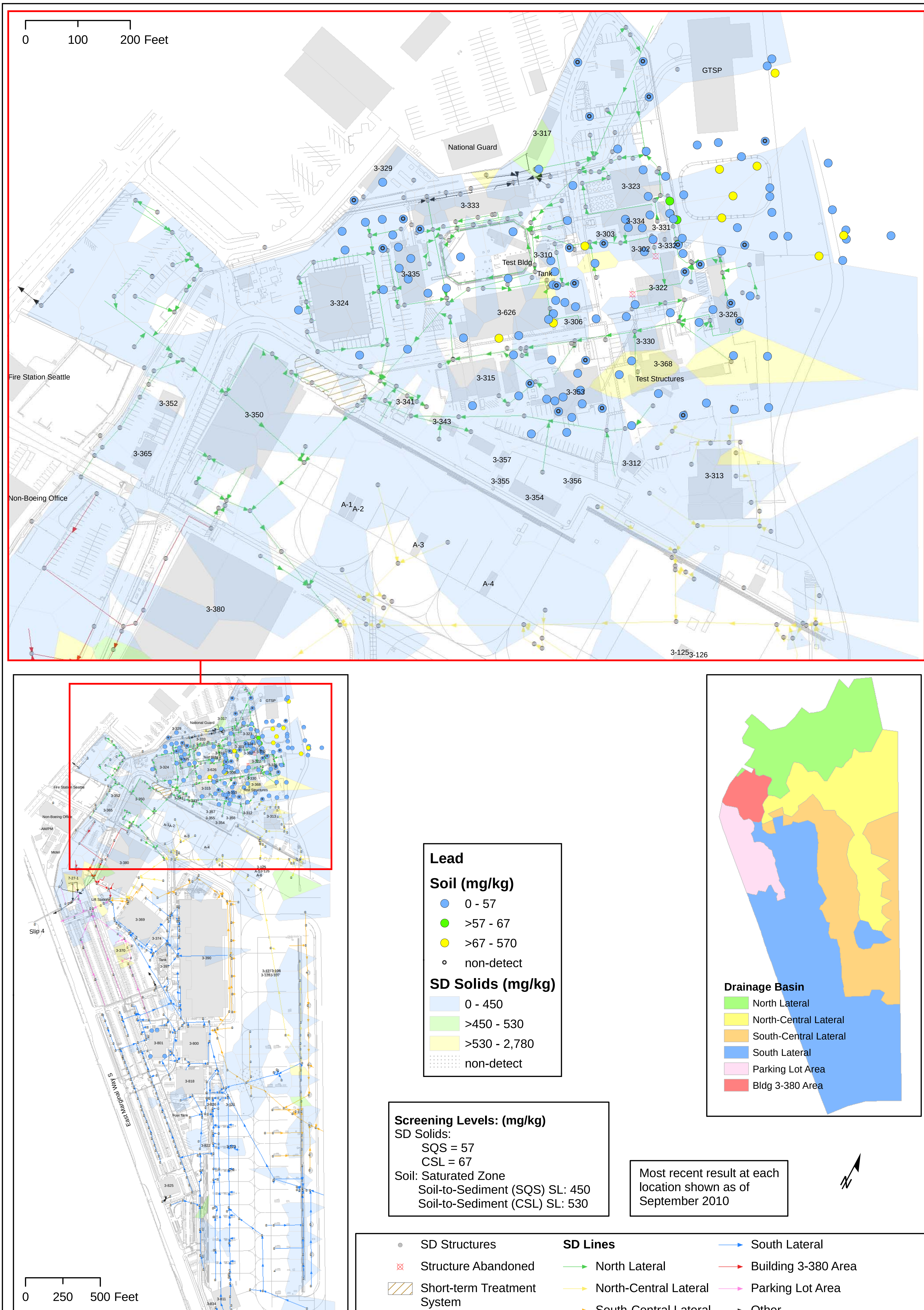

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Figure 5-10. Lead in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-04_Mercury_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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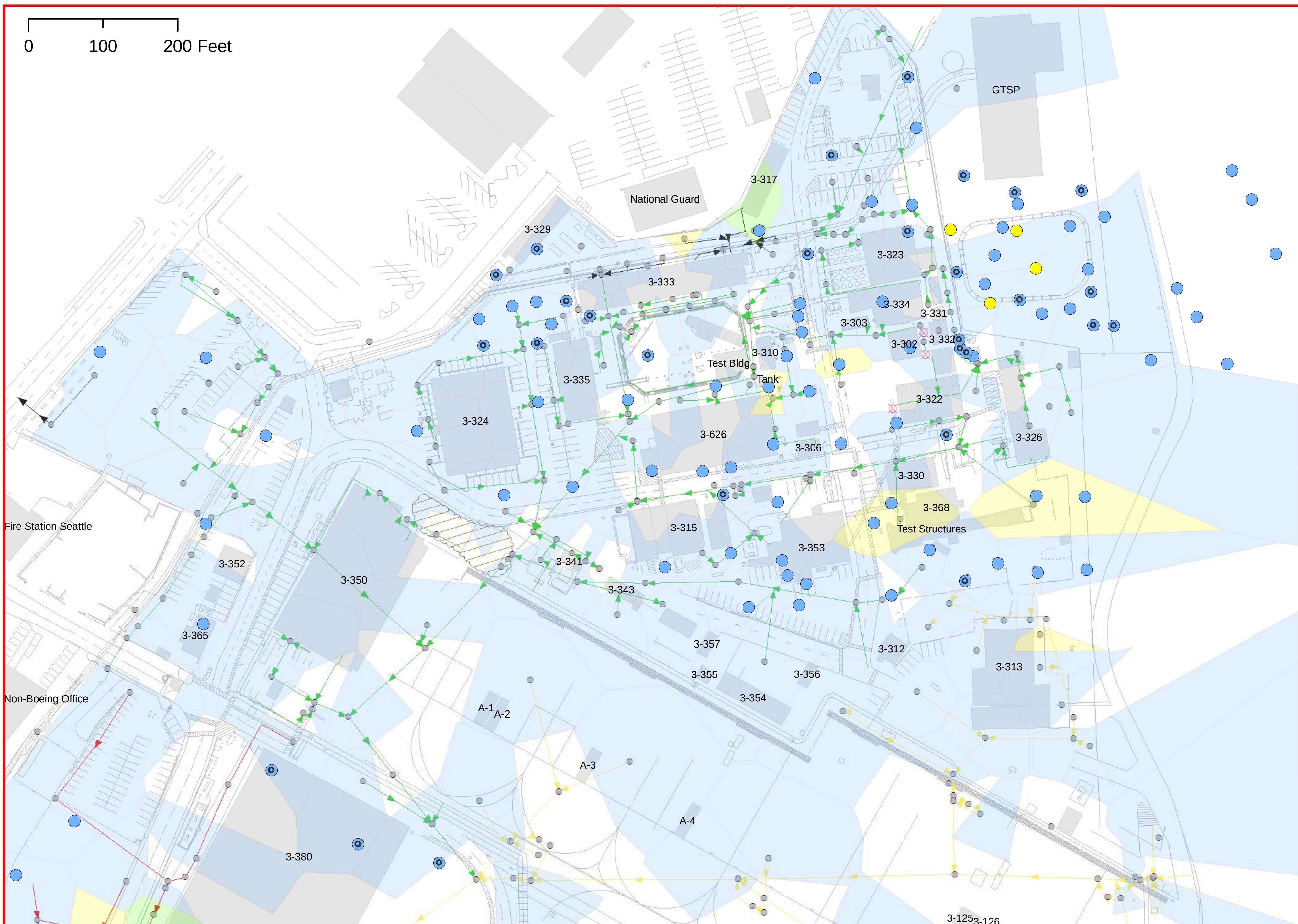
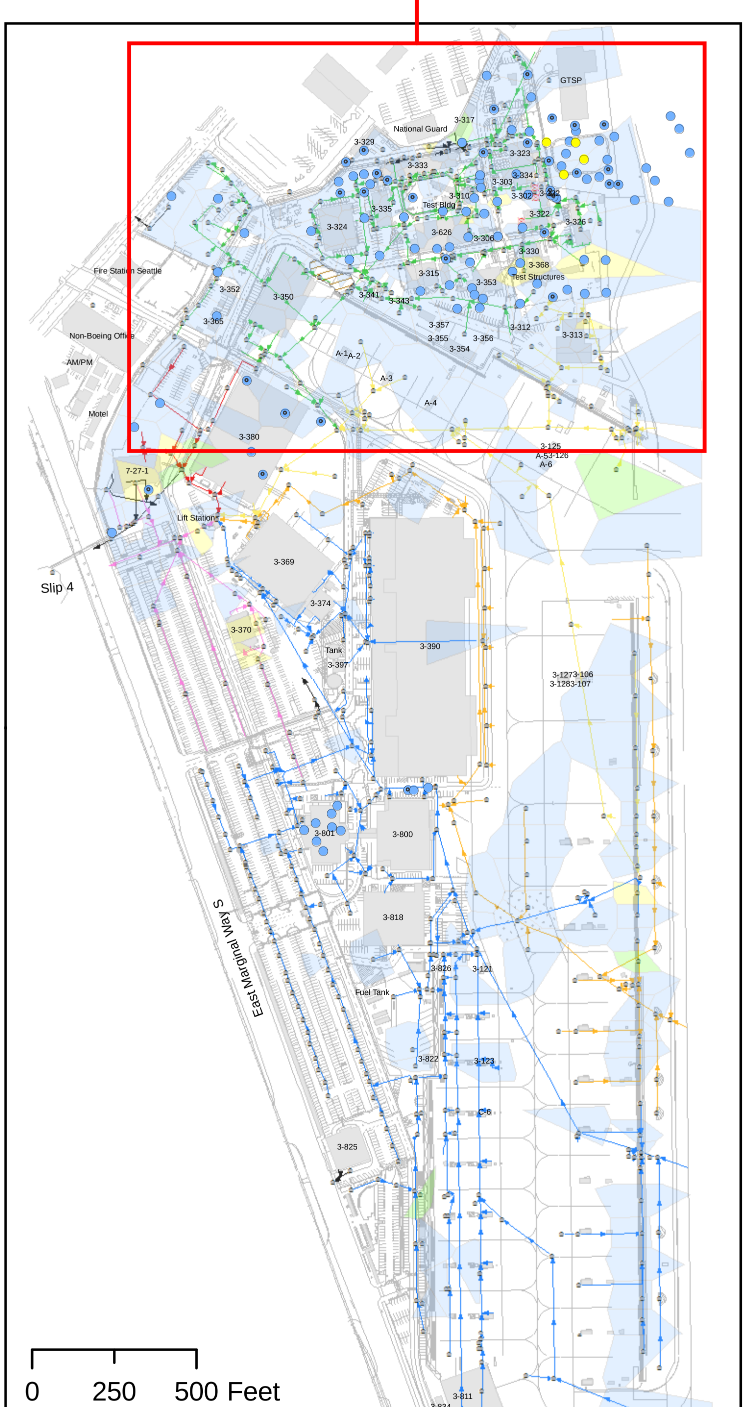




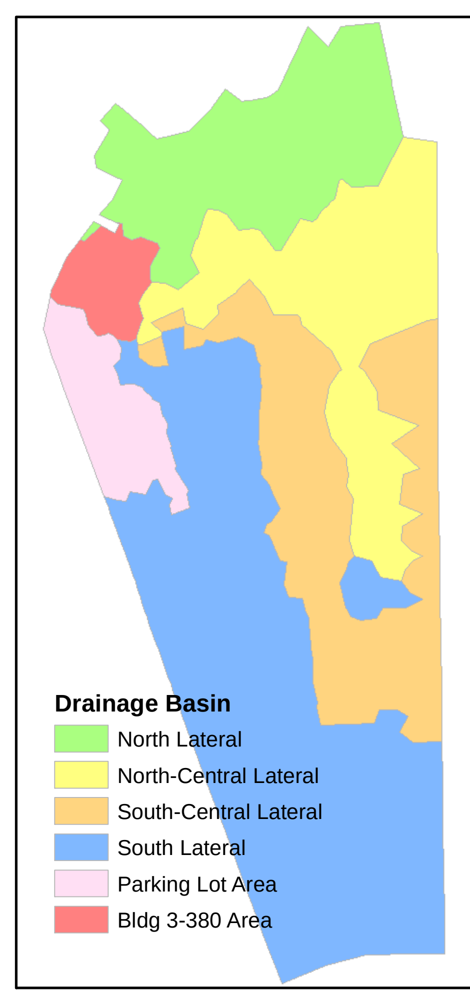
Lead

Soil (mg/kg)

- 0 - 57
- >57 - 67
- >67 - 570
- non-detect

SD Solids (mg/kg)

- 0 - 450
- >450 - 530
- >530 - 2,780
- non-detect



Screening Levels: (mg/kg)
SD Solids:
SQS = 57
CSL = 67
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 450
Soil-to-Sediment (CSL) SL: 530

Most recent result at each location shown as of September 2010

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 5-11. Lead in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-11_Lead_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.

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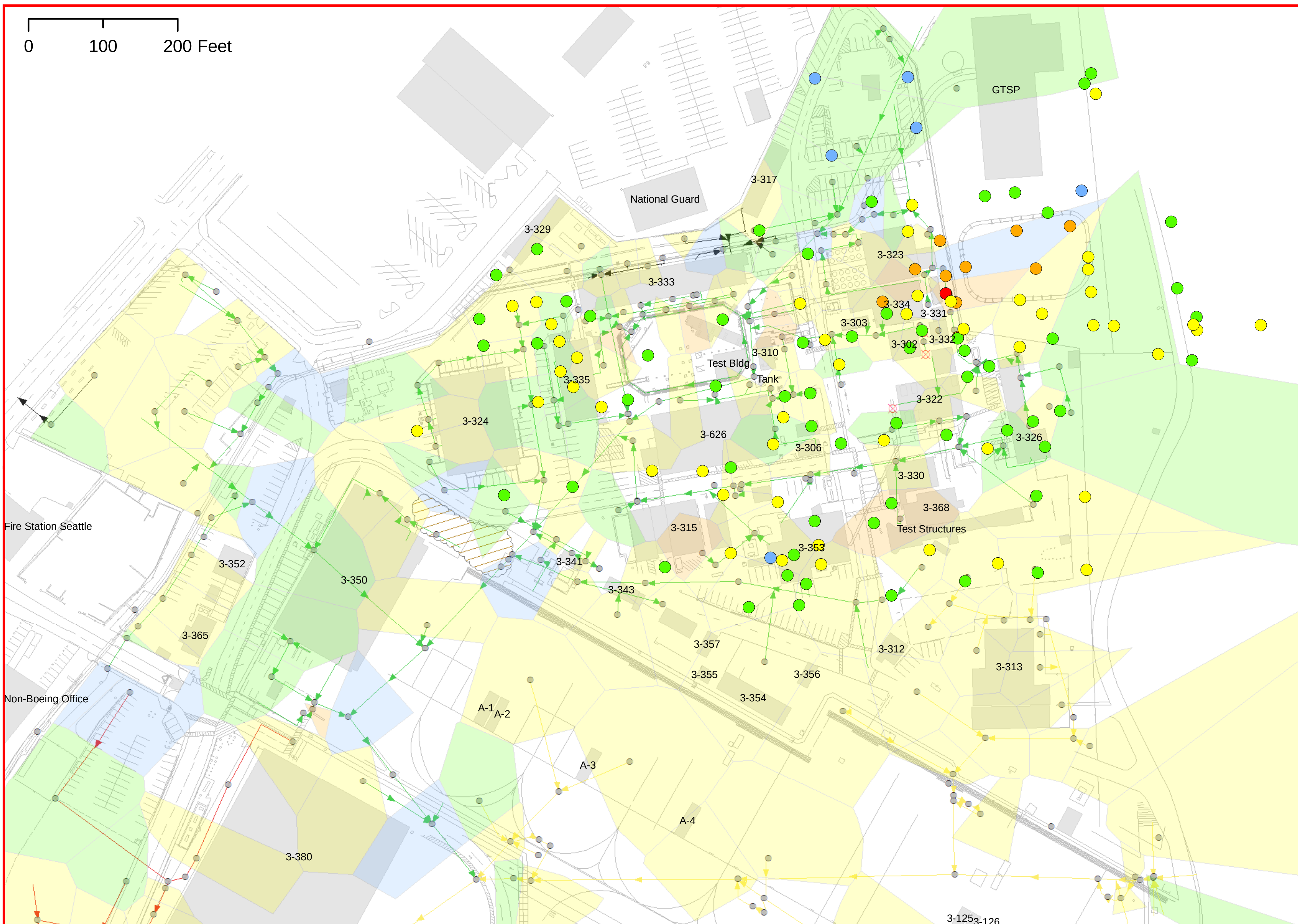
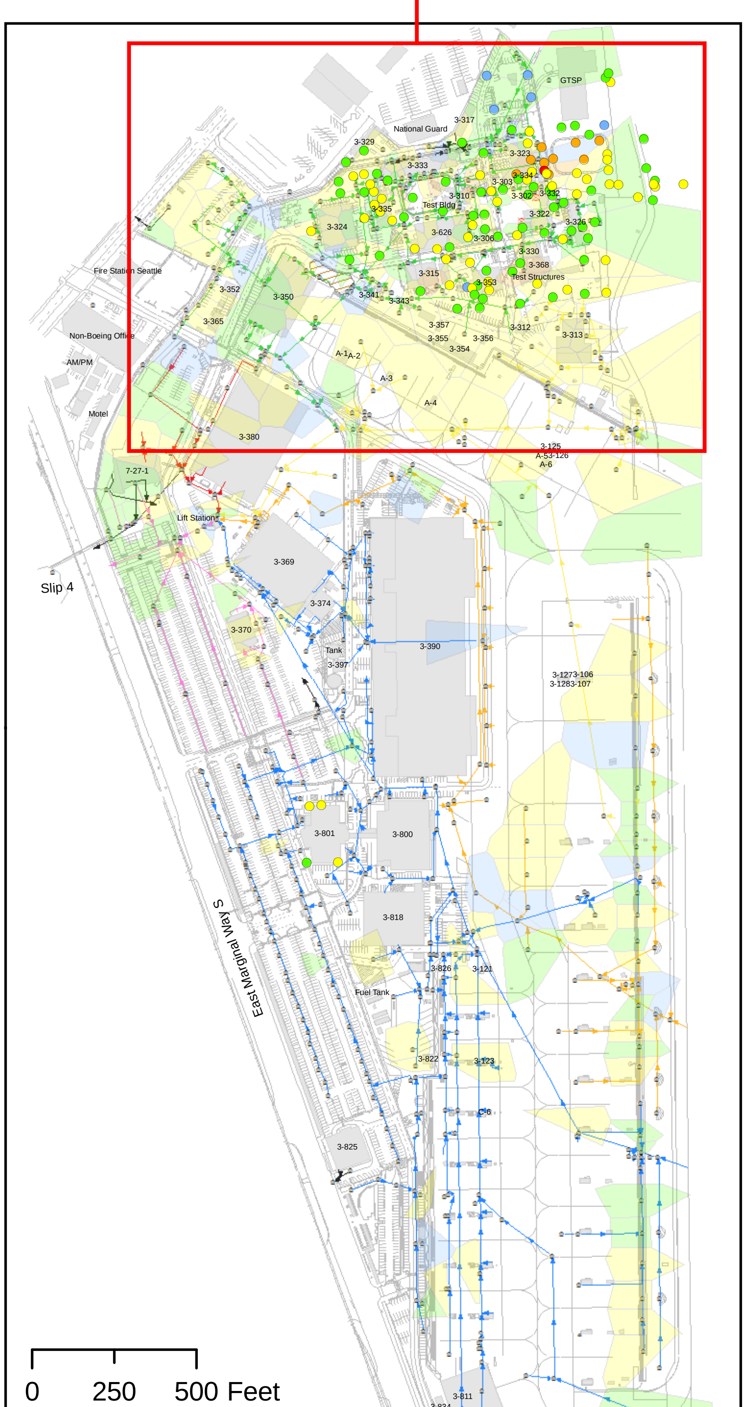




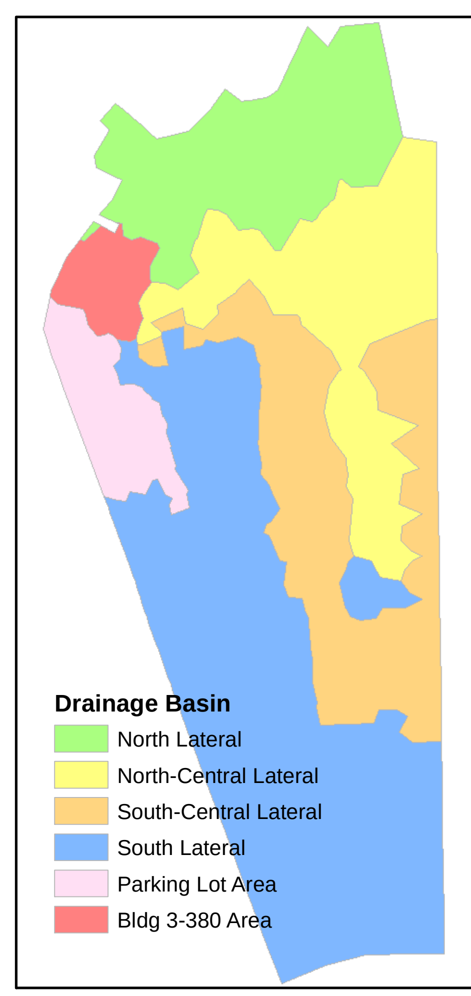
Zinc

Soil (mg/kg)

- 0 - 16
- >16 - 38
- >38 - 160
- >160 - 1,600
- >1,600 - 4,330
- non-detect

SD Solids (mg/kg)

- 0 - 410
- >410 - 960
- >960 - 4,100
- >4,100 - 22,900



Screening Levels: (mg/kg)
SD Solids:
SQS = 410
CSL = 960
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 16
Soil-to-Sediment (CSL) SL: 38

Most recent result at each location shown as of September 2010

SD Structures	**SD Lines**	South Lateral
Structure Abandoned	North Lateral	Building 3-380 Area
Short-term Treatment System	North-Central Lateral	Parking Lot Area
	South-Central Lateral	Other

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Figure 5-12. Zinc in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-12_Zinc_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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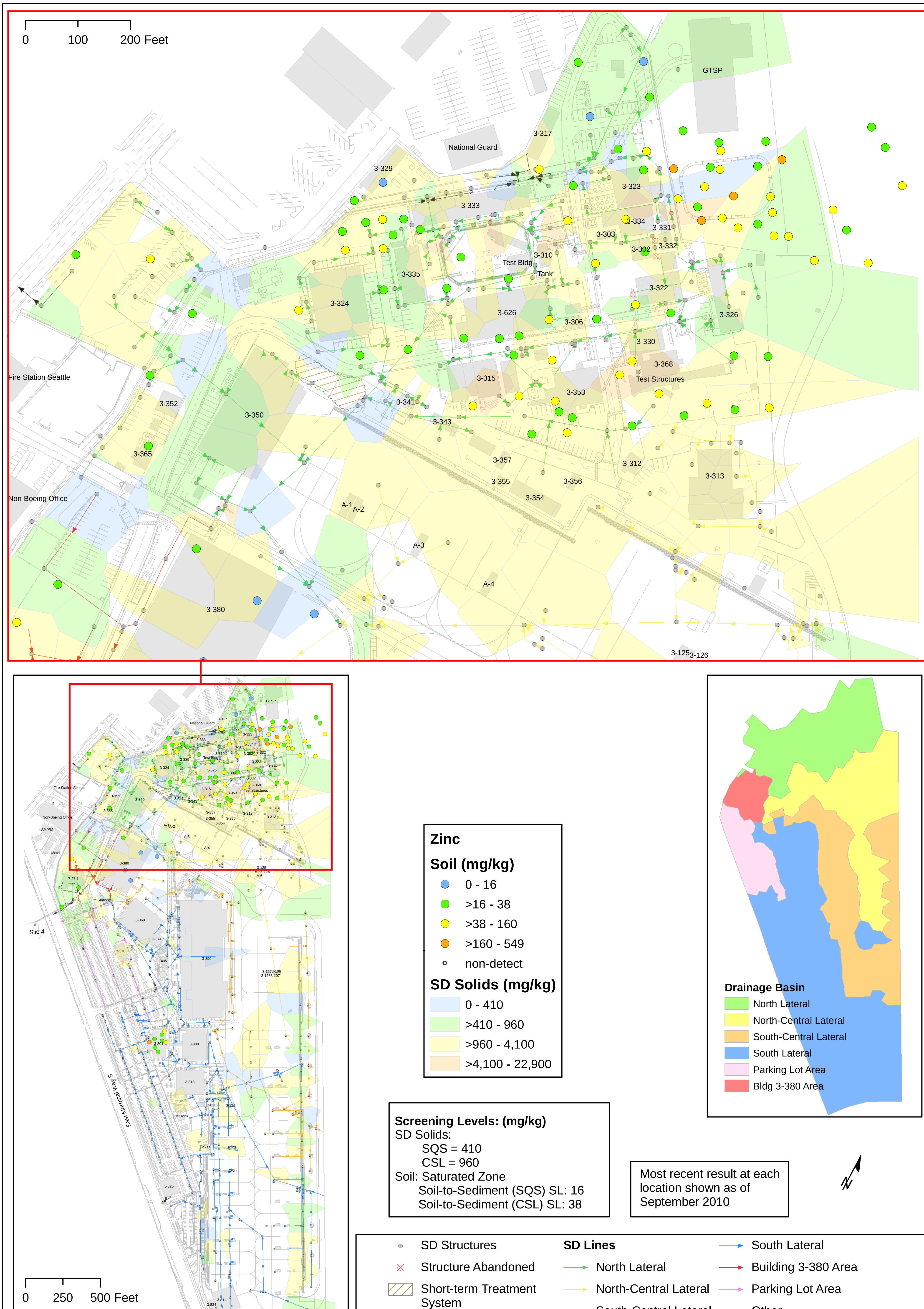

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Figure 5-13. Zinc in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-12_Zinc_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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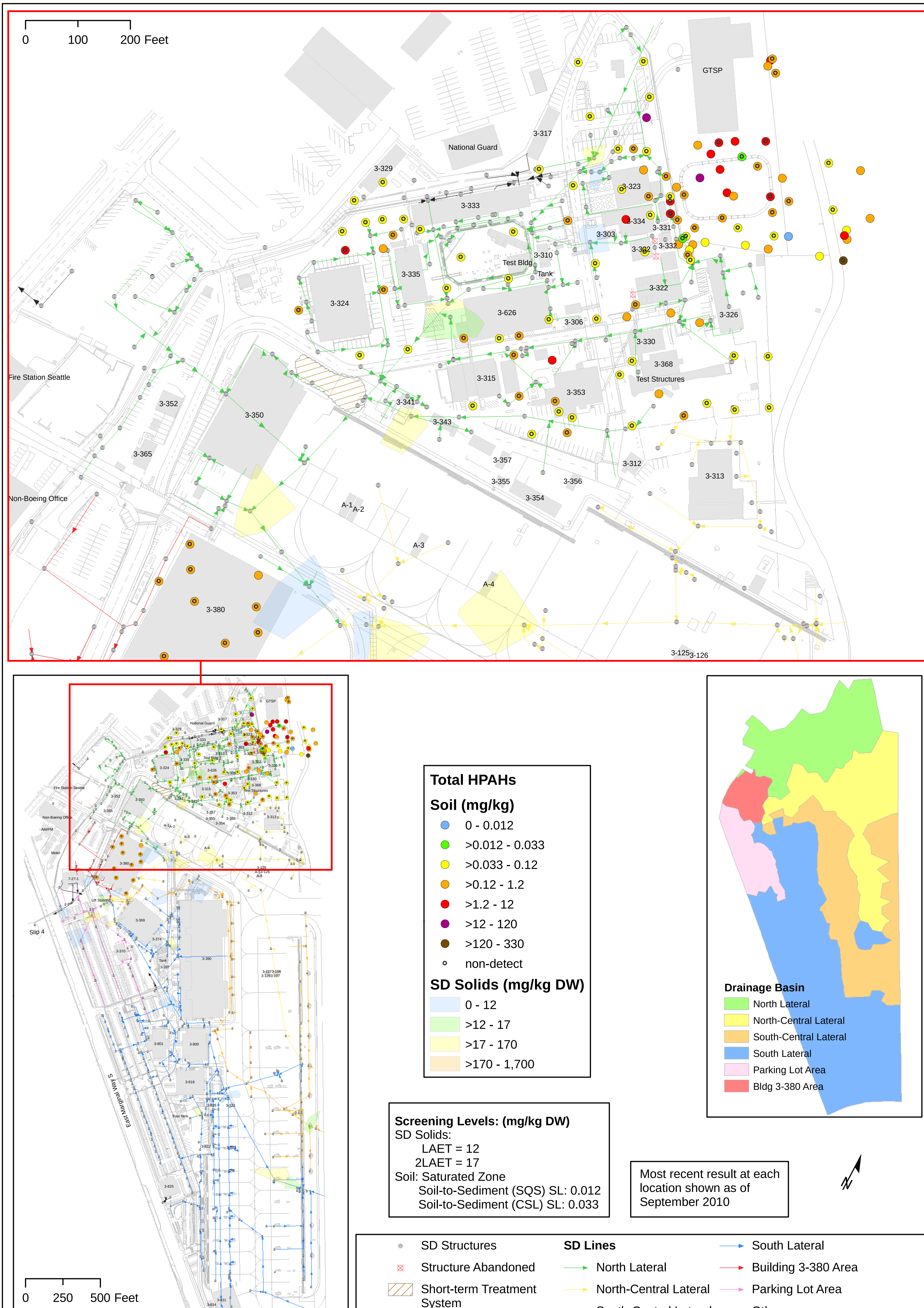

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Figure 5-14. Total HPAHs in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-14_HPAH_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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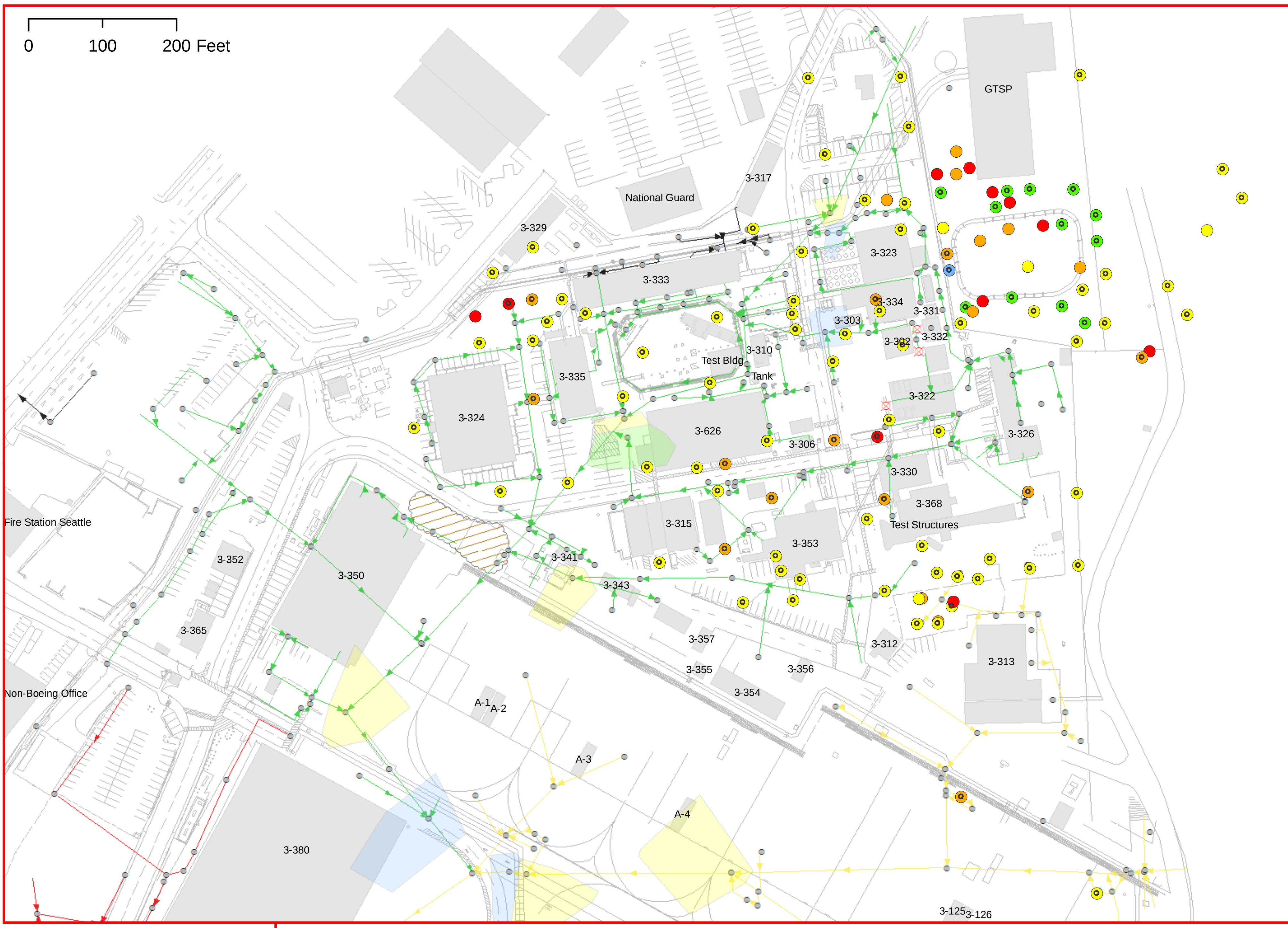
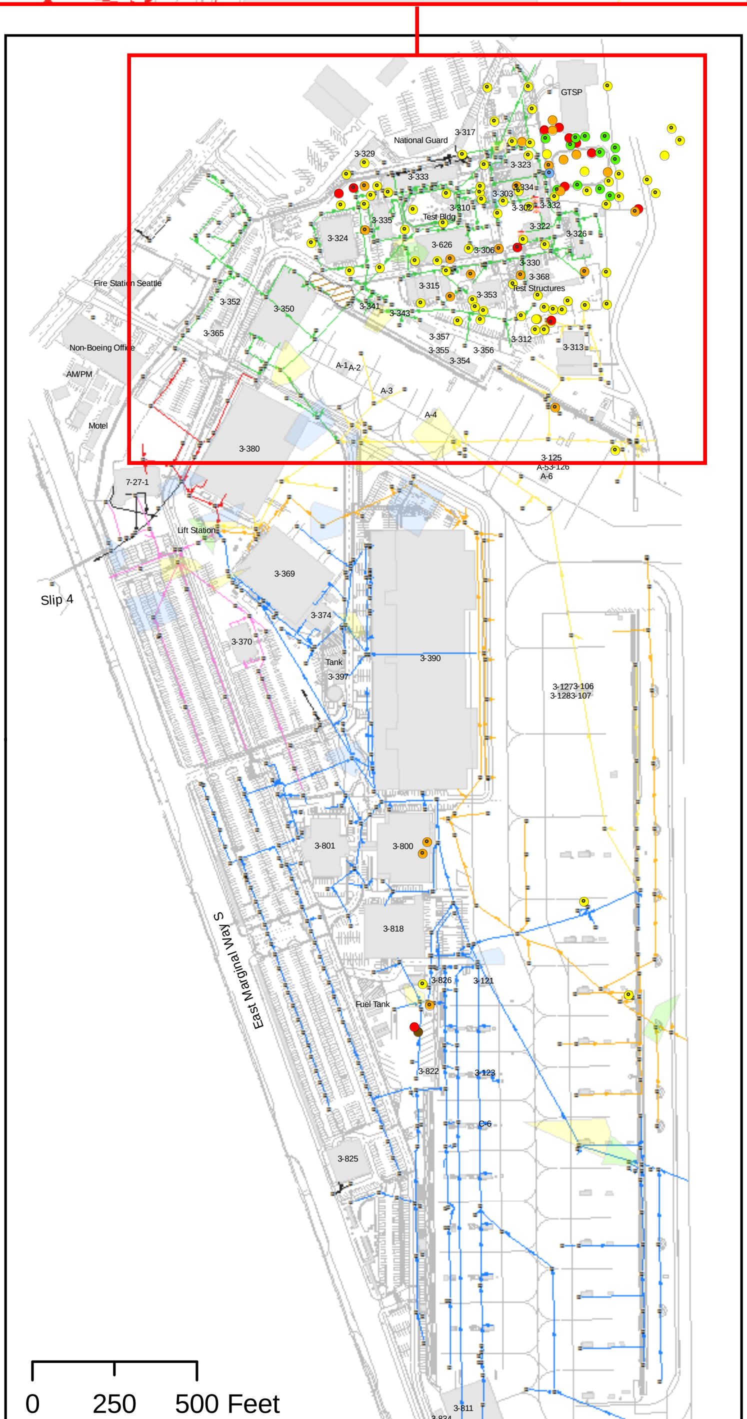
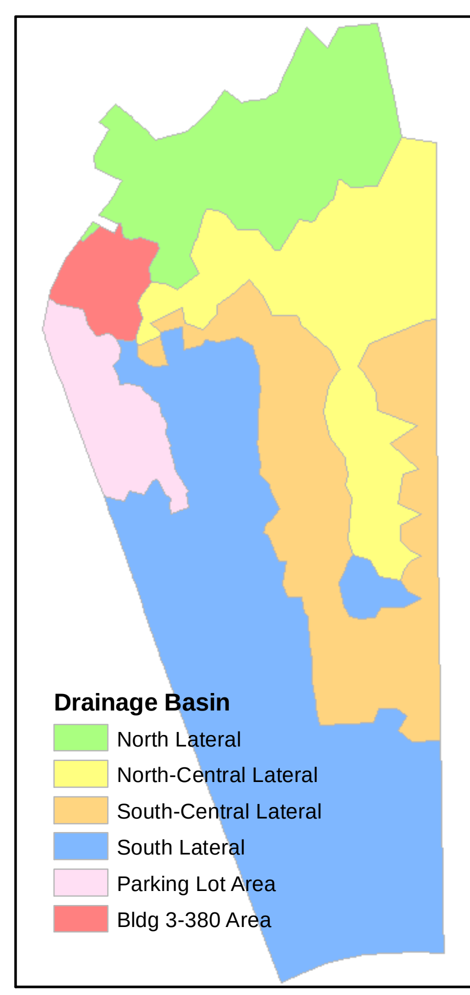




Total HPAHs

Soil (mg/kg)
- 0 - 0.012
- >0.012 - 0.033
- >0.033 - 0.12
- >0.12 - 1.2
- >1.2 - 12
- >12 - 75.77
- non-detect

SD Solids (mg/kg DW)
- 0 - 12
- >12 - 17
- >17 - 170
- >170 - 1,700



Screening Levels: (mg/kg DW)
SD Solids:
LAET = 12
2LAET = 17
Soil: Saturated Zone
Soil-to-Sediment (SQS) SL: 0.012
Soil-to-Sediment (CSL) SL: 0.033

Most recent result at each location shown as of September 2010

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines
- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 5-15. Total HPAHs in Deep (0-4 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-15_HPAH_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.

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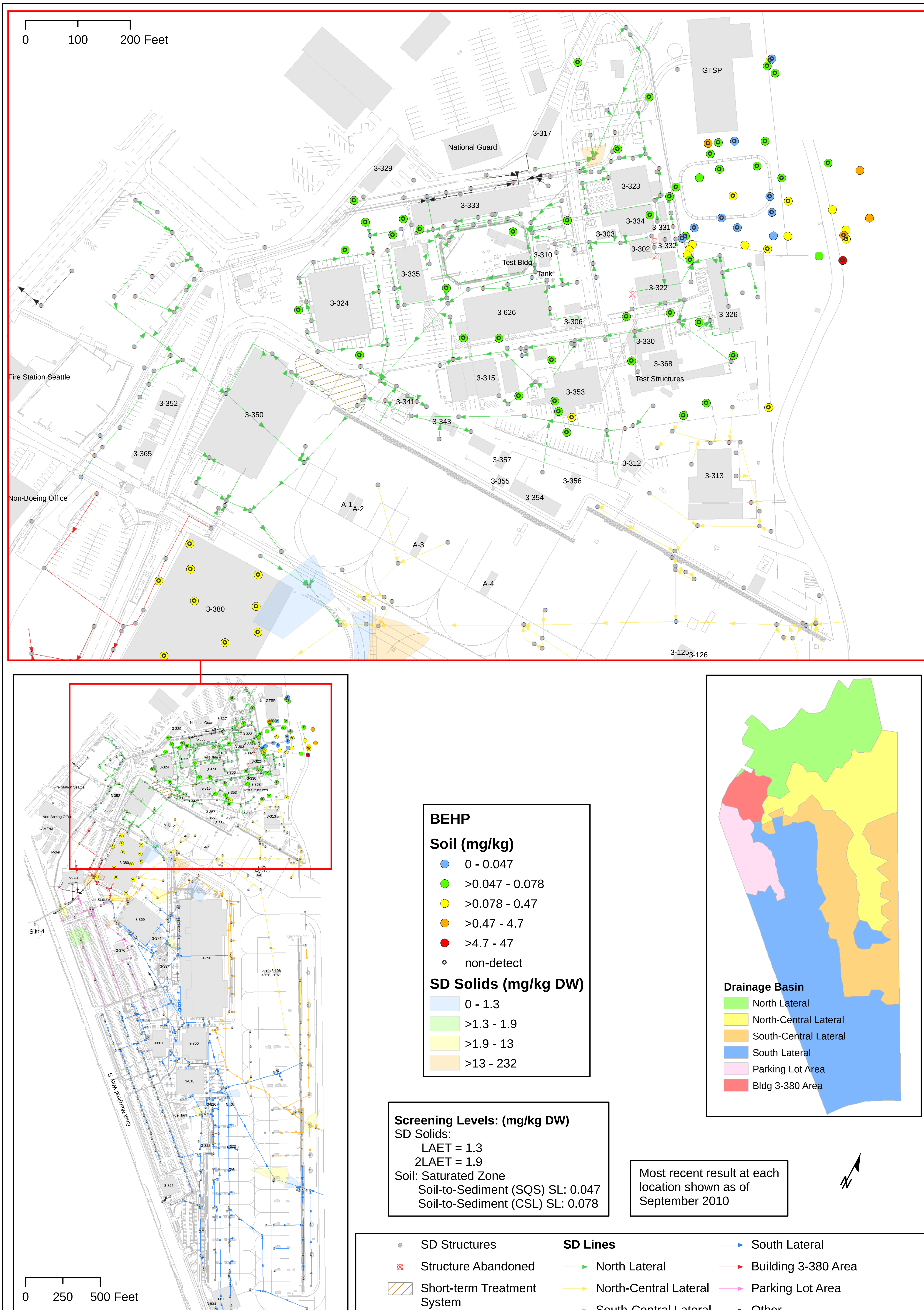

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Figure 5-16. BEHP in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-16_BEHP_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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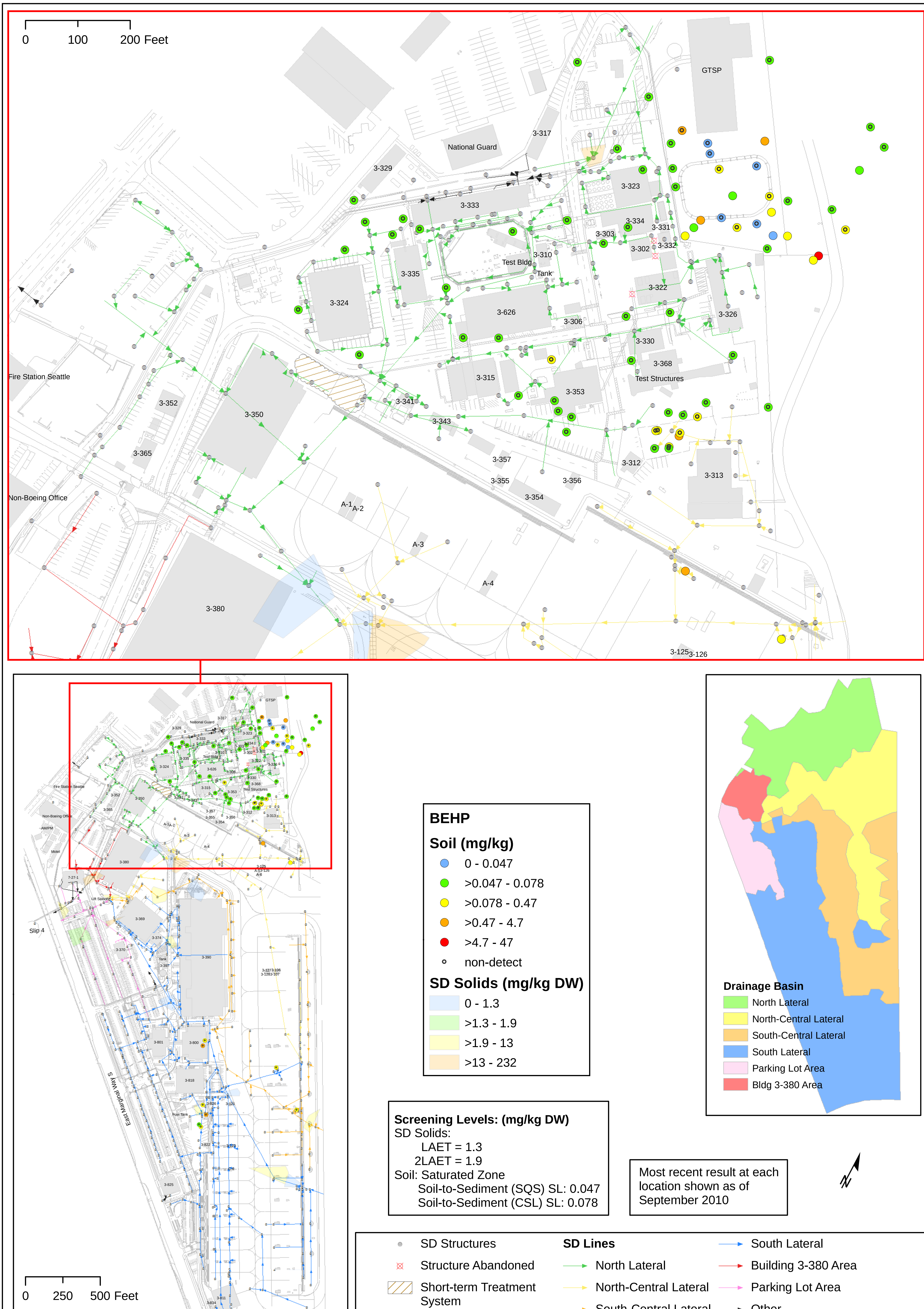

Figure 5-17. BEHP in Deep (4-8 ft) Soil at NBF-GTSP Site

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-17_BEHP_Soil_Deep-PORTRAIT.mxd
Illustrative purposes only.

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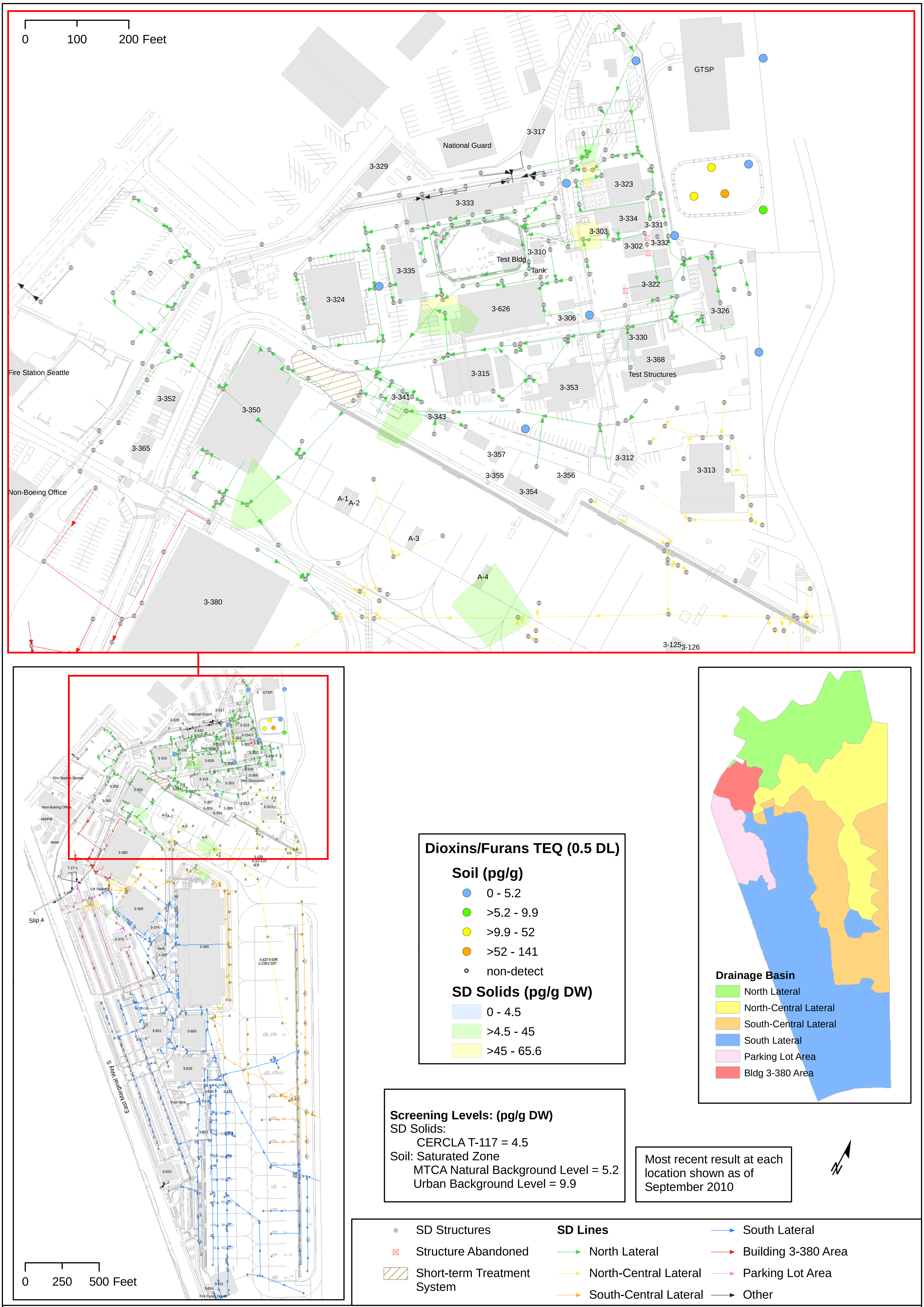

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Figure 5-18. Dioxins/Furans TEQ (0.5 DL) in Shallow (0-4 ft) Soil at NBF-GTSP Site

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-16_BEHP_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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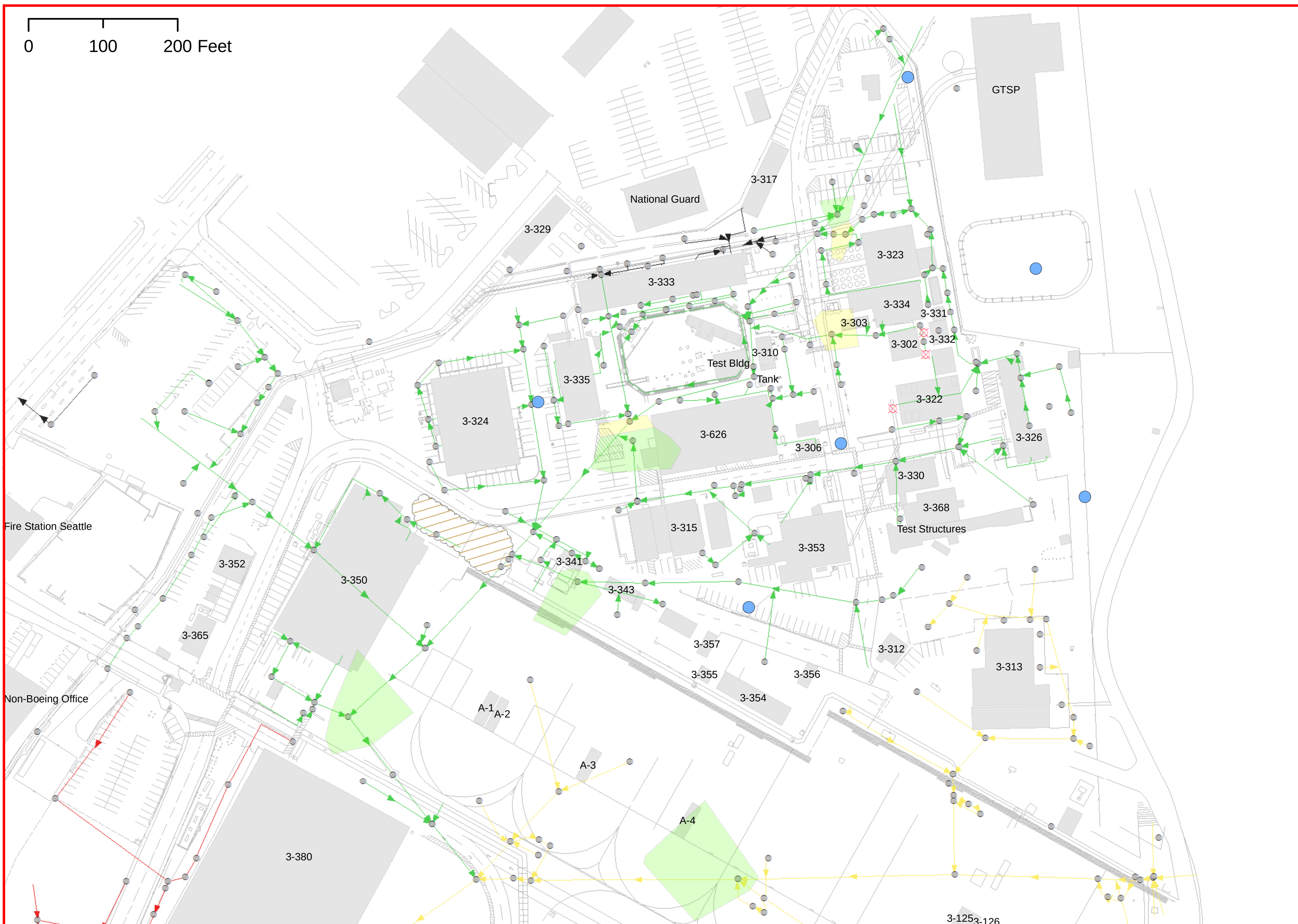

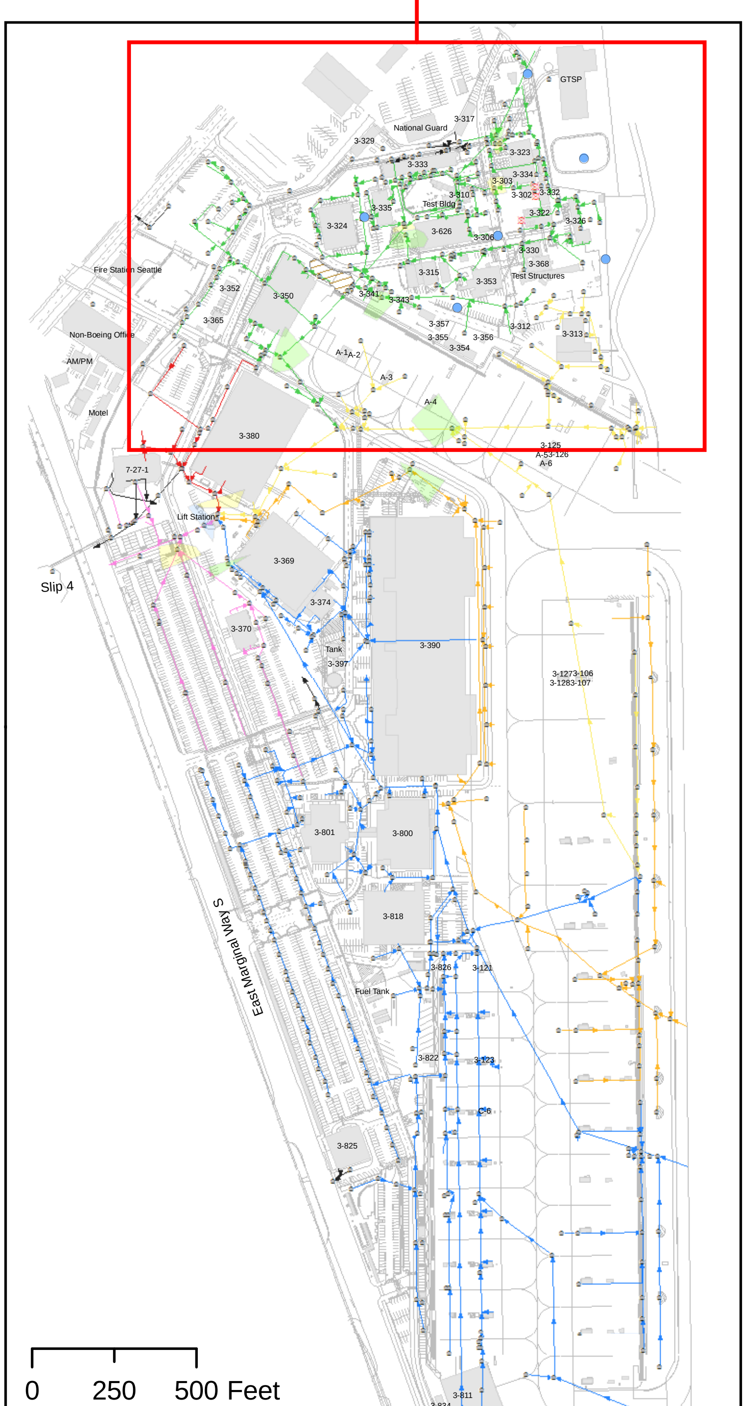

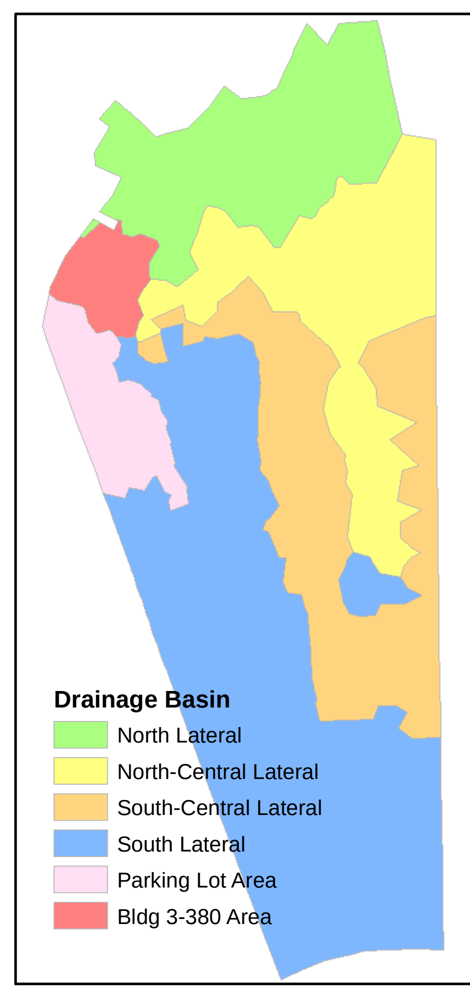

Dioxins/Furans TEQ (0.5 DL)

Soil (pg/g)

- 0 - 5.2
- >5.2 - 9.9
- >9.9 - 52
- >52 - 141
- non-detect

SD Solids (pg/g DW)

- 0 - 4.5
- >4.5 - 45
- >45 - 65.6

Screening Levels: (mg/kg DW)
SD Solids:
CERCLA T-117 = 4.5
Soil: Saturated Zone
MTCA Natural Background Level = 5.2
Urban Background Level = 9.9

Most recent result at each location shown as of September 2010

- SD Structures
- Structure Abandoned
- Short-term Treatment System

SD Lines

- North Lateral
- North-Central Lateral
- South-Central Lateral
- South Lateral
- Building 3-380 Area
- Parking Lot Area
- Other

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Figure 5-19. Dioxins/Furans TEQ (0.5 DL) in Deep (4-8 ft) Soil at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-16_BEHP_Soil_Shallow-PORTRAIT.mxd
Illustrative purposes only.

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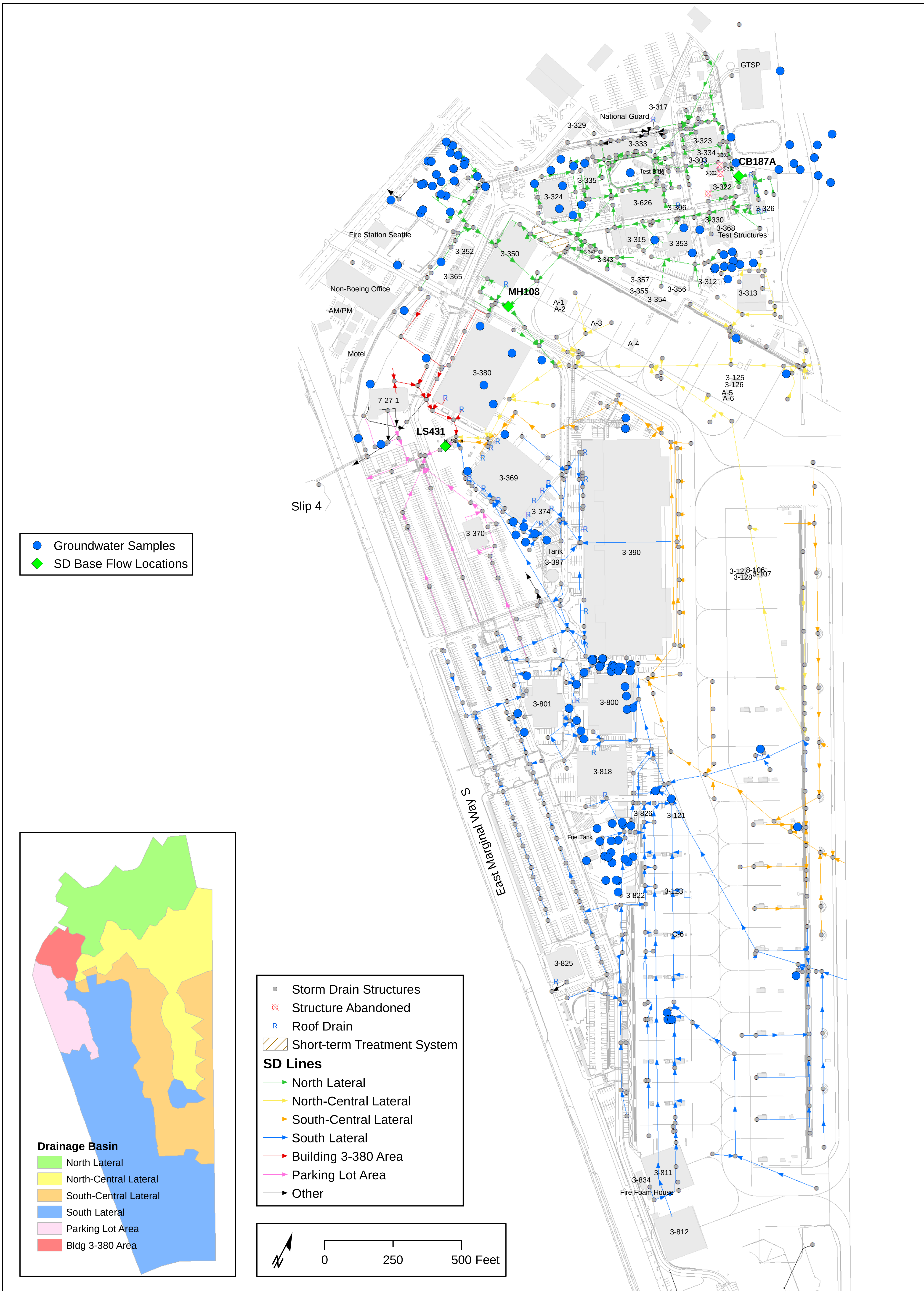

Figure 5-20. Groundwater and SD Base Flow Sampling Locations at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-20_Groundwater_sampling_overview-PORTRAIT.mxd
Illustrative purposes only.

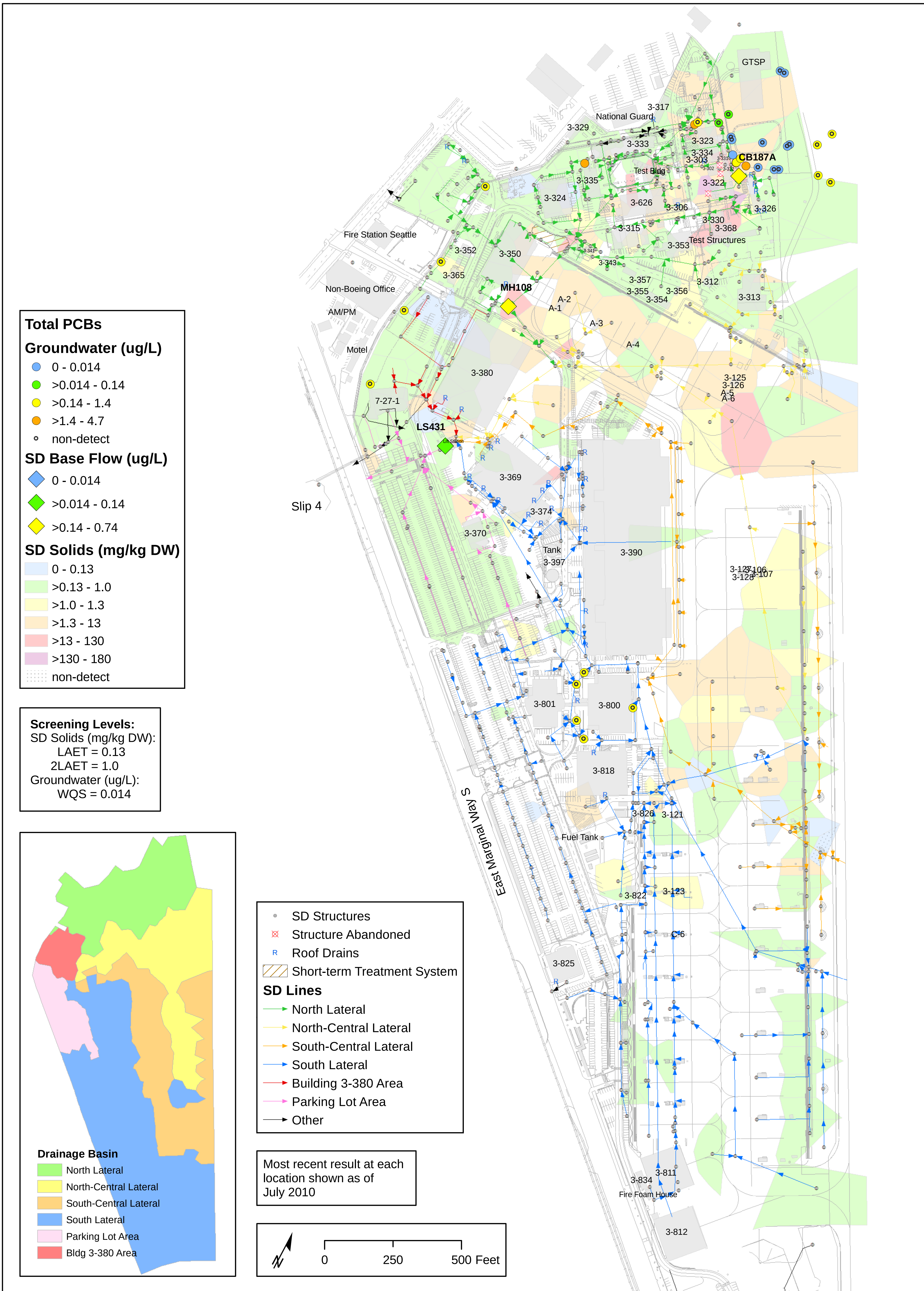

Figure 5-21. Total PCBs in Groundwater and SD Base Flow at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-20_Groundwater_sampling_overview-PORTRAIT.mxd
Illustrative purposes only.

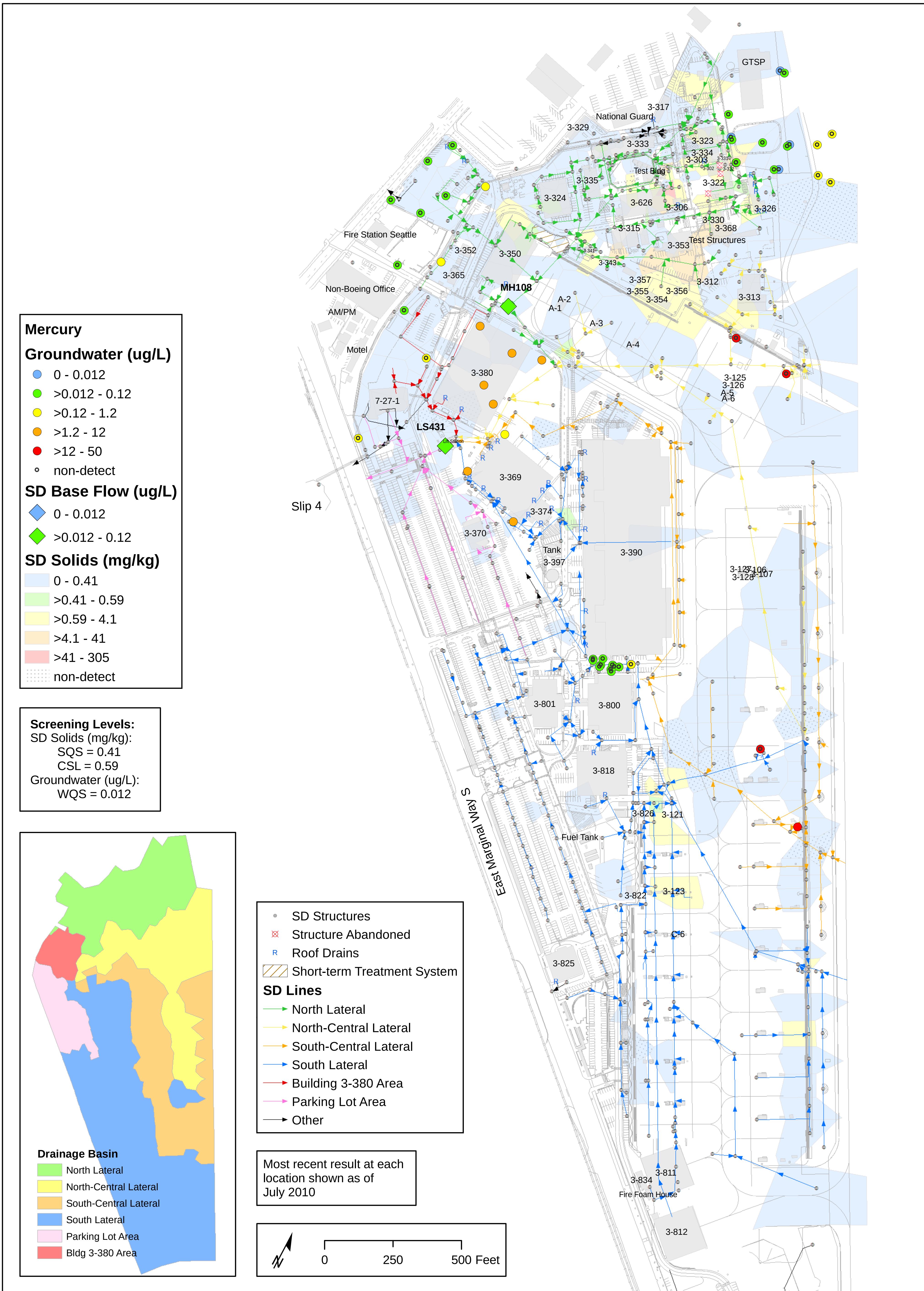

Figure 5-22. Mercury in Groundwater and SD Base Flow at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-22_Mercury_Groundwater-PORTRAIT.mxd
Illustrative purposes only.

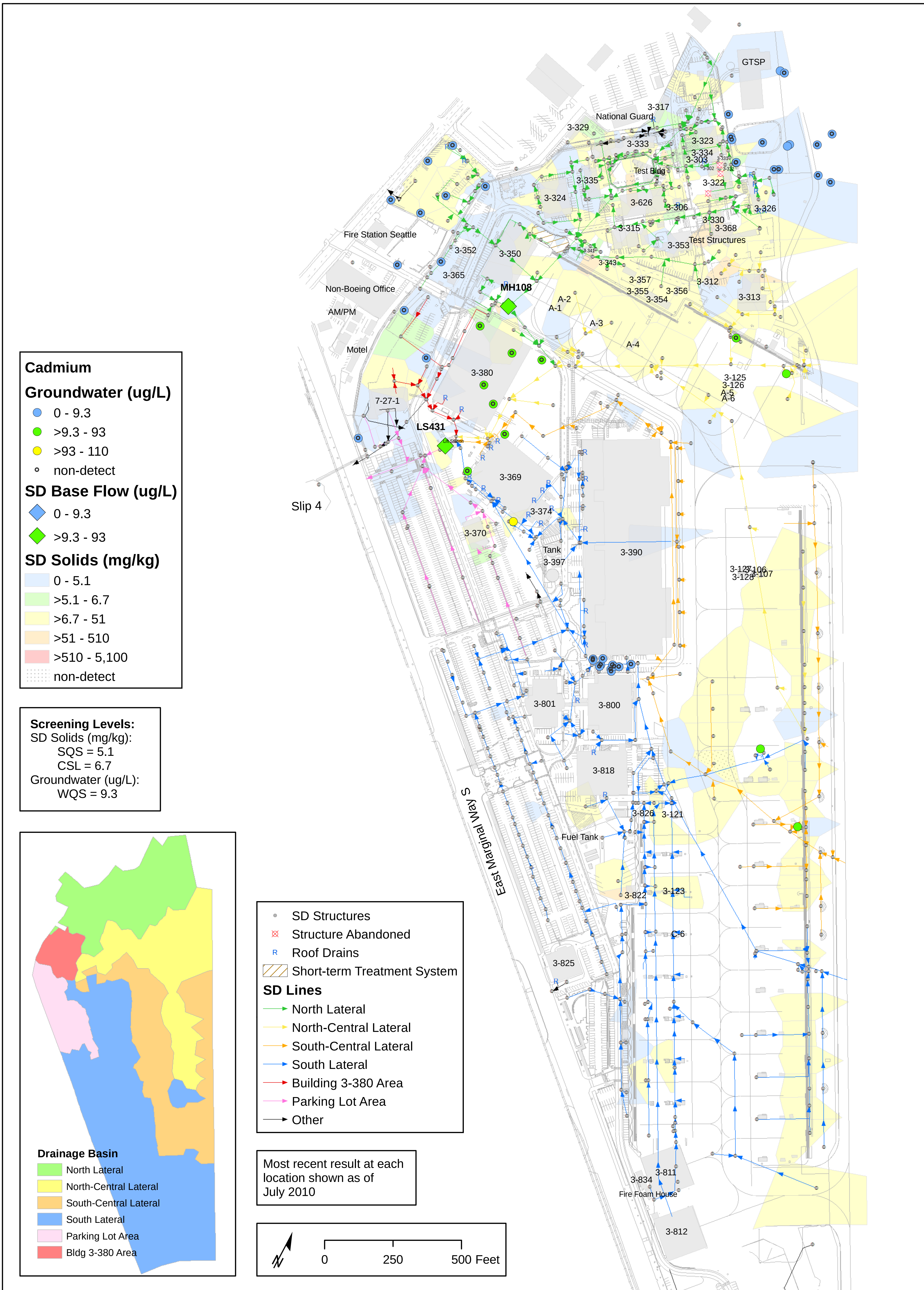

Figure 5-23. Cadmium in Groundwater and SD Base Flow at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-22_Mercury_Groundwater-PORTRAIT.mxd
Illustrative purposes only.

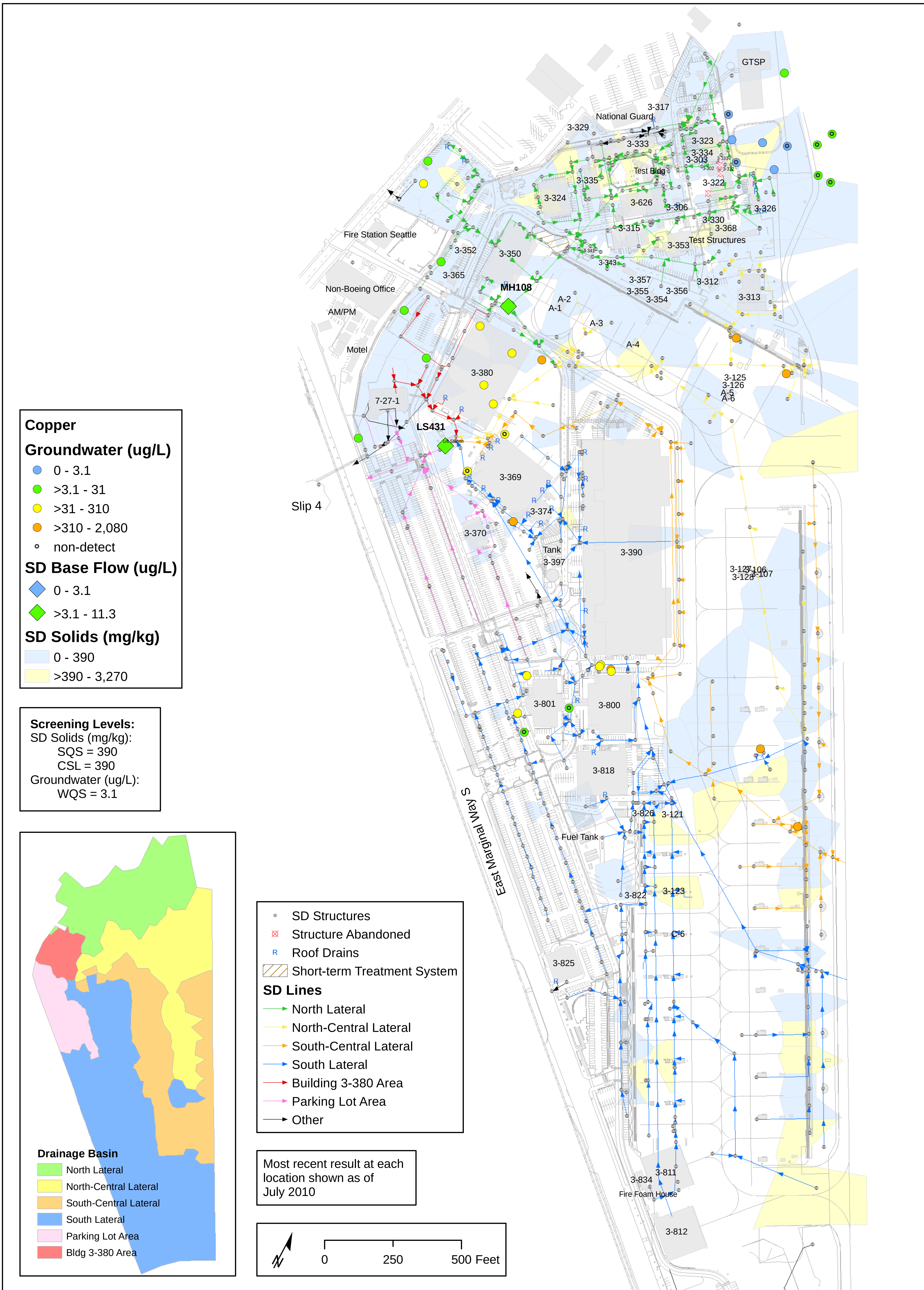

Figure 5-24. Copper in Groundwater and SD Base Flow at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-22_Mercury_Groundwater-PORTRAIT.mxd
Illustrative purposes only.

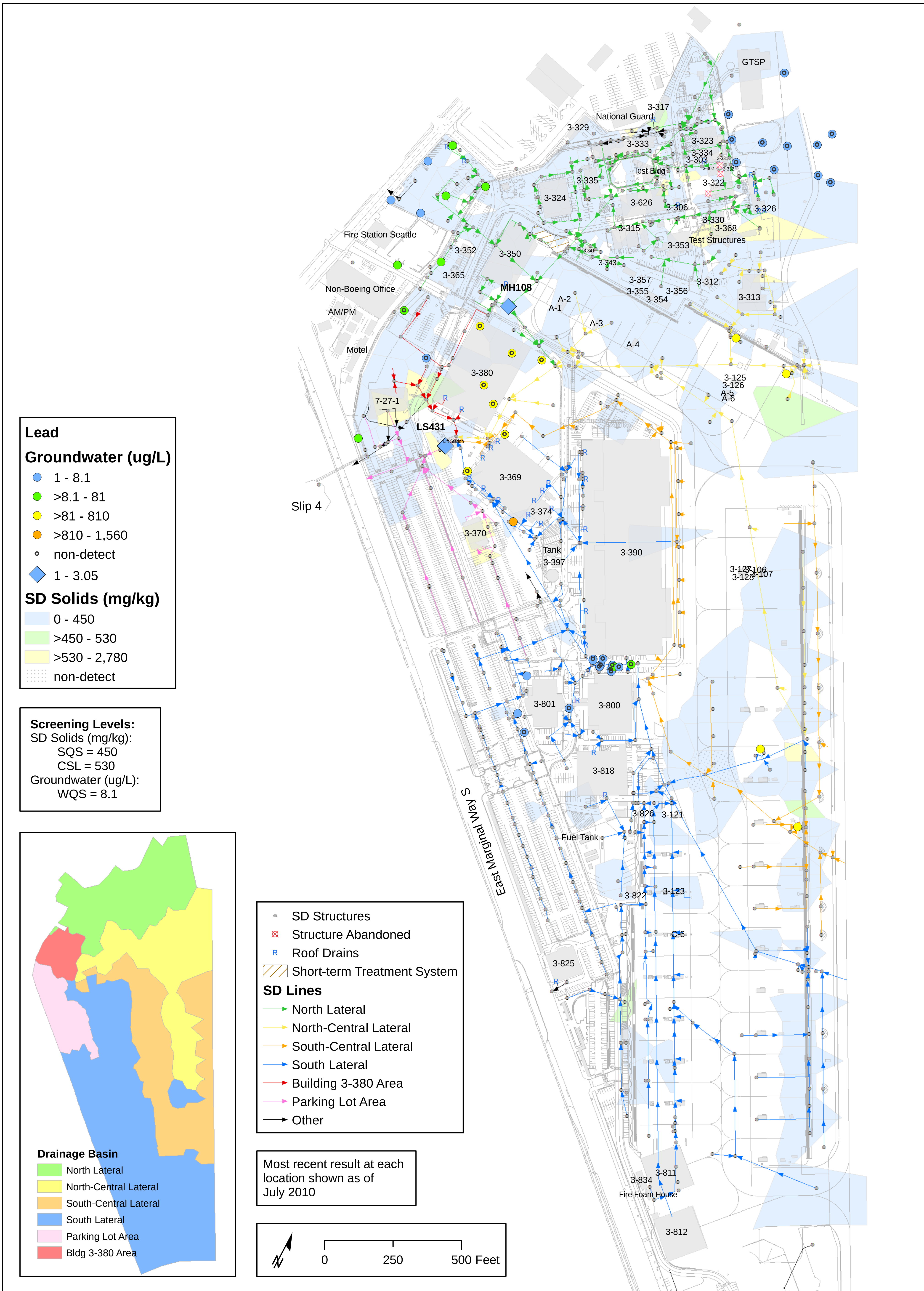

Figure 5-25. Lead in Groundwater and SD Base Flow at NBF-GTSP Site

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-22_Mercury_Groundwater-PORTRAIT.mxd
Illustrative purposes only.

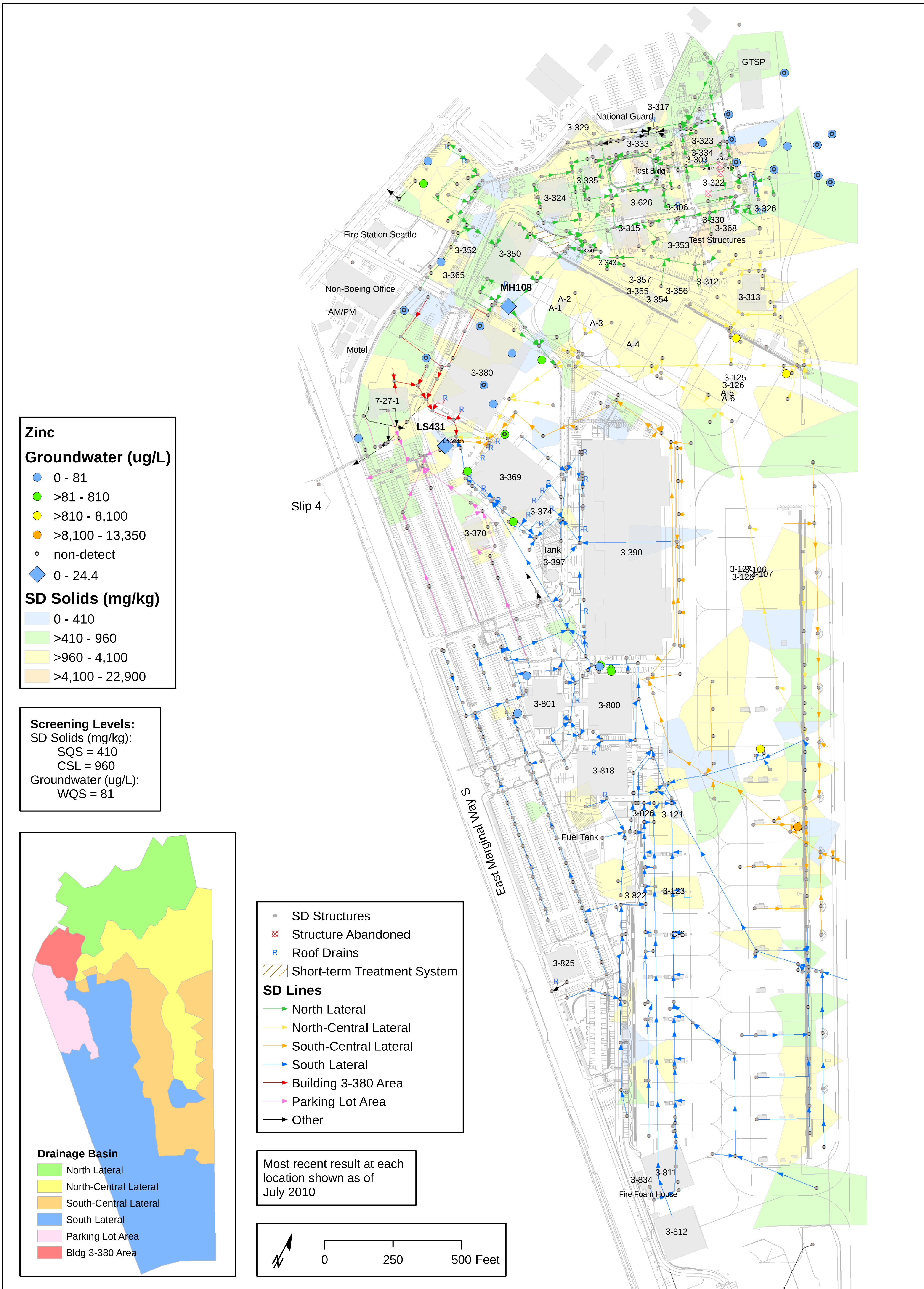

Figure 5-26. Zinc in Groundwater and SD Base Flow at NBF-GTSP Site

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-26_Zinc_Groundwater-PORTRAIT.mxd
Illustrative purposes only.

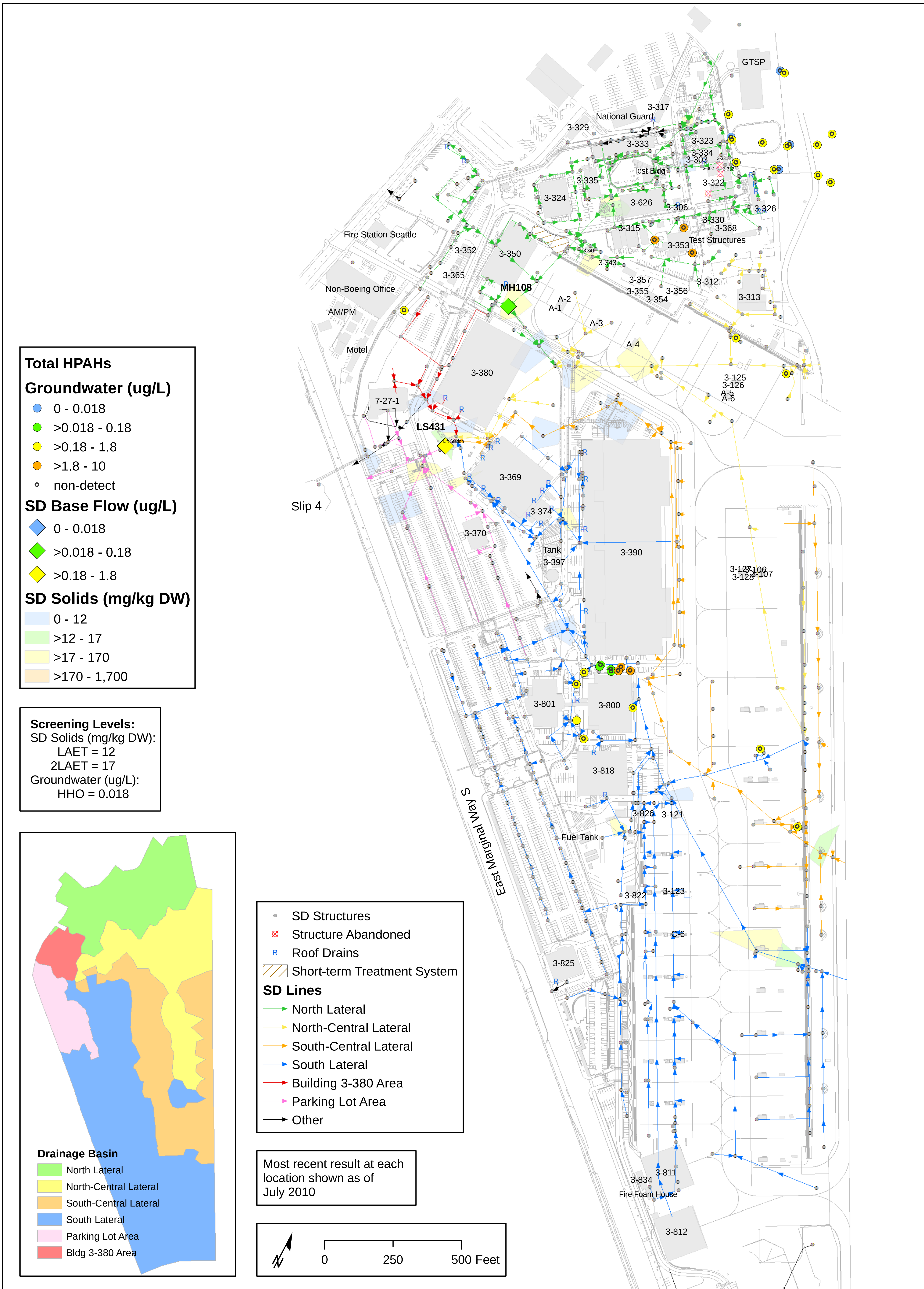

Figure 5-27. Total HPAHs in Groundwater and SD Base Flow at NBF-GTSP Site

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-20_Groundwater_sampling_overview-PORTRAIT.mxd
Illustrative purposes only.

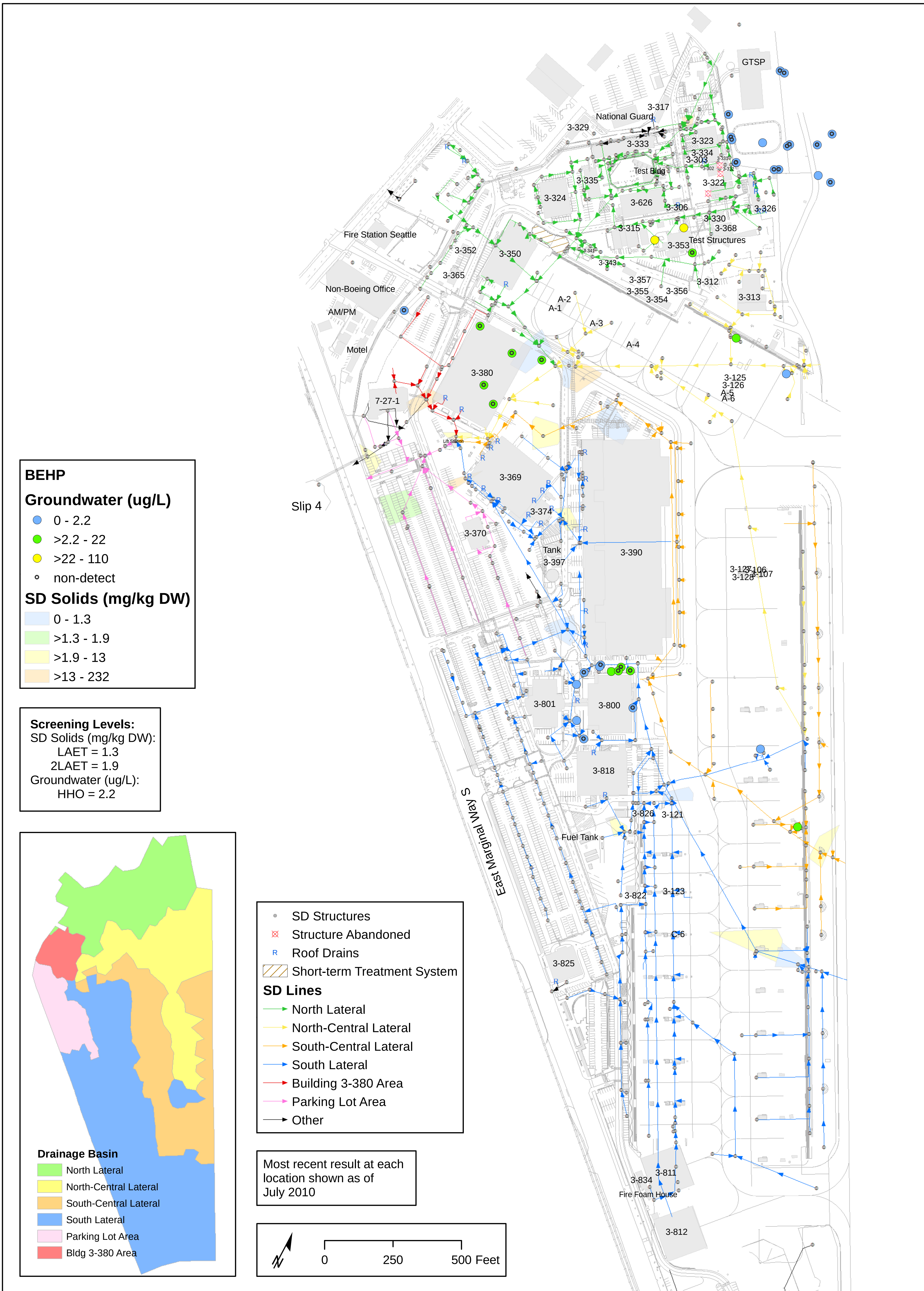

Figure 5-28. BEHP in Groundwater at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-28_BEHP_Groundwater-PORTRAIT.mxd
Illustrative purposes only.

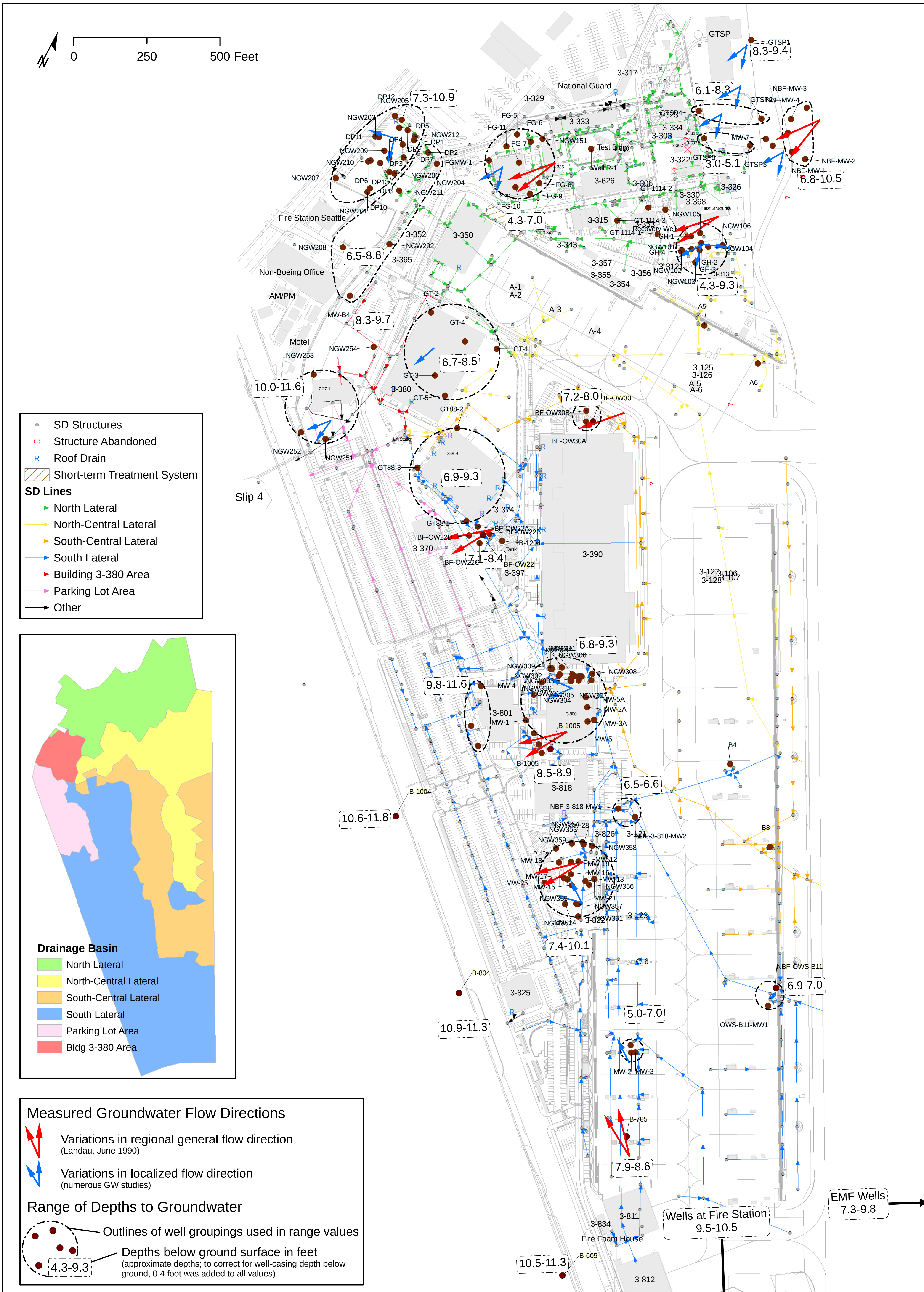

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Figure 5-29. Groundwater Flow and Depth at NBF-GTSP Site

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-15_GW_sampling_locations-PORTRAIT.mxd
Illustrative purposes only.

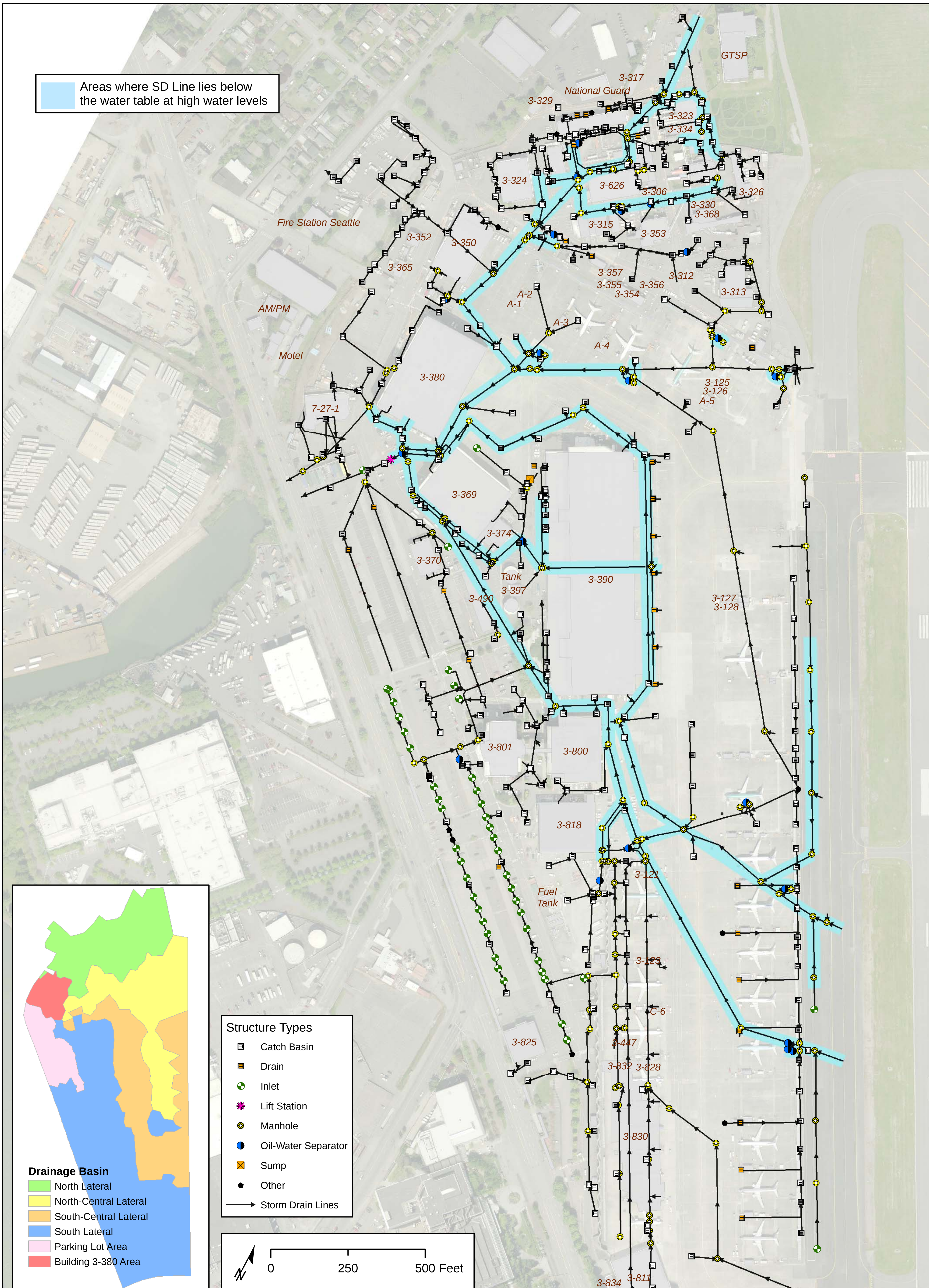

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Figure 5-30. Locations of Storm Drain Lines Below the Water Table at NBF-GTSP

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-31_SDLines_Below_WT_Overview.mxd
Illustrative purposes only.

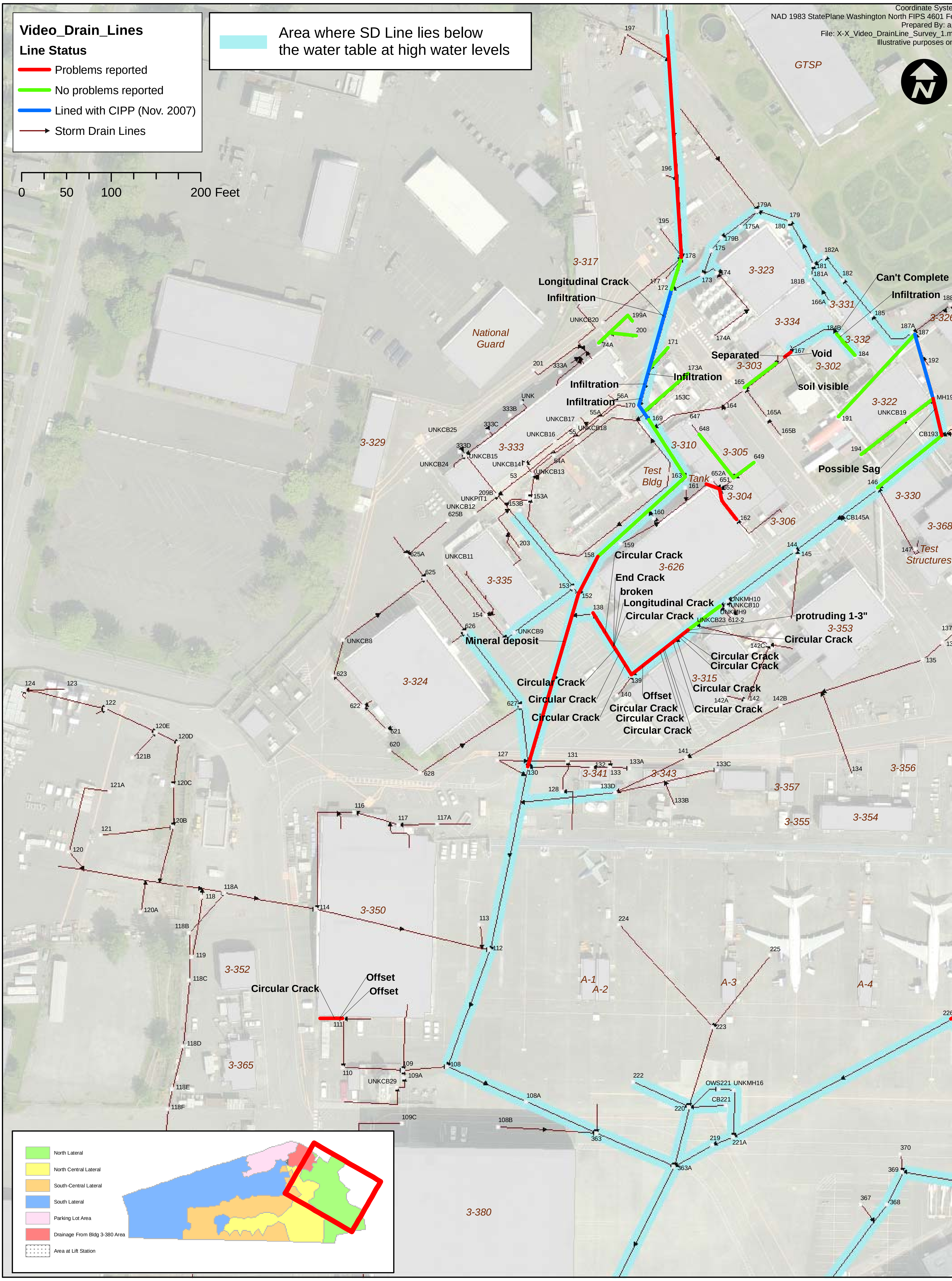

Figure 5-31. Results of 2007 Storm Drain Video Inspection

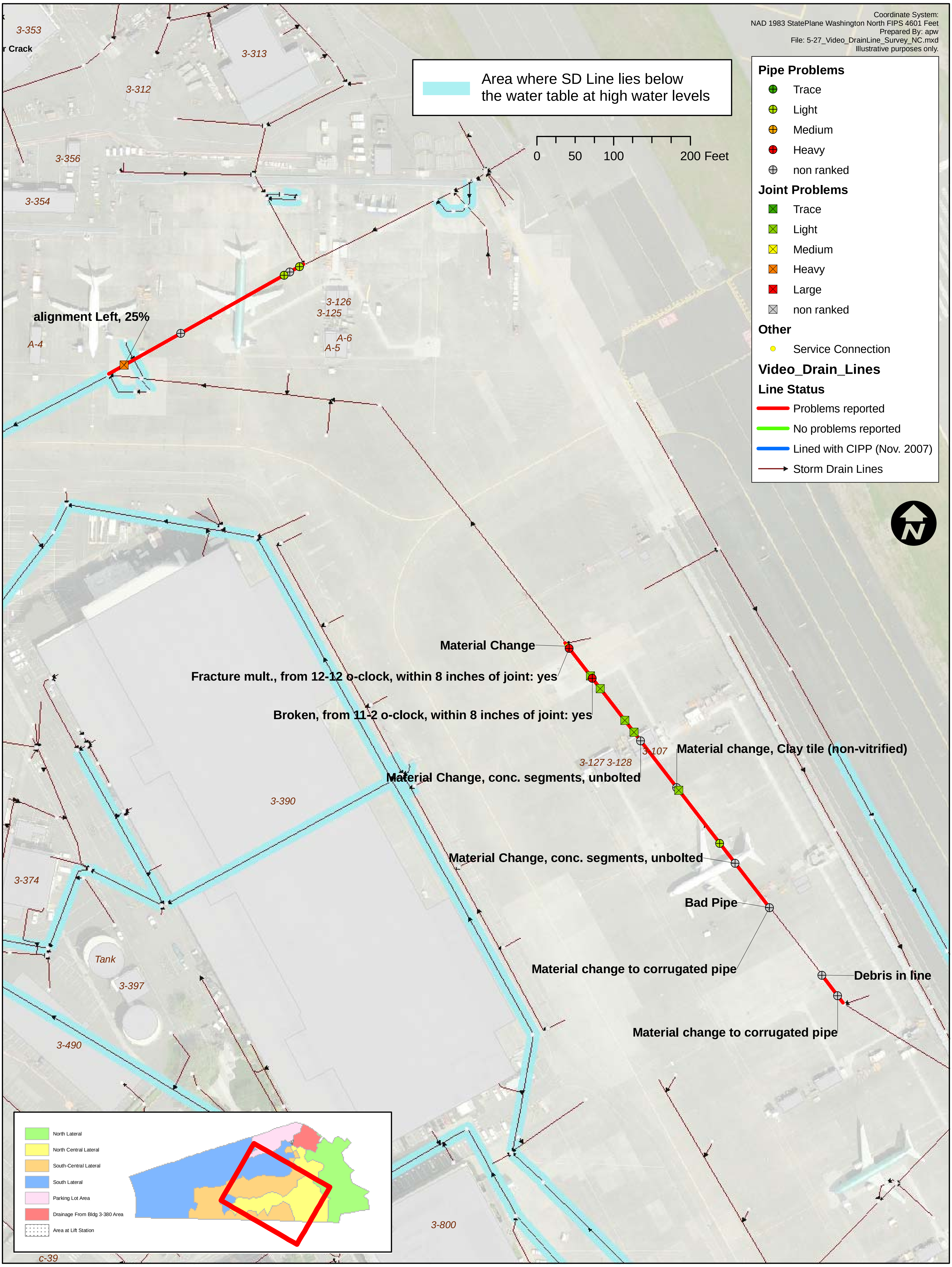

Figure 5-32. Results of 2008 Storm Drain Video Inspection

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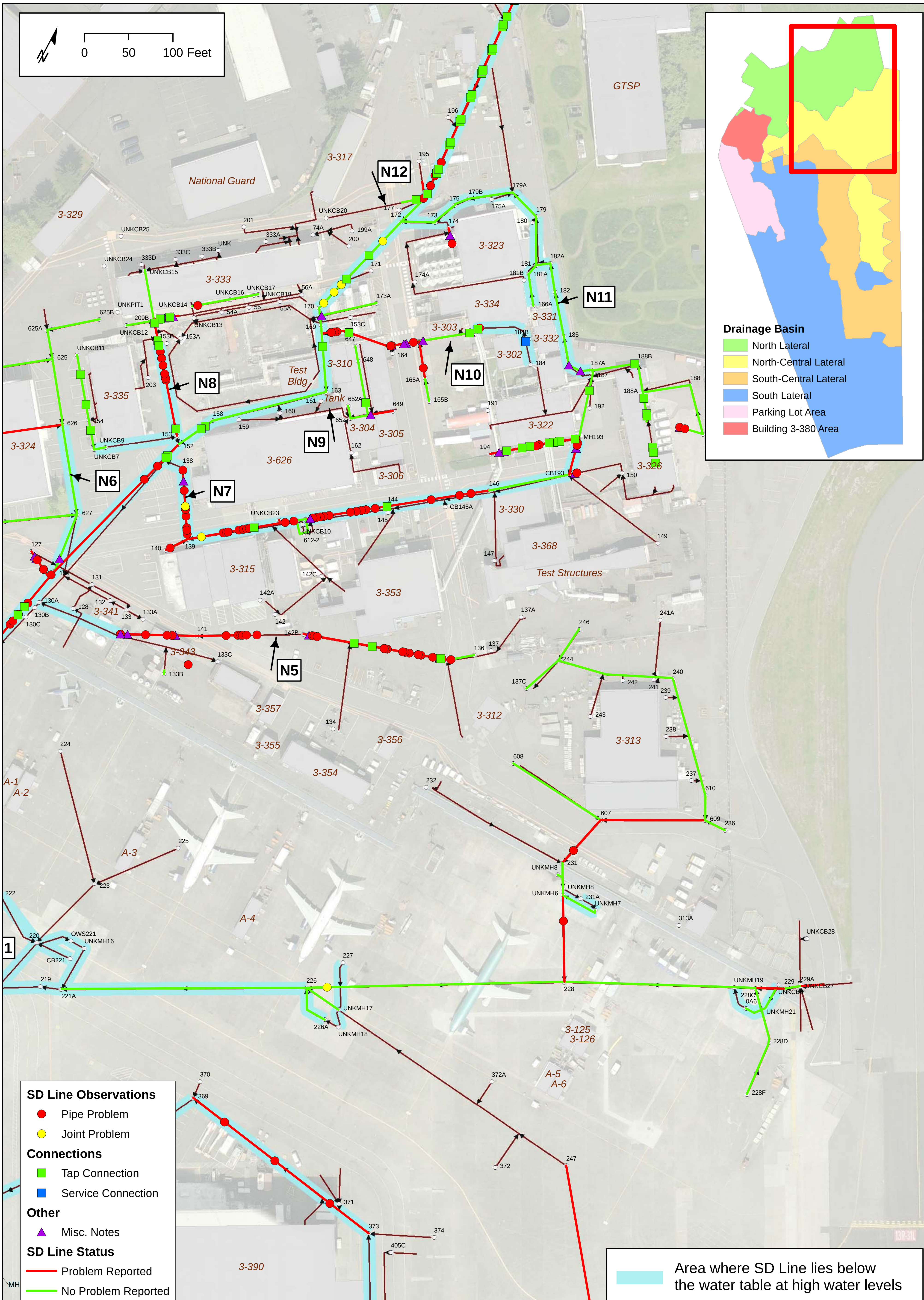

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Figure 5-33a. Results of 2010 Storm Drain Video Inspection

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Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-26_Video_DrainLine_Survey_N.mxd
Illustrative purposes only.

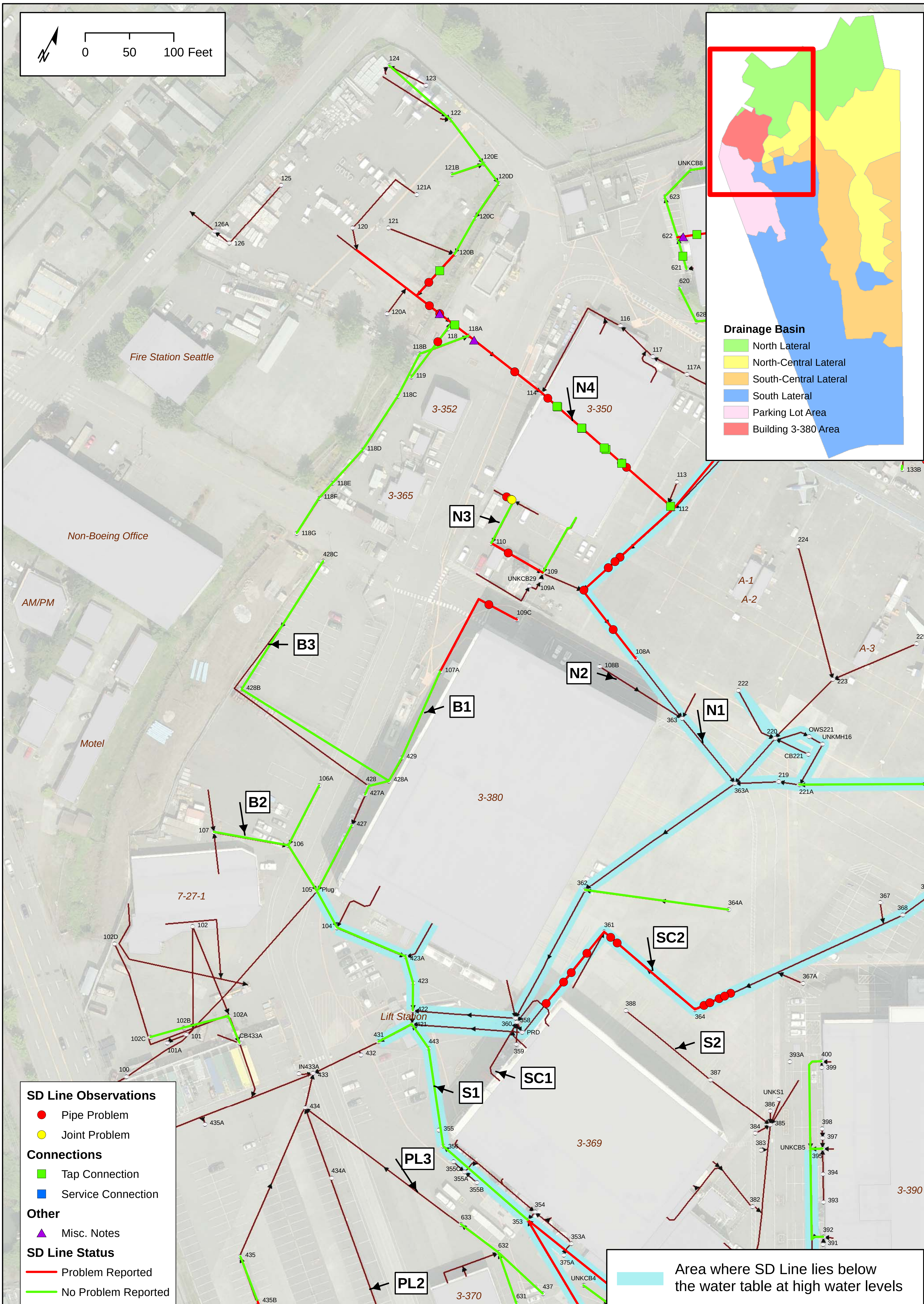

Figure 5-33b. Results of 2010 Storm Drain Video Inspection

Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-33b_SDLine_Video_Survey_2010.mxd
Illustrative purposes only.

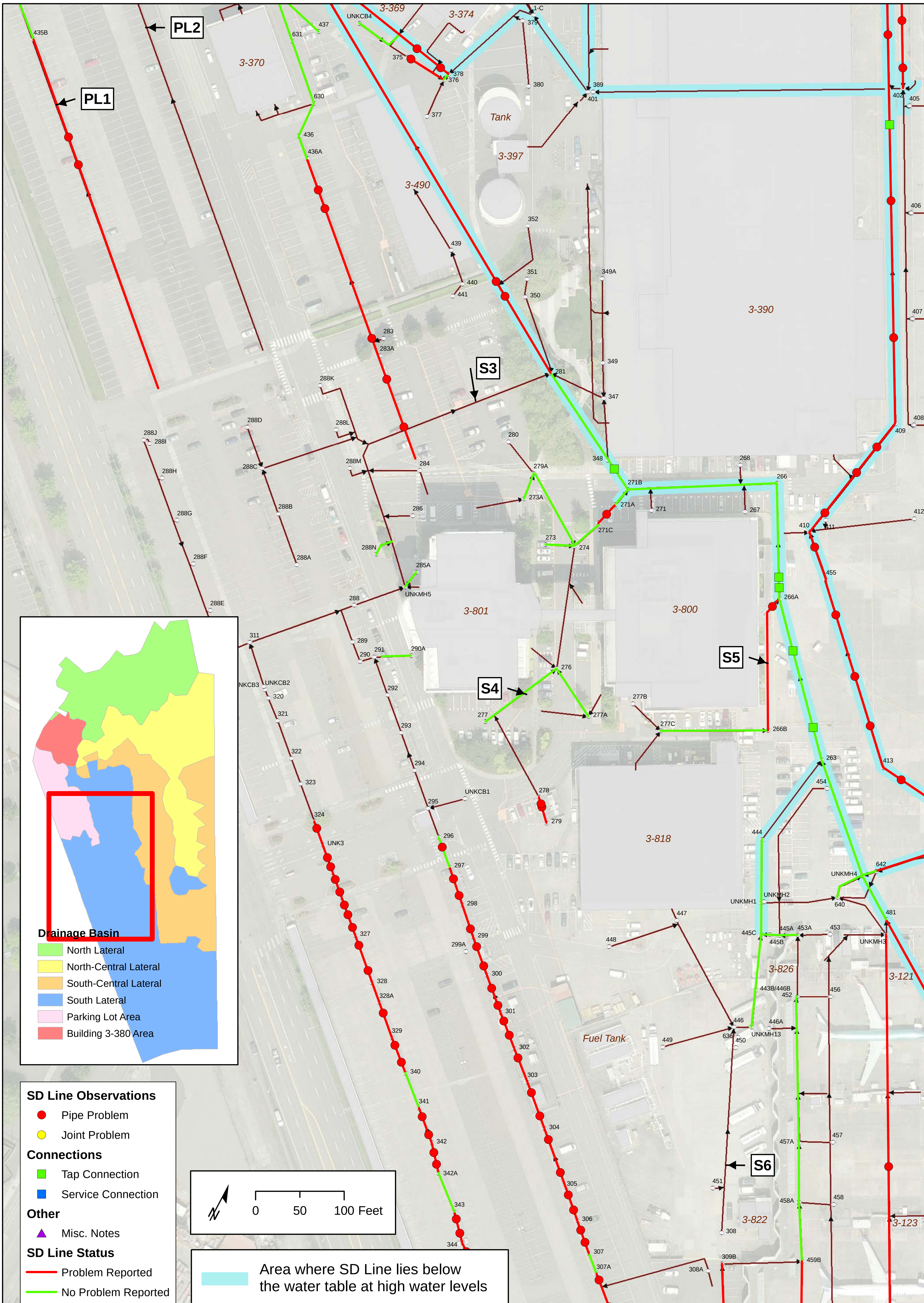

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Figure 5-33c. Results of 2010 Storm Drain Video Inspection

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-33c_SDLine_Video_Survey_2010.mxd
Illustrative purposes only.

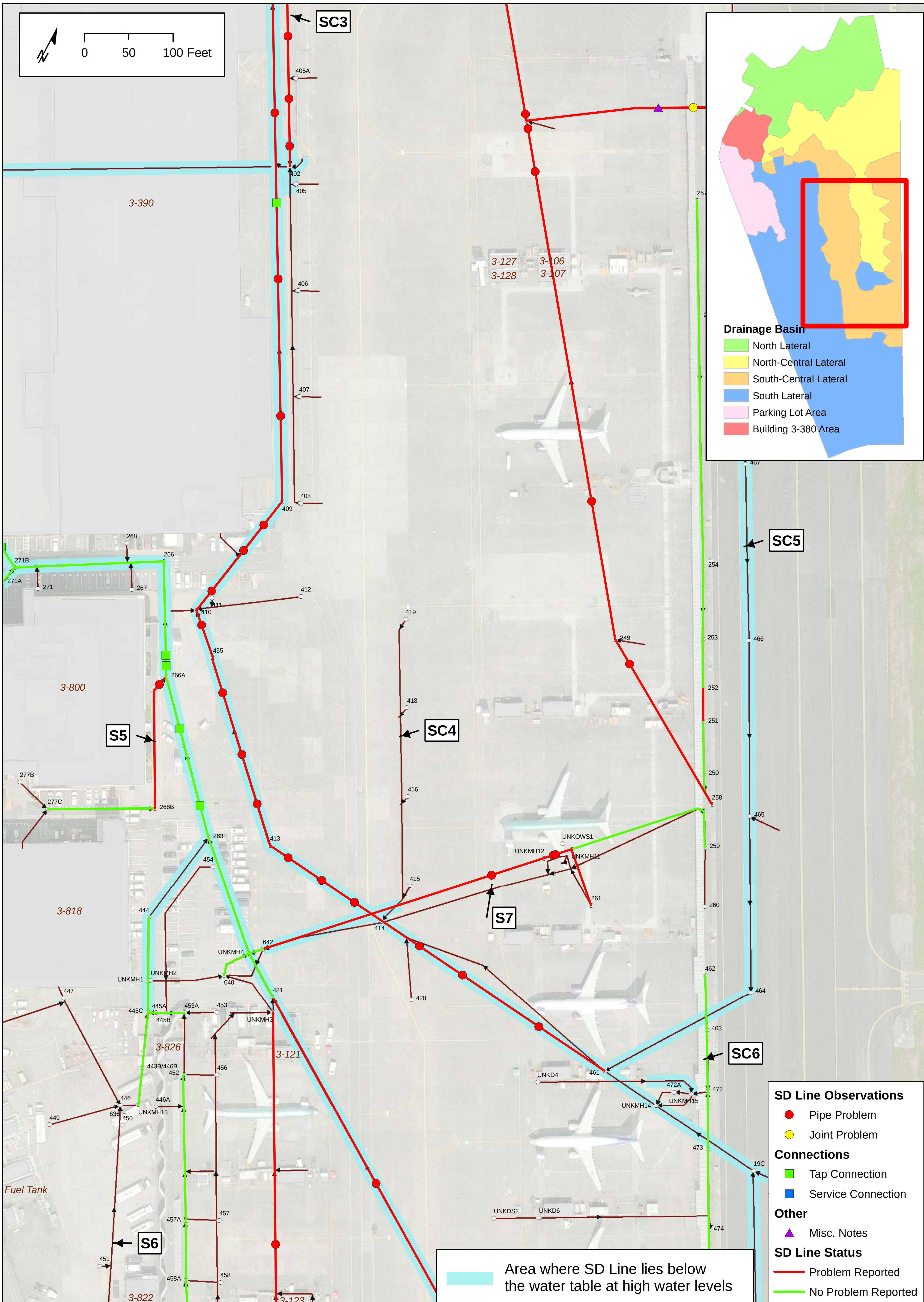

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Figure 5-33d. Results of 2010 Storm Drain Video Inspection

SAIC From Science to Solutions

Coordinate System: NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-33d_SDLine_Video_Survey_2010.mxd
Illustrative purposes only.

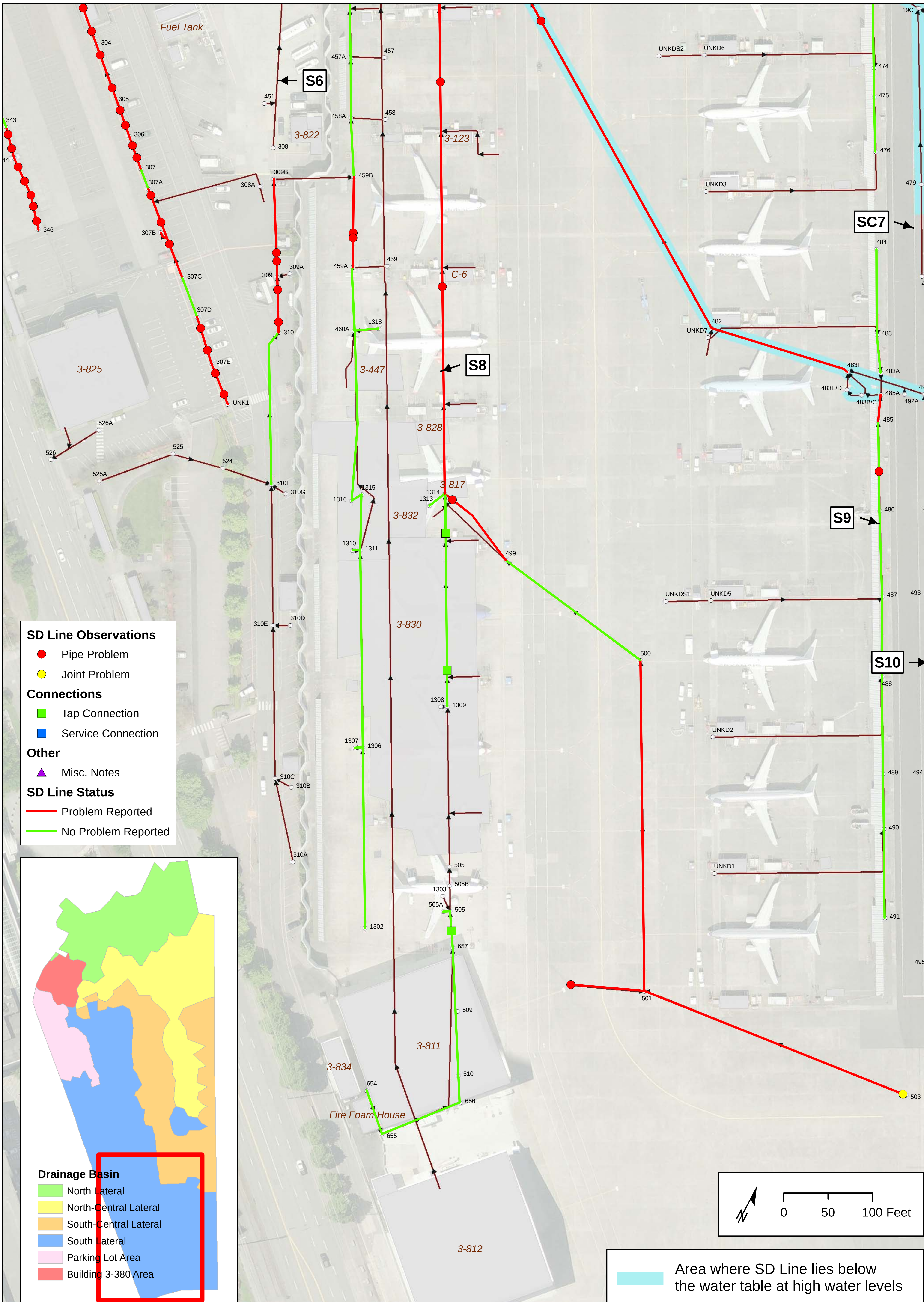

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Figure 5-33e. Results of 2010 Storm Drain Video Inspection

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Coordinate System:
NAD 1983 StatePlane Washington North FIPS 4601 Feet
Prepared By: apw
File: 5-26_Video_DrainLine_Survey_N.mxd
Illustrative purposes only.

Tables

Table ES-1
COPCs in SD Solids and Potential Source Material at NBF-GTSP Site

		COPCs in Storm Drain	COPCs in Inflow Sources								COPCs in Infiltration Sources	
			CJM	Building Materials					Outdoor Sources			
SD Drainage Area/ SD Lines	Buildings/ Structures Near SD Lines	SD Solids	Concrete Joint Material	Caulk	Paint/ Window Glaze	Rooftops/ Down-spouts	Rubber Gaskets/ Exterior Plastic	Siding/ Other	Asphalt/ Concrete	Surface Debris	Soil	Groundwater/ SD Base Flow
GEORGETOWN STEAM PLANT FACILITY											**P M H B D**	**P M** H B
NBF North Lateral Drainage Area												
N1, N2, N3, N4, and branch lines to CB113, CB118G, CB120A, CB121A, CB123, CB117	3-350, 3-380, 3-365, 3-352	**P M H B** D	**P** M H B	**P M**	**P M**	**M** P	P M B	M D	**P M**	**P M**	**M H** P B D	**P M H**
N1, N5, branch lines to MH131, D133C, CB134	3-354, 3-355, 3-357, 3-343, 3-341, 3-353, 3-315, 3-368, 3-312, 3-356	**P M H D** B	**P** M H B	**M** P	**P M**	**M** P	**P M** B		**P M**	**P M**	**P M H** B D	**B** P M H
N1,N6, N8, branch lines to CB620, CB621, CB127, UNKCB11, CB201, CB56A, UNKCB17	3-324, 3-335, 3-333, 3-329	**P M H D** B	**P** M H B	P M H B	P M	P M	M B		**P M**	**P M**	**P M H** B D	**P** M
N1, N7, branch lines to CB142A, CB147, MH149, CB194	3-368, 3-330, 3-326, 3-322, 3-353, 3-306, 3-626, 3-315	**P M H D** B	P M H B	**P M**	**P M**	**M** P	**P M** B	**P** M D	**P M**	**P M**	**P M H** B D	**B** P M H
N1, N10, N11, N12	3-626, 3-310, 3-306, 3-322, 3-326, 3-302, 3-303, 3-334, 3-323, 3-317, 3-333	**P M H B D**	**P** M H B	**P M**	**P M**	**P M**	P M B	**P** M D	**P M**	**P M**	**P M H B** D	**P** M H
Bollards, containers, tanks, unnumbered structures	North lateral - wide				**P M**	P M			**M** P			
NBF North-Central Lateral Drainage Area												
NC1, NC2, branch lines to CB222, CB224, CB364A	A-1 through A-4, 3-380, 3-369, Concourse A	**P M H B** D	**P** M H B	P M H B	M	P M H B D	B		P M			**M** B

Table ES-1
COPCs in SD Solids and Potential Source Material at NBF-GTSP Site

SD Drainage Area/ SD Lines	Buildings/ Structures Near SD Lines	COPCs in Storm Drain	COPCs in Inflow Sources								COPCs in Infiltration Sources	
			CJM	Building Materials					Outdoor Sources			
		SD Solids	Concrete Joint Material	Caulk	Paint/ Window Glaze	Rooftops/ Down-spouts	Rubber Gaskets/ Exterior Plastic	Siding/ Other	Asphalt/ Concrete	Surface Debris	Soil	Groundwater/ SD Base Flow
NC1, NC3, branch lines to CB372, CB372A, CB257	A-5, A-6, Concourse A, Concourse B	**P M H B D**	**P** M H B	P M H B	M	P M H B D	B		P M			M
NC1, NC4, NC5, branch lines to CB232, CB608, CB246, CB241A, CB243	3-125, 3-126, 3-313, 3-312, 3-356, 3-354	**P M H B** D	**P** M H B	M H B	M	P M H B D	B		M		**B**	**M B** H
NBF South-Central Lateral Drainage Area												
SC1, SC2,	3-369	**P H B** M D	**P** M H B	P M H B	M	P M H B D	B		P M		P	**M**
SC1, SC3	3-390 3-800 Concourse B	**P M D** H B	**P** M H B	P M H B	M	P M H B D	B		P M		M H B	
SC1, SC4 through SC7	Concourse B	**P M H B** D	**P** M H B	P					P			**M**
NBF South Lateral Drainage Area												
S1, S2, branch lines to D393A, CB352, and MH398	3-369 3-397	**P M H B D**	**P** M H B	P M H B	P M	P M H B D	B		P M			**M**
S3, branch lines to CB288A, CB346, UNK1, CB525A,	3-801 3-825 parking lot	**P M** H B D	**P** M H B	P M H B	P M	P M H B D	B		P M		**M**	**M**
S1, S4, S5, S6	3-800 3-801 3-818	**P M H B** D	**P** M H B	P M H B	P M	P M H B D	B	P M D	P M		**M** H B	**M H B** P
S6, S8	3-818, 3-822, 3-811, 3-812, 3-834, Concourse C	**P M H B** D	**P** M H B	P M H B	P M	P M H B D	B	P M D	P M		**P H** B	
S7	Concourse B	**P M H B** D	**P** M H B	P					P		P H B	**M B** H
S1, S9, S10	Concourse B 3-811	**P M H B** D	**P** M H B	P		P M H B D	B		P			

Table ES-1
COPCs in SD Solids and Potential Source Material at NBF-GTSP Site

SD Drainage Area/ SD Lines	Buildings/ Structures Near SD Lines	COPCs in Storm Drain: SD Solids	COPCs in Inflow Sources: CJM: Concrete Joint Material	Building Materials: Caulk	Building Materials: Paint/ Window Glaze	Building Materials: Rooftops/ Down-spouts	Building Materials: Rubber Gaskets/ Exterior Plastic	Building Materials: Siding/ Other	Outdoor Sources: Asphalt/ Concrete	Outdoor Sources: Surface Debris	COPCs in Infiltration Sources: Soil	COPCs in Infiltration Sources: Groundwater/ SD Base Flow
NBF Building 3-380 Drainage Area												
B1	3-380	**P M** H B D		P M H B	P M	P M H B D	B	P M D	P M		**M H** P B	**M** P
B1, B2	7-21-1 3-380	**P M H B D**		P M H B	P M	P M H B D	B	P M D	P M		**M H** P B	**M**
B1, B3	parking lot	**P M** H B D									**M** P H B	**M** P H B
NBF Parking Lot Drainage Area												
PL1	3-370 parking lot	**P M H D** B	P M H B	P M H B	P M	P M H B D	B	P M D	M			
PL2	3-370 parking lot	**P** M H B D	**P** M H B	P M H B	P M	P M H B D	B	P M D				
PL3	parking lot	**P M B** H D	**P** M H B							**P M**		
Drainage downstream of KC Lift Station	7-21-1	**P M H D** B	P M H B	P M H B	P M	P M H B D	B	P M D	P M		**M** P	

Bold letters indicate contaminants of potential concern (COPCs) detected above the lowest respective screening level per media.

Letters not in bold indicate suspected or likely COPCs based on historical usage, analytical results detected below the lowest respective screening level, or a non-detect MDL exceeding respective screening levels.

COPCs = contaminants of potential concern
P = polychlorinated biphenyls (PCBs)
M = metals (mercury, cadmium, copper, lead, and zinc)
H = high molecular weight polycyclic hydrocarbons (HPAHs)
B = bis(2-ethylhexyl)phthalate
D = dioxins/furans

Table ES-2
Recommended Source Control Actions for NBF-GTSP Site

Recommendations	Drainage Area	Building/Sub-Drainage	COPCs	Priority
NBF STORM DRAIN SYSTEM				
Sample SD solids where data do not currently exist or where data are limited	All six drainage areas		P M H B D	Medium to High
Install/replace filter socks in all SD structures having PCBs >1.0 mg/kg DW	All six drainage areas		P	High
For filter socks, evaluate methods to collect more representative samples of solids entering the SD system (to span full grain-size range), or collect filtered suspended solids samples to complement sock material	North, north-central, south-central		P	High
Sample SD solids and SD baseflow in areas near damaged SD structures	All six drainage areas		P M H B D	High
Repair/replace submerged SD structures and those for which significant problems were reported	All six drainage areas			High
Repair/replace SD structures observed as showing signs of soil and/or groundwater infiltration in the 2010 video inspection	North, north-central, south-central, south, parking lot area	N4, N5, N7, N10, N11, NC3, SC1, S1, S2, S8, PL1	P M H B D	High
Conduct additional video inspection of line segments where data were lost due to a hardware malfunction	North-central	NC1, NC2, NC3, NC5		High
Evaluate the sources of identified tap connections	North, north-central, south-central, south			Medium
Compile information (depths, elevations, structure types, and connections) regarding the SD system	All six drainage areas			High
POTENTIAL SOURCES OF INFLOW				
Concrete Joint Material				
Sample CJM near SD structures where concentrations of PCBs in nearby SD solids are >1.0 mg/kg	North, north-central, south-central, south, parking lot area		P	High
To confirm source and contribution to SD system, perform selected co-located PCB congener analysis of SD solids and nearby CJM	North, north-central, south-central		P	Low
Sample Type A and Type G caulk	North, south-central	3-350, Concourse B	P	Medium to High
Analyze COPCs in addition to PCBs in CJM samples	North, north-central, south-central, south, parking lot area		P M H B	High
Sample additional Type A, Residual-G, Residual-H caulk	North-central, south-central	Concourse A, Concourse B	P	Medium
Building Materials: Caulk				
Collect samples of caulk from vents, piping, flanges, joint seams, window seals, and door jambs from buildings	North	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-324, 3-326, 3-331, 3-332, 3-333, 3-334, 3-350, 3-353, 3-354, 3-357, 3-364, 3-365, 3-368, 3-626	P M H B	Low to High
	North-central	A-1 through A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356, 3-369	P M H B	Low
	South-central	3-369, 3-390, and crew shelters	P M H B	Low to High
	South	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-390, 3-397	P M H B	Low to High
	Building 3-380, Parking lot area	7-27-1, 3-380	P M H B	Low to Medium

Table ES-2
Recommended Source Control Actions for NBF-GTSP Site

Recommendations	Drainage Area	Building/Sub-Drainage	COPCs	Priority
Building Materials: Paint				
Paint samples should be collected from bollards to determine if paint abatement activities are necessary to remove PCB-bearing paint.	North-central, south-central, south, Building 3-380 area, parking lot area		P M	High
Collect representative samples of paint from buildings, at least 1 to 3 samples per building side and per type/color of paint, as identified in Sections 4.3.2 through 4.3.7	North	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-341, 3-342, 3-343 3-353, 3-354, 3-355, 3-356, 3-357, 3-368, 3-626	P M	Low to High
	North-central	A-1 through A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356, 3-369	P M	High
	South-central	3-369, 3-390, and crew shelters	P M	Low to High
	South	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-834, 3-390, 3-397	P M	Low to High
	Building 3-380, Parking lot area	7-27-1, 3-380	P M	Low to Medium
Building Materials: Window Glaze				
Collect at least one sample of window glaze from each window	North	3-302, 3-303, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-333, 3-334, 3-352, 3-353, 3-365, 3-368, and 3-626	P	Low to High
	South-central	3-369 and 3-390	P	High
	South	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397	P	High
	Building 3-380 area, parking lot area	7-27-1	P	Medium
Building Materials: Siding				
Sample exterior surfaces of buildings built before the ban on PCBs or that once housed PCB-filled transformers and/or capacitors	All six drainage areas	3-302, 3-303, 3-310, 3-315, 3-322, 3-323 & 3-364, 3-331, 3-390, 3-341, 3-342, 3-343, 3-350, 3-352, 3-355, 3-357, 3-365, 3-368, 3-369, 3-374, 3-818, 3-822, 3-825, 3-834, 3-397, 3-626, 7-27-1	P	High
Identify buildings completed with Galbestos siding	All six drainage areas	3-302, 3-303, 3-310, 3-315, 3-322, 3-323 & 3-364, 3-331, 3-390, 3-341, 3-342, 3-343, 3-350, 3-352, 3-355, 3-357, 3-365, 3-368, 3-369, 3-374, 3-818, 3-822, 3-825, 3-834, 3-397, 3-626, 7-27-1	P M	High
Building Materials: Rooftops & Downspouts				
Sample roof tops & material from downspout discharge (rain water) in the north lateral drainage area	North	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-324, 3-326, 3-331, 3-332, 3-334, 3-341, 3-342, 3-343, 3-350, 3-353, 3-354, 3-355, 3-356, 3-357, 3-368, 3-626	P M H B D	Low to Medium
	North-central	A-1 through A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356, 3-369s and 3-380	P M H B D	Low to Medium
	South-central	3-369, 3-390, and crew shelters	P M H B D	Low to Medium
	South	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, 3-397, crew shelters	P M H B D	Low to Medium
	Building 3-380 area, parking lot area	7-27-1, 3-380	P M H B D	Low to Medium

Table ES-2
Recommended Source Control Actions for NBF-GTSP Site

Recommendations	Drainage Area	Building/Sub-Drainage	COPCs	Priority
Building Materials: Miscellaneous				
Sample outdoor floor tiles in the north lateral drainage area (Building 3-310)	North	3-310	M H B	Low
Perform a visual survey and collect samples of building materials such as foam, pipe wrap, insulation, and rubber door gaskets for COPCs	North-central, south-central, south, Building 3-380 area, parking lot area		P M B	Low
Surface Material: Asphalt				
Replace or frequently clean surface materials near SD structures with elevated concentrations of COPCs	All six drainage areas		P M H B D	Medium
Surface Material: Concrete				
Sample concrete in selected locations for COPCs (e.g., stained areas on equipment pads)	North	PEL area, north-north east of Building 3-380, east of Building 3-353, utility pads near Buildings 3-334, 3-353, and 3-626, and Substation 87.	P M B	Low to High
	North-central	Concourse A, A-1 through A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356, 3-369	P M B	Low to High
	South-central	Concourse B, 3-369, 3-390, and crew shelters	P M B	Low to High
	South	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, 3-397, Vault No. 94 pad, Former Buildings 2-35, 3-830, 3-831, employee parking lot	P M B	Low to High
	Building 3-380, Parking lot area	7-27-1, 3-380	P M B	Low to Medium
Sample concrete near CJM with previously identified elevated concentrations	North, north-central, south-central, south		P	High
Replace or frequently clean surfaces near SD structures with elevated concentrations of COPCs in SD solids	All six drainage areas		P M H B D	Medium
Surface Debris				
Frequently clean surface materials near SD structures with elevated concentrations of COPCs in SD solids	All six drainage areas		P M H B D	Medium
Sample areas where SD solids have elevated levels of COPCs, to identify sources	All six drainage areas		P M H B D	High
Evaluate sweeper dump solids on a quarterly basis	Flightline areas		P M H B D	Low to Medium
Boeing to maintain regenerative air-type sweepers				Medium
General				
Evaluate building materials and conduct abatement activities as necessary	All six drainage areas		P M H B D	Low to High
Evaluate potential indoor sources of COPCs by performing a visual survey for potential contaminant sources (e.g. caulk) and collecting representative samples for analysis	All six drainage areas		P M H B D	Low to Medium
Conduct an interior floor drain survey to identify illicit connections, if any, to the NBF SD system	All six drainage areas			Medium
POTENTIAL SOURCES OF INFILTRATION				
Soil and Groundwater				
Sample soil and groundwater in areas near damaged SD structures with elevated levels of COPCs	All six drainage areas		P M H B D	High
Proceed with proposed excavations of COPC-impacted soil in the areas along the NBF-GTSP fenceline and between Buildings 3-335 and 3-333	North	3-335, 3-333, NBF-GTSP fence line area	P M H B D	High

Table ES-2
Recommended Source Control Actions for NBF-GTSP Site

Recommendations	Drainage Area	Building/Sub-Drainage	COPCs	Priority
Evaluate soil in the area southeast of Building 3-335 and the area north of Building 3-333 to determine if excavation is necessary due to PCBs. Currently, these two areas are not included in proposed excavation activities	North	3-335, 3-333	P M H B D	High

COPCs = contaminants of potential concern
P = polychlorinated biphenyls (PCBs)
M = metals (mercury, cadmium, copper, lead, and zinc)
H = high-molecular weight polycyclic aromatic hydrocarbons (HPAHs)
B = bis(2-ethylhexyl)phthalate
D = dioxins/furans

Table 1-1
Chemicals Exceeding Criteria in Slip 4 and SD Samples

Chemicals Detected at Concentrations Above the SQS/LAET or WQC	Slip 4 Sediment	Stormwater and Base Flow: Whole Water	Stormwater: Filtered Suspended Solids
	> SQS/LAET	> WQC	> SQS/LAET
PCBs			
PCBs (total)	●	●	●
Metals			
Cadmium (1)		●	●
Copper		●	
Lead	●	●	
Mercury (2)	●	●	●
Selenium (3)		●	
Zinc	●	●	●
LPAH			
Phenanthrene	●		●
HPAHs			
Benzo(a)anthracene	●	●	●
Benzo(a)pyrene	●	●	●
Benzofluoranthenes	●	●	●
Benzo(g,h,i)perylene			●
Chrysene	●	●	●
Dibenzo(a,h)anthracene	●	●	●
Fluoranthene	●		●
Indeno(1,2,3-cd)pyrene		●	●
Pyrene			●
Total HPAHs (4)	●		●
Phthalates			
BBP	●		NA
BEHP (5)	●	●	NA
Dioxins/Furans			
TEQ (0.5 DL) (6)	●	NA	●

(1) Cadmium was detected above the WQC in a base flow whole water sample at the lift station.

(2) Mercury was not detected in whole water samples, but the reporting limit exceeded the WQC.

(3) Selenium was detected above the WQC in a base flow whole water sample at the lift station.

(4) Total HPAHs were calculated as the sum of benzo(a)anthracene, benzo(a)pyrene, total benzofluoranthenes, benzo(g,h,i)perylene, chrysene, dibenzo(a,h)anthracene, fluoranthene, indeno(1,2,3-cd)pyrene, and pyrene.

(5) BEHP was detected above the WQC in two stormwater samples in the north lateral SD line (MH108), but not at the KC lift station (LS431).

(6) Dioxins/furans TEQ (0.5 DL) exceeded the CERCLA sediment screening level applied to Terminal 117.

NA – Not Analyzed

LPAH – Low molecular weight polycyclic aromatic hydrocarbon

HPAH – High molecular weight polycyclic aromatic hydrocarbon

BBP – butylbenzylphthalate

BEHP – bis(2-ethylhexyl)phthalate

TEQ – toxic equivalent (0.5 DL = applies half the detection limit for non-detected values in the TEQ calculation)

Table 1-2
Screening Levels Protective of Sediment Recontamination

Media	Screening Levels	Units	Contaminants of Potential Concern								
			Total PCBs	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAHs	BEHP	Dioxins/Furans TEQ (0.5 DL)
Groundwater, Stormwater and SD Base Flow	*WQS (a)*	*µg/L*	0.014	0.012	9.3	3.1	8.1	81	--	--	--
	HHO (b)	*µg/L*	--	--	--	--	--	--	0.018	2.2	--
	RCRA/MTCA (c)	*µg/L*	--	--	--	--	--	--	--	--	2.06 E-10
Storm Drain Solids	*LAET (d)*	*mg/kg*	0.13	--	--	--	--	--	12	1.3	--
	2LAET (d)	*mg/kg*	1.0	--	--	--	--	--	17	1.9	--
	SQS (d)	*mg/kg*	--	0.41	5.1	390	450	410	--	--	--
	CSL (d)	*mg/kg*	--	0.59	6.7	390	530	960	--	--	--
	CERCLA T-117 (e)	*pg/g*	--	--	--	--	--	--	--	--	4.5
Concrete Joint Material	*Interim Screening Level (f)*	*mg/kg*	1.0	--	--	--	--	--	--	--	--
Surface and Building Materials	*LAET (d)*	*mg/kg*	0.13	--	--	--	--	--	12	1.3	--
	2LAET (d)	*mg/kg*	1.0	--	--	--	--	--	17	1.9	--
	SQS (d)	*mg/kg*	--	0.41	5.1	390	450	410	--	--	--
	CSL (d)	*mg/kg*	--	0.59	6.7	390	530	960	--	--	--
Soil	*Soil-to-Sediment (SQS) (g)*	*mg/kg*	0.012	0.021	1.3	39	57	16	0.012	0.047	--
	Soil-to-Sediment (CSL) (g)	*mg/kg*	0.065	0.030	1.7	39	67	38	0.033	0.078	--
	MTCA Natural Background Level (h)	*pg/g*	--	--	--	--	--	--	--	--	5.2
	Urban Background Level (i)	*pg/g*	--	--	--	--	--	--	--	--	9.9

(a) Based on the Washington State Water Quality Standards (WQS) for Surface Water (WAC 173-201A), using the most conservative of the marine and fresh water criteria

(b) Based on the most conservative Human Health Organisms (HHO) Standard

(c) Based on the most stringent Surface Water criteria (Human Health adult carcinogen, Tribal fish comsumption, EPA RCRA, using MTCA equation 730-2) (Ecology 2011)

(d) Based on the Washington State Sediment Management Standards (WAC 173-204); note that the PCB RL (~0.8 mg/kg) for most building material samples (paint, caulk, other) is greater than the LAET, and therefore a screening level of 1.0 mg/kg (equivalent to the 2LAET value) is used for purposes of the I&I Assessment

(e) Based on the CERCLA sediment screening level for Terminal 117 (= 0.0000045 mg/kg) (Ecology 2011)

(f) Interim screening level used by Ecology for concrete joint material at the North Boeing Field facility, resulting from the PCB RL for CJM samples (~0.8 mg/kg)

(g) Based on Source Control Action Plan, Slip 4, Lower Duwamish Waterway, Soil and Groundwater Screening Criteria (SAIC 2006)

(h) Based on Ecology August 2010 Technical Memorandum #8, Natural Background for Dioxins/Furans in WA Soils (= 0.0000052 mg/kg)

(i) Based on Ecology August 2010 Technical Memorandum #8, Urban Background for Dioxins/Furans in WA Soils (= 0.0000099 mg/kg)

PCBs = polychlorinated biphenyls

HPAHs = high molecular weight polycyclic aromatic hydrocarbons

BEHP = bis(2-ethylhexyl)phthalate

TEQ = toxic equivalent (0.5 DL = applies half the detection limit for non-detected values in the TEQ calculation)

-- = information not applicable or unavailable

Table 2-1
Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW)								pg/g (DW)
			Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
North Lateral SD Line											
MH108 (a)	N1	6/30/2010	22	0.2	4	71	30	320	0.07	1 U	5.9
CB108A	N1	6/16/2009	4.8	NA	NA	NA	NA	NA	NA	NA	NA
MH130	N1	3/13/2007	57	NA	NA	NA	NA	NA	NA	NA	NA
MH152 (b)	N1	6/2/2010	3.7	0.4 J	6	419	210	1160	19.1	NA	49.0
MH163	N1	6/8/2009	2.3	NA	NA	NA	NA	NA	NA	NA	NA
MH169	N1	1/26/2007	37	0.09	NA	NA	NA	NA	NA	NA	NA
CB171	N1	3/30/2010	0.28	0.07	4.5	120	335	1010	NA	NA	NA
MH172	N1	3/29/2010	1.1	0.07	0.5	24.1	25	69	NA	NA	NA
MH178 (b, c)	N1	6/2/2010	1.3	0.3 J	4	413	240	565	43.8	16	24.8
CB363	N1	6/9/2009	6.8	0.18 J	NA	32.6	25 J	219 J	1.35	0.39	NA
MH363-T5	N1	4/8/2010	2.6	0.34	NA	287	277	705	44	10	NA
CB196	N1 branch	4/7/2010	7.2	0.70	11.0	131	118	633	NA	NA	NA
CB197	N1 branch	4/7/2010	0.20	0.06	4.5	189	52	492	NA	NA	NA
CB108B	N2	4/6/2010	1.0	0.16	9.5	234	241	1340	NA	NA	NA
OWS109A	N3	4/6/2010	0.72	0.13	98.1	179	242	9570	NA	NA	NA
D109B	N3	5/4/2010	0.45	0.08	90.5	211	164	4820	NA	NA	NA
CB110	N3	4/7/2010	0.30	0.10 J	2.3	72.9 J	257 J	863 J	NA	NA	NA
MH111	N3	4/7/2010	0.51	0.26	3.8	134	245	879	NA	NA	NA
CB113 (d)	N4	4/7/2010	31.7	0.17	20.7	225	280	1360	NA	NA	NA
CB114	N4	4/5/2010	0.95	0.26	2.5	96.1	146	773	NA	NA	NA
CB116	N4	4/5/2010	0.56	0.91 J	3.4	161	339 J	1160	NA	NA	NA
CB117	N4	4/5/2010	2.4	0.51	8.1	247	375	3150	NA	NA	NA
CB118	N4	4/12/2010	0.54	0.13	3.0	90.3	73	449	NA	NA	NA
CB118A	N4	4/6/2010	0.19	0.11	2.7	46.1	47	359	NA	NA	NA
CB118B	N4	4/6/2010	0.59	0.09	3.8 J	128	154	2590	NA	NA	NA
CB118C	N4	4/6/2010	0.20	0.04	1.8	62.3	48	1040	NA	NA	NA
CB118D	N4	4/6/2010	1.0	0.18	3.5	175	221	1560	NA	NA	NA
CB118E	N4	4/6/2010	0.90	0.12	3.2	156	173	1240	NA	NA	NA
CB118F	N4	4/6/2010	0.24	0.05	1.3	78.9	74	693	NA	NA	NA
CB118G	N4	4/6/2010	0.15	0.06	1.1	73.0	65	280	NA	NA	NA
CB120	N4	4/5/2010	0.44	0.27	16.9	185	240	1110	NA	NA	NA
CB120A	N4	4/5/2010	0.48	0.19	15.6	168	223	1370	NA	NA	NA
CB120C	N4	4/5/2010	0.18	0.08	3.5	145	73	449	NA	NA	NA
CB120D	N4	4/5/2010	0.16	0.07	2.3	113	36	284	NA	NA	NA

Table 2-1
Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
CB120E	N4	4/5/2010	0.40	0.33	10.3	186	183	1400	NA	NA	NA
CB121	N4	4/5/2010	0.26	0.13	9.1	283	271	1160	NA	NA	NA
CB121A	N4	4/5/2010	0.42	0.15	8.9	436	177	3030	NA	NA	NA
CB121B	N4	4/5/2010	0.56	0.14	12.5	287	223	1310	NA	NA	NA
CB122	N4	4/5/2010	0.24	0.14	9.1	238	156	1450	NA	NA	NA
CB124	N4	4/5/2010	0.26	0.16	21.8	324	228	1690	NA	NA	NA
CB125	N4	4/12/2010	0.36	0.15	29.7	246 J	225	1110	NA	NA	NA
CB126	N4	4/5/2010	0.22	0.09	20.3	136	163	818	NA	NA	NA
CB133B	N5	4/1/2010	0.52	0.07	9.5	192	130	976	NA	NA	NA
D133C	N5	5/4/2010	0.92	0.20	7.7	123	324	3680	NA	NA	NA
MH133D (b)	N5	6/2/2010	1.3	3.5 J	102	134	230	2650	97.4	NA	34.9
CB134	N5	4/1/2010	0.83	1.1	46.1	246	327	1480	NA	NA	NA
CB135	N5	4/1/2010	1.1	7.8	18.6	166	298	1580	NA	NA	NA
CB136	N5	4/1/2010	1.7	38	36.4	193	258	2460	NA	NA	NA
OWS137	N5	6/9/2009	4.9	NA	NA	NA	NA	NA	NA	NA	NA
CB137A	N5	4/1/2010	0.78	0.12	24.8	219	186	1810	NA	NA	NA
CB141	N5	4/1/2010	0.56	10.5	24	102	160	1120	NA	NA	NA
CB142B	N5	4/1/2010	0.33	26	31	147	220	1200	NA	NA	NA
CB127	N6	4/7/2010	0.61	0.17	4.1	135	177	923	NA	NA	NA
CB128	N6	4/7/2010	0.35	0.05	1.9	141	45	268	NA	NA	NA
CB131	N6	4/1/2010	1.5	0.62	8.3	351	208	1130	NA	NA	NA
OWS132	N6	3/15/2007	10.3	NA	NA	NA	NA	NA	NA	NA	NA
CB133	N6	4/7/2010	1.2	0.36	5.3	192	138	966	NA	NA	NA
CB620	N6	4/5/2010	0.46	0.21	4.1	166	249	954	NA	NA	NA
CB621	N6	4/12/2010	0.36	0.44	22.9	426	337	1380	NA	NA	NA
CB622	N6	4/5/2010	0.36	0.39	16.8	502	282	2860	NA	NA	NA
CB623	N6	4/12/2010	0.13	0.08	3.5	132	66	609	NA	NA	NA
CB625	N6	3/31/2010	0.25	0.10	4.9	777	303	1330	NA	NA	NA
CB625A	N6	3/31/2010	0.27	0.07	2.8	528	134	1200	NA	NA	NA
CB625B	N6	3/31/2010	0.32	0.10	7.4	221	161	766	NA	NA	NA
CB626	N6	3/31/2010	0.090	0.05	3.8	276	44	828	NA	NA	NA
CB627	N6	3/31/2010	1.0	0.27	10.1	367	287	1900	NA	NA	NA
CB628	N6	4/5/2010	0.82	0.21	1.7	113	78	349	NA	NA	NA
UNKCB8	N6	4/5/2010	0.30	0.16	7.6	201	111	1310	NA	NA	NA
MH138 (b)	N7	6/2/2010	13	0.37 J	11.1	149	90	1250	15.8	NA	17.6

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Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
CB140	N7	4/1/2010	0.50	0.18	7.5	381	165	953	NA	NA	NA
CB142	N7	4/1/2010	0.63	0.14	26.5	759	335	2820	NA	NA	NA
CB144	N7	4/1/2010	1.3	0.12	6.7	233	179	1150	NA	NA	NA
CB145A	N7	4/1/2010	0.54	0.08	3.7	145	818	983	NA	NA	NA
CB146	N7	4/1/2010	1.4	1.4 J	11.7	269 J	345	1810	NA	NA	NA
CB147	N7	4/1/2010	18.9	6.9	52.0	798	1220	4960	NA	NA	NA
CB149	N7	4/1/2010	0.55	0.15	11.8	167	602	1060	NA	NA	NA
CB150	N7	3/29/2010	1.1	0.67	8.0	138	245	883	NA	NA	NA
CB193	N7	3/13/2007	79	NA	NA	NA	NA	NA	NA	NA	NA
OWS612-2	N7	4/1/2010	4.6	0.34	17.0	323	272	2660	NA	NA	NA
UNKCB10	N7	4/1/2010	1.2	0.09	8.2	162	133	1050	NA	NA	NA
UNKMH9	N7	4/1/2010	1.8	0.55	10.5	263	166	1550	NA	NA	NA
UNKMH10	N7	4/1/2010	1.7	0.40	10.7	199	175	1540	NA	NA	NA
CB53	N8	3/31/2010	1.3	0.21	41.2	555	193	2760	NA	NA	NA
CB54A	N8	3/30/2010	0.92	0.31	34.7	500	244	3240	NA	NA	NA
CB55	N8	3/30/2010	0.73	0.21	30.1	450	197	4800	NA	NA	NA
CB55A	N8	3/30/2010	0.74	0.21	16.8	492	231	3010	NA	NA	NA
CB56A	N8	3/30/2010	0.59	0.33	14.2	508	359	2540	NA	NA	NA
OWS153	N8	1/5/2006	1.0	NA	NA	NA	NA	NA	NA	NA	NA
D153B	N8	5/10/2010	0.80	0.17	108	339	308	12000	NA	NA	NA
D153C	N8	5/4/2010	0.49	0.26	89.5	596	447	22900	NA	NA	NA
CB154	N8	4/12/2010	0.16	0.05	2.0	147	88	586	NA	NA	NA
CB173A	N8	3/30/2010	0.65	0.18	6.2	214	368	1730	NA	NA	NA
CB203	N8	3/31/2010	0.66	0.05	4.6	73.2	32	666	NA	NA	NA
CB209B	N8	3/31/2010	0.47	0.10	7.2	166	149	936	NA	NA	NA
D333B	N8	5/4/2010	0.30	0.15	5.1	830	157	1270	NA	NA	NA
D333C	N8	5/4/2010	0.45	0.11	6.8	219	204	2370	NA	NA	NA
D333D	N8	5/4/2010	0.22	0.05	6.2	148	123	834	NA	NA	NA
UNKCB7	N8	3/31/2010	0.38	0.12	2.9	188	128	951	NA	NA	NA
UNKCB9	N8	4/12/2010	0.20	0.09	1.8	105	73	718	NA	NA	NA
UNKCB11	N8	3/31/2010	0.40	0.15	4.3	338	174	914	NA	NA	NA
UNKCB12	N8	3/31/2010	0.66	0.18	22.8	427	162	2290	NA	NA	NA
UNKCB15	N8	4/7/2010	0.35	0.59	9.4	231	160	1400	NA	NA	NA
UNKCB24	N8	4/7/2010	0.25	0.10	6.8	143	189	2090	NA	NA	NA
UNKCB25	N8	4/7/2010	0.37	0.12	5.7	127	199	1030	NA	NA	NA

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Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
CB159	N9	3/31/2010	16.9	2.0	58.3	470	201	2950	NA	NA	NA
CB161	N9	3/31/2010	2.4	0.61	40.0	341	189	3580	NA	NA	NA
CB162	N9	4/7/2010	2.9	4.7	10.4	245	155	871	NA	NA	NA
CB647	N9	3/31/2010	1.6	5.6	9.5	318	230	4290	NA	NA	NA
CB648	N9	3/31/2010	0.75	1.5	14.2	216	163	2110	NA	NA	NA
CB649	N9	3/31/2010	1.5	0.75	13.6	290	257	1680	NA	NA	NA
MH651	N9	4/7/2010	1.1	61	7.1	228	90	1420	NA	NA	NA
MH652 (d)	N9	4/14/2010	4.3	173	14.8	295	2780	1970	NA	NA	NA
CB652A	N9	3/31/2010	2.7	0.18	13.2	256	635	2030	NA	NA	NA
CB165 (b)	N10	6/2/2010	2.6	2.17 J	6.3	150	332	2810	7.45	NA	49.6
CB165A	N10	3/30/2010	1.2	0.32	10.7	162	571	810	NA	NA	NA
CB165B	N10	8/5/2009	0.20	NA	NA	NA	NA	NA	NA	NA	NA
CB167	N10	3/30/2010	2.1	1.7	3.5	197	106	3280	NA	NA	NA
CB184	N10	3/29/2010	11	1.6	14.9	275	240	2640	NA	NA	NA
CB184B	N10	3/29/2010	9.7	0.50	26.8	195	169	2280	NA	NA	NA
MH166A	N11	7/15/2009	18	NA	NA	NA	NA	NA	NA	NA	NA
CB173 (e, f)	N11	3/29/2010	43	0.73	11.1	382	211	2320	4.34	NA	65.0
CB174	N11	3/29/2010	1.9	0.61	5.7	376	287	1920	NA	NA	NA
CB174A	N11	3/30/2010	0.70	0.27	6.2	145	183	1990	NA	NA	NA
CB175	N11	3/29/2010	1.4	0.31	1.1	111	28	251	NA	NA	NA
CB175A	N11	3/29/2010	0.70	0.11	4.2	104	70	804	NA	NA	NA
MH179	N11	8/5/2009	1.6	NA	NA	NA	NA	NA	NA	NA	NA
MH179A	N11	9/26/2005	3.7	NA	NA	NA	NA	NA	NA	NA	NA
MH179B	N11	3/29/2010	8.1	0.10	1.4	59.8	23	364	NA	NA	NA
CB180	N11	3/29/2010	2.1	0.59	9.2	357	295	2330	NA	NA	NA
MH181A	N11	3/29/2010	4.2	1.2	8.5	531	225	1860	NA	NA	NA
CB181B	N11	3/29/2010	0.74	0.32	13.2	484	143	21000	NA	NA	NA
CB182	N11	3/29/2010	3.1	1.0	15.5	1090	299	5600	NA	NA	NA
CB182A	N11	3/29/2010	0.90	0.23	0.7	32.5	8	246	NA	NA	NA
CB185	N11	3/29/2010	15	19.5	6.1	830	151	1490	NA	NA	NA
MH187	N11	3/13/2007	100	NA	NA	NA	NA	NA	NA	NA	NA
CB187A	N11	7/15/2009	7.5	NA	NA	NA	NA	NA	NA	NA	NA
CB188	N11	3/30/2010	0.45	0.07	5.1	157	131	947	NA	NA	NA
CB188B	N11	3/30/2010	2.0	0.08	4.0	3270	196 J	1680	NA	NA	NA
CB189	N11	4/7/2010	0.22	0.03 U	4.5	57.8	59	518	NA	NA	NA

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Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
Former CB191	N11	7/15/2009	180	NA	NA	NA	NA	NA	NA	NA	NA
CB192	N11	3/29/2010	8.0	0.53	18.3	306	313	1420	NA	NA	NA
CB194	N11	3/30/2010	2.8	3.1	9.9	84.6	100	651	NA	NA	NA
CB193	N11	3/13/2007	79	NA	NA	NA	NA	NA	NA	NA	NA
MH193	N11	3/13/2007	173	NA	NA	NA	NA	NA	NA	NA	NA
UNKCB19	N11	3/30/2010	6.0	0.70	16	507	430	3950	NA	NA	NA
UNKCB22	N11	3/30/2010	0.90	0.30	13.1	325	132	1180	NA	NA	NA
CB74A	N12	3/31/2010	0.24	0.08	2.7	106	110	608	NA	NA	NA
CB177	N12	3/29/2010	1.4	0.13	5.6	139	443 J	799	NA	NA	NA
CB195	N12	3/29/2010	0.50	0.12	1.9	84.9	66	424	NA	NA	NA
CB200	N12	3/30/2010	0.24	0.05	3.5	107	139	686	NA	NA	NA
CB201	N12	3/31/2010	0.42	0.13	6.9	223	631	1230	NA	NA	NA
D333A	N12	5/4/2010	0.30	0.08	2.0	208	127	385	NA	NA	NA
UNKCB20	N12	3/30/2010	0.85	0.16	6.7	183	473	1320	NA	NA	NA
North-Central Lateral SD Line											
MH219	NC1	6/10/2009	0.50	0.09 J	NA	49.8	59 J	637	4.4 J	0.39	NA
MH221A-T4	NC1	4/8/2010	1.1	0.37	NA	334	382	1880	46	18	NA
MH226 (b)	NC1	6/2/2010	0.5	0.3 J	22	469	300	2540	54.8	NA	44.7
MH228	NC1	4/10/2007	1.9	NA	NA	NA	NA	NA	NA	NA	NA
MH228C	NC1	6/10/2009	0.11	NA	NA	NA	NA	NA	NA	NA	NA
CB229A-T4A (h)	NC1	4/15/2010	0.11	0.04	3.2	35.6	91	590	26.0	2.5	NA
D313A	NC1	5/10/2010	2.0	NA	NA	NA	NA	NA	NA	NA	NA
MH422-T1	NC1	4/8/2010	4.0	0.36	NA	250	309	554	45.0	7.4	NA
MH220	NC2	4/14/2010	34	0.50	44.8	417	387	2140	NA	NA	NA
OWS221	NC2	12/30/2008	2.8	NA	NA	NA	NA	NA	NA	NA	NA
CB221	NC2	6/16/2009	2.8	NA	NA	NA	NA	NA	NA	NA	NA
CB222	NC2	4/14/2010	1.0	0.04	2.7	128	157	528	NA	NA	NA
MH223	NC2	5/1/2000	16.5	NA	NA	NA	NA	NA	NA	NA	NA
CB224	NC2	4/15/2010	2.5	0.13	23.5	174 J	202	1220	NA	NA	NA
CB225	NC2	4/15/2010	4.9	0.12	28.1	261	242	1320	NA	NA	NA
CB364A	NC2	6/10/2009	4.5	NA	NA	NA	NA	NA	NA	NA	NA
OWS226A	NC3	3/14/2007	11.3	NA	NA	NA	NA	NA	NA	NA	NA
CB227	NC3	4/15/2010	1.9	0.20	34.1	282	232	1340	NA	NA	NA
MH247	NC3	3/14/2007	34	NA	NA	NA	NA	NA	NA	NA	NA
MH249	NC3	3/14/2007	4.0	NA	NA	NA	NA	NA	NA	NA	NA

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Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
CB250	NC3	4/21/2010	0.40	0.02 U	4.5	44.1	128	366	NA	NA	NA
CB251	NC3	4/21/2010	0.58	0.03 U	5.1	60.7	208	440	NA	NA	NA
CB252	NC3	4/21/2010	0.89	0.15	23.2	164	245	819	NA	NA	NA
CB253	NC3	4/21/2010	0.65	0.08	11.2	150	150	616	NA	NA	NA
CB254	NC3	4/21/2010	1.1	0.09	8.6	147	207	593	NA	NA	NA
CB255	NC3	4/21/2010	0.71	0.10	7.7	170	146	394	NA	NA	NA
CB256	NC3	4/21/2010	1.3	0.14	28.9	282	167	1140	NA	NA	NA
CB257	NC3	4/21/2010	1.1	0.08	24.5	216	337	993	NA	NA	NA
CB372	NC3	4/15/2010	1.1	0.11	4.4	220	201	912	NA	NA	NA
CB137C	NC4	4/12/2010	0.46	0.18	62.9	239	284	1830	NA	NA	NA
OWS231	NC4	6/10/2009	1.5	NA	NA	NA	NA	NA	NA	NA	NA
CB231	NC4	4/14/2010	0.95	0.63	33.8	286	298	2890	NA	NA	NA
CB232	NC4	4/12/2010	1.2	0.74	20.7	201	390	2270	NA	NA	NA
CB236	NC4	4/14/2010	0.47	0.22	14.0	276	405	2910	NA	NA	NA
CB237	NC4	4/14/2010	0.29	0.11	6.8	202	359	3280	NA	NA	NA
CB238	NC4	4/14/2010	0.45	0.24	13.8	368	378	2820	NA	NA	NA
CB239	NC4	4/14/2010	0.77	0.27	54.1	335	352	1990	NA	NA	NA
CB241	NC4	4/14/2010	0.33	0.13	40.8	217	214	2480	NA	NA	NA
CB241A	NC4	4/12/2010	0.58	0.07	8.7	203	148	2280	NA	NA	NA
CB242	NC4	4/14/2010	0.33	0.12	23.2	180	196	1880	NA	NA	NA
CB243	NC4	4/14/2010	0.71	0.20	4.8	250	270	1470	NA	NA	NA
CB244	NC4	4/12/2010	0.96	0.23	110	263	417	3190	NA	NA	NA
CB246	NC4	4/12/2010	0.48	0.07	33.1	181	199	1260	NA	NA	NA
MH607	NC4	4/14/2010	0.76	2.27	10.5	139	150	1040	NA	NA	NA
CB608	NC4	4/12/2010	0.46	0.14	4.0	115	155	1110	NA	NA	NA
MH609	NC4	4/14/2010	1.8	0.28	31.5	241	304	1890	NA	NA	NA
UNKMH7	NC4	4/14/2010	1.1	0.23	13.7	120	163	1150	NA	NA	NA
MH228D	NC5	6/10/2009	7.3	NA	NA	NA	NA	NA	NA	NA	NA
CB228F	NC5	4/15/2010	0.76	0.08	18.0	187	501	1100	NA	NA	NA
UNKCB6	NC5	4/15/2010	1.5	0.20	18.4	277	197	1720	NA	NA	NA
UNKCB28	NC5	4/15/2010	0.22	0.26	7.2	242	262	1060	NA	NA	NA
UNKMH21	NC5	4/15/2010	7.5	0.68	13.9	244	261	1290	NA	NA	NA
CB372A	NC6	4/15/2010	4.5	0.30	20.9	242	238	1560	NA	NA	NA

Table 2-1
Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
South-Central Lateral SD Line											
MH19C-T3A (i)	SC1	10/7/2009	0.02 U	0.06 UJ	NA	56 J	60 J	163 J	14.7	3.8	NA
MH364-T3 (j)	SC1	4/8/2010	0.25	0.03 U	NA	4.3	4	30	7.9	4.0	NA
MH368	SC1	6/15/2009	0.54	0.06	NA	26.6	37	163	0.53	0.27	NA
MH369 (b)	SC1	6/2/2010	0.69	0.1 J	5	86	60	630	5.66	NA	17.3
CB370	SC1	6/10/2009	2.6	NA	NA	NA	NA	NA	NA	NA	NA
CB374	SC1	4/19/2010	1.0	0.04	2.4	200	109	597	NA	NA	NA
MH413	SC1	4/19/2010	0.37	0.06 U	3	115	100	103	NA	NA	NA
MH414	SC1	4/19/2010	0.12	0.1 U	4	12	30 U	110	NA	NA	NA
CB420	SC1	4/19/2010	0.52	0.34	17.9	842	41	492	NA	NA	NA
OWS421	SC1	1/13/2006	3.0	NA	NA	NA	NA	NA	NA	NA	NA
MH461	SC1	11/24/2004	0.040	NA	NA	NA	NA	NA	NA	NA	NA
CB359	SC2	12/30/2008	0.67	NA	NA	NA	NA	NA	NA	NA	NA
MH402	SC3	4/19/2010	0.68	0.04	2.5	83.9	94	304	NA	NA	NA
CB412	SC3	6/11/2009	1.5	NA	NA	NA	NA	NA	NA	NA	NA
MH415	SC4	4/19/2010	0.30	0.2 U	7 U	125	70 U	120	NA	NA	NA
CB416	SC4	4/19/2010	1.9	0.12	10.6	365	161	1220	NA	NA	NA
CB418	SC4	4/19/2010	1.2	0.19	13.0	322	168	1160	NA	NA	NA
CB419	SC4	4/19/2010	2.2	0.13	18.1	378	327	1440	NA	NA	NA
CB462	SC6	4/21/2010	0.83	0.20	18.4	193 J	312 J	695	NA	NA	NA
CB463	SC6	4/21/2010	0.61	0.15	25.7	385	479	1240	NA	NA	NA
MH471	SC6	4/21/2010	6.8	0.10	3.3	658	248	619	NA	NA	NA
CB472	SC6	4/21/2010	0.041	0.04	3.6	109	20	241	NA	NA	NA
OWS472A	SC6	6/11/2009	0.28	NA	NA	NA	NA	NA	NA	NA	NA
CB473	SC6	4/21/2010	0.72	0.03 U	11.0	148	256	661	NA	NA	NA
CB474	SC6	4/21/2010	1.5	0.09	18.5	296	308	1030	NA	NA	NA
CB475	SC6	4/21/2010	0.85	0.08	26.7	231	215	814	NA	NA	NA
CB476	SC6	4/21/2010	0.79	0.07	22.7	492	183	971	NA	NA	NA
UNKMH15	SC6	4/19/2010	0.88	0.15	34.5	496	210	1810	NA	NA	NA

Table 2-1
Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
South Lateral SD Line											
MH281	S1	6/15/2009	0.58	0.09	NA	141	82	497	6.3	0.56	NA
MH356-T2 (j)	S1	4/8/2010	0.46	0.08	NA	40.9	43	222	126	19	NA
MH356 (b)	S1	6/2/2010	0.47	0.3	14	250	200	1320	46	NA	6.6
MH481	S1	7/26/2006	NA	NA	NA	NA	NA	NA	0.64	1.1	NA
MH482	S1	4/27/2010	0.25	0.28	5.7	49.0	145	411	NA	NA	NA
MH492-T2A (k)	S1	10/7/2009	0.18	0.25 J	NA	216 J	311 J	1200 J	40.8	4.1	NA
OWS1-C	S2	4/26/2010	6.2	0.55	16 J	418 J	350 J	1590	NA	NA	NA
CB384	S2	3/14/2007	19.3	NA	NA	NA	NA	NA	NA	NA	NA
D393A	S2	5/10/2010	0.95	NA	NA	NA	NA	NA	NA	NA	NA
UNKCB4	S2	4/20/2010	1.1	0.22	10.0	230	406	1600	NA	NA	NA
OWS289	S3	4/26/2010	0.24	0.14	2.9	145	166	1470	NA	NA	NA
D299A	S3	5/10/2010	0.097	NA	NA	NA	NA	NA	NA	NA	NA
CB308	S6	4/26/2010	0.85	0.16	10.8	250	128	2240	NA	NA	NA
CB310B	S6	4/29/2010	0.27	0.06	2.2	134	125	565	NA	NA	NA
CB310D	S6	4/29/2010	0.30	0.03 U	1.5	87.2	54	285	NA	NA	NA
CB310G	S6	4/27/2010	0.60	0.23	4.9	194	458	1530	NA	NA	NA
MH445A	S6	7/26/2006	NA	NA	NA	NA	NA	NA	2.6	0.75	NA
CB446	S6	7/26/2006	NA	NA	NA	NA	NA	NA	22.7	5.9	NA
CB448	S6	4/26/2010	2.1	0.12	11.4	197	382	1000	NA	NA	NA
CB451	S6	4/26/2010	1.3	0.13	10.1	202	120	1940	NA	NA	NA
CB453	S6	4/29/2010	4.1	0.57	16.2	279	125	1910	NA	NA	NA
CB456	S6	4/26/2010	0.65	0.83	28.8	812	142	1900	NA	NA	NA
CB458	S6	4/26/2010	1.2	0.73	40.7	664	324	2990	NA	NA	NA
CB1307	S6	4/27/2010	0.60	0.34	14.6	874	201	1730	NA	NA	NA
CB259	S7	4/21/2010	1.3	0.12	19.7	228	851	895	NA	NA	NA
CB260	S7	4/21/2010	0.91	0.12	14.3	255	327	1010	NA	NA	NA
CB261	S7	4/26/2010	1.5	0.09	49.3	444	113	1210	45.1	26.0	NA
CB502	S8	6/16/2009	0.39	NA	NA	NA	NA	NA	NA	NA	NA
CB503	S8	4/21/2010	0.31	0.28	7.1	536	218	457	NA	NA	NA
OWS640	S8	4/26/2010	1.3	1.0	18.7	346	210	1780	NA	NA	NA
MH642	S8	4/26/2010	6.1	1.0	16.3	217	291	1170	NA	NA	NA
CB1308	S8	4/27/2010	0.41	0.14	40.8	1200	74	1330	NA	NA	NA
CB483	S9	4/21/2010	0.29	0.10	12.2	274	154	656	NA	NA	NA
MH483A	S9	4/21/2010	4.8	0.84	15.2	255	375	836	NA	NA	NA

Table 2-1
Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Chemical Concentration mg/kg (DW) Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	pg/g (DW) Dioxins/ Furans TEQ (0.5 DL)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
OWS483B	S9	3/15/2007	0.74	NA	NA	NA	NA	NA	113	35	NA
OWS483C	S9	4/27/2010	4.0	1.2	50.2	676	344	2310	NA	NA	NA
OWS483D	S9	4/27/2010	14	14.2	55.3	729	414	2990	NA	NA	NA
MH483F	S9	3/15/2007	0.14	NA	NA	NA	NA	NA	12.7	0.44	NA
CB486	S9	4/21/2010	0.28	0.06	9.7	166	100	602	NA	NA	NA
CB487	S9	4/21/2010	0.68	1.6	9.5	434	59	775	NA	NA	NA
CB488	S9	4/21/2010	0.72	0.19	11.3	502	119	1250	NA	NA	NA
CB489	S9	4/21/2010	0.96	0.28	10.8	376	104	1290	NA	NA	NA
CB490	S9	4/21/2010	0.19	0.31	15.5	366	134	1600	NA	NA	NA
CB491	S9	4/21/2010	0.19	0.17	12.1	509	155	968	NA	NA	NA
Building 3-380 Drainage Area											
CB104	B1	11/18/2008	0.12	0.05 U	NA	NA	NA	NA	NA	NA	NA
MH105	B1	6/9/2009	1.3	0.32	NA	321	486	2970	9.4	15	NA
CB107A	B1	12/30/2008	0.058	NA	NA	NA	NA	NA	NA	NA	NA
CB109C	B1	4/21/2010	0.43	0.23 J	6.4 J	326 J	373	2160	NA	NA	NA
CB423A	B1	12/30/2008	0.25	NA	NA	NA	NA	NA	NA	NA	NA
CB423 (b)	B1	6/2/2010	1.8	0.26 J	5	153	132	1860	2.35	NA	45.4
CB427	B1	4/21/2010	0.42	0.10	4.8	105	469	1680	NA	NA	NA
MH427A	B1	4/29/2010	0.29	0.06	2.4	90.3	164	1190	NA	NA	NA
MH428	B1	12/30/2008	0.041	NA	NA	NA	NA	NA	NA	NA	NA
MH428A	B1	12/30/2008	0.39	NA	NA	NA	NA	NA	NA	NA	NA
CB429	B1	4/21/2010	0.41	0.17	3.7	188	413	1930	NA	NA	NA
CB106	B2	4/21/2010	0.39	0.19	16.0	130	592	1370	NA	NA	NA
CB106A	B2	4/21/2010	0.28	0.06	2.8	73.8	111	622	NA	NA	NA
CB107	B2	4/21/2010	0.35	0.17	16.3	116	285	1270	NA	NA	NA
CB428B	B3	4/21/2010	0.18	0.07	5.8	98.5	209	949	NA	NA	NA
CB428C	B3	4/26/2010	0.098	0.05	1.2	65.1	77	365	NA	NA	NA
Parking Lot Drainage Area											
D283A	P1	5/10/2010	1.1	NA	NA	NA	NA	NA	NA	NA	NA
CB436	P1	4/20/2010	0.91	0.12	6.4	160	706	1030	NA	NA	NA
D436A	P1	5/10/2010	0.41	NA	NA	NA	NA	NA	NA	NA	NA
IN437	P3	6/15/2009	0.58	NA	NA	NA	NA	NA	NA	NA	NA
CB631	P1	4/20/2010	0.50	0.18	8.4	197	870	1490	NA	NA	NA

Table 2-1
Most Recent SD Solids Data at NBF-GTSP Site

Location Name	Sub-Drainage	Most Recent Sample Date	Total PCB	Mercury	Cadmium	Copper	Lead	Zinc	Total HPAH	BEHP	Dioxins/ Furans TEQ (0.5 DL)
			Chemical Concentration								
			mg/kg (DW)								pg/g (DW)
SQS/LAET			0.13	0.41	5.1	390	450	410	7.9	1.3	--
CSL/2LAET			1.0	0.59	6.7	390	530	960	12	1.7	--
CERCLA T-117			--	--	--	--	--	--	--	--	4.5
CB633	P1	4/20/2010	2.1	0.10	3.1	44.2	283	689	NA	NA	NA
MH434 (l)	P1	6/2/2010	0.61	0.2 J	5.1	162	236	1350	19.4	NA	65.6
D434A	P2	5/10/2010	0.55	NA	NA	NA	NA	NA	NA	NA	NA
CB435 (m)	P3	4/20/2010	0.24	0.08	2.0	110	113	487	1.2	1.5	NA
D435B	P3	5/10/2010	0.50	NA	NA	NA	NA	NA	NA	NA	NA
Main SD Line Downstream of Lift Station											
CB102	M	4/20/2010	0.27	0.10	3.6	104	715	699	NA	NA	NA
CB102A	M	4/20/2010	0.46	0.12	2.5	95.3	89	990	NA	NA	NA
CB102B	M	4/20/2010	0.49	0.06	1.4	56.1	69	460	NA	NA	NA
CB102C	M	4/20/2010	0.37	0.04	1.7	52.2	55	559	NA	NA	NA
CB102D	M	4/20/2010	0.30	0.08	2.8	82.3	77	941	NA	NA	NA
CB432	M	4/20/2010	0.57	0.14	8.0	197	657 J	1500	NA	NA	NA
CB433A	M	4/20/2010	0.25	0.06	2.0	112	111	668	NA	NA	NA
IN433A	M	4/20/2010	0.20	0.05	1.4	75.7	98	830	NA	NA	NA
CB435A	M	4/20/2010	0.26	0.07	1.7	120	118	746	NA	NA	NA

A site-wide SD solids sampling event was conducted from April to June 2010. Samples were not collected from all SD structures due to insufficient amounts of material. For SD structures not sampled in 2010, the most recent sample as was reported. Data collected prior to 2004 were excluc

(a) HPAH and BEHP samples collected 6/29/2010
(b) Dioxins/Furans TEQ (0.5 DL) filtered solids sample collected 5/20/2010
(c) BEHP sediment trap sample collected 4/8/2010
(d) PCB sample collected 7/7/2010
(e) HPAH sample collected 6/2/2010
(f) Dioxins/Furans TEQ (0.5 DL) filtered solids sample collected 6/30/2010
(g) PCB sample collected 3/31/2010
(h) HPAH and BEHP samples collected 4/6/2009
(i) HPAH and BEHP samples collected 8/5/2008
(j) Metals samples collected 10/29/2007
(k) HPAH and BEHP samples collected 10/11/2006
(l) Dioxins/Furans TEQ (0.5 DL) filtered solids sample collected 5/28/2010
(m) BEHP sample collected 6/15/2009

Sediment trap sample
Filtered solids sample
Concentration exceeds SQS/LAET value
Concentration exceeds CSL/2LAET value

SQS/LAET = Sediment Quality Standard/Lowest Apparent Effects Threshold
CSL/2LAET = Cleanup Screening Level/Second Lowest Apparent Effects Threshold
CERLA T-117 = CERCLA screening level for Terminal 117 sediment

-- = Not applicable
CB = Catch basin
D = Drain
DL = Detection limit
IN = Inlet
MH = Manhole
NA = Not analyzed
OWS = Oil/water separator

Table 2-2
Depths of SD System Components at NBF

Location Description	Sub-Drainage Area	Depth of SD Structures (feet bgs)	Approximate Depth of SD Lines (feet bgs)
North Lateral			
North of Bldg 3-380	N1 (CB108A to MH363A)	11.5 to 13.5	8.5 to 11.5, shallower downstream
Main N-S lateral through PEL area	N1 (MH178 to CB108A)	5.6 to 7.1	5.5 to 7
Area of Bldgs 3-350 and 3-360, upstream of MH112	N4	1.3 to 6.3	0.5 to 5.5, deeper eastward
Sweeper decant area to Wind Tunnel area	N5	2.1 to 5.8	1 to 5.5, deeper toward northwest
Bldg 3-324 area	N6	3.7 to 7.9	3 to 6.5
Test Bldg general area, Bldg 3-335 area	N8, N9	2.0 to 5.5 (OWS: 9.2)	1 to 5.5
Northern and eastern PEL areas (Bldgs 3-323 to 3-315)	N7, N10, N11	1.5 to 6.7 (OWS: 6.9)	1 to 6.5
North-Central Lateral			
Southeast of Bldg 3-380	NC1 (MH358 to KC lift station)	10.3 to 12.0	10.5 to 12
East of Bldg 3-380	NC1 (MH358 to junction with north lateral)	8.6 to 10.5	8.5 to 10.5
Straight lateral east of Bldg 3-380	N1 (upstream of junction with north lateral)	4.1 to 8.4 (two OWS: 6.9 & 10.0)	<2.5 to 8.5, deeper downstream
Tributary north of MH363A	NC2	4.5 to 7.7 (OWS: 9.3)	3.5 to 7.5
Tributary north of MH228	NC4	2.4 to 5.5 (OWS: 7.5)	1.5 to 4.5
Long concourse lateral east of Bldg 3-390	NC3	4.9 to 6.1	5 to 6
Line east of plane stalls B-1 to B-3	NC3 tributary (CB257 to CB250)	3.0 to 3.6	1.5 to 2
South-Central Lateral			
Southeast of Bldg 3-380	SC1 (MH-PRD to KC lift station)	>14	>14
North of Bldg 3-369	SC1 (MH364 to MH-PRD)	14.0 to 14.1	14 to >14
Large area N, E, and SE of Bldg 3-390	SC1 (MH461 to MH364)	9.0 to 11.7	9 to 12, and deeper (to 14) near MH364
Channel drain line east of Bldg 3-390	SC3	2.6 to 4.8 (drains), 7.5 (MH)	2.5 to 5, and deeper (to 7.5) near MH402
Lateral east of plane stalls	SC5	3.1 to 7.2	2.5 to 7, but 7 to 11 between MH464 & MH461
OWS loop in plane stall B-6	SC6	>4 to 11	4 to 11
Two lines east of plane stalls B-5 to B-7	SC6, SC7	3.3 to 4.4; 8.4 at MH477	2 to 3.5 (CBs); 4 to 6 (MH-IN), to 8.5 at MH477
South Lateral			
South and west of Bldg 3-369	S1 (MH353 to KC lift station), S2	10.4 to 14.4	>10.5 to >14.5
Long lateral west and south of Bldg 3-390	S1 (MH266A to MH353)	9.5 to 10.2	8.5 to 10, and deeper (to 14) near MH353
Large concourse area SE of Bldg 3-800	S1 (MH483F to MH266A)	7.3 to 9.1	7 to 9
Around Bldg 3-369 and northern 3-390	S2	12.5 to 13.8 (main deep line); 1.4 to 8.5 (branch lines)	9.5 to 12.5 (main line from middle of Bldg 3-390); 1 to 8.5 (branch lines)
Parking lot areas, upstream of MH281	S3	0.7 to 10.6	1 to 6.5
Tributary south of Bldg 3-390, upstream of MH271B	S4	2.0 to 6.0 (and 8.1 for CB271A)	1 to 4.5 (and to 8.5 near MH271B)
Three western lines SE of Bldg 3-818, upstream of MH263	S6	2.9 to 7.5	1.5 to 7

Table 2-2
Depths of SD System Components at NBF

Location Description	Sub-Drainage Area	Depth of SD Structures (feet bgs)	Approximate Depth of SD Lines (feet bgs)
Two eastern lines SE of Bldg 3-818, upstream of MH481	S8	(no available information)	<6 (limited information)
Two lines east of plane stalls B-8 to B-10	S9, S10	3.2 to 10.4	2 to 9.5
Outlier line in flightline NE of Bldg 3-818	S7	3.2 to 6.0 (and probably deeper)	1.5 to 3 (and probably deeper to west)
Building 3-380 Area			
South of Bldg 3-380	B1 (MH105 to MH422)	10 to 12 (approximate)	8.5 to 12
West of Bldg 3-380	B1 (CB109C to MH105), B3	6.9 to 9.3	5 to 8.5
Southwest of Bldg 3-380	B2	3 to 5.4 (approximate)	3 to 4
Parking Lot Area			
LS431 to off-property (Slip 4 discharge)	M1 (Lift station to Slip 4 outfall)	6.9 (also 2.9 & 4.3 for side CBs)	>7
Parking area near Bldg 3-370	PL1, PL2, PL3	1.9 to 6.3 (drains: 2.3 to 3.4)	1.5 to 6.5
Bldg 7-27-1 area	Drainage to M1	5.3 to 7.9 (limited information)	2 to 4 (limited information)

Table 3-1
Potential Uses of COPCs at NBF-GTSP Site

Potential Source/Application	PCBs	Mercury	Cadmium	Copper	Lead	Zinc	PAHs	BEHP
Building and Surface Materials/Components								
Air Conditioning				●				
Air Compressor Oils	●							
Asphalt	●						●	
Boilers		●						
Cable/Wire Coverings	●				●			●
Caulk/Grout/Sealant	●	●			●	●	●	●
Cement/Concrete	●				●			●
Electrical Materials/Equipment and Electronics	●	●	●	●	●			●
Flame/Fire retardants	●				●			
Floor Tiles								●
Fluorescent Lights		●						
Glass/Ceramics/Enamels/Glazes	●		●		●			
Heat transfer system fluids	●							
Paints/Pigments	●	● Red (anti-fouling agent)	● Orange, green, red, & yellow	● Green, blue, purple (anti-fouling agent)	● Black, red, yellow, & white	● White		
Plastic/Plastics Stabilizers/Plasticizers/PVC	●		●		●			●
Plumbing/Welding/Soldering fluxes				●	●	●		
Protective Coatings	●		●		●	●		●
Rubber, door seams, tires						●		●
Storage Tanks					●			
Wood preservatives - utility poles, building lumber, wood foundations	●			●		●		
Aircraft and Vehicles								
Aircraft Parts and Protective Coatings			●			●		
Aviation Fuel					●	●	●	
Brake Pads/Linings			●	●		●		●
Die Casting (Aviation Parts)	●							
Engine Exhaust							●	
Hydraulic fluids/Lubricants	●		●			●		
Serpentine belts								●
Materials Potentially Used in Operations								
Adhesives	●	●				●		●
Batteries/Battery Cart		●	●		●	●		
Chemical Resistant Linings					●			
Fungicides/Pesticides/Insectides/Herbicides	●	●	●	●	● (historical use)			●
Noise Control Materials					●			
Process Vessels					●			
Radiation Equipment Shielding					●			
Rain Gear								●
Solar Cells			●					
Miscellaneous								
Coal-/Petroleum-fueled Electricity Generating Facilities	●	● Coal				● Coal		
Natural Gas Lines	●	●						

PCB = polychlorinated biphenyl
PAH = polycyclic aromatic hydrocarbon
BEHP = bis(2-ethylhexyl)phthalate
PVC = polyvinyl chloride

Table 4-1
Summary of CJM Sampling Results at NBF

2000-2001 Sampling		Maximum Total PCB Concentration (mg/kg)			
General CJM Type	Total Number of Samples (including duplicates)	November 2000 Samples	April 2001 Samples	June-July 2001 Samples	December 2006 Samples of New Caulk
A	8	23,000	79,000	--	370
B	12	42	--	--	--
C	7	1.3 (and 270 U)	13	--	--
D	5	2.7	--	--	--
E	3	5.2	--	--	--
F	7	3.1	--	--	--
G	16	50,000	61,000 (residual = 57,000)	--	1.9
H	29	164	270 (residual = 2,240)	22	1.6
I	2	1.2	--	--	--
J	2	1.1	--	--	--
K	3	--	0.8	--	--
other	6	--	--	5.5	--
Total:	**100**				

Notes: (a) Results for June-July 2001 sampling: CJM "other" type is listed as "L" and "NEA."

(b) Type K is a fibrous material and not a true caulk.

(c) Resampling in 2006 included sampling new caulk that was recontaminated (5 total samples).

Table 4-2
Potential Contaminant Sources from Exterior Building Materials to the North Lateral Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber		Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	PCBs	Metals, Phthalates	PCBs	Metals	PCBs	Metals	
3-302	pre-1953*	●	●	●	●	●	●	●	●	●	●			●	●			
3-303	Unknown				●	●	●	●	●	●	●			●	●			Potential for PCB contamination due to connection with Building 3-
3-306	1983		●	●		●	●	●	●		●				●			
3-310	1962*	●	●	●	●	●	●	●	●	●	●	●	●	●	●			Exterior floor tiles east of building
3-315	1979	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
3-317	1982					●	●	●	●						●			
3-322	1955	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
3-323 & 3-364	1954	●	●	●	●	●	●	●	●	●	●			●	●	●	●	
3-324	~1993-1995		●	●			●	●	●						●			
3-326	~1984	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	Potential for PCB contamination due to connection with Building 3-
3-329	1991		●	●		●	●	●	●		●		●		●			
3-331	Unknown*	●	●	●	●	●	●	●	●	●	●			●	●			Potential for PCB contamination due to connection with Building 3-
3-332	recent	●	●	●	●	●	●	●	●	●	●		●	●	●			Potential for PCB contamination due to connection with Building 3-
3-333	1997	●	●	●	●		●	●	●	●	●		●	●	●			PCBs detected in air dryer oil in 2001.
3-334	1997	●	●	●	●	●	●	●	●	●	●		●	●	●			Potential for PCB contamination due to connection with Building 3-
3-335	1999		●	●			●	●	●		●				●			
3-341	NA						●	●	●		●				●			
3-342	NA						●	●	●				●		●			
3-343	NA						●	●	●						●			
3-350	1945*	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
3-352	Unknown				●	●	●	●	●					●	●			
3-353	1991	●	●	●	●	●	●	●	●	●	●		●	●	●			Potential for PCB contamination due to connection with Building 3-
3-354	1992		●	●		●	●	●	●	●	●				●			
3-355	Unknown		●	●		●	●	●	●	●	●			●	●			

Table 4-2
Potential Contaminant Sources from Exterior Building Materials to the North Lateral Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber		Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	PCBs	Metals, Phthalates	PCBs	Metals	PCBs	Metals	
3-356	after 1980		●	●		●	●	●	●				●		●			
3-357	Unknown*		●	●		●	●	●	●					●	●			
3-365	1956	●	●	●	●	●	●	●	●					●	●			Window glaze
3-368	1969	●	●	●	●	●	●	●	●	●	●			●	●			
3-626	1966	●	●	●	●	●	●	●	●	●	●	●	●	●	●			
3-380	1991		●	●		●	●	●	●		●		●		●			

* Boeing personnel indicate this structure was renovated or reconstructed after 1980.
NA - Not applicable, this is a covered storage area and not a building

Table 4-3
Summary of Exterior Building Materials Sample Results from the North Lateral Drainage Area

Structure/ Area	Construction Date	Caulk						Paint						Roofing Materials						Downspouts						Plastic/ Rubber						Concrete						Asphalt						Surface Debris						Other						Notes
		PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	PCBs	Cadmium	Copper	Lead	Mercury	Zinc	
3-302	pre-1953*																																					⊙	⊙	⊙	⊙	❍	⊙													
3-310	1962*																															☒	⊙	☒	⊙	⊙	☒																		
3-315	1979	□	☒	⊙	❍	❍	⊙	□	☒	⊙	☒	☒	☒	□	☒	⊙	⊙	⊙	☒							☒	☒	⊙	⊙	⊙	☒													☒	☒	⊙	⊙	⊙	☒	□	☒	⊙	⊙	❍	☒	Other: Orange foam-like material
3-322	1955	□	❍	⊙	❍	⊙	⊙	☒	☒	☒	☒	☒	☒	□	❍	⊙	⊙	❍	⊙													❍	⊙	⊙	⊙	❍	☒	☒	⊙	⊙	⊙	⊙	⊙							❍	❍	⊙	❍	❍	⊙	Other: Black, coal-like material
3-323 & 3-364	1954	□	❍	⊙	⊙	⊙	⊙	☒	☒	☒	☒	☒	☒																																					□	⊙	⊙	⊙	❍	⊙	Other: White pipe insulation
3-326	~1984	☒	☒	⊙	⊙	☒	☒	☒	☒	☒	☒	☒	☒	□	⊙	⊙	⊙	❍	☒																			☒	☒	⊙	⊙	☒	⊙	☒	☒	⊙	⊙	⊙	☒	☒	⊙	⊙	⊙	⊙	☒	Other: Pipe wrap
3-332	recent	□	❍	⊙	❍	❍	⊙																															⊙	⊙	⊙	⊙	❍	⊙													
3-333																																												☒	☒	⊙	⊙	☒	☒							
3-334	1997							☒	☒	☒	☒	⊙	☒																																											
3-335																																												☒	☒	⊙	⊙	⊙	☒							
3-350	1945*	☒	❍	⊙	⊙	☒	⊙	☒	☒	⊙	☒	☒	☒	□	⊙	⊙	☒	⊙	☒													☒	⊙	☒	⊙	⊙	☒	⊙	⊙	⊙	☒	☒	⊙	☒	⊙	⊙	⊙	⊙	☒							
3-353	1991																															❍	⊙	⊙	⊙	❍	⊙	⊙	⊙	⊙	⊙	⊙	⊙	☒	⊙	⊙	☒	⊙	☒							
3-354	1992							□	⊙	⊙	⊙	⊙	⊙																															☒	☒	⊙	⊙	⊙	☒							
3-365	1956	□	❍	⊙	⊙	⊙	⊙	□	☒	⊙	☒	☒	☒																															❍	⊙	⊙	⊙	⊙	☒							
3-368	1969	□	⊙	⊙	❍	☒	☒	☒	☒	⊙	☒	☒	☒	□	⊙	⊙	⊙	❍	⊙	□	⊙	⊙	⊙	☒	⊙							⊙	☒	⊙	⊙	⊙	☒	☒	⊙	⊙	⊙	⊙	⊙	☒	☒	☒	☒	⊙	☒							
3-626	1966							☒	☒	☒	☒	☒	☒																															☒	☒	☒	☒	☒	☒	☒	⊙	⊙	⊙	⊙	☒	Other: Black foam
3-380																																												☒	☒	⊙	⊙	⊙	☒							
Substation 87																																												☒	⊙	⊙	⊙	☒	☒							
Bollards/ Containers/ Tanks/ Un-numbered structures	Various							☒	☒	☒	☒	☒	☒							☒	☒	☒	☒	☒	☒							❍	☒	⊙	⊙	⊙	⊙	❍	⊙	⊙	⊙	⊙	⊙							⊙	□	☒	❍	❍	☒	Downspouts on open-air structure between Bldgs. 3-322 and 3-332. Other: Multi-colored material on base of metal structure between wind tunnel arms

* Boeing personnel indicate this structure was renovated or reconstructed after 1980.
NA - Not applicable, this is a covered storage area and not a building
❍ - Contaminant analyzed but not detected in samples, detection limit below the SQS/LAET (below the 2LAET for PCBs in caulk, paint, and roofing materials)
□ - Contaminant analyzed but not detected in samples, detection limit above the SQS/LAET
⊙ - Contaminant detected below SQS/LAET screening level in one or more samples
☒ - Contaminant detected in exceedance of SQS/LAET screening level in one or more samples

Table 4-4
Building-Specific Action Items/Sampling Recommendations
North Lateral Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
PCBs			
Paint	3-302, 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, and 3-368	High	3 samples per side
	3-310, 3-315, 3-352, 3-365, 3-626	Medium	
	3-333	Low	
Caulk	3-302, 3-303, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-353, 3-364, 3-365, 3-368, and 3-626	High	1 sample per caulk type from window frames, door frames, and around the exterior piping and vents
	3-333	Low	
Exterior Utilities	3-302, 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, 3-364 and 3-368	High	1 wipe sample per 100 feet of piping/utility
	3-310, 3-315, 3-352, 3-365, 3-626	Medium	
	3-333, 3-350	Low	
Concrete	3-302, 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, 3-364 and 3-368	High	Buildings: Wipe sampling to determine presence/absence of PCBs, followed by concrete core samples if necessary
	3-310, 3-315, 3-334 (concrete pad), 3-333, 3-350, 3-353 (concrete pad), 3-626, Substation No. 87	Medium	Pads: Concrete core samples
Window Glaze	3-302, 3-303, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, and 3-368	High	1 sample per window with glaze
	3-310, 3-315, 3-352, 3-365, 3-626	Medium	
	3-333	Low	
Wood	3-323 and 3-326	High	Core samples
	3-350	Low	
Roof Tops & Downspouts	All	Medium	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system
Mercury			
Paint	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-334, 3-353, 3-354, 3-355, 3-356, 3-357, 3-368, and 3-626	High	3 samples per side
	3-341, 3-342, 3-343	Medium	
	3-380*	Low	
Caulk	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-324, 3-326, 3-331, 3-332, 3-334, 3-350, 3-353, 3-354, 3-355, 3-356, 3-357, 3-364, 3-365, 3-368, and 3-626	High	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	3-302, 3-303, 3-310, 3-315, 3-322, 3-323, 3-326, 3-331, 3-332, 3-333, 3-334, 3-350, 3-352, 3-353, 3-364, 3-365, and 3-368 3-626	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain mercury.
			Determine if a mercury-bearing utility to stormwater pathway exists.
Roof Tops & Downspouts	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-324, 3-326, 3-331, 3-332, 3-334, 3-341, 3-342, 3-343, 3-350, 3-353, 3-354, 3-355, 3-356, 3-357, 3-368, 3-626	Medium	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts

Table 4-4
Building-Specific Action Items/Sampling Recommendations
North Lateral Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
Other Metals, Phthalates, PAHs			
Paint	All	Low	3 samples per side
Caulk	3-302, 3-303, 3-306, 3-310, 3-315, 3-322, 3-323, 3-324, 3-326, 3-329, 3-331, 3-332, 3-333, 3-334, 3-335, 3-350, 3-353, 3-354, 3-355, 3-356, 3-357, 3-364, 3-365, 3-368, 3-626, 3-380 (a)	Low	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	All	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain metal COPCs.
			Determine if a metal COPC-bearing utility to stormwater pathway exists.
Concrete	All	Low	Wipe or Core samples
Floor tiles	3-310	Low	1 sample
Wood	3-323, 3-326, 3-350	Low	Core samples
Roof Tops & Downspouts	All	Low	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system

(a) Indicates that the building is located primarily in the Building 3-380 drainage area.
Recommended actions for a building may apply to more than one drainage area.

Table 4-5
Potential Contaminant Sources from Exterior Building Materials to the North-Central Lateral Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber	Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	Phthalates	PCBs	Metals	PCBs	Metals	
A-1, A-2, A-3, and A-4	Portable Units		●	●		●	●	●	●		●	●		●			
A-5, A-6, 3-125 & 3-126	Portable Units		●	●		●	●	●	●		●	●	●	●			Historical location of PCB-containing transformers or capacitors
3-313	1989		●	●		●	●	●	●		●	●		●			
3-356	after 1980		●	●		●	●	●	●			●		●			
3-369	1966	●	●	●	●	●	●	●	●	●	●	●	●	●			Window glaze
3-380	1991		●	●		●	●	●	●		●	●		●			

Table 4-6
Building-Specific Action Items/Sampling Recommendations
North-Central Lateral Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
PCBs			
Paint	3-369 (a), Bollards	High	3 samples per side
Concrete	A-5, A-6, 3-125, 3-126, and 3-369 (a)	High	Buildings: Wipe sampling to determine presence/absence of PCBs, followed by concrete core samples if necessary
			Pads: Concrete core samples
Roof Tops & Downspouts	All	High	Sample air-deposited dry materials on roof tops Sample discharge from downspouts that are not connected to the SD system
Mercury			
Paint	3-313, 3-356 (c), 3-369 (a)	High	3 samples per side
	3-380(b)	Low	
Exterior Utilities	3-313, 3-356 (c), 3-369 (a) and 3-380 (b)	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain mercury.
			Determine if a mercury-bearing utility to stormwater pathway exists.
Roof Tops & Downspouts	3-313, 3-356 (c), 3-369 (a) and 3-380 (b)	Medium	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system
Other Metals, Phthalates, PAHs			
Paint	A-1, A-2, A-3, A-4, A-5, A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356 (c), 3-369 (a) and 3-380 (b)	Low	3 samples per side
Caulk	A-1, A-2, A-3, A-4, A-5, A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356 (c), 3-369 (a) and 3-380 (b)	Low	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	A-1, A-2, A-3, A-4, A-5, A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356 (c), 3-369 (a) and 3-380 (b)	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain metal COPCs.
			Determine if a metal COPC-bearing utility to stormwater pathway exists.
Concrete	A-1, A-2, A-3, A-4, A-5, A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356 (c), 3-369 (a) and 3-380 (b)	Low	Wipe or core samples
Roof Tops & Downspouts	A-1, A-2, A-3, A-4, A-5, A-6, 3-106, 3-107, 3-125, 3-126, 3-127, 3-128, 3-313, 3-356 (c), 3-369s and 3-380 (b)	Low	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system

(a) Indicates that the building is located primarily in the south lateral drainage area.
(b) Indicates that the building is located primarily in the Building 3-380 drainage area.
(c) Indicates that the building is located primarily in the north lateral drainage area.
Recommended actions for a building may apply to more than one drainage area.

Table 4-7
Potential Contaminant Sources from Exterior Building Materials to the South-Central Lateral Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber	Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	Phthalates	PCBs	Metals	PCBs	Metals	
3-369	1966	●	●	●	●	●	●	●	●	●	●	●	●	●			
3-390	1953	●	●	●	●	●	●	●	●	●	●	●	●	●			Window glaze

Table 4-8
Building-Specific Action Items/Sampling Recommendations
South-Central Lateral Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
PCBs			
Paint	3-369 (a) and 3-390 (a), Bollards	High	3 samples per side
			At 3-390 checkerboard, collect at least 6 samples – 3 for each color of paint
Caulk	3-369 (a) and 3-390 (a)	High	1 sample per caulk type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities		High	1 wipe sample per 100 feet of piping/utility
Concrete	3-369 (a) and 3-390 (a)	High	Buildings: Wipe sampling to determine presence/absence of PCBs, followed by concrete core samples if necessary
	3-369 generator pad	High	Pads: Concrete core samples
Window Glaze	3-369 (a) and 3-390 (a)	High	1 sample per glazed window
Roof Tops & Downspouts	All	High	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system
Mercury			
Paint	3-369 (a) and 3-390 (a)	High	3 samples per side
Caulk	3-369 (a) and 3-390 (a)	High	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	3-369 (a) and 3-390 (a)	High	1 wipe sample per 100 feet of piping/utility
Roof Tops & Downspouts	All (including crew shelters)	High	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system
Other Metals, Phthalates, PAHs			
Paint	3-369 (a) and 3-390 (a), and crew shelters	Low	3 samples per side
Caulk	3-369 (a) and 3-390 (a), and crew shelters	Low	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	3-369 (a) and 3-390 (a), and crew shelters	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain metal COPCs.
			Determine if a metal COPC-bearing utility to stormwater pathway exists.
Concrete	3-369 (a) and 3-390 (a), and crew shelters	Low	Wipe or core samples
Roof Tops & Downspouts	3-369 (a) and 3-390 (a), and crew shelters	Low	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system

(a) Indicates that the building is located primarily in the south lateral drainage area.
Recommended actions for a building may apply to more than one drainage area.

Table 4-9
Potential Contaminant Sources from Exterior Building Materials to the South Lateral Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber	Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	Phthalates	PCBs	Metals	PCBs	Metals	
3-369	1966	●	●	●	●	●	●	●	●	●	●	●	●	●			Window glaze
3-374	1967	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
3-800	1990		●	●		●	●	●	●		●	●		●			
3-801	1992		●	●		●	●	●	●		●	●		●			
3-811	2008							●	●			●					
3-812	2008							●	●			●					
3-818	1966	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	
3-822	1954	●	●	●	●	●	●	●	●	●	●		●	●			
3-825	1966	●	●	●	●	●	●	●	●	●	●		●	●			
3-834	Unknown	●	●	●		●	●	●	●		●	●	●	●			
3-390	1953	●	●	●	●	●	●	●	●		●	●	●	●			
3-397	1953	●	●	●	●	●	●	●	●		●		●	●			

Table 4-10
Building-Specific Action Items/Sampling Recommendations
South Lateral Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
PCBs			
Paint	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397, Bollards	High	3 samples per side
Caulk	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397	High	1 sample per caulk type from window frames, door frames, and around the exterior piping, flanges and vents
Exterior Utilities	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397	High	1 wipe sample per 100 feet of piping/utility
Concrete	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397	High	Buildings: Wipe sampling to determine presence/absence of PCBs, followed by concrete core samples if necessary
	Vault No. 94 pad	High	Pads: Concrete core samples
	Former Buildings 2-35, 3-830, and 3-831 and employee parking lot	High	Concrete core samples in areas where PCB-filled transformers/capacitors were historically located
Window Glaze	3-369, 3-374, 3-818, 3-822, 3-825, 3-390, and 3-397	High	1 sample per glazed window
Roof Tops & Downspouts	All	High	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts
Mercury			
Paint	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-834, 3-390, and 3-397	High	3 samples per side
Caulk	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-390, and 3-397	High	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	All (including crew shelters)	High	1 wipe sample per 100 feet of piping/utility
Roof Tops & Downspouts	All (including crew shelters)	High	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts
Other Metals, Phthalates, PAHs			
Paint	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-834, 3-390, and 3-397	Low	3 samples per side
Caulk	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-390, and 3-397	Low	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	All (including crew shelters)	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain metal COPCs.
			Determine if a metal COPC-bearing utility to stormwater pathway exists.
Concrete	3-369, 3-374, 3-800, 3-801, 3-818, 3-822, 3-825, 3-390, and 3-397	Low	Wipe or core samples
Roof Tops & Downspouts	All (including crew shelters)	Low	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system

Recommended actions for a building may apply to more than one drainage area.

Table 4-11
Potential Contaminant Sources from Exterior Building Materials to the Building 3-380 Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber	Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	Phthalates	PCBs	Metals	PCBs	Metals	
3-380	1991		●	●		●	●	●	●		●	●		●			
7-027-1	pre-1956	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	

Table 4-12
Building-Specific Action Items/Sampling Recommendations
Building 3-380 Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
PCBs			
Paint	3-380 and 7-027-1	Medium	3 samples per side
Caulk	3-380 and 7-027-11	Medium	1 sample per caulk type from window frames, door frames, and around the exterior piping, flanges and vents
Exterior Utilities	3-380 and 7-027-1	Medium	1 wipe sample per 100 feet of piping/utility
Concrete	3-380 and 7-027-1	Medium	Buildings: Wipe sampling to determine presence/absence of PCBs, followed by concrete core samples if necessary
Window Glaze	7-027-1	Medium	1 sample per glazed window
Roof Tops & Downspouts	3-380 and 7-027-1	Medium	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts
Metals, Phthalates, PAHs			
Paint	3-380 and 7-027-1	Low	3 samples per side
Caulk	3-380 and 7-027-1	Low	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	3-380 and 7-027-1	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain metal COPCs.
			Determine if a metal COPC-bearing utility to stormwater pathway exists.
Concrete	3-380 and 7-027-1	Low	Wipe or core samples
Roof Tops & Downspouts	3-380 and 7-027-1	Low	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system

Recommended actions for a building may apply to more than one drainage area.

Table 4-13
Potential Contaminant Sources from Exterior Building Materials to the Parking Lot Drainage Area

Structure/ Area	Construction Date	Caulk			Paint			Rooftops/ Downspouts		Utilities		Plastic/ Rubber	Concrete		Wood		Notes
		PCBs	Mercury	Metals, Phthalates, PAHs	PCBs	Mercury	Metals	All COPCs (dry materials)	All COPCs (downspout discharge)	PCBs	Metals, Phthalates	Phthalates	PCBs	Metals	PCBs	Metals	
3-370	~1993		●	●		●	●	●	●		●	●		●			
7-027-1	pre-1956	●	●	●	●	●	●	●	●	●	●	●	●	●	●	●	

Table 4-14
Building-Specific Action Items/Sampling Recommendations
Parking Lot Drainage Area

Building Material	Building/Structure	Priority	Actions/Sampling Locations
PCBs			
Paint	7-027-1, Bollards	Medium	3 samples per side
Caulk	7-027-1	Medium	1 sample per caulk type from window frames, door frames, and around the exterior piping, flanges and vents
Exterior Utilities	7-027-1	Medium	1 wipe sample per 100 feet of piping/utility
Concrete	7-027-1	Medium	Buildings: Wipe sampling to determine presence/absence of PCBs, followed by concrete core samples if necessary
	Former Building 3-490	Medium	Concrete core samples in area where PCB-filled transformer/capacitor was historically located
Window Glaze	7-027-1	Medium	1 sample per glazed window
Roof Tops & Downspouts	3-370 and 7-027-1	Medium	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts
Metals, Phthalates, PAHs			
Paint	3-370 and 7-027-1	Low	3 samples per side
Caulk	3-370 and 7-027-1	Low	1 sample per type from window frames, door frames, and around the exterior piping and vents
Exterior Utilities	3-370 and 7-027-1	Low	Site reconnaissance to inventory and catalog exterior utilities.
			Literature review to determine which utilities (if any) may contain metal COPCs.
			Determine if a metal COPC-bearing utility to stormwater pathway exists.
Concrete	3-370 and 7-027-1	Low	Wipe or core samples
Roof Tops & Downspouts	3-370 and 7-027-1	Low	Sample air-deposited dry materials on roof tops
			Sample discharge from downspouts that are not connected to the SD system

Recommended actions for a building may apply to more than one drainage area.

Table 5-1
Summary of Soil Screening Level Exceedances in the PEL Area

COPC	Shallow Soil (0-4 ft bgs)		Deep Soil (4-8 ft bgs)		SD Solids - Nearby Structures	
	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> SQS/LAET	> CSL/2LAET
Buildings 3-333 and 3-335, Bottom of SD Structures: Most less than 4 ft bgs						
PCBs	●	●	●	●	●	●
Mercury	●	●	●		●	
Cadmium	MDL>	MDL>	MDL>	MDL>	●	●
Copper	MDL>	MDL>	MDL>	MDL>	●	●
Lead						
Zinc	●	●	●	●	●	●
HPAHs	●	●	MDL>	MDL>	NA	NA
BEHP	MDL>		MDL>		NA	NA
Dioxins/Furans	NA	NA	NA	NA	NA	NA
Building 3-322, Bottom of SD Structures: Most less than 4 ft bgs						
PCBs	●	●	MDL>	MDL>	●	●
Mercury	●	●	●	●	●	●
Cadmium					●	●
Copper					●	●
Lead						
Zinc	●	●	●	●	●	●
HPAHs	●	●	MDL>	MDL>	NA	NA
BEHP	MDL>		MDL>		NA	NA
Dioxins/Furans	NA	NA	NA	NA	NA	NA
NBF-GTSP Fenceline, Bottom of SD Structures: Most 4 ft bgs or deeper						
PCBs	●	●	●	●	●	●
Mercury	●	●	MDL>	MDL>	●	●
Cadmium	●	●			●	●
Copper	●	●	●	●	●	●
Lead	●		●	●		
Zinc	●	●	●	●	●	●
HPAHs	●	●	●	●	NA	NA
BEHP	●	●	●	●	NA	NA
Dioxins/Furans			NA	NA	NA	NA
Building 3-626, Bottom of SD Structures: Most less than 4 ft bgs						
PCBs	●	●	MDL>	MDL>	●	●
Mercury	●	●	●	●	●	●
Cadmium	●		MDL>		●	●
Copper					●	●
Lead	●	●	●		●	●
Zinc	●	●	●	●	●	●
HPAHs	MDL>	MDL>	MDL>	MDL>	●	●
BEHP	MDL>		MDL>		NA	NA
Dioxins/Furans	NA	NA	NA	NA	NA	NA

Table 5-1
Summary of Soil Screening Level Exceedances in the PEL Area

COPC	Shallow Soil (0-4 ft bgs)		Deep Soil (4-8 ft bgs)		SD Solids - Nearby Structures	
	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> SQS/LAET	> CSL/2LAET
Building 3-353, Bottom of SD Structures: Most 4 ft bgs or deeper						
PCBs	MDL>	MDL>	MDL>	MDL>	●	●
Mercury	●	●	●	●	●	●
Cadmium					●	●
Copper	●	●	●	NA	●	●
Lead					●	●
Zinc	●	●	●	●	●	●
HPAHs	●	●	MDL>	MDL>	NA	NA
BEHP	MDL>		MDL>		NA	NA
Dioxins/Furans	NA	NA	NA	NA	NA	NA

MDL> indicates that the method detection limit was greater than the specified screening level.
NA = Samples were not analyzed for the COPC
Blank cells indicate that the COPC was non-detect or detected at concentrations below the screening level
● = Indicates areas/chemicals with a screening level exceedance
[yellow shading] Indicates areas/chemicals with screening level exceedances for both soil and SD solids

Table 5-2
Summary of Soil Screening Level Exceedances in the Building 3-380/3-360 Area

COPC	Shallow Soil (0-4 ft bgs)		Deep Soil (4-8 ft bgs)		SD Solids - Nearby Structures	
	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> SQS/LAET	> CSL/2LAET
Building 3-380, Bottom of SD Structures: Most 4 ft bgs or deeper						
PCBs	MDL>	MDL>	NA	NA	●	●
Mercury	NA	NA	●	●		
Cadmium					●	●
Copper	NA	NA				
Lead	NA	NA	MDL>		●	●
Zinc	NA	NA	●		●	●
HPAH	●	●	NA	NA		
BEHP	MDL>	MDL>	NA	NA		
Dioxins/furans	NA	NA	NA	NA	●	●
Former Building 3-360, Bottom of SD Structures: Most less than 4 feet bgs						
PCBs	NA	NA	NA	NA	●	
Mercury	NA	NA	●	●		
Cadmium	NA	NA			●	●
Copper	NA	NA			●	●
Lead	NA	NA				
Zinc	NA	NA	●	●	●	●
HPAH	NA	NA	NA	NA	NA	NA
BEHP	NA	NA	NA	NA	NA	NA
Dioxins/furans	NA	NA	NA	NA	NA	NA
Building 7-27-1, Bottom of SD Structures: Most 4 feet bgs or deeper						
PCBs	NA	NA	MDL>	MDL>	●	●
Mercury	NA	NA	MDL>	MDL>		
Cadmium	NA	NA			●	●
Copper	NA	NA				
Lead	NA	NA			●	●
Zinc	NA	NA	●	●	●	●
HPAH	NA	NA	NA	NA		
BEHP	NA	NA	NA	NA		
Dioxins/furans	NA	NA	NA	NA	NA	NA

MDL> indicates that the method detection limit was greater than the specified screening level.
NA = Samples were not analyzed for the COPC
Blank cells indicate that the COPC was non-detect or detected at concentrations below the screening level
● = Indicates areas/chemicals with a screening level exceedance
Indicates areas/chemicals with screening level exceedances for both soil and SD solids

Table 5-3
Summary of Soil Screening Level Exceedances in the Building 3-800/3-801 Area

COPC	Shallow Soil (0-4 ft bgs)		Deep Soil (4-8 ft bgs)		SD Solids - Nearby Structures	
	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> Soil-to-Sediment (SQS) Screening Level	> Soil-to-Sediment (CSL) Screening Level	> SQS/LAET	> CSL/2LAET
Building 3-800, Bottom of SD Structures: Most 4 ft bgs or deeper						
PCBs	NA	NA	NA	NA	●	●
Mercury	NA	NA	MDL>	MDL>	NA	NA
Cadmium	NA	NA			NA	NA
Copper	No Information					
Lead	NA	NA			NA	NA
Zinc	No Information					
HPAH	NA	NA	MDL>	MDL>	NA	NA
BEHP	NA	NA	MDL>	MDL>	NA	NA
Dioxins/furans	NA	NA	NA	NA	NA	NA
Building 3-801, Bottom of SD Structures: Most less than 4 feet bgs						
PCBs	No Information					
Mercury						
Cadmium	●	●	●	●	NA	NA
Copper	No Information					
Lead					NA	NA
Zinc	No Information					
HPAH						
BEHP	NA	NA	NA	NA	NA	NA
Dioxins/furans	NA	NA	NA	NA	NA	NA

MDL> indicates that the method detection limit was greater than the specified screening level.
NA = Samples were not analyzed for the COPC
Blank cells indicate that the COPC was non-detect or detected at concentrations below the screening level
● = Indicates areas/chemicals with a screening level exceedance
Indicates areas/chemicals with screening level exceedances for both soil and SD solids

Table 5-4
Summary of Soil Screening Level Exceedances in the Main Fuel Farm Area

<table>
<tr><th rowspan="2">COPC</th><th colspan="2">Shallow Soil (0-4 ft bgs)</th><th colspan="2">Deep Soil (4-8 ft bgs)</th><th colspan="2">SD Solids - Nearby Structures</th></tr>
<tr><th>> Soil-to-Sediment (SQS) Screening Level</th><th>> Soil-to-Sediment (CSL) Screening Level</th><th>> Soil-to-Sediment (SQS) Screening Level</th><th>> Soil-to-Sediment (CSL) Screening Level</th><th>> SQS/LAET</th><th>> CSL/2LAET</th></tr>
<tr><td colspan="7">Bottom of SD Structures: Even mix of less than 5 ft bgs and deeper than 5 ft bgs</td></tr>
<tr><td>PCBs</td><td>MDL></td><td>MDL></td><td>MDL></td><td>MDL></td><td>●</td><td>●</td></tr>
<tr><td>Mercury</td><td colspan="4" rowspan="5">No Information</td><td></td><td></td></tr>
<tr><td>Cadmium</td><td>●</td><td>●</td></tr>
<tr><td>Copper</td><td></td><td></td></tr>
<tr><td>Lead</td><td></td><td></td></tr>
<tr><td>Zinc</td><td>●</td><td>●</td></tr>
<tr><td>HPAH</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td><td>●</td></tr>
<tr><td>BEHP</td><td>MDL></td><td>MDL></td><td>MDL></td><td>MDL></td><td>●</td><td>●</td></tr>
</table>

MDL> indicates that the method detection limit was greater than the specified screening level.
NA = Samples were not analyzed for the COPC
● = Indicates areas/chemicals with a screening level exceedance
Indicates areas/chemicals with screening level exceedances for both soil and SD solids

Table 5-5
Areas of Potential Infiltration During High Water-Table Conditions

Location Description	Sub-Drainage Area	Depth of SD Structures (feet bgs)	Approximate Depth of SD Lines (feet bgs)	Expected Areas of SD Submergence at High Groundwater Levels
North Lateral				
North of Bldg 3-380	N1 (CB108A to MH363A)	11.5 to 13.5	8.5 to 11.5, shallower downstream	Submerged
Main N-S lateral through PEL area	N1 (MH178 to CB108A)	5.6 to 7.1	5.5 to 7	Submerged
Area of Bldgs 3-350 and 3-360, upstream of MH112	N4	1.3 to 6.3	0.5 to 5.5, deeper eastward	Not submerged
Sweeper decant area to Wind Tunnel area	N5	2.1 to 5.8	1 to 5.5, deeper toward northwest	Submerged upstream to MH133D
Bldg 3-324 area	N6	3.7 to 7.9	3 to 6.5	Submerged between CB6262 and MH130
Test Bldg general area, Bldg 3-335 area	N8, N9	2.0 to 5.5 (OWS: 9.2)	1 to 5.5	Submerged from CB209B and UNKCB9 downstream through OWS153; also near UNKCB13 and UNKCB14
Northern and eastern PEL areas (Bldgs 3-323 to 3-315)	N7, N10, N11	1.5 to 6.7 (OWS: 6.9)	1 to 6.5	Submerged on N11 downstream from about CB188B and MH166A and CB184; also all of N7 downstream of CB193
North-Central Lateral				
Southeast of Bldg 3-380	NC1 (MH358 to KC lift station)	10.3 to 12.0	10.5 to 12	Submerged
East of Bldg 3-380	NC1 (MH358 to junction with north lateral)	8.6 to 10.5	8.5 to 10.5	Submerged
Straight lateral east of Bldg 3-380	N1 (upstream of junction with north lateral)	4.1 to 8.4 (two OWS: 6.9 & 10.0)	<2.5 to 8.5, deeper downstream	Submerged upstream almost to MH226, and near OWS226A and OWS0A6
Tributary north of MH363A	NC2	4.5 to 7.7 (OWS: 9.3)	3.5 to 7.5	Submerged downstream of MH220 and near OWS220A
Tributary north of MH228	NC4	2.4 to 5.5 (OWS: 7.5)	1.5 to 4.5	Only submerged near OWS231A
Long concourse lateral east of Bldg 3-390	NC3	4.9 to 6.1	5 to 6	Not submerged
Line east of plane stalls B-1 to B-3	NC3 tributary (CB257 to CB250)	3.0 to 3.6	1.5 to 2	Not submerged
South-Central Lateral				
Southeast of Bldg 3-380	SC1 (MH-PRD to KC lift station)	>14	>14	Submerged
North of Bldg 3-369	SC1 (MH364 to MH-PRD)	14.0 to 14.1	14 to >14	Submerged
Large area N, E, and SE of Bldg 3-390	SC1 (MH461 to MH364)	9.0 to 11.7	9 to 12, and deeper (to 14) near MH364	Submerged

Table 5-5
Areas of Potential Infiltration During High Water-Table Conditions

Location Description	Sub-Drainage Area	Depth of SD Structures (feet bgs)	Approximate Depth of SD Lines (feet bgs)	Expected Areas of SD Submergence at High Groundwater Levels
Channel drain line east of Bldg 3-390	SC3	2.6 to 4.8 (drains), 7.5 (MH)	2.5 to 5, and deeper (to 7.5) near MH402	Submerged only near MH402
Lateral east of plane stalls	SC5	3.1 to 7.2	2.5 to 7, but 7 to 11 between MH464 & MH461	Submerged upstream to beyond MH467
OWS loop in plane stall B-6	SC6	>4 to 11	4 to 11	Submerged; also at/downstream of OWS472A
Two lines east of plane stalls B-5 to B-7	SC6, SC7	3.3 to 4.4; 8.4 at MH477	2 to 3.5 (CBs); 4 to 6 (MH-IN), to 8.5 at MH477	Submerged upstream to beyond MH479
South Lateral				
South and west of Bldg 3-369	S1 (MH353 to KC lift station), S2	10.4 to 14.4	>10.5 to >14.5	Submerged
Long lateral west and south of Bldg 3-390	S1 (MH266A to MH353)	9.5 to 10.2	8.5 to 10, and deeper (to 14) near MH353	Submerged
Large concourse area SE of Bldg 3-800	S1 (MH483F to MH266A)	7.3 to 9.1	7 to 9	Submerged
Around Bldg 3-369 and northern 3-390	S2	12.5 to 13.8 (main deep line); 1.4 to 8.5 (branch lines)	9.5 to 12.5 (main line from middle of Bldg 3-390); 1 to 8.5 (branch lines)	Submerged; short segment submerged north of MH389
Parking lot areas, upstream of MH281	S3	0.7 to 10.6	1 to 6.5	Not submerged
Tributary south of Bldg 3-390, upstream of MH271B	S4	2.0 to 6.0 (and 8.1 for CB271A)	1 to 4.5 (and to 8.5 near MH271B)	Submerged only a short distance upstream of MH271B
Three western lines SE of Bldg 3-818, upstream of MH263	S6	2.9 to 7.5	1.5 to 7	Submerged upstream to approximately MH445C
Two eastern lines SE of Bldg 3-818, upstream of MH481	S8	(no available information)	<6 (limited information)	Unknown, but likely shallow and not submerged
Two lines east of plane stalls B-8 to B-10	S9, S10	3.2 to 10.4	2 to 9.5	Submerged along main lateral to beyond MH492; also near MH483F (OWS)
Outlier line in flightline NE of Bldg 3-818	S7	3.2 to 6.0 (and probably deeper)	1.5 to 3 (and probably deeper to west)	Unknown, but likely submerged toward southwest
Building 3-380 Area				
South of Bldg 3-380	B1 (MH105 to MH422)	10 to 12 (approximate)	8.5 to 12	Submerged
West of Bldg 3-380	B1 (CB109C to MH105), B3	6.9 to 9.3	5 to 8.5	Not submerged
Southwest of Bldg 3-380	B2	3 to 5.4 (approximate)	3 to 4	Not submerged

Table 5-5
Areas of Potential Infiltration During High Water-Table Conditions

Location Description	Sub-Drainage Area	Depth of SD Structures (feet bgs)	Approximate Depth of SD Lines (feet bgs)	Expected Areas of SD Submergence at High Groundwater Levels
Parking Lot Area				
LS431 to off-property (Slip 4 discharge)	M1 (Lift station to Slip 4 outfall)	6.9 (also 2.9 & 4.3 for side CBs)	>7	Not submerged beyond LS4431 except due to tidal influence at higher tide levels
Parking area near Bldg 3-370	PL1, PL2, PL3	1.9 to 6.3 (drains: 2.3 to 3.4)	1.5 to 6.5	Not submerged
Bldg 7-27-1 area	Drainage to M1	5.3 to 7.9 (limited information)	2 to 4 (limited information)	Not submerged