DRAFT CLEANUP ACTION PLAN
Upland Area and Powder Mill Gulch (PMG)
Boeing Everett Facility

Washington State Department of Ecology
Northwest Regional Office
Hazardous Waste and Toxics Reduction Program

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CONTENTS

FIGURES

TABLES

ABBREVIATIONS AND ACRONYMS

AO	Agreed Order
AOC	area of concern
ARAR	applicable or relevant and appropriate requirement
AST	aboveground storage tank
BCA	Boeing Commercial Airplane
bgs	below ground surface
BHT	butylated hydroxytoluene
Boeing	The Boeing Company
BTEX	benzene, toluene, ethylbenzene, and xylenes
CAP	Cleanup Action Plan
cDCE	cis-1,2-dichloroethene
CDF	controlled density fill
CFR	Code of Federal Regulations
City	City of Everett
CLARC	Cleanup Level and Risk Calculation (database)
COC	chemical of concern
cPAH	carcinogenic polycyclic aromatic hydrocarbon
CPOC	conditional point of compliance
CSM	conceptual site model
CUL	cleanup level
CVOC	chlorinated volatile organic compound
cy	cubic yard
DCA	disproportionate cost analysis
dCAP	draft CAP
DCE	dichloroethene
DEQ	Department of Environmental Quality
DGR	dynamic groundwater recirculation
DNAPL	dense nonaqueous-phase liquid
DO	dissolved oxygen
DPE	dual-phase extraction
DPP	di-n-butyl phenyl phosphate
Ecology	Washington State Department of Ecology
EHC®	an in situ chemical reduction reagent
EHS	environmental health and safety
EISB	enhanced in situ bioremediation
EO	Enforcement Order
EPA	U.S. Environmental Protection Agency
EPM	exposure pathway model
Freon 12	dichlorodifluoromethane
FS	feasibility study

FSWP	Feasibility Study Work Plan
ft	feet
ft^2	square foot
GET	groundwater extraction and treatment
gpm	gallons per minute
HBU	highest beneficial use
IA	interim cleanup action
ISCO	in situ chemical oxidation
ISCR	in situ chemical reduction
Landau	Landau Associates, Inc.
L/m^3	liter per cubic meter
LNAPL	light nonaqueous-phase liquid
m^3	cubic meter
MCL	maximum contaminant level
MEK	methyl ethyl ketone
$\mu g/m^3$	microgram per cubic meter
µg/kg	microgram per kilogram
µg/L	microgram per liter
µmol/L	micromole per liter
mg/kg	milligram per kilogram
mg/L	milligram per liter
MIBK	4-methyl-2-pentanone
msl	mean sea level
MTCA	Model Toxics Control Act
NAPL	nonaqueous-phase liquid
nc-PAH	non-carcinogenic polycyclic aromatic hydrocarbon
NGVD 29	National Geodetic Vertical Datum of 1929
NAVD 88	North American Vertical Datum of 1988O&M operation and maintenance
ORC-A®	Oxygen Release Compound Advanced
ORP	oxidation reduction potential
OSHA	Occupational Safety and Health Administration
PAH	polycyclic aromatic hydrocarbon
PCE	tetrachloroethene
PEL	permissible exposure limit
PMC	Powder Mill Creek
PMG	Powder Mill Gulch
POC	Point of Compliance
POTW	publicly owned treatment works
RBCL	Risk-based cleanup levels
RCRA	Resource Conservation and Recovery Act
RCW	Revised Code of Washington
REL	remediation level

RI	remedial investigation
RME	reasonable maximum exposure
ROI	radius of influence
SMS	Sediment Management Standard
SVE	soil vapor extraction
SVOC	semivolatile organic compound
SWMU	solid waste management unit
TCA	trichloroethane
TCE	trichloroethene
tDCE	trans-1,2-dichloroethene
TEX	toluene, ethylbenzene, and xylenes
TOC	total organic carbon
TPH-D	total petroleum hydrocarbon as diesel
TPH-G	total petroleum hydrocarbon as gasoline
TPH-Jet A	total petroleum hydrocarbon as Jet A
TPH-O	total petroleum hydrocarbon as motor oil
TBP	tributyl phosphate
URS	URS Corporation
UST	underground storage tank
VC	vinyl chloride
VOC	volatile organic compound
WAC	Washington Administrative Code
WDFW	Washington State Department of Fish and Wildlife

1.0 INTRODUCTION

This Ecology cleanup action plan (CAP) presents the cleanup action selected by the Washington State Department of Ecology (Ecology) for a portion of the Boeing Everett Facility site (Site) located in Everett, Washington (Figure 1-1) (referred to herein as the "Upland Area and PMG"). This CAP addresses the uplands portions of the Site including those solid waste management units (SWMUs) and areas of concern (AOCs) located within the Boeing manufacturing facility, the Powder Mill Gulch (PMG) area both on and off Boeing property, and the BOMARC Building 45-70 Property (BOMARC Property). The CAP excludes part of the Site: sediment-related cleanup in the uplands and PMG/Powder Mill Creek (PMC). The CAP is based on a remedial investigation (RI; URS and Landau 2011), a feasibility study (FS; AECOM and Landau 2015), a supplemental FS (Landau 2018), various Ecology and Boeing comment and response letters (Boeing 2016; Boeing 2017a,b,c; Boeing 2018a,b; Boeing 2019a), and Ecology approval or contingent approval letters (Ecology 2016a,b; Ecology 2017; Ecology 2018; Ecology 2019a,b,c).

1.1 PURPOSE

This CAP presents the cleanup action for the Upland Area and PMG portion of the Boeing Everett Site: the Boeing Everett Facility Uplands Areas, PMG, and the adjacent BOMARC Property in Everett, Snohomish County, Washington (Figure 1-1). The purpose of a CAP is to identify the final cleanup actions for the Site per WAC 173-340-380(1)(a)(i)-(ix) and to provide an explanatory document for public review. More specifically, this plan:

- Describes the Site and the portion of the Site (Upland Area and PMG) addressed by this CAP,
- Briefly summarizes current site conditions,
- Briefly summarizes the cleanup action alternatives considered in the remedy selection process,
- Describes the selected cleanup action for the Site by SWMU/AOC and the rationale for their selection,
- Identifies site-specific cleanup levels and points of compliance for each hazardous substance and medium of concern for the proposed cleanup action,
- Identifies applicable state and federal laws for the proposed cleanup action,
- Identifies residual contamination remaining on the site after cleanup and restrictions on future uses and activities at the site to ensure continued protection of human health and the environment,
- Discusses compliance monitoring requirements, and
- Presents a schedule for implementing the CAP.

1.2 SITEWIDE FRAMEWORK

The Upland Area and PMG includes the Boeing Everett Facility that were described in the Upland Areas and PMG Feasibility Study (AECOM and Landau 2015) and three additional SWMUs/AOCs that were added after the completion of the FS, which includes Building 40-22, Utility Slants #2 and #3; Building 40-23, Static Test Pad; and Building 40-25, Utility Vault (SWMU/AOC No. 177). It also includes the BOMARC Property that was described in a separate feasibility study (URS 2014).

A separate CAP will be prepared for the remainder of the Site, including freshwater sediments and surface water at the Boeing Everett Facility as described in the separate sediment feasibility study (AECOM 2016) and will include the Former Gun Club Area B (EPM J) and the BOMARC Building 45-70 Property FS Wetland 3A (URS 2014).

2.0 SITE DESCRIPTION

This section presents an overview of the Upland Area and PMG including: a regulatory overview; a site description; a brief historical summary; remedial history, and current conditions.

2.1 BRIEF SITE BACKGROUND

The Boeing Everett Facility is the main manufacturing complex for Boeing's 747, 767, 777, and 787 jetliners. Construction of the facility began in 1966, including the final assembly building for assembly of the 747. The facility was expanded in 1980 to accommodate 767 production and again in 1992 to accommodate 777 production. The current and foreseeable future use of the facility property will be for commercial aircraft manufacturing operations.

Boeing notified the U.S. Environmental Protection Agency (EPA), Region 10, of its dangerous waste management activities at the Boeing Everett Facility on August 6, 1980, including the storage of dangerous wastes under the RCRA interim status requirements (Section 3005) and implementing regulations such as the authorized Washington State Dangerous Waste Regulations (WAC 173-303). Boeing submitted Part A of its RCRA dangerous waste storage permit application to EPA on November 17, 1980, and its Part B application on November 7, 1988, and subsequently sent several revised Part B applications in 1992, 1995, and 2000. Boeing eventually withdrew its application by letter dated February 11, 2002 and remains an interim status facility without any active units.

The Ecology-approved Upland RI report was used to determine which SWMUs/AOCs warrant feasibility study (FS) evaluation and to support the evaluation of remedial alternatives in the FS.

The Upland SWMUs/AOCs summarized in Table 1-1 were included in the FS, with the exception of the BOMARC Property, and three other sites added after the FS was complete. The SWMUs/AOCs carried forward to the Upland/PMG and BOMARC FS reports (excluding sediment areas) are shown on Figure 1-2. PMG and the BOMARC Property are shown on Figures 1-3 and 1-4, respectively.

2.1.1 UPLAND AREA AND PMG (PORTION OF THE BOEING EVERETT FACILITY SITE)

The Boeing Everett Facility consists of the North Complex (located north of Highway 526) and the South Complex and currently occupies a total of approximately 1,000 acres (Figure 1-1). The Boeing Everett Facility is owned, operated, and under the control of Boeing.

For the Upland Area, the SWMUs/AOCs investigated were grouped into areas based on their locations within the facility. Buildings located in the North Complex are identified by a building number starting with 40 (e.g., Building 40-56), whereas buildings in the South Complex start with number 45 (e.g., Building 45-01). The Upland Area SWMUs/AOC are summarized in Table 1-1.The current site conditions are summarized in Table 2-1 along with the primary chemicals of concern (COC) and media. A significant amount of soil and groundwater cleanup has been conducted at the Boeing Everett Facility during numerous independent remedial actions

and Ecology directed interim cleanup actions (IA) implemented under an Agreed Order. Cleanup levels were not attained by most of these interim actions, therefore, further remedial actions are required under this cleanup action plan (CAP). The IAs have included contaminated soil excavation, USTs and other facility infrastructure removal and groundwater extraction and treatment. Table 2-2 shows a summary of IAs that includes both the independent projects and those done under Ecology's oversight under the Agreed Order.

2.1.2 POWDER MILL GULCH (PART OF THE UPLAND AREA AND PMG PORTION OF THE SITE)

The PMG area (shown on Figures 1-2 and 1-3) is also referred to as the North Complex, Esperance Sand, PMG SWMU or SWMU 180. This contaminated groundwater area is located on the north end of the Boeing Everett Facility property and groundwater contamination extends off Boeing's property to the north beneath several properties including: the Seaway Center, Powder Mill Business Center (PMBC), and City of Everett (City) Lot 9 properties (Figure 1-3). The PMG landform is a steep canyon, incised by PMC that flows from its headwaters on Boeing property, toward and ultimately into the Puget Sound (the portion between Everett and Whidbey Island, which is also known as Possession Sound, Figure 1-1).

The portion of PMG on Boeing property includes several Boeing stormwater management structures and features, including a sedimentation basin, detention basin, peat filter, and engineered wetland that are located at the head of PMG (Figure 1-3). These features discharge into the headwaters of PMC on Boeing property. PMC runs north and eventually crosses Boeing's northern property boundary at Seaway Boulevard. The area on Boeing's property north of the stormwater management features is heavily wooded, and minimally developed, containing gravel access roads and a Boeing-maintained groundwater extraction and treatment (GET) system.

The Seaway Center property is occupied by two recently (2018) constructed commercial/light industrial buildings and a stormwater detention (lined) pond. The PMBC property is occupied by commercial/light industrial buildings and a stormwater retention (unlined) pond. City of Everett Lot 9 is a wooded, undeveloped property, through which PMC flows and is accessed by a gravel road.

Trichloroethene (TCE) contamination in surface water (PMC) in PMG was first discovered in 1998 during Boeing Everett Facility RI activities. TCE was first discovered in the Esperance Sand aquifer in PMG in 2003. The source area for the groundwater plume is located underneath the northeastern portion of the stormwater detention basin at the head of PMG. From there, a plume of dissolved-phase TCE above cleanup levels extends northward approximately 1,200 feet (ft) on the eastern side of PMC until it crosses under Seaway Boulevard and beneath a culverted segment of PMC. The plume remains on the western side of PMC until it enters the surface water of PMC and terminates on City of Everett property near monitoring well EGW205, approximately 1,600 ft north of Seaway Boulevard. The total plume length is approximately 2,800 ft and the width of the plume varies from approximately 250 ft to 800 ft. There are

currently no drinking water wells or other water supply wells within or proximate to the groundwater plume[1].

Surface water sampling in PMC conducted during the RI and subsequent surface water monitoring events identified TCE in surface water above screening levels and human health criteria (0.38 µg/L) recently promulgated as surface water quality standards (SWQS) for freshwater beneficial uses (drinking water and consumption of organisms; WAC 173-201A). TCE has been detected above the SWQS (0.38 µg/L) in PMC from its headwaters (within the groundwater plume boundaries) to approximately 3,500 feet north (at SW-PMG14) of the groundwater plume. From the northern end of the groundwater plume, PMC continues to run north approximately 1 mile before flowing into the Puget Sound.

No indications of vadose zone soil CVOC contamination above cleanup levels were identified at the PMG SWMU during the RI. No indication of soil gas CVOC concentrations above screening levels was identified during supplemental investigation activities on the PMBC property.

Results from the RI indicate that TCE is the primary COC in PMG. TCE breakdown products, cis-1,2-DCE (cDCE) and/or vinyl chloride (VC), were also detected in one or more groundwater samples at concentrations exceeding the RI groundwater screening levels. Within the upper portion of the PMG area, the TCE plume in the Esperance Sand is generally confined to the portion of the aquifer above a silt interbed; although, low concentrations of TCE are found below the silt interbed at various locations. TCE was not detected in groundwater upgradient of the detention basin, except for low concentrations at well EGW102[2]. TCE was also detected in PMC and in some groundwater seeps entering the creek. The RI findings prompted the performance of two groundwater interim cleanup actions (IAs) that have resulted in reductions in TCE groundwater concentrations within the TCE source area, downgradient TCE plume, as well as reductions in TCE groundwater flux to the creek. However, TCE groundwater and surface cleanup levels were not attained (and not the objective of the IAs). Therefore, additional remedial actions are required to meet both groundwater and surface water cleanup levels in a reasonable timeframe under this CAP.

The following sections provide additional information regarding historical Site conditions, the groundwater IAs, and the resulting current Site conditions at PMG.

2.1.2.1 GROUNDWATER CONDITIONS AND INTERIM ACTIONS

During the RI, the highest measured concentrations of TCE in groundwater throughout PMG were detected beneath the northeastern portion of the detention basin. Based on these results, this area was considered the source area for the TCE plume in PMG. A TCE groundwater source area IA cleanup action (Source Area IA) was performed beneath the detention basin, under Agreed

[1]The nearest water well identified was approximately 0.5 miles northwest of the northern end of the groundwater TCE plume. The well was reportedly installed in 1985, but according to the City of Everett is no longer in use and is presumed to have "been taken offline" as no municipal water for the City is sourced from wells (Olson 2019).
[2]The maximum TCE concentration detected at EGW102 was 0.6 µg/L (April 2006) but has not been detected above the laboratory reporting limit of 0.2 µg/L since April 2013.

Order amendment #3 (2006). The Source Area IA included implementation of electrical resistance heating in 2006 and 2007 and a subsequent enhanced bioremediation treatment program, which included injection and emplacement of electron donor beneath the detention basin in 2009 and 2010, respectively.

The combination of these actions resulted in achieving reductions in TCE concentrations below the initial treatment goal of 500 µg/L. The bioremediation program has consisted of continued groundwater performance monitoring and associated quarterly reporting. Groundwater sampling analytical results have been evaluated against a treatment goal for combined TCE and breakdown products (i.e., the sum of TCE, cDCE, tDCE, and VC) of 3.8 micromoles per liter (µmoles/L). After meeting the IA performance objectives, Ecology approved the discontinuation of this source area interim action in April 2020.

An additional downgradient plume interim action (Downgradient Plume IA) was performed under Agreed Order amendment #5 (2011). Specifically, the Phase 1 IA was implemented in 2012 to minimize migration of the plume off of Boeing property and to minimize contaminant flux to PMC south of Seaway Boulevard to the maximum extent practicable. A groundwater extraction and treatment (GET) system, comprised of three groundwater extraction wells and an air stripper groundwater treatment system south of Seaway Boulevard, was installed and has been running since November 2012. In September 2015, seven additional extraction wells north of Seaway Boulevard were brought online as a part of the Phase 2 IA expansion of the GET system, with the purpose of further minimizing flux of contaminated groundwater to PMC north of Seaway Boulevard to the maximum extent practicable. In February 2016, two additional extraction wells were added to the system south of Seaway Boulevard to supplement the Phase 1 IA portion of the system.

Hydrologic and water quality data collected during the Downgradient Plume IA indicate plume migration off Boeing property and TCE flux to PMC have been reduced by the groundwater capture zones created through operation of the 12 GET system extraction wells. Treated water from the GET system is currently discharged to PMC at an engineered outfall near the northern end of the plume under the Boeing Everett Facility's National Pollutant Discharge Elimination System (NPDES) permit (Permit No. WA0991001).

As a result of implementation of the Source Area IA and Downgradient Plume IAs, TCE concentrations have decreased throughout much of the plume. However, groundwater chemical data indicates that the TCE groundwater plume is still (to a lesser extent) migrating across Seaway Blvd onto City of Everett (Lot #9), PMBC and Seaway Center properties. Figures 2-1 and 2-2 show, respectively, TCE iso-concentration contours from 2012 prior to the implementation of any IAs, and recent data from October 2019. As indicated by the data represented in Figure 2-2, as a result of the source area IA, source area TCE concentrations have been reduced from over 2,500 µg/L at multiple wells (with a measured maximum concentration of 31,000 µg/L in 2005) to a maximum concentration of 330 µg/L as of April 2020. TCE concentrations in the downgradient plume have also substantially declined as a result of the source area and Downgradient Plume IAs, from a high concentration of 1,900 µg/L to a maximum concentration of 480 µg/L as of February 2020. However, TCE concentrations have

increased on the western boundary[3] of the downgradient plume on the PMBC and Seaway Center properties (up to 300 µg/L recently). These elevated concentrations have been routinely observed in groundwater monitoring wells EGW171R2 and EGW174 for several years and these groundwater chemical data are accurate and represent TCE concentrations on the western boundary of the downgradient plume and not anomalous.

PMG TCE groundwater source area and downgradient plume concentrations still remain up to several orders of magnitude above the Ecology groundwater cleanup level. Therefore, the final groundwater remedial actions discussed in this CAP are required to be compliant with the MTCA regulations.

2.1.2.2 SURFACE WATER CONDITIONS

Ongoing PMC surface water and seep sampling events were conducted as a part of the RI and the downgradient plume IA. Data collected from these events since the Phase 1 IA startup have generally indicated decreasing TCE concentrations correlating with the GET system operation and the reduction in TCE groundwater flux to PMC. Measured TCE concentrations in PMC have declined from as high as 38 µg/L on Boeing property before the IA, to single digit µg/L concentrations within the TCE plume discharge zone (both on Boeing and City of Everett property). Although TCE groundwater flux to the creek had been reduced, TCE concentrations in surface water still exceed WQC (0.38 µg/L) both on Boeing and City of Everett property by as much as one order of magnitude. This indicates further groundwater remedial actions are required under this CAP to meet Ecology surface water cleanup levels. Thus far, TCE breakdown products have not been detected in surface water samples from PMC.

2.1.2.3 SOIL GAS CONDITIONS

Potential soil vapor intrusion (VI) pathways have been evaluated in specific areas of the PMG TCE groundwater plume. The only buildings above or proximate to the plume are located on the Seaway Center (formerly CRISTA Ministries) and PMBC (formerly Panattoni) properties. Boeing has no current plan to develop the area on their property where the plume exists north of the detention basin because of the steep slopes, wetlands, and creek and associated buffers limiting the potential for construction. Similarly, the Lot 9 (City) property, located north of the Boeing property, will not be developed, as there is a pre-existing deed restriction on the property designating its use only for “open space purposes” (Snohomish County 1989), along with the previously identified steep slopes, wetlands, creek, and buffer areas.

In January 2014, to evaluate the potential VI pathway for (future) buildings at the Seaway Center and PMBC properties, soil gas sampling was conducted in the vadose zone. Two pairs of soil vapor monitoring wells were installed, one pair on the Panattoni (now PMBC) property and the other pair on the CRISTA Ministries (now Seaway Center) property.

Soil gas samples approximately 10 feet and 110 feet above the top of the water table were collected from each well pair and analyzed for CVOCs. Only one detection of TCE (9.6

[3] As seen at EGW174 (15-20 µg/L TCE) and EGW171R2 TCE (150-210 µg/L) over the last four sampling quarters

micrograms per cubic meter [µg/m^3]) was observed in the deeper of the two wells located on the CRISTA Ministries (now Seaway Center) property. This result was below the MTCA Method B deep soil gas screening level of 37 µg/m^3. Additional soil gas sampling in these same locations is planned under this Ecology CAP as explained in Section 4.4.

In March 2019, an additional soil vapor monitoring well was installed (22.5 ft deep) adjacent to one of the current PMBC property buildings in response to an observed westerly shift of the TCE groundwater plume boundaries (apparently related to large scale development of the PMBC and Seaway Center properties). The vapor monitoring well was sampled in April 2019. None of the CVOCs of concern at PMG (TCE, VC, and cDCE) were detected in the sample. Additional soil gas sampling is planned in this same location under this Ecology CAP as explained in Section 4.4.

2.1.3 BOMARC PROPERTY

The BOMARC Business Park property is owned by Snohomish County and is located near the southeast corner of the Airport Road and BOMARC Road intersection at 9205 Airport Road (Figure 1-1). Bomarc is situated southeast of the Boeing Everett Facility South Complex. Property use in this vicinity consists of commercial retail, office, and light industrial property use. The main Boeing Everett facility is located adjacent to the northwest. The BOMARC Property consists of an approximately 30.1-acre parcel developed with an approximately 455,380-square-foot building (Building 45-70) owned by Boeing. The building is surrounded by asphalt-paved parking and storage areas (Figure 1-4). Boeing occupied the BOMARC Property from 1990 through 1999 and operations included sub-assembly of commercial aircraft interiors. From 1999 through 2003 Building 45-70 was unoccupied. Boeing currently sub-leases the building to several tenants. Currently, three tenants occupy Building 45-70: Fibres International, Inc. (Fibres) (recycling facility), Giddens Industries (Giddens) (aerospace components and assemblies manufacturing), and XPO Logistics Company (XPO) (warehousing and distribution of Boeing 787 parts).

Shallow soils in the northwest portion of the BOMARC Property were investigated as part of the site-wide RI of the Everett Facility (URS and Landau 2011), and a soil IA was conducted in 2008 and is summarized in Table 2-2. Additional Boeing independent soil assessments occurred in 2007. Ecology also required supplemental RI activities, which have been completed and approved by Ecology (URS 2012a). The FS for the BOMARC Property identified SWMUs/AOCs within BOMARC Building 45-70 building (SWMU No. 011), at exterior locations (e.g., oil/water separators EV-151 and 152) and cadmium contaminated soils on the BOMARC Property. Wetland 3A was also identified as an AOC and will be addressed in a separate sediment CAP. The Ecology-approved FS report (URS 2014) added Freon-12 and TCE in sub-slab vapor and indoor air and cadmium (soil) as SWMUs (Ecology 2014). TCE is a COC in indoor air within the building.

2.2 GEOLOGY AND HYDROGEOLOGY

2.2.1 UPLANDS AND BOMARC PROPERTY

The geologic units which directly underlie the facility are a combination of natural and fill soils. Prior to construction of the Everett Facility, the geologic units exposed at the ground surface consisted primarily of weathered Vashon Till. Alluvial and swamp (peat) deposits were present in the former drainages and depressions. Facility development included cutting and filling of drainages and depressions in the original topography for the construction of buildings, vehicle roadways, parking areas, and aircraft access areas. Fill at the Boeing Everett Facility is generally less than 15 feet thick and is underlain by dense glacial deposits of the Vashon Till. In the deepest boring completed in the north-central portion of the facility near Building 40-56, the glacial till extended to a depth of approximately 85 feet below ground surface (bgs) (elevation 545 to 550 feet NSL above National Geodetic Vertical Datum of 1929 [NGVD29]) before encountering Esperance Sand (URS and Landau 2011). The Esperance Sand Unit consists of brown silty fine to coarse sand with some gravel and extends to a depth of at least 222 feet bgs (elevation 543 feet MSL above North American Vertical Datum of 1988 [NAVD 88]), the maximum depth of drilling performed in the Uplands portion of the site.

Groundwater occurs beneath the site as discontinuous zones of perched water within fill and weathered till overlying the dense glacial till; as discontinuous perched zones within the till, and unconfined groundwater within the Esperance Sand. The perched groundwater depth within the fill and weathered till is generally less than 20 feet bgs. The flow direction of perched water through the fill/weathered till is primarily controlled by gravity and typically flows following local topography. However, local variations in stratigraphic conditions and man-made features, such as cut-and fill areas or utility trenches, may influence perched groundwater flow. Generally, the various perched groundwater zones observed at the site are not hydraulically connected to each other, but these perched groundwater zones can move latterly or vertically to recharge the regional groundwater occurring within the underlying Esperance Sand Aquifer, especially during the wet season. Regionally, the Vashon Till unit is relatively impermeable and does not contain significant amount of groundwater. However, perched water has been observed at the Site in discontinuous lenses of sand and gravel within the till.

Groundwater within the Esperance Sand Aquifer is unconfined, with the upper portion of the sand typically unsaturated. Unconfined groundwater within the Esperance Sand occurs at a depth of approximately 215 to 200 feet bgs (approximately 345 to 340 feet above MSL NAVD 88]) from south to north beneath the upland portion of the site (Figure 2-4). The regional flow direction beneath the Everett Facility is to the northwest towards the Puget Sound.

2.2.2 POWDER MILL GULCH

As it proceeds north, PMG is incised into and through the Vashon glacial till, cuts into and through the Esperance Sand formation, and eventually cuts into the underlying Lawton Clay formation (north of Boeing property). The Lawton Clay acts as an aquitard at the lower extent of the Esperance Sand Aquifer. Most of the Esperance Sand Aquifer in PMG is divided into an

upper and lower zone by an approximately 4-ft thick silt interbed. The northern edge of the silt interbed has been incised by PMC and pinches out north of Seaway Boulevard, allowing for convergence of the upper and lower zones of the Esperance Sand aquifer. The Lawton Clay Aquitard outcrops farther north of where the silt interbed ends and the aquifer (and the plume) fully flow into PMC both as direct flow to the creek and via flow from surface water seeps.

PMG formerly extended south-southeast from its current southerly extent, but the upper southern reaches were filled for construction of the Boeing Everett Facility. Currently, the southerly end of PMG is occupied by the facility's stormwater detention basin, sedimentation basin, and the associated peat filter system and mitigation wetlands. The asphalt-lined detention basin was constructed during the original facility construction in 1968 and 1969. The detention basin was modified in 1991 and 1992, during the construction of the sedimentation basin (also asphalt lined), peat filters, and engineered wetlands.

3.0 CLEANUP STANDARDS

Under the MTCA regulation (WAC 173-340), the cleanup standards for a site remedial action consist of concentrations to which hazardous substances present at the site must be cleaned up to (cleanup levels); the location where those cleanup levels must be met (i.e., point of compliance [POC]); and other applicable, relevant, and appropriate requirements (ARARs) that apply to the site, including applicable requirements for how cleanup levels and POCs must be applied (WAC 173-340-700[3]).

3.1 CONTAMINANTS OF CONCERN

The types of hazardous substance that comprise the contaminants of concern (COCs) for the Boeing Everett Facility include:

- Volatile organic compounds (VOCs), both chlorinated and non-chlorinated
- Semi-volatile organic compounds (SVOCs), including carcinogenic and non-carcinogenic polycyclic aromatic hydrocarbons (cPAHs and nc-PAHs)
- Metals (chromium, lead, arsenic, cadmium)
- Petroleum hydrocarbons (gasoline, diesel, jet fuel, heavy oil)
- Hydraulic Jet Fluid, Skydrol and HyJetIV (tributyl phosphate, dibutyl phenyl phosphate, butyl diphenyl phosphate, triphenyl phosphate, butylated hydroxytoluene)

The primary COCs for each SWMU/AOC are presented in Table 2-1.

3.2 POINTS OF COMPLIANCE

The POC under MTCA are the point or points at a site where the cleanup levels must be attained to achieve cleanup standards.

For the Upland Area and PMG portion of the Site under this CAP, the points of compliance at which the cleanup levels must be met are as follows:

- soil cleanup levels at each SWMU/AOC must be met at the standard point of compliance [WAC 173-340-740(6)];
- groundwater cleanup levels must be met at each SWMU/AOC at the standard point of compliance, [WAC 173-340-720 (8)(b)]; and
- indoor air when there is a potential for vapor intrusion into indoor air, cleanup levels (WAC 173-340-750(4)) must be met at each SWMU/AOC at the standard point of compliance [WAC 173-340-750(6)]. Sub-slab vapor concentrations below screening levels are required in order to discontinue indoor air monitoring.

For the **PMG** SWMU, the points of compliances at which the cleanup levels must be met are as follows:

- surface water, cleanup levels must be met at the surface water standard point of compliance [WAC 173-340-730(6)];

- groundwater cleanup levels must be met at the condition point of compliance, (CPOC), [WAC 173-340-720(8)(c)] as described in Section 5.10.2.

3.3 ARARS

In accordance with MTCA, cleanup actions shall comply with applicable state and federal laws [WAC 173-340-710(1)]. MTCA defines applicable state and federal laws to include legally applicable requirements and those requirements that Ecology has identified as relevant and appropriate. Collectively, these requirements are referred to as applicable or relevant and appropriate requirements (ARARs). Chemical-specific ARARs are presented in Tables 3-1 through 3-11 and are also summarized in Section 5.0 for each remedy along with the location- and action-specific ARARs.

In accordance with MTCA (WAC 173-340-710(9)), cleanup actions performed under a consent decree, order, or agreed order will be exempt from the procedural requirements of Chapters 70.94, 70.95, 70.105, 75.20, 90.48, and 90.58 RCW, and of any laws requiring or authorizing local government permits or approvals unless Ecology determines that providing the exemption would result in a loss of state approval from a federal agency to implement a federal law. The substantive requirements of such permits or approvals must be met, Ecology will consult with the state agency or local government charged with implementing the permit/approval, and the substantive requirements will be part of a public notice and comment process.

3.4 CLEANUP LEVELS

The CAP final cleanup levels for this portion of the Site are listed in Tables 3-1 through 3-11.

3.4.1 MTCA METHOD A -EPM A THROUGH H; AND BOMARC

Method A soil cleanup levels for industrial properties may be used for cleanups at sites that meet the criteria in WAC 173-340-704(1) and -745(1). However, soil cleanup levels must not directly or indirectly cause exceedances of groundwater cleanup standards in the Esperance Sand Aquifer (WAC 173-340-745(2)). As a result, Method A unrestricted soil cleanup levels protective of groundwater cleanup levels are applied to these SWMUs for the following reasons:

- The majority of the SWMUs/AOCs involve only a few hazardous substances (in many cases petroleum related).

- Methods B and C soil cleanup levels cannot be calculated for petroleum without specialized additional analytical results that are not available.

- Soil cleanup levels were established to be protective of potable groundwater cleanup levels. Method A soil cleanup levels for unrestricted use meets this criteria for the BTEX and TPH contaminants.

MTCA Method A soil and groundwater cleanup levels for unrestricted use are appropriate for six SWMU/AOCs[4] for TPH and benzene, toluene, ethylbenzene and xylenes (BTEX) compounds in soil. MTCA Method A soil cleanup levels for unrestricted use are appropriate for two SWMUs[5] for metals (cadmium, chromium, and/or lead) and/or PAHs.

Method A unrestricted soil and groundwater cleanup levels for each SMWU/AOC are presented in EPM A through EPM J and the BOMARC Property and are listed in Tables 3-1, 3-2, 3-4 through 3-8, and 3-11.

3.4.2 MTCA METHOD B- EPM A THROUGH H; AND BOMARC

Method B may be used at any site and is the most common method for setting cleanup levels for sites where use of Method A is not appropriate. Method B cleanup levels[6] were selected for COCs in soil, and intended to be protective of potable groundwater. Method B groundwater cleanup levels apply to several SWMUs where subsurface contaminated soils have the potential to contamination the deeper Esperance Sand Aquifer.

3.4.3 MTCA METHOD C EPM A THROUGH H; AND BOMARC

Method C cleanup levels only apply to indoor air at the upland portions of the Boeing Everett Facility (within the security-controlled fenced portion of the facility), in accordance with WAC 173-340-706(1)(c).

3.4.4 RISK-BASED CLEANUP LEVELS- EPM A THROUGH H

The perched groundwater at eight SWMUs/AOCs[7] is not potable, per WAC 173-340-720(2)(AECOM and Landau 2015). Perched groundwater cleanup levels were either established as the Method A unrestricted groundwater cleanup levels for TPH OR calculated using human health risk assessment procedures for other COCs, consistent with WAC 173-340-720(6)(c) using the reasonable maximum exposure for current and potential future use. Refer to Section 4.1. The cleanup levels for each contaminant will result in an upper bound on the estimated excess cancer risk that is less than or equal to $1x10^{-6}$ (WAC 173-340-720(6)(c)(i) and not exceed a hazard quotient of one (1) for individual hazardous substances (WAC 173-340-720(6)(c)(i)).

Risk-based cleanup levels for groundwater were selected for seven of the eight SWMU/AOC's with non-potable water. Method A cleanup levels for groundwater were selected for SWMU 166, the remaining non-potable water SWMU.

[4]40-32 building; SWMU068; SWMU067/071; UST-EV-48-1; SWMU 083; and SWMU165.
[5]Bomarc 45-70 building and SWMU065.
[6]In most cases, soil cleanup levels were selected to be protective of drinking water cleanup levels.
[7]SWMU 090; SWMU 112; SWMU 151; SWMU 086/089/094; SWMU166; and Bomarc.

3.4.5 NATURAL BACKGROUND LEVELS

Metals in groundwater can be elevated based on natural background conditions. When establishing groundwater cleanup levels, WAC 173-340-720(7)(c) requires that cleanup levels not be set below natural background concentrations. The arsenic Method A groundwater cleanup level (11 µg/L), based on natural background concentrations in Washington State, apply to this Site.

3.4.6 SURFACE WATER AND GROUNDWATER CLEANUP LEVELS FOR POWDER MILL GULCH

Surface water and groundwater cleanup levels were developed for the Powder Mill Gulch for TCE and its breakdown products cis-1,2-DCE, trans-1,2-DCE, 1,1-DCE, and vinyl chloride (VC). The surface water and groundwater cleanup levels are presented in Tables3-10a and 3-10b, respectively. PMC sediment cleanup will be evaluated under the future CAP for sediment, accumulated solids, surface water, and stormwater.

3.4.6.1 SURFACE WATER

The CAP surface water cleanup levels protective of human health and the environment were developed using MTCA Method B for COCs. Under MTCA (WAC 173-340-730), surface water cleanup levels were based on estimates of the highest beneficial use (HBU) and the reasonable maximum exposure (RME) expected to occur under both current and potential future Site-use conditions. For PMG, the surface water cleanup levels (presented in Table 3-10a) are protective of human consumption of water and organisms and protective of ecological receptors as described below.

Powder Mill Creek Surface Water Classification and HBU

The classification and the HBU of a surface water body is determined in accordance with WAC 173-201A, Washington's surface water quality regulation. WAC 173-201A-600 and -602 (Table 602) identifies use designations for fresh water surface water bodies in the state of Washington. PMC is located within Water Resources Inventory Area 7, the Snohomish River Watershed. However, PMC (the specific water body within this area) and the use designation of PMC are not specifically identified in WAC 173-201A-602. However, WAC 173-201A-600 states that:

> *"All surface waters of the state not named in Table 602 are to be protected for the designated uses of: salmonid spawning, rearing, and migration; primary contact recreation; domestic, industrial, and agricultural water supply; stock watering; wildlife habitat; harvesting; commerce and navigation; boating; and aesthetic values."*

Fish use has not been identified in PMC south of Mukilteo Boulevard. Recent man-made fish barriers (culverts impassable to fish at Mukilteo Boulevard) and other natural barriers exist downstream of the project area that prevent anadromous fish species from migrating to, or

spawning or rearing in, the contaminated portion of PMC. If those culverts and other barriers to fish passage are removed or mitigated, PMC could possibly be used by anadromous fish.

PMC is not designated as a current or future drinking water source. Also, there is no current evidence of any diversionary structures along PMC that indicate any current use of water from the creek. Additionally, all residents and businesses within the City limits have access to the public drinking water system.

PMC cuts through the Esperance Sand Formation therefore is hydraulically connected to groundwater in the Esperance Sand Aquifer. Surface water in PMC may recharge groundwater in the aquifer and vice versa, depending on locations and time. If pumping wells were installed for domestic purposes in the vicinity of PMC, they may have the potential to create cones of depression that would draw surface water and contaminants into the domestic wells.

Current HBU for the creek is for recreational use, habitat for aquatic organisms, and future potential consumption of fish (if downstream obstacles to fish passage are removed and recreational fishing is permitted). However, regulatory considerations discussed above require protection of PMC to more stringent levels including domestic water supply.

Surface Water ARARs

The following ARARs identify the surface water concentrations established under applicable federal and state laws which apply to development of cleanup levels for surface water quality. Development of surface water cleanup levels considered criteria protective of human health based on consumption of aquatic organisms and water, and protective of aquatic organisms, wildlife, and fish (note, however, that there are currently no known or identified fish or other edible aquatic organisms in the impacted portion PMC). ARARs for the protection of aquatic species and human health are based on standards for freshwater contained in the following:

- WAC 173-201A – Water Quality Standards for Surface Waters of the State of Washington.
- National Recommended Ambient Water Quality Criteria (promulgated under Federal Clean Water Act Section 304[a]).

Where ARARs have not been established for environmental effects-based concentrations of hazardous substances, per WAC 173-340-730(3)(b)(ii), Method B cleanup levels must also consider “concentrations that are estimated to result in no adverse effects on the protection and propagation of wildlife, fish, and other aquatic life.” To satisfy this requirement, various EPA benchmark and screening values were considered for determining applicable values for use as ARARs in determining the appropriate surface water cleanup levels. In addition to WAC 173-340-730(3)(b)(ii), Equations 730-1 and 730-2, the toxicological benchmarks and screening levels for ecological receptors that were considered where ARARs have not been established included:

- EPA Region 3 Biological Technical Assistance Group (BTAG) Freshwater Screening Benchmarks, Jul. 2006, http://www.epa.gov/reg3hwmd/risk/eco/btag/sbv/fw/screenbench.htm

- EPA Region 4 Waste Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites, Supplement to Risk Assessment Guidance for Superfund (RAGS), 1995 updated Aug. 1999, http://www.epa.gov/region4/superfund/programs/riskassess/ecolbul.html
- EPA Region 5 Ecological Screening Levels, Aug. 22, 2003.http://www.epa.gov/region5/waste/cars/pdfs/ecological-screening-levels-200308.pdf

The most conservative value from these three resources (and the most conservative values for aquatic life and/or terrestrial/freshwater wildlife) were compared against other ARARs and Equations 730-1 and 730-2 derived cleanup levels. The most stringent value is the CAP surface water cleanup level (Table 3-10a).

3.4.6.2 GROUNDWATER

Currently, all residents and businesses within the City limits have access to the public drinking water system. However, the Esperance Sand Aquifer meets the regulatory definition (WAC 173-340-720(2) for a potable drinking water source and there is a potential it may be used in the future as a drinking water source. There are no currently known private drinking water wells, such wells are not currently strictly prohibited by the City of Everett.

The MTCA regulations stipulate that groundwater cleanup levels must also be as stringent as concentrations protective of surface water beneficial uses (WAC 173-340-720[4][b][ii]).The development of groundwater cleanup levels protective of surface water beneficial uses, requires the use of various surface water quality ARARs, as identified under WAC 173-340-730(3)(b).

The PMG groundwater cleanup concentration for TCE (and other hazardous substances such as vinyl chloride) established in accordance with WAC 173-340-720, used the process set out for Method B ground water cleanup levels, which requires a concentration at least as stringent as applicable state and federal laws[8]; all water quality criteria published in the water quality standards for surface waters of the state of Washington; water quality criteria based on the protection of aquatic organisms (acute and chronic criteria) and human health published under section 304 of the Clean Water Act; or National toxics rule. WAC 173-340-730(3)(b)(i).

The groundwater cleanup level for TCE and vinyl chloride are 0.38 µg/L and 0.02 µg/L respectively, to be met at the Ecology approved groundwater conditional POC[9] (Table 3-10b).

[8] In this process, Ecology would also review concentrations established under WAC 173-340-720(4)(b)(i) and (iii). In this case, those concentrations are either less stringent or not applicable.
[9] For the groundwater plume throughout the site (the standard POC), groundwater shall meet cleanup levels protective of drinking water beneficial use (TCE = 4 µg/L) at all locations.

4.0 CLEANUP ACTION ALTERNATIVES AND ANALYSIS

4.1 CLEANUP ACTION ALTERNATIVES

The Upland Areas and PMG FS report presented a number and type of cleanup action alternatives (WAC 173-340-350[8][c][i][B]) developed for each SWMU/AOC at the upland area and PMG portion of the Facility. These alternatives were developed based on the technology screening performed in the FSWP, the pilot studies performed as part of the FS investigations, and the CSMs developed in the FS (AECOM and Landau 2015). For some SWMUs, Ecology developed and evaluated additional cleanup alternatives to those alternatives proposed by Boeing's FS reports and the Supplemental FS (SFS) report.

SWMUs/AOCs with similar characteristics and similar FS evaluation results are discussed together in groups sharing similar contaminants and contaminated media. BOMARC Property is discussed separately.

The alternatives Ecology evaluated in the Upland Area and PMG FS and BOMARC FS, and Supplemental FS (for PMG) included one or more of the following remediation components:

- Institutional/Engineering Controls
  - Institutional Controls
  - Maintain Containment

- In Situ Treatment
  - Soil Vapor Extraction
  - EISB Source Area Remediation
  - Focused ISCO Remediation
  - Focused EISB Remediation

- Groundwater Extraction and Treatment
  - Groundwater Extraction
  - Periodic Groundwater Extraction
  - Dewatering
  - Continued Operation of Existing GET System
  - Dynamic Groundwater Recirculation

- Soil Excavation and Disposal
  - Near-Term Excavation with Dewatering
  - Future Excavation
  - Near-Term Excavation
  - Limited Excavation
  - Comprehensive Excavation

The specific alternatives that were evaluated and the final remedial alternatives are listed in Table 4-1.

The phrase “near-term” restoration timeframe is used to mean execution of the cleanup action as soon as practical after Ecology’s approval of the EDR. For near-term excavation, cleanup would be performed after Ecology approval of the EDR, and then per the time schedule in the EDR. “Near-term” is used in contrast to “future,” which refers to some later time, as defined in Section 4.4.

Many of the cleanup alternatives in this Ecology CAP include institutional controls as an essential element of the final cleanup action. An example of such institutional controls is a requirement to maintain pavement or flooring above contaminated media to prevent direct-contact exposure and prevent rainwater infiltration to contaminated soils to reduce contaminant leaching to deep groundwater, prevent withdrawal of contaminated groundwater for any use, and prevent contact with contaminated surface water.

Institutional controls would be implemented as part of a **property-wide environmental (restrictive) covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett. This covenant would be binding on future property owners. Institutional controls would also be implemented as part of an environmental (restrictive) covenant on non-Boeing owned property as part of the remedy.

4.2 INITIAL SCREENING OF ALTERNATIVES

Cleanup action technologies were screened as part of FSWP development, and the results of the screening were summarized in Tables 6.1 and 6.2 of the FSWP (URS and Landau 2012). All technologies retained following the screening process for each SWMU/AOC were incorporated into the cleanup action alternatives described and evaluated in the upland FS (AECOM and Landau 2015). For the BOMARC Property, cleanup action technologies were screened and are documented in the BOMARC FS (URS 2014).

4.3 EVALUATION OF ALTERNATIVES

The FS Reports (AECOM and Landau 2015 and URS 2014) evaluated each of the cleanup action alternatives developed for SWMUs/AOCs addressed in this CAP using the criteria established by MTCA. WAC 173-340-360 requires first that all alternatives evaluated meet the following four threshold requirements:

i. Protect human health and the environment.

ii. Comply with cleanup standards (WAC 173-340-700 through 760).

iii. Comply with applicable state and federal laws (WAC 173-340-710).

iv. Provide for compliance monitoring (WAC 173-340-410 and 720 through 760).

MTCA also requires that cleanup action alternatives that fulfill the threshold requirements be evaluated against the following “other requirements” (WAC 173-340-360[2][b]):

i. Use permanent solutions to the maximum extent practicable by evaluating specific elements described in WAC 173-340-360(3).

ii. Provide for a reasonable restoration time frame (WAC 173-340-360[4]).

iii. Consider public concerns (WAC 173-340-600).

MTCA requires that, when selecting a cleanup action, it must meet the threshold AND other requirements described above including permanent solutions to the maximum extent practical (WAC 173-340-360[3]). Permanent solutions are cleanup actions that meet the cleanup standards without further action required at the site (WAC 173-340-200).

Public participation and consideration of public concern are an integral part of the cleanup process under MTCA. Ecology respectfully considers all comments received. This may result in a final CAP that is a modification of the document earlier proposed to the public.

4.4 UPDATES TO FS EVALUATION SINCE FS REPORTS SUBMITTAL

The following are key components of the final site remedy that were not included in the upland FS or SFS reports:

Maintain Containment and Future Remediation

Future contaminated soil remediation, routine groundwater monitoring, and/or routine indoor air sampling in addition to maintaining containment are required at many SWMUs where soil contamination, above cleanup levels, exists below ground.[10] Boeing shall initially implement Alternative 1 (containment of contaminated soils) followed by future excavation or additional remedial actions at SWMU054, SWMU165, SWMU093, SWMU067/071, building 40-22, building 40-23, and SWMU 177 SWMU055/168, SWMU171, and EV48-1. The excavation or additional remedial actions portion of the remedy is a requirement of the final remedy but will not occur until (1) Boeing determines implementation of the remedy will not impact facility operations and (2) Ecology determines excavation or additional remedial actions is appropriate at that time and will result in either (a) a reduction in post-remedy monitoring or (b) a finding from Ecology that no further remedial action will be necessary after the excavation or additional remedial actions or (c) significant reduction in subsurface soil contamination and therefore a reduced threat to human health and the environment. However, Ecology may require Boeing to conduct immediate excavation or additional remedial actions by stating in writing the agency's decision that such action is necessary because the containment cap is no longer functioning to protect human health or if contamination from contained soil is migrating to the deeper aquifer. Ecology's decision that immediate excavation or additional remedial actions is necessary may be subject to Dispute Resolution. Boeing will annually assess its current and projected operations in these areas ("operational assessment") and will provide Ecology with statements in the annual

[10] "Ecology is allowing the initial remedy of contaminated soil containment in order to prevent negative impacts to facility operations; but to agree to do so, Ecology must have an adequate network of downgradient groundwater monitoring wells to verify/confirm that vadose zone soil contamination from each of these SWMUs is not reaching the underlying future drinking water aquifer." (Ecology 2019a).

inspection reports for Maintain Containment areas describing: the results of the operational assessment, the implementability of soil excavation or additional remedial actions at the facility, and if excavation or additional remedial actions at the facility are determined to be infeasible – the reasons why excavation or other remedial actions cannot occur in the following year.

Deep Well Installation and Monitoring[11]

Installation of deep downgradient aquifer monitoring wells to monitor potential contaminant transport through the unsaturated zone to the underlying aquifer (Ecology 2019a, b) is required at many SMWUs. A total of ten new deep wells will be installed for the following SWMUs and SWMU groups where soil containment is part of the final remedy[12]:

1) Nos. 055 and 168, Building 40-24 – one additional deep downgradient monitoring well near the southwest corner of Building 40-58 along the south exterior wall. No. 177, Building 40-25, will use the same additional well installed for Nos. 055 and 168, Building 40-24;
2) No. 171, Building 40-31, Former Bluestreak Vapor Degreaser – one additional deep downgradient monitoring well northwest of this SWMU along the south exterior wall of the 40-56 building or near the northwest corner of the north exterior wall of the building;
3) No. 098, Building 40-53, Mock-Up Degreaser – one additional downgradient monitoring well outside of the north exterior wall of the building;
4) No. 054, Building 40-51, Former Wastewater AST – one additional deep downgradient monitoring well outside of the northeast corner of the 40-51;
5) Building 40-32, Footing Excavation – one additional deep downgradient monitoring well on the eastern end of the exterior south wall of Building 40-56 building;
6) Building 40-11, UST EV-48-1 – one additional deep downgradient monitoring well on the north exterior side of the building;
7) No. 093, Building 45-01, Former Solvent USTs – one additional deep downgradient monitoring well on the exterior north side of the building;
8) Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST-153 – one additional deep downgradient monitoring well on the western side of the north exterior wall of the building between building 40-56 and the road. This new well will also serve to monitor any contamination migrating from SWMUs 086/089/094 which are also associated with Building 40-56[13];
9) Building 40-22 Utility Slants #2 and #3 – one additional deep groundwater monitoring well north of the outside north wall of the 40-32 building between the deep wells used to monitor the 40-32 building SWMU and SWMU 055/168. Building 40-23, Static Test Pad will use the same additional deep well installed for Building 40-22;

[11]Ecology reserves the right to require that these groundwater monitoring wells are installed earlier than at the implementation of the EDR, if continued negotiations for the final site cleanup take more time than expected.
[12]"The large distance (up to 1000 feet) between the SWMUs or SWMU groups justifies Ecology's requirement for its 10 distinct deep downgradient groundwater monitoring wells that will monitor the centerline and highest concentrations of any plume." (Ecology 2019b)
[13] One deep downgradient groundwater monitoring well must be installed on the western side of the north exterior wall of the 40-56 building. Well #6 is located too far west to be an appropriate location for monitoring this SWMU group (Ecology 2019b).

10) No. 165, Building 45-52, Former Fuel Farm USTs–one additional deep downgradient groundwater monitoring well located due north of the SWMU, on the south side of Hwy 526 or just north of Hwy 526.

Requirements for Groundwater Sampling Frequency

Quarterly groundwater monitoring is required at each of these new and two existing deep wells (EGW177 and EGW 178) as part of the EDR. After two consecutive years of non-detections for analyzed contaminants, Boeing may reduce the sampling frequency to semi-annual. However, any detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[14].

Quarterly sampling for two years establishes a baseline of chemical data that shows any seasonal fluctuations and verifies the low or high water season for future semi-annual groundwater sampling. Seasonality of vertical contaminant migration through the vadose zone could be different from the seasonality of horizontal contaminant migration within the Esperance Sand Aquifer. Therefore, a few years of quarterly monitoring is necessary to understand contaminant migration fluctuations and seasonality before less frequent monitoring can be considered.

These groundwater sampling frequencies are intended to **quickly detect** contaminant migration from SWMU soils to the Esperance Sand Aquifer.

Indoor Air Monitoring

The objective is to confirm that the initial phase of the remedy (i.e., containment of volatile contaminated soil and/or volatile contaminated groundwater below and near occupied buildings) does not pose any risk to human health, and that the capping remedy remains protective and further remedial actions are not required at that time. Routine indoor air sampling, and as needed soil gas sampling is part of compliance monitoring at 11 upland SWMUs. Indoor air sampling will be both economical and minimally intrusive to facilities with ongoing business operations.

Routine indoor air sampling is required to provide a baseline of data, and ensure current and future protection of human health. The indoor air sampling is only required for the volatile contaminants in soils or contaminated groundwater below or near a building being addressed by the CAP.

Boeing shall conduct routine indoor air monitoring at the following 10 SWMUs[15]:

- No. 090, Building 40-51, Former UST EV-11 (exterior contamination)
- No. 112, Building 40-11, Oil/Water Separator (exterior contamination)
- No. 171, Building 40-31, Former Bluestreak Vapor Degreaser (interior contamination)

[14]Routine groundwater sampling and analyses will end when groundwater contamination below a SWMU is below cleanup levels and contaminated soil from the associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling.

[15]Ecology February 8, 2019 letter.

- No. 098, Building 40-53, Mock-Up Degreaser (interior contamination)
- No. 170, Building 40-02, Large Vapor Degreaser (interior contamination)
- No. 169, Building 40-02, Small Vapor Degreaser (interior contamination)
- Building 40-02, Former Paint Crib (interior contamination)
- No. 054, Building 40-51, Former Wastewater AST (exterior contamination)
- Building 40-32, Footing Excavation (interior contamination)
- Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153 (interior contamination

At the SWMU group 086/089/094[16], routine indoor air sampling is normally required because this is a direct measurement of contaminants at the point of compliance where indoor air cleanup levels must be met. However, Boeing may elect instead to conduct indirect continuous sub-slab pressure monitoring in the manner described below.

Measure and record continuous and routine cross-slab pressures across several areas of the building floor where vapor intrusion potential exists. Boeing would need to show a downward pressure gradient from the entire affected part of the building floor to the sub-surface at all times during the day/night and weekdays/weekends. This indirect measurement method will be more expensive and more difficult than using indoor air sampling to directly measure compliance with the indoor air cleanup levels at the point of compliance.

Ecology will select the location of 40-56 building floor cross-slab pressure measurement points after it has reviewed the soil vapor extraction (SVE) system design in the engineering design report (EDR). The cross-slab pressure monitoring points must indicate a downward pressure gradient of at least 1 Pa[17]. The SVE system design and location of sub-surface vapor extraction piping is essential to determine where the most appropriate cross-slab pressure measuring points are located. The cross-slab pressure monitoring details will be specified in the EDR after Ecology has reviewed the SVE system design.

Cross-slab pressure would be continuously measured and downloaded every other week for 3 months and then quarterly until SVE operations end.

Further Requirements for Confirmatory Indoor Air Sampling at 40-56 Building, SWMUs 086/089/091[18]

SVE can be designed and operated to create and sustain pressures below a building's slab that are lower than pressures inside that building. When this "negative pressure field" extends across the footprint of the building it can act similarly to a sub-slab

[16]These SWMUs had soil gas samples collected nearby that were above screening levels. Ecology Vapor Intrusion Guidance says the next step is to conduct sub-slab vapor *and* indoor air samples. Even though a soil vapor extraction (SVE) system is the proposed final remedy, measures must be implemented to ensure the SVE system is working to protect the 40-56 building workers and eliminate the vapor intrusion pathway.

[17]The measurement required to show that sub-slab depressurization systems are operating to mitigate unacceptable vapor intrusion.

[18]Ecology final decision letter under Formal Dispute Resolution, dated May 2, 2019

depressurization system and minimize the transport of soil gas VOCs from the subsurface to the building's interior. However, if sub-slab soil gas VOC concentrations are sufficiently elevated to pose a potential threat to indoor air quality, post-mitigation sampling of indoor air is typically conducted to confirm the effectiveness of any depressurization system.[19] This confirmational sampling must be performed at the 40-56 Building once the SVE system is operational. It is the primary line of evidence for ensuring the adequate protection of workers inside the building.

After indoor air sampling data verify that vapor intrusion is not contaminating indoor air above protective levels, future "mitigation-effectiveness" monitoring during operation of the SVE system can be limited to pressure field extension measurements.

These cross-slab pressure-differential measurements should be compared to: a) initial measurements taken at the same time indoor air was sampled, and b) "acceptable" values established in the final SVE design document (work plan). Pressure monitoring can then provide an indirect indication that vapor intrusion does not unacceptably impact the building's indoor air.[20]

Or Boeing may instead collect routine indoor air samples (similar to the other 11 SWMUs) for SWMU 086/089/091[21].

Indoor air sampling frequency at buildings will be adjusted downward (but not eliminated) based on no indoor air exceedances of MTCA Method C levels and no increasing trends for consecutive indoor air sampling events. After one year of indoor air sampling events conducted during the summer and winter seasons, sampling frequency will be reduced to once per year in the season with highest indoor air concentrations. If indoor air concentrations remain below MTCA Method C levels and no increasing trends for two consecutive annual events, indoor air sampling frequency will be reduced to every other year. This assumes no building work is conducted that could exacerbate the vapor intrusion pathway.

At least two sub-slab vapor sampling events are also required at the SWMU if indoor air exceedances of MTCA Method C levels are detected or if Boeing proposes to terminate indoor air sampling.

Seasonal soil gas sampling (summer and winter) will be conducted at existing locations at Powder Mill Gulch for one year to evaluate if soil gas concentrations remain below screening levels under varying seasonal conditions. Future monitoring will not be required if (1) the soil gas is below screening levels, (2) TCE groundwater concentrations below or near the building do not increase over the corresponding maximum concentration observed in groundwater at the time

[19] The DTSC Cal EPA VI Mitigation Advisory and NJ VIM Technical Guidance discuss indoor air sampling to confirm VIM-SSD system performance. It is prudent to follow the recommendations of these guidances and not just rely on routine negative pressure field extension measurements in order to protect workers in the building.

[20] Assuming no newly identified building floor openings to the subsurface soils are found or created.

[21] Given the high concentrations of volatile soil, perched groundwater and LNAPL contamination under or adjacent to the south side of the 40-56 building, Ecology reserves the right to require the routine indoor air sampling at these SWMUs earlier than at the implementation of the EDR, if the agency determines it is necessary to be protective of human health and the environment. Indoor air and sub slab vapor concentrations vary temporally and one sub-slab vapor sampling event (2015) with low volatile concentrations at this SWMU is not adequate to eliminate future unacceptable vapor intrusion into the building.

of either soil gas sampling events, and (3) there are no building construction activities that create preferential vapor intrusion pathways. Even if Ecology agrees to suspend soil gas sampling in Powder Mill Gulch, Boeing shall maintain the soil gas sampling probes for future soil gas sampling if site specific conditions change warranting routine soil gas sampling. Construction of a new a soil gas sampling well was completed because the TCE groundwater plume has advanced further west under the Prudential warehouse property. Boeing installed this new soil gas monitoring well near the Prudential warehouse property, close to groundwater monitoring well EGW171R2.

The indoor air sampling will be eliminated for each SWMU unit after cleanup remedy implementation is completed and all media cleanup standards are met for that SWMU.

Powder Mill Gulch Remedy

The final cleanup action, for PMG TCE contaminated groundwater consist of concurrent enhanced in-situ bioremediation in the TCE groundwater source area AND full scale dynamic groundwater recirculation in the downgradient plume (Ecology 2019c).

5.0 DESCRIPTION OF SELECTED REMEDY

The following sections describe the final cleanup action for the Upland Area and PMG portion of the Site, broken out by each SWMU. Descriptions and details of technical and engineering design elements will be provided under separate cover in an engineering design report (EDR) and/or construction plans and specifications per the schedule in Section 6.0.

The descriptions of final cleanup alternatives for the Upland Area and PMG SWMUs/AOCs are presented in this section by EPM. EPMs are groupings of SWMUs/AOCs with similar contaminants, contaminant transport characteristics and similar FS evaluation procedures. The descriptions of selected cleanup alternatives for EPMs A through I and EPM K are provided in Sections 5.1 through 5.10. The BOMARC Property FS was evaluated in a separate FS report and was not incorporated into an EPM. The description of the final cleanup alternative for the BOMARC Property is provided in Section 5.11.

The selected cleanup alternatives for each SWMU/AOC are listed in Table 5-1. This table is organized by EPMs (A through I and K) followed by BOMARC Property.

5.1 EXPOSURE PATHWAY MODEL A (VOCS/PERCHED GROUNDWATER)

EPM A consists of SWMUs/AOCs with TCE and its daughter products and TPH contaminated soils and perched groundwater. EPM A includes SWMUs/AOCs No. 090, Building 40-51, Former UST EV-11; SWMU/AOC No. 112, Building 40-11, Oil Water Separator; and SWMU/AOC No. 151, Building 40-51, Sumps EV-112 and EV-119. Sources of contamination at EPM A included one or more of the following at each SWMU/AOC:

- Historical releases of solvents to and from the former spill containment storage tank (UST EV-11 at SWMU/AOC No. 090) and the oil/water separator at SWMU/AOC No.112.
- Historical releases of TCE solvent during operation of the USTs (EV-11 and the oil/water separator EV-118). Solvents containing TCE were stored in UST EV-11.
- Historical releases of TCE contaminated wastewater at SWMU/AOC No.112 and the Southern Air Scrubber Sump EV-112 and SWMU/AOC No. 151. At SWMU/AOC No. 112, TPH release would have originated from the automotive equipment and vehicles in the maintenance shop and TCE used as a degreaser.

The characteristics of EPM A SWMUs/AOCs:

- Industrial facility
- VOCs including TCE in sub-slab vapor exceeding screening levels outside existing structures
- Contaminated perched groundwater that is considered non-potable per WAC 173-340-720(2). Perched groundwater is not used as a drinking water source and will not be used in the future because of the very low pumping rates (e.g., less than 0.25 gallons per minute), limited lateral extent, and shallow depth of the perched groundwater.
- Pavement is in place above the contaminated soil and perched groundwater. However the fact that perched ground exists below the pavement indicates a pathway for rainwater to

enter the soils below the pavement. A thick vadose zone exists between the contaminated perched groundwater/soils and the potable Esperance Sand Aquifer. Deep downgradient monitoring well monitoring is required to verify that this SWMU contamination does not reach the deep potable aquifer.

- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491
- Soil contamination above cleanup levels.

There are no current complete exposure pathways at these SWMUs/AOCs to Boeing workers in the buildings. There is potential construction worker exposure to chemical constituents in perched groundwater. Where chemical constituents are present in perched groundwater above a concentration protective of the direct contact pathway, concrete flooring or pavement currently prevents direct contact by factory workers and perched groundwater monitoring will be performed. Many soil gas samples collected just exterior to these building exceeded the industrial MTCA indoor air screening levels. Contaminated soil gas exterior to but near a building has the potential to enter that building and behave as a sources of indoor air contamination. Potential future exposures could also include workers performing excavations in contaminated soil or perched groundwater at the site, or future site users if the building configuration changes in a way that exposes contaminated soil (new sumps, pits, floor removal/modification) or otherwise creates unacceptable vapor intrusion into those existing buildings.

5.1.1 DESCRIPTION OF CLEANUP ACTION

The final remedy for the SWMUs/AOCs in EPM A SWMU/AOC Nos. 090, 112, and 151 is containment of contaminated soils and groundwater monitoring (Modified FS Alternative 1). A summary of the selected remedies is included in Table 5-1, and the cleanup alternatives for EPM A are shown on Figures 5-1 through 5-3.

Contaminated soil above the cleanup level will be contained below asphalt or concrete, using institutional/engineering controls. Contaminated perched groundwater exceeding the cleanup levels will be contained below asphalt or concrete with an exposure pathway broken by institutional/engineering controls that will be implemented as discussed in Section 5.1.6. Ecology will determine if groundwater cleanup levels are met at the POC by compliance monitoring implemented as discussed in Section 5.1.5. If, over time, concentrations in perched groundwater meet or decline below cleanup levels, environmental covenants requiring institutional controls related to perched groundwater would be removed; and monitoring wells would be decommissioned. However, institutional controls for capped contaminated soils above cleanup levels will remain. Routine sampling of indoor air in these buildings is required as part of the evaluation of the vapor intrusion pathway until sub-slab soil vapor results indicate concentrations below screening levels as further described in Section 4.4-Indoor Air Monitoring and Section 5.1.5.

5.1.2 CLEANUP LEVELS

Section 3.0 describes the cleanup standards for the Boeing Everett Facility including a summary of the contaminants of concern and the cleanup levels for the SWMUs/AOCs included in EPM A. Based on the nature and extent of contamination at the EPM A SWMUs/AOCs and the potential current and future complete exposure pathways, numeric cleanup levels proposed for EPM A SWMUs/AOCs consist of the following:

- Soil – MTCA Method B, protection of groundwater for VOCs
- Perched groundwater (non-potable groundwater) – Construction worker risk-based cleanup levels for VOCs and metals and MTCA Method A for petroleum hydrocarbons
- Indoor air - MTCA Method C for VOCs

The specific numerical values for the contaminants of concern, which include chlorinated VOCs, arsenic, and petroleum hydrocarbons, are included in Table 3-1.

5.1.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to each of the SWMUs/AOCs, including the EPM A SWMUs/AOCs.

5.1.4 RESTORATION TIMEFRAME

A summary of the estimated restoration timeframes for the selected cleanup alternatives for each of the SWMUs/AOCs at the Boeing Everett Facility, including EPM A, is provided in Table 5-3. The final cleanup action provides for a reasonable restoration timeframe by establishing containment for contaminated soils, compliance monitoring of groundwater and indoor air, and institutional controls immediately following Ecology approval of the Institutional Controls Management Plan.

5.1.5 COMPLIANCE MONITORING

A summary of the compliance monitoring portion of the selected cleanup alternatives for each of the SWMUs/AOCs at the Boeing Everett Facility, including those in EPM A, are provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. The following compliance monitoring will be performed for the SWMUs/AOCs in EPM A:

- Perched groundwater in existing wells EGW030 through EGW032, EGW046, EGW054, EGW057, EGW058, EGW065, and EGW066, will be monitored semi-annually until concentrations are below cleanup levels.
- Indoor air monitoring and sub-slab vapor monitoring will be performed inside Building 40-51 (SWMU No. 090) and Building 40-11 (SWMU No. 112) per Section 4.4 and at the designated sampling locations in the engineering design report (EDR).
- Consistent with Section 4.4 – Indoor Air Monitoring: Upon written approval from Ecology, indoor air sampling frequency will be adjusted downward (but not eliminated)

based on no indoor air exceedances of MTCA Method C levels and no increasing trends for consecutive indoor air sampling events. After one year of indoor air sampling events conducted during the summer and winter seasons, sampling frequency will be reduced to once per year in the season with highest indoor air concentrations. If indoor air concentrations remain below MTCA Method C levels and no increasing trends for two consecutive annual events, indoor air sampling frequency will be reduced to every other year. This assumes no building work is conducted that could exacerbate the vapor intrusion pathway.

At least two sub-slab vapor sampling events are also required at the Site if indoor air exceedances of MTCA Method C levels are detected or if Boeing proposes to terminate indoor air sampling.

The indoor air sampling will be eliminated for each SWMU unit after cleanup remedy implementation is completed and all media cleanup standards are met for that SWMU.

5.1.6 INSTITUTIONAL/ENGINEERING CONTROLS

A summary of the institutional/engineering controls portion of the selected cleanup alternatives for each of the SWMUs/AOCs at the Boeing Everett Facility, including those in EPM A, are provided in Table 5-4. The SWMUs in EPM A are on Boeing Everett property. For the EPM A SWMUs/AOCs, institutional/engineering controls will be implemented, because soil and perched groundwater contamination above cleanup levels will remain in the sub-surface as part of the final cleanup action. Institutional controls will be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett.

Boeing is required to submit and implement a site-wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed when necessary to prevent infiltration of rainwater and exacerbation of soil contamination migration to the Esperance Sand Aquifer, until soil and groundwater concentrations are below cleanup levels. (2) Institutional controls, requiring that pavement or building flooring remain in place and in good condition, would be placed on the portion of the property where soil and groundwater COCs remain above cleanup levels. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, contaminated soil and perched groundwater handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing shall notify Ecology prior to any work in contaminated soil or perched groundwater which is above cleanup levels. (4) Institutional controls that require addressing or mitigating potential vapor intrusion for any future building construction or existing building renovation in the area where the existing floor is penetrated or the renovations results in changes to building use. The goal of addressing/mitigating potential vapor intrusion is to protect Boeing employees and their contractors from unacceptable contaminated indoor air exposure.

5.2 EXPOSURE PATHWAY MODEL B (BTEX/PERCHED GW)

EPM B consists of SWMUs/AOCs with fill, perched groundwater and, shallow glacial till soils contaminated with benzene, toluene, ethyl benzene and xylenes (BTEX). EPM B includes outdoor SWMUs Nos. 086, 089, 094, Building 40-56, Former USTs, and the associated piping. Sources of contamination at the EPM B SWMUs include historical releases from former USTs and piping. The characteristics of these EPM B SWMUs/AOCs are:

- Industrial facility
- VOCs in sub-slab vapor samples collected just outside the building exceed vapor intrusion screening levels
- Perched groundwater is non-potable per WAC 173-340-720(2). Perched groundwater at EPM B is not used as a drinking water source and will not be used in the future because of the very low pumping rates (e.g., less than 0.5 gallons per minute), limited lateral extent, and shallow depth of the perched groundwater.
- Free phase BTEX contamination in specific areas on top of the perched groundwater. Residual NAPL in the shallow fill soils in zones above the groundwater NAPL and above highly contaminated perched groundwater.
- Contaminated perched groundwater above cleanup levels.
- Contaminated soil above cleanup levels.
- Pavement maintained above the contaminated soils and perched groundwater. As long as this pavement is not breached, contact with contaminated soils and perched groundwater by Boeing employees is not possible. Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491

Potential future exposures could include workers performing excavations into contaminated soils or perched groundwater at the site or future site building users if the building configuration changes in a way that exposes contaminated soil (new sumps, pits, floor removal/modification) or otherwise creates unacceptable vapor intrusion into those existing buildings.

Soil gas samples collected just exterior to these buildings exceeded the industrial MTCA indoor air screening levels. Contaminated soil gas exterior to but near a building has the potential to enter that building and behave as a source of indoor air contamination. Although there is pavement in place above the contaminated soils and contaminated perched groundwater, rainwater is infiltrating the containment above the contaminated soils and perched groundwater. As a result the perched groundwater has been present year round for several decades. Under gravity driven vertical infiltration only, vadose zone modeling predicts subsurface contamination will reach the potable groundwater due to rainwater infiltrating into the vadose soils and recharging the perched aquifer. Empirical evidence to date from deep groundwater monitoring wells screened within the Esperance Sand and located throughout the facility demonstrates no current migration of BTEX to deep Esperance Sand groundwater at concentrations exceeding the MTCA Method B cleanup level for unrestricted use. However, deep downgradient monitoring wells will continue to be monitored to verify SWMU contamination is not reaching the Esperance Sand Aquifer during SWMU 086/089/094 remediation.

5.2.1 DESCRIPTION OF THE CLEANUP ACTION

The final remedy for EPM B SWMU/AOC Nos. 086, 089, and 094, Building 40-56 is In Situ Treatment (SVE and groundwater extraction, Modified FS Alternative 2). A summary of the selected cleanup alternative is included in Table 5-1, and the cleanup alternative for EPM B is shown on Figure 5-4. Under the In Situ Treatment remedy, the majority of soil and perched groundwater exceeding cleanup levels will be treated by SVE and groundwater extraction with treatment via the on-site industrial wastewater treatment facility and discharge of treated water to the sanitary sewer. The SVE system consists of one perched groundwater monitoring well near EGW007, and one new Esperance Sand monitoring well (new Well #8) will be installed. To ensure the remedy remains protective into the future, institutional/engineering controls will be implemented as discussed in Section 5.2.6; and compliance monitoring will be implemented as discussed in Section 5.2.5. Once the rate of concentration decline in extracted vapor exhibits asymptotic stabilization (as documented by performance sampling during operation and maintenance [O&M] of the SVE system) and concentrations in sub-surface soils and perched groundwater are reduced below cleanup levels, environmental covenants requiring institutional controls related to soils and perched groundwater would be removed and monitoring and extraction wells decommissioned. Routine indoor air sampling in the building is required to evaluate the vapor intrusion pathway consistent with the requirements described in Section 4.4 Indoor Air Monitoring. Indoor air monitoring will be performed as described in Section 5.2.5.

5.2.2 CLEANUP LEVELS

A summary of the contaminants of concern and the cleanup levels for the SWMUs/AOCs included in EPM B is provided in Section 3.0. Based on the nature and extent of contamination, and the potential current and future complete exposure pathways, numeric cleanup levels proposed for EPM B SWMUs/AOCs consist of the following:

- Soil – MTCA Method B, protection of groundwater
- Perched groundwater (non-potable groundwater) – construction worker risk-based cleanup levels
- Residual soil contamination cannot result in the presence of NAPL on or in the perched groundwater WAC 173-340-747(2)
- Indoor air – MTCA Method C
- Esperance Sand groundwater (potable groundwater) as measured below or downgradient and as close to the SWMU as possible. – MTCA Method B cleanup levels.

The specific numerical values for the contaminants of concern, which include chlorinated VOCs, BTEX, and 4-methyl-2-pentanone (MIBK), are included in Table 3-2 for EPM B.

5.2.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the EPM B SWMUs/AOCs.

5.2.4 RESTORATION TIMEFRAME

The estimated restoration timeframe for the selected remedy for the EPM B SWMUs/AOCs is provided in Table 5-3. The restoration timeframe for the soil vapor and perched groundwater extraction alternative will depend on the efficiency of each extraction component at SWMU/AOC Nos. 86, 89, and 94. Institutional controls will be implemented until cleanup standards are met.

5.2.5 COMPLIANCE MONITORING

A summary of the compliance monitoring to be implemented for the SWMUs/AOCs in EPM B is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. The following compliance monitoring will be performed for the SWMUs/AOCs in EPM B:

- Quarterly monitoring of deep groundwater in Esperance Sand groundwater monitoring wells (existing well EGW040 and new Well #8). After two consecutive years of quarterly non-detections for analyzed contaminants, Boeing may reduce the sampling frequency to semi-annual. However, any verified detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[22].

  Groundwater sampling frequencies are intended to **quickly detect** contaminant migration from SWMU soils to the Esperance Sand Aquifer.

- Routine indoor air monitoring will be performed consistent with Section 4.4 Indoor Air Monitoring at the designated sampling locations in the engineering design report (EDR).

In addition, Boeing shall conduct the following monitoring as part of the operation of the SVE and groundwater extraction systems:

- Groundwater in the five existing wells (extraction wells) and the new well (monitoring) completed in the perched groundwater will be monitored quarterly for the first year then semiannually following the first year of SVE operation and concurrent groundwater extraction, and for 2 years following system shutdown. Ecology may require longer post SVE system shut down groundwater monitoring to evaluate rebounding contaminant concentrations.
- Routine sampling and analysis of vapors extracted by the future SVE system will be performed.
- Groundwater monitoring frequency of the perched groundwater wells in the SVE zone of influence during SVE operation and post-SVE operation will be detailed in the EDR.
- Cross-slab pressure measurements locations, frequencies, and procedures shall be described in the EDR (refer to Section 4.4 for specific Building 40-56 requirements).

[22]Routine groundwater sampling and analyses will end when groundwater contamination below a SWMU is below cleanup levels and contaminated soil from the associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling.

5.2.6 INSTITUTIONAL/ENGINEERING CONTROLS

The institutional/engineering controls for EPM B are summarized in Table 5-4. The SWMUs in EPM B are on Boeing Everett property.

For the EPM B SWMUs/AOCs, institutional/engineering controls will be implemented, because soil and perched groundwater contamination above cleanup levels will remain in the sub-surface during SVE operations and concurrent groundwater extraction, as part of the final cleanup action. Institutional controls would be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett.

Boeing is required to submit and implement a site-wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed when necessary to prevent infiltration of rainwater and exacerbation of soil contamination migration to the Esperance Sand Aquifer, until soil and groundwater concentrations are below cleanup levels. (2) Institutional controls, requiring that pavement or building flooring remain in place and in good condition, would be placed on the portion of the property where soil and groundwater COCs remain above cleanup levels. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, contaminated soil and perched groundwater handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing shall notify Ecology prior to any work in contaminated soil or perched groundwater which is above cleanup levels. (4) Institutional controls that require addressing or mitigating potential vapor intrusion for any future building construction or existing building renovation in the area, where the existing floor is penetrated or renovations results in changes to building use. The goal of addressing/mitigating potential vapor intrusion is to protect Boeing employees and their contractors from unacceptable contaminated indoor air exposure.

5.3 EXPOSURE PATHWAY MODEL C (TPH/PERCHED GW)

EPM C consists of SWMUs/AOCs with TPH contaminated fill soils and TPH contaminated perched groundwater. EPM C consists of SWMU/AOC No. 166 near Building 45-53, former UST EV-110-1. Sources of contamination at the EPM C SWMU/AOC include the following:

- Historical releases from the former UST EV-110-1
- Historical releases of fuel during operation of the UST

The characteristics of the EPM C SWMU/AOC are:

- Industrial facility
- Perched groundwater classified as non-potable, per WAC 173-340-720(2). Perched groundwater at EPM A is not used as a drinking water source and will not be used in the future because of the very low pumping rates (e.g., less than 0.5 gallons per minute), limited lateral extent, and shallow depth of the perched groundwater.

- Soil concentrations did not exceed the MTCA Method B cleanup levels.
- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491

The current complete exposure pathway consists of construction worker exposure to contaminated perched groundwater via soil excavating work.

5.3.1 DESCRIPTION OF THE CLEANUP ACTION

The remedy for EPM C SWMU/AOC No. 166, Building 45-53, Former UST EV-110-1, is Containment of contaminated groundwater and compliance monitoring (Modified FS Alternative 1). A summary of the selected cleanup alternatives is included in Table 5-1, and the remedy for EPM C is shown on Figure 5-5. Under the remedy, perched groundwater exceeding the cleanup levels will be contained below asphalt or concrete and monitored. To ensure the remedy remains protective into the future, institutional/engineering controls will be implemented as discussed in Section 5.5.6; and compliance monitoring will be implemented as discussed in Section 5.5.5. Once concentrations in perched groundwater meet or decline below cleanup levels, environmental covenants requiring institutional controls related to perched groundwater would be removed and monitoring wells would be decommissioned.

5.3.2 CLEANUP LEVELS

A summary of the contaminants of concern and the cleanup levels for the SWMU/AOC included in EPM C is provided in Section 3.0. Based on the nature and extent of contamination at the EPM C SWMU/AOC, and the potential current and future complete exposure pathways, numeric cleanup levels proposed for the EPM C SWMU/AOC consists of:

- Perched groundwater (non-potable groundwater) – MTCA Method A, from Table 720-1, Chapter 173-340 WAC)

The specific numerical values for the contaminants of concern, which include petroleum hydrocarbons (TPH-Dx and TPH-Jet A), are provided in Table 3-3.

5.3.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the EPM C SWMUs/AOCs.

5.3.4 RESTORATION TIMEFRAME

The estimated restoration timeframe for the selected remedy for the EPM C SWMU/AOC is provided in Table 5-3. The final cleanup action provides for a reasonable restoration timeframe

by establishing containment compliance monitoring and institutional controls immediately following Ecology approval of the Institutional Controls Management Plan.

5.3.5 COMPLIANCE MONITORING

A summary of the compliance monitoring to be implemented for the EPM C SWMU/AOC is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. The following compliance monitoring will be performed for the SWMU/AOC in EPM C:

- Perched groundwater in the existing well (EGW035) will be monitored semi-annually until concentrations are below cleanup levels.

5.3.6 INSTITUTIONAL/ENGINEERING CONTROLS

The institutional/engineering controls for EPM C are summarized in Table 5-4. The SWMUs in EPM C are on Boeing Everett property.

For the EPM C SWMUs/AOCs, institutional/engineering controls will be implemented, because perched groundwater contamination above cleanup levels will remain in the sub-surface under containment for the duration of the final remedial action. Institutional controls will be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett.

Boeing is required to submit and implement a site-wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed when necessary to prevent infiltration of rainwater and exacerbation of soil and perched groundwater contamination migration to the Esperance Sand Aquifer, until soil and groundwater concentrations are below cleanup levels. (2) Institutional controls, requiring that pavement or building flooring remain in place and in good condition, would be placed on the portion of the property where groundwater COCs remain above cleanup levels. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, contaminated perched groundwater handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing shall notify Ecology prior to any work in perched contaminated groundwater above cleanup levels.

5.4 EXPOSURE PATHWAY MODEL D (HYDRAULIC FLUID/PERCHED GW)

EPM D consists of SWMUs/AOCs with hydraulic fluid contaminated soils with and without hydraulic fluid contaminated perched groundwater and NAPL. EPM D includes four SWMUs/AOCs:

- SWMU/AOC Nos. 055 and 168 at Building 40-24, Utility Trenches and Sumps[23]

[23]Evaluated in the uplands FS report (AECOM and Landau 2015)

- Building 40-22, Utility Slants #2 and #3
- Building 40-23, Static Test Pad
- SWMU/AOC No. 177, Building 40-25, Utility Vault

Sources of contamination at the EPM D SWMUs/AOCs include historical releases from utility vaults and sumps along the utility trench.

The characteristics of these EPM D SWMUs/AOCs are:

- Industrial facility
- Perched groundwater classified as non-potable, per WAC 173-340-720(2) (SWMUs/AOCs Nos.55 and 168 only).
- Perched groundwater at EPM D is not used as a drinking water source and will not be used in the future because of the very low pumping rates (e.g., less than 0.5 gallons per minute), limited lateral extent, and shallow depth of the perched groundwater.
- Pavement maintained above the contaminated soils and perched groundwater.
- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491
- Soil contamination above cleanup levels
- Perched groundwater above cleanup levels

The currently complete exposure pathway consists of construction worker exposure to contaminated soils and perched groundwater and NAPL at SWMUs/AOCs 055 and 168 only and contaminated soil at all EPM D SWMUs/AOCs. Future exposures could include workers performing excavations at the site or future site users if the building configuration changes in a way that exposes contaminated soil. Direct contact to site workers is currently prevented by the asphalt pavement/concrete building.

Although there is pavement in place above the contaminated soils and contaminated perched groundwater, rainwater is infiltrating through or around the containment above the contaminated soils and perched groundwater. As a result the rain water infiltration is regenerating the perched groundwater that has been present for several decades. Under gravity driven vertical infiltration only, vadose zone modeling predicts subsurface contamination may reach the potable groundwater above cleanup levels within 100 years due to rainwater infiltrating the pavement and recharging the perched aquifer. Empirical evidence to date from deep groundwater monitoring wells screened within the Esperance Sand Aquifer and located throughout the facility demonstrates no current migration of hydraulic fluid to deep groundwater in the Esperance Sand Aquifer. However, the most uncertainty in any vadose zone model is the time it takes for contamination to migrate. As a result, groundwater sampling from deep downgradient monitoring wells will verify SWMU contamination is not reaching the Esperance Sand Aquifer during the remediation of these four SWMUs.

5.4.1 DESCRIPTION OF THE CLEANUP ACTION

The selected cleanup alternatives for EPM D SWMUs/AOCs are listed below:

- Excavation with Dewatering and followed by Additional Excavation (Modified FS Alternative 4) to meet cleanup standards for SWMU/AOC Nos. 055 and 168, Building 40-24

- Containment of Contaminated Soils followed by Excavation for:
  - Building 40-22, Utility Slants #2 and #3
  - Building 40-23, Static Test Pad
  - SWMU/AOC No. 177, Building 40-25, Utility Vault

A summary of the selected cleanup alternatives is included in Table 5-1, and the cleanup alternatives for EPM D are shown on Figures 5-6 through 5-9.

Under Near-Term Excavation with Dewatering and Future Excavation remedy, which is only applicable to SWMU/AOC Nos. 55 and 168, the majority of soil and perched groundwater exceeding cleanup levels will be removed by excavation and disposed of at an off-site waste facility or treated by the on-site industrial wastewater facility, per the schedule in the EDR (i.e., "near term"). When changes in operations allow access (refer to Section 4.4), future excavation will be performed to remediate remaining contaminated soil above cleanup levels. Implementation of this remedy will include:

- Decommissioning of Vault E, including incoming utilities
- Demolition of Vault E structures and piping
- Decommissioning of six existing wells screened in the perched groundwater
- Excavation (using trench boxes near the building) and off-site disposal at a non-hazardous waste facility of approximately 300 cy of soil containing chemical constituents in the near term
- Removal of perched groundwater during excavation until only negligible perched groundwater enters the excavation
- Identification and rerouting of sources of perched water to this area (e.g., leaking roof drains or storm drain piping)
- Installation of piping connection to well EGW037, located inside of Building 40-24, and low-flow recovery pump installation in well EGW037
- Termination of EGW037 recovery well pump piping outside of Building 40-24 at the location of former Vault E
- Backfill of the excavation with relatively impermeable materials (CDF or equivalent) to preclude perching of groundwater in the future
- Installation of a new well near ESB1290 to monitor drawdown of perched groundwater and could be used for perched groundwater extraction, if necessary.
- Installation of new deep downgradient groundwater monitoring well #1 into the Esperance Sand aquifer north of building (refer to Section 4.4). This new groundwater monitoring well is intended to monitor for SWMU 055/168 contamination that may reach the Esperance Sand Aquifer.
- Extraction of perched groundwater from well EGW037 using portable equipment on a quarterly basis.
- Discharge of extracted perched groundwater into the on-site industrial wastewater treatment facility

- Future excavation of remaining contaminated soils when changes in operations allow access, per Section 4.4.

Once near-term and future excavation takes place, confirmation soil and perched groundwater samples will be collected and the results compared to the cleanup levels. In order to ensure that the remedy remains protective into the future and before cleanup levels are attained in all environmental media, institutional/engineering controls will be implemented as discussed in Section 5.4.6; and compliance monitoring will be implemented as discussed in Section 5.4.5. Once concentrations in perched groundwater and soil meet or are reduced to below cleanup levels, perched groundwater extraction would be discontinued. Sampling of well EGW037 would continue on a semiannual basis until performance and confirmation monitoring requirements are met, per the EDR. When monitoring conditions are met, and after Ecology determines that concentrations of perched groundwater will remain below cleanup levels institutional controls related to perched groundwater would be removed; and well EGW037 would be decommissioned.

The other three SWMUs/AOCs in EPM D use the Maintain Containment and Future Excavation remedy, which is applicable to Building 40-22, Utility Slants #2 and #3; Building 40-23, Static Test Pad; and SWMU/AOC No. 177. Soil exceeding the cleanup levels will be contained below asphalt or concrete. This remedy includes installation of new Well #9 into the Esperance Sand aquifer north of Building 40-22. In order to ensure that soil contamination does not migrate to the Esperance Sand Aquifer before the sub-surface contamination is removed and soil cleanup levels are attained, institutional/engineering controls will be implemented as discussed in Section 5.4.6 and compliance monitoring will be implemented as discussed in Section 5.4.5.

In the future when an infrastructure project provides an opportunity for excavation (Section 4.4), the soil exceeding the cleanup levels will be excavated and disposed of at an appropriate off-site waste facility, confirmation soil samples will be collected, and institutional/engineering controls will be removed.

5.4.2 CLEANUP LEVELS

A summary of the contaminants of concern and the cleanup levels for the SWMUs/AOCs included in EPM D is provided in Section 3.0. Based on the nature and extent of contamination, and the potential current and future complete exposure pathways, numeric cleanup levels proposed for EPM D SWMUs/AOCs consist of the following:

- Soil – MTCA Method B, protection of groundwater
- Residual soil contamination cannot result in the presence of NAPL on or in the perched groundwater WAC 173-340-747(2)
- Perched groundwater (non-potable groundwater) – Method B risk-based cleanup levels
- Esperance Sand groundwater (potable groundwater) – MTCA Method B and natural background for arsenic.

The specific numerical values for the contaminants of concern, which include tributyl-phosphate (TBP), dibutyl phenyl phosphate, butyl diphenyl phosphate, triphenyl phosphate, butylated hydroxytoluene, and arsenic, are included in Table 3-4 for EPM D.

5.4.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the EPM D SWMUs/AOCs.

5.4.4 RESTORATION TIMEFRAME

The estimated restoration timeframes for the selected cleanup alternatives for the EPM D SWMUs/AOCs are provided in Table 5-3. Near-term excavation would provide for a relatively short restoration timeframe. The implementation timeframe would most likely depend on the logistics of interrupting manufacturing operations to perform excavation. The restoration timeframe for future excavation could be years or decades and is dependent on the criteria established in Section 4.4. Institutional controls will be implemented until cleanup standards are met.

5.4.5 COMPLIANCE MONITORING

A summary of the compliance monitoring for the SWMUs/AOCs in EPM D is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. The following compliance monitoring will be performed for the SWMUs/AOCs in EPM D:

- Deep groundwater in Esperance Sand groundwater monitoring wells (new Wells #1 and #9) will be monitored quarterly for at least 2 years. Consistent with Section 4.4, after two consecutive years of non-detections for analyzed contaminants, Boeing may reduce the sampling frequency to semi-annual. However, any verified detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[24].

  Ecology's groundwater sampling frequencies are intended to **quickly detect** contaminant migration from SWMU soils to the Esperance Sand Aquifer.

In addition, the following monitoring will be performed as part of the operation of the periodic perched groundwater extraction for SWMU/AOC Nos. 55 and 168:

- Perched groundwater in existing well EGW037 (extraction well) and the new perched groundwater monitoring well (drawdown only) will be monitored quarterly for one year. Sampling of well EGW037 will continue on a semiannual basis until cleanup level are

[24]Routine groundwater sampling and analyses will end when groundwater contamination below a SWMU is below cleanup levels and contaminated soil from the associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling.

met. Once concentrations in perched groundwater and soil meet or are reduced to below cleanup levels, perched groundwater extraction will be discontinued. When Ecology agrees that concentrations of perched groundwater will remain below cleanup levels, institutional controls related to perched groundwater may be removed and well EGW037 (and new perched groundwater monitoring well) decommissioned.

5.4.6 INSTITUTIONAL/ENGINEERING CONTROLS

The institutional/engineering controls for the SWMUs/AOCs in EPM D are summarized in Table 5-4. The SWMUs in EPM D are on Boeing Everett property.

For the EPM D SWMUs/AOCs, institutional/engineering controls will be implemented, because soil and perched groundwater contamination above cleanup levels will remain in the sub-surface for potentially decades until future soil and perched groundwater remedial actions occur to attain soil and groundwater cleanup levels, as part of the final cleanup action. Institutional controls would be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett.

Boeing is required to submit and implement a site wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed when necessary to prevent infiltration of rainwater that could exacerbate soil contamination migration to the Esperance Sand Aquifer, until soil and groundwater concentrations are below cleanup levels. (2) Institutional controls, requiring that pavement or building flooring remain in place and in good condition, would be placed on the portion of the property where soil and groundwater COCs remain above cleanup levels. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, contaminated perched groundwater and soil handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing shall notify Ecology prior to any work in contaminated soil or perched groundwater above cleanup levels.

5.5 EXPOSURE PATHWAY MODEL E (VOCS/NO PERCHED GW)

EPM E consists of SWMUs/AOCs containing TCE, other chlorinated volatile compounds, benzene, toluene, ethyl benzene, xylenes, and TPH contaminated fill soils without perched groundwater. EPM E includes the following SWMUs/AOCs:

- SWMU/AOC No. 054, Building 40-51, Former Wastewater AST
- SWMU/AOC No. 097, Building 40-11, Former Vapor Degreaser
- SWMU/AOC No. 098, Building 40-53, Former Mock-Up Degreaser
- SWMU/AOC No. 169, Building 40-02, Former Small Vapor Degreaser
- SWMU/AOC No. 170, Building 40-02, Former Large Vapor Degreaser
- SWMU/AOC No. 171, Building 40-31, Former Bluestreak Vapor Degreaser
- Former Paint Crib, Building 40-02
- Footing Excavation, Building 40-32

Sources of contaminants at the EPM E SWMUs/AOCs include one or more of the following at each SWMU/AOC:

- Historical releases of solvents associated with the operation of active units, including vapor degreasers, a paint crib (Building 40-02, Paint Shop Chemical Crib), and an AST (SWMU/AOC 54)
- Historical spills in the vicinity of these units during operation
  Historical surface releases (in the case of the Building 40-32 footing excavation)

The characteristics of these EPM E SWMUs/AOCs are:

- Industrial facility
- VOCs in the sub-slab vapor exceeding screening levels. Indoor air samples collected but below Method C indoor air cleanup levels.
- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491
- Currently the pavement in place above contaminated soil.

- Subsurface soils above cleanup levels

There are no current complete exposure pathways at these SWMUs/AOCs. Where chemical constituents are present in soil above a concentration protective of the direct contact pathway, concrete flooring or pavement currently prevents direct contact by factory workers.

Future exposures could include workers performing excavations at the site or future site users if the existing building configuration changes in a way that exposes contaminated soil (new sumps, pits, floor removal/modification) or otherwise creates unacceptable vapor intrusion into the existing buildings.

The EPM E SWMUs/AOCs are located in areas without perched groundwater. Eight SWMUs are located indoors and one SWMU (054) is located outdoors. Under gravity driven vertical infiltration only, vadose zone modeling indicates that potential leaching to the Esperance Sand Aquifer will not occur if there is no rainwater infiltration into the contaminated soils. However, SWMU 054 is located outdoors and will be subject to rainfall events. It is also possible that the other eight SWMUs could be impacted by other future sources of infiltrating building water or stormwater[25]. Empirical evidence to date has not detected contamination from these SWMUs at distant deep groundwater monitoring wells screened within the Esperance Sand[26]. However, the most uncertainty in any vadose zone model is the time it takes for contamination to migrate. As a result, groundwater from deep downgradient monitoring wells will verify SWMU contamination is still not reaching the Esperance Sand Aquifer during the remediation of these four SWMUs.

[25]There is uncertainty with (un)saturated conditions under all areas of very large buildings. It is possible some perched groundwater is present now or will be in the future. Contaminated soil below these buildings may remain capped for decades. Rain/surface water infiltration over the next decade or more is unknown. FS vadose zone model shows that if water is present with contaminated soil, this results in infiltration of contamination to the potable aquifer. It is better to sample and analyze potable groundwater samples as a direct measurement of aquifer impacts rather than using other indirect measurements of possible groundwater contamination (Ecology, February 2019).

[26]Many of these currently existing deep groundwater wells are not located in optimal downgradient locations to these SWMUs.

5.5.1 DESCRIPTION OF THE CLEANUP ACTION

The selected cleanup alternatives for the SWMUs/AOCs in EPM E are listed below:

- Containment of Contaminated Soils (Modified FS Alternative 1) for the following SWMUs/AOCs:
  - SWMU/AOC No. 098, Building 40-53
  - SWMU/AOC No. 169, Building 40-02
  - SWMU/AOC No. 170, Building 40-02
  - Former Paint Crib, Building 40-02
  - Footing Excavation, Building 40-32
- Near-Term Excavation (FS Alternative 4) for SWMU/AOC No. 097, Building 40-11
- Containment of Contaminated soils followed by SVE (Modified FS Alternatives 1 and 2) for SWMU/AOC No. 171, Building 40-31
- Containment of Contaminated Soils followed by Excavation (FS Alternative 3) for SWMU/AOC No. 054, Building 40-51

A summary of the selected cleanup alternatives is included in Table 5-1, and the cleanup alternatives for EPM E are shown on Figures 5-10 through 5-17.

Under the final remedy applicable to all SWMUs/AOCs except for SWMU/AOC No. 097, soil exceeding the cleanup levels will be contained below asphalt or concrete. In order to ensure that the remedy remains protective into the future, institutional/engineering controls will be implemented as discussed in Section 5.5.6 and compliance monitoring will be implemented as discussed in Section 5.5.5.

Routine indoor air sampling is required until either sub-surface soils are remediated to cleanup levels or as otherwise described in Section 4.4. Previous indoor air sampling had concentrations of COCs below Method C indoor air cleanup levels. Routine indoor air sampling in the building is required to evaluate the vapor intrusion pathway for all EPM E SWMUs (with the exception of SWMU097 where near term soil excavation is planned to meet soil cleanup levels) are consistent with the requirements described in Section 4.4 Indoor Air Monitoring. Indoor air monitoring is to be performed as described in Section 5.5.5. Note that institutional/engineering controls and compliance monitoring will be required for SWMU/AOC Nos. 171 and 054 until the future SVE and future excavation portions of the cleanup alternatives are implemented and achieve environmental media cleanup levels.

Under the final remedy for SWMU/AOC No. 097 as shown in Figure 5-11, soil exceeding the cleanup levels will be excavated as detailed in the Ecology-approved EDR and disposed of at an off-site hazardous waste facility in accordance with the Schedule in the CAP and EDR. Implementation of this remedy will include relocation of the shelving units above the excavation area, demolition and repair of the wall on the southern side of the excavation area, excavation and disposal of approximately 3 cubic yards of soil, confirmation soil sampling, and site restoration. Existing Boeing production activities will be temporarily relocated during the excavation activities. Institutional/engineering controls and compliance monitoring would not be required for this SWMU/AOC after soil exceeding cleanup levels is removed.

Under the final remedy for SWMU/AOC No. 171 as shown in Figure 5-10, soil exceeding the cleanup levels will be treated using SVE at the time detailed in the CAP and EDR Schedules, and consistent with Section 4.4. Routine periodic sampling and analysis of the extracted vapors begins immediately after startup of the SVE system. Once concentrations of extracted vapor are sufficiently reduced, confirmation soil samples shall be collected. If confirmation soil samples indicate cleanup levels are met, institutional/engineering controls will be removed for this SWMU. Maintain Containment, institutional/engineering controls and compliance monitoring, will be implemented until the Future SVE remedy is implemented and cleanup levels verified

For final remedy applicable to SWMU/AOC No. 054 as shown in Figure 5-16, soil exceeding the cleanup levels will be excavated and disposed of at an appropriate off-site waste facility at the time detailed in the CAP and EDR Schedules, and consistent with Section 4.4. Once excavation takes place, confirmation soil samples shall be collected. Once SWMU cleanup levels are met, then institutional/engineering controls will be removed. Prior to excavation, contaminated soils above cleanup levels shall be contained on site and include institutional/engineering controls and compliance monitoring.

5.5.2 CLEANUP LEVELS

A summary of the contaminants of concern and the cleanup levels for the SWMUs/AOCs included in EPM E is provided in Section 3.0. Based on the nature and extent of contamination at these SWMUs/AOCs and the potential current and future complete exposure pathways, numeric cleanup levels proposed for EPM E SWMUs/AOCs consist of the following:

- Soil – MTCA Method B, protection of groundwater for VOCs and MTCA Method A for petroleum hydrocarbons
- Indoor air – MTCA Method C for VOCs
- Esperance Sand groundwater (potable groundwater, as measured below or downgradient and as close to the SWMU as possible) – MTCA Method B for VOCs and MTCA Method A for petroleum hydrocarbons.

The specific numerical values for the contaminants of concern, which include chlorinated VOCs, BTEX, and petroleum hydrocarbons, are included in Table 3-5.

5.5.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the EPM E SWMUs/AOCs.

5.5.4 RESTORATION TIMEFRAME

Estimated restoration timeframes for the selected cleanup alternatives for the EPM E SWMUs/AOCs are provided in Table 5-3. The following describes the restoration timeframes for the selected cleanup alternatives for SWMUs/AOCs included in EPM E:

- SWMU/AOC Nos. 098, 170, 169; Former Paint Crib, Building 40-02; and Footing Excavation, Building 40-32 – The Containment remedy provides for a reasonable restoration timeframe by establishing containment and institutional controls immediately following Ecology approval of the Institutional Controls Management Plan. Routine downgradient groundwater monitoring and routine indoor air sampling is required for these SWMUs, consistent with Section 4.4.
- SWMU/AOC No. 097 – Near-term excavation would provide for a relatively short restoration timeframe. The implementation timeframe depends on the logistics of interrupting manufacturing operations to perform excavation.
- SWMU/AOC No. 171 – The restoration timeframe using SVE could be years or decades and will depend on when SVE is implemented (per Section 4.4 requirements). Institutional controls, downgradient groundwater monitoring and routine indoor air monitoring is required (per Section 4.4) until cleanup standards are met.
- SWMU/AOC No. 054 – The restoration timeframe could be years or decades and is dependent on when contaminated soil excavation occurs in accordance with Section 4.4. Institutional controls, routine downgradient groundwater monitoring and indoor air sampling is required (per Section 4.4) until cleanup standards are met.

5.5.5 COMPLIANCE MONITORING

A summary of the compliance monitoring to be implemented for the SWMUs/AOCs in EPM E is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. No compliance monitoring will be performed for SWMU/AOC No. 097 assuming the excavation remedial action is performed immediately after the approval of the EDR. The following compliance monitoring will be performed for all other SWMUs/AOCs in EPM E:

- Deep groundwater in Esperance Sand groundwater monitoring wells (existing wells EGW177 and EGW178 and new Wells #2, #3, #4, and #5) will be monitored quarterly for at least 2 years, for SWMU054, SWMU098, SWMU169, SWMU170, former paint crib, SWMU171, and building 40-32 foot excavation. Consistent with Section 4.4, after two consecutive years of non-detections for analyzed contaminants, Boeing may reduce the sampling frequency to semi-annual. However, any verified detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[27].

- Routine indoor air sampling is required at SWMU054, SWMU098, SWMU169, SWMU170, former paint crib, SWMU171, and building 40-32 foot excavation, consistent with Section 4.4. Upon written notice from Ecology, indoor air sampling frequency will be adjusted downward (but not eliminated) based on no indoor air exceedances of MTCA Method C levels and no increasing trends for consecutive indoor air sampling events. After one year of indoor air sampling events conducted during the summer and winter seasons, sampling frequency will be reduced to once per year in the

[27]Routine groundwater sampling and analyses will end when groundwater contamination below a SWMU is below cleanup levels and contaminated soil from the associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling.

season with highest indoor air concentrations. If indoor air concentrations remain below MTCA Method C levels and no increasing trends for two consecutive annual events, indoor air sampling frequency will be reduced to every other year. This assumes no building work is conducted that could exacerbate the vapor intrusion pathway.

- At least two sub-slab vapor sampling events are also required at the Site if indoor air exceedances of MTCA Method C levels are detected or if Boeing proposes to terminate indoor air sampling.

In addition, periodic sampling and analysis of vapors extracted by the future SVE system at SWMU/AOC No. 171 will be performed.

5.5.6 INSTITUTIONAL/ENGINEERING CONTROLS

Institutional/engineering controls to be implemented for the SWMUs/AOCs in EPM E are summarized in Table 5-4. The SWMUs in EPM E are on Boeing Everett property.

For all EPM E SWMUs/AOCs (except SWMU 097), institutional/engineering controls will be implemented, because soil contamination above cleanup levels will remain in the sub-surface, as part of the final cleanup action or until required future contaminated soil remediation is completed to attain cleanup levels. Institutional controls will be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett.

Boeing is required to submit and implement a site wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed when necessary to prevent infiltration of rainwater and exacerbation of soil contamination migration to the Esperance Sand Aquifer, until soil and groundwater concentrations are below cleanup levels. (2) Institutional controls, requiring that pavement or building flooring remain in place and in good condition, are placed on the portion of the property where COCs remain above soil and groundwater cleanup levels. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, contaminated perched groundwater and soil handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing shall notify Ecology prior to any work in contaminated soil which is above cleanup levels. (4) Institutional controls that require addressing or mitigating potential vapor intrusion for any future building construction or existing building renovation in the area where the existing floor is penetrated or the renovations results in changes to building use. The goal of addressing/mitigating potential vapor intrusion is to protect Boeing employees and their contractors from unacceptable contaminated indoor air exposure.

5.6 EXPOSURE PATHWAY MODEL F (NO PERCHED GW)

EPM F consists of the South Fire Pit, SWMU/AOC068, with benzene, toluene, ethyl benzene, xylenes and TPH (-G, -D, -O), contaminated fill soils without perched groundwater.

Sources of contaminants at the EPM F SWMU/AOC include:

- Design and intentional releases of fuel into the former fire pit, subsequently burned to train firefighters, and was demolished in 1979 and paved over. Incomplete combustion of fuels disposed of at the former fire pit.

The characteristics of the EPM F SWMU/AOC are:

- Industrial facility
- Pavement covering these contaminated soils
- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491

There is no current building over the VOC-contaminated soils. BTEX was not analyzed in many of the shallow soil samples where its presence would be expected (co-located with TPH-G). BTEX migrations rates could not be effectively modeled using this vadose zone modeling program. In addition, the largest uncertainty in the vadose model results are in the time required for contamination to reach the Esperance Sand Aquifer. Regardless, as previously mentioned, the contaminated soils from this SWMU are intended to be excavated (near term) to achieve cleanup levels.

5.6.1 DESCRIPTION OF THE CLEANUP ACTION

The selected remedy for the EPM F SWMU/AOC No. 068, South Fire Pit is Excavation (FS Alternative 4). A summary of the selected remedy for EPM F SWMU/AOC No. 068 is included in Table 5-1 and shown on Figure 5-18. Under the selected remedy for SWMU/AOC No. 068, soil exceeding the cleanup levels will be excavated in accordance with the requirements and timeline in the Ecology-approved EDR and disposed of at an off-site non-hazardous waste facility. Implementation of this remedy will include completion of a pedestrian and traffic control plan, temporary closure of the parking lot and road, excavation and disposal of approximately 470 cubic yards of soil, confirmation soil sampling, and site restoration. Institutional/engineering controls would not be required for this SWMU/AOC, because soil exceeding cleanup levels will be removed. Compliance monitoring will be implemented as discussed in Section 5.6.5.

5.6.2 CLEANUP LEVELS

A summary of the contaminants of concern and the cleanup levels for the SWMU/AOC included in EPM F is provided in Section 3.0. Based on the nature and extent of contamination at this SWMU/AOC, and the potential current and future complete exposure pathways, numeric cleanup levels proposed for the EPM F SWMU/AOC consist of the following:

Soil – MTCA Method A Unrestricted Direct Contact and Protective of Groundwater

The specific numerical values for the contaminants of concern, which include BTEX and petroleum hydrocarbons, are included in Table 3-6 for EPM F.

5.6.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs for the EPM F SWMU/AOC No. 068, South Fire Pit.

5.6.4 RESTORATION TIMEFRAME

The estimated restoration timeframe for the selected remedy for the EPM F SWMU/AOC is provided in Table 5-3. Near-term excavation would provide for a relatively short restoration timeframe. The implementation timeframe depends on the logistics of interrupting manufacturing operations to perform excavation.

5.6.5 COMPLIANCE MONITORING

Compliance monitoring for EPM F SWMU/AOC No. 068 will be detailed in the EDR for post excavation confirmational sampling. Water depth will be measured at EGW060 for use in generating a site-wide deep groundwater contour map for the Esperance Sand aquifer.

5.6.6 INSTITUTIONAL/ENGINEERING CONTROLS

No institutional/engineering controls are included in the remedy for SWMU/AOC No. 068, because Soil Excavation will be performed at that SWMU/AOC.

5.7 EXPOSURE PATHWAY MODEL G AND H (VOCS, TPH, OR METALS/NO PERCHED GW)

EPM G and EPM H consist of SWMUs/AOCs with soil contaminated with one or more of the following: benzene, toluene, ethyl benzene, xylenes, MEK, TPH (-G, -D, -O), cadmium, chromium and lead, without perched groundwater.

EPM G includes the following SWMUs/AOCs:

- SWMU/AOC No. 065, Building 40-51, Former Paint Stripping Tankline
- SWMU/AOC No. 083, Former UST EV-15
- SWMU/AOC No. 165, Former Fuel Farm USTs and Fuel Stall Piping
- UST EV-48-1, Building 40-11

EPM H includes the following SWMUs/AOCs:

- SWMU/AOC Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153
- SWMU/AOC No. 093, Building 45-01, Former Solvent USTs

Sources of contaminants at the EPM G SWMUs/AOCs include one or more of the following at each SWMU/AOC:

- Historical releases during operation of equipment (Former Paint Stripping Tankline and former fuel farm USTs and underground fuel piping)
- Historical releases while cleaning the former dump tank
- Historical release of unleaded gasoline at the Building 40-11 UST EV-48-1, on May 18, 2006, discovered by Boeing personnel during routine maintenance and reported to the Ecology UST program on the same day.

Sources of contaminants at the EPM H SWMUs/AOCs include one or more of the following at each SWMU/AOC:

- Historical release of MEK from the former solvent tank system at SWMU/AOC No. 093, or of silk-screen solvents from the historical aboveground solvent recycling still and former UST at SWMU/AOC Nos. 067 and 071
- Historical release of MEK from the piping associated with EV-19 at SWMU/AOC No. 93, or movement of MEK in more permeable piping backfill from a release at EV-19
- Historical spills in the vicinity of the solvent tanks while they were in operation

The characteristics of these EPM G and H SWMUs/AOCs are:

- Industrial facility
- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491
- Currently the pavement in place above soil contamination.
- Subsurface soils above cleanup levels.

There are no current complete exposure pathways at these SWMUs/AOCs. Direct contact (excavation) is prevented by the concrete or asphalt pavement, concrete flooring, and up to 8 feet of CDF backfill below the concrete in the historical excavations at SWMU/AOC Nos. 067 and 071. At SWMU/AOC No. 065, the Former Paint Stripping Tankline, the contaminated soil is enclosed by the concrete floor slab and the historical concrete containment. Potential future exposures could include workers performing excavations at the site or future site users if the existing building configuration changes in a way that exposes contaminated soil (new sumps, pits, floor removal/modification) or otherwise creates unacceptable vapor intrusion into the building. Concentrations of VOCs in the sub-slab vapor samples at SWMU/AOC No. 093 also did not exceed the residential air screening levels. Sub-slab vapors were not collected in areas directly above the highest known subsurface VOC soil contamination below the 40-56 building floor (SWMU 067/071).

SWMU093, SWMU165, SWMU083 and EV-48-1 are located outdoors and will receive rainfall. These SWMUs are in areas without current perched groundwater, and vadose modeling indicated that potential leaching to the Esperance Sand aquifer will not occur without rainwater infiltration into the contaminated soils. However, for many of these SWMUs, the vadose zone model does indicate soil contamination will migrate to the Esperance Sand Aquifer if rainwater penetrates the containment. SWMU065 and SWMU067/071 are located inside buildings. Empirical

evidence to date indicates no contamination from any of these six SWMUs was detected in existing[28]downgradient deep Esperance Sand groundwater wells. However, since subsurface soil contamination may remain in place for decades, Ecology must consider the possibility all six SWMUs could be impacted by other future sources of infiltrating building water or stormwater[29]. Furthermore, the most uncertainty in any vadose zone model is the time it takes for contamination to migrate. As a result, groundwater sampling from deep downgradient monitoring wells will be used to verify SWMU contamination has not reached the Esperance Sand Aquifer during the remediation of these four SWMUs.

5.7.1 DESCRIPTION OF THE CLEANUP ACTION

The selected cleanup alternatives for SWMUs/AOCs in EPMs G and H are listed below:

- Containment of contaminated soils (FS Alternative 1) for the following SWMUs/AOCs:
  - SWMU/AOC No. 065, Building 40-51, Former Paint Stripping Tankline
  - SWMU/AOC No. 083, Former UST EV-15
- Limited excavation and containment of contaminated soil followed by Excavation that meets cleanup standards(Combination of FS Alternatives 2 and 3)
  - SWMU/AOC No. 165, Former Fuel Farm USTs, and Fuel Stall Piping
- Containment of contaminated soil followed by excavation that attains cleanup standards (FS Alternative 2)
  - Building 40-11, UST EV-48-1
  - SWMU/AOC No. 093, Building 45-01, Former Solvent USTs
  - SWMU/AOC Nos. 067 and 071, Building 40-56, Former Recycling Unit, and UST EV-153

A summary of the selected cleanup alternatives is included in Table 5-1, and the cleanup alternatives for EPM G and EPM H are shown on Figures 5-20 through 5-24.

Under the final remedy of these EPM G and H SWMUs, contaminated soils exceeding the cleanup levels will be initially contained below asphalt, concrete, and/or flightline panels. In order to ensure that the remedy remains protective in the future, institutional/engineering controls are required as discussed in Section 5.7.6. Compliance monitoring will be implemented as discussed in Section 5.7.5 for Building 40-11, UST EV-48-1; SWMU/AOC No. 165; SWMU/AOC No. 093; and SWMs/AOCs Nos. 067 and 071 when contaminated soils exceed cleanup levels. Institutional/engineering controls are required for all SWMUs under EPM G and H as long as contaminated soils exceed cleanup levels.

[28]Many of these currently existing deep groundwater wells are not located in optimal downgradient locations to these SWMUs.
[29]There is uncertainty with (un)saturated conditions under all areas of very large buildings. It is possible some perched groundwater is present now or will be in the future. Contaminated soil below these buildings may remain capped for decades. Rain/surface water infiltration over the next decade or more is unknown. FS vadose zone model shows that if water is present with contaminated soil, this results in infiltration of contamination to the potable aquifer. It better to sample and analyze potable groundwater samples as a direct measurement of aquifer impacts rather than using other indirect measurements of possible groundwater contamination (Ecology, February 2019).

Limited excavation of contaminated soils will occur at SWMU/AOC No. 165 in accordance with the description and timeline in the Ecology approved EDR. Soil in the area of the former fuel farm where free product was observed during UST removal will be excavated and disposed of at an off-site non-hazardous waste facility. Approximately 150 cy of soil/CDF beneath the utility ducts will be excavated to a depth of 9 feet bgs, where free product was noted. Implementation of this remedy will also include installation of a shoring system, confirmation soil sampling, and site restoration. The excavation work will be performed in conjunction with electrical substation upgrades (in the next 5 to 10 years), so that the substations does not have to be relocated during remediation. Soil exceeding the cleanup levels will be excavated and disposed of at off-site non-hazardous and hazardous waste facilities in accordance with the Schedule in the Ecology approved EDR and in accordance with the requirements in Section 4.4.

The containment of contaminated soils above cleanup levels component of this remedial action for Building 40-11, UST EV-48-1; SWMU/AOC No. 165; SWMU/AOC No. 093; and SWMs/AOCs Nos. 067 and 071, including institutional/engineering controls and compliance monitoring, will be implemented until the soil excavation to attain cleanup levels is implemented. Soil exceeding the cleanup levels will be excavated and disposed of at off-site non-hazardous and hazardous waste facilities in accordance with the Schedule in the Ecology approved EDR and in accordance with the requirements in Section 4.4.

In addition, TPH contamination found in May 2018 during work on EV-49-1, which is near UST EV-48-1, will be removed when both tanks are removed in accordance with the Schedule in the Ecology approved EDR. After excavation takes place and confirmation soil samples show attainment of cleanup levels, institutional/engineering controls will be removed.

5.7.2 CLEANUP LEVELS

A summary of the contaminants of concern and the cleanup levels for the SWMUs/AOCs included in EPM G and EPM H is provided in Section 3.0. Based on the nature and extent of contamination at these SWMUs/AOCs, and the potential current and future complete exposure pathways, numeric cleanup levels proposed for EPM G and EPM H SWMUs/AOCs are as follows:

- Soil – MTCA Method B, protection of groundwater for methyl ethyl ketone (MEK), MTCA Method A unrestricted for benzene, toluene, ethyl benzene, xylenes (BTEX), metals (cadmium, chromium, and lead), also protective of groundwater MCLs.
- Esperance Sand groundwater (potable groundwater,) – MTCA Method A for TPH, benzene, toluene, ethyl benzene, xylenes (BTEX)
- Indoor Air – MTCA Method C for BTEX and MEK

The specific numerical values for the contaminants of concern for EPM G, which include BTEX, petroleum hydrocarbons, and metals, are included in Table 3-7. The specific numerical values for the contaminants of concern for EPM H, which include MEK and BTEX, are included in Table 3-8.

5.7.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the EPM G and EPM H SWMUs/AOCs.

5.7.4 RESTORATION TIMEFRAME

Estimated restoration timeframes for the selected cleanup alternatives for the EPM G and EPM H SWMUs/AOCs are provided in Table 5-3. The following describes the restoration timeframes for the selected cleanup alternatives for SWMUs/AOCs included in EPM G and EPM H:

- SWMU/AOC Nos. 065 and 083– The containment of contaminated soils above cleanup levels remedy provides for a reasonable restoration timeframe by establishing containment and institutional controls immediately following Ecology approval of the Institutional Controls Management Plan.
- SWMU/AOC No. 165 – The Limited Excavation remedy will provide for a relatively short restoration timeframe. The timeline for the future excavation component of the remedial action could be years or decades and is dependent on the timing of those future excavation actions as defined in the Ecology approved EDR and consistent with Section 4.4).
- Building 40-11, UST EV-48-1; SWMU/AOC No. 093, and SWMU/AOC Nos. 067 and 071 – The timeline for the future excavation component of the remedial action could be years or decades and is dependent on the timing of those future excavation actions as defined in the Ecology approved EDR and consistent with Section 4.4. Institutional/engineering controls will be implemented as long as contaminated soils exceed cleanup levels.

5.7.5 COMPLIANCE MONITORING

A summary of the compliance monitoring to be implemented for the SWMUs/AOCs in EPM G and EPM H is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. No compliance monitoring will be performed for SWMU/AOC Nos. 065 and 083. The following compliance monitoring will be performed for all other SWMUs/AOCs in EPM G and EPM H:

- Deep groundwater in Esperance Sand groundwater monitoring wells (existing well EGW040 and new Wells #6, #7, #8 and #11) will be monitored quarterly for at least 2 years. Consistent with Section 4.4, after two consecutive years of non-detections for analyzed contaminants, Boeing may reduce the sampling frequency to semi-annual.

However, any verified detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[30].

In addition, indoor air monitoring will only be performed as follows:

- Routine indoor air sampling is required at SWMU067 and SWMU071 consistent with Section 4.4. Indoor air sampling frequency will be adjusted downward (but not eliminated) based on no indoor air exceedances of MTCA Method C levels and no increasing trends for consecutive indoor air sampling events. After one year of indoor air sampling events conducted during the summer and winter seasons, sampling frequency will be reduced to once per year in the season with highest indoor air concentrations. If indoor air concentrations remain below MTCA Method C levels and no increasing trends for two consecutive annual events, indoor air sampling frequency will be reduced to every other year. This assumes no building work is conducted that could exacerbate the vapor intrusion pathway.
- At least two sub-slab vapor sampling events are also required at the Site if indoor air exceedances of MTCA Method C levels are detected or if Boeing proposes to terminate indoor air sampling.

5.7.6 INSTITUTIONAL/ENGINEERING CONTROLS

Institutional/engineering controls for the cleanup alternatives in EPM G and EPM H are summarized in Table 5-4. The SWMUs in EPM G and H are on Boeing Everett property.

For all EPM G and H SWMUs/AOCs, institutional/engineering controls will be implemented, because soil contamination above cleanup levels will remain in the sub-surface, as part of the final remedial action or until required future contaminated soil remediation is completed to attain cleanup levels. Institutional controls will be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Boeing property and recorded on the deeds registered with Snohomish County/City of Everett.

Boeing is required to submit and implement a site wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed when necessary to prevent infiltration of rainwater and exacerbation of soil contamination migration to the Esperance Sand Aquifer, until soil and groundwater concentrations are below cleanup levels. (2) Institutional controls, requiring pavement or building flooring remain in place and in good condition, would be placed on the portion of the property where soil and groundwater COCs remain above cleanup levels. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, soil handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing

[30]Routine groundwater sampling and analyses will end when groundwater contamination below a SWMU is below cleanup levels and contaminated soil from the associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling.

shall notify Ecology prior to any work in contaminated soil or perched groundwater which is above cleanup levels. (4) Institutional controls that require addressing or mitigating potential vapor intrusion for any future building construction in the area (excluding SWMU 65), where the existing floor is penetrated or the renovations results in changes to building use. The goal of addressing/mitigating potential vapor intrusion is to protect Boeing employees and their contractors from unacceptable contaminated indoor air exposure.

5.8 EXPOSURE PATHWAY MODEL I (ARSENIC/ESPERANCE SAND)

EPM I consists of one SWMUs/AOCs exhibiting arsenic in deep Esperance Sand groundwater and includes only Esperance Sand Well EGW061. There are no known or documented releases that suggest a source of elevated arsenic in deep Esperance Sand groundwater in this area (total depth of EGW061 is 219 feet bgs). Arsenic is naturally occurring in glacial outwash deposits in the Puget Lowlands (Snohomish County 2006)

There is no current potential exposure to arsenic in deep Esperance Sand groundwater at this AOC, because deep groundwater in this area is not used as a drinking water source. A municipal supply of drinking water is available and is currently in use at the property. Potential future exposures could result if deep Esperance Sand groundwater is developed in this area for drinking water.

The selected remedy for EPM I is no further action. Sampling and analysis of total and dissolved arsenic and lead from EGW217, EGW061, EGW067, and EGW079 indicate that metals concentrations near EGW061 are stable in accordance with guidance from Ecology (Ecology 2016b). Additional monitoring of arsenic (total and dissolved) and lead (total and dissolved) were performed in October 2016; January, April, and October 2017, April and October 2018, and April and October 2019 at EGW061, and monitoring was performed in October 2016 and January 2017 at EGW217 (AECOM 2019a). Concentrations of total and dissolved arsenic at EGW061 and EGW217 have been stable, with the exception of one anomalous result in EGW217 for total arsenic collected in January 2017. Lead has been detected once at EGW060 in January 2019 and once at EGW217 at a value between the method detection limit and the reporting limit. Similar to arsenic, one anomalous result in EGW217 for total lead in a sample collected in January 2017. These results indicate that arsenic and lead are stable in the Esperance Sand aquifer.

However, water depth will continue to be collected at EGW061 for use in generating a site-wide deep groundwater contour map for the Esperance Sand aquifer. Water level monitoring would be implemented on the same schedule as the groundwater monitoring for other SWMUs/AOCs, which is quarterly for 2 years, and semiannually thereafter. The no further action remedy for EPM I is included in Table 5-1. The location of Well EGW061 is shown on Figure 5-25. Institutional/engineering controls for the cleanup alternatives in EPM I are summarized in Table 5-4.

5.9 EXPOSURE PATHWAY MODEL K (POWDER MILL GULCH)

EPM K includes the PMG SWMU. The source of contamination at the EPM K SWMU is TCE contamination beneath the Boeing Everett Facility detention basin, which has contaminated the Esperance Sand Aquifer beneath the basin and approximately 2,800 feet further downgradient. The TCE contaminated groundwater discharges to Powder Mill Creek (PMC) and therefore approximately 3,600 feet of the creek (and associated groundwater seeps) is contaminated with TCE[31]. One on-going interim action (IA) is helping to reduce the amount of TCE contaminated groundwater entering PMC. Another recently completed IA reduced TCE groundwater concentrations in the source area beneath the detention basin. Even though these completed and on-going IAs were effective, TCE groundwater concentrations are still up to several orders of magnitude above final cleanup levels, thus final remedial actions at this SWMU are necessary (see Section 2.1.2.1).

The characteristics of the EPM K SWMU/AOC are:

- TCE groundwater source area (beneath detention basin) and part of the downgradient TCE plume is located on Boeing Everett property.
- Downgradient TCE groundwater plume migrated off Boeing property and on to City of Everett (Lot #9), Powder Mill Business Center (PMBC) and Seaway Center properties.
- TCE and its degradation products contaminated the Esperance Sand Aquifer.
- Esperance Sand Aquifer is not currently used for drinking water purposes, however, the Aquifer is a future potential drinking water source and the remedial action will assume this for the required cleanup.
- No current TCE soil gas to indoor air exposure pathway at the PMBC property based on soil gas samples collected from three paired (deep/shallow) soil gas probes on the PMBC property.

The Esperance Sand is underlain by the Lawton Clay, which serves as an aquitard below the Esperance Sand Aquifer. Within the upper PMG a discontinuous interbedded silt unit is observed in the lower Esperance Sand. The TCE plume is generally found in the portion of the aquifer above the silt interbed in the upper PMG area although low concentrations of TCE are found below the silt interbed. The silt interbed has been incised by PMC and pinches out north of Seaway Boulevard, at which point the plume is then contained by the Lawton Clay aquitard. The Lawton Clay aquitard outcrops farther north of where the silt interbed pinches out, and the Esperance Sand Aquifer (and the TCE plume) fully flows into PMC as direct flow to the creek or via flow from surface water (seeps). TCE contamination in PMC is diluted by the increasing stream flow and volatilization until TCE is no longer detected in water samples more than 3,600 feet north of the detention basin.

Based on the presence of contaminated groundwater, surface water, and seeps present within PMG, current and potential human and ecological receptors were identified based on current and future reasonable future land use. Current and potential human receptors include the following:

[31] SW-PMG14 (0.5 ppb TCE)

- Temporary construction workers: Personnel temporarily working within PMG (on and off Boeing property) may come into direct contact with TCE contaminated shallow groundwater, surface water, or seeps during future construction activities.
- Remediation field staff required to sample groundwater near PMC, surface water within PMC, and perform any reconnaissance activities near PMC.
- City of Everett workers performing duties requiring excavation work on the Lot#9 property near PMC or performing sewer line maintenance activities via excavation work on Lot#9.
- General public on City of Everett property (Lot#9): PMC is not currently and unlikely to be used as a source of drinking water by the public (Section 3.4.6.2). However, members of the public participating in recreational activities on City (Lot #9) property within the vicinity of the plume may come into direct contact with TCE contaminated surface water or seeps and, it is possible they will incidentally contact and ingest small amounts of TCE contaminated creek or groundwater seep water. The general public may also ingest TCE contaminated groundwater if used as a drinking water source in the future. If PMC becomes a fish bearing stream in the future, consumption of freshwater organisms from PMC could be a source of exposure. It is unlikely that spawning fish can overcome the culvert barrier in place under Mukilteo Speedway Blvd in order to reach the upper reaches of PMC. It is possible that those culvert barriers will be removed as part of future fish restoration projects.

The potential for future construction near PMC is unlikely due to the steep topography, presence of wetlands, and surface water bodies. The Seaway Center and PMBC properties above the TCE groundwater plume are located further west of PMC, where the topography of the land flattens. The vapor intrusion pathway on these properties could become complete if there were construction activities that cause the migration of TCE soil gas vapors above the TCE groundwater plume to the current buildings on those properties, or if TCE groundwater concentrations increase below and near those buildings. Based on current soil gas samples collected at three nested soil gas wells (deep/shallow) on the PMBC property, human exposure to subsurface vapor is currently an incomplete pathway on the PMBC property.

Potential ecological receptors include the following:

- Terrestrial plants, exposed through interaction with or uptake of shallow groundwater, surface water, or seeps
- Terrestrial invertebrates, exposed through interaction with or consumption of shallow groundwater, surface water, or seeps
- Terrestrial birds, exposed through interaction with or consumption of surface water or seeps, or consumption of freshwater organisms from PMC
- Terrestrial mammals, exposed through interaction with or consumption of surface water or seeps or consumption of freshwater organisms from PMC
- Amphibians and other aquatic life, exposed through the interaction with or consumption of surface water or seeps, or consumption of other freshwater organisms from PMC
- Benthic invertebrates, exposed through interaction with or consumption of surface

water/shallow groundwater at the groundwater-surface water interface of the creek

Groundwater cleanup levels established at the Site are more stringent than Ecological based cleanup levels.

5.9.1 DESCRIPTION OF THE CLEANUP ACTION

The final remedy for the EPM K PMG SWMU is enhanced in situ bioremediation (EISB) in the source area and concurrent operation of a dynamic groundwater recirculation (DGR) system on all portions of the downgradient TCE groundwater plume (on Boeing Everett, City of Everett (Lot #9), Powder Mill Business Center (PMBC) and Seaway Center property). The DGR system consists of modifying and upgrading the existing GET system to convert and operate the system as a DGR system. Monitored natural attenuation (MNA) will also be implemented, as needed, upon completion of active stages of EISB and DGR to complete cleanup of the PMG TCE/cVOC groundwater plume. Because the source of surface water contamination is the flow of the TCE-contaminated groundwater to PMC, attaining groundwater cleanup levels (Section 5.10.3) is intended to result in attaining surface water cleanup levels in Powder Mill Creek. In order to ensure that the remedy is protective of current and potential human receptors, Boeing will implement required institutional/engineering controls as discussed in Section 5.10.6, until cleanup levels are attained. Boeing shall implement compliance monitoring as discussed in Section 5.10.5. EISB, DGR, and MNA are described in greater detail in the subsections below. A summary of the selected remedy for the EPM K PMG SWMU is included in Table 5-1 and shown on Figure 5-26.

5.9.1.1 SOURCE AREA ENHANCED IN SITU BIOREMEDIATION (EISB)

The EISB injections shall commence in accordance with the Schedule as one of the first remedial actions after Ecology EDR approval, and no later than concurrently with the DGR Pilot Study (see Section 5.10.1.2)[32]. EISB will be performed in the source area using an electron donor to stimulate microbial degradation of residual concentrations of TCE and/or breakdown products and to minimize future contributions to downgradient groundwater contamination. The biologically active zone would be created/enhanced and maintained periodically, as necessary, by emplacement of solution ("injections" for the purposes of this document) through injection wells, direct-push injection equipment, or augered donor borings (methodology to be determined during engineering design). Injection points will be located hydraulically upgradient of areas beneath the detention basin with TCE concentrations above groundwater cleanup levels to ensure attaining groundwater cleanup levels in the source zone in a reasonable timeframe. These injection areas will also include, areas where rebound from the IA bioremediation is evident, and where concentration trends for COCs are stagnant or declines have become asymptotic. Ecology will select the actual locations for treatment of the remaining source area based on data available

[32] Ecology response letter dated September 5, 2019 stated, *Ecology assumes that source area and downgradient groundwater remediation will occur concurrently…*and that *... Ecology expects source area EISB to be implemented immediately, even if an analysis of contingent downgradient remedies is later required.*

at the time of the engineering design. Each injection location would receive an adequate injection volume to create overlapping zones of influence downgradient of injection locations.

Ecology will evaluate the advantages of additional injection areas with the benefits of reduced source area restoration timeframe and reduced migration of TCE contaminant flux to the downgradient plume for both source area and downgradient plumes. Depending on the performance monitoring results following each injection event, Boeing will conduct additional injections as determined necessary by Ecology, until a steady downward trend of TCE and breakdown product concentrations toward the cleanup levels is established in groundwater in the source area and rebound of TCE is no longer occurring. An adaptive management approach will be used to determine locations, donor materials/formulations, and timing related to additional injections.

The design of the remedial action will use installation of two clusters of injection wells (or donor borings) set up in rows across the width of the higher concentration areas in the detention basin. Figure 5-26 identifies the approximate areas where elevated TCE concentrations currently remain in the source area and a conceptual layout of EISB injection wells (or donor borings). Minor modifications to this designed may be made with Ecology approval as the final EISB design and approach will be based on data available at the time of the engineering design. Injection spacing will be designed to allow for the development of biological treatment zones between and downgradient of the injection locations as donor substrate and fermentation byproducts (e.g., volatile fatty acids and hydrogen) are carried downgradient by groundwater flow. Injection spacing will be designed to provide adequate treatment coverage while maximizing the treatment potential of injection fluid as it moves downgradient with groundwater. Injections will be performed across vertical intervals above the silt interbed in the source area. To facilitate reasonably uniform distribution of injected donor solution across the vertical target treatment interval, injection locations may have multiple injection intervals.

In order to both accelerate the biological degradation of the contaminants and to provide for prolonged treatment to minimize the number of injection events, it is assumed that injections fluids/materials will include both fast- and slow-release donor substrates. Use of such mixtures can result in several months to more than a year of longevity, depending on the mass of donor injected, the continuing flux of contaminant, and the mass of natural electron acceptors within the treatment zone.

The total number of injection events will depend on monitoring data from the source area and downgradient of the source area subsequent to each prior event, with consideration for the effectiveness of the treatment. Ecology will consider the results and all available data from the source area IA when designing and implementing EISB injection locations and events. These data and results will include successes and lessons learned during the IA implementations. It is initially assumed that two to three injection events conducted over a period of 2 to 3 years would result in 4 to 6 years of optimal bioremediation, with ongoing residual treatment to extend another 3 to 5 years. Ecology will use the performance monitoring results to verify this assumption and evaluate if additional EISB injection events are required beyond the 2 or 3 initially planned injection events.

5.9.1.2 DYNAMIC GROUNDWATER RECIRCULATION (DGR)

For cleanup of the downgradient portion of the TCE plume, the existing GET system will be converted into a groundwater recirculation system through the installation of groundwater injection wells and additional extraction wells. The recirculation system will be adaptively managed and dynamically operated, yielding a remedial approach/technology that has come to be known as DGR (Suthersan et al. 2015). The objective of the DGR system is to increase contaminant mass recovery rates by modifying groundwater flow paths to provide flushing of pore spaces not readily or as rapidly accessed under natural or pumping influenced flow conditions, accelerate the clean-up timeframe through overall increased aquifer flushing rates, and provide additional hydraulic control of contamination in the downgradient portion of the groundwater plume through operation of groundwater injection and extraction well network. DGR wells will not be installed and operated in or near the source area treatment or downgradient influenced zones to avoid adverse impacts. The approximately 500 foot distance from the source area EISB injections to the first extraction well (Figure 5-26) should provide adequate buffer zone for the two remediation systems.

The sequence for design and implementation of the full scale DGR system will be as follows in accordance with the Schedule:

- Use the existing groundwater flow model (initial modeling) and existing GET system infrastructure to design and perform a DGR pilot study.
- Use the pilot study results to inform and update the groundwater flow model and perform full-scale design and installation of the full scale DGR system. Cleanup levels do not need to be met in the pilot study before full scale DGR system is designed, constructed and operated. The pilot study needs to provide enough data to design the full scale DGR system.

- The full-scale DGR, any follow-up as needed Ecology injections, and approved MNA are intended to meet cleanup levels. Optimization of the full scale DGR system will target reducing groundwater flow path distances between extraction and injection wells, and maximize aquifer flushing and mass recovery through dynamic operation and manipulation of hydraulic gradients and groundwater flow paths throughout the downgradient plume. Through the optimization process, the need for additional injection or extraction wells will be evaluated and such wells will be added as necessary.
- Continue to optimize full scale DGR system operations as the plume contracts and is cleaned up, observed through effectiveness and performance monitoring. If Ecology determines ongoing groundwater monitoring and system evaluation concludes the need for additional injection wells or extraction wells, Boeing shall add such wells, as necessary.

The following sections provide additional details for the DGR pilot study and a description of the conceptual design and implementation of the DGR.

DGR Pilot Study

Prior to full-scale design and implementation of the DGR system, Boeing will conduct a pilot study to demonstrate proof of concept and provide additional information and data that would be

utilized for the full-scale design. The pilot study will be conducted in the area of higher TCE concentrations around groundwater monitoring points P8, P10, and EGW090 and using the existing extraction wells of the Phase 1 IA GET system with the addition of new injection wells outside the plume in this area and possibly new extraction wells (see Figure 5-26). The actual number and location of injection and extraction wells installed and used for the pilot study will be evaluated through detailed engineering design of the pilot study and hydraulic evaluation/modeling, as reviewed and approved by Ecology.

The pilot study results will be evaluated after one year. If additional time is required to collect information and data that would be utilized for the full-scale DGR design, then Boeing may request a time extension, no later than 60 calendar days prior before the end of the planned end of the pilot study. Each time extension will not exceed one year and Ecology does not expect more than two years of time extensions[33]. During the pilot study, groundwater elevation and water quality data will be collected from the pilot study area on at least a monthly basis or as appropriate and adequate to observe and evaluate the effects of various injection and extraction scenarios during the pilot study. Data and parameters collected and observed in the pilot study target area will include:

- Groundwater elevations at injection wells, extraction wells, and monitoring wells/piezometers
- Groundwater TCE concentrations in monitoring wells and from extraction wells
- Groundwater physical and chemical properties (typically measured by field parameters) in monitoring wells and from extraction wells
- Extraction and injection flow rates, and well capacity and efficiency
- Hydraulic conductivity and flow capacity data, to the extent practicable, based on injection rates
- Observation and analysis of injection well fouling (and effectiveness of well rehabilitation measures, if needed)

Qualitative criteria and observations related to the effectiveness of DGR during the pilot study will also include:

- Observed degree that hydraulic gradients and flow directions can be influenced by the DGR system compared to the current GET conditions
- Distance and depth of hydraulic influence of the DGR system (i.e., measured vertical gradients where available, area of groundwater mounding from injection wells established around the perimeter of the pilot study area, and complementary capture zones established by extraction wells)
- Changes in mass flux of recovered TCE at extraction wells

[33] Ecology has indicated its preference that the pilot study be completed in one year or less (Ecology 2019c).

- Trends (different than current trends) in groundwater TCE concentrations in target area monitoring wells over the course of the pilot study
- Continued hydraulic capture and control of the plume, such that the DGR system achieves the cleanup action objectives for the downgradient plume

The combination of these recommended parameters should allow calibration of the PMG groundwater model using actual injection rates and observed mounding (draw up) at injection wells and drawdown at extraction wells, which will then be used for full-scale DGR system design. One of the primary metrics of successful design and operation of a DGR system that will be evaluated with the collected data is the ability to manage flow path lengths and pore volume flushing times, while still maintaining hydraulic control of the plume.

Dynamic Groundwater Recirculation Conceptual Plan

A conceptual layout of the approximate location of groundwater injection wells and new (and existing) extraction wells for a full-scale DGR system is provided in Figure 5-26. This layout (subject to change based on the results of the pilot study) is based on the following considerations and limitations:

- Current known TCE plume configuration
- Site topography, natural features (wetlands, surface water, vegetation), and infrastructure
- Location, spacing, and area of influence of the existing GET system extraction wells
- Initial (pre-pilot study) groundwater modeling results.

As indicated on Figure 5-26, the conceptual layout includes:

- 9 new injection wells installed outside the eastern edge of the plume south of Seaway Boulevard and outside the western edge of the plume north of Seaway Boulevard
- 12 existing extraction wells and 2 new extraction wells installed within the core of the plume
- The conceptual locations of future optimization injection wells are also shown for consideration at such time as the plume contracts sufficiently to allow for new injection points at the plume periphery.

The exact number and location of injection wells and new extraction wells would be determined through detailed engineering design and hydraulic evaluation/modeling including information and data derived from the results of the pilot study, and geotechnical and hydraulic evaluations including slope stability evaluations. For locations off of Boeing property, permission from property owners/operators will also be required for installation of wells and associated DGR system infrastructure. Boeing shall start communications with these property owner within 30 days of the effective date of the Enforcement Order to inform them of the off Boeing property component of the DGR remedial action component of the final cleanup action. Boeing shall start property access negotiations within 30 days of the effective date of the Enforcement Order so that best efforts are made to ensure the site access and other necessary agreements are signed and

in place prior to the design and construction of the full-scale DGR system. The use and operation of injection wells will require permit(s) authorized by Ecology's Underground Injection Control (UIC) program. With Ecology approval, as necessary after operation and optimization of the new full scale DGR system, other new injection and extraction wells not included in the initial system design may be added to supplement the system and to optimize the cleanup as the plume is decreased in size and/or to increase the effectiveness of the system through additional groundwater flow manipulation and increased flushing. Boeing shall start communications with the appropriate Ecology Water Quality staff to inform them of the planned pilot and full scale DGR remedial action.

Injection wells will be supplied with treated groundwater from the existing GET system treatment train. Injection wells will be monitored through the existing GET system monitoring system that will be expanded and upgraded to include water level meters (pressure transducers) and flow meters at each injection well. The existing treated groundwater discharge line, which extends to the outfall on PMC beyond the north end of the plume, will be spliced/branched and valved appropriately to provide controllable and adjustable flow to each individual injection well. In addition to the existing discharge pump, booster pumps and intermediate storage tanks will be added, as necessary, to provide flow to each injection well located at higher elevations than the GET system discharge line. The new extraction wells will be tied into the existing collection and transfer piping network and instrumented and monitored in the same fashion as existing extraction wells.

Ecology may determine that Boeing needs to install additional monitoring wells/piezometers (during the pilot study and full-scale implementation) to evaluate the hydrologic impacts on the groundwater table and groundwater quality resulting from operation of the injection wells. The exact number and locations of additional monitoring wells would be determined through detailed engineering design and hydraulic evaluation/modeling.

5.9.1.3 MONITORED NATURAL ATTENUATION

As identified in the Supplemental FS, it may not be practicable for EISB and/or DGR alone to reach the cleanup standards for the PMG SWMU (Section 5.10.2). Both EISB and DGR are both technically and administratively implementable; and MNA can also be effective as a follow up remedial action. This is particularly applicable when MNA is implemented following other cleanup technologies. The combination of the EISB and DGR, together with follow-up MNA, are capable – technically – of achieving the groundwater cleanup levels specified in Section 3. (Ecology 2019c), at the points of compliance specified in Section 5.10.4.

Upon the effective completion of active EISB and DGR implementation (i.e., when EISB injections have achieved remediation objectives and operation of the DGR system has reached a point of diminishing return for further reductions in groundwater CVOC concentrations), if areas of the plume are not meeting the cleanup standards, Ecology may approve MNA to complete groundwater cleanup at the PMG SWMU. The remediation objectives and criteria for when the transition from EISB and DGR to MNA occurs will be based on effective EISB and DGR treatment attaining a remediation level (RL). MNA must meet the requirements of WAC 173-340-370(7).

5.9.2 CLEANUP STANDARDS AND POINT OF COMPLIANCE

A summary of the contaminants of concern and the cleanup levels for the EPM K/PMG SWMU is provided in Section 3.0. Based on the nature and extent of contamination at this SWMU and the potential current and future complete exposure pathways, numeric cleanup levels for the EPM K/PMG SWMU consist of the following:

- Groundwater – MTCA Method B, protective of drinking water and at least as stringent as surface water standards protective of surface water beneficial uses per WAC 173-340-720(4)(b).
- Surface water – MTCA Method B, protective of drinking water use, human consumption of organisms and ecological receptors.

- Indoor Air – MTCA Method C for TCE and daughter products

The potential use of remediation levels (RLs) as allowable under WAC 173-340-355, to establish the appropriate time to discontinue EISB actions and DGR operations and complete cleanup using MNA (see Section 5.10.1.3). RL will be attained for EISB or DRG treatment when the higher cost and diminished additional effectiveness of additional injections in the TCE groundwater source area and longer operation of the full scale DGR system to more quickly attain groundwater cleanup at the point of compliance is disproportionate to no further injections; reduced or terminated operation of the full scale DGR system; potentially longer restoration timeframe; and the likely effectiveness for attaining groundwater cleanup levels under an MNA approach.

The specific cleanup levels for the contaminants of concern, which include TCE, and its breakdown products (DCE and VC) are included in Tables 3-10a and 3-10b for surface water and groundwater, respectively. The point of compliance (POC) for the surface water is the standard point of compliance.

A conditional groundwater POC shall be established at the Boeing Everett property line (Seaway Blvd) and in groundwater upgradient of the transition zone and prior to its discharge to the creek on Boeing property. This groundwater point of compliance is permanent to the maximum extent practicable (WAC 173-340-360[3]).

The groundwater cleanup levels (Table 10.2) shall be attained at the groundwater conditional point of compliance. Furthermore, groundwater cleanup levels upgradient of the groundwater CPOC must attain MTCA B drinking water cleanup levels protective of potable water.

5.9.3 APPLICABLE, RELEVANT, AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Plant are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the EPM K/PMG SWMU.

5.9.4 RESTORATION TIMEFRAME

The restoration timeframe for the selected remedy for the EPM K SWMU is provided in Table 5-3. The estimated restoration timeframe for achieving the cleanup levels at the groundwater conditional point of compliance (Section 5.10.2) for the EPM K PMG SWMU is approximately 24 years. This restoration timeframe was determined using groundwater modeling (GMS/MODFLOW) in combination with one or both of two restoration timeframe estimating models (the Batch Flushing model [US Environmental Protection Agency {EPA} 1988] and the BIOCHLOR Natural Attenuation Decision Support System model [BIOCHLOR, Version 2.2, 2002 release]). As described in the Supplemental FS, the results of particle tracking related to the MODFLOW model were used to identify flow paths, distances, and travel times that could be used as input parameters for the Batch Flushing and BIOCHLOR modeling to estimate restoration timeframes associated with the source area and downgradient plume areas of PMG.

The total restoration time is assumed to be the longer of the restoration timeframes for the source area (resulting from EISB) and the downgradient plume (resulting from DGR). The estimated restoration timeframe for EISB and DGR is approximately 24 years to reach the groundwater cleanup levels within the source and downgradient plume. However, it should be noted that, if the effectiveness of EISB and DGR become limited due to back diffusion and desorption processes, Batch Flushing model suggests that cleanup (by MNA) may take an additional 8 years or longer (total of 32 years or longer) to reach the cleanup standards.

5.9.5 COMPLIANCE MONITORING

A summary of the compliance monitoring required for the EPM K SWMU is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. As required under WAC 173-340-400(b, c), in conjunction with preparation of construction plans and specifications and an operation and maintenance plan; compliance monitoring plans will be prepared describing compliance monitoring during construction and during operation and maintenance phases of final remedy implementation. The compliance monitoring plans will include the appropriate elements identified under WAC 173-340-410:

- Protection Monitoring: Confirm that human health and the environment are adequately protected during construction and the operation and maintenance period of a cleanup action as described in the safety and health plan.
- Performance Monitoring: Confirm that the cleanup action has attained cleanup standards and, if appropriate, remediation levels or other performance standards such as construction quality control measurements or monitoring necessary to demonstrate compliance with a permit or, where a permit exemption applies, the substantive requirements of other laws.
- Confirmation Monitoring: Confirm the long-term effectiveness of the cleanup action once cleanup standards and, if appropriate, remediation levels or other performance standards have been attained.

While the specifics of compliance monitoring will be included in the construction plans and specifications and the operations and maintenance plan, the following provides a general

overview of the anticipated types and frequencies of groundwater and surface water compliance monitoring that will be performed during the final remedy for the PMG SWMU:

- **EISB**: **Protection and performance monitoring** during EISB implementation in the source area will consist of:
    - **Protection monitoring** measures will be performed to monitor and mitigate health and safety risks for workers during donor injection events in the source area and subsequent groundwater performance monitoring events, as provided through appropriate health and safety protocols outlined under a site-specific health and safety plan.
    - **Performance monitoring** of the source area EISB remediation activities will be accomplished by monitoring groundwater parameters and collecting groundwater samples from select wells (to be defined in the engineering design report) within and downgradient of the treatment area. Groundwater monitoring parameters will include aquifer redox conditions and other indicators of biologically mediated reductive dechlorination (as evidenced by monitoring of dissolved oxygen [DO]; oxidation reduction potential [ORP]; and dissolved iron, nitrate, sulfate, methane, pH, temperature); TOC concentrations; and concentrations of TCE, breakdown products (DCE and VC), and end products (ethene/ethane). Groundwater samples will be collected from selected monitoring wells on a **quarterly basis** for the interim period between injection events and for a minimum of one year.
    - **Confirmation monitoring** will consist of groundwater sampling to monitor for changes to aquifer redox conditions and other indicators of biologically mediated reductive dechlorination (as evidenced by monitoring of dissolved oxygen [DO]; oxidation reduction potential [ORP]; and dissolved iron, nitrate, sulfate, methane, pH, temperature); TOC concentrations; and concentrations of TCE, breakdown products (DCE and VC), and end products (ethene/ethane). Groundwater samples will be collected from these wells on a **quarterly basis for a minimum of one year or** until EISB remediation objectives (to be defined in the engineering design report) have been met in the source area. The performance monitoring frequency may be increased or reduced, as appropriate, if proposed by Ecology or Boeing and approved by Ecology. If performance monitoring indicates that the remediation objectives are unlikely to be achieved in the source area, Ecology will evaluate whether further injections of electron donor are necessary to further reduce COC concentrations. Performance monitoring for subsequent MNA (after EISB remediation objectives have been achieved) will consist of collecting MNA parameters as described below.

- **DGR**: Protection and performance monitoring during DGR implementation in the downgradient plume will consist of:
    - **Protection monitoring** measures are required to monitor and mitigate health and safety risks for workers and resident walkers on City of Everett property (Lot #9) during construction of the DGR system, and operations, maintenance, and monitoring events in the downgradient plume and subsequent groundwater performance

monitoring events, as provided through appropriate health and safety protocols outlined under a site-specific health and safety plan.

- **Performance monitoring** associated with remediation activities in the downgradient plume will be accomplished by collecting surface water and groundwater samples from select surface water sampling locations and groundwater monitoring wells (to be defined in the engineering design report) within the downgradient plume for TCE, cDCE, tDCE, and VC analysis as well as standard field parameters including temperature, pH, conductivity, turbidity, DO and ORP. Surface water samples will be collected on a **quarterly** basis to evaluate overall trends in surface water quality. Groundwater samples will be collected from representative plume monitoring wells on a **quarterly** basis to evaluate overall trends in groundwater quality. After the first year of full scale DGR operation, surface water and groundwater plume performance monitoring frequencies at specific wells or creek sampling stations may be revised (increased or decreased), as appropriate, if proposed by Boeing or Ecology and approved by Ecology.
- DGR system operation monitoring related specifically to dynamic operation of the full scale DGR system will be performed at wells specifically selected to monitor changes in conditions related to specific configurations of the DGR system (i.e., which extraction wells and injection wells are used) that are being operated at any given time. The frequency of this monitoring and groundwater sampling may occur at a higher frequency (potentially as frequent as weekly or monthly). The protocols for well selection and sampling frequency related to DGR operations will be defined in the engineering design report.
- Consistent with Section 4.4, Boeing shall perform soil gas monitoring during protection and performance monitoring of the final remedy in the downgradient plume. Seasonal soil gas sampling events (summer and winter) shall be conducted at the five existing soil gas monitoring well locations at PMG.

- **MNA**: After completion of EISB and DGR performance monitoring, if Ecology approves implementation of MNA as the follow-up groundwater remedial action, MNA groundwater and surface water performance monitoring shall be performed initially **quarterly** for at least one year at select creek locations and groundwater monitoring wells within the plume per the Ecology approved MNA performance and confirmation monitoring plans. Groundwater will be sampled and analyzed for MNA parameters (COCs, DO, ORP, dissolved iron, nitrate, sulfate, methane, ethane, and ethene) at the PMG SWMU. This data will be used to confirm that natural processes and CVOC concentration decreasing trends continue to demonstrate progress toward achieving groundwater cleanup standards. The MNA performance monitoring frequency at specific wells may be reduced or increased, as appropriate, if proposed by Ecology or Boeing and approved by Ecology.

- Final **confirmation monitoring** will be performed on a site-wide basis after completion of performance monitoring for EISB, DGR, and MNA. Confirmation monitoring will consist of a minimum of four quarters of groundwater and surface water sampling for the

COCs and appropriate groundwater geochemical parameters in the PMG SWMU to demonstrate that cleanup standards or other performance standards have been attained and will continue to be met.

5.9.6 INSTITUTIONAL/ENGINEERING CONTROLS

Institutional/engineering controls to be implemented for the EPM K SWMU are summarized in Table 5-4. Because a conditional point of compliance will be established for the cleanup of the PMG SWMU (see Section 5.10.2), a restrictive environmental covenant will be required for the Boeing property portion of the PMG SWMU and recorded on the deeds registered with Snohomish County (County)/City. The covenant on Boeing property may be removed at Boeing's request once groundwater cleanup levels (table 3-10a and b) attained. (WAC 173-340-440(4)(e)).

Institutional controls will be implemented as part of a restrictive environmental covenant on non-Boeing owned property which is part of the site, in accordance with WAC 173-340-440, and recorded on the deeds registered with Snohomish County/City of Everett. Institutional controls on non-Boeing owned properties are also required to prevent unacceptable exposures to Boeing contamination until off-property cleanup levels are met.

Institutional Controls will be established to:

- Prohibit the use of groundwater or surface water on Boeing-owned property as a potable water supply or for any use until cleanup levels are attained.
- Restrict intrusive activities on Boeing-owned property that would put workers in contact with contaminated groundwater
- Prohibit use of the contaminated Boeing properties for other than industrial use.
- Prohibit the use of the non-Boeing contaminated properties for other than current uses (industrial or commercial use on PMBC and Seaway Center properties, and open space for municipal and recreational purposes on Lot #9).
- Restrict activities on City of Everett (Lot#9), PMBC, and Seaway Center properties from withdrawing contaminated groundwater or surface water for any use.
- Provide annual notifications to the City of Everett regarding the safety measures required for workers digging or excavating to the TCE contaminated groundwater (on Lot #9).
- Maintain existing and increase signage near PMC to warn resident walkers to stay on the trails and not to approach the creek.
- Require that proper safety measures and construction practices be implemented on Boeing-owned property as part of any project involving disturbance of soils at depths that may encounter groundwater
- Notification to property owners that the indoor air quality in newly constructed buildings near and above the TCE groundwater plume maybe contaminated by vapor intrusion. Boeing shall provide all available and applicable soil gas and shallow groundwater VOC data to those property owners.

Documented administrative procedures are necessary to ensure that development and construction activities on Boeing property are coordinated carefully to prevent potential unacceptable exposure of subsurface contamination to construction contractors.

The City of Everett has provided signage on the City's Lot 9 property to stay on the walking trails and that the surface water of PMC is not suitable for recreation or consumption. Boeing will provide supplemental signage along PMC on Lot 9 property near all access areas to the creek throughout the cleanup. This current and additional signage is, and will be, sufficiently frequent and visible to notify potential workers of the risk and protocols for performing intrusive work and notify the general public to stay on the walking trails and that the surface water of PMC is not suitable for recreation or consumption.

5.10 BOMARC PROPERTY (CADMIUM, CPAHS AND VOCS)

The BOMARC Property SWMUs/AOCs have TPH, cPAH and cadmium contaminated soils. Two oil/water separators EV-151 and EV-152 (SWMU/AOC Nos. 123 and 124) have cPAH contaminated soils. Freon-112 and TCE above indoor air screening levels are found in sub-slab vapor beneath the building (SWMU/AOC No. 011). A small volume of cadmium contaminated soil is beneath the 9-70 building above the MTCA Method A cleanup level of 2 mg/kg (approximately 1 cubic yard). However, based on the limited quantity, detected concentrations, and location of the cadmium contaminated soils, Ecology has determined that in the department's judgement, this does not pose a threat to human health or the environment (WAC 173-340-310(5)(d)(ii)). Therefore, a cleanup action is not required for the cadmium contaminated soils and will not be discussed further. VOCs and metals in surficial sediments in Wetland 3A will be incorporated into the Sediment CAP.

Sources of chemical constituents at the SWMUs/AOCs include one or more of the following at each SWMU/AOC:

- Historical and current releases from the oil/water separators, the stormwater system piping, or the catch basins during operations by Boeing or Boeing's tenants
- Historical releases by Boeing and/or previous users of the property with cPAH concentrations present in the fill soil near the stormwater oil/separator units (SWMU/AOC Nos. 123 and 124) or contamination placed during property development by Snohomish County
- Historical surface releases of TCE within Building 45-70 while under Boeing operation.
- Freon-12 detected in soil gas below the 45-70 building. The source of Freon-12 cannot be positively identified at this time. However, potential sources of Freon-12 in the sub-slab vapor include the following:
    - Historical operations within the Building 45-70 (e.g. aerosols, refrigerants, and solvents): There is no documented historical use of Freon-12 in the Building 45-70, but such historical use is possible. Use of Freon-12 was banned in 1994, and therefore current operations are not considered a potential source.
    - Outgassing from building materials (e.g. foams)
    - Building systems (e.g. fire suppression and leak detection devices).

The characteristic of the BOMARC Property SWMUs/AOCs are:

- Industrial facility
- Currently soil contamination contained by pavement.
- Contaminated soils are above cleanup levels
- Excluded from terrestrial ecological risk evaluation in accordance with the criteria of WAC 173-340-7491
- VOCs in the sub-slab vapor exceeding screening levels (building 45-70).
- Past indoor air sample analysis below Method C cleanup levels

Where chemical constituents are present in soil above a concentration protective of the direct contact pathway, concrete flooring or pavement currently prevents direct contact by factory workers. Volatile constituent concentrations in one-time sub-slab vapor samples exceeded the industrial MTCA indoor air screening levels. One-time indoor air samples collected were below Method C indoor air cleanup levels.

Potential future exposures could include workers performing excavations in contaminated soil (prior to removal) at the site or if the building configuration changes in a way that exposes contaminated soil (new sumps, pits, floor removal/modification) or otherwise creates unacceptable vapor intrusion into the 45-70 building.

5.10.1 DESCRIPTION OF THE CLEANUP ACTION

The selected cleanup alternatives for the SWMUs/AOCs at the BOMARC Property are as follows:

- Near Term Excavation (FS Alternative 1) for SWMU/AOC Nos. 123 and 124 Oil/Water separators EV-151 and 152
- Routine Air Monitoring for SWMU/AOC No. 011

A summary of the selected cleanup alternatives is included in Table 5-1, and the cleanup alternatives for the BOMARC Property are shown on Figures 5-27 through 5-29.

Under the final remedy for SWMU/AOC Nos. 123 and 124, contaminated soils will be excavated and disposed of at an off-site hazardous waste facility after execution of the CAP, Ecology approval of the engineering design report, current property owner approval, and then as soon as access can be practicably arranged. Implementation of the remedy would include:

- Demolishing and reconstructing surface features at EV-151 and EV-152, including pavement, fencing, and landscaping grass;
- Excavation of soil from around EV-152 to a depth of 11 feet bgs and to a depth of approximately 8 feet bgs around EV-151;
- Confirmation soil sampling from all areas of excavated soil;

- Off-site disposal of excavated soil and sediment at a RCRA Subtitle D landfill, or an approved recycling facility;
- Restoration of on-site infrastructure to match existing conditions (changes or upgrades to the existing stormwater system are assumed not to be required).

Institutional/engineering controls would not be required for these SWMUs/AOCs, because soil exceeding cleanup levels will be removed. Compliance monitoring will be implemented as discussed in Section 5.11.5.

Under the Air Monitoring remedy for SWMU/AOC No. 011, institutional/engineering controls will be implemented as discussed in Section 5.11.6; and compliance monitoring will be implemented as discussed in Section 5.11.5.

5.10.2 CLEANUP STANDARDS AND POINT OF COMPLIANCE

A summary of the contaminants of concern and the cleanup levels for the BOMARC Property is provided in Section 3.0. Based on the nature and extent of contamination at these SWMUs/AOCs, and the current and future complete exposure pathways, numeric cleanup levels proposed for the BOMARC Property SWMUs/AOCs are as follows:

- Soil – MTCA Method A, unrestricted land uses
- Indoor air – MTCA Method C for VOCs

The specific numerical values for the contaminants of concern, which include cPAHs, Freon-12, and TCE, are included in Table 3-11.

5.10.3 APPLICABLE, RELEVANT AND APPROPRIATE REQUIREMENTS (ARARS)

ARARs applicable to the selected cleanup actions for the Boeing Everett Facility are described in Section 3.0. Table 5-2 provides a summary of the applicability of the ARARs to the BOMARC Property SWMUs/AOCs.

5.10.4 RESTORATION TIMEFRAME

The estimated restoration timeframes for the selected cleanup alternatives for the BOMARC Property are provided in Table 5-3. The following describes the restoration timeframes for the selected cleanup alternatives for BOMARC Property SWMUs/AOCs:

- SWMU/AOC Nos. 123 and 124 – Excavation would provide for a relatively short restoration timeframe. All soil exceeding cleanup levels would be removed from the site according to the schedule in the Ecology approved EDR.

- SWMU/AOC No. 011 – Routine indoor air sampling is required consistent with Section 4.4 protocols and provides for a reasonable restoration timeframe by establishing

additional institutional controls. Perform indoor air sampling in accordance with the schedule in the Ecology approved EDR.

5.10.5 COMPLIANCE MONITORING

A summary of the compliance monitoring to be implemented for the BOMARC Property SWMUs/AOCs is provided in Table 5-3. This table includes a summary of the chemicals planned for monitoring. The following compliance monitoring will be performed for SWMUs/AOC Nos. 123 and 124:

Existing wells (EGW179, EGW180, and EGW181) will be monitoring semi-annually for 2 years to verify no migration of contaminants to the perched groundwater. After two consecutive years of non-detections for analyzed contaminants, and removal of all cPAH contaminated soils above cleanup levels, Boeing may request termination of groundwater monitoring at these three wells. However, any verified detections in groundwater analytes immediately require return to quarterly groundwater sampling for that well[34].

Groundwater sampling frequencies are intended to quickly detect contaminant migration from SWMU soils to the Esperance Sand Aquifer.

In addition, routine indoor air sampling will be performed for SWMU/AOC No. 11. Indoor air sample locations will be approved by Ecology in the EDR. Indoor air sampling will follow the sampling protocol consistent with Section 4.4.

As approved by Ecology, indoor air sampling frequency will be adjusted downward (but not eliminated) based on no indoor air exceedances of MTCA Method C levels and no increasing trends for consecutive indoor air sampling events. After one year of indoor air sampling events conducted during the summer and winter seasons, sampling frequency will be reduced to once per year in the season with highest indoor air concentrations. If indoor air concentrations remain below MTCA Method C cleanup levels and no increasing trends for two consecutive annual events, indoor air sampling frequency will be reduced to every other year. This assumes no building work is conducted that could exacerbate the vapor intrusion pathway.

At least two sub-slab vapor sampling events are also required at the Site if indoor air exceedances of MTCA Method C cleanup levels are detected or if Boeing proposes to terminate indoor air sampling.

5.10.6 INSTITUTIONAL/ENGINEERING CONTROLS

Institutional/engineering controls for the BOMARC Property cleanup alternatives are summarized in Table 5-4.

[34]Routine groundwater sampling and analyses will end when groundwater contamination below a SWMU is below cleanup levels and contaminated soil from the associated SWMU is excavated or otherwise treated and soil cleanup levels met through confirmation sampling.

For all BOMARC SWMUs/AOCs where routine indoor air sampling is required (TCE, Freon-12), institutional/engineering controls will be implemented as part of the final cleanup action. Institutional controls will be implemented as part of a **property-wide restrictive environmental covenant**, in accordance with WAC 173-340-440, on the Snohomish County property and recorded on the deeds registered with Snohomish County/City of Everett.

Until indoor air sampling is no longer required by Ecology, Boeing is required to submit and implement a site-wide Institutional Controls Management Plan that describes: (1) Annual monitoring/inspection/reporting of the land use and concrete/pavement integrity will be performed, and maintenance of the concrete/pavement will be completed as necessary to prevent exacerbation of the vapor intrusion pathway such that indoor air concentrations of TCE and 1,2-Freon may exceed Method C indoor air cleanup levels. (2) Institutional controls, requiring that pavement or building flooring remain in place and in good condition to prevent exacerbation of the vapor intrusion pathway into the 45-70 building. (3) Procedures are in place to protect Boeing and its contractor construction workers through requirements for notification, training, contaminated soil and perched groundwater handling, and appropriate personal protective equipment during work within these SWMUs/AOCs. Boeing shall notify Ecology prior to any work in contaminated soil or perched groundwater which is above cleanup levels.
(4) Institutional controls that would require addressing or mitigating potential vapor intrusion for any future building construction or existing building renovation in the area where the existing floor is penetrated or the renovations results in changes to building use. The goal of addressing/mitigating potential vapor intrusion is to protect tenants and their contractors from unacceptable contaminated indoor air exposure.

6.0 SCHEDULE FOR IMPLEMENTATION

The schedules for implementation of the cleanup actions are summarized in Sections 6.1 for the EPMs A-J/BOMARC Building and EPM K, respectively. Estimated restoration timeframes for each SWMU/AOC are included in Sections 5.1 through 5.11.

6.1 EXPOSURE PATHWAY MODELS A-I/BOMARC PROPERTY (DAYS REFERS TO CALENDAR DAYS)

Activity	**Schedule** (Days refers to Calendar Days)
Conduct annual monitoring/inspection of land use and concrete/pavement integrity	Annually starting the first month after Ecology's approval of the Institutional Controls Management Plan.
Submit Agency Review Institutional Controls Management Plan Submit Agency Review Environmental Covenants to Ecology for SWMUs where contamination is contained on Boeing Everett property	120 days following the effective date of the Enforcement Order
Environmental Covenants Finalized and Filed with Snohomish County	12 months following the approval of the Agency Review submittals
Submit Agency Review Site Wide Protection Monitoring Plan to Ecology for review	120 days following the effective date of the Enforcement Order
Submittal of Agency Review SWMU performance monitoring and confirmation monitoring plans (where containment of contamination with or without future excavation/treatment is required.)	120 days following the effective date of the Enforcement Order
Submit Agency Review work plan to Ecology for Additional soil investigation at SWMU Nos. 086, 089, and 094, SWMU No. 068, and SWMU No. 100	120 days following the effective date of the Enforcement Order
Submit Agency Review EDR, construction plans and specifications for near-term excavation (SWMUs Nos. 097, 055/168, 068), dewatering or groundwater extraction (SWMUs Nos. 055/168, 086/089/094), SVE (SWMUs Nos. 086/089/094), and all associated performance monitoring and confirmation monitoring plans submitted to Ecology	9 months following the effective date of the Enforcement Order or 120 days following the approval of any Ecology required work plans for additional investigations at those SWMUs
Conduct indoor air monitoring	Begin within 30 days of Ecology approval of protection and performance monitoring plans. Frequency of indoor air monitoring specified by Ecology

Activity	**Schedule** (Days refers to Calendar Days)
	CAP, EDR, and performance monitoring plans.
Remedy construction **completed and operational** for near-term excavation (SWMU Nos. 097, 055/168, 068), SVE (SWMU Nos. 086/089/094) (also includes routine sampling and analysis of extracted vapors), and groundwater extraction or dewatering) (SWMU Nos. 086, 089, and 094, and SWMU Nos. 055 and 168)	12 months after Ecology approval of the EDR
Submit Agency Review EDR, construction plans and specifications for future excavation or other Ecology approved remedial action (SWMU Nos. 055/168, 177, 054, 165, 067/071, 093, Bld 40-22 Utility Slants #2, #3, Bld 40-23 Static Test Pad, UST EV 48-1) and future SVE (SWMU 171) submitted to Ecology. Associated performance and confirmation monitoring plans submitted to Ecology.	Consistent with Section 4.4.
Remedy construction **completed and operational** for future excavation and future remedial actions (SWMU Nos. 055/168, 177, 054, 165, 067/071, 093, Bld 40-22 Utility Slants #2, #3, Bld 40-23 Static Test Pad, UST EV 48-1) in accordance with Section 4.4. This includes future SVE at SWMU 171 (also includes routine sampling and analysis of extracted vapors).	Timeline in accordance with Ecology approved supplemental EDR.
Submit an Agency Review (Draft) engineering as-built report for each SWMU.	Within 90 calendar days of construction completion of SWMU remedial action system.
Submit revised engineering as-built report for each SWMU to Ecology including all Ecology comments.	Within 30 calendar days of receipt of Ecology comments
Maintenance of concrete/pavement	As needed but reported in annual reports to Ecology
Remove institutional controls	After Ecology confirms all media concentrations below cleanup levels and Ecology completes required comment period for removal of an environmental covenant.

Activity	**Schedule** (Days refers to Calendar Days)
All documents requested by Ecology as additional work and all revised documents submitted to Ecology in accordance with Ecology comments.	Delivered 30 days after receiving Ecology comments on a document or Ecology request for additional work

6.2 EXPOSURE PATHWAY MODEL K (POWDER MILL GULCH)

Activity	**Schedule**(Days refers to Calendar Days)
Submit Agency Review Environmental Covenants to Ecology for the City of Everett (Lot#9), Seaway Center, and PMCB properties	120 days following the effective date of the Enforcement Order
Boeing, City of Everett Lot #9, Seaway Center, and PMBC property Environmental Covenant Finalized and Filed with Snohomish County	12 months following the Ecology approval of the Environmental Covenants
Agency Review EISB source area design EDR (work plan and compliance monitoring submitted to Ecology[35])	6 months following the effective date of the Enforcement Order
EISB injections into the source area initiated	Within 3 months after EISB EDR approved by Ecology
Agency Review DGR pilot study work plan submittal to Ecology (preparation of work plan, technical designs and bid documents; does not include Ecology review and approval)	6 months following the effective date of the Enforcement Order
DGR pilot study construction completed (including bidding and contractor procurement)	9 months after Ecology approval of pilot study EDR

[35] Ecology response letter dated September 5, 2019 stated, *Ecology assumes that source area and downgradient groundwater remediation will occur concurrently…*and that ... *Ecology expects source area EISB to be implemented immediately, even if an analysis of contingent downgradient remedies is later required.*

DGR pilot study implemented	Immediately after construction completed.
Agency Review DGR pilot study technical memorandum submitted to Ecology summarizing the results of the DGR pilot study and providing recommendations to begin full scale DGR design or request a time extension to continue the DGR pilot study.	Technical memorandum submitted one year after DGR pilot study start up or as required under any time extension.
Ecology determination DGR pilot study operation completed (field implementation, data collection) and submittal of final DGR pilot study technical memorandum with conceptual design of full scale DGR system.	DGR pilot study final technical memorandum submitted to Ecology within 120 days after Ecology determines DGR pilot study is completed.
Agency Review Full scale DGR EDR, construction plans and specifications and compliance monitoring plan submitted to Ecology (preparation of EDR, construction plans and specifications, operations and maintenance plan, and bid documents; does not include Ecology review and approval)	9 months after Ecology approval of the DGR pilot study final technical memorandum.
DGR system full-scale construction completed (including bidding and contractor procurement)	12 months after Ecology approval of full-scale DGR EDR. Boeing may request a time extension if needed.
All documents requested by Ecology as additional work and all revised documents submitted to Ecology in accordance with Ecology comments. Additional work documents include but not limited to MNA work plans, additional EISB injection work plans, etc.	Delivered 30 days after Ecology comments on a document or 30 days after Ecology request for additional work

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Ecology. 2019a. Letter Re: The Boeing Everett Site, Final Decision on the Remaining Three Issues under Dispute Resolution Agreed Order DE96HS-N274. From Raman Iyer, Section Manager, Washington State Department of Ecology, Northwest Regional Office, to Katie Moxley, Manager, Environmental Remediation, The Boeing Company. February 8

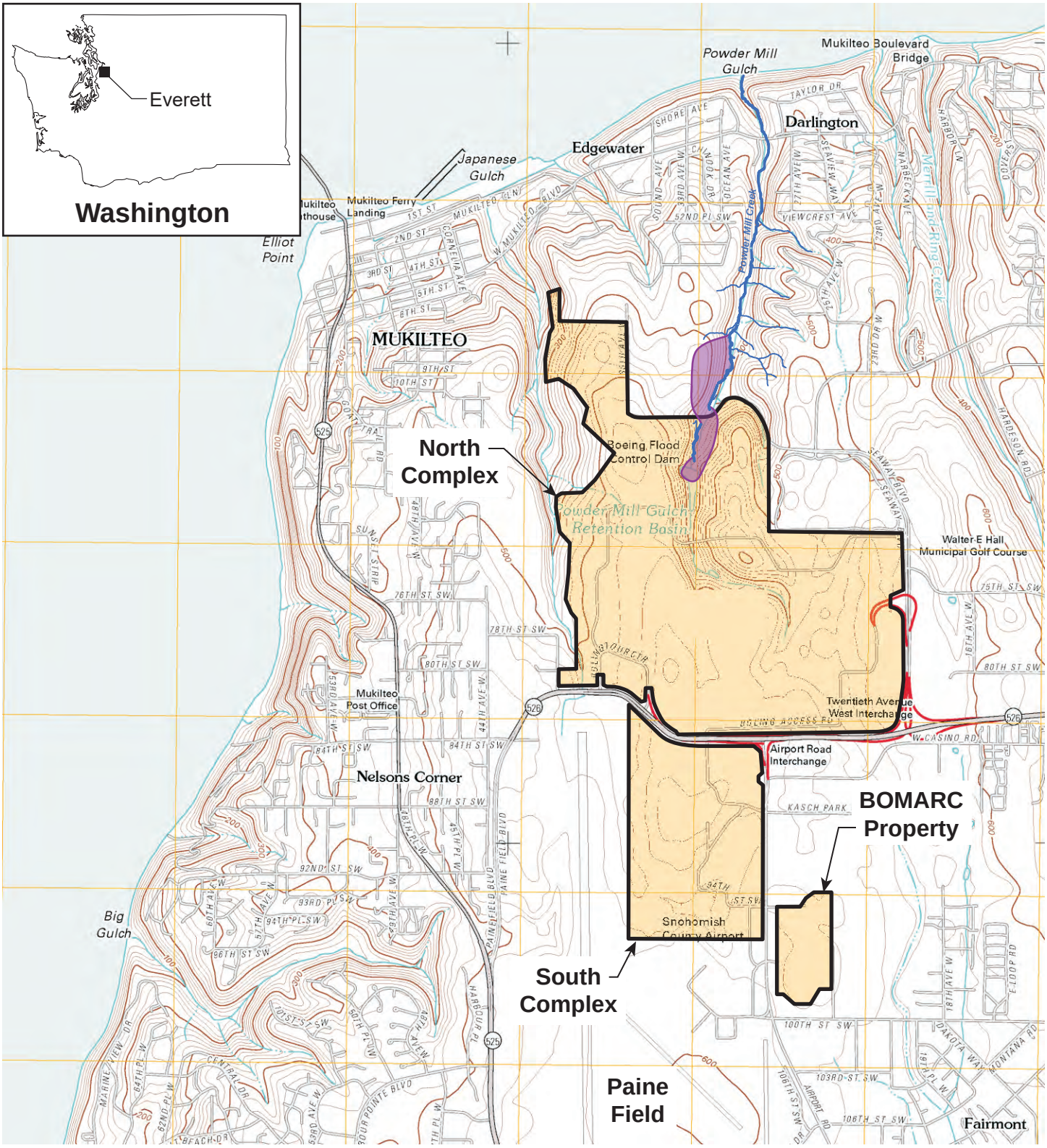
Ecology. 2019b. Letter Re: Washington State Department of Ecology Final Decision Under Formal Dispute Resolution: Agreed Order No. DE96HS-N274, Upland Deep Groundwater Monitoring Wells, Groundwater Sampling Frequency and Indoor Air Sampling at the 40-56 Building. From Raman Iyer, Section Manager, Washington State Department of Ecology, Northwest Regional Office, to Katie Moxley, Manager, Environmental Remediation, The Boeing Company. May 2.

Ecology. 2019c. Letter Re: Washington State Department of Ecology Response to the Supplemental Feasibility Study, dated November 29, 2018. From Raman Iyer, Section Manager, Washington State Department of Ecology, Northwest Regional Office, to Katie Moxley, Manager, Environmental Remediation, The Boeing Company. September 5.

Ecology. 2019d. Letter Re: Washington State Department of Ecology (Ecology) Response to The Boeing Company Letter, Dated October 14, 2019 AND Ecology Requirements to Submit the Draft Uplands Cleanup Action Plan. From Raman Iyer, Section Manager, Washington State Department of Ecology, Northwest Regional Office, to Katie Moxley, Manager, Environmental Remediation, The Boeing Company. November 4.

Ecology website. 2020. Water Resources Explorer – Online Water Rights Database ;https://fortress.wa.gov/ecy/waterresources/map/WaterResourcesExplorer.aspx. Accessed January 2020.

FIGURES



Source: USGS 7.5-minute topographic quadrangle, Mukilteo, Washington, 2011

Legend

- Everett Plant boundary
- Inferred Area with TCE Concentration in Groundwater > 4 µg/L

0 0.5 1.0

Scale in Miles

Figure 1-1

Site Vicinity Map

AECOM

Boeing Everett Facility
draft Cleanup Action Plan

Boeing Everett Plant - Soil, Groundwater, and Surface Water Areas of Concern

- Everett Plant Boundary
- BOMARC Property Parcel Boundary
- Soil Contamination Above FS Cleanup Level
- Soil Vapor Above FS Cleanup Levels
- Flightline Area with Residual PCBs in Joint Compound and Underlying Soil
- TCE in Groundwater Downgradient Plume Above FS CULs
- Boeing Lake
- TCE Source Area
- Former Gun Club Areas
- Existing Deep Monitoring Well
- New Deep Monitoring Well

N

1,000 500 0 1,000

Feet

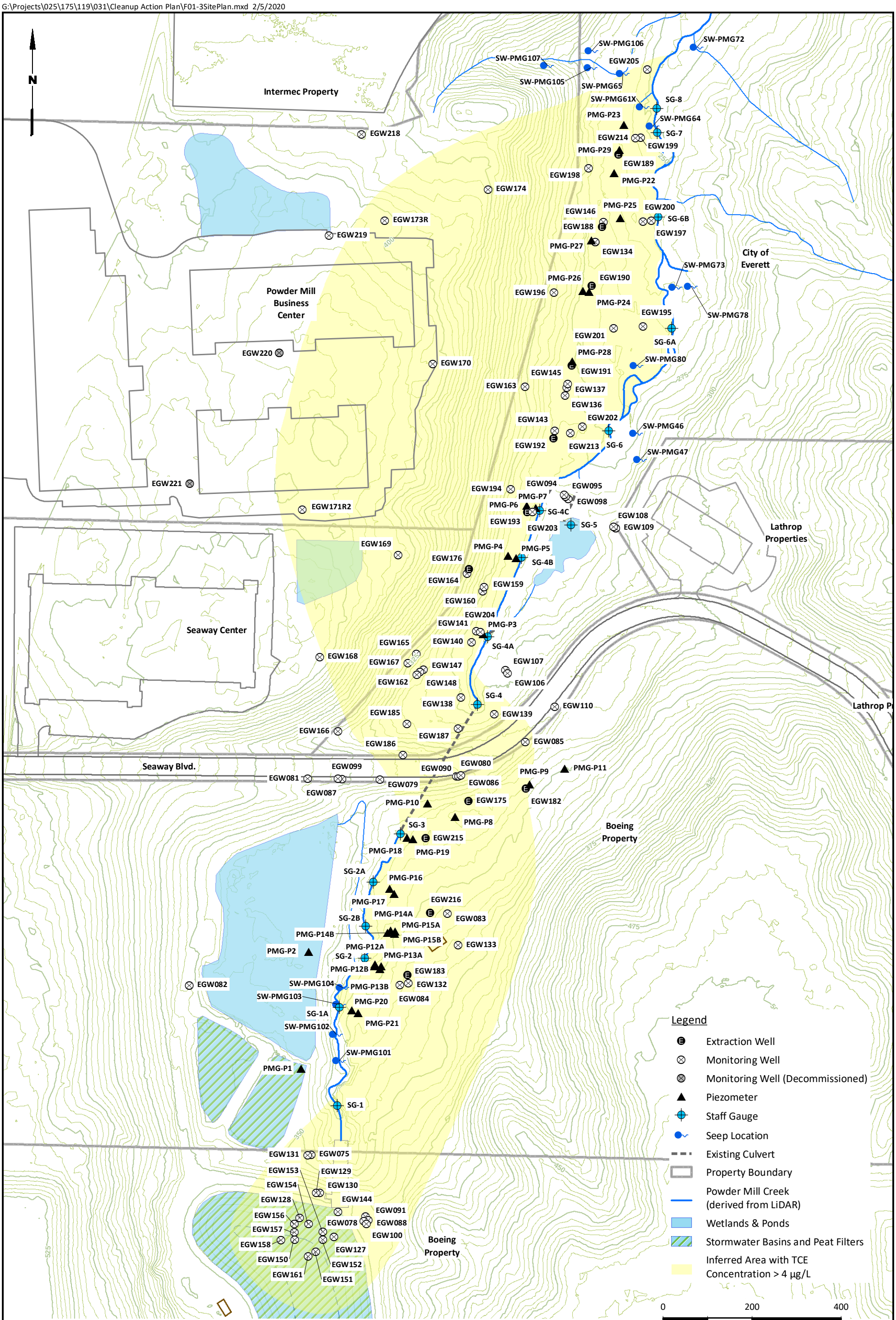
Note: Sediment AOCs 3A and Former Gun Club Area B will be included in the Sediment CAP.

Imagery ©2017 , CNES / Airbus, DigitalGlobe, Island County, U.S. Geological Survey, USDA Farm Service Agency

Figure 1-2

Site Plan – Boeing Everett Plant

G:\Projects\025\175\119\031\Cleanup Action Plan\F01-3SitePlan.mxd 2/5/2020



Note

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

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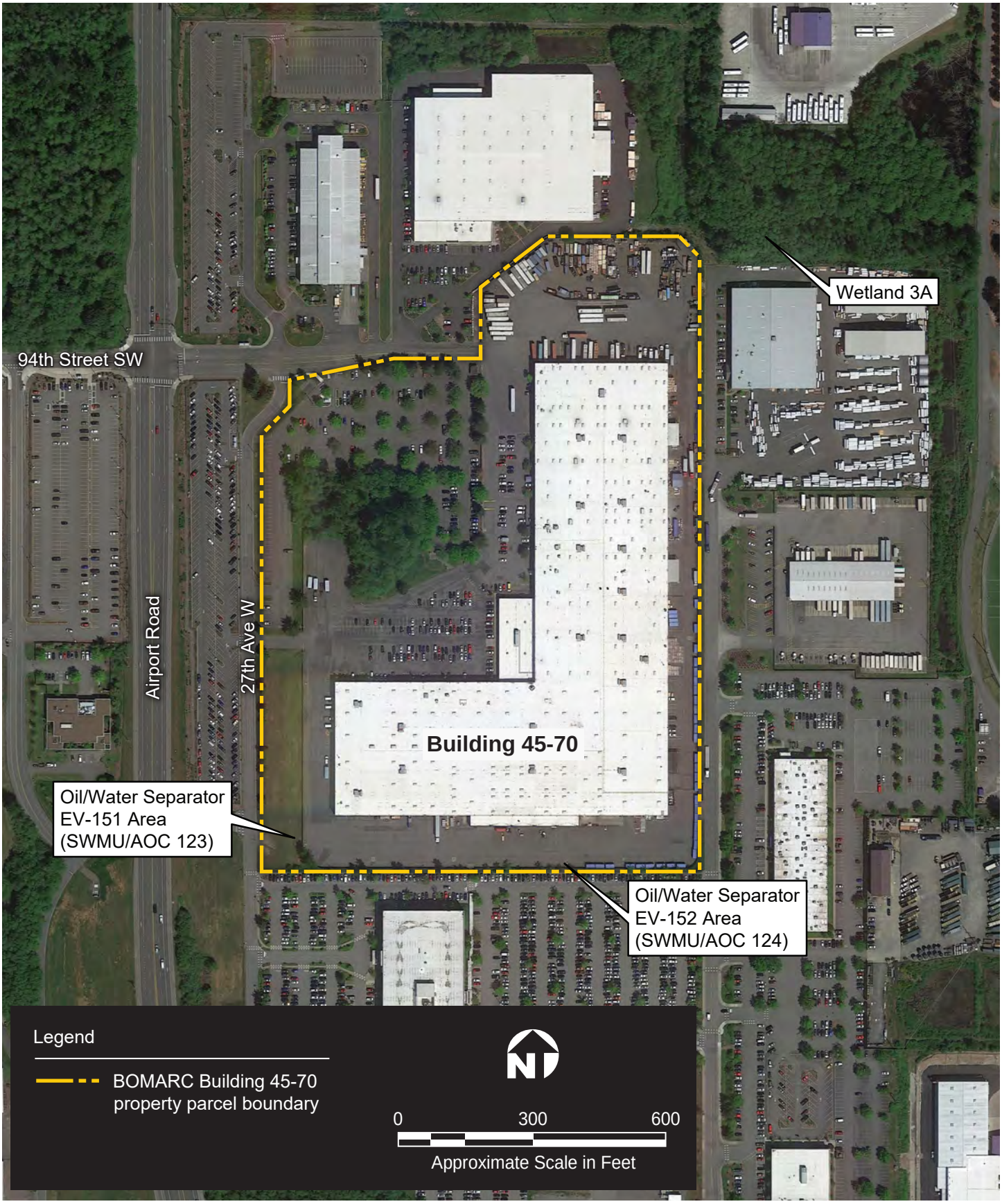
Boeing Everett Facility Draft Cleanup Action Plan Everett, Washington	**Site Plan - Powder Mill Gulch**	Figure 1-3



Source: Google Earth Pro, imagery dated 5/13/18

Figure 1-4

Site Plan – BOMARC Building 45-70

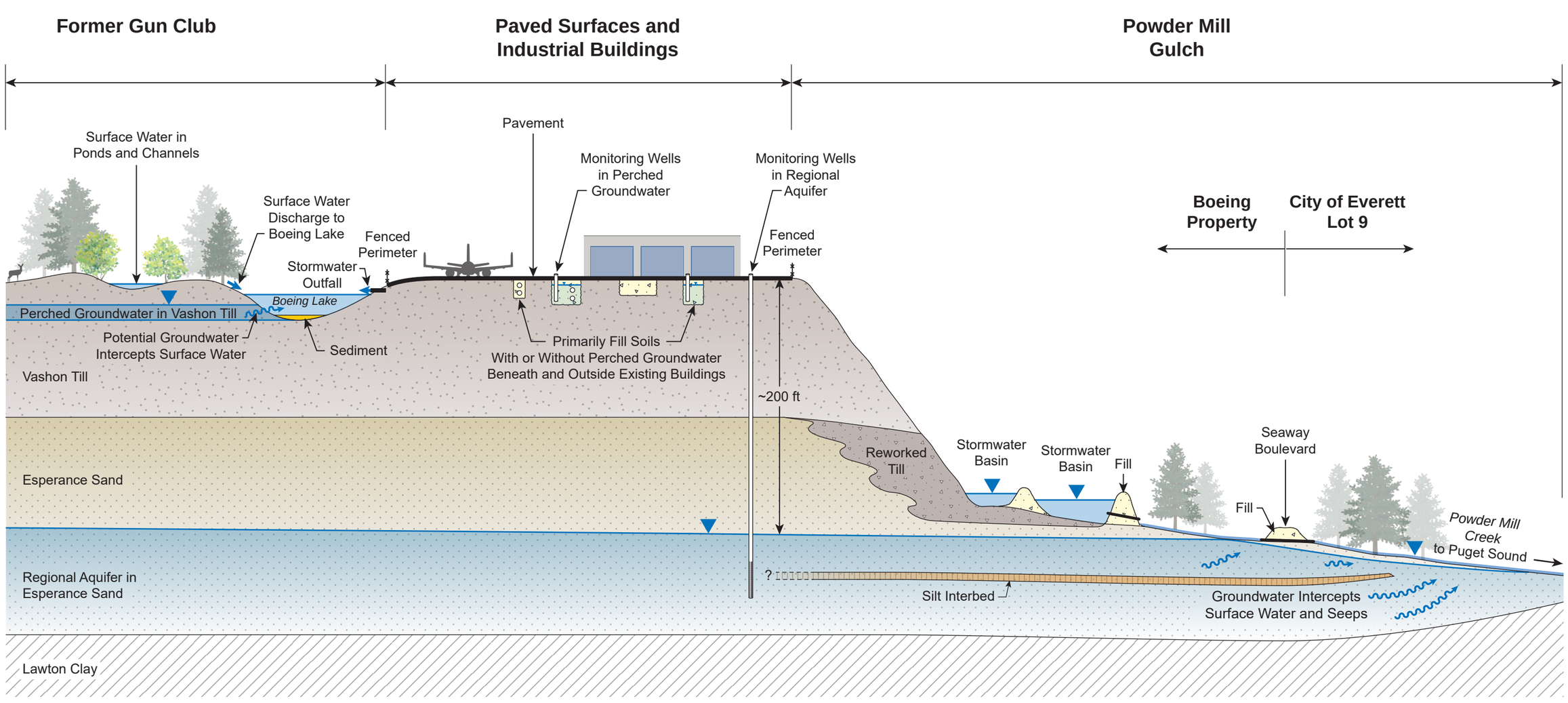
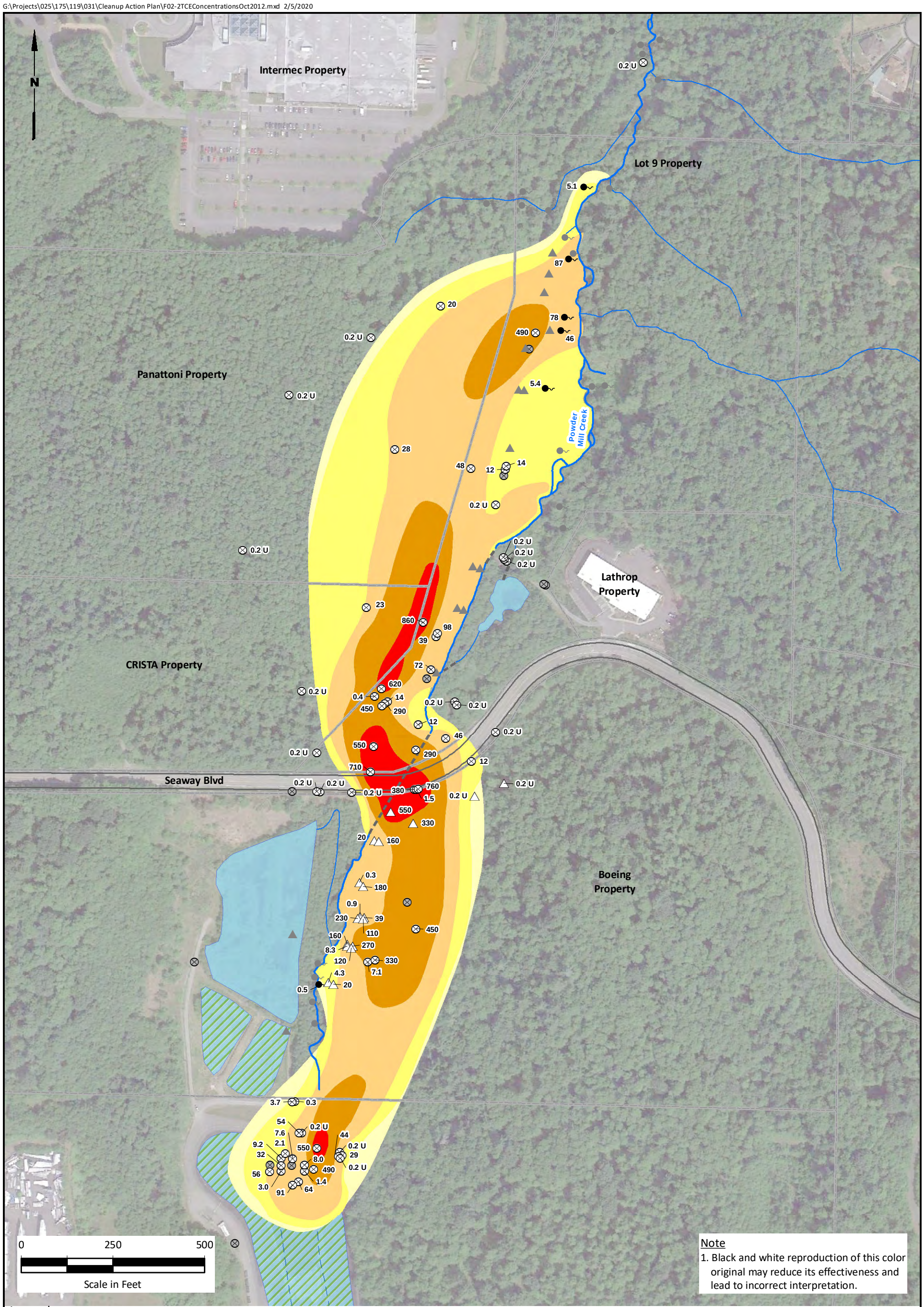


Figure 2-1
Sitewide Conceptual Site Model

G:\Projects\025\175\119\031\Cleanup Action Plan\F02-2TCEConcentrationsOct2012.mxd 2/5/2020



Legend

Samples Collected in October 2012
- Monitoring Well
- Piezometer
- Seep

Other Monitoring Locations
- Monitoring Well
- Piezometer
- Seep

- 0.49 ≤ TCE < 4 µg/L
- 4 ≤ TCE <25 µg/L
- 25 ≤ TCE <250 µg/L
- 250 ≤ TCE <500 µg/L
- 500 ≤ TCE <2,500 µg/L
- Wetlands & Ponds
- Stormwater Basins and Peat Filters
- Existing Culvert

Data Sources: Google Earth Pro.

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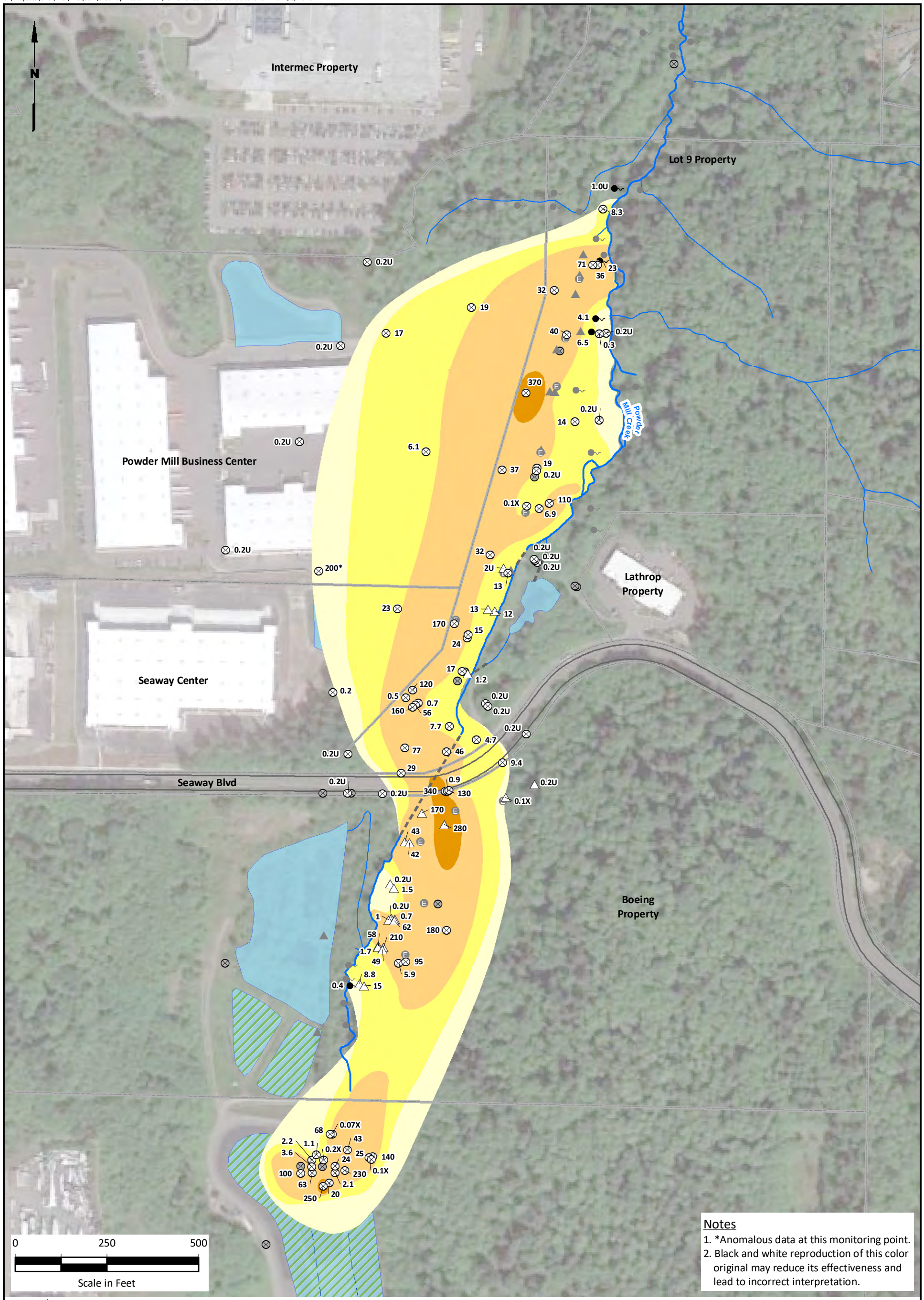
Boeing Everett Facility
Draft Cleanup Action Plan
Everett, Washington

Baseline TCE Concentrations - October 2012 (Pre-Interim Action Groundwater Conditions)

Figure 2-2

G:\Projects\025\175\119\031\Cleanup Action Plan\F02-3TCEConcentrationsOct2019.mxd 2/5/2020



Legend

Samples Collected in October 2019
- Monitoring Well
- Piezometer
- Seep

Other Monitoring Locations
- Monitoring Well
- Piezometer
- Seep
- Extraction Well

- 0.3 ≤ TCE <4µg/L
- 4 ≤ TCE <25 µg/L
- 25 ≤ TCE <250 µg/L
- 250 ≤ TCE <500 µg/L
- Wetlands & Ponds
- Stormwater Basins and Peat Filters
- Existing Culvert

Data Sources: Google Earth Pro. Aerial Photo Date: 5/18.

LANDAU ASSOCIATES

Boeing Everett Facility Draft Cleanup Action Plan Everett, Washington	**Current TCE Concentrations - October 2019 (Post-Interim Action Groundwater Conditions)**	Figure 2-3

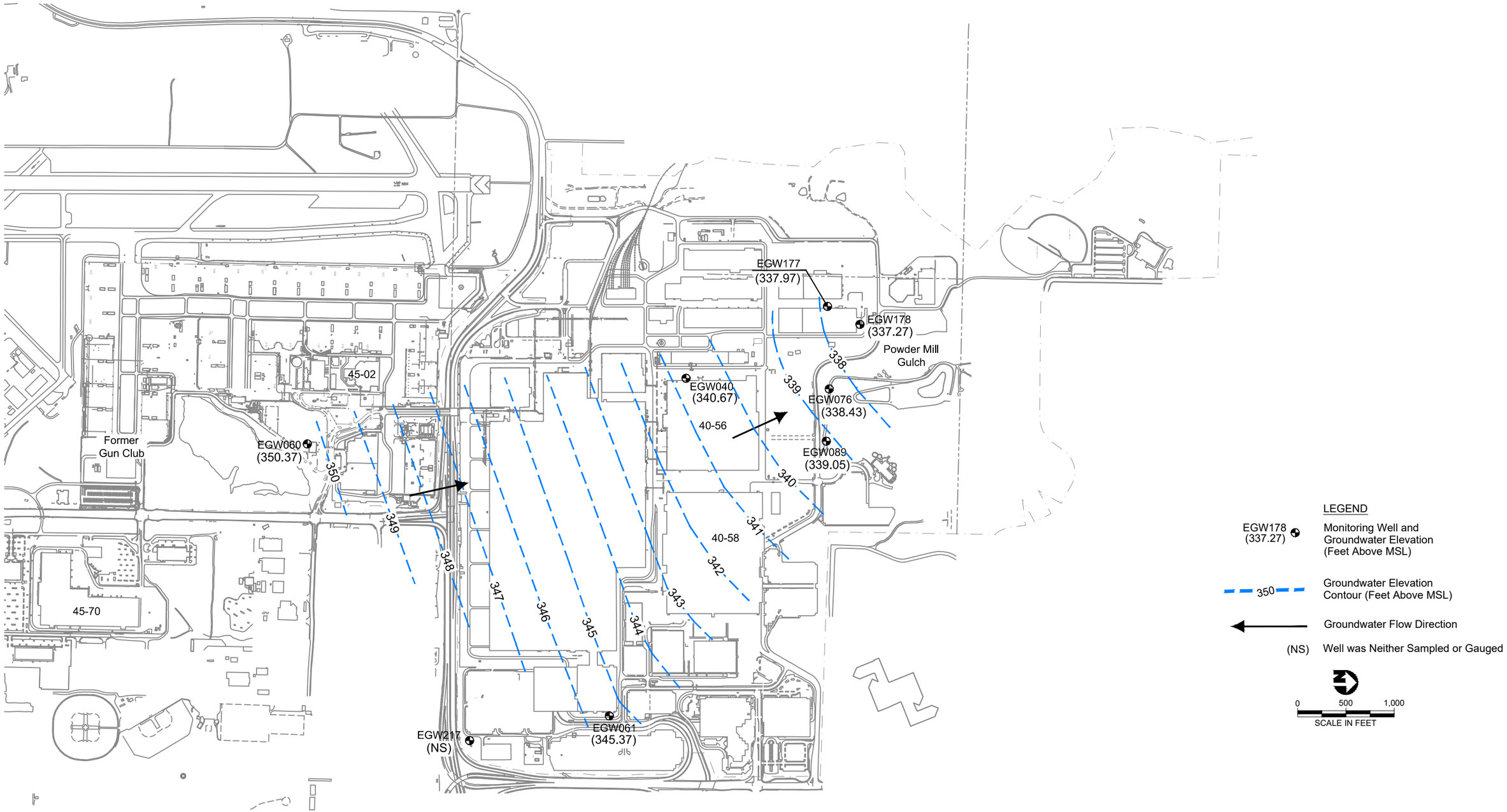
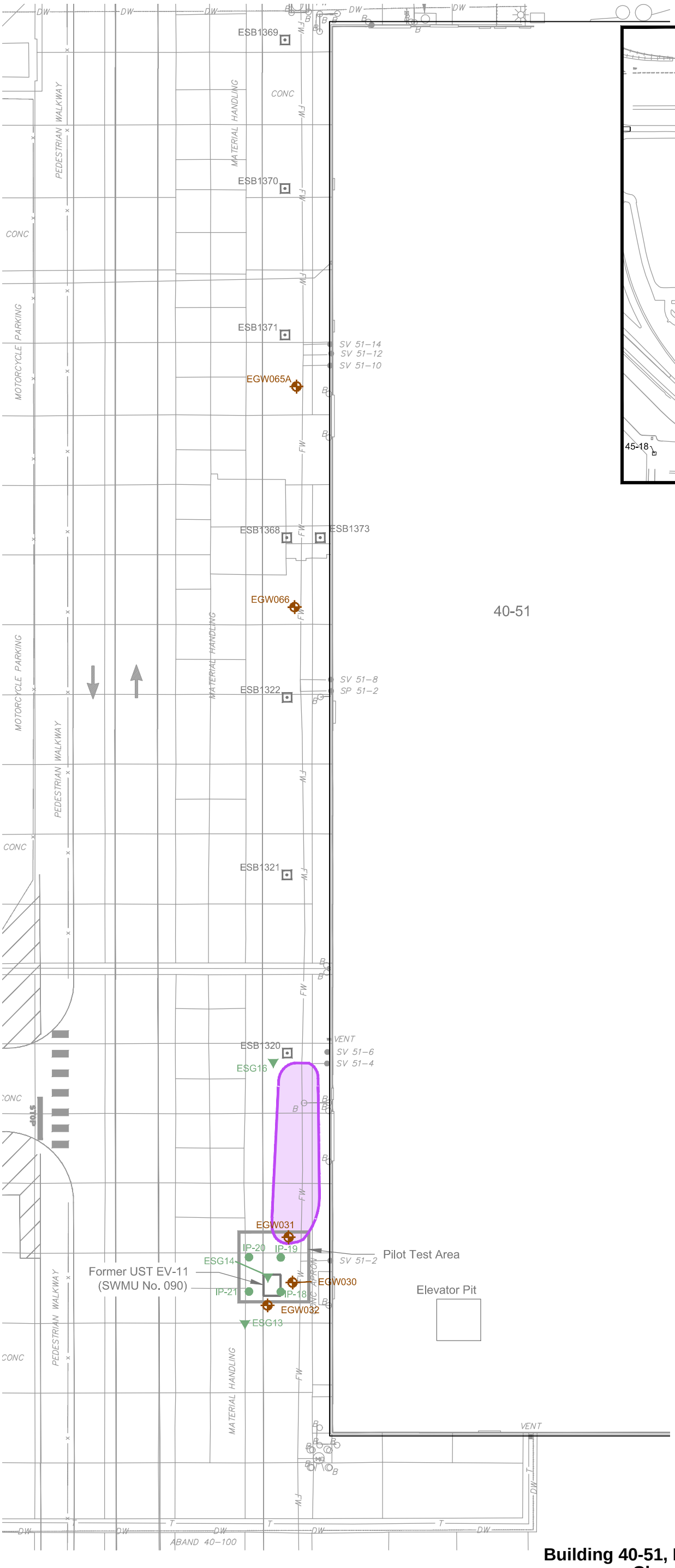
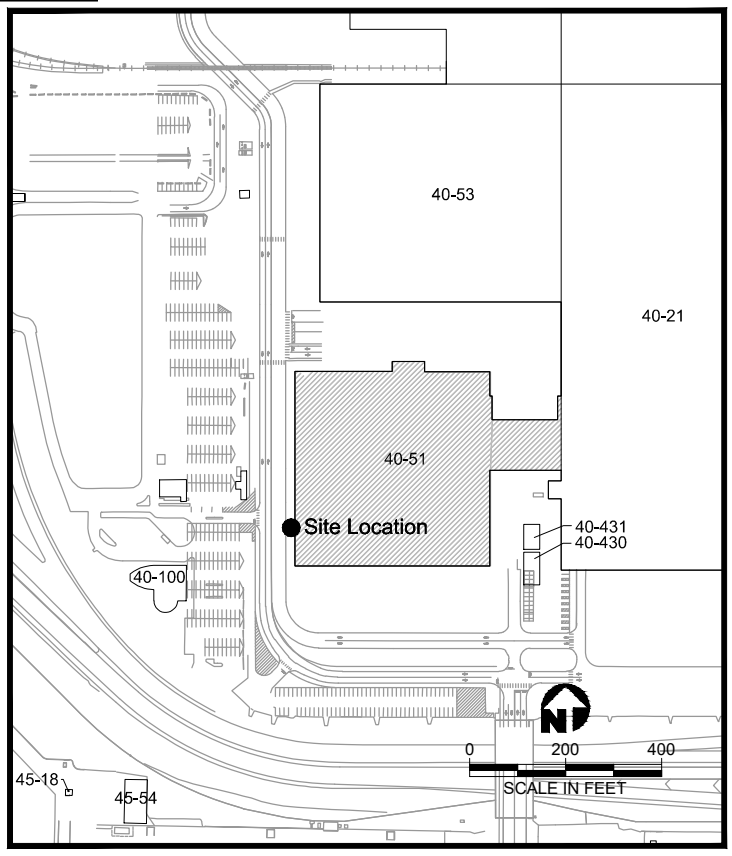


Figure 2-4
Groundwater Elevation Contour Map
Upland Esperance Sands - October 2018





40-51

Legend

- Groundwater Monitoring Well
- Historical Grab Groundwater Sample
- Historical Soil Boring
- FS Injection Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Groundwater Monitoring Well Planned for Monitoring
- Estimated Area of Perched Groundwater Contamination

Notes:

1. Indoor air monitoring to be performed in the building.
2. Institutional controls will be applied to the SWMU/AOC.

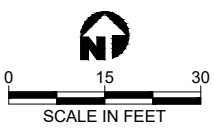
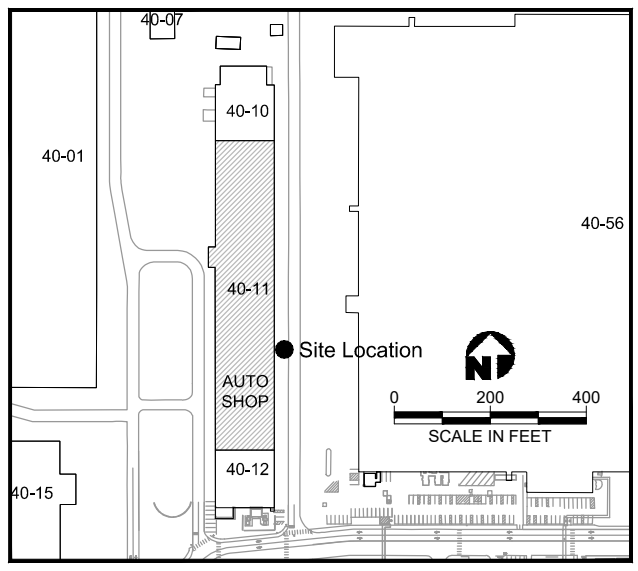


Figure 5-1
Building 40-51, Former UST EV-11 (SWMU/AOC No. 090)
Cleanup Alternative 1 - Maintain Containment



Inter-Plant Transportation Artery

Steel Lined Concrete Containment Trench

Building 40-11 Exterior Wall

Building 40-11 (Auto Shop)

Steam Clean Area

4" Pipe

4" Drain

3" Pipe

2" Pipe

Vent

4" Pipe

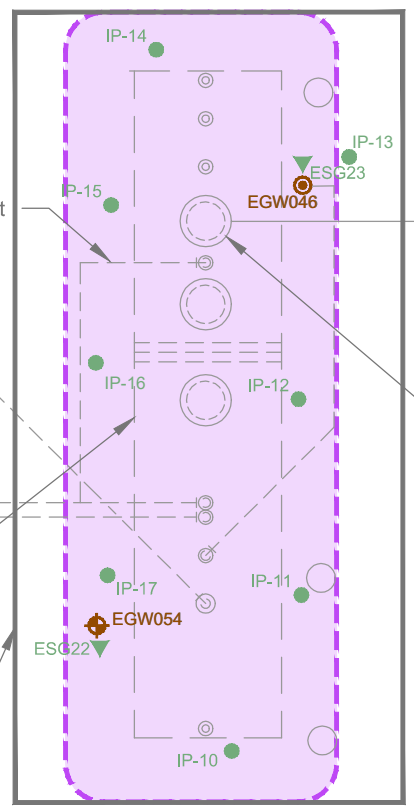
2" Vent

To Wasterwater Treatment Plant

Sump Pump

12,000 Gallon Double Wall Steel Oil/Water Separator EV-118-1 (SWMU/AOC No. 112)

Pilot Test Area



Legend

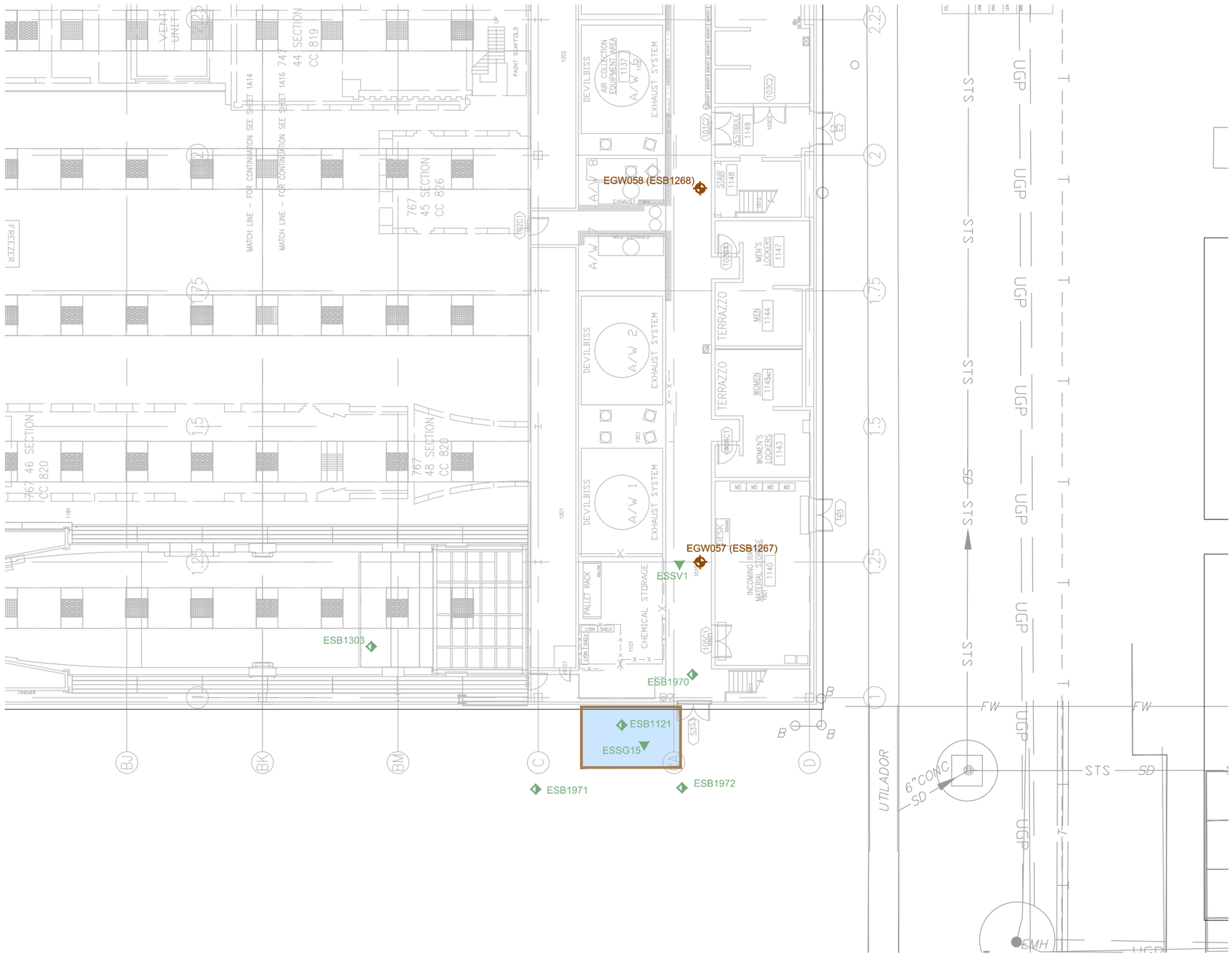
- Groundwater Monitoring Well to be Monitored
- Groundwater Recovery Well
- FS Injection Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Perched Groundwater Contamination (Dashed Where Inferred)
- Catch Basin/ Floor Drain

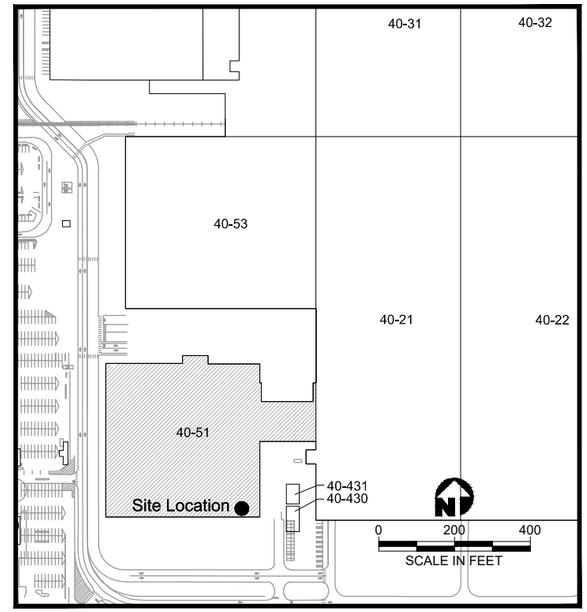
0 5 10
SCALE IN FEET

Notes:

1. Indoor air monitoring to be performed in the building.
2. Institutional controls will be applied to the SWMU/AOC.

Figure 5-2
Building 40-11, Oil/Water Separator (SWMU/AOC No. 112)
Cleanup Alternative 1 - Maintain Containment





Legend

- Groundwater Monitoring Well to be Monitored
- Historical Soil Boring
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Gas Contamination (Dashed Where Inferred)

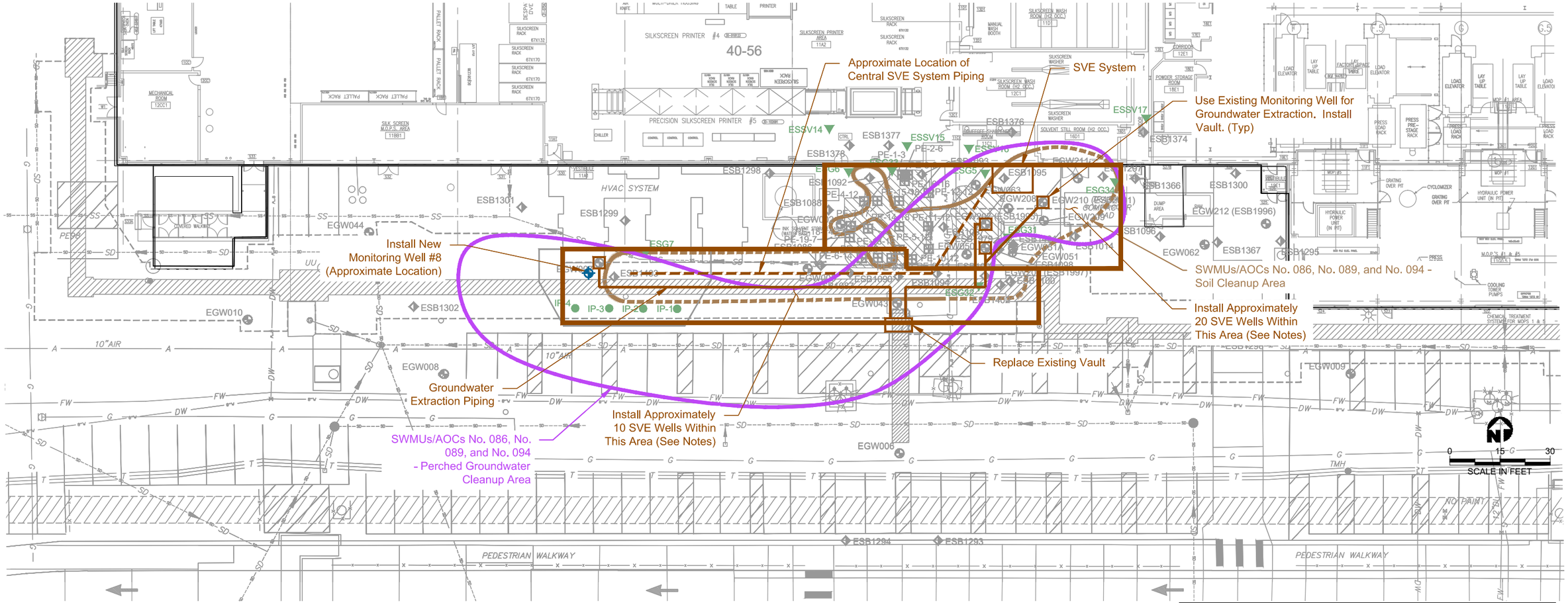
Notes:

1. Institutional controls will be applied to the SWMU/AOC.

0 10 20
SCALE IN FEET

Figure 5-3
Building 40-51, Southern Air Scrubber Sump (SWMU/AOC No. 151)
Cleanup Alternative 1 - Maintain Containment

Boeing Everett Facility
draftt Cleanup Action Plan



Legend

- Historical Soil Boring
- Historical Monitoring Well
- Abandoned Groundwater Monitoring Well
- Historical Excavation Sample
- FS Soil Gas or Sub-slab Vapor Sample
- FS Injection Boring
- FS Monitoring Well
- Groundwater Monitoring Well
- New Groundwater Monitoring Well to be Installed
- Recovery Trench
- Former UST Excavation
- Redundant Steam Line Utility Upgrade Excavation
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Estimated Area of Perched Groundwater Contamination (Dashed Where Inferred)
- Sawcut of Pavement and Approximate Limits of Excavation for the 2011 Steamline Replacement
- Groundwater Extraction Piping
- SVE Piping

Notes:

1. New monitoring Well #8 to be installed.
2. Groundwater monitoring to be performed at new Well #8.
3. Additional groundwater monitoring to be performed at EGW040.
4. Indoor air monitoring to be performed in the building.
5. Engineering design report will provide details.

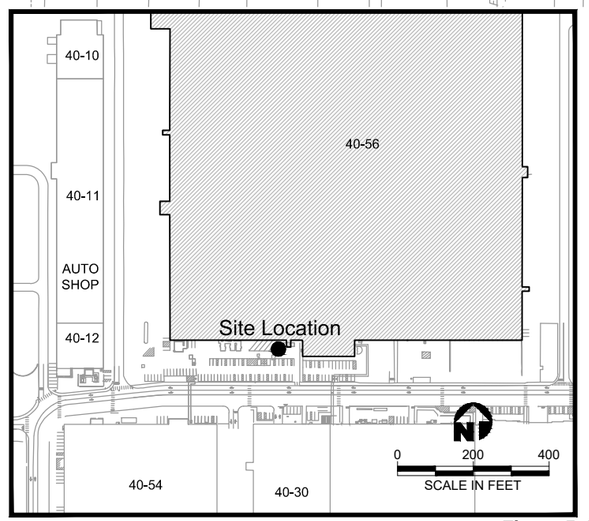
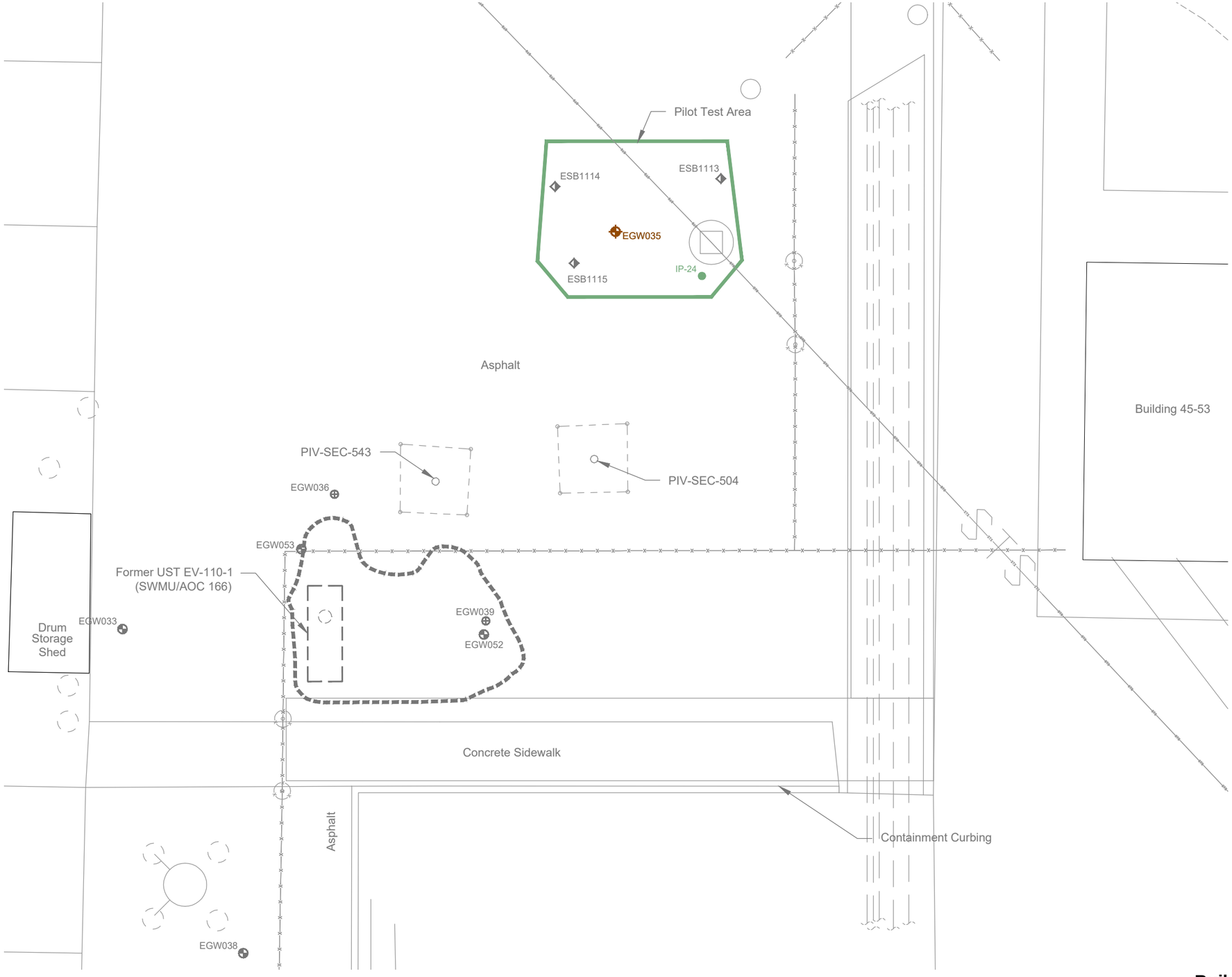
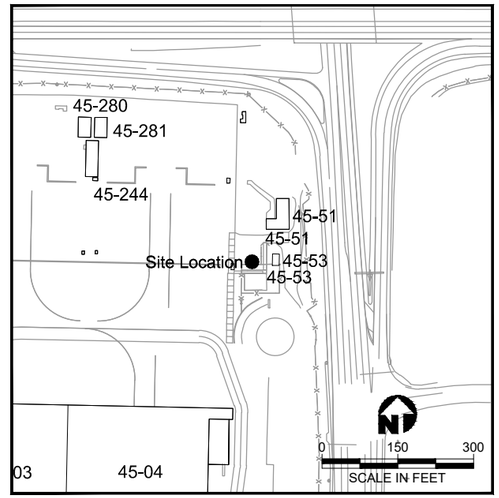


Figure 5-4
Building 40-56, Former USTs (SWMUs/AOCs No. 086, No. 089, and No. 094)
Modified Cleanup Alternative 2 - Soil Vapor and Groundwater Extraction





Legend:

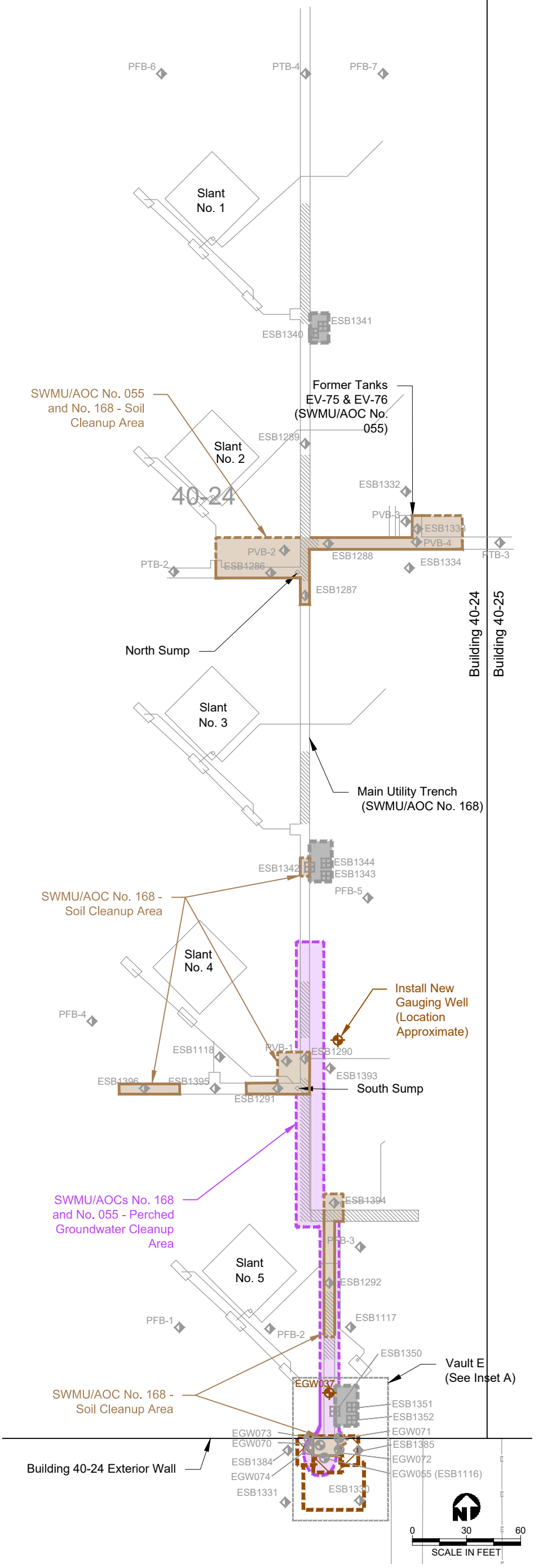
- Groundwater Monitoring Well
- Abandoned Groundwater Monitoring Well (Abandoned February 1997)
- Historical Soil Boring
- FS Injection Boring
- Groundwater Monitoring Well to be Monitored
- Chain Link Fence
- STS — Storm Drain
- Abandoned Subsurface Gravity Feed Drain
- Edge of Former Excavation

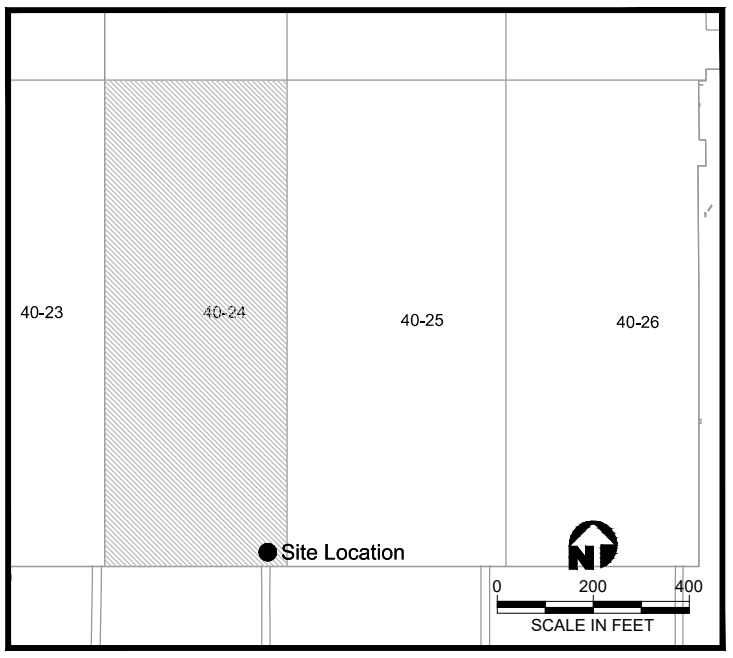
Note:

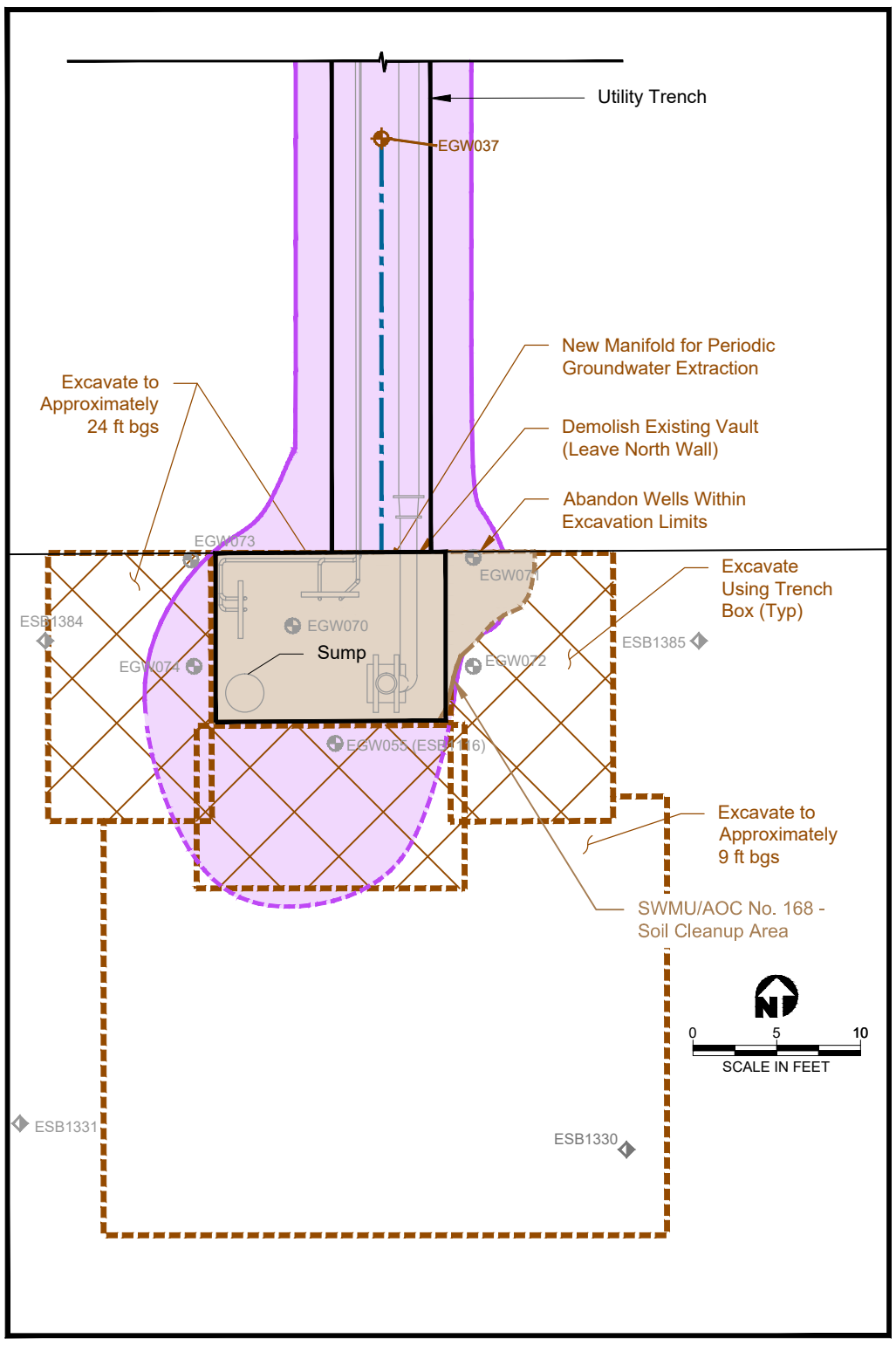
1. Institutional controls will be applied to the SWMU/AOC.

0 4 8
SCALE IN FEET

Figure 5-5
Building 45-53, UST EV-110-1 (SWMU/AOC No. 166)
Modified Cleanup Alternative 1 - Maintain Containment







VAULT E (Inset A) (SWMU/AOC No. 168)

Legend

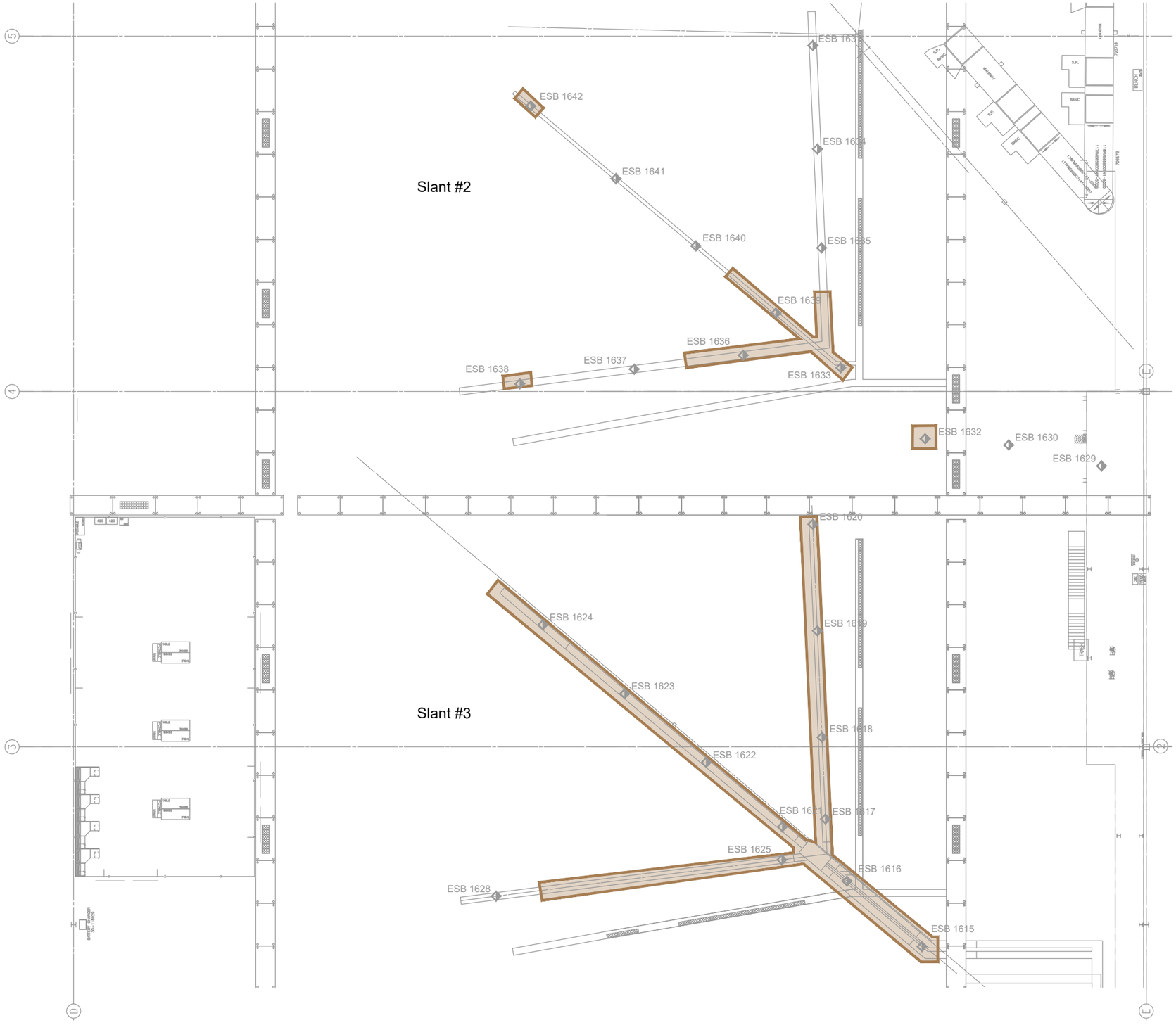
- Groundwater Monitoring Well
- New Gauging Well to be Installed
- Historical Soil Boring
- Historical Excavation Sample
- Estimated Area of Perched Groundwater Contamination (Dashed Where Inferred)
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Floor of Trench Inaccessible To Drilling
- Historical Utility Vault Excavation
- Approximate Excavation Limits
- Groundwater Extraction Tubing

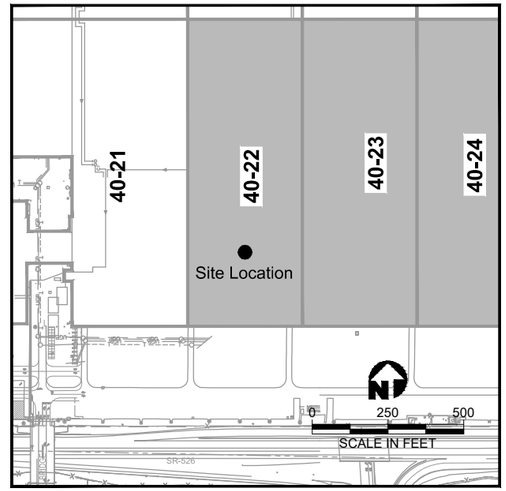
Notes:

1. New Well #1 will be installed into the Esperance Sand aquifer north of building 40-24.
2. Groundwater monitoring to be performed at new Well #1.
3. Engineering design report will provide further details.

Figure 5-6

Building 40-24 (SWMU/AOCs No. 055 and No. 168)
Modified Cleanup Alternative 4 - Near-Term Excavation and Dewatering





LEGEND:

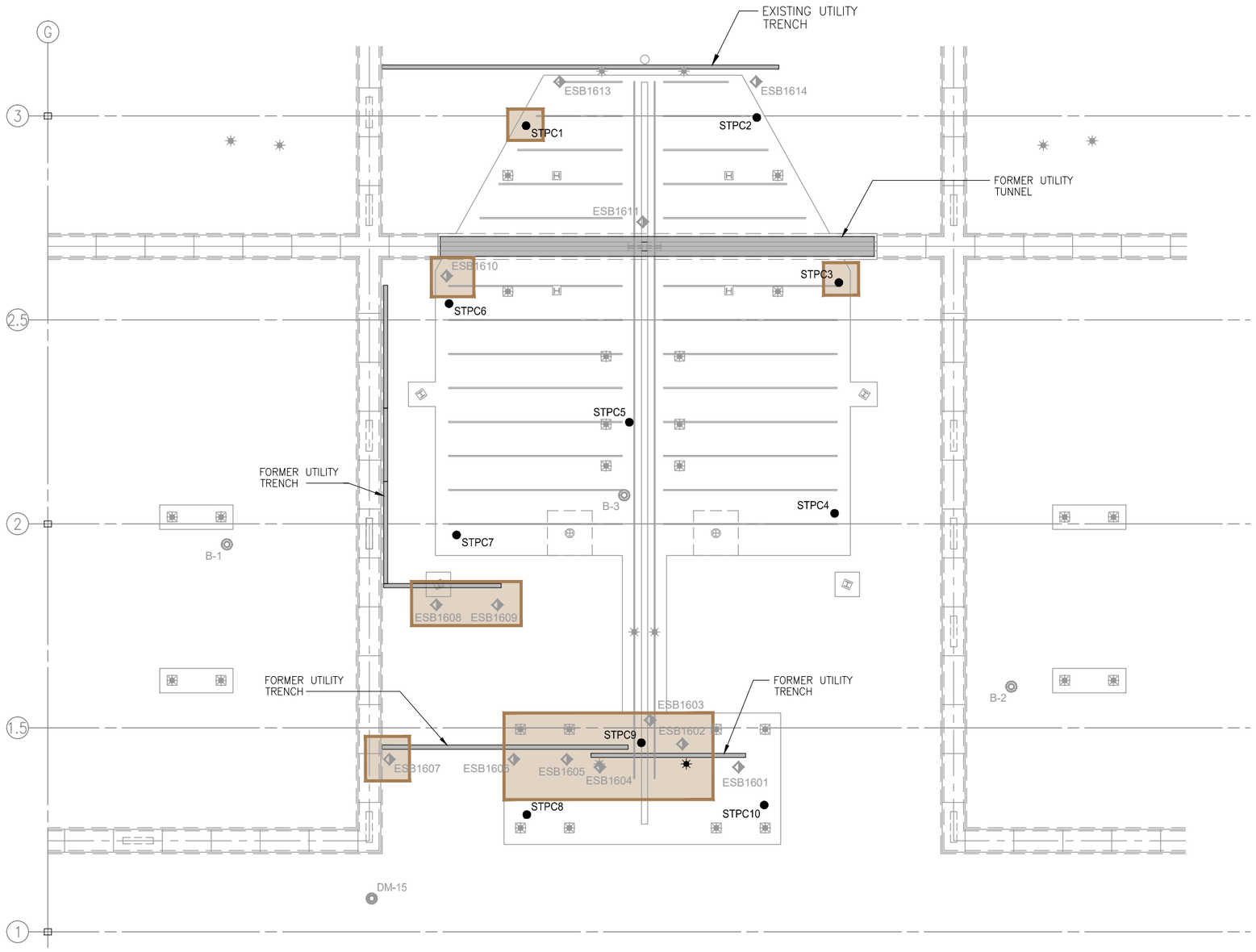
ESB 1600 Historic Soil Boring

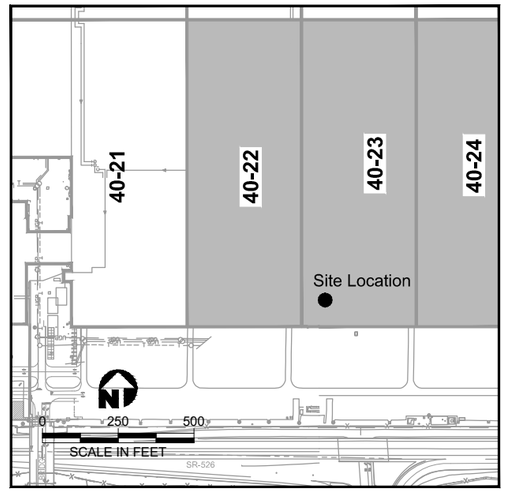
Estimated Area of Soil Contamination (Dashed Where Inferred)

Notes:

1. Institutional controls will be applied to the SWMU/AOC.

Figure 5-7
Building 40-22, Slant #2 and #3
Maintain Containment With Future Excavation





LEGEND:

- STPC1 — Historical Sample Location
- Tie-Down Anchor Point
- ESB1600 — Historical Soil Boring (URS 2006)
- DM-15/B-1 — Historical Geotechnical Boring
- Estimated Area of Soil Contamination

Notes:

1. Institutional controls will be applied to the SWMU/AOC until soil cleanup levels met.

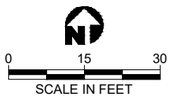
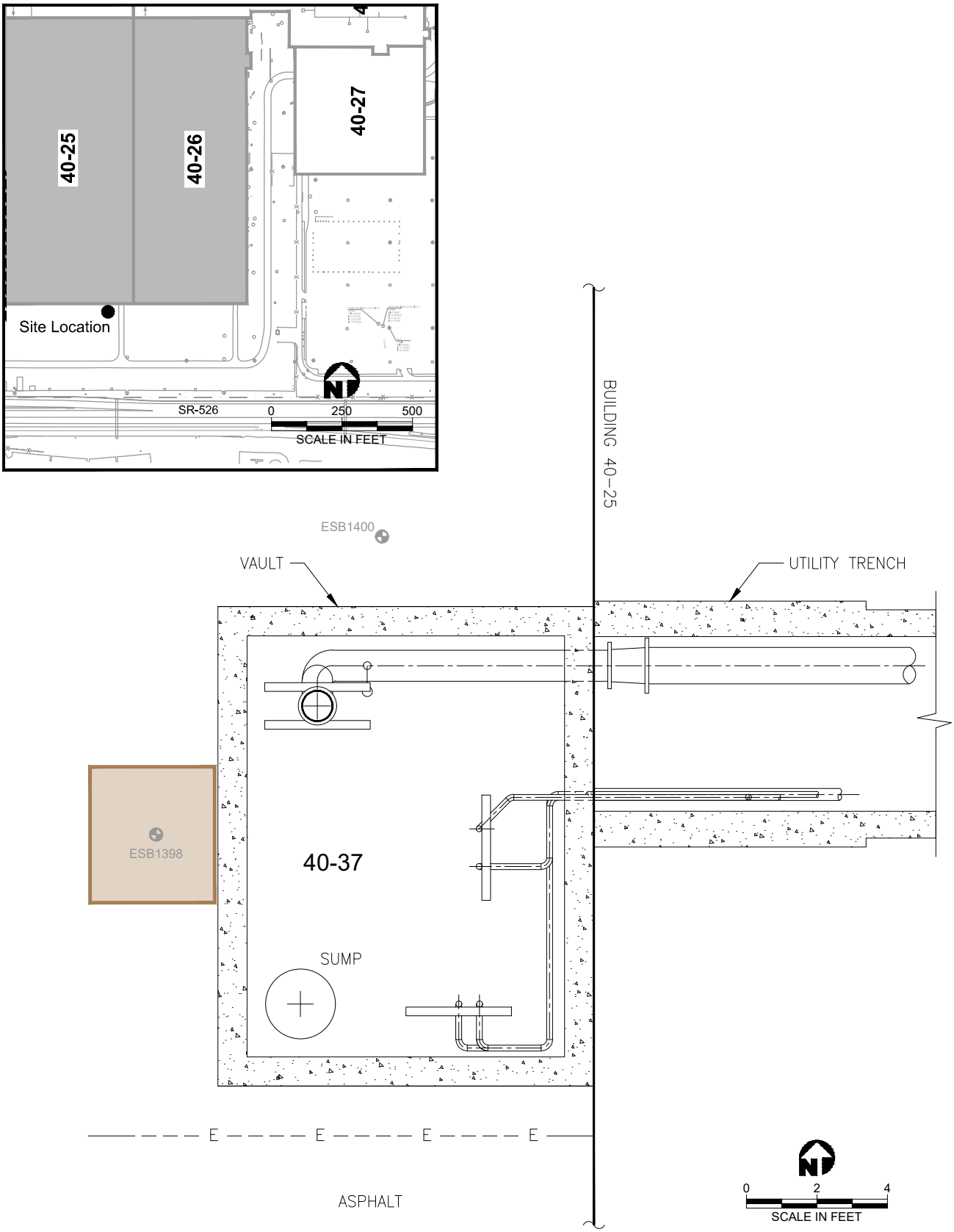


Figure 5-8
Building 40-23, Static Test Pad
Maintain Containment With Future Excavation



Legend:

ESB1400 Groundwater Monitoring Well

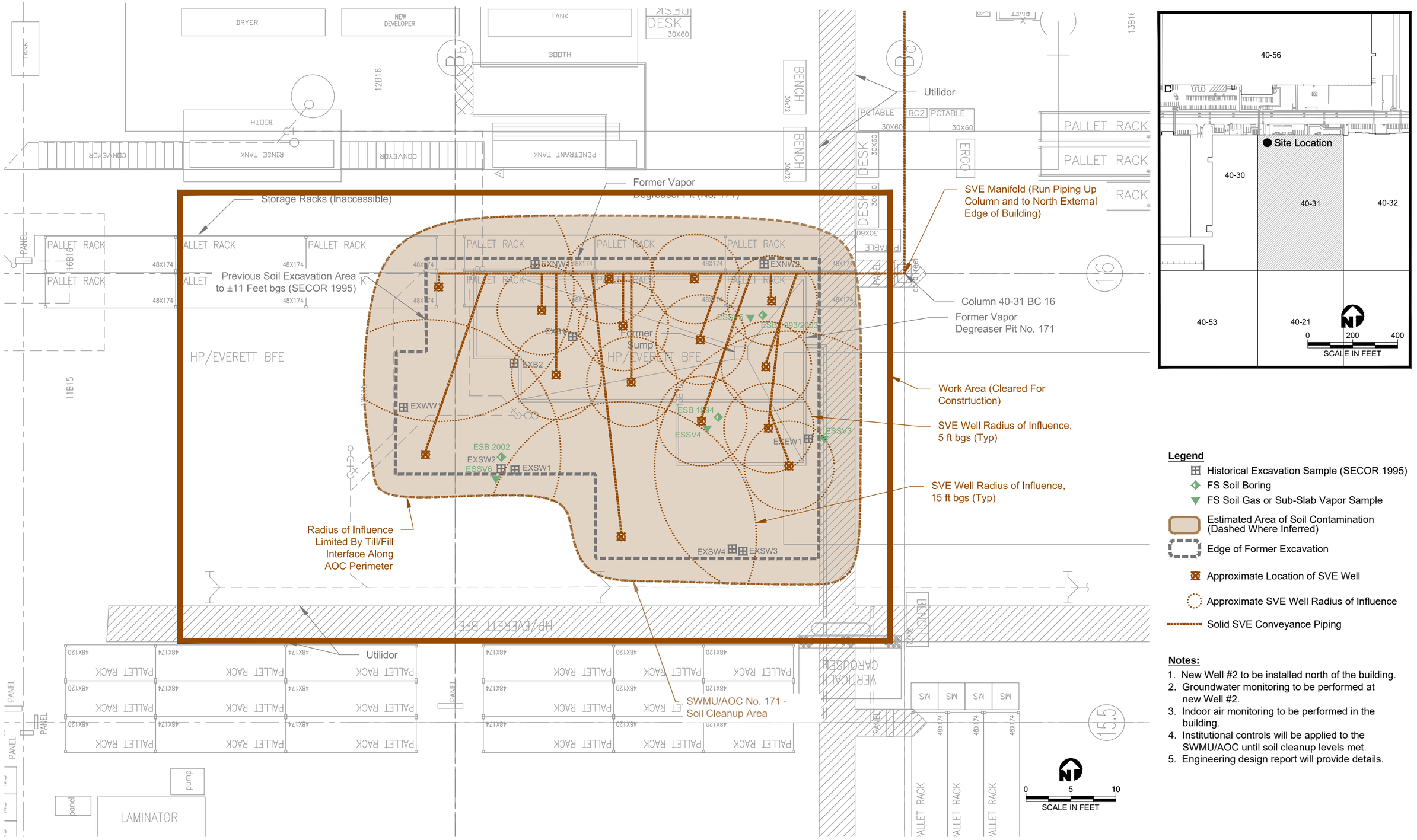
Estimated Area of Soil Contamination (Dashed Where Inferred)

Note:

1. Institutional controls will be applied to the SWMU/AOC until soil cleanup levels met.

Figure 5-9

Building 40-25, Utility Vault (SWMUs/AOCs No. 177) Maintain Containment With Future Excavation



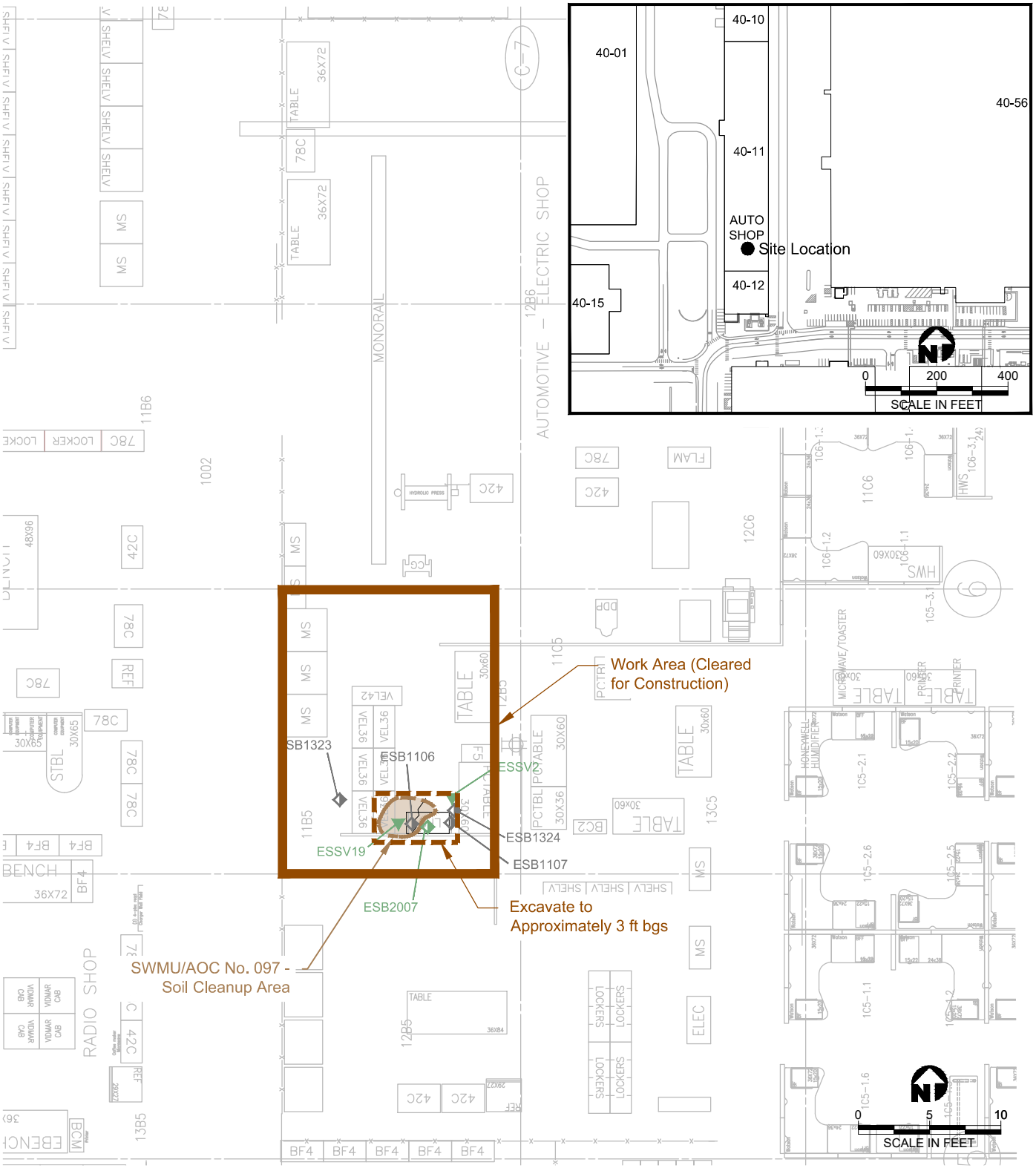
Legend

- Historical Excavation Sample (SECOR 1995)
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Edge of Former Excavation
- Approximate Location of SVE Well
- Approximate SVE Well Radius of Influence
- Solid SVE Conveyance Piping

Notes:

1. New Well #2 to be installed north of the building.
2. Groundwater monitoring to be performed at new Well #2.
3. Indoor air monitoring to be performed in the building.
4. Institutional controls will be applied to the SWMU/AOC until soil cleanup levels met.
5. Engineering design report will provide details.

Figure 5-10
Building 40-31, Former Bluestreak Vapor Degreaser (SWMU/AOC No. 171)
Modified Cleanup Alternatives 1 and 2 - Maintain Containment and Future Soil Vapor Extraction



Legend

- Historical Soil Boring
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Approximate Excavation Limits

Notes:

1. Engineering design report will provide details.

Figure 5-11

Building 40-11, Former Vapor Degreaser (SWMU/AOC No. 097) Cleanup Alternative 4 - Near-Term Excavation

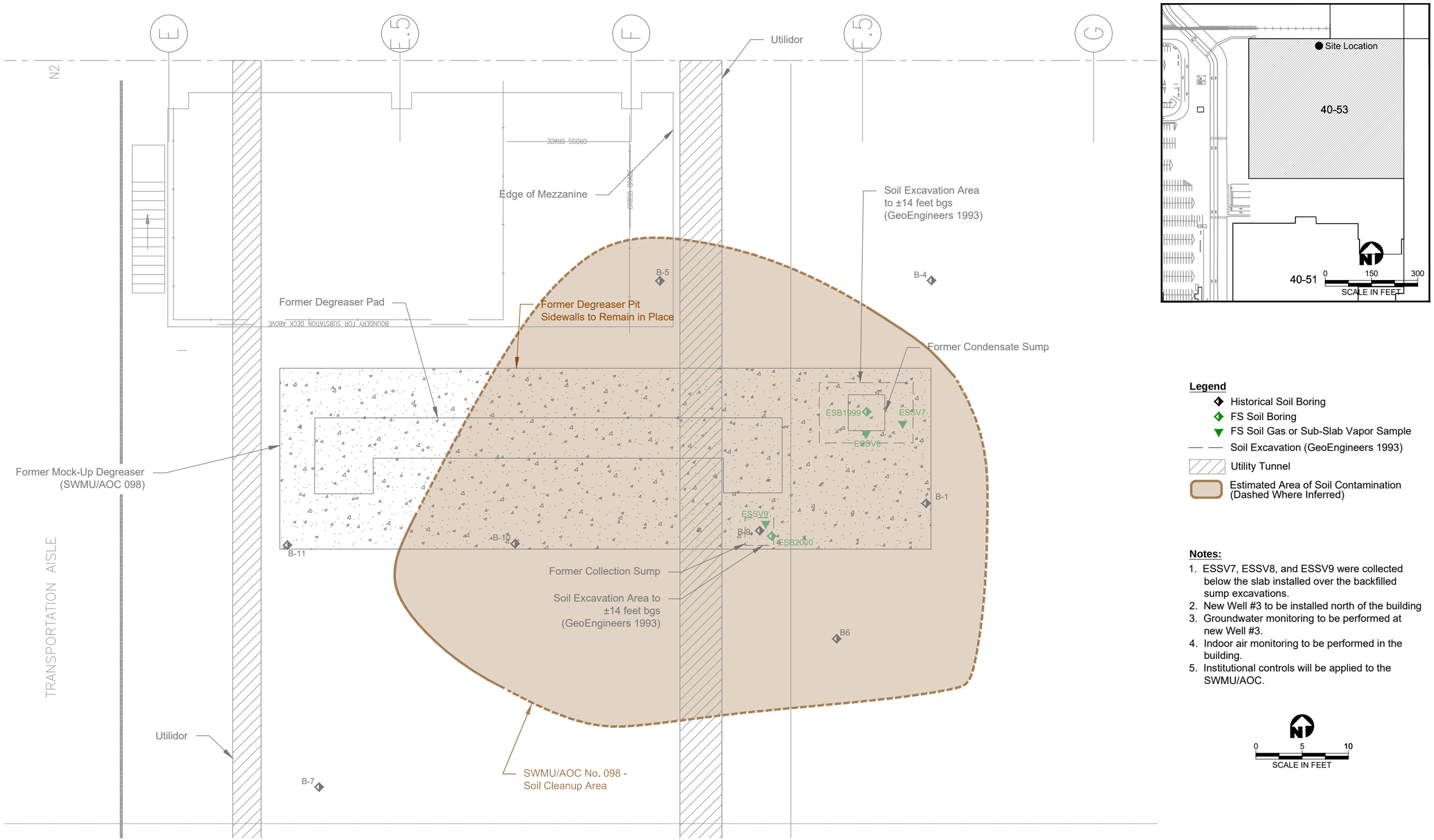
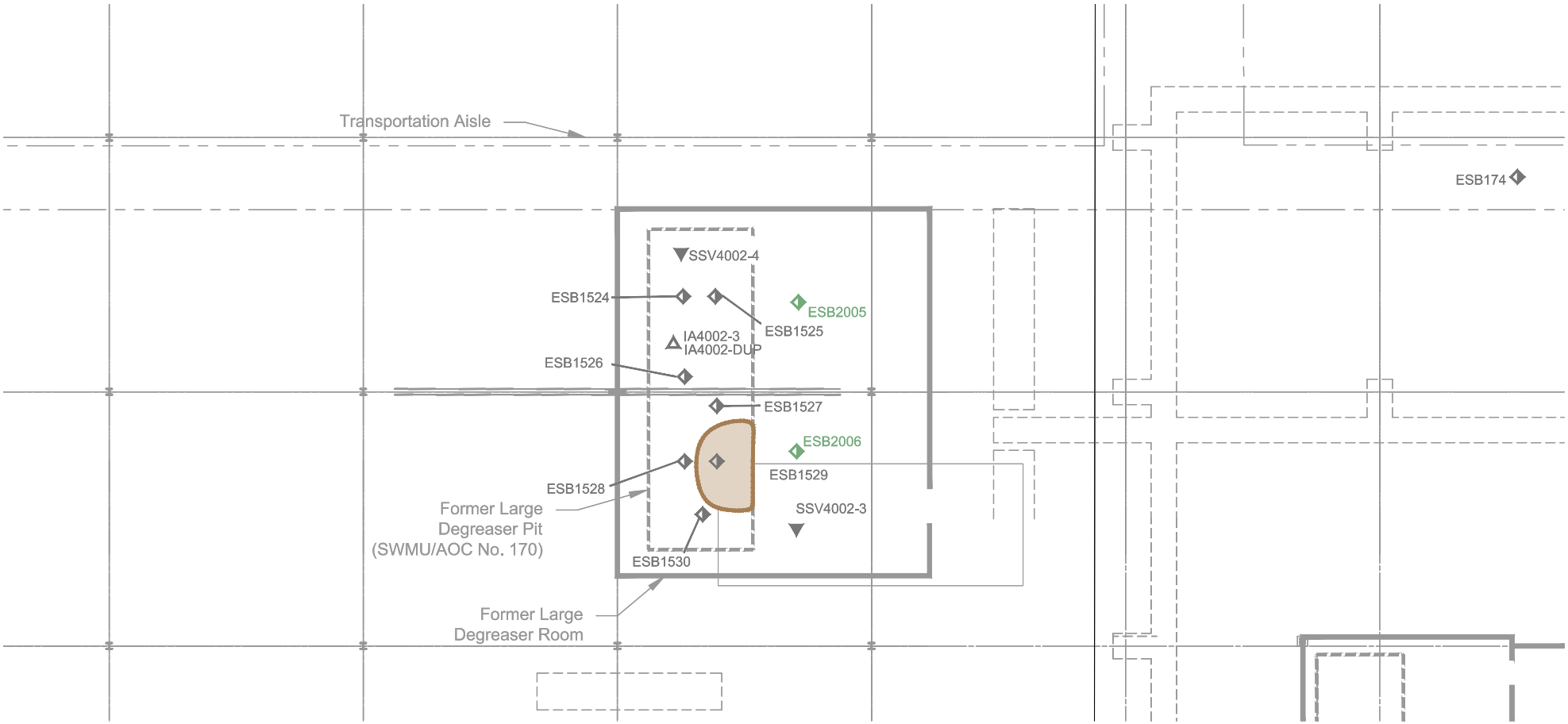


Figure 5-12
Building 40-53, Former Mock-Up Degreaser (SWMU/AOC No. 098)
Modified Cleanup Alternative 1 - Maintain Containment



Legend

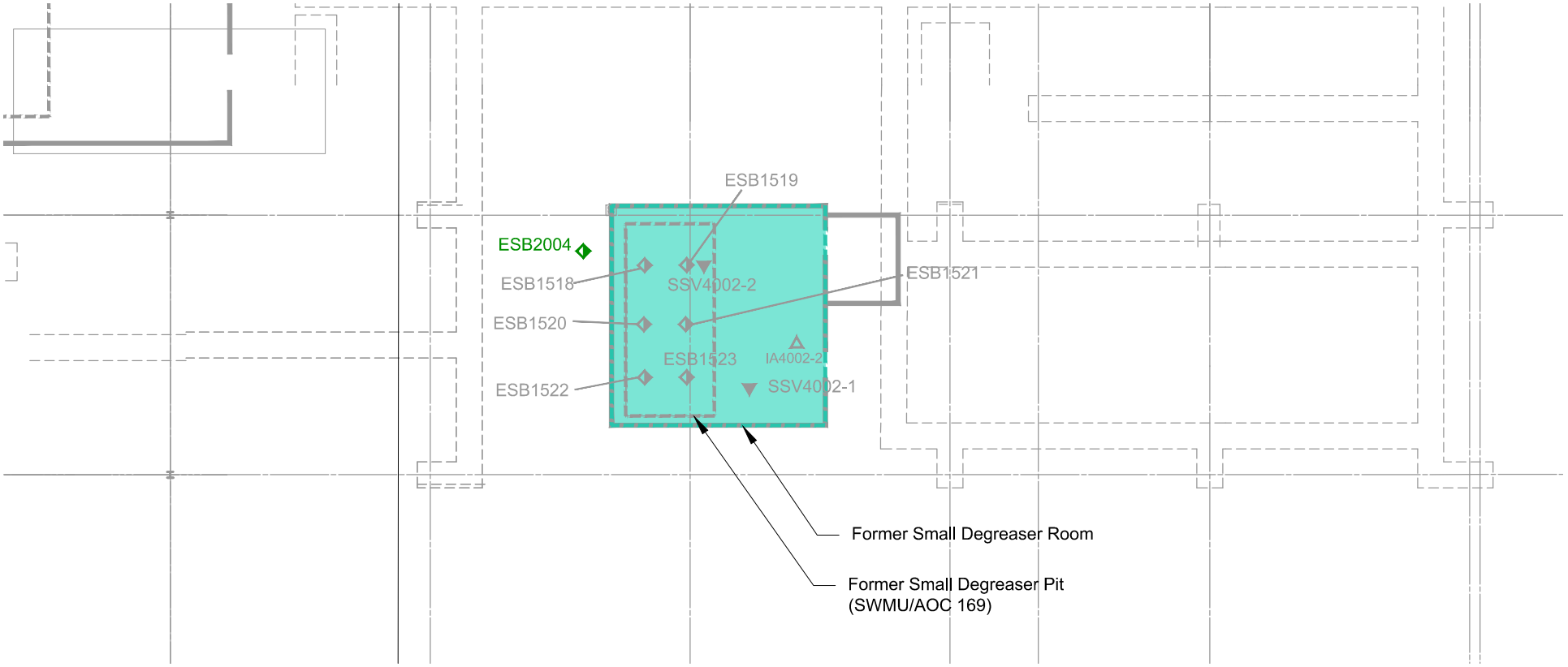
- Subsurface Utility Trench
- Historical Indoor Air Sample
- Historical Soil Boring
- Historical Soil Gas or Sub-Slab Vapor Sample
- FS Soil Boring
- Estimated Area of Soil Contamination (Dashed Where Inferred)

Notes:

1. Groundwater monitoring to be performed at Wells EGW177 and EGW178.
2. Indoor air monitoring to be performed in the building.
3. Institutional controls will be applied to the SWMU/AOC.

0 15 30
SCALE IN FEET

Figure 5-13
Building 40-02, Former Large Vapor Degreaser (SWMU/AOC No. 170)
Modified Cleanup Alternative 1 - Maintain Containment



Legend

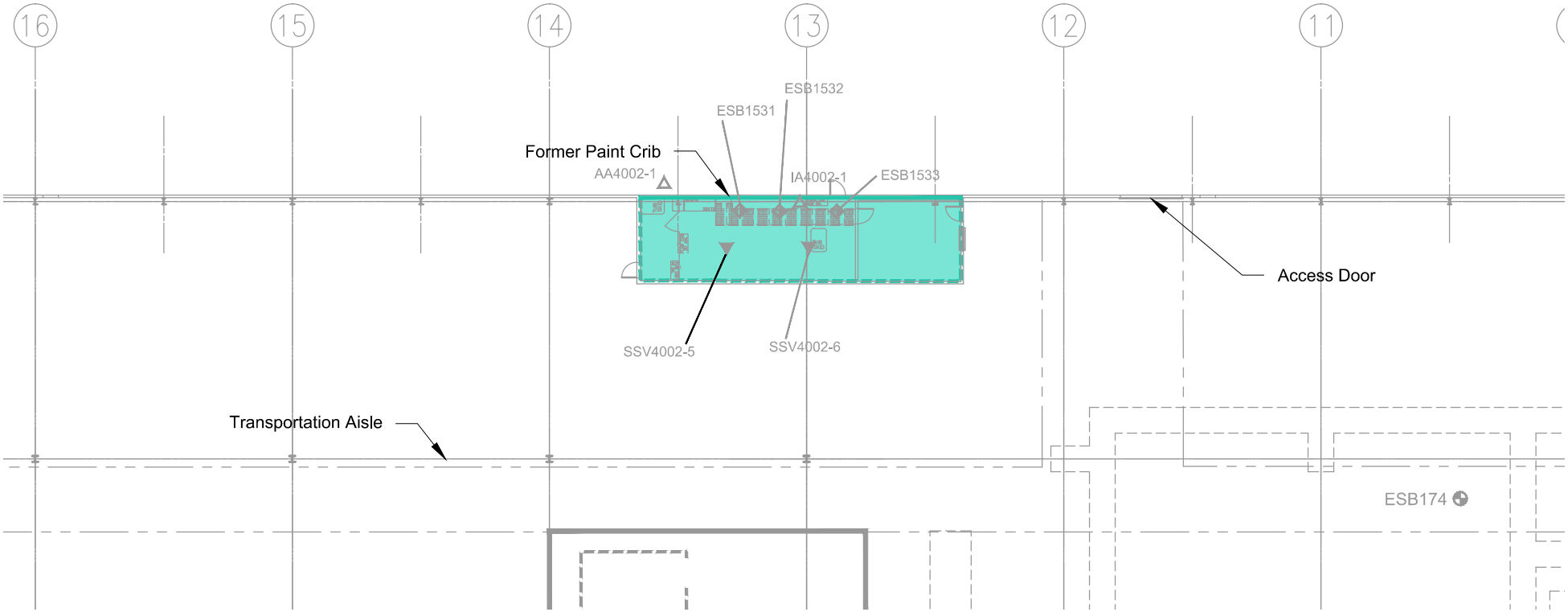
- Subsurface Utility Trench
- Historical Indoor Air Sample
- Historical Soil Boring
- Historical Soil Gas or Sub-Slab Vapor Sample
- FS Soil Boring
- Estimated Area of Sub-Slab Vapor Detected Above a Method C Screening Level (Dashed where Inferred) (See Note 1)

Notes:

1. At this SWMU, soil concentrations were below cleanup levels and perched groundwater is not present, so sub-slab vapor concentrations were used to define the estimated area of concern.
2. Samples collected by Landau in 2008 were collected below the former concrete pit floor. Samples collected by URS in 2009 were collected below the new slab floor installed over the backfilled pit.
3. Groundwater monitoring to be performed at Wells EGW177 and EGW178.
4. Indoor air monitoring to be performed in the building.
5. Institutional controls will be applied to the SWMU/AOC.

0 15 30
SCALE IN FEET

Figure 5-14
Building 40-02, Former Small Degreaser (SWMU/AOC No. 169)
Modified Cleanup Alternative 1 - Maintain Containment



Legend

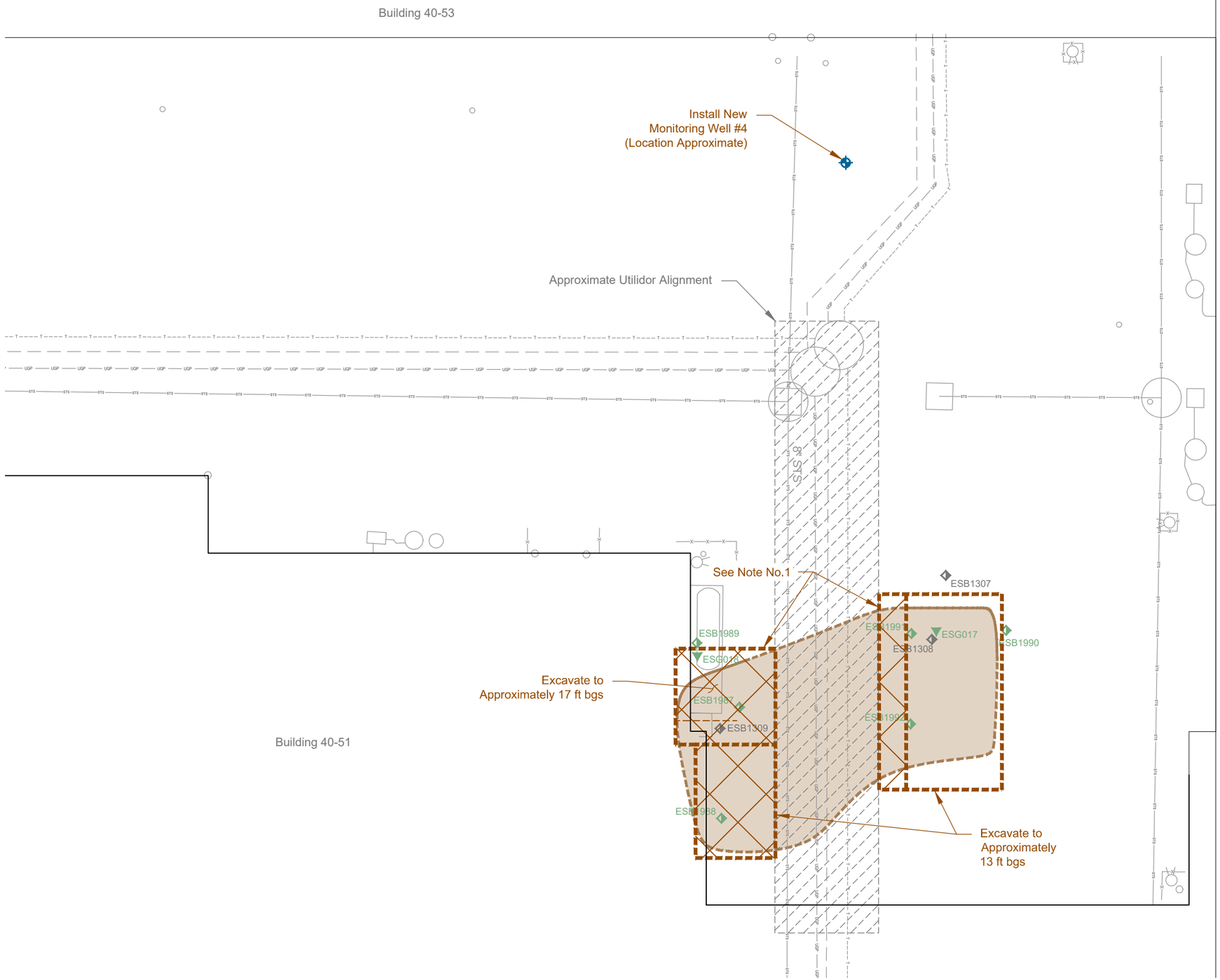
- Subsurface Utility Trench
- Groundwater Monitoring Well
- Historical Indoor Air Sample
- Historical Soil Boring
- Historical Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Sub-Slab Vapor Detected Above a Method C Screening Level (Dashed where Inferred) (See Note 1)

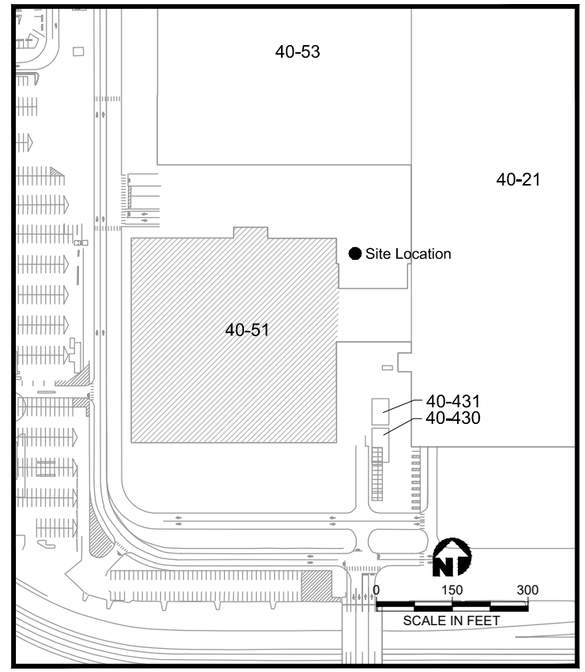
Notes:

1. At this SWMU, soil concentrations were below cleanup levels and perched groundwater is not present, so sub-slab vapor concentrations were used to define the estimated area of concern.
2. Samples collected by Landau in 2008 were collected below the former concrete pit floor. Samples collected by URS in 2009 were collected below the new slab floor installed over the backfilled pit.
3. Indoor air monitoring to be performed in the building.
4. Institutional controls will be applied to the SWMU/AOC.

0 15 30
SCALE IN FEET

Figure 5-15
Building 40-02, Former Paint Crib
Modified Cleanup Alternative 1 - Maintain Containment





Legend

- Historical Soil Boring
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- New Groundwater Monitoring Well to be Installed
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Appoximate Excavation Limits

Notes:

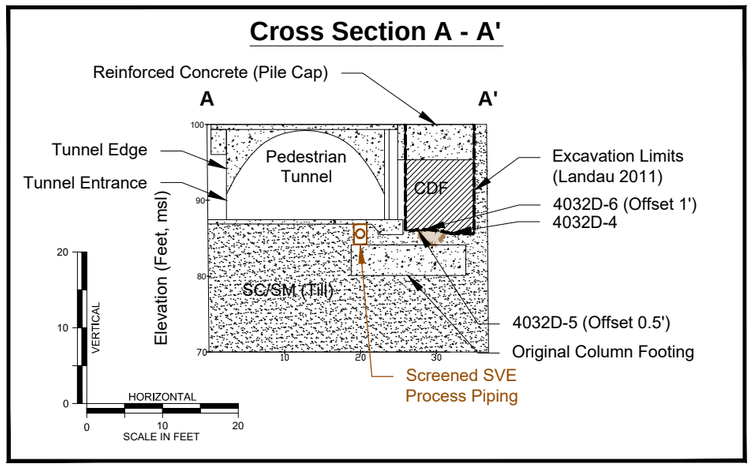
1. Use trenching and shoring in excavations adjacent to the utilidor and building edges.
2. New Well #4 to be installed north of the building.
3. Groundwater monitoring to be performed at new Well #4.
4. Indoor air monitoring to be performed in the building.
5. Institutional controls will be applied to the SWMU/AOC.
6. Engineering design report will provide details.

0 15 30
SCALE IN FEET

5-16

Building 40-51, Former Waste Water AST (SWMU No. 054)
Cleanup Alternative 3 - Maintain Containment With Future Excavation

Cross Section A - A'



Legend

- Historical Excavation Sample (Landau 2011)
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- New Groundwater Monitoring Well to be Installed
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Concrete Footing or Foundation Bordering Excavation
- Estimated Excavation Extent (Filled by Concrete [Footing] and CDF Backfill) (Landau 2011)
- A A' Cross Section Location

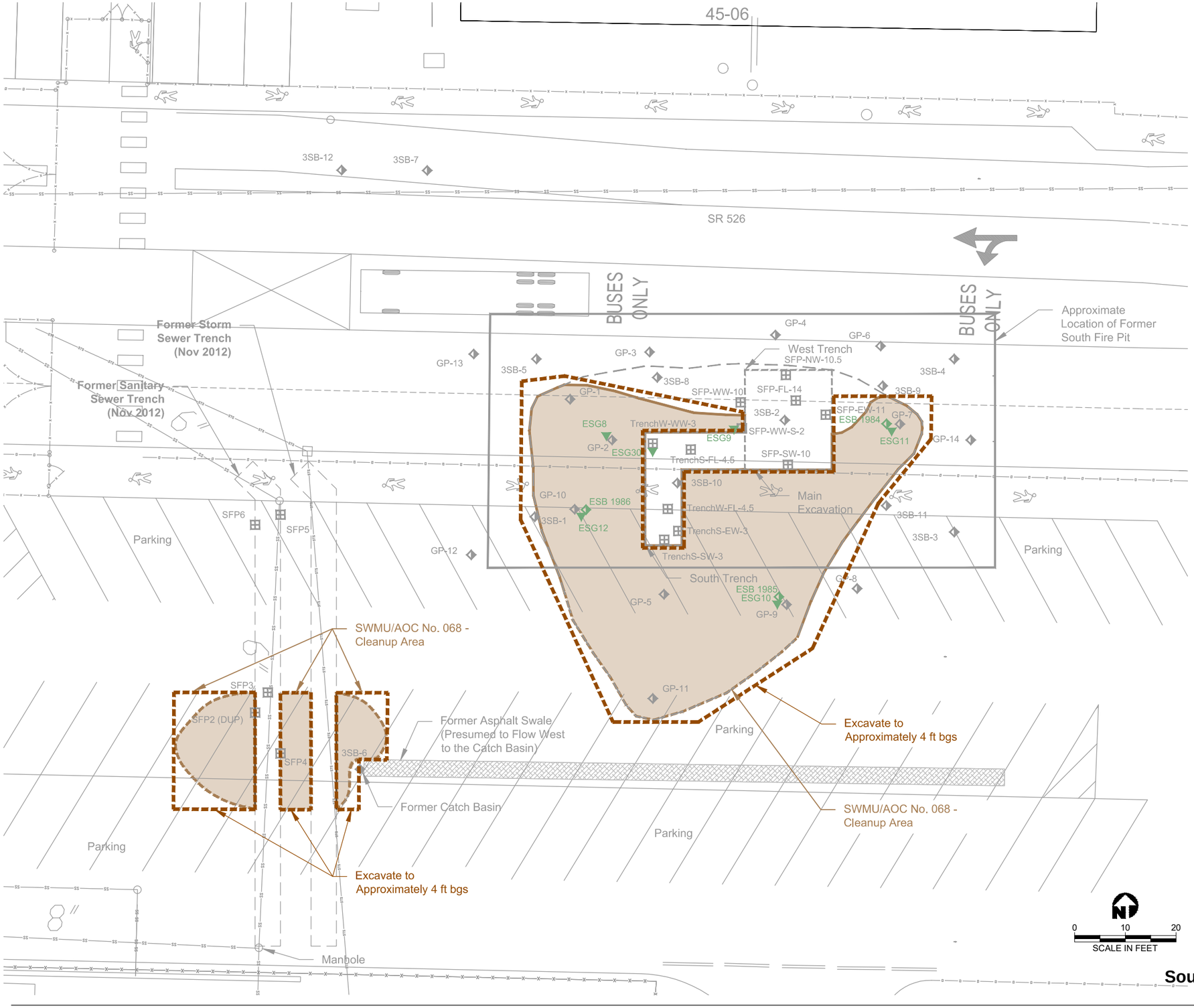
Notes:

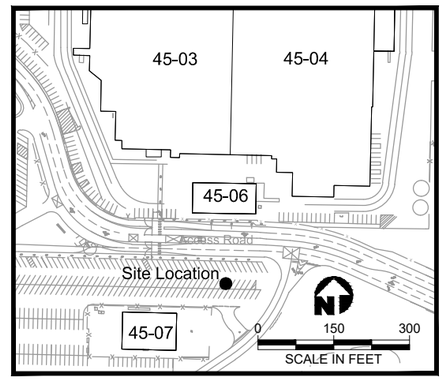
1. New Well #5 to be installed north of the building.
2. Groundwater monitoring to be performed at new Well #5.
3. Indoor air monitoring to be performed in the building.
4. Institutional controls will be applied to the SWMU/AOC.

Figure 5-17
Building 40-32 Footing Excavation
Modified Cleanup Alternative 1 - Maintain Containment

Boeing Everett Facility
draft Cleanup Action Plan

AECOM
\\seattle\Seattle\DCS\Projects\GIS\Boeing\Everett\FEASIBILITY STUDY\Reports\Upland\FS Report\Section 5\Fig 5-17 (Alt 2 Bldg 40-32 Footing).dwg
Mod: 02/05/2020, 15:56 | Plotted: 02/05/2020, 15:57 | mark.gagnon





Legend

- Historical Soil Boring (Converse 1994)
- Historical Excavation Sample (Converse 1994 and URS 2012)
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Approximate Excavation Limits

Notes:

1. Pre-design sampling will be performed to confirm lateral extent of contamination.
2. Water level measurement will be performed at EGW060.
3. Engineering design report will provide details.

Figure 5-18
South Complex - South Fire Pit (SWMU/AOC No. 068)
Cleanup Alternative 4 - Near-Term Excavation

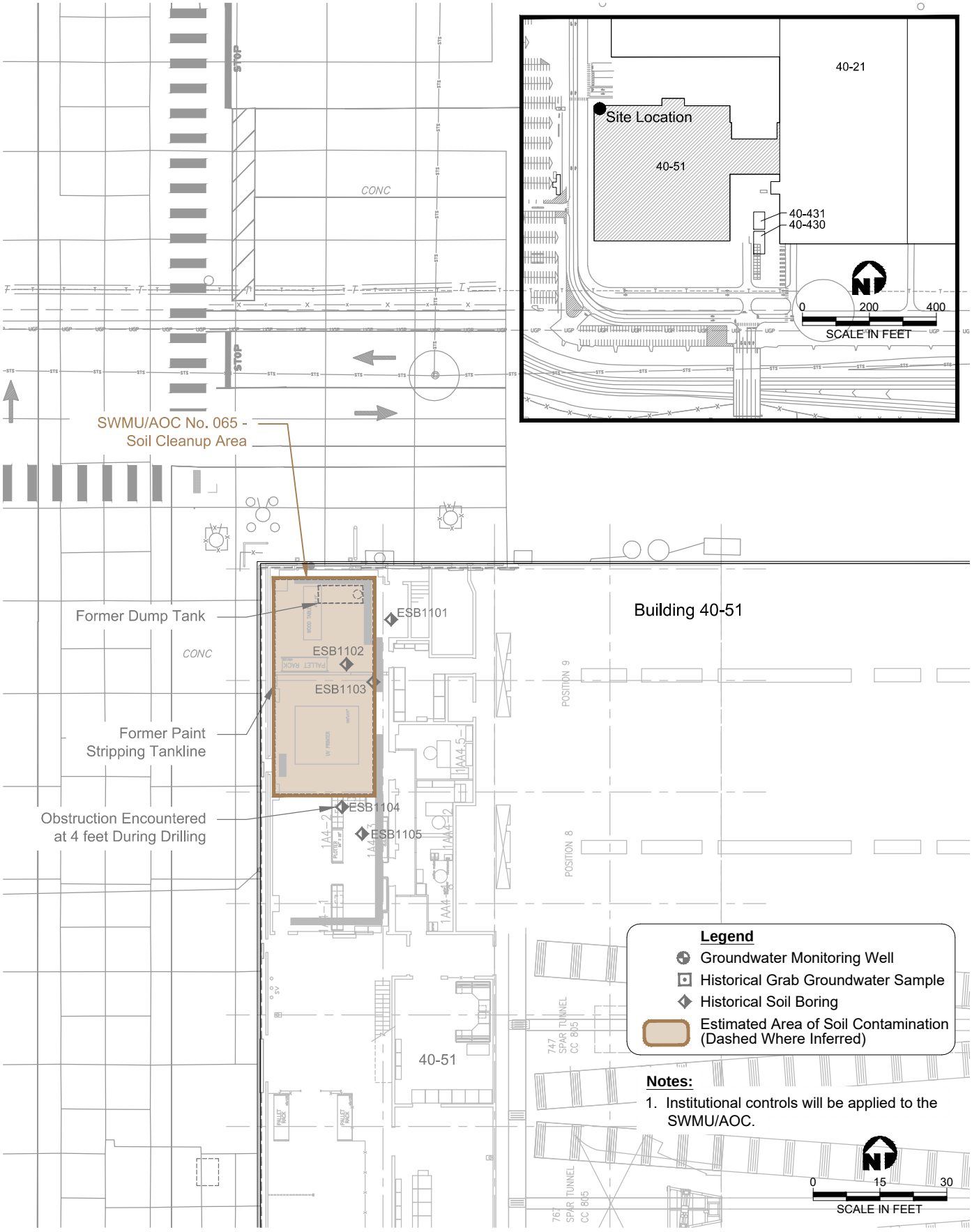
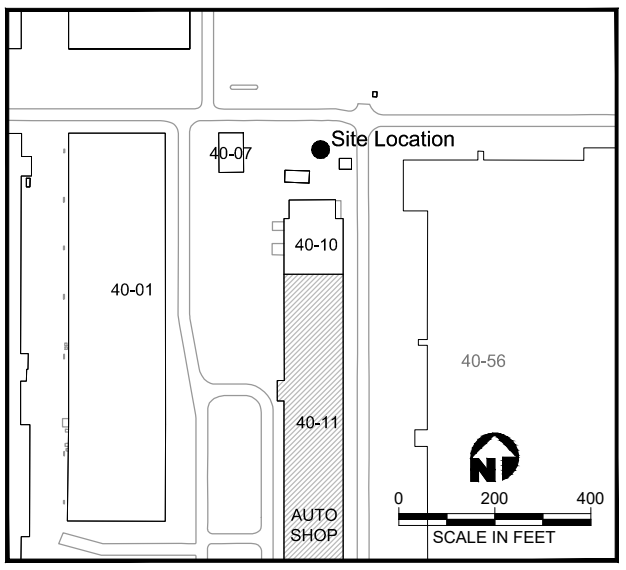


Figure 5-19

Building 40-51, Former Paint Stripping Tankline (SWMU/AOC No. 065) Cleanup Alternative 1 - Maintain Containment



Work Area

Catch Basin
PB49BX

ESB1976
ESB1975
ESG24
ESB1679
ESB1678
ESB1677
ESG27
ESB1998
ESG26
ESG25
ESB1675
ESB1676
ESB1680

UST EV-48-1 -
Soil Cleanup Area

UST EV-049-1 (15,000 Gallon)
No. 2 Diesel Fuel

2" Vent

Remove USTs and
Excavate to Approximately
23 ft bgs

Storm Water
Shutoff Valve and
550 Gallon
Oil/Water Separator

Unleaded Gasoline
Tank EV-48-1
(15,000 Gallon)

2" Vent

Pressure/Vacuum
Vent 15' above
Pavement

Pump Island

Piping to 550-Gallon
Oil/Water Separator

1 1/2" Fuel Supply
Pipe With 3"
Secondary
Containment

2" Dbl.
Contained
Vapor
Recovery Line
Conn. at Pump

Pressure/Vacuum
Vent 15' above
Pavement

Legend

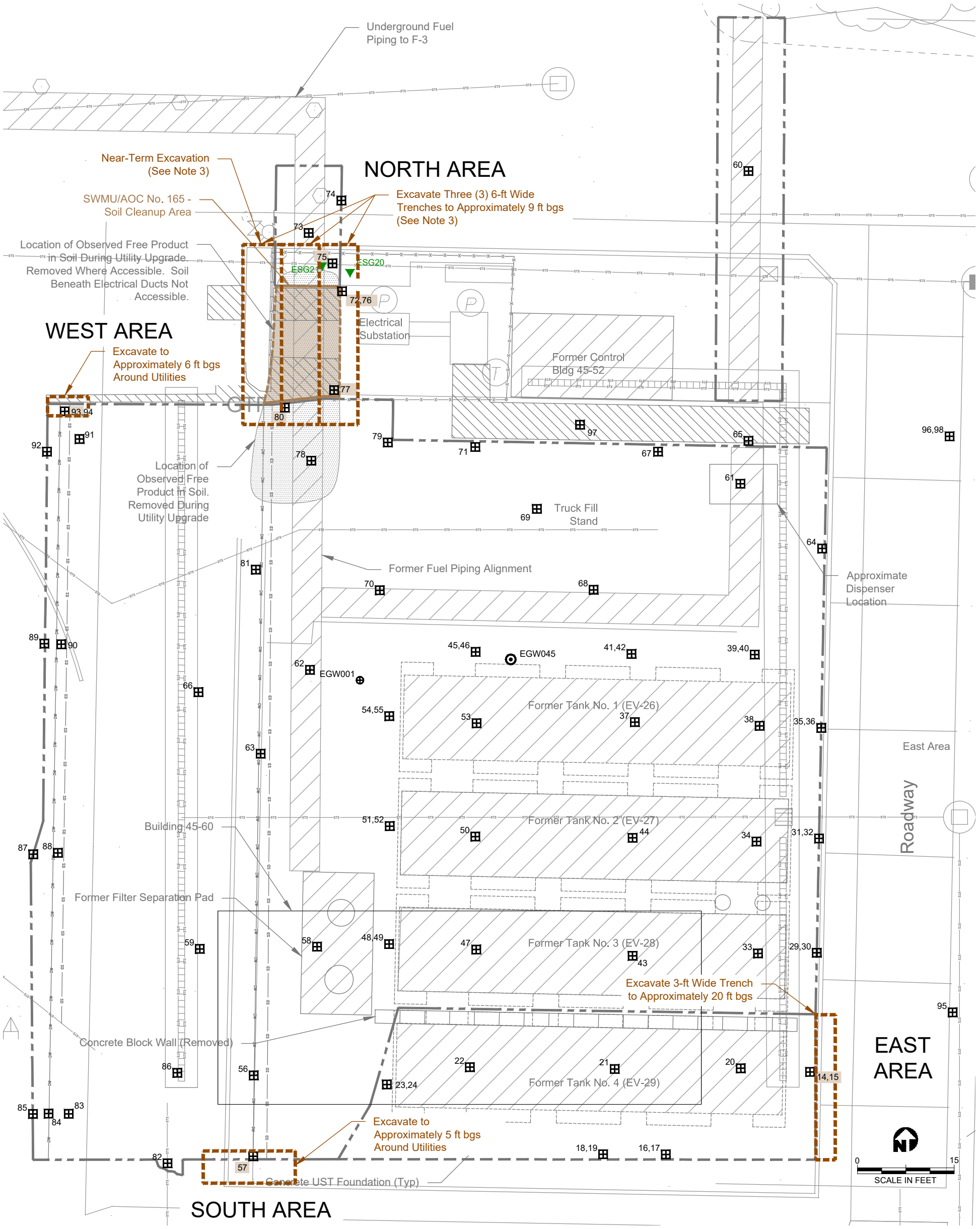
- Historical Soil Boring
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Approximate Excavation Limits

Notes:

1. New Well #6 to be installed north of the building.
2. Groundwater monitoring to be performed at new Well #6.
3. TPH contamination found during work on nearby EV-49-1 in May 2018; will be addressed when tanks are removed.
4. Institutional controls will be applied to the SWMU/AOC.
5. Engineering design report will provide details.

0 10 20
SCALE IN FEET

Figure 5-20
Building 40-11, UST EV-48-1
Modified Cleanup Alternative 2 - Future Excavation



Legend

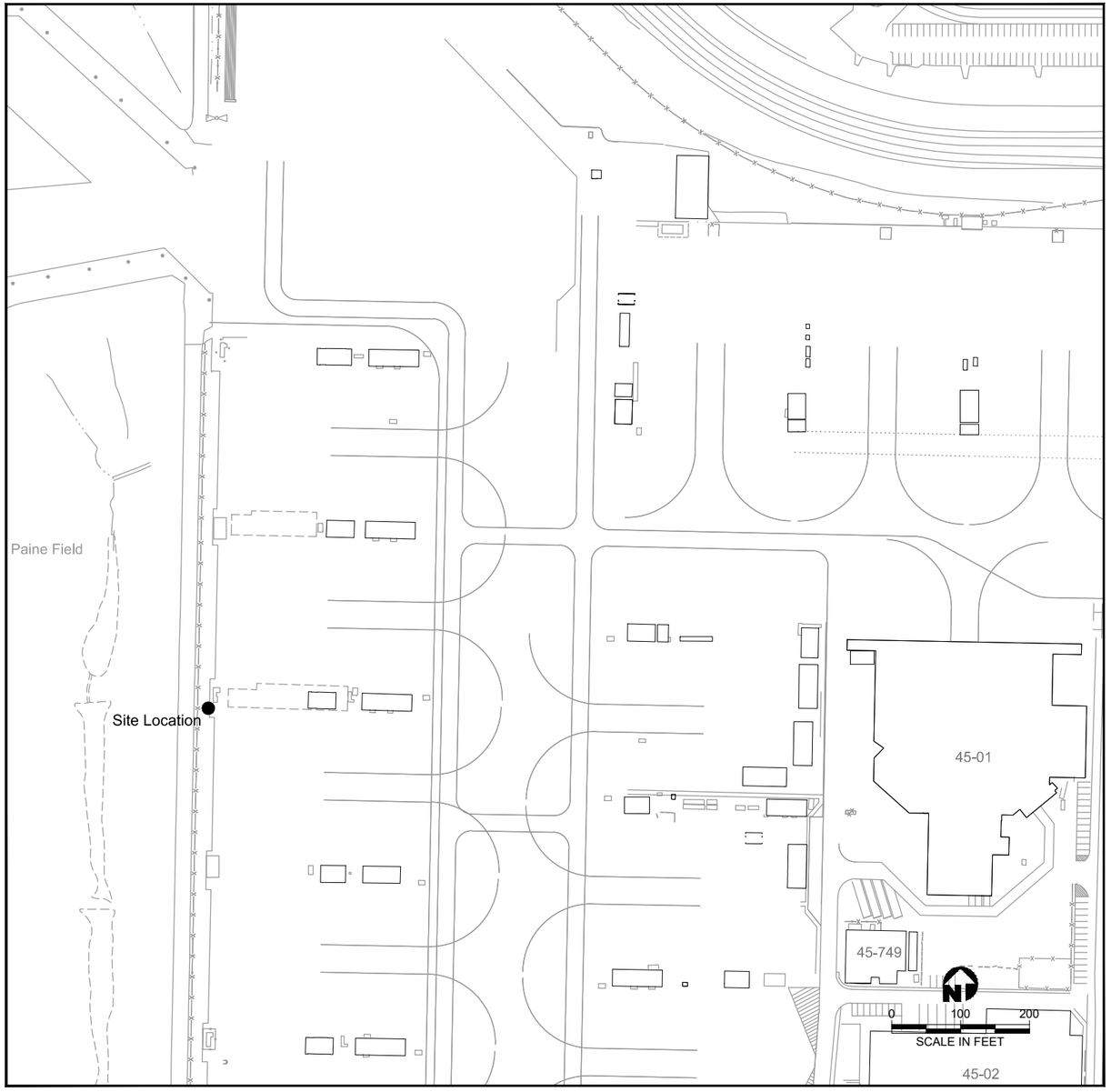
- Abandoned Groundwater Monitoring Well
- Abandoned Groundwater Recovery Well
- Historical Excavation Sample
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- 2008 Excavation Outline
- 2007 Excavation Outline
- SD — Storm Drain Line
- DW — Water Line
- Electrical Duct
- Approximate Excavation Limits
- Former Features

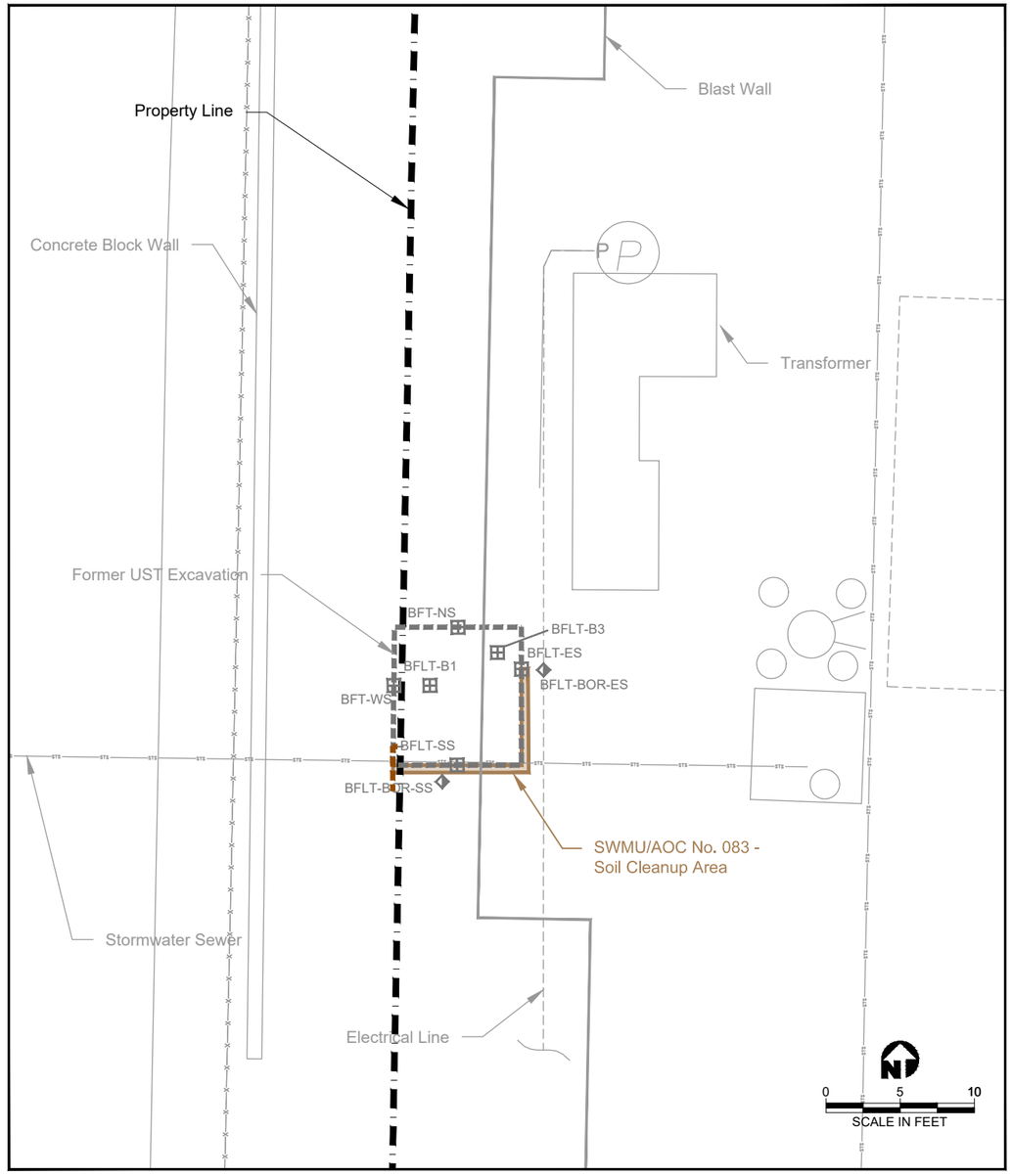
Notes:

1. New Well #11 to be installed north of the SWMU.
2. Groundwater monitoring to be performed at new Well #11.
3. The limited excavation portion of the remedy includes excavation of the north area where free product was observed under the utility ducts.
4. Remaining contaminated soil will be excavated in the future when changes in operation allow access.
5. Institutional controls will be applied to the SWMU/AOC.
6. Engineering design report will provide details.

Figure 5-21

Building 45-52, Former Fuel Farm USTs (SWMU/AOC No. 165)
Combined Alternatives 2 and 3 - Limited Excavation and Future Excavation





Inset A

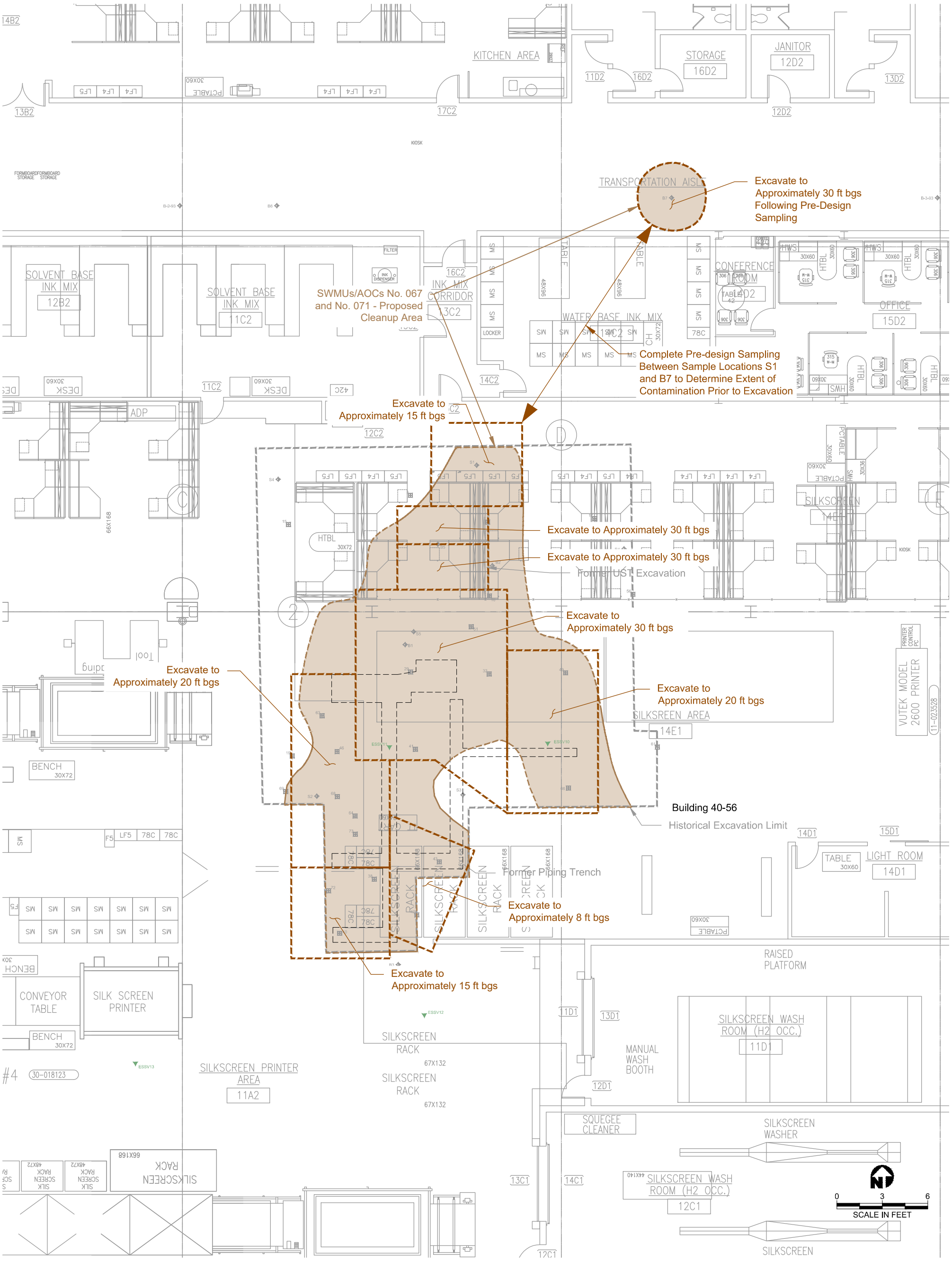
Legend

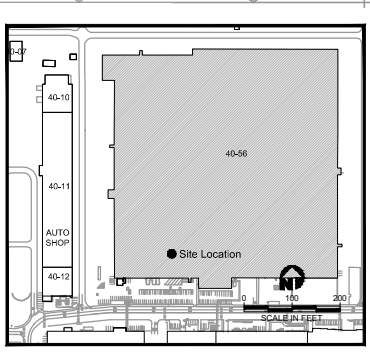
- Historical Soil Boring (O'Sullivan Omega 1994)
- Historical Excavation Sample (O'Sullivan Omega 1994)
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Edge of Former Excavation

Notes:

1. Institutional controls will be applied to the SWMU/AOC.

Figure 5-22
Flightline, Former UST EV-15 (SWMU/AOC No. 083)
Cleanup Alternative 1 - Maintain Containment





Legend

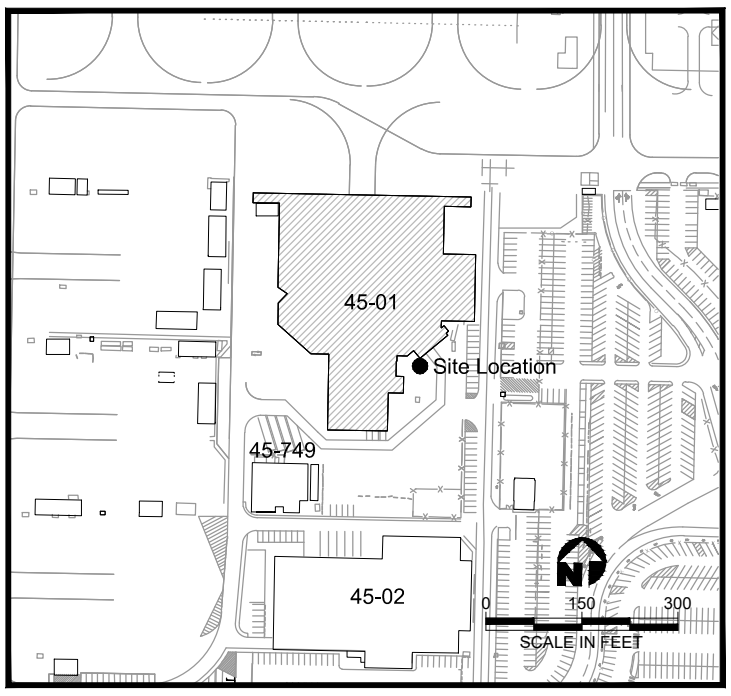
- Historical Soil Boring
- Historical Excavation Sample
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Proposed Excavation Limits

Notes:

1. New Well #8 to be installed north of the SWMU.
2. Groundwater monitoring to be performed at new Well #8 and EGW040.
3. Indoor air monitoring to be performed in the building.
4. Excavated in the future when changes in operation allow access.
5. Institutional controls will be applied to the SWMU/AOC until soil cleanup levels are met.
6. Engineering design report will provide details.

Figure 5-23

Building 40-56, Former Recycling Unit and UST EV-153 (SWMUs/AOCs No. 067 and No. 071) Cleanup Alternative 2 - Future Excavation



45-01

Excavate Three 5-ft Wide Trenches to Approximately 20 ft bgs. Backfill With CDF After Each Trench Excavation.

SWMU/AOC No. 093 - Soil Cleanup Area

Former Solvent Tank P-21

Former Solvent Pump P-20

ESB1137

ESB1136

ESB1140

Former EV-20

Former EV-19

ESB1974

ESG29

ESB1386 (ESB1134)

ESG28

ESB1141

ESG19

ESB1973

ESB1139

Former Fuel and Vent Lines

ESB1138

Institutional Controls Will Be Applied to the Shaded AOC until Soil Cleanup Levels Met

Buried Utility Lines

Former SWMU/AOC No. 093

ESB1129

ESB1131

ESB1128

Former EV-18

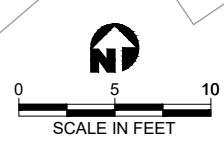
Former EV-54

ESB1127

ESB1130

ESB1122

ESB1123



Legend

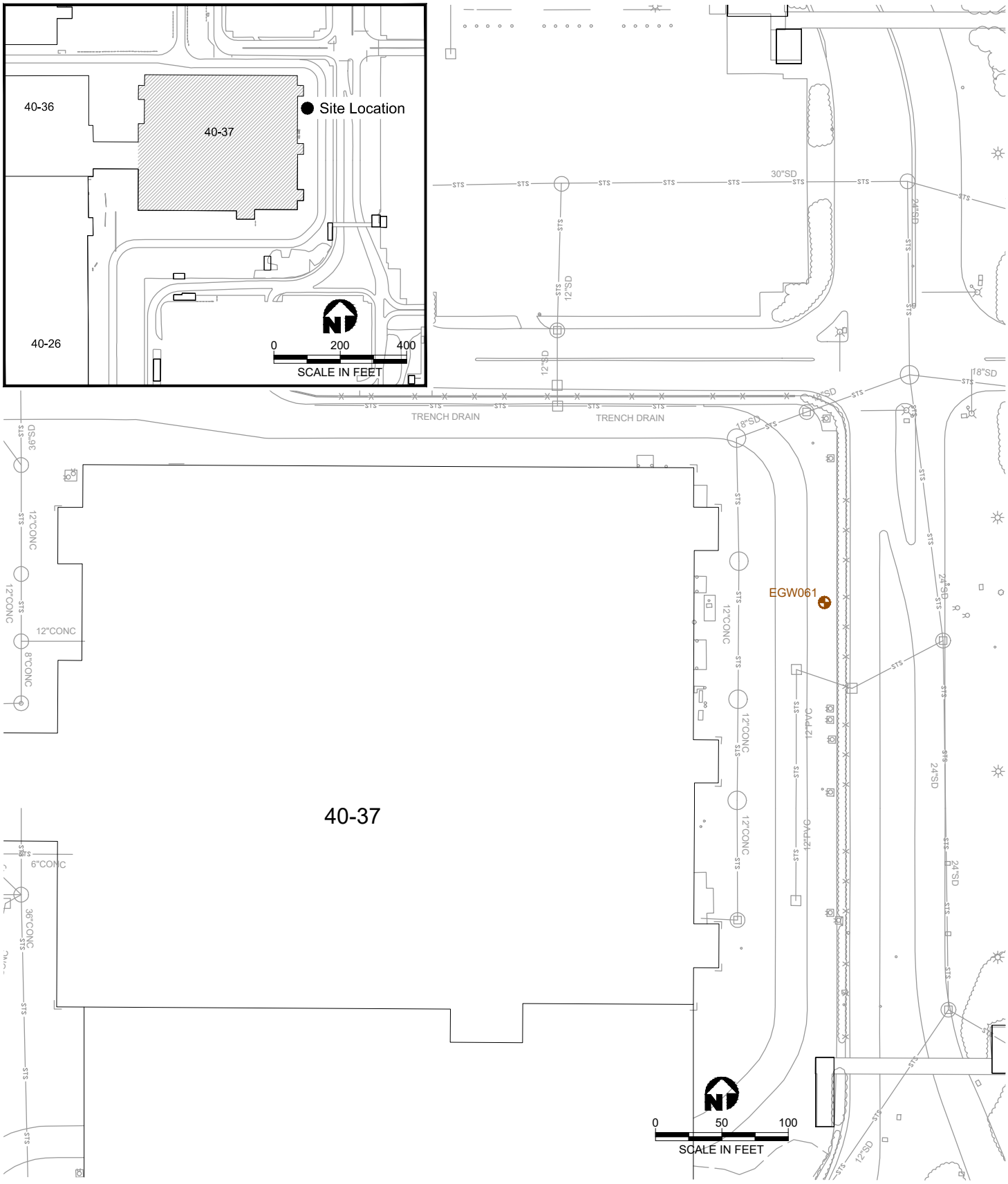
- Historical Soil Boring
- FS Soil Boring
- FS Soil Gas or Sub-Slab Vapor Sample
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Approximate Excavation Limits

Notes:

1. New Well #4 to be installed on northeast exterior corner of building 45-01
2. New Well #7 to be installed north of building 45-01
3. Groundwater monitoring to be performed at new Well #7
4. Excavation will be performed in the future when changes in operation allow access
5. Institutional controls will be applied to the SWMU/AOC until soil cleanup levels met.
6. Engineering design report will provide details.

Figure 5-24

Building 45-01, Former Solvent Tanks (SWMU/AOC No. 093) Cleanup Alternative 2 - Future Excavation



Legend:

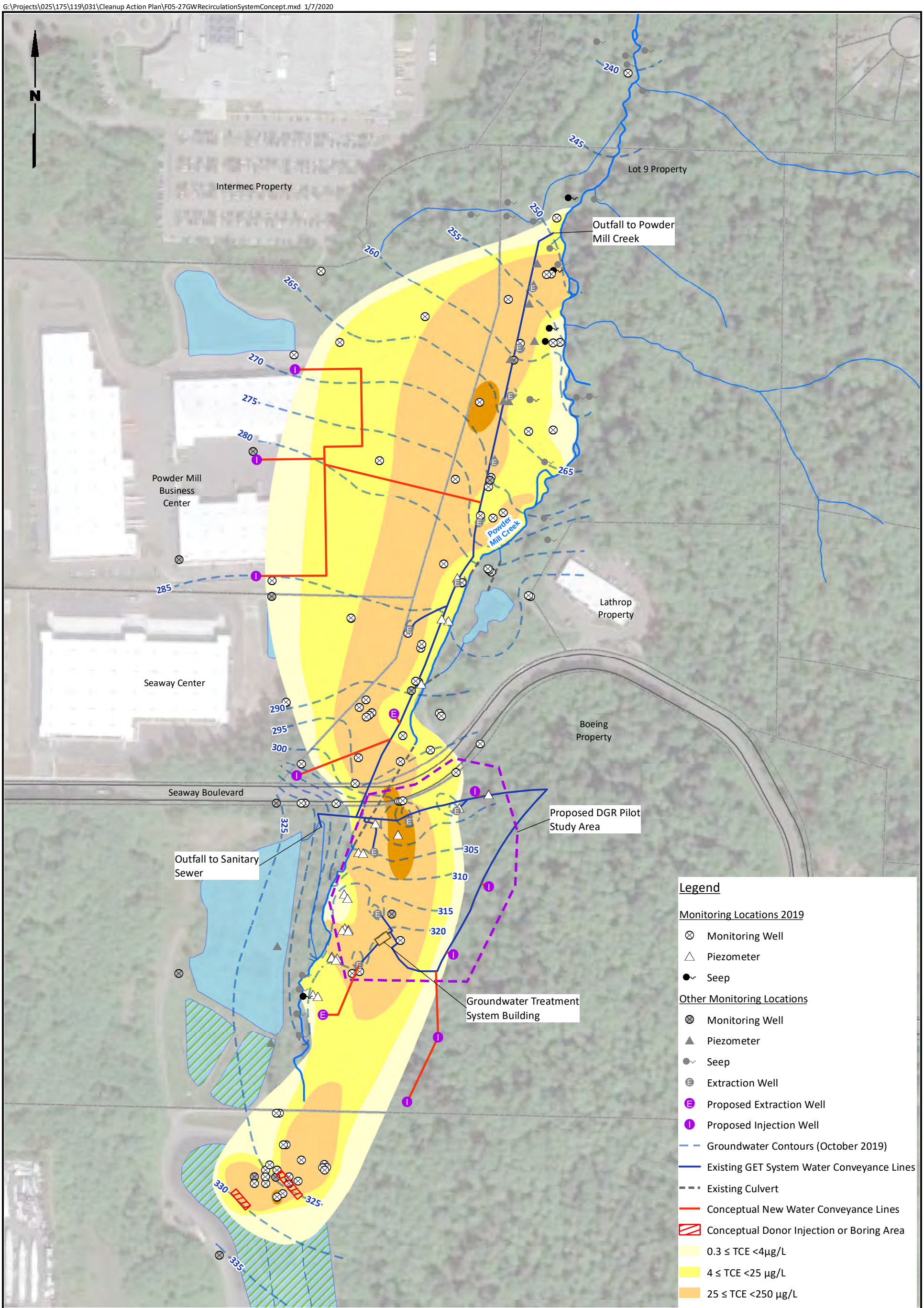
- Groundwater Gauging Well

Note:

1. Groundwater gauging to be performed at Well EGW061.

Figure 5-25
Esperance Sand
No Further Action

G:\Projects\025\175\119\031\Cleanup Action Plan\F05-27GWRecirculationSystemConcept.mxd 1/7/2020



Note

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

0 250 500

Scale in Feet

Data Sources: Google Earth Pro. Aerial Photo Date: 5/18.

LANDAU ASSOCIATES

Boeing Everett Facility
Cleanup Action Plan
Everett, Washington

PMG Source Area EISB and Downgradient DGR System - Conceptual Layout

Figure
5-26

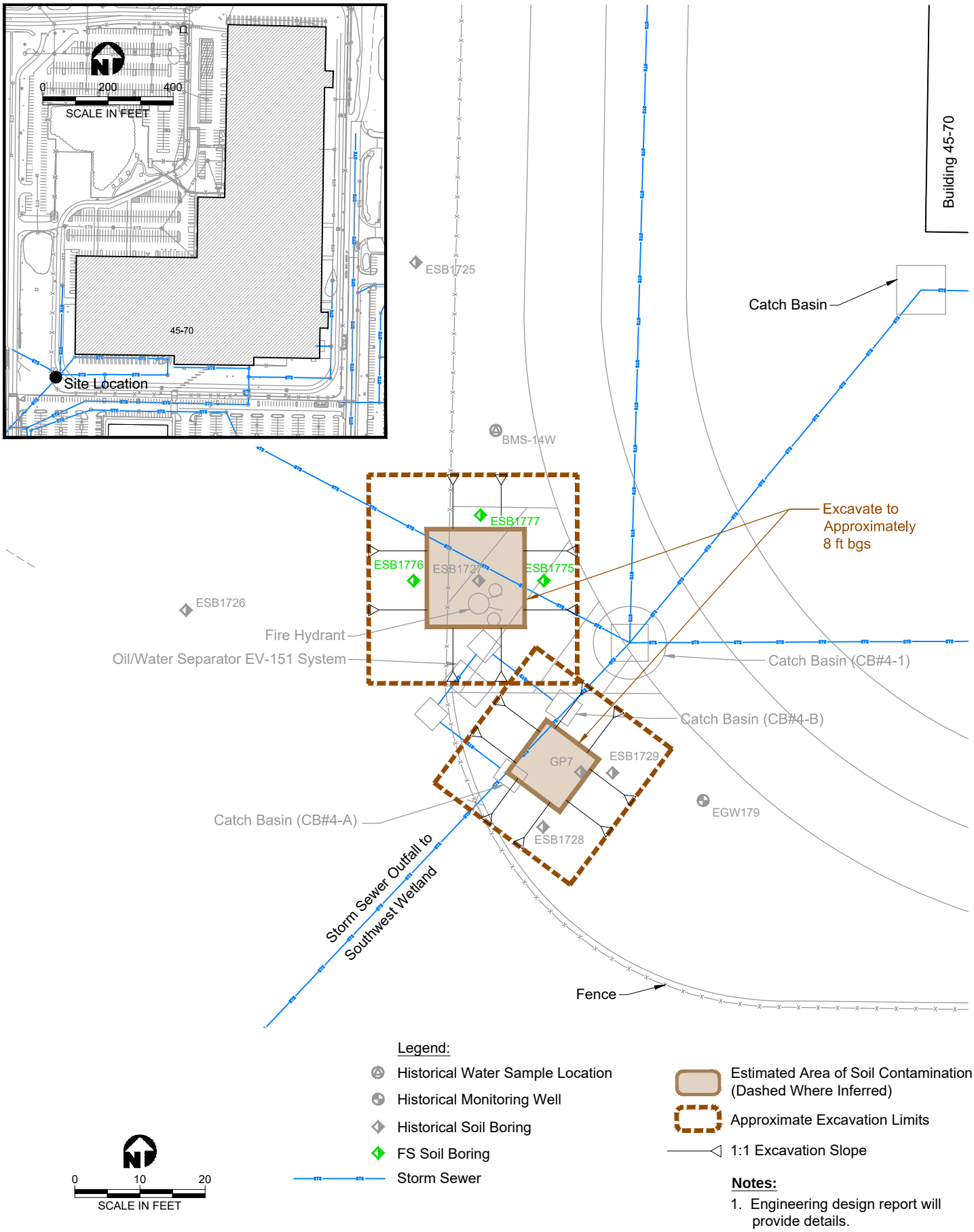
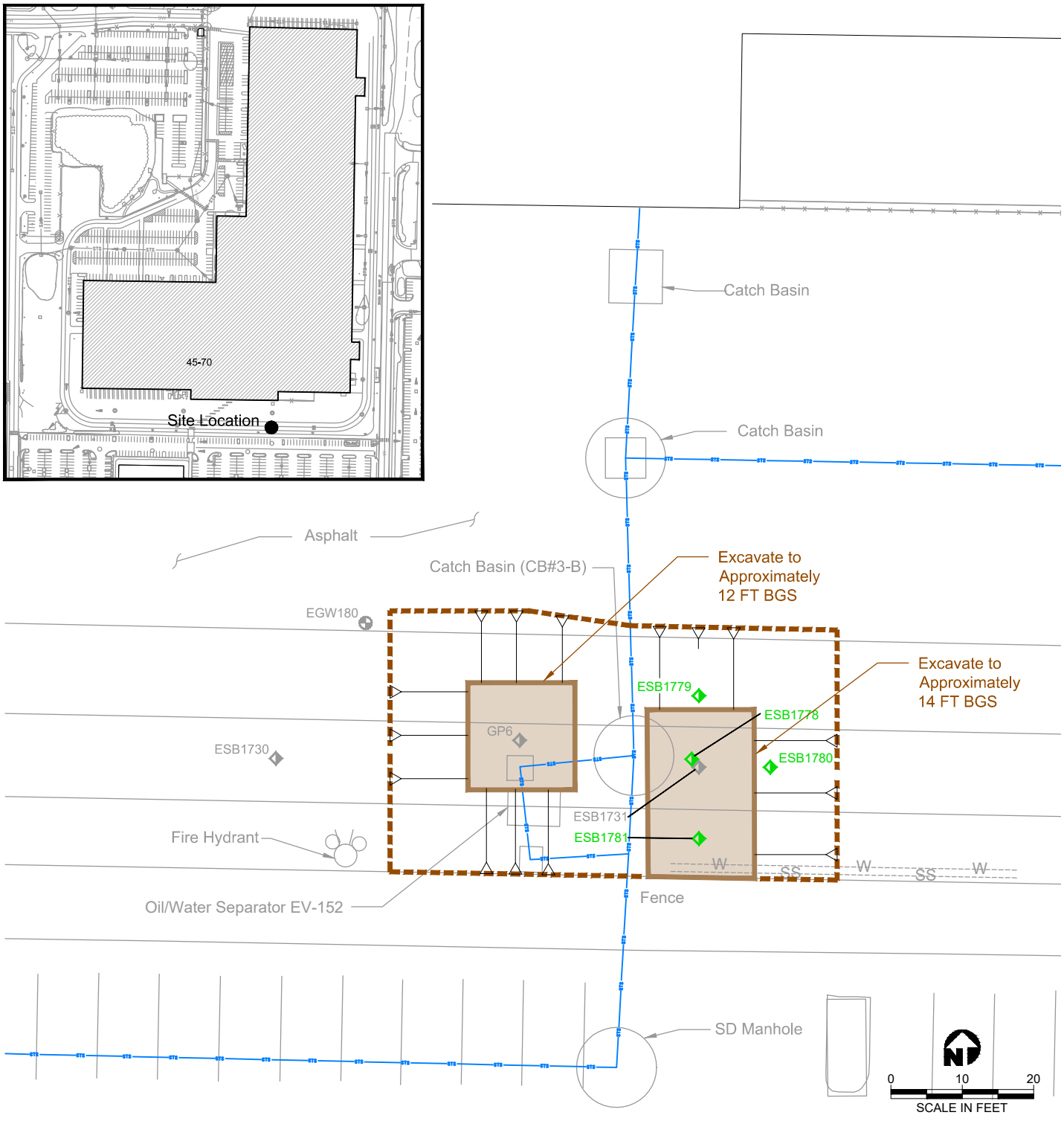


Figure 5-27

BOMARC Property, 011 / Water Separators EV-151 (SWMU/AOC No. 123)
Cleanup Alternative 1 - Near-Term Excavation



Legend:

- Existing Monitoring Well
- Existing Soil Boring
- FS Soil Boring
- Storm Sewer
- Estimated Area of Soil Contamination (Dashed Where Inferred)
- Approximate Excavation Limits
- 1:1 Excavation Slope

Notes:

1. Engineering design report will provide details.

Figure 5-28

BOMARC Property, 011 / Water Separator EV-152 (SWMU/AOC No. 124)
Cleanup Alternative 1 - Near-Term Excavation

Paine Field Airport

Airport Road

Former Septic Tank and Leach Field Area

Wetland Area

IA6

UST EV-228

UST EV-229

TEDLAR5

AA1

ESB1732

IA5

B1

ESB1733

SSV10

ESB1734

SSV11

Former Paint Room

Former ESB1735 Chemical Storage

Former Paint Room

ESB1736

UST EV-230

SSV9

B6

Former Chemical Storage

SSV8

IA1

SUMMA1 TEDLAR1

Former Paint Room

Building 45-70

B2

SSV1

IA4

Former Chemical Storage

UST EV-155

IA8

SSV12

SSV2

Former Paint Room

AA2

SSV3

Former Chemical Storage

SUMMA4 TEDLAR4

IA7

SSV13

B3

SUMMA3 TEDLAR3

IA3

SSV4

Former Chemical Storage Area

SSV14

ESB1739

IA6

ESB1738

B4

ESB1737

ESB1782

ESB1740

ESB1783

Former Glue Room

SUMMA2 TEDLAR2

SSV6

Former Paint Room

B5

SSV7

SSV5

IA2

Former Chemical Storage

N: 335388.91
E: 1288653.65

ESB1725

ESB1777

ESB1727

ESB1776

ESB1775

ESB1726

OWS

ESB1729

ESB1728

Loading Docks

UST EV-227

ESB1779

ESB1778

ESB1780

OWS

ESB1730

ESB1731

ESB1781

Building 45-801

(9501)

0 100 200

Approximate Scale in Feet

LEGEND

- Subject property/parcel boundary
- Fence
- Former room location
- Existing room location
- Trench Drain
- OWS Oil/water separator
- Former UST location
- B4 Soil boring location (Farallon, 2007)
- SSV8 Sub-slab vapor location (URS, 2007)*
  * SSV samples collected in 2007 and 2013-2014
- SUMMA1 TEDLAR1 Ambient air location (URS, 2007)
- ESB1658 Soil boring location (URS, 2010-2011)
- IA1 AA1 Indoor/ambient air location (URS, 2013)
- Freon-12 detected above screening level

Note: Indoor air monitoring to be performed in the building.

Figure 5-29

BOMARC Property Indoor Air and Subslab Vapor Sampling Locations

TABLES

Table 1-1
Summary of Upland Areas and PMG
CAP - Upland Areas and PMG

SWMU/AOC Location	SWMU/AOC Name	SWMU/AOC Number	EPM	CAP Section
Building 40-02	Small Vapor Degreaser	169	E	5.5
	Former Large Vapor Degreaser	170	E	5.5
	Former Paint Crib	NA	E	5.5
Building 40-11	Oil/Water Separator	112	A	5.1
	UST EV-48-1	NA	G	5.7
	Former Vapor Degreaser	097	E	5.5
Building 40-22[a]	Utility Slants #2 and #3	NA	D	5.4
Building 40-23[a]	Static Test Pad	NA	D	5.4
Building 40-24	Utility Trenches and Sumps	055, 168	D	5.4
Building 40-25[a]	Utility Vault	177	D	5.4
Building 40-31	Former Bluestreak Vapor Degreaser	171	E	5.5
Building 40-32	Footing Excavation	NA	E	5.5
Building 40-51	Former Paint Stripping Tankline	065	G	5.7
	Former Wastewater AST	054	E	5.5
	Sumps EV-112 and EV-119	151	A	5.1
	Former UST EV-11	090	A	5.1
Building 40-53	Former Mock-Up Degreaser	098	E	5.5
Building 40-56	Former USTs	086, 089, 094	B	5.2
	Former Recycling Unit and UST EV-153	067, 071	H	5.7
North Complex	Esperance Sand, Powder Mill Gulch	180	K	5.9
Building 45-01	Former Solvent USTs	093	H	5.7
Building 45-52	Former Fuel Farm USTs and Fuel Stall Piping	165	G	5.7
Building 45-53	Former UST EV-110-1	166	C	5.3
BOMARC Property	BOMARC Building Interior	011	NA	5.10
	Parking Lot / Water Separators EV-151	123	NA	5.10
	Parking Lot / Water Separators EV-152	124	NA	5.10
South Complex	Esperance Sand Well EGW061	NA	I	5.8
South Complex	Former Gun Club	100	J	NA[1]
South Complex	South Fire Pit	068	F	5.6
Flightline	Former UST EV-15	083	G	5.7

Notes:
AOC - area of concern
FS - feasibility study
SWMU - solid waste management unit
NA - not applicable
[a] – AOC added during FS negotiations
[1]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

Table 2-1
Summary of Exposure Pathway Models
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/ AOC No.	Building Number and Description	Current Use	Primary Media Cleanup Levels Established[a]	Primary COC Exceeding Proposed CUL	Source	Potential Exposure Pathway Characteristics
EPM A (VOCs/Perched GW)						
090	40-51, Former UST EV-11	Airplane tow path	Perched groundwater, indoor air	TCE	Former UST, OWS, Sumps	• Construction Worker Exposure to Perched Groundwater • Fill Soils with Perched Groundwater and VOC/TPH Contamination • Indoor Air media since Soil Gas above IA screening levels • No Soil Above Direct-Contact Cleanup Levels but above cleanup levels protective of potable aquifer
112	40-11, Oil/Water Separator	Oil/Water Separator		TCE, TPH		
151	40-51, Sumps EV-112 and EV 119	Hallway and Building Entrance	Soil; perched groundwater	TCE, As		
EPM B (BTEX/Perched GW)						
086, 089, 094	40-56, Former USTs	Parking lot and location of HVAC system for Building 40-56, fire lane, garbage compactor	Perched groundwater, soil, indoor air, potable groundwater	BTEX	Former USTs	• Construction Worker Exposure to Perched Groundwater • Soil Gas above IA screening levels • Soil Above Direct-Contact Cleanup Levels AND above cleanup levels protective of potable aquifer; Potential migration to Esperance Sand Aqufer
EPM C (TPH/Perched GW)						
166	45-53, Former UST EV-110-1	Paved area and fuel system	Perched groundwater	TPH	Former UST	• Construction Worker Exposure to Perched Groundwater • No Soil Contamination above Protection of Groundwater or Direct Contact Cleanup Levels
EPM D (Hydraulic Fluid/Perched GW)						
055, 168	40-24, Utility Trenches and Sumps	Final assembly of 787 aircraft transitioning to 777X final assembly and 777X wing assembly, vault outside is not in use	Perched groundwater, soil; Potable groundwater	TBP	Utility Sumps, Trenches	• Construction Worker Direct Contact with Soil • Construction Worker Exposure to Perched Groundwater and NAPL • Soil Above Direct-Contact Cleanup Levels and Cleanup levels protective of potable aquifer
NA	40-22, Utility Slants #2 and #3	747-8 and 767 final assembly	Soil; Potable groundwater			• Construction Worker Direct Contact with Soil; Soil Above Direct-Contact Cleanup Levels and Cleanup levels protective of potable aquifer
NA	40-23, Static Test Pad	777 final assembly				
177	40-25, Utility Vault	Utility Vault				
EPM E (VOCs/No Perched GW)						
054	40-51, Former Wastewater AST	Parking lot, storage and roadway	Soil, Indoor Air; Potable Groundwater	TCE	Former AST; Paint Crib; Vapor Degreasers	• Construction Worker Direct Contact with Soil • VOCs in Soil Gas and Sub-Slab Vapor Exceeding Screening Levels Outdoors and Below Building, No Current VOCs in Indoor Air above CULs; • Soil Above Cleanup levels protective of potable aquifer
097	40-11, Former Vapor Degreaser	Auto Shop office area				
098	40-53, Former Mock-up Degreaser	777/777X feeder line (subassembly manufacturing)				
170	40-02, Former Large Vapor	777X Spar Assembly Shop				
171	40-31, Former Bluestreak Vapor	Carpet shop for storing carpet				
NA	40-32, Footing Excavation	Below footing for hangar door and adjacent to pedestrian/utility tunnel		TCE, ethylbenzene, xylenes, TPH		
169	40-02, Small Vapor Degreaser	777X Spar Assembly Shop	Soil; Indoor Air; Potable Groundwater	TCE, Freon 12		
NA	40-02, Former Paint Crib	777X Spar Assembly Shop parts staging and AGV (automated guided vehicle) charging stations		TCE		
EPM F (TPH/No Perched GW)						
068	South Complex, South Fire Pit	Parking Lot and entrance to Boeing Facility	Soil;	TPH; BTEX	Former Fire Pit	• Construction Worker Direct Contact with Soil • Soil Above Cleanup levels protective of potable aquifer

Table 2-1
Summary of Exposure Pathway Models
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/ AOC No.	Building Number and Description	Current Use	Primary Media Cleanup Levels Established[a]	Primary COC Exceeding Proposed CUL	Source	Potential Exposure Pathway Characteristics
EPM G (VOCs, TPH, or Metals/No Perched GW)						
065	40-51, Former Paint Stripping Tankline	Office Space/Printing Operation (may not still be present; some equipment is located in the room).	Soil; Potable Groundwater	Cadmium, chromium, lead	Former USTs, Former Tankline	• Construction Worker Direct Contact with Soil • Soils Above CUL protective of GW • No existing buildings near or above VOC contaminated soils
083	Flightline, Former UST EV-15	Flightline (partially under concrete earthern blast wall)		TPH		
165	45-52, Former Fuel Farm USTs and Fueling Positions	Fuel Farm and Fuel Piping/Stalls, electrical substation, roadway		TPH, benzene, ethylbenzene, xylenes		
NA	40-11, UST EV-48-1	UST EV-48-1 and UST EV-49-1. USTs connected to existing pump island south of AOC. OWS located adjacent to USTs.		TPH, benzene, ethylbenzene, xylenes		
EPM H (MEK,TEX/No Perched GW)						
067, 071	40-56, Former Recycling Unit and UST EV-153	Silkscreen shop	Soil; Potable Groundwater; Indoor Air	toluene, ethyl benzene, xylenes	Former USTs	• Construction Worker Direct Contact with Soil • IA vapor intrusion potential due to elevated subsurface VOC soils at SWMU067/071; Soil contamination above CULs protective of potable groundwater • Soil Above Cleanup levels protective of potable aquifer
093	45-01, Former Solvent USTs	Entrance to Building 45-01 occasionally used as an external laydown area		2-Butanone (methyl ethyl ketone)		
EPM I (Arsenic/Esperance Sand)						
NA	Esperance Sand Well EGW061	Paved roadway	Groundwater	Arsenic	Unknown	• Future Drinking Water, but No Current Drinking Water Pathway • Esperance Sand Aquifer • Elevated Arsenic Concentrations in Regional Aquifer
EPM J (PAHs/Former Gun Club)[1]						
EPM K (TCE/Powder Mill Gulch)						
NA	North Complex, Esperance Sand, Powder Mill Gulch	Forest, creek, wetlands, trails, utilities, unpaved and paved roads	Groundwater; Surface water	TCE	Undocumented spills and releases to soils below detention basin	• Future Drinking Water (Groundwater), but No Current Drinking Water Pathway (Groundwater or Surface Water) • No VOCs in Soil Gas above IA Screening Levels at the PMBC or Seaway Center Properties • Direct Contact with Contaminated Groundwater and Surface Water on Boeing, PMBC, Seaway and City of Everett Properties • Future Human Consumption of Surface Water Organisms • Ecological Receptors • Esperance Sand Aquifer • Terrestrial Ecological Risk Evaluation Not Required
BOMARC Property						
011	BOMARC Building 45-70 Interior	Property owned by Snohomish County and leased by Boeing, building owned by Boeing and leased to several tenants	Indoor Air	Freon 12 (Indoor air); TCE (Indoor air)	Unknown	• Current Soil contamination above CULs • Construction Worker Direct Contact with Soil
123, 124	Oil/Water Separator	Oil/Water Separator	Soil	cPAHs	Historic Facility	

[a]Cleanup level for Media listed for each SWMU/AOC.

Notes:
AOC - area of concern
AST - aboveground storage tank
BTEX - benzene, toluene, ethylbenzene, and xylenes
CUL - cleanup level
COC - chemical of concern
EPM - exposure pathway model
NA - not applicable
NAPL - nonaqueous phase liquid
OWS - oil/water separator
PAH - polycyclic aromatic hydrocarbon
SWMU - solid waste management unit
TBP - tributyl phosphate
VOCs - volatile organic compounds
UST - underground storage tank
TCE - trichloroethene
TEX - toluene, ethylbenzene, and xylenes
TPH - total petroleum hydrocarbons

[1]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

Table 2-2
Summary of Interim Actions
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/ AOC No.	Building Number and Description	Media[a]	Primary COC Exceeding CUL	Interim Actions[1]
EPM A (VOCs/Perched GW)				
090	40-51, Former UST EV-11	Perched groundwater, indoor air	TCE	
112	40-11, Oil/Water Separator		TPH	
151	40-51, Sumps EV-112 and EV-119	Indoor Air, soil	None	NA
EPM B (BTEX/Perched GW)				
086, 089, 094	40-56, Former USTs	Perched groundwater, soil, Indoor Air; Esperance Sand Aquifer	BTEX	Although not an interim action under Ecology oversight, 285 tons of soil were removed in the 1997 removal of UST EV-43-1 Maintain and operate pump used for dewatering perched groundwater in fill adjacent to underground utilities and USTs
EPM C (TPH/Perched GW)				
166	45-53, Former UST EV-110-1	Perched groundwater	TPH	Although not an interim action under Ecology oversight, UST was removed in 1997
EPM D (Hydraulic Fluid/Perched GW)				
055, 168	40-24, Utility Trenches and Sumps	Perched groundwater, soil	TBP	Although not an interim action under Ecologyy oversight, USTs were removed in 1993.
NA	40-22, Utility Slants #2 and #3	Soil		NA
NA	40-23, Static Test Pad			
177	40-25, Utility Vault			

Table 2-2
Summary of Interim Actions
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/ AOC No.	Building Number and Description	Media[a]	Primary COC Exceeding CUL	Interim Actions[1]
EPM E (VOCs/No Perched GW)				
054	40-51, Former Wastewater AST	Soil, Indoor air	TCE	NA
097	40-11, Former Vapor Degreaser			
098	40-53, Former Mock-up Degreaser			
170	40-02, Former Large Vapor Degreaser			
171	40-31, Former Bluestreak Vapor Degreaser			
NA	40-32, Footing Excavation		TCE, ethylbenzene, xylenes, TPH	
169	40-02, Small Vapor	Indoor air	TCE, Freon 12	
NA	40-02, Former Paint Crib		TCE	
EPM F (TPH/No Perched GW)				
068	South Complex, South Fire	Soil	TPH	NA
EPM G (VOCs, TPH, or Metals/No Perched GW)				
065	40-52, Former Paint Stripping Tankline	Soil	Cadmium, chromium, lead	NA
083	Flightline, Former UST EV-15		TPH	
165	45-52, Former Fuel Farm USTs and Fuel Stall Piping		TPH, benzene, ethylbenzene, xylenes	Although not an interim action under Ecology oversight, Excavation and disposal of soil containing petroleum hydrocarbons during removal of four USTs and removal of one dewatering well (2008)
NA	40-11, UST EV-48-1		BTEX, TPH	NA

Table 2-2
Summary of Interim Actions
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/ AOC No.	Building Number and Description	Media[a]	Primary COC Exceeding CUL	Interim Actions[1]
EPM H (MEK, TEX/No Perched GW)				
067, 071	40-56, Former Recycling Unit and UST EV-153	Soil,	toluene, ethyl benzene, xylenes	Although not an interim action under Ecology oversight, features were removed in 1991, and soil was removed from the floor during the 1991/1992 remodel
093	45-01, Former Solvent USTs		2-Butanone (methyl ethyl ketone)	NA
EPM I (Arsenic/Esperance Sand)				
NA	Esperance Sand Well EGW061	Groundwater	Arsenic	NA
EPM J (PAHs/Former Gun Club)[2]				
EPM K (TCE/Powder Mill Gulch)				
NA	North Complex, Esperance Sand, Powder Mill Gulch	Groundwater, surface water	TCE	Source area treatment of TCE in groundwater by in-situ Electric Resistance Heating and bioremediation (2006-2010); Downgradient TCE groundwater interim action by operating 12 groundwater extraction wells to reduce migration of TCE groundwater beyond Boeing Property and reduce TCE groundwater migration to Powder Mill Creek.
BOMARC Property[b]				
011	BOMARC Building 45-70 Interior	Indoor air	Freon 12; TCE	
123, 124	BOMARC Building 45-70, Oil/Water Separators	Soil	cPAHs	NA

[a]Media listed for each SWMU/AOC have chemical concentrations above a cleanup level or screening level.

[b]Only includes upland AOCs. Wetland 3A AOC will be addressed in the Sediment dCAP. Cadmium in soil is considered NFA.

BOLD – The alternative shown in bold text was the selected cleanup alternative.

Notes:

AOC - area of concern
AST - aboveground storage tank
BTEX - benzene, toluene, ethylbenzene, and xylenes
CUL - cleanup level
EPM - exposure pathway model
NA - not applicable
PAH - polycyclic aromatic hydrocarbon
SWMU - solid waste management unit
TBP - tributyl phosphate
TCE - trichloroethene
TEX - toluene, ethylbenzene, and xylenes
TPH - total
VOCs - volatile
UST - underground storage tank

[1]Interim Actions are described in the Upland FS (URS and Landau, 2012)

[2]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

Table 3-1
Exposure Pathway Model A (VOCs/Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Media	ARAR/Source	40-51, SWMU 90	40-11, SWMU 112	40-51, SWMU 151
VOCs					
TCE	Soil	Method B[b]	NA	NA	25 µg/kg
	Perched Groundwater	RBCL[c]	0.011 mg/L	0.011 mg/L	0.011 mg/L
	Indoor Air[a]	Method C[d]	2 µg/m^3	2 µg/m^3	NA
1,1-DCE	Soil	Method B[b]	NA	NA	46 µg/kg
	Perched Groundwater	RBCL[c]	0.91 mg/L	0.91 mg/L	0.91 mg/L
	Indoor Air[a]	Method C[d]	200 µg/m^3	200 µg/m^3	NA
cis-1,2-DCE[e]	Soil	Method B[b]	NA	NA	78 µg/kg
	Perched Groundwater	RBCL[c]	3.02 mg/L	3.02 mg/L	3.02 mg/L
	Indoor Air[a]	Method C[d]	NE	NE	NE
trans-1,2-DCE	Soil	Method B[b]	NA	NA	520 µg/kg
	Perched Groundwater	RBCL[c]	30.2 mg/L	30.2 mg/L	30.2 mg/L
	Indoor Air[a]	Method C[d]	NE	NE	NE
PCE	Groundwater	RBCL[c]	0.222 mg/L	NA	NA
	Indoor Air[a]	Method C[d]	40 µg/m^3	NA	NA
Vinyl chloride	Soil	Method B[b]	NA	NA	1.7 µg/kg
	Perched Groundwater	RBCL[c]	0.35 mg/L	0.35 mg/L	0.35 mg/L
	Indoor Air[a]	Method C[d]	2.8 µg/m^3	2.8 µg/m^3	NA
TPH-Gx	Perched Groundwater	Method A[e]	NA	1.0 mg/L	NA
TPH-Dx	Perched Groundwater	Method A[e]	NA	0.5 mg/L	NA
TPH-O	Perched Groundwater	Method A[e]	NA	0.5 mg/L	NA
Metals					
Arsenic	Perched Groundwater	RBCL[c]	NA	NA	5.26 mg/L

[a]Monitoring only requirement

[b]MTCA Protection of Groundwater (PGW) in the vadose zone at 13°C, where available, otherwise at 25°C

[c]Construction Worker Risk-Based Cleanup Level (RBCL)

[d]MTCA Method C Indoor Air Cleanup Level

[e]MTCA Method A Direct Contact Cleanup Level

[f]The soil vapor CUL for cis-1,2-DCE and trans-1,2-DCE is not established.

NE - not established

NA - not applicable

Table 3-2
Exposure Pathway Model B (BTEX/Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Media	ARAR/Source	40-56, SWMUs 86, 89, 94
TCE	Soil	Method B[a]	25 µg/kg
	Perched Groundwater	RBCL[b]	0.009 mg/L
	Deep Groundwater	Method B[c]	0.004 mg/L
	Indoor Air	Method C[d]	2 µg/m^3
1,1-DCE	Soil	Method B[a]	46 µg/kg
	Perched Groundwater	RBCL[b]	0.799 mg/L
	Deep Groundwater	EPA MCL[e]	0.007 mg/l
	Indoor Air	Method C[d]	200 µg/m^3
cis-1,2-DCE[f]	Soil	Method B[a]	78 µg/kg
	Perched Groundwater	RBCL[b]	3.02 mg/L
	Deep Groundwater	Method B[c]	0.016 mg/L
	Indoor Air	Method C[d]	NE
trans-1,2-DCE	Soil	Method B[a]	520 µg/kg
	Perched Groundwater	RBCL[b]	30.2 mg/L
	Deep Groundwater	EPA MCL[e]	0.1 mg/L
	Indoor Air	Method C[d]	NE
PCE	Deep Groundwater	Method B[c]	0.021 mg/L
	Indoor Air	Method C[d]	40 µg/m^3
Vinyl Chloride	Soil	Method B[a]	1.7 µg/kg
	Perched Groundwater	RBCL[b]	0.35 mg/L
	Deep Groundwater	Method B[c]	0.000029 mg/L
	Indoor Air	Method C[d]	2.8 µg/m^3
Benzene	Soil	Method B[a]	27 µg/kg
	Perched Groundwater	RBCL[b]	0.122 mg/L
	Deep Groundwater	Method B[c]	0.0008 mg/L
	Indoor Air	Method C[d]	3.20 µg/m^3
Ethylbenzene	Soil	Method B[a]	5,900 µg/kg
	Perched Groundwater	RBCL[b]	4.3 mg/L
	Deep Groundwater	Method B[c]	0.8 mg/L
	Indoor Air	Method C[d]	1,000 µg/m^3
Toluene	Soil	Method B[a]	4,500 µg/kg
	Perched Groundwater	RBCL[b]	15.1 mg/L
	Deep Groundwater	Method B[c]	0.640 mg/L
	Indoor Air	Method C[d]	5,000 µg/m^3
m,p-xylenes	Soil	Method B[a]	13,000 µg/kg
			14,000 µg/kg (total)
	Perched Groundwater	RBCL[b]	0.485 mg/L (total)
	Deep Groundwater	Method B[c]	1.6 mg/L
			1.6 mg/L (total)
	Indoor Air	Method C[d]	100 µg/m^3
o-xylenes	Soil	Method B[c]	14,000 µg/kg
			14,000 µg/kg (total)
	Perched Groundwater	RBCL[b]	0.485 mg/L (total)
	Deep Groundwater	Method B[c]	1.6 mg/L
	Indoor Air	Method C[d]	100 µg/m^3

Table 3-2
Exposure Pathway Model B (BTEX/Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Media	ARAR/Source	40-56, SWMUs 86, 89, 94
MIBK	Soil	Method B[a]	6,400,000 µg/kg
	Deep Groundwater	Method B[c]	0.64 mg/L

[a]MTCA Protection of Groundwater in the vadose zone at 13°C, where available, otherwise at 25°C

[b]Construction Worker Risk-Based Cleanup Level (RBCL)

[c]MTCA Method B Groundwater Cleanup Level

[d]MTCA Method C Indoor Air Cleanup Level

[e]EPA MCL (maximum contaminant limit)

[f]The soil vapor cleanup level for cis-1,2-DCE and trans-1,2-DCE is not established.

NE - not established

Table 3-3
Exposure Pathway Model C (TPH/Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	45-53, SWMU 166
TPH-D	Perched Groundwater	Method A[a]	0.5 mg/L
TPH-Jet A	Perched Groundwater	Method A[a]	0.5 mg/L

[a]MTCA Method A Direct Contact Cleanup Level

Table 3-4
Exposure Pathway Model D (Hydraulic Fluid/Perched GW) Cleanup Levels
CAP -Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	40-24, SWMUs 055 and 168	40-22, Utility Slants #2 and #3	40-23, Static Test Pad	40-25, SWMU 177
Tributyl Phosphate	Soil	Method B[a]	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg
	Perched Groundwater	RBCL[b]	4.3 mg/L	4.3 mg/L	4.3 mg/L	NA
	Deep Groundwater	Method B[c]	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l
Dibutyl Phenyl Phosphate	Soil	Method B[a]	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg
	Perched Groundwater	RBCL[b]	4.3 mg/L	NA	NA	NA
	Deep Groundwater	Method B[c]	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l
Butyl Diphenyl Phosphate	Soil	Method B[a]	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg
	Perched Groundwater	RBCL[b]	4.3 mg/L	NA	NA	NA
	Deep Groundwater	Method B[c]	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l
Triphenyl Phosphate	Soil	Method B[a]	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg	0.51 mg/kg
	Perched Groundwater	RBCL[b]	4.3 mg/L	NA	NA	NA
	Deep Groundwater	Method B[c]	0.0097 mg/l	0.0097 mg/l	0.0097 mg/l	NA
BHT	Soil	Method B[a]	7.4 mg/kg	7.4 mg/kg	7.4 mg/kg	NA
	Perched Groundwater	RBCL[b]	12 mg/L	NA	NA	NA
	Deep Groundwater	Method B[c]	0.024 mg/l	0.024 mg/l	0.024 mg/l	NA
n-Butyl Alcohol	Soil	Method B[a]	3,300 µg/kg	NA	NA	NA
	Deep Groundwater	Method B[c]	0.8 mg/L	NA	NA	NA
Arsenic	Perched Groundwater	RBCL[b]	5.3 mg/L	NA	NA	NA
	Deep Groundwater	Background[d]	0.011 mg/L	NA	NA	NA

[a]MTCA Method B Protection of Groundwater calculated using MTCA equation 747-1 (WAC 173-340-747)

[b]Construction Worker Risk-Based Cleanup Level (RBCL) - see Appendix C of the Feasibility Study, Upland Areas and Powder Gulch (AECOM and Landau 2015)

[c]MTCA Method B Groundwater Cleanup Level calculated based on carcinogenicity

[d]Ecology Natural Background Groundwater Arsenic Concentrations in WA State June 2015

NA - Not Applicable

Table 3-5
Exposure Pathway Model E (VOCs/No Perched GW) Cleanup Levels
dCAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/ Source	40-31, SWMU 171	40-11, SWMU 97	40-53, SWMU 98	40-02, SWMU 170	40-02, SWMU 169	40-02, Former Paint Crib	40-51, SWMU 54	40-32, Footing Excavation
TCE	Soil	Method B[b]	25 µg/kg	25 µg/kg	25 µg/kg	25 µg/kg	25 µg/kg	25 µg/kg	25 µg/kg	25 µg/kg
	Deep Groundwater	Method B[c]	0.004 mg/L	NA	0.004 mg/L	0.004 mg/L	0.004 mg/L	0.004 mg/L	0.004 mg/L	0.004 mg/L
	Indoor Air[a]	Method C[d]	2 µg/m³	NA	2 µg/m³	2 µg/m³	2 µg/m³	2 µg/m³	2 µg/m³	2 µg/m³
1,1-DCE	Soil	Method B[b]	46 µg/kg	46 µg/kg	46 µg/kg	46 µg/kg	46 µg/kg	46 µg/kg	46 µg/kg	46 µg/kg
	Deep Groundwater	EPA MCL[e]	0.007 mg/L	NA	0.007 mg/L	0.007 mg/L	0.007 mg/L	0.007 mg/L	0.007 mg/L	0.007 mg/L
	Indoor Air[a]	Method C[d]	200 µg/m³	NA	200 µg/m³	200 µg/m³	200 µg/m³	200 µg/m³	200 µg/m³	200 µg/m³
cis-1,2-DCE[1]	Soil	Method B[b]	78 µg/kg	78 µg/kg	78 µg/kg	78 µg/kg	78 µg/kg	78 µg/kg	78 µg/kg	78 µg/kg
	Deep Groundwater	Method B[c]	0.016 mg/L	NA	0.016 mg/L	0.016 mg/L	0.016 mg/L	0.016 mg/L	0.016 mg/L	0.016 mg/L
	Indoor Air[a]	Method C[d]	NE	NE	NE	NE	NE	NE	NE	NE
trans-1,2-DCE	Soil	Method B[b]	520 µg/kg	520 µg/kg	520 µg/kg	520 µg/kg	520 µg/kg	520 µg/kg	520 µg/kg	520 µg/kg
	Deep Groundwater	EPA MCL[e]	0.1 mg/L	NA	0.1 mg/L	0.1 mg/L	0.1 mg/L	0.1 mg/L	0.1 mg/L	0.1 mg/L
	Indoor Air[a]	Method C[d]	NE	NE	NE	NE	NE	NE	NE	NE
PCE	Indoor Air[a]	Method C[d]	40 µg/m³	NA	40 µg/m³	NA	NA	NA	NA	40 µg/m³
Vinyl Chloride	Soil	Method B[b]	1.7 µg/kg	1.7 µg/kg	1.7 µg/kg	1.7 µg/kg	1.7 µg/kg	1.7 µg/kg	1.7 µg/kg	1.7 µg/kg
	Deep Groundwater	Method B[c]	0.000029 mg/L	NA	0.000029 mg/L	0.000029 mg/L	0.000029 mg/L	0.000029 mg/L	0.000029 mg/L	0.000029 mg/L
	Indoor Air[a]	Method C[d]	2.8 µg/m³	NA	2.8 µg/m³	2.8 µg/m³	2.8 µg/m³	2.8 µg/m³	2.8 µg/m³	2.8 µg/m³
Freon 12	Indoor Air[a]	Method C[d]	NA	NA	NA	100 µg/m³	100 µg/m³	100 µg/m³	NA	NA
Chloroform	Indoor Air[a]	Method C[d]	NA	NA	NA	1.1 µg/m³	1.1 µg/m³	1.1 µg/m³	NA	NA
Benzene	Soil	Method B[b]	NA	NA	NA	NA	NA	NA	NA	27 µg/kg
	Deep Groundwater	Method B[c]	NA	NA	NA	NA	NA	NA	NA	0.0008 mg/L
	Indoor Air[a]	Method C[d]	NA	NA	NA	NA	NA	NA	NA	3.20 µg/m³
Ethylbenzene	Soil	Method B[b]	NA	NA	NA	NA	NA	NA	NA	5,900 µg/kg
	Deep Groundwater	Method B[c]	NA	NA	NA	NA	NA	NA	NA	0.8 mg/L
	Indoor Air[a]	Method C[d]	NA	NA	NA	NA	NA	NA	NA	1,000 µg/m³
Toluene	Soil	Method B[b]	NA	NA	NA	NA	NA	NA	NA	4,500 µg/kg
	Deep Groundwater	Method B[c]	NA	NA	NA	NA	NA	NA	NA	0.640 mg/L
	Indoor Air[a]	Method C[d]	NA	NA	NA	NA	NA	NA	NA	5,000 µg/m³
m,p-xylenes	Soil	Method B[b]	NA	NA	NA	NA	NA	NA	NA	13,000 µg/kg
			NA	NA	NA	NA	NA	NA	NA	14,000 µg/kg (total)
	Deep Groundwater	Method B[c]	NA	NA	NA	NA	NA	NA	NA	1.6 mg/L
			NA	NA	NA	NA	NA	NA	NA	1.6 mg/L (total)
	Indoor Air[a]	Method C[d]	NA	NA	NA	NA	NA	NA	NA	100 µg/m³

Table 3-5
Exposure Pathway Model E (VOCs/No Perched GW) Cleanup Levels
dCAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/ Source	40-31, SWMU 171	40-11, SWMU 97	40-53, SWMU 98	40-02, SWMU 170	40-02, SWMU 169	40-02, Former Paint Crib	40-51, SWMU 54	40-32, Footing Excavation
o-xylenes	Soil	Method B[b]	NA	NA	NA	NA	NA	NA	NA	14,000 µg/kg
			NA	NA	NA	NA	NA	NA	NA	14,000 µg/kg (total)
	Deep Groundwater	Method B[c]	NE	NE	NE	NE	NE	NE	NE	1.6 mg/L
	Indoor Air[a]	Method C[d]	NA	NA	NA	NA	NA	NA	NA	100 µg/m^3
TPH-G	Soil	Method A[f]	NA	NA	NA	NA	NA	NA	NA	30 mg/kg [2]
	Deep Groundwater	Method A[g]	NA	NA	NA	NA	NA	NA	NA	0.8 mg/L [3]
TPH-D	Soil	Method A[f]	NA	NA	NA	NA	NA	NA	NA	2,000 mg/kg
	Deep Groundwater	Method A[g]	NA	NA	NA	NA	NA	NA	NA	0.5 mg/L
TPH-O	Soil	Method A[f]	NA	NA	NA	NA	NA	NA	NA	2,000 mg/kg
	Deep Groundwater	Method A[g]	NA	NA	NA	NA	NA	NA	NA	0.5 mg/L
TPH-Jet A	Soil	Method A[f]	NA	NA	NA	NA	NA	NA	NA	2,000 mg/kg
	Deep Groundwater	Method A[g]	NA	NA	NA	NA	NA	NA	NA	0.5 mg/L
Hydrocarbons										
TPH Generic	Indoor Air	Method C[c]	NA	NA	NA	NA	NA	NA	NA	140 µg/m^3

[a]Monitoring only requirement

[b]MTCA Protection of Groundwater (PGW) in the vadose zone at 13 degrees Celsius, where available, otherwise at 25 degrees Celsius

[c]MTCA Method B Groundwater Cleanup Level

[d]MTCA Method C Indoor Air Cleanup Level

[e]EPA MCL (maximum contaminant level)

[f]MTCA Method A Direct Contact Cleanup Level

[g]MTCA Method A Groundwater Cleanup Level

[1]The soil vapor CUL for cis-1,2-DCE and trans-1,2-DCE is not established.

[2]The cleanup level is 100 mg/kg if benzene is not present, and the total of ethylbenzene, toluene, and xylenes is less than 1% of the gasoline mixture.

[3]The cleanup level is 1.0 mg/L if benzene is not present

NE - not established

NA - not applicable

Table 3-6
Exposure Pathway Model F (TPH/No Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	Former South Fire Pit, SWMU 68
Benzene	Soil	Method A[a]	30 µg/kg
Ethylbenzene	Soil	Method A[a]	6,000 µg/kg
Toluene	Soil	Method A[a]	7,000 µg/kg
m,p-xylenes	Soil	Method A[a]	9,000 µg/kg (total)
o-xylenes	Soil	Method A[a]	9,000 µg/kg (total)
TPH-G	Soil	Method A[a]	30 mg/kg[b]
TPH-D	Soil	Method A[a]	2,000 mg/kg
TPH-O	Soil	Method A[a]	2,000 mg/kg
TPH-Jet A	Soil	Method A[a]	2,000 mg/kg

[a]MTCA Method A Direct Contact Cleanup Level

[b]The cleanup level is 100 mg/kg if benzene is not present, and the total of ethylbenzene, toluene, and xylenes is less than 1% of the gasoline mixture.

Table 3-7
Exposure Pathway Model G (VOCs, TPH, or Metals/No Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	40-51, SWMU 65	40-11, UST EV-48-1	Fuel Farm, SWMU 165	SWMU 83, Former UST EV-15
Benzene	Soil	Method A[a]	NA	30 µg/kg	30 µg/kg	NA
	Deep Groundwater	Method A[c]	NA	0.005 mg/L	0.005 mg/L	NA
Ethylbenzene	Soil	Method A[a]	NA	6,000 µg/kg	6,000 µg/kg	NA
	Deep Groundwater	Method A[c]	NA	0.7 mg/L	0.7 mg/L	NA
Toluene	Soil	Method A[a]	NA	7,000 µg/kg	7,000 µg/kg	NA
	Deep Groundwater	Method A[c]	NA	1.0 mg/L	1.0 mg/L	NA
m,p-xylenes	Soil	Method A[a]	NA	9,000 µg/kg (total)	9,000 µg/kg (total)	NA
	Deep Groundwater	Method B[b]	NA	1.6 mg/L	1.6 mg/L	NA
		Method A[c]	NA	1.0 mg/L (total)	1.0 mg/L (total)	NA
o-xylenes	Soil	Method A[a]	NA	9,000 µg/kg (total)	9,000 µg/kg (total)	NA
TPH-G	Soil	Method A[a]	NA	100 mg/kg [1]	100 mg/kg [1]	NA
	Deep Groundwater	Method A[c]	NA	0.8 mg/L [2]	0.8 mg/L [2]	NA
TPH-D	Soil	Method A[a]	NA	NE	2,000 mg/kg	2,000 mg/kg
	Deep Groundwater	Method A[c]	NA	0.5 mg/L	0.5 mg/L	NA
TPH-O	Soil	Method A[a]	NA	NE	2,000 mg/kg	NA
	Deep Groundwater	Method A[c]	NA	0.5 mg/L	0.5 mg/L	NA
Metals						
Cadmium	Soil	Method A[a]	2 mg/kg	NA	NA	NA
Chromium	Soil	Method A[a]	2,000 mg/kg Cr (III) 19 mg/kg Cr(VI)	NA	NA	NA
Lead	Soil	Method A[a]	250 mg/kg	NA	NA	NA

[a]MTCA Method A Direct Contact Cleanup Level

[b]MTCA Method B Groundwater Cleanup Level

[c]MTCA Method A Groundwater Cleanup Level

[1]The cleanup level is 100 mg/kg if benzene is not present, and the total of ethylbenzene, toluene, and xylenes is less than 1% of the gasoline mixture.

[2] The cleanup level is 1.0 mg/L if benzene is not present NE - not established

NA - not applicable

Table 3-8
Exposure Pathway Model H (MEK, TEX/No Perched GW) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	45-01, SWMU 93	40-56, SWMUs 67, 71
2-Butanone (MEK)	Soil	Method B[b]	20,000µg/kg	NA
	Deep Groundwater	Method B[c]	4,800 µg/L	NA
Benzene	Soil	Method A[e]	NA	30 µg/kg
	Deep Groundwater	Method A[f]	NA	0.0005 mg/L
	Indoor Air[a]	Method C[d]	NA	3.2 µg/m^3
Ethylbenzene	Soil	Method A[e]	NA	6,000 µg/kg
	Deep Groundwater	Method A[f]	NA	0.7 mg/L
	Indoor Air[a]	Method C[d]	NA	1,000 µg/m^3
Toluene	Soil	Method A[e]	NA	7,000 µg/kg
	Deep Groundwater	Method A[f]	NA	1.0 mg/L
	Indoor Air[a]	Method C[d]	NA	5,000 µg/m^3
m,p,o-xylenes	Soil	Method A[e]	NA	9,000 µg/kg (total)
	Deep Groundwater	Method B[c]	NA	1.6 mg/L
		Method A[f]	NA	1.0 mg/L (total)
	Indoor Air[a]	Method C[c]	NA	100 µg/m^3

[a]Monitoring only requirement

[b]MTCA Protection of Groundwater (PGW) in the vadose zone at 13°C, where available, otherwise at 25°C

[c]MTCA Method B Groundwater Cleanup Level

[d]MTCA Method C Indoor Air Cleanup Level

[e]MTCA Method A Direct Contact Cleanup Level

[f]MTCA Method A Groundwater Cleanup Level

NA - not applicable

Table 3-9
Exposure Pathway Model I (Arsenic/Esperance Sand) Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	Esperance Sand Well EGW061
Arsenic	Deep Groundwater	Background[a]	0.011 mg/L[b]

[a]Gauging only requirement

[b]Ecology Natural Background Groundwater Arsenic Concentrations in WA State June 2015

Table 3-10a
Exposure Model Pathway K (Powder Mill Gulch) Surface Water Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Contaminant of Concern	Surface Water ARARs						Surface Water Cleanup Level (µg/L)	Excess Cancer Risk	
	Water Quality Criteria - WAC 173-201A-240 (µg/L) (a)		Human Health – Fresh Water – Clean Water Act §304 (µg/L) (b)		MTCA Method B Standard Formula Value (µg/L)			Concentration (µg/L) at Carcinogenic Risk = $1x10^{-6}$ (c)	Excess Cancer Risk for Surface Water at Cleanup Level (d)
	(drinking water + organism consumption)	(organism consumption only)	(drinking water + organism consumption)	(organism consumption only)	(carcinogen)	(non-carcinogen)			
Trichloroethene	0.38(a)	0.86	0.6	7	13	118	0.38	13	2.9E-08
cis-1,2-dichloroethene	NE	NE	NE	NE	N/A	NE	590[e] (Eco)	N/A	N/A
trans-1,2-dichloroethene	600	5,800	100	4,000	N/A	32,400	100	N/A	N/A
1,1-dichloroethene	1,200	4,100	300	20,000	N/A	23,100	300	N/A	N/A
Vinyl Chloride	0.02	0.26	0.022	1.6	3.7	6,480	0.02	3.7	5.4E-09

TOTAL EXCESS CANCER RISK
3.5E-08

NE = not established
N/A = not applicable
µg/L = micrograms per liter

ARAR = Applicable, Relevant, and Appropriate Requirements
CFR = Code of Federal Regulations
EPA = U.S. Environmental Protection Agency
MTCA = Model Toxics Control Act
WAC = Washington Administrative Code
RAGS = Risk Assessment Guidance for Superfund
BTAG = Biological Technical Assistance Group

Notes:
boxed cells = most conservative cleanup level for applicable surface water ARARs and exposure pathway(s)/receptors

(a) August 1, 2016 rulemaking for WAC 173-201A new numan health criteria were established under part 240 (became effective September 1, 2016), but during the U.S. EPA (EPA) approval process the state water quality criteria were revised for some COCs by the EPA's November 15, 2016 response and codified under NTR (40 CFR 131.45) on November 28, 2016.-However, EPA has since finalized rulemaking to withdraw most of the human health criteria for Washington found in the NTR.

(b) EPA June 2015 published final national recommended ambient water quality criteria for protection of human health for 94 chemical pollutants. Updated recommendations reflect the latest scientific information and EPA policies, including updated body weight, drinking water consumption rate, fish consumption rate, bioaccumulation factors, health toxicity values, and relative source contributions.

(c) Concentration at carcinogenic risk = 1E-06 is equal to the Method B formula value for surface water.

(d) Carcinogenic risk at cleanup level = (cleanup level divided by the concentration at which the risk is 1E-06) x 1E-06.

Table 3-10b
Exposure Model Pathway K (Powder Mill Gulch) Groundwater Cleanup Levels
CAP -Upland Areas and PMG
Boeing Everett Facility

	Groundwater ARARs							Excess Cancer Risk
Contaminant of Concern	**Federal/State Primary Maximum Contaminant Level (MCL) (µg/L)**	**Method A, Table Value (µg/L)**	**MTCA Method B Carcinogen Standard Formula Value (µg/L)**	**MTCA Method B Non-carcinogen Standard Formula Value (µg/L)**	**Groundwater Cleanup Level Protective of Drinking Water (µg/L) (a)**	**Surface Water Quality Standards Protective of Surface Water Beneficial Uses (µg/L) (b)**	**Ecology Groundwater Cleanup Level (µg/L) (g)**	**Excess Cancer Risk for Ecology Groundwater at Cleanup Level (g)**
Trichloroethene	5	5	0.54	4 (e)	4	0.38	**0.38**	7.00E-07
cis-1,2-dichloroethene	70	NE	N/A	16 (e)	16	N/A	**16**	N/A
trans-1,2-dichloroethene	100	NE	N/A	160	100	100	**100**	N/A
1,1-dichloroethene	7	NE	N/A	400	7	300	**7**	N/A
Vinyl Chloride	2	0.2	0.029	24	0.07 (f)	0.02	**0.02**	6.90E-07
							TOTAL EXCESS CANCER RISK	**1.39E-06**

N/A = not applicable
µg/L = micgrograms per liter
ARAR = Applicable, Relevant, and Appropriate Requirements
MTCA = Model Toxics Control Act

Notes:
boxed cells = most conservative cleanup level for applicable groundwater ARARs and exposure pathway(s)/receptors
(a) Cleanup level established through MTCA Method B protective of human health for drinking water (see notes on Table 3-11a).
(b) Based on surface water ARARs (see Table 3-11a); cleanup level at point where groundwater flows to surface water (see notes on Table 3-11a).
(e) For cis-1,2-DCE (non-carcinogen), cleanup level based on MCL (70 µg/L) must be adjusted down to 16 ug/L so hazard quotient is less than 1 per WAC 173-340-720(7)(b). For TCE (carcinogen) cleanup level must not exceed and excess cancer risk of 1x10-5, and if based on an MCL (5 µg/L) must be adjusted down to 4 µg/L so hazard quotient is less than 1 as described in May 2015 CLARC Guidance "Trichloroethylene (TCE) - Deriving Cleanup Levels Under the Model Toxics Control Act (MTCA)"
(f) Adjustments to the CULs for carcinogens (such as TCE and vinyl chloride) may be made as allowable under WAC 173-340-720(7)(a) and WAC 173-340-708(5)(d) which states that "for carcinogens . . . the cancer risks resulting from exposure to multiple hazardous substances may be apportioned between hazardous substances in any combination as long as the total excess cancer risk does not exceed one in one hundred thousand (1 x 10-5)". Vinyl chloride value adjusted down from Federal MCL to 0.07 µg/L such that total site risk is less than 1 x 10-5.

Table 3-11
BOMARC Property Cleanup Levels
CAP - Upland Areas and PMG
Boeing Everett Facility

Chemical of Concern	Medium	ARAR/Source	EV-151 and EV-152 (SWMUs 123 and 124)	BOMARC Property Cleanup Level
cPAHs - Benzo(a)pyrene TTEC	Soil	Method A[b]	NA	100 µg/kg
	Perched Groundwater	Method A[c]	0.1 µg/L	0.1 µg/L
TCE	Indoor Air[a]	Method C[d]	NA	2 µg/m^3
Freon-12	Indoor Air[a]	Method C[d]	NA	100 µg/m^3

[a]Monitoring only requirement

[b]Method A soil cleanup levels for unrestricted land uses, WAC 173-340-900, Table 740-1

[c]MTCA Method A Groundwater Cleanup Level

[d]MTCA Method C Indoor Air Cleanup Level

TTEC - Total Toxicity Equivalent Concentration. The MTCA cleanup level for TTEC is based on benzo(a)pyrene.

Table 4-1
Summary of Cleanup Action Alternatives Evaluated
CAP – Upland Areas and PMG
Boeing Everett Facility

SWMU/ AOC No.	Building Number and Description	Media[a]	Primary COC Exceeding CUL	Alternatives Considered[b]
EPM A (VOCs/Perched GW)				
090	40-51, Former UST EV-11	Perched groundwater, indoor air	TCE	• **Alternative 1 - Maintain Containment** [c] • Alternative 2 - In Situ Treatment (SWMU/AOC 90: ISCR; SWMU/AOC 112: in situ sorption and bioremediation). • Alternative 3 - Groundwater Extraction • SWMU/AOC 112 only: Alternative 4 - Near-Term Excavation with Dewatering
112	40-11, Oil/Water Separator	Perched groundwater, indoor air	TPH	
151	40-51, Sumps EV-112 and EV-119	Soil; perched groundwater	None	• **Alternative 1 – Institutional Controls** [c]
EPM B (BTEX/Perched GW)				
086, 089, 094	40-56, Former USTs	Perched groundwater, indoor air, potable groundwater, soil	BTEX	• Alternative 1 - Maintain Containment • Alternative 2 - In Situ Treatment (Soil Vapor and Groundwater Extraction) [c] • Alternative 3 - Near-Term Excavation with Dewatering
EPM C (TPH/Perched GW)				
166	45-53, Former UST EV-110-1	Perched groundwater	TPH	• Alternative 1 - Maintain Containment [c] • Alternative 2 - Groundwater Extraction
EPM D (Hydraulic Fluid/Perched GW)[d]				
055, 168	40-24, Utility Trenches and Sumps	Perched groundwater, soil, potable groundwater	TBP	• Alternative 1 - Maintain Containment • Alternative 2 - Periodic Groundwater Extraction • Alternative 3 - Continuous Groundwater Extraction • Alternative 4 - Near-Term Excavation with Periodic Groundwater Removal AND Future Excavation[c] for SWMUs Nos. 055 and 168 AND Alternative 1 modified-Maintain Containment Plus Future Excavation for SWMUs 177 and Buildings 40-22 and 40-23.
NA	40-22, Utility Slants #2 and #3	Soil, potable groundwater		
NA	40-23, Static Test Pad			
177	40-25, Utility Vault			
EPM E (VOCs/No Perched GW)				
054	40-51, Former Wastewater AST	Soil, indoor air, potable groundwater	TCE	• Alternative 1 - Maintain Containment; Plus Future Excavation for SWMUs 054, 171[c] • Alternative 2 - Soil Vapor Extraction • Alternative 3 - Future Excavation • Alternative 4 - Near-Term Excavation for SWMU 097 Only
097	40-11, Former Vapor Degreaser	Soil, indoor air, potable groundwater	TCE	
098	40-53, Former Mock-up Degreaser			
170	40-02, Former Large Vapor Degreaser			
171	40-31, Former Bluestreak Vapor Degreaser	Soil, indoor air, potable groundwater	TCE	
NA	40-32, Footing Excavation		TCE, ethylbenzene, xylenes, TPH	
169	40-02, Small Vapor Degreaser	Soil, indoor air, potable groundwater	TCE, Freon 12	
NA	40-02, Former Paint Crib		TCE	
EPM F (TPH/No Perched GW)				
068	South Complex, South Fire Pit	Soil	TPH; BTEX	• Alternative 1 - Maintain Containment [c] • Alternative 2 - Soil Vapor Extraction • Alternative 3 - Future Excavation • **Alternative 4 - Near-Term Excavation**

Table 4-1
Summary of Cleanup Action Alternatives Evaluated
CAP – Upland Areas and PMG
Boeing Everett Facility

EPM G (VOCs, TPH, or Metals/No Perched GW)				
065	40-51, Former Paint Stripping Tankline	Soil; Potable Groundwater	Cadmium, chromium, lead	• Alternative 1 - Maintain Containment for SWMUs 065, 083 [c] • Alternative 2 - Maintain Containment and Future Excavation for SWMUs165 and EV48-1 [c] • Alternative 3 - Near-Term and Future Excavation for SWMU 165 [c]
083	Flightline, Former UST EV-15		TPH	
165	45-52, Former Fuel Farm USTs and Fuel Stall Piping		TPH, benzene, ethylbenzene, toluene, xylenes	
NA	40-11, UST EV-48-1		BTEX, TPH	
EPM H (MEK, TEX/No Perched GW)				
067, 071	40-56, Former Recycling Unit and UST EV-153	Soil; Potable Groundwater and Indoor Air	ethylbenzene, toluene, xylenes	• Alternative 1 - Maintain Containment and Future Excavation [c] • Alternative 2 - Future Excavation • Alternative 3 - Near-Term Excavation
093	45-01, Former Solvent USTs		2-Butanone (methyl ethyl ketone)	
EPM I (Arsenic/Esperance Sand)				
NA	Esperance Sand Well EGW061	Groundwater	Arsenic	• Alternative 1 - Institutional Controls [c, e]
EPM J (PAHs/Former Gun Club)[1]				
EPM K (TCE/Powder Mill Gulch)				
NA	North Complex, Esperance Sand, Powder Mill Gulch	Groundwater; Surface Water; Indoor Air	TCE	• Alternative 2 - EISB Source Area Remediation, Continued Operation of Existing GET System, and Institutional Controls • Alternative 3 - Focused ISCO Remediation, Continued Operation of Existing GET System, and Institutional Controls • Alternative 4 - Focused EISB Remediation, Continued Operation of Existing GET System, and Institutional Controls
				• Ecology Selected Remedy - Concurrent EISB treatment in the TCE Groundwater Source Area AND Dynamic Groundwater Recirculation (DGR) in ALL downgradient portions of the plume on Boeing and non-Boeing property.
BOMARC Property[f]				
011	BOMARC Building 45-70 Interior	Indoor Air	Freon 12, TCE	• Alternative 1 - Near-Term Excavation at All AOCs and Air Monitoring • Alternative 2 – Future Excavation of Soil at the Three AOCs Within the Parcel Boundaries and Air Monitoring
123, 124	BOMARC Building 45-70, Oil/Water Separators	Soil	cPAHs	

[a]Cleanup level for Media listed for each SWMU/AOC

[b]This column includes the alternatives evaluated in the FS. The bolded alternative is the alternative that was the recommended preferred cleanup alternative in the FS. The recommended preferred cleanup alternative may be different than the selected remedy presented in Section 5, which are based on negotiations with Washington State Department of Ecology.

[c]The FS alternative was modified or a different alternative was selected as the remedy based on negotiations with the Washington State Department of Ecology. Selected remedies are presented in Section 5.

[d]Only SWMU/AOC 055 and 168 were evaluated in the FS. Maintain Containment with Future Excavation is the selected remedy for the three new sites in EPM D (see Table 5-1)

[e]Ecology eliminated this remedial alternative #1 since it failed threshold criteria.

[f] Only includes upland AOCs. Wetland 3A AOC will be addressed in the Sediment dCAP.

BOLD – The alternative shown in bold text was the selected cleanup alternative.

Notes:

AOC - area of concern
AST - aboveground storage tank
BTEX - benzene, toluene, ethylbenzene, and xylenes
COC - chemical of concern
CUL - cleanup level
EPM - exposure pathway model
ICs - institutional controls
ISCR - in situ chemical reduction
NA - not applicable
PAH - polycyclic aromatic hydrocarbon
SWMU - solid waste management unit
SVE - soil vapor extraction
TBP - tributyl phosphate
TCE - trichloroethene
TEX - toluene, ethylbenzene, and xylenes
TPH - total petroleum hydrocarbons
VOCs - volatile organic compounds
UST - underground storage tank

[1]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

Table 5-1
Summary of Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Selected Remedy	Media[1]		COCs Exceeding Proposed CULs	Additional Investigation	Institutional/ Engineering Controls[2]	Monitoring[3]	New Groundwater Monitoring Well Installation	SVE	Future SVE	Enhanced In Situ Bioremediation	Dewatering	Groundwater Extraction	GET System Operation/ Dynamic Groundwater Recirculation	MNA	Near-Term Excavation[4]/ Comprehensive Excavation	Limited Excavation	Future Excavation	NFA
		Impacted	Point of Compliance																
EPM A																			
No. 090, Building 40-51, Former UST EV-11	Maintain Containment with Groundwater Monitoring	Soil, perched groundwater	Indoor air	Chlorinated VOCs		X	X												
No. 112, Building 40-11, Oil/Water Separator	Maintain Containment with Groundwater Monitoring	Perched groundwater	Indoor air	Chlorinated VOCs, TPH		X	X												
No. 151, Building 40-51, Sumps EV-112 and EV-119	Maintain Containment with Groundwater Monitoring	Soil, perched groundwater	Indoor air	Chlorinated VOCs, arsenic		X	X												
EPM B																			
Nos. 086, 089, 094, Building 40- 56, Former USTs	SVE and Groundwater Extraction	Soil, perched groundwater	Potable groundwater, indoor air	Chlorinated VOCs, BTEX, MIBK	X[5]	X	X	X	X				X						
EPM C																			
No. 166, Building 45-53, Former UST EV-110-1	Maintain Containment with Groundwater Monitoring	Perched groundwater	NA	TPH		X	X												
EPM D																			
Nos. 055 and 168, Building 40- 24, Utility Trenches and Sumps	Near-Term Excavation with Dewatering and Future Excavation	Soil, perched groundwater	Potable groundwater	TBP, DPP, BDP, TPP, BHT, n-butyl alcohol, arsenic		X	X	X				X				X		X	
Building 40-22, Utility Slants #2 and #3	Maintain Containment with Future Excavation	Soil	Potable groundwater	TBP, DPP, BDP, TPP, BHT		X	X	X										X	
Building 40-23, Static Test Pad	Maintain Containment with Future Excavation	Soil	Potable groundwater	TBP, DPP, BDP, TPP, BHT		X	X	X										X	
No. 177, Building 40-25, Utility Vault	Maintain Containment with Future Excavation	Soil	Potable groundwater	TBP, DPP, BDP		X	X											X	

Table 5-1
Summary of Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Selected Remedy	Media[1]		COCs Exceeding Proposed CULs	Additional Investigation	Institutional/ Engineering Controls[2]	Monitoring[3]	New Groundwater Monitoring Well Installation	SVE	Future SVE	Enhanced In Situ Bioremediation	Dewatering	Groundwater Extraction	GET System Operation/ Dynamic Groundwater Recirculation	MNA	Near-Term Excavation[4]/ Comprehensive Excavation	Limited Excavation	Future Excavation	NFA
		Impacted	Point of Compliance																
EPM E																			
No. 054, Building 40-51, Former Wastewater AST	Maintain Containment with Future Excavation	Soil	Potable groundwater, indoor air	TCE, vinyl chloride		X	X	X										X	
No. 097, Building 40-11, Former Vapor Degreaser	Near-Term Excavation	Soil	Indoor air	Chlorinated VOCs												X			
No. 098, Building 40-53, Former Mock-Up Degreaser	Maintain Containment	Soil	Potable groundwater, indoor air	Chlorinated VOCs		X	X	X											
No. 169, Building 40-02, Former Small Vapor Degreaser	Maintain Containment	Soil	Potable groundwater, indoor air	Chlorinated VOCs, Freon 12, chloroform		X	X												
No. 170, Building 40-02, Former Large Vapor Degreaser	Maintain Containment	Soil	Potable groundwater, indoor air	Chlorinated VOCs, Freon 12, chloroform		X	X												
No. 171, Building 40-31, Former Bluestreak Vapor Degreaser	Maintain Containment with Future SVE	Soil	Potable groundwater, indoor air	Chlorinated VOCs		X	X	X		X									
Building 40-02, Former Paint Crib	Maintain Containment	Soil	Potable groundwater, indoor air	Chlorinated VOCs, Freon 12, chloroform		X	X												
Building 40-32, Footing Excavation	Maintain Containment	Soil	Potable groundwater, indoor air	Chlorinated VOCs, BTEX, TPH		X	X	X											
EPM F																			
No. 068, South Complex, South Fire Pit	Near-Term Excavation	Soil	Potable groundwater	BTEX, TPH	X[6]		X									X			

Table 5-1
Summary of Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Selected Remedy	Media[1]		COCs Exceeding Proposed CULs	Additional Investigation	Institutional/ Engineering Controls[2]	Monitoring[3]	New Groundwater Monitoring Well Installation	SVE	Future SVE	Enhanced In Situ Bioremediation	Dewatering	Groundwater Extraction	GET System Operation/ Dynamic Groundwater Recirculation	MNA	Near-Term Excavation[4]/ Comprehensive Excavation	Limited Excavation	Future Excavation	NFA
		Impacted	Point of Compliance																
EPM G																			
No. 065, Building 40-51, Former Paint Stripping Tankline	Maintain Containment	Soil	NA	Cadmium, chromium, lead		X													
No. 083, Former UST EV-15	Maintain Containment	Soil	NA	TPH		X													
No. 165, Building 45-52, Former Fuel Farm USTs	Limited Excavation and Maintain Containment with Future Excavation	Soil	Potable groundwater, ~~indoor air~~	BTEX, TPH		X	X	X									X	X	
Building 40-11, UST EV-48-1	Maintain Containment with Future Excavation	Soil	Potable groundwater, ~~indoor air~~	BTEX, TPH		X	X	X										X	
EPM H																			
Nos. 067 and 071, Building 40- 56, Former Recycling Unit and UST EV-153	Maintain Containment with Future Excavation	Soil	Potable groundwater, indoor air	BTEX		X	X	X										X	
No. 093, Building 45-01, Former Solvent USTs	Maintain Containment with Future Excavation	Soil	Potable groundwater, indoor air	2-Butanone (methyl ethyl ketone)		X	X	X										X	
EPM I																			
Esperance Sand Well EGW061	NFA	NA	Groundwater	Arsenic			X												X
EPM J[7]																			
EPM K																			
North Complex, Esperance Sand, Powder Mill Gulch	Enhanced In Situ Bioremediation and Concurrent GET System Operation/Dynamic Groundwater Recirculation/MNA and Institutional Controls[8]	Groundwater, surface water	Potable groundwater, surface water, Indoor Air	TCE, DCE, vinyl chloride		X	X	X			X			X	X				

Table 5-1
Summary of Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Selected Remedy	Media[1]		COCs Exceeding Proposed CULs	Additional Investigation	Institutional/ Engineering Controls[2]	Monitoring[3]	New Groundwater Monitoring Well Installation	SVE	Future SVE	Enhanced In Situ Bioremediation	Dewatering	Groundwater Extraction	GET System Operation/ Dynamic Groundwater Recirculation	MNA	Near-Term Excavation[4]/ Comprehensive Excavation	Limited Excavation	Future Excavation	NFA
		Impacted	Point of Compliance																
BOMARC Property																			
No. 011, Bomarc Building 45-70	Air Monitoring	~~Sub-slab vapor~~	Indoor air	Freon-12, TCE		X	X												
Nos. 123 and 124, Oil Water Separators EV-151 and EV-152	Near-term Excavation	Soil	NA	cPAHs;			X									X			

Notes:

AOC - area of concern
AST - above-ground storage tank
BDP - butyl diphenyl phosphate
BHT - butylated hydroxytoluene
BTEX - benzene, toluene, ethylbenzene, and xylenes
COC - chemical of concern
cPAH - carcinogenic polycyclic aromatic hydrocarbons
CUL - cleanup level
DPP - dibutyl phenyl phosphate
GET - groundwater extraction and treatment
MIBK - 4-methyl-2-pentanone
NA - Not Applicable
NAPL - nonaqueous-phase liquid
NFA - no further action
PAH - polycyclic aromatic hydrocarbon
SVE - soil vapor extraction
SWMU - solid waste management unit
TBP - tributyl phosphate
TCE - trichloroethylene
TEX - toluene, ethylbenzene, and xylenes
TPH - total petroleum hydrocarbons
TPP - triphenyl phosphate
UST - underground storage tank
VI - vapor intrusion
VOC - volatile organic compound

[1]This includes all media with Ecology cleanup level addressed by the remedy. Media included in the impacted sub-column have chemical concentrations above a cleanup or screening level OR are Media at the point of compliance included because the remedy includes monitoring of that media to address potential future contamination of that media or potential future risks from exposure to that media. Potable water is included if concentrations in soil are greater than the protection of drinking water CULs for selected remedy of maintain containment. Indoor air is included if potential vapor intrusion issues have been identified for that SWMU/AOC.

[2]Refer to Table 5-4 for details

[3]Refer to Table 5-3 for details

[4]In these alternatives the phrase "near-term" is used to mean execution of the cleanup action as soon as practical after Ecology's approval of the final CAP. For these excavations, cleanup would be performed after execution of the CAP, Ecology approval of the engineering design report, and then as soon as access can be practicably arranged. Near-term is used in contrast to "future", which refers to some later time, not specifically defined, during which excavation of contaminated soil is linked to some other site development project on the Facility.

[5]Sampling will be performed to better characterize the area prior to SVE implementation.

[6]Pre-design sampling will be performed.

[7]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

[8]Refer to Ecology letter dated September 5, 2019 for full description of Ecology preferred remedy, groundwater cleanup levels and groundwater point of compliance

Table 5-2
Applicability of ARARs to the SWMUs/AOCs
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Chemical-Specific ARARs																		Location-Specific ARARs[3]								Action-Specific ARARs									
	Soil						Indoor Air		Potable Groundwater		Nonpotable Groundwater		Surface Water[3]				Sediment																				
	MTCA Method B, Protection of Groundwater	MTCA Method B, Direct Contact	MTCA Method A, Direct Contact and in most cases protective of groundwater use	MTCA Method A	Ecological Indicator Soil Concentrations for Protection of Plants and Animals (MTCA Table 749-3)	Puget Sound Background	MTCA Method C	Airborne Contaminants (WAC 296-841)	MTCA Method A	MTCA Method B	MTCA Method A	Risk-Based Cleanup Levels (WAC 173-340-708(3))	MTCA Method B	EPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks	EPA Region 4 Waste Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites	EPA Region 5 Ecological Screening Levels	Site-Specific Background	Sediment Cleanup Objectives (Chapter 173-204)	Clean Water Act, Section 404, Dredge or Fill Requirements Regulations, 33 USC 1344(a)–(d); 33 CFR Parts 320–330; 40 CFR Part 230	Clean Water Act, Section 401, Water Quality Certification, 33 USC 1340; WAC 173-225-10	Washington Hydraulics Project Approval (RCW 75.20.100; Chapter 220-110 WAC)	Native American Graves Protection and Repatriation Act Regulations, 25 USC 3001 et. seq; 43 CFR Part 10.1, 10.4 and 10.5	National Historic Preservation Act, 16 USC 470; 36 CFR Parts 60, 65, and 800	Archaeological and Historic Preservation Act, 16 USC 469	Everett Municipal Code 14.56.040, Discharge of Polluting Matter into the Surface Water System Prohibited	WAC 173-201A, Water Quality Standards for Surface Waters of the State of Washington	Clean Water Act's Pretreatment Regulations (40 CFR Part 503.5, City of Everett Code Title 14 Water and Sewers)	National Pollutant Discharge Elimination System	Stormwater Permit Program (33 USC 1342, RCW 90.48.260, 40 CFR 122.26; Chapter 173-220 WAC)	State Environmental Policy Act (RCW 43.21.036, WAC 197-11-250 through 268)	Washington Clean Air Act and Implementing Regulations (Chapter 70.94 RCW, WAC 173-400-040[8], and WAC 173-460) and Puget Sound Clean Air Agency Regulation 1, Section 9.15	Washington Solid Waste Management Act and Solid Waste Management Handling Standards Regulations (Chapter 70.95 RCW and Chapter 173-350 WAC)	Washington MTCA (Chapter 173-340-440) Institutional Controls	Washington Minimum Standards for Construction and Decommissioning Wells (WAC 173-160-381)	Underground Injection Control Program (WAC 173-218)	City of Everett Requirements (Title 19, Chapters 37 and 18.23)
EPM A																																			
No. 090, Building 40-51, Former UST EV-11							X					X																			X	X	X		
No. 112, Building 40-11, Oil/Water Separator							X				X	X																			X	X	X		
No. 151, Building 40-51, Southern Scrubber Sumps	X						X					X																			X	X	X		
EPM B																																			
Nos. 086, 089, and 094, Building 40-56, Former USTs	X						X			X		X										X	X	X			X			X	X	X	X	X		X
EPM C																																			
No. 166, Building 45-53, Former UST EV-110-1									X		X																					X	X	X		
EPM D																																			
Nos. 055 and 168, Building 40-24, Utility Trenches and Sumps	X									X		X										X	X	X	X		X			X	X	X	X	X		X
Building 40-22, Utility Slants #2 and #3	X									X												X	X	X	X					X	X	X	X	X		X
Building 40-23, Static Test Pad	X									X												X	X	X	X					X	X	X	X	X		X
No. 177, Building 40-25, Utility Vault	X									X												X	X	X	X					X	X	X	X			X

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Applicability of ARARs to the SWMUs/AOCs
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Chemical-Specific ARARs																		Location-Specific ARARs[3]								Action-Specific ARARs							
	Soil						Indoor Air		Potable Groundwater		Nonpotable Groundwater		Surface Water[3]				Sediment																			
	MTCA Method B, Protection of Groundwater	MTCA Method B, Direct Contact	MTCA Method A, Direct Contact and in most cases protective of groundwater use	MTCA Method A	Ecological Indicator Soil Concentrations for Protection of Plants and Animals (MTCA Table 749-3)	Puget Sound Background	MTCA Method C	Airborne Contaminants (WAC 296-841)	MTCA Method A	MTCA Method B	MTCA Method A	Risk-Based Cleanup Levels (WAC 173-340-708(3))	MTCA Method B	EPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks	EPA Region 4 Waste Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites	EPA Region 5 Ecological Screening Levels	Site-Specific Background	Sediment Cleanup Objectives (Chapter 173-204)	Clean Water Act, Section 404, Dredge or Fill Requirements Regulations, 33 USC 1344(a)–(d); 33 CFR Parts 320–330; 40 CFR Part 230	Clean Water Act, Section 401, Water Quality Certification, 33 USC 1340; WAC 173-225-10	Washington Hydraulics Project Approval (RCW 75.20.100; Chapter 220-110 WAC)	Native American Graves Protection and Repatriation Act Regulations, 25 USC 3001 et. seq; 43 CFR Part 10.1, 10.4 and 10.5	National Historic Preservation Act, 16 USC 470; 36 CFR Parts 60, 65, and 800	Archaeological and Historic Preservation Act, 16 USC 469	Everett Municipal Code 14.56.040, Discharge of Polluting Matter into the Surface Water System Prohibited	WAC 173-201A, Water Quality Standards for Surface Waters of the State of Washington	Clean Water Act's Pretreatment Regulations (40 CFR Part 503.5, City of Everett Code Title 14 Water and Sewers)	National Pollutant Discharge Elimination System	Stormwater Permit Program (33 USC 1342, RCW 90.48.260, 40 CFR 122.26; Chapter 173-220 WAC)	State Environmental Policy Act (RCW 43.21.036, WAC 197-11-250 through 268)	Washington Clean Air Act and Implementing Regulations (Chapter 70.94 RCW, WAC 173-400-040[8], and WAC 173-460) and Puget Sound Clean Air Agency Regulation 1, Section 9.15	Washington Solid Waste Management Act and Solid Waste Management Handling Standards Regulations (Chapter 70.95 RCW and Chapter 173-350 WAC)	Washington MTCA (Chapter 173-340-440) Institutional Controls	Washington Minimum Standards for Construction and Decommissioning Wells (WAC 173-160-381)	Underground Injection Control Program (WAC 173-218)	City of Everett Requirements (Title 19, Chapters 37 and 18.23)
EPM E																																		
No. 054, Building 40-51, Former Wastewater AST	X						X			X												X	X	X	X				X	X	X	X	X		X
No. 097, Building 40-11, Former Vapor Degreaser	X						X			X												X	X	X	X				X	X	X				X
No. 098, Building 40-53, Former Mock-Up Degreaser	X						X			X												X	X	X					X		X	X	X		
No. 169, Building 40-02, Small Vapor Degreaser	X						X			X																					X	X	X		
No. 170, Building 40-02, Large Vapor Degreaser	X						X			X																					X	X	X		
No. 171, Building 40-31, Former Bluestreak Vapor Degreaser	X						X			X												X	X	X			X			X	X	X	X	X		X
Building 40-02, Former Paint Crib	X						X			X																						X			
Building 40-32, Footing Excavation	X		X				X			X												X	X	X					X		X	X	X		X
EPM F																																		
No. 068, South Complex, South Fire Pit			X																			X	X	X					X	X	X		X		X
EPM G																																		
No. 065, Building 40-51, Former Paint Stripping Tankline			X																													X			
No. 083, Former UST EV-15			X						X																							X			
No. 165, Building 45-52, Former Fuel Farm USTs and Fueling Positions			X						X													X	X	X	X				X	X	X	X	X		X
Building 40-11, UST EV-48-1			X						X													X	X	X	X				X	X	X	X	X		X

Table 5-2
Applicability of ARARs to the SWMUs/AOCs
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Chemical-Specific ARARs																		Location-Specific ARARs[3]								Action-Specific ARARs									
	Soil						Indoor Air		Potable Groundwater		Nonpotable Groundwater		Surface Water[3]				Sediment																				
	MTCA Method B, Protection of Groundwater	MTCA Method B, Direct Contact	MTCA Method A, Direct Contact and in most cases protective of groundwater use	MTCA Method A	Ecological Indicator Soil Concentrations for Protection of Plants and Animals (MTCA Table 749-3)	Puget Sound Background	MTCA Method C	Airborne Contaminants (WAC 296-841)	MTCA Method A	MTCA Method B	MTCA Method A	Risk-Based Cleanup Levels (WAC 173-340-708(3))	MTCA Method B	EPA Region 3 Biological Technical Assistance Group Freshwater Screening Benchmarks	EPA Region 4 Waste Management Division Freshwater Surface Water Screening Values for Hazardous Waste Sites	EPA Region 5 Ecological Screening Levels	Site-Specific Background	Sediment Cleanup Objectives (Chapter 173-204)	Clean Water Act, Section 404, Dredge or Fill Requirements Regulations, 33 USC 1344(a)–(d); 33 CFR Parts 320–330; 40 CFR Part 230	Clean Water Act, Section 401, Water Quality Certification, 33 USC 1340; WAC 173-225-10	Washington Hydraulics Project Approval (RCW 75.20.100; Chapter 220-110 WAC)	Native American Graves Protection and Repatriation Act Regulations, 25 USC 3001 et. seq; 43 CFR Part 10.1, 10.4 and 10.5	National Historic Preservation Act, 16 USC 470; 36 CFR Parts 60, 65, and 800	Archaeological and Historic Preservation Act, 16 USC 469	Everett Municipal Code 14.56.040, Discharge of Polluting Matter into the Surface Water System Prohibited	WAC 173-201A, Water Quality Standards for Surface Waters of the State of Washington	Clean Water Act's Pretreatment Regulations (40 CFR Part 503.5, City of Everett Code Title 14 Water and Sewers)	National Pollutant Discharge Elimination System	Stormwater Permit Program (33 USC 1342, RCW 90.48.260, 40 CFR 122.26; Chapter 173-220 WAC)	State Environmental Policy Act (RCW 43.21.036, WAC 197-11-250 through 268)	Washington Clean Air Act and Implementing Regulations (Chapter 70.94 RCW, WAC 173-400-040[8], and WAC 173-460) and Puget Sound Clean Air Agency Regulation 1, Section 9.15	Washington Solid Waste Management Act and Solid Waste Management Handling Standards Regulations (Chapter 70.95 RCW and Chapter 173-350 WAC)	Washington MTCA (Chapter 173-340-440) Institutional Controls	Washington Minimum Standards for Construction and Decommissioning Wells (WAC 173-160-381)	Underground Injection Control Program (WAC 173-218)	City of Everett Requirements (Title 19, Chapters 37 and 18.23)
EPM H																																			
No. 93, Building 45-01, Former Solvent USTs	X						X			X												X	X	X	X					X	X	X	X	X		X
Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153			X[4]				X		X													X	X	X	X					X	X	X	X	X		X
EPM I																																			
Esperance Sand[1]																																			
EPM J[2]																																			
EPM K																																			
North Complex, Esperance Sand, Powder Mill Gulch							X			X			X							X	X	X	X	X	X	X		X	X	X	X	X	X	X	X	X
BOMARC Property																																			
No. 011, BOMARC Building 45-70							X																											X		
Nos. 123 and 124, EV-151 and EV-152 Oil Water Separator				X					X													X	X	X	X					X	X	X		X		X

Notes:

AST - above ground storage tank
CFR - Code of Federal Regulations
EPA - U.S. Environmental Protection Agency
MCL - maximum contaminant limit
MTCA - Model Toxics Control Act
RCW - Revised Code of Washington
SWMU/AOC - Solid Waste Management Unit/Area of Concern
USC - United States Code
UST - underground storage tank
WAC - Washington Administrative Code

[1]No further action is the selected remedy for Esperance Sand. Therefore, no ARARs are applicable to this SWMU/AOC

[2]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

Table 5-3
Summary of Restoration Timeframes and Compliance and Performance Monitoring for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Restoration Timeframe				Compliance Monitoring						Performance Monitoring				
					Groundwater and/or Surface Water Monitoring			Vapor Monitoring			Extracted Groundwater and/or Surface Water			Extracted Vapors	
	Immediate[1]	Short-Term[2]	Moderate-Term[3]	Long-Term[4]	Locations	Monitored Parameters	Monitoring Frequency	Sub-Slab Vapor Monitored Parameters	Indoor Air Monitored Parameters	Monitoring Frequency	Locations	Monitored Parameters	Monitoring Frequency	Monitored Parameters	Monitoring Frequency
EPM A															
No. 090, Building 40-51, Former UST EV-11	X				EGW030, EGW031, EGW032, EGW065, EGW066	Groundwater elevation, TCE, 1,1-DCE, cis-1,2,-DCE, trans-1,2-DCE, PCE, vinyl chloride	Semi-annually until cleanup levels attained	TCE, 1,1-DCE, PCE, vinyl chloride	TCE, 1,1-DCE, PCE, vinyl chloride	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 112, Building 40-11, Oil/Water Separator	X				EGW046, EGW054	Groundwater elevation, TCE, 1,1-DCE, cis-1,2,-DCE, trans-1,2-DCE, vinyl chloride, TPH-Gx, TPH-Dx, TPH-Motor Oil	Semi-annually until cleanup levels attained	TCE, 1,1-DCE, vinyl chloride	TCE, 1,1-DCE, vinyl chloride	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 151, Building 40-51, Southern Scrubber Sumps	X				EGW057, EGW058	Groundwater elevation, TCE, 1,1-DCE, cis-1,2,-DCE, trans-1,2-DCE, vinyl chloride, arsenic	Semi-annually until cleanup levels attained	NA	NA	NA	NA	NA	NA	NA	NA
EPM B															
Nos. 086, 089, and 094, Building 40-56, Former USTs	X			X	EGW040, Well #8	Groundwater elevation, TCE, 1,1-DCE, cis-1,2,-DCE, trans-1,2-DCE, PCE, vinyl chloride, benzene, ethylbenzene, toluene, xylenes (total), o-xylenes, 4-methyl-2-pentanone (this chemical only in Well #8)	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, PCE, vinyl chloride, benzene, ethylbenzene, toluene, xylenes (total)	Initial indoor air sampling after SVE system operational and cross-slab pressures are negative, per Section 4.4	5 Existing Extraction Wells, and One New Well near EGW007 (elevation only)	TCE, 1,1-DCE, cis-1,2,-DCE, trans-1,2-DCE, PCE, vinyl chloride, benzene, ethylbenzene, toluene, xylenes (total)	Quarterly for one year then semiannually following the first year of groundwater extraction; continuing for 2 years following system shutdown. Operation timeframe is approximately 20 years.	TCE, 1,1-DCE, PCE, vinyl chloride, benzene, ethylbenzene, toluene, xylenes (total)	Routine, to be specified in the system O&M plan. Operation timeframe is approximately 5 years.
EPM C															
No. 166, Building 45-53, Former UST EV-11[1]	X				EGW035	Groundwater elevation, TPH-Dx, TPH-Jet A	Semi-annually until cleanup levels attained	NA	NA	NA	NA	NA	NA	NA	NA
EPM D															
Nos. 055 and 168, Building 40-24, Utility Trenches and Sumps		X		X	Well #1	Groundwater elevation, tributyl phosphate, dibutyle phenyl phosphate, butyl diphenyl phosphate, triphenyl phosphate, BHT, arsenic	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	NA	NA	EGW037	Tributyl phosphate, dibutyle phenyl phosphate, butyl diphenyl phosphate, BHT, n-butyl alcohol	Quarterly for first year, semiannually thereafter until cleanup levels met	NA	NA
Building 40-22, Utility Slants #2 and #3	X			X	Well #9	Groundwater elevation, tributyl phosphate	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	NA	NA	NA	NA	NA	NA	NA
Building 40-23, Static Test Pad	X			X	Well #9	Groundwater elevation, tributyl phosphate	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	NA	NA	NA	NA	NA	NA	NA
No. 177, Building 40-25, Utility Vault	X			X	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA

Table 5-3
Summary of Restoration Timeframes and Compliance and Performance Monitoring for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Restoration Timeframe				Compliance Monitoring						Performance Monitoring				
					Groundwater and/or Surface Water Monitoring			Vapor Monitoring			Extracted Groundwater and/or Surface Water			Extracted Vapors	
	Immediate[1]	Short-Term[2]	Moderate-Term[3]	Long-Term[4]	Locations	Monitored Parameters	Monitoring Frequency	Sub-Slab Vapor Monitored Parameters	Indoor Air Monitored Parameters	Monitoring Frequency	Locations	Monitored Parameters	Monitoring Frequency	Monitored Parameters	Monitoring Frequency
EPM E															
No. 054, Building 40-51, Former Wastewater AST	X			X	Well #4	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, vinyl chloride	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 097, Building 40-11, Former Vapor Degreaser		X			NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
No. 098, Building 40-53, Mock-Up Degreaser	X				Well #3	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, PCE, vinyl chloride	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 169, Building 40-02, Small Vapor Degreaser	X				EGW177, EGW178	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, vinyl chloride, freon 12, chloroform	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 170, Building 40-02, Large Vapor Degreaser	X				EGW177, EGW178	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, vinyl chloride, freon 12, chloroform	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 171, Building 40-31, Former Bluestreak Vapor Degreaser	X			X	Well #2	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, PCE, vinyl chloride	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	TCE, 1,1-DCE, PCE, vinyl chloride	Routine, to be specified in the system O&M plan.
Building 40-02, Former Paint Crib	X				EGW177, EGW178	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, vinyl chloride, freon 12, chloroform	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
Building 40-32, Footing Excavation	X				Well #5	Groundwater elevation, TCE, 1,1-DCE, cis-1,2-DCE, trans-1,2-DCE, vinyl chloride, benzene, ethylbenzene, toluene, xylenes (total), o-xylene, TPH-Gx, TPH-Dx, TPH-Motor Oil, TPH-Jet A	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	TCE, 1,1-DCE, PCE, vinyl chloride, benzene, ethylbenzene, toluene, xylenes (total), o-xylene	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
EPM F															
No. 068, South Complex, South Fire Pit		X			EGW060	Groundwater elevation only	Quarterly monitoring for first 2 years, then semiannually thereafter	NA	NA	NA	NA	NA	NA	NA	NA

Table 5-3
Summary of Restoration Timeframes and Compliance and Performance Monitoring for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Restoration Timeframe				Compliance Monitoring						Performance Monitoring				
					Groundwater and/or Surface Water Monitoring			Vapor Monitoring			Extracted Groundwater and/or Surface Water			Extracted Vapors	
	Immediate[1]	Short-Term[2]	Moderate-Term[3]	Long-Term[4]	Locations	Monitored Parameters	Monitoring Frequency	Sub-Slab Vapor Monitored Parameters	Indoor Air Monitored Parameters	Monitoring Frequency	Locations	Monitored Parameters	Monitoring Frequency	Monitored Parameters	Monitoring Frequency
EPM G															
No. 065, Building 40-51, Former Paint Stripping Tankline	X				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
No. 083, Former UST EV-15	X				NA	NA	NA	NA	NA	NA	NA	NA	NA	NA	NA
No. 165, Building 45-52, Former Fuel Farm USTs and Fueling Positions	X		X		Well #11	Groundwater elevation, benzene, ethylbenzene, toluene, xylenes (total), TPH-Gx, TPH-Dx, TPH-Motor Oil	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	NA	NA	NA	NA	NA	NA	NA
Building 40-11, UST EV-48-1	X			X	Well #6	Groundwater elevation, benzene, ethylbenzene, toluene, xylenes (total), TPH-Gx, TPH-Dx, TPH-Motor Oil	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	NA	NA	NA	NA	NA	NA	NA
EPM H															
Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153	X			X	Well #8, EGW040	Groundwater elevation, benzene, ethylbenzene, toluene, xylenes (total)	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	Benzene, ethylbenzene, toluene, xylenes (total)	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
No. 93, Building 45-01, Former Solvent USTs	X			X	Well #7	Groundwater elevation, 2-butanone	Quarterly monitoring for two years, with provisions to reduce sampling frequency per Section 4.4	NA	NA	NA	NA	NA	NA	NA	NA
EPM I															
Esperance Sand[7]					EGW061	Groundwater elevation only	Quarterly monitoring for first 2 years, then semiannually thereafter	NA	NA	NA	NA	NA	NA	NA	NA
EPM J[8]															

Table 5-3
Summary of Restoration Timeframes and Compliance and Performance Monitoring for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No. and Description	Restoration Timeframe				Compliance Monitoring						Performance Monitoring				
					Groundwater and/or Surface Water Monitoring			Vapor Monitoring			Extracted Groundwater and/or Surface Water			Extracted Vapors	
	Immediate[1]	Short-Term[2]	Moderate-Term[3]	Long-Term[4]	Locations	Monitored Parameters	Monitoring Frequency	Sub-Slab Vapor Monitored Parameters	Indoor Air Monitored Parameters	Monitoring Frequency	Locations	Monitored Parameters	Monitoring Frequency	Monitored Parameters	Monitoring Frequency
EPM K															
North Complex, Esperance Sand, Powder Mill Gulch				X	TBD in EDR including both groundwater and surface water sampling locations	TCE, DCE, and vinyl chloride	Quarterly groundwater and surface water monitoring initally following EISB injections, full scale DGR operation, and MNA initiation with provisions in the EDR to reduce frequency	NA	NA	NA	TBD in EDR	EISB: DO, ORP, dissolved iron, nitrate, sulfate, methane, pH, temperature, TOC, TCE, DCE, vinyl chloride, ethane, and ethene in groundwater	EISB: Quarterly groundwater and surface water monitoring for one year minimum with provisions in the EDR to reduce frequency	NA	NA
												DGR: TCE, DCE, and vinyl chloride in groundwater and surface water	DGR: Quarterly groundwater and surface water monitoring for one year minimum with provisions in the EDR to reduce frequency. Also monitor in compliance with NPDES permit.	DGR: TCE	DGR: one time summer and winter events in the five existing soil gas monitoring well locations
												MNA: TCE, DCE, vinyl chloride, DO, ORP, dissolved iron, nitrate, sulfate, methane, ethane, and ethene in groundwater	MNA: Quarterly groundwater and surface water monitoring for one year minimum with provisions in the EDR to reduce frequency	NA	NA
BOMARC Property															
No. 011 Bomarc Building 45-70	X				NA	NA	NA	NA	TCE, Freon-12	Initally twice per year, with provisions to reduce frequency per Section 4.4[5,6]	NA	NA	NA	NA	NA
Nos. 123 and 124, Oil Water Separators EV-151 and EV-152		X			EGW179, EGW180, EGW181	cPAHs	Semi-Annual monitoring for 2 years	NA	NA	NA	NA	NA	NA	NA	NA

Notes:

AST - above ground storage tank
BHT - butylated hydroxytoluene
cPAH - carcinogenic polycyclic aromatic hydrocarbons
CUL - cleanup levels
DCE - dichloroethylene
DGR - dynamic groundwater recirculation
DO - dissolved oxygen
Dx - diesel range
EDR - engineering design report
EISB - enhanced in situ bioremediation
Gx - gasoline range
MNA - monitored natural attenuation
NA - not applicable
O&M - operation and maintenance
ORP - oxidation/reduction potential
PAH - polycyclic aromatic hydrocarbon
PCE - tetrachloroethylene
SWMU/AOC - Solid Waste Management Unit/Area of Concern
TBD - to be determined
TCE - trichloroethylene
TOC - total organic carbon
TPH - total petroleum hydrocarbons
UST - underground storage tank
VC - vinyl chloride

[1]Immediate restoration timeframe is identified for cleanup actions such as institutional controls, groundwater monitoring, indoor air sampling, sub-slab vapor sampling, and maintenance of containment measures. These measures will be implemented immediately following Washington State Department of Ecology approval of the Institutional Controls Management Plan.
[2]Short-term restoration timeframe is identified for cleanup actions such as near-term excavation. The implementation time frame would most likely be dependent on the logistics of interrupting manufacturing operations to perform excavation.
[3]Moderate-term restoration timeframe is identified for cleanup actions of approximately 5 to 10 years (SWMU/AOC No. 165).
[4]Long-term restoration timeframe is identified for cleanup actions such as SVE, groundwater extraction systems, and excavations that are dependent on future site renovations.
[5]Per requirements in Section 4.4 for terminating indoor air sampling requirements in Section 4.4.
[6]Per indoor air samplimg frequency requirements in Section 4.4.
[7]No further action is the selected remedy for Esperance Sand. Therefore, no restoration timeframe provided. However, groundwater elevation monitoring will be performed at one well.
[8]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan

Table 5-4
Summary of Institutional and Engineering Controls for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Include in Site-Wide ICMP	Restrict Land Use to Industrial	Prohibit Use of Groundwater (Perched and Esperance Sand) or Surface Water as a Potable Water Supply OR For Any Use	Restrict Intrusive Activities on Boeing-Owned Property and Require Proper Safety Measures and Construction Practices when Contaminated Soil and Groundwater may be Encountered	Protection of Construction Workers through Requirements for Notifications, Training, Proper Soil and Perched Groundwater Handling, and Appropriate PPE	Signage	Require Pavement/ Concrete Flooring Remain in Place	Future Building Construction/ Renovation would Address Potential Vapor Intrusion	Perform Annual Monitoring/ Inspection of Land Use	Perform Annual Monitoring/ Inspection of Pavement and Concrete Flooring	Maintain Pavement and Concrete Flooring
EPM A											
No. 090, Building 40-51, Former UST EV-11	X	X	X	X	X		X	X	X	X	X
No. 112, Building 40-11, Oil/Water Separator	X	X	X	X	X		X	X	X	X	X
No. 151, Building 40-51, Southern Scrubber Sumps	X	X	X	X	X		X	X	X	X	X
EPM B											
Nos. 086, 089, 094, Building 40-56, Former USTs	X	X	X	X	X		X	X	X	X	X
EPM C											
No. 166, Building 45-53, Former UST EV-110-1	X	X	X	X	X		X		X	X	X
EPM D											
Nos. 055 and 168, Building 40-24, Utility Trenches and Sumps	X	X	X	X	X		X		X	X	X
Building 40-22, Utility Slants #1 and #2	X	X		X	X		X		X	X	X
Building 40-23, Static Test Pad	X	X		X	X		X		X	X	X
No. 177, Building 40-25, Utility Vault	X	X		X	X		X		X	X	X

Table 5-4
Summary of Institutional and Engineering Controls for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Include in Site-Wide ICMP	Restrict Land Use to Industrial	Prohibit Use of Groundwater (Perched and Esperance Sand) or Surface Water as a Potable Water Supply OR For Any Use	Restrict Intrusive Activities on Boeing-Owned Property and Require Proper Safety Measures and Construction Practices when Contaminated Soil and Groundwater may be Encountered	Protection of Construction Workers through Requirements for Notifications, Training, Proper Soil and Perched Groundwater Handling, and Appropriate PPE	Signage	Require Pavement/ Concrete Flooring Remain in Place	Future Building Construction/ Renovation would Address Potential Vapor Intrusion	Perform Annual Monitoring/ Inspection of Land Use	Perform Annual Monitoring/ Inspection of Pavement and Concrete Flooring	Maintain Pavement and Concrete Flooring
EPM E											
No. 054, Building 40-51, Former Wastewater AST	X	X		X	X		X	X	X	X	X
No. 097, Building 40-11, Former Vapor Degreaser[1]											
No. 098, Building 40-53, Mock-Up Degreaser	X	X		X	X		X	X	X	X	X
No. 169, Building 40-02, Small Vapor Degreaser	X	X		X	X		X	X	X	X	X
No. 170, Building 40-02, Large Vapor Degreaser	X	X		X	X		X	X	X	X	X
No. 171, Building 40-31, Former Bluestreak Vapor Degreaser	X	X		X	X		X	X	X	X	X
Building 40-02, Former Paint Crib	X	X		X	X		X	X	X	X	X
Building 40-32, Footing Excavation	X	X		X	X		X	X	X	X	X
EPM F											
No. 068, South Complex, South Fire Pit[1]											
EPM G											
No. 065, Building 40-51, Former Paint Stripping Tankline	X	X		X	X		X		X	X	X
No. 083, Former UST EV-15	X	X		X	X		X		X	X	X
No. 165, Building 45-52, Former Fuel Farm USTs and Fueling Positions	X	X		X	X		X	X	X	X	X
Building 40-11, UST EV-48-1	X	X		X	X		X	X	X	X	X

Table 5-4
Summary of Institutional and Engineering Controls for Selected Cleanup Alternatives
CAP - Upland Areas and PMG
Boeing Everett Facility

SWMU/AOC, Building No., and Description	Include in Site-Wide ICMP	Restrict Land Use to Industrial	Prohibit Use of Groundwater (Perched and Esperance Sand) or Surface Water as a Potable Water Supply OR For Any Use	Restrict Intrusive Activities on Boeing-Owned Property and Require Proper Safety Measures and Construction Practices when Contaminated Soil and Groundwater may be Encountered	Protection of Construction Workers through Requirements for Notifications, Training, Proper Soil and Perched Groundwater Handling, and Appropriate PPE	Signage	Require Pavement/ Concrete Flooring Remain in Place	Future Building Construction/ Renovation would Address Potential Vapor Intrusion	Perform Annual Monitoring/ Inspection of Land Use	Perform Annual Monitoring/ Inspection of Pavement and Concrete Flooring	Maintain Pavement and Concrete Flooring
EPM H											
Nos. 067 and 071, Building 40-56, Former Recycling Unit and UST EV-153	X	X		X	X		X	X	X	X	X
No. 093, Building 45-01, Former Solvent USTs	X	X		X	X		X	X	X	X	X
EPM I											
Esperance Sand[1]		X	X								
EPM J[2]											
EPM K											
North Complex, Esperance Sand, Powder Mill Gulch	X[3]	X[3]	X[3]	X[3]	X	X[3]		X[3]			
Bomarc Property											
No. 011 Bomarc Building 45-70	X	X					X	X	X	X	X
Nos. 123 and 124, EV-151 and EV-152 Oil/Water Separators[1]											

Notes:
AST - above ground storage tank
ICMP - Institutional Controls Management Plan
NA - Not Applicable
PPE - personal protective equipment
SWMU/AOC - Solid Waste Management Unit/Area of Concern
UST - underground storage tank

[1]No further action is the selected remedy for Esperance Sand. Therefore, no institutional/engineering controls included for the SWMU/AOC.
[2]EPM J (SWMU/AOC No. 100) will be addressed in the Sediment Cleanup Action Plan
[3]EPM K applies to Boeing, PMBC, Seaway LLC, and City of Everett (Lot#9) Properties All Above the TCE Groundwater Plume