STORMWATER SYSTEM WORK PLAN
TO CONTROL STORM DRAIN DISCHARGES

FOR BOEING PLANT 2

Boeing Plant 2
Seattle/Tukwila, Washington

Prepared for:

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1.0 INTRODUCTION

This Stormwater System Work Plan (Work Plan) has been prepared on behalf of The Boeing Company (Boeing) to address stormwater management across the entire Plant 2 property. It comprehensively presents the general approach for the reconfiguration of stormwater lines and outfalls, the inclusion of potential treatment options, further source identification and elimination or control, and future monitoring for compliance of the upgraded stormwater system. This Work Plan addresses requirements established in the United States Environmental Protection Agency's (EPA) December 4, 2009; February 9, 2010; and March 30, 2010 letters to Boeing on this subject (EPA 2010a, b, c). It has been prepared and will be carried out in accordance with the 1994 Administrative Order on Consent (Order) No. 1092-01-22-3008(h) between Boeing and EPA Region X. The Order is issued pursuant to Section 3008(h) of the Solid Waste Disposal Act, also referred to as the Resource Conservation and Recovery Act (RCRA). This plan necessarily addresses design on a conceptual level. Engineering work is continuing in preparation of detailed design plans for the permitting, construction, and operation of upgraded stormwater management systems at Plant 2 as discussed below.

Plant 2 is located on East Marginal Way South in Seattle, Washington with the southern portion extending into Tukwila, Washington. The west side of Plant 2 adjoins a section of the Lower Duwamish Waterway. The sediment in front of Plant 2 is being addressed as part of the Order, and is referred to as the Duwamish Sediment Other Area (DSOA).

As part of the sediment cleanup action and within the context of a Duwamish-wide initiative, potential sources of contamination must be identified and demonstrated to be eliminated or controlled. An objective of source control is to prevent recontamination of cleaned sediment areas, including from contaminants that might be transported through stormwater drainage systems. Similarly, the Order requires Boeing to "investigate and clean up releases of contaminants to the environment from Plant 2", including contaminants potentially conveyed via stormwater. This Work Plan has been prepared on behalf of Boeing as part of the continuing Plant 2 source control activities.

The annual source control monitoring program was initiated in 2006. The Boeing Company (Boeing) submitted the Stormwater Source Control Work Plan (original source control work plan) (Golder and Floyd|Snider 2006) to EPA on October 4, 2006 based on EPA's August 31, 2006 approval (with modifications) of the draft work plan. In December 2007, following completion of the first round (round 1) of source control sampling, Boeing submitted a Revised Stormwater Source Control Work Plan (revised source control work plan) (Golder and Floyd|Snider 2007), which EPA approved in January, 2008. Since 2006, four rounds of source control sampling have been completed at Plant 2. Reports for rounds 1 through 3 have been submitted and approved by EPA (Golder 2007a, 2008a, and 2010a); the round 4 report has been submitted in draft form (Golder 2010d).

This Work Plan further addresses source control requirements by establishing the source control approach for the active stormwater lines at Plant 2, describing modifications to the stormwater collection and treatment system, and identifying methods to further reduce or eliminate contaminant sources. The objectives of this Work Plan are to: 1) consolidate and reroute existing stormwater lines where feasible to optimally control and treat stormwater as necessary prior to discharge, 2) identify and mitigate ongoing sources of target pollutants through elimination and/or enhancing existing Best Management Practices (BMPs), and 3)

implement monitoring as part of system upgrades. Boeing is evaluating several approaches to determine which would best achieve discharge, operational, maintenance, and land use objectives. The Work Plan proposes two alternatives, either of which would successfully control discharges and satisfy EPA's stated objectives for this work. Source control activities are also summarized, including ongoing work to identify and eliminate or control remaining sources of target constituents at Plant 2.

Objectives for stormwater control and monitoring based on recent correspondence from EPA (EPA 2010b; 2010c) are as follows:

- Monitor for and control the discharge of cadmium, chromium, and zinc in suspended solids from storm lines A, B, I, J, and Z; and dissolved zinc from storm lines A, B, J, and V
- Monitor for and control the discharge of polychlorinated biphenyls (PCBs) in suspended solids from storm lines B, I, J, and Z
- Monitor for and control the discharge of PCBs in whole water from storm lines A, B, I, J, and Z to the Toxics Substance Control Act concentration (at 40 CFR 761.50(a)(3)) of 3 parts per billion (ppb)
- Monitor for and control the discharge of SVOCs from line G
- Control the discharge of dissolved metals upon completion of the Plant 2 Uplands Corrective Measures Implementation (CMI) process
- Control the discharge of suspended solids within six months of completion of the DSOA Interim Measure (IM)

Respective Source Control Action Levels (SCALs) for target constituents are summarized in Table 1. Detailed objectives and monitoring requirements are specified in the revised source control work plan (Golder and Floyd|Snider 2007) and an addendum addressing the introduction of whole water sampling to the source control monitoring program during round 5 (2010-2011) (Golder 2010e), which is being submitted concurrently with this document.

1.1 Background

Boeing assembled aircraft and manufactured airplane parts at Plant 2 from the late 1930s through the mid-1990s. Some of the plant processes used hazardous chemicals, including heavy metals (chromium, zinc, copper, cadmium, and silver), cyanide, mineral acids and bases, petroleum products, PCBs, and chlorinated solvents, such as trichloroethene, for degreasing. Plant 2 was also used for office and administrative functions and was Boeing's corporate headquarters until 2002. Many older buildings have been demolished, and the southern and northern sections of the facility have been entirely rebuilt. Plant 2 is now used for mostly research and testing, motor pooling and vehicle maintenance, and warehousing of parts and equipment. Some small-scale manufacturing operations are also ongoing, in conjunction with research and testing functions.

Source control is designed in part to prevent recontamination of DSOA sediments by the cumulative impact of all pathways that may transport contaminants to the Waterway. Potential pathways from Plant 2 to the Waterway include groundwater discharges, bank erosion, and

stormwater discharges. This Work Plan focuses solely on the monitoring and control of contaminants associated with the Plant 2 stormwater system.

1.2 Description of Current Plant 2 Stormwater System

Figure 1 is a general vicinity map. The ground surface at Plant 2 is paved or covered by buildings, except for some small landscaped areas primarily in the northwest portion of the plant. The stormwater system consists of 26 outfalls, which are variously connected by piping to catch basins, stormwater vaults, bioswales, oil/water separators, roof drains, and other containment structures. Two of these outfalls, designated X and Y, were deactivated in the spring of 2006 in response to elevated concentrations of PCBs and metals detected in catch basin solids samples in those lines during a 2005 storm system survey (Tier 1/Tier 2 survey) (Floyd|Snider, 2005). These outfalls continue to remain deactivated at this time. Stormwater is discharged from Plant 2 under an NPDES permit, as discussed in Section 1.4.

Table 2 summarizes the outfalls at Plant 2, including their size, drainage areas, and a brief description of the portion of the facility they serve. Figure 2 is an aerial photo of Plant 2 with the approximate extent of each current outfall's drainage area colored. Fifteen of the 24 active outfalls discharge stormwater falling upon building roofs. Note that the drainage areas for the roof-drain outfalls have been grouped into lines G through C for building 2-10, and U through M for buildings 2-40 and 2-41. The remaining nine active outfalls (A, B, H, I, J, K, L, V, Z) drain mostly paved areas or paved areas and building roofs combined. The drainage basins of lines J and Z include some public roadway runoff from the 16th Ave South (South Park) Bridge and roadway (line J) and a small area within the East Marginal Way right-of-way (line Z).

In addition, small areas in the south part of the Plant 2 facility historically drained to outfalls on the Jorgensen Forge property adjoining Plant 2 to the south. These are known as the 24-inch and the 15-inch property line outfalls. The 24-inch line also drained portions of King County International Airport, East Marginal Way, and the Jorgensen property. These lines are being administered through a separate action with EPA and are not part of this Work Plan.

1.3 Future Plant 2 Stormwater System

As part of several redevelopment activities at Plant 2, the stormwater systems throughout the property will be upgraded over the next several years, providing new options and capacity for stormwater treatment including a reduction in the number of outfalls that discharge stormwater to the Duwamish Waterway. Sections 1.3.1 and 1.3.2 summarize the planned changes; a more detailed description of the potential and preliminary stormwater system designs is presented in Section 2.

1.3.1 North of the 16th Ave. S. Bridge (North System)

Stormwater lines A, B, and I will be redirected to two water quality discharge points. Depending on the results of an engineering study currently in progress, line I may be rerouted underneath the 16th Avenue S. Bridge and consolidated with the new stormwater system planned for the area south of the bridge.

The rationale for consolidation of the north area system is based in part on source control monitoring results and the ability to provide centralized biofiltration treatment for much of the

drainage area. Lines A, B, and I have consistently exhibited SCAL exceedances for dissolved metals in water samples and for total metals (A, B and I) and PCBs (B and I) in filtered solids samples (Golder 2007a, 2008a; 2010a). Consolidation of the lines where feasible from an engineering standpoint will enable control at a reduced number of discharge points and the potential use of biofiltration (vs. mechanical or other treatment types), increasing effectiveness and sustainability of the system as well as simplifying evaluation of source control actions and continued monitoring.

The new stormwater system in this area may include new catch basins/inlets (limited or none), collection lines (primarily for local re-routing of runoff), pump stations, biofiltration systems (bioswales/bioretention with selected media) with underdrains, and treatment vaults. Detailed engineering design work has been initiated for this future system. Additional details on planned modifications to the north system are presented in Section 2.

1.3.2 South of the 16th Ave. S. Bridge (South System)

Much of the south Plant 2 area will be re-developed, with new stormwater inlets, conveyance lines, and treatment systems added. The re-development will include demolition of buildings and existing pavements, excavation of some contaminated soils (presented in a separate IM work plan in progress), and construction of a low permeability layer where required to significantly limit the amount of infiltrating stormwater contacting underlying soils.

Stormwater line J will be separated into two portions: 1) the portion that currently drains the 16th Avenue South road and bridge pavement areas will be separated from the existing outfall and will become the property and responsibility of King County, and 2) the portion that currently drains pavement around Buildings 2-22 and 2-25 will be consolidated into the future system constructed for the 2-31 area and part of the 2-40s area. Lines currently draining the property further south will be collected into combined bioswales and treatment vaults and discharged through two new outfalls to be constructed further south of the bridge as part of the redevelopment activities in the 2-40s, 2-66, and 2-60s areas. It is anticipated a portion of the current line Z will also be separated from its Plant 2 drainages for continued use by the City of Tukwila storm system for drainage for East Marginal Way; the City of Tukwila is currently evaluating options available for its East Marginal Way drainage area.

The new stormwater system in the redevelopment area south of the bridge will include construction and installation of new catch basins, collection lines, bioswales, treatment vaults, and outfalls and termination of most of the current system. Detailed engineering design work will be initiated as needed for this future system based on north system performance. Section 2 provides additional detail on the planned changes for the south system.

1.4 National Pollutant Discharge Elimination System Compliance Activities

Stormwater falling upon pavement or building roofs is discharged to the Duwamish Waterway under an NPDES/State Waste Discharge General Permit for Stormwater Discharges Associated with Industrial Activities (the Permit), in compliance with the State of Washington Water Pollution Control Law (Chapter 90.48 RCW) and the Federal Water Pollution Control Act (The Clean Water Act) (Title 33 United States Code, Section 1251 et seq.). The Permit is issued by the State of Washington Department of Ecology (Ecology). Stormwater system sampling, pollutant control, management, and maintenance are conducted in accordance with the

Plant 2 Stormwater Pollution Prevention Plan (SWPPP). Work proposed in this Plan will be performed separate from ongoing activities that support NPDES compliance, but in most cases the work will overlap and support both stormwater compliance mandates.

BMPs are implemented to control the quality of stormwater discharges. BMPs currently employed at Plant 2 include secondary containment and weather protection for outside containers or tanks, conducting manufacturing within buildings (not exposed to stormwater) only, regular (monthly) sweeping outside and inside buildings, installation and regular maintenance/cleanout of catch basin inserts to assure solids containment capacity, installation of automated gate valves in storm lines to capture and/or contain spills within the lines, installation of oil/water separators in areas where petroleum is used, installation of three bioswales to treat stormwater runoff prior to waterway discharge, and numerous other management and training practices as described in the Plant 2 SWPPP. Consistent with the Permit, some conditionally approved non-stormwater sources are occasionally discharged to the Plant 2 stormwater system. These sources include the periodic flushing of fire, drinking water, and irrigation lines.

1.5 Source Control Activities at Plant 2

As described in Section 1, source control must be demonstrated at Plant 2. The following sections describe historical and recent source control activities at Plant 2.

1.5.1 Previous Source Control Activities

Over the past several decades, as the activity at Plant 2 has changed from aerospace manufacturing to office-oriented research and development and warehousing, many historical sources of contamination to the waterway have been eliminated. For example, the transition from manufacturing has resulted in the elimination of hundreds of hazardous chemicals and waste generation processes, along with the concurrent decommissioning, cleanup, and interim closure of many inactive RCRA waste management units.

Specific activities undertaken by Boeing to control or eliminate sources of contaminants to the waterway include installation of three sheetpile enclosures to contain solvent-contaminated soil and groundwater, the removal of free petroleum product from groundwater, and the replacement of hazardous materials, such as chlorinated solvents, with less toxic alternatives. For example, fluids have been drained from all transformers at Plant 2 and replaced with less hazardous fluids.

Historical releases in some parts of Plant 2 have been a source of PCB contamination to the Duwamish Waterway, and have been eliminated, controlled, or identified for future actions. For example, a subsurface transformer vault within the 2-49 building was once connected to Outfall 12 (part of line W) by a sump pump; after a spill of transformer fluids containing PCBs was automatically pumped to Outfall 12, the line to the waterway was replaced and PCBs were removed from the system in the 1990s. Similarly, there were historical PCB releases to soil and an Outfall 9 (part of line Z) manhole structure in the area of the former Seattle City Light transformers at the southern property boundary; this pathway to surface water has been controlled and the stormwater manhole has been temporarily plugged. Other stormwater lines that parallel the property line with Jorgensen Forge have also been assessed for possible sources and have been plugged where possible as an initial control.

1.5.2 Recent Source Control Activities

The list below comprehensively presents source control activities in recent years; the paragraphs that follow present additional detail on several of the activities, including ongoing work to identify and eliminate or control remaining sources at Plant 2.

- *August 2005 to October 2005*. Storm system survey conducted in two phases (Tier 1 and Tier 2) consisting of catch basin solids for PCBs and metals and joint caulk sampling for PCBs.
- *October 2005 to April 2006*. Joint material and floor sealant sampling for PCBs in the 2-66 and 2-60s Areas.
- *March 2006 to October 2006.* Temporary stormwater collection and treatment system installed to replace drainage capacity of storm lines X and Y. Storm lines X and Y and associated catch basins were sealed and taken out of service. Joint caulk was removed from specific portions of the 2-60s Area slabs.
- *October 2006 to April 2007.* Stormwater Source Control monitoring, Round 1 completed.
- *February 2007 to May 2007.* Stormwater lines X and Y (RCRA Units OA 23.1 and OA 23.2) in the 2-60s Area decommissioned and removed. Runoff from this area currently drains to outfall Z.
- *May 2007.* Catch basin resampling of all Tier 1 and Tier 2 locations and selected locations upgradient of Tier 1 locations for PCBs.
- *October 2007 to November 2007*. Phase 1 caulk investigation, review of existing data and sampling for PCBs in the 2-10 and 2-40s Areas.
- *October 2007 to May 2008.* Stormwater Source Control monitoring, round 2 conducted.
- *June 2008 to November 2008.* Stormwater catch basin sampling and storm line cleaning conducted.
- *July 2008 to September 2008*. Phase 2 caulk investigation, 2-10, 2-40s & 2-60s Areas mapping and sampling for PCBs.
- *November 2008 to May 2009.* Stormwater Source Control monitoring, round 3 conducted.
- *October 2009 to November 2009.* Removal of joint caulk from concrete slabs in the 2-60s Area and sampling and cleaning or replacement of fabric catch basin inserts along storm lines B, I, J, and Z.
- *December 2009.* Cleaning of the containment area around the Jet A fuel tanks near the east end of storm line B.
- *October 2009 to April 2010.* Stormwater Source Control monitoring, round 4 conducted.
- *July/August 2010.* Completion of remaining joint caulk removal from concrete slabs in the 2-10 and 2-31 Areas; annual catch basin solids sampling and cleaning along active stormlines.

Storm System Survey. A storm system survey was conducted in 2005 to identify PCB and metal constituents in storm solids within Plant 2 stormwater structures. The resulting data were summarized in a memo previously provided to EPA (Floyd|Snider, 2005). The survey was conducted from August through October of 2005 in two phases (Tier 1 and 2). Eight stormwater lines that together drained most of the paved portions of Plant 2 were selected for the initial phase (Tier 1) of the survey, in which a sample of accumulated solids was collected from the furthest downgradient structure associated with each line (i.e., the last catchment along the main trunk line prior to the outfall or prior to discharge from municipal storm drains). Results from the Tier 1 sampling were used to select additional sampling locations for Tier 2 sampling.

In general, PCBs were detected well above 1 ppm in line X (2,600 ppm) and line Y (37 ppm), and slightly above 1 ppm in line I. Elevated concentrations of lead, chromium, and mercury were also detected in solids samples associated with these lines. Thus, Tier 2 sampling was subsequently conducted along lines X, Y, and I.

Tier 2 sampling results confirmed the Tier 1 results and all catch basins associated with lines X and Y were cleaned of solids in August (Tier 1 structures), and November (Tier 2 structures) of 2005. Cleanout of catch basins along line I was completed in May of 2006. Based on this analysis, lines X and Y were identified for decommissioning.

Stormwater Line X & Y Decommissioning and Removal. Based upon the results above, in winter of 2006, lines X and Y were decommissioned and their stormwater drainages were diverted from lines X and Y to a new stormwater collection system and treatment vault plumbed to line Z and designed to remove solids. The *Draft Interim Measure Work Plan for Stormwater Lines X & Y* (Golder 2006) describes the decommissioning, and presents the permanent removal and management approaches for lines X and Y.

Following the storm system survey, floor caulking and sealants in building slabs and roadways within the drainage areas of lines X and Y were tested to identify potential sources of PCBs to storm solids. The results indicated that some PCB-containing products that were applied as joint caulking and floor sealants are present along some sections of the floor slabs. PCB-contaminated joint caulking and floor sealant from this area has been removed as part of demolition and/or redevelopment actions in that part of Plant 2.

In May 2007, stormwater lines X and Y were excavated and removed in the 2-60s Area of Plant 2 and confirmatory soil sampling was conducted, as documented in the *Interim Measure Completion Report – Removal of Stormwater Lines X & Y (OA 23.1 and OA 23.2)* (Golder 2008b). The portions of the lines remaining in the 2-66 Area have been decommissioned and left in place. Removal of these remaining lines will be completed during the implementation of the DSOA cleanup action.

Stormwater Source Control Monitoring. Four rounds of stormwater source control monitoring have been completed and sampling reports for rounds 1 through 3 have been submitted to and approved by EPA (Golder 2007a, 2008a, 2010a). The report for round 4 has been submitted to EPA for review and comment. During the upcoming 2010–2011 monitoring season (round 5), suspended solids and water-only sampling will be continued and supplemented with whole water sampling for PCBs. The methods and procedures for implementation of whole water monitoring are being provided in an addendum to the current source control work plan (Golder 2010e).

Joint Caulk Interim Measures. Pursuant to EPA letters dated February 15, 2007 and April 11, 2007, Boeing completed a baseline characterization study to identify all PCB-contaminated caulk (greater than 1 ppm) in outdoor concrete pavement at Plant 2. This work was described in the *Interim Measure Work Plan – Characterization of Caulk in Concrete Pavements* (Golder 2007b).

Based on the results of the caulk characterization study, during October and November 2009, approximately 2,660 linear feet of caulk materials containing > 25 ppm PCBs, as well as two inches of underlying soil, were removed from the concrete slabs in the 2-60s Area of Plant 2, in accordance with the *Phase 3 Interim Measure Work Plan: Removal of PCB-Containing Caulk in Concrete Pavements* (Golder 2009a). A description of the work completed is provided in the *Preliminary Interim Measure Completion Report – Removal of PCB-Containing Caulk in Concrete Pavements* (Golder 2010b).

The second phase of the caulk removal IM, addressing the lines I and J drainages, is scheduled for the summer of 2010.

Catch Basin Sampling and Storm Line Cleaning. Several rounds of catch basin sampling have been completed at Plant 2, consisting of: the 2005 Tier 1 and 2 sampling (Floyd|Snider 2005); follow-up sampling of 13 catch basins in 2007 (Golder 2007c); catch basin and insert sampling at 364 locations as part of the 2008 source control IM (Golder 2008c); and sampling of geotextile surface inserts as part of Fall 2009 Source Control Actions (Golder 2010c).

In addition, as part of the 2008 source control IM, during the summer and fall of 2008, catch basins and storm lines were cleaned via high-pressure jetting and vacuuming, and geotextile filter fabric inserts were installed at storm system entry points (Golder 2009b). Fabric inserts were inspected and cleaned or replaced, as necessary, during completion of the Fall 2009 Source Control Actions (Golder 2010c).

Additional inspection, sampling, and cleaning of catch basin inserts; sampling of inserts and bottoms; and additional storm line cleaning are planned for the summer of 2010 where levels of target constituents persist.

1.5.3 Future Source Control Measures

Future source control measures will be implemented to control or eliminate the discharge of PCBs and metals in the stormwater system. These include actions for known and potential PCB and metals sources. A complete description of actions to be completed for each of these source types is provided in Sections 2 and 3.

2.0 PLANNED STORMWATER SYSTEM MODIFICATIONS

The section describes the Plant 2 stormwater system modifications being planned to meet the requirements established in EPA's December 4, 2009; February 9, 2010; and March 30, 2010 letters to Boeing on this subject (EPA 2010a, b, c). Section 2.1 provides a background discussion of the monitoring results being considered in development of the modifications. Sections 2.2 and 2.3 present the recommendations for the north and south Plant 2 stormwater systems (respectively). Section 5.0 presents the associated implementation schedule.

2.1 Introduction and Background

Four rounds of stormwater source control monitoring data have been collected at Plant 2 since 2006 (Golder 2007a, 2008c, 2010a, 2010d). Based on this work, PCBs remain variably present in Plant 2 stormwater solids at concentrations above SCALs in lines B, I, J, and Z. Various metals continue to be variably present above action levels in suspended solids from in lines A, B, I, J, and Z. Dissolved copper and/or zinc continue to be variably present above SCALs in lines A, B, J, and V.

Following stormwater source control monitoring results, recent EPA correspondence, and planned changes to Plant 2 north and south of the 16th Avenue S. Bridge, Boeing intends to modify the stormwater systems throughout Plant 2. A conceptual design study of the north stormwater system has been completed; preliminary results are presented in section 2.2. In preparation for site redevelopment south of the bridge, a design was developed for a new stormwater system to be constructed following demolition of buildings and slabs in the 2-31, 2-40, 2-60s, and 2-66 areas of Plant 2. A conceptual design for the south stormwater system is presented in section 2.3. In this plan, the term BMPs includes the physical components of installed drainage systems as well as stormwater source controls.

Implementation of the north system modifications will begin in 2011; the north system design and its operational and performance characteristics through the winter of 2011/2012 will inform possible refinements to the design of the south system, which will be constructed in 2012 following completion of building, slab, and utility demolition.

Following implementation and monitoring of system modifications, should COCs remain above SCALs after three years of monitoring, additional treatment system modifications will be proposed in subsequent revisions to this work plan.

2.2 North System

Background

Stormwater source control monitoring at catch basins in the north stormwater system has shown exceedances of SCALs for: metals in both filtered solids and filtered water samples at line A; PCBs and metals in filtered solids and dissolved metals in water at line B; and PCBs and metals in filtered solids at line I. As a result, an engineering study is in progress to develop a detailed plan for modifications to the north system. This design will accommodate habitat placement planned for the northwest corner of Plant 2. Currently, stormwater lines A, B, and I will be redirected to two water quality discharge points (A and a discharge point on the proposed

south stormwater system; the minor roof drains from Building 2-120 outfalls C-H, would remain as they are). Periodic sampling of line G, originally designated for one-time only sampling of whole water for SVOCs, has continued due to slight exceedances of SCALs. This monitoring will continue during the 2010/2011 sampling season; however, it is anticipated that line G may soon be eliminated from future monitoring based on source control evaluation results.

Line I is currently proposed to be rerouted underneath the 16th Avenue S. Bridge and combined with the new stormwater system planned for the area south of the bridge. Redirecting the lines as described will enable more focused treatment and control at a reduced number of discharge points, simplifying evaluation of response actions and continued monitoring.

Conceptual Stormwater Design

A conceptual design for the north system has been developed as part of an eight-step process:

- Step 1: Plant 2 storm water study
- Step 2: Design north system
- Step 3: Develop enhanced source control matrix and implementation plan.
- Step 4: System O&M costs
- Step 5: Implement enhanced source control plan
- Step 6: Construction of north storm water system
- Step 7: Monitor north system for compliance with EPA limits
- Step 8: Modify north and south systems to assure compliance

Once the north system design process is complete according to the schedule provided in Section 5.0, the south system design will be reevaluated under a similar process.

Step 1 has been completed for the north system and included the following analyses:

- **Drainages and Existing BMP Treatment Options.** Existing Plant 2 drainages and BMPs were evaluated. The line A drainage area was divided into six drainage areas (A1 through A6, Figure 3) based on the complexity of its drainage system, including invert elevations of the drainage system and locations of discharge to the main line, and the multiple BMPs currently in place. Drainage areas B and I were not subdivided.

- **Hydrologic/Hydraulic Modeling.** The EPA Storm Water Management Model (SWMM), a dynamic rainfall-runoff model, was used for a continuous simulation analysis of the various facility configurations and hydrologic processes that produce runoff. The model considers runoff and external inflows with the existing system network of pipes, channels, storage/treatment units and diversion structures (EPA 2008). The model was run using 60 years of precipitation data from Seattle-Tacoma Airport (1948 – 2008) because rain gauge data from King County International Airport (KCIA) was not sufficiently comprehensive. Attachment A provides a tabular summary of the model input assumptions and output results for comparison purposes. Model results indicate

that the current and proposed systems have adequate capacity to fully convey flows from the 25 year 24 hour rain event.

- **BMP Selection.** Once model results were completed and analyzed, multiple alternatives for each drainage area were developed and assessed for fatal flaws in implementation, operation, and performance, and compared with one another. Preference was given to BMPs that best met the following criteria (in order of importance): 1) treatment of constituents of concern to required concentrations; 2) maximizing the amount of runoff treated; 3) consolidation of treatment areas to maximize the use of biofiltration; 4) ease/cost of modifications to existing storm drainage system (minimizing new storm drains and connections, utilizing gravity flows and minimizing pumping where feasible, and utilizing existing swale BMPs); 5) elimination of (or reduction of flows to) outfalls; and 6) cost and future maintenance considerations.

Following these analyses, alternatives were assembled into appropriate system components and collection and treatment options, and two design scenarios (scenario 1 and scenario 2) were selected, as described in the following sections (Tables 3 and 4 and Figures 4 through 7).

2.2.1 Scenario 1: Outfall Consolidation

Scenario 1 is described in Table 3 and shown in Figures 4 and 5. Scenario 1 would result in greater consolidation of stormwater flow from the north Plant 2 stormwater system, allowing for more surface biological/media treatment to take place instead of using underground media filters.

Line A Drainage. For the initial system design, the line A drainage area was divided into six drainage areas (A1 through A6, Figure 3). Each of the drainage areas and the system components and treatment properties are described below:

- Drainage Area A-1: This area has an existing swale that currently receives all runoff tributary to it. Minor modifications would be performed to the swale to enhance its treatment properties, including revegetation, reconfiguration of layout, including the outlet configuration and/or addition of media or amended soils. No modifications are required to the drainage and this area will continue to discharge at outfall A as currently configured.
- Drainage Area A-2: This drainage area will be tied into the proposed settling basin of the primary treatment system in drainage area A-6. The existing drainage line that runs through A-2 will be removed during BMP installation of the A-6 primary treatment system, as it is currently situated in areas that will be excavated for the installation of the system. Drainage area A-2, through the A-6 treatment system, will discharge at outfall A.
- Drainage Area A-3: This area, encompassing the eastern portion of building 2-122, does not currently pass through any treatment systems prior to discharging to outfall A. Due to elevation differences; connecting this line to the primary treatment area in area A-6 is not feasible without pumping. For this reason, at the junction (2-453) with untreated areas from A-5 and swale treated areas from A-4, an underground media filter will be installed to ensure that all runoff is treated prior to discharge. Media will be selected during the design phase, but will likely be a granulated activated carbon (GAC) blend.

The media filter will discharge to outfall A. The media filter size and configuration will be sufficient to accommodate multiple treatment, operation and maintenance, and monitoring options.

- Drainage Area A-4: This area currently drains through a vegetated swale. This swale will be left as-is or enhanced (similar to potential enhancements to the swale in A-1); flows will receive additional treatment from the media filter to be located at junction 2-453 prior to discharge to outfall A.
- Drainage Area A-5: This roof area will be tied into the media filter at junction 2-453 prior to discharge to outfall A.
- Drainage Area A-6: The primary treatment area for the subject property will be located here, west of building 2-122. An initial forebay or settling basin will be required at the location where runoff from drainage areas A-2, B, and potentially I will be discharged (Figure 3). This settling basin will be the primary settlement BMP for sediment and solids; it will, therefore, be constructed with an impervious concrete bottom to allow for equipment access for cleanout. An outfall structure from this basin will be sized with multiple orifices to control flows to step #2 of the treatment system, a vegetated media filtration system with underdrains (a modified bioretention system). Media selection will be refined during the design process based on north Plant 2 constituents of concern and the required flow-through capacity.

Finally, at a location prior to existing outfall A, a sampling access vault will be installed to enable sampling and assessment of stormwater in accordance with source control monitoring and evaluation requirements (Golder and Floyd|Snider 2007).

Line B Drainage. Existing flows to outfall B will be routed to the primary treatment system in A-6 through a pump station placed near the outfall. An analysis will be performed on pump size wet well volume and yearly treatment volume to determine the optimal treatment capacity (evaluation of sizing vs. amount of runoff treated) for this location during the design stage. The pump station will be sized accordingly, and overflows will discharge via the existing outfall B.

During periods of overflow discharge out outfall B, source control monitoring will be continued at catch basin 3-307 in accordance with the revised source control work plan (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

Line I Drainage. Due to the lack of adequate surface area by outfall I, elevation differences, the distance to drainage area A-6, and in order to utilize the same primary treatment system, a pump station will be installed at outfall I and a new storm drain line will be run from line I to the proposed settling basin in drainage area A-6. (An alternate route directing line I to the south will also be considered under scenario 2 below.) This storm drain line will likely be mounted under Building 2-10. The pump station will be designed for the treatment volume (to be determined), with overflow discharging through the existing outfall I. An analysis will be performed on pump size wet well volume and yearly treatment volume to determine the optimal treatment capacity (evaluation of sizing vs. amount of runoff treated) for this location during the design stage.

During periods of overflow discharge out outfall I, source control monitoring will be continued at catch basin 4-283 in accordance with the revised source control work plan (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

The design study will be completed and a final design developed and permitted by early 2011 in time to begin site preparation and construction in mid 2011.

2.2.2 Scenario 2: Multiple Outfalls/Minimize Pumping

Scenario 2 is described in Table 4 and shown in Figures 6 and 7. The primary differences between Scenarios 1 and 2 are the removal of pump stations in drainage areas B and I and the removal of the underground media filter located at junction 2-453 that would treat multiple areas under the current drainage configuration. These differences change the potential treatment for the majority of drainage areas as described below. An advantage of scenario 2 is that fewer pump stations, which require energy and maintenance, would be required.

Line A Drainage. As described above for scenario 1, six sub-drainage areas were evaluated and options for each were considered. Figure 7 depicts each of the drainage area options for this scenario.

- Drainage Area A-1: The existing BMP drainage swale will be converted to a media filtration system with an underdrain and will be sized to receive additional flows from north roof drainage of Building 2-122.
- Drainage Area A-2: No change from scenario 1 in routing to the primary treatment system.
- Drainage Area A-3: A small pump station would be installed to connect the existing storm drain to catch basin 2-370, where it will flow through the existing treatment swale prior to direct discharging to outfall A. Media filtration at 2-453 or 2-451 is still a possible alternative if treatment goals are not achieved by the existing swale.
- Drainage Area A-4: This area currently drains through a vegetated swale and directly to outfall A. In this scenario, no additional BMP is required. Media filtration at 2-453 or 2-451 is still a possible alternative if treatment goals are not achieved by the existing swale.
- Drainage Area A-5: The roof drains on the northern side of Building 2-122 will be connected to the A-1 drainage system which will then pass through the existing drainage swale and to outfall A. The western roof drain of Building 2-122 that discharges at 2-454 will require individual treatment through a downspout planter box or media filter.
- Drainage Area A-6: An initial forebay or settling basin will be required at the location where runoff from drainage areas A-2 and most of B will be discharged (size will be smaller than in scenario 1, as drainage area I is not routed to this location). This settling basin will be the primary settlement BMP for sediment and solids, and therefore it is proposed to be constructed with an impermeable concrete bottom to allow for equipment access for cleanout. An outfall structure from this basin will be sized with multiple orifices to control flows to step 2 of the treatment system, a “racetrack” vegetated swale system, designed with multiple flow paths to maximize vegetation contact. A final clarifying media filtration BMP can be included at the terminal end of the swales if monitoring indicates that effluent quality does not meet discharge limits.

Finally, at a location prior to existing outfall A, a sampling access vault will be installed to enable sampling and assessment of stormwater in accordance with source control monitoring and

evaluation requirements (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

Line B Drainage: The majority of site drainage northeast of Building 2-10 (including the northeast roof of the building) is currently routed to outfall B. A connection will be installed between catch basin 3-207 and the A-2 storm drain line at 2-391 diverting the majority of drainage area B flows to the primary treatment system located in A-6 via gravity flow. A small swale will be constructed in an existing tree-lined area to treat the small area downstream of 3-307 prior to discharge at outfall B. A sampling vault will be installed downstream of the swale for monitoring purposes, tidal control will be required to prevent backflow. Monitoring will be conducted as specified in the revised source control work plan (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

Line I Drainage: Instead of the scenario 1 pump station and new drainage line to the primary treatment system in A-6, an underground media filter will be installed at the terminal point of drainage area I (if line I is not rerouted underneath the bridge to the south system). Media will be selected during the design phase, but will likely be a GAC blend. Due to required depth and to prevent backflow into the media filter, tidal control will be required on outfall I. A sampling vault will be installed downstream of the media filter for monitoring purposes. Monitoring will be conducted as specified in the revised source control work plan (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

2.2.3 Final Conceptual Design

The two preliminary design scenarios presented above as part of early conceptual design were refined based on BMP sizing analyses, recent designs of the Outfall B replacement, and new information on the on-site areas available for treatment BMP installation (inclusion of habitat restoration footprint). A recommended design was selected that was anticipated to best achieve water quality goals within the usable footprint. The final recommended design scenario retains the flexibility to allow additions to the system if post-construction sampling indicates water quality benchmarks are not being achieved. Figure 8 is provided for reference to the refined drainage areas used for final conceptual design; note that these drainage areas were refined and modified from the original delineations based on additional drainage information and included refinements to Line A drainage areas and separation of Line B into two drainage areas, B-1 and B-2.

The final conceptual design is described in Table 5 and shown in Figure 9. Changes from the original proposed scenarios include pumping line I drainage to proposed BMPs on the south stormwater system (expanded from original south system conceptual designs) and treating the roof drainage from Building 2-122 with a distributed BMP system (planter boxes, downspout media filters).

Line A Drainage. Figure 9 depicts each of the drainage area BMPs for the final conceptual design.

- Drainage Area A-1: The existing BMP drainage swale will be enhanced with amended soils, vegetation, and an underdrain.

- Drainage Area A-2: This drainage area will be tied into the proposed settling basin of the primary treatment system in drainage area A-6. The existing drainage line that runs through A-2 will be removed during BMP installation of the A-6 primary treatment system, as it is currently situated in areas that will be excavated for the installation of the system. Drainage area A-2, through the A-6 treatment system, will discharge at outfall A.
- Drainage Area A-3: Roof drainage will be treated through a distributed BMP system. Options include planter box treatment, downspout media filters, or roof inlet media filters. Engineering analysis is currently being performed to determine the feasibility of each of these options for final selection.
- Drainage Area A-4: This area currently drains through a vegetated swale and directly to outfall A. This swale will be enhanced with media, an underdrain, and with outlet control.
- Drainage Area A-5: Roof drainage will be treated through a distributed BMP system. Options include planter box treatment, downspout media filters, or roof inlet media filters. Engineering analysis is currently being performed to determine the feasibility of each of these options for final selection.
- Drainage Area A-6: An initial forebay or settling basin will be required at the location where runoff from drainage areas A-2 and most of B will be discharged. This settling basin will be the primary settlement BMP for sediment and solids, and therefore it is proposed to be constructed with an impermeable concrete bottom to allow for equipment access for cleanout. An outfall structure from this basin will be sized with multiple orifices to control flows to step 2 of the treatment system, a vegetated media filtration system with underdrains (a modified bioretention system). Media selection will be refined during the design process based on north Plant 2 constituents of concern and the required flow-through capacity.

Finally, at a location prior to existing outfall A, a sampling access vault will be installed to enable sampling and assessment of stormwater in accordance with source control monitoring and evaluation requirements (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

Line B Drainage: The majority of site drainage northeast of Building 2-10 (including the northeast roof of the building) is currently routed to outfall B. A connection will be installed between catch basin 3-307 and the A-2 storm drain line at 2-391 diverting drainage area B-1 flows to the primary treatment system located in A-6 via gravity flow. Recent improvements to Line B have allowed for the remainder of the drainage area (shown as B-2) to also directly connect to the primary treatment system in A-6 via gravity flow. Monitoring will be conducted as specified in the revised source control work plan (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e).

Line I Drainage: A new pump station will be installed at the terminus of line I drainage to pump water quality flows under the 16th Avenue S. bridge to a BMP system that has been proposed as part of the south stormwater system. Initial analyses have shown adequate capacity in this system if expanded and reconfigured; final design will confirm the size and orientation required. This design allows for a smaller pump station than original conceptual design scenario 1 due to proximity to south system. Original conceptual design scenario 2, which proposed including a

media filtration vault prior to Line I discharge was determined to be infeasible due to depth of drainage lines and tidal effects on the system.

The design study will be completed and a final design developed and permitted by early 2011 in time to begin site preparation and construction in mid 2011.

2.3 South System

Beginning in mid- to late-2010, demolition and redevelopment activities will commence in areas south of the bridge and continue through mid-2012. As part of those redevelopment activities, a new stormwater system will be constructed once selected buildings and slabs are removed and contaminated soil is excavated. The area will be graded and paved as part of installation of a new stormwater system. The new inlets and catch basins will include water quality filtration to act as a gross solids removal/pre-treatment for the planned downstream treatment systems.

Following installation of the stormwater system, addition of a low permeability asphalt layer is currently being proposed to allow for parking use in selected areas and to minimize infiltration of stormwater in all areas. The design of the paving layer has not been completed. However, design considerations to minimize the amount of stormwater infiltration will include: whether a long-term use (e.g., parking lots) will be designated for the area (or if it will remain in a short-term vacant state to be rebuilt once a long-term land use has been determined); selection and design of the paving materials to minimize aging (e.g., cracking); placement of low-permeability layers within or below the paving materials; the location of underground infrastructure; and location of underground to-remain-in-place pollutants. The demolition, decommissioning, and paving of this area will significantly reduce sources of pollutants. However, it is expected that runoff from these areas will still contain typical pollutants associated with urban pavement; therefore, stormwater treatment is being proposed to address runoff from these surfaces as well as from the other areas of the south Plant 2 that will remain in use.

Figure 10 depicts the planned configuration changes to the south stormwater system, including new inlets and storm drain lines associated with the demolition and decommissions, connections from the existing drainage systems to the new drainage system, proposed treatment systems (lined bioswales), sampling vaults, and the proposed new outfalls, S-1, S-2, and S-3. As with the north Plant 2 system, designs are preliminary; final designs will be completed after additional engineering studies.

For the existing area to remain adjacent to 16th Ave South, stormwater line J will be separated into two portions as follows: 1) the portion that currently drains the 16th Avenue S. road and bridge pavement areas will remain in place with the Plant 2 runoff separated from the existing outfall, which will then become the responsibility of King County; and 2) the portion that currently drains pavement around Buildings 2-22 and 2-25 will be consolidated into the future reconstructed 2-40s area stormwater system for collection into combined bioswales and treatment vaults prior to discharge. As noted above, line J may also incorporate the rerouted line I depending on results of the design study underway for the north system.

Line Z and its outfall will remain and will be used as overflow for the Plant 2 drainages, but will otherwise be separated from the Plant 2 drainages and will continue to be utilized by the City of Tukwila to drain portions of East Marginal Way.

The new stormwater system in the redevelopment area will include construction and installation of new catch basins, collection lines, bioswales, treatment vaults, and outfalls. Once the north system is constructed and operational, its performance will be evaluated and used to inform design modifications to the south system in time for its construction and installation.

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3.0 SOURCE CONTROL MEASURES

Source control measures will be implemented to reduce or eliminate the discharge of PCBs and metals to the stormwater system and the Duwamish Waterway. Ongoing measures to control or eliminate sources of PCBs and/or metals will continue, and additional measures, including conducting research, inspections, and sampling, will be implemented to further identify and control unknown sources, as documented most recently in the Fall 2009 Plant 2 Source Control Actions Completion Report (Golder 2010c). In addition, mechanical and manual sweeping will continue and be enhanced to better intercept particulate materials that may transport PCBs and metals to stormwater drainage conveyances. This work will include more consistent documentation of surfaces swept and an increased sweeping frequency and coverage in target areas demonstrated through sample results as possibly transporting source materials (Figures 11 & 12). Other specific source control measures that will be undertaken are summarized in the following sections. One of the largest actions serving as a source control measure is the demolition and redevelopment of a large portion of the south Plant 2 area, as noted above.

3.1 Actions for Known PCB Sources

Caulk Removal and Storm Line Cleaning. During the summer of 2010, removal of caulk containing >25 ppm PCBs will be completed from near Building 2-15 and 2-10 and under the 16th Ave. S. Bridge.

In addition, catch basin/manhole insert and bottom sampling, surface insert cleaning and/or replacement, and selected line cleaning will also be conducted (Golder, 2010c). These actions will be repeated annually as dictated by annual stormwater system sampling results. Incremental actions undertaken to contain or eliminate potential sources will be performed and documented in the annual report.

3.2 Actions for Potential PCB Sources

A building materials assessment will be conducted to identify potential PCB-containing materials that may be contributing to presence of PCBs in storm solids. Activities will include:

- Research - Review site plans for potential PCB-containing materials used in construction or retrofits in target areas, and research specified product contents for PCBs, including such materials as:
    - Exterior building components
    - Paint and coatings
    - Wood preservatives, varnish, adhesives, waterproofing
    - Caulk materials in exterior construction joints of building walls
    - Caulk around windows in buildings
    - Products or materials commonly used during the construction or retrofit era (if specific product information is not found)
- Visual inspection and sampling of building exteriors in target areas
    - Inspect and sample materials identified during research
    - Inspect target areas for undocumented presence of wood preservatives, varnish, adhesives, and waterproofing, and sample any such materials

  - Visually observe exterior finishes on buildings near ground level for signs of friable or flaking paint and coatings, and sample deteriorating materials
  - Sample caulks in exterior building wall seams and around window
  - Observe roof downspouts in the target areas to determine whether they are plumbed to the stormwater system. If downspouts are found to be discharging to the ground surface, associated roofing materials will be sampled for PCBs.
  - Inspect target areas for release of dielectric fluid from electrical equipment and lubrication fluids from old machinery that could contain PCBs, and sample as necessary

- Prepare a summary of results, along with recommendations for control measures, to accompany the next annual source control sampling report

3.3 Actions for Potential Metals Sources

A similar effort to identify potential metals sources will be integrated with the building materials assessment described above for PCB sources, and will include:

- Research - Review site plans for target metals-containing materials used in construction or retrofits in target areas, and research specified product contents for the target metals, including such materials as:
  - Exterior building components
  - Paint and coatings on buildings and pavements
  - Exterior stored metal equipment or materials
  - If specific product information is not found, research products or materials commonly used during the construction or retrofit era.
- Visual inspection and sampling of building exteriors in target areas
  - Inspect and sample materials identified during research
  - Inspect building exteriors for exposed metal surfaces and collect samples of any such materials
  - Visually observe exterior finishes on buildings near ground level for signs of friable or flaking paint and coatings, and sample any deteriorating materials
  - Visually observe exposed metal equipment or materials (if feasible remove or cover)
  - Observe roof downspouts in the target areas to determine whether they are plumbed to the stormwater system. If downspouts are found to be discharging to the ground surface, sample downspout material and roofing materials for metals where feasible.
- Prepare a summary of results, along with recommendations for control measures, to accompany the next annual source control sampling report.

4.0 SAMPLING REQUIREMENTS

For each of the existing and new outfalls, stormwater sampling vaults are planned to support sampling efforts (e.g., weirs, sampling intakes, lines, etc.). Upon installation of each new system, sampling as described in the revised stormwater source control work plan (Golder and Floyd|Snider 2007) and its addendum for whole water sampling (Golder 2010e) will be continued in order to document the effectiveness of source control measures. Depending upon the final system configuration, the number of monitoring locations in the north system may be reduced from the current four to two or one. Similarly, the number of monitoring locations in the south system may be reduced from the current four to three locations, depending upon the final system design. Resulting data will be compiled in an annual report consistent with that plan.

Table 6 provides a summary of sampling and analysis requirements for each storm drain line being monitored as well as a summary of the constituents that have exceeded SCALs within the last three sampling rounds (per the source control work plan, Golder and Floyd Snider 2007).

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5.0 SCHEDULE AND REPORTING

5.1 Sampling Rationale

North System. Following EPA review, comment and approval of this plan, and upon completion of the north system modifications in fall 2011, monitoring will commence at lines A, B, and/or I depending on the final system design. Sampling will be conducted seasonally for PCBs and SMS metals in suspended solids, dissolved SMS metals in water, and PCBs in whole water according to the plan as revised and amended (Golder and Floyd|Snider 2007). Required samples will be collected and analyzed from each target outfall (sampling vault) annually.

South System. When redevelopment activities have been completed and the new south system has been installed in summer 2012, sampling will be conducted at each new outfall (sampling vault) and at the current source control sampling location on line Z (if used for overflow discharge). Sampling will be conducted seasonally for PCBs and SMS metals in suspended solids, dissolved SMS metals in water, and PCBs in whole water. Required samples will be collected and analyzed from each target outfall (sampling vault) annually.

All sampling, analysis, and data evaluation will be conducted in accordance with the revised stormwater source control work plan (Golder and Floyd|Snider 2007) and the work plan addendum addressing the implementation of whole water sampling for PCBs during round 5 (2010-2011), which is being submitted concurrently with this document (Golder 2010e).

Annual sampling will continue until the DSOA corrective action begins construction in order to demonstrate that stormwater source control has been attained. Requirements for sampling after the DSOA action is completed will be evaluated and coordinated as part of that action in conjunction with other monitoring requirements. Exceedances of action levels will trigger further source control actions, as described in the following section.

5.2 Reporting and Source Control Actions

A construction completion report will be submitted within 60 days following completion of each system. If annual sampling data indicate discharges remain above action levels, source control work will continue with a focus on individual line drainage areas. Possible evaluations to further an understanding of the remaining sources include the following:

- Sampling of sediments in front of the outfall
- Mass loading or similar calculations to assess the potential for sediment impacts
- Wet/dry sampling of sources derived from atmospheric deposition

Should these evaluations indicate that additional source control is necessary or feasible, specific actions will be proposed on a case-by-case basis. Source control actions will likely repeat and further focus those discussed above. Reports on source control actions will be submitted when results are available following each dry season work period.

5.3 Schedule and Deliverables

The following schedule and process are intended to support the current known timing for completion of the north area storm system construction, the south area redevelopment, and the DSOA construction schedule.

Task		Estimated Completion Date
1	Work Plan submittal	July 1, 2010
2	EPA review/comment	August 9, 2010
3	Plan resubmittal and approval	September 8, 2010
4	North system design study/completion	Winter/Spring 2010/2011
5	Work plan update and resubmittal	Spring 2011
6	EPA review/comment/approval	Spring 2011
7	Detailed design/permitting north system	Spring/Early Summer 2011
8	North system construction/completion report	Mid-Summer/Fall 2011/Winter 2011/2012
9	North system monitoring, south system design changes	Winter/Spring 2011/2012
10	Work plan update and resubmittal	Spring/Summer 2012
11	EPA review/comment/approval	Summer 2012
12	South system detailed design and permitting	Spring/Summer 2012
13	South system construction	Summer 2012

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TABLES

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Table 1: Source Control Analytes and Action Levels

	Suspended Solids			Filtered Water [1]			Whole Water	
	Action Level		Source	Action Level		Source	Action Level	Source
Metals								
Arsenic	93	mg/kg dw	CSL	36	µg/L	201A	NA	
Cadmium	6.7	mg/kg dw	CSL	9.3	µg/L	201A	NA	
Chromium	270	mg/kg dw	CSL	NA			NA	
Copper	390	mg/kg dw	CSL	3.1	µg/L	201A	NA	
Lead	530	mg/kg dw	CSL	8.1	µg/L	201A	NA	
Mercury	0.59	mg/kg dw	CSL	0.025	µg/L	201A	NA	
Silver	6.1	mg/kg dw	CSL	NA			NA	
Zinc	960	mg/kg dw	CSL	81	µg/L	201A	NA	
PCBs								
Total PCB	1,000	µg/kg dw	2LAET	NA			3 µg/L	TSCA
SVOCs [2]								
2,4,6-Trichlorophenol	NA			NA			2.4 µg/L	NRWQC
2,4-Dichlorophenol	NA			NA			290 µg/L	NRWQC
2,4-Dimethylphenol	NA			NA			850 µg/L	NRWQC
2,4-Dinitrophenol	NA			NA			5,300 µg/L	NRWQC
2,4-Dinitrotoluene	NA			NA			3.4 µg/L	NRWQC
2-Chloronaphthalene	NA			NA			1,600 µg/L	NRWQC
2-Chlorophenol	NA			NA			150 µg/L	NRWQC
3,3'-Dichlorobenzidine	NA			NA			0.5 µg/L	RL
4,6-Dinitro-2-Methylphenol	NA			NA			280 µg/L	NRWQC
Acenaphthene	NA			NA			990 µg/L	NRWQC
Anthracene	NA			NA			40,000 µg/L	NRWQC
Benzidine	NA			NA			1 µg/L	RL
Benzo(a)Anthracene	NA			NA			0.1 µg/L	RL
Benzo(a)Pyrene	NA			NA			0.1 µg/L	RL
Benzo(b)Fluoranthene	NA			NA			0.1 µg/L	RL
Benzo(k)Fluoranthene	NA			NA			0.1 µg/L	RL
Bis-(2-chloroethyl) ether	NA			NA			0.53 µg/L	NRWQC
bis(2-Ethylhexyl) phthalate	NA			NA			2.2 µg/L	NRWQC
Butylbenzylphthalate	NA			NA			1,900 µg/L	NRWQC
Chrysene	NA			NA			0.1 µg/L	RL
Dibenzo(a,h)anthracene	NA			NA			0.1 µg/L	RL
Diethylphthlalate	NA			NA			44,000 µg/L	NRWQC
Dimethylphthalate	NA			NA			1,100,000 µg/L	NRWQC
Di-n-butylphthalate	NA			NA			4,500 µg/L	NRWQC
Fluoranthene	NA			NA			140 µg/L	NRWQC
Fluorene	NA			NA			5,300 µg/L	NRWQC
Hexachlorobenzene	NA			NA			0.1 µg/L	RL
Hexachlorocyclopentadiene	NA			NA			1,100 µg/L	NRWQC
Hexachloroethane	NA			NA			3.3 µg/L	NRWQC
Indeno(1,2,3-cd)Pyrene	NA			NA			0.1 µg/L	RL
Isophorone	NA			NA			960 µg/L	NRWQC
Nitrobenzene	NA			NA			690 µg/L	NRWQC
N-Nitrosodimethylamine	NA			NA			3 µg/L	NRWQC
N-Nitroso-di-n-propylamine	NA			NA			0.51 µg/L	NRWQC
N-Nitrosodiphenylamine	NA			NA			6 µg/L	NRWQC
Pentachlorophenol	NA			NA			3 µg/L	NRWQC
Pyrene	NA			NA			4,000 µg/L	NRWQC

Notes:

1. Filtered water samples collected for metals analysis represent the dissolved fraction.
2. SVOC analysis performed on line G samples only.
3. CSL = Marine Sediment Cleanup Screening Levels, from Table III, Chapter 173-204 WAC, Sediment Management Standards.
4. 201A = Water Quality Standards for Surface Waters of the State of Washington, Chapter 173-201A WAC.
5. NRWQC = National Recommended Water Quality Criteria for Priority Toxic Pollutants, published in 40 CFR 131.36, updated 2006.
6. RL = Reporting Limit; action levels are set to the reporting limit where RL exceeds NRWQC criteria.
7. 2LAET = Second Lowest Apparent Effects Threshold, from Barrick et al., 1998.
8. dw = dry weight
9. NA = Not applicable
10. TSCA = 40 CFR 761.50(a)(3))

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Table 2: Plant 2 Outfall Summary

Drainage Basin Information			Outfall Information		
Outfall	**Drainage Area (approx acres)**	**Receives Drainage Primarily From**	**Outfall Size**	**Outfall Elevation**	**Sampled Under ISWGP Permit?**
A	19.9	Parking and roof around 2-122 building.	Twin 30"	NA	Yes
B	5.7	Pavement around 2-10 and 2-123 buildings	18"	NA	Yes
C	0.7	Roof area from 2-10 building	8"	6.69	No
D	1.1	Roof area from 2-10 building	10"	6.69	Yes
E	0.9	Roof area from 2-10 building	6"	7.4	No
F	0.9	Roof area from 2-10 building	8"	7.03	No
G	1.1	Roof area from 2-10 building	10"	6.97	No
H	0.3	Roof area from 2-10 building and minor pavement area	6"	NA	No
I	15.1	Vehicle maintenance area and fueling island and parking lot of former BOC gases property	24"	2.98	Yes
J	4.9	16th Avenue South (public) and pavement around 2-22 and 2-25 buildings	12"	NA	No
K	0.4	Small paved area under bridge	4"	NA	No
L	5.8	Roof and small parking area from 2-40's complex	12"	1.59	No
M	1.1	Roof area from 2-40's complex	6"	4.91	No
N	3.1	Roof area from 2-40's complex	10"	4.91	No
O	2.6	Roof area from 2-40's complex	10"	5.6	No
P	3.4	Roof area from 2-40's complex	6"	3.48	No
Q	3.5	Roof area from 2-40's complex	10"	5.55	Yes
R	0.2	Roof area from 2-40's complex	8"	3.03	No
S	0.2	Roof area from 2-40's complex	6"	4.73	No
T	0.2	Roof area from 2-40's complex	6"	NA	No
U	0.2	Roof area from 2-40's complex	6"	?	No
V	6.3	Roof area from 2-40's complex and limited pavement from transportation corridor	10"	5.58	Yes
W	0.6	Roof area from 2-49 building	8"	5.22	No
~~**X**~~	~~NA~~	~~Rerouted to line Z~~	~~15"~~	~~NA~~	~~No~~
~~**Y**~~	~~NA~~	~~Rerouted to line Z~~	~~18"~~	~~1.5~~	~~No~~
Z	37.9	Pavement and roof areas in South Yard, section of E. Marginal Way S., parking areas along E. Marginal Way plus drainage from 2-60s roadways, and rerouted X and Y basin stormwater.	38"	1.43	Yes

Notes:
ISWGP = Industrial Stormwater General Permit
Stormwater lines X and Y were decommissioned in spring of 2006.

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Table 3: Scenario 1 – Outfall Consolidation BMP Description

Basin	BMP Description	Final Discharge Point
A-1	Vegetated swale enlargement/ enhancement; maintain existing drainage to outfall	Outfall A
A-2	Drain to primary treatment system located in A-6 at 2-374	Outfall A
A-3	Drain to underground media filter at 2-453	Outfall A
A-4	Vegetated swale to remain as-is; drain to media filter located at	Outfall A
A-5	Roof drainage to remain as-is; drain to media filter located at 2-453.	Outfall A
A-6 Primary Treatment System	Settling basin (with concrete bottom for maintenance), to vegetated media filtration w/underdrain; drain to Outfall A (optional tie in to underground media filter at 2-453 if effluent does not meet EPA	Outfall A
B	Tie in to proposed I-line (strapped under building catwalk); drain to primary treatment area in A-5. Pump station will be required due to elevation.	Outfall A, overflow to Outfall B
I	Pump station at Outfall I; pumped under building catwalk to primary treatment system in A-6.	Outfall A, overflow to Outfall I

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Table 4: Scenario 2 – Multiple Outfalls/Minimize Pumping

Basin	BMP Description	Final Discharge Point
A-1	Vegetated swale converted to vegetated media filtration with underdrain	Outfall A
A-2	Drain to primary treatment system located in A-6 at 2-374	Outfall A
A-3	Drain to pump station upstream of 2-371; pumped to A-4 swale drainage	Outfall A
A-4	Vegetated swale to remain as designed; flow direct to Outfall A as currently configured	Outfall A
A-5	Connect roof drains on northern side of building to A-1 swale drainage system; western roof drain treated individually prior to discharge to Outfall A	Outfall A
A-6 Primary Treatment System	Settling basin (with concrete bottom for maintenance), to vegetated swale conveyance; optional construction of underground media filter at 2-453 if effluent does not meet EPA limits	Outfall A
B	Drain to A-6 primary treatment system (connect 2-307 to 2- 391); localized treatment (swale) for small remaining area that drains to Outfall B.	Majority to Outfall A; Small area to Outfall B
I	Drain to underground media filter near Outfall I - discharge through Outfall I. (requires outfall control to prevent backflow into media filter - automated tide gates or bladder valves)	Outfall I

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Table 5: Recommended Design Scenario Summary

Basin	BMP Description	Final Discharge Point
A 1	Vegetated swale enhanced with amended soils, vegetation and underdrain system	Outfall A
A 2	Drain to primary treatment system located in A-6	Outfall A
- A 3	Distributed roof treatment system (downspout planter boxes, media filters, etc…); to be determined in final design. This avoids a costly and difficult to maintain deep media filter due to deep depth of collection system	Outfall A
A 4	Vegetated swale to be enhanced with addition of media, and installation of underdrains and outfall controls	Outfall A
- A 5	Distributed roof treatment system (downspout planter boxes, media filters, etc…); to be determined in final design. This avoids a costly and difficult to maintain deep media filter due to deep depth of collection system	Outfall A
A 6 Primary Treatment System	Settling basin (with concrete bottom for maintenance), discharge to vegetated media filtration with underdrains	Outfall A
B (both B-1 and B-2)	Recent improvements to be performed on the B-line drainage allow gravity drainage to primary treatment system in A-6	Outfall A; overflow to Outfall B (only rare large storm event occurrences anticipated)
C through H	No treatment anticipated	Existing Outfalls C - H
I	Pumped to treatment BMP (to be determined) located on Plant 2 - South	New Plant 2 - South Outfall; overflow to Outfall I (rare occurrences anticipated)

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Table 6: Round 5 (2010-2011) Source Control Sampling Matrix

Stormwater Line	Sampling Location	Suspended Solids Analyses	Suspended Solids COCs[1]	Water Analyses	Water COCs[1]
A	2-371	SMS metals [2]	Cd, Zn	SMS metals (dissolved) [3] PCBs (whole water)	Zn
B	3-307	PCBs SMS metals [2]	Cd, Cr, Pb, Hg, Zn PCBs	SMS metals (dissolved) PCBs (whole water)	Cu, Zn
G	discharge	NS	NS	SVOCs	bis(2-ethylhexyl)phthalate
I	4-283	PCBs SMS metals [2]	Cd, Cr, Cu, Pb, Zn PCBs	PCBs (whole water)	none
J	18-249	PCBs SMS metals [2]	Cd, Cu, Hg, Ag, Zn PCBs	SMS metals (dissolved) PCBs (whole water)	Cu, Zn
	18-505A	PCBs SMS metals [2]	Cu, Zn PCBs	SMS metals (dissolved) PCBs (whole water)	Cu, Zn
V	2-44 gate valve	NS	NS	SMS metals (dissolved)	Cu, Zn
Z	36-131	PCBs SMS metals [2]	Cr, Zn PCBs	PCBs (whole water)	none

Notes:

1. COCs - source control analytes that have been detected above action levels at least one time over the past three years of monitoring
2. Metals analysis for suspended solids samples is contingent upon adequate solids mass recovery.
3. Water samples for metals analysis are field-filtered using a 0.45 micron filter.
4. SMS -State of Washington Sediment Management Standards (Chapter 173-204 WAC)
5. NS -Not sampled

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FIGURES

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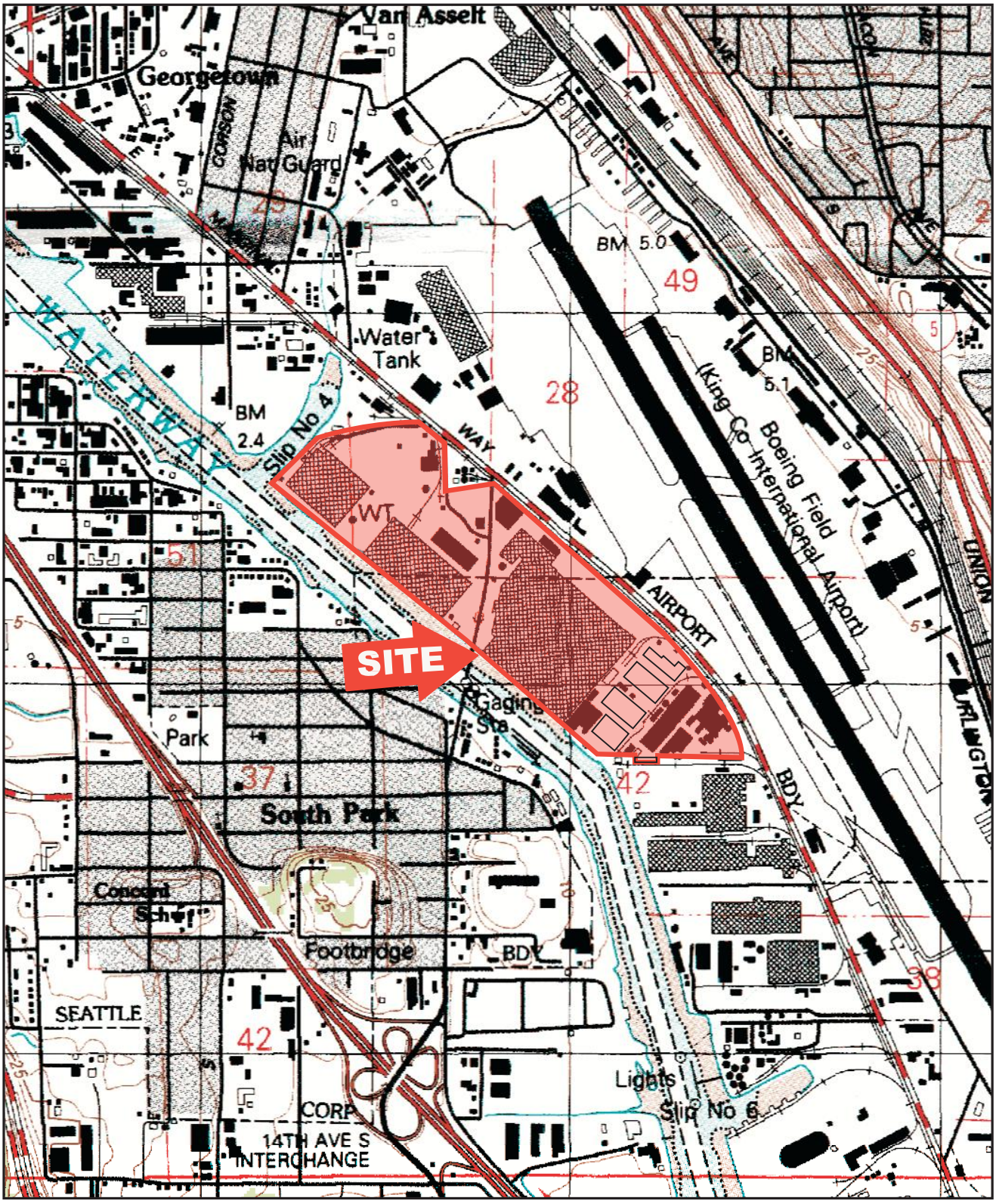


SHEET	DRAWN BY	REVIEWED BY	DATE
1 of 1	JDD	AMP	07/10/06

STORMWATER SYSTEM
WORK PLAN
Boeing Plant 2
Seattle/Tukwila, Washington

Figure 1
Vicinity Map

DRAWING NO. 013164600160Ofg09.fh11

This figure was originally produced in color. Reproduction in black and white may result in a loss of information.

0 350

Scale in Feet

Map Projection:
Washington State Plane North
NAD 1983, Feet

Source: Microsoft Virtual Earth (Imagery), Golder Associates Inc.

N

STORMWATER SYSTEM WORK PLAN
BOEING PLANT 2
SEATTLE/TUKWILA, WASHINGTON

FIGURE **2**

APPROXIMATE EXTENT OF DRAINAGE BASINS

BOEING/PLANT 2 CMS AND CONST SUPPORT/WA

0131646010600F03_StormwaterSystemWorkPlan.mxd | 6/29/2010 | THAMMOND

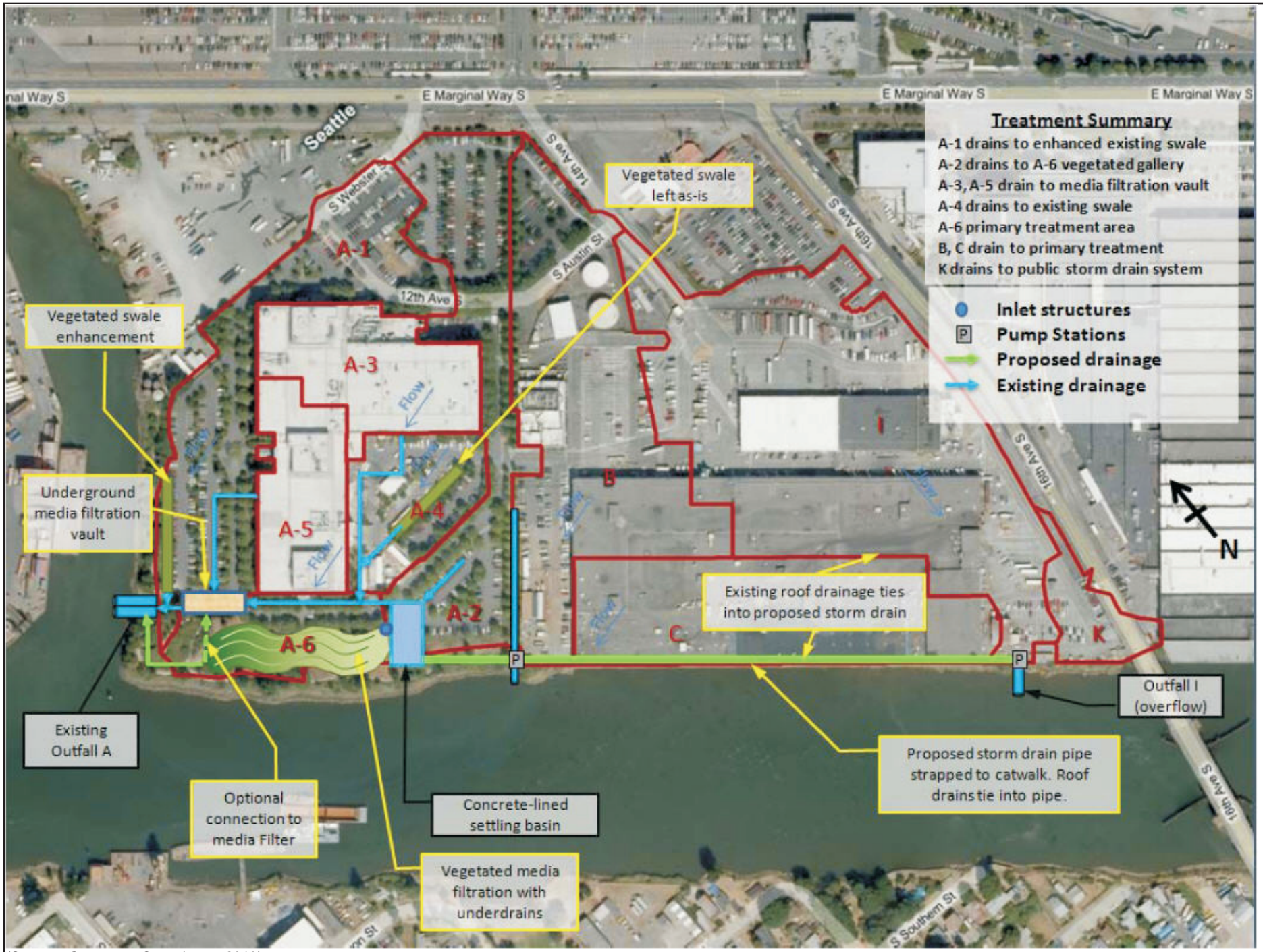
Golder Associates

(Source: Geosyntec Consultants, 2010)

FIGURE 3

NORTH STORMWATER SYSTEM, DRAINAGE BASINS

PLANT 2 STORMWATER SYSTEM WORK PLAN



(Source: Geosyntec Consultants, 2010)

FIGURE 4

NORTH STORMWATER SYSTEM, SCENARIO 1

PLANT 2 STORMWATER SYSTEM WORK PLAN

Drainage Area A-1

Drainage Area A-2

Drainage Area A-3

Drainage Area A-4

Drainage Area A-5

Drainage Area A-6

Drainage Area B

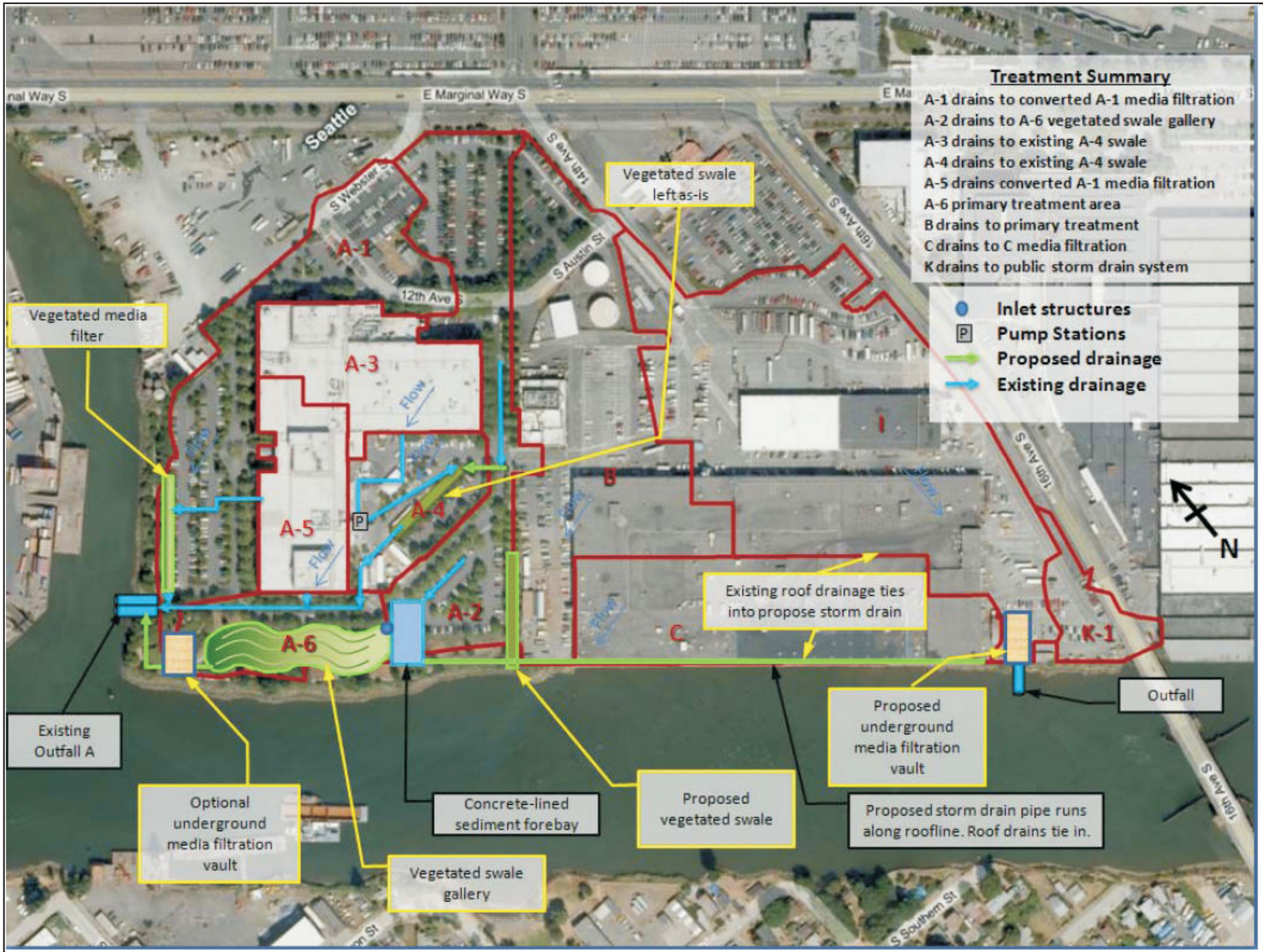
Drainage Area I

(Source: Geosyntec Consultants, 2010)

FIGURE 5
NORTH STORMWATER SYSTEM
SCENARIO #1 DRAINAGE AREA DETAIL
PLANT 2 STORMWATER SYSTEM WORK PLAN

0131646010.600.03 - Figure 5.cdr - 6/5/10

Golder Associates



(Source: Geosyntec Consultants, 2010)

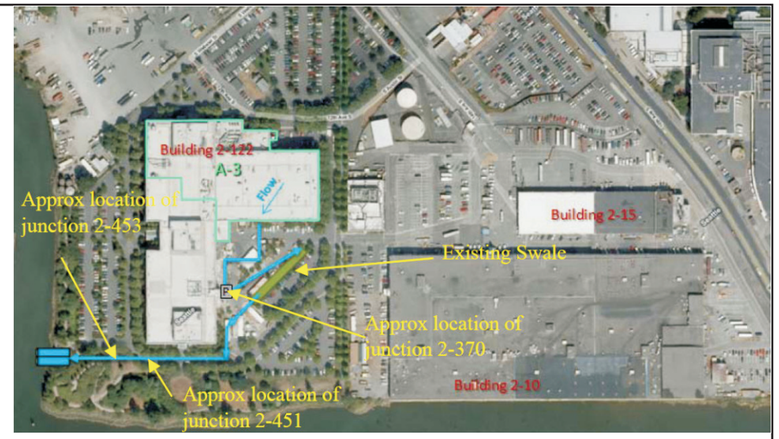
FIGURE 6

NORTH STORMWATER SYSTEM, SCENARIO 2

PLANT 2 STORMWATER SYSTEM WORK PLAN

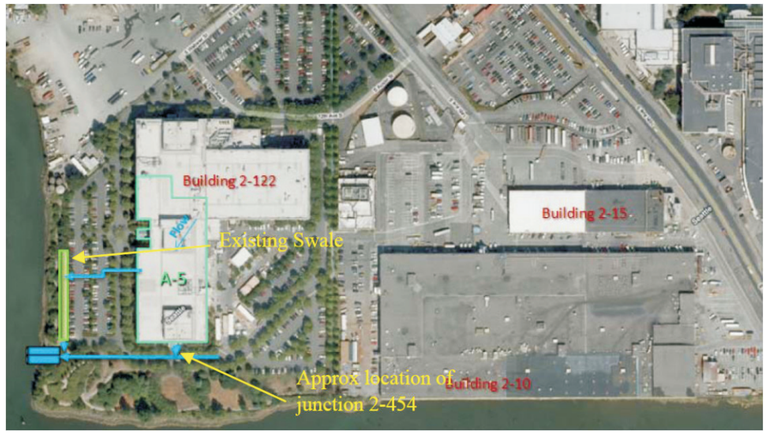
Drainage Area A-1

Drainage Area A-2 (see note)



Drainage Area A-3

Drainage Area A-4



Drainage Area A-5

Drainage Area A-6

Drainage Area B

Drainage Area I

(Source: Geosyntec Consultants, 2010)

Note: No change in from Scenario #1 in routing to the primary treatment system.

FIGURE 7

NORTH STORMWATER SYSTEM
SCENARIO #2 DRAINAGE AREA DETAIL

PLANT 2 STORMWATER SYSTEM WORK PLAN

0131646010.600.03 - Figure 7.cdr - 6/5/10

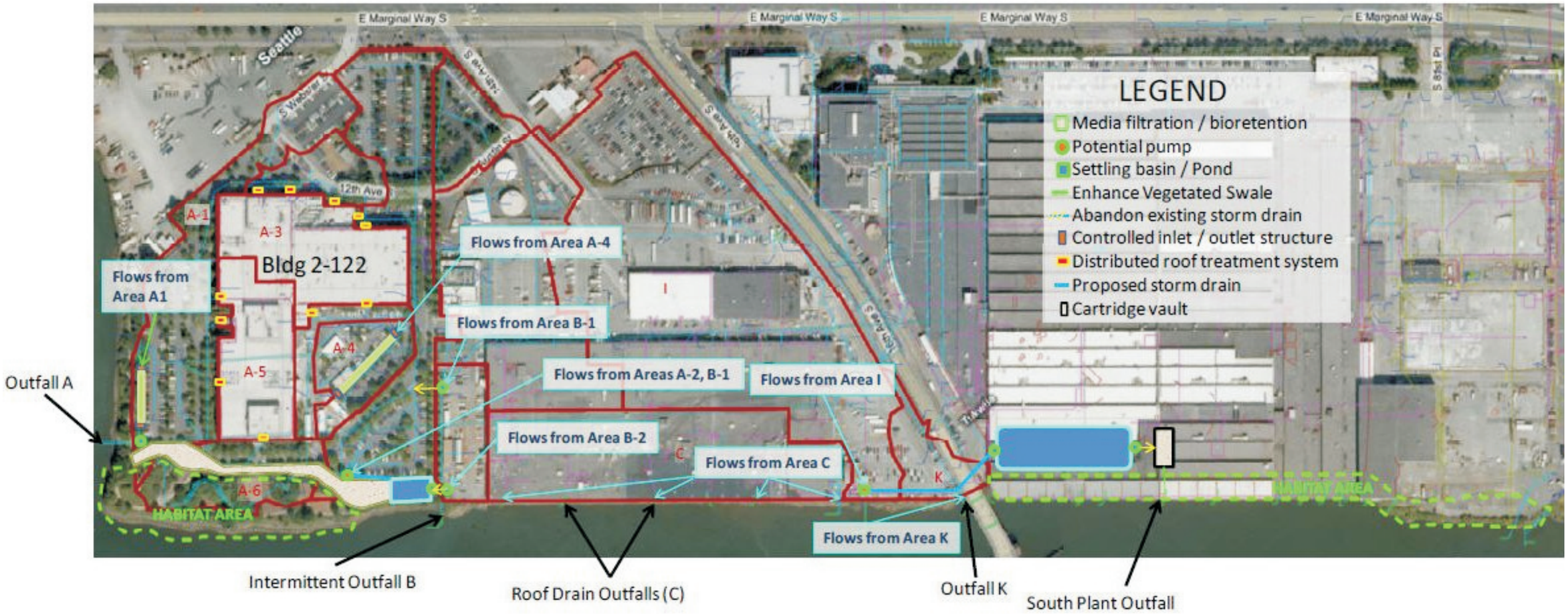
Golder Associates

(Source: Geosyntec Consultants, 2010)

FIGURE 8

NORTH STORMWATER SYSTEM, FINAL DRAINAGE BASINS

PLANT 2 STORMWATER SYSTEM WORK PLAN



(Source: Geosyntec Consultants, 2010)

FIGURE 9

NORTH STORMWATER SYSTEM
RECOMMENDED SCENARIO DETAIL

PLANT 2 STORMWATER SYSTEM WORK PLAN

Golder Associates

EAST MARGINAL WAY SOUTH

EAST MARGINAL WAY SOUTH

WEST TAX

16TH AVE. SOUTH

2-25

2-28

2-31

2-40

2-44

2-41

2-49

2-45

2-85

2-84

2-126

2-117

2-81

WIND TUNNEL

NEW STORMWATER SYSTEM

Includes consolidated
Line J drainage

Connections to existing South Yard
storm lines and catch basins

Lined bioswale

Optional treatment
and sampling vault

New Outfall S-1

New Outfall S-2

New Outfall S-3

0 200 400

SCALE IN FEET

PLANT NORTH

TRUE NORTH

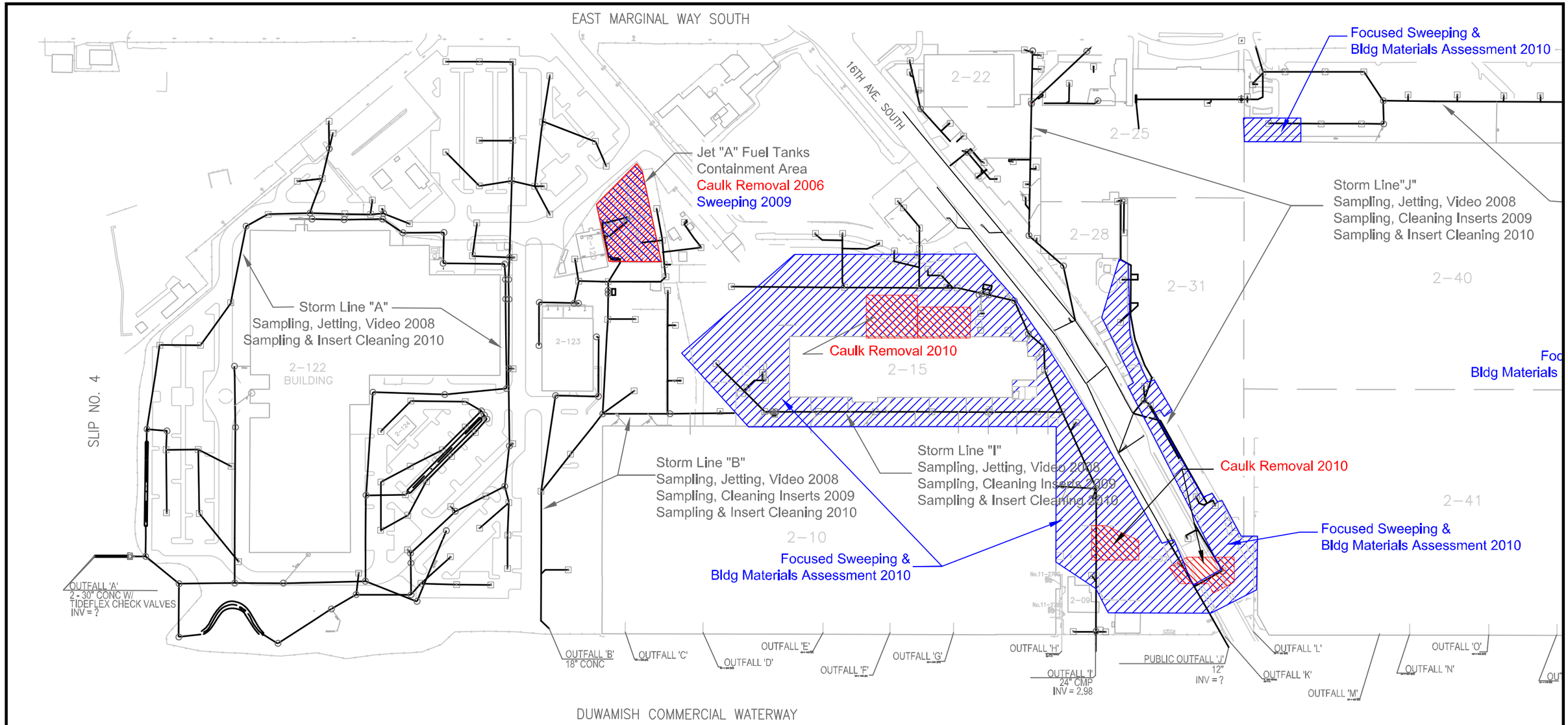
FIGURE 10

SOUTH STORMWATER SYSTEM PLANNED CHANGES

PLANT 2 STORMWATER SYSTEM WORK PLAN

0131646010.600.03 - Figure 8.cdr - 6/5/10

Golder Associates



LEGEND

CAULK REMOVAL
2006, 2009, 2010

FOCUSED SWEEPING & BUILDING
MATERIALS ASSESSMENT 2010

TRUE NORTH

PLANT NORTH

0 200 400

SCALE IN FEET

FIGURE **11**

SOURCE CONTROL ACTIONS
STORM LINES A, B, I, AND J
PLANT 2 STORMWATER SYSTEM
FALL 2009 SOURCE CONTROL ACTIONS

Golder Associates

Rtext (Rtext)

EAST MARGINAL WAY SOUTH

Focused Sweeping &
Bldg Materials Assessment 2010

Focused Sweeping &
Bldg Materials Assessment 2010

Storm Line"J"
Sampling, Jetting, Video 2008
Sampling, Cleaning Inserts 2009
Sampling & Insert Cleaning 2010

Storm Line "Z"
Sampling, Jetting, Video 2008,
Sampling, Cleaning Inserts 2009
Sampling & Insert Cleaning 2010

Caulk Removed 2009

Focused Sweeping &
Bldg Materials Assessment 2010

Storm Line "Z"

New Temporary
Stormwater System 2006

Caulk Removal 2010

16TH AVE. SOUTH

Focused Sweeping &
Bldg Materials Assessment 2010

Caulk Removed 2009

EAST MARGINAL WAY SOUTH

Focused Sweeping &
Bldg Materials Assessment 2010

WEST TAX

WIND TUNNEL

Storm Line "Z"
Sampling, Jetting, Video 2008
Sampling, Cleaning Inserts 2009
Sampling & Insert Cleaning 2010

JORGENSEN STEEL

2-25 2-28 2-31 2-40 2-41 2-44 2-45 2-49 2-80 2-81 2-85 2-88 2-09L

OUTFALL 'H'
OUTFALL 'I'
24" CMP
INV = 2.98
PUBLIC OUTFALL 'J'
12"
INV = ?
OUTFALL 'K'
OUTFALL 'L'
OUTFALL 'M'
OUTFALL 'N'
OUTFALL 'O'
OUTFALL 'P'
OUTFALL 'Q'
OUTFALL 'R'
OUTFALL 'S'
OUTFALL 'T'
OUTFALL 'U'
OUTFALL 'V'
INV = 5.58 (10")
OUTFALL 'W'
INV = 5.22 (8")
OUTFALL 'Z'
36" RCP
INV = 1.43

DUWAMISH COMMERCIAL WATERWAY

LEGEND

CAULK REMOVAL
2006, 2009, 2010

FOCUSED SWEEPING & BUILDING
MATERIALS ASSESSMENT 2010

0 200 400
SCALE IN FEET

PLANT NORTH

TRUE NORTH

FIGURE **12**

SOURCE CONTROL ACTIONS
STORM LINE Z
PLANT 2 STORMWATER SYSTEM
FALL 2009 SOURCE CONTROL ACTIONS

RText (RText)

Golder Associates

ATTACHMENT A

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Table A-1: Baseline SWMM Model Input Parameters

Parameter	Value	Units	Source/Rationale
Rainfall	SeaTac Gauge	in/hr	Representative of rainfall pattern at project location; long period of record (1948-2008); good resolution; minimal missing data
ET	0	in/mo	ET is ignored for the preliminary alternatives screening
Imperviousness	100% (except Area A6 = 45%)	%	Based on Plant 2 Site Plan and aerial photos
Slope	0.7	%	Site is mostly flat based on Plant 2 Site Plan. Generalized for preliminary alternatives screening
Impervious Roughness	0.01	-	Literature[1] (not sensitive to analysis)
Pervious Roughness	0.1	-	Literature[1] (not sensitive to analysis)
Impervious Depression Storage	0.02	inches	Literature[1] (not sensitive to analysis, selected conservatively)
Pervious Depression Storage	0.06	inches	Literature[1] (not sensitive to analysis, selected conservatively)
Ksat	0.05	in/hr	Literature[1] (representative of D soils, site is impervious, therefore not sensitive to analysis)
IMD	0.20	in/in	Literature[1] (representative of D soils, site is impervious, therefore not sensitive to analysis)
Suction Head	7	inches	Literature[1] (representative of D soils, not sensitive to analysis)
Path Length	500 ft	ft	Path length measured from site plan; however for preliminary screening of alternatives assumed to be 500ft for all catchments (moderately sensitive to analysis)
Routing	All areas routed to catchment outlet	-	Conservative representation; in reality some imperviousness will be routed over pervious area, resulting in diminished volumes for small storm events.
Dry Weather Flow (DWF)	0	cfs	DWF assumed to be minimal for Plant 2

[1] – Based on James and James, 2000.

Table A-2: Model Output Summary – Estimated Outfall A

Existing Flow Capacity of Outfall A				Estimated Flows from Entire North Site			
Diameter	**Slope**	**Manning's N**	**Flow Capacity**	**All Drainage Areas**	**SWMM***	**2-yr Rational Method**	**25-yr Rational Method**
(ft)	**(ft/ft)**	**(unit less)**	**(cfs)**	**(ac)**	**(cfs)**	**(cfs)**	**(cfs)**
2 x 30"	0.005	0.013	60	41.7	25	21	47

*Maximum hourly flow rate in 60 year model.

Table A-3: Model Output Summary – Peak Runoff Rates by Catchment

Catchment	Area (ac)	% Imperviousness	Peak Hourly Runoff Rate (cfs)
A1	5.2	100	3.302
A2	4.6	100	2.685
A3	2.7	100	1.715
A4	2.0	100	1.27
A5	2.1	100	1.334
A6	1.9	45	1.207
B1	7.1	100	4.509
C1	5.0	100	3.175
I1	11.1	100	7.05
Totals	**41.7**		**26.2**