Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix H
Lora Lake Parcel Remedial Action Mitigation Plan, Engineering Floodplain Analysis, and Miller Creek Bank Stability Analysis

:

LORA LAKE PARCEL REMEDIAL ACTION

Mitigation Plan

Prepared for

Port of Seattle

Date March 2016

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SUMMARY

Lora Lake covers approximately 3 acres within Miller Creek's floodplain at the north end of SeaTac International Airport (STIA). Lora Lake has experienced substantial changes over time, starting with its creation as a result of peat mining. Peat had formed and accumulated in this protected corner of the alluvial valley, supported by substantial groundwater discharge from surrounding glacial outwash deposits. Lora Lake was further changed with the development of houses around the northern and western shores. These houses and associated fill and bulkheads were removed in 2004 as part of the expansion of STIA and the area was included within the Port of Seattle's (Port) Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area.

Lora Lake also received contaminated runoff from the adjacent Lora Lake Apartments site, located west of Des Moines Memorial Drive SE, and is now a component of a Model Toxics Control Act (MTCA) remedial action. The primary contaminant of concern at Lora Lake Parcel is dioxins/furans. In January 2015, the Port finalized the *Lora Lake Apartments Site Remedial Investigation/ Feasibility Study* (RI/FS; Floyd|Snider 2015) for the Lora Lake Apartments Site that details the type and extents of contamination within the study area.

The preferred remedial action for Lora Lake requires that a wildlife barrier (geotextile material) and at least 18 inches of cap material (carbon amended sand) be placed throughout the lake. Impacts to jurisdictional waters of the U.S. including wetlands will occur as part of this work. As the RI/FS was being developed, the project team also noted the potential for longer term water quality impacts. Lora Lake is an existing source of high temperature water to Miller Creek so placing the cap without additional action would not have a large or beneficial effect on water temperatures or dissolved oxygen levels (Floyd|Snider 2015).

To mitigate impacts to jurisdictional waters resulting from implementation of the remediation action, the Port is proposing to return the lake to its historical state of a vegetated wetland and create a self-mitigating project that provides significant functional lift. The wetland rehabilitation will include filling the lake to near its historical land surface and establishing a shrub-dominated plant community. The wetland will be better connected to Miller Creek to improve floodplain functioning. The wetland rehabilitation was included as an Alternative (3) in the RI/FS as a measure to be protective of Miller Creek and associated wetlands.

A functional analysis of the wetland rehabilitation detailed in this report indicates that the project will have a net benefit to the overall Miller Creek system. The rehabilitated wetland will be integrated into the Port's successful Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area, and will be monitored to ensure its success.

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CONTENTS

SUMMARY ..... **i**

1.0 INTRODUCTION **1**

1.1 Site History 2
1.2 Regulatory Context 3
1.2.1 NRMP Requirements *4*
1.2.2 Cleanup Action Plan *4*
1.2.3 State and Local Regulations *5*
1.3 Data Sources 5
1.3.1 Vertical Datum *6*

2.0 EXISTING CONDITIONS **7**

2.1 Vegetation 7
2.2 Hydrology 7
2.2.1 Hydroperiod Components *9*
2.2.2 Hydrologic Summary *14*

3.0 Mitigation Approach **15**

3.1 Avoidance and Minimization 15
3.2 Rectifying the Impact 16
3.3 Mitigation Design 16
3.4 No-Rise Floodplain 18
3.5 Qualitative Functional Assessment 20
3.6 Function Credits and Debits 26
3.6.1 Key Rating Score Assumptions *27*
3.6.2 Key Credit/Debit Assumptions *28*
3.7 Summary of Functional Benefits 29

4.0 PERFORMANCE STANDARDS AND MONITORING **30**

4.1 Goals and Objectives 30

5.0 LIMITATIONS **32**

6.0 REFERENCES **33**

APPENDIX A: Credit-Debit form **A-1**

APPENDIX B: Credit-Debit Figures **B-1**

APPENDIX C: Credit-Debit Excel Calculator **C-1**

APPENDIX D: 60% Design Sheets **D-1**

APPENDICES

APPENDIX A: Credit-Debit Form
APPENDIX B: Credit-Debit Figures
APPENDIX C: Credit-Debit Excel Calculator
APPENDIX D: 60% Design Sheets

LIST OF TABLES

Table 1. Qualitative Function Assessment for Lora Lake remedial action 21

Table 2. Function Scores for Existing and Future Conditions using Ecology Credit/Debit System 28

Table 3. Credit-Debit Summary for the proposed Lora Lake Wetland Rehabilitation 29

Table 4. Proposed Monitoring Criteria and standards 30

LIST OF FIGURES

Figure 1. Site overview with key site features 1

Figure 2. Mitigation Areas and Restrictive Covenant Boundary 3

Figure 3. Lora Lake Site Features 7

Figure 4. Groundwater stage adjacent to lake (Aspect data) 10

Figure 5. Lora Lake and Miller Creek stage with elevations of key features (Aspect Consulting) 12

Figure 6. Clip from revised 2007 FEMA flood profile for Miller Creek (FEMA 2007). 13

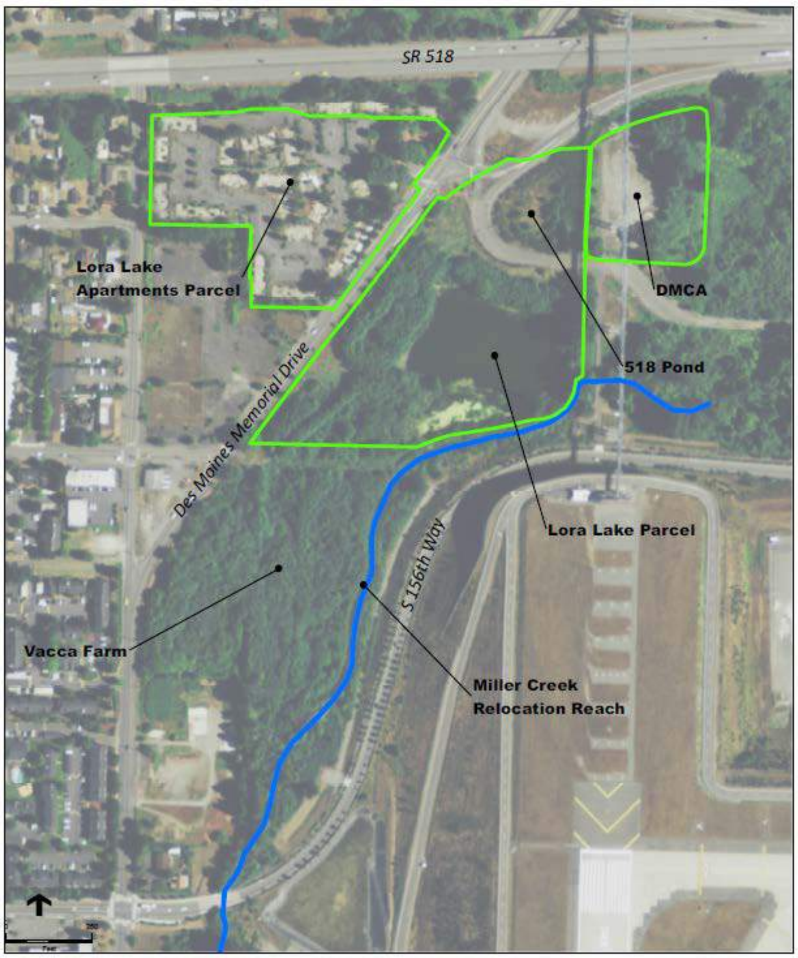
Figure 7. Pre- and Post-Project Flood Flow Profiles along Miller Creek adjacent to the proposed berm lowering. 20

Figure 8. Wetland Rating Unit Overview 27

1.0 INTRODUCTION

The Port of Seattle (Port) is planning to remove and contain contaminated soil and sediment on its property at the former Lora Lake Apartments near SeaTac International Airport (STIA). The cleanup is occurring in accordance with the Model Toxics Control Act (MTCA) under the direction of the Department of Ecology (Ecology). The cleanup action encompasses three parcels: the Lora Lake Apartments Parcel, the Lora Lake Parcel, and the 1982 Dredged Material Containment Area (DMCA). The Lora Lake Parcel lies on the east side of Des Moines Memorial Highway just upstream of the Miller Creek Relocation Reach and the Vacca Farm Mitigation Site (Figure 1). This report addresses the remedial actions and associated wetland rehabilitation proposed within the Lora Lake Parcel.

Figure 1. Site overview with key site features



In January 2015, the Port finalized the Lora Lake Apartments Site Remedial Investigation/Feasibility Study (RI/FS; Floyd|Snider 2015), which describes the type and extents of contamination present across three parcels. As part of the RI/FS process, and as described in the Cleanup Action Plan (CAP) (Ecology 2015a) and the Consent Decree (Ecology 2015b), remedial actions were selected by Ecology to address contamination in soil, groundwater, and sediments. The primary contaminant of concern at Lora Lake Parcel is dioxins/furans.

The preferred alternative selected by Ecology for cleanup of the Lora Lake Parcel includes the following:

- Upland Soil Excavation – Shallow excavation of contaminated soils in upland areas between the Lora Lake and Des Moines Memorial Drive.
- Lake Sediment Capping – Placement of a permeable geotextile liner and an 18-inch thick carbon-amended sand cap to isolate contaminated lake sediments.
- Wetland Rehabilitation – Filling the lake and establishing a scrub-shrub plant community on the fill surface.

Work within the Lora Lake Parcel will occur within jurisdictional waters of the United States including wetlands (waters/wetlands) and within the Port's existing aquatic resource mitigation areas. The rehabilitation of a wetland within the Lora Lake footprint was identified during the development of the CAP process as having the potential to substantially improve ecological functions and create a net benefit for the Miller Creek/Vacca Farm/Lora Lake wetland system.

Filling the lake and establishing a scrub-shrub plant community on the fill surface rehabilitates the system and re-establishes the conditions that existed before the lake was mined for peat. In its current state as a shallow body of open water, Lora Lake is a significant source of high temperature water to Miller Creek. The wetland rehabilitation plan was presented to federal and state agencies as the cleanup plan was being developed and received initial support. Resource agencies, including the Corps of Engineers and Ecology, indicated that they prefer the rehabilitation be included as part of the cleanup to address a broad set of ecological (non-MTCA) objectives beyond just the contaminant remediation.

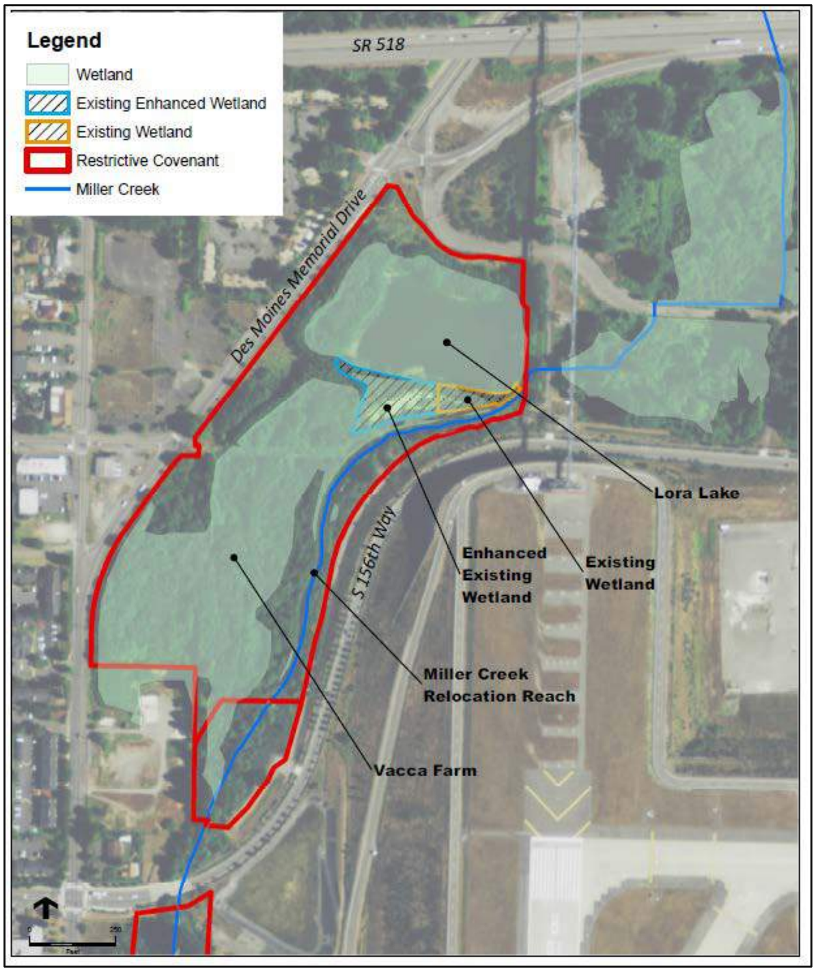
1.1 Site History

The Vacca Farm/Lora Lake wetland complex is a single large unit within Miller Creek's floodplain, spanning 2,000 feet of stream and covering over twenty acres. By the 1930s, the floodplain was cleared and the wetlands drained to facilitate farming. A portion of the wetland was mined for peat in the 1950s and 1960s, creating Lora Lake (Rigg 1958, NRMP 2004, Floyd Snider 2015). The lake shoreline was later converted to residential development.

The Port purchased the entire site and removed the homes around the lake in the early 2000s as part of mitigation for the 1997 Master Plan Update (MPU) project. Substantial mitigation efforts occurred throughout the valley including, realigning Miller Creek, removing fill around Lora Lake, and removing fill and re-grading the Vacca Farm wetlands. Native vegetation communities were installed and maintained throughout the area. The entire wetland complex is now protected though a Restrictive Covenant (Figure 2). The Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area is discussed in the Port's Natural Resources Mitigation Plan (NRMP; Parametrix 2004).

Prior to the Port's mitigation activities, a wetland occurred directly south of Lora Lake. The western two-thirds of this wetland were enhanced and the eastern portion was unmodified. The enhanced portion is known as the Enhanced Existing Wetland, and was part of the Port's overall mitigation area (Figure 2). The untreated portion of the existing wetland was not included in the mitigation calculations. Both are within the Restrictive Covenant.

Figure 2. Mitigation Areas and Restrictive Covenant Boundary



1.2 Regulatory Context

The Port is seeking a Nationwide Permit 38 under the Clean Water Act (CWA) for the Lora Lake Remedial Action and Wetland Rehabilitation Project. The project lies within the Port's Restrictive Covenant; work within the Restrictive Covenant, unless specifically allowed by the covenant, requires Corps and Ecology approval. As such, the wetland rehabilitation needs to be integrated into the surrounding mitigation projects implemented as part of CWA Permit 1996-4-02325 and outlined in the NRMP.

The Port’s mitigation sites are subject to the monitoring requirements and performance standards of the Port’s existing permits and regulatory agencies will require the Port to show that the remedial action will not adversely impact the existing systems. The Port is currently monitoring these mitigation areas as part of a 15-year monitoring effort. The monitoring allows the Port to track impacts to the existing systems, and develop adaptive management measures if necessary. The proposed rehabilitation of Lora Lake will have its own 10-year monitoring period.

1.2.1 NRMP Requirements

The NRMP includes a number of specific requirements for the Lora Lake/ Vacca Farm wetland complex. The proposed work within the Lora Lake Parcel, including the wetland rehabilitation has been designed to be consistent with these requirements.

1.2.2 Cleanup Action Plan

The mitigation must comply with requirements of the MTCA CAP, which stipulates the following:

1. The rehabilitated wetland shall be a palustrine scrub-shrub wetland system.
2. The rehabilitated wetland will be capable of supporting emergent and woody vegetation and will create habitat that is consistent with the goals of the NRMP.
3. The design will maintain the Miller Creek channel stability and will minimize erosion potential.
4. The design will maintain the current upward groundwater flow path beneath Lora Lake by requiring placement of high conductivity fill material (relative to the adjacent wetland soils).
5. The wetland will be designed so that it does not adversely impact the function of the Port’s mitigation areas covered by the NRMP. Specifically, this includes:
    a. Increase vegetated wetland habitat, plant species diversity, and microtopographic variations, which could encourage and support a more diverse assemblage of terrestrial species;
    b. Allow for persistent vegetation growth, which improves primary productivity functions, shading, and sediment trapping functions;
    c. Remove habitat for non-native fish species including pumpkinseed, sunfish and largemouth bass, which compete with native salmonid species in the Miller Creek system and which prey on juvenile salmonids;
    d. Eliminate warm water/low dissolved oxygen inputs to Miller Creek by replacing the lake with a more complex vegetated wetland system;
    e. Decrease the avian habitat functions in the current open water wetland that pose aircraft safety concerns; and
    f. Preserve the flow-through characteristics of the site and retain flood attenuation benefits of Lora Lake to the Miller Creek system as much as feasible.

6. The project will not adversely impact flood frequencies in Miller Creek.

1.2.3 State and Local Regulations

As a MTCA action, the project will not need to obtain permits from the State of Washington or the City of SeaTac, but will need to meet the substantive requirements of applicable state and local laws. The project team has met with representatives from Ecology, WDFW, and SeaTac during the design process to present results and address comments.

1.3 Data Sources

The Port and its contractors have collected considerable data, which has informed the mitigation design process. Data includes:

1. 2015 survey (combined topography and bathymetry) of Lora Lake and the immediate surroundings collected by David Evans and Associates (DEA).
2. 2004-era design and as-built drawings of the Miller Creek relocation and floodplain restoration projects.
3. 2001-era LiDAR data obtained from King County.
4. Hydrology data collected for performance monitoring of nearby wetlands within the Port's Natural Resources Mitigation Plan (NRMP) mitigation areas from 2004 to the present.
5. Borings and soil samples collected as part of the Remedial Investigation/Feasibility Study (RI/FS) process.
6. Miller Creek stage, flow, and temperature at a number of locations, collected by Aspect Consulting (2013 – 2014 baseline monitoring).
7. Miller Creek stage and flow collected by King County at their control structure in Miller Creek (Lake Reba Outlet; Monitoring Location 42B) at the access road just upstream of the project site.
8. Lora Lake water surface elevation and temperature, collected by Aspect Consulting (2013 – 2014 baseline monitoring).
9. Groundwater elevations and temperature, collected by Aspect Consulting (2013 – 2014 baseline monitoring).
10. Stormwater inflow rates into Lora Lake collected by Cardno TEC (2013 – 2014 baseline monitoring).
11. 1995 (adopted) and 2007 (draft) FEMA floodplain maps and studies, which include base flood elevations and profiles for Miller Creek.
12. *Miller and Walker Creeks Basin Plan,* King County, 2006.
13. Groundwater Modeling Memo, Aspect Consulting,Draft 2015

1.3.1 Vertical Datum

All elevations in this report are referenced to NAVD 88, in units of feet. If necessary, elevations were converted from the NGVD 29 vertical datum using a conversion of NGVD 29 + 3.547 = NAVD 88, obtained from the NOAA VERTCON program for a horizontal location in the middle of Lora Lake. Elevations found in earlier documents, such as the NRMP, must be translated to the NAVD 88.

2.0 E□ISTING CONDITIONS

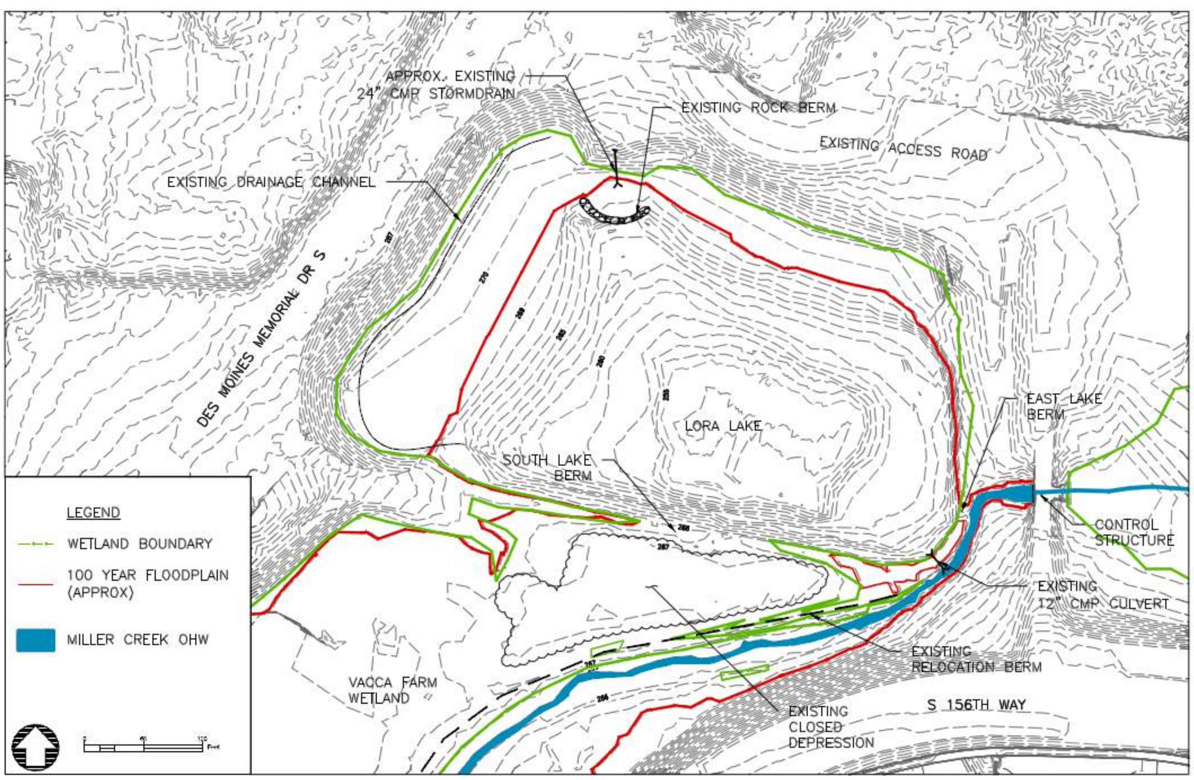
2.1 Vegetation

Vegetation communities throughout the Lora Lake Parcel have been developing since the area was planted in 2006 as part of the Port's mitigation efforts. Surrounding the western and northern shores of Lora Lake is an early successional wetland forest. The slopes and terraces above the lake are dominated by 10-year old alders with closed canopy. There is a stand of older hardwood forest on the eastern shore of the lake, outside the current project boundary. Willows and cottonwood dominate on portions of the berm along the southern portion of Lora Lake. The understory includes reed canarygrass and blackberry species in places. A narrow emergent community occurs around the lakeshore has developed in the depression south of Lora Lake.

2.2 Hydrology

ESA used monitoring data from 2013-2014 collected by Aspect Consulting to develop a conceptual understanding of the hydrology of Lora Lake. A key finding is that water levels within Lora Lake are a result of the interaction of groundwater discharge to the lake, Miller Creek stage variations, and the configuration of the existing lake outlet culvert. Figure 3 shows key hydrologic characteristics around Lora Lake.

Figure 3. Lora Lake Site Features



Lora Lake's primary hydrologic inflows include:

1. Direct precipitation.
2. Stormwater discharge from an approximately 80-acre subbasin in the City of Burien, which enters the lake via a 24-inch HDPE pipe. The City of Burien is planning stormwater retrofits that will provide water quality treatment and flow control for this basin, and will relocate the primary discharge downstream of the lake to Vacca Farm.
3. Groundwater discharge, including direct seepage into the lake and flows from an interceptor ditch on the west terrace of the lake. This ditch was installed to lower groundwater levels on the terrace sufficiently for growth of mitigation planting.
4. Surface flows from Miller Creek can flow into Lora Lake when the creek is high. Miller Creek can flow into the lake via a low spot in the eastern perimeter berm (with a 'weir' elevation at 267.8 feet), which occurs frequently during the wet season. Miller Creek can also backwater the outlet culvert (flat-sloped 12-inch diameter HDPE) with invert elevation at 266.8 feet. The direction of flow through the culvert a is dependent on the relative elevations of the creek and the lake, but is predominantly from the lake to the creek except during the rising limb of storm events.

Water leaves Lora Lake via:

1. Evapotranspiration.
2. Subsurface seepage down the Miller Creek valley.
3. Surface discharge to Miller Creek through a 12-inchdiameter culvert with invert elevation at 266.8 feet.
4. Overtopping of the southern perimeter berm, minimum elevation 267.4 feet, and flowing into the closed wetland depression (which includes the Enhanced Existing Wetland and the un-enhanced wetland).
5. Overtopping the eastern perimeter berm, minimum elevation 267.8 feet, at high lake levels, and flowing into Miller Creek.

These flow paths vary widely in their overall influence on the water level within the lake. The major influences are described and summarized below.

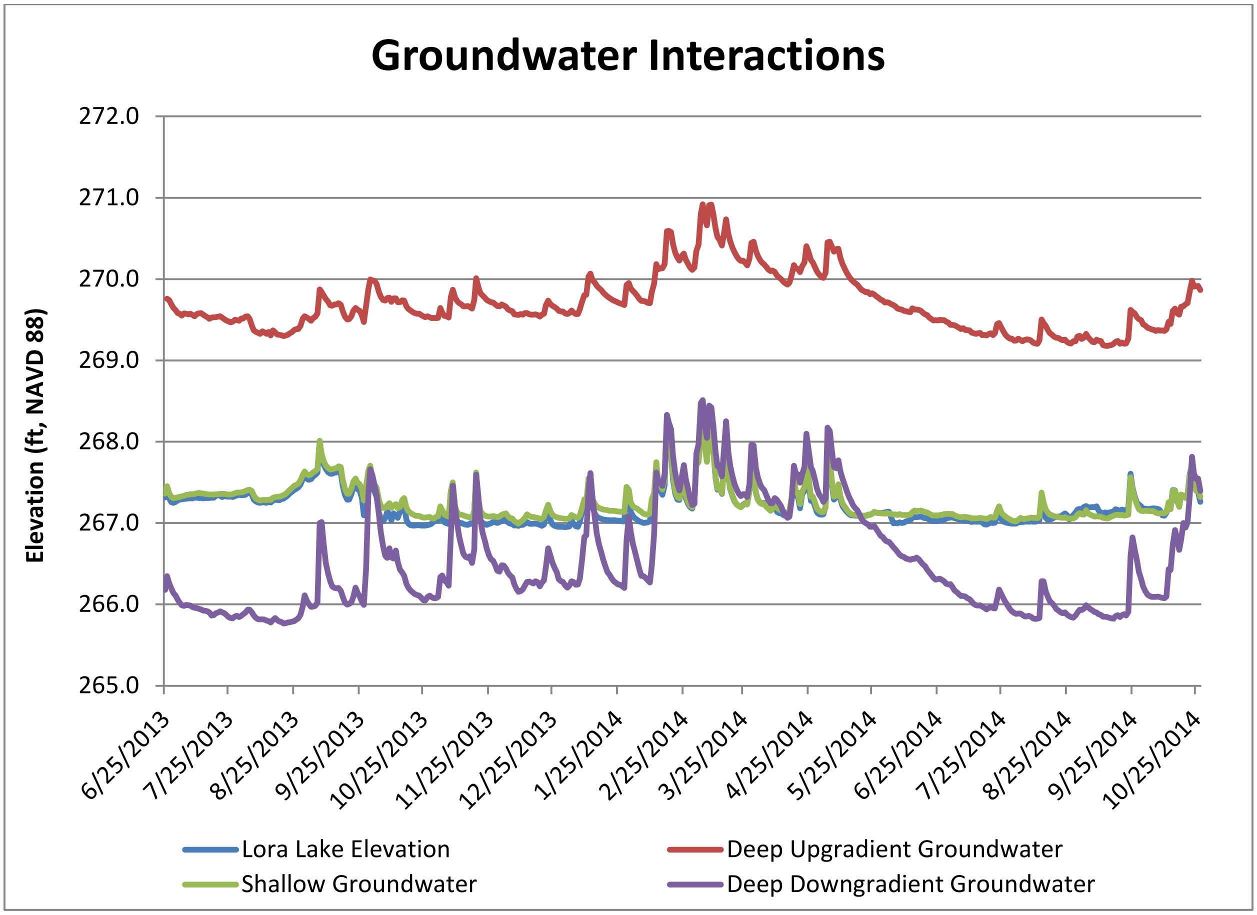
2.2.1 Hydroperiod Components

There are three primary aspects of the Lora Lake hydrologic system that were key drivers in the analysis and design of the new wetland system: (1) interactions with groundwater, (2) stormwater input, and (3) interactions with Miller Creek. These factors define the hydroperiod of the lake and influence the following design elements: the surface elevation of the wetland, the topography of the wetland, and the plant pallet that can be established within the rehabilitated wetland system.

Groundwater Interactions

The hydroperiod of the rehabilitated wetland will be controlled primarily by groundwater levels. Aspect Consulting's groundwater monitoring data indicates that Lora Lake's water elevation is strongly tied to the regional groundwater profile, which exhibits a north-south groundwater gradient (on the order of 0.7 percent), and rises and falls in sync with the groundwater table (Figure 4). Shallow groundwater levels follow lake surface elevations, suggesting a high degree of connection between Lora Lake and surface water downslope in the closed depression (Enhanced Existing Wetland and un-enhanced wetland).

Figure 4. Groundwater stage adjacent to lake (Aspect data)



Note: upgradient and downgradient refer to position relative to Lora Lake

Groundwater sustains the base water level within Lora Lake. When not responding to storm events, the lake flows continuously into Miller Creek, supported by regional groundwater discharge and moderated by the outlet culvert elevation. Modeling by Aspect (2015b) indicates that groundwater flow through the lake is on the order of 0.1 to 0.5 cfs. This finding is consistent with field observations that show the existing channel draining the lake's west shoreline intercepts groundwater and conveys it to the lake.

The recent (2015) drawdown test indicated the influence of the regional groundwater aquifer on the lake is damped by low transmissivity from the aquifer to the lake. The drawdown test demonstrated that flow from the surrounding aquifer into the lake is relatively slow even under current conditions and that the regional aquifer can sustain a steep groundwater gradient despite the proximity of topographic lows at Miller Creek. The details discussed more fully in Aspect Consulting's Pump Down/Pump-Back Test Memo (2015a).

Stormwater

Lora Lake currently receives stormwater discharge from an 80-acre basin in located in the City of Burien. Stormwater is discharged to the lake via a 24-inch-diameter culvert at the northwest corner of the lake.

The City of Burien is currently pursuing a stormwater retrofit project that will reroute majority of this flow to a different location, likely within Vacca Farm. It is anticipated that this retrofit will be completed before the wetland rehabilitation project. The existing culvert will continue to discharge local drainage from Des Moines Memorial Drive.

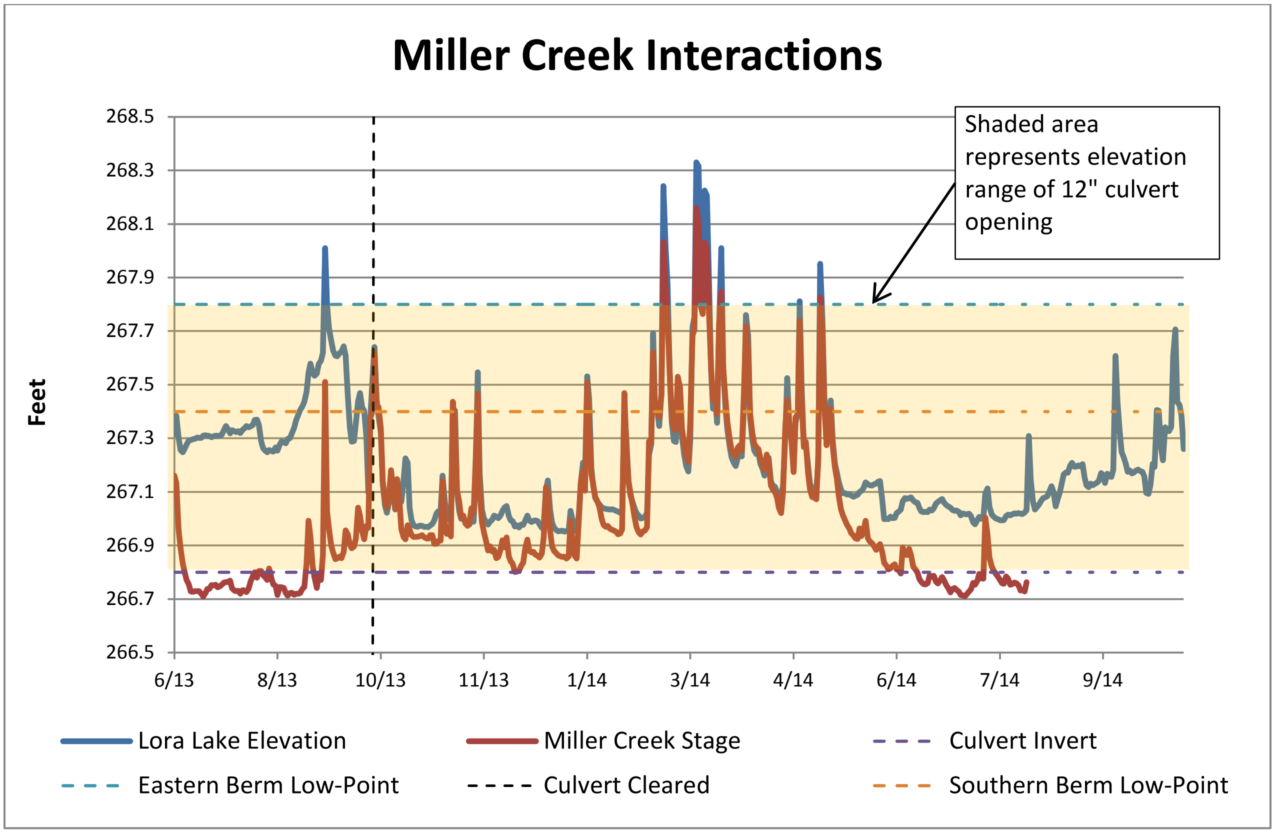
Flow from the stormwater culvert was measured by Cardno TEC during the same monitoring period as our other time series data (2013-2014). Base flows were reported at 0.004 cfs with short duration peak storm flows between 3 and 9 cfs. The stormwater input volume was small enough compared to the lake volume that it had a limited influence on lake level. Storm flows were detained within the lake, with residence times related to the degree of backwater control on the culvert from Miller Creek.

Given that stormwater plays only a minor role in the hydroperiod of the existing lake and the retrofit project will remove the majority what currently discharges to the Lora Lake system, stormwater is not expected to have a significant influence on the hydroperiod of the proposed rehabilitated wetland. The reroute of stormwater from the upland subbasin to Vacca Farm was considered during the design of this habilitation project but will be assessed separately. This separate analysis will address the ability of the Vacca Farm drainage channels to adequately convey additional stormwater to Miller Creek and compatibility with the established plant communities.

Miller Creek Flow Interactions

Miller Creek appears to be a dominant factor in raising lake elevation above base groundwater levels under existing conditions. During the 2013 to 2014 monitoring period, water levels within Lora Lake fluctuated from 267.0 to 268.3 feet (Figure 5). Elevated water levels were typically short lived. Levels rose quickly during storm events due to stormwater inputs and backwater from Miller Creek and drained nearly as quickly once the storm had passed.

Figure 5. Lora Lake and Miller Creek stage with elevations of key features (Aspect Consulting)



During the monitoring period, there was a continuous surface connection between Lora Lake and Miller Creek through the 12-inch diameter lake culvert. Using the monitoring data, we identified the following ways that surface water in Lora Lake and Miller Creek interact:

1. Stage in Miller Creek is lower than Lora Lake. This is the most frequent condition, occurring on 83% of days during the monitoring period indicating predominant drainage from the lake to the creek. This stage includes times when Miller Creek is backwatering the outlet culvert and when the lake connection is free-flowing:
    a. The lake outlet is free-flowing. This occurs 26 percent of the time over the monitoring period.
    b. Stage in Miller Creek backwaters the lake culvert outlet, but remains lower than the lake stage. This causes lake levels to rise even though there is still net flow from the lake to the creek. This condition occurs 56 percent of the monitoring period.

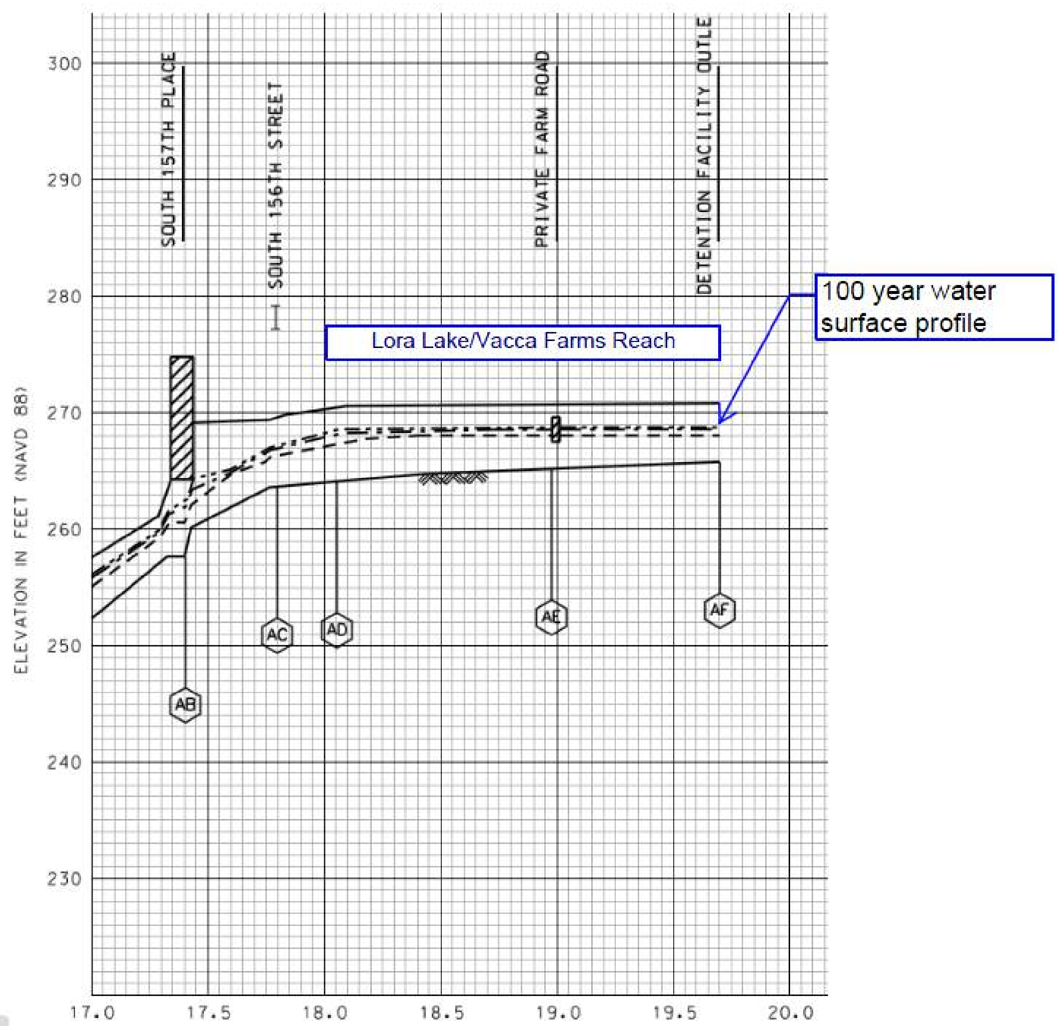
2. Stage in Miller Creek exceeds the stage in Lora Lake, resulting in creek flow through the culvert into the lake. This occurs in 17 percent of days during the monitoring period.

Miller Creek can also spill into Lora Lake through the notch in the eastern berm (approximately 267.8 feet), and the creek flows directly into Lora Lake upstream of the outlet culvert. This state occurs frequently during the wet season, based on field observations.

Floodplain Interactions

The majority of the Lora Lake project area lies within the regulatory floodplain of Miller Creek (Sheet 2, attached). The current adopted FEMA map dates from 1995 and shows a base flood elevation of 269.6 feet at the Control Structure (shown in Figure 3), dropping to 268.6 feet by the south side of Lora Lake. The revised, but unofficial, map developed in 2007 shows a base flood elevation of 268.8 at the Control Structure that remains nearly constant for the next 1,000 feet down valley past Lora Lake, until the stream drops through a higher slope reach near South 157th Way (Figure 6). The 2007 mapping is used herein as the best available data.

Figure 6. Clip from revised 2007 FEMA flood profile for Miller Creek (FEMA 2007).



Note: X-axis represents thousands of feet in the FEMA model. The noted detention facility is the upstream end of this project reach, and south 156th Street is the downstream end of the Vacca Farm mitigation area. The private farm road no longer exists.

To better understand high flow dynamics, ESA developed a 1D steady HEC-RAS hydraulic model of the project reach. Miller Creek's connectivity to its floodplain was altered as part of the Vacca Farm mitigation project. Portions of the Miller Creek floodplain were filled, other portions were excavated, and the channel was re-aligned. These changes were not captured in the draft 2007 FEMA map for this reach.

High flow dynamics were considered during the Port's Miller Creek Relocation project, which was implemented in by 2004. The relocated stream reach included a low flow channel and floodplain within an area delineated by a berm. As-built drawings indicate that the relocation reach berm crest was designed to be at a constant elevation of 268.6 feet, which is equal to the 1995 FEMA base flood elevation (100-year recurrence flood event). Therefore, in all but the largest events, flood waters would travel within the channel bounded by the berm, reach the constriction at the southern end of the valley where the floodplain narrows (roughly 1,600 feet downstream of Lora Lake), then backwater to engage floodplain storage within Vacca Farm. After the flood passed, the water would drain back out to Miller Creek via the ditch cut into the Vacca Farm wetlands to prevent long durations of standing water. At flows above the 100-year recurrence event, the system becomes fully connected: water over tops the relocation berm entering the backwater area from upstream and the Vacca Farm/Lora Lake section of the Miller Creek floodplain.

The relocation design was intended to maintain the overall floodplain dynamics by preserving channel capacity and overall floodplain volume.

2.2.2 Hydrologic Summary

High groundwater levels cause the lake surface to remain consistently higher than the lake outlet culvert invert elevation (266.8 feet). This dynamic has the following implications for the rehabilitated wetland in this location:

1. Lora Lake receives significant groundwater discharge, efficiently draining water eastward into Miller Creek and lowering local groundwater levels. There is net outflow from Lora Lake to Miller Creek resulting from groundwater discharge.
2. Post-remediation groundwater levels will be influenced by the type and depth of fill placed within the basin. Different scenarios were tested by Aspect Consulting to iterate to a surface elevation and typical water levels to achieve the ecological goal of a scrub-shrub dominated wetland.
3. Peak stormwater inflows to Lora Lake occur over short durations and represent a small proportion of the volumetric contribution to the lake. Burien's project to reroute this inflow will further reduce the significance of stormwater on this syste
4. Lora Lake provides a dynamic water storage function between approximately 267.4 and 269 feet in elevation. This dynamic storage is used for both stormwater inflows and by Miller Creek.

3.0 MITIGATION APPROACH

The remedial action will require work within jurisdictional waters of the U.S. This work will include fill placement into Lora Lake, which has the potential to result in short-term water quality impacts during construction. In addition, construction access necessitates removal of establishing vegetation, which will require time to re-establish following construction.

To comply with CWA permit requirements, the project includes measures to mitigate adverse impacts on aquatic functions. Mitigation in this context includes the first three steps in the preferred mitigation sequence:

1. Avoiding the impact altogether by not taking a certain action or parts of an action;
2. Minimizing impacts by limiting the degree or magnitude of the action, and restoring temporary impacts;
3. Rectifying the impact by repairing, rehabilitating, or restoring the affected environment;
4. Reducing or eliminating the impact over time by preservation and maintenance operations; and
5. Compensating for the impact by replacing, enhancing, or providing substitute resources or environments.

3.1 Avoidance and Minimization

The project is designed to avoid and minimize adverse impacts as follows:

1. Lora Lake will be drawn down prior to any fill placement to break the surface water connection between Lora Lake and Miller Creek. The feasibility of this approach was tested in the Pump Down/Pump-back Test in 2015.
2. Cap placement includes the placement of geotextile fabric to minimize disturbance of lake bottom sediments.
3. Access roads will be located to minimize impacts to jurisdictional wetlands and forested areas.
4. Construction activities will be confined to the minimum areas necessary to minimize clearing of established vegetation.
5. Construction sequencing was developed to allow major fill placement activities in the dry season and allows sufficient time for settlement before installing plantings.

Construction of the access road and staging area will temporarily impact the young (~10 year old) alder stand around the lake. The access road and staging area will be in place throughout two construction seasons for an approximate duration of 18 months. Although the area will be repaired and restored following construction, there will be a temporal loss of wetland and buffer functions because of the time required for the plant community to re-establish.

3.2 Rectifying the Impact

The Lora Lake Remedial Action and Rehabilitation Project rectifies the past impacts including mining and residential development by rehabilitating Lora Lake and returning it to a close approximation of its historic condition. The overall goal of wetland rehabilitation is to offset unavoidable impacts associated with the required MTCA remedial action and provide a net benefit to the overall Miller Creek floodplain and Vacca Farm wetland system.

To achieve the project goal, fill placement will be necessary to fill in the lake to elevations that will support a woody plant (scrub-shrub) community. It is necessary to minimize this fill to avoid impacts to dynamic surface water storage functions and to allow for greater connection between Miller Creek and its floodplain. To meet Port and Federal Aviation Administration requirements for Wildlife Hazard Management, it is necessary to avoid long duration of surface ponding (Port 2004).

3.3 Mitigation Design

The wetland rehabilitation design includes a number of elements intended to build a wetland surface that interacts with proposed groundwater and Miller Creek to result in a shrub-dominated floodplain and wetland surface. The design is currently articulated at 60% design and depicted on JARPA Figures 5-7. Rehabilitation-specific Drawings are included as Appendix D.

A key element in the design was the groundwater model developed by Aspect Consulting to assess the effects of the proposed wetland fill on the local groundwater table. Initial modeling results indicated that due to reduced hydraulic conductivity in the filled lake (as compared to open water), groundwater levels within the proposed wetland could be several feet higher than the existing lake surface (Aspect Consulting 2015b). To achieve a ground surface elevation capable of supporting a shrub-dominated wetland under this condition would have required excessive depths of fill that would have intruded into the surrounding wetland areas. Managing groundwater levels under these circumstances became a one of the driving objectives of the design process.

The wetland rehabilitation design was developed by iterating between surface topographic configurations and testing with the goundwater modeling results to forecast post-fill groundwater levels within the site (Aspect 2015b). Proposed grading plans were developed then tested with the groundwater model to determine performance and refine the fill surface. The grading plan allows for placement of topsoil that will include fine inorganic soil particles and organic material to help soil structure development and promote vegetation establishment.

The design includes the following elements:

1. High conductivity fill materials. Medium sand or coarser will be used to minimize the risk of elevated groundwater levels within the filled lake footprint.
2. Perimeter swale on the north and west sides of the fill surface. This swale will allow groundwater to flow from the surrounding alder stand into the swale system on the wetland

perimeter to avoid local groundwater mounding at the transition from native soils to the fill area. This design feature is 5-feet wide with a consistent bottom elevation of 267 feet.

3. <u>Swales through the wetland</u>. Swales are included to create drainage pathways through the wetland, lower local groundwater level, and minimize fill within the dynamic water storage zone. Maintaining lower local groundwater levels is important to the success of the vegetative plantings. These swales will have a 3 to 5 -foot wide (with width increasing downstream), flat bottom and very gentle (5H to 10H:1V) side slopes. They will be installed at a typical 0.2 percent slope draining from elevation 267 at the perimeter drain to elevation 266 at the outlet to Miller Creek. The swales are designed to provide positive drainage to Miller Creek and to avoid creating isolated depressions that could cause fish stranding concerns. To provide initial stability, the swales will be installed with coir logs on each side and a shallow (0.5 foot) depth of fine gravel. The coir logs are intended to help hold the topsoil to be placed on each side of the swale. Livestakes will be planted in and along in the coir logs to establish shrubs along each of the swales to establish swales within 3 to 5 years. The coir logs will degrade over time and the vegetative root systems will provide long-term erosion resistance.

4. <u>Hummocks with a range of elevations between 267 and 269 feet.</u> This will allow for more diverse vegetation and a greater range of habitat types occurring throughout the wetland.

5. <u>A new opening in the relocation reach berm to Miller Creek</u>. This will allow for positive drainage of the system, remove the impoundment created behind the Miller Creek Relocation Reach berm. The elevation of the opening is set at elevation 266 feet, which daylights on the bank of Miller Creek above the low flow channel to avoid altering low flow dynamics in the creek. The opening width is designed to allow free drainage while minimizing adjacent tree removal.

   The project will include work south of Lora Lake through a closed depression area south of the lake. The depression is approximately 0.6 acre and includes the Enhanced Existing Wetland, and an existing wetland that was not part of the previous mitigation, and is bordered to the south by the Miller Creek Relocation Reach Berm. The depression currently receives surface water from Lora Lake, which is impounded behind the relocation reach berm. Water levels within the depression are deeper than anticipated as part of the original planting plan. By excavating an outlet and routing the swale system discharge through this depression and the Relocation Reach Berm, water levels should be lower than the current condition, which was identified as a corrective action for the depression.

   Best available survey data indicate that existing bottom elevations of the Enhanced Existing Wetland allow for positive drainage from the lake (266.4 feet) to the proposed outlet to Miller Creek (266.0 feet). This will be confirmed with survey in the field as part of final design. Livestakes are proposed within a portion of the impounded area to jumpstart the development of the intended community in this location.

6. <u>Remove the berm and establish a new streambank along the eastern Lora Lake shoreline to increase floodplain connectivity</u>. The berm will be removed to elevation 267.5 along Miller

Creek, sloping gently (>20H:1V) up to meet the wetland surface at elevation 268. Removing the berm will improve connectivity to the floodplain. This modification will lower the flood stage and velocities during high flow events, which will mitigate loss of 0.5 acre-feet of floodplain storage. The streambank protections will be designed to establish a stable bank that provides ecosystem function but does not allow Miller Creek to migrate into the remediation area. The current design relies on bioengineering methods including coir logs, coir blanket, and dense willow plantings along with a very gentle slope. A buried rock trench (extending below the current low flow channel) is included as a fallback measure to prevent stream migration into the wetland. Final design will include a review of velocities within the proposed channel to determine if additional measures, such as large wood, are necessary to increase bank strength.

7. Native vegetation communities. There are four general communities throughout the wetland rehabilitation area. These plant communities will be adaptively managed over the proposed 10-year monitoring program as follows:
   - Wetland Shrub Community 1 includes species adapted for wet conditions, Emergent vegetation will be planted as plugs and seeds in the areas along the swales with the intent of having an emergent understory.
   - Wetland Shrub Community 2 will be installed on the hummocks and includes a wider variety of species with greater range of hydrologic tolerance. The hummocks will support a more diverse assemblage and taller shrub species and will accommodate some settlement over time.
   - Riparian Forest Community will be established in the disturbed areas of the Miller Creek bank to establish stable banks with overhanging cover.
   - The Riparian Infill community consists of livestakes installed within the closed depression that will be opened to Miller Creek. The livestakes will establish shrub cover will allow the Enhanced Existing Wetland to meet its performance standards and will help prevent weed establishment (e.g., reed canarygrass) in the existing unmitigated wetland.

8. Re-vegetatate disturbed areas within the Lora Lake buffer area. Areas disturbed for access roads or shallow soil excavation will be re-vegetated per the as-built planting plans.

3.4 No-Rise Floodplain

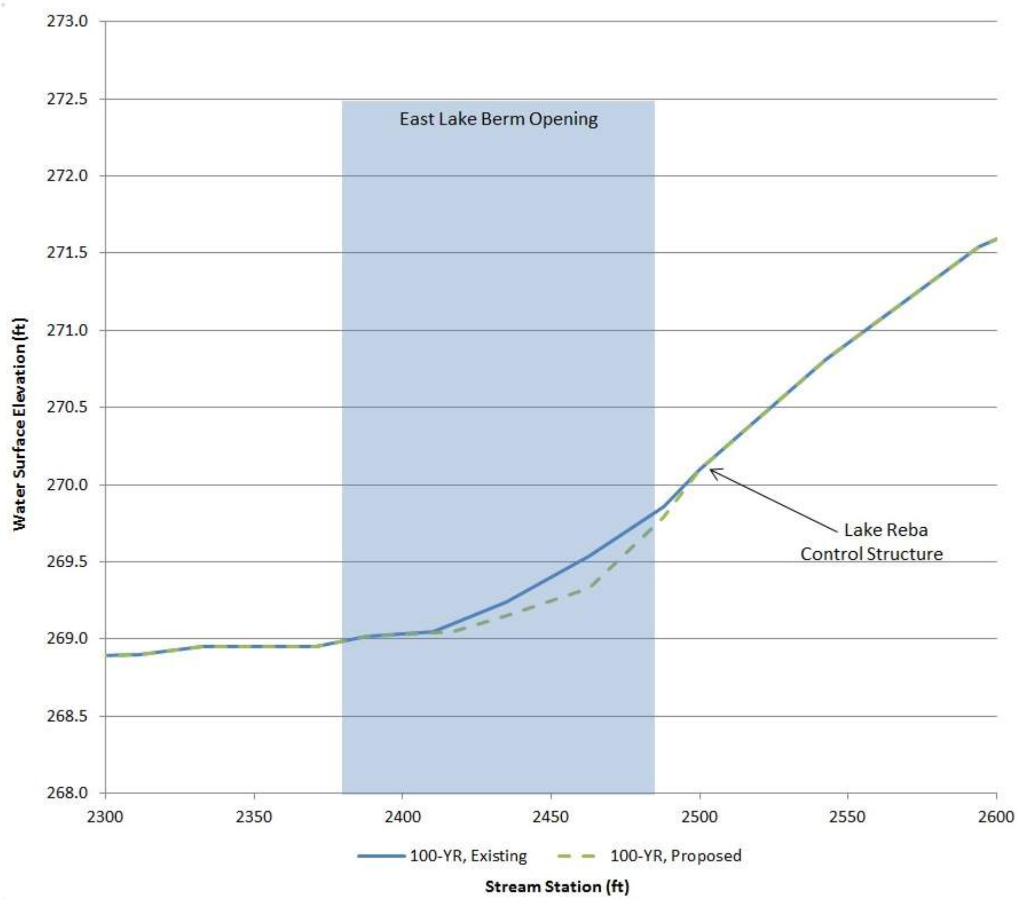
A key objective of the proposed wetland design is to avoid changing the floodplain dynamics in Miller Creek. To support the desired wetland vegetation species, the lake must be filled to an elevation above the existing groundwater level, which has the potential to change the dynamic water surface functioning of the system. The elevation of the final wetland surface is set at the top of inactive storage (i.e. storage that is consistently full of water so does not provide flood storage).This matches the average wet season lake water level from the monitoring period (267.4 feet), which is the best available representation of inactive storage during the portion of the year when flooding is most likely to occur. Fill above this elevation, but below the base flood elevation (268.6 feet), represents fill in the floodplain. The fill would occupy a volume of approximately 0.5 acre-feet. This volume is less than the excess floodplain volume previously created within Vacca Farm, which offset the floodplain fill associated with the Third Runway project. As a result, there is still an overall net gain in floodplain storage capacity even with the proposed 0.5-acre-foot of fill.

The loss of 0.5 acre-feet of floodplain storage could result in an increase in flood stage and velocities within Miller Creek, particularly during the rising limb of flood events. The design offsets these changes by removing the existing eastern berm of Lora Lake to improve floodplain connectivity. This approach was discussed informally with FEMA, and they concurred that, given the restoration context, this approach is appropriate for this site.

Removing the eastern berm along Lora Lake wetland will allow overbank flows to engage the rehabilitated wetland more frequently than the current condition. Improved floodplain connectivity here will lower water levels in the channel and thus hydraulic head at the upstream end of the project reach during peak flow events. The proposed berm removal will not impact the low flow channel, and will expand water top widths starting with the annual flood. For flows above the 50 percent annual chance event (2 year), flows will engage the wetland surface annual floodplain.

To test this approach, the proposed wetland configuration was simulated using the HEC RAS model developed by ESA for the project reach. The result was a reduction in flood stage of between 0.5 and 1.0 feet under proposed conditions along the downstream reach of over 2,000 feet of channel (Figure 7).

Figure 7. Pre- and Post-Project Flood Flow Profiles along Miller Creek adjacent to the proposed berm lowering.



These results indicate that greater floodplain connectivity in the upper reach will reduce velocities and flood heights, offsetting lost floodplain storage volume.

3.5 Qualitative Functional Assessment

ESA assessed the functions of the existing lake and adjacent wetlands qualitatively to show how the proposed rehabilitation will alter existing functions (Table 2).

Table 1. Qualitative Function Assessment for Lora Lake remedial action

Wetland Function	Current Condition	Functional Shift (+) = functional gain; (=) no discernable change (-) functional loss.	Notes	Design Objectives
Hydrologic Functions				
Dynamic surface water storage and outflow to Miller Creek	Wetlands in the Lora Lake system provide flood storage and desynchronization functions to Miller Creek.	(=)	Some floodplain storage volume will be filled to successfully establish native shrubs. Floodplain connectivity will be enhanced with the removal of the eastern berm between the lake and Miller Creek. Monitoring data from 2013/4 indicate the majority of the volume filled for the remedial action is below regional groundwater, so most of the lake volume does not provide dynamic water surface storage or flood desynchronization.	The design will include lowering the berm adjacent to the creek to allow more floodplain connectivity. Tested with HEC RAS model to confirm lower flood stage due to greater connectivity.
Local groundwater dynamics	Monitoring data indicate that the site is a groundwater discharge area (there is down-valley groundwater seepage from the lake which is visible along the stream channel near the power line crossing, suggesting that the Lora Lake system supports summer baseflows in the creek.	(=)	Sand fill placement may alter existing infiltration and subsurface flow pathways. Alterations in the outlet may change water levels, which in turn would alter local groundwater flow.	Design will optimize fill elevation and hydraulic conductivity to avoid impacts to surrounding areas. Significant groundwater discharge will still occur, supporting baseflow in Miller Creek.

Wetland Function	Current Condition	**Functional Shift** (+) = functional gain; (=) no discernable change (-) functional loss.	Notes	Design Objectives
Changes in amount/quality of stormwater influent	The lake currently receives untreated stormwater runoff.	(+)	The majority of the stormwater will be directed elsewhere under a suite of stormwater improvements implemented by the City of Burien. This will reduce peak flows and pollutant loading to Lora Lake footprint.	
Water Quality Functions				
Sediment Retention	Sediment retention functions are currently moderately high to high for the lake. Open water and a relatively large storage to inflow ratio likely provides sufficient residence time for most sediments to settle out.	(+)	Persistent woody vegetation growth and increased floodplain connectivity will increase sediment retention on the floodplain.	Design includes finish grading of the placed fill surface to provide microtopographic roughness and support establishment of native emergent and shrub vegetation communities.
Nutrient and pollutant retention	Nutrient and pollutant retention functions are moderately high to high for the lake. Open water provides increased residence time for nutrients and pollutants sorbed to sediments to settle. Organic and fine-textured sediment substrates also provide exchange surfaces for retaining nutrients and pollutants.	(+)	Water would have longer contact time with vegetated soil surfaces with enhanced ability for nutrient cycling. Water/soil contact time will increase the potential for adsorbtion.	Design includes finish grading of the placed fill surface to provide microtopographic roughness and support establishment of native emergent and shrub vegetation communities.

Wetland Function	Current Condition	**Functional Shift** (+) = functional gain; (=) no discernable change (-) functional loss.	Notes	Design Objectives
Water temperature regulation	Miller Creek and Lora Lake, and associated wetlands have seasonally high temperatures.	(+)	Increase in total shade coverage for the rehabilitated wetland will reduce insolation and water temperature.	Design includes finish grading of the placed fill surface to provide microtopographic roughness and support establishment of native emergent and shrub vegetation communities.
Changes in downstream water dissolved oxygen (DO)	Lora Lake have dissolved oxygen diurnal fluctuations due to elevated primary productivity function which seasonally influence dissolved oxygen Miller Creek.	(+)	Increase in shade will likely decrease temperatures which will increase dissolved oxygen levels. However, groundwater discharge to the lake is still likely to be low in overall DO.	As with temperature, design promotes increased shade.
Habitat Functions				
Nesting/breeding/foraging for wetland-dependent and wetland –associated avian species	Lora Lake with open water rated moderate for waterfowl use.	(-)	The substantial reduction of open water will likely eliminate waterfowl use of the Lora Lake system.	This is a design objective under the Wildlife Hazard Management Plan to reduce bird strike risk.
Presence/breeding/foraging for wetland-dependent and wetland –associated terrestrial species	Wetland terrestrial species use is predominantly limited to fringe wetlands surrounding the waterbody.	(+)	The conversion to vegetated wetland habitat will likely provide better support functions for terrestrial species.	

Wetland Function	Current Condition	Functional Shift (+) = functional gain; (=) no discernable change (-) functional loss.	Notes	Design Objectives
Presence/breeding/foraging for wetland-dependent and wetland –associated native fish species	Overall, fish use is limited to warm water species by poor water quality and the presence of water control structures.	(+)	Converting the existing open water component will reduce or eliminate habitat for non-native fish species including pumpkinseed, sunfish and largemouth bass (captured upstream and downstream of the outlet), which compete with native salmonid species in the Miller Creek system and which prey on juvenile salmonids. The conversion should also provide higher quality refugia for rearing salmonids.	The rehabilitated wetland surface will have positive drainage to Miller Creek to avoid fish stranding.

Wetland Function	Current Condition	Functional Shift (+) = functional gain; (=) no discernable change (-) functional loss.	Notes	Design Objectives
Presence/breeding/foraging for wetland-dependent and wetland –associated amphibian species	Lora Lake and its associated wetland provides amphibian breeding habitat around its vegetated fringe. The majority of the lake is likely too deep to support the aquatic bed/emergent vegetation necessary for laying egg masses. Non-breeding amphibians are generally expected to prefer associated wetlands (A1) and riverine systems along Miller Creek rather than Lora Lake. Amphibian habitat functions for the lake (when assessed separately from Wetland A1 are expected to be low to moderately low.	(=/+)	The functioning of the adjacent wetland is anticipated to be generally unchanged, with the potential for significantly greater breeding habitat.	Design of the surface of the fill and outlet structure would be considered to determine if the proposed wetland hydroperiod would be conductive to native amphibian breeding, which could result in functional increase.
Primary productivity functions	This function is generally associated with vegetated wetlands where water flows through the system. Wetland A1, which surrounds Lora Lake, likely provides moderate primary productivity functions; however, since the lake is primarily open water, as a separate unit it provides low primary productivity function.	(+)	Rehabilitating a vegetated wetland in this location would increase overall primary productivity of the lake/wetland unit.	Design includes monitoring and adaptive management efforts to avoid weed colonization.

3.6 Function Credits and Debits

To supplement our qualitative assessment, we evaluated the overall functional change to the system under the proposed remediation and wetland rehabilitation using the 'credit-debit' methodology described in Ecology's *Calculating Credits and Debits for Compensatory Mitigation in Wetlands of Western Washington* (Hruby, 2012). This method estimates the functions lost when a wetland is altered and estimates the gain in functions and values that result from mitigation. Function ratings are transformed into units expressed as "acre-points," which can allow for a comparison between pre-and post-project conditions.

The Credit-Debit approach has limitations in terms of resolution and applicability to this unique wetland rehabilitation project. The method was developed to track broad changes in levels of functioning, typically due to complete loss (e.g., fill) of a wetland. Therefore, it is difficult to use the method to assess the marginal functioning that would result from filling an open water area and rehabilitating a vegetated wetland. Best professional judgement has been used to derive the credit-debit scores.

Lora Lake has both riverine and depressional hydrogeomorphic (HGM) characteristics. The lake's size (approximately 3 acres) requires that it be rated as a riverine or depressional wetland, rather than a lacustrine system[1]. We chose to rate it as a riverine system because the Ecology guidance emphasizes the degree of connection to the river as a determining factor in making this decision. The rehabilitated wetland will have greater floodplain connectivity compared to the current condition. Water level monitoring data from 2013-2014 also show a high degree of connection between Miller Creek and the lake, with the creek backwatering into the lake for the majority of the wet season, with flows substantially less than the 2 year recurrence interval flow.

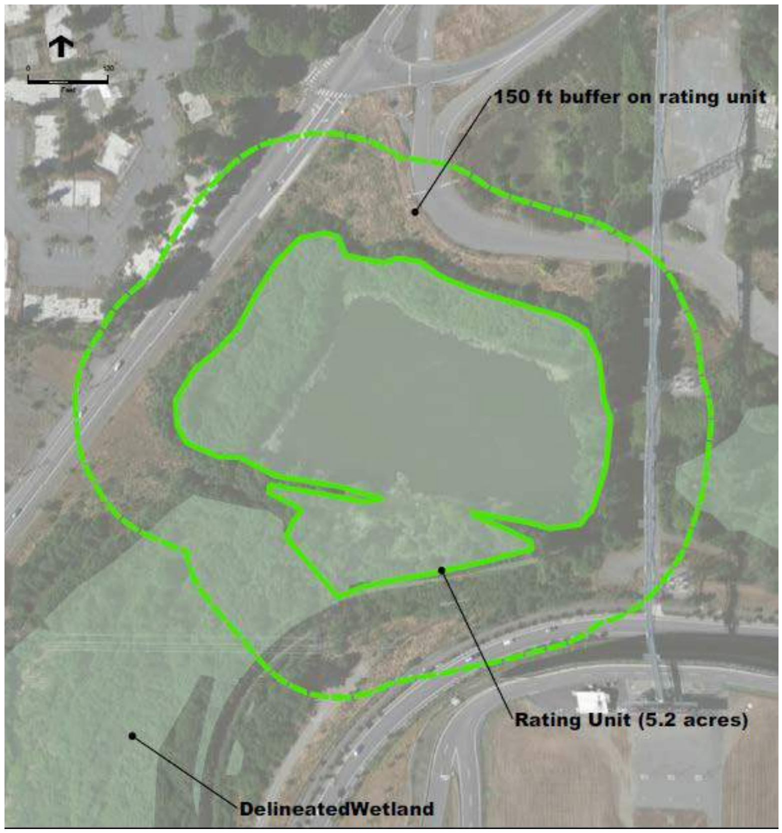
Our rating also assumed that Lora Lake and the fringe wetlands immediately adjacent to the lake, including the Enhanced Existing Wetland, are one assessment unit for project impacts and mitigation (Figure 8). The unit boundary includes a delineation between the rated unit and the contiguous wetland area extending downvalley within Vacca Farm. The unit was divided on a topographic high point that would only be overtopped by surface waters on significant (50+ year recurrence interval) flood events. Therefore, under typical conditions, surface waters do not connect though there is a continuous wetland through this area. The rating reflects these additional assumptions about future condition of Lora Lake:

1. Debits were assessed for the temporary clearing of the alder canopy within the fringe wetland area associated with the construction access road. Since canopy will be cleared, these impacts were assessed as permanent impacts with mitigation credit deriving from re-vegetating the cleared areas. This area totals 0.21 acre.

[1] According to Ecology's credit-debit system, a lake must be 20 acres or larger to be considered lacustrine

2. Credits were generated from the rehabilitated area (former lake open water footprint) (2.8 acres). Although the adjacent Existing Enhanced Wetland will benefit from the rehabilitation actions, this area is mitigation for past impacts, so no additional credit is assumed for this area.

Figure 8. Wetland Rating Unit Overview



3.6.1 Key Rating Score Assumptions

For the rating, the following assumptions drove the relative difference in pre-and post-project ratings. These are organized by credit/debit question (see Appendix A) and parentheses indicate pre- and post-points, respectively.

1. The proposed rehabilitation will not change the landscape context nor value of the system – the only changes were assigned to the Site Potential scores.
2. R1.1 – Surface depressions assumed to increase from the current open water/fringing terrace to a complex, rough, vegetated surface (4 to 8 points).
3. R1.2 – Shrub area anticipated to increase (6 to 8 points).
4. R4.2 – The area of shrub within the flooded area will substantially increase (4 to 7 points).
5. H1.1 – One to two classes – based on no aquatic bed only open water (0 to 1 point).
6. H1.2 – Hydroperiods increase (2 points to 3 points).

7. H1.4 – Interspersion substantially increases (1 to 3 points).

3.6.2 Key Credit/Debit Assumptions

For the scoring, the following assumptions drove the relative difference in pre-and post-project rating:

1. Rehabilitation credits assume a low risk factor (0.9). The system has been well-studied and design has maximized the use of site data, draw down test results, and comprehensive groundwater and wetland design models calibrated with empirical site data, water is plentiful, and the adjacent Vacca Farm restoration gives on- the-ground experience to restoring the target habitats here. The Port is also committed to monitoring and adaptively managing the rehabilitated wetland to achieve project goals.
2. The debits assume a low Temporal Loss Factor (1.75). The impacts to forested wetlands are focused on young (<10 year old) alder stands. These will regenerate relatively quickly, and the temporary construction access road has been aligned in areas of past disturbance to minimize the impacts.

The results of the credit-debit analysis are given in the following tables, and the score sheets are included as Appendix A, supporting figures are in Appendix B:

Table 2. Function Scores for Existing and Future Conditions using Ecology Credit/Debit System

	Water Quality		**Hydrologic**		**Habitat**	
	Before	After	Before	After	Before	After
Site Potential	M	H	M	H	M	H
Landscape Potential	H	H	M	M	M	M
Value	H	H	M	M	H	H
Score	8	9	6	7	7	8

The pre- and post- project ratings resulted in a 1 unit increase for each function group. This result is generally consistent with the qualitative assessment that removing the source of high temperature water is a substantial benefit for the system. Further, providing a more integrated vegetated floodplain will have hydrologic and habitat benefits.

Applying these functional unit benefits over the impact and rehabilitation areas results in a net increase in wetland functioning, using the credit-debit calculator, see Table 4 for a summary and Appendix C for the excel sheets.

Table 3. Credit-Debit Summary for the proposed Lora Lake Wetland Rehabilitation

Credit/Debit	Notes	Water Quality (acre-points)	Hydrologic (acre-points)	Habitat (acre-points)
Debit based on long term temporary access road clearing	0.21 acre access road clearing with 1.75 temporal loss factor	(2.9)	(2.2)	(2.6)
Rehabilitation **Credit**	2.8 acre rehabilitated area as shrub (only counts open water area). Risk factor = 0.9	2.5	2.5	2.5
Rehabilitation **Credit** for access road revegetation	0.21 acre – existing site potential set to low, post-project ratings used as scoring	0.8	0.6	0.6
Net		**0.4**	**0.9**	**0.5**

3.7 Summary of Functional Benefits

The functional analysis indicates that the overall project will be a net benefit to the overall wetland system. Overall water quality, hydrologic functions, and habitat functions are expected to increase (net credit-debit positive balances) as a result of the remedial action and would generate positive credits for these functions. The results of this analysis indicate that the project will be self-mitigating, meaning the benefits of rehabilitating the wetland offset the short-term construction impacts (including the temporal loss of function due to clearing for the remedial construction access road); therefore, we assume no additional mitigation would be needed.

The Lora Lake wetland rehabilitation is a unique project being implemented as part of a MTCA remedial action. As such, standard assessment methods such as the Ecology Credit-Debit System may not be directly applicable. We have provided the basis for our determinations of scorings, which employ best professional judgement to capture our understanding of changes to the wetland system.

4.0 PERFORMANCE STANDARDS AND MONITORING

4.1 Goals and Objectives

The Port proposes a 10 year monitoring and adaptive management period for the Lora Lake wetland rehabilitation. The overall goal is to rehabilitate a vegetated palustrine scrub-shrub wetland. The following are the proposed monitoring metrics and approaches. These criteria and standards are structured based on Table 5.1-7 from the NRMP, tailored to the Lora Lake project

Table 4. Proposed Monitoring Criteria and standards

Design Criteria	Performance Standard	Evaluation Approach	Contingency Measures
I. Miller Creek			
Flows greater than the annual peak flow will overtop the channel and inundate the adjacent floodplain restoration.	Flows greater than the annual peak flow (40 cfs) will overtop the channel and inundate the adjacent floodplain restoration.	Measure water elevations in the stream channel and floodplain and relate to streamflow and as-built topography.	Adjust bank height, channel morphology, or roughness to alter amounts of overbank flow.
Preserve a stable low flow channel in Miller Creek	Miller Creek low flow channel retains existing geometry	Visual observation of Miller Creek	Placement of temporary erosion control BMPs as vegetation establishes.
Densely plant woody vegetation along the new channel to cover open water and reduce use of the area by waterfowl	Canopy Cover over swales shall be 80% by the end of the monitoring period	Vegetation sampling to determine cover over the swales and Miller Creek	Add additional plants if cover is not establishing over the swales or Miller Creek
II. Wetland Enhancement and Restoration			
Create topographic variation in the floodplain	Installed hummocks remain stable compared to as-built	Visual observations	Temporary erosion control measures.

Establish canopy cover within the rehabilitated wetland. Plant native trees, shrubs at densities of 280 trees/acre and 1,700 shrubs/acre	• Survival of 100% in Year 0 • Survival of 80% in Years 1-3 • Combined tree and shrub cover of 40% by Year 5 • Combined tree/shrub cover of 80% by Year 10 Invasive cover <10% in all years	Sampling methods described in As-built Addendum (Port 2010)	Install additional plants if necessary. Identify substitute native species that are adapted to site conditions. Eliminate or reduce the abundance of non-native invasive species. Install protective collards to reduce herbivore damage.
III. Lora Lake Buffer Enhancement			
Restore disturbed portions of Lora Lake buffer and restoration areas with native trees and shrubs. Tree densities of greater than 280 per acre. Shrubs at densities of greater than 1,700 per acre.	• Survival of 100% in Year 0 • Survival of 80% in Years 1-3 • Cover of 40% by Year 5 • Cover of 80% by Year 10 • Invasive cover <10% in all years	Sampling methods described in As-built Addendum (Port 2010)	Install additional plants if necessary. Identify substitute native species that are adapted to site conditions. Eliminate or reduce the abundance of non-native invasive species. Install protective collars to reduce herbivore damage.
Previously created wetland areas remain wetland	• No change in extent of jurisdictional wetlands surrounding Lora Lake	Redelineation (next scheduled for 2018)	Evaluate hydrologic monitoring data and determine appropriate corrective actions

5.0 LIMITATIONS

Within the limitations of schedule, budget, scope-of-work, and seasonal constraints, we warrant that this study was conducted in accordance with generally accepted environmental science practices, including the technical guidelines and criteria in effect at the time this study was performed, as outlined in the Methods section. The results and conclusions of this report represent the authors' best professional judgment, based upon information provided by the project proponent in addition to that obtained during the course of this study. No other warranty, expressed or implied, is made.

6.0 REFERENCES

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APPENDIX A:
CREDIT-DEBIT FORM

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Wetland name or number _____

Note: Intended for use with ESA Memo
Dated February 8, 2016

SCORING FORM

Scoring functions to calculate mitigation credits and debits in Western Washington

Name of wetland (if known): Lora Lake Date of site visit: Multiple 2012 - 2016

Scored by Steve Winter

SEC: ___ TWNSHP: ___ RNGE: ___ Estimated size: 3 acres Aerial photo included? Yes

These scores are for:

_________Wetland being altered

_x_____Mitigation site before mitigation takes place

_____x__Mitigation site after goals and objectives are met

Note: Red scores indicate pre-project; Green post-project

SUMMARY OF SCORING

FUNCTION	Improving Water Quality	Hydrologic	Habitat
Rating of Site Potential	M H	M H	L M
Rating of Landscape Potential	H H	M M	M M
Rating of Value	H H	M M	H H
Score Based on Ratings (see table below)	7 8	6 7	6 7

Note: Proposed rehabilitation project will not change Landscape Potential or Value; only Site Potential will be influenced.

	Wetland HGM Class Used for Rating	
	Depressional	
	Riverine	x
	Lake-fringe	
	Slope	
	Flats	
	Freshwater Tidal	
	Check if unit has multiple HGM classes present	x

Scores
(*Order of ratings is not important*)

9 = H,H,H
8 = H,H,M
7 = H,H,L
7 = H,M,M
6 = H,M,L
6 = M,M,M
5 = H,L,L
5 = M,M,L
4 = M,L,L
3 = L,L,L

NOTE: Form is not complete without the figures requested.
Put only the highest score for a question in each box of the form, even if more than one indicator applies to the unit. Do NOT add the scores within a question.

Wetland name or number Lora Lake

HGM Classification of Wetlands in Western Washington

For questions 1-7 the criteria described must apply to the entire unit being rated.

If the hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1-7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides (i.e., except during floods)?

NO – go to 2 **YES** – the wetland class is **Tidal Fringe** – go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

YES – Freshwater Tidal Fringe **NO – Saltwater Tidal Fringe (Estuarine)**

*If your wetland can be classified as a Freshwater Tidal Fringe use the forms for **Riverine** wetlands. If it is Saltwater Tidal Fringe it is an **Estuarine** wetland and not scored. This method cannot be used for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (>90%) of water to it. Groundwater and surface water runoff are NOT sources of water to the unit.

NO – go to 3 **YES** – The wetland class is **Flats**

*If your wetland can be classified as a "Flats" wetland, use the form for **Depressional** wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?

___The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface) at least 20 acres (8 ha) in size;

___At least 30% of the open water area is deeper than 6.6 ft (2 m)?

NO – go to 4 **YES** – The wetland class is **Lake-fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?

___The wetland is on a slope (*slope can be very gradual*),

___The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks.

___The water leaves the wetland **without being impounded**?

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

NO - go to 5 **YES** – The wetland class is **Slope**

5. Does the entire wetland unit **meet all** of the following criteria?

_X_The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river

_X_The overbank flooding occurs at least once every two years.

NOTE: The riverine unit can contain depressions that are filled with water when the river is not flooding.

NO - go to 6 **YES – The wetland class is Riverine**

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

NO – go to 7 **YES** – The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

NO – go to 8 **YES** – The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM Classes Within the Wetland Unit Being Rated	HGM Class to Use in Rating
Slope + Riverine	Riverine
Slope + Depressional	Depressional
Slope + Lake-fringe	Lake-fringe
Depressional + Riverine along stream within boundary of depression	Depressional
Depressional + Lake-fringe	Depressional
Riverine + Lake-fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have more than 2 HGM classes within a wetland boundary, classify the wetland as Depressional for the rating.

Unit classified as riverine due to frequency of connectivity to Miller Creek and the wetland rehabilitation's goals of restoring floodplain connectivity.

Wetland name or number Lora Lake

Note: Red scores indicate pre-project; Green post-project

Riverine and Freshwater Tidal Fringe Wetlands **WATER QUALITY FUNCTIONS** - Indicators that site functions to improve water quality Questions R 1.1 – R 1.2 are from the Wetland Rating System (Hruby 2004b).			
R 1. Does the wetland unit have the potential to improve water quality?			
R 1.1 Area of surface depressions within the riverine wetland that can trap sediments during a flooding event: *If depressions > ½ of area of unit draw polygons on aerial photo or map* Depressions cover >3/4 area of wetland points = 8 Depressions cover > 1/2 area of wetland points = 4 Depressions present but cover < 1/2 area of wetland points = 2 No depressions present points = 0	F CD1a Existing CD1b Proposed	4	8
R 1.2 Characteristics of the plants in the unit (areas with >90% cover at person height): *Include photo or map showing polygons of different plants types* Trees or shrubs > 2/3 area of the unit points = 8 Trees or shrubs > 1/3 area of the unit points = 6 Herbaceous plants (> 6" high) > 2/3 area of unit points = 6 Herbaceous plants (> 6" high) > 1/3 area of unit points = 3 Trees, shrubs, and ungrazed herbaceous < 1/3 area of unit points = 0	CD2a Existing CD2b Proposed	6	8
Total for R 1 Add the points in the boxes above		10	16
Rating of Site Potential: If score is 12 – 16 = H **6 - 11 = M** **0 - 5 = L** *Record the rating on the first page*		M	H

R 2.0 Does the landscape have the potential to support the water quality function at the site?			
R 2.1 Is the unit within an incorporated city or within its UGA? Yes = 2 No = 0		2	2
R. 2.2 Does the contributing basin include a UGA or incorporated area? Yes = 1 No = 0		1	1
R 2.3 Does at least 10% of the contributing basin contain tilled fields, pastures, or forests that have been clearcut within the last 5 years? Yes = 1 No = 0		0	0
R 2.4 Is more than 10% of the area within 150 ft of the wetland unit in agricultural, pasture, golf courses, residential, commercial, or urban? Yes = 1 No = 0		1	1 CD4
Total for R 2 Add the points in the boxes above		4	4
Rating of Landscape Potential: If score is 3 - 5 = H **1 or 2 = M** **0 = L** *Record the rating on the first page*		H	H

Wetland name or number Lora Lake

R 3.0 Is the water quality improvement provided by the site valuable to society?		
R 3.1 Is the unit along a stream or river that is on the 303(d) list or on a tributary that drains to one? Yes = 1 No = 0	1	1
R 3.2 Does the river or stream have TMDL limits for nutrients, toxics, or pathogens? Yes = 1 No = 0	1	1
R 3.3 Has the site been identified in a watershed or local plan as important for maintaining water quality? (*answer YES if there is a TMDL for the drainage in which unit is found*) Yes = 2 No = 0	0	0
Total for R 3 Add the points in the boxes above	2	2
Rating of Value: If score is 2 - 4 = H; 1 = M; 0 = L	H	H

Record the rating on the first page

Riverine and Freshwater Tidal Fringe Wetlands **HYDROLOGIC FUNCTIONS** - Indicators that site functions to reduce flooding and stream erosion Questions R 4.1 and R 4.2 are from Wetland Rating System (Hruby 2004b).		
R 4.0 Does the wetland unit have the potential to reduce flooding and erosion?		
R 4.1 Characteristics of the overbank storage the unit provides: *Provide aerial photo showing average widths* Estimate the average width of the wetland unit perpendicular to the direction of the flow and the width of the stream or river channel (distance between banks). Calculate the ratio: (average width of unit)/(average width of stream between banks). If the ratio is more than 20 points = 9 If the ratio is between 10 – 20 points = 6 If the ratio is between 5 - <10 points = 4 If the ratio is between 1 - <5 points = 2 If the ratio is < 1 points = 1	No figure - no changes proposed 6	6
R 4.2 Characteristics of plants that slow down water velocities during floods: *Treat large woody debris as "forest or shrub". Choose the points appropriate for the best description* (polygons need to have >90% cover at person height NOT Cowardin classes): *Provide photo or map showing polygons of different plants types* Forest or shrub for >1/3 area OR herbaceous plants > 2/3 area points = 7 Forest or shrub for > 1/10 area OR herbaceous plants > 1/3 area points = 4 Plants do not meet above criteria points = 0	Figure CD2a Existing CD2b Proposed 0	7
Total for R 4 Add the points in the boxes above	6	13
Rating of Site Potential: If score is 12 – 16 = H; 6 - 11 = M; 0 - 5 = L	M	H

Wetland name or number Lora Lake

R 5.0 Does the landscape have the potential to support the hydrologic functions at the site?		
R5.1 Is the stream/river adjacent to the unit downcut? Yes = 0 No = 1	0	0
R 5.2 Does the contributing basin include a UGA or incorporated area? Yes = 1 No = 0	1	1
R 5.3 Is the upgradient stream or river controlled by dams? Yes = 0 No = 1 Lake Reba Control Structure	1	1
Total for R 5 Add the points in the boxes above	2	2

Rating of Landscape Potential: If score is 3 = H
1 or 2 = M
0 = L

M M

Record the rating on the first page

R 6.0 Are the hydrologic functions provided by the site valuable to society?		
R 6.1 Distance to the nearest areas downstream that have flooding problems? *Choose the description that best fits the site.* The sub-basin immediately down-gradient of site has surface flooding problems that results in $$ loss or loss of natural resources. points = 2 Surface flooding problems are in a sub-basin further down-gradient. points = 1 No flooding problems anywhere downstream. points = 0	1	1
R 6.2 Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	0	0
Total for R 6 Add the points in the boxes above	1	1

Rating of Value: If score is 2 – 4 = H
1 = M
0 = L

M M

Record the rating on the first page

NOTES and FIELD OBSERVATIONS:

Wetland name or number Lora Lake

These questions apply to wetlands of all HGM classes. **HABITAT FUNCTIONS** - Indicators that site functions to provide important habitat. Questions H 1.1 – H 1.5 are from Wetland Rating System (Hruby 2004b).	
H 1. Does the wetland unit have the potential to provide habitat for many species?	
H 1.1 Structure of plant community – *indicators are Cowardin classes and layers in forest* Check the Cowardin plant classes in unit – *Polygons for each class must total ¼ acre, or more than 10% of the unit if it is smaller than 2.5 acres.* *Provide map of Cowardin plant classes* Existing system is open water (no aquatic bed) surrounded by canopy. Future system Will have scrub/shrub and forest with ___Aquatic bed ___Emergent plants ___Scrub/shrub (areas where shrubs have > 30% cover) ___Forested (areas where trees have > 30% cover) If the unit has a forested class check if: ___The forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the forested polygon Add the number of structures checked. If you have: 4 structures or more points = 4 3 structures points = 2 2 structures points = 1 1 structure points = 0	Figure__ CD2a Existing CD2b Proposed 0 1
H 1.2. Hydroperiods Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or ¼ acre to count (*see text for descriptions of hydroperiods*). *Provide map of polygons with different hydroperiods* ___Permanently flooded or inundated — 4 or more types present points = 3 _X_Seasonally flooded or inundated — 3 types present points = 2 _X_Occasionally flooded or inundated — 2 types present points = 1 _X_Saturated only — 1 type present points = 0 _X_Permanently flowing stream or river in, or adjacent to, the wetland ___Seasonally flowing stream in, or adjacent to, the wetland **___Lake-fringe wetland = 2 points** **___Freshwater tidal wetland = 2 points**	Figure__ 2 3
H 1.3. Richness of Plant Species Count the number of plant species in the wetland unit that cover at least 10 ft². *Different patches of the same species can be combined to meet the size threshold and you do not have to name the species.* Do not include Eurasian Milfoil, reed canarygrass, purple loosestrife, Canadian Thistle If you counted: > 19 species points = 2 *List species below if you want to:* 5 - 19 species points = 1 < 5 species points = 0	1 1

Wetland name or number Lora Lake

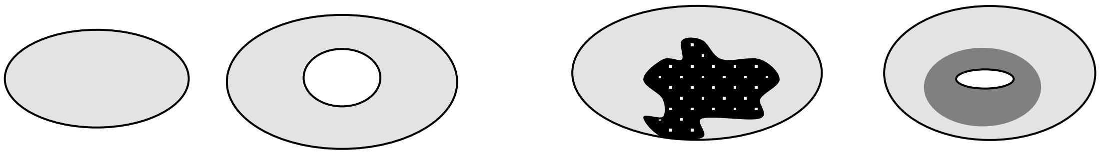
H 1.4. Interspersion of habitats

Decide from the diagrams below whether interspersion between Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, medium, low, or none.

Provide map of Cowardin plant classes (same as H1.1)

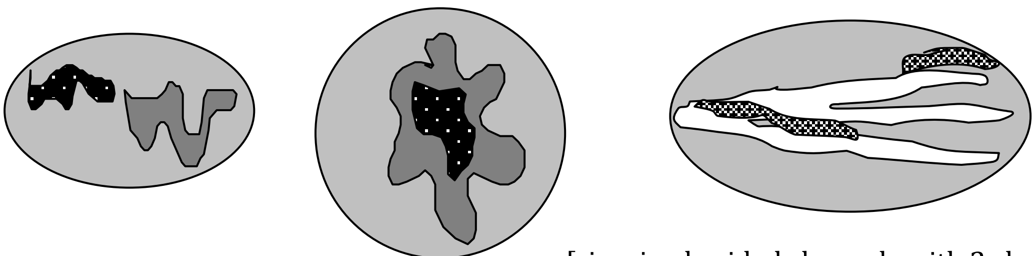
Figure__

CD2a Existing
CD2b Proposed



None = 0 points Low = 1 point Moderate = 2 points

1 3



[riparian braided channels with 2 classes]

High = 3 points

NOTE: If you have four or more classes or three plants classes and open water the rating is always "high."

H 1.5. Special Habitat Features:

Check the habitat features that are present in the wetland. The number of checks is the number of points you put into the next column.

___Large, downed, woody debris within the unit (>4 inches diameter and 6 ft long).

___Standing snags (diameter at the bottom > 4 inches) within the unit

___Undercut banks are present for at least 6.6 ft (2m) **and/or** overhanging plants extends at least 3.3 ft (1m) over a stream (or ditch) in, or contiguous with the unit, for at least 33 ft (10m)

___Stable steep banks of fine material that might be used by beaver or muskrat for denning (>30degree slope) OR signs of recent beaver activity are present *(cut shrubs or trees that have not yet weathered where wood is exposed)*

___At least ¼ acre of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated.*(structures for egg-laying by amphibians)*

___Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)

2 3

H 1. TOTAL Score - potential for providing habitat

Add the scores from H 1.1, H 1.2, H 1.3, H 1.4, and H 1.5

6 12

Rating of Site Potential: If score is

15 - 18 = H

7 – 14 = M

0 – 6 = L

L M

Record the rating on the first page

Wetland name or number Lora Lake

H 2.0 Does the landscape have the potential to support habitat at the site?	
H 2.1 Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* % undisturbed habitat **+** [(% moderate and low intensity land uses)/2] **=** ______ *Provide map of land use within 1 km of unit edge* If total accessible habitat is: > 1/3 (33.3%) of 1 km circle *(~100 hectares or 250 acres)* points = 3 20 - 33% of 1 km circle points = 2 10 - 19% of 1 km circle <10% of 1 km circle	Figure__
H 2.2 Undisturbed habitat in 1 km circle around unit. If: Undisturbed habitat > 50% of circle points = 3 Undisturbed habitat 10 - 50% and in 1-3 patches points = 2 Undisturbed habitat 10 - 50% and > 3 patches points = 1 Undisturbed habitat < 10% of circle points = 0	
H 2.3 Land use intensity in 1 km circle. If: > 50% of circle is high intensity land use points = (- 2) Does not meet criterion above points = 0	
Total for H 2 Add the points in the boxes above	

Assumed Medium; no changes will occur as part of the project

Rating of Landscape Potential: If score is 4- 6 = H
1-3 = M
< 1 = L

M M

Record the rating on the first page

H 3.0 Is the Habitat provided by the site valuable to society?	
H3.1Does the site provides habitat for species valued in laws, regulations or policies? *(choose only the highest score)* Site meets ANY of the following criteria: points = 2 — It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) — It is a "priority area" for an individual WDFW species — It is a Natural Heritage Site as determined by the Department of Natural Resources — It scores 4 on question H2.3 of the wetland rating system — It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site scores 1-3 on question H2.3 of the wetland rating system points = 1 Site does not meet any of the criteria above points = 0	Site is within the Port of Seattle NRMP and is part of mitigation for lost wetland functions

Rating of Value: If score is 2 = H
1 = M
0 = L

H H

Record the rating on the first page

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APPENDIX B:
CREDIT-DEBIT FIGURES

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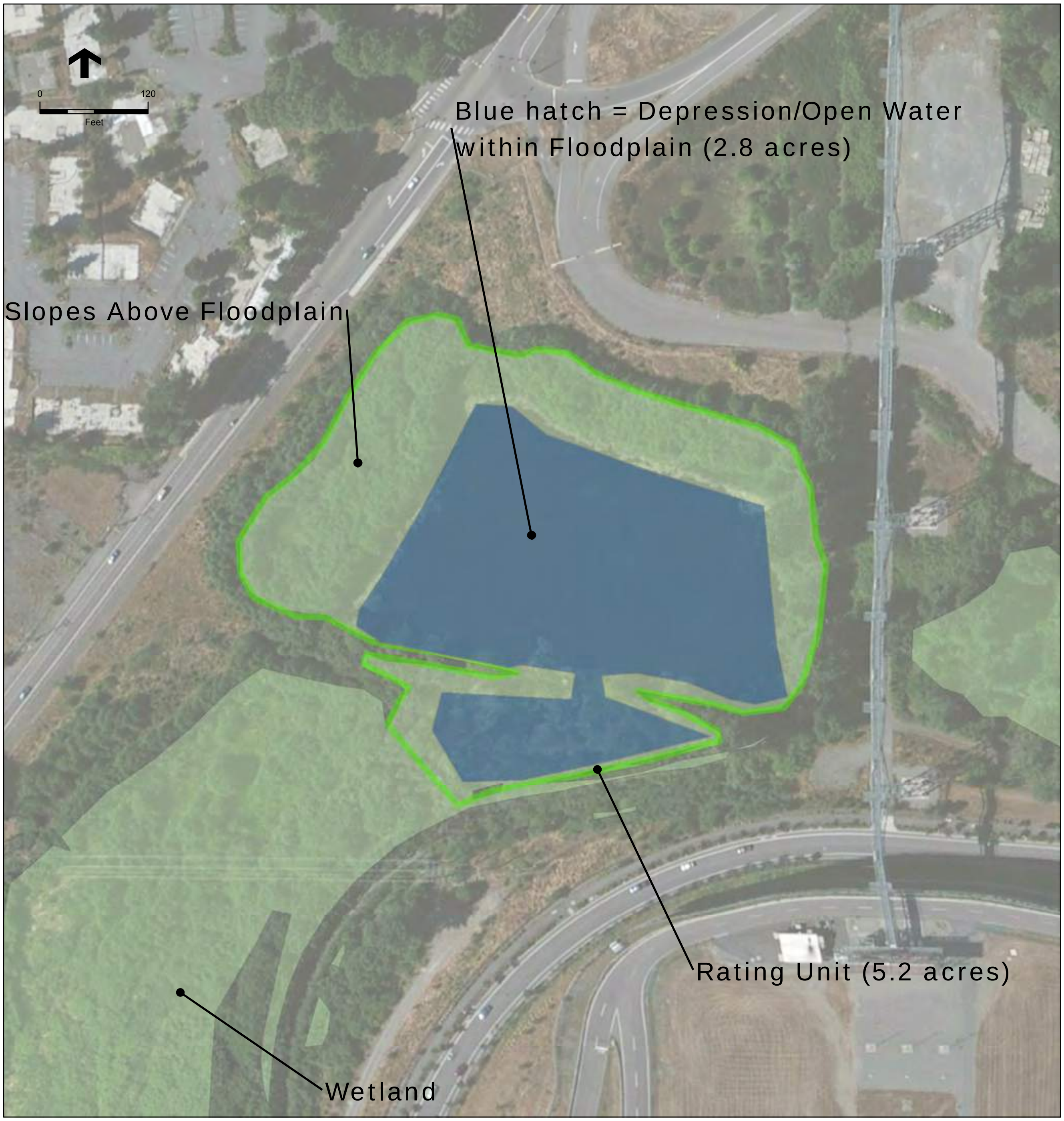
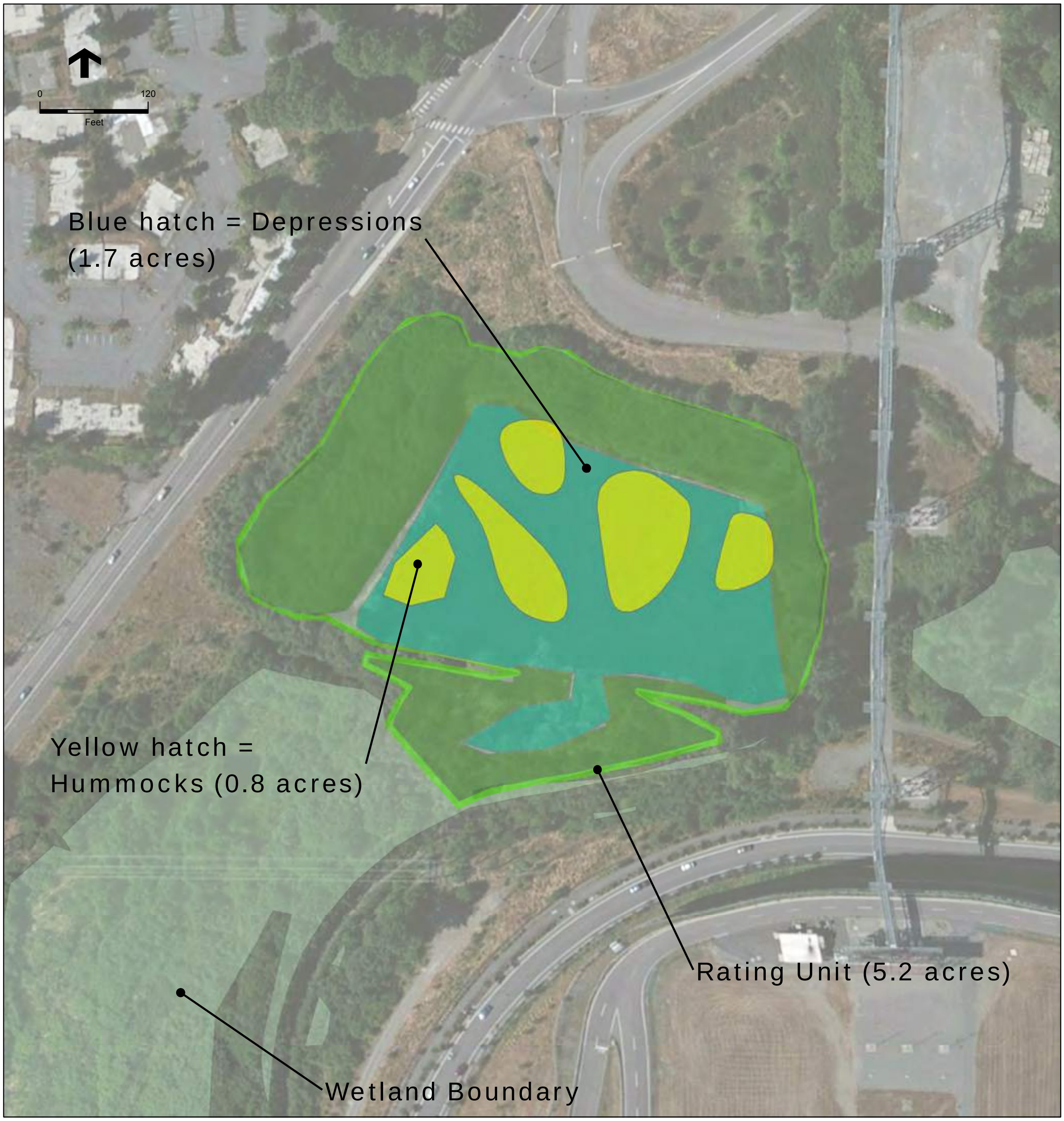


SOURCE:

Project . 140009

Figure x

Credit - Debit - Surface Depression

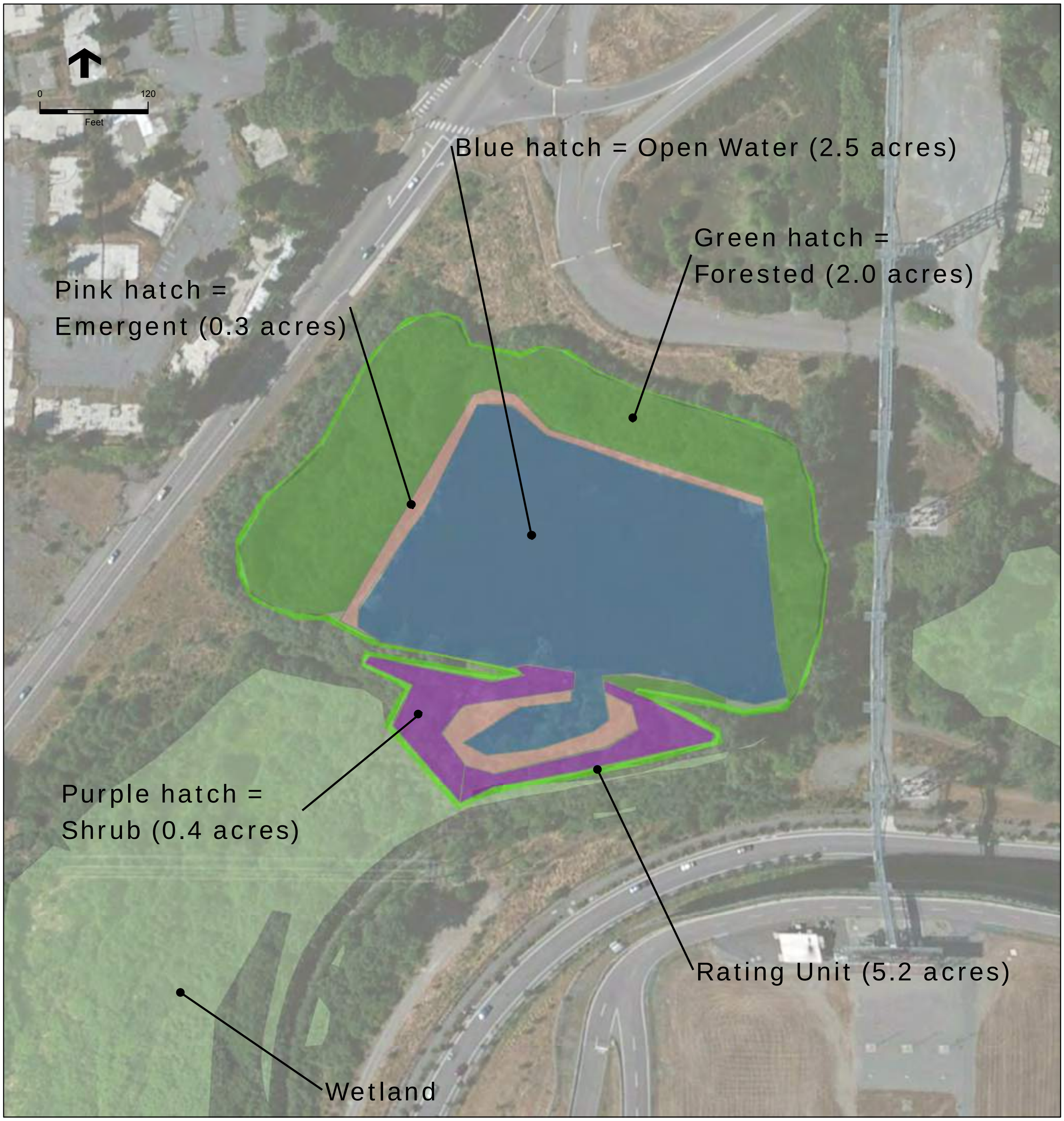


SOURCE:

Project . 140009

Figure x

Credit - Debit - Proposed Depresional Areas



SOURCE:

Project . 140009

Figure x

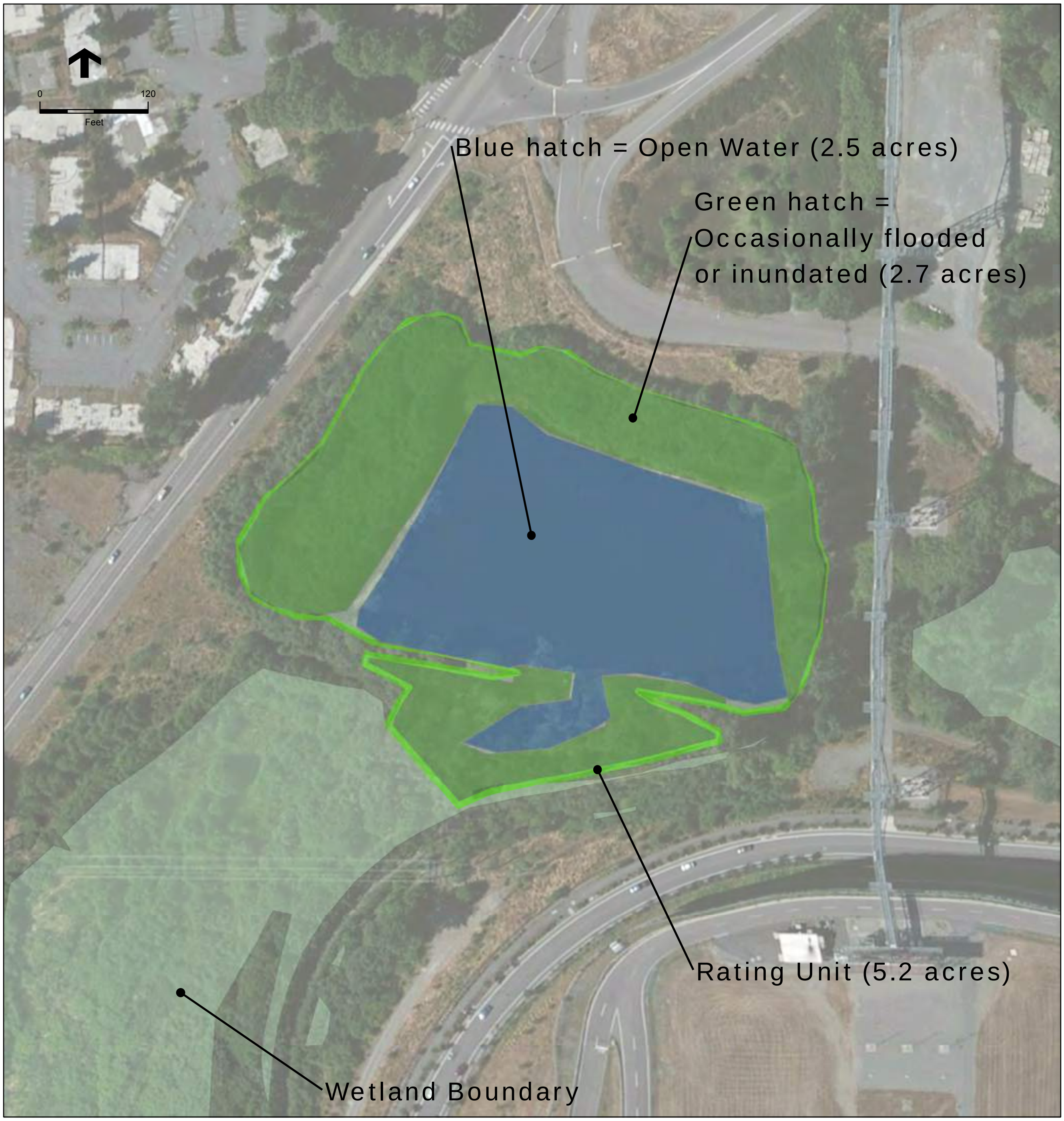
Credit - Debit - Plant Communities

SOURCE:

Project . 140009

Figure x

Credit - Debit - Proposed Plant Communities

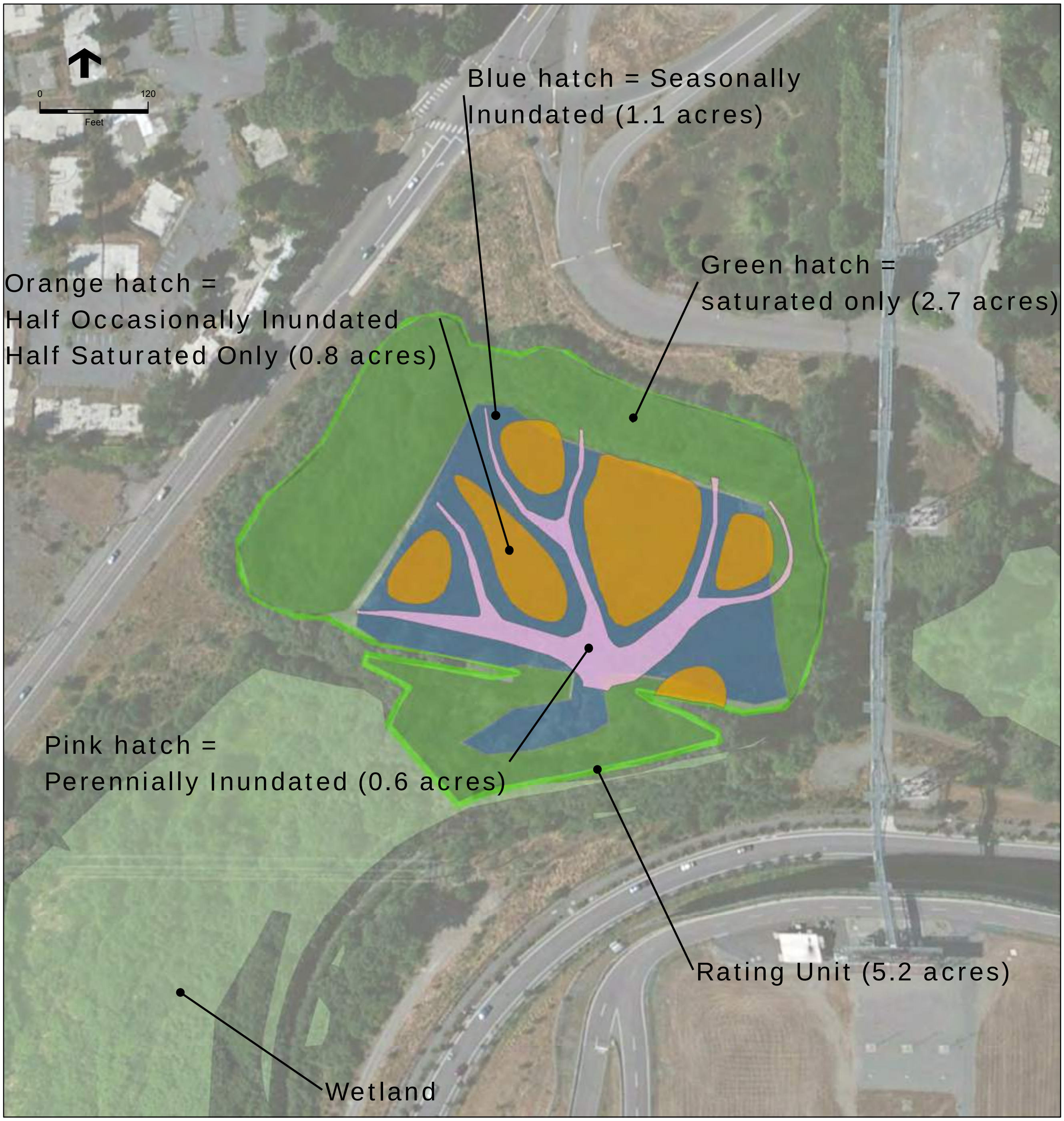


SOURCE:

Project . 140009

Figure x

Credit - Debit - Existing Hydroperiods



SOURCE:

Project . 140009

Figure x

Credit - Debit - Post-Rehabilitation Hydroperiods

SOURCE:

Project . 140009

Figure x

Credit - Debit - Urban Cover Within 150 ft of unit Patterns

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APPENDIX C:
CREDIT-DEBIT EXCEL CALCULATOR

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Calculating Credits and Debits for Compensatory Mitigation in Wetlands of Western Washington

Debit Worksheet (corrected 5/5/13) **Project** Lora Lake MTCA Action

Mitigation Project is: Advanced________ Concurrent____x_____ Delayed_________

Only fill in boxes that are highlighted. Use table for Temporal Loss Factors from the table below (Appendix E)

Input Ratings for Functions from Scoring Sheet

	Wetland Unit Altered (#1)			**Wetland Unit Altered (#2)**			**Wetland Unit Altered (#3)**		
	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat
Site Potential (H,M,L)	M	M	M						
Landscape Potential (H,M,L)	H	M	M						
Value (H,M,L)	H	M	H						
Score for Wetland Unit	8	6	7	3	3	3	3	3	3
Acres of **non-forested** areas impacted									
Basic mitigation requirement (BMR)	0	0	0	0	0	0	0	0	0
Temporal loss factor (see below)									
DEBITS	0	0	0	0	0	0	0	0	0
Acres of Deciduous **forest** impacted	0.21								
Basic mitigation requirement (BMR)	1.68	1.26	1.47	0	0	0	0	0	0
Temporal loss factor	1.75								
DEBITS	2.94	2.205	2.5725	0	0	0	0	0	0
Acres of **Evergreen Forest** impacted									
Basic mitigation requirement (BMR)	0	0	0	0	0	0	0	0	0
Temporal loss factor (see below)									

DEBITS	0	0	0	0	0	0	0	0	0
Acres of **Cat. 1 Deciduous forest**									
Basic mitigation requirement (BMR)	0	0	0	0	0	0	0	0	0
Temporal loss factor (see below)									
DEBITS	0	0	0	0	0	0	0	0	0
Acres of **Cat. 1 Evergreen forest**									
Basic mitigation requirement (BMR)	0	0	0	0	0	0	0	0	0
Temporal loss factor (see below)									
DEBITS	0	0	0	0	0	0	0	0	0

TOTALS

	Wetland Unit Altered (#1)			**Wetland Unit Altered (#2)**			**Wetland Unit Altered (#3)**		
Function	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat
Acre-points	**2.94**	**2.205**	**2.5725**	**0**	**0**	**0**	**0**	**0**	**0**

Total Debits by Function	Improving Water Quality	Hydrologic	Habitat
Acre-points	**2.94**	**2.205**	**2.5725**

Timing of Mitigation	**Temporal Loss Factor**
Advance – At least two years has passed since plantings were completed or one year since "as-built" plans were submitted to regulatory agencies	1.25
Concurrent – Physical alterations at mitigation site are completed within a year of the impacts, but planting may be delayed by up to 2 years if needed to optimize conditions for success.	
For impacts to an emergent or shrub community	1.5
For impacts to a deciduous forested wetland community	2.0
For impacts to an evergreen forested wetland community	2.5
For impacts to a deciduous Category I forested wetland community	3
For impacts to an evergreen Category I forested wetland community	3.5
Delayed - Construction is not completed within one year of impact, but is completed (including plantings if required) within 5 growing seasons of impact.	
For impacts to an emergent or shrub community	3
For impacts to a deciduous forested wetland community	4
For impacts to an evergreen forested wetland community	5
For impacts to a deciduous Category I forested wetland community	6

Calculating Credits and Debits for Compensatory Mitigation in Wetlands of Western Washington

Credit Worksheet (corrected 5/6/13) **Project** Lora Lake

Only fill in boxes that are highlighted. Use risk factors from Appendix E.

Mitigation Project is: Advanced_______ Concurrent_X________

This spreadsheed can calculate credits for three separate mitigation sites.

Input Ratings for Functions from Scoring Sheet.

	Site 1			Site 2			Site 3		
Insert a "1" in cell if creation or re-establishment									
Rating of Unit BEFORE mitigation	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat
Site Potential (H,M,L)	M	M	M	L	L	L			
Landscape Potential (H,M,L)	H	M	M	H	M	M			
Value (H,M,L)	H	M	H	L	L	L			
Score for Wetland Unit	8	6	7	5	4	4	3	3	3

	Site 1			Site 2			Site 3		
Rating of Unit AFTER mitigation	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat
Site Potential (H,M,L)	H	H	H	H	H	H			
Landscape Potential (H,M,L)	H	M	M	H	M	M			
Value (H,M,L)	H	M	H	H	M	M			
Score for Wetland Unit	9	7	8	9	7	7	3	3	3
Lift in Functions	1	1	1	4	3	3	0	0	0

CREATION and RE-ESTABLISHMENT									
Acres created or re-established **(aquatic bed, shrub, forest)**									
Basic mitigation Credit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Risk Factor (see Appendix E)									
CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acres created or re-established (**emergent**)									
Basic mitigation Credit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Risk Factor (see Appendix E)									
CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
REHABILITATION AND ENHANCEMENT									
Acres rehabilitated or enhanced (**aquatic bed, shrub, forest)**	2.8			0.2					
Basic mitigation Credit	2.8	2.8	2.8	0.8	0.6	0.6	0.0	0.0	0.0
Risk Factor (see Appendix E)	0.9			0.9					
CREDITS	2.5	2.5	2.5	0.8	0.6	0.6	0.0	0.0	0.0
Acres rehabilitated or enhanced (**emergent**)									
Basic mitigation Credit	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Risk Factor (see Appendix E)									
CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
PRESERVATION									
Acres of **wetlands preserved**									

Score for wetland functions from Scoring Sheet									
Sum of scaling factors (Appendix E)									
CREDITS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
Acres of **upland preserved**									
Habitat score for upland									
Sum of scaling factors (Appendix E)									
CREDITS			0.0			0.0			0.0

TOTALS

	Site 1			Site 2			Site 3		
Function	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat	Improving Water Quality	Hydrologic	Habitat
Acre-points	**2.5**	**2.5**	**2.5**	**0.8**	**0.6**	**0.6**	**0.0**	**0.0**	**0.0**

Total Credits by Function for Project	Improving Water Quality	Hydrologic	Habitat
Acre-points	**3.3**	**3.1**	**3.1**

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APPENDI□ D:
60□ DESIGN SHEETS

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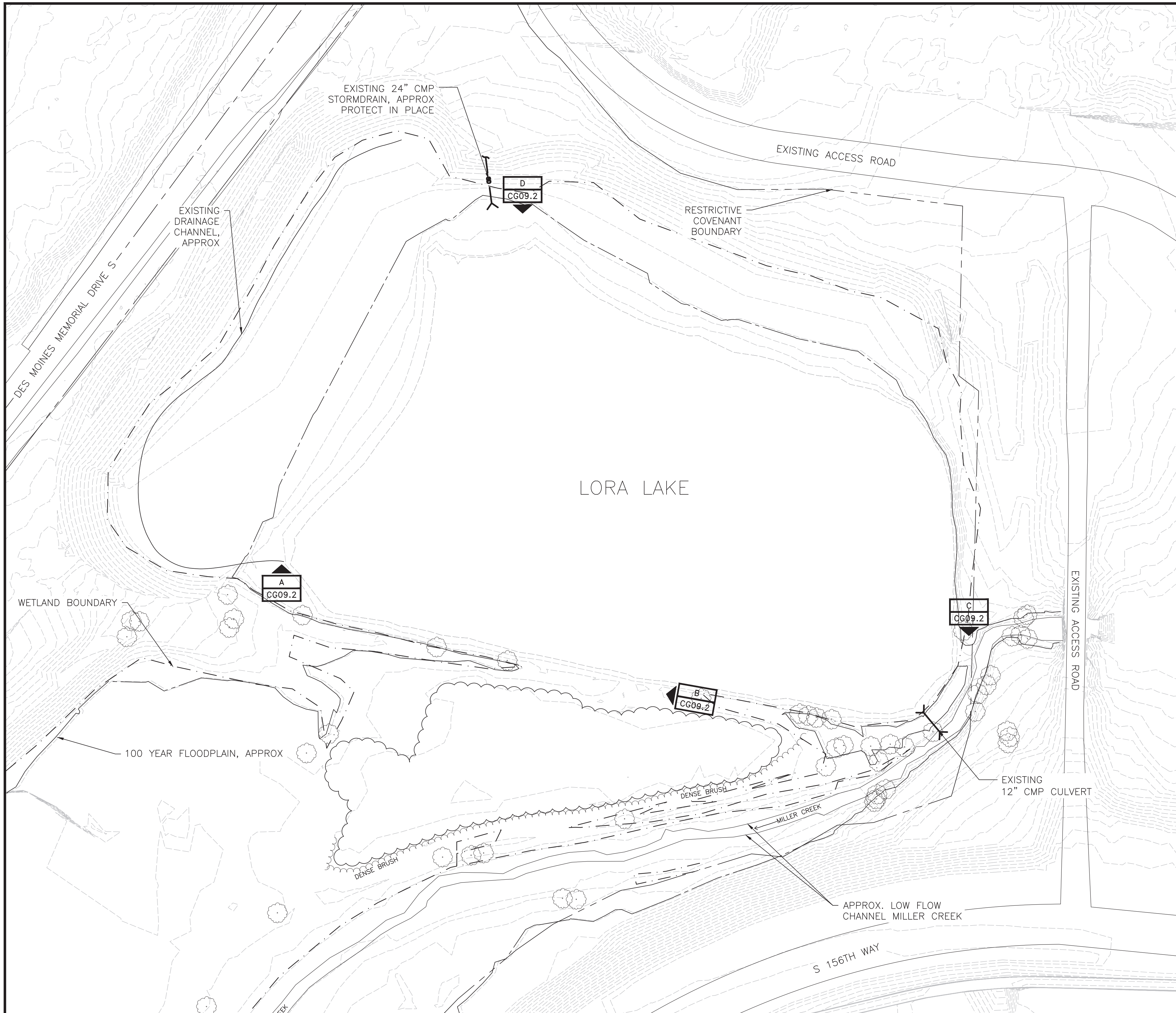

NOTES:

1. 60% DRAFT NOT FOR CONSTRUCTION
2. EXISTING CONDITION WILL BE POST CAP AND INITIAL FILL (APPROX. ELEVATION 266.0), SEE SHEETS CG08.1 & CU03.1

N

1"=40'-0" 40 0 40 80
Scale Feet

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH: RB
DESIGNER: SW
DRAWN BY: SW
SCALE: AS SHOWN
DATE: 12/07/2015
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

RYAN S. BARTELHEIMER, STATE OF WASHINGTON, 36565, REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
.	.	.	.	.	.	.	.	.	.
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POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE: 1"=40'-0"
POS DATE: 2/8/2016
POS CHECKED/APPROVED BY: NAME

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION

SHEET TITLE: LORA LAKE WETLAND
OVERVIEW

POS WORK PROJECT NUMBER
104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG09.1

PHOTO CG09.1
A – EXISTING DRAINAGE CHANNEL

PHOTO CG09.1
B – SOUTH LAKE BERM LOW SPOT

PHOTO CG09.1
C – EAST LAKE BERM AT CULVERT

PHOTO CG09.1
D – EXISTING STORMWATER OUTFALL

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P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH:	RB
DESIGNER:	SW
DRAWN BY:	SW
SCALE:	NA
DATE:	12/07/2015
CHECKED BY:	NAME
CHECKED/APPROVED BY:	NAME

RYAN S. BARTELHEIMER STATE OF WASHINGTON 36046 REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.
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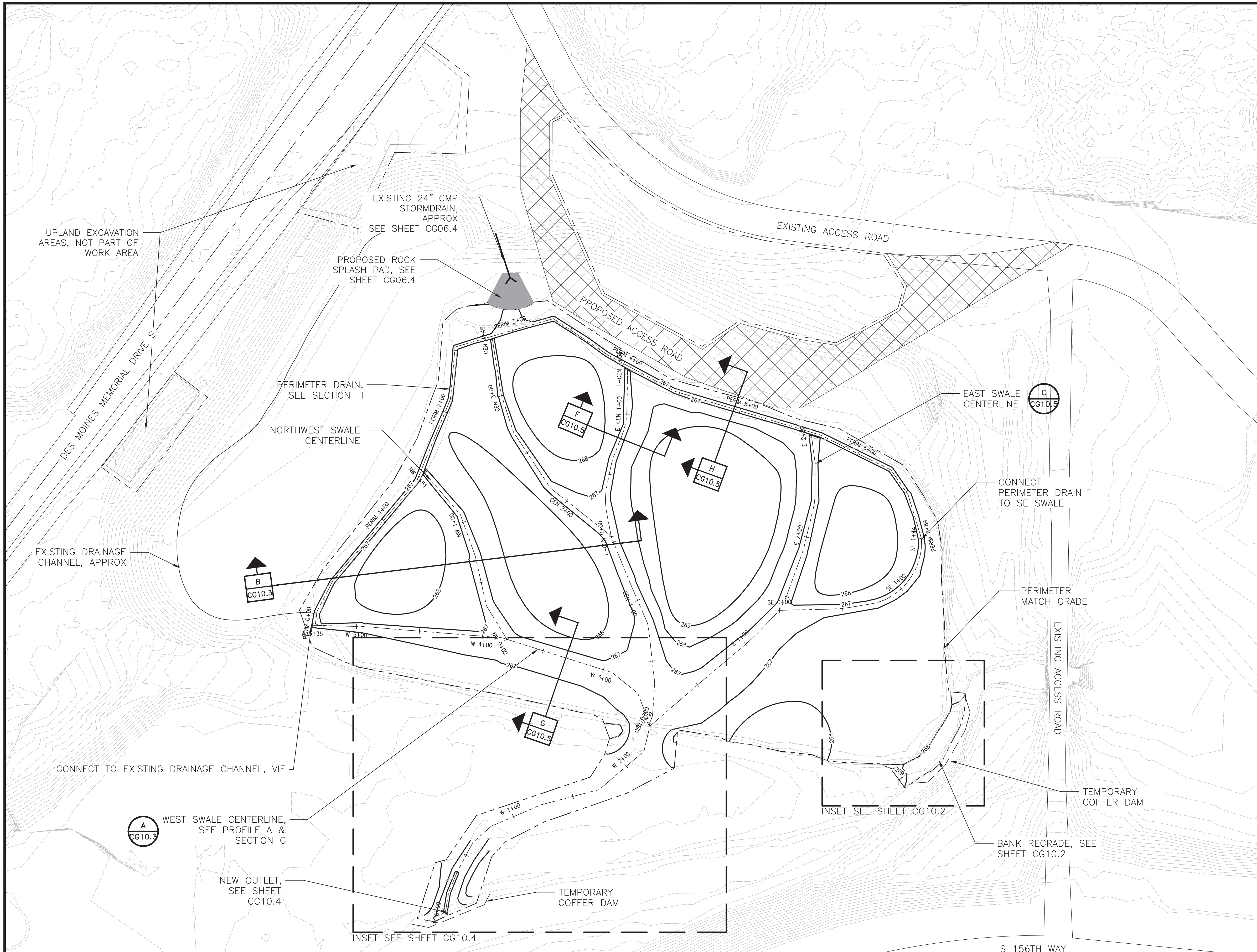
POS PROJECT MANAGER:	JANENE AXT
POS PROJECT ENGINEER:	NAME
POS DESIGN ENGINEER:	NAME
POS DRAFTER:	NAME
POS SCALE:	NA
POS DATE:	2/8/2016
POS CHECKED/APPROVED BY:	NAME

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION

SHEET TITLE: **LORA LAKE WETLAND PHOTOS**

POS WORK PROJECT NUMBER
104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG09.2



NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.
2. CLEARING LIMITS NOT SHOWN
3. EXISTING CONDITION WILL BE POST CAP AND INITIAL FILL (APPROX. ELEVATION 266.0)
4. STAKE GRADES FOR APPROVAL
5. ACCESS ROAD WILL BE INSTALLED IN SEASON 1
6. WETLAND REGRADING TO BE IMPLEMENTED IN SEASON 2

SWALE CONTROL LINE STATIONS:

1.	WEST SWALE:	W
2.	NORTHWEST SWALE:	NW
3.	CENTRAL SWALE:	CEN
4.	EAST CENTRAL SWALE:	E_CEN
5.	EAST SWALE:	E
6.	SOUTHEAST SWALE:	SE
7.	PERIMETER DRAIN:	PERIM

N

1"=40'–0" 40 0 40 80
Scale Feet

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH:	RB
DESIGNER:	SW
DRAWN BY:	EB
SCALE:	1"=40'–0"
DATE:	RELEASE
CHECKED BY:	NAME
CHECKED/APPROVED BY:	NAME

RYAN S. BARTELHEIMER STATE OF WASHINGTON 36565 REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.
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POS PROJECT MANAGER:	JANENE AXT
POS PROJECT ENGINEER:	NAME
POS DESIGN ENGINEER:	NAME
POS DRAFTER:	NAME
POS SCALE:	1"=40'–0"
POS DATE:	BID
POS CHECKED/APPROVED BY:	NAME

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

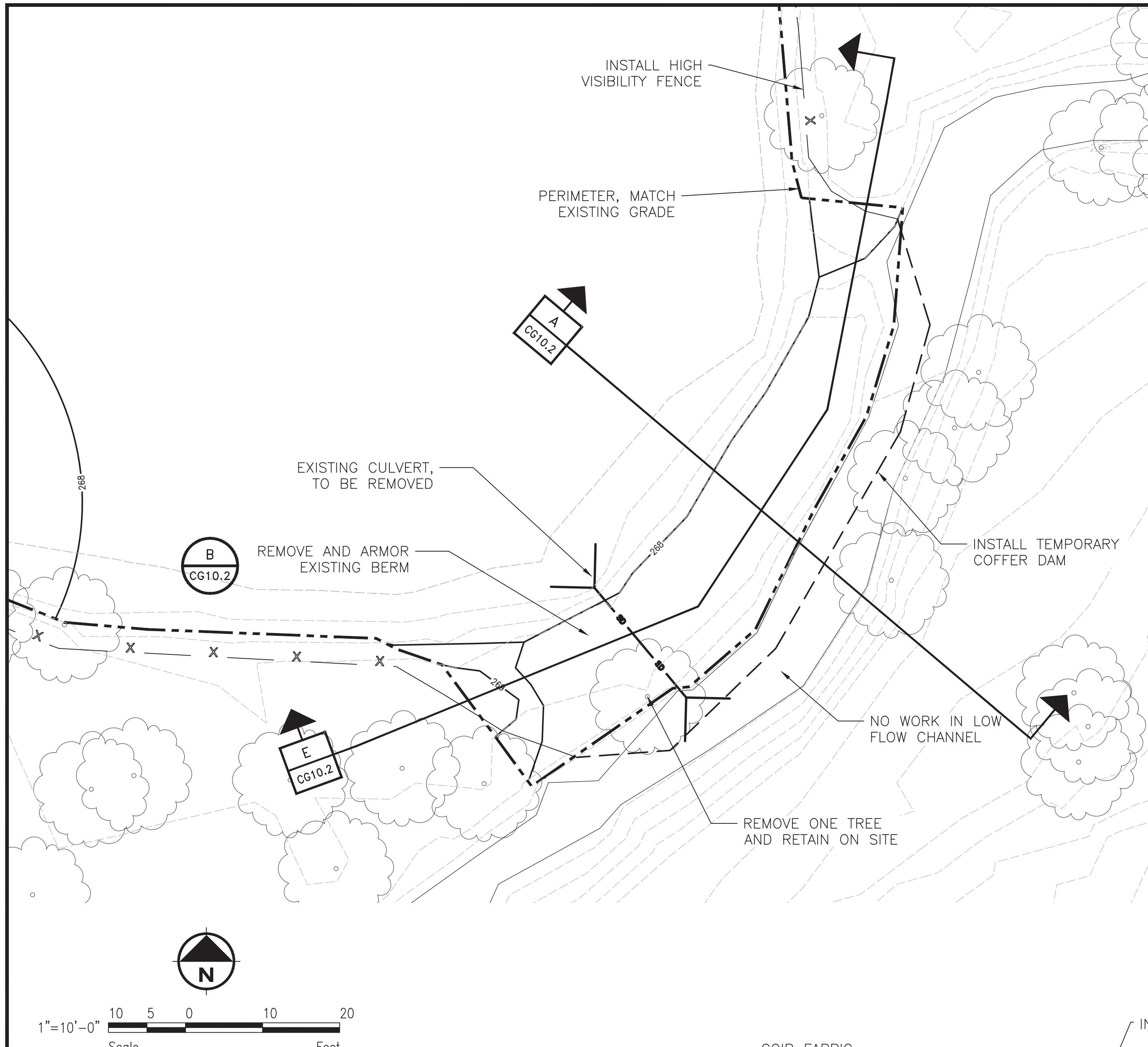
PROJECT NAME: **LORA LAKE APARTMENTS SITE**
MTCA REMEDIAL ACTION

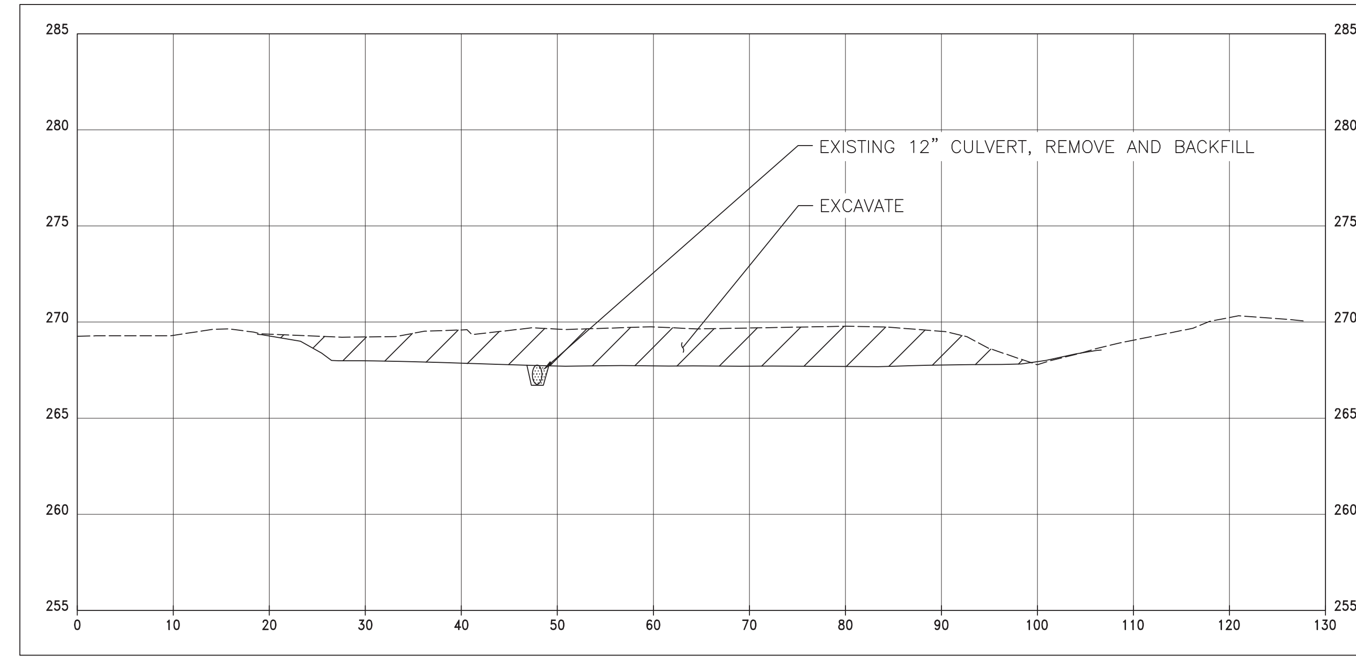
SHEET TITLE: **LORA LAKE WETLAND**
FINAL GRADING PLAN

POS WORK PROJECT NUMBER
104396

CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL

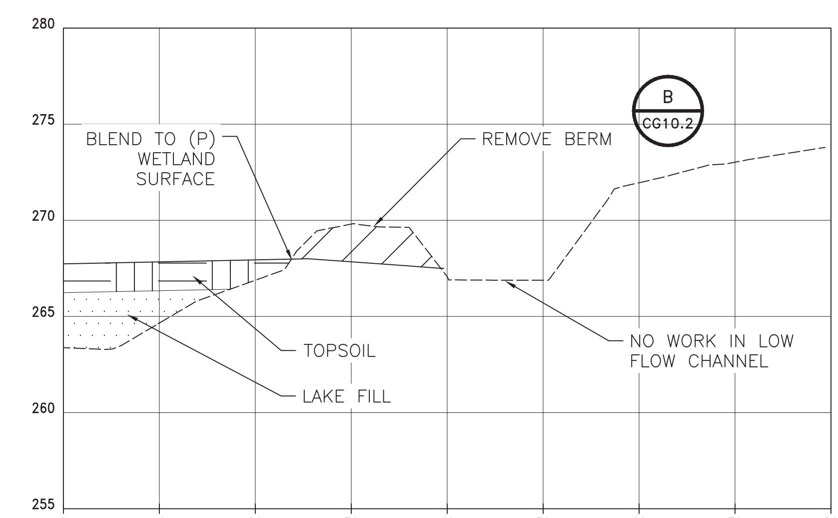
POS PROJECT TRACKING NUMBER
STIA-1701 CG10.1





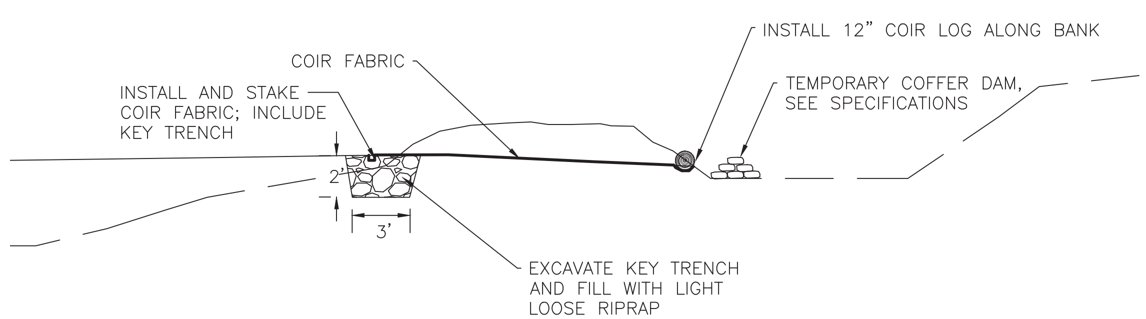
SECTION E CG10.2

MILLER CREEK BANK GRADING
H: 1" = 10'
V: 1" = 5'



SECTION A CG10.2

MILLER CREEK BANK GRADING
H: 1" = 10'
V: 1" = 5'



DETAIL B CG10.2

BANK PROTECTION DETAIL
1" = 5'

NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.
2. TO BE COMPLETED IN SEASON 2

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PROJECT ENGR./ARCH:	RB
DESIGNER:	SW
DRAWN BY:	EB
SCALE:	AS SHOWN
DATE:	RELEASE
CHECKED BY:	NAME
CHECKED/APPROVED BY:	NAME

PRELIMINARY

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NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC					

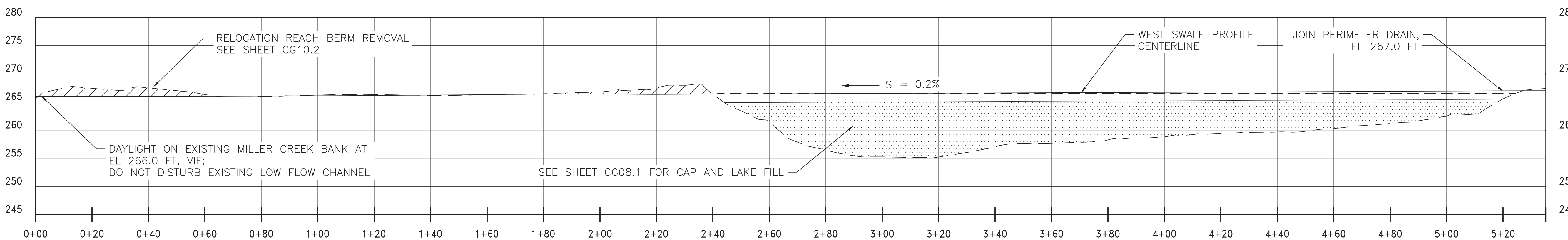
POS PROJECT MANAGER:	JANENE AXT
POS PROJECT ENGINEER:	NAME
POS DESIGN ENGINEER:	NAME
POS DRAFTER:	NAME
POS SCALE:	1"=10-0"
POS DATE:	BID
POS CHECKED/APPROVED BY:	NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION

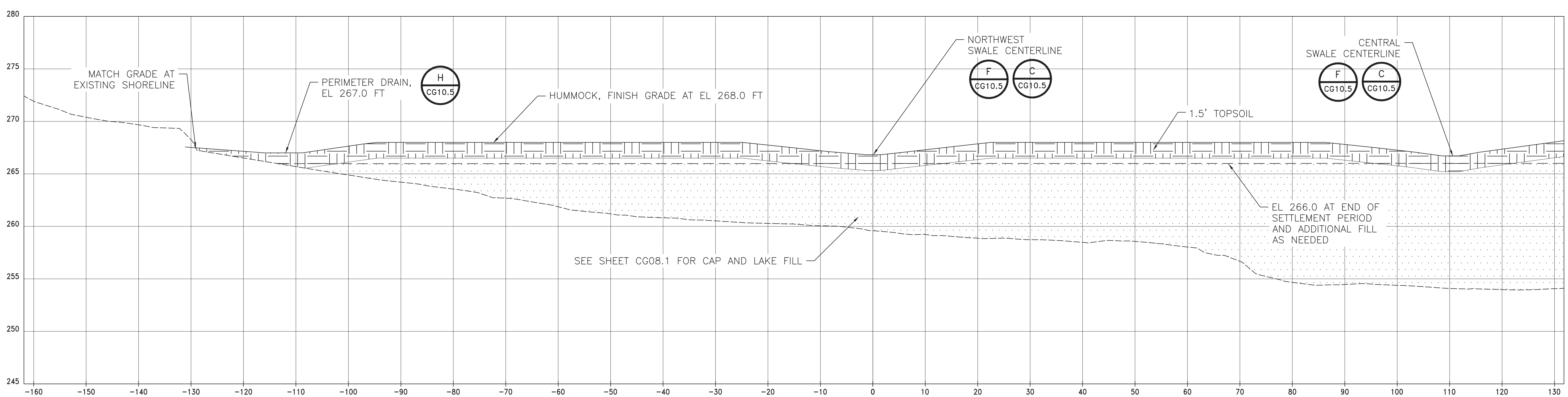
SHEET TITLE: LORA LAKE WETLAND
GRADING SECTIONS - SHEET 1

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG10.2



PROFILE A / CG10.1

WEST SWALE
H: 1" = 20'
V: 1" = 10'



SECTION B / CG10.1

WETLAND REHABILITATION, TYPICAL
H: 1" = 10'
V: 1" = 5'

NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.

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PROJECT ENGR./ARCH: RB
DESIGNER: SW
DRAWN BY: EB
SCALE: AS SHOWN
DATE: RELEASE
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

PRELIMINARY

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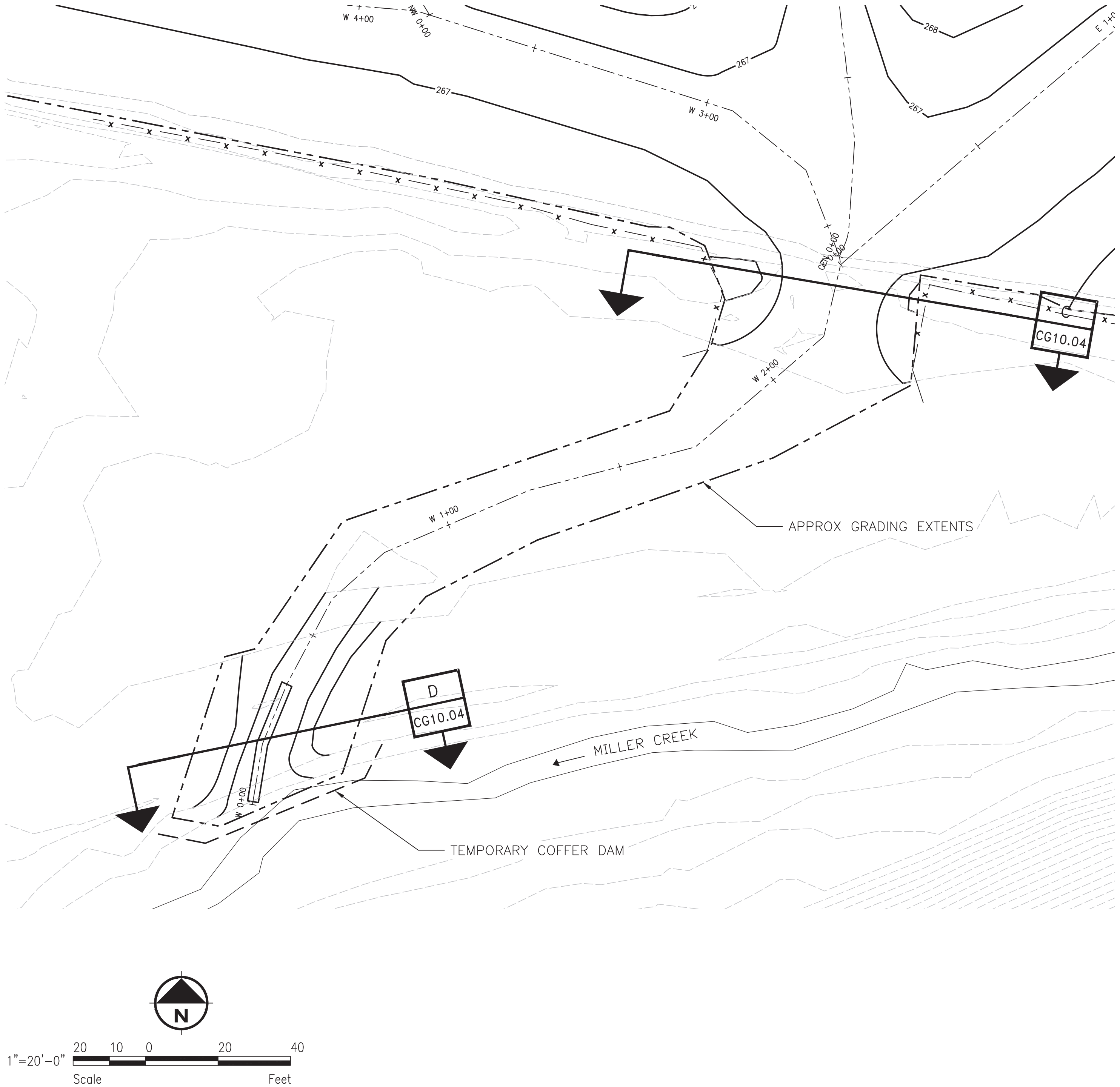
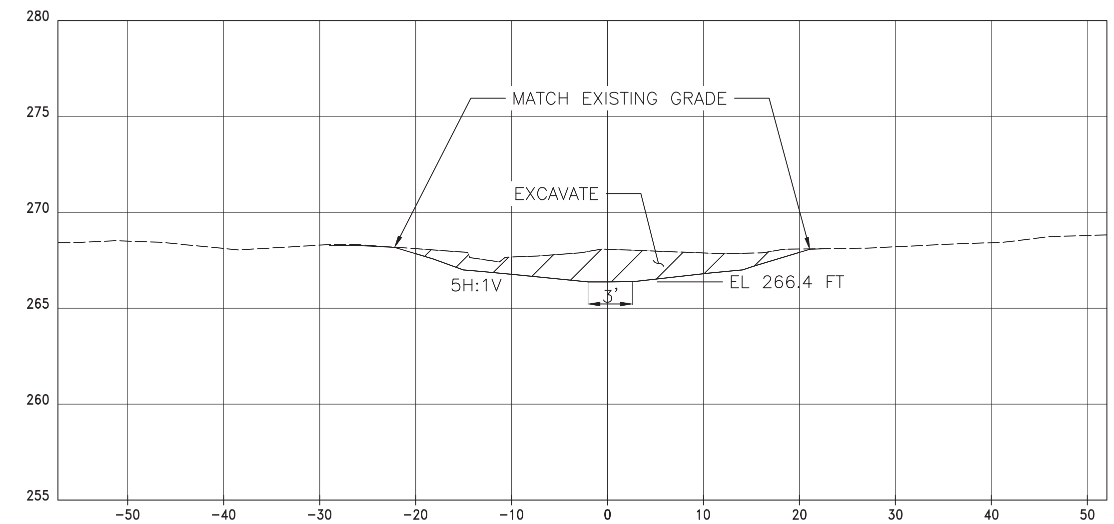
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.

POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE: 1"=40'-0"
POS DATE: BID
POS CHECKED/APPROVED BY: NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION
SHEET TITLE: LORA LAKE WETLAND
GRADING SECTIONS - SHEET 2

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG10.3

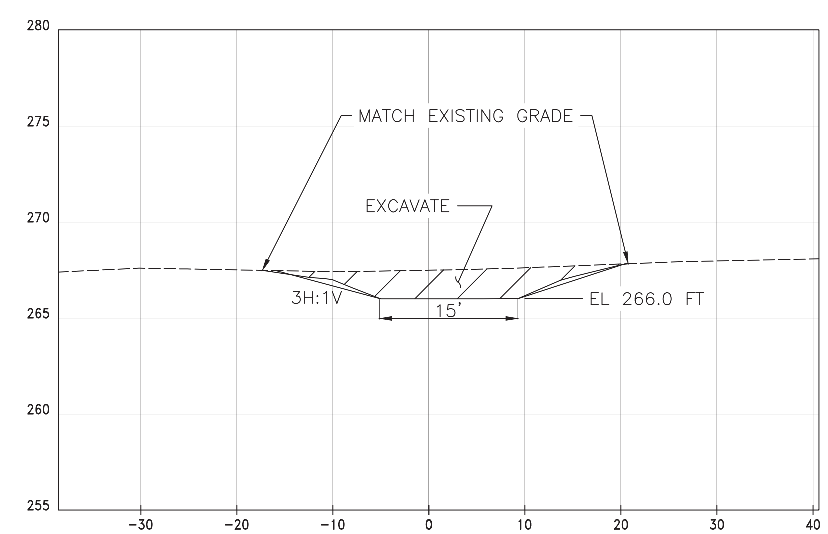




SECTION C

CG10.4

SOUTHERN LAKE BERM BREACH
H: 1" = 10'
V: 1" = 5'



SECTION D

CG10.4

NEW OUTLET
H: 1" = 10'
V: 1" = 5'

NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.

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PROJECT ENGR./ARCH:	RB
DESIGNER:	SW
DRAWN BY:	EB
SCALE:	AS SHOWN
DATE:	RELEASE
CHECKED BY:	NAME
CHECKED/APPROVED BY:	NAME

RYAN R. BARTELHEIMER STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER
PRELIMINARY

REVISIONS

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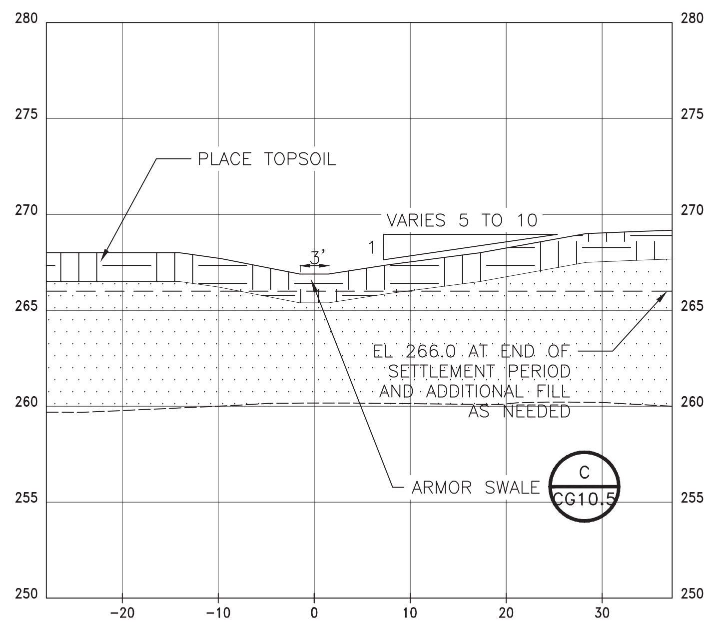
1	00-00-00	ABC	REVISION TO	ABC	.	.	.	.	.

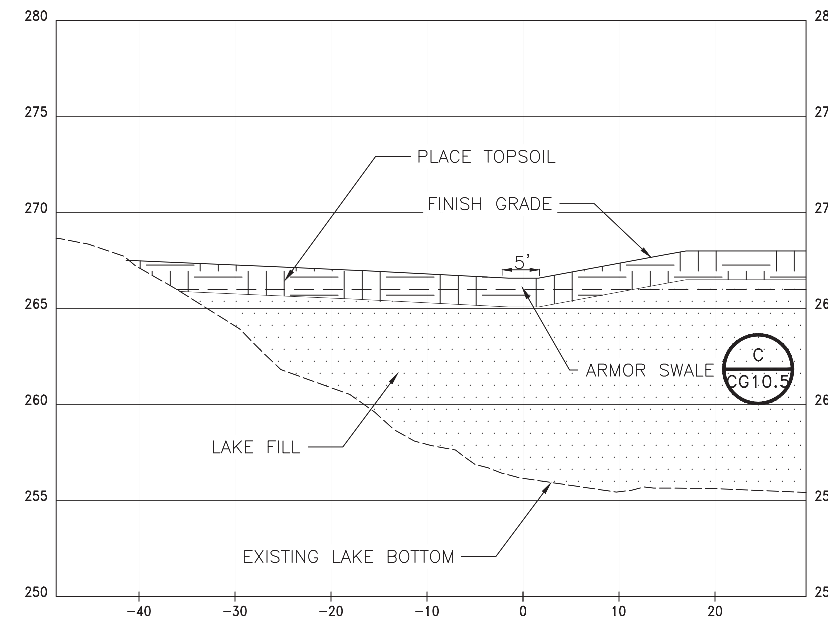
POS PROJECT MANAGER:	JANENE AXT
POS PROJECT ENGINEER:	NAME
POS DESIGN ENGINEER:	NAME
POS DRAFTER:	NAME
POS SCALE:	
POS DATE:	BID
POS CHECKED/APPROVED BY:	NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION
SHEET TITLE: LORA LAKE WETLAND
GRADING SECTIONS - SHEET 3

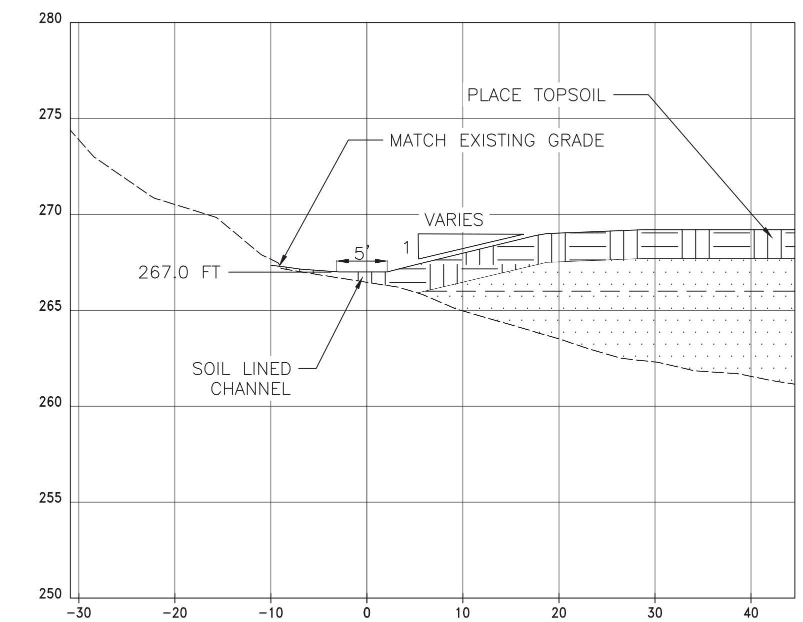
POS WORK PROJECT NUMBER
104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG010.04



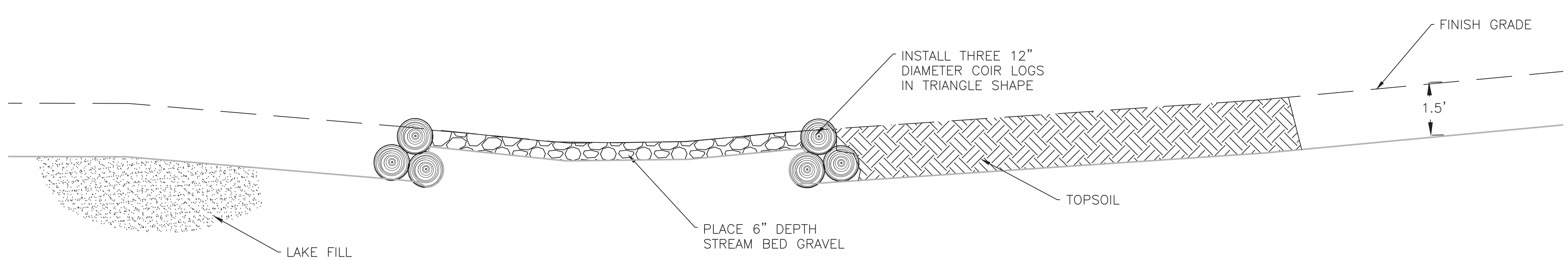
SECTION F
SMALL DRAINAGE SWALE, TYP
H: 1" = 10'
V: 1" = 5'
CG10.1



SECTION G
LARGE DRAINAGE SWALE, TYP
H: 1" = 10'
V: 1" = 5'
CG10.1



SECTION H
PERIMETER DRAIN, TYP
H: 1" = 10'
V: 1" = 5'
CG10.1



DETAIL C
SWALE DETAIL
1" = 2'
CG10.1

NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.

ESA
5309 Shilshole Ave NW
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PROJECT ENGR./ARCH: RB
DESIGNER: SW
DRAWN BY: EB
SCALE: AS SHOWN
DATE: RELEASE
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

PRELIMINARY

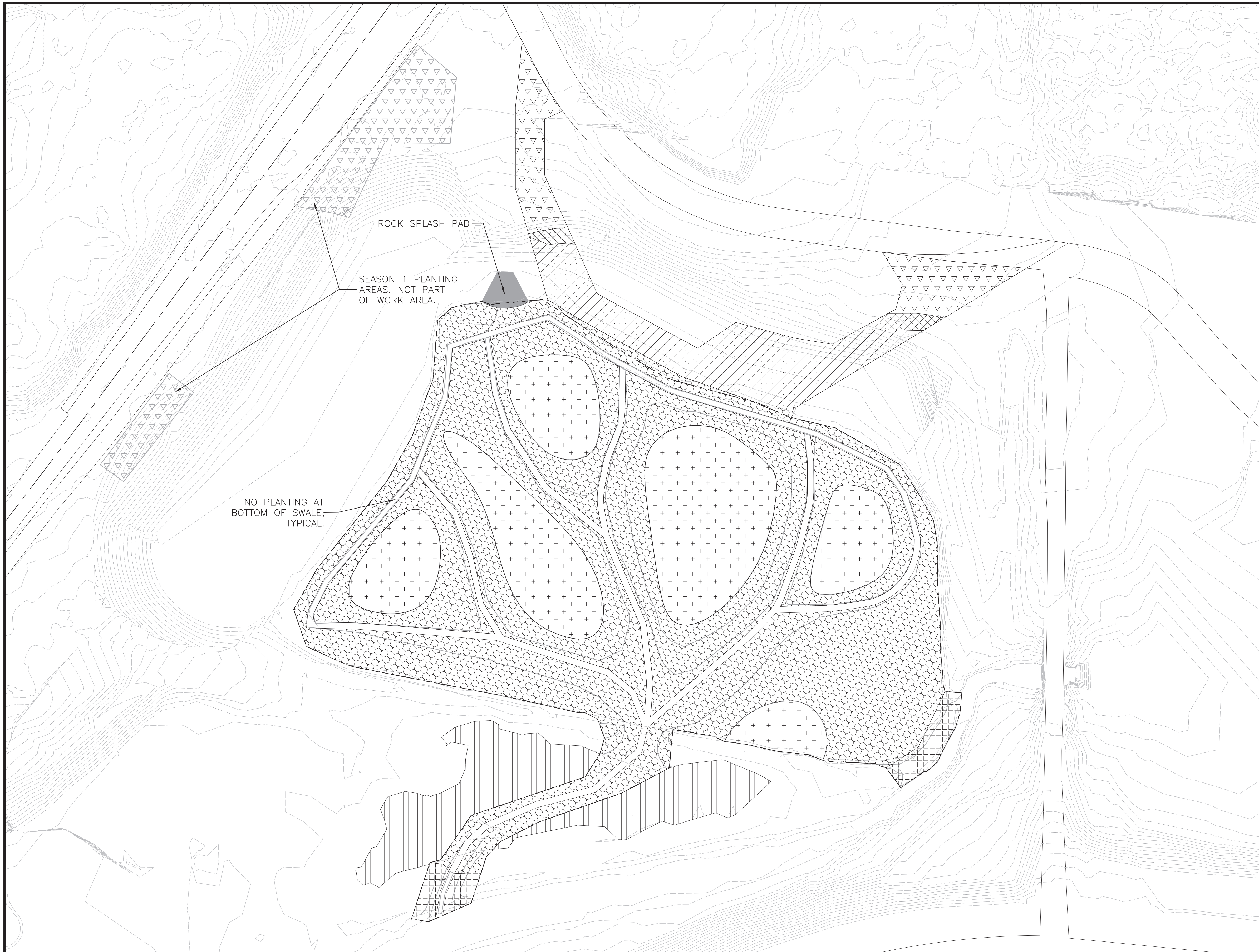
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.

POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE:
POS DATE: BID
POS CHECKED/APPROVED BY: NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION
SHEET TITLE: LORA LAKE WETLAND
GRADING SECTIONS - SHEET 4

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG10.5



LEGEND

- WETLAND SHRUB COMMUNITY 1
- WETLAND SHRUB COMMUNITY 2
- RIPARIAN FOREST COMMUNITY
- RIPARIAN INFILL COMMUNITY
- FLOODPLAIN ZONE #1
- FLOODPLAIN ZONE #2
- UPLAND PLANTING ZONE #3

NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.
2. SEE SHEET LZ01.1 FOR PLANT SCHEDULE AND TYPICAL PLANTING DETAILS.
3. SEE SHEET CG08.1 FOR DETAILS ON SEASON 1 PLANTING AREAS.

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH: RB
DESIGNER: CL
DRAWN BY: GB
SCALE: 1"=40'-0"
DATE: RELEASE
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

PRELIMINARY
STATE OF WASHINGTON LICENSED LANDSCAPE ARCHITECT
CURTIS LAPIERRE
LICENSE NO. 474
EXPIRES ON 06/30/2017

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.
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POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE: 1"=40'-0"
POS DATE: BID
POS CHECKED/APPROVED BY: NAME

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: LORA LAKE APARTMENTS SITE MTCA REMEDIAL ACTION

SHEET TITLE: LORA LAKE WETLAND SEASON 2 PLANTING PLAN

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 LP01.1

PLANT SCHEDULE

WETLAND SHRUB COMMUNITY 1			
COMMON NAME	BOTANICAL NAME	SIZE	SPACING (FT,OC)
TREES			
BLACK COTTONWOOD	POPULUS BALSAMIFERA SSP. TRICHOCARPA	48" LIVE STAKE	12
OREGON ASH	FRAXINUS LATIFOLIA	1 GAL	12
PACIFIC WILLOW	SALIX LUCIDA SSP. LASISANDRA	48" LIVE STAKE	4
SHRUBS			
HARDHACK SPIREA	SPIRAEA DOUGLASII	BARE ROOT	4
HOOKER'S WILLOW	SALIX HOOKERIANA	48" LIVE STAKE	2
REDOSIER DOGWOOD	CORNUS SERICEA	48" LIVE STAKE	2
SITKA WILLOW	SALIX SITCHENSIS	48" LIVE STAKE	2
EMERGENTS			
BIGLEAF SEDGE	CAREX AMPLIFOLIA	PLUG	1
MEADOW SEDGE	CAREX PRACTICOLA	PLUG	1
SAWBEAK SEDGE	CAREX STIPATA	PLUG	1
WOOLY SEDGE	SCIRPUS ATROCINCTUS	PLUG	1

WETLAND SHRUB COMMUNITY 2			
COMMON NAME	BOTANICAL NAME	SIZE	SPACING (FT,OC)
TREES			
OREGON ASH	FRAXINUS LATIFOLIA	1 GAL	12
PACIFIC WILLOW	SALIX LUCIDA SSP. LASISANDRA	48" LIVE STAKE	2
SITKA SPRUCE	PICEA SITCHENSIS	1 GAL	12
SHRUBS			
PACIFIC NINEBARK	PHYSOCARPUS CAPITATUS	BARE ROOT	8
REDOSIER DOGWOOD	CORNUS SERICEA	48" LIVE STAKE	2
SCOULER WILLOW	SALIX SOULERIANA	48" LIVE STAKE	2
SWAMP ROSE	ROSA PISOCARPA	BARE ROOT	4

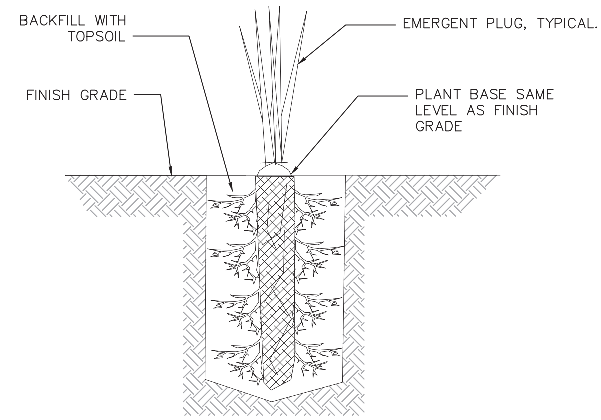
RIPARIAN FOREST COMMUNITY			
COMMON NAME	BOTANICAL NAME	SIZE	SPACING (FT,OC)
TREES			
BLACK COTTONWOOD	POPULUS BALSAMIFERA SSP. TRICHOCARPA	48" LIVE STAKE	4
OREGON ASH	FRAXINUS LATIFOLIA	1 GAL	12
PACIFIC WILLOW	SALIX LUCIDA SSP. LASISANDRA	48" LIVE STAKE	4
SHRUBS			
HOOKER'S WILLOW	SALIX HOOKERIANA	48" LIVE STAKE	4
REDOSIER DOGWOOD	CORNUS SERICEA	48" LIVE STAKE	4

RIPARIAN INFILL COMMUNITY			
COMMON NAME	BOTANICAL NAME	SIZE	SPACING (FT,OC)
TREES			
PACIFIC WILLOW	SALIX LUCIDA SSP. LASISANDRA	48" LIVE STAKE	4
SHRUBS			
HOOKER'S WILLOW	SALIX HOOKERIANA	48" LIVE STAKE	4
REDOSIER DOGWOOD	CORNUS SERICEA	LIVE STAKE	4

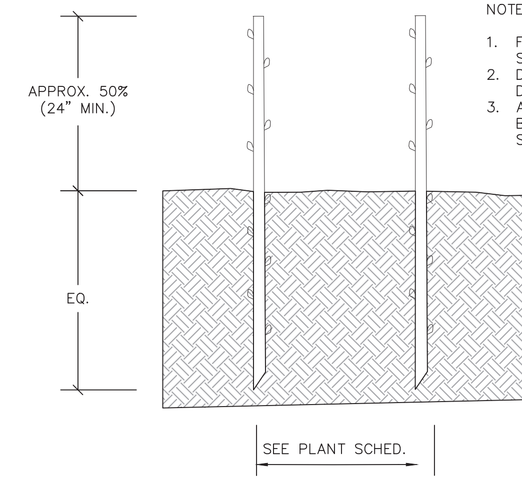
FLOODPLAIN ZONE #1 AND #2			
COMMON NAME	BOTANICAL NAME	SIZE	SPACING (FT,OC)
TREES			
SITKA SPRUCE	PICEA SITCHENSIS	1 GAL	12
WESTERN REDCEDAR	THUJA PLICATA	1 GAL	12
SHRUBS			
PACIFIC NINEBARK	PHYSOCARPUS CAPITATUS	1 GAL	4
PACIFIC WILLOW	SALIX LUCIA SPP. LASIANDRA	1 GAL	4
SCOULER'S WILLOW	SALIX SCOULERIANA	1 GAL	4
SITKA WILLOW	SALIX SITCHENSIS	1 GAL	4
HARDHACK SPIRAEA	SPIRAEA DOUGLASII	1 GAL	4

UPLAND PLANTING ZONE #3			
COMMON NAME	BOTANICAL NAME	SIZE	SPACING (FT,OC)
TREES			
GRAND FIR	ABIES GRANDIS	1 GAL	12
BIGLEAF MAPLE	ACER MACROPHYLLUM	1 GAL	12
RED ALDER	ALNUS RUBRA	1 GAL	8
SITKA SPRUCE	PICEA SITCHENSIS	1 GAL	12
BLACK COTTONWOOD	POPULUS BALSAMIFERA SSP. TRICHOCARPA	1 GAL	12
DOUGLAS-FIR	PSEUDOTSUGA MENZIESII	1 GAL	12
WESTERN REDCEDAR	THUJA PLICATA	1 GAL	12
WESTERN HEMLOCK	TSUGA HETEROPHYLLA	1 GAL	12
SHRUBS			
SCOULER'S WILLOW	SALIX SCOULERIANA	1 GAL	12
SITKA WILLOW	SALIX SITCHENSIS	1 GAL	4
HARDHACK SPIRAEA	SPIRAEA DOUGLASII	1 GAL	4

Note: Planting densities are under review and will be revised to match Mitigation Plan (ESA 2016) for the 90% submittal

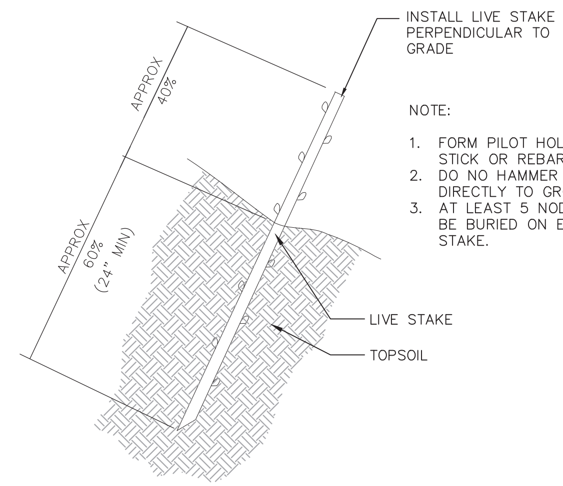


DETAIL 1 LZ01.1
TYPICAL EMERGENT PLUG PLANTING
NTS



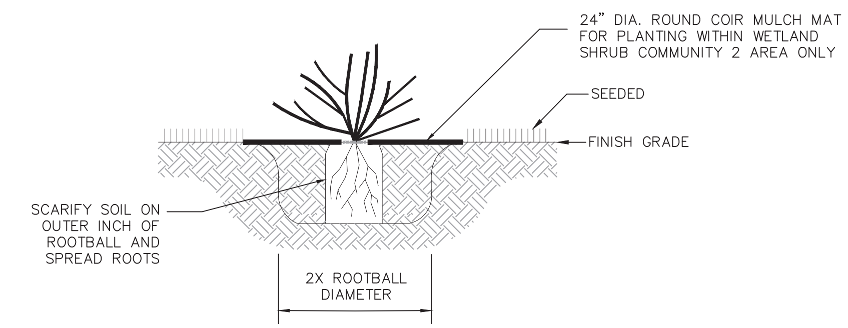
NOTE:
1. FORM PILOT HOLE USING A STICK OR REBAR.
2. DO NO HAMMER LIVESTAKE DIRECTLY TO GROUND.
3. AT LEAST 5 NODES SHALL BE BURIED ON EACH LIVE STAKE.

DETAIL 2 LZ01.1
TYPICAL LIVE STAKE PLANTING
NTS

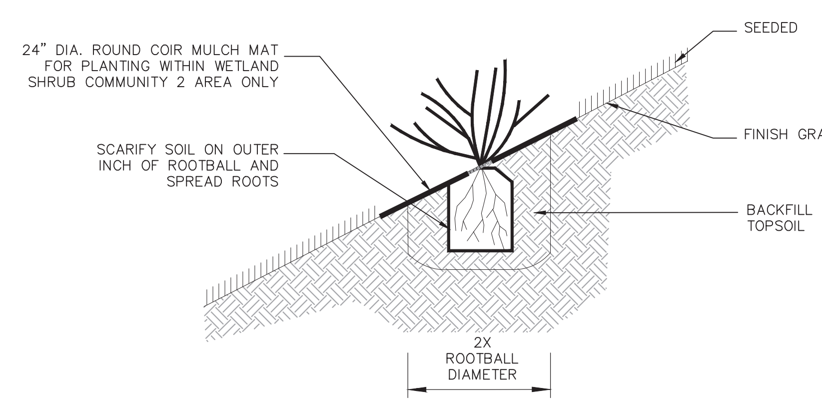


NOTE:
1. FORM PILOT HOLE USING A STICK OR REBAR.
2. DO NO HAMMER LIVESTAKE DIRECTLY TO GROUND.
3. AT LEAST 5 NODES SHALL BE BURIED ON EACH LIVE STAKE.

DETAIL 3 LZ01.1
TYPICAL LIVE STAKE PLANTING ON SLOPE
NTS

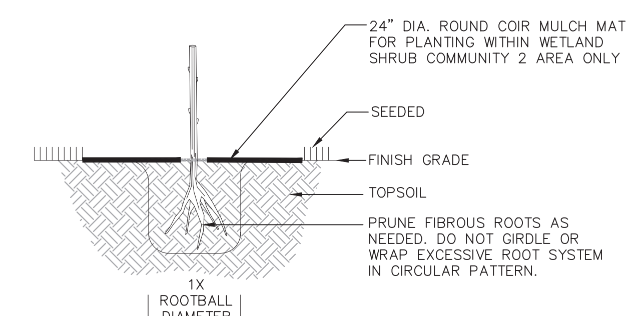


DETAIL 4 LZ01.1
TYPICAL CONTAINER PLANTING
NTS



DETAIL 5 LZ01.1
TYPICAL CONTAINER PLANTING ON SLOPE
NTS

NOTE:
1. BAREROOT SHALL BE DORMANT AT THE TIME OF INSTALLATION.
2. WATER BAREROOT THOROUGHLY ON THE SAME DAY OF PLANTING.



DETAIL 6 LZ01.1
TYPICAL BAREROOT PLANTING
NTS

NOTES:
1. 60% DRAFT – NOT FOR CONSTRUCTION.
2. SEE SPECIFICATIONS FOR DETAILS.

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
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PROJECT ENGR./ARCH: RB
DESIGNER: CL
DRAWN BY: GB
SCALE: NA
DATE: RELEASE
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

PRELIMINARY
STATE OF WASHINGTON LICENSED LANDSCAPE ARCHITECT
CURTIS LAPIERRE

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISION TO	ABC					

POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE: NA
POS DATE: BID
POS CHECKED/APPROVED BY: NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION
SHEET TITLE: LORA LAKE WETLANDS
PLANT SCHEDULE AND PLANTING DETAILS

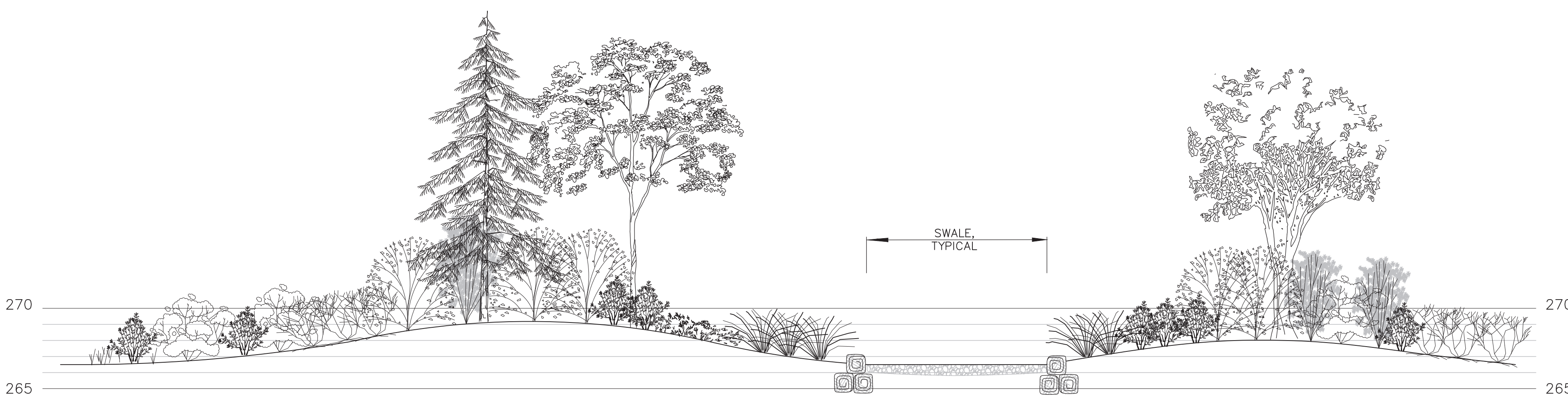
POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
LZ01.1

NOTES:

1. 60% DRAFT – NOT FOR CONSTRUCTION.
2. SEE SPECIFICATIONS FOR DETAILS.

(TO BE DEVELOPED)

DETAIL 1 / LZ01.2
TOPSOIL PREPARATION
NTS



SECTION 2 / LZ01.2
PROPOSED SOIL PROFILE AND PLANT COMMUNITIES
NTS

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH:	RB
DESIGNER:	CL
DRAWN BY:	GB
SCALE:	NA
DATE:	RELEASE
CHECKED BY:	NAME
CHECKED/APPROVED BY:	NAME

PRELIMINARY
STATE OF WASHINGTON LICENSED LANDSCAPE ARCHITECT
CURTIS LAPIERRE
LICENSE NO. 474
EXPIRES ON 06/30/2017

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISON TO	ABC	.	.	.	.	.
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POS PROJECT MANAGER:	JANENE AXT
POS PROJECT ENGINEER:	NAME
POS DESIGN ENGINEER:	NAME
POS DRAFTER:	NAME
POS SCALE:	NA
POS DATE:	BID
POS CHECKED/APPROVED BY:	NAME

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: **LORA LAKE APARTMENTS SITE MTCA REMEDIAL ACTION**

SHEET TITLE: **LORA LAKE WETLANDS TOPSOIL PREPARATION AND INSTALLATION**

POS WORK PROJECT NUMBER
104396

CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL

POS PROJECT TRACKING NUMBER
STIA-1701 LZ01.2

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technical memorandum

date May 12, 2016

to Robert Duffner, Port of Seattle
Don Robbins, Port of Seattle

from Eleanor Bartolomeo, PE, Project Engineer
Curtis Loeb, PE, Supervisory Engineer

subject Lora Lake Remedial Action -
Engineering Floodplain Analysis

Introduction

As part of the Lora Lake Remedial Action Project team (Port of Seattle, Floyd Snider, Aspect Consulting, and Environmental Science Associates (ESA)), ESA is responsible for developing plans to rehabilitate Lora Lake as a palustrine scrub-shrub wetland system as part of a remedial action under the Model Toxics Control Act (MTCA).

Lora Lake is located in the City of SeaTac, immediately adjacent to SeaTac International Airport. The current lake was created in the 1950s after the wetland formerly on the site was mined for peat. Lora Lake and portions of the neighboring upland area are contaminated with dioxin/furans from a former barrel-washing facility located in the upland area. This project will cap the contaminated sediments in the lake bottom, fill the lake with clean fill material (medium sand or coarser), and rehabilitate the filled surface to a palustrine scrub-shrub wetland. Converting the site from an open water feature to a scrub-shrub wetland will have the additional benefits of providing a significant functional lift to the local ecosystem and removing an existing source of warm, low quality water to Miller Creek. Additionally, this action will reduce the aviation hazards caused by the presence of waterfowl that are attracted to the open lake. Due to the high groundwater table of this area, in order to establish wetland vegetation on the site, portions of the soil surface of the proposed wetland will have to be raised above the current average lake elevation.

As the project is not located in a mapped floodway, a FEMA No-Rise Certification (NFIP 60.3(d)(3)) is not required. To meet local ordinance requirements and to protect public health and safety, we performed an Engineering Floodplain Analysis to determine that the proposed project will not cause increased flood risks as compared to current conditions. The purpose of this analysis is two-fold:

- Demonstrate no increase in the FEMA base flood elevation for Miller Creek, and

- Document substantive compliance with the City of SeaTac's critical areas code (15.700.210), which states that "development proposals shall not reduce the effective base flood storage volume of the floodplain."

The project extent includes the immediate vicinity of Lora Lake. The Vacca Farm mitigation area downstream will not be modified by this project. All elevations presented herein are in the North American Vertical Datum of 1988 (NAVD 88).

Existing Conditions

Miller Creek is located immediately to the southeast of Lora Lake and flows generally from northeast to southwest in this area. In 2004, Miller Creek was rerouted and habitat restoration actions were completed in its floodplain (Vacca Farm) as part of the Port of Seattle's Master Plan Update. Miller Creek currently flows in a narrow channel along the east side of its valley, separated from Lora Lake and the downstream Vacca Farm floodplain by a berm (design crest elevation 268.6 feet, settled unevenly) that is overtopped by the creek during major flood events. See Map 1, Existing Conditions[1]. Water passes from Lora Lake into Miller Creek through a 12-inch-diameter culvert with invert elevation 266.8 feet. Flow through the culvert is predominantly from the lake into the creek, but reverses direction during the rising limb of a flood. During high flow events, the creek also flows into the lake through a low point in the existing berm along the eastern side of the lake (east lake berm), weir elevation 267.8 feet.

Lora Lake currently receives municipal stormwater from an approximately 80-acre basin in the City of Burien, which enters the lake through a 24-inch-diameter outfall. The majority of this stormwater inflow will be rerouted prior to project construction and will no longer be discharged to the Lora Lake system.

Lora Lake is primarily a groundwater driven system with year-round base water levels corresponding to the regional water table. The lake levels were monitored in 2013 and 2014, during which the water surface elevation of the lake varied between 267.0 and 268.3 feet. Rain events caused short-lived surcharges in lake level, when Miller Creek flows and municipal stormwater entered the lake. After Miller Creek crested and then fell below the lake level, the lake surface dropped back to pre-event levels as water drained through the 12-inch-diameter culvert into Miller Creek.

Proposed Project Remedial Action Conditions

The proposed remedial action design caps the contaminated sediments with an organic carbon amended sand cap and fills the lake with clean fill material. The fill surface will be graded into a series of hummocks and swales with final elevations, including topsoil, ranging from 267 feet to 269 feet and will be planted with wetland species. The swales will convey groundwater seepage daylighting from the existing lake perimeter and overbank flows from Miller Creek southwards through the wetland to a proposed downstream outlet in the relocation berm and back to the creek. A second opening, approximately 100 feet long, will be cut in the low berm that separates the eastern edge of the lake from Miller Creek. This opening will increase interchange between Miller Creek and the rehabilitated wetland, See Map 2, Proposed Conditions.

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[1] The geographic extent of the floodplain shown on Map 1 does not match the draft FEMA floodplain extent (FEMA 2007) because the FEMA documentation does not reflect the changes made to the creek alignment as part of the Port's 2004 Master Plan Update. Instead the FEMA base flood elevation (268.6 ft) was used to delineate the floodplain based on the existing topography.

Analysis Procedure

ESA used the U.S. Army Corps of Engineers Hydrologic Engineering Center – River Analysis System (HEC-RAS) software version 4.1.0 to evaluate the base flood (100-yr) elevations along Miller Creek. The modeled domain runs from the outlet of the Reba Lake Detention Basin (upstream control structure), which is northeast of the lake, to the South 156th Way Bridge at the southern end of the valley. The eastern and western boundaries are South 156th Way to the east and Des Moines Memorial Drive to the west, see attachment Figure A1.

The most recent FEMA flood model (draft 2007) for Miller Creek does not reflect the Master Plan Update changes made to the creek in 2004. Consequently, the FEMA model cross sections were not used for this study. Topographic survey data for the site was collected by David Evans and Associates in early 2015 and was used to represent existing conditions in the model (DEA 2015). The analysis procedure used by ESA is outlined below.

1. ESA created the Existing Conditions model using cross sections from the most recent 2015 topographic survey. Hydrology data was based on the 2001 Natural Resources Mitigation Plan produced by the Montgomery Water Group for the Vacca Farm mitigation area and is consistent with the FEMA Flood Insurance Study. Results were calibrated by comparing modeled water surface elevations to recorded water level monitoring data from King County Gauge 42a, located at the upstream control structure, and validated with FEMA's model results.

2. ESA created the Proposed Conditions model by modifying the model cross sections from the Existing Conditions model to reflect the proposed site grading.

3. ESA compared the 100-year base flood water surface elevations between the HEC-RAS Existing Conditions and Proposed Conditions models to assess the proposed project's effect on the base flood elevation.

Analysis Results

Base Flood Water Surface Elevation

ESA analyzed output from the Proposed Remedial Action Conditions and Existing Conditions HEC-RAS models. Figure 1 and Table 1, below, provide graphical and numerical summaries of the model output. As shown in Figure 1, creating an opening in the east lake berm decreases the base flood water surface elevations in that section of the channel, while water surface elevations upstream and downstream of the proposed berm opening remain unchanged. The reduction in base flood elevation is caused by opening a section of the east lake berm, which increases the effective width of the channel and lowers water depth in the stream reach beside the lake. Detailed hydraulic model results are attached at the end of this document.

Floodplain Fill

To support the desired wetland vegetation species, the lake must be filled to an elevation above the existing groundwater table. The low point of the final wetland surface is set at the top of the current inactive storage (267.4 feet). Fill above this elevation, but below the base flood elevation (268.6 feet), represents fill in the floodplain. The fill will occupy a volume of approximately 0.5 acre-feet, relative to the existing ground and lake surface. This volume of fill is less than the excess floodplain volume previously created within Vacca Farm as part of the Port of Seattle Master Plan Update. As a result, there is still an overall net gain in floodplain storage capacity, relative to pre-2004 conditions, even with the proposed fill. The loss of 0.5 acre-feet of floodplain storage could theoretically result in an increase in flood stage and velocities within Miller Creek, particularly during the rising limb of flood events. However, the proposed design offsets these changes by removing portions of the existing berm surrounding Lora Lake to improve floodplain connectivity and drainage.

Conclusion

The proposed design uses swales and hummocks to achieve the Ecology Cleanup Action Plan goals of establishing a palustrine scrub-shrub wetland on the surface of Lora Lake, while minimizing fill in the active floodplain. Modeling shows that the proposed project has no negative effect on the base flood elevation or flood conveyance capacity of the Miller Creek floodplain. No-rise criteria are therefore met.

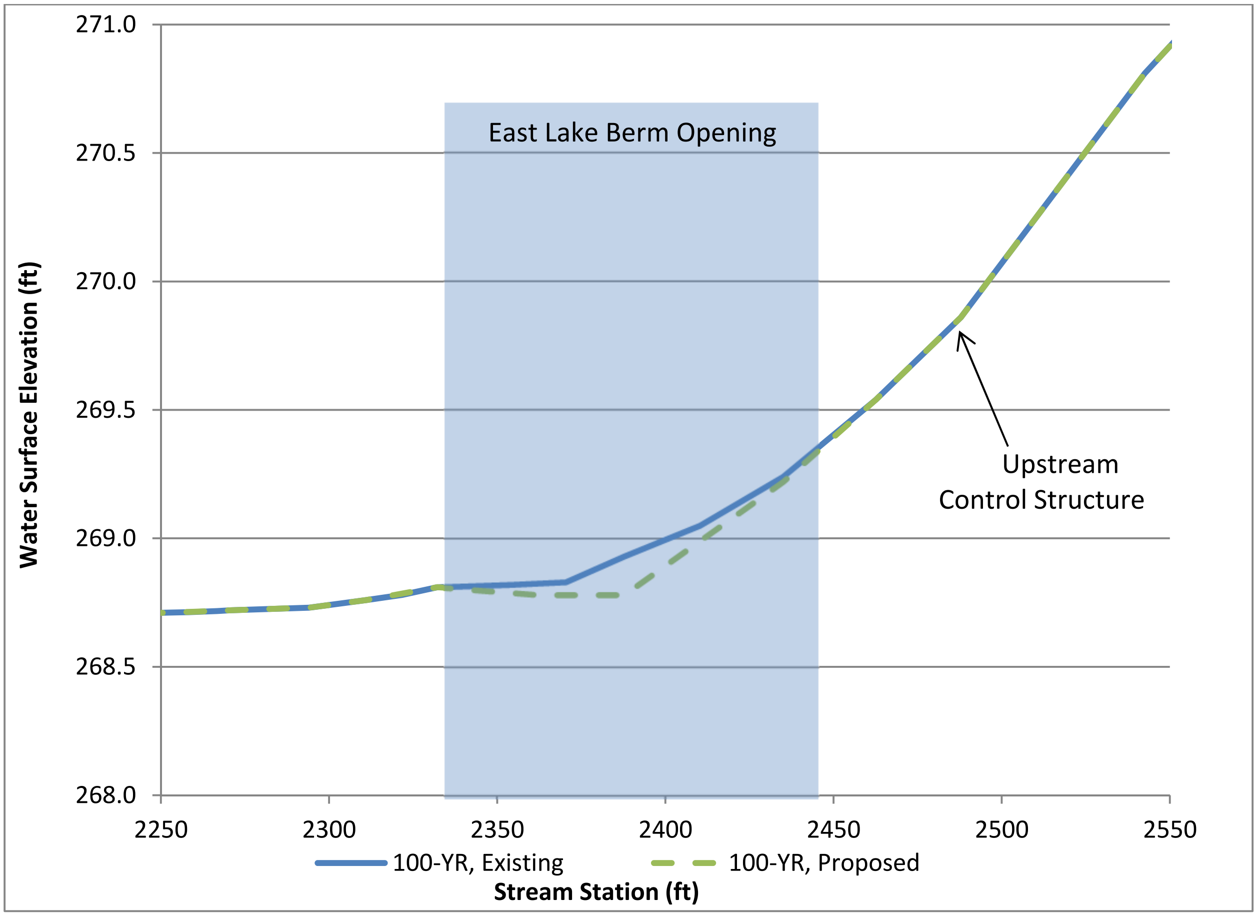


Figure 1. Change in Miller Creek 100 year flood stage under Existing and Proposed conditions.

River Station	Description	Existing WSE	Proposed WSE	Difference
2844.1	Top of Modeled Reach	272.43	272.43	0.00
2487.9	Control Structure	269.86	269.86	0.00
2370.5	Lake Berm Opening	268.83	268.78	-0.05
1958.6	Swale Outlet	268.65	268.65	0.00
495.3	S 156th Way Bridge	268.10	268.10	0.00
285.1	Bottom of Modeled Reach	268.19	268.19	0.00

Table 1. Summary of modeled change in water surface elevation (WSE) with the proposed project.

Attachments: Hydraulic Model Results

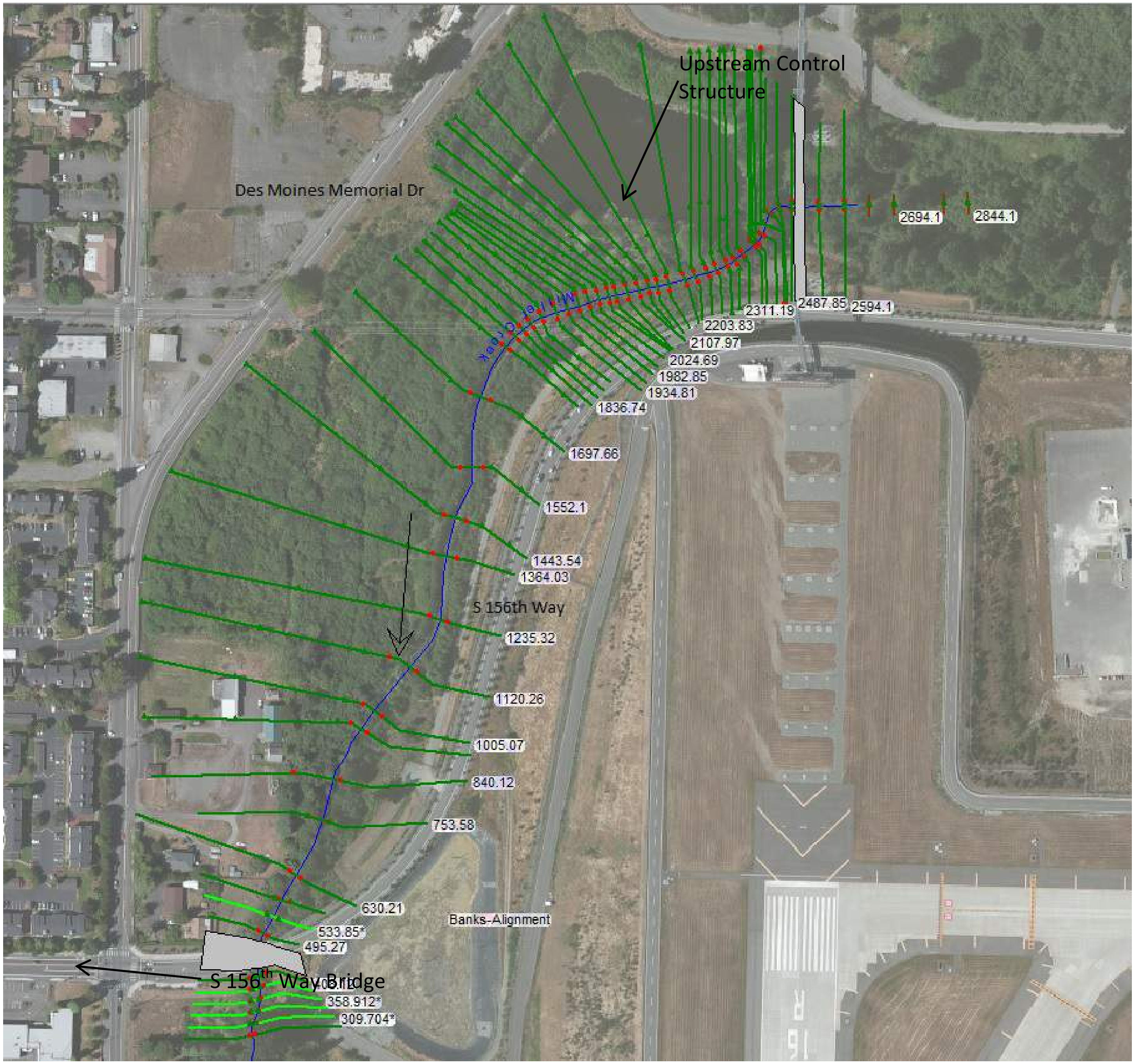


Figure A1. HEC-RAS model schematic showing cross-section locations

Table A1. HEC-RAS output tables

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Froude # Chl
Miller Creek	2844.1	100YR	PG_Rev(1)	175	267.22	272.43	272.5	0.000257	2.1	83.34	0.16
Miller Creek	2844.1	100YR	Existing	175	267.22	272.43	272.5	0.000257	2.1	83.34	0.16
Miller Creek	2794.1	100YR	PG_Rev(1)	175	267.21	272.43	272.49	0.000204	1.88	93.9	0.14
Miller Creek	2794.1	100YR	Existing	175	267.21	272.43	272.49	0.000204	1.88	93.9	0.14
Miller Creek	2694.1	100YR	PG_Rev(1)	175	267.2	272.35	272.45	0.000404	2.62	66.86	0.2
Miller Creek	2694.1	100YR	Existing	175	267.2	272.35	272.45	0.000404	2.62	66.86	0.2
Miller Creek	2644.1	100YR	PG_Rev(1)	175	267.19	271.96	272.38	0.001798	5.25	33.35	0.42
Miller Creek	2644.1	100YR	Existing	175	267.19	271.96	272.38	0.001798	5.25	33.35	0.42
Miller Creek	2594.1	100YR	PG_Rev(1)	175	267.18	271.54	272.24	0.003284	6.69	26.17	0.56
Miller Creek	2594.1	100YR	Existing	175	267.18	271.54	272.24	0.003284	6.69	26.17	0.56
Miller Creek	2542.54	100YR	PG_Rev(1)	175	267.17	270.81	271.95	0.006931	8.6	20.35	0.8
Miller Creek	2542.54	100YR	Existing	175	267.17	270.81	271.95	0.006931	8.6	20.35	0.8
Miller Creek	2512.23			Culvert							
Miller Creek	2487.85	100YR	PG_Rev(1)	175	267.16	269.86	270.55	0.006469	6.68	26.2	0.73
Miller Creek	2487.85	100YR	Existing	175	267.16	269.86	270.55	0.00645	6.67	26.22	0.73
Miller Creek	2462.65	100YR	PG_Rev(1)	175	267.13	269.54	270.34	0.010533	7.31	26.18	0.86
Miller Creek	2462.65	100YR	Existing	175	267.13	269.54	270.34	0.010514	7.3	26.19	0.85
Miller Creek	2435.01	100YR	PG_Rev(1)	175	267.18	269.22	270	0.014269	7.06	24.81	0.95
Miller Creek	2435.01	100YR	Existing	175	267.18	269.24	270	0.013914	7.01	25	0.94
Miller Creek	2410.29	100YR	PG_Rev(1)	175	266.98	268.99	269.62	0.012762	6.41	27.3	0.9
Miller Creek	2410.29	100YR	Existing	175	266.98	269.05	269.67	0.011707	7.29	39.82	0.91
Miller Creek	2387.82	100YR	PG_Rev(1)	175	266.9	268.78	269.34	0.011152	6.75	38.02	0.88
Miller Creek	2387.82	100YR	Existing	175	266.9	268.93	269.37	0.007972	6.03	40.57	0.75
Miller Creek	2370.46	100YR	PG_Rev(1)	175	266.9	268.78	269.15	0.008513	6.08	54.35	0.78
Miller Creek	2370.46	100YR	Existing	175	266.9	268.83	269.25	0.00855	6.06	43.93	0.78

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Froude # Chl
Miller Creek	2362.37	100YR	PG_Rev(1)	175	266.83	268.78	269.06	0.0071	4.73	51.83	0.69
Miller Creek	2354.27	100YR	Existing	175	266.7	268.82	269.09	0.006654	4.94	47.33	0.66
Miller Creek	2332.24	100YR	PG_Rev(1)	175	266.2	268.81	268.89	0.002387	3.09	104.01	0.4
Miller Creek	2332.24	100YR	Existing	175	266.2	268.81	268.96	0.003359	3.67	64.05	0.48
Miller Creek	2321.71*	100YR	Existing	175	266.18	268.78	268.92	0.003013	3.64	71.15	0.46
Miller Creek	2311.19	100YR	PG_Rev(1)	175	266.17	268.76	268.85	0.002013	3.08	100.89	0.38
Miller Creek	2311.19	100YR	Existing	175	266.17	268.76	268.89	0.002612	3.51	69.17	0.43
Miller Creek	2294.01	100YR	PG_Rev(1)	175	266.06	268.73	268.82	0.001777	3.07	103.58	0.36
Miller Creek	2294.01	100YR	Existing	175	266.04	268.73	268.86	0.002133	3.42	76.25	0.39
Miller Creek	2270.81	100YR	PG_Rev(1)	175	265.98	268.72	268.78	0.000989	2.5	143.41	0.28
Miller Creek	2270.81	100YR	Existing	175	265.98	268.72	268.81	0.001197	2.75	96.74	0.31
Miller Creek	2251.8	100YR	PG_Rev(1)	175	265.82	268.71	268.77	0.000678	2.22	167.62	0.24
Miller Creek	2251.8	100YR	Existing	175	265.82	268.71	268.79	0.000887	2.54	118.01	0.27
Miller Creek	2238.81*	100YR	Existing	175	265.81	268.71	268.77	0.000675	2.22	140.45	0.24
Miller Creek	2225.83	100YR	PG_Rev(1)	175	265.8	268.71	268.75	0.000435	1.78	201.51	0.19
Miller Creek	2225.83	100YR	Existing	175	265.8	268.71	268.76	0.000535	1.98	153.86	0.21
Miller Creek	2214.83*	100YR	Existing	175	265.67	268.71	268.75	0.000383	1.73	179.83	0.18
Miller Creek	2203.83	100YR	PG_Rev(1)	175	265.51	268.71	268.73	0.000207	1.31	270.94	0.13
Miller Creek	2203.83	100YR	Existing	175	265.55	268.71	268.74	0.00029	1.55	194.89	0.16
Miller Creek	2186.3*	100YR	Existing	175	265.53	268.7	268.73	0.000294	1.54	190.83	0.16
Miller Creek	2168.77	100YR	PG_Rev(1)	175	265.51	268.7	268.72	0.000207	1.28	253.33	0.13
Miller Creek	2168.77	100YR	Existing	175	265.51	268.7	268.72	0.000264	1.45	206.38	0.15
Miller Creek	2157.38*	100YR	Existing	175	265.53	268.7	268.72	0.000255	1.43	205.31	0.15
Miller Creek	2146	100YR	PG_Rev(1)	175	265.54	268.69	268.71	0.000187	1.23	249.75	0.13
Miller Creek	2146	100YR	Existing	175	265.54	268.69	268.71	0.000247	1.41	203.61	0.14
Miller Creek	2128.97	100YR	PG_Rev(1)	175	265.48	268.68	268.7	0.000223	1.34	238.04	0.14

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Froude # Chl
Miller Creek	2128.97	100YR	Existing	175	265.48	268.68	268.71	0.000265	1.46	212.44	0.15
Miller Creek	2107.97	100YR	PG_Rev(1)	175	265.53	268.66	268.69	0.000313	1.55	185.66	0.16
Miller Creek	2107.97	100YR	Existing	175	265.55	268.66	268.7	0.000356	1.65	166.13	0.17
Miller Creek	2084.43	100YR	PG_Rev(1)	175	265.54	268.68	268.68	0.000104	0.9	384.46	0.09
Miller Creek	2084.43	100YR	Existing	175	265.54	268.68	268.68	0.000114	0.94	363.1	0.1
Miller Creek	2061.34	100YR	PG_Rev(1)	175	265.49	268.67	268.68	0.000134	1.04	320.38	0.11
Miller Creek	2061.34	100YR	Existing	175	265.49	268.67	268.68	0.000112	0.95	372.93	0.1
Miller Creek	2046.45	100YR	PG_Rev(1)	175	265.38	268.67	268.68	0.00012	1	332.02	0.1
Miller Creek	2046.45	100YR	Existing	175	265.55	268.67	268.68	0.00012	0.99	333.63	0.1
Miller Creek	2024.69	100YR	PG_Rev(1)	175	265.48	268.66	268.67	0.000132	1.05	314.3	0.11
Miller Creek	2024.69	100YR	Existing	175	265.48	268.66	268.67	0.000138	1.07	308.35	0.11
Miller Creek	2004.09	100YR	PG_Rev(1)	175	265.41	268.66	268.67	0.000112	0.97	335.87	0.1
Miller Creek	2004.09	100YR	Existing	175	265.48	268.66	268.67	0.000135	1.06	310.43	0.11
Miller Creek	1982.85	100YR	PG_Rev(1)	175	265.45	268.66	268.67	0.000141	1.08	267.67	0.11
Miller Creek	1982.85	100YR	Existing	175	265.6	268.65	268.67	0.00018	1.2	239.76	0.12
Miller Creek	1958.56	100YR	PG_Rev(1)	175	265.37	268.65	268.66	0.000135	1.07	304.96	0.11
Miller Creek	1958.56	100YR	Existing	175	265.55	268.65	268.66	0.000157	1.14	283.32	0.12
Miller Creek	1934.81	100YR	PG_Rev(1)	175	265.44	268.65	268.66	0.000172	1.18	286.87	0.12
Miller Creek	1934.81	100YR	Existing	175	265.44	268.65	268.66	0.000172	1.18	286.79	0.12
Miller Creek	1906.39	100YR	PG_Rev(1)	175	265.33	268.63	268.65	0.000307	1.6	251.48	0.16
Miller Creek	1906.39	100YR	Existing	175	265.33	268.63	268.65	0.000307	1.61	251.39	0.16
Miller Creek	1879.25	100YR	PG_Rev(1)	175	265.44	268.61	268.64	0.000382	1.78	230.14	0.18
Miller Creek	1879.25	100YR	Existing	175	265.44	268.61	268.64	0.000382	1.78	230.05	0.18
Miller Creek	1857.44	100YR	PG_Rev(1)	175	265.5	268.58	268.63	0.000509	2.05	157.83	0.21
Miller Creek	1857.44	100YR	Existing	175	265.5	268.58	268.63	0.000509	2.05	157.79	0.21
Miller Creek	1836.74	100YR	PG_Rev(1)	175	265.39	268.58	268.62	0.000422	1.87	194.77	0.19

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Froude # Chl
Miller Creek	1836.74	100YR	Existing	175	265.39	268.58	268.62	0.000422	1.87	194.72	0.19
Miller Creek	1810.81	100YR	PG_Rev(1)	175	265.39	268.58	268.61	0.000311	1.63	255.2	0.16
Miller Creek	1810.81	100YR	Existing	175	265.39	268.58	268.61	0.000311	1.63	255.1	0.16
Miller Creek	1697.66	100YR	PG_Rev(1)	175	265.18	268.58	268.59	0.000086	0.89	393.75	0.09
Miller Creek	1697.66	100YR	Existing	175	265.18	268.58	268.59	0.000086	0.89	393.64	0.09
Miller Creek	1552.1	100YR	PG_Rev(1)	175	265	268.57	268.58	0.00004	0.62	555.68	0.06
Miller Creek	1552.1	100YR	Existing	175	265	268.57	268.58	0.00004	0.62	555.59	0.06
Miller Creek	1443.54	100YR	PG_Rev(1)	175	264.86	268.57	268.57	0.000045	0.67	472.27	0.06
Miller Creek	1443.54	100YR	Existing	175	264.86	268.57	268.57	0.000045	0.67	472.2	0.06
Miller Creek	1364.03	100YR	PG_Rev(1)	175	264.76	268.56	268.57	0.00003	0.55	595.68	0.05
Miller Creek	1364.03	100YR	Existing	175	264.76	268.56	268.57	0.00003	0.55	595.59	0.05
Miller Creek	1235.32	100YR	PG_Rev(1)	175	264.6	268.54	268.56	0.000127	1.16	173.49	0.11
Miller Creek	1235.32	100YR	Existing	175	264.6	268.54	268.56	0.000127	1.16	173.46	0.11
Miller Creek	1120.26	100YR	PG_Rev(1)	175	264.45	268.53	268.54	0.000098	0.9	194.68	0.09
Miller Creek	1120.26	100YR	Existing	175	264.45	268.53	268.54	0.000098	0.9	194.65	0.09
Miller Creek	1005.07	100YR	PG_Rev(1)	175	264.31	268.5	268.53	0.000211	1.26	140.48	0.13
Miller Creek	1005.07	100YR	Existing	175	264.31	268.5	268.52	0.000211	1.26	140.46	0.13
Miller Creek	958.36	100YR	PG_Rev(1)	175	264.25	268.46	268.51	0.000554	1.84	99.12	0.2
Miller Creek	958.36	100YR	Existing	175	264.25	268.45	268.51	0.000554	1.84	99.1	0.2
Miller Creek	840.12	100YR	PG_Rev(1)	175	264.1	268.45	268.47	0.000141	0.85	213.65	0.1
Miller Creek	840.12	100YR	Existing	175	264.1	268.45	268.47	0.000141	0.85	213.61	0.1
Miller Creek	753.58	100YR	PG_Rev(1)	175	263.99	268.4	268.44	0.000461	1.67	106.46	0.19
Miller Creek	753.58	100YR	Existing	175	263.99	268.4	268.44	0.000458	1.67	110.31	0.19
Miller Creek	630.21	100YR	PG_Rev(1)	175	263.83	268.28	268.37	0.000765	2.3	77.46	0.24
Miller Creek	630.21	100YR	Existing	175	263.83	268.28	268.37	0.000765	2.3	77.46	0.24
Miller Creek	572.43	100YR	PG_Rev(1)	175	263.76	268.25	268.32	0.000699	2.23	81.46	0.23

Reach	River Sta	Profile	Plan	Q Total (cfs)	Min Ch El (ft)	W.S. Elev (ft)	E.G. Elev (ft)	E.G. Slope (ft/ft)	Vel Chnl (ft/s)	Flow Area (sq ft)	Froude # Chl
Miller Creek	572.43	100YR	Existing	175	263.76	268.25	268.32	0.000699	2.23	81.46	0.23
Miller Creek	533.85*	100YR	PG_Rev(1)	175	263.71	268.19	268.29	0.000851	2.53	70.51	0.26
Miller Creek	533.85*	100YR	Existing	175	263.71	268.19	268.29	0.000851	2.53	70.51	0.26
Miller Creek	495.27	100YR	PG_Rev(1)	175	263.66	268.1	268.25	0.001254	3.06	61.35	0.31
Miller Creek	495.27	100YR	Existing	175	263.66	268.1	268.25	0.001254	3.06	61.35	0.31
Miller Creek	449.87			Bridge							
Miller Creek	408.12	100YR	PG_Rev(1)	175	263.04	268.08	268.17	0.000369	2.39	73.32	0.19
Miller Creek	408.12	100YR	Existing	175	263.04	268.08	268.17	0.000369	2.39	73.32	0.19
Miller Creek	383.516*	100YR	PG_Rev(1)	175	262.71	268.07	268.16	0.000346	2.32	75.38	0.18
Miller Creek	383.516*	100YR	Existing	175	262.71	268.07	268.16	0.000346	2.32	75.38	0.18
Miller Creek	358.912*	100YR	PG_Rev(1)	175	262.38	268.06	268.15	0.000373	2.34	74.93	0.18
Miller Creek	358.912*	100YR	Existing	175	262.38	268.06	268.15	0.000373	2.34	74.93	0.18
Miller Creek	334.308*	100YR	PG_Rev(1)	175	262.05	268.03	268.13	0.000515	2.54	68.95	0.21
Miller Creek	334.308*	100YR	Existing	175	262.05	268.03	268.13	0.000515	2.54	68.95	0.21
Miller Creek	309.704*	100YR	PG_Rev(1)	175	261.72	267.93	268.11	0.001066	3.37	51.94	0.27
Miller Creek	309.704*	100YR	Existing	175	261.72	267.93	268.11	0.001066	3.37	51.94	0.27
Miller Creek	285.1	100YR	PG_Rev(1)	175	261.39	267.79	268.06	0.002302	4.22	44.65	0.36
Miller Creek	285.1	100YR	Existing	175	261.39	267.79	268.06	0.002302	4.22	44.65	0.36

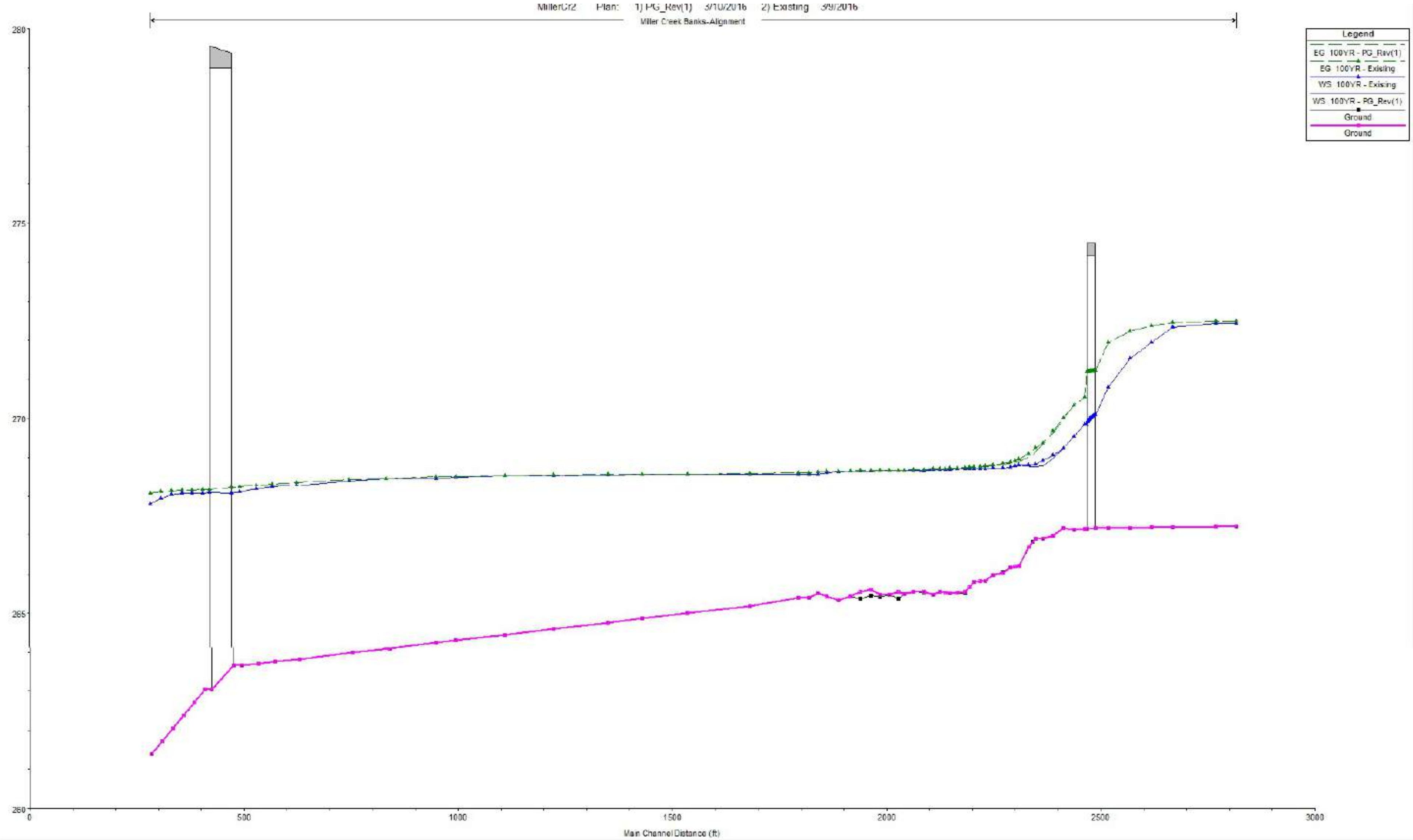
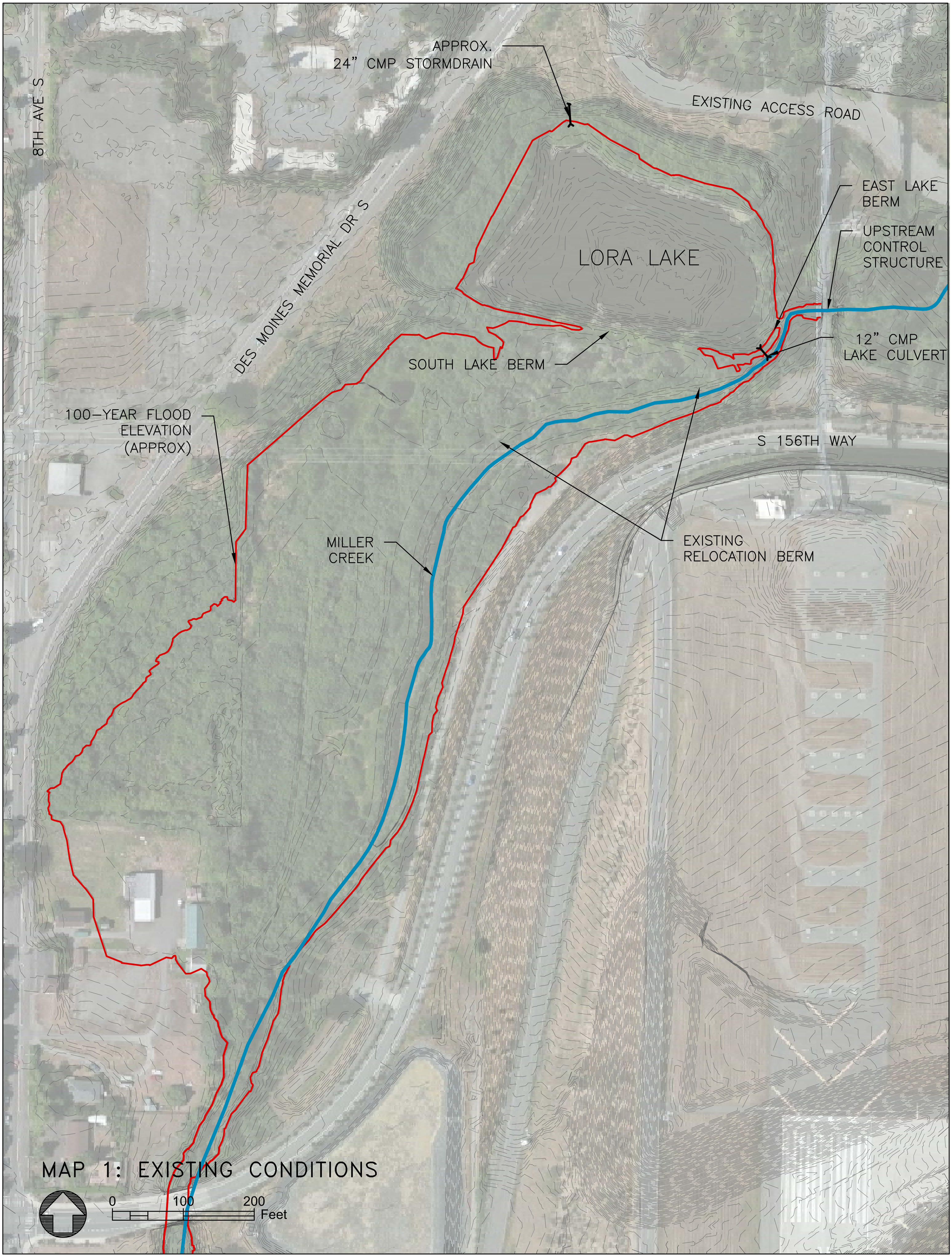
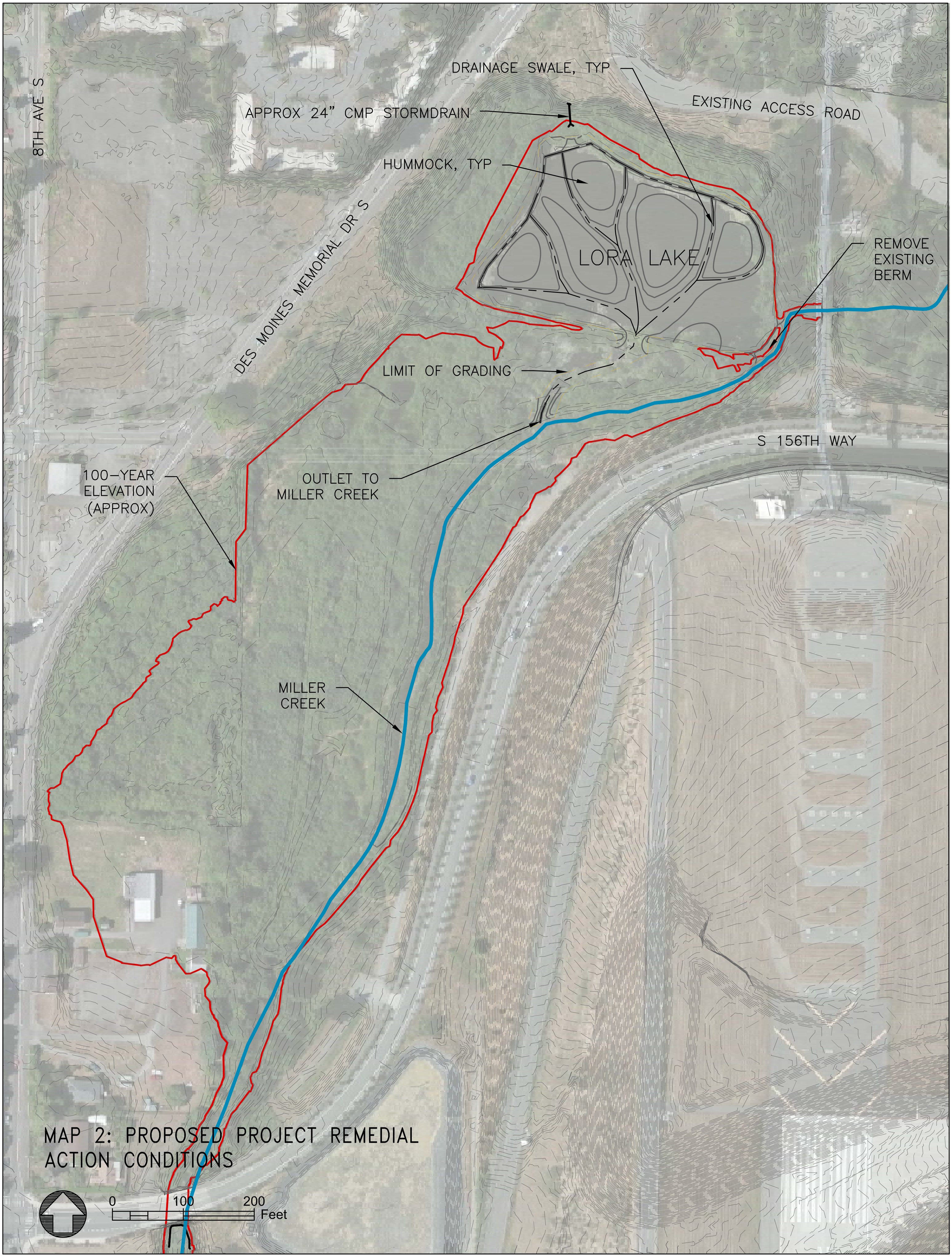


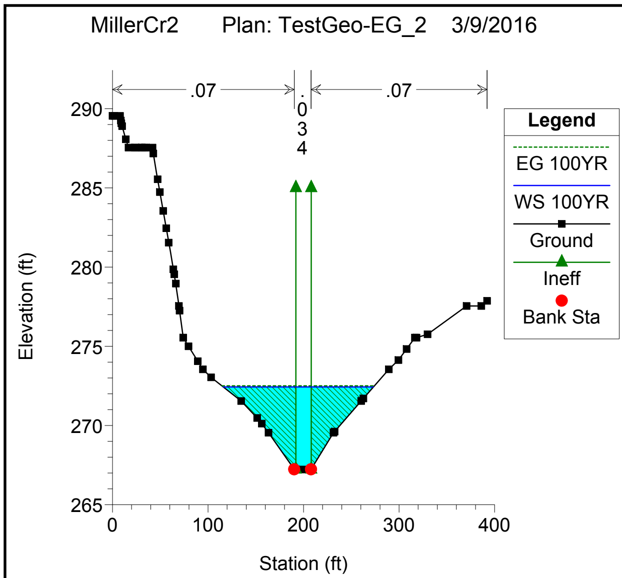
Figure A2. HEC-RAS water surface profiles comparing base flood elevations in the existing and proposed scenarios



MAP 1: EXISTING CONDITIONS



MAP 2: PROPOSED PROJECT REMEDIAL ACTION CONDITIONS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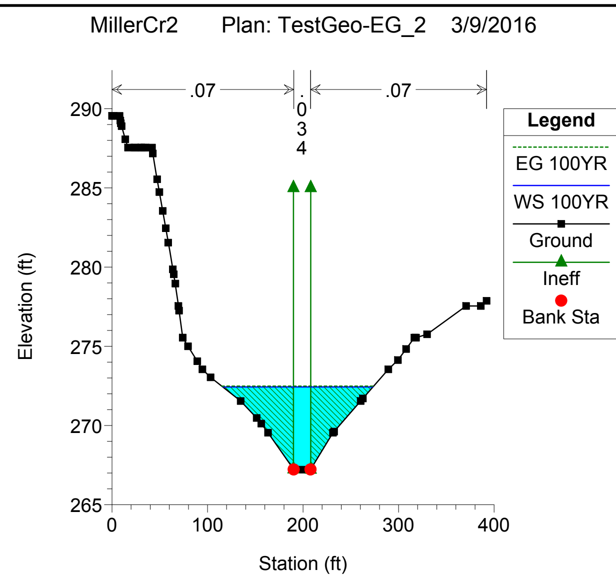
Station (ft)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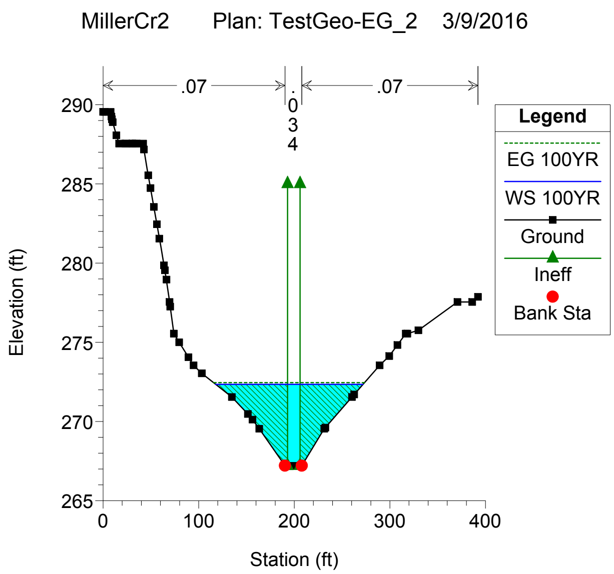
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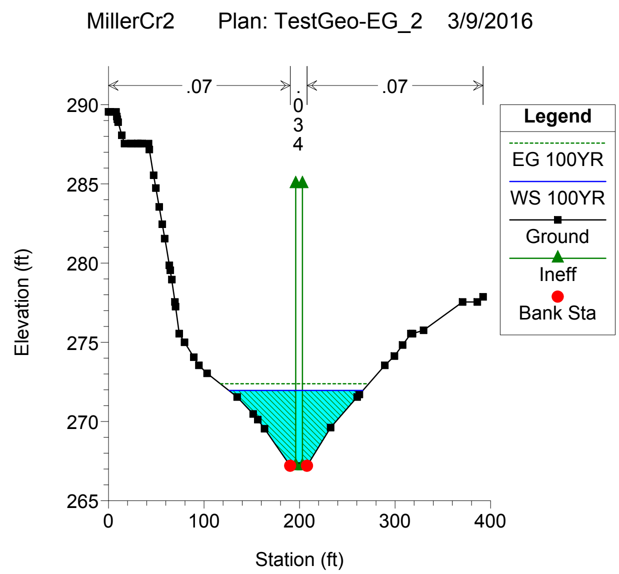
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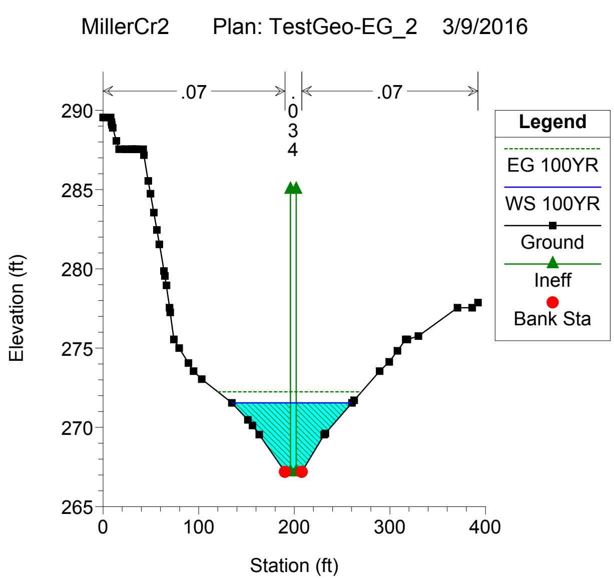
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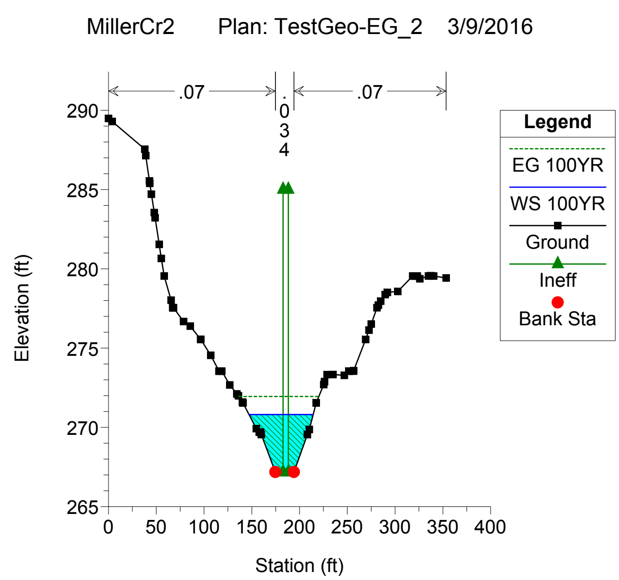
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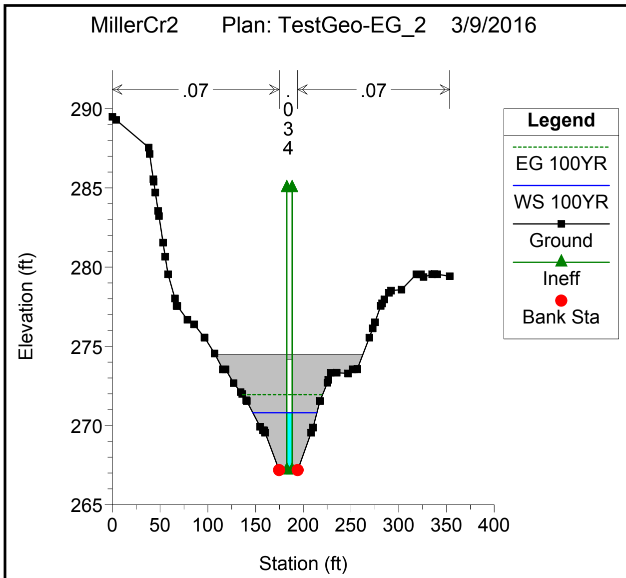
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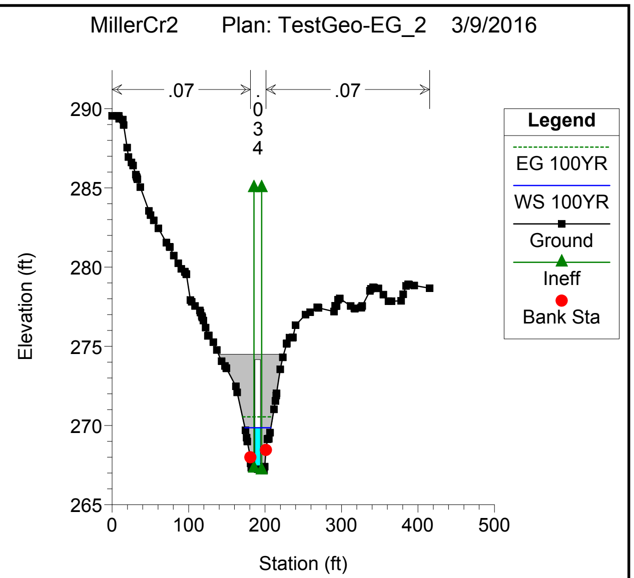
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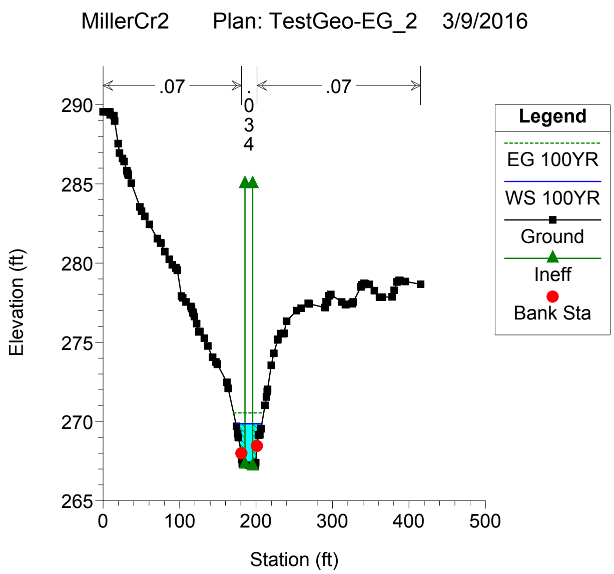
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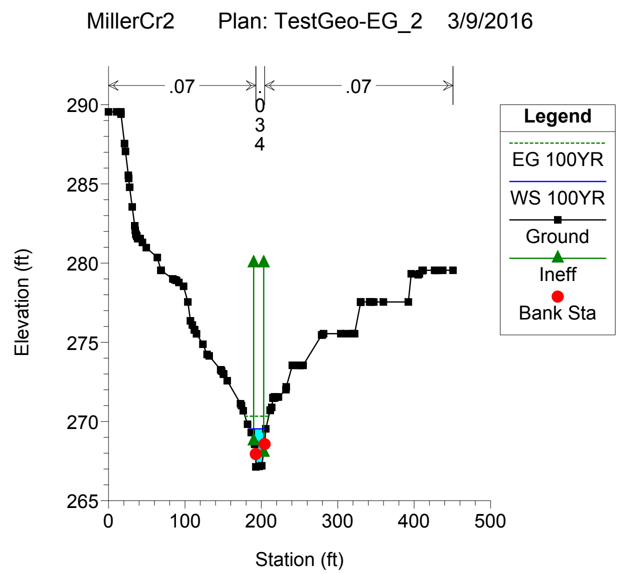
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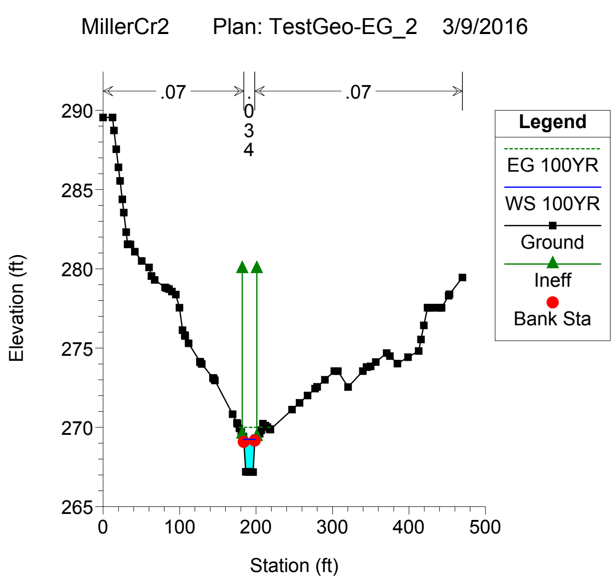
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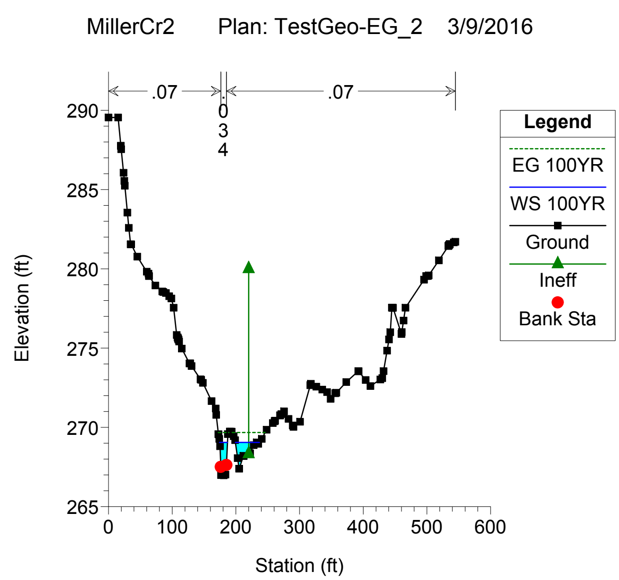
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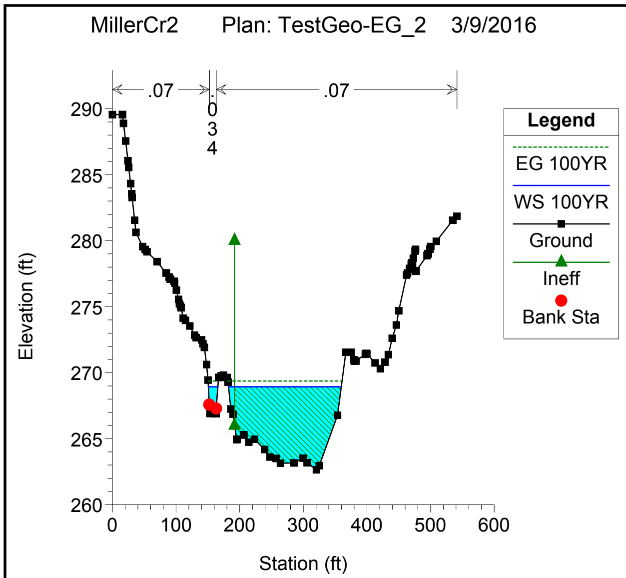
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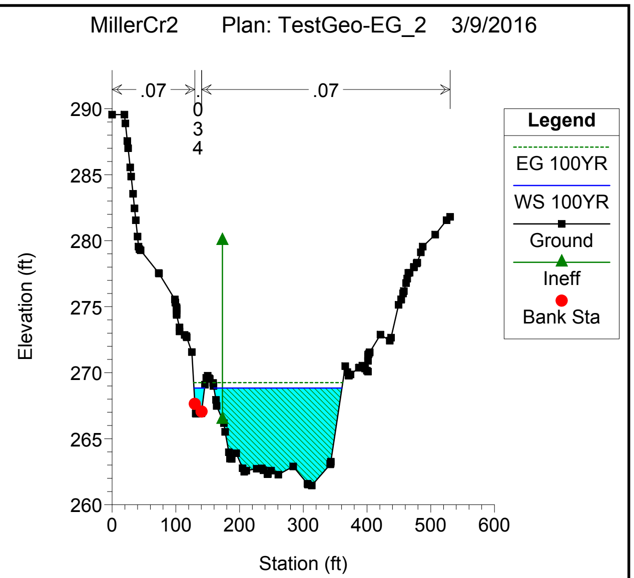
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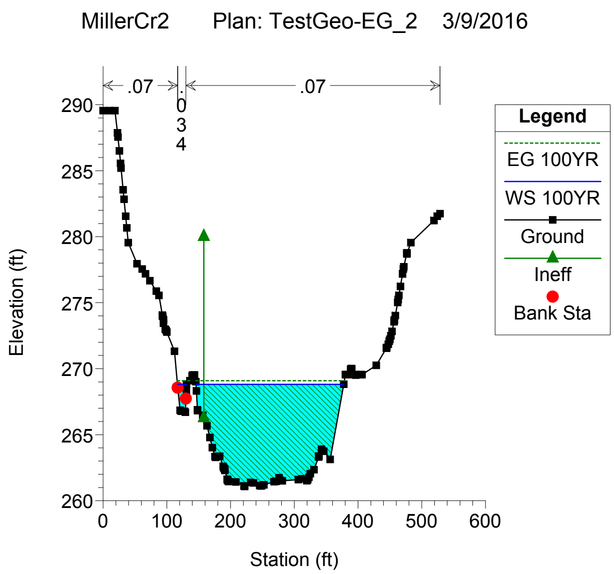
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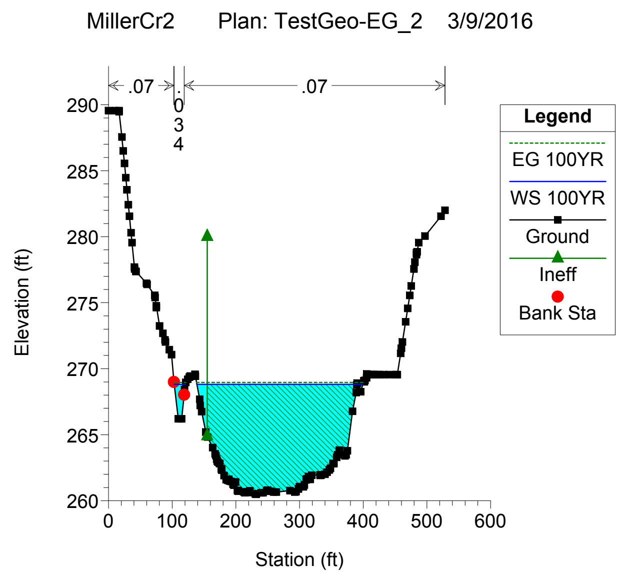
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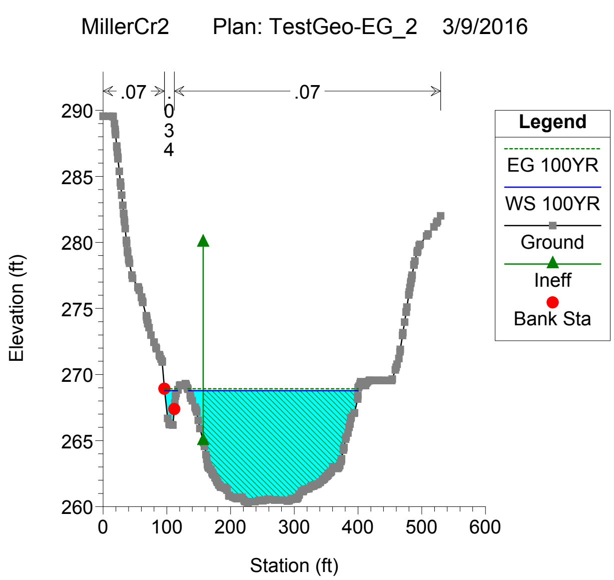
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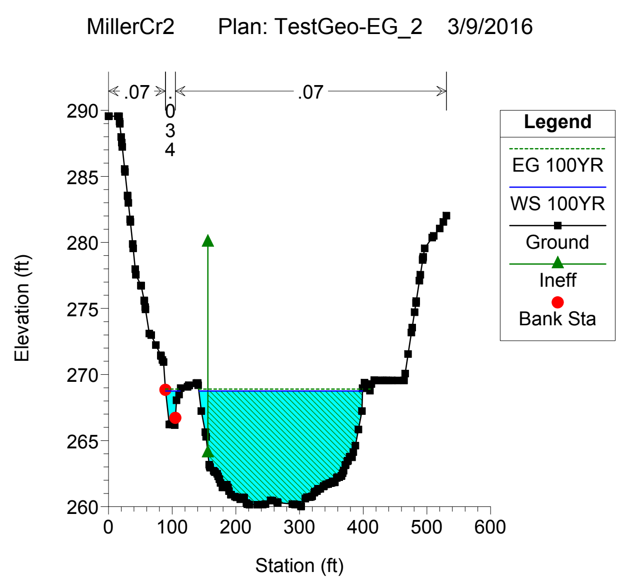
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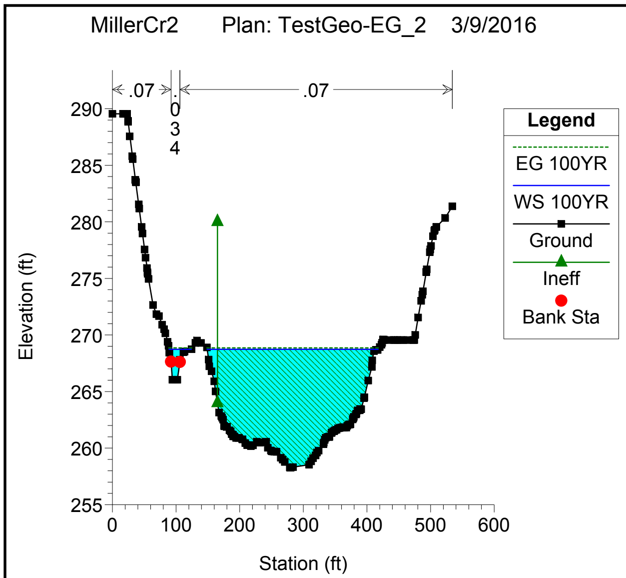
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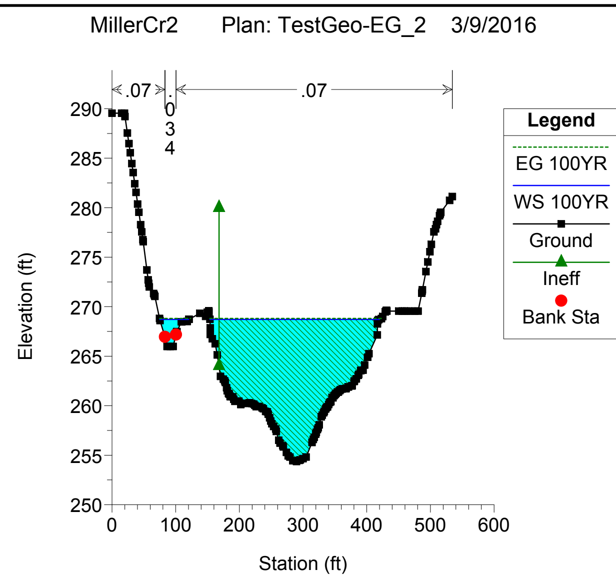
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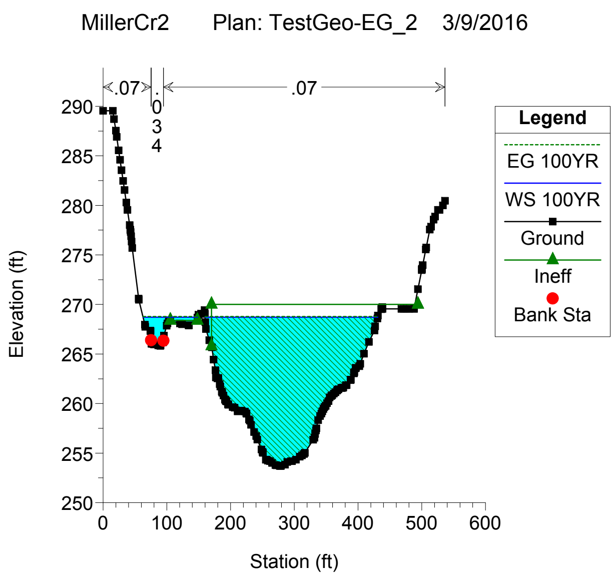
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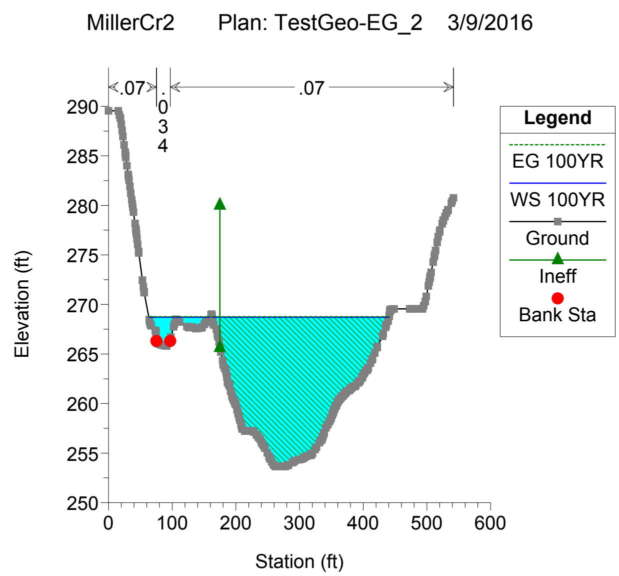
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Station (ft)
Legend
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Ground
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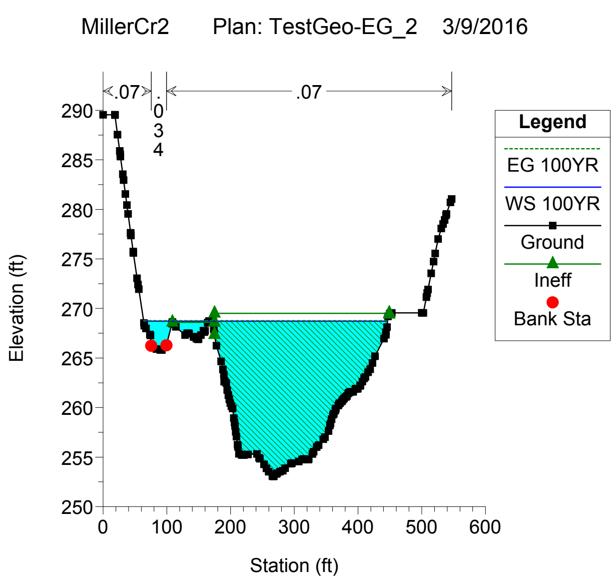
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Station (ft)
Legend
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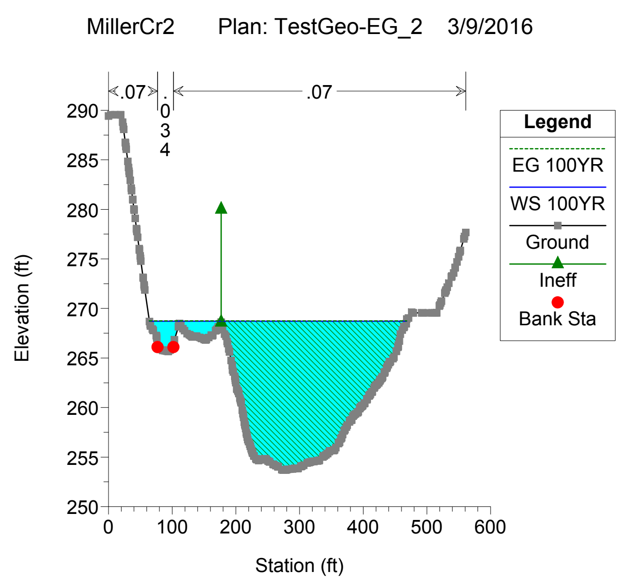
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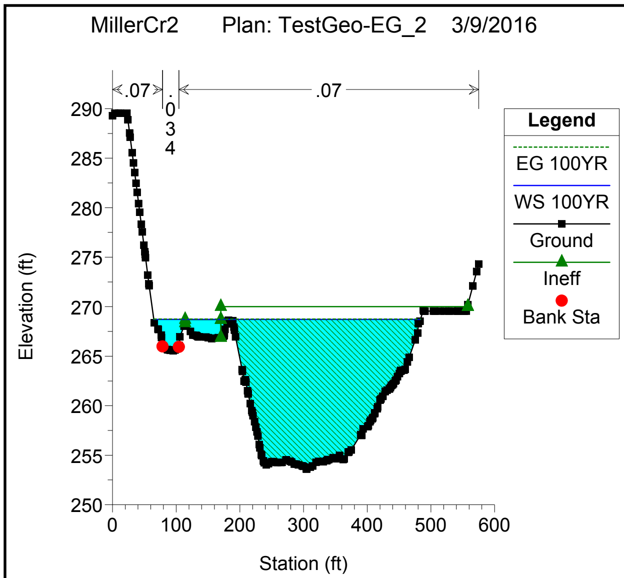
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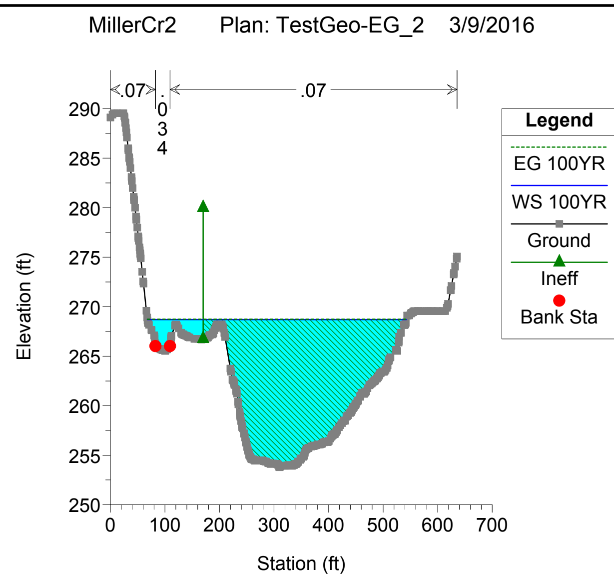
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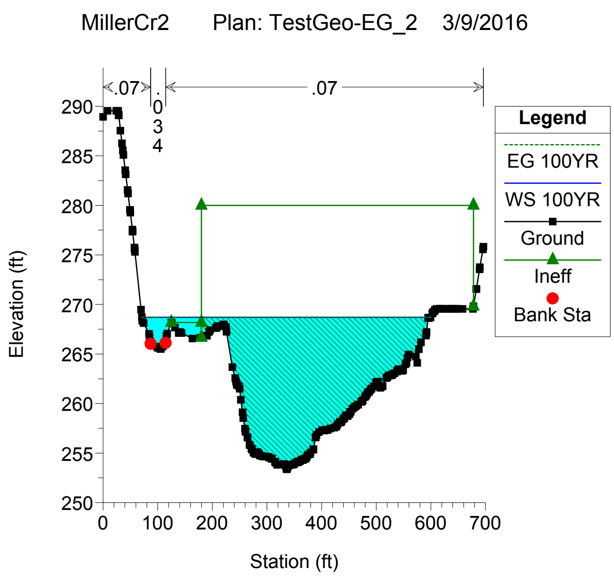
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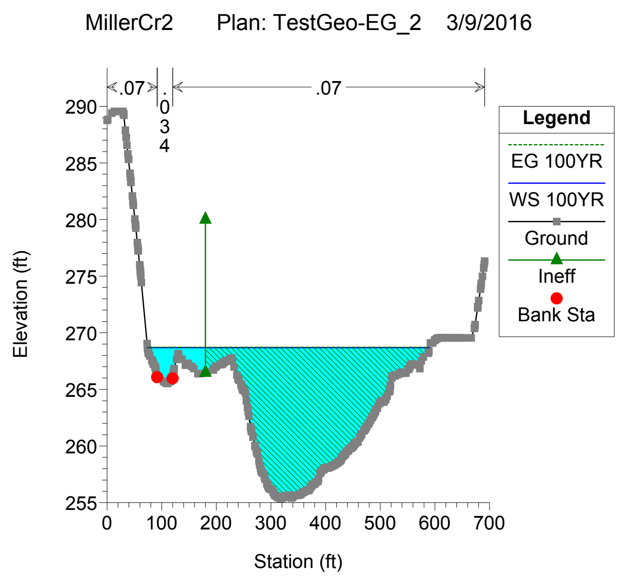
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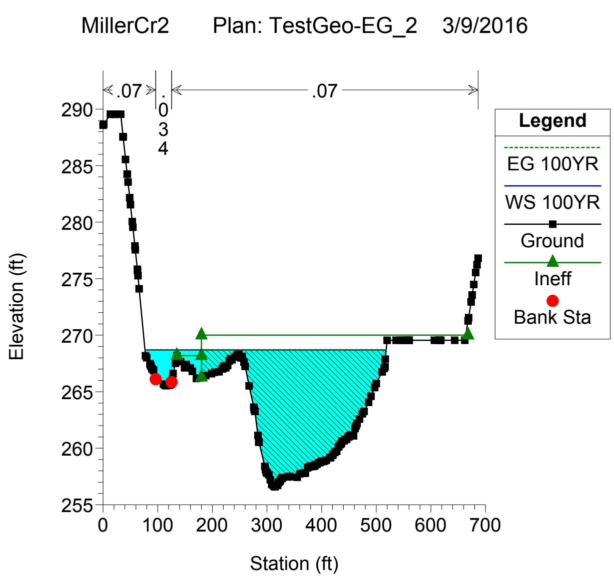
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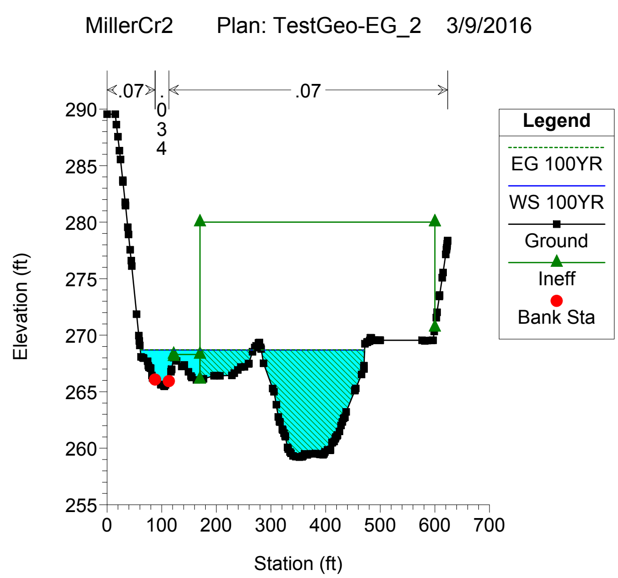
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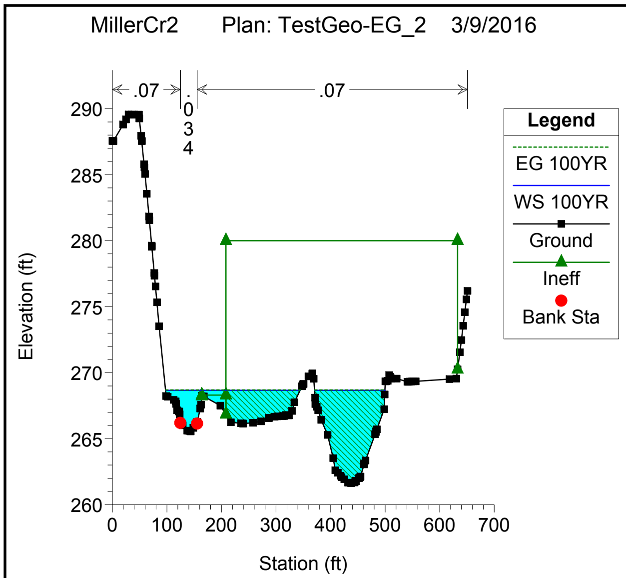
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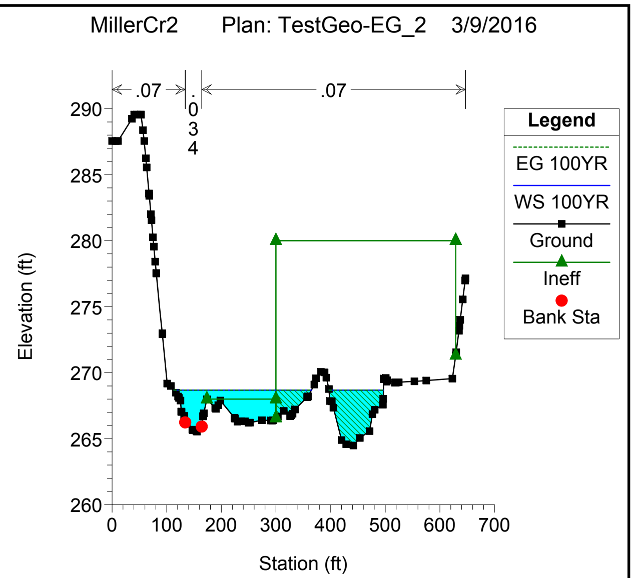
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Station (ft)
Legend
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WS 100YR
Ground
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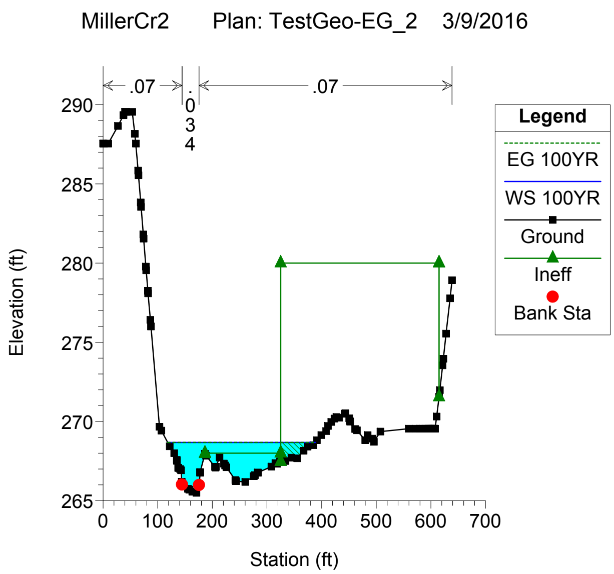
Bank Sta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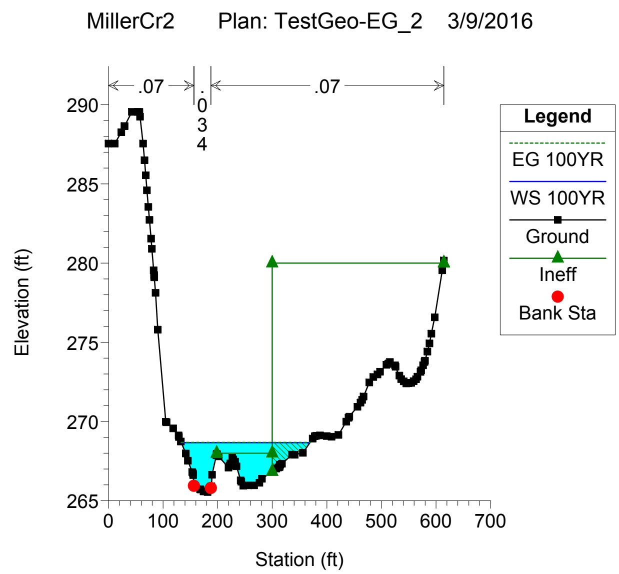
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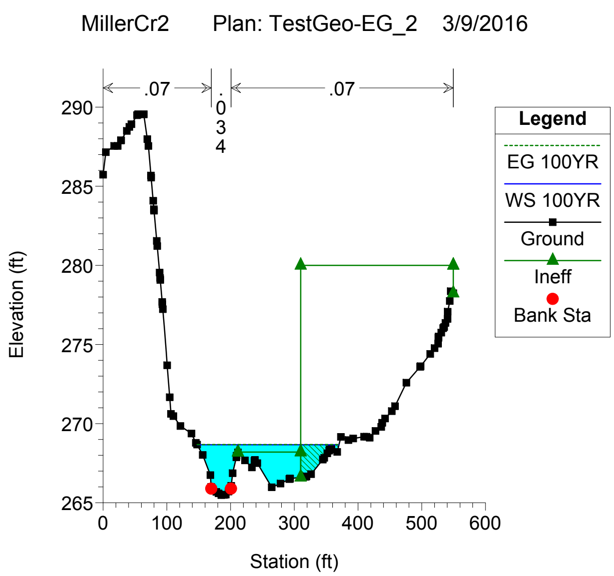
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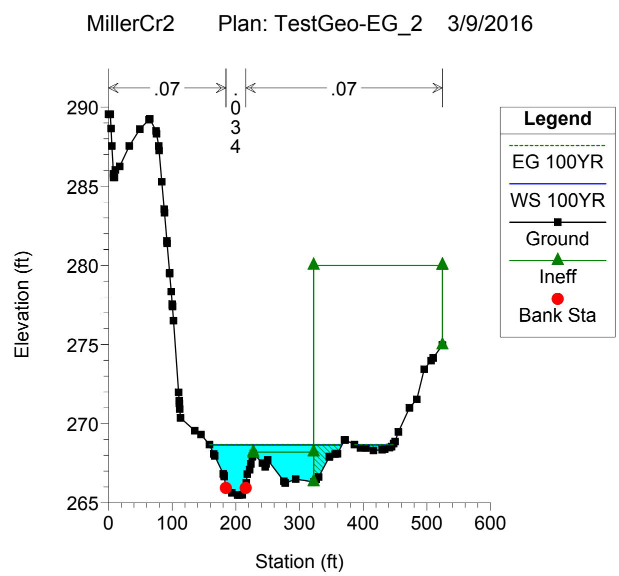
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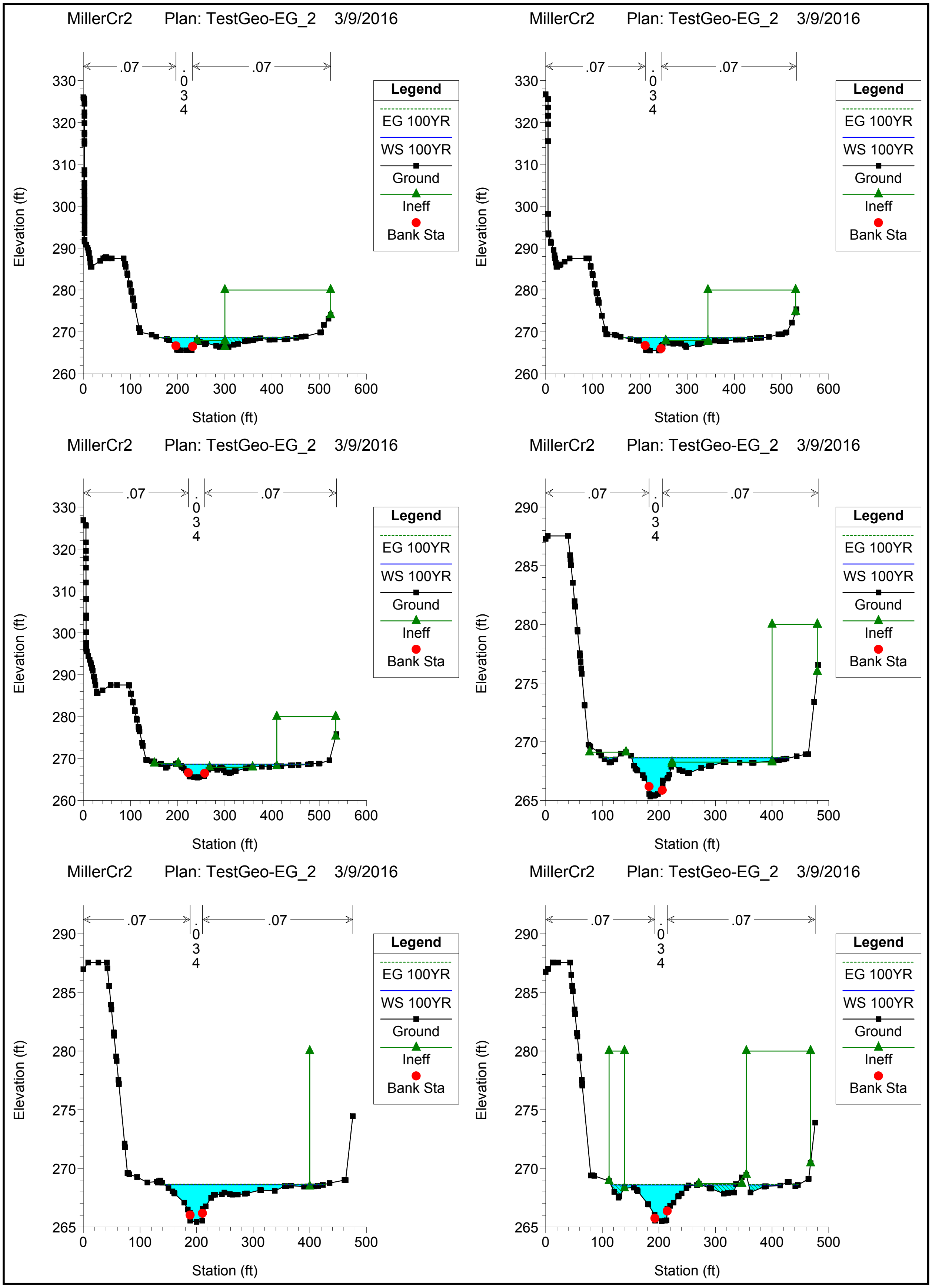
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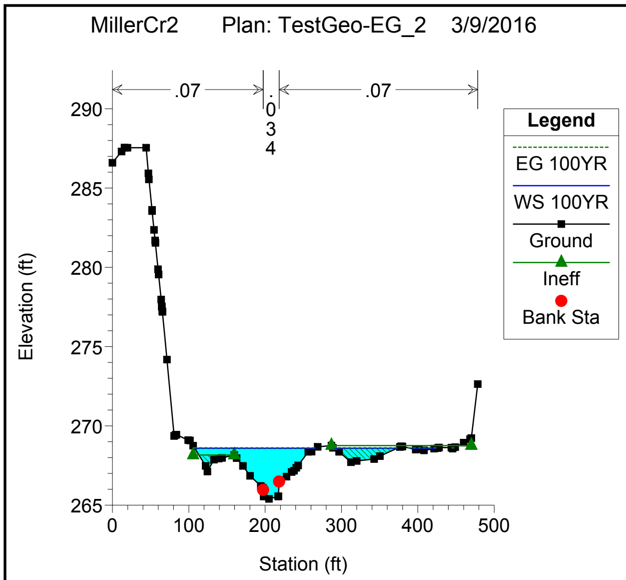
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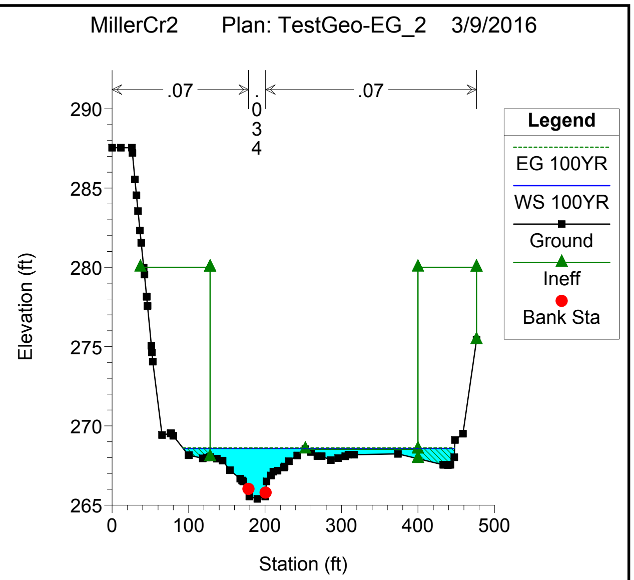
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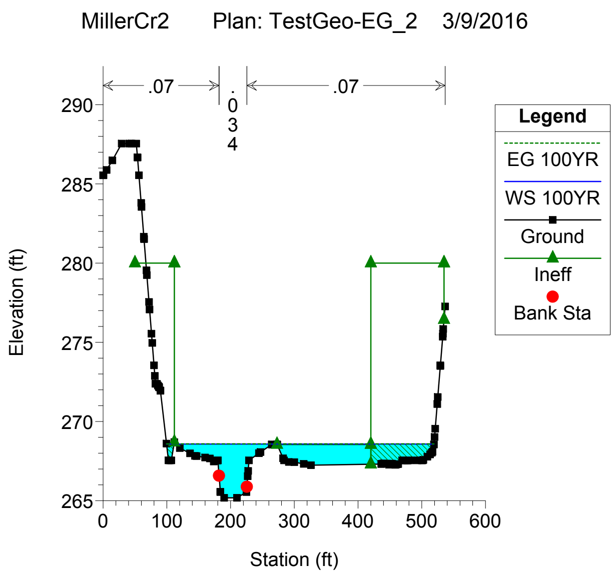
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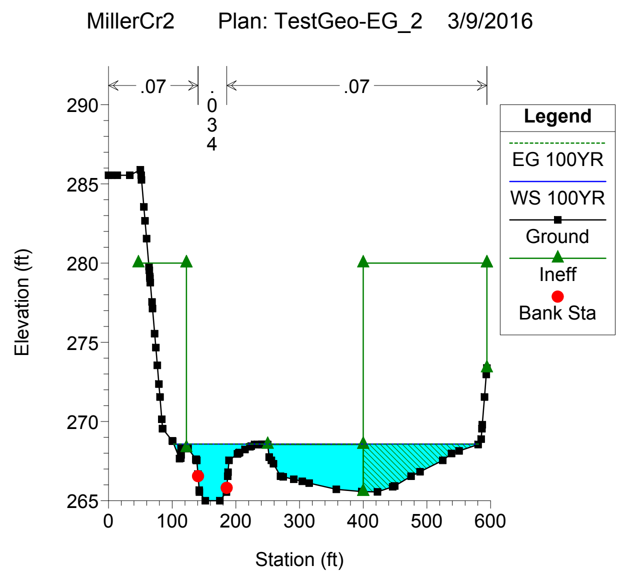
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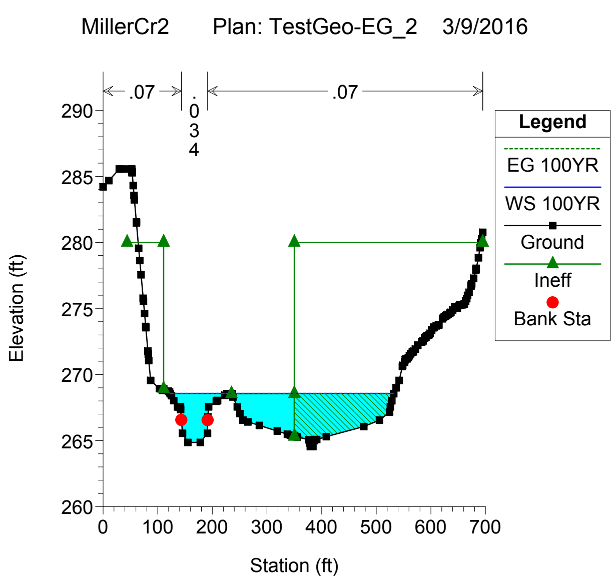
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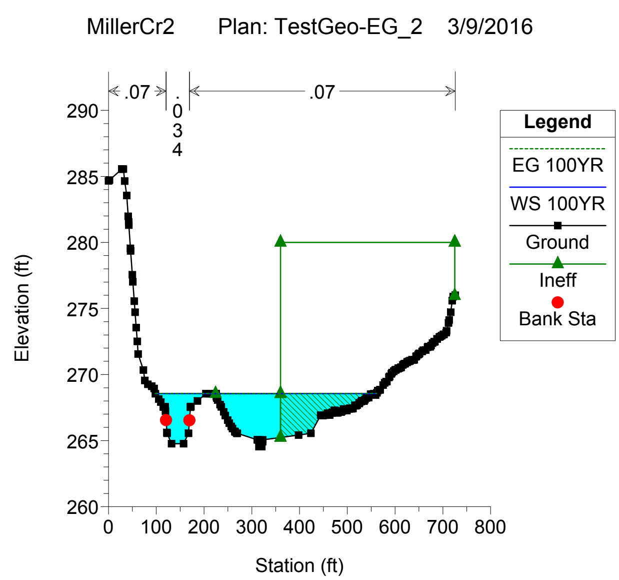
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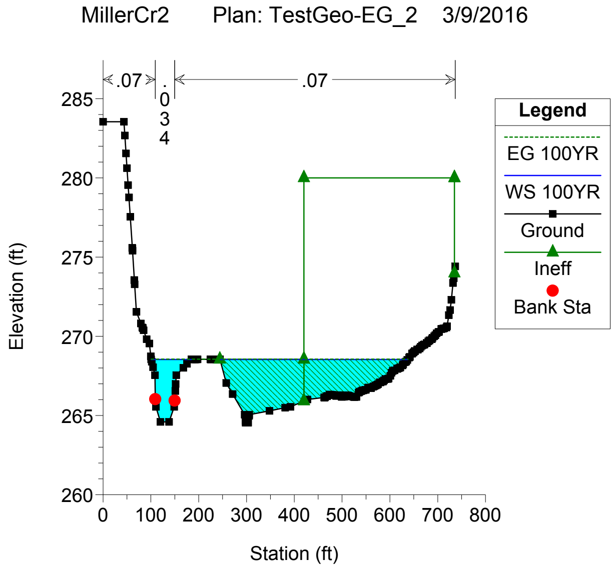
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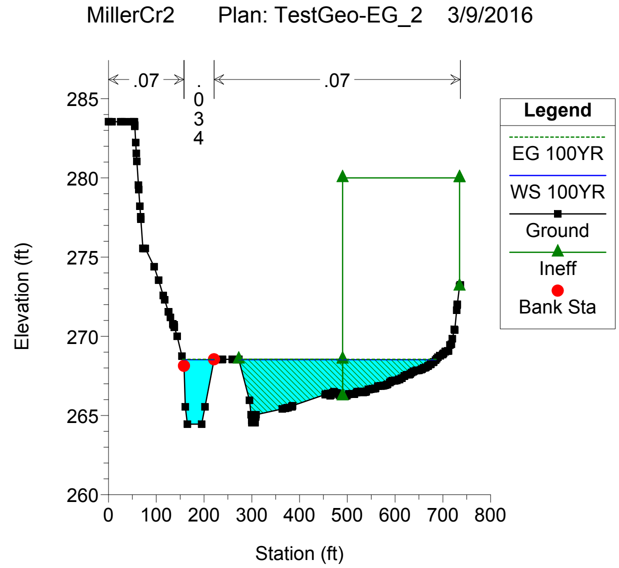
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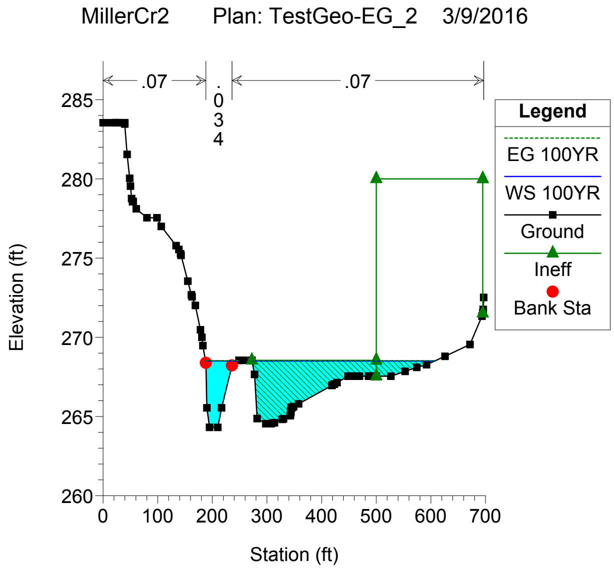
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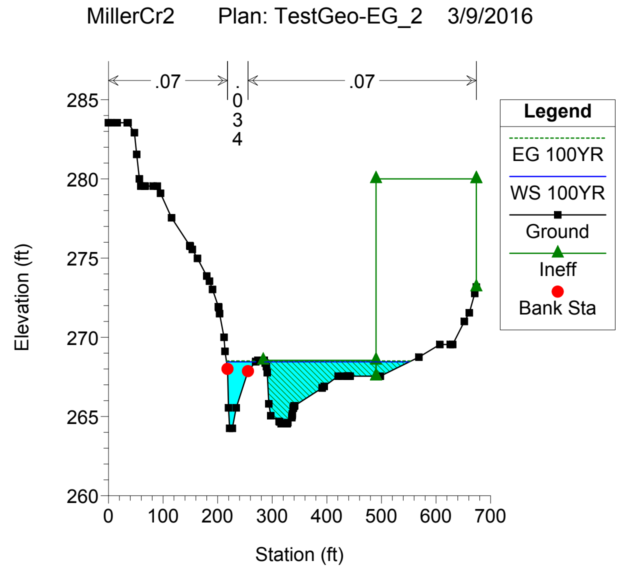
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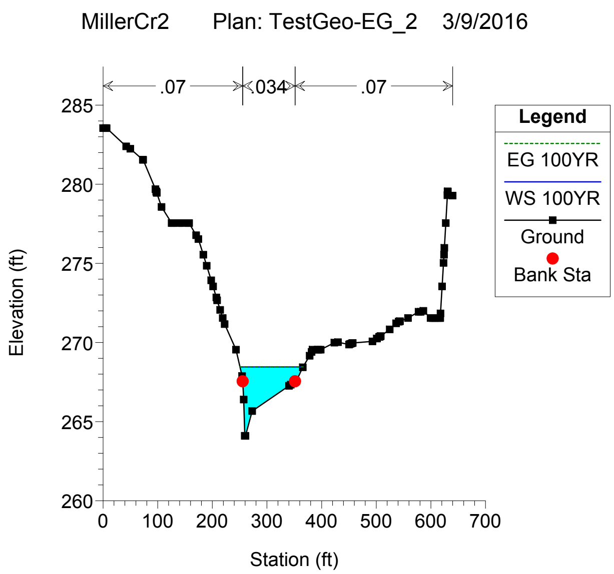
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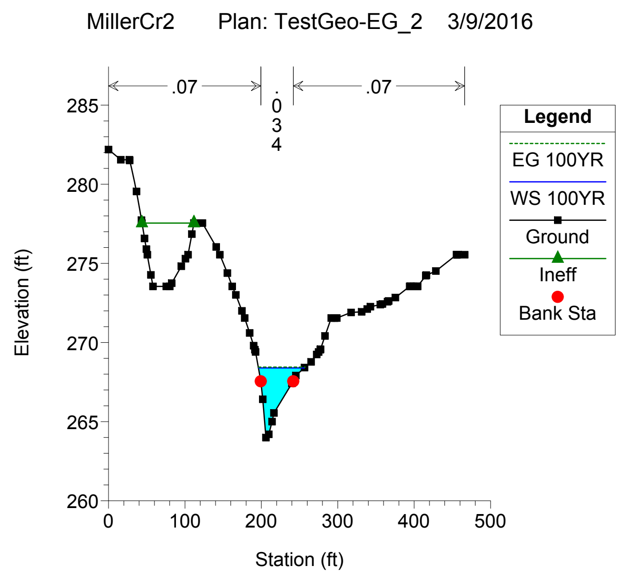
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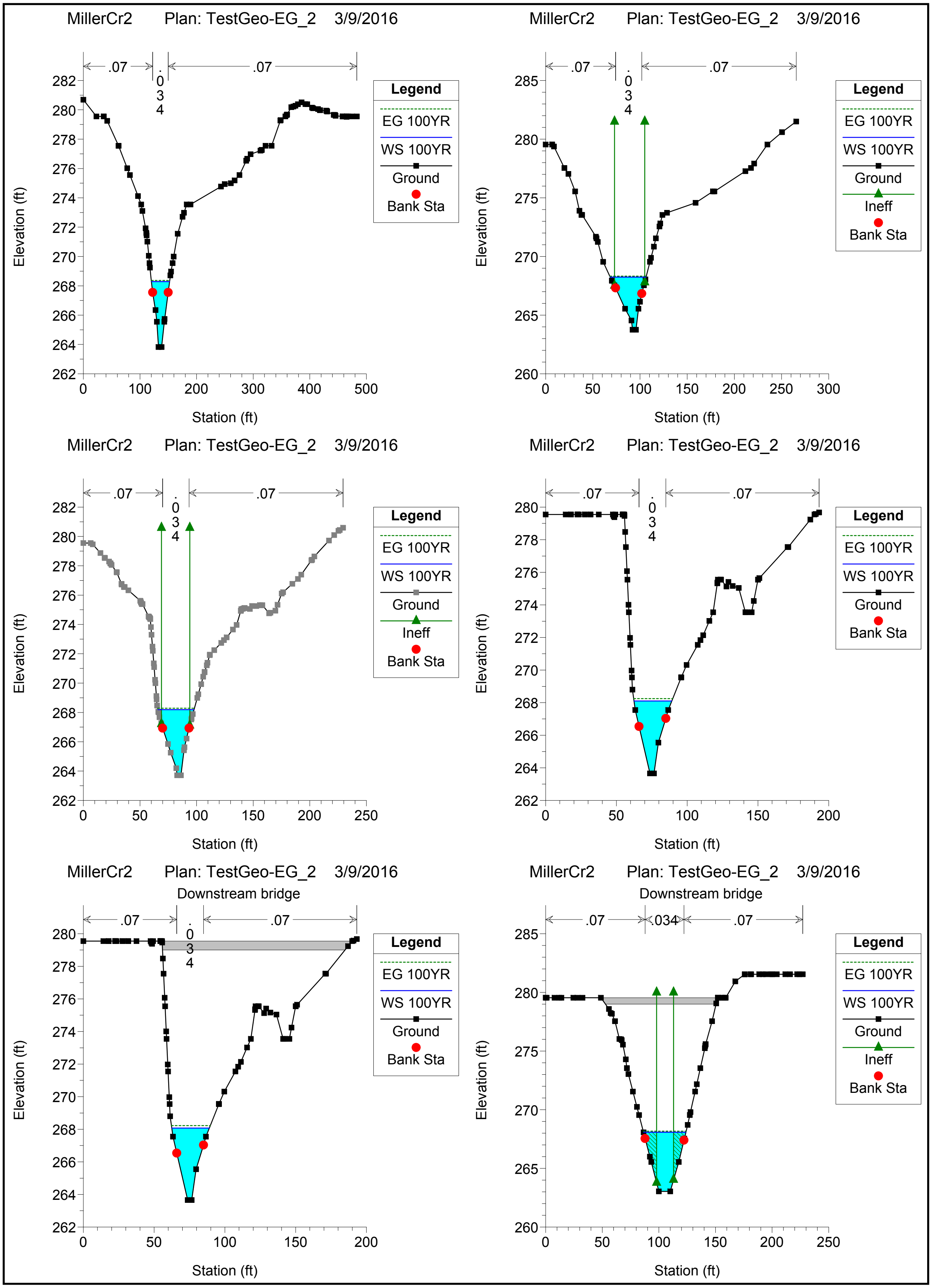

MillerCr2 Plan: TestGeo-EG_2 3/9/2016
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MillerCr2 Plan: TestGeo-EG_2 3/9/2016
Downstream bridge
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MillerCr2 Plan: TestGeo-EG_2 3/9/2016
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Elevation (ft)
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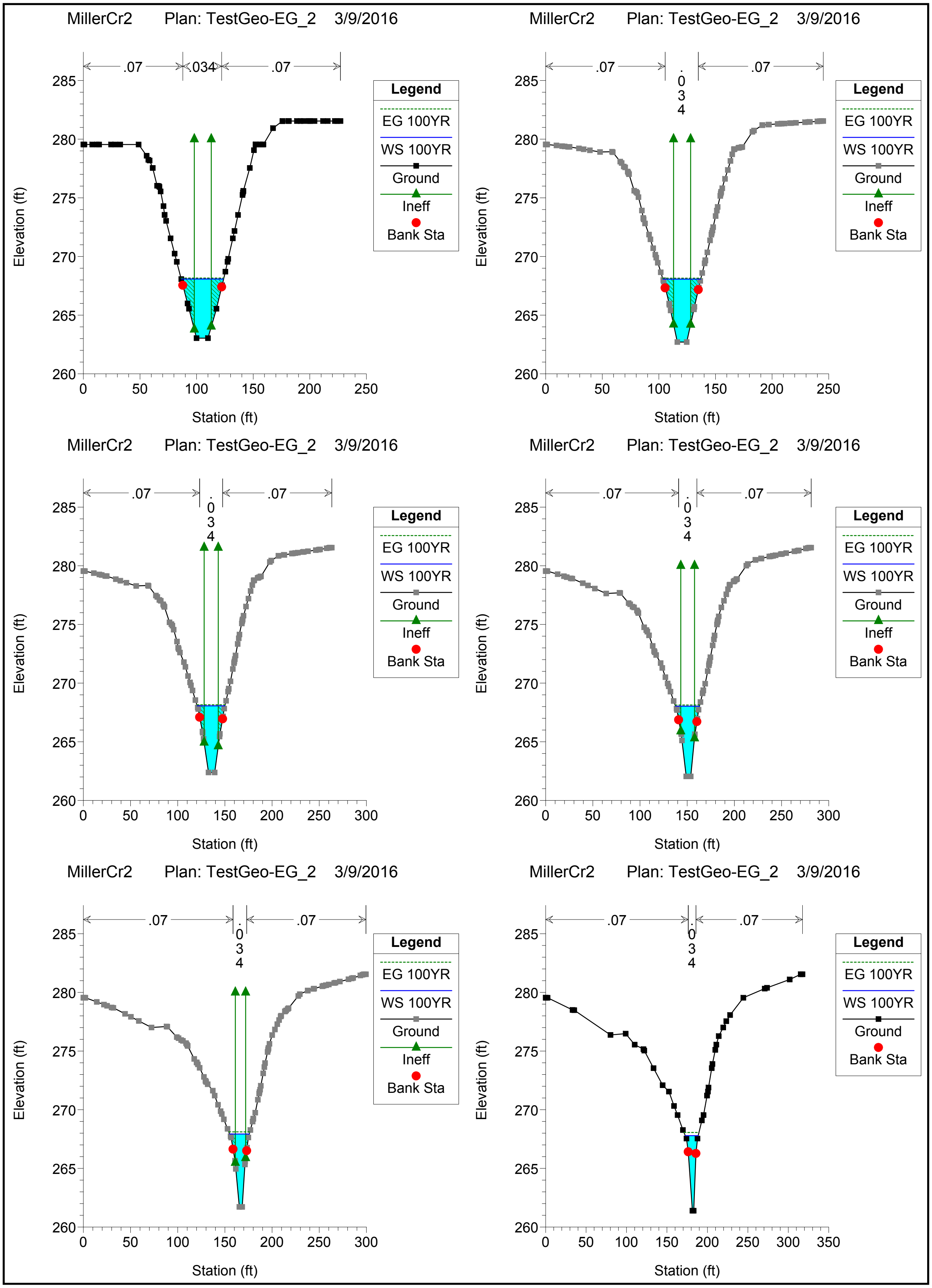
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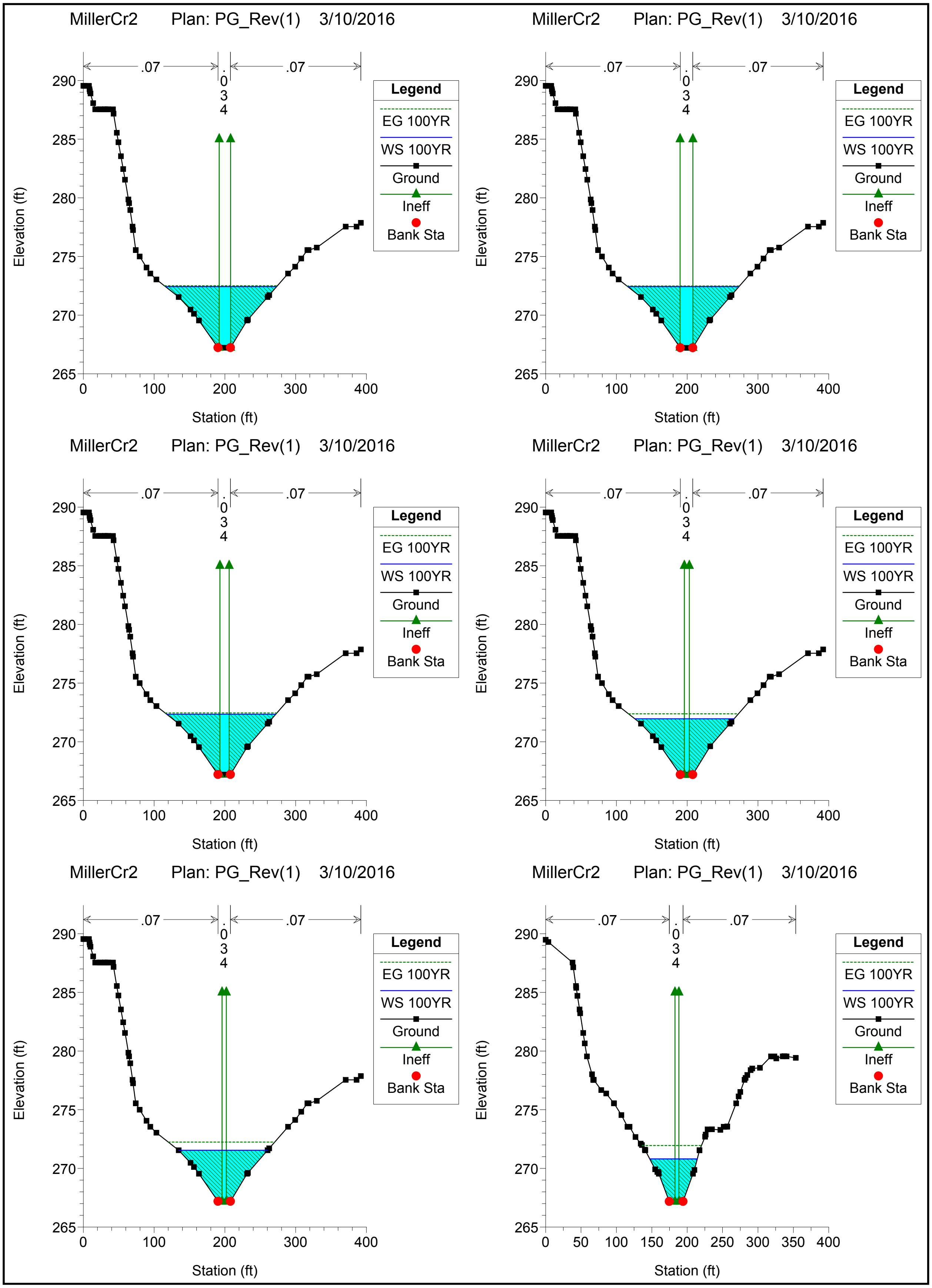

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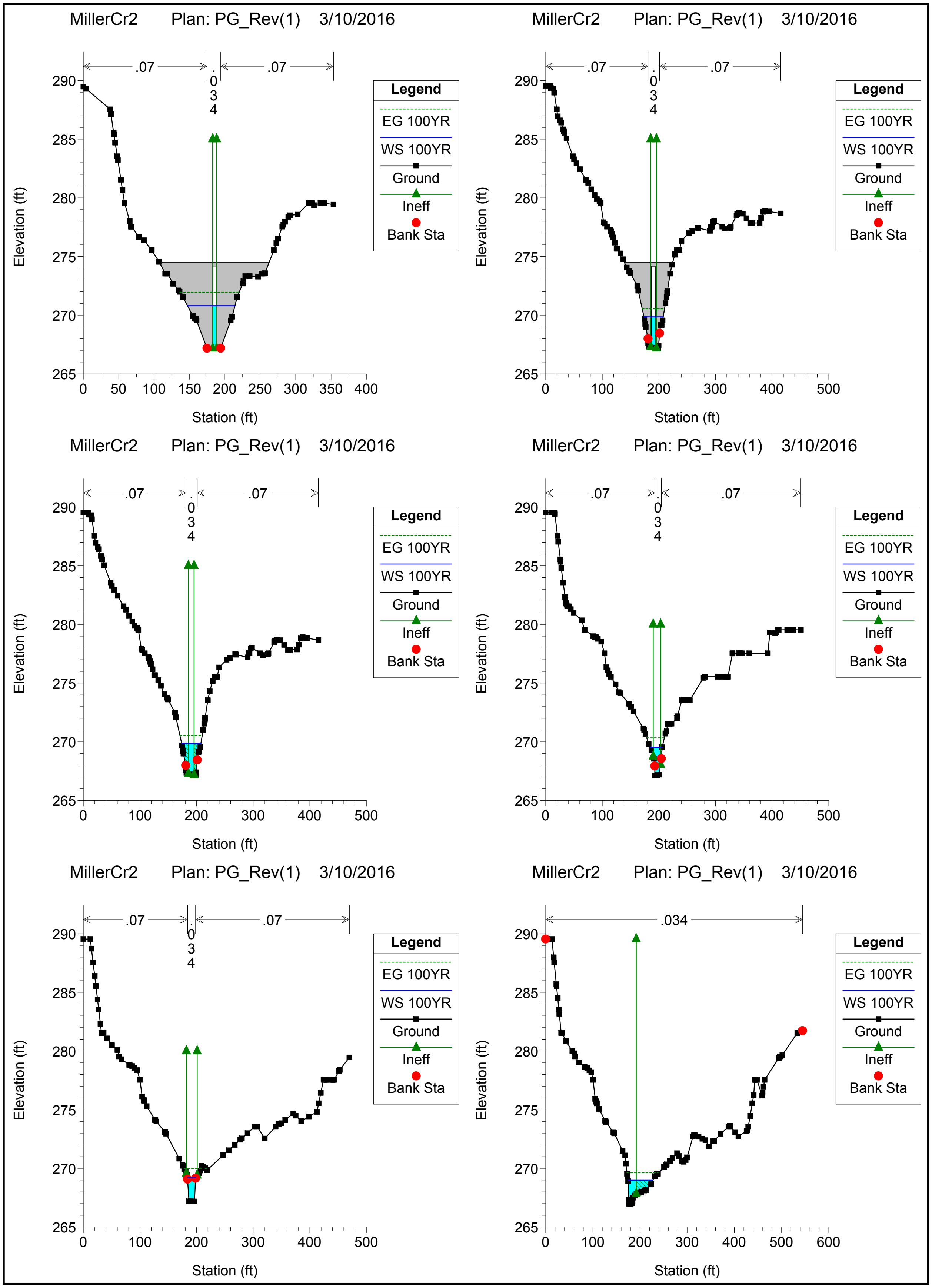
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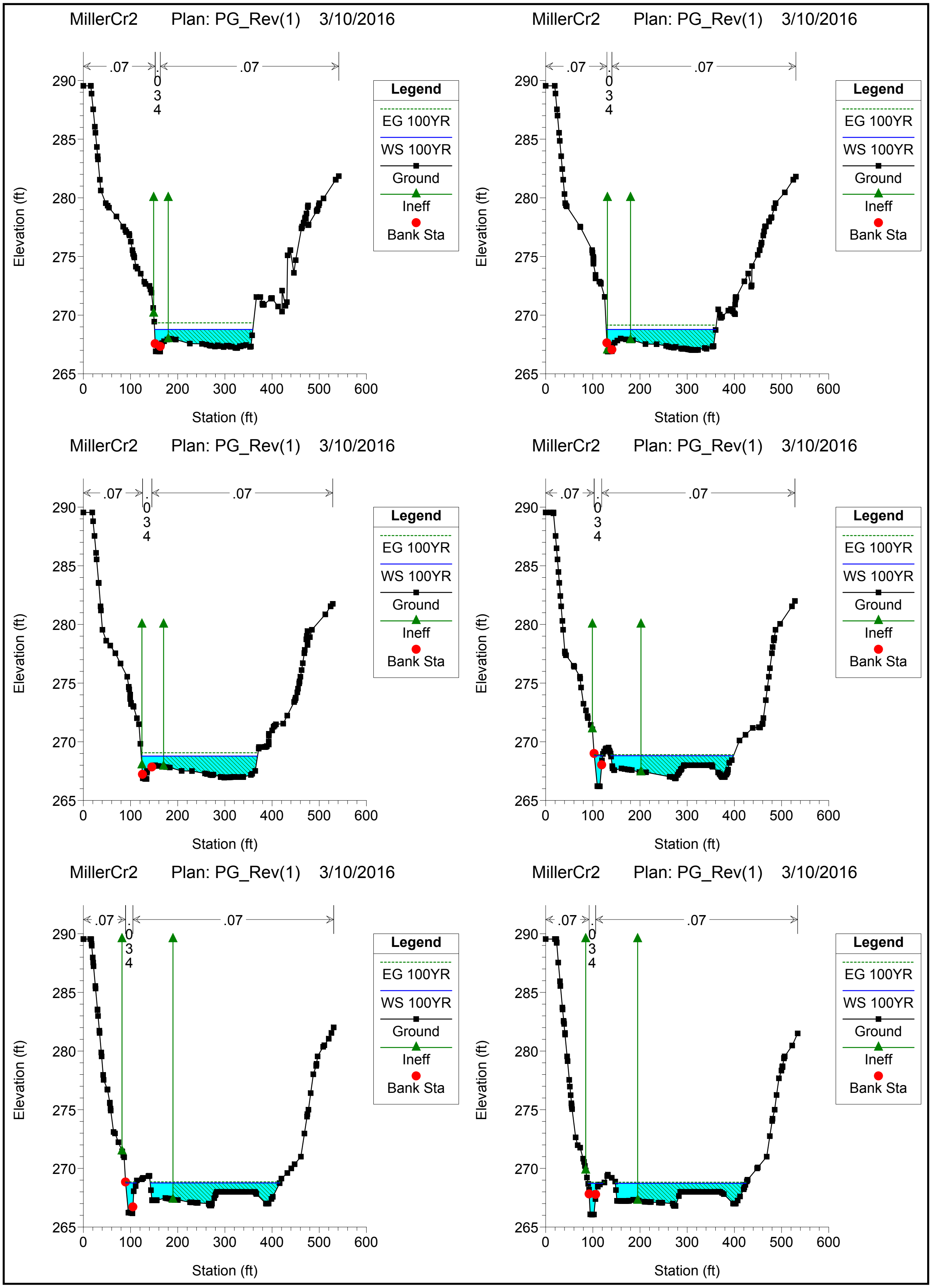
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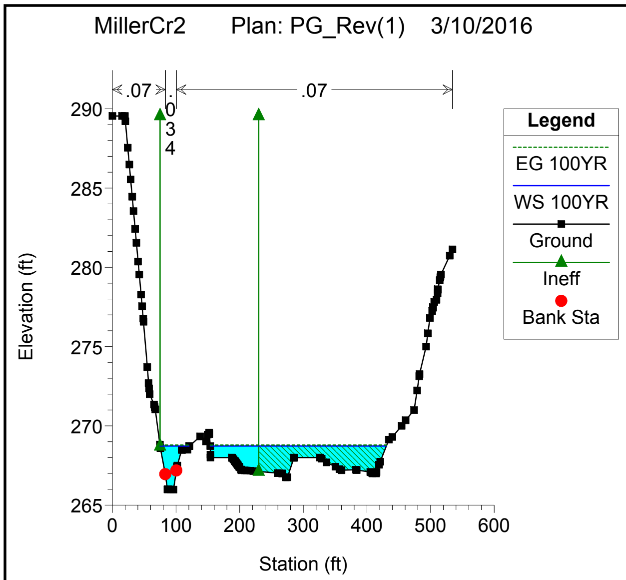
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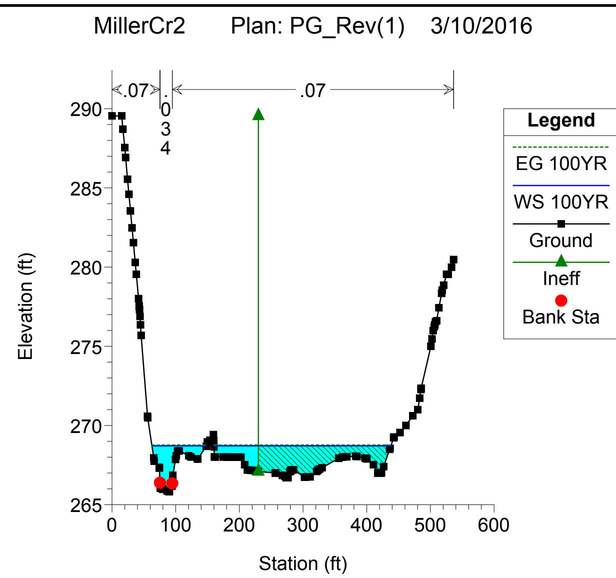
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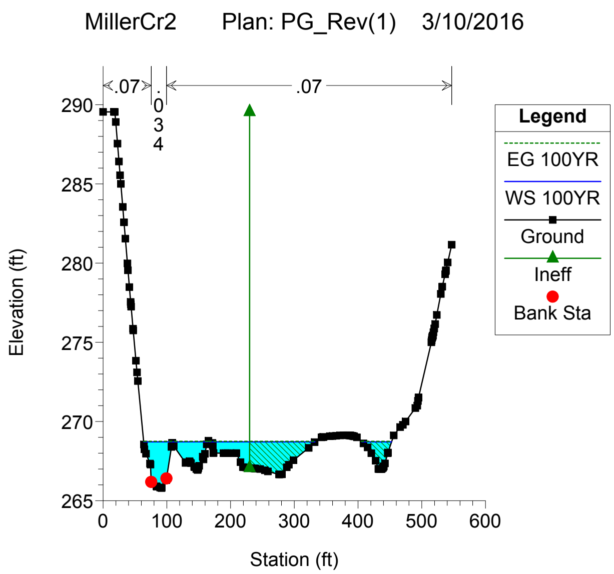
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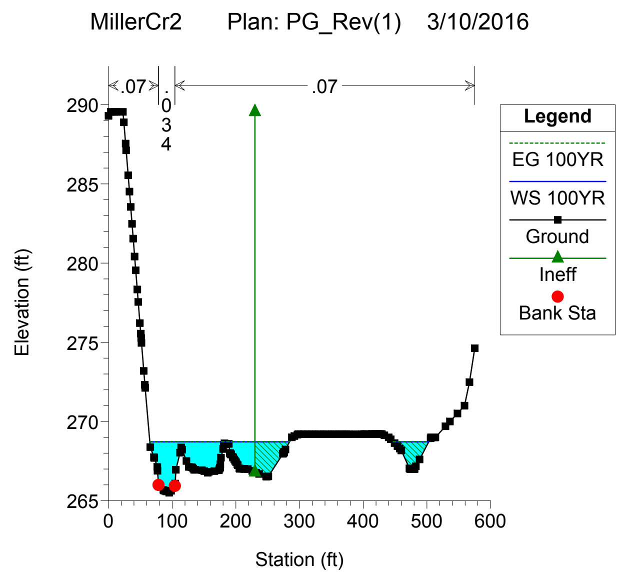
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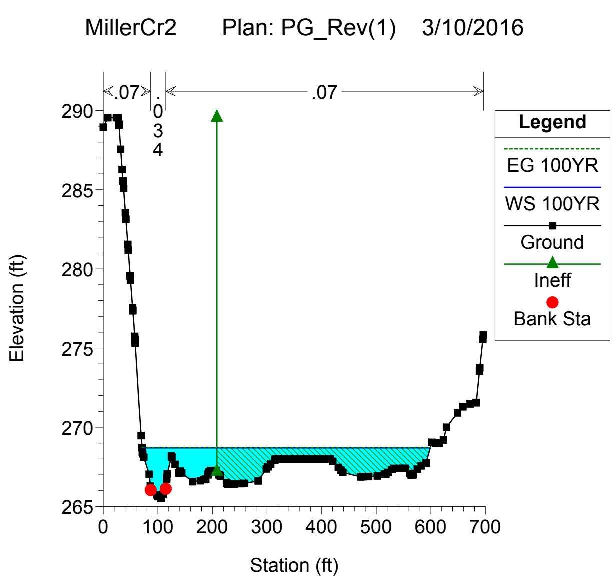
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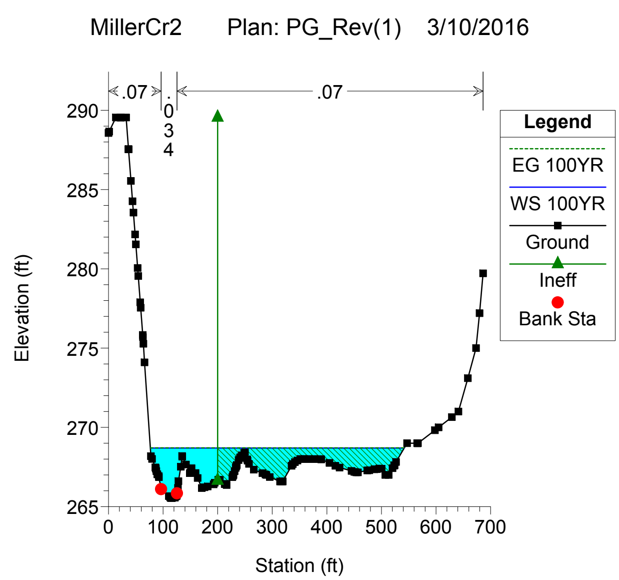
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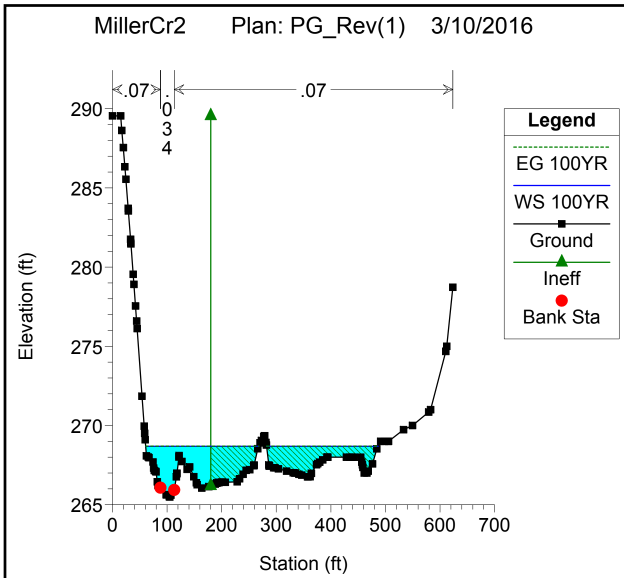
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Station (ft)
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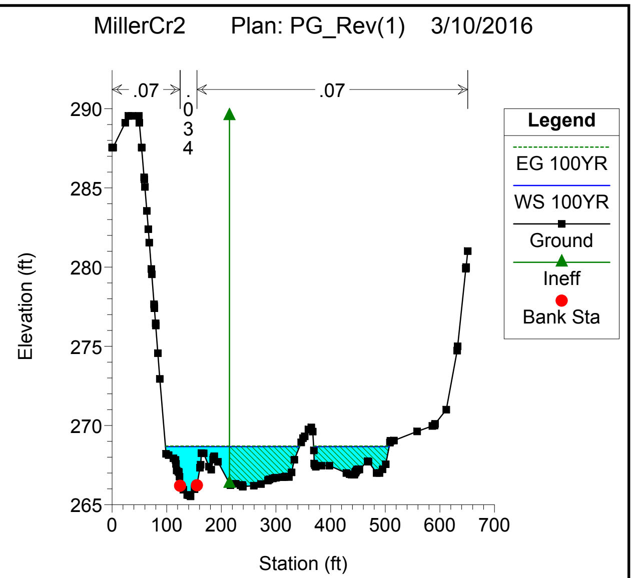
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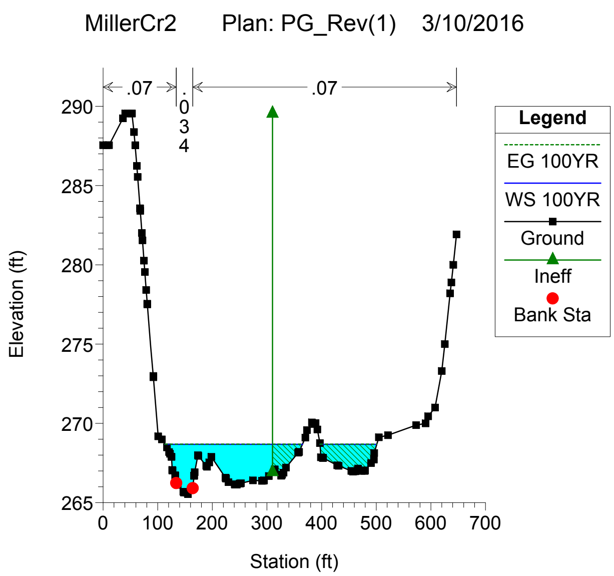
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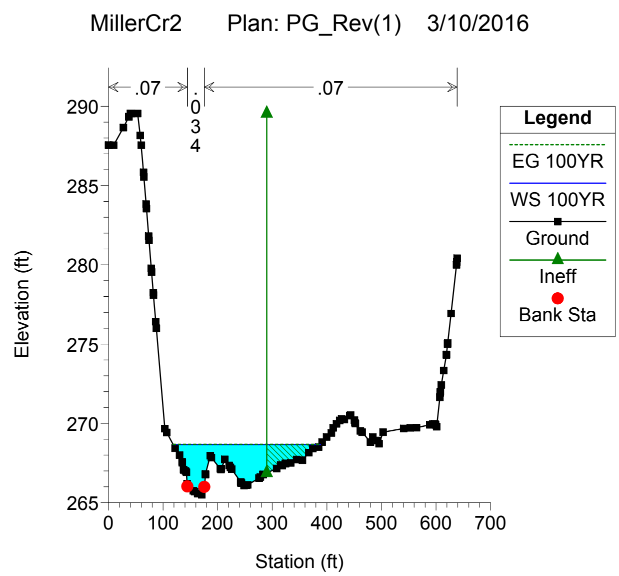
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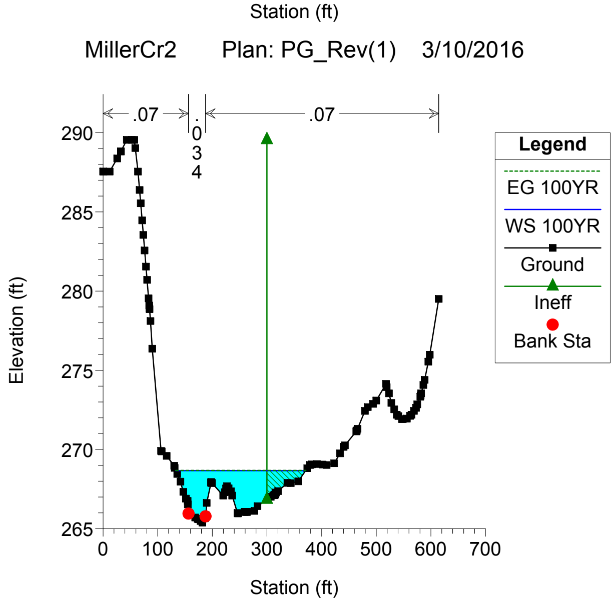
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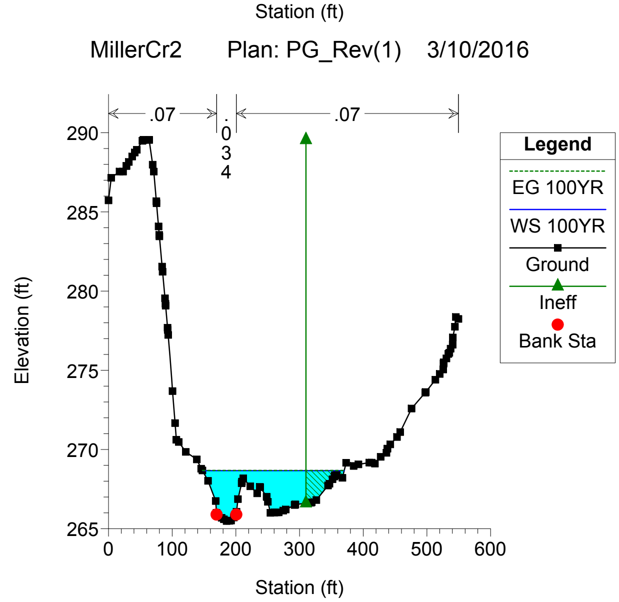
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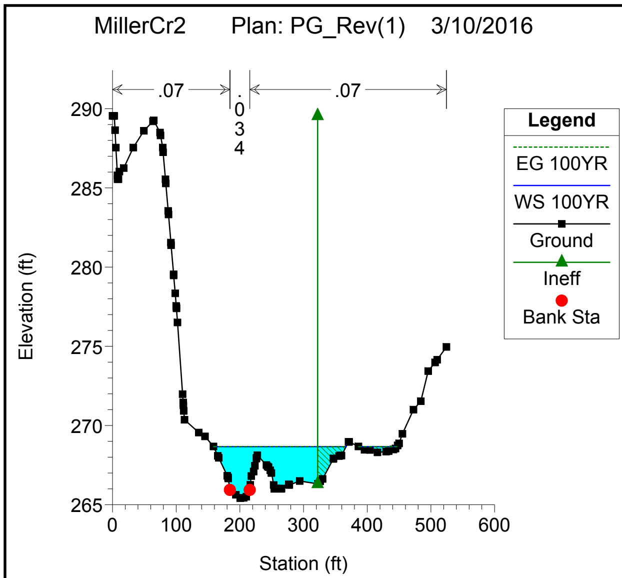
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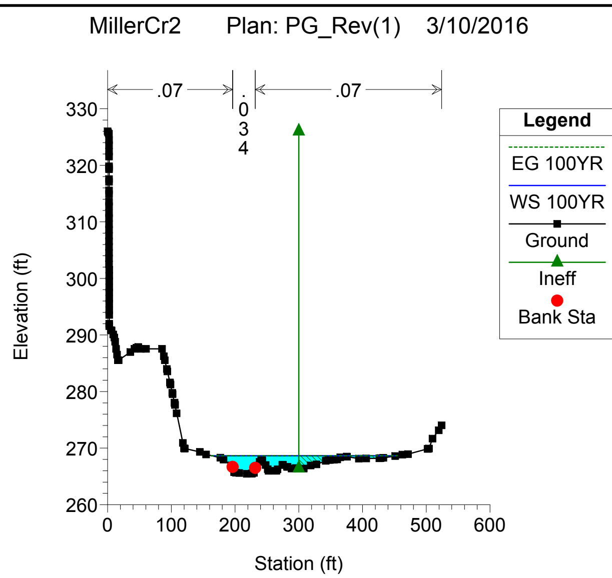
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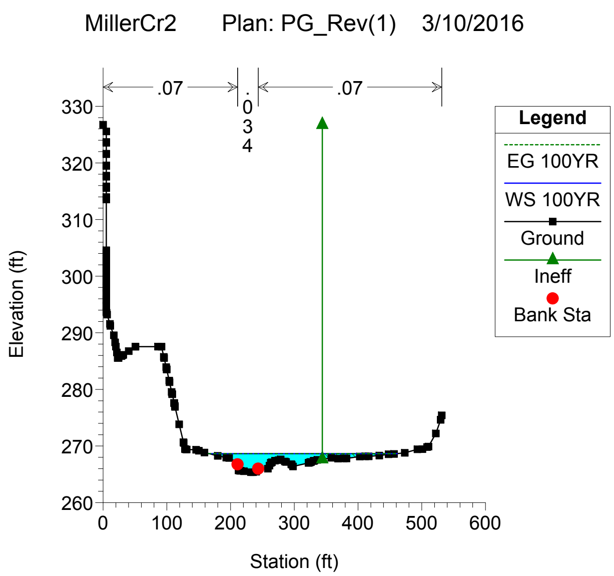
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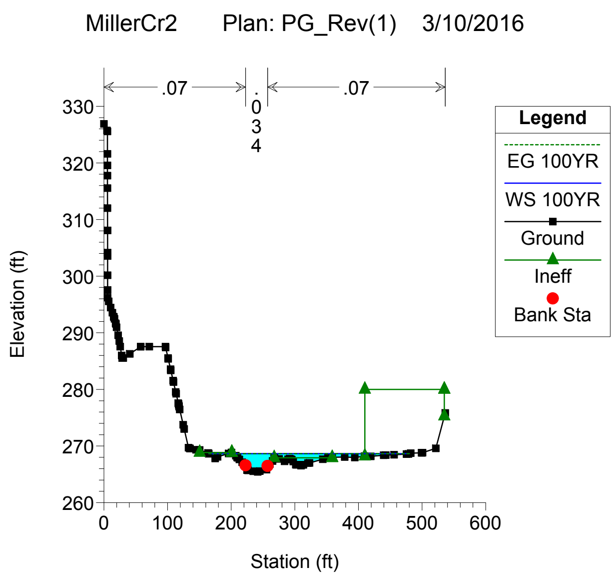
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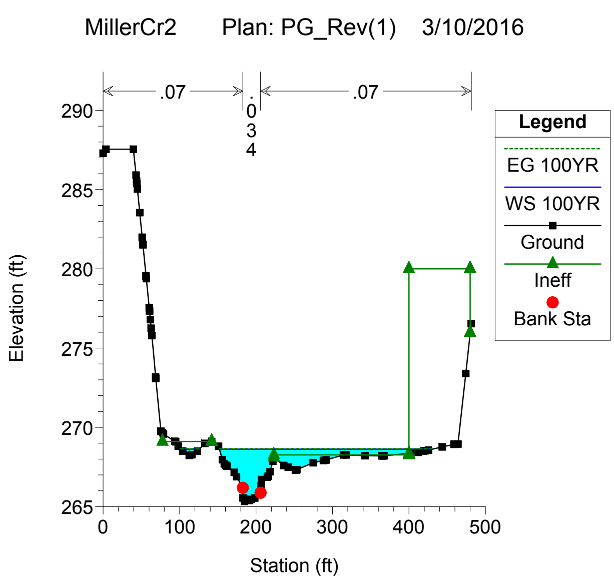
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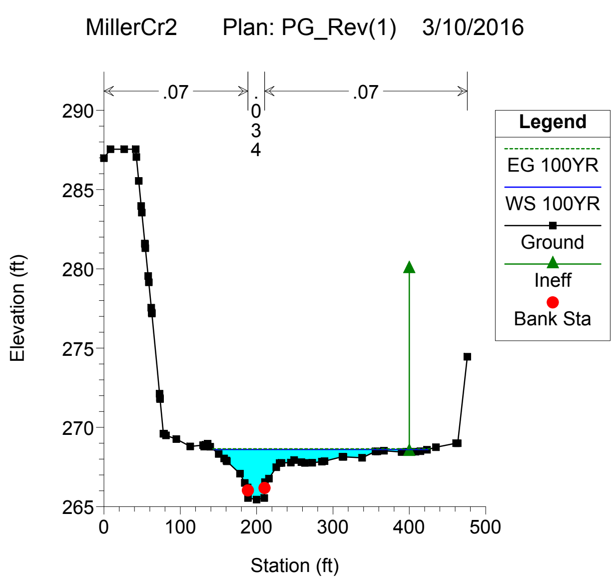
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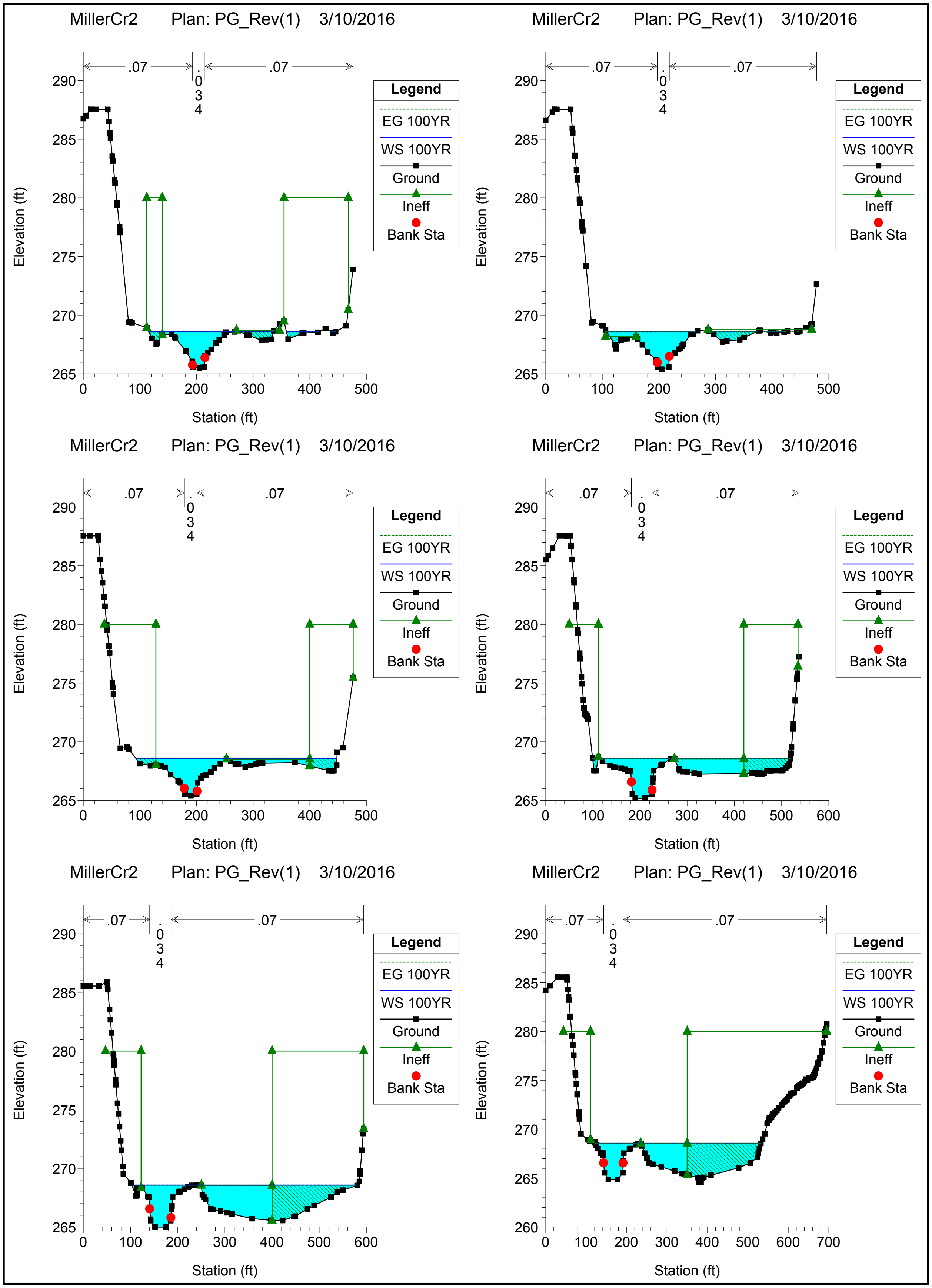
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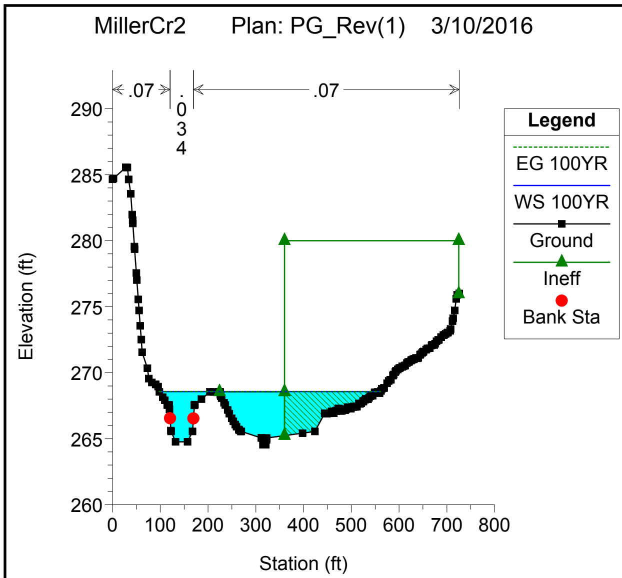
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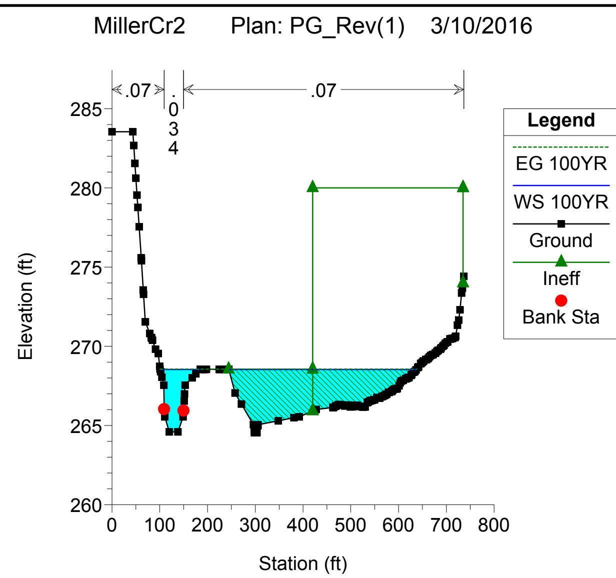
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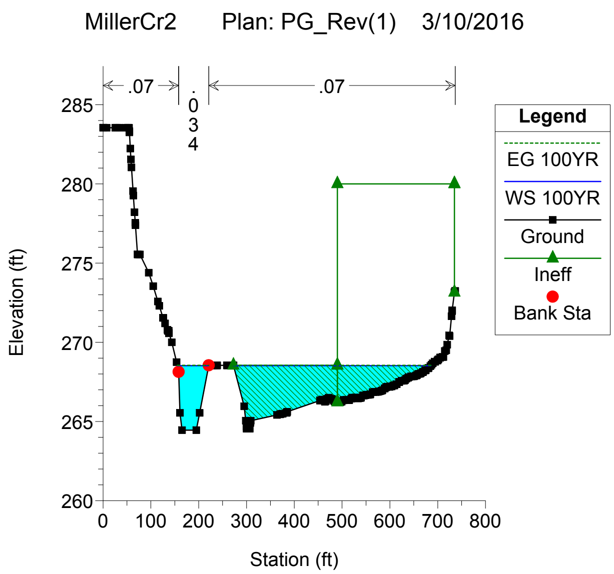
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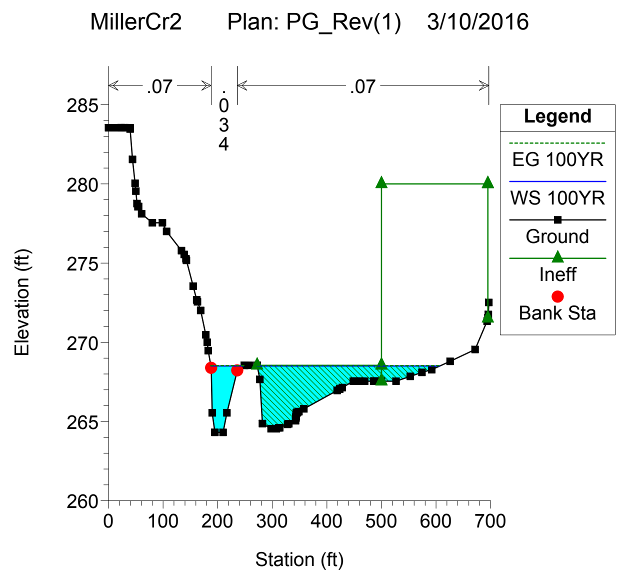
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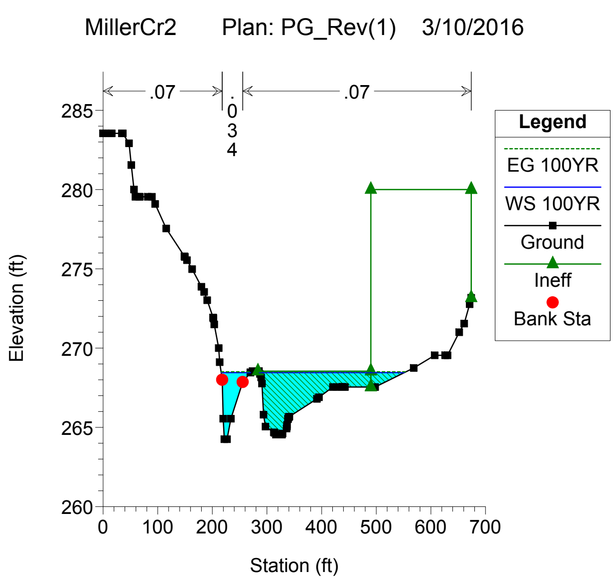
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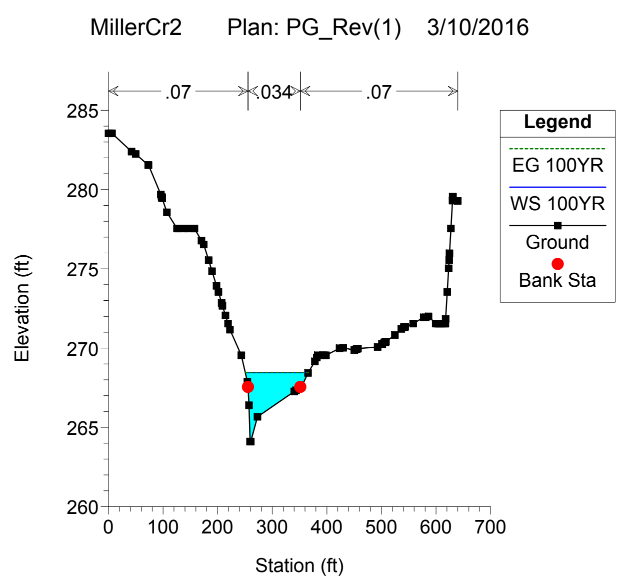
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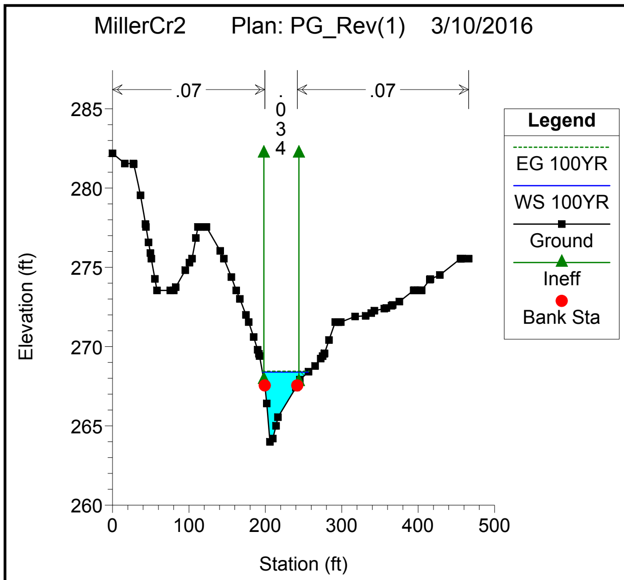
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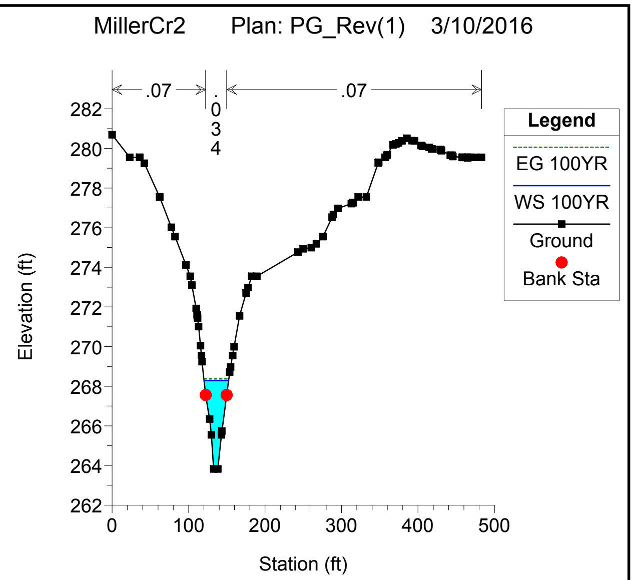
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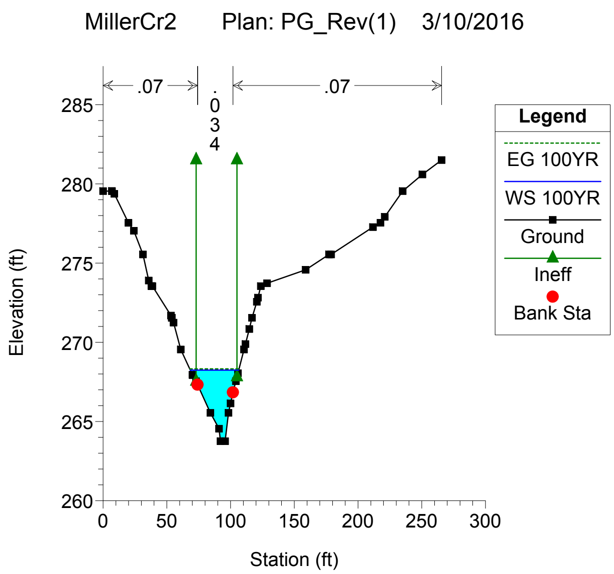
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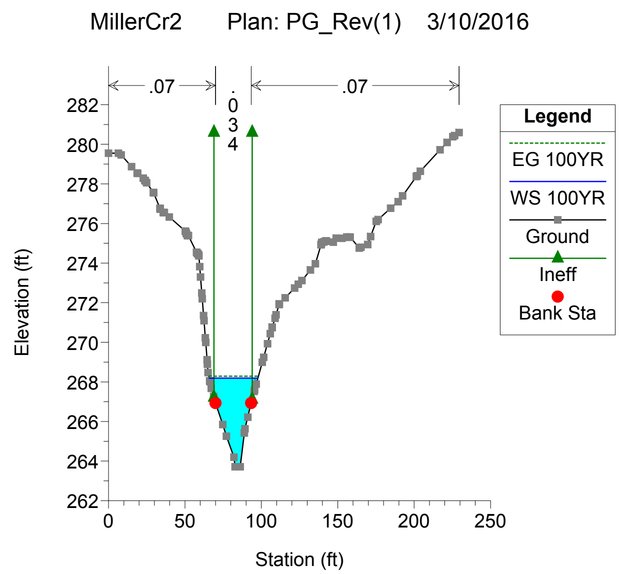
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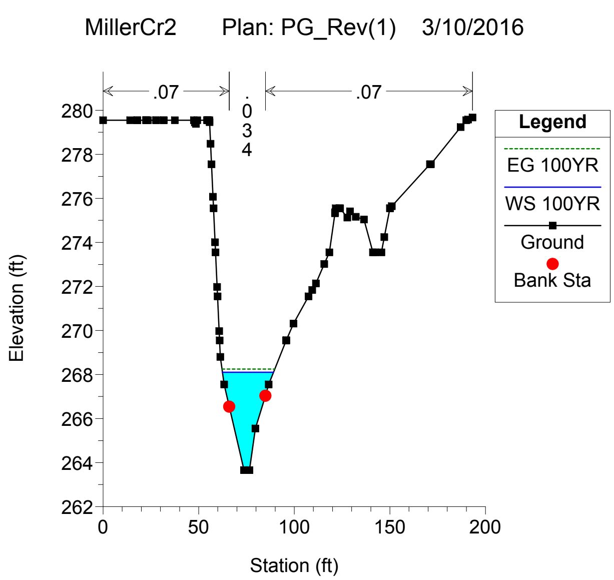
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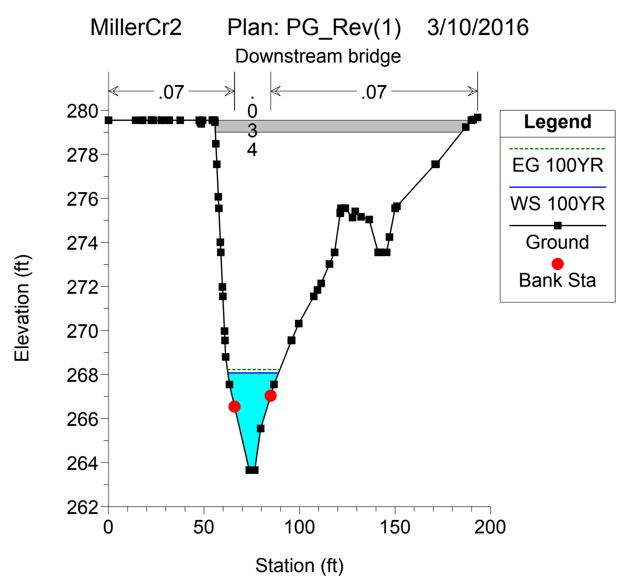
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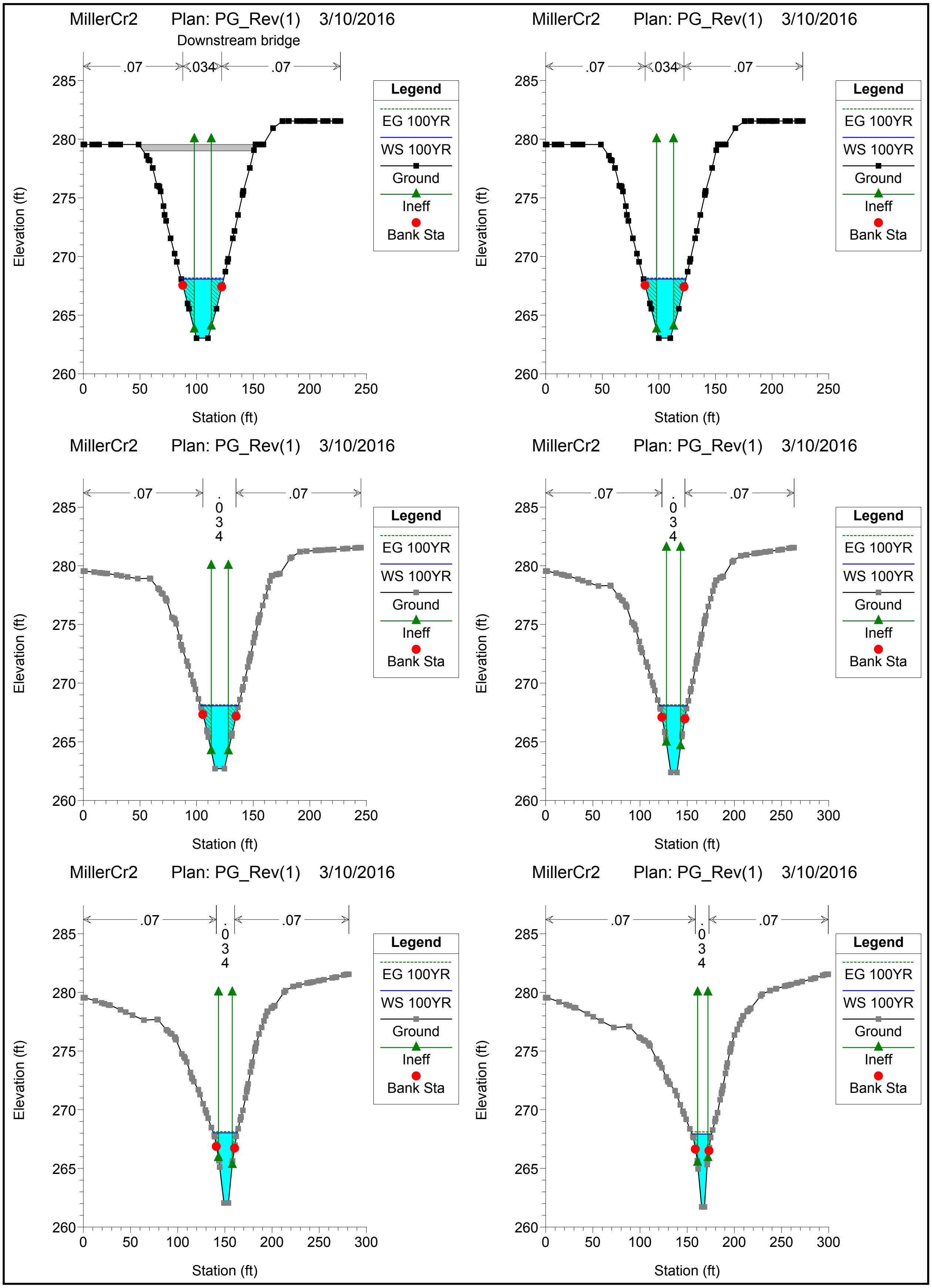
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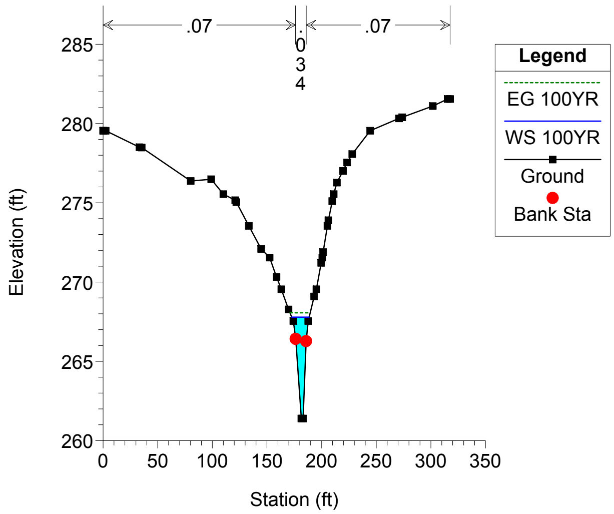

ESA

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memorandum

date 5/12/2016

to Robert Duffner, Port of Seattle
Don Robbins, Port of Seattle

from Eleanor Bartolomeo, PE, Project Engineer
Curtis Loeb, PE, Supervisory Engineer

subject Miller Creek Bank Stability Analysis

Introduction

Lora Lake was created when a former wetland site was mined for peat in the 1940s and 1950s and allowed to fill with water after the peat mining ceased. Lake-bottom sediments are contaminated with dioxin/furans from upland sources. The Port of Seattle plans to remediate the contaminated soils and sediments at the Site under the Model Toxics Control Act in accordance with the Washington State Department of Ecology Cleanup Action Plan (Ecology 2015). The Lora Lake remedial action and wetland rehabilitation design involves placing a sand cap over the contaminated lake-bed sediments, filling the lake with clean fill, and rehabilitating a functioning palustrine scrub-shrub wetland on the fill surface.

Purpose

The purpose of this memorandum and the associated analysis is to provide documentation that the proposed project will not negatively affect the stability of the banks of Miller Creek and to describe the basis of the proposed design elements that protect and enhance bank stability. It also evaluates the effectiveness of the erosion control and bank stabilization measures proposed in the 60% design for the east lake berm opening and the downstream swale outlet. Environmental Science Associates (ESA) evaluated site hydraulics for the proposed design. This memorandum discusses how the proposed design will affect velocities and shear stresses in Miller Creek and describes how these changes impact the potential for bank erosion.

Existing Conditions

Miller Creek flows along the south-eastern edge of Lora Lake, separated from the lake by a berm approximately three feet high (approximately elevation 267.0 feet to 269.0 feet). An existing outlet culvert through the berm (flat-sloped 12-inch diameter HDPE) with invert elevation at 266.8 feet provides exchange of flow between the lake and the creek. The direction of flow through the culvert is dependent on the relative elevations of the creek and the lake, but is predominantly from the lake to the creek except during the rising limb of storm events. Miller Creek can also flow into the lake over a low spot in the east lake berm (with a ‘weir’ elevation at 267.8 feet). This overflow occurs frequently during the wet season. The presence of this low spot suggests some current and ongoing bank erosion in this location. Near the lake, the toe of the channel banks is armored with riprap, transitioning downstream to a low-energy depositional reach containing unarmored banks and engineered large woody debris.

Proposed Design

The proposed 60% design includes the creation of an opening approximately 100 feet long in the east lake berm to enhance connectivity between Miller Creek and its floodplain when water levels in Miller Creek are elevated. The opening would have a base elevation of 268.0 feet and would enable to stream to engage to wetland at flows at or above the two-year recurrence interval event. The enhanced connectivity will provide ecological benefits to the system and improve habitat conditions for native species. The proposed 90% east lake berm opening design is attached as Appendix 1. Additionally, a new wetland drainage swale outlet, approximately 30 feet wide, and extending from the existing lake southern berm to the Miller Creek relocation berm. The new outlet is located approximately 400 stream feet downstream of the east lake berm opening to provide positive drainage from the wetland to Miller Creek. The proposed 60% swale outlet design is attached as Appendix 2. No work is proposed in the Miller Creek channel below the ordinary high water mark in either location.

The construction of the Lora Lake remedial action and wetland rehabilitation is planned to occur over two construction seasons; Construction Season 1 (2017) and Construction Season 2 (2018). These openings will be created in Construction Season 2, after Lora Lake has been capped and filled and concurrent with the fine grading and planting of the wetland. Between Construction Seasons 1 and 2, the low point in the east lake berm will be reinforced with sandbags to prevent overbank flows from Miller Creek from entering the site. Because no work beyond that will have yet been performed at either proposed berm opening site, erosive potential in these locations during the winter between active construction seasons is expected to be the same as under existing conditions.

Methods

ESA built a HEC-RAS 4.1 model (USACE 2010) of the Miller Creek project reach extending from the Lake Reba Detention Facility outlet structure (control structure) to the South 156th Way Bridge. For more details on model selection and development, refer to the Miller Creek Floodplain Memorandum prepared for this project (ESA 2016a). HEC-RAS 4.1 is a one-dimensional model and calculates channel velocities and shear stresses as average values within each cross-section (USACE 2010). This may result in slight under- or over-estimation of the locally effective erosive forces at the channel banks, but will provide a reasonable estimate for design purposes. In sensitive locations, such as the outside of channel bends, the average shear stress was translated into a local maximum using the methods presented in Fischenich (2001).

The model evaluated channel hydraulics (velocities and shear stresses) in Miller Creek at events ranging from the 1-year to the 100-year recurrence interval flow. The erosive potential of the existing and proposed bank conditions was assessed under each scenario. The highest modeled stream velocities and shear stresses occur during the 100-year flow event (175 cfs) under both the existing and proposed scenarios. Consequently, this event was chosen to analyze the potential for bank erosion.

Results

Under the proposed 60% design conditions, channel velocities, shear stresses, and water depths all decrease or remain unchanged as compared to the corresponding values under existing conditions. This indicates that there will be no increase in the erosive potential of Miller Creek due to the proposed project and that the portions of the bank which are not disturbed by the project will not experience any increase in erosion. Bank protection for the disturbed sections of the Miler Creek bank is discussed below under Bank Stabilization Design Recommendations.

The highest velocities in the model occur in the upstream 75 feet of the modeled reach, just upstream of the proposed berm opening. The velocities in this section are higher than those further downstream because the channel bed slope here is steeper. Figures 1 through 3 display results from the hydraulic modeling analysis, with the portion of the reach adjacent to the proposed east lake berm opening highlighted. Results are displayed for only the upstream 220 feet of the modeled reach, where velocities and erosive potential are the greatest and significant differences exist between the existing and proposed scenarios. These 220 feet are comprehensive of the stream section from the control structure to approximately 100 feet downstream of the berm opening. Downstream of this section, results from the existing and proposed scenarios rapidly converge.

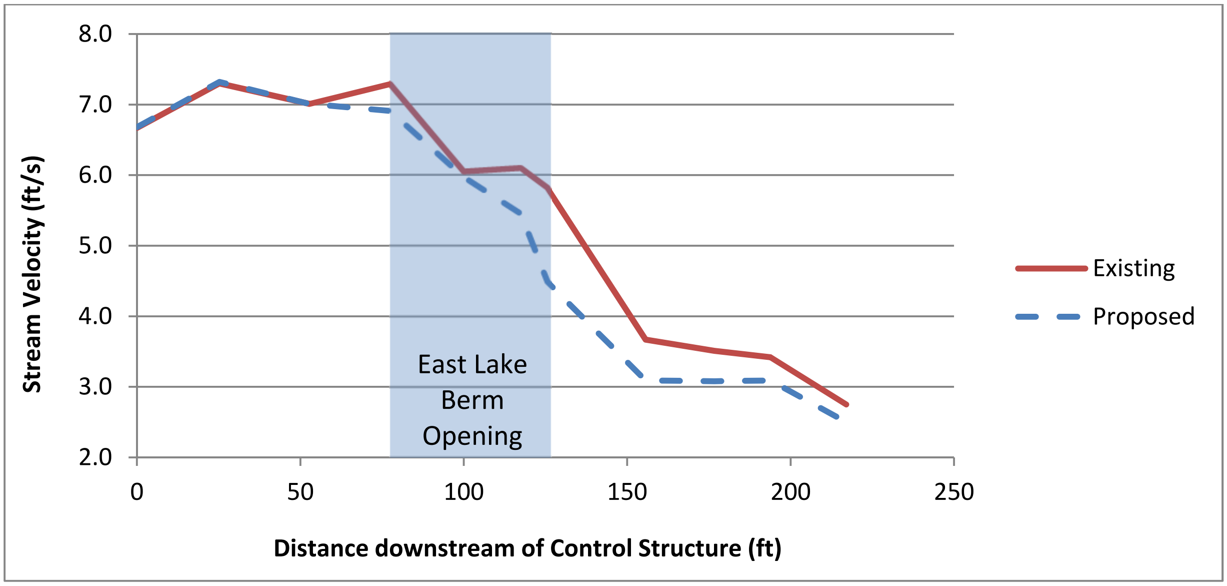

Figure 1. Channel Velocity (ft/s) modeled during a 100-year flow on Miller Creek in the vicinity of Lora Lake.

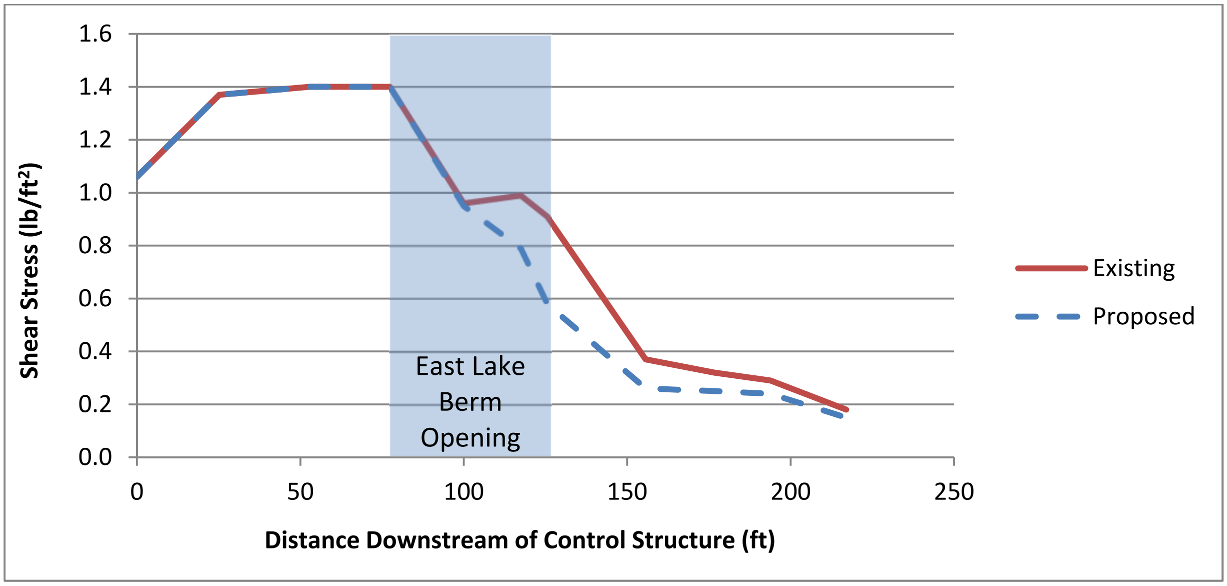

Figure 2. Shear Stress (lb/ft^2) modeled during a 100-year flow on Miller Creek in the vicinity of Lora Lake.

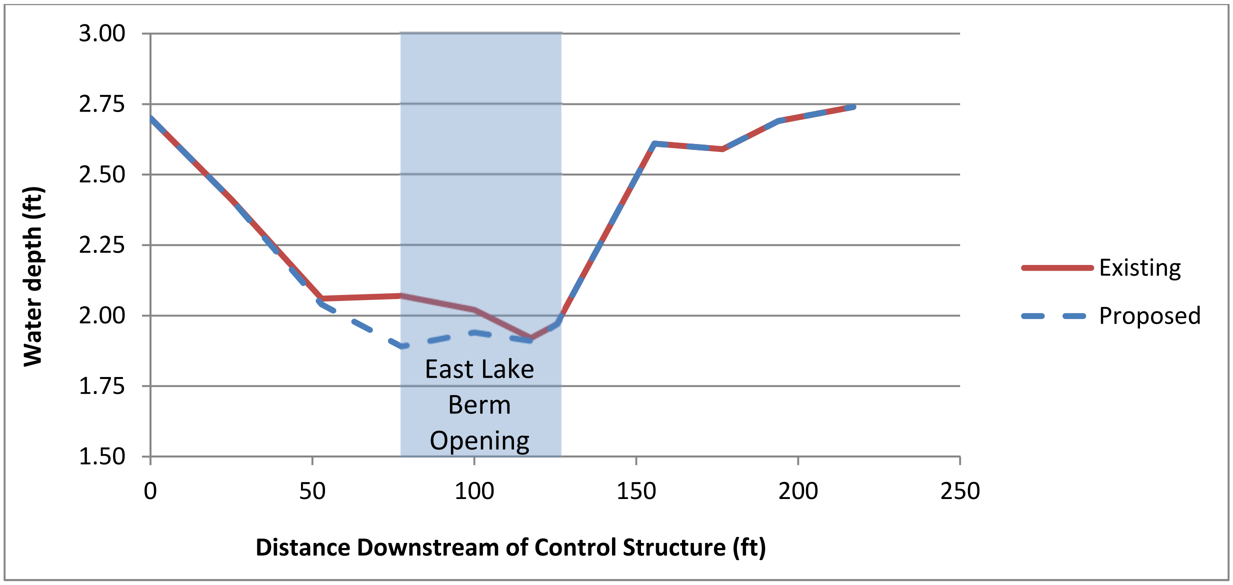

Figure 3. Water Depth (ft) modeled during a 100-year flow on Miller Creek in the vicinity of Lora Lake.

In both the existing and proposed scenarios, the maximum modeled velocity is 7.3 ft/s and the corresponding average channel shear stress is 1.4 lb/ft^2. This maximum occurs where the stream bends sharply, approximately 25 feet downstream of the control structure (50 feet upstream of the proposed east lake berm opening). In the existing scenario, the same velocity and shear stress also occurs 75 feet downstream of the control structure, at the existing erosion and overflow point in the east lake berm. In the proposed scenario, the velocity at the existing erosion point decreases to 6.9 ft/s, although the shear stress remains unchanged at 1.4 lb/ft^2. Applying the Fischenich equations transforms the average channel shear stress of 1.4 lb/ft^2 to a local maximum shear stress of 2.1 lb/ft^2 acting on the channel banks at the bend and at the existing erosion and overflow point.

Starting at the control structure and extending approximately 200 feet downstream, the existing bank is armored with riprap at its toe and partially vegetated with grasses, shrubs, and trees, which will not be disturbed during construction. The existing vegetation and armoring increases resistance to erosion (laboratory studies have shown that dense, well-established vegetation – which this is not – can resist shear stress up to 2.5 lb/ft^2, and 9-inch riprap can resist shear stress up to 3.8 lb/ft^2). While the riprap adequately protects the bank toe, the partial vegetation is insufficient to protect the upper banks at higher flows, leading to localized erosion.

In the portion of Miller Creek below the lake (not shown in the Figures 1 – 3, above), velocities and shear stresses rapidly decrease and the potential for stream bank erosion drops significantly. In the section of channel adjacent to the downstream swale outlet, velocity is only 1.1 ft/s while shear stress is 0.03 lb/ft^2. For reference, the maximum permissible velocity and shear stress to avoid entrainment of bank sediments in unvegetated, loamy soils is 2.5 ft/s and 0.05 lb/ft^2 respectively (Fischenich 2001). Consequently, bank erosion is highly unlikely in this portion of the channel, even in the areas disturbed by the proposed project. HEC-RAS model output including summary tables and cross section plots are included in Appendix 3.

Bank Stabili□ation Design Recommendations

While the proposed project is not expected to increase the erosive potential of Miller Creek in the modeled reach relative to existing conditions, channel velocity and shear stress upstream of the proposed berm opening are both high enough during the 100-year flow event to justify additional bank protection in this area. It is recommended that the 90% design include the planting of willow live stakes in the high velocity areas within and immediately upstream of the new east lake berm opening. This will provide additional bank protection while minimizing the disturbance to the existing vegetation and providing a functional ecological lift to the system. Limits of planting will be determined as part of the 90% design process. Laboratory studies have shown willow live stakes to be capable of resisting erosion in velocities from 3 to 10 ft/s and shear stresses of 2.1 to 3.1 lb/ft^2 (Fischenich 2001). Combined with riprap in scour critical areas, this will meet or exceed the maximum expected velocity and shear stress for this system and provide a margin of safety against bank erosion. At the existing erosion point in the east lake berm, a rock berm of light loose riprap is proposed to guarantee that the existing stream bend does not avulse or migrate into the lake cap and fill.

Bank protection measures for the disturbed soils within the proposed east lake berm breach are described in the Mitigation Plan for this project and shown in Appendix 1. Protection includes coir logs, coir fabric, willow live stakes, and initial seeding. Additionally, a buried key trench of riprap will be installed at the back edge of the berm opening to provide long-term protection against lateral channel migration, transitioning into the exposed rock berm described above, see Appendix 1 (ESA 2016b). Laboratory studies have shown coir mat to be capable of resisting erosion in velocities of 8 ft/s and shear stresses from 3 to 5 lbs/ft^2 (Fischenich 2001). Based on the modeled channel velocities and shear stresses in this section of the channel, the coir mat alone is expected to provide sufficient protection against bank erosion during willow establishment (one growing season ~ 3 to 9 months). After will establishment, the willows will provide the primary bank stabilization, with the riprap trench providing redundancy.

Modeled velocities and shear stresses downstream at the new drainage swale outlet are much lower and do not necessitate any additional erosion protection in this location. However, in order to provide additional assurance, as well as to improve ecological function, the sides of the new outlet will be revegetated with riparian plantings.

References

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King County, 2015. “Hydrologic Information Center Data Download”, http://green2.kingcounty.gov/hydrology/DataDownload.aspx?G_ID=144&Parameter=Stream%20Flow. Accessed 3/15/2015.

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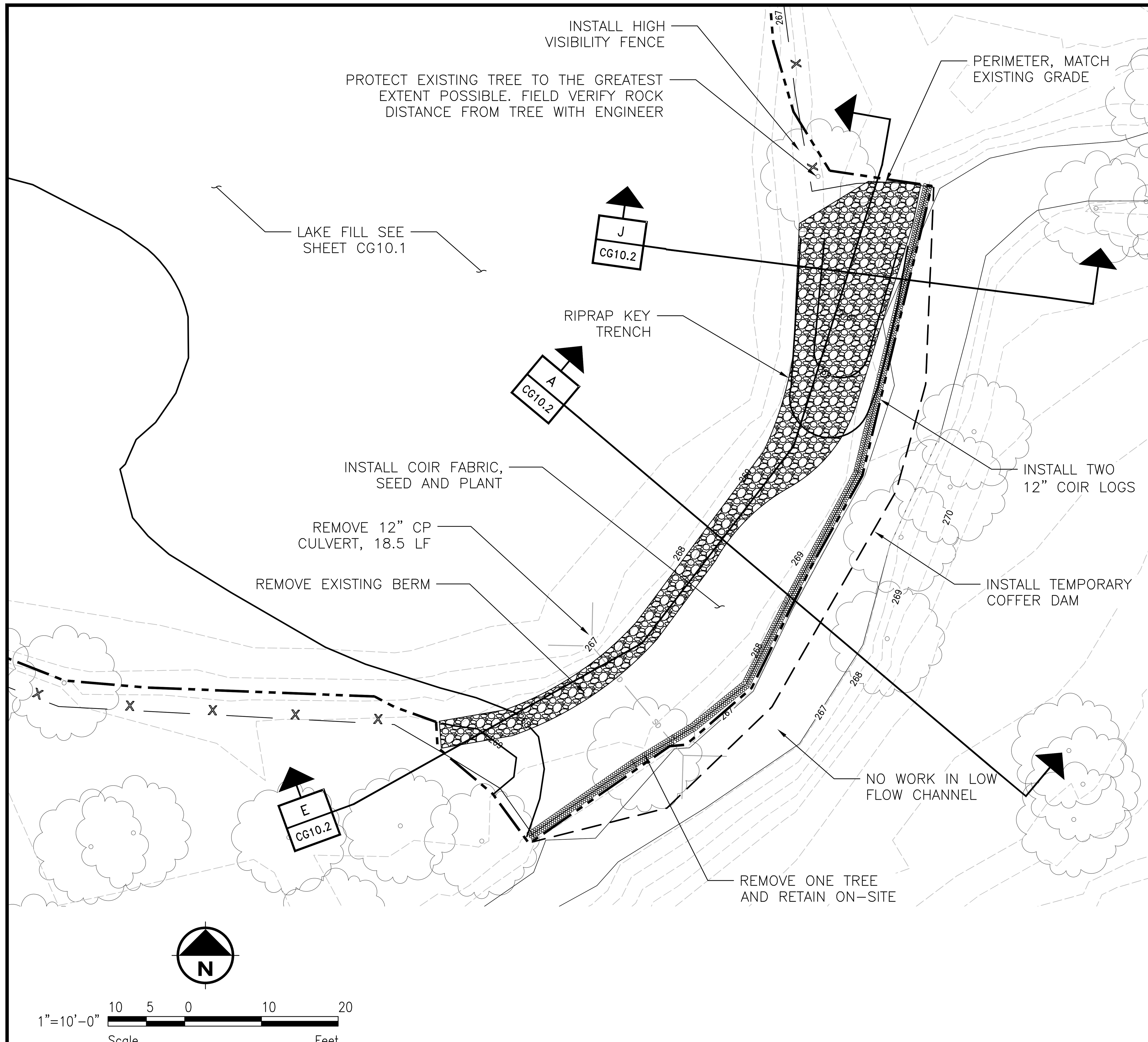
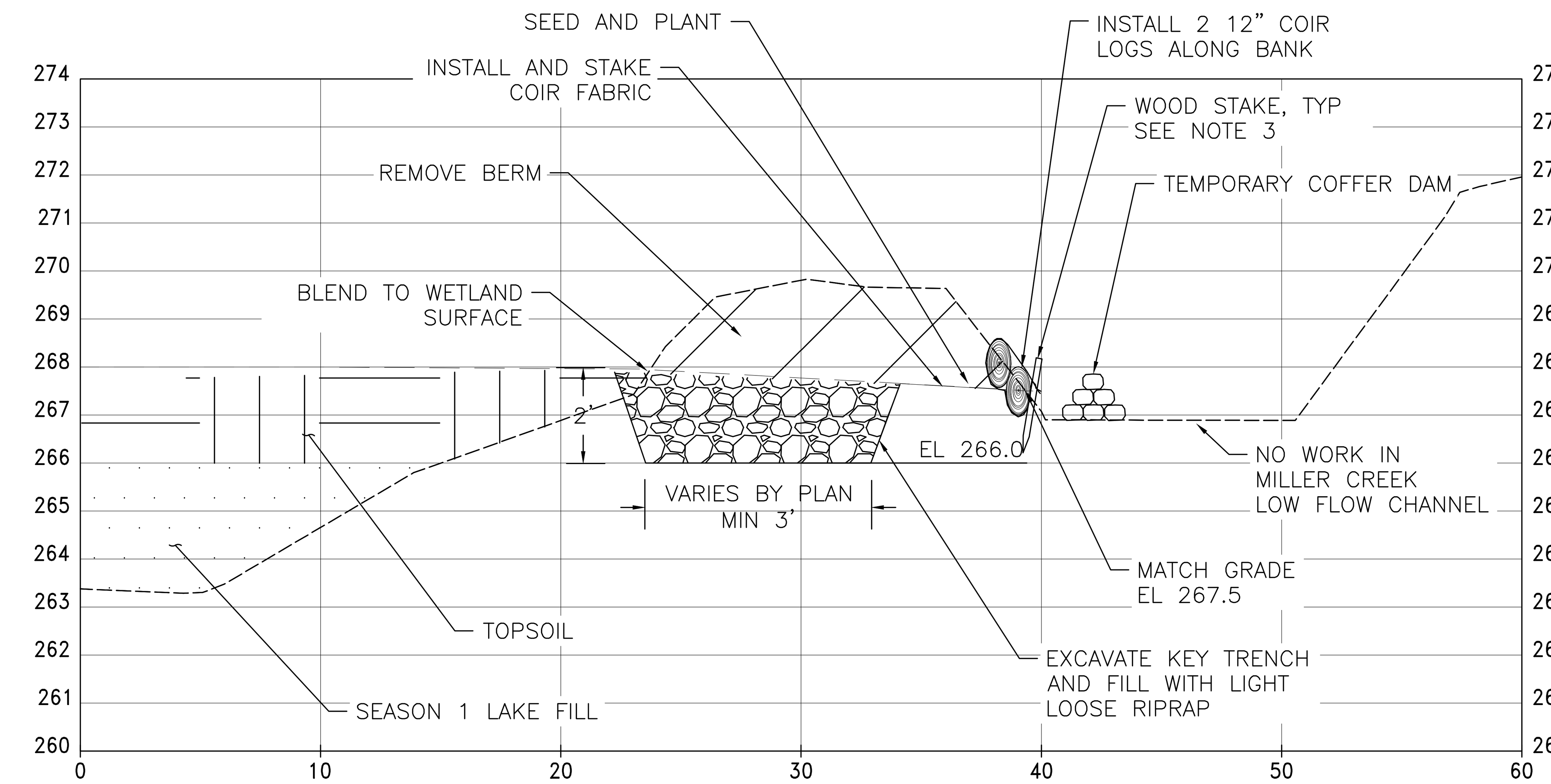
Appendix 1

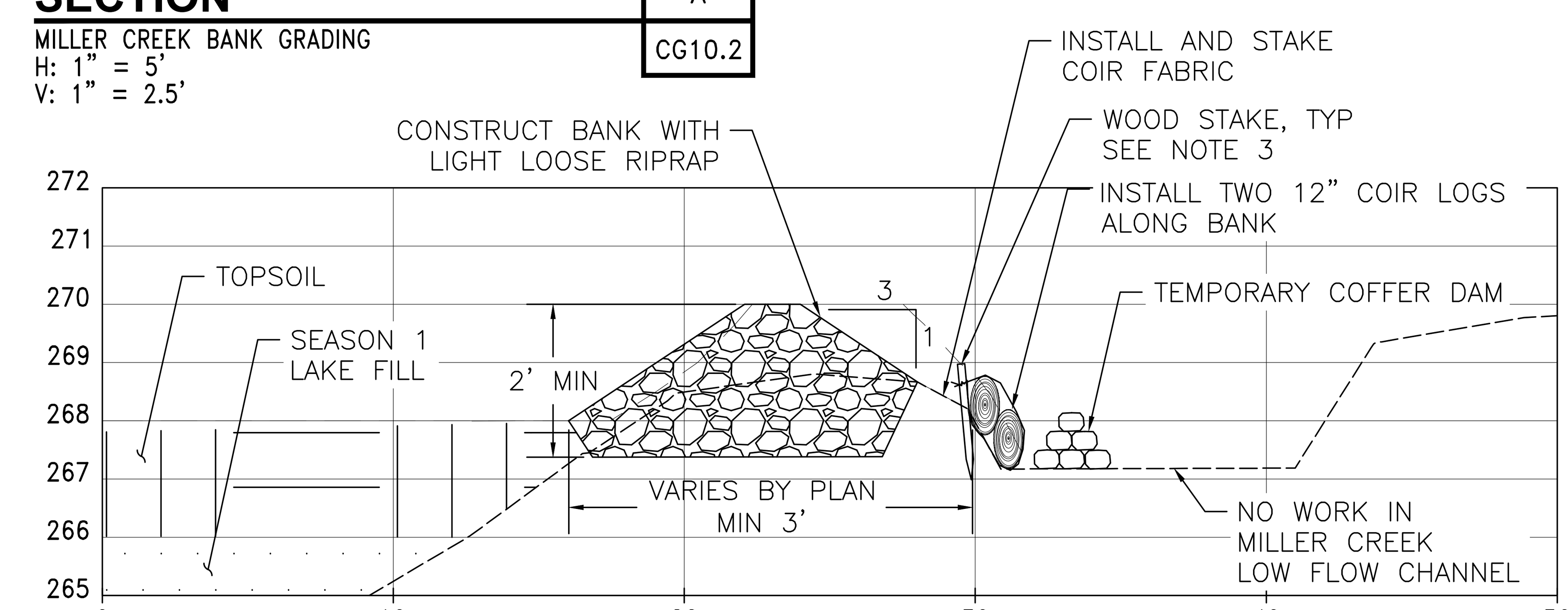




SECTION A

CG10.2

MILLER CREEK BANK GRADING
H: 1" = 5'
V: 1" = 2.5'



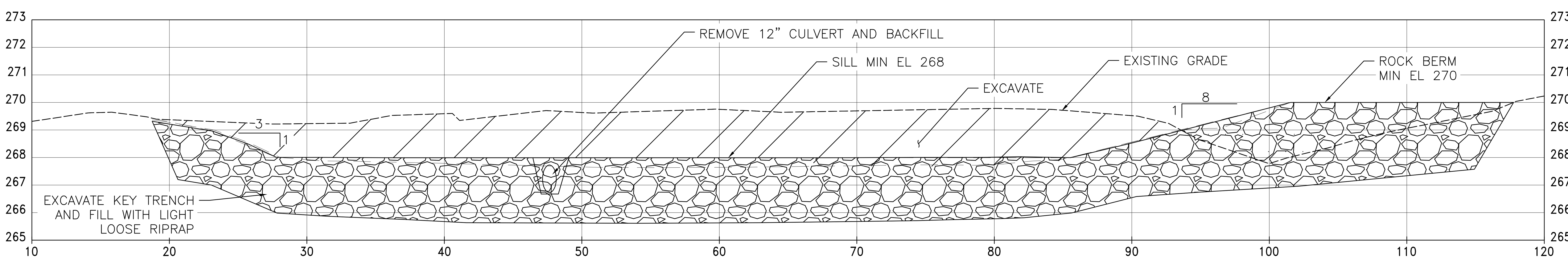
SECTION J

CG10.2

MILLER CREEK BANK GRADING
H: 1" = 5'
V: 1" = 2.5'

NOTES:

1. SEE SHEET V01.1 FOR SITE SURVEY CONTROL.
2. SEASON 2 INITIAL CONDITIONS WILL BE POST SEDIMENT CAP AND INITIAL ILL IN THE LORA LAKE REGION (APPROX EL 266 AFTER SETTLEMENT). SEE SHEETS CG08.1AND CU03.1. THE SEDIMENT CAP REGION WILL BE GENERALLY FLAT.
3. INSTALL 2 12" COIR LOGS ALONG THE BANK. WRAP BOTH COIR LOGS WITH COIR TWINE AND SECURE TO 30" WOOD STAKES. ALTERNATE WOOD STAKES FROM TOP TO BOTTOM OF COIR LOG 3' ON CENTER.



SECTION E

CG10.2

MILLER CREEK BANK GRADING
H: 1" = 5'
V: 1" = 2.5'

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH: RB
DESIGNER: SW, CL
DRAWN BY: EB, AJ
SCALE: AS SHOWN
DATE: RELEASE
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

PRELIMINARY

REVISIONS

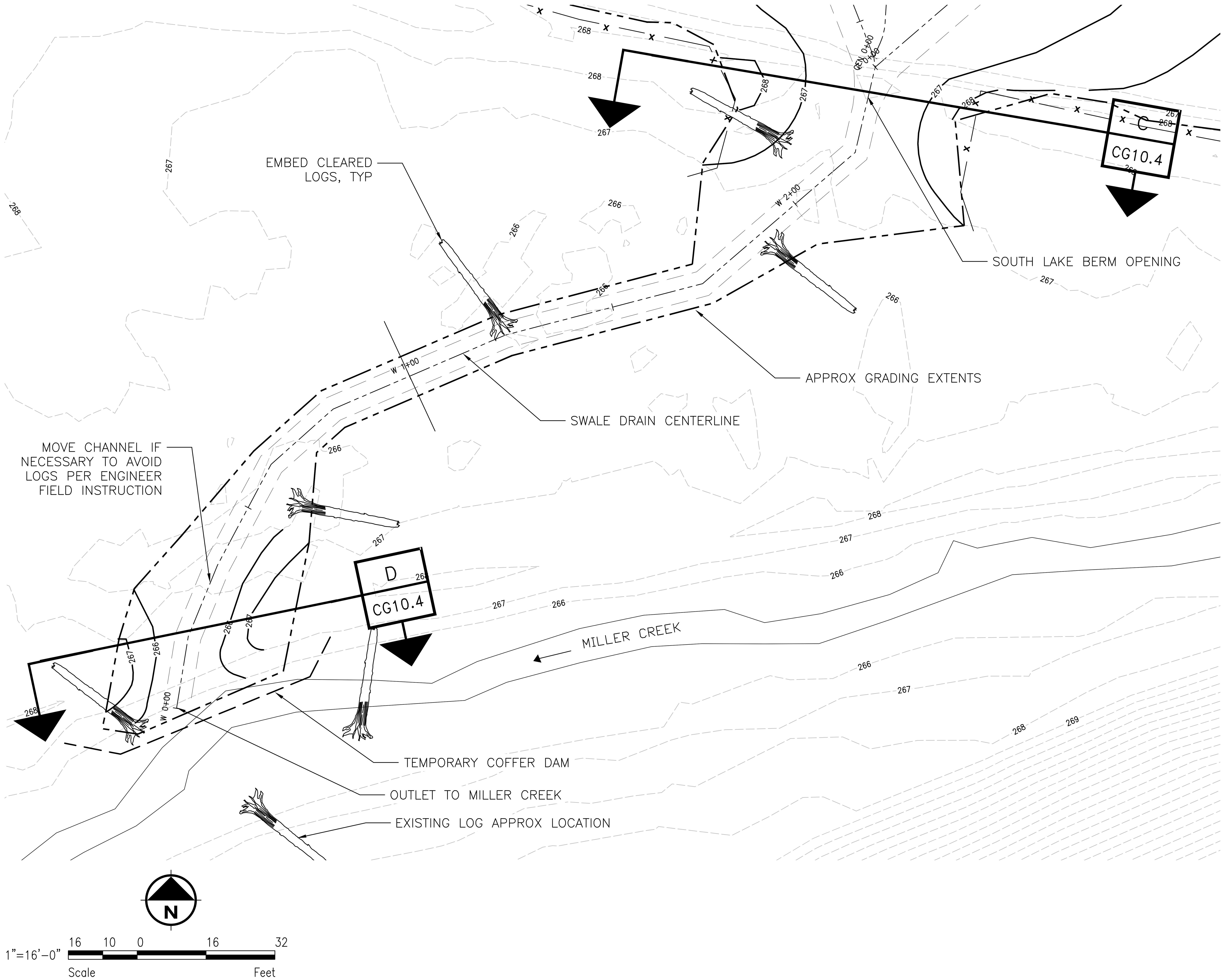
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISION TO	ABC					

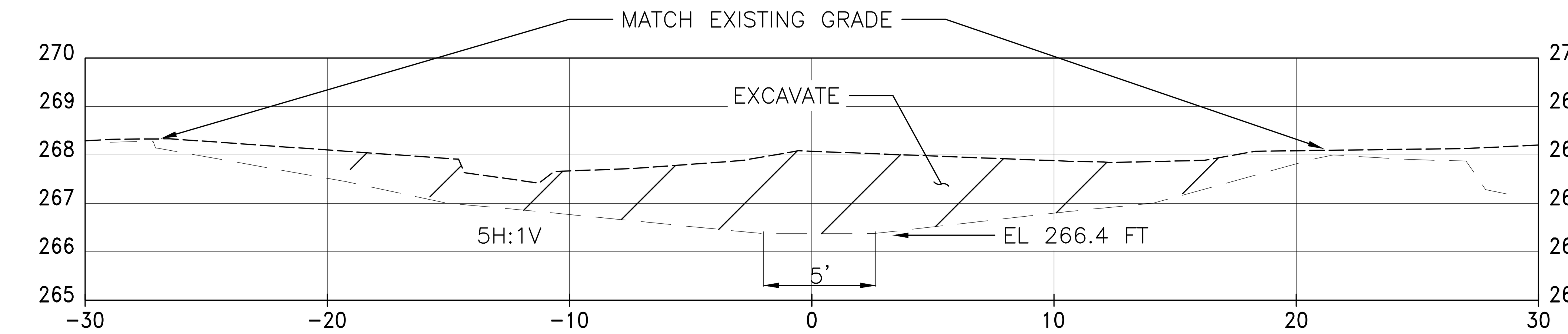
POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE: 1"=10-0"
POS DATE: BID
POS CHECKED/APPROVED BY: NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION
SHEET TITLE: LL SEASON 2 WETLAND GRADING SECTIONS - SHEET 1

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG10.2

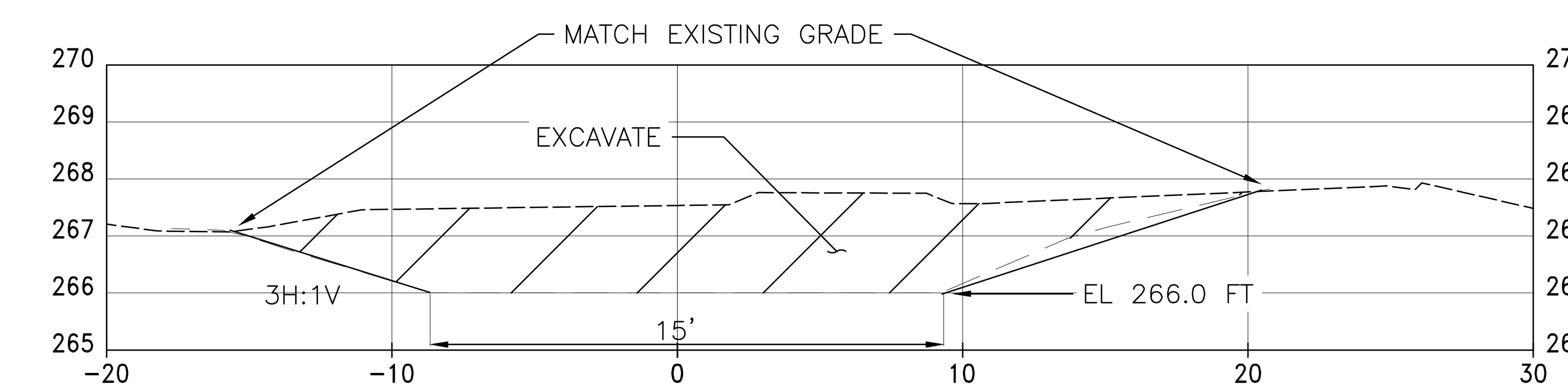
Appendix 2





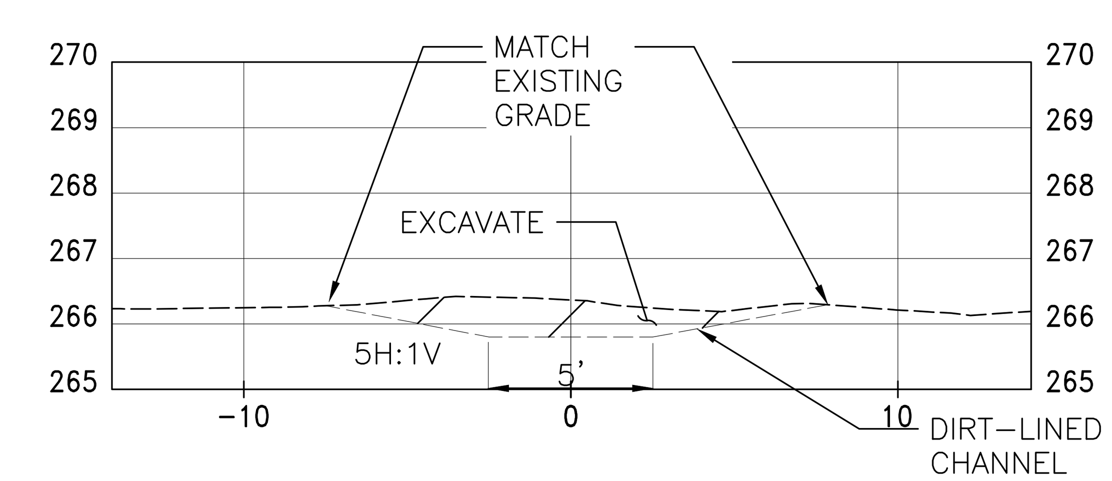
SECTION C / CG10.4

SOUTH LAKE BERM OPENING
H: 1" = 5'
V: 1" = 2.5'



SECTION D / CG10.4

OUTLET TO MILLER CREEK
H: 1" = 5'
V: 1" = 2.5'



SECTION I / CG10.4

SWALE DRAIN, TYP
H: 1" = 5'
V: 1" = 2.5'

NOTES:

1. SALVAGE CLEARED TREES, EMBED LOGS MORE THAN 4" INTO SWALE AS SHOWN ON THE PLAN. REDRESS ADJACENT CLEARED AREAS WITH SMALL LOGS, DEBRIS.

ESA
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Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH: RB
DESIGNER: SW, CL
DRAWN BY: EB, AJ
SCALE: AS SHOWN
DATE: RELEASE
CHECKED BY: NAME
CHECKED/APPROVED BY: NAME

PRELIMINARY

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D
1	00-00-00	ABC	REVISION TO	ABC					

POS PROJECT MANAGER: JANENE AXT
POS PROJECT ENGINEER: NAME
POS DESIGN ENGINEER: NAME
POS DRAFTER: NAME
POS SCALE:
POS DATE: BID
POS CHECKED/APPROVED BY: NAME

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: LORA LAKE APARTMENTS SITE
MTCA REMEDIAL ACTION
SHEET TITLE: LORA LAKE WETLAND - SEASON 2
GRADING SECTIONS - SHEET 3

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG010.04

Appendix 3

HEC-RAS River: Miller Creek Reach: Banks-Alignment Profile: 100YR

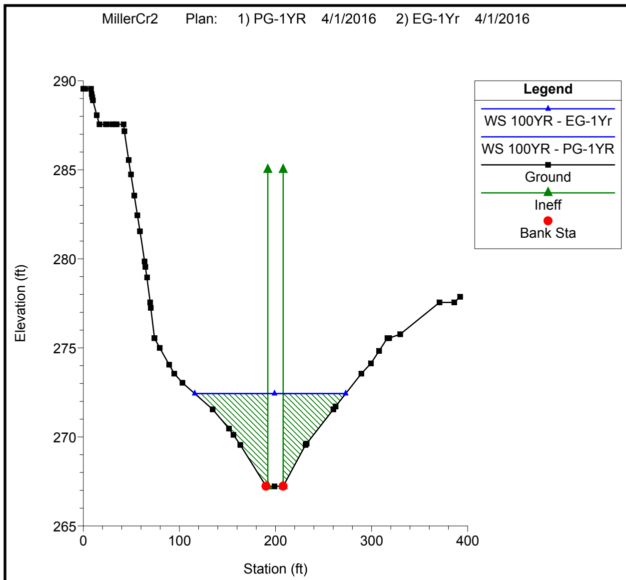
Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Banks-Alignment	2844.1	100YR	PG-1YR	175.00	267.22	272.43	268.77	272.50	0.000257	2.10	83.34	157.11	0.16
Banks-Alignment	2844.1	100YR	EG-1Yr	175.00	267.22	272.43	268.77	272.50	0.000257	2.10	83.34	157.11	0.16
Banks-Alignment	2794.1	100YR	PG-1YR	175.00	267.21	272.43		272.49	0.000204	1.88	93.89	157.06	0.14
Banks-Alignment	2794.1	100YR	EG-1Yr	175.00	267.21	272.43		272.49	0.000204	1.88	93.90	157.06	0.14
Banks-Alignment	2694.1	100YR	PG-1YR	175.00	267.20	272.35		272.45	0.000404	2.62	66.86	154.03	0.20
Banks-Alignment	2694.1	100YR	EG-1Yr	175.00	267.20	272.35		272.45	0.000404	2.62	66.86	154.03	0.20
Banks-Alignment	2644.1	100YR	PG-1YR	175.00	267.19	271.96		272.38	0.001799	5.25	33.35	140.11	0.42
Banks-Alignment	2644.1	100YR	EG-1Yr	175.00	267.19	271.96		272.38	0.001798	5.25	33.35	140.12	0.42
Banks-Alignment	2594.1	100YR	PG-1YR	175.00	267.18	271.54		272.24	0.003284	6.69	26.17	125.47	0.56
Banks-Alignment	2594.1	100YR	EG-1Yr	175.00	267.18	271.54		272.24	0.003284	6.69	26.17	125.47	0.56
Banks-Alignment	2542.54	100YR	PG-1YR	175.00	267.17	270.81	270.28	271.95	0.006931	8.60	20.35	67.08	0.80
Banks-Alignment	2542.54	100YR	EG-1Yr	175.00	267.17	270.81	270.28	271.95	0.006931	8.60	20.35	67.08	0.80
Banks-Alignment	2512.23			Culvert									
Banks-Alignment	2487.85	100YR	PG-1YR	175.00	267.16	269.86		270.55	0.006467	6.68	26.20	33.98	0.73
Banks-Alignment	2487.85	100YR	EG-1Yr	175.00	267.16	269.86		270.55	0.006450	6.67	26.22	34.00	0.73
Banks-Alignment	2462.65	100YR	PG-1YR	175.00	267.13	269.54	269.36	270.34	0.010579	7.32	26.14	21.26	0.86
Banks-Alignment	2462.65	100YR	EG-1Yr	175.00	267.13	269.54	269.36	270.34	0.010514	7.30	26.19	21.30	0.85
Banks-Alignment	2435.01	100YR	PG-1YR	175.00	267.18	269.22	269.15	270.00	0.014535	7.10	24.67	14.71	0.95
Banks-Alignment	2435.01	100YR	EG-1Yr	175.00	267.18	269.24	269.15	270.00	0.013913	7.01	25.00	14.81	0.94
Banks-Alignment	2410.29	100YR	PG-1YR	175.00	266.98	268.87	268.87	269.61	0.016097	6.91	25.31	51.30	1.00
Banks-Alignment	2410.29	100YR	EG-1Yr	175.00	266.98	269.05	269.05	269.67	0.011730	7.29	39.79	49.96	0.91
Banks-Alignment	2387.82	100YR	PG-1YR	175.00	266.90	268.84	268.70	269.25	0.008349	5.97	47.59	208.42	0.76
Banks-Alignment	2387.82	100YR	EG-1Yr	175.00	266.90	268.92	268.50	269.37	0.008071	6.05	40.39	192.09	0.76
Banks-Alignment	2370.46	100YR	PG-1YR	175.00	266.90	268.81	268.63	269.11	0.007001	5.45	59.58	232.19	0.70
Banks-Alignment	2370.46	100YR	EG-1Yr	175.00	266.90	268.82	268.46	269.24	0.008727	6.10	43.61	217.53	0.79
Banks-Alignment	2362.37	100YR	PG-1YR	175.00	266.83	268.80	268.53	269.05	0.006264	4.49	57.04	246.56	0.65
Banks-Alignment	2362.37	100YR	EG-1Yr	175.00	266.83	268.80	268.33	269.16	0.008193	5.82	45.49	232.37	0.75
Banks-Alignment	2332.24	100YR	PG-1YR	175.00	266.20	268.81	268.55	268.89	0.002386	3.09	104.03	277.34	0.40
Banks-Alignment	2332.24	100YR	EG-1Yr	175.00	266.20	268.81	268.55	268.96	0.003366	3.67	64.01	276.98	0.48
Banks-Alignment	2311.19	100YR	PG-1YR	175.00	266.17	268.76	268.23	268.85	0.002012	3.08	100.92	297.28	0.38
Banks-Alignment	2311.19	100YR	EG-1Yr	175.00	266.17	268.76	268.22	268.89	0.002612	3.51	69.16	279.52	0.43
Banks-Alignment	2294.01	100YR	PG-1YR	175.00	266.04	268.73	268.14	268.82	0.001746	3.09	104.35	310.93	0.36
Banks-Alignment	2294.01	100YR	EG-1Yr	175.00	266.04	268.73	268.14	268.86	0.002134	3.42	76.24	303.61	0.39
Banks-Alignment	2270.81	100YR	PG-1YR	175.00	265.98	268.72	267.72	268.78	0.000989	2.50	143.43	322.23	0.28
Banks-Alignment	2270.81	100YR	EG-1Yr	175.00	265.98	268.72	267.72	268.81	0.001197	2.75	96.74	311.83	0.31
Banks-Alignment	2251.8	100YR	PG-1YR	175.00	265.82	268.71	267.33	268.77	0.000677	2.22	167.65	363.17	0.24
Banks-Alignment	2251.8	100YR	EG-1Yr	175.00	265.82	268.71	267.33	268.79	0.000887	2.54	118.01	356.04	0.27
Banks-Alignment	2238.81□	100YR	EG-1Yr	175.00	265.81	268.71		268.77	0.000675	2.22	140.45	373.41	0.24
Banks-Alignment	2225.83	100YR	PG-1YR	175.00	265.80	268.71	267.17	268.75	0.000435	1.77	201.53	313.14	0.19
Banks-Alignment	2225.83	100YR	EG-1Yr	175.00	265.80	268.71	267.16	268.76	0.000535	1.98	153.86	382.09	0.21
Banks-Alignment	2214.83□	100YR	EG-1Yr	175.00	265.67	268.71		268.75	0.000383	1.73	179.83	403.85	0.18
Banks-Alignment	2203.83	100YR	PG-1YR	175.00	265.51	268.71	266.83	268.73	0.000207	1.31	270.96	274.76	0.13
Banks-Alignment	2203.83	100YR	EG-1Yr	175.00	265.55	268.71	266.83	268.74	0.000290	1.55	194.89	418.92	0.16
Banks-Alignment	2186.3□	100YR	EG-1Yr	175.00	265.53	268.70		268.73	0.000294	1.54	190.83	474.74	0.16
Banks-Alignment	2168.77	100YR	PG-1YR	175.00	265.51	268.70	266.86	268.72	0.000207	1.28	253.35	528.07	0.13
Banks-Alignment	2168.77	100YR	EG-1Yr	175.00	265.51	268.70	266.86	268.72	0.000264	1.45	206.38	528.68	0.15
Banks-Alignment	2157.38□	100YR	EG-1Yr	175.00	265.53	268.70		268.72	0.000255	1.43	205.31	516.37	0.15
Banks-Alignment	2146	100YR	PG-1YR	175.00	265.54	268.69	266.77	268.71	0.000187	1.23	249.77	465.02	0.13
Banks-Alignment	2146	100YR	EG-1Yr	175.00	265.54	268.69	266.77	268.71	0.000247	1.41	203.61	441.47	0.14
Banks-Alignment	2128.97	100YR	PG-1YR	175.00	265.48	268.68	266.85	268.70	0.000223	1.34	238.05	411.41	0.14
Banks-Alignment	2128.97	100YR	EG-1Yr	175.00	265.48	268.68	266.85	268.71	0.000265	1.46	212.44	396.34	0.15
Banks-Alignment	2107.97	100YR	PG-1YR	175.00	265.53	268.66	266.84	268.69	0.000313	1.55	185.67	383.78	0.16
Banks-Alignment	2107.97	100YR	EG-1Yr	175.00	265.55	268.66	266.83	268.70	0.000356	1.65	166.13	375.48	0.17
Banks-Alignment	2084.43	100YR	PG-1YR	175.00	265.54	268.68	266.82	268.68	0.000104	0.90	384.49	355.54	0.09
Banks-Alignment	2084.43	100YR	EG-1Yr	175.00	265.54	268.68	266.82	268.68	0.000114	0.94	363.11	351.28	0.10

HEC-RAS River: Miller Creek Reach: Banks-Alignment Profile: 100YR (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Banks-Alignment	2061.34	100YR	PG-1YR	175.00	265.49	268.67	266.71	268.68	0.000134	1.04	320.41	270.00	0.11
Banks-Alignment	2061.34	100YR	EG-1Yr	175.00	265.49	268.67	266.71	268.68	0.000112	0.95	372.93	270.12	0.10
Banks-Alignment	2046.45	100YR	PG-1YR	175.00	265.38	268.67	266.65	268.68	0.000120	1.00	332.05	237.75	0.10
Banks-Alignment	2046.45	100YR	EG-1Yr	175.00	265.55	268.67	266.69	268.68	0.000120	0.99	333.63	235.87	0.10
Banks-Alignment	2024.69	100YR	PG-1YR	175.00	265.48	268.66	266.65	268.67	0.000132	1.05	314.33	222.35	0.11
Banks-Alignment	2024.69	100YR	EG-1Yr	175.00	265.48	268.66	266.65	268.67	0.000138	1.07	308.35	222.37	0.11
Banks-Alignment	2004.09	100YR	PG-1YR	175.00	265.41	268.66	266.60	268.67	0.000112	0.97	335.89	267.33	0.10
Banks-Alignment	2004.09	100YR	EG-1Yr	175.00	265.48	268.66	266.63	268.67	0.000135	1.06	310.44	267.28	0.11
Banks-Alignment	1982.85	100YR	PG-1YR	175.00	265.60	268.66	266.60	268.67	0.000148	1.09	265.29	290.79	0.11
Banks-Alignment	1982.85	100YR	EG-1Yr	175.00	265.60	268.65	266.60	268.67	0.000180	1.20	239.77	290.53	0.12
Banks-Alignment	1958.56	100YR	PG-1YR	175.00	265.37	268.65	266.52	268.66	0.000135	1.07	304.96	295.99	0.11
Banks-Alignment	1958.56	100YR	EG-1Yr	175.00	265.55	268.65	266.56	268.66	0.000157	1.14	283.33	295.70	0.12
Banks-Alignment	1934.81	100YR	PG-1YR	175.00	265.44	268.65	266.60	268.66	0.000172	1.18	286.87	307.24	0.12
Banks-Alignment	1934.81	100YR	EG-1Yr	175.00	265.44	268.65	266.60	268.66	0.000172	1.18	286.80	307.21	0.12
Banks-Alignment	1906.39	100YR	PG-1YR	175.00	265.33	268.63	266.71	268.65	0.000307	1.60	251.48	302.56	0.16
Banks-Alignment	1906.39	100YR	EG-1Yr	175.00	265.33	268.63	266.71	268.65	0.000307	1.61	251.39	302.52	0.16
Banks-Alignment	1879.25	100YR	PG-1YR	175.00	265.44	268.61		268.64	0.000382	1.78	230.14	281.31	0.18
Banks-Alignment	1879.25	100YR	EG-1Yr	175.00	265.44	268.61		268.64	0.000382	1.78	230.05	281.28	0.18
Banks-Alignment	1857.44	100YR	PG-1YR	175.00	265.50	268.58	266.83	268.63	0.000509	2.05	157.83	276.81	0.21
Banks-Alignment	1857.44	100YR	EG-1Yr	175.00	265.50	268.58	266.83	268.63	0.000509	2.05	157.79	276.74	0.21
Banks-Alignment	1836.74	100YR	PG-1YR	175.00	265.39	268.58	266.86	268.62	0.000422	1.87	194.77	274.72	0.19
Banks-Alignment	1836.74	100YR	EG-1Yr	175.00	265.39	268.58	266.86	268.62	0.000422	1.87	194.73	274.59	0.19
Banks-Alignment	1810.81	100YR	PG-1YR	175.00	265.39	268.58	266.75	268.61	0.000311	1.63	255.20	354.96	0.16
Banks-Alignment	1810.81	100YR	EG-1Yr	175.00	265.39	268.58	266.75	268.61	0.000311	1.63	255.10	354.96	0.16
Banks-Alignment	1697.66	100YR	PG-1YR	175.00	265.18	268.58	266.10	268.59	0.000086	0.89	393.75	416.32	0.09
Banks-Alignment	1697.66	100YR	EG-1Yr	175.00	265.18	268.58	266.10	268.59	0.000086	0.89	393.65	416.31	0.09
Banks-Alignment	1552.1	100YR	PG-1YR	175.00	265.00	268.57	265.93	268.58	0.000040	0.62	555.68	478.21	0.06
Banks-Alignment	1552.1	100YR	EG-1Yr	175.00	265.00	268.57	265.93	268.58	0.000040	0.62	555.60	478.20	0.06
Banks-Alignment	1443.54	100YR	PG-1YR	175.00	264.86	268.57	265.80	268.57	0.000045	0.67	472.27	409.43	0.06
Banks-Alignment	1443.54	100YR	EG-1Yr	175.00	264.86	268.57	265.80	268.57	0.000045	0.67	472.20	409.42	0.06
Banks-Alignment	1364.03	100YR	PG-1YR	175.00	264.76	268.56	265.72	268.57	0.000030	0.55	595.68	463.17	0.05
Banks-Alignment	1364.03	100YR	EG-1Yr	175.00	264.76	268.56	265.72	268.57	0.000030	0.55	595.59	463.16	0.05
Banks-Alignment	1235.32	100YR	PG-1YR	175.00	264.60	268.54	265.72	268.56	0.000127	1.16	173.49	476.72	0.11
Banks-Alignment	1235.32	100YR	EG-1Yr	175.00	264.60	268.54	265.72	268.56	0.000127	1.16	173.46	476.70	0.11
Banks-Alignment	1120.26	100YR	PG-1YR	175.00	264.45	268.53	265.41	268.54	0.000098	0.90	194.68	478.56	0.09
Banks-Alignment	1120.26	100YR	EG-1Yr	175.00	264.45	268.53	265.41	268.54	0.000098	0.90	194.65	478.54	0.09
Banks-Alignment	1005.07	100YR	PG-1YR	175.00	264.31	268.50	265.69	268.53	0.000211	1.26	140.48	393.48	0.13
Banks-Alignment	1005.07	100YR	EG-1Yr	175.00	264.31	268.50	265.69	268.52	0.000211	1.26	140.46	393.44	0.13
Banks-Alignment	958.36	100YR	PG-1YR	175.00	264.25	268.46	266.39	268.51	0.000554	1.84	99.12	318.57	0.20
Banks-Alignment	958.36	100YR	EG-1Yr	175.00	264.25	268.45	266.39	268.51	0.000554	1.84	99.10	318.54	0.20
Banks-Alignment	840.12	100YR	PG-1YR	175.00	264.10	268.45		268.47	0.000141	0.85	213.65	115.32	0.10
Banks-Alignment	840.12	100YR	EG-1Yr	175.00	264.10	268.45		268.47	0.000141	0.85	213.61	115.31	0.10
Banks-Alignment	753.58	100YR	PG-1YR	175.00	263.99	268.40		268.44	0.000461	1.67	106.46	60.08	0.19
Banks-Alignment	753.58	100YR	EG-1Yr	175.00	263.99	268.40		268.44	0.000458	1.67	110.31	60.09	0.19
Banks-Alignment	630.21	100YR	PG-1YR	175.00	263.83	268.28		268.37	0.000765	2.30	77.46	32.00	0.24
Banks-Alignment	630.21	100YR	EG-1Yr	175.00	263.83	268.28		268.37	0.000765	2.30	77.46	32.00	0.24
Banks-Alignment	572.43	100YR	PG-1YR	175.00	263.76	268.25		268.32	0.000699	2.23	81.46	38.02	0.23
Banks-Alignment	572.43	100YR	EG-1Yr	175.00	263.76	268.25		268.32	0.000699	2.23	81.46	38.02	0.23
Banks-Alignment	533.85	100YR	PG-1YR	175.00	263.71	268.19		268.29	0.000851	2.53	70.51	31.85	0.26
Banks-Alignment	533.85	100YR	EG-1Yr	175.00	263.71	268.19		268.29	0.000851	2.53	70.51	31.85	0.26
Banks-Alignment	495.27	100YR	PG-1YR	175.00	263.66	268.10	266.41	268.25	0.001254	3.06	61.35	26.73	0.31
Banks-Alignment	495.27	100YR	EG-1Yr	175.00	263.66	268.10	266.41	268.25	0.001254	3.06	61.35	26.73	0.31
Banks-Alignment	449.87			Bridge									
Banks-Alignment	408.12	100YR	PG-1YR	175.00	263.04	268.08		268.17	0.000369	2.39	73.32	37.39	0.19
Banks-Alignment	408.12	100YR	EG-1Yr	175.00	263.04	268.08		268.17	0.000369	2.39	73.32	37.39	0.19

HEC-RAS River: Miller Creek Reach: Banks-Alignment Profile: 100YR (Continued)

Reach	River Sta	Profile	Plan	Q Total	Min Ch El	W.S. Elev	Crit W.S.	E.G. Elev	E.G. Slope	Vel Chnl	Flow Area	Top Width	Froude # Chl
				(cfs)	(ft)	(ft)	(ft)	(ft)	(ft/ft)	(ft/s)	(sq ft)	(ft)	
Banks-Alignment	383.516□	100YR	PG-1YR	175.00	262.71	268.07		268.16	0.000346	2.32	75.38	33.30	0.18
Banks-Alignment	383.516□	100YR	EG-1Yr	175.00	262.71	268.07		268.16	0.000346	2.32	75.38	33.30	0.18
Banks-Alignment	358.912□	100YR	PG-1YR	175.00	262.38	268.06		268.15	0.000373	2.34	74.93	29.32	0.18
Banks-Alignment	358.912□	100YR	EG-1Yr	175.00	262.38	268.06		268.15	0.000373	2.34	74.93	29.32	0.18
Banks-Alignment	334.308□	100YR	PG-1YR	175.00	262.05	268.03		268.13	0.000515	2.54	68.95	25.35	0.21
Banks-Alignment	334.308□	100YR	EG-1Yr	175.00	262.05	268.03		268.13	0.000515	2.54	68.95	25.35	0.21
Banks-Alignment	309.704□	100YR	PG-1YR	175.00	261.72	267.93		268.11	0.001066	3.37	51.94	20.86	0.27
Banks-Alignment	309.704□	100YR	EG-1Yr	175.00	261.72	267.93		268.11	0.001066	3.37	51.94	20.86	0.27
Banks-Alignment	285.1	100YR	PG-1YR	175.00	261.39	267.79	265.49	268.06	0.002302	4.22	44.65	15.92	0.36
Banks-Alignment	285.1	100YR	EG-1Yr	175.00	261.39	267.79	265.50	268.06	0.002302	4.22	44.65	15.92	0.36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Legend
WS 100YR - EG-1Yr
WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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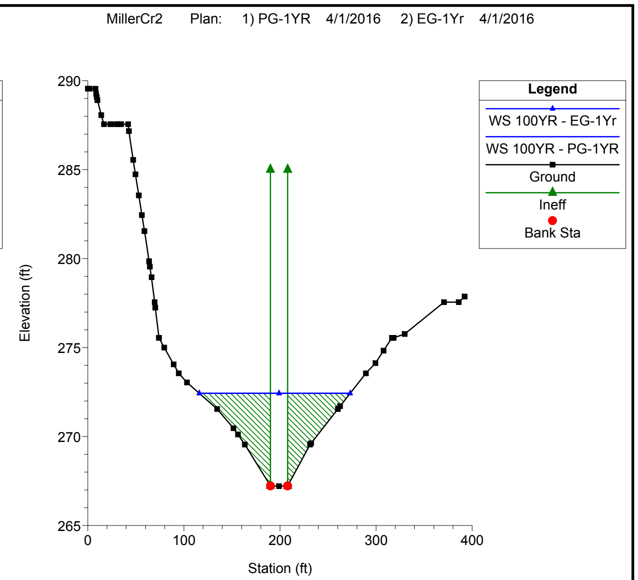
MillerCr2 Plan: 1) PG-1YR 4/1/2016 2) EG-1Yr 4/1/2016
Legend
WS 100YR - EG-1Yr
WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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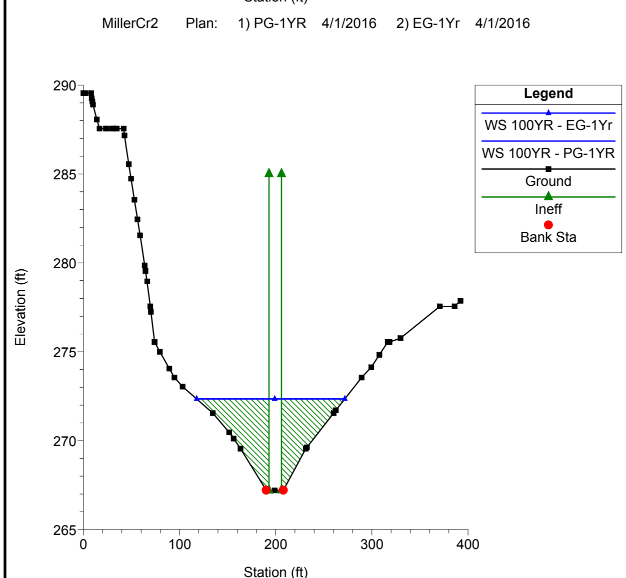
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Legend
WS 100YR - EG-1Yr
WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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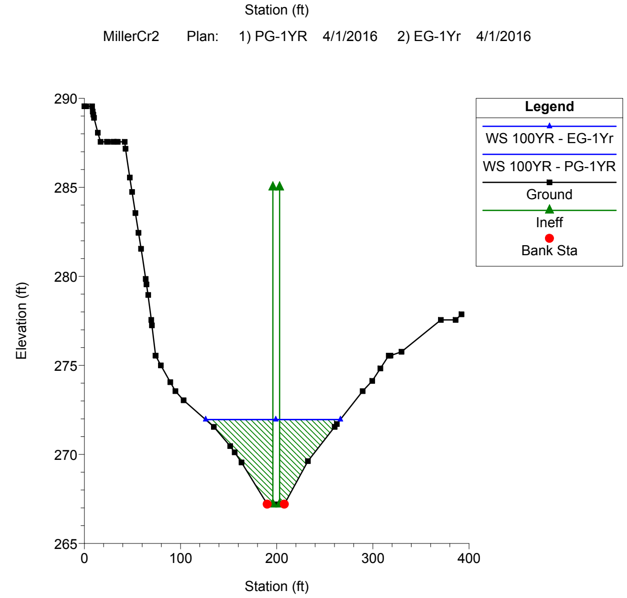
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Legend
WS 100YR - EG-1Yr
WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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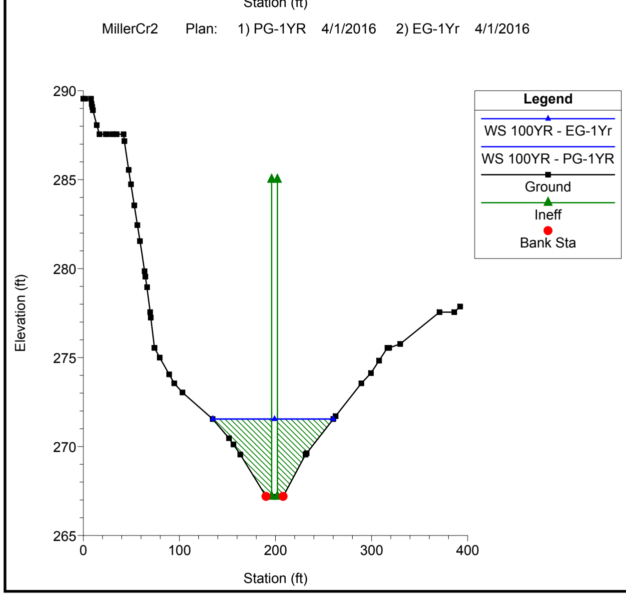
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Legend
WS 100YR - EG-1Yr
WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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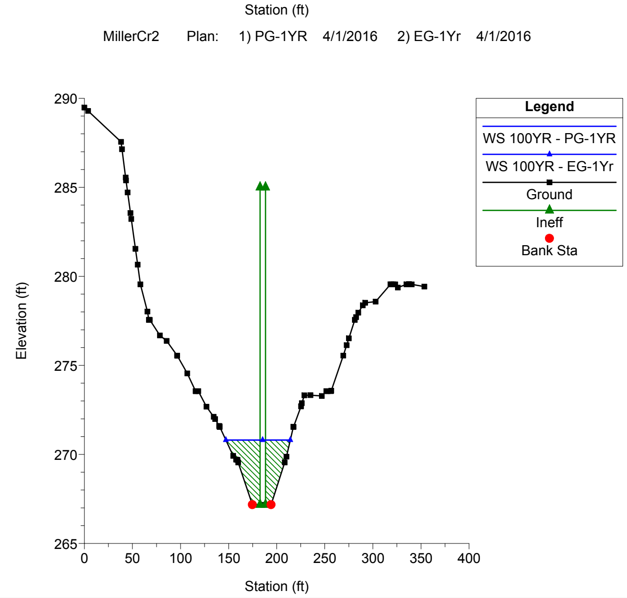
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Legend
WS 100YR - PG-1YR
WS 100YR - EG-1Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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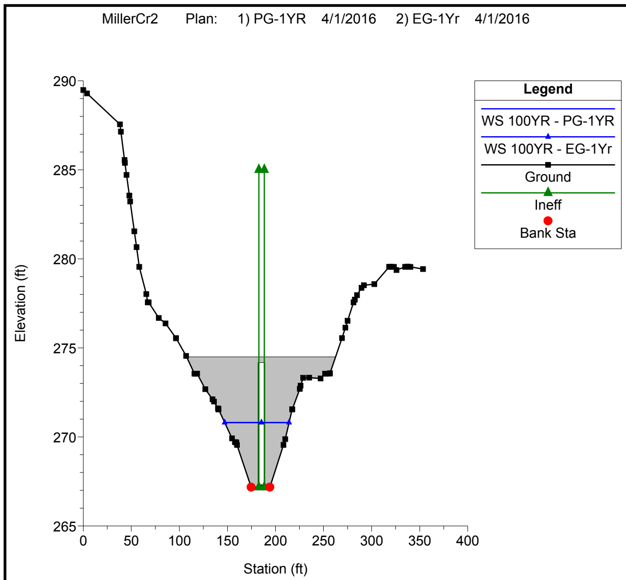
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Legend
WS 100YR - PG-1YR
WS 100YR - EG-1Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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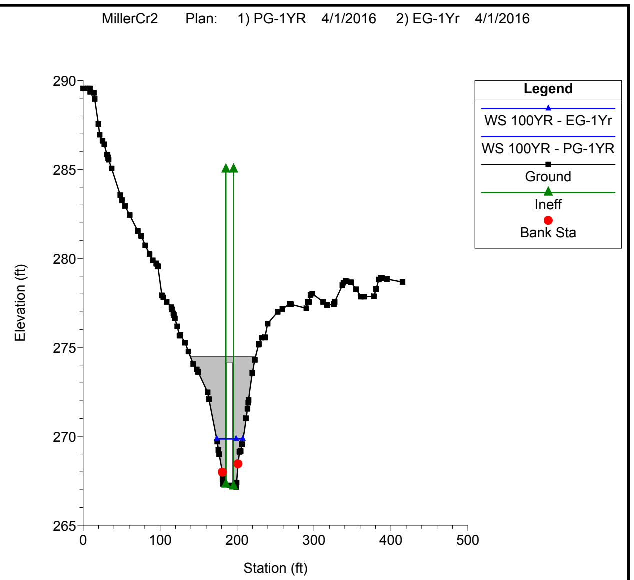
0 50 100 150 200 250 300 350 400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Legend
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Ground
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Bank Sta
Elevation (ft)
Station (ft)
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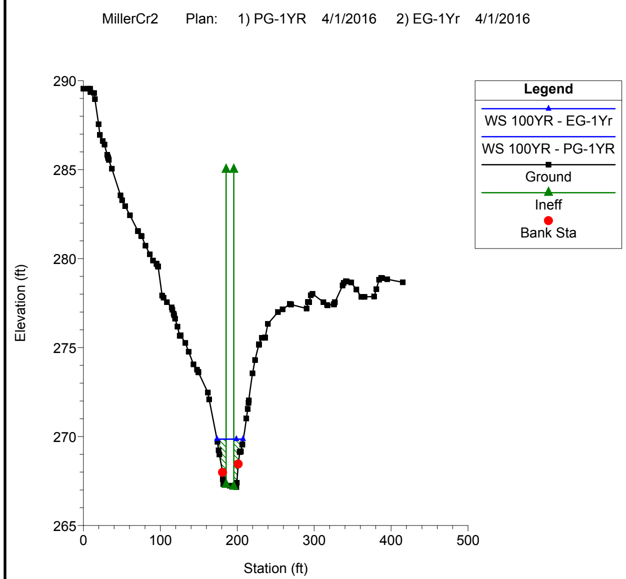
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Legend
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Bank Sta
Elevation (ft)
Station (ft)
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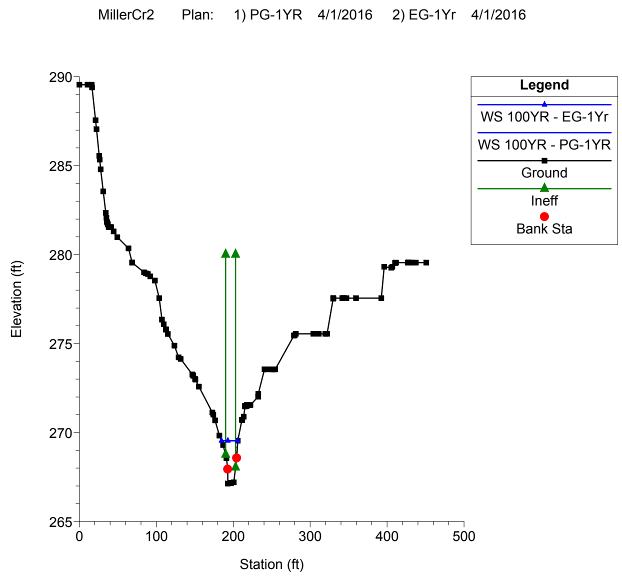
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Legend
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WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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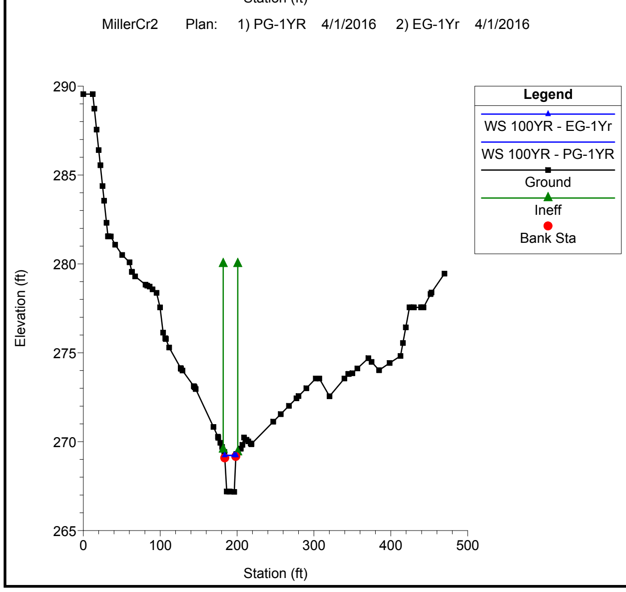
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Legend
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WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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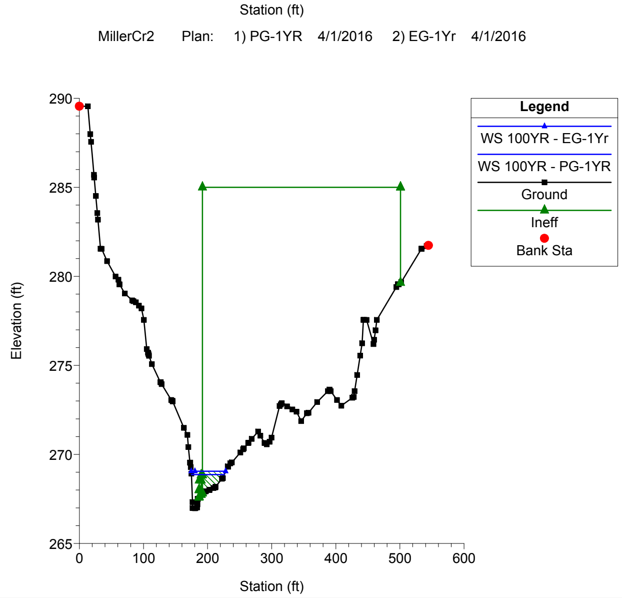
0 100 200 300 400 500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Ground
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Bank Sta
Elevation (ft)
Station (ft)
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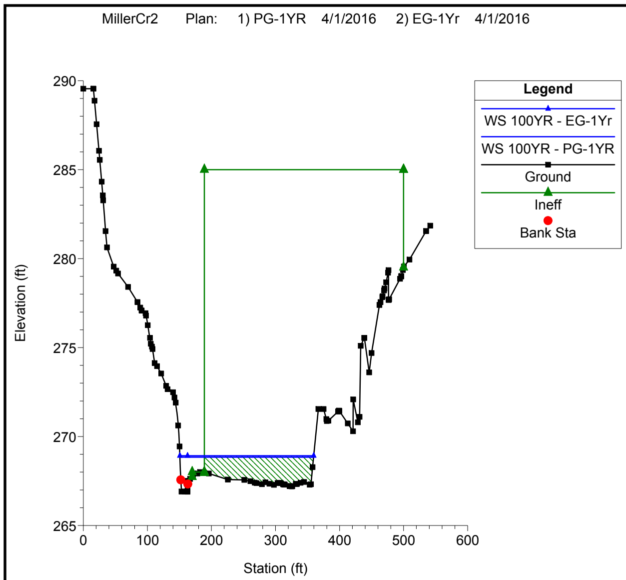
0 100 200 300 400 500 600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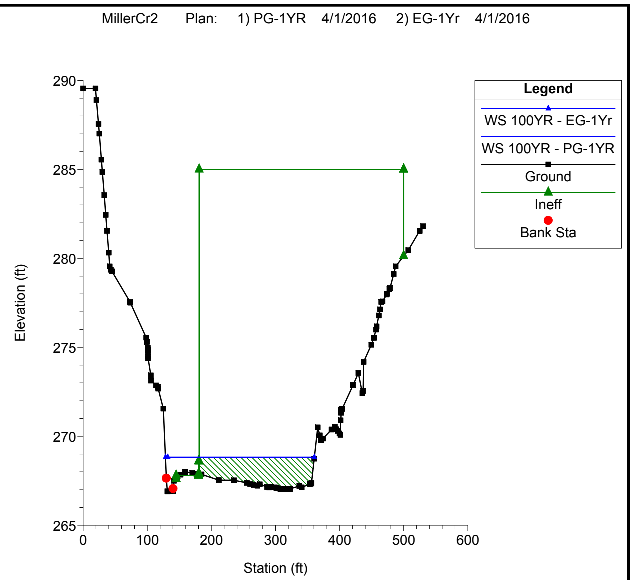
WS 100YR - PG-1YR
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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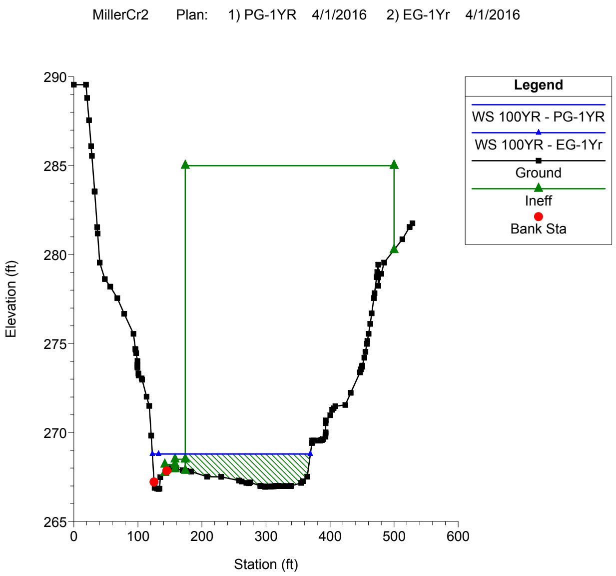
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)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Elevation (ft)
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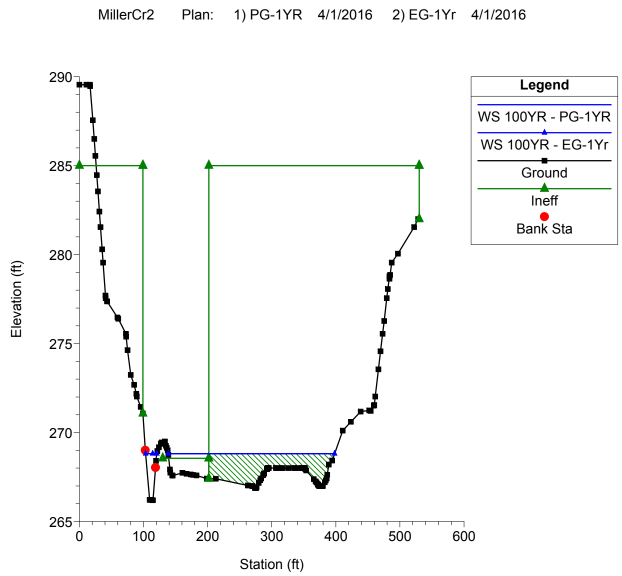
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Ground
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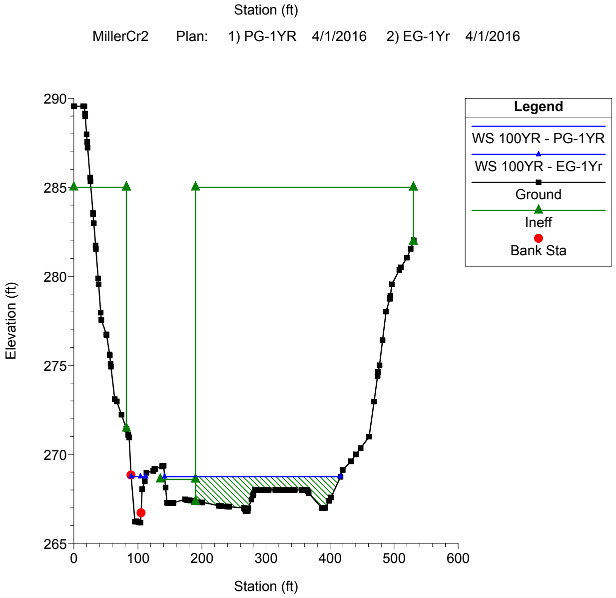
Bank Sta
Elevation (ft)
Station (ft)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WS 100YR - EG-1Yr
Ground
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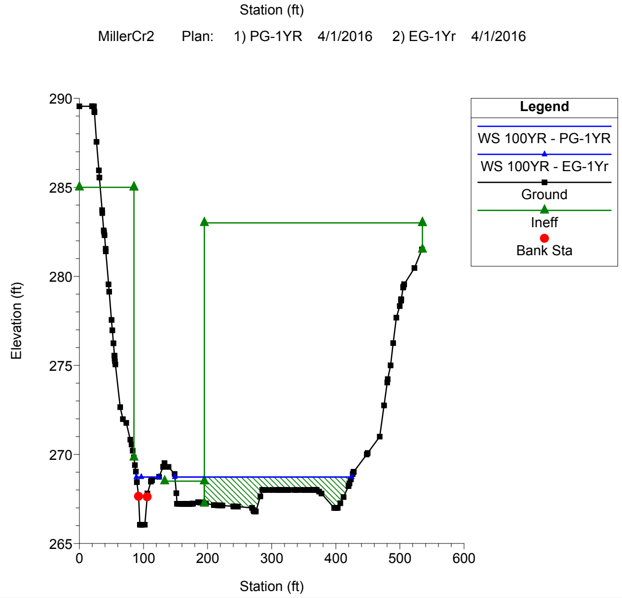
Bank Sta
Elevation (ft)
Station (ft)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Elevation (ft)
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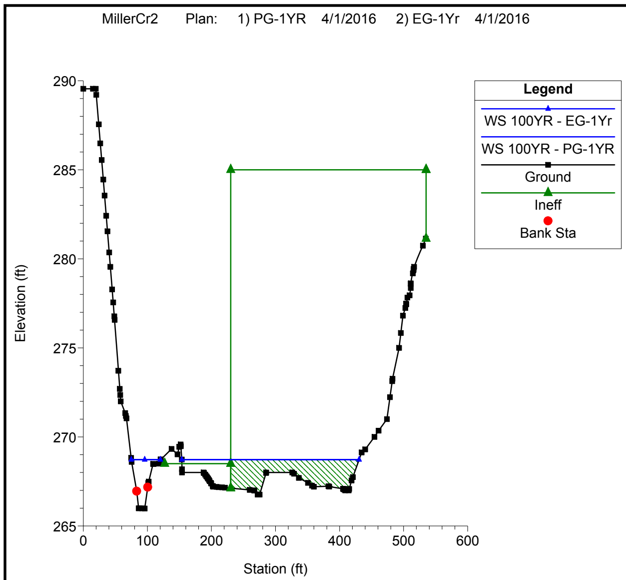
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Legend
WS 100YR - EG-1Yr
WS 100YR - PG-1YR
Ground
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Station (ft)
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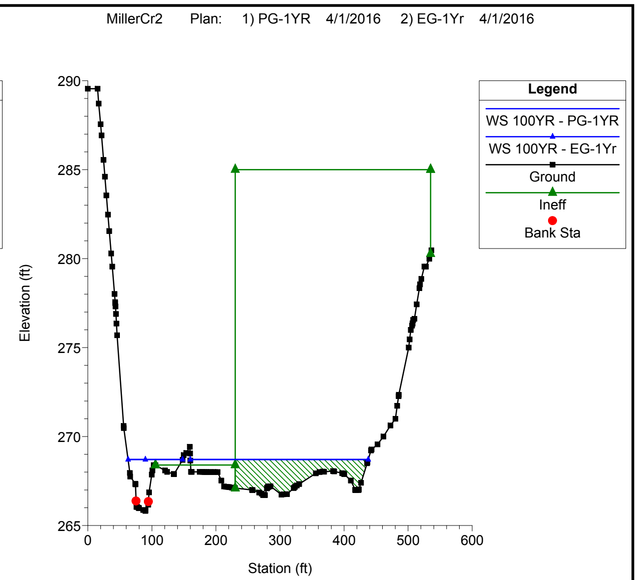
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Ground
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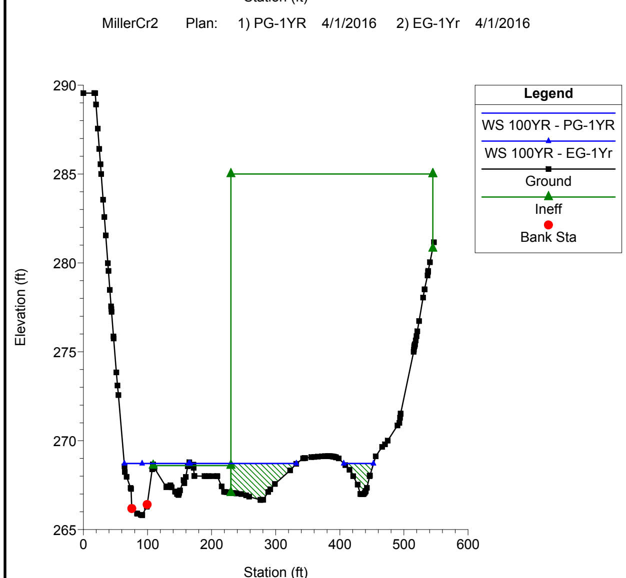
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Legend
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WS 100YR - EG-1Yr
Ground
Ineff
Bank Sta
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Station (ft)
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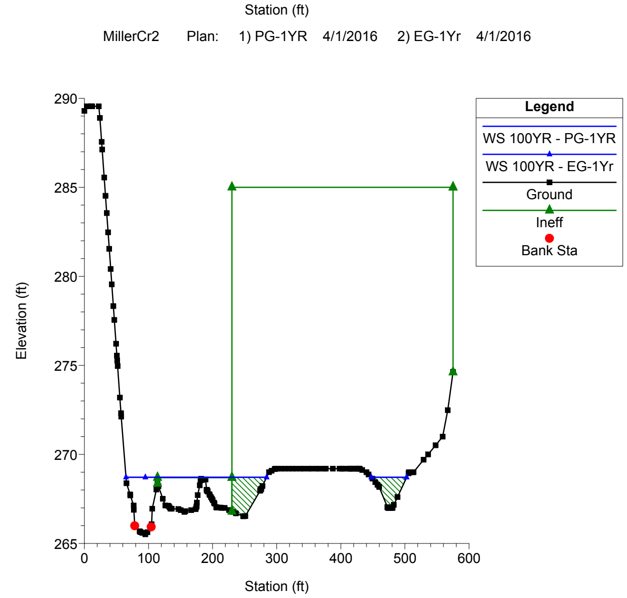
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Legend
WS 100YR - PG-1YR
WS 100YR - EG-1Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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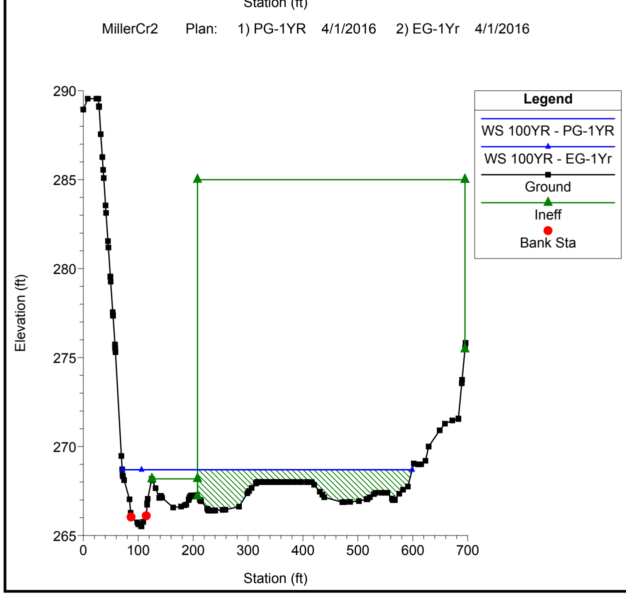
MillerCr2 Plan: 1) PG-1YR 4/1/2016 2) EG-1Yr 4/1/2016
Legend
WS 100YR - PG-1YR
WS 100YR - EG-1Yr
Ground
Ineff
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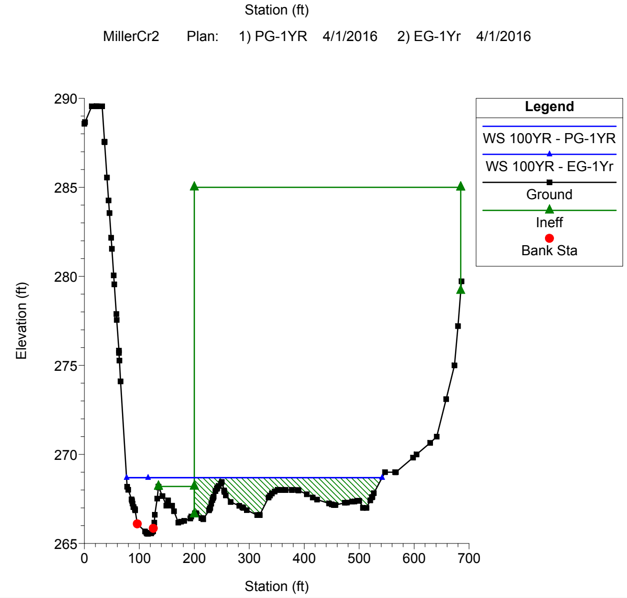
MillerCr2 Plan: 1) PG-1YR 4/1/2016 2) EG-1Yr 4/1/2016
Legend
WS 100YR - PG-1YR
WS 100YR - EG-1Yr
Ground
Ineff
Bank Sta
Elevation (ft)
Station (ft)
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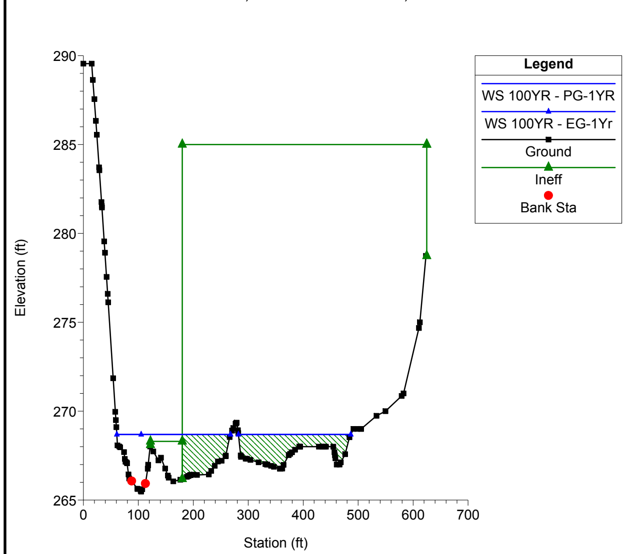
MillerCr2 Plan: 1) PG-1YR 4/1/2016 2) EG-1Yr 4/1/2016



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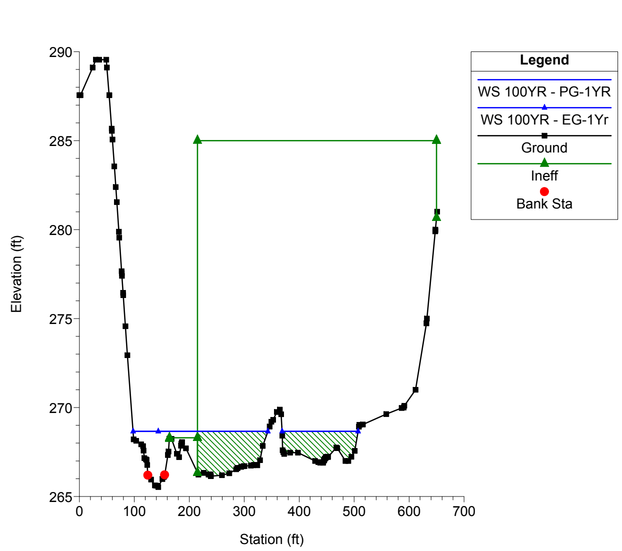

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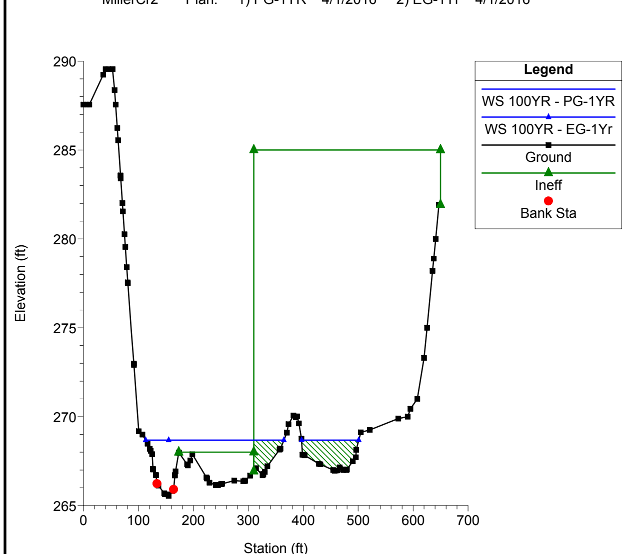

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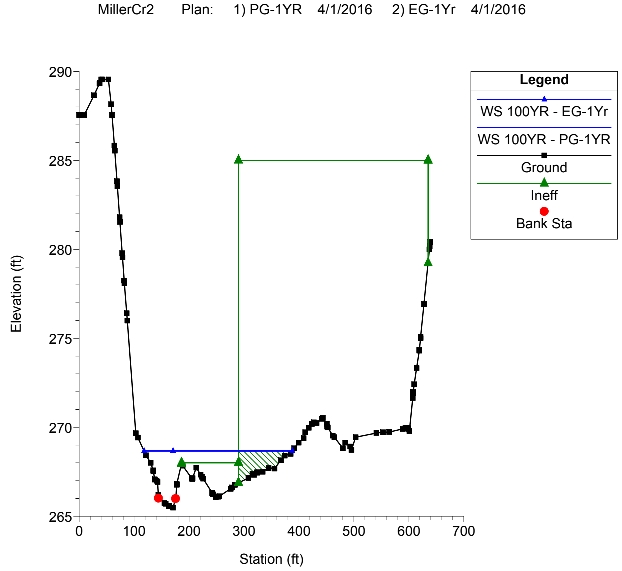

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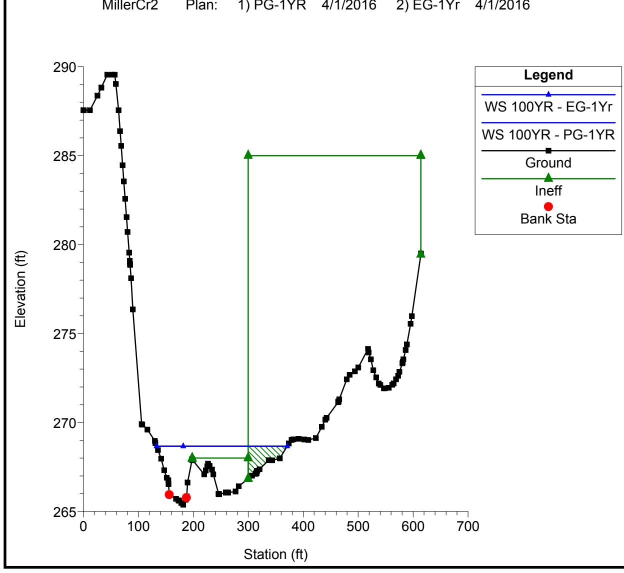

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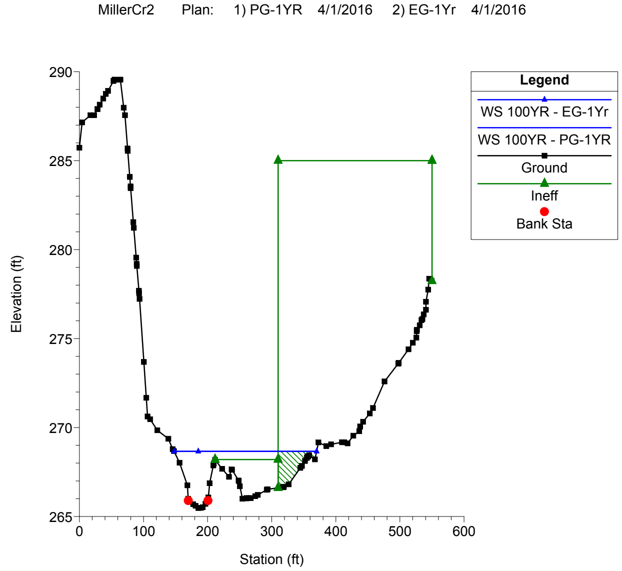

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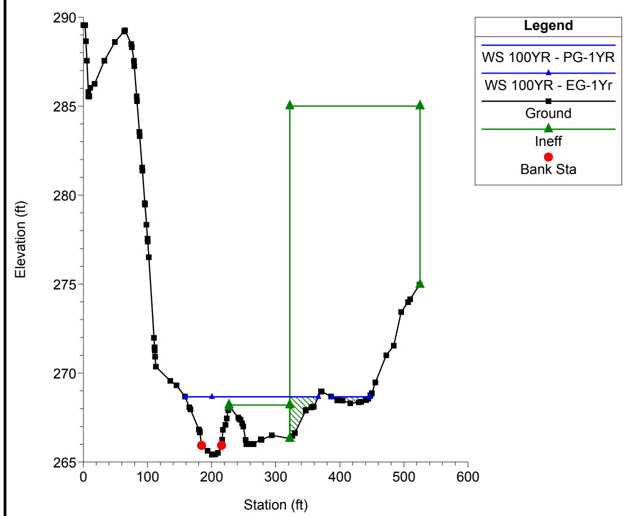

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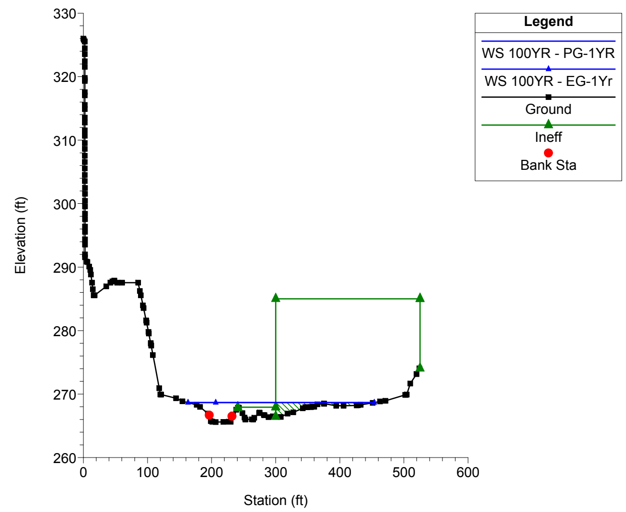

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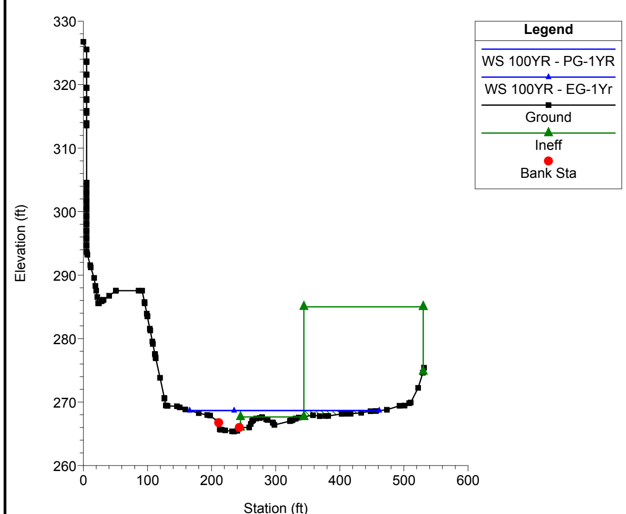

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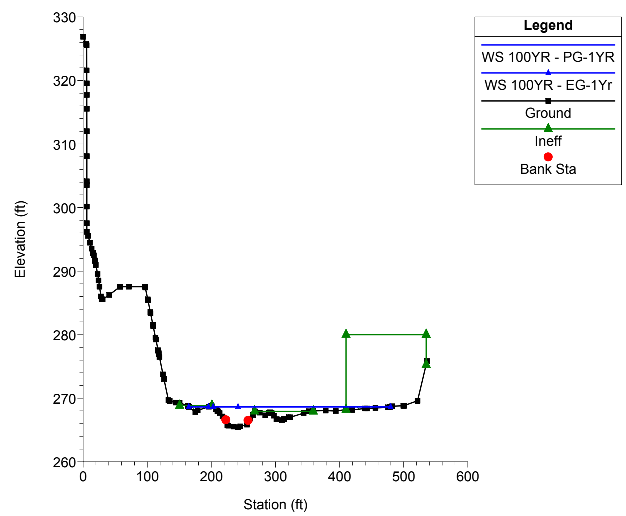

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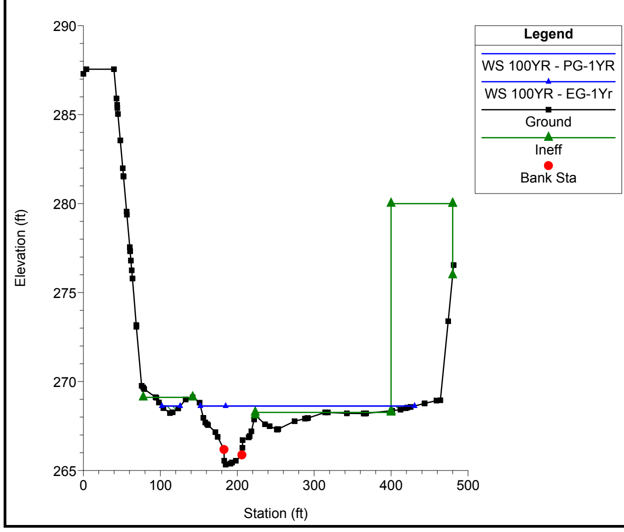

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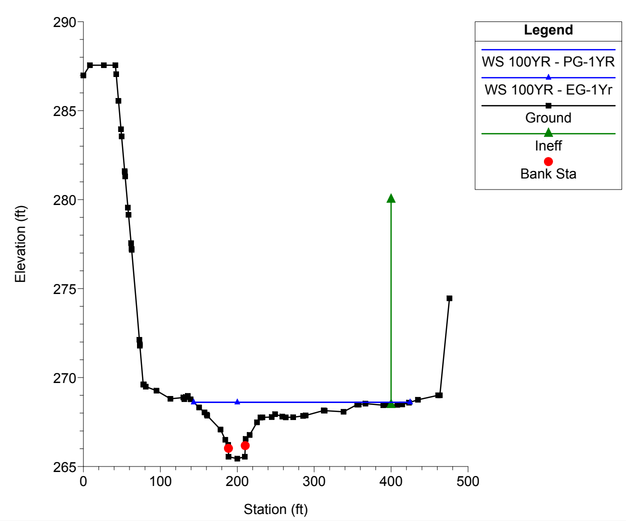

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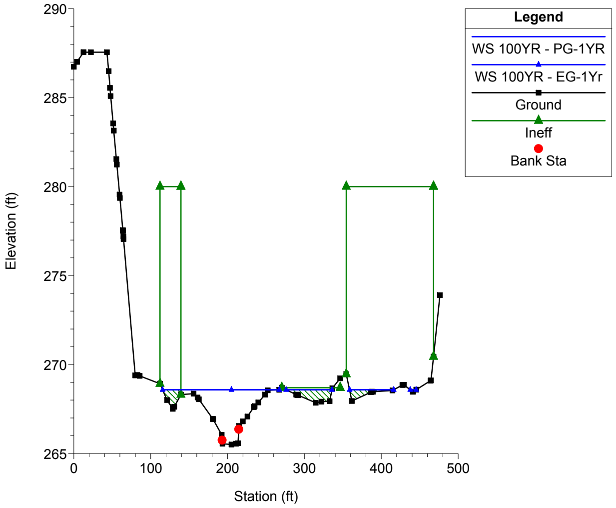

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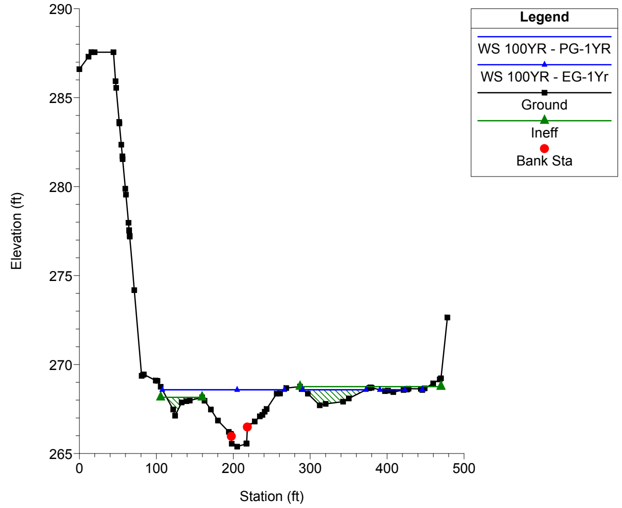

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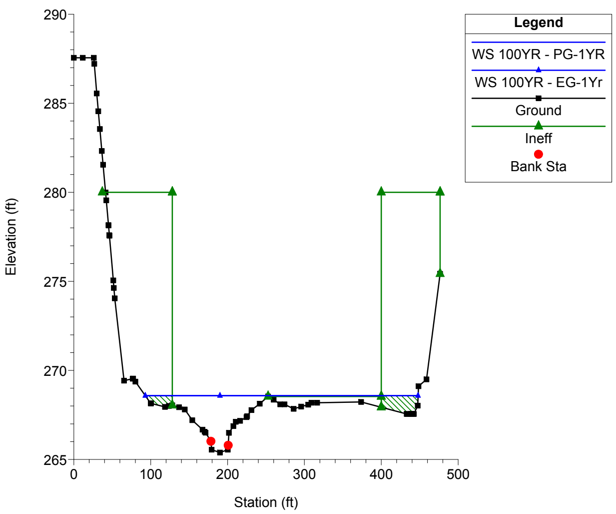

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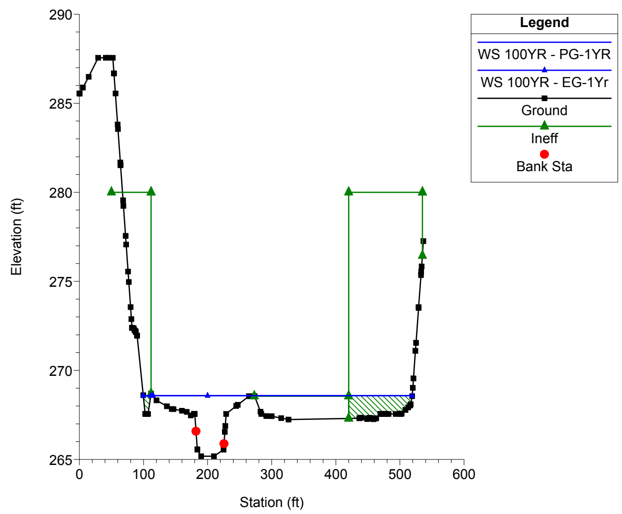

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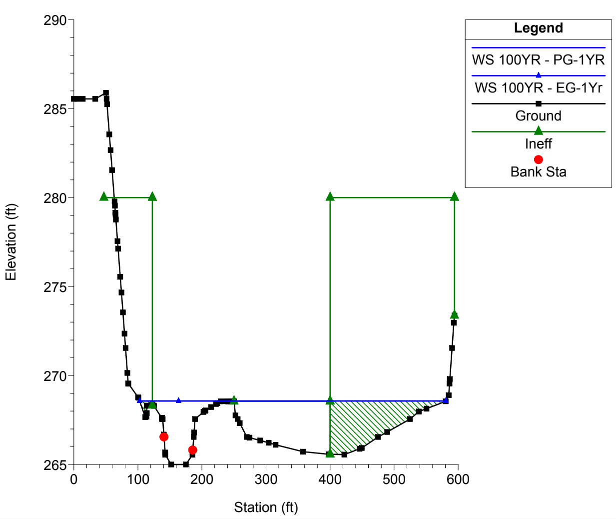

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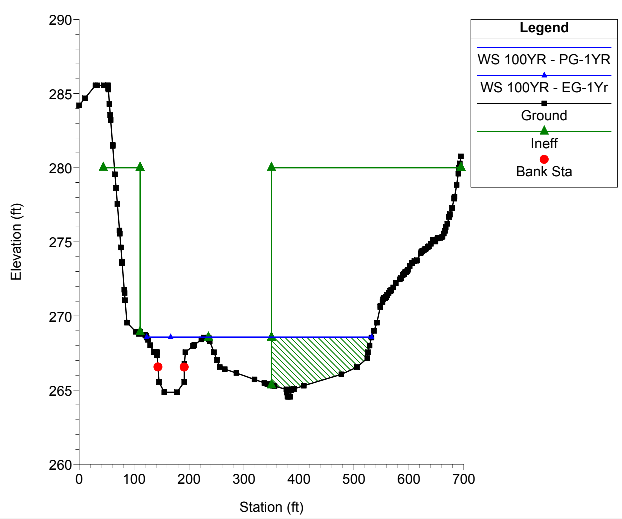

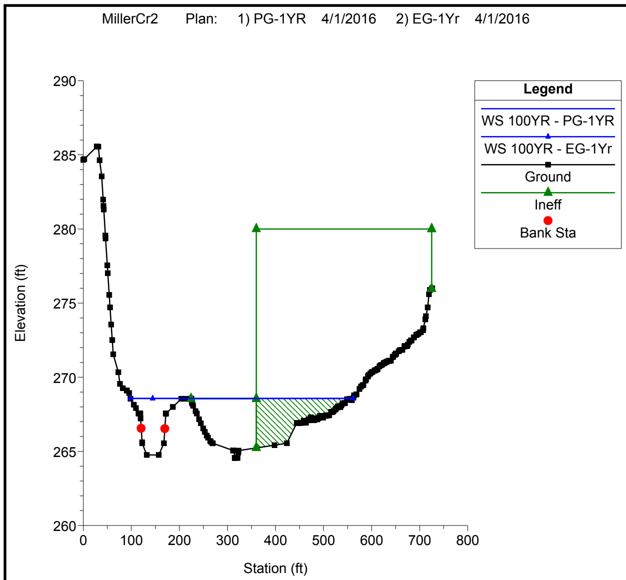
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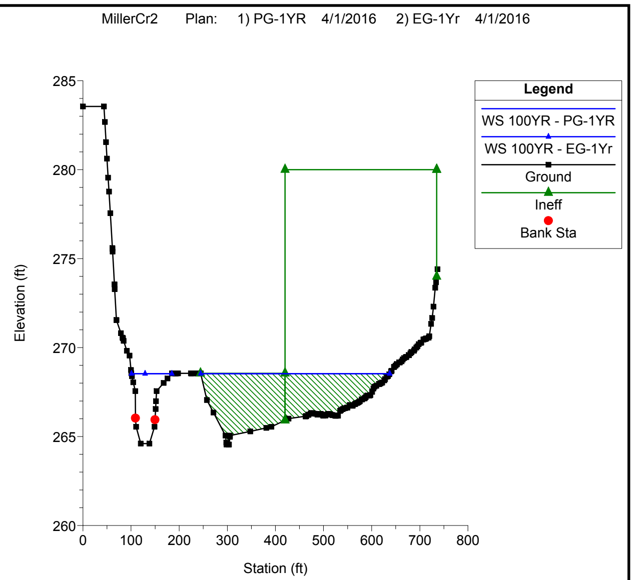
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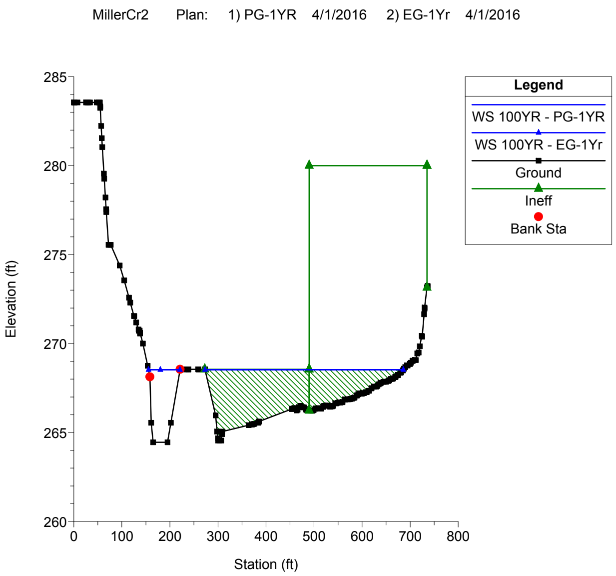
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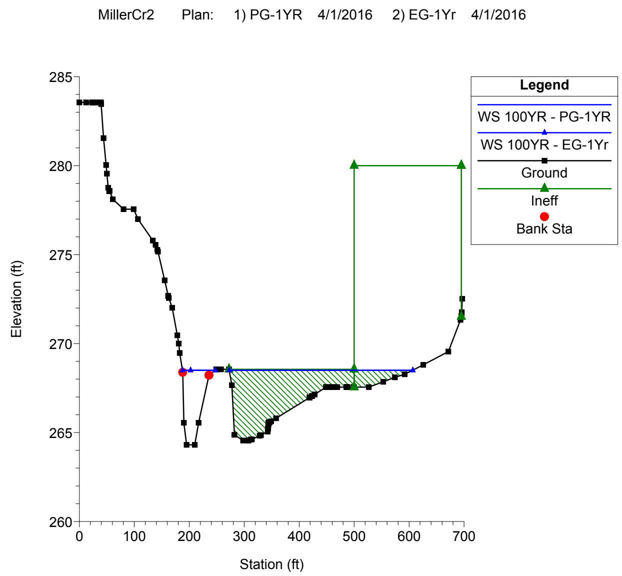
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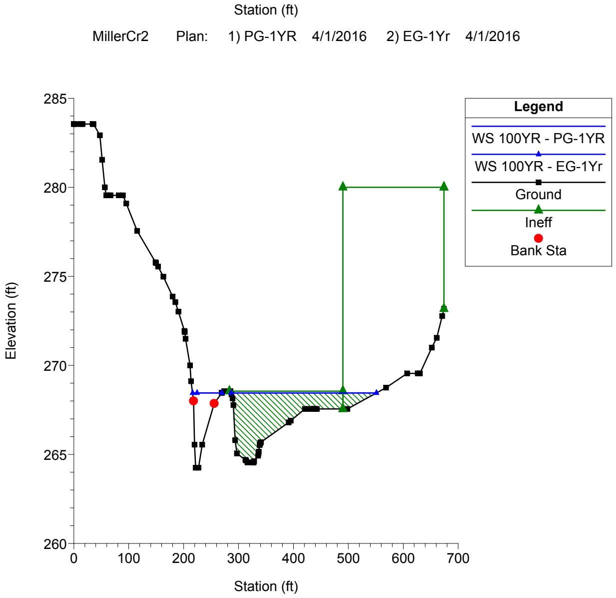
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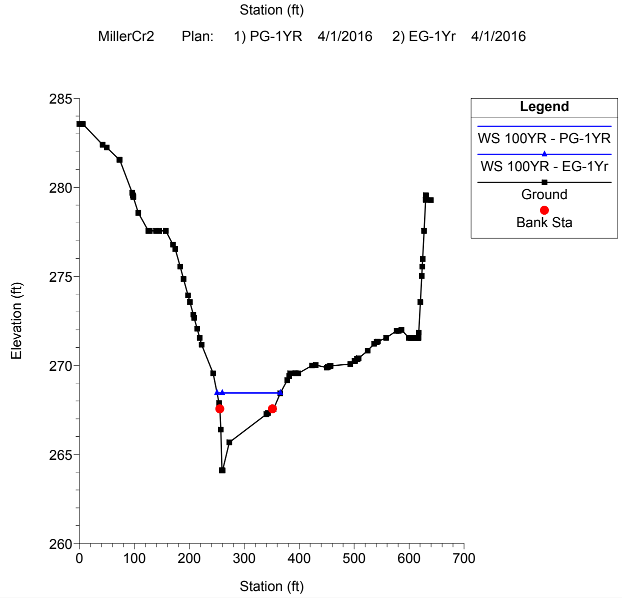
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Legend
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WS 100YR - EG-1Yr
Ground
Bank Sta
Elevation (ft)
Station (ft)

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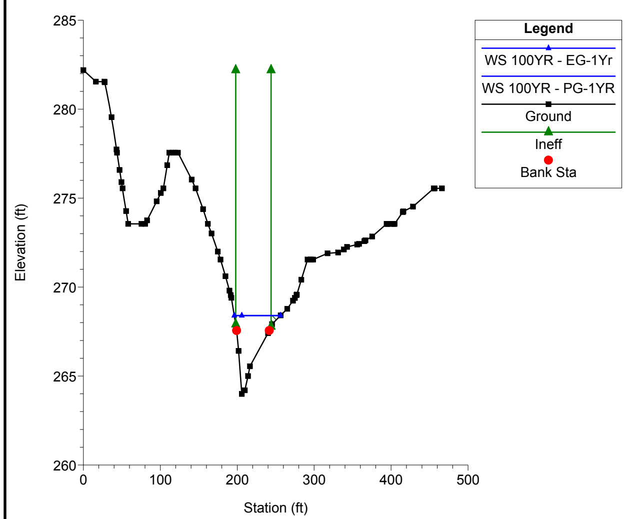

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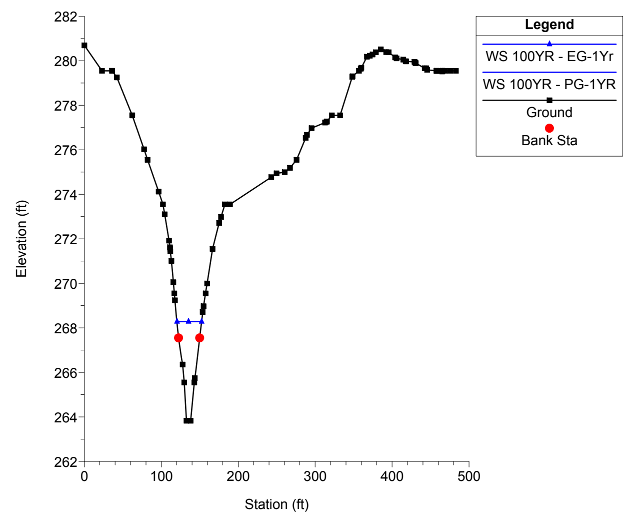

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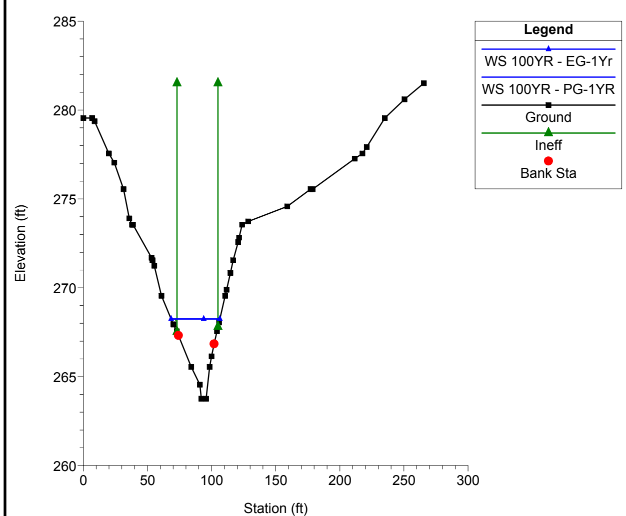

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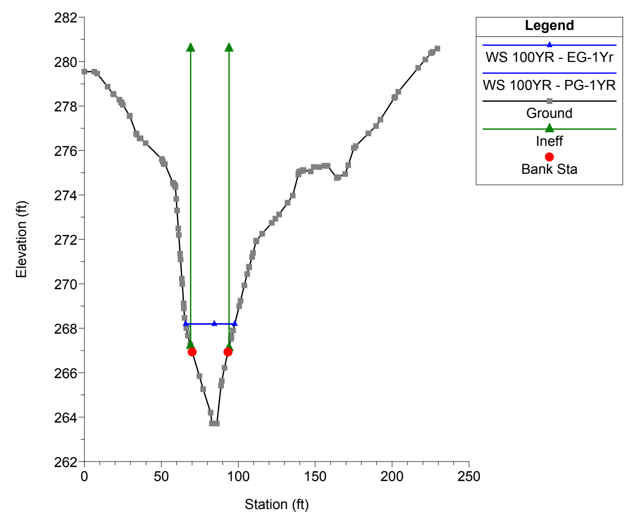

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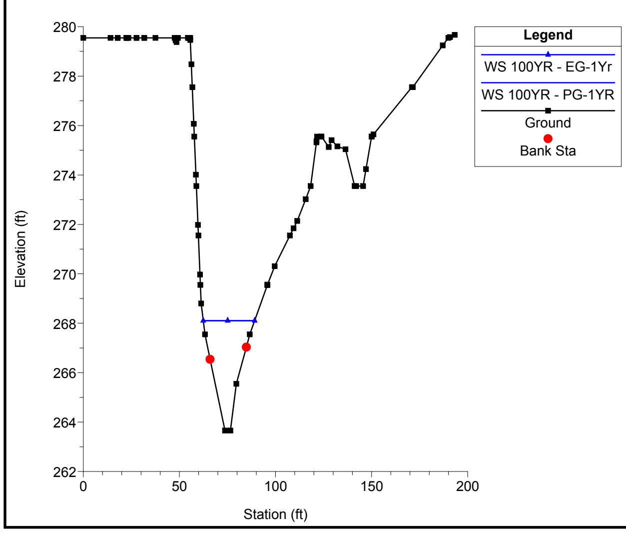

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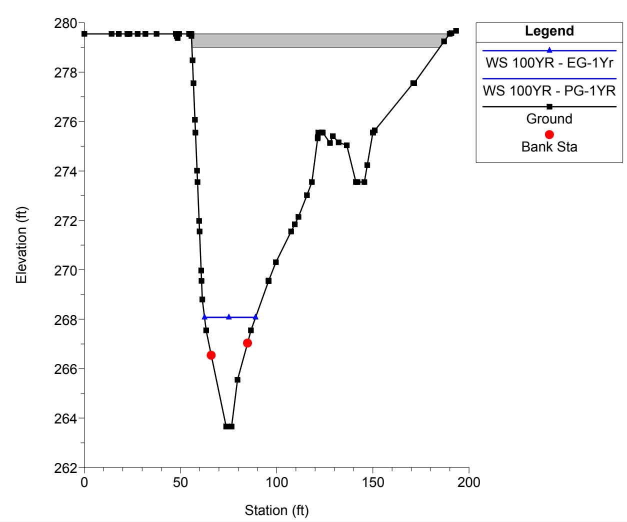

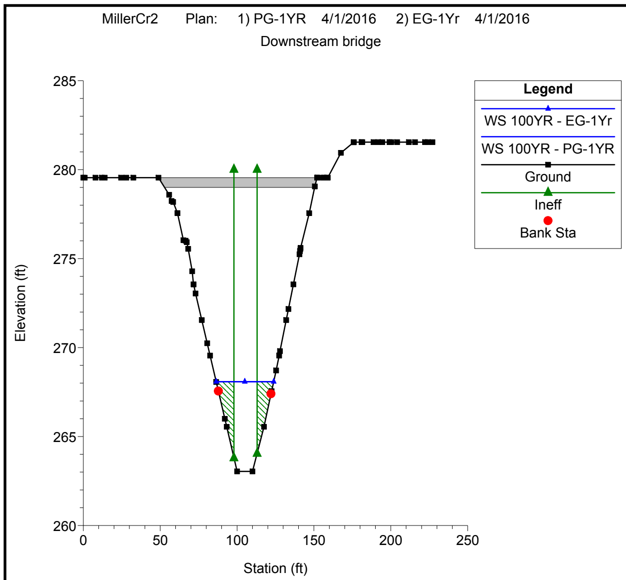
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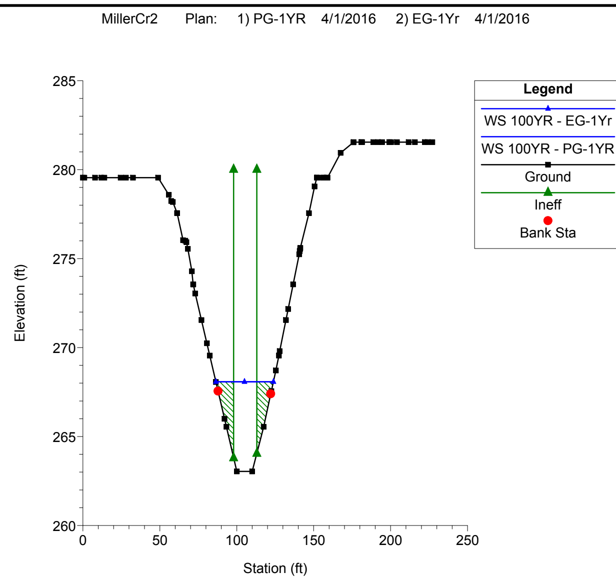
Elevation (ft)
Station (ft)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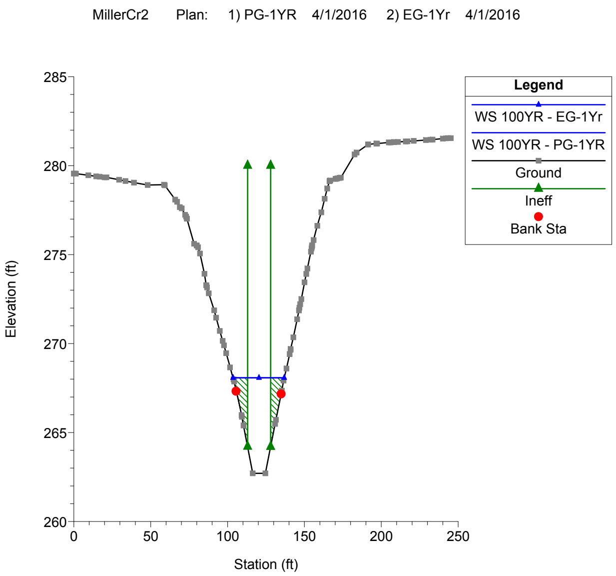
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Legend
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Ground
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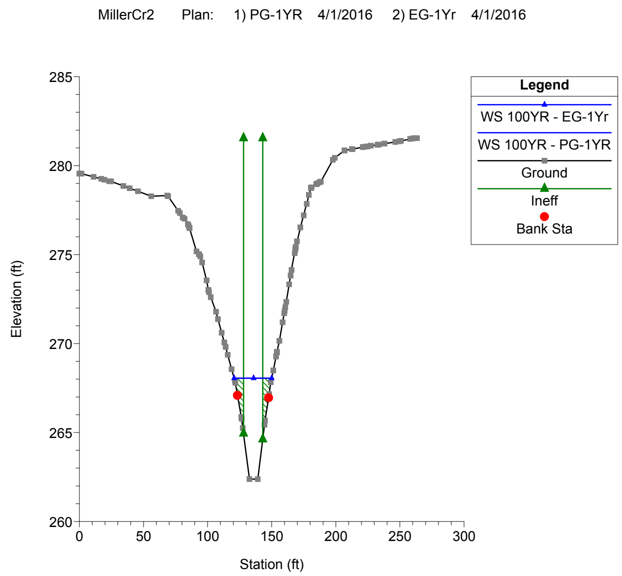
Bank Sta
Elevation (ft)
Station (ft)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Legend
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WS 100YR - PG-1YR
Ground
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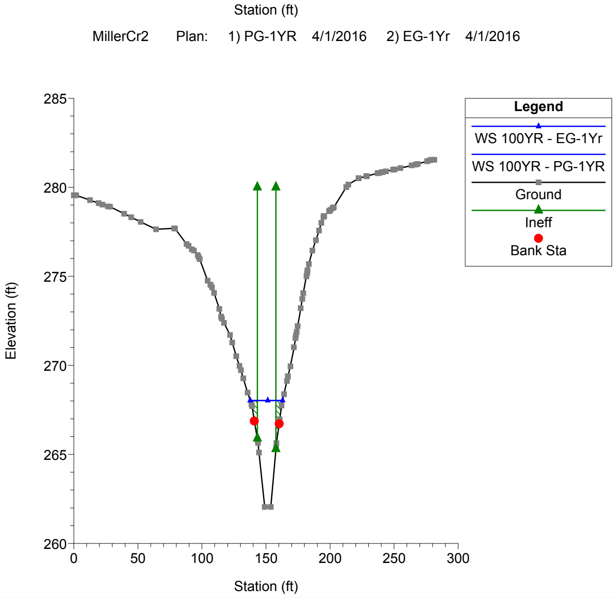
Bank Sta
Elevation (ft)
Station (ft)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Elevation (ft)
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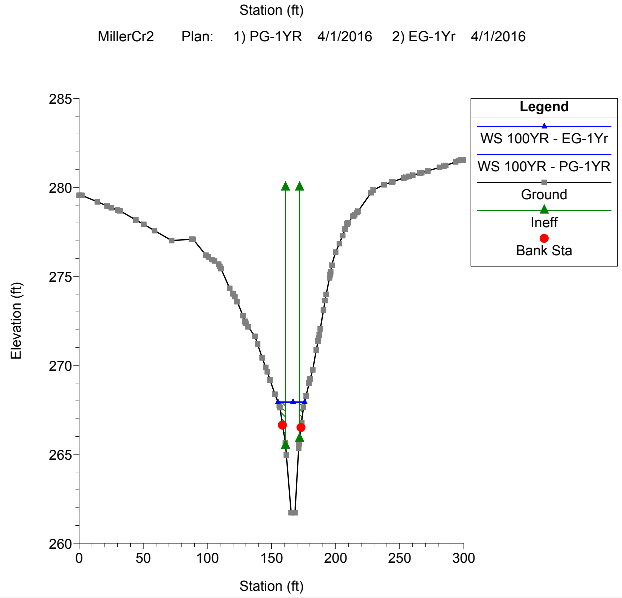
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Bank Sta
Elevation (ft)
Station (ft)

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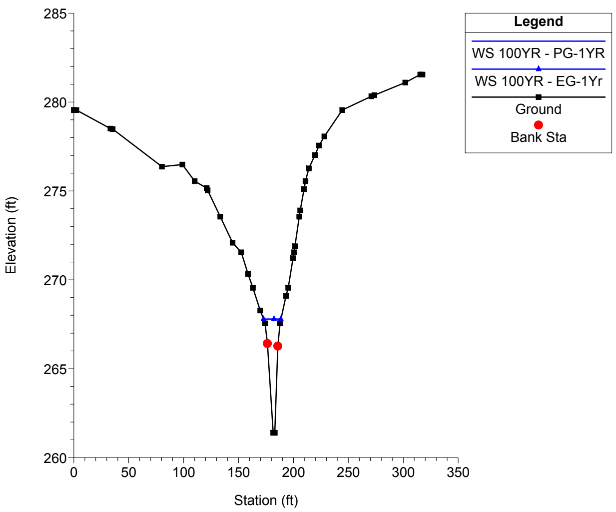

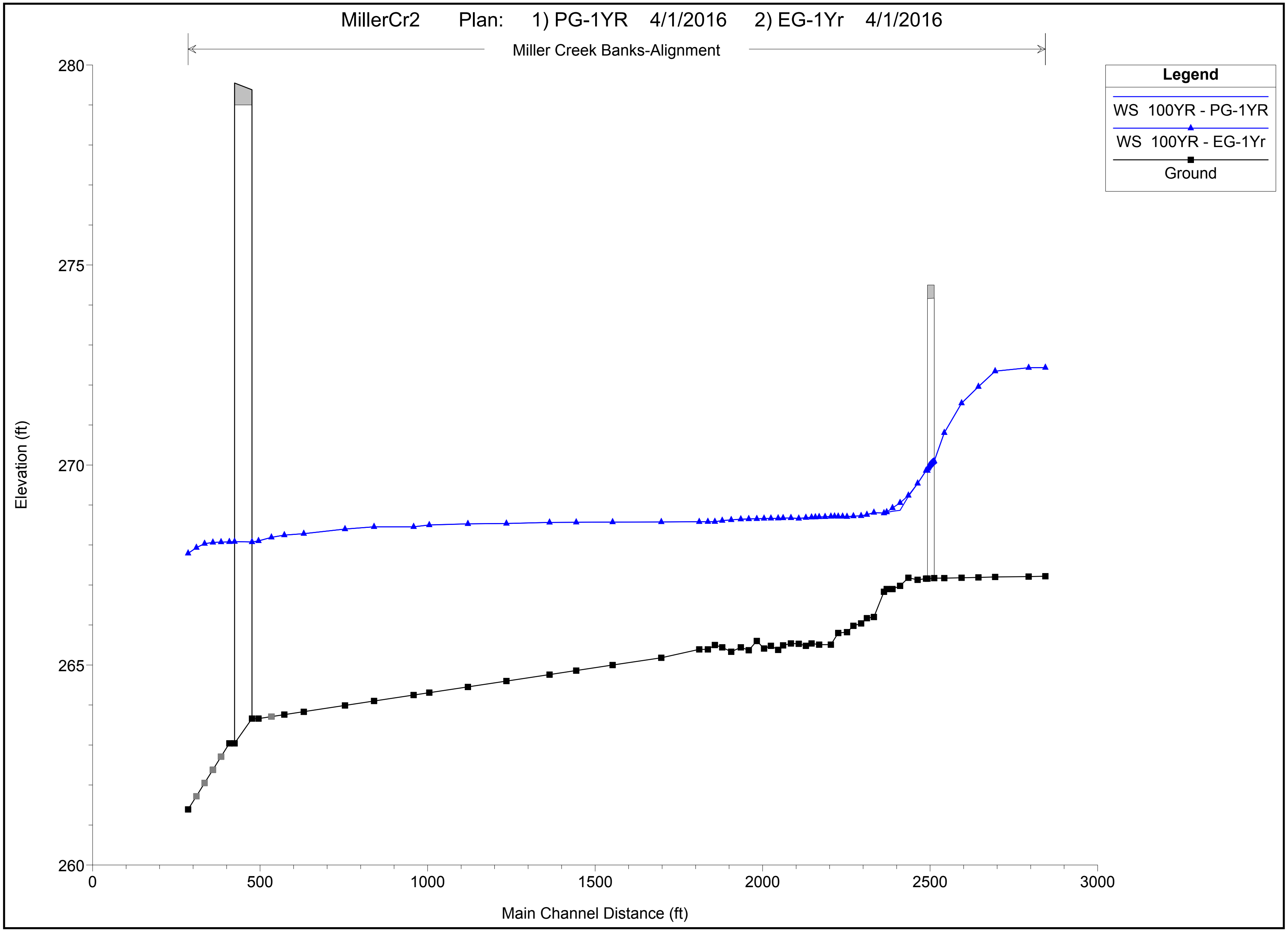
MillerCr2 Plan: 1) PG-1YR 4/1/2016 2) EG-1Yr 4/1/2016
Miller Creek Banks-Alignment
Legend
WS 100YR - PG-1YR
WS 100YR - EG-1Yr
Ground
Elevation (ft)
280
275
270
265
260
0
500
1000
1500
2000
2500
3000
Main Channel Distance (ft)

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix I
Geotechnical Support for the Lora Lake Parcel Remedial Action Memorandum

MEMORANDUM

Project No.: 110125-003-04

August 1, 2016

To: Jessi Massingale, Floyd|Snider

cc: Eleanor Bartolomeo, ESA

From:

Henry Haselton, PE
Principal Geotechnical Engineer
hhaselton@aspectconsulting.com

Re: **Geotechnical Support for Lora Lake Parcel Remedial Action—90-Percent Design Phase**

Introduction

This report contains geotechnical conclusions and recommendations in support of the Remedial Action 90-percent design phase for the Lora Lake parcel. Remediation of Lora Lake will consist of capping existing sediment, limited sediment removal, and open-water filling of the lake. The Remedial Action will immobilize contaminated sediments and prevent leaching of contaminated groundwater into the surface water, while rehabilitating the lake to wetland conditions. More information on the remedial design objectives and approach are included in the *Lora Lake Groundwater Modeling—Support for Remedial Action Design* memorandum (Aspect, 2016), the Cleanup Action Plan (CAP) and the Remedial Investigation/Feasibility Study (RI/FS) (Floyd|Snider, 2015), and in the 90-percent submittal design plans for Lora Lake Apartments Site MTCA Remedial Action (Port of Seattle, 2016).

We conducted geotechnical analysis to estimate the magnitude and duration of settlement that will occur in compressible fine-grained lake sediments and underlying organic-rich layers following the placement of remedial fill. Our analyses were based on limited, preexisting subsurface data that were produced for other projects, along with limited laboratory testing of soil samples collected from the ground surface near Lora Lake. Therefore, the results of our analyses should be considered to be approximate. We also collaborated with the design team throughout the hydrogeologic modeling process to specify recommended lake cap and fill materials that would meet geotechnical criteria, maintain upward groundwater flow paths, and address other CAP objectives.

Summary of Findings

Our analysis indicates that primary settlement is expected to occur within about one month of fill placement. Longer-term settlement, termed secondary compression, is a slower process that will continue for months to years; however, the majority of total settlement is expected to occur within approximately the first six months after fill placement. Total settlement is estimated to range from about 1 to 3 feet over the first six months, with an additional 0.5 feet occurring over the subsequent decade. Due to uncertainties related to the total thickness of peat and lake sediments within the lake, and additional uncertainties related to the geotechnical properties of the soils, it will be impossible to precisely predict the exact amount of settlement at all points around the lake. We therefore recommend placing an estimated thickness of fill cover on the lake during the first construction season, installing settlement points to monitor and determine when settlement has decreased to a manageable rate, and returning for a second construction season (after approximately 4 to 6 months) to place additional fill where needed to establish the design grades. Design grades should account for secondary compression over the design life of the project.

Subsurface Conditions

Our understanding of subsurface conditions is based on review of various documents relating to previous work conducted at and near the Lora Lake parcel. The data we reviewed included boring logs and sediment cores, test pits, laboratory testing, topographic and bathymetric survey results, and well monitoring data. Documents included the RI/FS (Floyd|Snider, 2015), various subsurface investigations conducted by Hart Crowser (2000a, 2000b, 2003), groundwater reports previously produced by Aspect Consulting (2015, 2004), groundwater modeling results (Aspect, 2016), and a description of local peat (Rigg, 1958).

According to geologic mapping and preexisting vicinity explorations, near-surface geologic units at the Lora Lake site include glacial deposits from the Vashon Stade of the Fraser glaciation (which ended approximately 13,000 years ago), and recent alluvial and lacustrine deposits. Geologic units are described below in order from youngest to oldest.

Recent (Postglacial) Geologic Units

Recent Alluvium—Recent alluvium consists of stream and river sands, gravels, and silty sands. This unit commonly contains interbedded silt and clay or organic matter. Recent alluvium drapes the ravines and creek bottoms that drain the upland areas, including portions of Miller Creek, and thickens near the shoreline.

Recent Lacustrine Deposits—Recent lacustrine (lake) deposits include silt, clay, and silty fine sand collected in ponds, lakes, floodplains and other low-energy or slack water bodies. These fine-grained deposits commonly contain some organics and wood and may include peat. The fine-grained consistency of these deposits makes them susceptible to compression when loaded.

Miller Creek Peat—The Miller Creek Peat is a complex geologic unit with a wide range of properties as described by Rigg (1958). According to Rigg, the unit includes fibrous peat, sedimentary peat, wood, diatomite, organic soil, and peat "slime." Several borings in the project vicinity have encountered fibrous peat organic soils associated with this unit. As is typical for peat, water content levels (mass of water/mass of solids) for this unit can reach several hundred percent. This is a highly compressible unit due to its high water content and organic-rich nature.

Vashon Stade Glacial Geologic Units

Recessional Outwash—Recessional outwash deposits consist of coarse-grained glaciofluvial (glacial meltwater) river and stream sediments (Qvr) associated with the retreat of the Vashon ice sheet. The sediments typically consist of sand, gravel, and silty sand. Recessional outwash was deposited as the glaciers were receding; therefore, it was not overridden by glacial ice and is substantially less dense than the older deposits.

Vashon Till—This unit consists primarily of lodgement till, a typically very dense mixture of clay, silt, sand, and gravel with cobbles that was deposited at the base of the Vashon glacier. The till contains interbeds or lenses of water-worked, outwash-like sand and gravel, thin lacustrine lenses, and boulders. Unweathered till generally exhibits very low permeability and forms an aquitard; wetlands commonly occur in enclosed depressions on the till surface.

Advance Outwash—Advance glacial meltwater deposits in the project area generally consist of dense to very dense, brown to gray, relatively homogeneous, clean (no appreciable silt or clay) to silty, fine to medium sand, with variable gravel content.

Groundwater and Surface Water Conditions

According to previous investigations (Aspect, 2015; Floyd|Snider, 2015), groundwater migrates generally towards the lake from the uplands north and northwest of Lora Lake (Lora Lakes Apartments parcel). At Lora Lake, groundwater levels generally coincide with the lake level. Additional information regarding groundwater conditions can be found in the RI/FS (Floyd|Snider, 2015) and other documents. For more information regarding modeled pre- and post-remediation conditions, see the groundwater modeling memorandum (Aspect, 2016).

Settlement Analysis

We conducted settlement analyses for proposed conditions as based on the 90-percent design for the wetland (Port of Seattle, 2016). The proposed wetland design consists of a variable-elevation surface that includes swales (intended to drain groundwater and flood-level surface water) and small, higher-elevation islands (to support a drier community of scrub-shrub dominated vegetation). For settlement analysis purposes, we assumed an average ground surface fill elevation (including topsoil) of 267.5 feet (NAVD88) per 90-percent design plans (Port of Seattle, 2016).

For analysis purposes, we reviewed existing vicinity subsurface exploration data and identified two compressible layers that underlie Lora Lake: Miller Creek Peat (peat) and Recent Lacustrine Deposits (lake sediments). Compressible layers were assumed to be underlain by some thickness of relatively permeable Vashon recessional outwash (Qvr), which is in turn assumed to be underlain by relatively impermeable Vashon till (Qvt). We then constructed a schematic geologic cross section that we used as the basis of our settlement analysis. Our cross section, which runs approximately east-west through the long axis of Lora Lake, is included below as Figure 1.

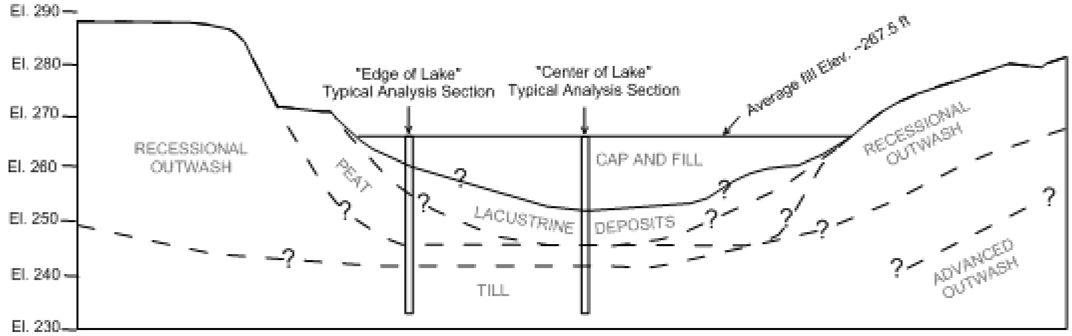

Figure 1. Schematic geologic cross section extending approximately east-west through Lora Lake

We then constructed two “typical sections” (shown on Figure 1) to represent idealized conditions at the edge of Lora Lake, where a relatively thick peat layer is overlain by a relatively thin lake sediment layer, and at the center of Lora Lake, where a relatively thick lake sediment layer is present with no underlying peat. The two typical sections selected for analysis are shown in Table 1 below.

Table 1 Unit Thickness for Edge-of-Lake and Center-of-Lake Typical Sections

Unit	Unit Thickness (feet)	
	Edge-of-Lake Section	Center-of-Lake Section
Minimum Required Fill (including remedial cap and topsoil)	7.5	14.5
Anticipated Required Fill (adjusted for expected settlement)	10.5	15.5
Lake Sediments	5	8
Peat	9	0
Recessional Outwash	4	2
Till	N/A	N/A

Notes: The sections used for analysis are generalized and assume an average target fill (including topsoil) surface elevation of 267.5 ft.

Settlement analysis was necessarily an iterative process. After conducting initial settlement analysis, we revised our initial assumptions to account for a thicker layer of fill that would make up for the anticipated amount of expected settlement. The addition of a thicker fill layer, however, would result in increased anticipated settlement, thereby requiring placement of a yet-thicker fill layer. While this process was somewhat circular, we were able to arrive at reasonable values after several iterations. Due to the inherent level of uncertainty within the analysis, we did not differentiate between different types of fill soils (e.g. bulk, remedial, topsoil).

Laboratory Testing

We did not conduct any subsurface explorations or have access to preexisting soil samples from previous subsurface explorations. However, we collected surface samples of lake sediments and peat for observation and in order to conduct limited geotechnical laboratory testing. Samples were collected by hand from near-surface (less than 6 inches deep) wetland soils to the south of Lora Lake on October 9, 2015, by Aspect personnel during drawdown testing of Lora Lake. We conducted laboratory testing of these samples in order to help us to refine our assumed soil properties for settlement analysis; however, laboratory results were of limited use given the fibrous nature of the peat deposits, and the unknown correlation of our surface grab samples to subsurface conditions and geologic units directly underlying Lora Lake.

We conducted moisture content, plasticity testing, grain size distribution, and shrinkage testing for select samples. Additionally, we reviewed available geotechnical laboratory test data for soil samples collected from nearby peat deposits and other subsurface units.

Soil and Consolidation Parameters and Assumptions

Because only limited geotechnical laboratory testing had been completed for the peat and lacustrine units, we used our interpretation of existing soil descriptions, limited laboratory testing results, and engineering judgement to determine analysis input parameters. Assumed soil and consolidation parameters are summarized below in Table 2.

Table 2□ Soil and Consolidation Parameters Used for Lora Lake Settlement Analysis

Input Parameter	Peat	Lake Sediments
Moist Unit Weight, lbs/ft^3 (ɣ)	80	110
Modified Compression Index (Cc□)	0.6	0.3
Overconsolidation Compression Index (Cc□R)	0.06	0.03
Modified secondary compression index (Csec, Cαε)	0.04	0.02
Coefficient of consolidation, ft^2/day (Cv)	2	2.5

Notes:
lbs/ft^3 □pounds per cubic feet
ft^2/day □square feet per day

Effects of Settlement Due to Filling Lora Lake

We made estimated predictions of primary and secondary consolidation based on the two typical sections described above. In general, edge-of-lake areas are expected to experience a greater magnitude of settlement than center-of-lake areas due to the greater peat thickness characterized around the perimeter of the lake. Estimated settlement amounts are shown versus time on Figures 2 and 3. In general, estimated settlement amounts are:

- Around the perimeter of Lora Lake, where peat is characterized as thickest, approximately 3 feet of settlement is anticipated to occur in the first 6 months following fill placement.

- Near the center of Lora Lake, where peat is assumed to be absent, slightly more than 1 feet of settlement is anticipated to occur in the first 6 months following fill placement.

- Secondary settlement of up to about an additional 0.5 feet is expected to occur over the course of 10 years following the initial 6-month period.

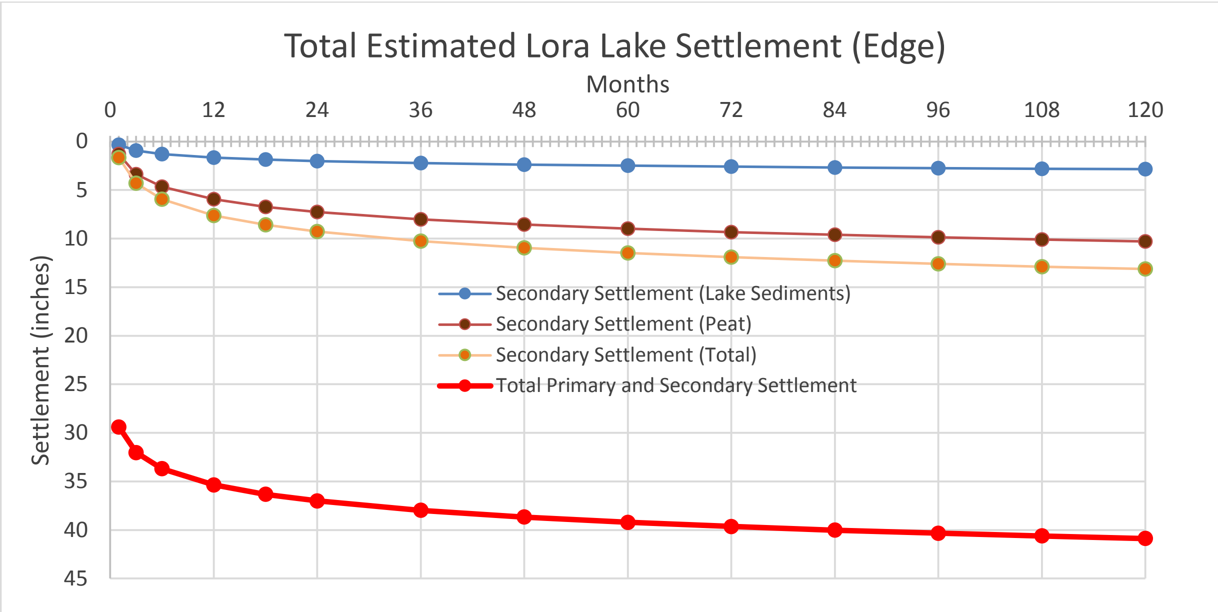

Figure 2. Total estimated settlement for edge-of-lake typical section

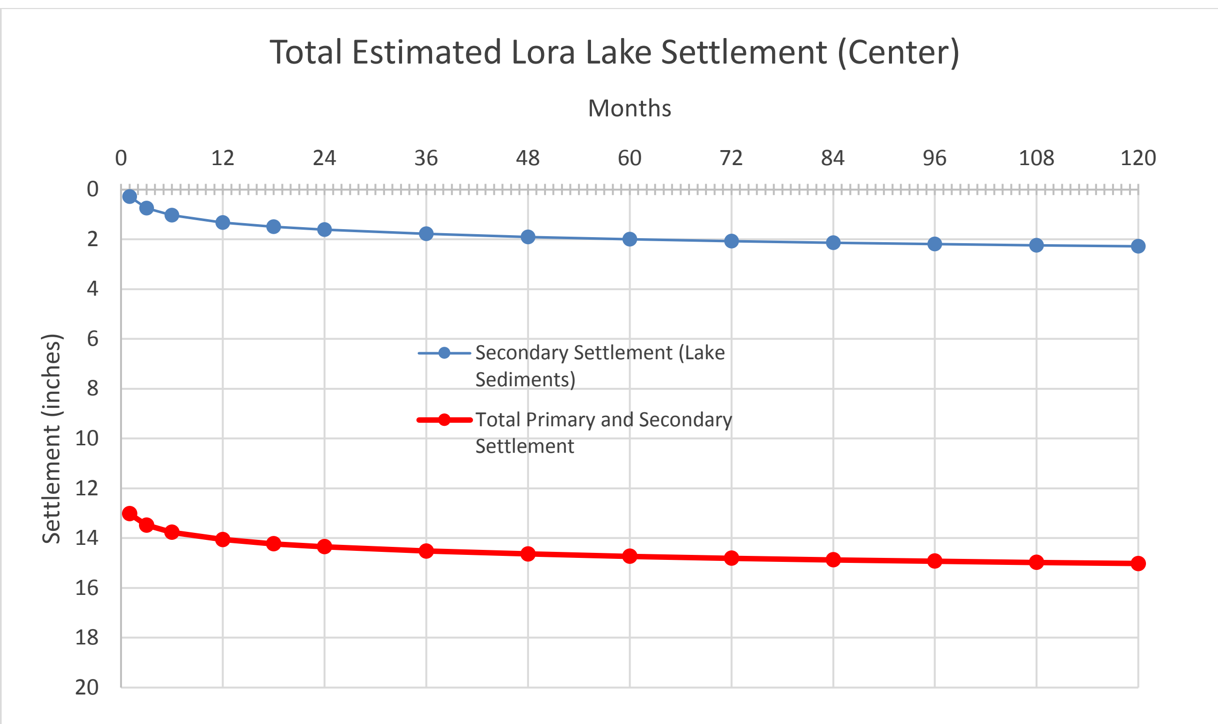

Figure 3. Total estimated settlement for center-of-lake typical section

Conclusions and Recommendations

Magnitude and Timing of Predicted Settlement

Settlement will result from two components: primary consolidation and secondary settlement. Primary consolidation will occur relatively fast, within about 1 month. Secondary is a slower process that is expected to continue for months to years, but will slowly decrease over time. The majority of total (primary and secondary) settlement is expected to occur within approximately the first 6 months after fill placement.

Where peat is present along the edges Lora Lake, as was assumed to be the case, significant secondary settlement will continue to occur for years and/or decades after fill placement. We anticipate that beyond the initial 6-month initial settlement period, the settlement will become gradual, and planning for the wetland design should take this into account.

Historical design drawings (King County Department of Public Works, 1982) indicate that an existing rock berm (to be removed) in the northeastern corner of Lora Lake constructed in the early to mid-1980s is approximately 30 feet wide and has a maximum height of about 5 feet at its center, tapering down in height toward the shore and toward the center of the lake at a slope of 3 horizontal: 1 vertical (3H:1V). The load of the rock berm has likely resulted in partial primary and secondary compaction of the compressible lake and peat soils in this vicinity. However, due to the limited lateral extent of the berm and the high degree of uncertainty incorporated into our settlement analysis, this factor does not significantly impact our predictions for settlement magnitude or timing.

Primary settlement is expected to be rapid, and will begin as soon as the fill is placed. Our settlement estimates can be converted into reasonable estimates of required fill volume; however, due to the complexity and softness of the lake bottom surface and the vast size of the area, fill quantity will be difficult to track in the field from surveying. Therefore, we recommend tracking fill quantity by way of truck counts or another similar, and more easily quantifiable, method.

Due to the variability of peat and lake-sediment thickness within the lake, and uncertainty of the geotechnical properties of the peat and organic soils, it will be impossible to precisely predict the exact amount of settlement (and therefore also the ultimate required adjusted-for-settlement fill thickness) at all points around the lake. We therefore recommend placing an estimated minimum expected amount of fill cover on the lake (as described below) during the first season of construction, installing settlement points to determine when settlement has decreased to a manageable rate, and returning during the second season of construction (after approximately 4 to 6 months) to “top off” the fill area as needed.

Recommended Lake Fill Elevations

Our assumptions for final Lora Lake surface elevations were made based on 90-percent design plans (Port of Seattle, 2016), which indicate final grade elevations of approximately 267 feet in swales and 268 feet in hummocks. The upper 1.5 feet of fill material will consist of topsoil. For settlement prediction purposes, we assumed that fill would initially be placed to relatively uniform elevations in each portion of the lake, and would be redistributed after settlement occurs to create swales and islands prior to placement of wetland topsoil.

We understand that placement of fill material may occur either "in the wet" or within dewatered conditions. In either placement scenario, some initial settlement is expected to occur internally within the imported fill layer. Regardless of the selected fill placement method, settlement of sand or gravel fill materials is expected to occur relatively rapidly during placement and does not need to be accounted for in determination of proposed lake fill elevations.

As a preliminary estimate for initial (Season 1) fill placement, we recommend that fill be placed to account for approximately half of our maximum estimated settlement amounts described above. We understand that the final fill surface at the end of Season 1 will be sloped to facilitate drainage; therefore, we recommend that Season 1 fill be placed to an elevation ranging between 268.5 (in the northern portion of Lora Lake) and 267 feet (in the southern portion of Lora Lake).

For Season 2, assuming that settlement is occurring approximately at or below anticipated rates, we recommend re-distributing Season 1 fill as needed, placing remedial cap fill to the approximate final pre-topsoil target baseline elevation (266 feet) across the entire lake, adding additional fill as needed to achieve the final target hummock and swale remedial cap grades, and then placing topsoil to the final target grade elevations. Appropriate consideration should be given to the potential ecological impacts of final swale/island elevations that err either higher or lower than target elevations.

Fill Gradation Criteria

The CAP specifies that a remedial sand cap of at least 18 inches be placed directly over lake-bottom sediments, overlain by bulk high-conductivity fill material, and topped off by a topsoil suitable for wetland plantings. We understand from the Lora Lake Groundwater Modeling memorandum (Aspect, 2016), and based on our own preliminary analysis, that certain clean (low fines content), poorly graded (sand grain sizes are relatively uniform), medium to coarse sand materials may have sufficient permeability to meet the target hydraulic conductivity (approximately 150 ft/day) of fill material which would be required to minimize the slope of the water table and achieve mandated groundwater flow objectives. From a geotechnical perspective, either sand or gravel would likely be considered acceptable as a bulk fill material, provided the hydraulic conductivity requirements are met.

Based on documented hydraulic conductivity value ranges and preliminary empirical hydraulic conductivity analysis conducted by Aspect, we recommend that materials classified as USCS poorly graded, medium to coarse sand (SP) be considered for use as bulk fill material. A medium to coarse sand (SP) is also suitable to meet the hydraulic conductivity requirements of the remedial sand cap material. These recommendations are consistent with soil parameters assumed for post-remediation groundwater modeling. Therefore, the same medium to coarse sand (SP) material may be suitable for use as sand cap material and bulk fill material, with carbon added to the sand cap material to meet environmental protection requirements as detailed in the CAP.

We recommend that the contractor be held responsible for identifying an available bulk fill material that meets project requirements. The contractor should facilitate both grain size distribution testing and hydraulic conductivity testing (ASTM D2434 - *Standard Test Method for Permeability of Granular Soils [Constant Head])* prior to construction, and also complete tests on at least one sample for every 5,000 cubic yards of the selected material, or every material change (whichever comes first), during construction.

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Limitations

Work for this project was performed for Floyd|Snider and the Port of Seattle (Clients), and this report was prepared in accordance with generally accepted professional practices for the nature and conditions of work completed in the same or similar localities, at the time the work was performed. This report does not represent a legal opinion. No other warranty, expressed or implied, is made.

Experience has shown that subsurface soil and groundwater conditions can vary significantly over small distances. Inconsistent conditions can occur between explorations and may not be detected by a geotechnical study. If, during future Site operations, subsurface conditions are encountered which vary appreciably from those described herein, Aspect Consulting should be notified for review of the recommendations of this report, and revision of such if necessary. If there is a substantial lapse of time between the submission of this report and the start of construction, or if conditions have changed due to construction operations at or near the Site, it is recommended that this report be reviewed to determine the applicability of the conclusions and recommendations considering the changed conditions and time lapse.

This report is issued with the understanding that the information and recommendations contained herein will be incorporated into the 90-percent project plans and specifications, and the necessary steps will be taken to verify that the contractor and subcontractors carry out such recommendations in the field. This report will be revised as necessary as the design progresses from 90-percent through final design.

This firm does not practice or consult in the field of safety engineering. We do not direct the contractor's operations, and we cannot be responsible for the safety of personnel other than our own on the Site; the safety of others is the responsibility of the contractor. The contractor should notify the owner if they consider any of the recommended actions presented herein unsafe.

All reports prepared by Aspect Consulting for the Clients apply only to the services described in the Agreement(s) with the Clients. Any use or reuse by any party other than the Clients is at the sole risk of that party, and without liability to Aspect Consulting. Aspect Consulting's original files/reports shall govern in the event of any dispute regarding the content of electronic documents furnished to others.

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Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix J
Sampling and Analysis Plan/
Quality Assurance Project Plan Addendum

Table of Contents

1.0 Project Description J-1
1.1 INTRODUCTION J-1
2.0 Project Organization and Responsibility J-3
2.1 MANAGEMENT RESPONSIBILITIES J-3
2.1.1 Don Robbins—Port of Seattle Project Manager J-3
2.1.2 Megan King and Jessi Massingale—Floyd|Snider Project Managers J-3
2.1.3 Floyd|Snider Project Engineer J-3
2.2 QUALITY ASSURANCE RESPONSIBILITIES J-4
2.2.1 Chell Black—Floyd|Snider Data Manager/Quality Assurance Manager J-4
2.3 LABORATORY RESPONSIBILITIES J-4
2.3.1 Cheronne Oreiro—ARI Project Manager J-4
2.4 FIELD RESPONSIBILITIES J-5
2.4.1 Corey Wilson—Floyd|Snider Field Supervisors J-5
2.4.2 Floyd|Snider Field Sampling Lead J-5
3.0 Data Quality Objectives J-7
4.0 Soil Performance Monitoring Plan J-9
4.1 SOIL EXCAVATION SIDEWALL AND BASE PERFORMANCE MONITORING J-9
5.0 Groundwater Performance and Confirmation Monitoring J-11
5.1 LORA LAKE APARTMENTS PARCEL PERFORMANCE AND CONFIRMATION MONITORING J-11
5.2 LORA LAKE PARCEL PERFORMANCE AND CONFIRMATION MONITORING J-12
6.0 Field Procedures J-13
6.1 SOIL SAMPLING PROTOCOLS J-13
6.1.1 Excavation Sidewall and Base Soil Sampling J-13
6.2 GROUNDWATER SAMPLING PROTOCOLS J-13
6.3 SAMPLE NOMENCLATURE, HANDLING, AND ANALYSIS J-14
6.4 EQUIPMENT DECONTAMINATION J-15
6.5 SURVEYING J-15

6.6 INVESTIGATION-DERIVED WASTE MANAGEMENT J-15

7.0 References J-17

List of Tables

Table J.1 Data Quality Assurance and Quality Control Criteria

Table J.2 Analytical Requirements, Methods, Preservation, Bottle Types, and Holding Times

Table J.3 Analytical Methods, Detection Limits, and Reporting Limits

Table J.4 Soil and Groundwater Cleanup Levels

List of Figures

Figure J.1 Soil Performance Monitoring Sampling Locations

Figure J.2 Groundwater Monitoring Well Network

List of Attachments

Attachment J.1 Field Sampling Forms

List of Abbreviations and Acronyms

Acronym/ Abbreviation	Definition
ARI	Analytical Resources, Inc.
bgs	Below ground surface
CMP	Compliance Monitoring Plan
COC	Contaminant of concern
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
DMCA	1982 Dredged Material Containment Area
DQO	Data quality objective
EDR	Engineering Design Report
EIM	Environmental Information Management
IDW	Investigation-derived waste
LL Apartments Parcel	Lora Lake Apartments Parcel

Acronym/ Abbreviation	Definition
LL Parcel	Lora Lake Parcel
PCP	Pentachlorophenol
POC	Point of compliance
Port	Port of Seattle
QA	Quality assurance
QC	Quality control
RI/FS	Remedial Investigation/Feasibility Study
SAP/QAPP	Sampling and Analysis Plan/Quality Assurance Project Plan
Site	Lora Lake Apartments Site
TEQ	Toxicity equivalent
USEPA	U.S. Environmental Protection Agency
WSDOE	Washington State Department of Ecology

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1.0 Project Description

This Sampling and Analysis Plan/Quality Assurance Project Plan (SAP/QAPP) Addendum presents the specific field protocols and field and laboratory quality assurance/quality control (QA/QC) procedures associated with the cleanup action to be conducted by the Port of Seattle (Port) at the Lora Lake Apartments (Site) in Burien, Washington. The Site is divided into three parcels: the Lora Lake Apartments Parcel (LL Apartments Parcel), the Lora Lake Parcel (LL Parcel), and the 1982 Dredged Material Containment Area (DMCA). The DMCA is not discussed in this SAP/QAPP because no sampling will be conducted on that parcel during the remedial action. This SAP/QAPP is an addendum to the SAP/QAPP previously presented as Appendix B of the Remedial Investigation/Feasibility Study (RI/FS) Work Plan (Floyd|Snider 2010).

1.1 INTRODUCTION

This SAP/QAPP Addendum describes field compliance monitoring activities to be performed as part of the soil excavation on the LL Apartments Parcel and LL Parcel and groundwater sampling to be performed on the LL Apartments Parcel and LL Parcel after the remedial action construction. All imported backfill materials (the LL Apartments Parcel and LL Parcel soil backfill and the LL Parcel sand cap, fill, and wetland topsoil) will be sampled and analyzed by the Contractor and, therefore, protocols are not presented in this SAP/QAPP Addendum. Imported fill will be required to comply with the project specifications. The sampling activities will include the following:

- Excavation soil performance monitoring, including the following:
  - Collection of soil performance monitoring samples from the LL Apartments Parcel after the excavation of the eastern sidewall abutting the paved sidewalk along Des Moines Memorial Drive to document any concentrations of dioxins/furans, carcinogenic polycyclic aromatic hydrocarbons (cPAHs), pentachlorophenol (PCP), or lead remaining in place beneath the right-of-way.
  - Collection of soil performance monitoring samples from the LL Parcel after excavation at the base of one of the excavations at 6 feet below ground surface (bgs; the conditional point of compliance [POC]) and at the western sidewall abutting the paved sidewalk along Des Moines Memorial Drive to document any concentrations of dioxins/furans or lead remaining in place at the conditional POC (dioxins/furans only) or beneath the right-of-way.
- Collection of quarterly performance and confirmation groundwater samples to define the conditions of the Site after the remedial action construction and to assess the effectiveness of the remedial action. Once groundwater cleanup levels have been achieved for an individual Site contaminant of concern (COC) during four consecutive monitoring events, the Port will request approval from the Washington State Department of Ecology (WSDOE) to discontinue confirmation monitoring for that analyte.

This SAP/QAPP Addendum is organized as described below:

- **Section 2.0—Project Organization and Responsibility.** This section presents the overall project, field, and data quality management responsibilities assigned to the members of the project team.
- **Section 3.0—Data Quality Objectives.** This section summarizes the project data quality objectives (DQOs) that are consistent with the SAP/QAPP presented as Appendix B of the RI/FS Work Plan (Floyd|Snider 2010).
- **Section 4.0—Soil Performance Monitoring Plan.** This section details the soil performance sampling and analytical approach.
- **Section 5.0—Groundwater Performance and Confirmation Monitoring.** This section details the groundwater sampling and analytical approach.
- **Section 6.0—Field Procedures.** This section describes the field sample collection protocols to be used for all sampling activities.
- **Section 7.0—References.** This section provides a list sources used in the development of this SAP/QAPP Addendum.

2.0 Project Organization and Responsibility

This section defines the various QA/QC management, laboratory, and field responsibilities of key project personnel.

2.1 MANAGEMENT RESPONSIBILITIES

2.1.1 Don Robbins—Port of Seattle Project Manager

Don Robbins is the Port's primary point of contact. He will perform the following:

- Authorizing and coordinating access for field activities
- Communicating with WSDOE and project stakeholders
- Reviewing and approving all reports (deliverables) before their submission to WSDOE
- Representing the project team at meetings and public hearings

2.1.2 Megan King and Jessi Massingale—Floyd|Snider Project Managers

Megan King and Jessi Massingale, project managers, will have overall responsibility for project implementation. As project managers, they will be responsible for maintaining QA on this project and ensuring that the DQOs are met. The project managers will perform the following:

- Monitoring project activity and quality
- Providing an overview of field activities to the Port and WSDOE
- Providing technical representation of project activities at meetings

2.1.3 Floyd|Snider Project Engineer

The project engineer (Engineer), who will be either one of the Floyd|Snider project managers or an additional engineer, will have overall responsibility for implementation of the remedial action. As Engineer, she or he will be responsible for ensuring that the remedial objectives are met. The Engineer will perform the following:

- Approving contractor submittals and procedures for the handling and disposal of contaminated media to ensure consistency with the Cleanup Action Plan (State of Washington 2015, Exhibit B), the Compliance Monitoring Plan (CMP; Floyd|Snider 2015a), and the Engineering Design Report (EDR)
- Providing an overview of field activities to the Port and WSDOE
- Providing technical representation of project activities at meetings
- Overseeing preparation of the Construction Completion Reports (as-built reports).

2.2 QUALITY ASSURANCE RESPONSIBILITIES

2.2.1 Chell Black—Floyd|Snider Data Manager/Quality Assurance Manager

The data manager/QA manager will be responsible for coordinating data validation of all sample results from the analytical laboratories and entering the data into Floyd|Snider's custom database. Additional responsibilities include the following:

- Reviewing laboratory reports
- Coordinating the supply of performance evaluation samples and review results from performance audits
- Uploading analytical data into WSDOE's Environmental Information Management (EIM) database
- Advising on data corrective action procedures
- Providing QA/QC on analytical data reports
- Performing database management and queries

2.3 LABORATORY RESPONSIBILITIES

Analytical Resources, Inc. (ARI) will perform the chemical analytical services for the sampling activities led by Floyd|Snider, the soil excavation performance monitoring, and the groundwater performance and confirmation monitoring. The sample collection and analysis of the imported fill materials will be conducted by the selected contractor and may be performed by a different laboratory; however the sampling procedures and analyses will be required to comply with the project specifications, including analytical methods, reporting limits, and sample holding times.

2.3.1 Cheronne Oreiro—ARI Project Manager

The ARI project manager will report directly to the Floyd|Snider data manager/QA manager and will be responsible for the following:

- Ensuring that all resources of the laboratory are available
- Advising Floyd|Snider's data manager/QA manager of laboratory status
- Reviewing and approving final analytical reports
- Coordinating internal laboratory analyses
- Supervising in-house chain-of-custody procedures
- Scheduling sample analyses
- Overseeing data review

2.4 FIELD RESPONSIBILITIES

2.4.1 Tucker Stevens and Corey Wilson—Floyd|Snider Field Supervisors

The field supervisors will be responsible for managing day-to-day work activities in the field during the project construction. The field supervisors will report directly to the Floyd|Snider Engineer. Specific responsibilities include the following:

- Overseeing and reviewing field QA/QC
- Ensuring that the Contractor is performing according to the plans and specifications
- Preparing daily reports
- Tracking project activities and schedule
- Tracking quantities of materials used
- Coordinating and managing work activity
- Managing the disposal of any investigation-derived waste (IDW)

2.4.2 Floyd|Snider Field Sampling Lead

The field sampling lead will be responsible for leading and coordinating sampling activities in the field. The field sampling lead will report directly to the Floyd|Snider Engineer and field supervisor. Specific responsibilities include the following:

- Coordinating with the Engineer and field supervisor
- Managing collection of all field samples
- Reviewing field data
- Coordinating with the laboratory

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3.0 Data Quality Objectives

The SAP/QAPP included in Appendix B of the RI/FS Work Plan (Floyd|Snider 2010) established detailed QA/QC criteria to meet the DQOs established for all field and laboratory activities.

The SAP/QAPP specifies QA/QC for sampling, chain-of-custody, laboratory instrument calibration, laboratory analysis, data reporting, internal QC, audits, and preventive maintenance of field/laboratory equipment. Details of the required QA/QC are presented in the SAP/QAPP (Floyd|Snider 2010, Appendix B) and summarized in this section, with the overall DQO for the QA/QC to obtain the type and quantity of data in a manner such that the data are of known, appropriate, and sufficient quality to support the intended use. QA/QC for the field activities and the laboratory analysis includes the following components:

- **Field quality control procedures.** A rinsate blank will be collected from non-dedicated field equipment for each sampling event to ensure that field decontamination procedures are effective. Blind field duplicates will be collected at a frequency of 1 in 20 samples to evaluate the efficiency of field decontamination procedures, variability from sample handling, and site heterogeneity.
- **Laboratory quality assurance criteria.** Analytical data will be evaluated against criteria for the principal data quality indicators (i.e., precision, accuracy, representativeness, completeness, and comparability) as defined in WSDOE and U.S. Environmental Protection Agency (USEPA) guidance (WSDOE 2004; USEPA 2002).
- **Data reduction and laboratory reporting.** The laboratory will be responsible for checks on data reporting, correction of identified errors, and reporting to the Floyd|Snider data manager/QA manager. The laboratory is required to report the project narrative, sample IDs, chain-of-custody records, sample results, and QA/QC summaries. The project narrative will be summarized in the Construction Completion Report, with all laboratory reports included as an appendix.
- **Data validation.** Laboratory reports will be reviewed for adherence to the DQOs. Data validation will be performed by EcoChem. A Level III Data Quality Review (Summary Validation) will be performed on all the analytical data, except dioxins, which will be subjected to a Level IV, Tier III Data Quality Review (Full Validation). Data Validation Reports will be included as an appendix to the Construction Completion Report.
- **Data management.** Field and analytical data will be entered into Floyd|Snider's custom analytical database and provided to the Port. The data will also be uploaded to WSDOE's EIM database and included in the Construction Completion Report. Data will be mapped in ArcGIS.

- **Corrective actions for field sampling and laboratory analysis.** The Floyd|Snider field supervisor will be responsible for correcting field sampling errors and resolving situations in the field that may result in noncompliance with the SAPP/QAPP (and this SAP/QAPP Addendum. The laboratory is required to comply with the requirements of the USEPA analytical methods specified in Tables J.1, J.2, and J.3. The ARI project manager will be responsible for ensuring that appropriate corrective actions are initiated as required for compliance.

Laboratory data QA/QC criteria for the required soil analyses to be performed during the remedial action construction and subsequent groundwater performance and confirmation monitoring are presented in Table J.1. The analytical requirements, methods, preservation, bottle types, and holding times for these analyses are presented in Table J.2. The detection limits and reporting limits for the analytical methods are presented in Table J.3.

4.0 Soil Performance Monitoring Plan

Soil performance monitoring will be conducted at both the LL Apartments Parcel and the LL Parcel, including sidewall sampling of LL Apartments soil excavation areas, and sidewall and base sampling of the LL Parcel soil excavation areas to characterize contaminant concentrations that are left in place after the remedial action construction.

The laboratory analyses to be conducted for the soil performance monitoring are presented in Table J.2. All analytical results will be compared against the LL Apartments Parcel and LL Parcel cleanup levels presented in Table J.4.

4.1 SOIL EXCAVATION SIDEWALL AND BASE PERFORMANCE MONITORING

After the completion of the shallow soil excavation within Excavation Areas 3 and 4 on the LL Apartments Parcel, three samples will be collected from the sidewalls abutting the paved sidewalk along Des Moines Memorial Drive to document any concentrations of dioxins/furans, lead, cPAHs, or PCP remaining in place beneath the right-of-way (Figure J.1). One sidewall sample will be collected from Excavation Area 3, and two sidewall samples will be collected from Excavation Area 4. The samples will be collected approximately midway down the excavation sidewalls.

Within the shallow soil in Excavation Areas 5 and 6 along the western boundary of the LL Parcel abutting the paved sidewalk along Des Moines Memorial Drive, two sidewall samples will be collected, one from each of the excavation areas, to document any concentrations of dioxins/furans or lead remaining in place beneath the right-of-way at concentrations greater than the cleanup levels. Samples will be collected at a depth approximately midway down the excavation sidewalls. In addition, one base sample will be collected from Excavation Area 5 at a depth of 6 feet bgs to document any concentrations of dioxins/furans remaining in place at the conditional POC.

The soil excavation sidewall and base sampling locations are shown in Figure J.1. Samples will be collected according to the procedures presented in Section 6.1.1.

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5.0 Groundwater Performance and Confirmation Monitoring

After the remedial action construction, groundwater performance and confirmation monitoring will be conducted at both the LL Apartments Parcel and the LL Parcel. The monitoring well networks to be sampled include both new and existing monitoring wells: four monitoring wells for the LL Apartments Parcel and eleven monitoring wells for the LL Parcel. The new monitoring wells will be installed and developed in a manner consistent with the protocols outlined in the SAP/QAPP (State of Washington 2015, Appendix B). During installation, well construction details will be recorded on Monitoring Well Installation Log forms (Attachment J.1). Several monitoring well locations that were originally presented in the CMP (Floyd|Snider 2015a) have been relocated, as described in Section 5.7.1 of the EDR.

The laboratory analyses to be conducted for the groundwater performance and confirmation monitoring are presented in Table J.2. All analytical results will be compared against the site-wide cleanup levels presented in Table J.4.

5.1 LORA LAKE APARTMENTS PARCEL PERFORMANCE AND CONFIRMATION MONITORING

Groundwater performance and confirmation monitoring on the LL Apartments Parcel will include the collection of groundwater samples from four monitoring wells (MW-C1/VB1, MW-C2, MW-C3, and MW-10/C4) in the monitoring network, three of which will be installed after the remedial action construction (MW-C1/VB1, MW-C2, and MW-C3). The monitoring well locations are shown in Figure J.2. Groundwater samples will be analyzed for dioxins/furans, arsenic, and PCP, which are the COCs that exceeded their respective cleanup levels during the RI/FS groundwater monitoring. The data collected from this network will be used to assess the effectiveness of the remedial action.

Groundwater will be sampled during four quarterly events per year: two wet season monitoring events and two dry season monitoring events. The first monitoring event, after the remedial action construction, is expected to occur in the winter of 2017–2018, as a wet season event. Groundwater monitoring will continue until four consecutive monitoring events have documented that the COC concentration in groundwater are less than the Site cleanup levels for all groundwater COCs. Once the groundwater cleanup level has been achieved for an individual analyte (dioxins/furans toxicity equivalent [TEQ], arsenic, or PCP) in four consecutive monitoring events, the Port will request WSDOE approval to discontinue monitoring for that analyte.

If the COC concentrations are greater than the applicable cleanup levels for more than 5 years after the remedial action construction, then contingency actions will be evaluated by the Port in coordination with WSDOE. Potential contingency actions are described in the CMP (Floyd|Snider 2015a).

5.2 LORA LAKE PARCEL PERFORMANCE AND CONFIRMATION MONITORING

Performance and confirmation monitoring of the sediment cap remedy on the LL Parcel will be performed to assess whether contamination from the isolated and immobilized Lora Lake sediment is migrating through the sediment cap or laterally away from the constructed wetland within the former lake footprint. Four sediment cap monitoring well points ("monitoring wells") will be installed within the former lake footprint (MW-CP1 to MW-CP4), and three monitoring wells will be installed at locations between the former lake footprint and Miller Creek (MW-CP5 through MW-CP7). The monitoring well network also includes four upgradient background wells (called site vicinity wells): new installed wells MW-C1/VB1 and MW-VB2 and existing wells HCOO-B312 and HCOO-B311 (Figure J.2). Groundwater samples will be analyzed for dioxins/furans and arsenic, the COCs that influenced the determination of the required sediment cap thickness and organic carbon content, to assess the performance of the sediment cap remedy.

Confirmation monitoring data for dioxins/furans and arsenic will be evaluated for statistical difference between them and the set of results from site vicinity background samples collected from the Port-owned property or the public right-of-way during the 5-year periodic review. This statistical comparison method was selected for determining compliance because groundwater data from wells in the site vicinity show that background dioxins/furans TEQ concentrations in groundwater currently exceed the laboratory practical quantitation limit. Similarly, arsenic is a known regional background contaminant and has been detected in upgradient and cross-gradient groundwater wells. Further details of the statistical comparison of the confirmation monitoring data to the site vicinity background data are provided in the CMP (Floyd|Snider 2015a).

Confirmation monitoring of the sediment cap remedy on the LL Parcel will be conducted annually for the first 5 years after the remedial action construction, and concurrently with the quarterly groundwater monitoring events if possible. The first 5-year periodic review will assess the appropriate monitoring frequency for the next 5 years, and subsequent 5-year periodic reviews will set the frequency for the following 5-year period.

If more than 20 percent of the confirmation groundwater sample results exceed the background concentration or a detected result exceeds 2 times the background concentration, the sediment cap confirmation monitoring data will be considered to exceed the site vicinity background concentration, and contingency actions may be necessary. Additionally, if dioxins/furans TEQ concentrations in the confirmation monitoring groundwater samples exceed the Site groundwater dioxins/furans TEQ cleanup level of 6.7 picograms per liter, contingency actions may be required. The Port, in coordination with and at the direction of WSDOE, will determine what contingency actions may be necessary and appropriate. Potential contingency actions to be considered are described in the CMP (Floyd|Snider 2015a).

6.0 Field Procedures

This section described the specific protocols that will be used to collect the samples for the soil performance monitoring and groundwater confirmation and performance monitoring described in Sections 4.0 and 5.0.

6.1 SOIL SAMPLING PROTOCOLS

Soil sampling will include the collection of excavation sidewall and base performance samples from the LL Apartments Parcel and the LL Parcel excavation areas.

6.1.1 Excavation Sidewall and Base Soil Sampling

The method of sample collection (from the excavator bucket or as hand grabs from within the excavations) will be determined in coordination with the Contractor and will dependent on safe conditions for entry of the excavation by field sampling personnel. Soil excavation samples will be collected as hand grabs only if the excavations are shallower than 4 feet bgs. Excavations deeper than 4 feet bgs will not be entered by the field sampling personnel because they are considered confined space and require specialized training.

Before sample collection, the LL Apartments Parcel and LL Parcel excavation depths below ground surface will be verified by the field sampling lead. For the LL Apartments Parcel and LL Parcel sidewalls abutting Des Moines Memorial Drive (Excavation Areas 3, 4, 5, and 6), samples will be collected in five locations. Samples will be collected approximately midway down the excavation sidewalls after exposing a fresh soil surface if sampling is not performed immediately after excavation. A base sample will be collected from Excavation Area 5 on the LL Parcel, at a depth of 6 feet bgs.

The field sampling lead will maintain a field notebook with any relevant observations including the location and depth of the soil samples. The sidewall and base sampling locations are shown in Figure J.1.

6.2 GROUNDWATER SAMPLING PROTOCOLS

After installation, groundwater wells will first be developed according to the procedures described in the SAP/QAPP (Floyd|Snider 2010, Appendix B), including purging and surging, at least 48 hours before sampling to remove water and fines from the well casing, filter pack, and surrounding formation. Well development will establish a hydraulic connection between the well and the surrounding water table and will be completed by alternating cycles of surging the well with a surge block or submersible pump to draw fine-grained material into the well casing and pumping at a steady rate to remove the fine-grained material.

Groundwater samples will be collected using low-flow techniques. Before groundwater samples are collected, the wells will be purged, and the following water quality parameters will be measured in the purge water using a multi-parameter water quality instrument: temperature, pH, conductivity, oxidation-reduction potential, salinity, and turbidity. The field measurements will be recorded on a groundwater sample collection form (Attachment J.1). If the field measurements are approximately stable (within 10 percent) for three consecutive readings, the groundwater sample will be collected. If dissolved oxygen is less than 5 milligrams per liter (mg/L), three consecutive readings within 1 mg/L will be considered stable. Should the turbidity readings be negative values, the measurement will be recorded as less than 1 (<1). The last set of field parameters measured during purging will represent the field parameters for the groundwater sample.

6.3 SAMPLE NOMENCLATURE, HANDLING, AND ANALYSIS

The sample nomenclature for soil samples will be "field sampling location number—depth interval—month/day/year of collection." The sample nomenclature for groundwater samples will be "well number—month/day/year of collection."

Chain-of-custody procedures will be strictly followed to provide an accurate written record of the possession of each sample from the time it is collected in the field through laboratory analysis. Adequate sample custody will be achieved by means of approved field and analytical documentation. Such documentation includes the chain-of-custody record, which is initially completed by the field sampler and is thereafter signed by those individuals who accept custody of the sample. A sample will be considered to be in custody if any one of the following circumstances applies:

- It is in someone's physical possession.
- It is in someone's view.
- It is locked or secured in a locked container or vehicle or otherwise sealed so that any tampering would be evident.
- It is kept in a secured area, accessible to only authorized personnel.

The laboratory will provide sufficient copies of blank Chain-of-Custody Forms. All sample information (i.e., sample date/time, sample matrix, number of containers, etc.), including all required analyses, will be logged on a Chain-of-Custody Form before formal transfer of sample containers to the analytical laboratory. Any time possession of the samples is transferred, the individuals relinquishing and receiving the samples will sign, date, and note the time of transfer on the Chain-of-Custody Form. This form documents the transfer of custody of samples from the sampler to the laboratory.

The field sampler responsible for transfer/transport of the samples to the laboratory will complete and sign the Chain-of-Custody Form, keeping a copy for future reference. The field sampler will place the original form in a clear zip-lock bag inside the sample cooler with the samples.

6.4 EQUIPMENT DECONTAMINATION

Field sampling equipment, such stainless steel bowls and spoons, will be cleaned between each use, according to the following procedure:

1. Water will be sprayed over equipment to dislodge and remove any particles.
2. Surfaces of equipment that contact sample material will be scrubbed with brushes using an Alconox solution.
3. Scrubbed equipment will be rinsed and scrubbed with clean water.
4. Equipment will undergo a final spray rinse of deionized water.

6.5 SURVEYING

All soil sampling locations and newly constructed monitoring well locations will be surveyed by the Port survey group for reference and mapping purposes. The survey requirements are as follows:

- Survey soil sampling locations to a horizontal and vertical closure of 1:5,000.
- Survey monitoring well locations to a vertical closure of 1:10,000.
- Survey monitoring well casing elevations to an accuracy within 0.01 foot.

Site mapping will be conducted using the Washington State Plane North Coordinate System. Survey data will be included in the Construction Completion Report.

6.6 INVESTIGATION-DERIVED WASTE MANAGEMENT

IDW includes waste soils from soil excavation performance monitoring, purged groundwater from well development and groundwater performance and confirmation monitoring, and sampling equipment decontamination water. All generated IDW be containerized in 55-gallon drums approved by the Washington State Department of Transportation, sealed, and appropriately labeled with content, date, and contact information.

IDW profiling for waste material classification will be coordinated by Floyd|Snider. The drums will be stored temporarily in secured areas on the LL Apartments Parcel and LL Parcel until the IDW is properly characterized for disposal. Disposal of IDW will be coordinated by the Port in accordance with appropriate state and federal regulations and will be transported by a licensed waste hauler to a USEPA-approved disposal facility for treatment or direct land disposal, depending on the laboratory analytical results and the waste characterization.

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7.0 References

Floyd|Snider. 2010. *Lora Lake Apartments Site Remedial Investigation/Feasibility Study Work Plan*. Prepared for Port of Seattle, Seattle, Washington. September.

_____. 2015a. *Lora Lake Apartments Site Compliance Monitoring Plan*. Prepared for Port of Seattle, Seattle, Washington. September.

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State of Washington. 2015. *Consent Decree No. 15-2-21413-6*. Lora Lake Apartments Site, Burien, Washington. Washington State Department of Ecology v. Port of Seattle. 9 September.

U.S. Environmental Protection Agency (USEPA). 2002. *Guidance for Quality Assurance Project Plans*. EPA QA/G-5, EPA/240/R-02/009. USEPA Office Environmental Information. December.

Washington State Department of Ecology (WSDOE). 2004. *Guidelines for Preparing Quality Assurance Project Plans for Environmental Studies.* Publication No. 04-03-030. Revision of Publication No. 01-03-003. July.

_____. 2010. *Natural Background for Dioxins/Furans in WA Soils*. Technical Memorandum No. 8. Prepared by Dave Bradley, Ecology Toxics Cleanup Program. Publication No. 10-09-053. 9 August.

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix J
Sampling and Analysis Plan/
Quality Assurance Project Plan Addendum

Tables

Table J.1
Data Quality Assurance and Quality Control Criteria

Parameter	Units	Precision	Accuracy	Completeness	Reference
Soil Excavation Performance Samples					
Lead	mg/kg	± 20%	80–120%	95%	USEPA Method 6010
cPAHs	µg/kg	± 30%	50–150%	95%	USEPA Method 8270D
Pentachlorophenol	µg/kg	± 30%	50–150%	95%	USEPA Method 8041
Dioxins/Furans	pg/g	± 30%	50–150%	95%	USEPA Method 1613B
Groundwater Performance and Confirmation Samples					
Arsenic	mg/L	± 20%	80–120%	95%	USEPA 200.8
Pentachlorophenol	µg/L	± 30%	50–150%	95%	USEPA Method 8041
Dioxins/Furans	pg/L	± 30%	50–150%	95%	USEPA Method 1613B

Abbreviations:

cPAH Carcinogenic polycyclic aromatic hydrocarbon
µg/kg Micrograms per kilogram
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
mg/L Milligrams per liter
pg/g Picograms per gram
pg/L Picograms per liter
USEPA U.S. Environmental Protection Agency

Table J.2
Analytical Requirements, Methods, Preservation, Bottle Types, and Holding Times

Parameter	Method	Bottle Type	Preservative	Holding Time
Soil Excavation Performance Samples				
Lead	USEPA Method 6010	One 4-oz WMG	None, cool to <6 °C	6 months (or freeze for 1 year)
cPAHs	USEPA Method 8270D	One 8-oz WMG	None, cool to <6 °C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Pentachlorophenol	USEPA Method 8041	One 8-oz WMG (can pull from cPAHs jar)	None, cool to <6 °C	14 days to extract, then 40 days to analyze (or freeze for 1 year)
Dioxins/Furans	USEPA Method 1613B	One 8-oz amber WMG	None, cool to <6 °C	1 year
Groundwater Performance and Confirmation Samples				
Arsenic	USEPA Method 200.8	One 500-mL HDPE	Laboratory filtered and preserved with HNO_3, cool to <6 °C	6 months
Pentachlorophenol	USEPA Method 8041	Two 500-mL amber glass	None, cool to <6 °C	7 days to extract, then 40 days to analyze
Dioxins/Furans	USEPA Method 1613B	Two 1-liter amber glass	None, cool to <6 °C	1 year

Abbreviations:
°C Degrees Celsius
J2cPAH Carcinogenic polycyclic aromatic hydrocarbon
HDPE High-density polyethylene
mL Milliliter
oz Ounces
USEPA U.S. Environmental Protection Agency
WMG Wide-mouth glass jar

Table J.3
Analytical Methods, Detection Limits, and Reporting Limits

Parameter	Analysis Method	Detection Limit	Reporting Limit[1] (PQL or LOQ)
Soil Excavation Performance Samples			
Lead	USEPA Method 6010	0.130 mg/kg	2.0 mg/kg
cPAHs	USEPA Method 8270D	7-14 µg/kg	20 µg/kg
Pentachlorophenol	USEPA Method 8041	2.49 µg/kg	6.25 µg/kg
Dioxins/Furans	USEPA Method 1613B	0.02 to 0.17 pg/g	0.5 to 5.0 pg/g
Groundwater Performance and Confirmation Samples			
Arsenic	USEPA 200.8	0.00003 mg/L	0.0005 mg/L
Pentachlorophenol	USEPA Method 8041	0.08 µg/L	1.0 µg/L
Dioxins/Furans	USEPA Method 1613B	0.003 to .127 µg/L	0.5 to 5 µg/L

Note:

1 All reporting limits shown are method PQLs or LOQs from Analytical Resources, Inc., located in Tukwila, Washington.

Abbreviations:

cPAH Carcinogenic polycyclic aromatic hydrocarbon
LOQ Limit of quantitation
µg/kg Micrograms per kilogram
µg/L Micrograms per liter
mg/kg Milligrams per kilogram
mg/L Milligrams per liter
pg/g Picograms per gram
pg/L Picograms per liter
PQL Practical quantitation limit
USEPA U.S. Environmental Protection Agency

Table J.4
Soil and Groundwater Cleanup Levels

Contaminant of Concern	Cleanup Level Source/Reference[1]	Cleanup Level Value	Unit	Area of Site Where Cleanup Level Applies
Soil Excavation Performance Samples				
Lead	MTCA Method A—unrestricted land use	250	mg/kg	Lora Lake Apartments Parcel
	MTCA ecological indicator soil concentration	50	mg/kg	Lora Lake Parcel
Pentachlorophenol	MTCA Method B—standard, carcinogen	2,500	µg/kg	Lora Lake Apartments Parcel and Lora Lake Parcel
cPAHs TEQ	MTCA Method B—standard, carcinogen	137	µg/kg	Lora Lake Apartments Parcel and Lora Lake Parcel
Dioxins/Furans TEQ	MTCA Method B—standard, carcinogen	13	pg/g	Lora Lake Apartments Parcel
	Natural Background for Dioxins/Furans in WA Soils, Technical Memorandum No. 8 (WSDOE 2010)[2]	5.2	pg/g	Lora Lake Parcel
Groundwater Performance and Confirmation Samples				
Arsenic	MTCA Method A	5	µg/L	Site-wide
Pentachlorophenol	State and federal maximum contaminant level	1	µg/L	Site-wide
Dioxins/Furans TEQ	MTCA Method B—adjusted, carcinogen[3]	6.7	pg/L	Site-wide

Notes:

1 The most stringent applicable cleanup levels for the complete human health pathways are identified for the Lora Lake Apartments Site.

2 As presented in the WSDOE 2010 technical memorandum, the Washington state natural background concentration of 5.2 pg/g TEQ is calculated as the lower of the 90th percentile and 4 × 50 percentile (per WAC 173-340-709). For more details refer to Appendix M of the *Lora Lake Apartments Site Remedial Investigation/Feasibility Study* (Floyd|Snider 2015b).

3 Cleanup level is adjusted MTCA Method B value for protection of human health for consumption of drinking water calculated using adjusted MTCA Method B per MTCA Equation 720-2 (with a risk level of 10^{-5}).

Abbreviations:

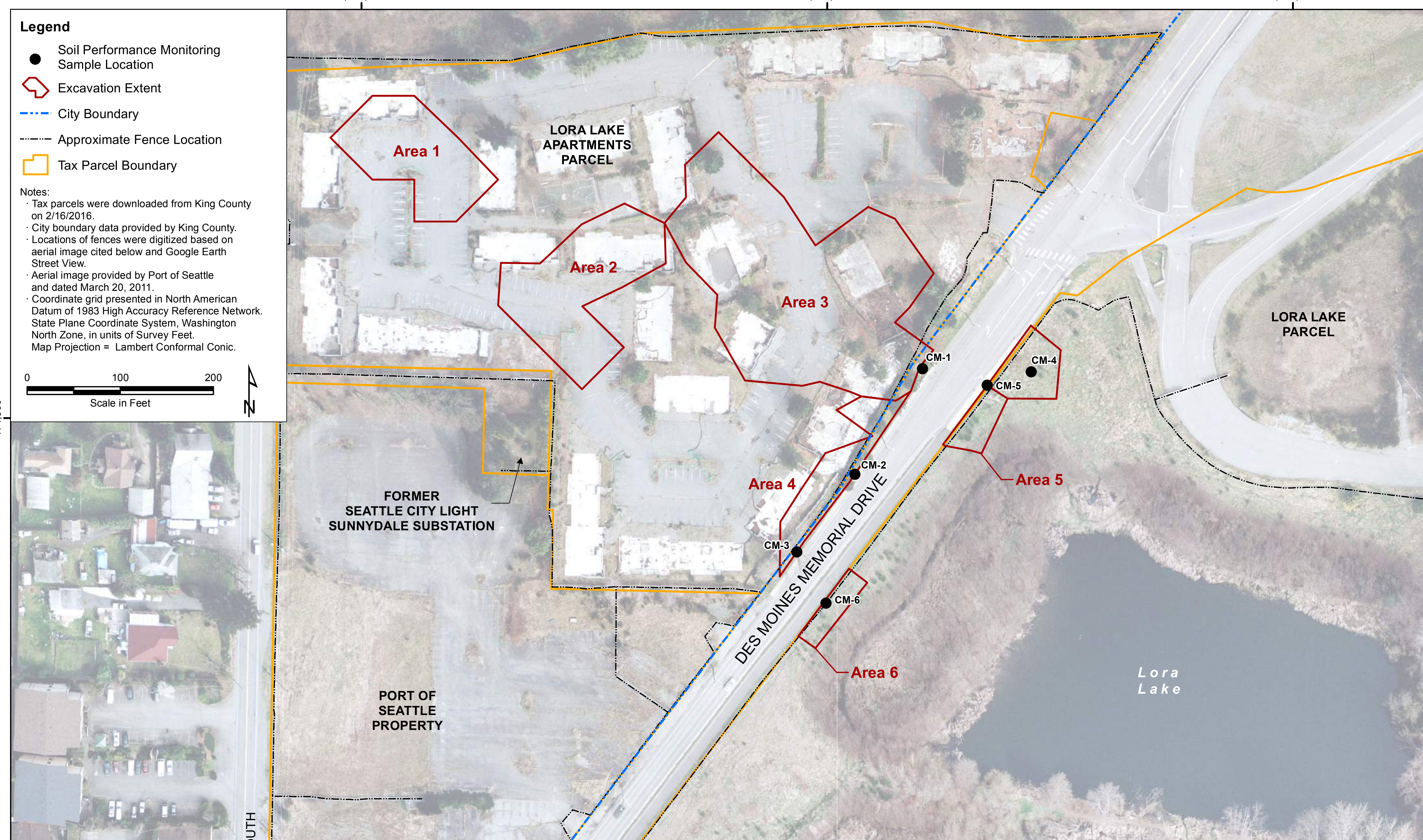
cPAH	Carcinogenic polycyclic aromatic hydrocarbon
µg/kg	Micrograms per kilogram
µg/L	Micrograms per liter
mg/kg	Milligrams per kilogram
MTCA	Model Toxics Control Act
pg/g	Picograms per gram
pg/L	Picograms per liter
TEQ	Toxicity Equivalent
WAC	Washington Administrative Code
WSDOE	Washington State Department of Ecology

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix J
Sampling and Analysis Plan/
Quality Assurance Project Plan Addendum

Figures



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Lora Lake Apartments Site
Burien, Washington

Figure J.1
Soil Performance Monitoring Sampling Locations

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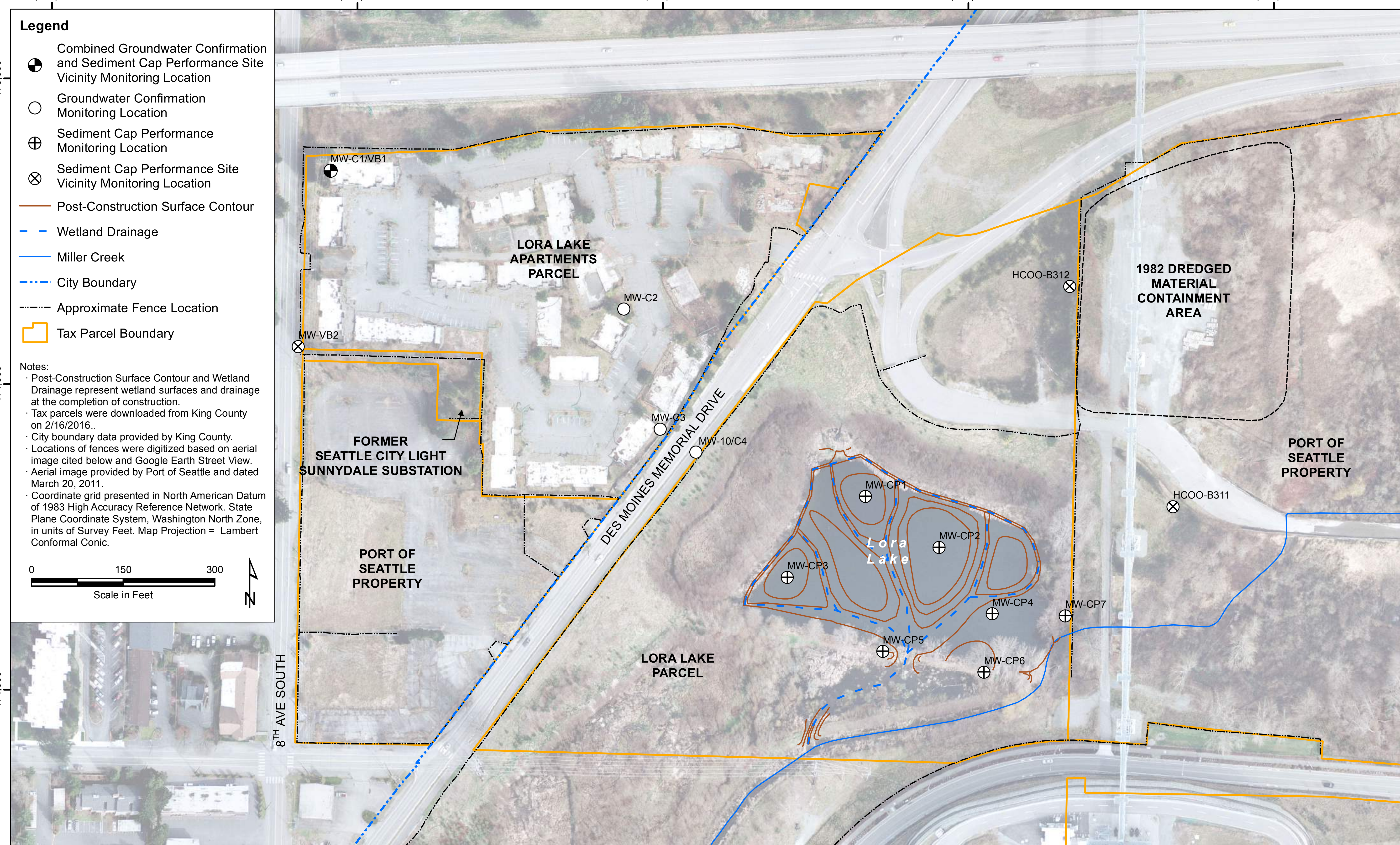
8/30/2016



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Engineering Design Report
Port of Seattle
Lora Lake Apartments Site
Burien, Washington

Figure J.2
Groundwater Monitoring Well Network

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8/30/2016

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix J
Sampling and Analysis Plan/
Quality Assurance Project Plan Addendum

Attachment J.1
Field Sampling Forms

GROUNDWATER OR SURFACE WATER SAMPLE COLLECTION FORM

Project Name:______________________________ Date of Collection: ______________________________

Project Number:______________________________ Field Personnel: ______________________________

Purge Data

Well ID: ______________________ Secure: ☐ Yes ☐ No Well Condition/Damage Description: ______________________________

____

Depth Sounder decontaminated Prior to Placement in Well: ☐ Yes ☐ No One Casing Volume (gal): ______________________

Depth of water (from top of well casing): ______________________ Well Casing Type/Diameter/Screened Interval: ______________________

After 5 minutes of purging (from top of casing): ______________________

Begin purge (time):______________________

End purge (time): ______________________

Gallons purged: ______________________

Purge water disposal method: ______________________

Volume of Schedule 40 PVC Pipe

Diameter	O.D.	I.D.	Volume (Gal/Linear Ft.)	Weight of Water (Lbs/Lineal Ft.)
1	1.660	1.380	0.08	0.64
2	2.375	2.067	0.17	1.45
3	3.500	3.068	0.38	3.2
4	4.500	4.026	0.66	5.51
6	6.625	6.065	1.5	12.5

Time	Depth to Water	Vol. Purged	pH	DO	Conductivity	Turbidity	Temp	ORP	Comments

Sampling Data

Sample No:______________________ Location and Depth: ______________________

Date Collected (mo/dy/yr): ______________ Time Collected: __________ ☐ AM ☐ PM Weather: ______________

Type: ☐ Ground Water ☐ Surface Water Other: ______________ Sample: ☐ Filtered ☐ Unfiltered Other:______________

Sample Collected with: ☐ Bailer ☐ Pump Other: ______________ Type: ______________________

Water Quality Instrument Data Collected with: Type: ☐ Horiba U-22 ☐ Horiba U-50 Other:______________________

Sample Decon Procedure: Sample collected with (circle one): decontaminated <u>all</u> tubing; disposable and/or dedicated silicon and poly tubing Other: __________

Sample Description (Color, Turbidity, Odor, Other): ______________________________

Sample Analyses

TPH-D	(HCl) ☐	Chlor / Fluor	(unpres) ☐	COD / TOC	(H2SO4) ☐	Orthophos	(FILTER) ☐	Diss. Metals	(HNO3) ☐
TPH-G	(HCl) ☐	BTEX	(HCl) ☐	Total Metals	(HNO3) ☐	TKN/Phos	(N2SO4) ☐	VOCs	(HCl) ☐

Additional Information

Types of Sample Containers:	Quantity:	Duplicate Sample Numbers:	Comments:

Signature: ______________________________ **Date:** ______________________

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Boring ID:

Drill Date:
Logged By:
Drilled By:

Coordinate System:	**Drill Type:**	**Client:**
Ground Surface Elevation:	**Sample Method:**	**Project:**
Latitude/Northing:	**Boring Diameter:**	**Task:**
Longitude/Easting:	**Boring Depth (ft bgs):**	**Address:**
Boring Location:	**Groundwater ATD (ft bgs):**	

Remarks:

PID (ppm)	SAMPLE INTERVAL	SAMPLE ID	DRIVEN / RECOVERED	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS (color, texture, moisture, MAJOR CONSITIUENT, odor, staining, sheen, debris, etc.)
				0		
				1		
				2		
				3		
				4		
				5		
				6		
				7		
				8		
				9		
				10		
				11		
				12		
				13		
				14		
				15		
				16		
				17		
				18		
				19		
				20		

Notes:
FT BGS = feet below ground surface
ppm = parts per million
--- Dashed contact line in soil description indicates a gradational contact
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Log of Test Pit

TEST PIT NO. ____________

(Approx. Elev. ____________ ft.)

Project ______________________________ Project No. ____________

Client ______________________________ Observer ____________

Comments/Field Notes: ______________________________

Depth (ft.)	USCS Symbol	Description color, modifier, predominant size class, with modifiers (density/consistencey, moisture) (Geologic Unit)	Sample No./ Depth	Moisture Content,%	Other Tests

- Test Pit completed to ____________ ft. on (date) ______________________
- No ground water seepage encountered

or • (Describe/Quantity) ______________________ ground water seepage encountered at __________ ft.

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			0			
			1			
			2			
			3			
			4			
			5			
			6			
			7			
			8			
			9			
			10			
			11			
			12			
			13			
			14			
			15			
			16			
			17			
			18			
			19			
			20			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
= denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. □ Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			20			
			21			
			22			
			23			
			24			
			25			
			26			
			27			
			28			
			29			
			30			
			31			
			32			
			33			
			34			
			35			
			36			
			37			
			38			
			39			
			40			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. □ Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			40			
			41			
			42			
			43			
			44			
			45			
			46			
			47			
			48			
			49			
			50			
			51			
			52			
			53			
			54			
			55			
			56			
			57			
			58			
			59			
			60			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:
Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Ground Surf Elev. Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			60			
			61			
			62			
			63			
			64			
			65			
			66			
			67			
			68			
			69			
			70			
			71			
			72			
			73			
			74			
			75			
			76			
			77			
			78			
			79			
			80			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:
Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Ground Surf Elev. Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			80			
			81			
			82			
			83			
			84			
			85			
			86			
			87			
			88			
			89			
			90			
			91			
			92			
			93			
			94			
			95			
			96			
			97			
			98			
			99			
			100			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. □ **Datum:**
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			100			
			101			
			102			
			103			
			104			
			105			
			106			
			107			
			108			
			109			
			110			
			111			
			112			
			113			
			114			
			115			
			116			
			117			
			118			
			119			
			120			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

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Monitoring Well ID:

Drill Date:
Logged By:
Drilled By:

Ground Surf Elev. □ Datum:
Coordinate System:
Latitude/Northing:
Longitude/Easting:
Casing Elevation:

Drill Type:
Sample Method:
Boring Diameter:
Boring Depth (ft bgs):
Groundwater ATD (ft bgs):

Client:
Project:
Task Number:
Site Location:

Remarks:

PID/SAMPLE INTERVAL	DRIVE / RECOVERY	BLOW COUNT	DEPTH FT BGS	USCS SYMBOL	SOIL DESCRIPTION AND OBSERVATIONS: (color, texture, moisture, MAJOR CONSTITUENT, odor, staining, sheen, debris, etc.)	MONITORING WELL DETAIL
			120			
			121			
			122			
			123			
			124			
			125			
			126			
			127			
			128			
			129			
			130			
			131			
			132			
			133			
			134			
			135			
			136			
			137			
			138			
			139			
			140			

Notes:
FT BGS = feet below ground surface
ppm = parts per million
USCS = Unified Soil Classification System
▼ = denotes groundwater table

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix K
Rating Form and Documentation for Wetland 8

RATING SUMMARY Western Washington

Name of wetland (or ID #): Wetland 8 Date of site visit: 3/9/2016

Rated by J. Redman Trained by Ecology? ☑ Yes ☐ No Date of training Mar-15

HGM Class used for rating Depressional & Flats Wetland has multiple HGM classes? ☐ Yes ☐ No

NOTE: Form is not complete with out the figures requested (*figures can be combined*).
Source of base aerial photo/map ESRI Online Aerial Basemap

OVERALL WETLAND CATEGORY II (based on functions ☐ or special characteristics ☐)

1. Category of wetland based on FUNCTIONS

____ **Category I** - Total score = 23 - 27
____ **Category II** - Total score = 20 - 22
____ **Category III** - Total score = 16 - 19
____ **Category IV** - Total score = 9 - 15

FUNCTION	Improving Water Quality	Hydrologic	Habitat	
	List appropriate rating (H, M, L)			
Site Potential	M	L	M	
Landscape Potential	H	H	L	
Value	H	H	M	**Total**
Score Based on Ratings	8	7	5	**20**

Score for each function based on three ratings
(*order of ratings is not important*)

9 = H, H, H
8 = H, H, M
7 = H, H, L
7 = H, M, M
6 = H, M, L
6 = M, M, M
5 = H, L, L
5 = M, M, L
4 = M, L, L
3 = L, L, L

2. Category based on SPECIAL CHARACTERISTICS of wetland

CHARACTERISTIC	Category
Estuarine	
Wetland of High Conservation Value	
Bog	
Mature Forest	
Old Growth Forest	
Coastal Lagoon	
Interdunal	
None of the above	☐

Maps and Figures required to answer questions correctly for Western Washington

Depressional Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	D 1.3, H 1.1, H 1.4	Figure 5
Hydroperiods	D 1.4, H 1.2	Figure 6
Location of outlet (*can be added to map of hydroperiods*)	D 1.1, D 4.1	Figure 6
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	D 2.2, D 5.2	Figure 2
Map of the contributing basin	D 4.3, D 5.3	Figure 3
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	Figure 4
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	D 3.1, D 3.2	Figure 1
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	D 3.3	see notes

Riverine Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Ponded depressions	R 1.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	R 2.4	
Plant cover of trees, shrubs, and herbaceous plants	R 1.2, R 4.2	
Width of unit vs. width of stream (*can be added to another figure*)	R 4.1	
Map of the contributing basin	R 2.2, R 2.3, R 5.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	R 3.1	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	R 3.2, R 3.3	

Lake Fringe Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	L 1.1, L 4.1, H 1.1, H 1.4	
Plant cover of trees, shrubs, and herbaceous plants	L 1.2	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	L 2.2	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	L 3.1, L 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	L 3.3	

Slope Wetlands

Map of:	To answer questions:	Figure #
Cowardin plant classes	H 1.1, H 1.4	
Hydroperiods	H 1.2	
Plant cover of **dense** trees, shrubs, and herbaceous plants	S 1.3	
Plant cover of **dense, rigid** trees, shrubs, and herbaceous plants (*can be added to another figure*)	S 4.1	
Boundary of area within 150 ft of the wetland (*can be added to another figure*)	S 2.1, S 5.1	
1 km Polygon: Area that extends 1 km from entire wetland edge - including polygons for accessible habitat and undisturbed habitat	H 2.1, H 2.2, H 2.3	
Screen capture of map of 303(d) listed waters in basin (from Ecology website)	S 3.1, S 3.2	
Screen capture of list of TMDLs for WRIA in which unit is found (from web)	S 3.3	

HGM Classification of Wetland in Western Washington

For questions 1 -7, the criteria described must apply to the entire unit being rated.
If hydrologic criteria listed in each question do not apply to the entire unit being rated, you probably have a unit with multiple HGM classes. In this case, identify which hydrologic criteria in questions 1 - 7 apply, and go to Question 8.

1. Are the water levels in the entire unit usually controlled by tides except during floods?

☑ NO - go to 2 ☐ **YES** - the wetland class is **Tidal Fringe** - go to 1.1

1.1 Is the salinity of the water during periods of annual low flow below 0.5 ppt (parts per thousand)?

☑ **NO - Saltwater Tidal Fringe (Estuarine)** ☐ **YES - Freshwater Tidal Fringe**
If your wetland can be classified as a Freshwater Tidal Fringe use the forms for ***Riverine*** *wetlands. If it is Saltwater Tidal Fringe it is an* ***Estuarine*** *wetland and is not scored. This method* ***cannot*** *be used to score functions for estuarine wetlands.*

2. The entire wetland unit is flat and precipitation is the only source (□90%) of water to it.
Groundwater and surface water runoff are NOT sources of water to the unit.

☑ NO - go to 3 ☐ **YES** - The wetland class is **Flats**
If your wetland can be classified as a Flats wetland, use the form for ***Depressional*** *wetlands.*

3. Does the entire wetland unit **meet all** of the following criteria?
☐ The vegetated part of the wetland is on the shores of a body of permanent open water (without any plants on the surface at any time of the year) at least 20 ac (8 ha) in size;
☐ At least 30% of the open water area is deeper than 6.6 ft (2 m).

☑ NO - go to 4 ☐ **YES** - The wetland class is **Lake Fringe** (Lacustrine Fringe)

4. Does the entire wetland unit **meet all** of the following criteria?
☐ The wetland is on a slope (*slope can be very gradual*),
☐ The water flows through the wetland in one direction (unidirectional) and usually comes from seeps. It may flow subsurface, as sheetflow, or in a swale without distinct banks.
☐ The water leaves the wetland **without being impounded.**

☑ NO - go to 5 ☐ **YES** - The wetland class is **Slope**

NOTE: Surface water does not pond in these type of wetlands except occasionally in very small and shallow depressions or behind hummocks (depressions are usually <3 ft diameter and less than 1 ft deep).

5. Does the entire wetland unit **meet all** of the following criteria?
☑ The unit is in a valley, or stream channel, where it gets inundated by overbank flooding from that stream or river,
☑ The overbank flooding occurs at least once every 2 years.

☐ NO - go to 6 ☑ **YES** - The wetland class is **Riverine**

NOTE: The Riverine unit can contain depressions that are filled with water when the river is not flooding.

6. Is the entire wetland unit in a topographic depression in which water ponds, or is saturated to the surface, at some time during the year? *This means that any outlet, if present, is higher than the interior of the wetland.*

☐ NO - go to 7 ☑ **YES** - The wetland class is **Depressional**

7. Is the entire wetland unit located in a very flat area with no obvious depression and no overbank flooding? The unit does not pond surface water more than a few inches. The unit seems to be maintained by high groundwater in the area. The wetland may be ditched, but has no obvious natural outlet.

☑ NO - go to 8 ☐ **YES** - The wetland class is **Depressional**

8. Your wetland unit seems to be difficult to classify and probably contains several different HGM classes. For example, seeps at the base of a slope may grade into a riverine floodplain, or a small stream within a Depressional wetland has a zone of flooding along its sides. GO BACK AND IDENTIFY WHICH OF THE HYDROLOGIC REGIMES DESCRIBED IN QUESTIONS 1-7 APPLY TO DIFFERENT AREAS IN THE UNIT (make a rough sketch to help you decide). Use the following table to identify the appropriate class to use for the rating system if you have several HGM classes present within the wetland unit being scored.

NOTE: Use this table only if the class that is recommended in the second column represents 10% or more of the total area of the wetland unit being rated. If the area of the HGM class listed in column 2 is less than 10% of the unit; classify the wetland using the class that represents more than 90% of the total area.

HGM classes within the wetland unit being rated	HGM class to use in rating
Slope □ Riverine	Riverine
Slope □ Depressional	Depressional
Slope □ Lake Fringe	Lake Fringe
Depressional □ Riverine along stream within boundary of depression	Depressional
Depressional □ Lake Fringe	Depressional
Riverine □ Lake Fringe	Riverine
Salt Water Tidal Fringe and any other class of freshwater wetland	Treat as ESTUARINE

If you are still unable to determine which of the above criteria apply to your wetland, or if you have ***more than 2 HGM classes*** *within a wetland boundary, classify the wetland as Depressional for the rating.*

NOTES and FIELD OBSERVATIONS:
The wetland, along with several other wetlands in the vicinity, have been identified by the Port of Seattle as being important for flood storage and maintaining water quality.

Wetland name or number Wetland 8

DEPRESSIONAL AND FLATS WETLANDS

Water Quality Functions - Indicators that the site functions to improve water quality

D 1.0. Does the site have the potential to improve water quality?	
D 1.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression (QUESTION 7 on key) with no surface water leaving it (no outlet). points = 3 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet. points = 2 ☐ Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 1 ☐ Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch. points = 1	2
D 1.2. The soil 2 in below the surface (or duff layer) is true clay or true organic (*use NRCS definitions*). Yes = 4 No = 0	0
D 1.3. Characteristics and distribution of persistent plants (Emergent, Scrub-shrub, and/or Forested Cowardin classes): Wetland has persistent, ungrazed, plants □95% of area points = 5 Wetland has persistent, ungrazed, plants □□ of area points = 3 Wetland has persistent, ungrazed plants □ $^1/_{10}$ of area points = 1 Wetland has persistent, ungrazed plants < $^1/_{10}$ of area points = 0	5
D 1.4. Characteristics of seasonal ponding or inundation: *This is the area that is ponded for at least 2 months. See description in manual.* Area seasonally ponded is □□ total area of wetland points = 4 Area seasonally ponded is □□ total area of wetland points = 2 Area seasonally ponded is < □ total area of wetland points = 0	0
Total for D 1 Add the points in the boxes above	**7**

Rating of Site Potential If score is: ☐ **12 - 16 □H** ☑ **6 - 11 □M** ☐ **0 - 5 □L** *Record the rating on the first page*

D 2.0. Does the landscape have the potential to support the water quality function of the site?	
D 2.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	1
D 2.2. Is □10% of the area within 150 ft of the wetland in land uses that generate pollutants? Yes = 1 No = 0	1
D 2.3. Are there septic systems within 250 ft of the wetland? Yes = 1 No = 0	0
D 2.4. Are there other sources of pollutants coming into the wetland that are not listed in questions D 2.1 - D 2.3? Source Exhaust from airplanes Yes = 1 No = 0	1
Total for D 2 Add the points in the boxes above	**3**

Rating of Landscape Potential If score is: ☑ **3 or 4 □H** ☐ **1 or 2 □M** ☐ **0 □L** *Record the rating on the first page*

D 3.0. Is the water quality improvement provided by the site valuable to society?	
D 3.1. Does the wetland discharge directly (i.e., within 1 mi) to a stream, river, lake, or marine water that is on the 303(d) list? Yes = 1 No = 0	1
D 3.2. Is the wetland in a basin or sub-basin where an aquatic resource is on the 303(d) list? Yes = 1 No = 0	1
D 3.3. Has the site been identified in a watershed or local plan as important for maintaining water quality (*answer YES if there is a TMDL for the basin in which the unit is found*)? Yes = 2 No = 0	2
Total for D 3 Add the points in the boxes above	**4**

Rating of Value If score is: ☑ **2 - 4 □H** ☐ **1 □M** ☐ **0 □L** *Record the rating on the first page*

DEPRESSIONAL AND FLATS WETLANDS

Hydrologic Functions - Indicators that the site functions to reduce flooding and stream degradation

D 4.0. Does the site have the potential to reduce flooding and erosion?	
D 4.1. Characteristics of surface water outflows from the wetland: Wetland is a depression or flat depression with no surface water leaving it (no outlet) points = 4 Wetland has an intermittently flowing stream or ditch, OR highly constricted permanently flowing outlet points = 2 Wetland is a flat depression (QUESTION 7 on key), whose outlet is a permanently flowing ditch points = 1 Wetland has an unconstricted, or slightly constricted, surface outlet that is permanently flowing points = 0	2
D 4.2. Depth of storage during wet periods: *Estimate the height of ponding above the bottom of the outlet. For wetlands with no outlet, measure from the surface of permanent water or if dry, the deepest part.* Marks of ponding are 3 ft or more above the surface or bottom of outlet points = 7 Marks of ponding between 2 ft to < 3 ft from surface or bottom of outlet points = 5 ☑ Marks are at least 0.5 ft to < 2 ft from surface or bottom of outlet points = 3 ☐ The wetland is a □headwater□wetland points = 3 Wetland is flat but has small depressions on the surface that trap water points = 1 Marks of ponding less than 0.5 ft (6 in) points = 0	3
D 4.3. Contribution of the wetland to storage in the watershed: *Estimate the ratio of the area of upstream basin contributing surface water to the wetland to the area of the wetland unit itself.* ☐ The area of the basin is less than 10 times the area of the unit points = 5 The area of the basin is 10 to 100 times the area of the unit points = 3 The area of the basin is more than 100 times the area of the unit points = 0 ☐ Entire wetland is in the Flats class points = 5	0
Total for D 4 Add the points in the boxes above	**5**

Rating of Site Potential If score is: ☐**12 - 16 □ H** ☐**6 - 11 □ M** ☑**0 - 5 □ L** *Record the rating on the first page*

D 5.0. Does the landscape have the potential to support hydrologic function of the site?	
D 5.1. Does the wetland unit receive stormwater discharges? Yes = 1 No = 0	1
D 5.2. Is □10% of the area within 150 ft of the wetland in land uses that generate excess runoff? Yes = 1 No = 0	1
D 5.3. Is more than 25% of the contributing basin of the wetland covered with intensive human land uses (residential at □1 residence/ac, urban, commercial, agriculture, etc.)? Yes = 1 No = 0	1
Total for D 5 Add the points in the boxes above	**3**

Rating of Landscape Potential If score is: ☑**3 □ H** ☐**1 or 2 □ M** ☐**0 □ L** *Record the rating on the first page*

D 6.0. Are the hydrologic functions provided by the site valuable to society?	
D 6.1. The unit is in a landscape that has flooding problems. *Choose the description that best matches conditions around the wetland unit being rated. Do not add points. Choose the highest score if more than one condition is met.* The wetland captures surface water that would otherwise flow down-gradient into areas where flooding has damaged human or natural resources (e.g., houses or salmon redds): ● Flooding occurs in a sub-basin that is immediately down-gradient of unit. points = 2 ☐ ● Surface flooding problems are in a sub-basin farther down-gradient. points = 1 ☐ Flooding from groundwater is an issue in the sub-basin. points = 1 ☐ The existing or potential outflow from the wetland is so constrained by human or natural conditions that the water stored by the wetland cannot reach areas that flood. Explain why points = 0 ☐ There are no problems with flooding downstream of the wetland. points = 0	1
D 6.2. Has the site been identified as important for flood storage or flood conveyance in a regional flood control plan? Yes = 2 No = 0	2
Total for D 6 Add the points in the boxes above	**3**

Rating of Value If score is: ☑ **2 - 4 □ H** ☐**1 □ M** ☐ **0 □ L** *Record the rating on the first page*

These □uestions apply to wetlands of all HGM classes.

HABITAT FUNCTIONS - Indicators that site functions to provide important habitat

H 1.0. Does the site have the potential to provide habitat?

H 1.1. Structure of plant community: *Indicators are Cowardin classes and strata within the Forested class.* Check the Cowardin plant classes in the wetland. *Up to 10 patches may be combined for each class to meet the threshold of ¼ ac or more than 10% of the unit if it is smaller than 2.5 ac. Add the number of structures checked.*

☐ Aquatic bed	4 structures or more: points = 4	2
☑ Emergent	3 structures: points = 2	
☑ Scrub-shrub (areas where shrubs have □30% cover)	2 structures: points - 1	
☑ Forested (areas where trees have □30% cover)	1 structure: points = 0	

If the unit has a Forested class, check if:

☐ The Forested class has 3 out of 5 strata (canopy, sub-canopy, shrubs, herbaceous, moss/ground-cover) that each cover 20% within the Forested polygon

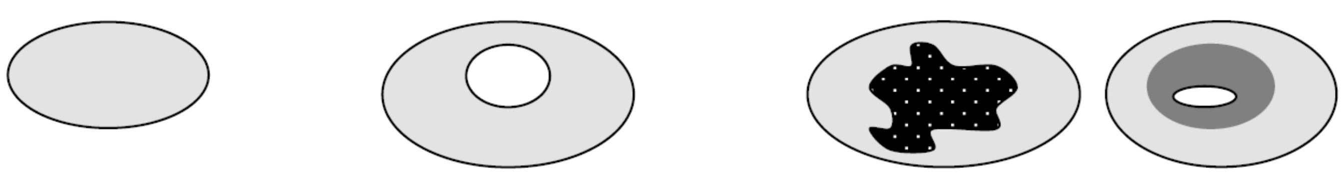
H 1.2. Hydroperiods
Check the types of water regimes (hydroperiods) present within the wetland. The water regime has to cover more than 10% of the wetland or □ ac to count (*see text for descriptions of hydroperiods*).

☐ Permanently flooded or inundated	4 or more types present: points = 3	3
☑ Seasonally flooded or inundated	3 types present: points = 2	
☑ Occasionally flooded or inundated	2 types present: points = 1	
☑ Saturated only	1 types present: points = 0	
☑ Permanently flowing stream or river in, or adjacent to, the wetland		
☐ Seasonally flowing stream in, or adjacent to, the wetland		
☐ **Lake Fringe wetland**	**2 points**	
☐ **Freshwater tidal wetland**	**2 points**	

H 1.3. Richness of plant species
Count the number of plant species in the wetland that cover at least 10 ft^2.
Different patches of the same species can be combined to meet the size threshold and you do not have to name the species. ***Do not include Eurasian milfoil, reed canarygrass, purple loosestrife, Canadian thistle***

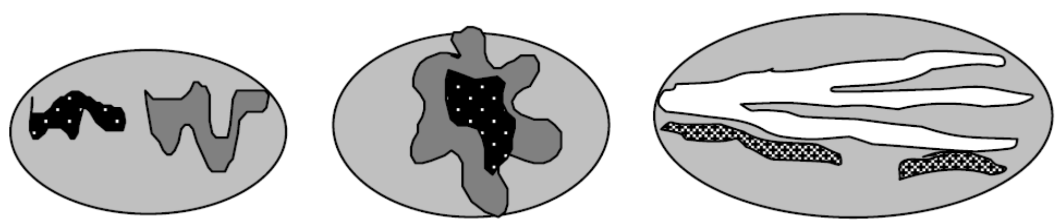
If you counted:	□19 species	points = 2	1
	5 - 19 species	points = 1	
	< 5 species	points = 0	

H 1.4. Interspersion of habitats
Decide from the diagrams below whether interspersion among Cowardin plants classes (described in H 1.1), or the classes and unvegetated areas (can include open water or mudflats) is high, moderate, low, or none. *If you have four or more plant classes or three classes and open water, the rating is always high.*



None = 0 points **Low** = 1 point **Moderate** = 2 points

All three diagrams in this row are **HIGH** = 3 points



3

H 1.5. Special habitat features: Check the habitat features that are present in the wetland. *The number of checks is the number of points.* ☑ Large, downed, woody debris within the wetland (□4 in diameter and 6 ft long) ☐ Standing snags (dbh □4 in) within the wetland ☐ Undercut banks are present for at least 6.6 ft (2 m) **and/or** overhanging plants extends at least 3.3 ft (1 m) over a stream (or ditch) in, or contiguous with the wetland, for at least 33 ft (10 m) ☐ Stable steep banks of fine material that might be used by beaver or muskrat for denning (□30 degree slope) OR signs of recent beaver activity are present (*cut shrubs or trees that have not yet weathered where wood is exposed*) ☐ At least □ ac of thin-stemmed persistent plants or woody branches are present in areas that are permanently or seasonally inundated (*structures for egg-laying by amphibians*) ☐ Invasive plants cover less than 25% of the wetland area in every stratum of plants (*see H 1.1 for list of strata*)	
Total for H 1 — Add the points in the boxes above	**9**

Rating of Site Potential If Score is: ☐**15 - 18 □H** ☑**7 - 14 □M** ☐**0 - 6 □L** *Record the rating on the first page*

H 2.0. Does the landscape have the potential to support the habitat function of the site?	
H 2.1 Accessible habitat (include *only habitat that directly abuts wetland unit*). *Calculate:* 2 % undisturbed habitat □ (0 % moderate & low intensity land uses / 2) = 2% If total accessible habitat is: □ $^1/_3$ (33.3%) of 1 km Polygon — points = 3 20 - 33% of 1 km Polygon — points = 2 10 - 19% of 1 km Polygon — points = 1 < 10 % of 1 km Polygon — points = 0	0
H 2.2. Undisturbed habitat in 1 km Polygon around the wetland. *Calculate:* 17 % undisturbed habitat □ (15 % moderate & low intensity land uses / 2) = 24.5% Undisturbed habitat □50% of Polygon — points = 3 Undisturbed habitat 10 - 50% and in 1-3 patches — points = 2 Undisturbed habitat 10 - 50% and □3 patches — points = 1 Undisturbed habitat < 10% of 1 km Polygon — points = 0	1
H 2.3 Land use intensity in 1 km Polygon: If □50% of 1 km Polygon is high intensity land use — points = (-2) ≤ 50% of 1km Polygon is high intensity — points = 0	-2
Total for H 2 — Add the points in the boxes above	**-1**

Rating of Landscape Potential If Score is: ☐ **4 - 6 □H** ☐ **1 - 3 □M** ☑ **□1 □L** *Record the rating on the first page*

H 3.0. Is the habitat provided by the site valuable to society?	
H 3.1. Does the site provide habitat for species valued in laws, regulations, or policies? *Choose only the highest score that applies to the wetland being rated*. Site meets ANY of the following criteria: — points = 2 ☐ It has 3 or more priority habitats within 100 m (see next page) ☐ It provides habitat for Threatened or Endangered species (any plant or animal on the state or federal lists) ☐ It is mapped as a location for an individual WDFW priority species ☐ It is a Wetland of High Conservation Value as determined by the Department of Natural Resources ☐ It has been categorized as an important habitat site in a local or regional comprehensive plan, in a Shoreline Master Plan, or in a watershed plan Site has 1 or 2 priority habitats (listed on next page) with in 100m — points = 1 Site does not meet any of the criteria above — points = 0	1

Rating of Value If Score is: ☐ **2 □H** ☑ **1 □M** ☐ **0 □L** *Record the rating on the first page*

WDFW Priority Habitats

Priority habitats listed by WDFW (see complete descriptions of WDFW priority habitats, and the counties in which they can be found, in: Washington Department of Fish and Wildlife. 2008. Priority Habitat and Species List. Olympia, Washington. 177 pp.
http://wdfw.wa.gov/publications/00165/wdfw00165.pdf or access the list from here:
http://wdfw.wa.gov/conservation/phs/list/

Count how many of the following priority habitats are within 330 ft (100 m) of the wetland unit: ***NOTE**: This question is independent of the land use between the wetland unit and the priority habitat.*

- ☐ **Aspen Stands**: Pure or mixed stands of aspen greater than 1 ac (0.4 ha).
- ☐ **Biodiversity Areas and Corridors**: Areas of habitat that are relatively important to various species of native fish and wildlife (*full descriptions in WDFW PHS report*).
- ☐ **Herbaceous Balds**: Variable size patches of grass and forbs on shallow soils over bedrock.
- ☐ **Old-growth/Mature forests**: Old-growth west of Cascade crest Stands of at least 2 tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) 32 in (81 cm) dbh or 200 years of age. Mature forests Stands with average diameters exceeding 21 in (53 cm) dbh; crown cover may be less than 100%; decay, decadence, numbers of snags, and quantity of large downed material is generally less than that found in old-growth; 80-200 years old west of the Cascade crest.
- ☐ **Oregon White Oak**: Woodland stands of pure oak or oak/conifer associations where canopy coverage of the oak component is important (*full descriptions in WDFW PHS report p. 158 – see web link above*).
- ☑ **Riparian**: The area adjacent to aquatic systems with flowing water that contains elements of both aquatic and terrestrial ecosystems which mutually influence each other.
- ☐ **Westside Prairies**: Herbaceous, non-forested plant communities that can either take the form of a dry prairie or a wet prairie (*full descriptions in WDFW PHS report p. 161 – see web link above*).
- ☑ **Instream**: The combination of physical, biological, and chemical processes and conditions that interact to provide functional life history requirements for instream fish and wildlife resources.
- ☐ **Nearshore**: Relatively undisturbed nearshore habitats. These include Coastal Nearshore, Open Coast Nearshore, and Puget Sound Nearshore. (*full descriptions of habitats and the definition of relatively undisturbed are in WDFW report – see web link on previous page*).
- ☐ **Caves**: A naturally occurring cavity, recess, void, or system of interconnected passages under the earth in soils, rock, ice, or other geological formations and is large enough to contain a human.
- ☐ **Cliffs**: Greater than 25 ft (7.6 m) high and occurring below 5000 ft elevation.
- ☐ **Talus**: Homogenous areas of rock rubble ranging in average size 0.5 - 6.5 ft (0.15 - 2.0 m), composed of basalt, andesite, and/or sedimentary rock, including riprap slides and mine tailings. May be associated with cliffs.
- ☐ **Snags and Logs**: Trees are considered snags if they are dead or dying and exhibit sufficient decay characteristics to enable cavity excavation/use by wildlife. Priority snags have a diameter at breast height of 20 in (51 cm) in western Washington and are 6.5 ft (2 m) in height. Priority logs are 12 in (30 cm) in diameter at the largest end, and 20 ft (6 m) long.

Note: All vegetated wetlands are by definition a priority habitat but are not included in this list because they are addressed elsewhere.

CATEGORIZATION BASED ON SPECIAL CHARACTERISTICS

Wetland Type *Check off any criteria that apply to the wetland. List the category when the appropriate criteria are met.*	**Category**
SC 1.0. Estuarine Wetlands Does the wetland meet the following criteria for Estuarine wetlands? ☐ The dominant water regime is tidal, ☐ Vegetated, and ☐ With a salinity greater than 0.5 ppt ☐ Yes - Go to **SC 1.1** ☑ No = **Not an estuarine wetland**	
SC 1.1. Is the wetland within a National Wildlife Refuge, National Park, National Estuary Reserve, Natural Area Preserve, State Park or Educational, Environmental, or Scientific Reserve designated under WAC 332-30-151? ☐ Yes = **Category I** ☐ No - Go to **SC 1.2**	
SC 1.2. Is the wetland unit at least 1 ac in size and meets at least two of the following three conditions? ☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing, and has less than 10% cover of non-native plant species. (If non-native species are *Spartina* , see page 25) ☐ At least □ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland. ☐ The wetland has at least two of the following features: tidal channels, depressions with open water, or contiguous freshwater wetlands. ☐ Yes = **Category I** ☐ No = **Category II**	
SC 2.0. Wetlands of High Conservation Value (WHCV) SC 2.1. Has the WA Department of Natural Resources updated their website to include the list of Wetlands of High Conservation Value? ☐ Yes - Go to **SC 2.2** ☑ No - Go to **SC 2.3** SC 2.2. Is the wetland listed on the WDNR database as a Wetland of High Conservation Value? ☐ Yes = **Category I** ☑ No = **Not WHCV** SC 2.3. Is the wetland in a Section/Township/Range that contains a Natural Heritage wetland? http://www1.dnr.wa.gov/nhp/refdesk/datasearch/wnhpwetlands.pdf ☐ Yes - **Contact WNHP/WDNR and to SC 2.4** ☑ No = **Not WHCV** SC 2.4. Has WDNR identified the wetland within the S/T/R as a Wetland of High Conservation Value and listed it on their website? ☐ Yes = **Category I** ☑ No = **Not WHCV**	
SC 3.0. Bogs Does the wetland (or any part of the unit) meet both the criteria for soils and vegetation in bogs? *Use the key below.* ***If you answer YES you will still need to rate the wetland based on its functions*** *.* SC 3.1. Does an area within the wetland unit have organic soil horizons, either peats or mucks, that compose 16 in or more of the first 32 in of the soil profile? ☐ Yes - Go to **SC 3.3** ☑ No - Go to **SC 3.2** SC 3.2. Does an area within the wetland unit have organic soils, either peats or mucks, that are less than 16 in deep over bedrock, or an impermeable hardpan such as clay or volcanic ash, or that are floating on top of a lake or pond? ☐ Yes - Go to **SC 3.3** ☑ No = **Is not a bog** SC 3.3. Does an area with peats or mucks have more than 70% cover of mosses at ground level, AND at least a 30% cover of plant species listed in Table 4? ☐ Yes = **Is a Category I bog** ☐ No - Go to **SC 3.4** **NOTE**: If you are uncertain about the extent of mosses in the understory, you may substitute that criterion by measuring the pH of the water that seeps into a hole dug at least 16 in deep. If the pH is less than 5.0 and the plant species in Table 4 are present, the wetland is a bog. SC 3.4. Is an area with peats or mucks forested (□30% cover) with Sitka spruce, subalpine fir, western red cedar, western hemlock, lodgepole pine, quaking aspen, Engelmann spruce, or western white pine, AND any of the species (or combination of species) listed in Table 4 provide more than 30% of the cover under the canopy? ☐ Yes = **Is a Category I bog** ☐ No = **Is not a bog**	

SC 4.0. Forested Wetlands

Does the wetland have at least 1 contiguous acre of forest that meets one of these criteria for the WA Department of Fish and Wildlife's forests as priority habitats? ***If you answer YES you will still need to rate the wetland based on its functions.***

☐ **Old-growth forests** (west of Cascade crest): Stands of at least two tree species, forming a multi-layered canopy with occasional small openings; with at least 8 trees/ac (20 trees/ha) that are at least 200 years of age OR have a diameter at breast height (dbh) of 32 in (81 cm) or more.

☐ **Mature forests** (west of the Cascade Crest): Stands where the largest trees are 80-200 years old OR the species that make up the canopy have an average diameter (dbh) exceeding 21 in (53 cm).

☐ Yes = **Category I** ☑ No = **Not a forested wetland for this section**

SC 5.0. Wetlands in Coastal Lagoons

Does the wetland meet all of the following criteria of a wetland in a coastal lagoon?

☐ The wetland lies in a depression adjacent to marine waters that is wholly or partially separated from marine waters by sandbanks, gravel banks, shingle, or, less frequently, rocks

☐ The lagoon in which the wetland is located contains ponded water that is saline or brackish (□0.5 ppt) during most of the year in at least a portion of the lagoon (*needs to be measured near the bottom*)

☐ Yes - Go to **SC 5.1** ☑ No = **Not a wetland in a coastal lagoon**

SC 5.1. Does the wetland meet all of the following three conditions?

☐ The wetland is relatively undisturbed (has no diking, ditching, filling, cultivation, grazing), and has less than 20% cover of aggressive, opportunistic plant species (see list of species on p. 100).

☐ At least □ of the landward edge of the wetland has a 100 ft buffer of shrub, forest, or un-grazed or un-mowed grassland.

☐ The wetland is larger than $^{1}/_{10}$ ac (4350 ft^2)

☐ Yes = **Category I** ☐ No = **Category II**

SC 6.0. Interdunal Wetlands

Is the wetland west of the 1889 line (also called the Western Boundary of Upland Ownership or WBUO)? ***If you answer yes you will still need to rate the wetland based on its habitat functions.***

In practical terms that means the following geographic areas:

☐ Long Beach Peninsula: Lands west of SR 103

☐ Grayland-Westport: Lands west of SR 105

☐ Ocean Shores-Copalis: Lands west of SR 115 and SR 109

☐ Yes - Go to **SC 6.1** ☑ No = **Not an interdunal wetland for rating**

SC 6.1. Is the wetland 1 ac or larger and scores an 8 or 9 for the habitat functions on the form (rates H,H,H or H,H,M for the three aspects of function)?

☐ Yes = **Category I** ☐ No - Go to **SC 6.2**

SC 6.2. Is the wetland 1 ac or larger, or is it in a mosaic of wetlands that is 1 ac or larger?

☐ Yes = **Category II** ☐ No - Go to **SC 6.3**

SC 6.3. Is the unit between 0.1 and 1 ac, or is it in a mosaic of wetlands that is between 0.1 and 1 ac?

☐ Yes = **Category III** ☐ No = **Category IV**

Category of wetland based on Special Characteristics

If you answered No for all types, enter "Not Applicable" on Summary Form

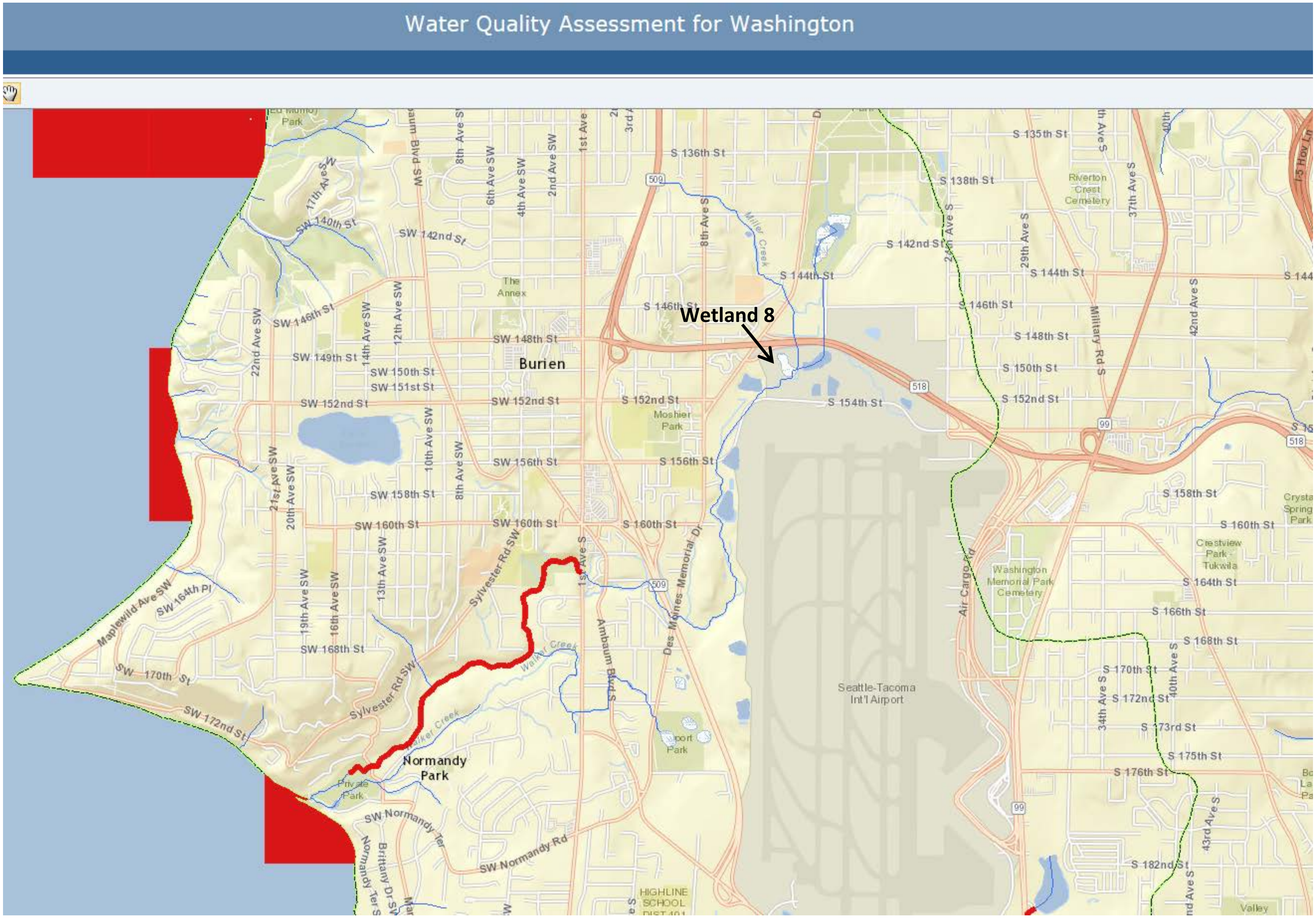
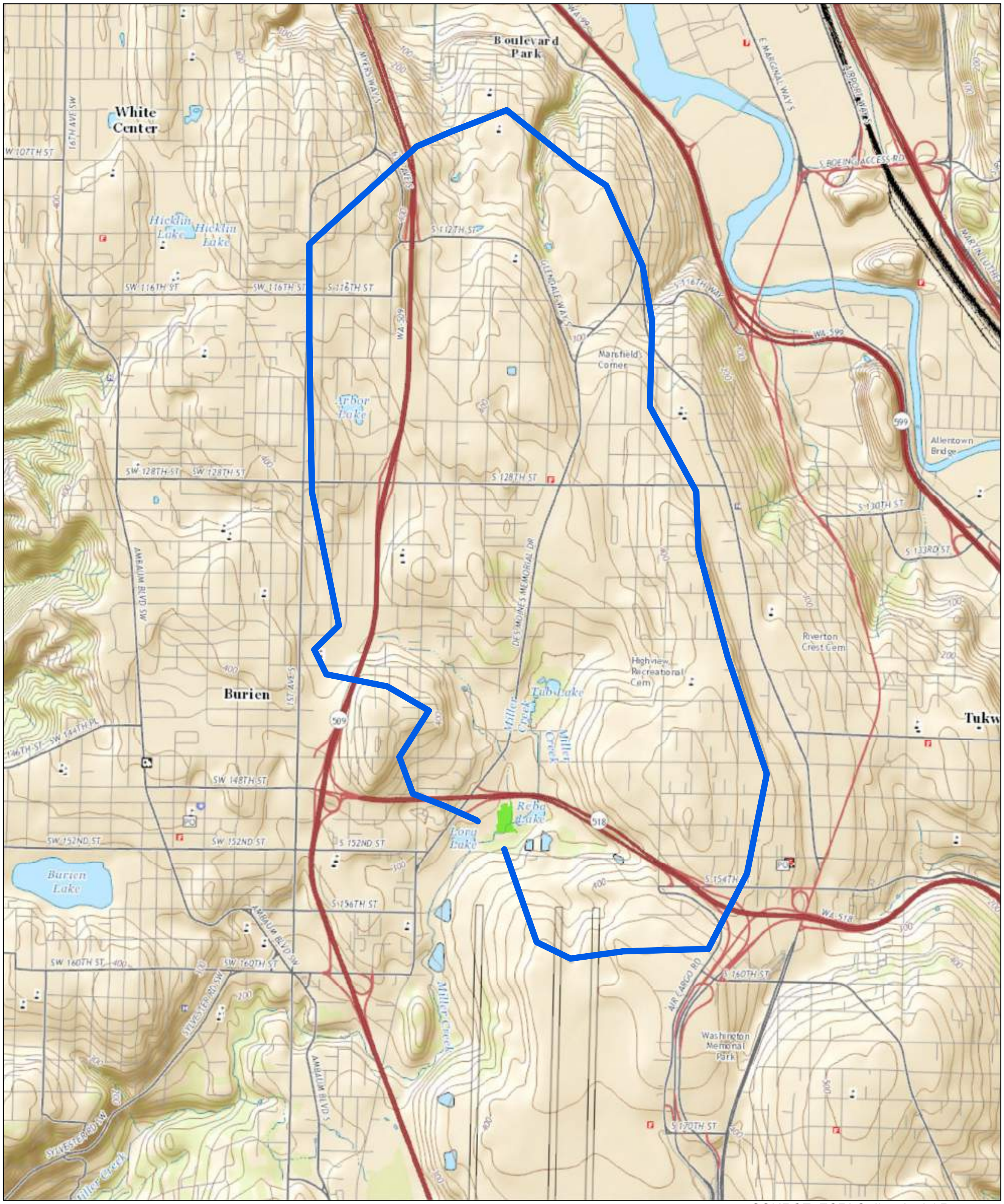


Figure 1: 303(d) listed waters in basin

Figure 2: 150' Buffer

SOURCE: ESRI Online Aerial Basemap



SOURCE: ESRI Online Aerial Basemap

Figure 3: Contributing Basin

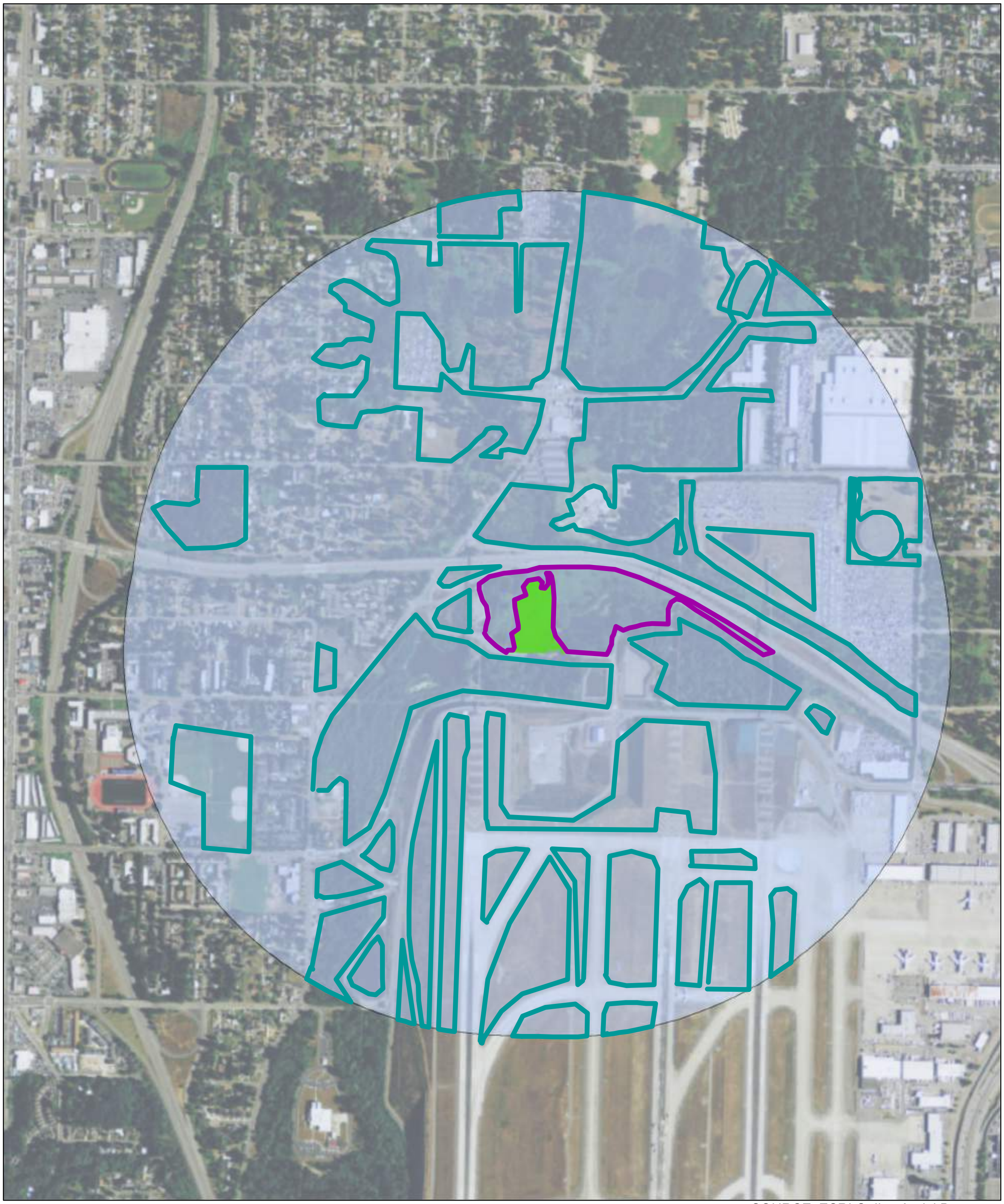
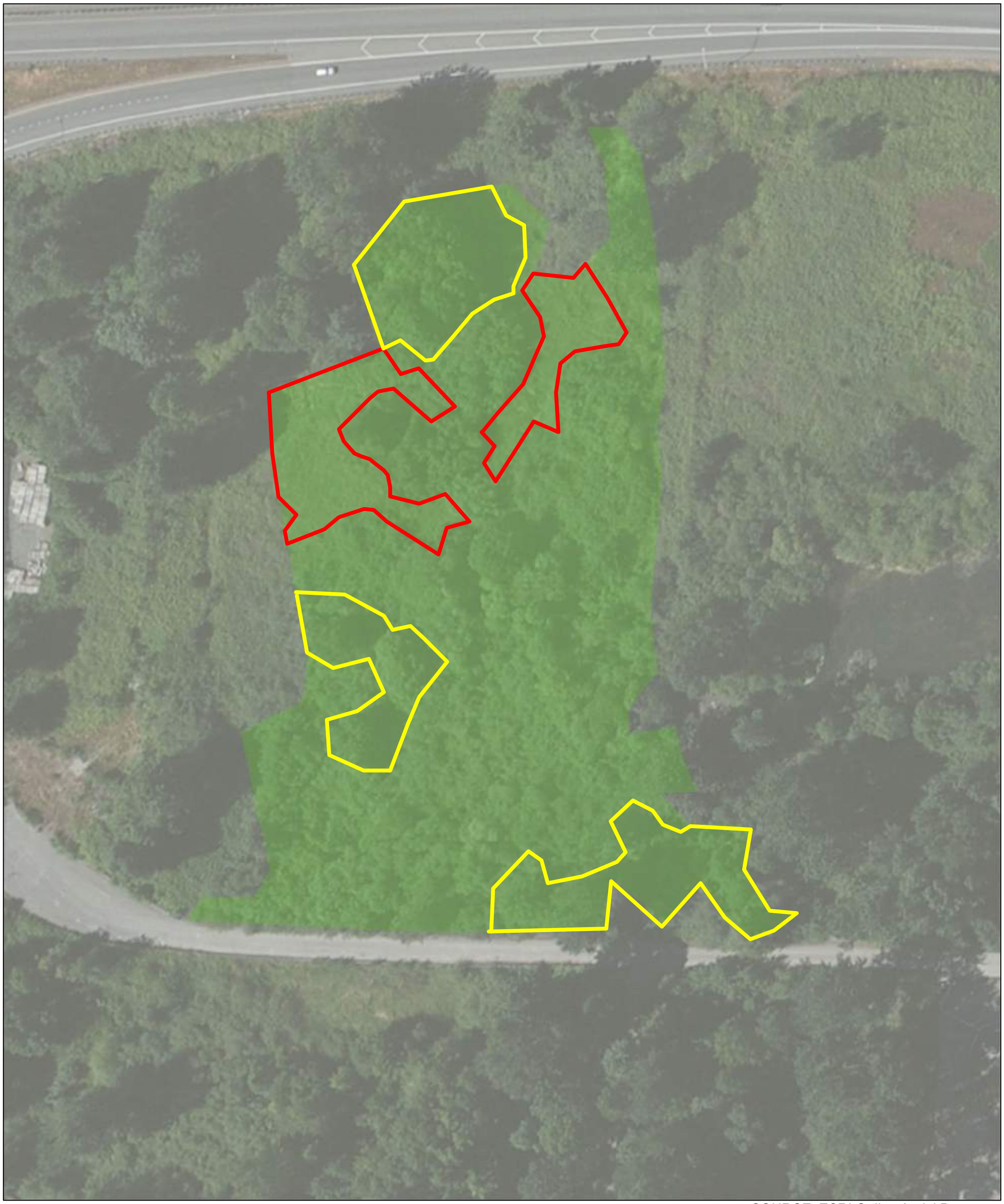
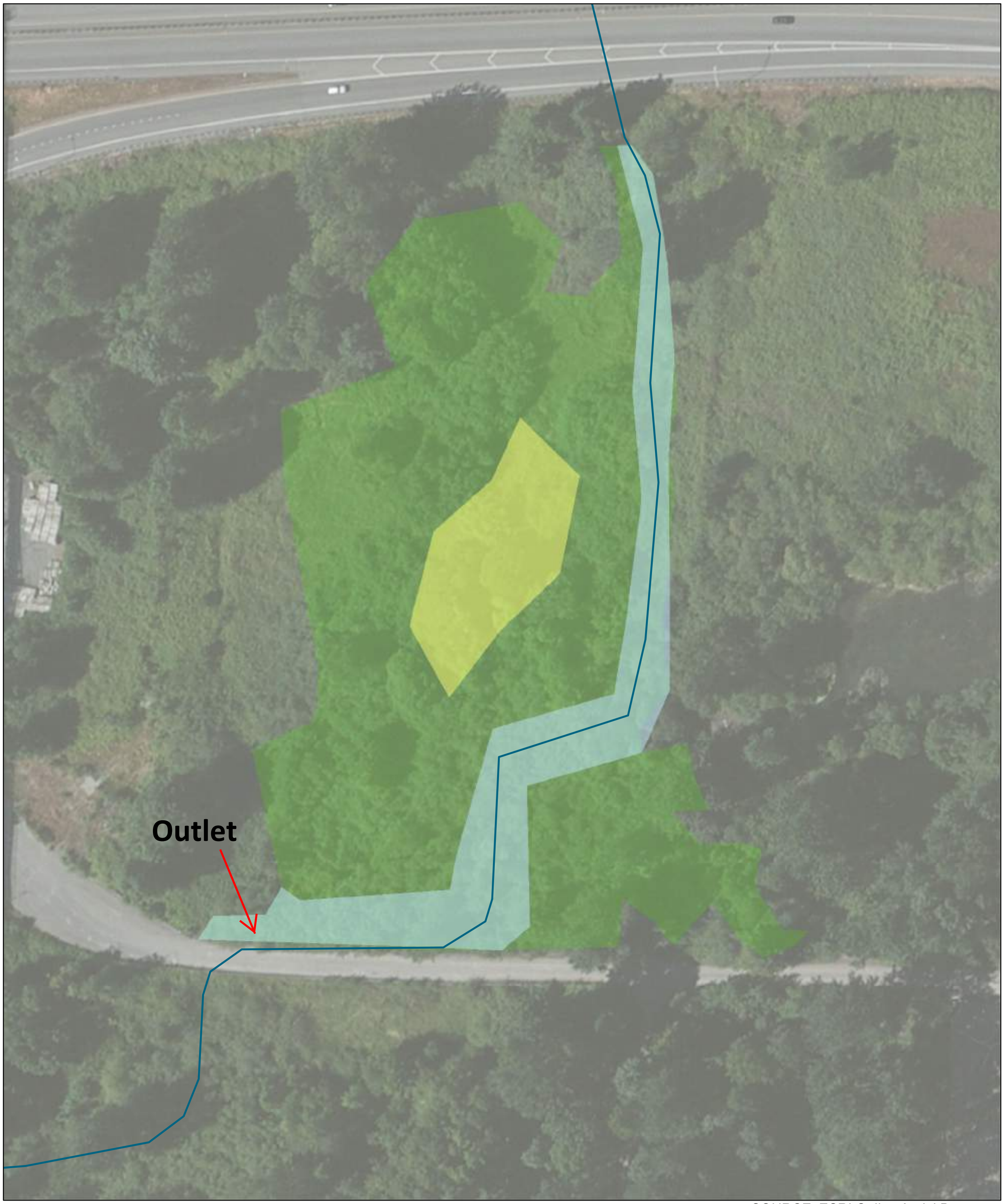


Figure 4: 1 km Buffer. Purple = Accessible Habitat; Blue = Undisturbed Habitat



SOURCE: ESRI Online Aerial Basemap

Figure 5: Cowardin Classes. Yellow = Forested; Red = Emergent; Remainder is scrub-shrub



SOURCE: ESRI Online Aerial Basemap

Figure 6: Hydropoeriods & Outlet

Blue = Seasonally Flooded; Yellow = Occasionally Saturated; Remainder is Saturated

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix L
Health and Safety Plan

Table of Contents

1.0 Plan Objectives and Applicability L-1

2.0 Background L-3

2.1 SITE BACKGROUND L-3

2.2 SCOPE OF WORK L-5

3.0 Emergency Contacts and Information L-7

3.1 DIAL 911 .... L-7

3.2 HOSPITAL AND POISON CONTROL L-7

3.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL L-8

3.4 EMERGENCY CONTACTS L-9

4.0 Primary Responsibilities and Requirements L-11

4.1 PROJECT MANAGERS L-11

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR L-11

4.3 SITE SAFETY OFFICERS L-11

4.4 FLOYD|SNIDER PROJECT PERSONNEL L-12

4.5 TRAINING REQUIREMENTS L-12

5.0 Hazard Evaluation and Risk Analysis L-13

5.1 CHEMICAL EXPOSURE HAZARDS L-13

5.2 FIRE AND EXPLOSION HAZARDS L-15

5.3 PHYSICAL HAZARDS L-16

5.3.1 Cold Stress L-19

5.3.2 Heat Stress L-21

5.3.3 Biohazards L-21

5.3.4 Traffic Hazards L-21

5.4 HAZARD ANALYSIS BY TASK L-22

6.0 Site Monitoring L-23

7.0 Hazard Reduction L-25

7.1 PERSONAL PROTECTIVE EQUIPMENT L-25

8.0 Site Control and Communication L-27

8.1 SITE CONTROL L-27

8.2 COMMUNICATION L-27

9.0 Decontamination and Waste Disposal L-29
9.1 CONTAMINATION PREVENTION L-29
9.2 DECONTAMINATION L-29
9.3 WASTE DISPOSAL L-30
10.0 Emergency Response and Contingency Plan L-31
10.1 MEDICAL EMERGENCIES L-31
10.2 ACCIDENTAL RELEASE OF CONTAMINATED MATERIALS OR WASTES L-32
10.3 GENERAL EMERGENCIES L-32
10.4 EMERGENCY COMMUNICATIONS L-33
10.5 EMERGENCY EQUIPMENT L-33
11.0 Administrative L-35
11.1 MEDICAL SURVEILLANCE L-35
11.2 RECORDKEEPING L-35
12.0 Approvals L-37
13.0 Signature Page L-39
14.0 References L-41

Figures

Figure L.1 Hospital Directions L-7
Figure L.2 Lora Lake Apartments Site Location L-8

List of Attachments

Attachment L.1 Daily Tailgate Safety Meeting and Debrief Form

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
CAA	Controlled Activity Area
CAP	Cleanup Action Plan
COC	Contaminant of concern
DMCA	1982 Dredged Material Containment Area
EZ/CRZ	Exclusion zone/contamination reduction zone
HASP	Health and Safety Plan
HSO/SS	Health and Safety Officer/Site Supervisor
LL Apartments	Lora Lake Apartments Parcel
LL Parcel	Lora Lake Parcel
Mueller	The Mueller Group
PID	Photoionization detector
PM	Project Manager
Port	Port of Seattle
PPE	Personal protective equipment
ppm	Parts per million
RI/FS	Remedial Investigation/Feasibility Study
RPZ	Runway Protection Zone
Site	Lora Lake Apartments Site
SR	State Route
SSO	Site Safety Officer
STIA	Seattle-Tacoma International Airport
SZ	Support zone
VOC	Volatile organic compound
WAC	Washington Administrative Code
WSDOT	Washington State Department of Transportation
XOFA	Extended Object Free Area

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1.0 Plan Objectives and Applicability

This Health and Safety Plan (HASP) has been written to comply with the standards prescribed by the Occupational Safety and Health Act (OSHA) and the Washington Industrial Safety and Health Act (WISHA).

The purpose of this HASP is to establish protection standards and mandatory safe practices and procedures for all personnel involved with cleanup activities and construction at the Lora Lake Apartments Site (Site), which is divided into three parcels: the Lora Lake Apartments Parcel (LL Apartments Parcel), the Lora Lake Parcel (LL Parcel), and the 1982 Dredged Material Containment Area (DMCA).

This HASP assigns responsibilities, establishes standard operating procedures, and provides for contingencies that may be implemented during field work activities. This plan consists of site descriptions, a summary of work activities, the identification and evaluation of chemical and physical hazards, monitoring procedures, personnel responsibilities, a description of site zones, decontamination and disposal practices, emergency procedures, and administrative requirements.

The provisions and procedures outlined in this HASP apply to all Floyd|Snider personnel on-site. Contractors, subcontractors, other oversight personnel, and all other persons involved in the field work activities described herein are required to develop and comply with their own HASP. All Floyd|Snider staff conducting field activities are required to read this HASP and indicate that they understand its contents by signing the Health and Safety Officer/Site Supervisor's (HSO/SS's) copy of this plan.

It should be noted that this HASP is based on information that was available as of the date indicated on the title page. It is possible that additional hazards that are not specifically addressed by this HASP may exist at the work site or may be created as a result of on-site activities. It is the firm belief of Floyd|Snider that active participation in health and safety procedures and acute awareness of on-site conditions by all workers is crucial to the health and safety of everyone involved. Should project personnel identify a site condition that is not addressed by this HASP and have any questions or concerns about site conditions, they should immediately notify the HSO/SS, and an addendum to this HASP will be provided.

The HSO/SS has field responsibility for ensuring that the provisions outlined herein adequately protect worker health and safety and that the procedures outlined in this HASP are properly implemented. In this capacity, the HSO/SS will conduct regular site inspections to ensure that this HASP remains current in terms of its application to potentially changing site conditions. The HSO/SS has the authority to make health and safety decisions that may not be specifically outlined in this HASP, should site conditions warrant such actions. In the event that the HSO/SS leaves the Site while work is in progress, an alternate Site Safety Officer (SSO) will be designated. Personnel responsibilities are further described in Section 4.0.

This HASP was reviewed by the Project Managers (PMs) and the HSO/SS prior to commencement of work activities. All Floyd|Snider personnel shall review the plan and be familiar with on-site health and safety procedures. A copy of the HASP will be on-site at all times.

2.0 Background

2.1 SITE BACKGROUND

The Site is located adjacent to the northwest corner of the Seattle-Tacoma International Airport (STIA) and straddles the boundary between the Cities of Burien and SeaTac, Washington. The Site is currently located on property owned by the Port of Seattle (Port). The LL Apartments Parcel is located within the City of Burien, at 15001 Des Moines Memorial Drive. The LL Parcel located across Des Moines Memorial Drive to the southeast, and the DMCA, located northeast of the LL Parcel, are both within the City of SeaTac.

A portion of the LL Apartments Parcel and all of the LL Parcel and DMCA are within designated safety zones established for operation of the STIA 3rd Runway. Collectively, these zones are called Runway Protection Zones (RPZs). Two subzones cover the Site: the Extended Object Free Area (XOFA) and the Controlled Activity Area (CAA). The XOFA must be kept clear of objects (including structures, equipment, and terrain), with the exception of objects necessary for air navigation or aircraft ground-maneuvering purposes. The CAA is farther from the runway; however, construction of residences and public gathering places, such as shopping centers, offices, or hospitals, is prohibited in the CAA. The Port will own the land within the RPZs in perpetuity.

The LL Apartments Parcel occupies approximately 8.3 acres of currently vacant land that is bounded to the north by State Route 518 (SR 518), to the east and southeast by Des Moines Memorial Drive, to the west by 8th Avenue South, and to the south by an open area that was previously used as a commercial area and the former Seattle City Light Sunnydale Substation, which was purchased by the Port in 2011. The LL Apartments Parcel is currently covered by asphalt parking areas, concrete building foundations, and landscaped areas remaining from the previous Lora Lake Apartments complex.

In 1940, the LL Apartments Parcel served as an orchard, farm, and private residence. The property was first converted to industrial use in the early to mid-1940s, when the Novak family purchased the property and established the Novak Barrel Cleaning Company, which continued operations until the 1960s, when the property became the Burien Auto Wrecking facility. The property was operated as an auto-wrecking facility from the 1960s through the 1980s, and by 1985, the auto-wrecking yard had ceased operations and been vacated, leaving only the few remaining buildings and fences as markers of the past industrial operations. The property was purchased for residential development by The Mueller Group (Mueller) in 1986. Mueller constructed the Lora Lake Apartments in 1987. Contamination present at the LL Apartments Parcel is associated with the historical barrel-washing and auto-wrecking uses.

The LL Parcel is located southeast of the LL Apartments Parcel, on the east side of Des Moines Memorial Drive. The LL Parcel consists of approximately 7.1 acres of land, including the approximately 3-acre Lora Lake and the Miller Creek/Lora Lake/Vacca Farm Wetland and Floodplain Mitigation Area (Port Mitigation Area). Lora Lake ranges in depth from 1 foot at the perimeter to 15 feet at the center of the lake. The LL Parcel is bounded to the north by the SR 518 highway interchange, to the east and south by the Port Mitigation Area and the northern boundary of the STIA air operations area, and to the west and northwest by Des Moines Memorial Drive. Miller Creek runs past the southeast margin of Lora Lake. The LL Parcel and surrounding areas are located within the Miller Creek Watershed, which eventually drains to Puget Sound. The LL Parcel is located within a secured fence associated with STIA.

Lora Lake was created in the 1940s and 1950s when this area was mined for peat. After mining operations were discontinued, single-family residences were built around the west and north sides of the lake. These residences remained through the late 1990s, when the Port acquired the LL Parcel as part of its plan for constructing the STIA 3rd Runway Project. The residences were demolished by the Port prior to construction of the Port Mitigation Area. The multiple phases of site investigation identified contamination at the LL Parcel and the DMCA that is similar to the contamination identified at the LL Apartments Parcel.

The DMCA is located adjacent to the LL Parcel, to the northeast, on Port property. The DMCA is located within a secured fence associated with STIA that is monitored and access-controlled by Port security. Entry by the public is prohibited.

In 1982, King County agreed to dredge approximately 4 feet of sediment from the bottom of Lora Lake in response to complaints from residents around the lake regarding excessive siltation caused by stormwater discharge into the lake. At this time, King County was the owner of this stormwater system. King County arranged with the Port to place the dredged material in a specifically constructed facility on Port-owned property northeast of Lora Lake. The historical project plans for the dredging work indicate that a total of 16,000 cubic yards of material would be dredged, then placed and dewatered inside an approximately 120,000-square-foot area surrounded by a constructed soil berm. The dredging project was implemented in 1982. The dredged spoil containment area is now referred to as the DMCA.

The DMCA covers an area of approximately 2.75 acres, as determined by a review of aerial photographs. The eastern half of the DMCA is an approximately 1.5-acre vegetated area covered by a few trees and a mix of grasses and invasive and pioneering plant species, including Scotch broom, alder saplings, Himalayan blackberry, and butterfly bush. The remaining approximately 1.25 acres is the location of the approach lighting system for the STIA 3rd Runway, which was constructed in 2006. This area has been regraded and covered with gravel and is kept vegetation-free by the Port. The DMCA is located outside the Port Mitigation Area. It is subject to the Port's Wildlife Hazard Management Plan.

The Lora Lake Apartments Site Remedial Investigation/Feasibility Study (RI/FS) was prepared by Floyd|Snider on behalf of the Port and finalized in 2015 (Floyd|Snider 2015a). The RI/FS determined the contaminants of concern (COCs), cleanup standards, and contaminant distribution in soil, groundwater, and sediment. Subsequently, a Cleanup Action Plan (CAP) was developed for the Site using information presented in the RI/FS (State of Washington 2015). The CAP describes the remedial actions to be conducted at the Site, which generally include excavation and capping of contaminated soil, capping and open-water filling of Lora Lake to address sediment contamination, wetland rehabilitation, and site restoration. The Cleanup Monitoring Plan for the Site describes protection monitoring, performance monitoring, and confirmation monitoring methods to be implemented during the remedial action field activities (Floyd|Snider 2015b).

2.2 SCOPE OF WORK

The full scope of work necessary to complete the remedial action as presented in the CAP is described in detail in the Engineering Design Report. This HASP focuses on remedial action field activities, including construction oversight throughout the Site, collection of confirmation samples from the soil excavation sidewalls, oversight of well installation, oversight of the sediment cap monitoring point installation, and post-construction groundwater monitoring.

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3.0 Emergency Contacts and Information

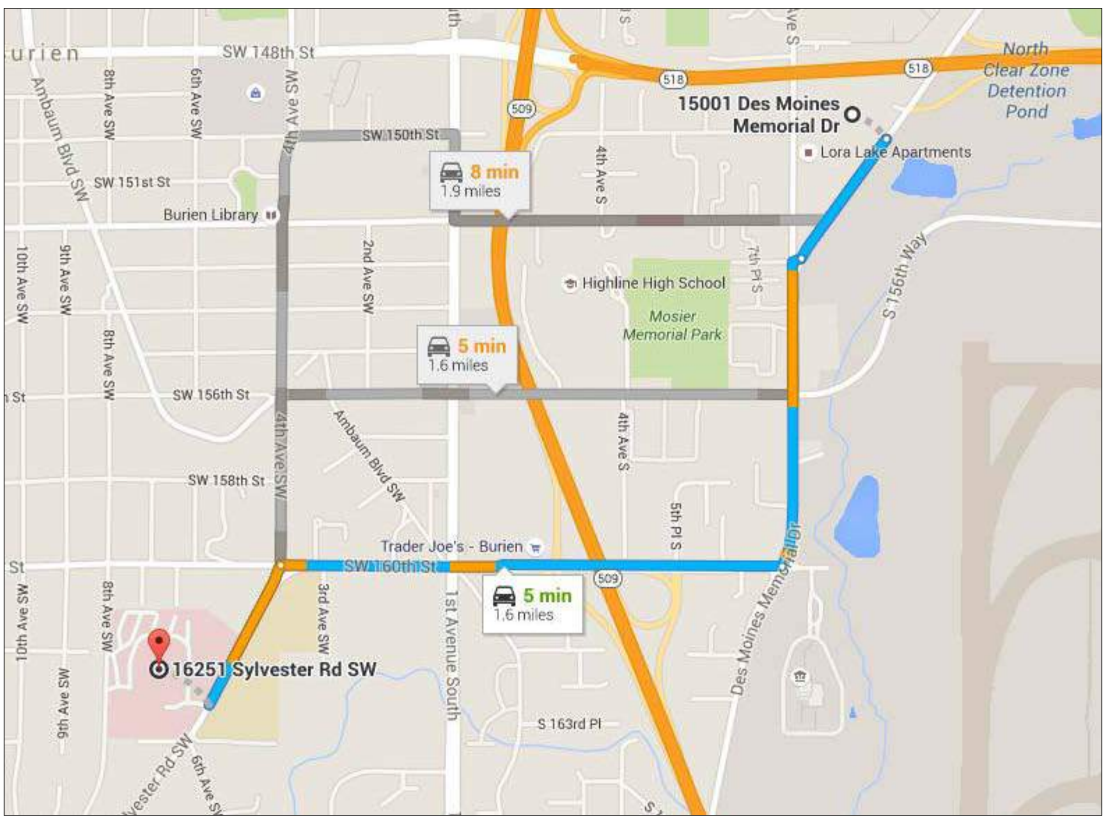
3.1 DIAL 911

In the event of an emergency, dial 911 to reach fire, police, and first aid.

3.2 HOSPITAL AND POISON CONTROL

Nearest Hospital Location and Telephone: Refer to Figure L.1 below for map and directions to the hospital.	Highline Medical Center—Main Campus 16251 Sylvester Road SW Burien, WA 98166 (206) 431-5314
Washington Poison Control Center:	(800) 222-1222

Figure L.1
Hospital Directions



1. Leave Site Heading SOUTH on DES MOINES MEMORIAL DRIVE.
2. Turn RIGHT onto SW 160th STREET; keep left.
3. Turn LEFT onto Sylvester Road SW.
4. Highline Medical Center will be on the right.

3.3 PROVIDE INFORMATION TO EMERGENCY PERSONNEL

All Floyd|Snider project personnel should be prepared to give the following information:

Information to Give to Emergency Personnel	
Site Location: Refer to Figure L.2 below	Lora Lake Apartments Site 15001 Des Moines Memorial Drive Burien, WA (south of SR 518, west of Seattle-Tacoma International Airport) **Site:** The entrance to the Site is located on the west side of Des Moines Memorial Drive for the LL Apartments Parcel and the east side of Des Moines Memorial Drive for the LL Parcel and the DMCA, at the stop light for the freeway entrance to SR 518, immediately south of SR 518, and immediately west of the NW corner of Seattle-Tacoma International Airport.
Number You Are Calling from:	This information can be found on the phone you are calling from.
Type of Accident or Type(s) of Injuries:	Describe accident and/or incident and number of individuals needing assistance.

Figure L.2
Lora Lake Apartments Site Location

3.4 EMERGENCY CONTACTS

After contacting emergency response crews as necessary, contact the Floyd|Snider PM, or a Principal to report the emergency. The Floyd|Snider PM may then contact the site owner, or direct the field staff to do so.

Floyd|Snider Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Megan King, PM	(206) 292-2078	(206) 291-7713
Jessi Massingale, PM		(206) 683-4307
Kate Snider, Principal		(206) 375-0762
Kristin Anderson, HSO/SS		(206) 552-4241
Tucker Stevens, SSO		(406) 579-0451
Corey Wilson, SSO		(508) 264-1516

Port of Seattle Emergency Contacts:

Contact	Office Phone Number	Cell Phone Number
Don Robbins	(206) 787-4918	(206) 369-0808

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4.0 Primary Responsibilities and Requirements

4.1 PROJECT MANAGERS

The PM will have overall responsibility for the completion of the project, including implementation and review of this HASP. The PM will review health and safety issues as needed and as consulted and will have authority to allocate resources and personnel to safely accomplish the field work.

The PM will direct all Floyd|Snider personnel involved in field work at the Site. If the project scope changes, the PM will notify the HSO/SS so that the appropriate addendum will be included in the HASP. The PM will ensure that all Floyd|Snider personnel on-site have received the required training, are familiar with the HASP, and understand the procedures to follow should an accident and/or incident occur on-site.

4.2 HEALTH AND SAFETY OFFICER AND SITE SUPERVISOR

The HSO/SS will approve this HASP and any amendments thereof and will ultimately be responsible for full implementation of all elements of the HASP.

The HSO/SS will advise the PM and project personnel on all potential health and safety issues associated with the field investigation activities to be conducted at the Site. The HSO/SS will specify required exposure monitoring to assess site health and safety conditions, modify this site HASP based on field assessment of health and safety accidents and/or incidents, and recommend corrective action if needed. The HSO/SS will report all accidents and/or incidents to the PM. If the HSO/SS observes unsafe working conditions for Floyd|Snider personnel or any contractor personnel, the HSO/SS will suspend all work until the hazard has been addressed.

4.3 SITE SAFETY OFFICERS

The SSO may be a person dedicated to the task of assisting the HSO/SS during field work activities. The SSO will ensure that all personnel have appropriate personal protective equipment (PPE) on-site and that PPE is properly used. The SSO will assist the HSO/SS in field observation of Floyd|Snider personnel safety. If a health or safety hazard is observed, the SSO shall suspend all work activity until the hazard has been addressed. The SSO will conduct on-site safety meetings daily before work commences and complete the Daily Tailgate Safety Meeting and Debrief Form (provided as Attachment L.1) after the completion of field work at the end of the day. All health and safety equipment will be calibrated daily, and records will be kept in the daily field logbook. The SSO may perform exposure monitoring if needed and will ensure that equipment is properly maintained.

4.4 FLOYD|SNIDER PROJECT PERSONNEL

All Floyd|Snider project personnel involved in field work activities will take precautions to prevent accidents and/or incidents involving themselves and others in the work areas. Personnel will report all accidents and/or incidents or other unsafe working conditions to the HSO/SS or SSO immediately. Personnel will inform the HSO/SS or SSO of any physical conditions that could affect their ability to perform field work.

4.5 TRAINING REQUIREMENTS

All Floyd|Snider project personnel must comply with applicable regulations specified in Washington Administrative Code (WAC), Chapter 296-843, Hazardous Waste Operations, administered by the Washington State Department of Labor and Industries. Project personnel will be 40-hour Hazardous Waste Operations and Emergency Response (HAZWOPER) trained and maintain their training with an annual 8-hour refresher. Personnel with limited tasks and minimal exposure potential will be required to have 24-hour training and a site hazard briefing and be escorted by a trained employee. Personnel with defined tasks that do not include potential contact with disturbed site soils or waste, potential contact with groundwater, or exposures to visible dust (e.g., surveying) are not required to have any level of hazardous waste training beyond a site emergency briefing and hazard orientation by the HSO/SS. Floyd|Snider project personnel will fulfill the medical surveillance program requirements.

At least one person on-site during field work will have current cardiopulmonary resuscitation (CPR)/first aid certification. All field personnel will have a minimum of 3 days of hazardous materials field experience under the direction of a skilled supervisor.

Additional site-specific training that covers on-site hazards; PPE requirements, use, and limitations; decontamination procedures; and emergency response information as outlined in this HASP will be provided by the HSO/SS before on-site work activities begin.

5.0 Hazard Evaluation and Risk Analysis

In general, there are three broad hazard categories that may be encountered during site work: chemical exposure hazards, fire/explosion hazards, and physical hazards. Sections 5.1 through 5.3 discuss the specific hazards that fall within each of these broad categories. Section 5.4 summarizes the hazard analysis for each specific task.

5.1 CHEMICAL EXPOSURE HAZARDS

This section describes potential chemical hazards associated with the field activities being conducted. Based on previous site data, the COCs at the Site are the following:

- Dioxins/furans in soil, groundwater, and sediment
- Carcinogenic polycyclic aromatic hydrocarbons in soil, groundwater, and sediment
- Arsenic in soil, groundwater, and sediment
- Lead in soil and sediment
- Gasoline range, diesel range and heavy oil range hydrocarbons in soil and groundwater
- Toluene and ethylbenzene in soil
- Pentachlorophenol in soil, groundwater, and sediment

Human health hazards associated with these chemicals are presented in the following table. This information covers potential toxic effects that might occur in the event of relatively significant acute and/or chronic exposure. This information does not mean that such effects will occur as a result of the planned site activities. Potential routes of exposure include inhalation, dermal contact, ingestion, and eye contact. The primary exposure route of concern during site work is ingestion of contaminated water, soil, or sediment, though such exposure is considered unlikely and highly preventable. In general, the chemicals that may be encountered at this Site are not expected to be present at concentrations that could result in significant exposures. The types of planned work activities and use of monitoring procedures and protective measures will limit potential exposures at this Site. The use of appropriate PPE and decontamination practices will assist in controlling exposure by means of all pathways to the contaminants listed in the following table.

Chemical Hazard	DOSH-Permissible Exposure Limits (8-hour TWA/STEL)	Highest Historical Concentration[1]	Routes of Exposure	Potential Toxic Effects
Dioxins/Furans	None established	2.34E-7 mg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Eye irritation; allergic dermatitis; chloracne; GI distress; liver, kidney damage; breast and other cancers.
Carcinogenic Polycyclic Aromatic Hydrocarbons	0.2 mg/m^3 / 0.6 mg/m^3 (as coal tar pitch volatiles)	0.243 mg/kg in soil	Inhalation	Dermatitis; bronchitis; lung, skin, and stomach cancer.
Arsenic	0.01 mg/m^3 in air	11.2 mg/kg in soil	Inhalation, skin absorption, ingestion, skin/eye contact	Ulceration of nasal septum; dermatitis; GI disturbance; respiratory irritation; hyperpigmentation of skin; skin and lung cancer.
Lead	0.05 mg/m^3 / action level of 0.03 mg/m^3	370 mg/kg in soil	Inhalation, ingestion, skin/eye contact	Weakness, insomnia, facial pallor, weight loss, constipation, abdominal pain, anemia, tremors, eye irritation, hypotension, central nervous system deficits, reproductive system effects.
Diesel Range and Heavy Oil Range Hydrocarbons	None established	17,000 mg/kg in soil	Inhalation, skin/eye contact	Irritation of eyes, reduction in pulmonary function, and effects to central nervous system.

Chemical Hazard	DOSH-Permissible Exposure Limits (8-hour TWA/STEL)	Highest Historical Concentration[1]	Routes of Exposure	Potential Toxic Effects
Gasoline Range Hydrocarbons	300 ppm/ 500 ppm	1900 mg/L in water	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation of eyes, skin, mucus membranes; headache; fatigue; blurred vision; dizziness; slurred speech; confusion; convulsions; liver, kidney damage.
Pentachlorophenol	0.5 mg/m^3 / 1.5 mg/m^3 (skin)	15 mg/kg (soil)	Inhalation, skin absorption, ingestion, skin/eye contact	Irritation to eyes, nose, throat; sneezing, coughing, weakness; weight loss; sweating; headache; dizziness; nausea; chest pain; fever; dermatitis.
Laboratory Preservatives (hydrochloric acid, methanol, sodium bisulfate, nitric acid)	Not applicable	Not applicable	Dermal contact, eye contact	Irritation to skin or eyes. Avoid contact by proper use of PPE during sample handling and collection.

Note:
1 Historical sediment concentrations are not included because no sediment samples will be collected and sediments are being capped in place.

Abbreviations:
GI Gastrointestinal
mg/kg Milligrams per kilogram
mg/L Milligrams per liter
mg/m^3 Milligrams per cubic meter
ppm Parts per million
STEL Short-term exposure limit
TWA Time-weighted average

5.2 FIRE AND EXPLOSION HAZARDS

Hazards due to flammable and combustible liquids are associated with fuels and lubricants brought to the Site for excavation equipment. When on-site storage of such material is necessary, it will be stored in containers approved by the Washington State Department of Transportation (WSDOT) in a location not exposed to strike hazards and provided with secondary containment.

A minimum 2-A:20-B fire extinguisher will be located within 25 feet of the storage location and where refueling occurs. Any subcontractors bringing flammable and combustible liquid hazards to the Site are responsible for providing appropriate material for containment and spill response and should address these containment and cleanup measures in their respective HASPs. Flammable liquids (e.g., gasoline) will be transferred only after a positive metal-to-metal connection has been made between the containers, which may be achieved by the use of a bonding strap. Ignitable and combustible materials will be stored away from fueling operations.

5.3 PHYSICAL HAZARDS

When working in or around any hazardous or potentially hazardous substances or situations, including an open excavation, in-water work, and vehicle traffic, all site personnel should plan all activities before starting any task. A tailgate safety meeting, in which personnel identify health and safety hazards associated with the planned work and consult with the HSO/SS as to how the task can be performed in the safest manner shall be conducted prior to the start of work.

All field personnel will adhere to general safety rules including wearing appropriate PPE—hard hats, steel-toed boots, high-visibility vests, safety glasses, gloves, hearing protection, and personal flotation devices, as appropriate. Eating, drinking, and/or use of tobacco or cosmetics will be restricted in all work areas. Personnel will prevent splashing of liquids containing chemicals and minimize dust emissions.

The following table summarizes a variety of physical hazards that may be encountered on the Site during work activities. For convenience, these hazards have been categorized into general groupings with recommended preventive measures.

Hazard	Cause	Prevention
Head strike	Falling and/or sharp objects, bumping hazards, construction equipment.	Hard hats will be worn by all personnel at all times when overhead hazards exist, such as during excavation or lake-filling activities.
Falls	Fall into open excavation or other pits on-site.	Excavated areas that are not undergoing active work and are not properly sloped for entry by field personnel will be marked by high-visibility tape or temporary fencing and will be backfilled as soon as practical. All personnel will pay attention to fall hazards when walking through the Site.
Foot/ankle twist, crush, or slip/trip/ fall	Sharp objects, dropped objects, uneven and/or slippery surfaces.	Steel-toed boots must be worn on-site at all times while heavy equipment is present. Pay attention to footing on uneven or wet terrain and do not run. Keep work areas organized and free from unmarked trip hazards. Use caution when entering the excavation area.

Hazard	Cause	Prevention
Hand cuts, splinters, and/or chemical irritation/burns	Hands or fingers pinched or crushed, chemical hazards. Cut or splinters from handling sharp/rough objects and tools.	Nitrile safety gloves will be worn to protect the hands from dust and chemicals. Leather or cotton outer gloves will be used when handling sharp-edged rough materials or equipment. Refer to preventive measures for mechanical hazards below.
Eye damage	Sharp objects, poor lighting, flying debris or splashes.	Safety glasses will be worn at all times on-site. If a pressure washer is used to decontaminate heavy equipment, a face shield will be worn over safety glasses or goggles. Care will be taken during decontamination procedures and groundwater sampling to avoid splashing or dropping equipment into decontamination water.
Electrical hazards	Underground utilities, overhead utilities. Electrical cord hazards, such as well-development pumps.	Utility locator service will be used to locate all underground utilities prior to excavation. Visual inspection of work areas will be conducted prior to starting work. Whenever possible, avoid working under overhead high-voltage lines. Make sure that no damage to extension cords occurs. If an extension cord is used, make sure it is the proper size for the load that is being served and rated SJOW or STOW (an “-A” extension is acceptable for either) and inspected for defects prior to use. The plug connection on each end should be of good integrity. Insulation must be intact and extend to the plugs at either end of the cord. All portable power tools will be inspected for defects before use and must be either a double-insulated design or grounded with a ground-fault circuit interrupter (GFCI).
Mechanical hazards	Heavy equipment such as drill rigs, excavators, service trucks, Putzmeister Telebelt(s)®, cranes, etc. Conducting work in road rights-of-	Ensure the use of competent operators, backup alarms, regular maintenance, daily mechanical checks, and proper guards. Subcontractors will supply their own HASP. All project personnel will make eye contact with the operator and obtain a clear “OK” before approaching or working within the swing radius of heavy equipment, staying clear of the swing radius.

Hazard	Cause	Prevention
	way (on the road shoulder).	
Traffic hazards	Vehicle traffic and hazards when working near active operations.	When working in or near the right-of-way, orange cones and/or flagging will be placed around the work area. Safety vests will be worn at all times while conducting work off-site. Multiple field staff will work together (buddy system) and spot traffic for each other. Avoid working with your back to traffic whenever possible.
Noise/ hearing damage	Loud machinery	Wear earplugs or protective ear covers when a conversational level of speech is difficult to hear at a distance of 3 feet; when in doubt, a sound level meter may be used on-site to document noise exposure.
Strains due to improper lifting	Injury due to improper lifting techniques, over-reaching/ overextending, lifting overly heavy objects.	Use proper lifting techniques and mechanical devices where appropriate. The proper lifting procedure first involves testing the weight of the load by tipping it. If in doubt, ask for help. Do not attempt to lift a heavy load alone. Take a good stance and plant your feet firmly with legs apart, one foot farther back than the other. Turn the forward foot and point it in the direction of the eventual movement. Make sure you stand on a level area with no slick spots or loose gravel. Use as much of your hands as possible, not just your fingers. Keep your back straight, almost vertical. Bend at the hips, holding load close to your body. Keep the weight of your body over your feet for good balance. Use large leg muscles to lift. Push up with one foot positioned in the rear as you start to lift. Avoid quick, jerky movements and twisting motions. Never try to lift more than you are accustomed to lifting.
Cold stress	Cold temperatures and related exposure.	Workers will wear appropriate clothing, stay dry, and take breaks in a heated environment when working in cold temperatures. **Further detail on cold stress is provided in Section 5.3.1.**
Accidents due to inadequate lighting	Improper illumination.	Work will proceed during daylight hours only or under sufficient artificial light.

Hazard	**Cause**	**Prevention**
Drowning	Unsafely entering water during activities associated with Lora Lake.	Personnel will wear personal flotation devices at all times when on sampling boats, rafts, canoes, or row boats in Lora Lake. Field staff will move cautiously on the vessel to avoid falling into the lake, and enter/exit vessels only when they are securely docked onshore.

5.3.1 Cold Stress

Field work is expected to be completed in the summer season; therefore, cold stress is not expected to be an issue. However, exposure to moderate levels of cold can cause the body's internal temperature to decrease to a dangerously low level, resulting in hypothermia. Symptoms of hypothermia include slow, slurred speech; mental confusion; forgetfulness; memory lapses; lack of coordination; and drowsiness.

To prevent hypothermia, site personnel will stay dry and avoid exposure to cold. Site personnel will have access to a warm, dry area, such as a vehicle, to take breaks from the cold weather and warm up. Site personnel will be encouraged to wear sufficient clothing in layers such that outer clothing is wind- and waterproof and inner layers retain warmth (wool or polypropylene), if applicable. Site personnel will keep hands and feet well protected at all times. The signs and symptoms and treatment for hypothermia are summarized in the following text.

Signs and Symptoms

- Mild hypothermia (body temperature of 98–90 °F)
  - Shivering
  - Lack of coordination, stumbling, fumbling hands
  - Slow, slurred speech
  - Memory loss
  - Pale, cold skin
- Moderate hypothermia (body temperature of 90–86 °F)
  - Cessation of shivering
  - Inability to walk or stand
  - Confusion and irrationality
- Severe hypothermia (body temperature of 86–78 °F)
  - Severe muscle stiffness
  - Extreme sleepiness or unconsciousness
  - Ice cold skin
  - Death

Treatment of Hypothermia—Proper Treatment Depends on Severity of Hypothermia

- Mild hypothermia
  - Move to warm area.
  - Stay active.
  - Remove wet clothes and replace with dry clothes or blankets and cover the head.
  - Drink warm (not hot) sugary drinks.
- Moderate hypothermia
  - All of the above, plus:
    - Call 911 for an ambulance.
    - Cover all extremities completely.
    - Place very warm objects such as hot packs or water bottles on the victim's head, neck, chest, and groin.
- Severe hypothermia
  - Call 911 for an ambulance.
  - Treat the victim very gently.
  - Do not attempt to rewarm—the victim should receive treatment in a hospital.

Frostbite

Frostbite occurs when the skin actually freezes and loses water. In severe cases, amputation of the frostbitten area may be required. Although frostbite usually occurs when the temperatures are 30 °F or lower, frostbite can occur in above-freezing temperatures as a result of the wind-chill factor. Frostbite typically affects the extremities, particularly the feet and hands. Frostbite symptoms include a cold, tingling, stinging, or aching feeling in the frostbitten area, followed by numbness and skin discoloration from red to purple, progressing to white or very pale skin. Should any of these symptoms be observed, wrap the area in soft cloth, do not rub the affected area, and seek medical assistance. Call 911 if the condition is severe.

Protective Clothing

Wearing the appropriate clothing is the most important way to avoid cold stress. The type of fabric also makes a difference. Cotton loses its insulation value when it becomes wet. Wool, on the other hand, retains its insulation even when wet. The following are recommendations for working in cold environments:

- Wear *at least three layers* of clothing:
  - An outer layer to break the wind and allow some ventilation (like Gortex or nylon)
  - A middle layer of down or wool to absorb sweat and provide insulation even when wet
  - An inner layer of cotton or synthetic weave to allow ventilation

- Wear a hat—up to 40 percent of body heat can be lost when the head is exposed.
- Wear insulated boots or other footwear.
- Keep a change of dry clothing available in case work clothes become wet.
- Do not wear tight clothing—loose clothing allows better ventilation.

Work Practices

- Drinking—Drink plenty of liquids, avoiding caffeine and alcohol. It is easy to become dehydrated in cold weather.
- Work Schedule—If possible, heavy work should be scheduled during the warmer parts of the day. Take breaks out of the cold in heated vehicles.
- Buddy System—Try to work in pairs to keep an eye on each other and watch for signs of cold stress.

5.3.2 Heat Stress

To avoid heat-related illness, current regulations (WAC 296-62-095 through 296-62-09560) will be followed during all outdoor work activities. These regulations apply to any outdoor work environment from May 1 through September 30, when workers are exposed to temperatures greater than 89 °F when wearing breathable clothing, greater than 77 °F when wearing double-layered woven clothing (such as jackets or coveralls), or greater than 52 °F when wearing non-breathable clothing such as chemical-resistant suits or Tyvek.

5.3.3 Biohazards

Bees and other insects may be encountered during the field work tasks. Persons with allergies to bees will make the HSO/SS aware of their allergies and will avoid areas where bees are identified. Controls such as repellents, hoods, nettings, masks, or other personal protection may be used. Report any insect bites or stings to the HSO/SS and seek first aid, if necessary. Site personnel will maintain a safe distance from any urban wildlife encountered, including stray dogs, raccoons, and rodents, to avoid being bitten by a sick or injured animal. Personnel will wear gloves and use tools to lift covers from catch basins and monitoring wells.

5.3.4 Traffic Hazards

During work nearby or alongside a roadway, the use of signs, signals, and barricades is required. Because signs, signals, and barricades do not always provide appropriate protection, spotters will be used to monitor traffic during work activities along roadways. All workers will wear high-visibility, reflective neon/orange vests. Traffic control plans and permits from the City of SeaTac will be required for any lane closures. WSDOT-required signage, protection devices, and flagging will be used by the Contractor during lane closures.

5.4 HAZARD ANALYSIS BY TASK

This section identifies potential hazards associated with each task listed in Section 2.2 of this HASP. Tasks have been grouped according to the types of potential hazard associated with them.

Task	Potential Hazard
Excavation Oversight	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards; soil vapor and/or dust inhalation hazards; potential dermal or eye exposure to site contaminants in groundwater and soil; fall hazards; traffic hazards; and heat or cold exposure hazards.
Confirmation Soil Sample Collection, Oversight of Well Installation and Sampling, and Sediment Monitoring Point Installation and Sampling	Chemical hazards include potential dermal or eye exposure to site contaminants in soil and groundwater. Physical hazards include slip, trip, or fall hazards; heat and cold exposure hazards; and biological hazards.
Lora Lake Capping and Filling Oversight	Exposure to loud noise; overhead hazards; head, foot, ankle, hand, and eye hazards; electrical and mechanical hazards; lifting hazards, fall hazards, heat or cold exposure hazards, and drowning hazards.

6.0 Site Monitoring

This section describes site monitoring techniques and equipment that are to be used during site field activities. The HSO/SS, or a designated alternate, is responsible for site control and monitoring activities.

Since the Site is currently vacant, and noise-generating activities will be conducted within the site boundary, noise levels are expected to be less than the allowable levels at the site boundaries. All noise-generating activities will be conducted during the allowable noise-generating hours as stated by the City of Burien. Construction Noise Hours for the City of Burien are between 7:00 a.m. and 10:00 p.m., Monday through Friday.

Air monitoring will not be conducted, because previous investigations have adequately characterized the type and concentrations of chemicals present at the Site. Of the site COCs listed in Section 5.1, gasoline and diesel are the only volatile chemicals present. Visual monitoring for dust will be conducted by the HSO/SS to ensure that inhalation of contaminated soil particles does not occur. If visible dust is present in the work area, work will cease, and the area will be cleared until the dust settles. Water may be used to suppress any dust clouds generated during work activities. The concentrations of volatile organic compounds (VOCs) encountered at the Site are orders of magnitude lower than the exposure limits developed by the Occupational Safety and Health Administration. Since the concentrations of VOCs are low, and all work will be conducted outdoors in an open-air ventilated environment, vapor concentrations are not expected to exceed allowable levels. A photoionization detector (PID) will be used to monitor concentrations of total VOCs (in ppm) contained in breathing air. Should the PID read a sustained concentration of total VOCs greater than 500 ppm for 5 minutes, the HSO/SS will stop work and evacuate the area until vapor concentrations return to background concentrations. If necessary, vapor concentrations in the work area will be reduced by covering exposed soil or using fans to dissipate vapors.

The HSO/SS will visually inspect the work site at least daily to identify any new potential hazards. If new potential hazards are identified, immediate measures will be taken to eliminate or reduce the risks associated with these hazards.

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7.0 Hazard Reduction

7.1 PERSONAL PROTECTIVE EQUIPMENT

All work involving heavy equipment will proceed in Level D PPE, which shall include a hard hat, steel-toed boots, hearing protection, eye protection, gloves, and sturdy and removable cotton outer work clothing.

Lora Lake capping and filling oversight will proceed in modified Level D PPE, which shall include rubber boots, eye protection, gloves, water-protective outer work clothing, and a personal flotation device when necessary.

All personnel will be properly fitted and trained in the use of PPE. The level of protection will be upgraded by the HSO/SS whenever warranted by conditions in the work area. The HSO/SS will periodically inspect equipment such as gloves and hard hats for defects.

For all work involving potential exposure to soil, sediment, or groundwater, workers will wear nitrile gloves and Level D PPE.

High-visibility vests will be worn when working around heavy equipment and off-site on road shoulders.

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8.0 Site Control and Communication

8.1 SITE CONTROL

The LL Apartments Parcel is vacant and fenced. The LL Parcel and the DMCA are located within a secured fenced area associated with STIA. Pedestrians and other unauthorized personnel will not be allowed in the work areas. Access to the work site will be restricted to designated personnel. The purpose of site control is to minimize the public's potential exposure to site hazards, to prevent vandalism in the work area and access by transients, children, and other unauthorized persons, and to provide adequate facilities for workers.

Activities conducted off-site in the public roadway shoulders will be controlled through the use of barricades, flagging, or similar measures. If members of the public enter the work area, field staff will stop work until the individuals have left the work area.

Work area controls and decontamination areas will be provided to limit the potential for chemical exposure associated with site activities and the transfer of contaminated media from one area of the Site to another. The support zone (SZ) for the Site includes all areas outside the work area and decontamination areas. An exclusion zone/contamination reduction zone (EZ/CRZ) will be set up for work being conducted within each parcel boundary surrounding each excavation area and lake area. Only authorized personnel shall be permitted access to the EZ/CRZs. Floyd|Snider staff will decontaminate all equipment and gear as necessary prior to exiting the CRZ. Decontamination areas will be constructed with plastic sheeting on the ground to reduce potential transport of contaminated soils from the EZ to the SZ.

8.2 COMMUNICATION

All site work will occur in teams and the primary means of communication on-site and with off-site contacts will be cell phones. An agreed-upon system of alert by means of air horns and/or vehicle horns may be used around heavy equipment to signal an emergency if shouting is ineffective.

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9.0 Decontamination and Waste Disposal

9.1 CONTAMINATION PREVENTION

To avoid personal contact with contaminants, personnel will adhere to the following guidelines:

- Do not walk through areas of known contamination.
- Do not directly handle or touch contaminated materials.
- Make sure all PPE is intact and in good working condition prior to donning.
- Take particular care to protect any skin injuries.
- Stay upwind of airborne contaminants.
- Do not use tobacco products, gum, or similar items in contaminated areas.

To avoid spreading equipment and sample contamination, personnel will do the following:

- Take care to limit contact with heavy equipment and vehicles.
- If contaminated tools are to be placed on uncontaminated equipment/vehicles for transport to a decontamination area, use plastic to keep the uncontaminated equipment clean.
- Place sampling derived waste into clearly labeled receptacles in designated areas.
- Bag sample containers prior to emplacement of sample material.

9.2 DECONTAMINATION

A majority of field and sampling activities are expected to be conducted using Level D PPE. Decontamination procedures for both PPE and field equipment will be strictly followed to prevent off-site spread of contaminated soil or water. The HSO/SS will assess the effectiveness of decontamination procedures by visual inspection. Hands must be thoroughly washed before leaving the Site to eat, drink, or use tobacco.

Equipment and vehicle decontamination generally consists of sweeping (if dry) and/or pressure washing with detergent solution followed by a potable water rinse, requiring construction of a temporary decontamination station. Equipment decontamination will be designed and implemented by the Contractor, and the HSO/SS will monitor equipment decontamination to ensure that contaminated media and/or equipment do not leave the Site. Floyd|Snider staff will perform sampling equipment decontamination consistent with this plan and the contractor’s system set up in place.

9.3 WASTE DISPOSAL

Floyd|Snider and its subcontractors will use safe and prudent waste collection and housekeeping practices to minimize the spread of contamination beyond the work zone and the amount of investigation-derived wastes. The Floyd|Snider HSO/SS will work with site personnel to ensure the proper collection, packaging, and identification of waste materials so that waste materials will be properly disposed of.

Waste soils left over from sample processing and decontamination wastewater will be disposed of in accordance with the established procedures for the removal and hauling of excavated site soil.

10.0 Emergency Response and Contingency Plan

This section defines the emergency action plan for the Site. It will be rehearsed with all Floyd|Snider field personnel and subcontractors directly overseen by Floyd|Snider, and it will be reviewed whenever the plan is modified or the HSO/SS believes that field personnel are unclear about the appropriate emergency actions.

A muster point of refuge (that is clear of adjacent hazards and not located downwind of site investigation activities) will be identified by the HSO/SS and communicated to the field team each day. In an emergency, all field personnel and visitors will evacuate to the muster point for roll call. It is important that all persons on-site understand their role in an emergency and that they remain calm and act efficiently to ensure everyone's safety.

After each emergency is resolved, the entire project team will meet and debrief on the incident—the purpose is not to fix blame but to improve the planning and response to future emergencies. The debriefing will review the sequence of events, what was done well, and what can be improved. The debriefing will be documented in a written format and communicated to the PM. Modifications to the emergency plan will be approved by the PM.

Reasonably foreseeable emergency situations include medical emergencies, accidental release of hazardous materials (such as gasoline or diesel) or hazardous waste, and general emergencies such as a vehicle accident, fire, thunderstorm, and earthquake. Expected actions for each potential incident are outlined in the following subsections.

10.1 MEDICAL EMERGENCIES

This section describes general emergency procedures that are applicable to almost every activity.

In the event of a medical emergency, the following procedures should be used:

- Stop any imminent hazard if you can safely do so.
- Remove ill, injured, or exposed person(s) from immediate danger if moving them will clearly not cause them harm and no hazards exist to the rescuers.
- Evacuate other on-site personnel to a safe place in an upwind or cross-wind direction until it is safe for work to resume.

In the event of a chemical exposure, use the following procedures:

- **Skin Contact.** Flush the area with copious quantities of cold water for at least 15 minutes. Do not let contamination spread to other personnel. Seek medical attention. If injuries are severe, summon an ambulance as described in Section 10.2.
- **Eye Contact.** Wash/rinse affected area for at least 15 minutes. An emergency eye wash system will be present on-site. Seek medical attention.

- **Inhalation.** Remove the person from further exposure. Summon an ambulance and contact the hospital as described in Section 10.2 and be prepared to provide respiratory support if the person has difficulty breathing.
- **Ingestion.** Dilute the material with large quantities of water. Summon an ambulance and contact the hospital or poison control center immediately for further instructions.
- If serious injury or a life-threatening condition exists, call **911** for paramedics, fire department, and police. Clearly describe the location, injury, and conditions to the dispatcher. Designate a person to go to the site entrance and direct emergency equipment to the injured person(s). Provide the responders with a copy of this HASP to alert them to chemicals of potential concern.
- Trained personnel may provide cardiopulmonary resuscitation/first aid if it is necessary and safe to do so. Remove contaminated clothing and PPE only if this can be done without endangering the injured person.
- Call the PM and HSO/SS.
- Immediately implement steps to prevent recurrence of the accident.

Refer to Section 3.2 for a map showing the nearest hospital location (Figure L.1) as well as the hospital phone number and address.

10.2 ACCIDENTAL RELEASE OF CONTAMINATED MATERIALS OR WASTES

1. Evacuate all on-site personnel to a safe place in an upwind direction until the HSO/SS determines that it is safe for work to resume.
2. Instruct a designated person to contact the PM and confirm a response.
3. Contain the spill, if it is possible and can be done safely.
4. If the release is not stopped, contact 911 to alert the fire department.
5. Contact the Washington State Emergency Response Commission at 1-800-258-5990 to report the release.
6. Initiate cleanup.
7. The PM will submit a written report to the Washington State Department of Ecology in the event of a reportable release of hazardous materials or wastes.

10.3 GENERAL EMERGENCIES

In the case of fire, explosion, earthquake, or imminent hazards, work shall be halted and all on-site personnel will be immediately evacuated to a safe place. The local police/fire department shall be notified, by calling 911, if the emergency poses a continuing hazard.

In the event of a thunderstorm, outdoor work will be discontinued until the threat of lightning has abated. During the incipient phase of a fire, the available fire extinguisher(s) may be used by persons trained in putting out fires, if it is safe for them to do so. Contact the fire department as soon as feasible.

10.4 EMERGENCY COMMUNICATIONS

In the case of an emergency, an air horn will be used as needed to signal the emergency. One long (5-second) blast will be sounded as the emergency/stop work signal. If the air horn is not working, a vehicle horn and/or overhead waving of arms will be used to signal the emergency. In any emergency, all personnel will evacuate to the designated refuge area and await further instruction.

10.5 EMERGENCY EQUIPMENT

The following minimum emergency equipment will be readily available on-site and functional at all times:

- First aid kit—contents approved by the HSO/SS, including two blood-borne pathogen barriers and an emergency eye wash station
- Spill kit
- Portable fire extinguisher (2-A:10 B/C min)
- A copy of the current HASP

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11.0 Administrative

11.1 MEDICAL SURVEILLANCE

Floyd|Snider personnel involved with field activities must be covered under Floyd|Snider's medical surveillance program that includes biennial physical examinations. These medical monitoring programs must be in compliance with all applicable worker health and safety regulations.

11.2 RECORDKEEPING

The HSO/SS, or a designated alternate, will be responsible for keeping documentation of site activities including attendance lists of personnel present at site health and safety meetings, accident reports, and signatures of all personnel who have read this HASP.

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12.0 Approvals

Project Manager	Date
Project Manager	Date
Project Health & Safety Officer	Date

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13.0 Signature Page

I have read this Health and Safety Plan and understand its contents. I agree to abide by its provisions and will immediately notify the HSO/SS if site conditions or hazards not specifically designated herein are encountered.

Name (Print)	Signature	Date	Company/Affiliation

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14.0 References

Floyd|Snider. 2015a. *Lora Lake Apartments Site Remedial Investigation/Feasibility Study.* Prepared for the Port of Seattle. 16 January.

_____. 2015b. *Lora Lake Apartments Site Compliance Monitoring Plan.* Prepared for the Port of Seattle. September.

State of Washington. 2015. *Consent Decree No. 15-2-21413-6*. Lora Lake Apartments Site, Burien, Washington. Washington State Department of Ecology v. Port of Seattle. 9 September.

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix L
Health and Safety Plan

Attachment L.1
Daily Tailgate Safety Meeting and Debrief Form

DAILY TAILGATE SAFETY MEETING AND DEBRIEF FORM

Instructions:
To be completed by supervisor prior to beginning of work each day, when changes in work procedures occur, or when additional hazards are present. Please maintain a copy of this form with the site-specific HASP for the record.

PROJECT NAME AND ADDRESS:	**WORK COMPLETED/TOOLS USED:**

TOPICS/HAZARDS DISCUSSED:

Chemicals of concern:
Slip, trip, fall:
Heat or cold stress:
Required PPE:
Other Potential Hazards:
• Environmental:
• Physical:
• Biological:
• Other :

INFORMAL TRAINING CONDUCTED (Name, topics):

NAMES OF EMPLOYEES:

ADDITIONAL HAZARDS IDENTIFIED AT END OF WORK DAY:

Near Misses/Incidents? If so proceed to Page 2 Near Miss and Incident Reporting Form

Supervisor's Signature/Date: ____

NEAR MISS AND INCIDENT REPORTING FORM

INCIDENTS:

INJURIES:

NEAR MISSES:

CORRECTIVE ACTIONS:

Supervisor's Signature/Date: ____

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix M
Inadvertent Discovery Plan

Table of Contents

1.0 Introduction M-1

1.1 CULTURAL RESOURCES BACKGROUND INFORMATION M-1

2.0 Inadvertent Discovery Procedures M-3

2.1 DISCOVERY OF ARCHAEOLOGICAL RESOURCES M-3

2.2 DISCOVERY OF HUMAN SKELETAL REMAINS M-4

2.3 CONFIDENTIALITY M-5

3.0 Project Contacts List M-7

4.0 References M-11

List of Acronyms and Abbreviations

Acronym/ Abbreviation	Definition
DAHP	Washington State Department of Archaeology and Historic Preservation
IDP	Inadvertent Discovery Plan
LAAS	Larson Anthropological Archaeological Services Limited
LL Apartments Parcel	Lora Lake Apartments Parcel
LL Parcel	Lora Lake Parcel
PL	Public Law
Port	Port of Seattle
RCW	Revised Code of Washington
SEPA	State Environmental Policy Act
Site	Lora Lake Apartments Site
STIA	Seattle-Tacoma International Airport
USC	United Stated Code
WSDOE	Washington State Department of Ecology

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1.0 Introduction

Floyd|Snider is assisting the Port of Seattle (Port) with the cleanup of environmental contamination at the Lora Lake Apartments Site (Site) under Consent Decree No. 15-2-21413-6 (State of Washington 2015) with the Washington State Department of Ecology (WSDOE). The Site is located at 15001 Des Moines Memorial Drive in Burien, Washington, near the northwest corner of Seattle-Tacoma International Airport (STIA). The Site consists of three parcels, referred to as the Lora Lake Apartments Parcel (LL Apartments Parcel), the Lora Lake Parcel (LL Parcel), and the 1982 Dredged Material Containment Area (DMCA). Construction activities are planned on all three Site parcels as part of the Site cleanup.

This Inadvertent Discovery Plan (IDP) will be in place during construction at the Site to address any unanticipated archaeological discoveries. This IDP details procedures that must be followed should archaeological resources and/or human skeletal remains be discovered during any ground-disturbing activity. Due to the low probability of encountering archaeological resources at the Site, an archaeological monitor will not be present during construction.

1.1 CULTURAL RESOURCES BACKGROUND INFORMATION

A State Environmental Policy Act (SEPA) checklist was prepared for the Site (included as Appendix A of the Lora Lake Apartments Site Cleanup Action Plan [State of Washington 2015, Exhibit B]). This SEPA checklist addressed potential impacts to cultural resources on the Site and received no comments from WSDOE and/or interested parties and tribes concerning impacts to archaeological or historic resources on or in close proximity to the Site. WSDOE issued a mitigated determination of nonsignificance for the Site (State of Washington 2015).

As summarized in the SEPA checklist for the Site cleanup, there are no places or objects listed on, or proposed for, national, state, or local preservation registers known to be on or adjacent to the Site. A search of the Washington State System for Architectural and Archaeological Records (WISAARD) revealed no archaeological sites or historic (or potentially historic) structures in the vicinity of the Site. The nearest archaeological site is a pre-contact lithic isolate recovered from a disturbed context, located approximately 1,500 feet southwest of the Site. A historic site is located just under a mile north of the Site.

The project area was previously assessed for archaeological resources in 2000 as part of the STIA Master Plan. The review concluded that “Water features in the project area at Miller Creek, Des Moines Creek, Lora Lake, and Lake Reba have a moderate probability for hunter-fisher-gatherer archaeological deposits as these areas would have been utilized for procuring fish and potable water. However, Lora Lake and Lake Reba are not represented on historic maps. If Lora Lake and Lake Reba are not natural water features, they have a low probability for hunter-fisher-gatherer archaeological deposits” (LAAS 2000). The former Vacca Farm, located to the south of Lora Lake, had a higher probability for encountering historic period archaeological resources.

The project area has historically been disturbed by farming, peat mining, industrial activities, and construction of apartments in the northern portion of the project area. Historical documentation has confirmed that Lora Lake was man-made, created by peat mining processes in the mid-1940s and 1950s; therefore, this artificial lake has a low potential for encountering early hunter-fisher-gatherer archaeological resources. Additionally, the remedial activities to be conducted at the LL Parcel, where peat deposits are present at depth, include mainly fill placement activities and excavation activities that are shallow and limited to previous fill materials and surface wetland or berm materials/soils. However, in general, undisturbed peat deposits have a high probability for low-density, early hunter-fisher-gatherer archaeological resources, and paleontological findings.

In June 2001, Larson Anthropological Archaeological Services Limited (LAAS) completed an archaeological resources monitoring plan for excavation associated with the proposed STIA 3rd Runway project. This plan outlined procedures and protocols for construction monitoring and discovery of archaeological resources based on previous work completed by LAAS in 2000 for the STIA Master Plan (LAAS 2001). Subsequent archaeological monitoring during excavation activities occurred in 2004 in the area adjacent to and south of Lora Lake, the former Vacca Farm. LAAS concluded that the peat deposit was larger than anticipated and extended beyond the eastern boundary of the former Vacca Farm. Areas monitored outside of the former Vacca Farm boundary were considered to have a high probability for hunter-fisher-gatherer archaeological resources due to continuation of the peat deposits within the former Vacca Farm boundary. Recent debris and historic period archaeological resources, such as glass bottles, plastic and metal pipes, horseshoes, red terracotta pipe, brick fragments, earthenware sherds, farm equipment, non-human mammal bones, and the like were identified in this area. However, these resources were isolated finds and did not retain integrity of condition or location and were determined to likely not be significant (LAAS 2006).

2.0 Inadvertent Discovery Procedures

The following discoveries would require the Contractor to stop work:

- Discovery of potential or actual archaeological sites, or cultural resources as defined by Revised Code of Washington (RCW) Chapter 27.44 (Indian Graves and Records) and RCW Chapter 27.53 (Archaeological Sites and Resources)
- Discovery of potential historic properties as defined by the National Historic Preservation Act of 1966, Public Law (PL) 89-665, 16 United States Code (USC) Section 470 et seq. (NHPA)
- Discovery of human remains and other cultural items as defined by the Native American Graves Protection and Repatriation Act of 1990, PL 101-601, 25 USC Section 3001 et seq. (NAGPRA)

Upon discovery, the Contractor shall immediately halt ground-disturbing, construction, or other activities around the immediate area of the discovery and secure the area with a perimeter of no less than 30 feet.

An archaeological site is defined as a site greater than 50 years old. Features that one may encounter at an archaeological site include, but are not limited to, the following:

- Concentrations of shells and burned materials, also known as shell middens
- Evidence of fire pits and/or camp fires
- Concentrations of ceramic material
- Bottles and cans
- Stone tools
- Human remains and/or funerary objects

The remainder of this section details the protocol to follow if such archaeological resources and/or human remains are inadvertently discovered.

2.1 DISCOVERY OF ARCHAEOLOGICAL RESOURCES

If Floyd|Snider and/or the Contractor believe that an unanticipated discovery of archaeological resources has occurred during any ground-disturbing activity at the Site, all work at the location of ground disturbance will cease immediately. Upon discovery by the Contractor, Floyd|Snider shall be notified immediately. Floyd|Snider will immediately contact the Port Project Manager and a consulting archaeologist, at the direction of the Port.

The area of work stoppage will be large enough to adequately provide for the security and protection of the discovery. No vehicle, equipment, or foot traffic will be permitted in the vicinity of the discovery, except that which is needed to vacate the immediate vicinity, until a qualified consulting archaeologist has inspected the discovery.

The consulting archaeologist will photograph and describe the discovery and document its location. The discovery will be analyzed to determine whether it is in primary depositional context, is an isolated find, and is—in fact—an archaeological resource. Based on this analysis, the consulting archaeologist will implement one of the following procedures:

- If the discovery is determined to not be an archaeological resource by the consulting archaeologist, project-related ground disturbance may continue in the location of the discovery.
- If the discovery is determined to be in disturbed depositional context (i.e., located within fill or in an area that was previously mixed), and/or an isolated find by the consulting archaeologist, the artifact's location will be recorded. The artifact will then be collected, and ground disturbance may continue at the location of the discovery. Under this inadvertent discovery protocol, an isolated archaeological find is defined as a single artifact in primary depositional context that is not associated with an archaeological feature or located within 6 feet of another artifact or archaeological feature.
- If the discovery is determined to be an archaeological resource, the consulting archaeologist will take the appropriate steps to protect the discovery and immediately contact the Port Project Manager. The Port will then contact the Washington State Department of Archaeology and Historic Preservation (DAHP), as well as the appropriate consulting tribes and other parties, as necessary. Ground-disturbing excavations shall not continue at the location of the discovery until after the appropriate consultation between DAHP and any affected tribes or other parties has occurred and the necessary permissions from the Port are obtained to resume work activities. Ground-disturbing excavations may resume within 20 feet of the discovery, if monitored by an archaeologist.

2.2 DISCOVERY OF HUMAN SKELETAL REMAINS

Any human skeletal remains that are discovered during project-related excavation will be treated with dignity and respect.

Per RCW 27.44.055, "Any person who discovers skeletal human remains must notify the county coroner and local law enforcement in the most expeditious manner possible. Any person knowing of the existence of human remains and not having good reason to believe that the coroner and local law enforcement has notice thereof and who fails to give notice thereof is guilty of a misdemeanor."

In the event that human skeletal remains are discovered, the following procedures are to be followed to ensure compliance with RCW Chapter 68.50 (Human Remains), RCW Chapter 68.60

(Abandoned and Historic Cemeteries and Historic Graves), and RCW Chapter 27.44 (Indian Graves and Records).

If ground-disturbing activities encounter human skeletal remains during construction activities at the Site, then all activity must cease that may cause further disturbance to those remains and the area of the find **must** be secured and protected from further disturbance. Floyd|Snider will notify the Port Project Manager immediately. The Port, and their consulting archaeologist, must report the finding of human skeletal remains to the King County Coroner and the City of Burien Police Department in the most expeditious manner possible. Concurrent with this notification, the Port will also notify WSDOE.

During this time, the remains should not be touched, moved, or further disturbed. The King County Coroner will assume jurisdiction and determine if the remains are forensic or non-forensic/archeological. If remains are not forensic, the Coroner will report that to DAHP, who will then take jurisdiction over the human remains and report the remains to any appropriate cemeteries and to affected tribes. The DAHP State Physical Anthropologist will make a determination of whether the remains are Native American or not and will report that finding to any appropriate cemeteries, to affected tribes, and to other appropriate consulting parties. DAHP will then conduct all consultation with the affected parties as to the future preservation, excavation, and disposition of the remains.

2.3 CONFIDENTIALITY

Archaeological properties are sensitive and archaeological sites are susceptible to vandalism and illegal removal activities. All information regarding the discovery and/or location of the archaeological resource, especially human remains, shall be treated as confidential and is exempt from public disclosure under RCW 42.56.300. Therefore, the Contractor and other construction site personnel shall not photocopy documents and/or photograph culturally sensitive material, release any information to the media or third parties, or share any information with the general public.

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3.0 Project Contacts List

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City of Burien Police Department
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Burien, WA 98166
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King County Medical Examiner

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908 Jefferson Street, 2nd Floor
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4.0 References

Larson Anthropological Archaeological Services Limited (LAAS). 2000. *Port of Seattle, Seattle-Tacoma International Airport Master Plan, Proposed Third Runway, Archaeological Resources and Traditional Cultural Places Assessment, King County, Washington*. Submitted to Port of Seattle. LAAS Technical Report #2000-10. Written by David R. Iversen, Leonard A. Forsman, Dennis E. Lewarch, and Lynn L. Larson. 12 May.

_____. 2001. *Draft Port of Seattle, Seattle-Tacoma International Airport Master Plan, Proposed Third Runway, Archaeological Resources Monitoring Plan, King County, Washington*. Submitted to Port of Seattle. LAAS Report #2001-11. Written by Dennis E. Lewarch, Lynn L. Larson, Leonard A. Forsman, and David R. Iversen. 7 June.

_____. 2006. *Third Runway Seattle-Tacoma International Airport Project Stream Channel Excavation, Over-excavation for the North Subgrade Improvement Area, and Floodplain Restoration and Wetland Mitigation Elements, Vacca Farm Archaeological Resources Monitoring*. Letter report from Jenny L. Dellert and Lynn L. Larson, LAAS, to Robin Kordik, Port of Seattle. 31 January.

State of Washington. 2015. *Consent Decree No. 15-2-21413-6*. Lora Lake Apartments Site, Burien, Washington. Washington State Department of Ecology v. Port of Seattle. 9 September.

Port of Seattle
Lora Lake Apartments Site

Engineering Design Report

Appendix N
Design Drawings

Port of Seattle

SEA-TAC INTERNATIONAL AIRPORT

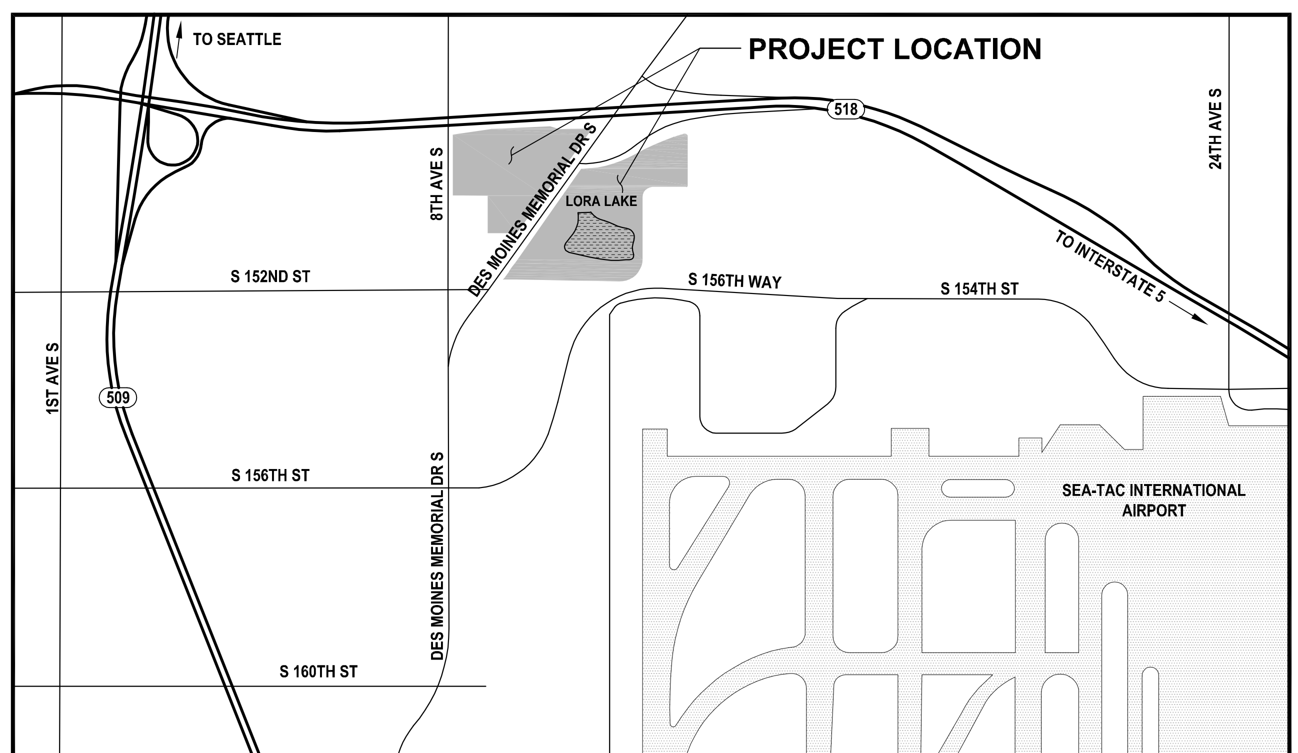
2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS (MC-0318573)

LORA LAKE APARTMENTS SITE REMEDIATION (104395)

LORA LAKE PARCEL SITE REMEDIATION (104396)

100% SUBMITTAL (NOT FOR CONSTRUCTION)

8-29-2016



VICINITY MAP
SCALE: NTS

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JESSI MASSINGALE, PE

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MAJOR CONTRACT

RECOMMENDED FOR APPROVAL

DATE

DATE

DATE

APPROVED BY

DATE

WORK PROJECT NO.	PORT OF SEATTLE NO. + SHEET NUMBER
104395 + 104396	STIA-1701 G00.1

SHEET NO.	SHEET TITLE
G00.1	TITLE SHEET
G01.1	SHEET INDEX
G02.1	SYMBOLS AND ABBREVIATIONS
G03.1	OVERALL SITE PLAN
G03.2	LLA SITE PLAN
G03.3	LL AND DMCA SITE PLAN
G04.1	LLA ACCESS AND HAUL ROUTES
G04.2	SITE TRAFFIC CONTROL PLAN
G04.3	SOUTHBOUND LANE CLOSURE TRAFFIC CONTROL PLAN
G04.4	NORTHBOUND RIGHT TURN LANE CLOSURE TRAFFIC CONTROL PLAN
G05.1	LL AND DMCA ACCESS AND HAUL ROUTES
V01.1	SITE SURVEY CONTROL
CB01.1	LLA CLEARING, GRUBBING AND SURFACE DEMOLITION PLAN
CB01.2	LLA SUBSURFACE DEMOLITION PLAN
CE01.1	LLA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN – MINIMUM REQUIREMENTS
CE02.1	LL AND DMCA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN – MINIMUM REQUIREMENTS
CG01.1	LLA EXCAVATION PLAN
CG01.2	LLA EXCAVATION PLAN – EXCAVATION AREAS 1 AND 2
CG01.3	LLA EXCAVATION PLAN – EXCAVATION AREA 3
CG01.4	LLA EXCAVATION PLAN – EXCAVATION AREA 4
CG01.5	LLA EXCAVATION SECTIONS A AND B
CG01.6	LLA EXCAVATION SECTIONS C AND D
CG01.7	LLA EXCAVATION SECTIONS E AND F
CG01.8	LLA EXCAVATION SECTIONS G AND H
CG02.1	LLA DEWATERING PLAN
CG03.1	DMCA GRADING AND SURFACE COMPLETION PLAN
CG04.1	LLA TYPICAL BACKFILL SECTION
CG04.2	LLA BACKFILL SECTION D
CG04.3	LLA BACKFILL SECTION H
CG05.1	LLA GRADING AND SURFACE COMPLETION PLAN
CG05.2	LLA GRADING AND DRAINAGE DETAILS
CG05.3	DMCA GRADING AND DRAINAGE DETAILS
CG06.1	LL SEASON 1 EXCAVATION PLAN – AREAS 5 AND 6
CG06.2	LL SEASON 1 EXCAVATION SECTION A
CG06.3	LL SEASON 1 EXCAVATION SECTION B
CG06.4	LL SEASON 1 EXCAVATION SECTION C
CG07.1	LL SEASON 1 BACKFILL AND PLANTING PLAN
CG07.2	LL SEASON 1 BACKFILL AND PLANTING SECTION
CG08.1	LL DEWATERING, SEDIMENT CAP, AND FILL PLAN
CG08.2	LL SEDIMENT CAP AND FILL SECTIONS
CG09.1	LL SEASON 2 WETLAND REHABILITATION AREA INITIAL CONDITIONS
CG09.2	LL SEASON 2 WETLAND PHOTOS
CG10.1	LL SEASON 2 WETLAND FINAL GRADING PLAN
CG10.2	LL SEASON 2 WETLAND EAST LAKE BERM OPENING
CG10.3	LL SEASON 2 WETLAND GRADING SECTIONS
CG10.4	LL SEASON 2 WETLAND OUTLET TO MILLER CREEK
CG10.5	LL SEASON 2 WETLAND GRAVEL SWALE SECTIONS
CG10.6	LL SEASON 2 WETLAND DETAILS
CU02.1	LLA GROUNDWATER MONITORING WELL INSTALLATION PLAN
CU02.2	LLA GROUNDWATER MONITORING WELL INSTALLATION DETAILS
CU03.1	LL SEASON 2 SEDIMENT CAP MONITORING WELL POINT INSTALLATION PLAN
CU03.2	LL SEASON 2 SEDIMENT CAP MONITORING WELL POINT INSTALLATION DETAIL AND TYPICAL SECTION
LP01.1	LL SEASON 2 WETLAND PLANTING PLAN
LZ01.1	LL SEASON 2 WETLAND PLANT SCHEDULE AND PLANTING DETAILS
LZ01.2	LL SEASON 2 WETLAND PROFILE AND PLANT COMMUNITIES

FLOYD | SNIDER
strategy ▪ science ▪ engineering

kpff

PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
48922
REGISTERED
PROFESSIONAL ENGINEER
3/8/17

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**

SHEET TITLE: **SHEET INDEX**

POS WORK PROJECT NUMBER
104396, 104396

CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL

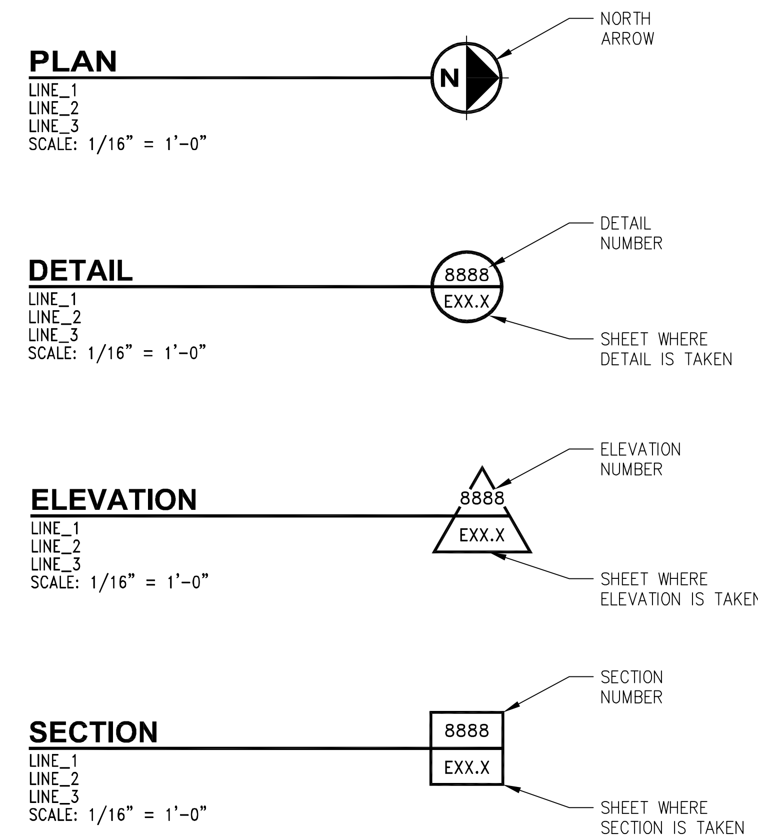
POS PROJECT TRACKING NUMBER
STIA-1701 G01.1

ABBREVIATIONS:

'	FEET, FOOT
"	INCHES
ø	DIAMETER
#	NUMBER
%	PERCENT
APPROX	APPROXIMAT (–E, –LY)
ASTM	AMERICAN SOCIETY FOR TESTING AND MATERIALS INTERNATIONAL
AVE	AVENUE
B&B	BALLED AND BURLAPPED
BGS	BELOW GROUND SURFACE
BMP	BEST MANAGEMENT PRACTICE
CB	CATCH BASIN
CEN	CENTER
CMP	CORRUGATED METAL PIPE
CONT, CONT'D	CONTINU (–ED, –OUS, –ATION)
CP	CONTROL POINT
DIA, DIAM	DIAMETER
DMCA	1982 DREDGED MATERIAL CONTAINMENT AREA
E	EAST/EASTING
E_CEN	EAST CENTRAL
EL/ELEV	ELEVATION
FEMA	FEDERAL EMERGENCY MANAGEMENT AGENCY
FT	FEET, FOOT
GAL	GALLON
GPM	GALLONS PER MINUTE
H	HORIZONTAL
HDPE	HIGH DENSITY POLYETHYLENE
HT	HEIGHT
IE	INVERT ELEVATION
IN	INCH (–ES)
LF	LINEAL FEET
LL	LORA LAKE
LLA	LORA LAKE APARTMENTS
MAX	MAXIMUM
MH	MANHOLE
MIN	MINIMUM
MISC	MISCELLANEOUS
MTCA	MODEL TOXICS CONTROL ACT
MW	MONITORING WELL
N	NORTH
N/A	NOT APPLICABLE
NAD 83	NORTH AMERICAN DATUM OF 1983
NAVD 88	NORTH AMERICAN VERTICAL DATUM OF 1988
NE	NORTHEAST
NG	NATURAL GAS
NGVD 29	NATIONAL GEODETIC VERTICAL DATUM OF 1929
NO	NUMBER
NTS	NOT TO SCALE
NW	NORTHWEST
OC	ON CENTER
P	POWER
PE	PROFESSIONAL ENGINEER
PERIM	PERIMETER
POS	PORT OF SEATTLE
PVC	POLY VINYL CHLORIDE
QTY	QUANTITY
ROW	RIGHT–OF–WAY
S	SOUTH; SLOPE
SCHED, SCH	SCHEDULE
SD	STORM DRAIN
SE	SOUTHEAST
SPEC	SPECIFICATIONS
SR	STATE ROUTE
SS	SANITARY SEWER
ST	STREET
STA	STATION
STIA	SEATAC INTERNATIONAL AIRPORT
SW	SOUTHWEST
T, TEL, TELE	TELEPHONE
TESC	TEMPORARY EROSION AND SEDIMENT CONTROL
TYP	TYPICAL
US	UNITED STATES
VERT, V	VERTICAL
VIF	VERIFY IN FIELD
W	WIDTH; WEST
WSDOT	WASHINGTON STATE DEPARTMENT OF TRANSPORTATION

CALL 2 DAYS
BEFORE YOU DIG
1–800–424–5555

DRAWING TITLES:



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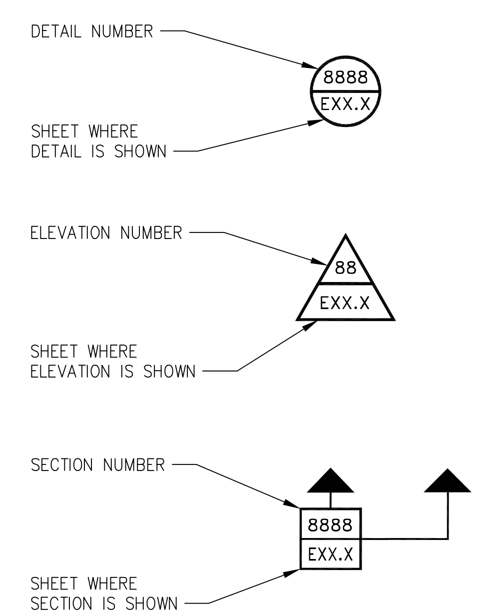

LEGEND:

FIRE HYDRANT
VALVE (GAS, WATER, NATURAL GAS, WATER
TRANSFORMER
CATCH BASIN STORM SEWER
MANHOLE
TELEPHONE VAULT
LIGHT POLE
POWER POLE
MONITORING WELL
WATER LINE
POWER LINE
NATURAL GAS LINE
SANITARY SEWER LINE
STORM DRAIN LINE

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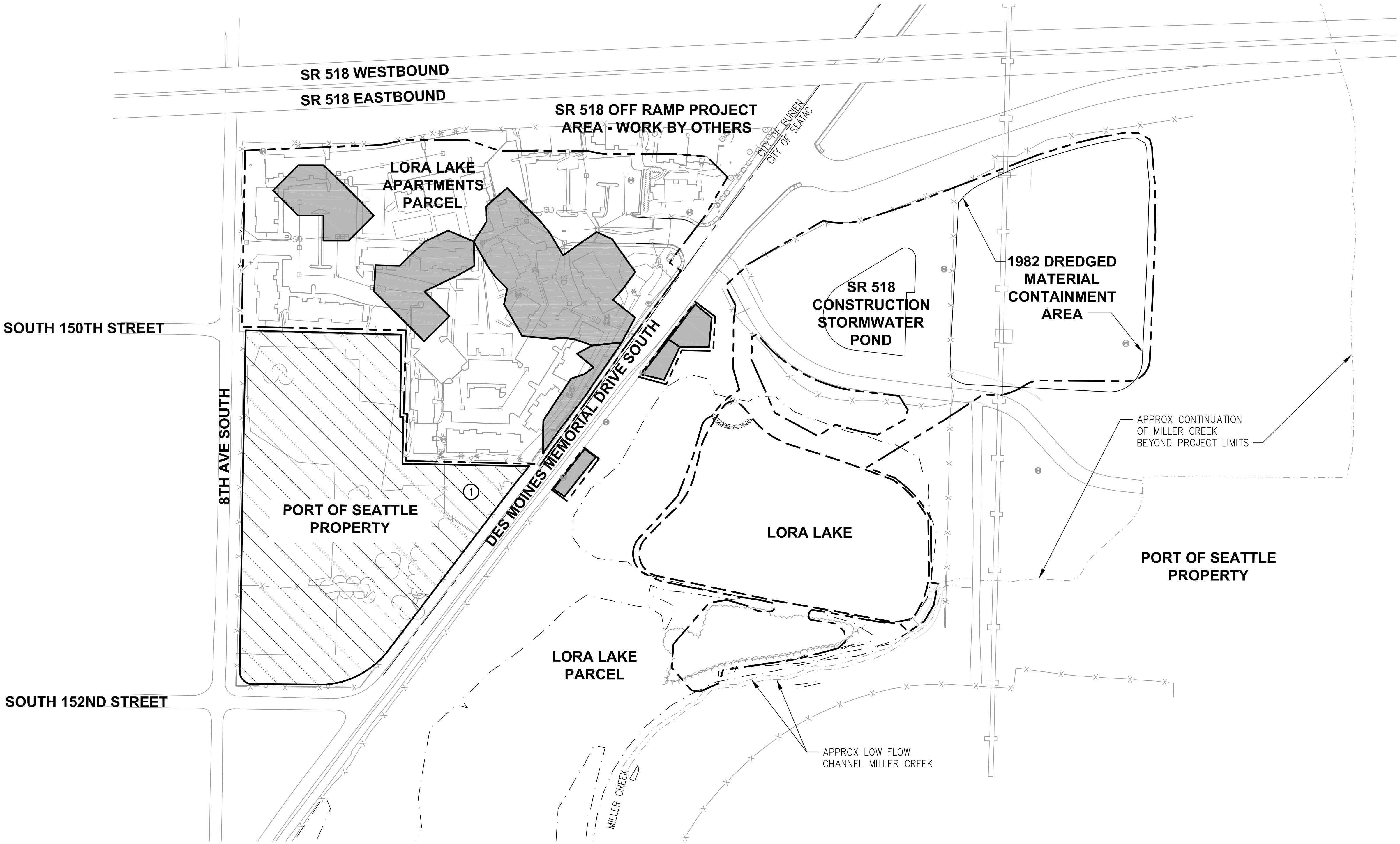
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: SYMBOLS AND ABBREVIATIONS

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G02.1



NOTES:

1. INSTALLATION OF STORMWATER DRAINAGE CONNECTION TO THE CITY OF BURIEN SYSTEM WILL OCCUR WITHIN THE STAGING AREA. REFER TO SHEET CG05.2.

LEGEND:

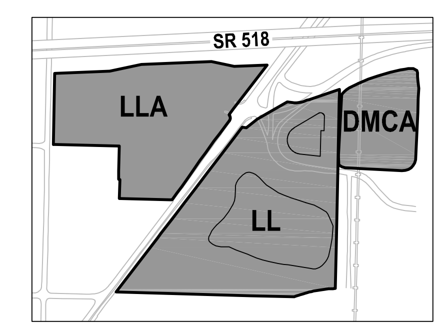
- PROJECT WORK AREA LIMITS
- SOIL EXCAVATION AREAS
- CITY BOUNDARY
- MILLER CREEK
- EXISTING FENCE
- LORA LAKE CLEANUP AREA
- EXISTING GROUNDWATER MONITORING WELL
- WETLAND BOUNDARY
- STAGING AREA

PLAN

OVERALL SITE PLAN
SCALE: 1" = 100'

1"=100' 100 0 100 200
Scale Feet

N



KEY MAP

NTS

FLOYD | SNIDER
strategy • science • engineering
kpff

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DRAWN BY: JKH
SCALE: AS SHOWN
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CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

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3/18/17

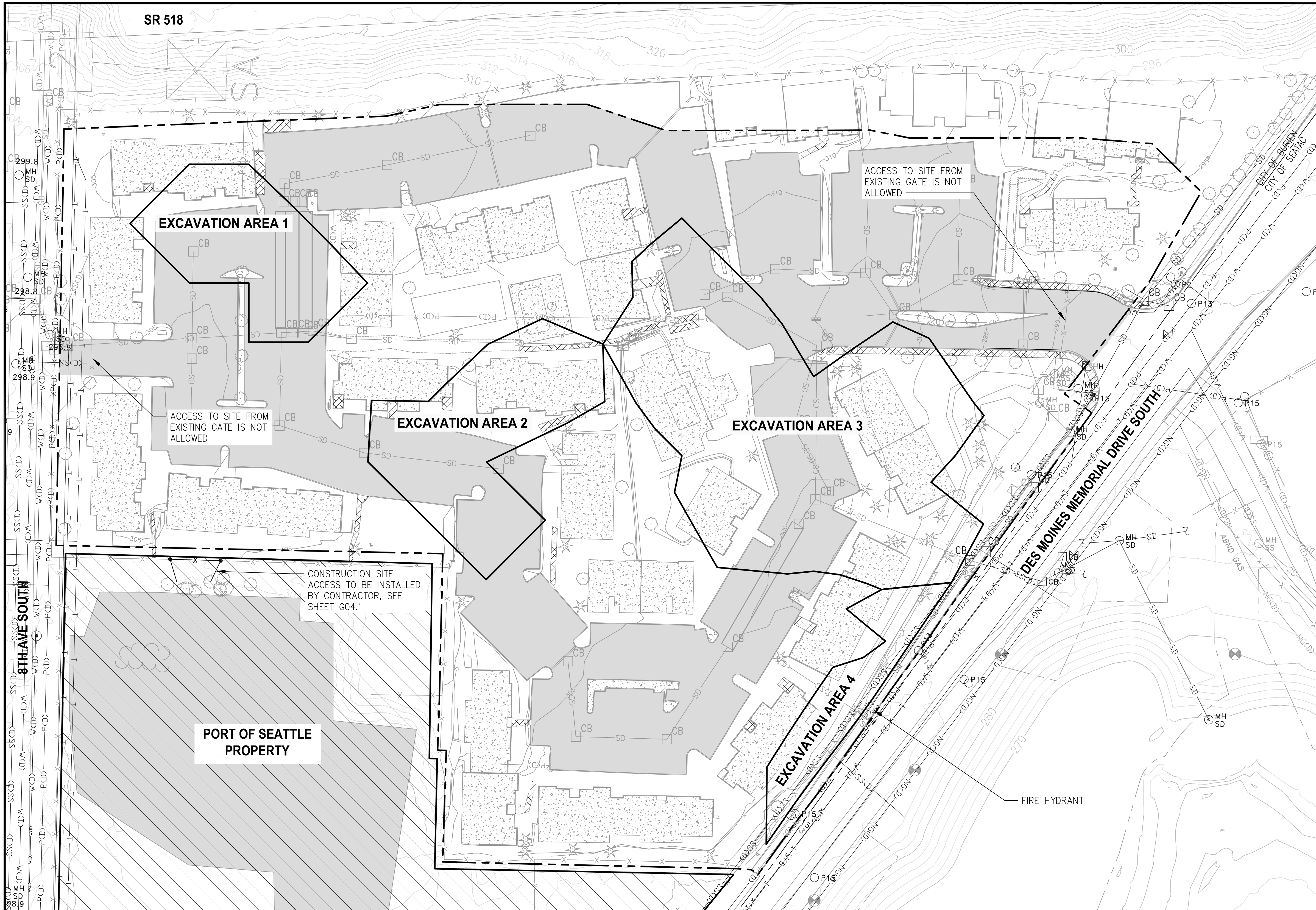
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: OVERALL SITE PLAN

POS WORK PROJECT NUMBER
104396, 104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 G03.1



PLAN

LLA SITE PLAN
SCALE: 1" = 40'

1"=40' Scale: 40 0 40 80 Feet

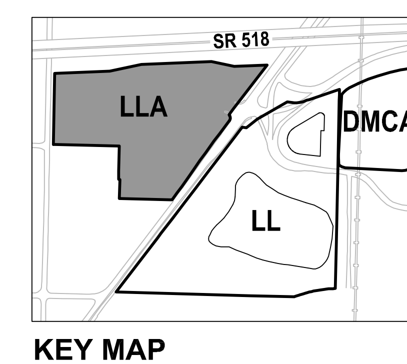
N

NOTES:

1. AREAS WITHIN THE PROJECT WORK AREA LIMITS NOT IDENTIFIED AS EXISTING CONCRETE ONSITE ASPHALT OR MISC. CONCRETE SIDEWALKS, PATHS, STAIRS ARE LANDSCAPED AND COVERED IN PLASTIC.
2. STOCKPILING OF CONTAMINATED EXCAVATION SOIL AND COMMON EXCAVATION SOIL IS NOT ALLOWED IN STAGING AREA.
3. ON-SITE POWER, WATER, SANITARY SEWER, AND TELEPHONE PREVIOUSLY ABANDONED IN PLACE, CUT AND CAPPED AT PROPERTY BOUNDARY. ALL RIGHT OF WAY UTILITIES ASSUMED ACTIVE.
4. COMMON EXCAVATION OCCURS IN THE AREAS BETWEEN SOIL EXCAVATION AREAS AND THE PROJECT WORK AREA LIMITS.

LEGEND:

- PROJECT WORK AREA LIMITS
- CITY BOUNDARY
- EXISTING CONCRETE FOUNDATIONS
- ON-SITE ASPHALT PAVEMENT
- MISC CONCRETE SIDEWALKS, PATHS STAIRS
- SOIL EXCAVATION AREAS
- EXISTING FENCE
- EXISTING GROUNDWATER MONITORING WELL
- EXISTING TREES
- ELEVATION CONTOUR IN FEET (NAVD 88)
- DETENTION TANK
- STAGING AREA
- CATCH BASINS
- OVERHEAD POWER – TO BE PROTECTED
- STORM DRAIN LINES
- POWER
- WATER
- NATURAL GAS
- SANITARY SEWER
- TELEPHONE



KEY MAP

NTS

FLOYD | SNIDER
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PROJECT ENGR./ARCH.: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
3/18/17

REVISIONS

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POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
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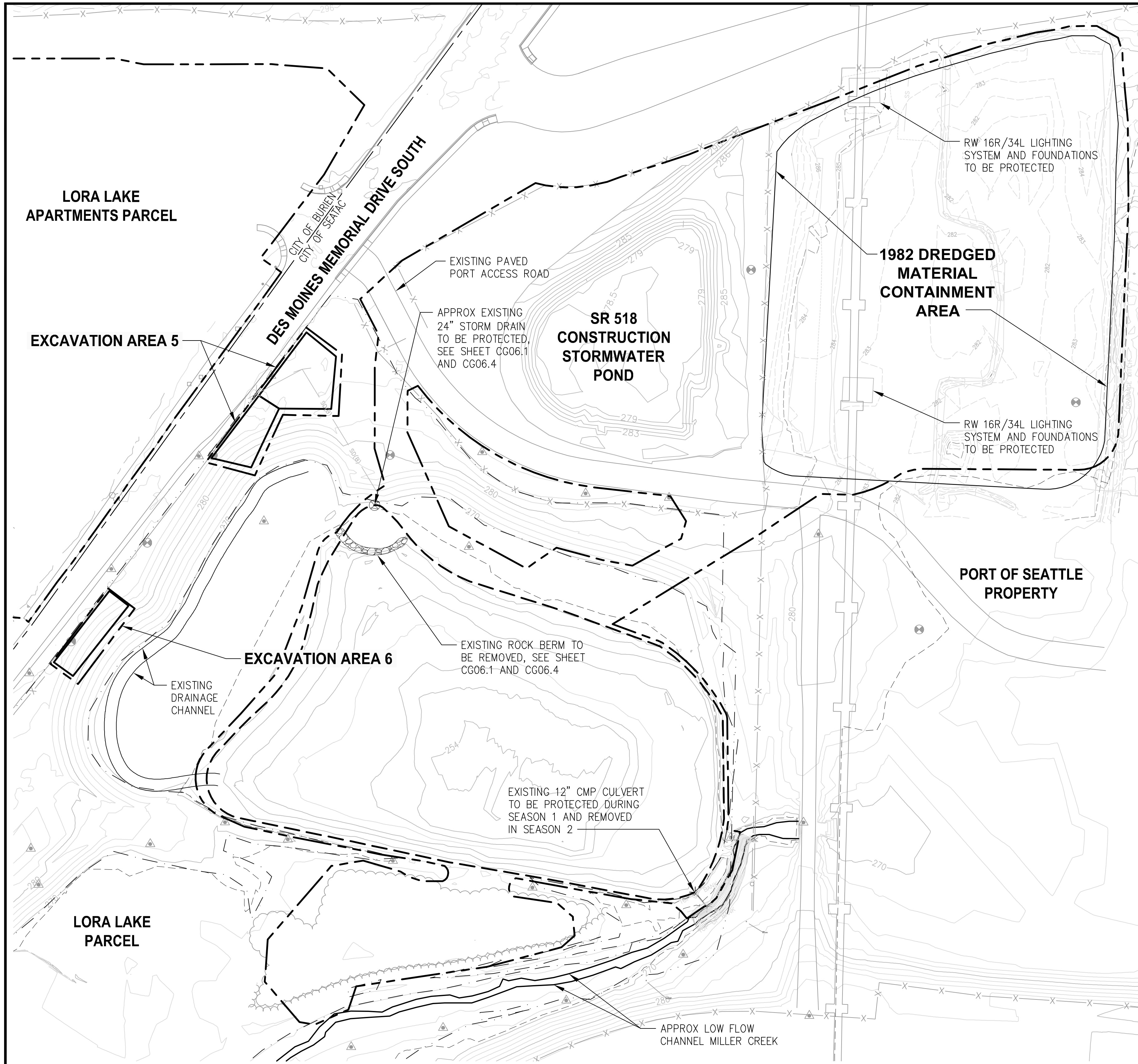
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**
SHEET TITLE: **LLA SITE PLAN**

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
G03.2



PLAN
LL SITE PLAN
SCALE: 1" = 60'

1"=60' 60 0 60 120
Scale Feet

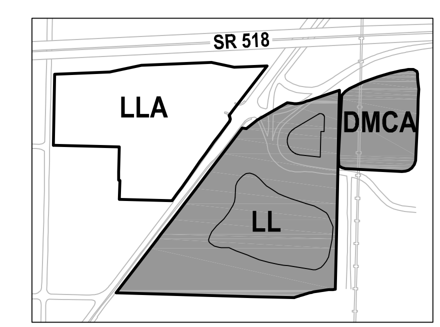
N

NOTES:

1. THIS PLAN PROVIDES AN OVERVIEW OF THE PROJECT ELEMENTS AND DOES NOT COMPLETELY DESCRIBE THE PROJECT. SEE COMPLETE CONTRACT DOCUMENTS FOR ALL CONTRACT AND PROJECT REQUIREMENTS.
2. THE CONTRACTOR SHALL SCHEDULE PROJECT WORK SUCH THAT WATER DRAW DOWN FROM LORA LAKE OR DEWATERING DISCHARGE FROM THE LL APARTMENTS PARCEL NOT INFILTRATED AT THE LL APARTMENTS PARCEL, SHALL BE TREATED AND PUMPED TO THE SR 518 CONSTRUCTION STORMWATER POND AT A CONTROLLED RATE SUCH THAT WATER IN THE POND WILL NOT EXCEED THE POND STAGE OF 4.3 FEET (WHICH HAS A CORRESPONDING VOLUME OF APPROXIMATELY 800,000 GALLONS). ESTIMATED ALLOWABLE PUMPING RATES RANGE FROM 300 GPM FOR AN 8 HOUR, 7-DAY PER WEEK OPERATION, TO 400 GPM FOR AN 8 HOUR, 5-DAY PER WEEK OPERATION. CONTRACTOR SHALL CALCULATE PUMPING RATES RELATIVE TO CONTRACTOR WORK SCHEDULE UTILIZING PROVIDED INFORMATION IN EDR APPENDIX A -SR 518 CONSTRUCTION STORMWATER POND INFILTRATION ASSESSMENT. RATES OF LAKE VOLUME DISPLACEMENT DURING FILLING, AND DEWATERING REQUIREMENTS DURING EXCAVATION AT THE LL APARTMENTS PARCEL, AND ACTUAL POND INFILTRATION RATES MAY VARY OVER TIME, AND THE CONTRACTOR SHALL MANAGE TREATMENT AND PUMPING RATES SO AS TO NOT EXCEED THE COMBINED INFILTRATION AND STORAGE CAPACITY OF THE POND, TANK STORAGE OR TRUCKING VOLUMES.
3. THE DREDGED MATERIAL CONTAINMENT AREA SHALL BE USED AS A STAGING AND STOCKPILE AREA FOR LAKE CAPPING AND FILLING, AND WETLAND REHABILITATION WORK.
4. FLOOD PLAIN EXTENTS SHOWN HERE REPRESENT A BASE FLOOD ELEVATION OF 269 FEET (NAVD 88) AROUND THE LAKE BASED ON FEMA FLOOD INSURANCE STUDY (PANEL 954K AND PROFILE 155P), AND THE FEMA 2007 DELINEATION ELSEWHERE.
5. ENTRANCE TO EXISTING PORT ACCESS ROAD AND ROAD CONFIGURATION IS REFLECTIVE OF THE SR 518 INTERCHANGE RESTORATION PROJECT TO BE COMPLETED IN 2016.
6. ALL CONTRACTOR WORK SHALL BE CONFINED TO AREAS OUTSIDE OF COVENANT AND WETLAND LINES UNLESS OTHERWISE DIRECTED, SEE SHEET G05.1.
7. LORA LAKE CONSTRUCTION ACTIVITIES WILL TAKE PLACE OVER TWO CONSTRUCTION SEASONS.
8. SOIL EXCAVATION AREAS AT THE LORA LAKE PARCEL CONTAIN HEAVY TREE COVER.

LEGEND:

- PROJECT WORK AREA LIMITS
- SOIL EXCAVATION AREAS
- LORA LAKE CLEANUP AREA
- 100-YEAR FLOOD PLAIN BOUNDARY
- 270 ELEVATION CONTOUR IN FEET (NAVD 88)
- EXISTING GROUNDWATER MONITORING WELLS
- EXISTING GROUNDWATER PIEZOMETER
- EXISTING FENCE
- RESTRICTIVE COVENANT BOUNDARY
- WETLAND BOUNDARY



KEY MAP
NTS

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strategy • science • engineering
kpff

PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM

JESSICA S. MASSINGALE STATE OF WASHINGTON 46140 REGISTERED PROFESSIONAL ENGINEER
exp. 10/29/16

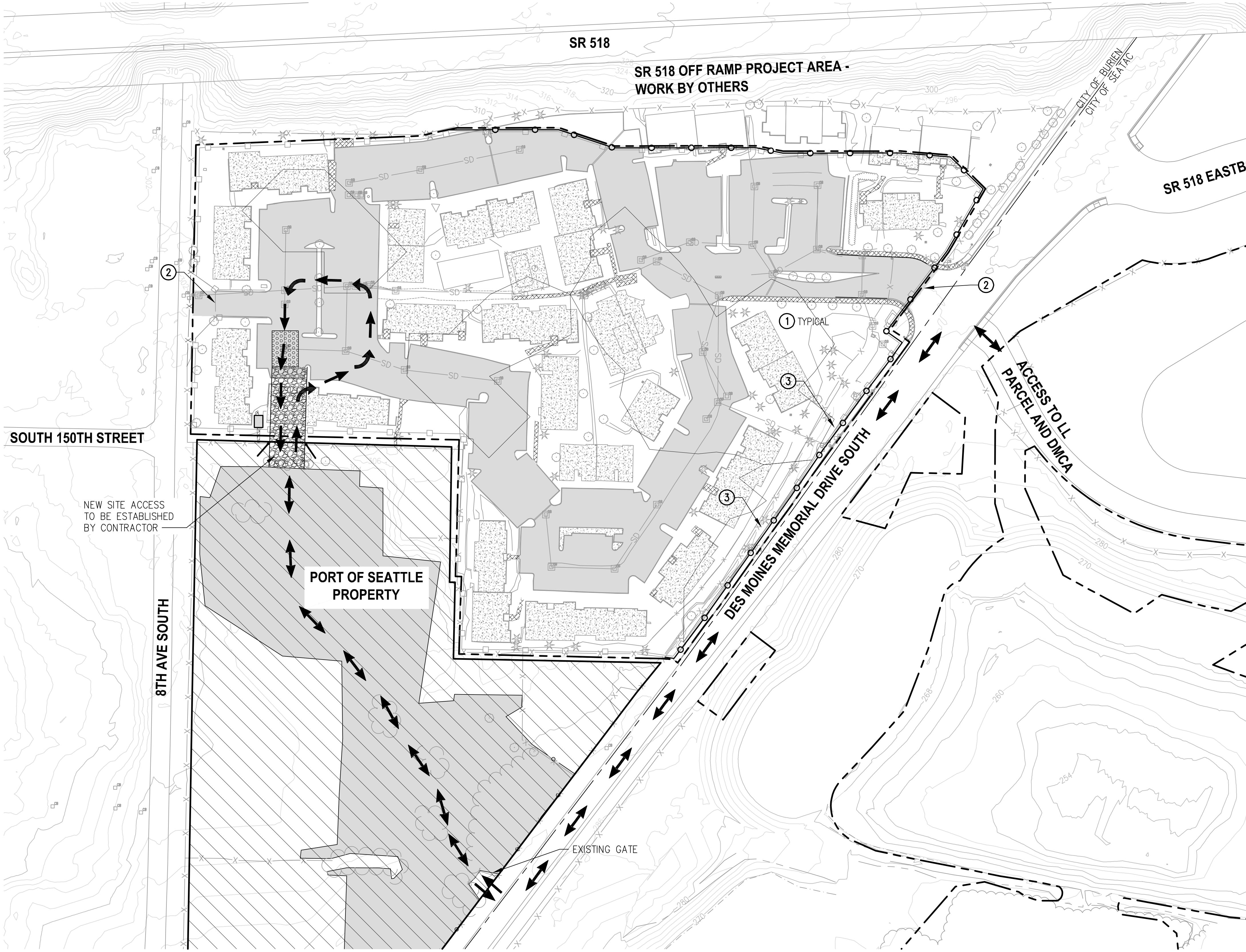
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL AND DMCA SITE PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G03.3



PLAN

LLA ACCESS AND HAUL ROUTES
SCALE: 1" = 40'

1"=40' Scale 40 0 40 80 Feet

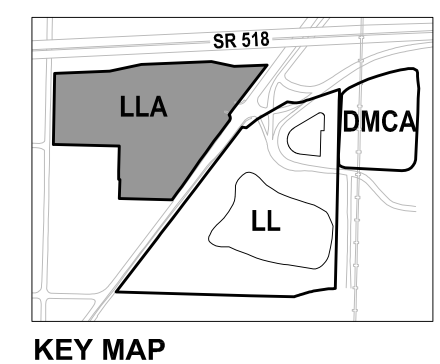
N

NOTES:

1. AREAS WITHIN THE PROJECT WORK AREA LIMITS NOT IDENTIFIED AS EXISTING CONCRETE, ONSITE ASPHALT, OR MISC. CONCRETE SIDEWALKS, PATHS, STAIRS ARE LANDSCAPED AND COVERED IN PLASTIC.
2. ACCESS TO SITE FROM EXISTING GATE IS NOT ALLOWED.
3. IF ACCESSING EXCAVATION AREAS FROM RIGHT OF WAY, TRAFFIC CONTROL REQUIREMENTS APPLY. SEE SHEET G04.3

LEGEND:

- PROJECT WORK AREA LIMITS
- SOIL EXCAVATION AREAS
- WHEEL WASH
- ON-SITE ASPHALT PAVEMENT
- MISC. CONCRETE SIDEWALKS, PATHS STAIRS
- STAGING AREA
- TEMPORARY CONSTRUCTION FENCE
- SILT FENCE
- CONTRACTOR ACCESS ROUTES
- EXISTING FENCE
- CONCRETE BUILDING FOUNDATION
- ELEVATION CONTOUR IN FEET (NAVD 88)
- QUARRY SPALL PAD
- PERMANENT GATE – TO BE INSTALLED



KEY MAP

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER 3/18/17

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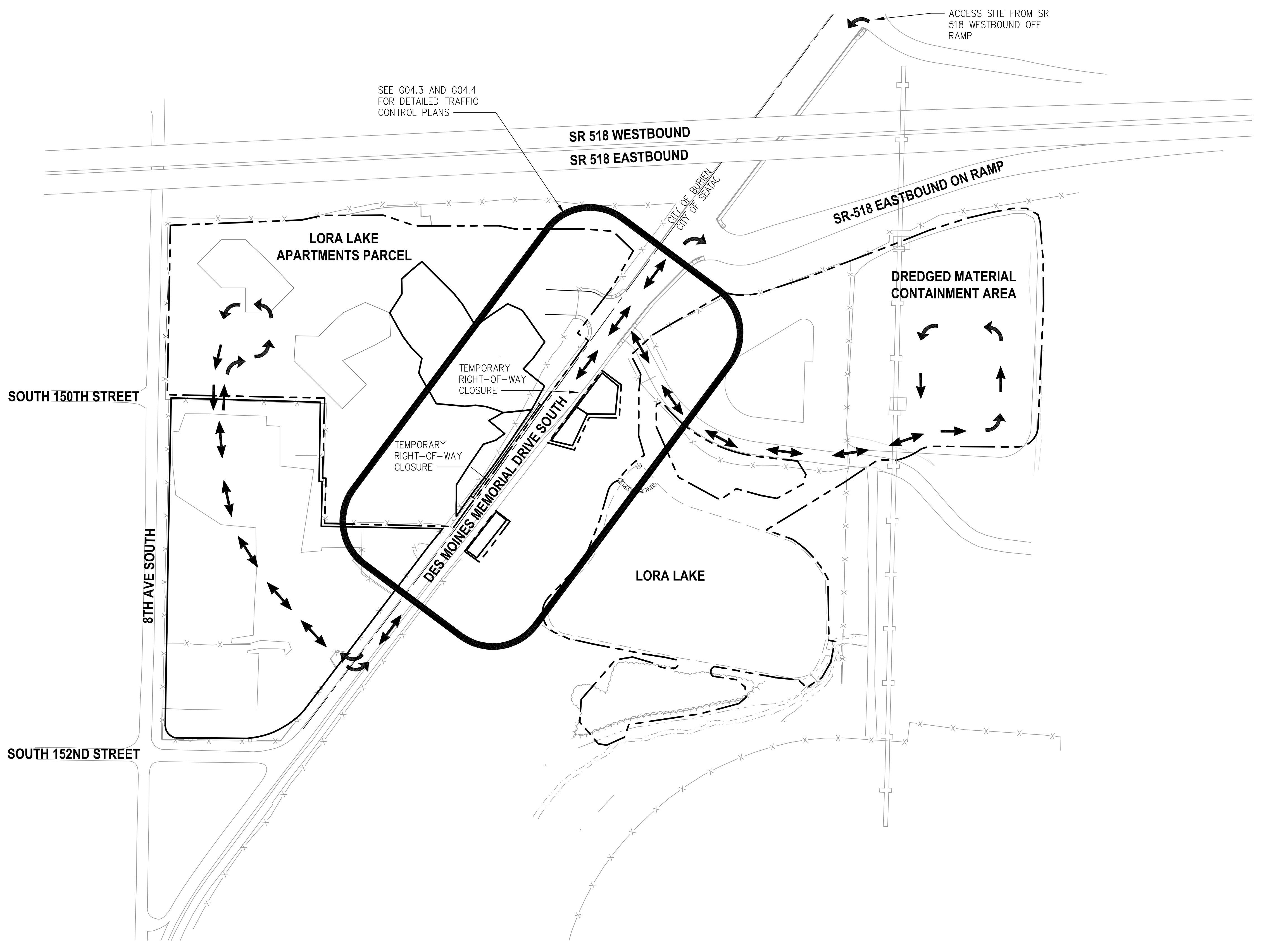
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA ACCESS AND HAUL ROUTES

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G04.1



NOTES:

1. FOR TRAFFIC CONTROL PLAN CONTRACTOR TO COORDINATE AND OBTAIN APPLICABLE PERMITS.

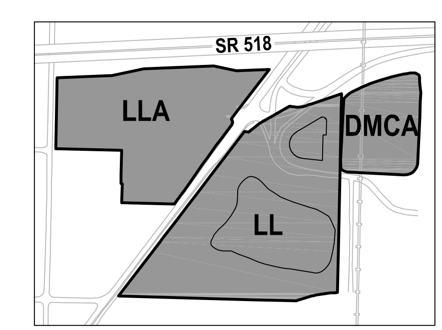
LEGEND:

PROJECT WORK AREA LIMITS
EXISTING FENCE
CONTRACTOR ACCESS ROUTES
CITY BOUNDARY
WORK AREAS REQUIRING TRAFFIC CONTROL PLAN
LORA LAKE CLEANUP AREA

PLAN
LLA TRAFFIC CONTROL PLAN
SCALE: 1" = 100'

1"=100' 100 0 100 200
Scale Feet

N



KEY MAP
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PROJECT ENGR./ARCH:	MEGAN KING
DESIGNER:	MMK
DRAWN BY:	JKH
SCALE:	AS SHOWN
DATE:	8/29/2016
CHECKED BY:	JSM
CHECKED/APPROVED BY:	MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
3/13/17

REVISIONS

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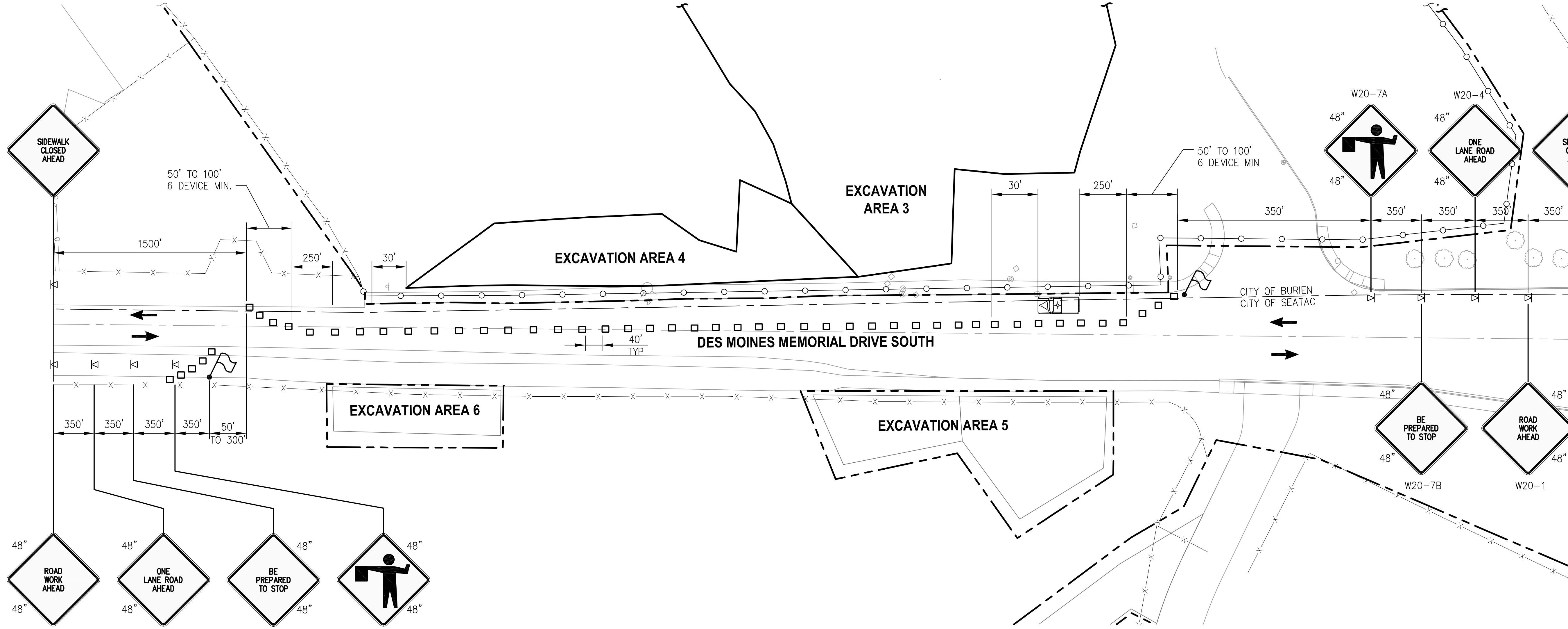
POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: SITE TRAFFIC CONTROL PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G04.2



PLAN

SOUTHBOUND LANE CLOSURE
TRAFFIC CONTROL PLAN
SCALE: 1" = 30'

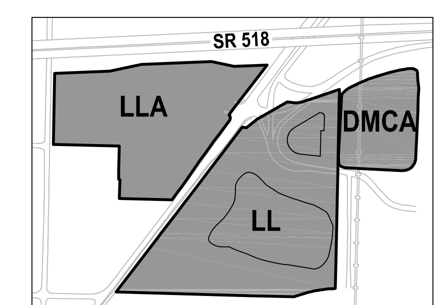
1"=30' — 30 0 30 60 — Scale — Feet

NOTES:

1. SIDEWALK CLOSED AHEAD SIGNS ARE NOT SHOWN IN EXACT LOCATIONS.
2. FOR TRAFFIC CONTROL PLAN CONTRACTOR TO COORDINATE AND OBTAIN APPLICABLE PERMITS.

LEGEND:

- CHANNELIZING DEVICES
- FLAGGING STATION
- PROTECTIVE VEHICLE
- PATROL CAR AND OFFICER
- TEMPORARY SIGN LOCATION
- PROJECT WORK AREA LIMITS
- TEMPORARY CONSTRUCTION FENCE
- EXISTING FENCE
- CITY BOUNDARY
- SOIL EXCAVATION AREAS



KEY MAP

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 3/18/17

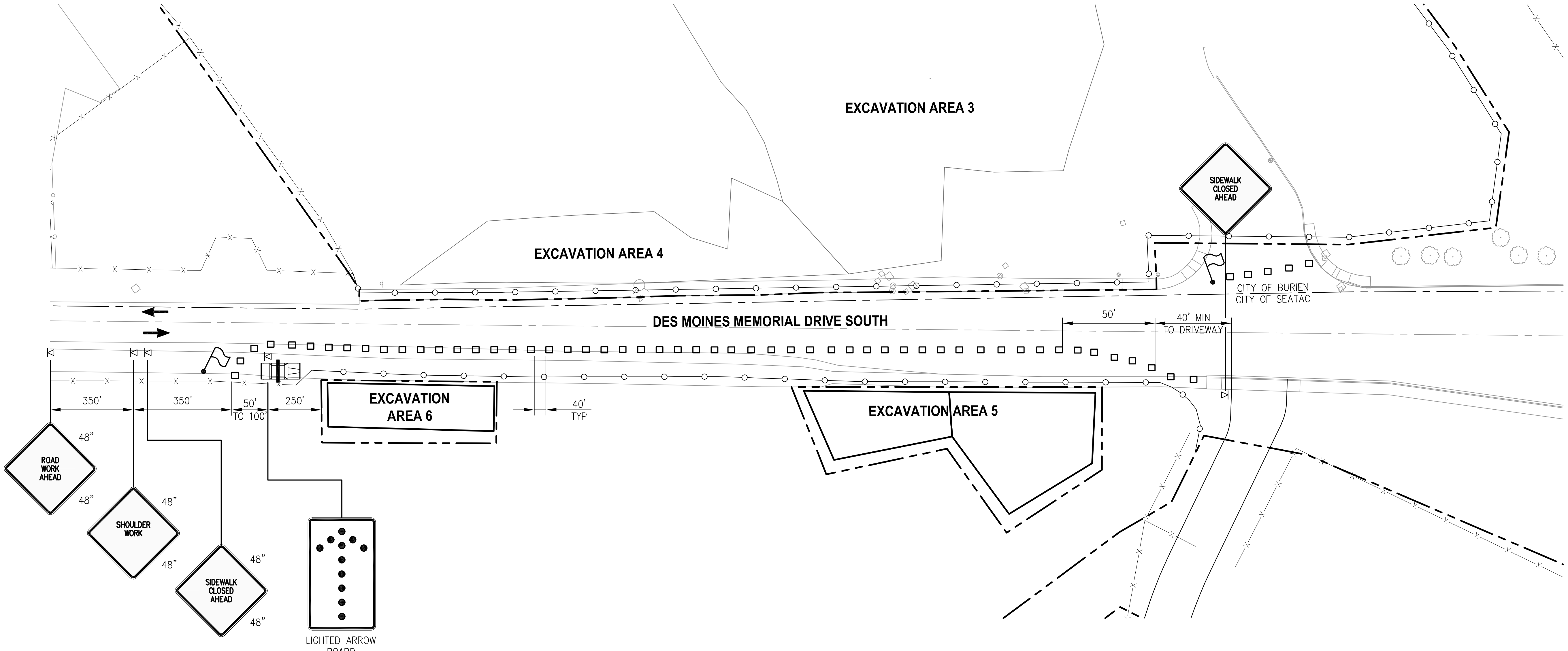
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle — SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: SOUTHBOUND LANE CLOSURE TRAFFIC CONTROL PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G04.3



PLAN

NORTHBOUND RIGHT TURN LANE CLOSURE
TRAFFIC CONTROL PLAN
SCALE: 1" = 30'

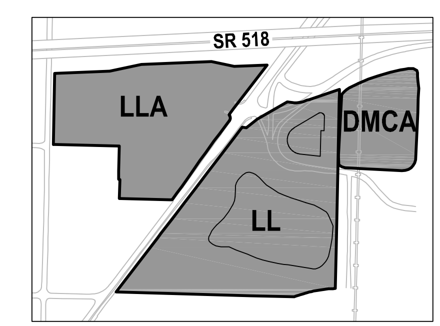
1"=30' 30 0 30 60
Scale Feet

NOTES:

1. SIDEWALK CLOSED AHEAD SIGNS ARE NOT SHOWN IN EXACT LOCATIONS.
2. FOR TRAFFIC CONTROL PLAN CONTRACTOR TO COORDINATE AND OBTAIN APPLICABLE PERMITS.

LEGEND:

- CHANNELIZING DEVICES
- FLAGGING STATION
- PATROL CAR AND OFFICER
- TEMPORARY SIGN LOCATION
- PROJECT WORK AREA LIMITS
- TEMPORARY CONSTRUCTION FENCE
- EXISTING FENCE
- SOIL EXCAVATION AREAS



KEY MAP

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
3/18/17

REVISIONS

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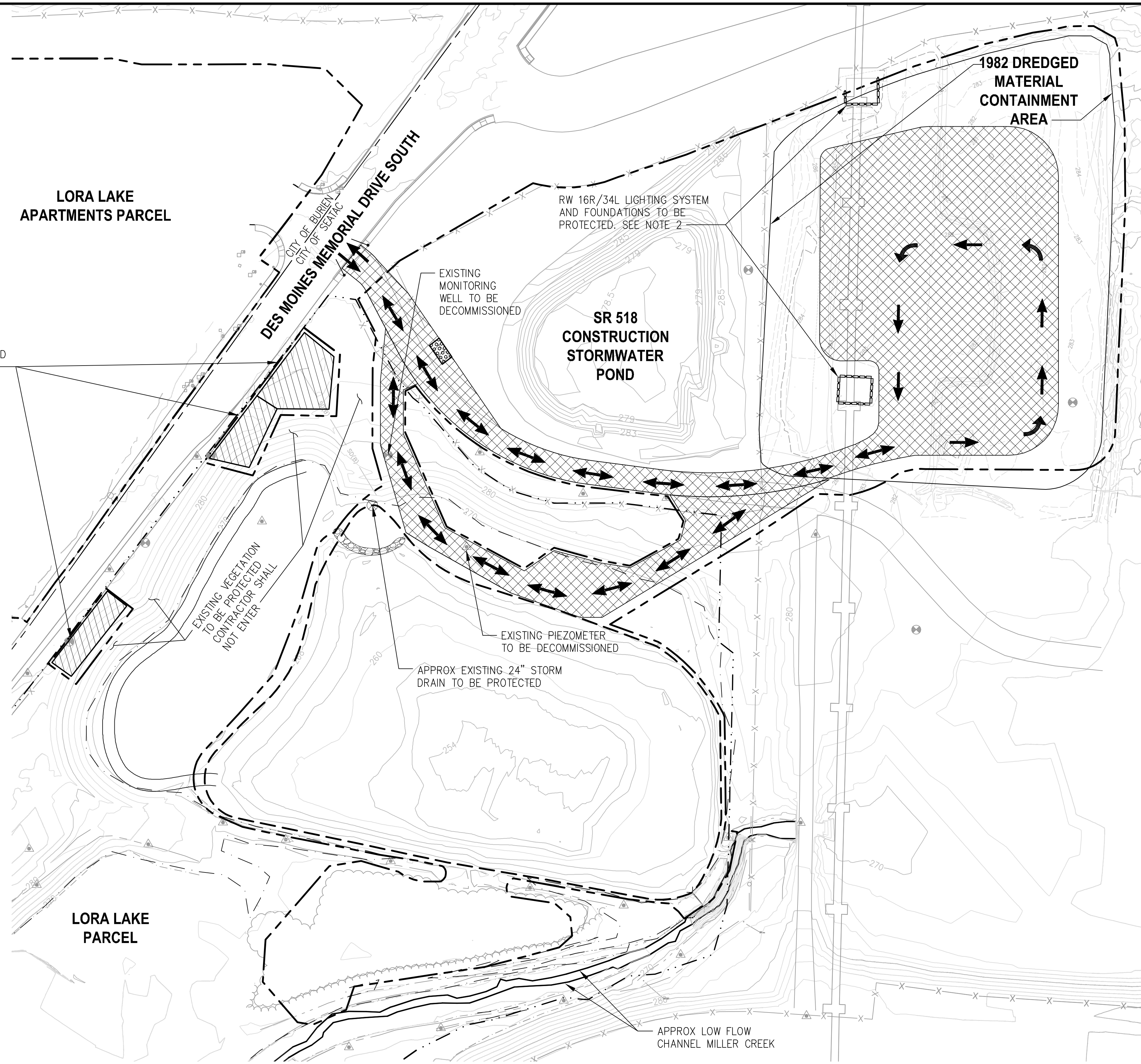
POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: NORTHBOUND RIGHT TURN LANE CLOSURE TRAFFIC CONTROL PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G04.4



PLAN

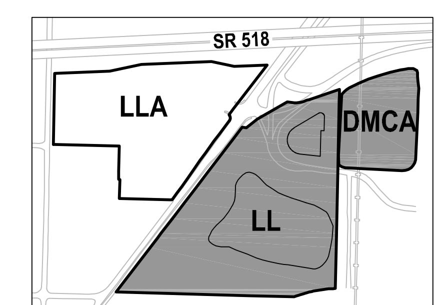
LL AND DMCA ACCESS AND HAUL ROUTES
SCALE: 1" = 60'

NOTES:

1. VEGETATION OUTSIDE OF IDENTIFIED ACCESS AND HAUL ROUTES AND SOIL EXCAVATION AREAS TO BE PROTECTED.
2. PLACE HIGH VISIBILITY FENCE AND ECOLOGY BLOCK TEMPORARY PROTECTION WALL 10 FEET OUTSIDE EXISTING CONCRETE PAD. MAINTAIN DURING ALL USE OF DMCA AS CONSTRUCTION STAGING AREAS.
3. SEE SHEET CG03.1 FOR DMCA CONSTRUCTION SEQUENCING OF CONSTRUCTION ACCESS AND STAGING AREA.

LEGEND:

- PROJECT WORK AREA LIMITS
- WHEEL WASH
- CONSTRUCTION ACCESS AND STAGING AREA
- SOIL EXCAVATION AREAS
- ELEVATION CONTOUR IN FEET (NAVD 88)
- LORA LAKE CLEANUP AREA
- RESTRICTIVE COVENANT BOUNDARY
- WETLAND BOUNDARY
- EXISTING FENCE
- CONTRACTOR ACCESS ROUTE
- HIGH VISIBILITY FENCE AND ECOLOGY BLOCK TEMPORARY PROTECTION
- EXISTING GROUNDWATER MONITORING WELL
- EXISTING GROUNDWATER PIEZOMETER



KEY MAP

NTS

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PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM

JESSICA S. MASSINGALE STATE OF WASHINGTON 46140 REGISTERED PROFESSIONAL ENGINEER
EXP. 10/29/18

REVISIONS

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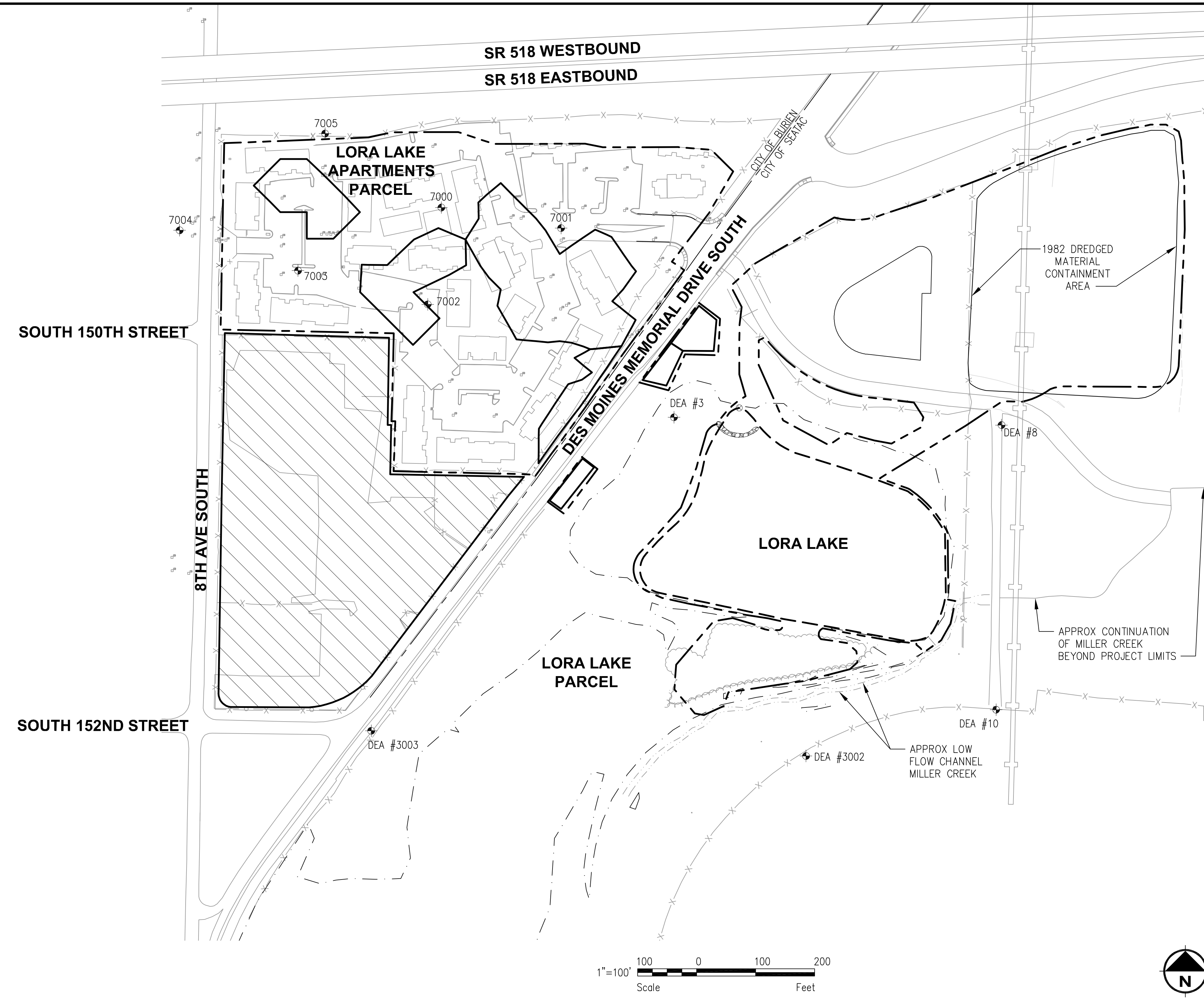
POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL AND DMCA ACCESS AND HAUL ROUTES

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 G05.1

SURVEY CONTROL BENCHMARK INFORMATION				
PT#	NORTHING	EASTING	ELEVATION	DESCRIPTION
DEA #3003	173877.02	1272165.53	283.04	MAG NAIL AND WASHER
DEA #3002	173834.31	1272902.39	289.66	MAG NAIL AND WASHER
DEA #8	174395.12	1273233.67	282.04	SET MAG AND WASHER
DEA #3	174408.22	1272678.51	308.81	SET MAG AND WASHER
DEA #10	173912.73	1273224.49	290.79	SET MAG AND WASHER
7000	174728.89	1272487.25	304.76	MAG NAIL
7001	174694.00	1272690.08	288.48	MAG NAIL
7002	174564.84	1272464.12	299.65	MAG NAIL
7003	174621.94	1272244.35	308.32	MAG NAIL
7004	174690.27	1272043.70	304.95	MAG NAIL
7005	174854.21	1272290.16	311.63	MAG NAIL



LEGEND:

SURVEY CONTROL POINT

SOIL EXCAVATION AREA

PROJECT WORK AREA LIMITS

WETLAND BOUNDARY

LORA LAKE CLEANUP AREA

STAGING AREA

SURVEY AND DATUM INFORMATION

1. DATUM INFORMATION:

   HORIZONTAL DATUM: NAD 83 WASHINGTON STATE PLANE NORTH ZONE (FIPS 4601), IN US FEET.

   VERTICAL DATUM: NAVD 88, IN US FEET.

2. NGVD 29 IS CONVERTED TO NAVD 88 BY ADDING 3.547 FEET.

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
3/8/17

REVISIONS									
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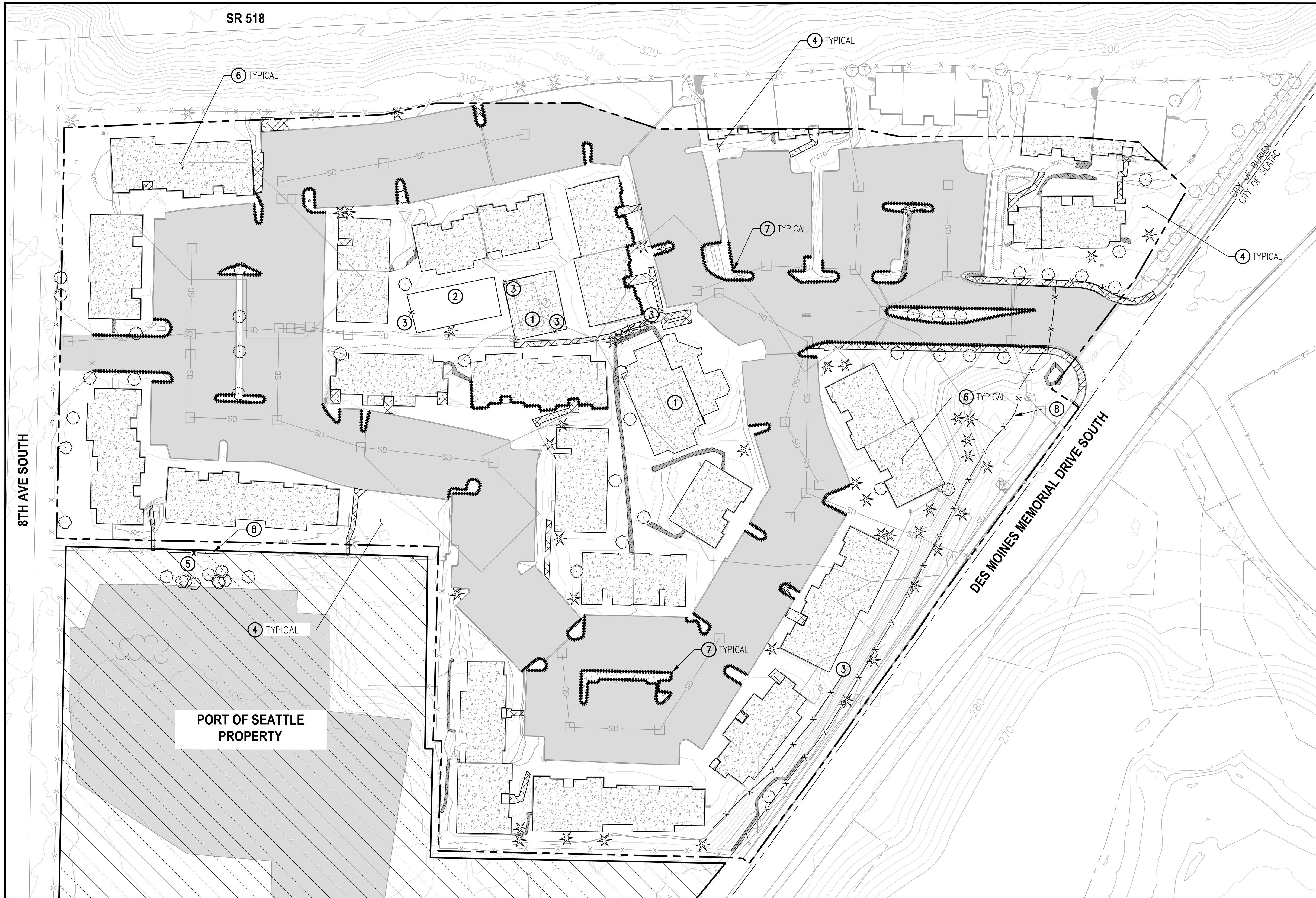
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: SITE SURVEY CONTROL

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 V01.1



NOTES:

1. SWIMMING POOL SURFACE FEATURES TO BE REMOVED.
2. SPORT COURT TO BE REMOVED.
3. MISC FENCES TO BE REMOVED AND DISPOSED OFF-SITE AS SUBTITLE D MATERIAL.
4. AREAS BETWEEN BUILDING FOUNDATIONS AND PAVEMENT COMPRISED OF DENSE VEGETATED LANDSCAPING TO BE REMOVED.
5. FENCE AND TREES TO BE REMOVED FOR THE ESTABLISHMENT OF NEW SITE ACCESS POINT. ONLY REMOVE TREES IF REQUIRED FOR SITE ACCESS. OTHER TREES ON SITE NOT SHOWN.
6. ALL NON-YELLOW PAINTED CONCRETE TO BE CRUSHED AND REUSED ON-SITE.
7. YELLOW PAINTED CONCRETE SHALL BE DISPOSED OFF-SITE AS SUBTITLE D MATERIAL.
8. CHAIN LINK FENCE TO BE REMOVED AND RECYCLED OFF-SITE

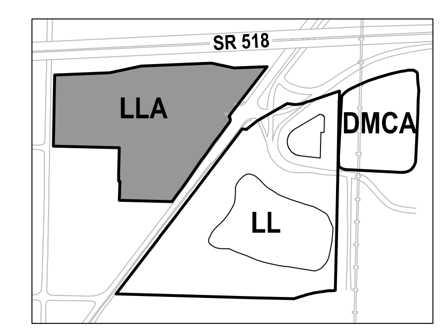
LEGEND:

- PROJECT WORK AREA LIMITS
- SOIL EXCAVATION AREAS
- FENCE – TO BE REMOVED
- ASPHALT – TO BE REMOVED
- CONCRETE BUILDING FOUNDATION – TO BE REMOVED
- ROCK RETAINING WALL – TO BE REMOVED
- EXISTING TREES – TO BE REMOVED
- CURB – TO BE REMOVED
- EXISTING FENCE
- ELEVATION CONTOUR IN FEET (NAVD 88)
- MISC. CONCRETE SIDEWALKS, PATHS, STAIRS – TO BE REMOVED
- STAGING AREA
- YELLOW PAINTED CONCRETE – TO BE REMOVED

PLAN

LLA CLEARING, GRUBBING AND SURFACE DEMOLITION
SCALE: 1" = 40'

1"=40'
40 0 40 80
Scale Feet



KEY MAP

NTS

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strategy ▪ science ▪ engineering
kpff

PROJECT ENGR./ARCH:	MEGAN KING
DESIGNER:	MMK
DRAWN BY:	JKH
SCALE:	AS SHOWN
DATE:	8/29/2016
CHECKED BY:	JSM
CHECKED/APPROVED BY:	MMK

MEGAN MARIE KING STATE OF WASHINGTON 48922 REGISTERED PROFESSIONAL ENGINEER 3/18/17

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

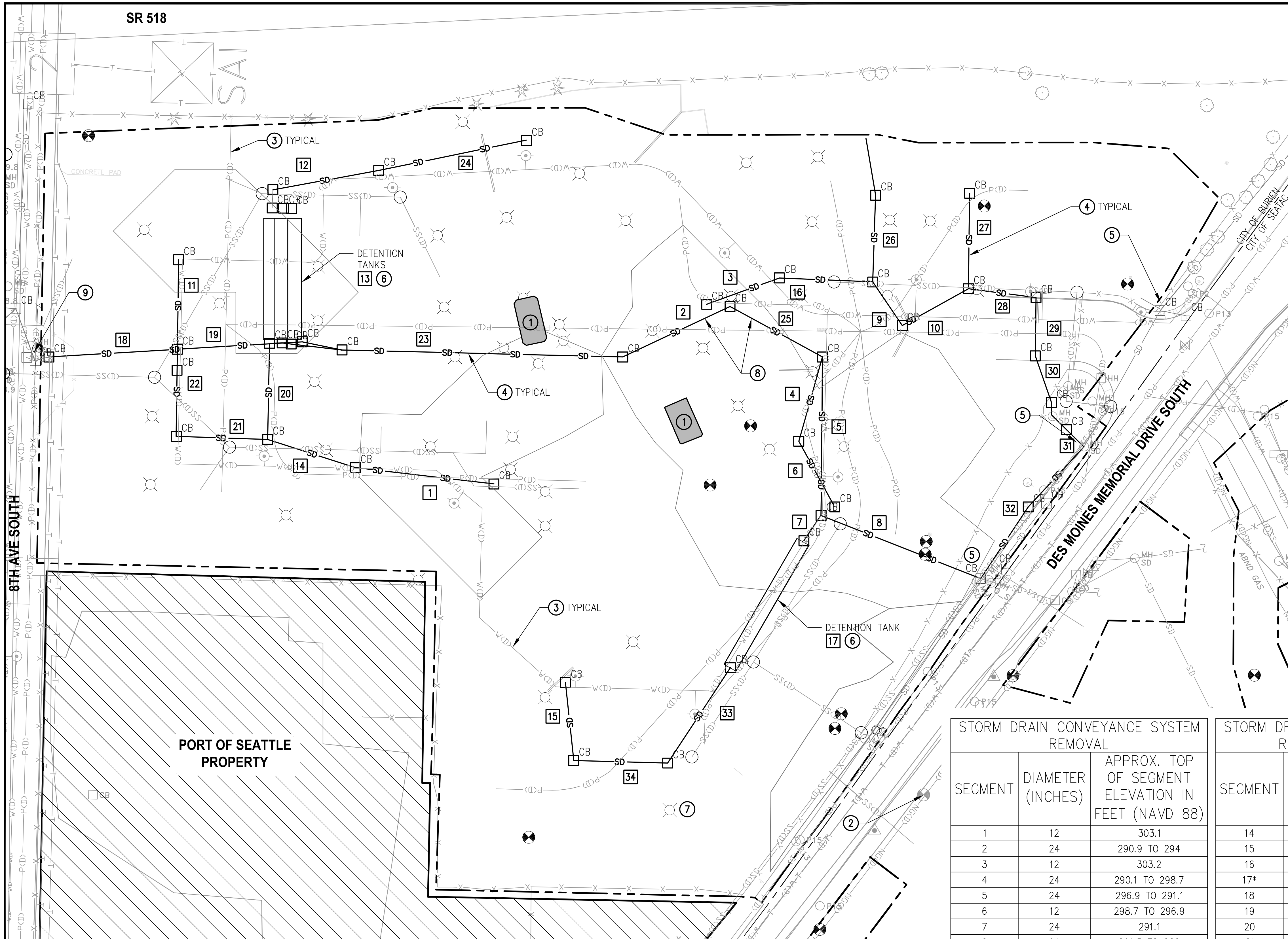
POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS

SHEET TITLE: LLA CLEARING, GRUBBING, AND SURFACE DEMOLITION PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CB01.1



NOTES

1. SWIMMING POOL PREVIOUSLY ABANDONED IN PLACE, FILLED WITH GRAVEL, TO BE REMOVED.
2. MONITORING WELL TO BE PROTECTED.
3. ALL UTILITIES EXCEPT STORM DRAIN HAVE BEEN DISCONNECTED. NO ONSITE UTILITIES REMAIN ACTIVE. UTILITIES IN THE RIGHT OF WAY ARE ACTIVE. CONTRACTOR TO REMOVE UNDERGROUND OBSTRUCTIONS AS NEEDED TO COMPLETE WORK.
4. EXPECTED STORM DRAIN LINES TO BE REMOVED ARE DETAILED IN TABLE. STORM DRAIN LINES TO BE REMOVED ARE CORRUGATED STEEL, EXCEPT WHERE NOTED.
5. CUT AND CAP STORM DRAIN LINES DOWNSTREAM OF SITE. OFFSITE STORM DRAIN SYSTEM TO REMAIN ACTIVE.
6. EXPECTED DETENTION TANKS TO BE REMOVED ARE DETAILED IN TABLE. PIPE SEGMENT 13 CONSISTS OF THREE 54-INCH DIAMETER DETENTION TANKS. PIPE SEGMENT 17 CONSISTS OF ONE 36-INCH DIAMETER DETENTION TANK.
7. POWER POLES HAVE BEEN CUT AT THE GROUND LEVEL. ONLY FOUNDATIONS REMAIN
8. STORM DRAIN PIPE SEGMENTS 2 AND 25 ARE CONCRETE.
9. STORM DRAIN SYSTEM DISCONNECTED FROM MAIN LINE UPSTREAM OF SITE. WORK PERFORMED BY OTHERS.

LEGEND:

- PROJECT WORK AREA LIMITS
- EXISTING MONITORING WELLS TO BE DECOMMISSIONED
- SD EXISTING STORM DRAIN LINE
- CB EXISTING CATCH BASIN
- SD EXISTING STORM DRAIN LINE – TO BE REMOVED
- CB EXISTING CATCH BASIN – TO BE REMOVED
- SOIL EXCAVATION AREAS
- X X EXISTING FENCE
- STAGING AREA
- P(D) POWER
- W(D) WATER
- NG(D) NATURAL GAS
- SS(D) SANITARY SEWER
- T T TELEPHONE
- POWER POLE FOUNDATIONS – TO BE REMOVED
- EXISTING SANITARY SEWER MANHOLE – TO BE REMOVED
- FIRE HYDRANT – TO BE PROTECTED

STORM DRAIN CONVEYANCE SYSTEM REMOVAL

SEGMENT	DIAMETER (INCHES)	APPROX. TOP OF SEGMENT ELEVATION IN FEET (NAVD 88)
1	12	303.1
2	24	290.9 TO 294
3	12	303.2
4	24	290.1 TO 298.7
5	24	296.9 TO 291.1
6	12	298.7 TO 296.9
7	24	291.1
8	24	291.5 TO 288
9	12	297
10	12	297
11	12	301.6
12	12	302.1
13*	3x54	302.1

STORM DRAIN CONVEYANCE SYSTEM REMOVAL CONTINUE

SEGMENT	DIAMETER (INCHES)	APPROX. TOP OF SEGMENT ELEVATION IN FEET (NAVD 88)
14	12	300.2 to 302.3
15	12	302.4
16	12	303.2 TO 301
17*	36	297
18	24	294.4 TO 297.4
19	24	297.4 TO 300
20	12	300 TO 300.2
21	12	300.2 TO 299.8
22	12	299.8 TO 297.4
23	24	294.8 TO 293.4
24	12	302.1 TO 306.5
25	24	289.4 TO 289.1
26	12	296 TO 302.2

STORM DRAIN CONVEYANCE SYSTEM REMOVAL CONTINUE

SEGMENT	DIAMETER (INCHES)	APPROX. TOP OF SEGMENT ELEVATION IN FEET (NAVD 88)
27	12	294.5 TO 293.4
28	12	293.4 TO 288.8
29	12	288.8 TO 286
30	12	286
31	12	288
32	12	288
33	12	293.3 TO 293.5
34	12	293.5 TO 298.4

* SEGMENTS 13 AND 17 ARE STORM DRAIN DETENTION TANKS – TO BE REMOVED

PLAN

LLA SUBSURFACE DEMOLITION PLAN
SCALE: 1" = 40'

1"=40' 40 0 40 80
Scale Feet

N

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 3/18/17

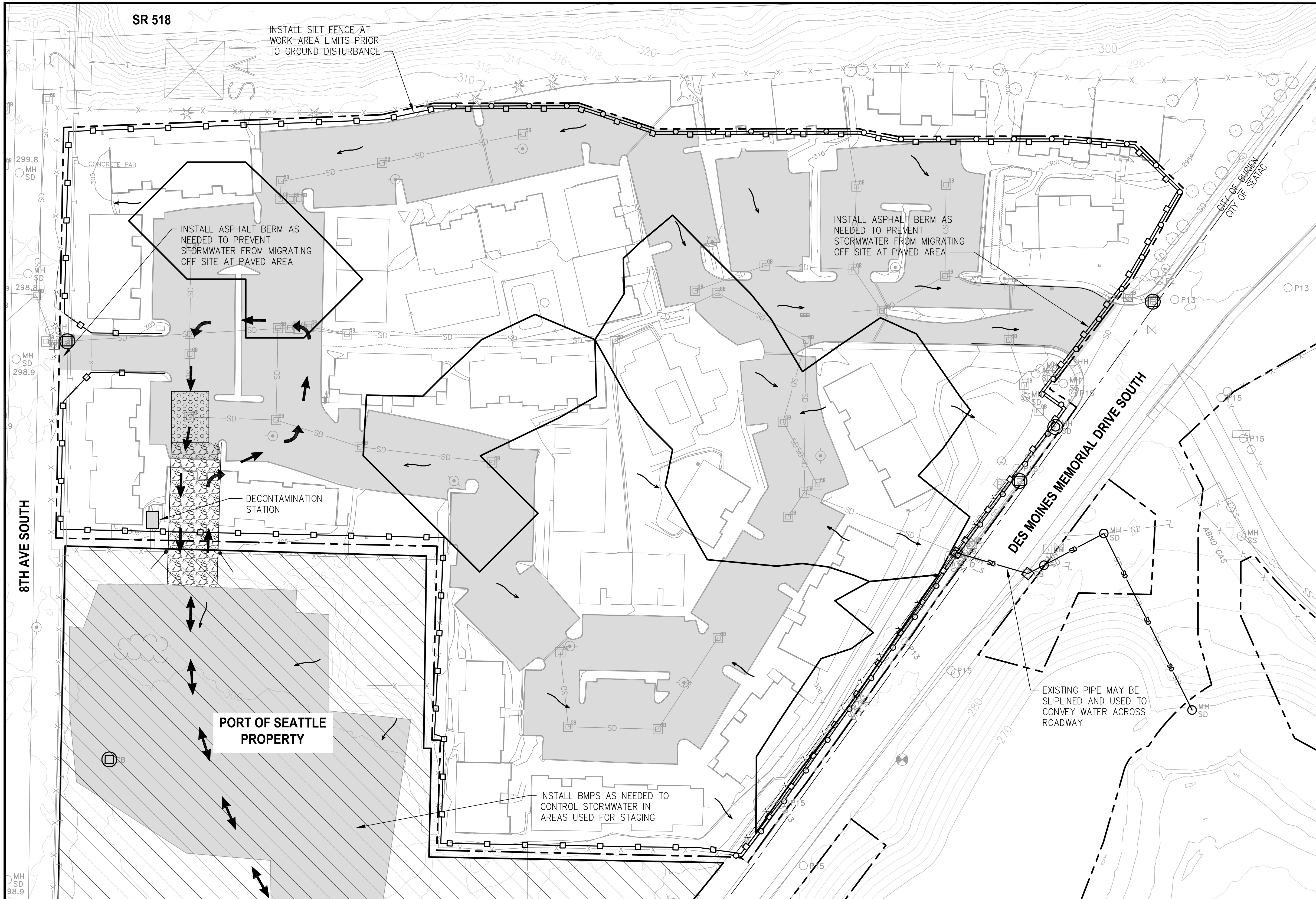
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA SUBSURFACE DEMOLITION PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CB01.2



PLAN

LLA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN
SCALE: 1" = 40'

1"=40'-0" Scale 40 0 40 80 Feet

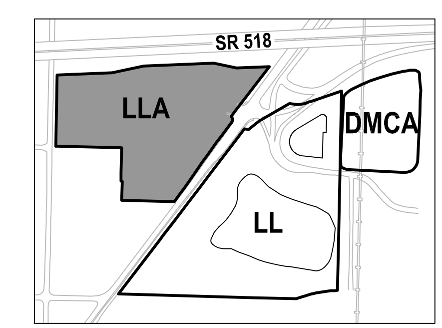
N

NOTES:

1. CONTRACTOR TO UPDATE TESC PLAN AS PART OF SWPPP PRE-CONSTRUCTION SUBMITTAL.
2. BMPS SHOWN ARE MINIMUM REQUIREMENTS. INSTALL ADDITIONAL BMPS AS NECESSARY SO THAT NO UNCONTROLLED STORMWATER OR DEWATERING WATER LEAVES THE SITE.
3. SOIL STOCKPILING AND WATER TREATMENT EQUIPMENT MAY OCCUR IN COMMON EXCAVATION AREAS. STOCKPILE BMPS ARE DETAILED IN THE SPECIFICATIONS.
4. ALL CONSTRUCTION STORMWATER AND EXCAVATION DEWATERING WATER WILL BE CHEMICALLY TREATED AND THEN DISCHARGED TO THE SR 518 CONSTRUCTION STORMWATER POND FOR INFILTRATION WITH CONTINGENCY OVERFLOW DISCHARGE TO MILLER CREEK VIA AN EXISTING VEGETATED SWALE, SEE SHEET CE02.1.

LEGEND:

- PROJECT WORK AREA LIMITS
- SILT FENCE
- TEMPORARY CONSTRUCTION FENCE
- CATCH BASIN INLET PROTECTION
- WHEEL WASH
- SOIL EXCAVATION AREAS
- STAGING AREA
- ON-SITE ASPHALT PAVEMENT
- STORMWATER DRAINAGE LINE
- GENERAL DIRECTION OF SURFACE FLOW
- ELEVATION CONTOUR IN FEET (NAVD 88)
- SUPPORT ZONE
- EXISTING FENCE
- GRAVEL PAD (12" MIN)



KEY MAP

NTS

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING STATE OF WASHINGTON REGISTERED PROFESSIONAL ENGINEER 3/13/17

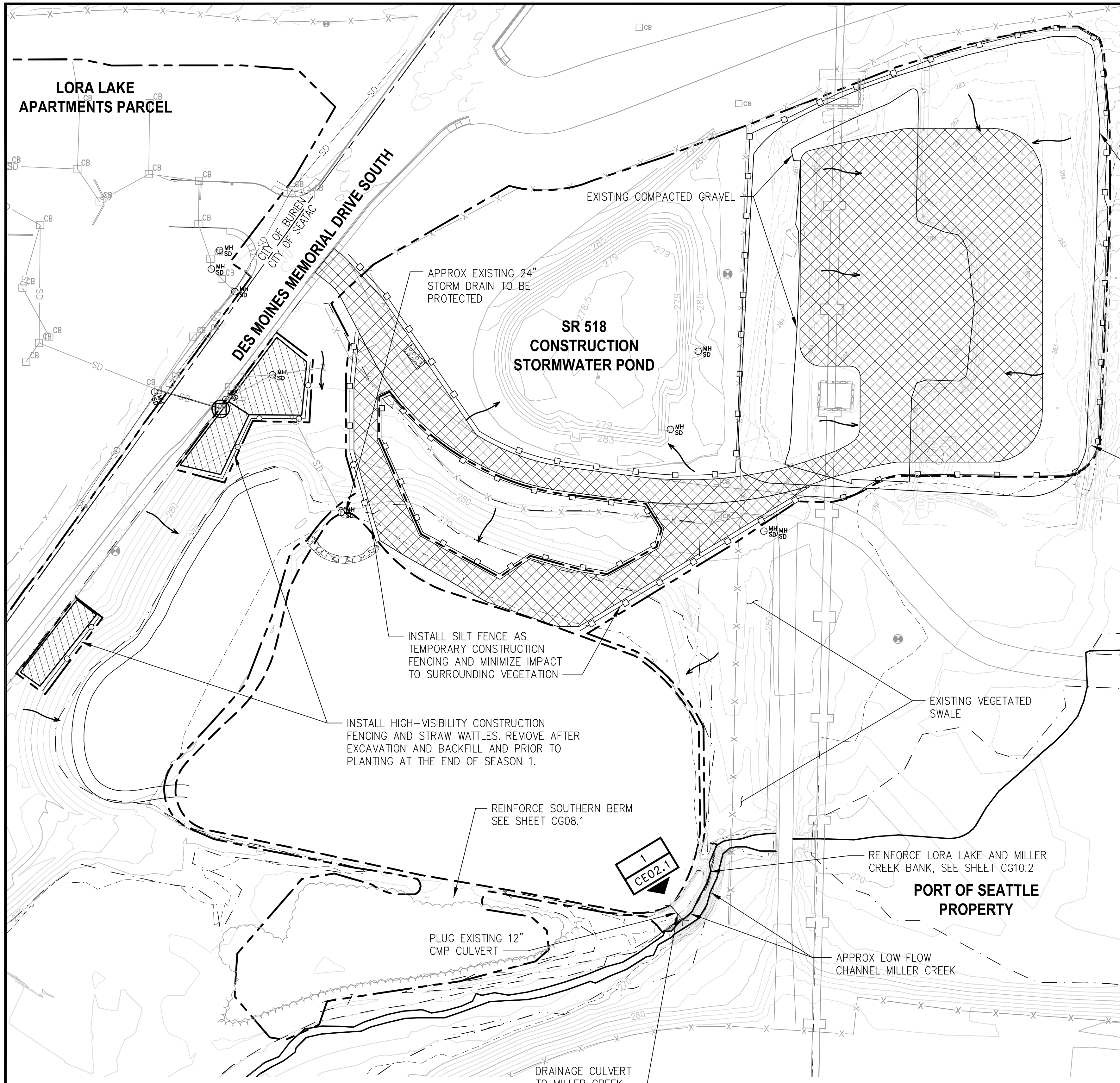
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN - MINIMUM REQUIREMENTS

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CE01.1



PLAN
LL AND DMCA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN
SCALE: 1" = 60'

1"=60' 60 0 60 120 Scale Feet

N

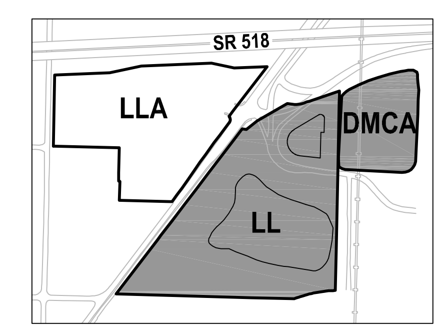
PHOTO 1/CE02.1
LL AND DMCA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN
CREEK DRAINAGE CULVERT

TESC NOTES:

1. VEGETATION OUTSIDE OF IDENTIFIED ACCESS AND HAUL ROUTES AND SOIL EXCAVATION AREAS TO BE PROTECTED.
2. SURFACE COMPLETION OCCURS FIRST PRIOR TO USE AS CONSTRUCTION ACCESS AND STAGING AREA.
3. SOIL STOCKPILING ALLOWED IN CONSTRUCTION ACCESS AND STAGING AREAS ONLY. STOCKPILE BMP'S ARE DETAILED IN THE PROJECT SPECIFICATIONS.
4. ALL CONSTRUCTION STORMWATER, LAKE DEWATERING AND EXCAVATION DEWATERING WATER WILL BE CHEMICALLY TREATED AND THEN DISCHARGED TO THE SR 518 CONSTRUCTION STORMWATER POND FOR INFILTRATION WITH CONTINGENCY OVERFLOW DISCHARGE TO MILLER CREEK VIA AN EXISTING VEGETATED SWALE. SEE SHEET CE02.1.

LEGEND:

- PROJECT WORK AREA LIMITS
- SILT FENCE
- HIGH VISIBILITY CONSTRUCTION FENCING AND STRAW WATTLES
- WHEEL WASH
- CONSTRUCTION ACCESS AND STAGING AREA
- SOIL EXCAVATION AREAS
- LORA LAKE CLEANUP AREA
- 270 ELEVATION CONTOUR IN FEET (NAVD 88)
- RESTRICTIVE COVENANT BOUNDARY
- WETLAND BOUNDARY
- EXISTING FENCE
- 100-YEAR FLOOD PLAIN BOUNDARY
- SURFACE FLOW
- SD STORMWATER DRAINAGE LINE
- CATCH BASIN INLET PROTECTION
- HIGH VISIBILITY FENCE AND ECOLOGY BLOCK TEMPORARY PROTECTION



KEY MAP
NTS

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PROJECT ENGR./ARCH:	JESSI MASSINGALE
DESIGNER:	JSM
DRAWN BY:	JKH
SCALE:	AS SHOWN
DATE:	8/29/2016
CHECKED BY:	MMK
CHECKED/APPROVED BY:	MMK

JESSICA S. MASSINGALE STATE OF WASHINGTON 46140 REGISTERED PROFESSIONAL ENGINEER
EXP. 10/29/18

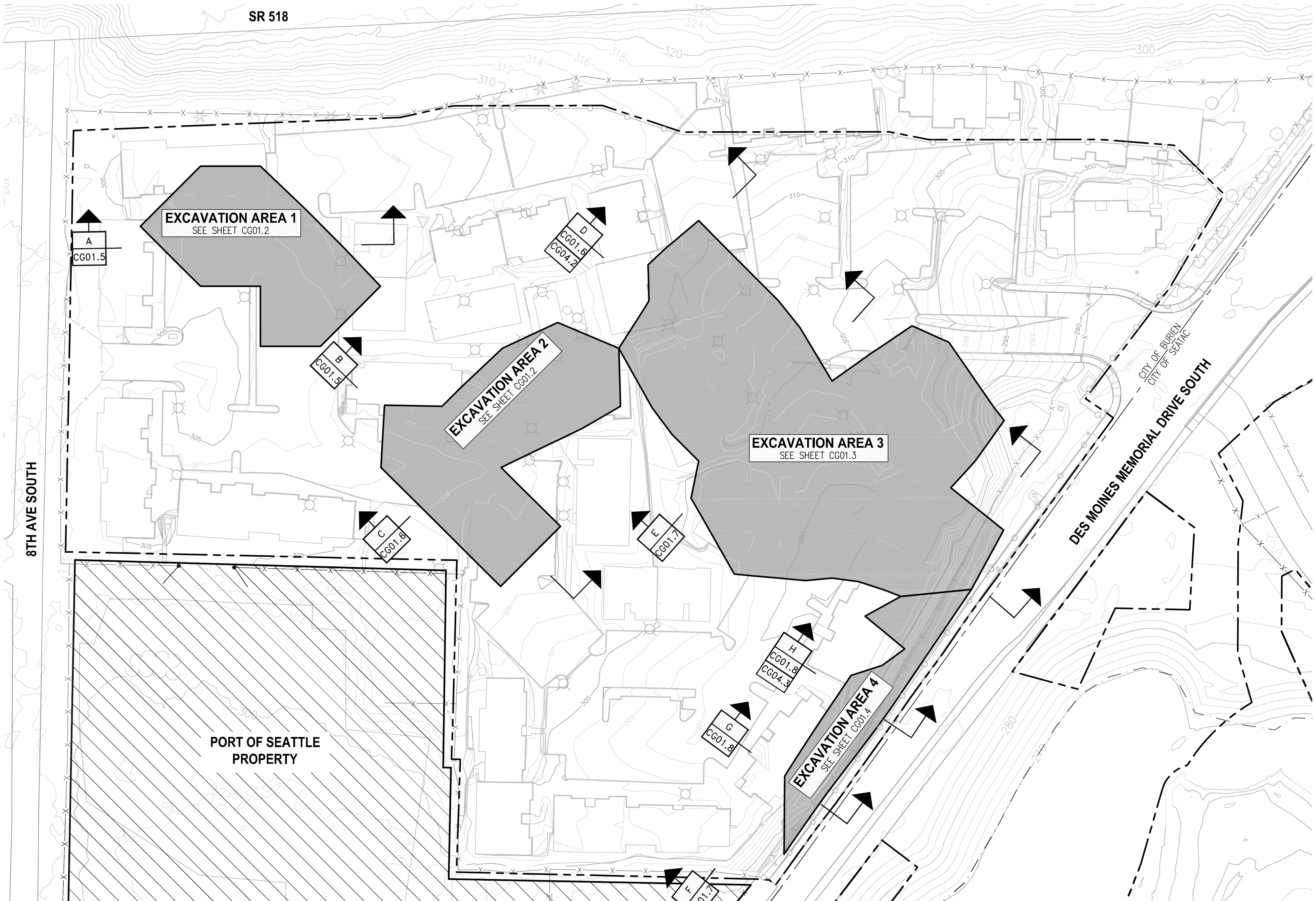
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:	
POS PROJECT ENGINEER:	
POS DESIGN ENGINEER:	
POS DRAFTER:	
POS SCALE:	
POS DATE:	
POS CHECKED/APPROVED BY:	

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL AND DMCA TEMPORARY EROSION AND SEDIMENT CONTROL PLAN - MINIMUM REQUIREMENTS

POS WORK PROJECT NUMBER	104396, 104396
CONSULTANT'S PROJECT NUMBER	POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER	STIA-1701 CE02.1



LEGEND:

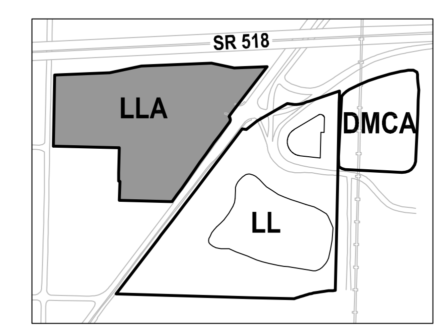
- PROJECT WORK AREA LIMITS
- CONTAMINATED SOIL EXCAVATION AREA
- ELEVATION CONTOUR IN FEET (NAVD 88)
- EXISTING FENCE
- STAGING AREA
- TEMPORARY CONSTRUCTION FENCE
- PERMANENT GATE – TO BE INSTALLED

PLAN

LLA EXCAVATION PLAN
SCALE: 1" = 40'

1"=40' 40 0 40 80
Scale Feet

N



KEY MAP
NTS

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

REVISIONS

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POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**
SHEET TITLE: **LLA EXCAVATION PLAN**

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG01.1

PLAN
LLA EXCAVATION PLAN – AREAS 1 AND 2
SCALE: 1" = 20'

1"=20' Scale 20 0 20 40 Feet

N

LLA EXCAVATION AREA 1 CONTROL POINTS		
Point #	Northing	Easting
1	174801.10	1271966.40
2	174828.10	1271993.50
3	174773.00	1271994.60
4	174756.10	1272011.40
5	174846.10	1272011.40
6	174800.00	1272021.60
7	174846.10	1272032.00
8	174756.10	1272034.20
9	174771.70	1272049.90
10	174828.30	1272049.90
11	174711.10	1272056.40
12	174721.70	1272056.40
13	174756.10	1272056.40
14	174846.10	1272056.40
15	174840.60	1272062.20
16	174743.40	1272078.10
17	174800.00	1272078.10
18	174813.00	1272091.10
19	174711.10	1272101.40
20	174715.60	1272106.00
21	174771.70	1272106.40
22	174784.60	1272119.30
23	174743.90	1272134.20
24	174756.10	1272146.40

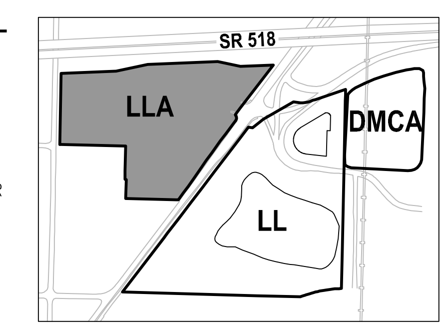
LLA EXCAVATION AREA 2 CONTROL POINTS		
Point #	Northing	Easting
25	174620.30	1272146.80
26	174667.00	1272149.40
27	174666.80	1272159.00
28	174649.60	1272176.20
29	174590.00	1272177.40
30	174666.10	1272192.70
31	174619.20	1272206.60
32	174680.00	1272206.60
33	174559.70	1272207.80
34	174531.00	1272236.50
35	174620.20	1272236.90
36	174588.80	1272237.00
37	174649.60	1272237.00
38	174709.60	1272237.90
39	174604.50	1272252.70
40	174629.80	1272256.80
41	174560.20	1272265.60
42	174680.00	1272267.40
43	174729.00	1272279.30
44	174576.10	1272281.40
45	174649.60	1272297.80
46	174710.40	1272297.80
47	174718.00	1272305.30
48	174709.60	1272325.20
49	174682.30	1272326.00
50	174677.90	1272326.10
51	174666.10	1272326.40

NOTES:

1. SEE SHEET CB01.2 FOR UTILITY DEMOLITION.

LEGEND:

- PROJECT WORK AREA LIMITS
- CONTAMINATED SOIL EXCAVATION AREA
- 000.0 EXCAVATION DEPTH ELEVATION IN FEET (NAVD 88)
- XXX CONTROL POINT
- FENCE
- P(D) POWER
- W(D) WATER
- NG(D) NATURAL GAS
- SS(D) SANITARY SEWER
- T TELEPHONE



KEY MAP
NTS

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

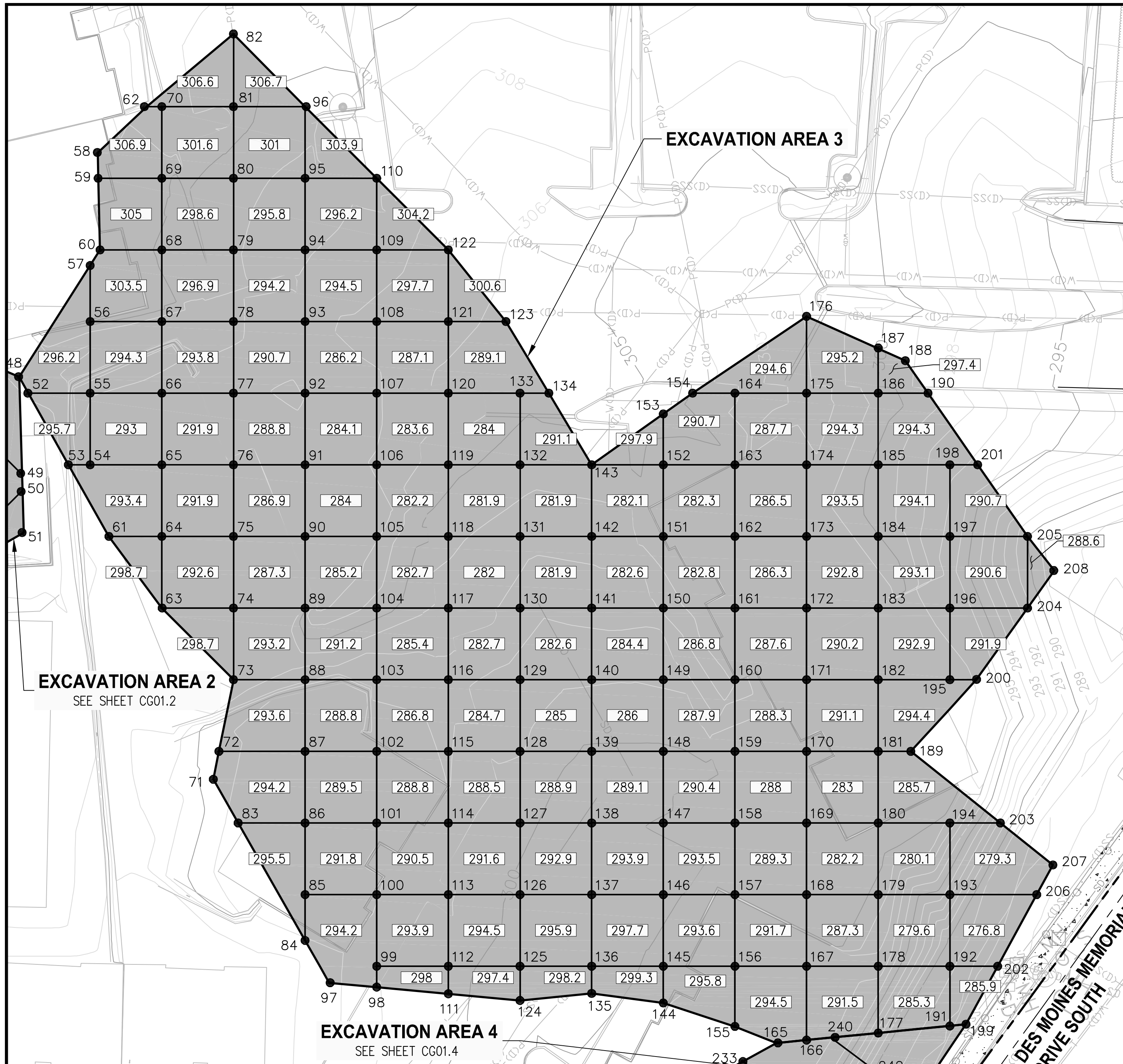
MEGAN MARIE KING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 3/18/17

REVISIONS									
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION PLAN - EXCAVATION AREAS 1 AND 2

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG01.2



PLAN

LLA EXCAVATION PLAN – AREA 3
SCALE: 1" = 20'

1"=20' 20 0 20 40
Scale Feet

N

LEGEND:

PROJECT WORK AREA LIMITS	POWER
CITY BOUNDARY	WATER
CONTAMINATED SOIL EXCAVATION AREA	NATURAL GAS
000.0 EXCAVATION DEPTH ELEVATION IN FEET (NAVD 88)	SANITARY SEWER
XXX CONTROL POINT	TELEPHONE
PAVED SIDEWALK (TO BE PROTECTED)	TEMPORARY CONSTRUCTION FENCE

NOTES:

1. SEE SHEET CB01.2 FOR UTILITY DEMOLITION
2. IF ACCESSING EXCAVATION AREA FROM RIGHT OF WAY, TRAFFIC CONTROL REQUIREMENTS APPLY. SEE SHEET G04.3

LLA EXCAVATION AREA 3 CONTROL POINTS

Point #	Northing	Easting
52	174705.00	1272327.80
53	174685.00	1272339.00
54	174685.00	1272345.00
55	174705.00	1272345.00
56	174725.00	1272345.00
57	174740.70	1272345.00
58	174772.20	1272347.10
59	174765.00	1272347.30
60	174745.00	1272347.80
61	174665.00	1272350.20
62	174785.00	1272360.80
63	174645.00	1272365.00
64	174665.00	1272365.00
65	174685.00	1272365.00
66	174705.00	1272365.00
67	174725.00	1272365.00
68	174745.00	1272365.00
69	174765.00	1272365.00
70	174785.00	1272365.00
71	174597.20	1272379.40
72	174605.00	1272381.00
73	174625.00	1272385.00
74	174645.00	1272385.00
75	174665.00	1272385.00
76	174685.00	1272385.00
77	174705.00	1272385.00
78	174725.00	1272385.00
79	174745.00	1272385.00
80	174765.00	1272385.00
81	174785.00	1272385.00
82	174805.30	1272385.00
83	174585.00	1272386.30
84	174552.20	1272405.00
85	174565.00	1272405.00
86	174585.00	1272405.00
87	174605.00	1272405.00
88	174625.00	1272405.00

LLA EXCAVATION AREA 3 CONTROL POINTS CONT'D

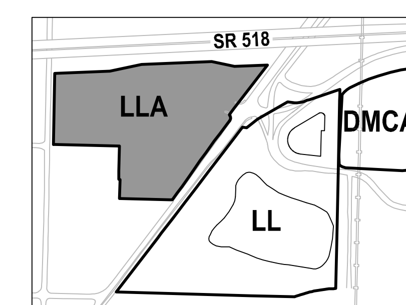
Point #	Northing	Easting
89	174645.00	1272405.00
90	174665.00	1272405.00
91	174685.00	1272405.00
92	174705.00	1272405.00
93	174725.00	1272405.00
94	174745.00	1272405.00
95	174765.00	1272405.00
96	174785.00	1272405.00
97	174540.40	1272411.70
98	174539.10	1272425.00
99	174545.00	1272425.00
100	174565.00	1272425.00
101	174585.00	1272425.00
102	174605.00	1272425.00
103	174625.00	1272425.00
104	174645.00	1272425.00
105	174665.00	1272425.00
106	174685.00	1272425.00
107	174705.00	1272425.00
108	174725.00	1272425.00
109	174745.00	1272425.00
110	174765.00	1272425.00
111	174537.30	1272445.00
112	174545.00	1272445.00
113	174565.00	1272445.00
114	174585.00	1272445.00
115	174605.00	1272445.00
116	174625.00	1272445.00
117	174645.00	1272445.00
118	174665.00	1272445.00
119	174685.00	1272445.00
120	174705.00	1272445.00
121	174725.00	1272445.00
122	174745.00	1272445.00
123	174725.00	1272461.00
124	174535.40	1272465.00
125	174545.00	1272465.00
126	174565.00	1272465.00
127	174585.00	1272465.00
128	174605.00	1272465.00
129	174625.00	1272465.00
130	174645.00	1272465.00
131	174665.00	1272465.00
132	174685.00	1272465.00
133	174705.00	1272465.00
134	174705.00	1272473.00
135	174537.40	1272485.00

LLA EXCAVATION AREA 3 CONTROL POINTS CONT'D

Point #	Northing	Easting
136	174545.00	1272485.00
137	174565.00	1272485.00
138	174585.00	1272485.00
139	174605.00	1272485.00
140	174625.00	1272485.00
141	174645.00	1272485.00
142	174665.00	1272485.00
143	174685.00	1272485.00
144	174534.70	1272505.00
145	174545.00	1272505.00
146	174565.00	1272505.00
147	174585.00	1272505.00
148	174605.00	1272505.00
149	174625.00	1272505.00
150	174645.00	1272505.00
151	174665.00	1272505.00
152	174685.00	1272505.00
153	174699.20	1272505.00
154	174705.00	1272513.20
155	174528.20	1272525.00
156	174545.00	1272525.00
157	174565.00	1272525.00
158	174585.00	1272525.00
159	174605.00	1272525.00
160	174625.00	1272525.00
161	174645.00	1272525.00
162	174665.00	1272525.00
163	174685.00	1272525.00
164	174705.00	1272525.00
165	174523.60	1272536.60
166	174524.40	1272545.00
167	174545.00	1272545.00
168	174565.00	1272545.00
169	174585.00	1272545.00
170	174605.00	1272545.00
171	174625.00	1272545.00
172	174645.00	1272545.00
173	174665.00	1272545.00
174	174685.00	1272545.00
175	174705.00	1272545.00
176	174726.40	1272545.00
177	174526.40	1272565.00
178	174545.00	1272565.00
179	174565.00	1272565.00
180	174585.00	1272565.00
181	174605.00	1272565.00
182	174625.00	1272565.00

LLA EXCAVATION AREA 3 CONTROL POINTS CONT'D

Point #	Northing	Easting
183	174645.00	1272565.00
184	174665.00	1272565.00
185	174685.00	1272565.00
186	174705.00	1272565.00
187	174717.50	1272565.00
188	174714.10	1272572.60
189	174605.00	1272574.10
190	174705.00	1272578.90
191	174528.40	1272585.00
192	174545.00	1272585.00
193	174565.00	1272585.00
194	174585.00	1272585.00
195	174625.00	1272585.00
196	174645.00	1272585.00
197	174665.00	1272585.00
198	174685.00	1272585.00
199	174528.80	1272589.50
200	174625.00	1272592.40
201	174685.00	1272592.80
202	174545.00	1272598.30
203	174585.00	1272599.10
204	174645.00	1272606.70
205	174665.00	1272606.70
206	174565.00	1272609.20
207	174573.30	1272613.80
208	174655.50	1272614.10



KEY MAP

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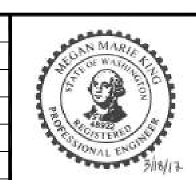
PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK



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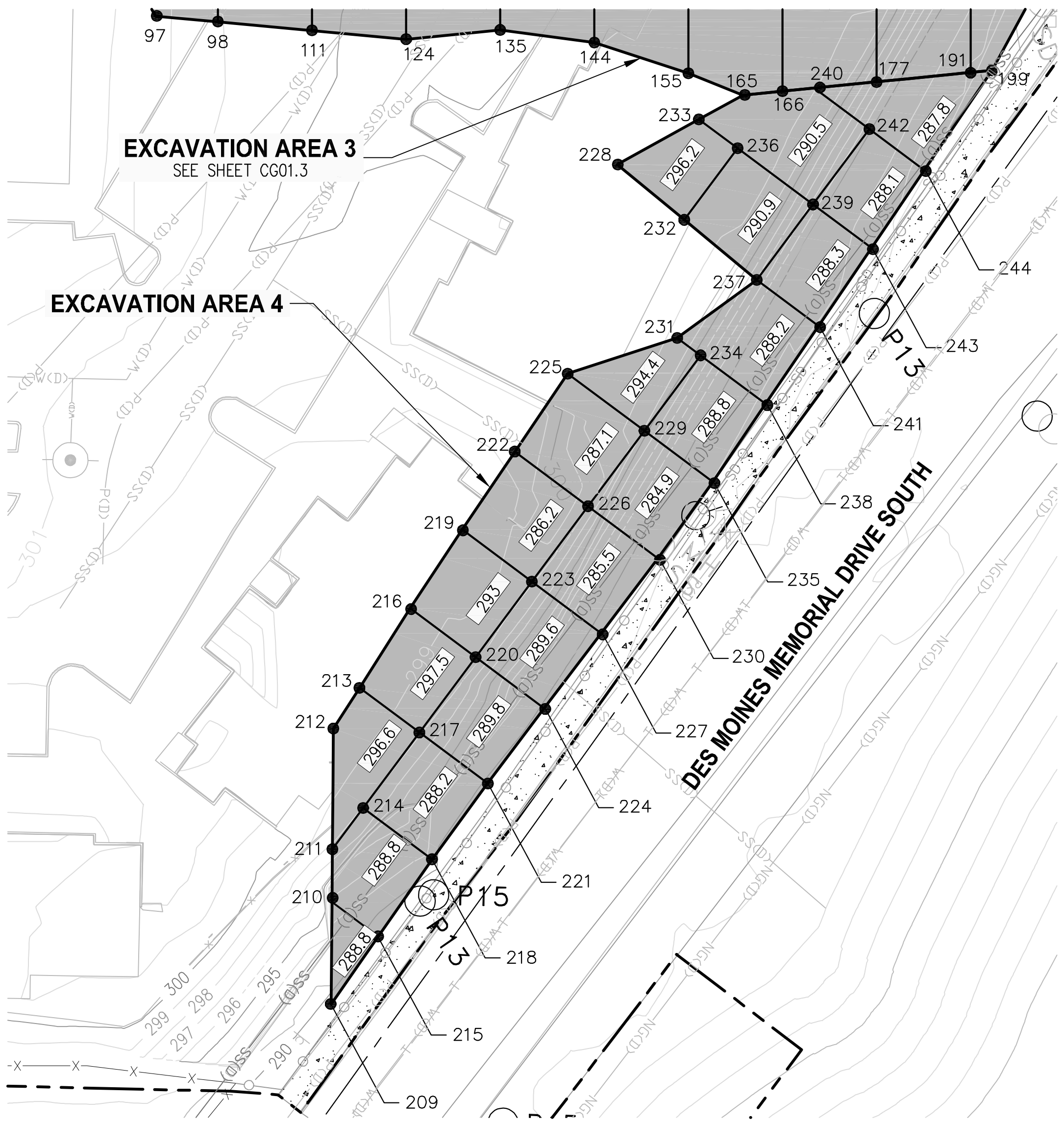
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION PLAN - EXCAVATION AREA 3

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG01.3



PLAN

LLA EXCAVATION PLAN – AREA 4
SCALE: 1" = 20'

1"=20' 20 0 20 40
Scale Feet

N

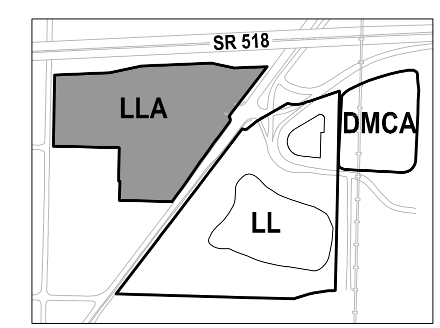
LLA EXCAVATION AREA 4 CONTROL POINTS		
POINT #	NORTHING	EASTING
209	174330.30	1272449.10
210	174352.00	1272449.20
211	174363.30	1272449.30
212	174388.90	1272449.50
213	174397.60	1272455.10
214	174372.00	1272455.90
215	174344.70	1272459.10
216	174414.50	1272465.90
217	174388.10	1272467.80
218	174361.10	1272470.50
219	174431.20	1272476.90
220	174404.10	1272479.80
221	174377.30	1272482.30
222	174447.80	1272488.10
223	174420.10	1272491.70
224	174393.20	1272494.40
225	174464.30	1272499.30
226	174436.20	1272503.70
227	174409.20	1272506.40
228	174508.80	1272509.90
229	174452.20	1272515.60
230	174425.10	1272518.50
231	174471.90	1272522.60
232	174497.00	1272524.10
233	174518.40	1272527.20
234	174468.20	1272527.60
235	174441.40	1272530.20
236	174512.30	1272535.50
237	174484.30	1272539.50
238	174457.90	1272541.40
239	174500.30	1272551.50
240	174525.10	1272551.70
241	174474.50	1272552.70
242	174516.30	1272563.40
243	174491.10	1272563.90
244	174507.60	1272575.10

NOTES:

1. SEE SHEET CB01.2 FOR UTILITY DEMOLITION.
2. IF ACCESSING EXCAVATION AREAS FROM RIGHT OF WAY, TRAFFIC CONTROL REQUIREMENTS APPLY. SEE SHEET G04.3.
3. POWER LINE IN RIGHT OF WAY IS OVERHEAD.

LEGEND:

— — —	PROJECT WORK AREA LIMITS
	CONTAMINATED SOIL EXCAVATION AREA
000.0	EXCAVATION DEPTH ELEVATION IN FEET (NAVD 88)
XXX	CONTROL POINT
SD	STORM DRAIN LINES
P(D)	POWER
W(D)	WATER
NG(D)	NATURAL GAS
SS(D)	SANITARY SEWER
T	TELEPHONE
	TEMPORARY CONSTRUCTION FENCE
	PAVED SIDEWALK (TO BE PROTECTED)
	CITY BOUNDARY
P13	OVERHEAD POWER POLE – TO BE PROTECTED
	FIRE HYDRANT – TO BE PROTECTED



KEY MAP

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PROJECT ENGR./ARCH.: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
3/18/17

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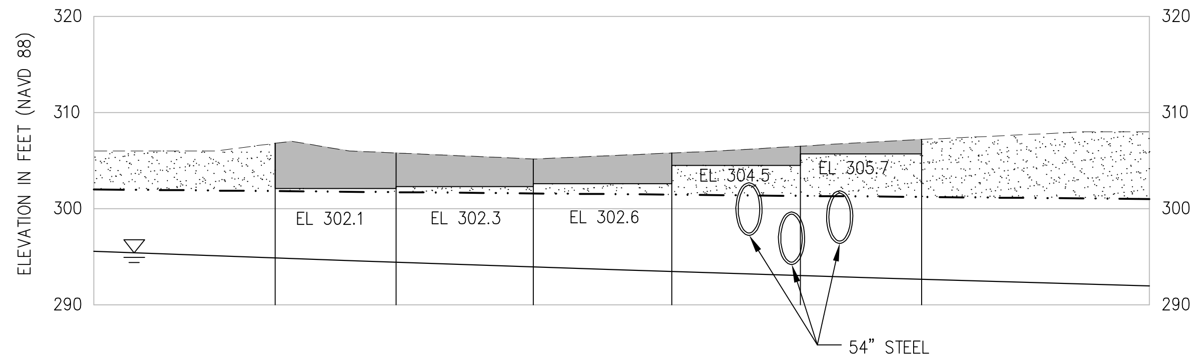
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION PLAN - EXCAVATION AREA 4

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG01.4

NOTES:

1. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.
2. EXCAVATION SECTIONS SHOWN ARE POST CLEARING AND GRUBBING,
3. SEE SHEET CB01.2 FOR UTILITY DEMOLITION



SECTION A
CG01.1
LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

LEGEND:

EXISTING GROUND SURFACE

STORM DRAIN SYSTEM – TO BE REMOVED

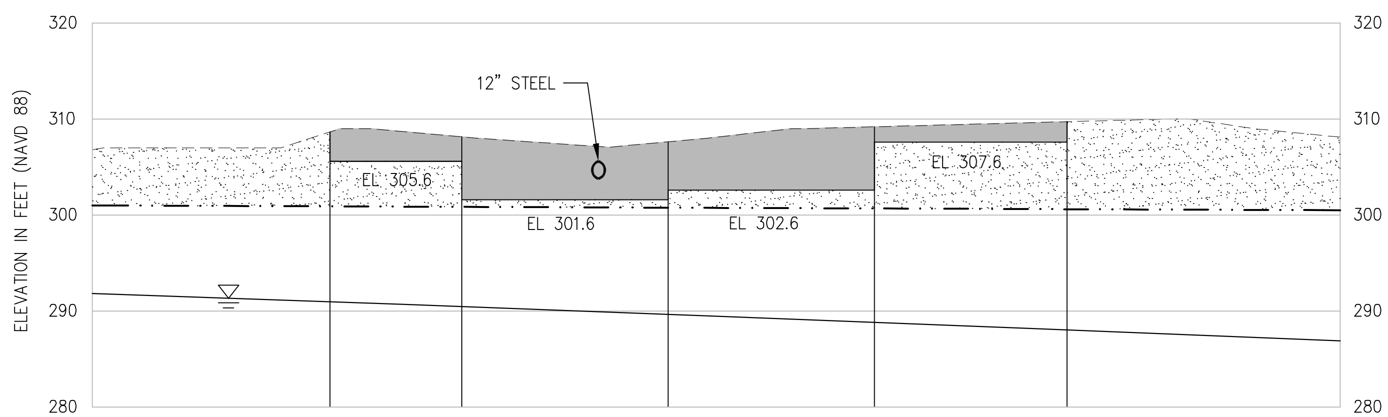
APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)

EXCAVATION OF CONTAMINATED SOIL

DETENTION TANKS – TO BE REMOVED

FINAL GRADE

COMMON EXCAVATION



SECTION B
CG01.1
LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

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DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
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MEGAN MARIE KING
STATE OF WASHINGTON
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PROFESSIONAL ENGINEER
3/8/17

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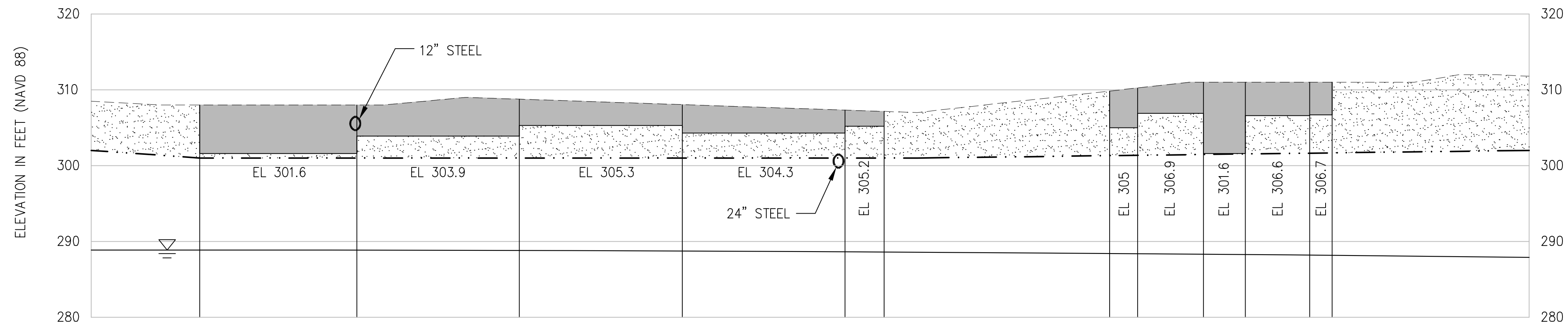
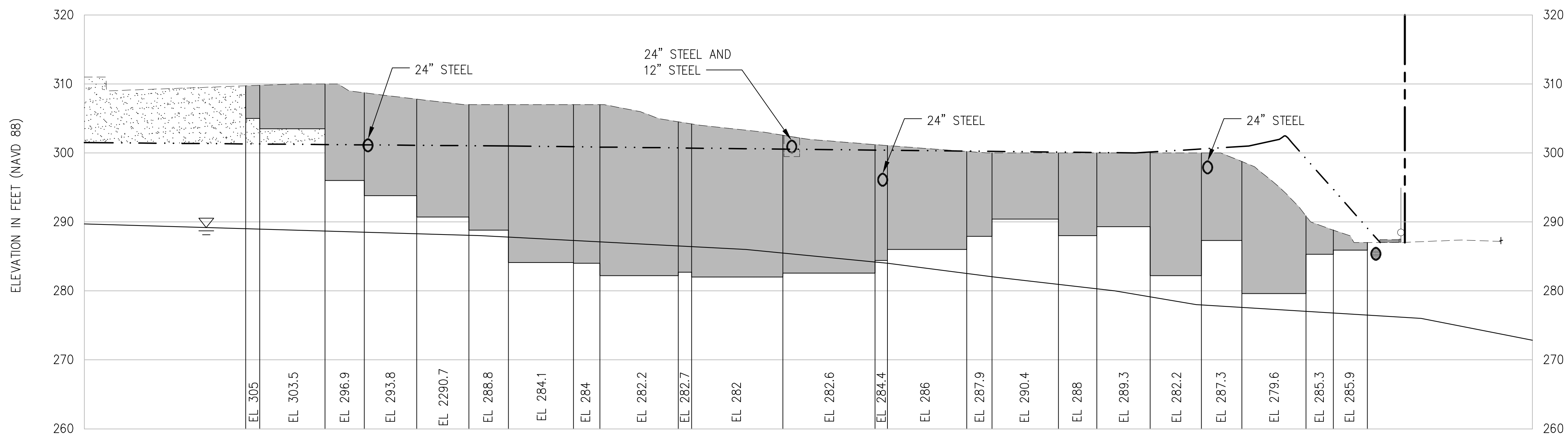
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION SECTIONS A AND B

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG01.5



SECTION C / CG01.1
LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'



SECTION D / CG01.1
LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

NOTES:

1. TEMPORARY CONSTRUCTION FENCE WILL BE USED WHILE WORKING ADJACENT TO DES MOINES MEMORIAL DRIVE SOUTH AND SIDEWALK WILL BE CLOSED.
2. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.
3. EXCAVATION SECTIONS SHOWN ARE POST CLEARING AND GRUBBING. ROOT MASSES TO BE DISPOSED OF AT SUBTITLE D LANDFILL.
4. SEE SHEET CB01.2 FOR UTILITY DEMOLITION

LEGEND:

- PROJECT WORK AREA LIMITS
- EXISTING GROUND SURFACE
- STORM DRAIN SYSTEM – TO BE REMOVED
- CATCH BASIN – TO BE REMOVED
- TEMPORARY CONSTRUCTION FENCE
- APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)
- EXCAVATION OF CONTAMINATED SOIL
- PAVED SIDEWALK – TO BE PROTECTED
- FINAL GRADE
- COMMON EXCAVATION

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING — STATE OF WASHINGTON — REGISTERED PROFESSIONAL ENGINEER — 3/13/17

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POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
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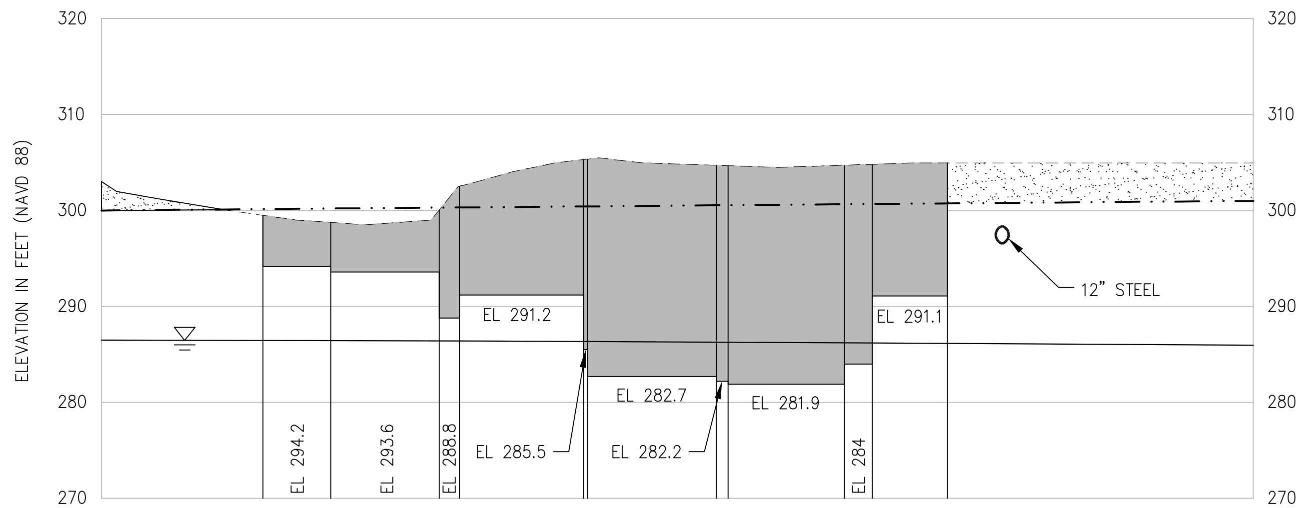
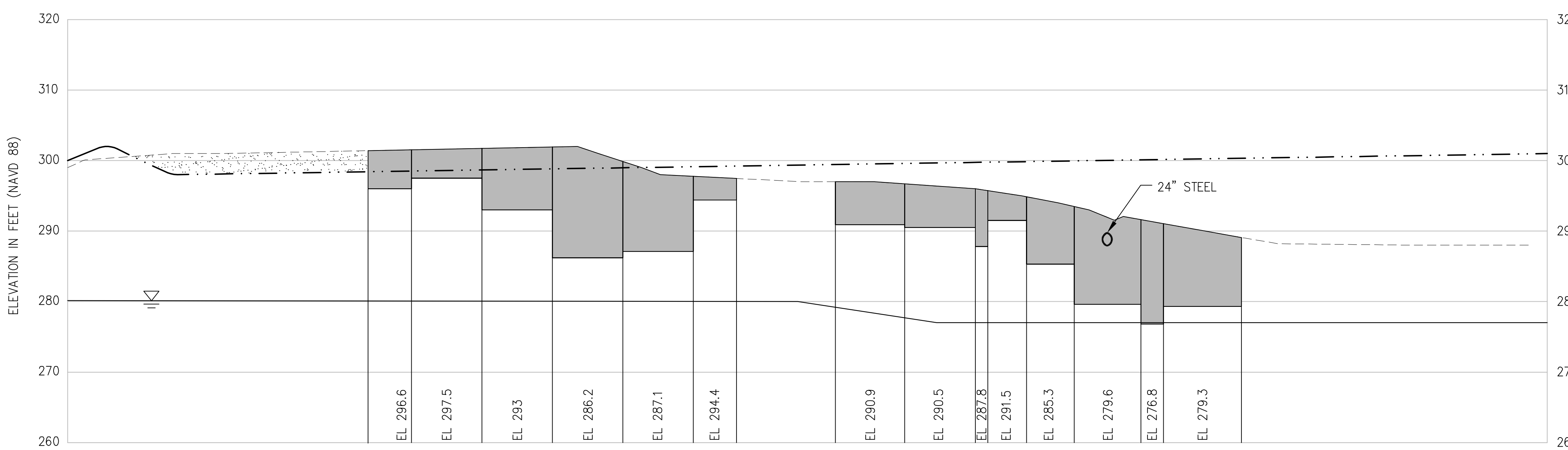
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION SECTIONS C AND D

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG01.6



SECTION E CG01.1

LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'



SECTION F CG01.1

LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

NOTES:

1. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.
2. EXCAVATION SECTIONS SHOWN ARE POST CLEARING AND GRUBBING. ROOT MASSES TO BE DISPOSED OF AT SUBTITLE D LANDFILL.
3. SEE SHEET CB01.2 FOR UTILITY DEMOLITION.

LEGEND:

- EXISTING GROUND SURFACE
- STORM DRAIN SYSTEM – TO BE REMOVED
- APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)
- EXCAVATION OF CONTAMINATED SOIL
- FINAL GRADE
- COMMON EXCAVATION

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED
PROFESSIONAL ENGINEER
3/18/17

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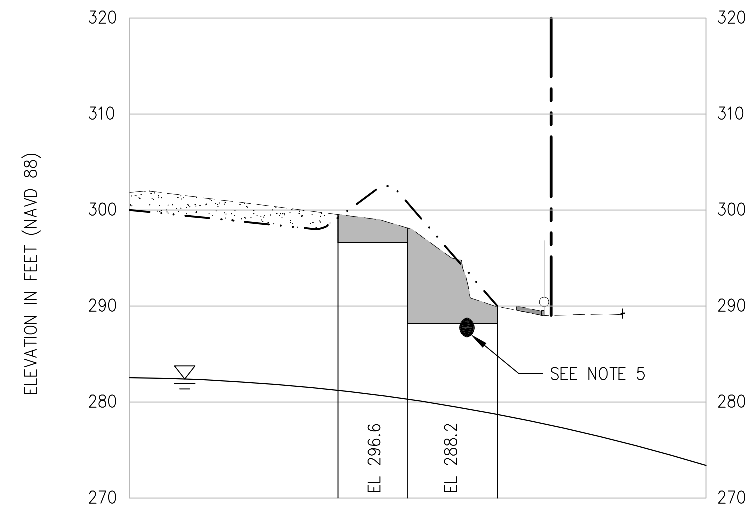
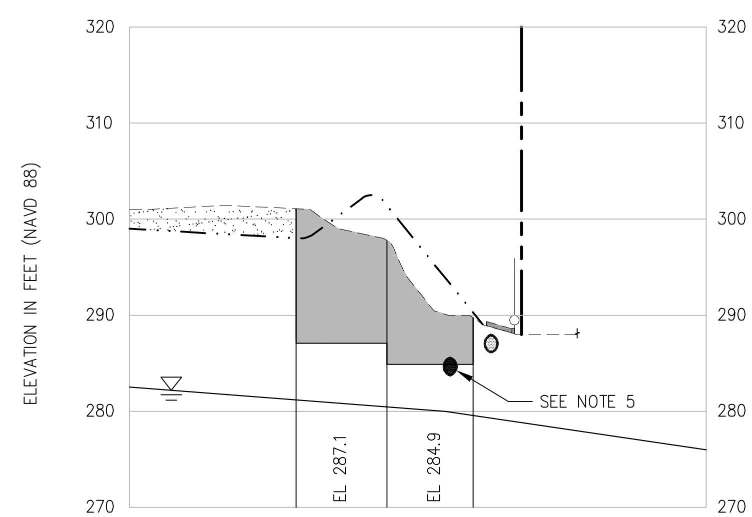
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS
MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION SECTIONS E AND F

POS WORK PROJECT NUMBER
104396, 104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG01.7



SECTION G / CG01.1
LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'



SECTION H / CG01.1
LLA EXCAVATION SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

NOTES:

1. TEMPORARY CONSTRUCTION FENCE WILL BE USED WHILE WORKING ADJACENT TO DES MOINES MEMORIAL DRIVE SOUTH AND SIDEWALK WILL BE CLOSED.
2. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.
3. EXCAVATION SECTIONS SHOWN ARE POST CLEARING AND GRUBBING. ROOT MASSES TO BE DISPOSED OF AT SUBTITLE D LANDFILL.
4. SEE SHEET CB01.2 FOR UTILITY DEMOLITION
5. DEPTH OF SANITARY SEWER LINES UNKNOWN. CONTRACTOR TO LOCATE PRIOR TO EXCAVATION.

LEGEND:

- PROJECT WORK AREA LIMIT
- EXISTING GROUND SURFACE
- STORM DRAIN SYSTEM – TO BE REMOVED
- TEMPORARY CONSTRUCTION FENCE
- APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)
- EXCAVATION OF CONTAMINATED SOIL
- STORM DRAIN SYSTEM – TO REMAIN
- PAVED SIDEWALK – TO BE PROTECTED
- FINAL GRADE
- COMMON EXCAVATION
- ACTIVE UTILITIES TO REMAIN

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER
3/18/17

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POS DATE:
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Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA EXCAVATION SECTIONS G AND H

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG01.8

PLAN

LLA DEWATERING PLAN
SCALE: 1" = 40'

1"=40' 40 0 40 80
Scale Feet

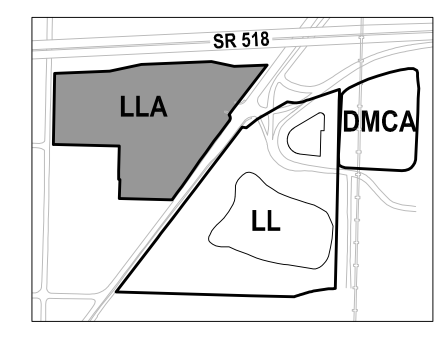
N

NOTES:

1. AREAS EXPECTED TO REQUIRE DEWATERING WERE DETERMINED FROM THE WET SEASON GROUNDWATER CONTOURS GENERATED IN JANUARY 2011.
2. STORMWATER DRAINAGE LINE TO BE PROTECTED MAY BE USED TO DIRECT DEWATERING WATER ACROSS ROADWAY FOR TREATMENT. TO BE COORDINATED WITH AND APPROVED BY ENGINEER. ALL CONSTRUCTION STORMWATER AND DEWATERING WATER WILL BE CHEMICALLY TREATED AND THEN DISCHARGED TO THE SR 518 CONSTRUCTION STORMWATER POND FOR INFILTRATION.
3. CONTRACTOR TO INSTALL TEMPORARY PUMPS/PIPING FOR TRANSFER OF DEWATERING WATER TO THE SR 518 CONSTRUCTION STORMWATER POND. WATER FROM THE LL APARTMENTS MAY NOT DISCHARGE TO LORA LAKE.

LEGEND:

- AREAS EXPECTED TO REQUIRE DEWATERING
- PROJECT WORK AREA LIMITS
- EXISTING FENCE
- STAGING AREA
- SOIL EXCAVATION AREAS
- STORM DRAIN LINES



KEY MAP

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER
3/18/17

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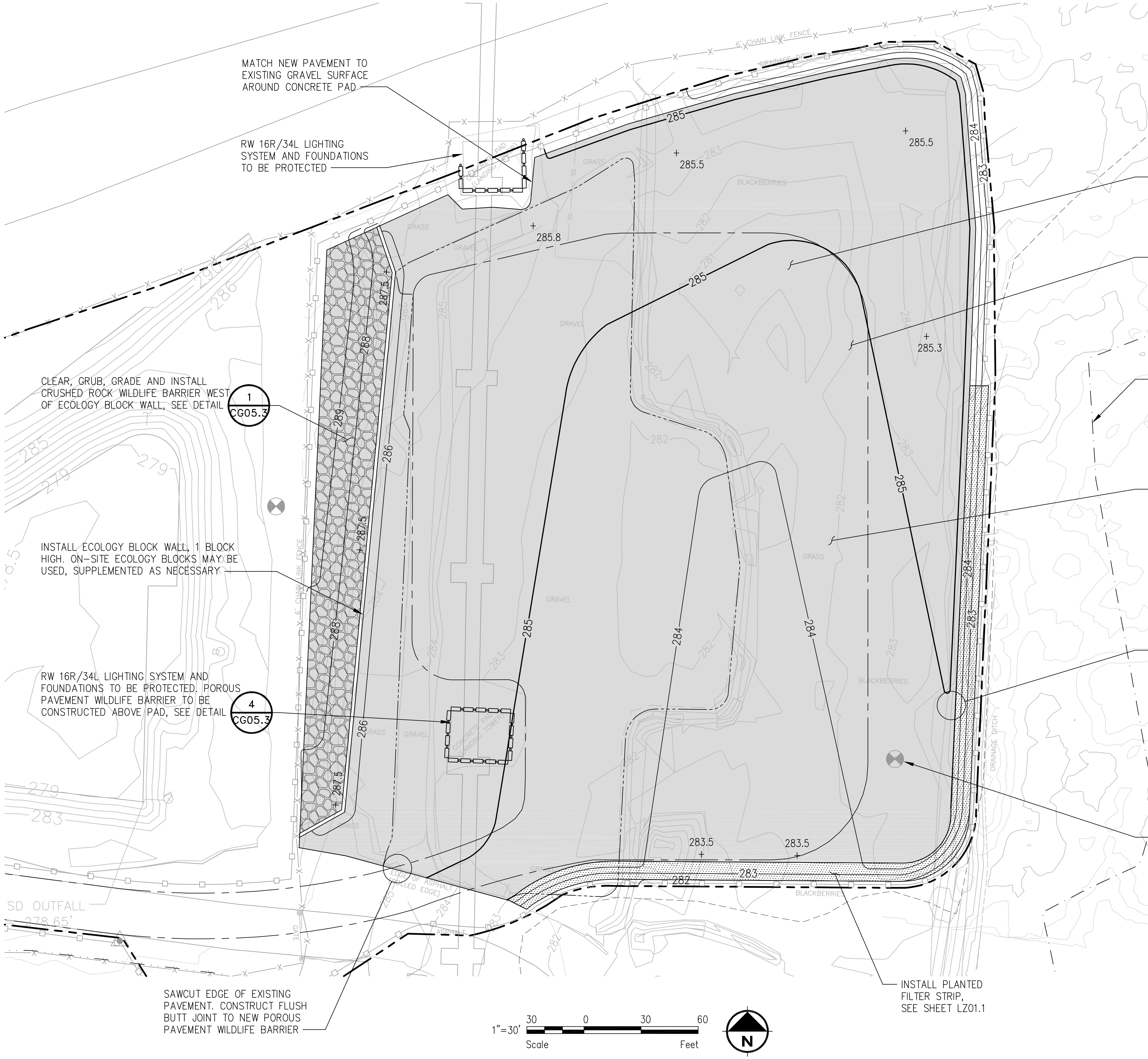
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS

SHEET TITLE: LLA DEWATERING PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG02.1



NOTES:

1. 2013 WETLAND 8 DELINEATION SITE VISIT AND RATING UPDATE FROM MARCH 2016.
2. 100 YEAR FLOOD PLAIN BOUNDARY SHOWN REPRESENTS FEMA 2007 DELINEATION.

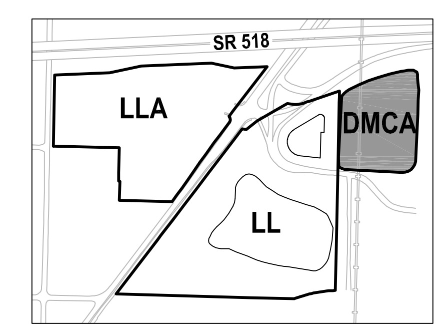
LEGEND:

- PROJECT WORK AREA LIMITS
- SILT FENCE
- PLANTED FILTER STRIP
- LORA LAKE CLEANUP AREA
- 100 YEAR FLOOD PLAIN BOUNDARY
- ELEVATION CONTOUR IN FEET (NAVD 88)
- WETLAND BOUNDARY
- EXISTING MONITORING WELL
- POROUS PAVEMENT WILDLIFE BARRIER
- LIMITS OF EXISTING GRAVEL SURFACE
- CRUSHED ROCK WILDLIFE BARRIER
- CONSTRUCTION ACCESS AND STAGING AREA

CONSTRUCTION SEQUENCE:

THE FOLLOWING CONSTRUCTION SEQUENCE SHALL BE USED IN THE DMCA:

1. INSTALL TESC, AND DECOMISSION MONITORING WELL. INSTALL RUNWAY LIGHTING PROTECTION.
2. CLEAR AND GRUB VEGETATED AREAS WITHIN DMCA THAT ARE TO BE USED BY CONTRACTOR FOR SOIL STOCKPILE, STAGING, AND ACCESS. ROUGH GRADE AS DESIRED AND PLACE A 9" THICK CRUSHED ROCK WORKING SURFACE. THE EXISTING GRAVEL SURFACED AREAS CAN BE USED FOR CONTRACTOR STAGING IN THEIR CURRENT CONDITION.
3. FOLLOWING COMPLETION OF USE BY CONTRACTOR FOR SOIL STOCKPILE AND SOIL HANDLING, CLEAR AND GRUB REMAINING AREAS GRADE TO FINAL SUBGRADE ELEVATIONS, AND INSTALL POROUS PAVEMENT WILDLIFE BARRIER AND PLANTED FILTER STRIP.
4. AFTER POROUS PAVEMENT WILDLIFE BARRIER IS INSTALLED, USE OF DMCA FOR STOCKPILING OR HANDLING OF SOILS WILL NOT BE ALLOWED.



KEY MAP
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PROJECT ENGR./ARCH: KATHRYN SNIDER
DESIGNER: KHS
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

REVISIONS

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POS PROJECT ENGINEER:
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POS DATE:
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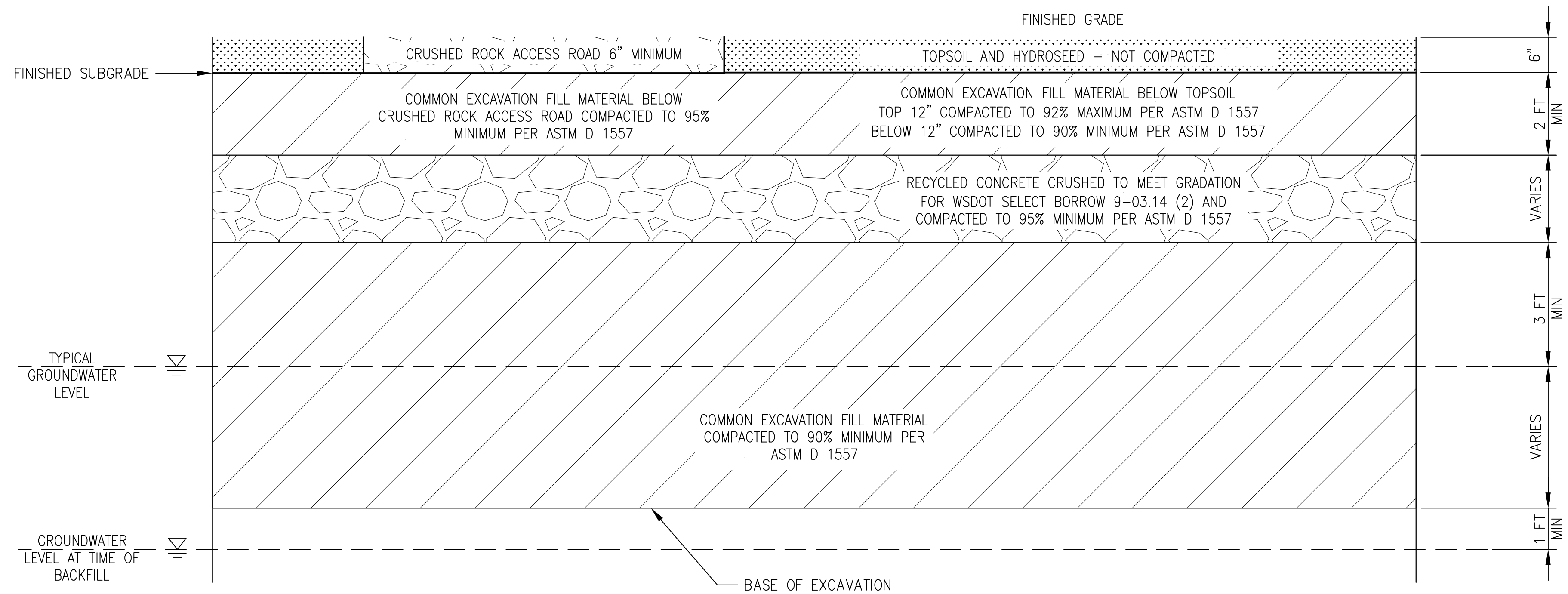
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: DMCA GRADING AND SURFACE COMPLETION PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG03.1



TYPICAL BACKFILL SECTION

LORA LAKE APARTMENTS PARCEL
SCALE: NTS

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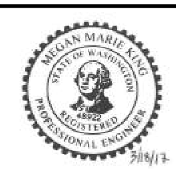
PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK



REVISIONS

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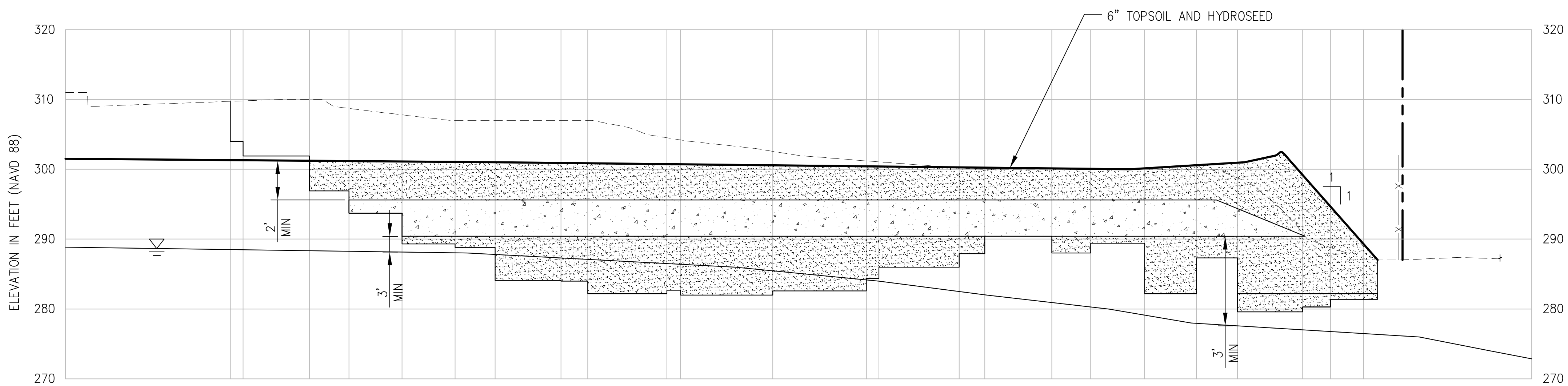
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA TYPICAL BACKFILL SECTION

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG04.1



LEGEND:

- EXCAVATION EXTENT
- APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88) PRIOR TO DEWATERING
- COMMON EXCAVATION FILL MATERIAL
- RECYCLED CRUSHED CONCRETE
- FINISHED GRADE
- EXISTING GROUND SURFACE
- FENCE TO BE INSTALLED
- PROJECT WORK AREA LIMITS

SECTION D / CG01.1

LLA BACKFILL SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

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PROJECT ENGR./ARCH:	MEGAN KING
DESIGNER:	MMK
DRAWN BY:	JKH
SCALE:	AS SHOWN
DATE:	8/29/2016
CHECKED BY:	JSM
CHECKED/APPROVED BY:	MMK

MEGAN MARIE KING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER, 48922, 3/18/17

REVISIONS

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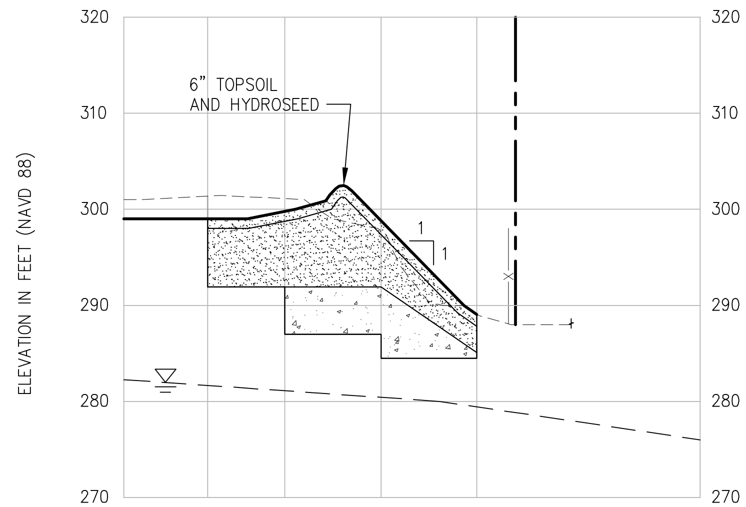
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**
SHEET TITLE: **LLA BACKFILL SECTION D**

POS WORK PROJECT NUMBER: **104396, 104396**
CONSULTANT'S PROJECT NUMBER: **POS-LLA/POS-LL**
POS PROJECT TRACKING NUMBER: **STIA-1701** **CG04.2**



SECTION H / CG01.1

LLA BACKFILL SECTION
SCALE: H: 1" = 20'
V: 1" = 10'

LEGEND:

- EXCAVATION EXTENT
- APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88) PRIOR TO DEWATERING
- COMMON EXCAVATION FILL MATERIAL
- RECYCLED CRUSHED CONCRETE
- FINISHED GRADE
- EXISTING GROUND SURFACE
- FENCE – TO BE INSTALLED
- PROJECT WORK AREA LIMITS

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER, 48922
3/13/17

REVISIONS

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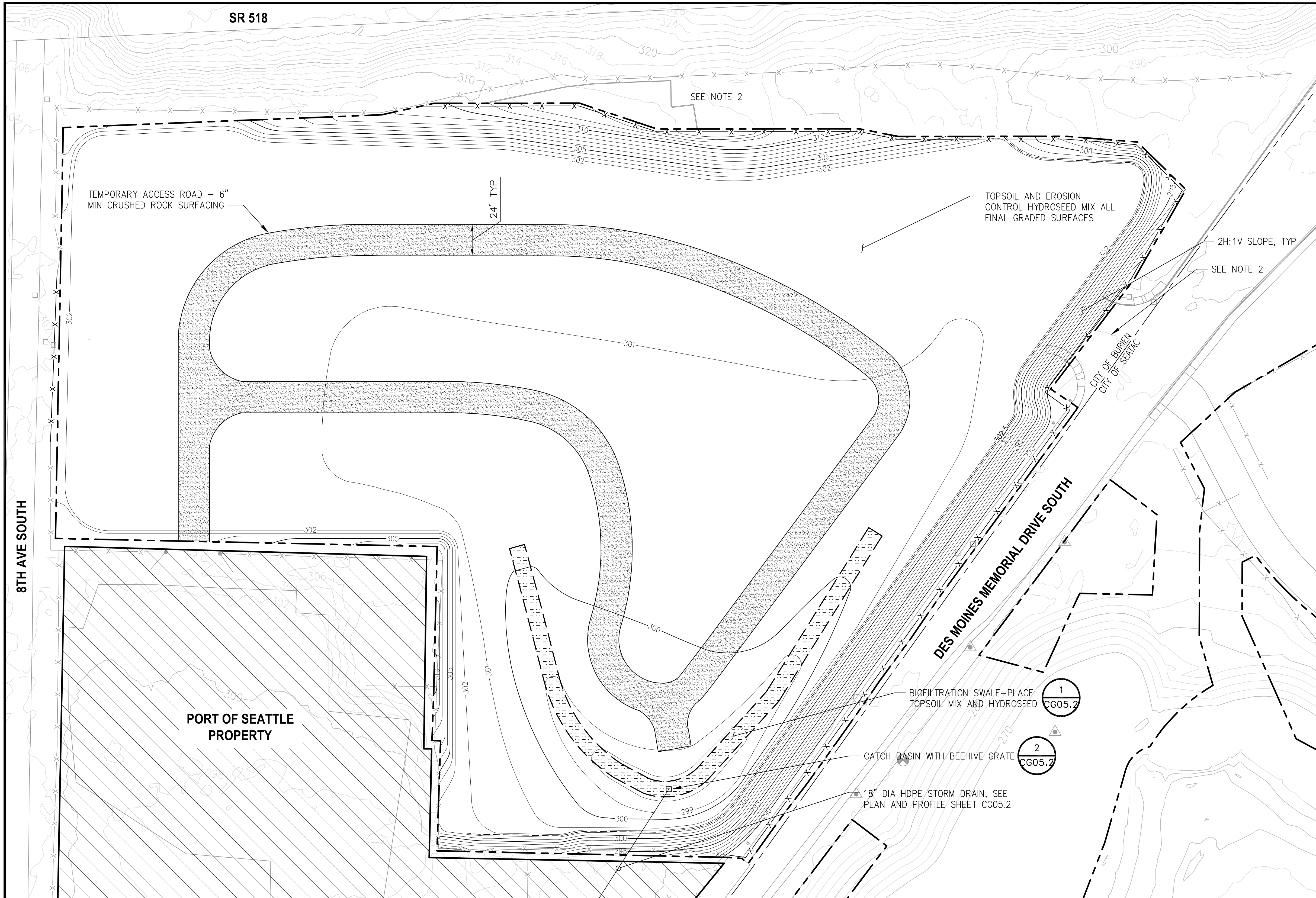
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA BACKFILL SECTION H

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG04.3



PLAN

LLA GRADING AND SURFACE COMPLETION PLAN
SCALE: 1" = 40'

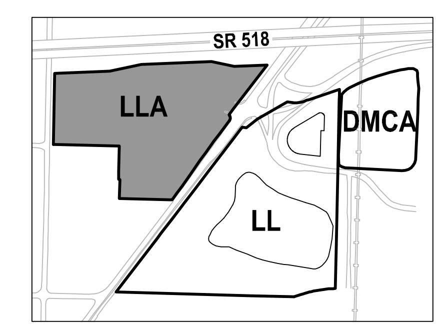
1"=40' 40 0 40 80
Scale Feet

NOTES:

1. SITE GRADING, SURFACE COMPLETION, TEMPORARY ACCESS ROAD, FENCE AND DRAINAGE FEATURES TO REMAIN IN PLACE AT CONTRACT COMPLETION. COMMERCIAL SITE REDEVELOPMENT TO BE COMPLETED BY OTHERS IN THE FUTURE.
2. COORDINATE WITH AND MATCH TO WORK CONSTRUCTED BY OTHERS FOR SR 518 OFF-RAMP.

LEGEND:

- EXISTING FENCE
- PROJECT WORK AREA LIMITS
- ELEVATION CONTOUR IN FEET (NAVD 88)
- PROPOSED MAJOR ELEVATION CONTOUR IN FEET (NAVD 88)
- PROPOSED MINOR ELEVATION CONTOUR IN FEET (NAVD 88)
- FENCE TO BE INSTALLED
- TEMPORARY ACCESS ROAD – CRUSHED ROCK SURFACING
- STAGING AREA
- GATE TO BE INSTALLED
- BIOFILTRATION SWALE



KEY MAP

NTS

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PROJECT ENGR./ARCH.: KATHRYN SNIDER
DESIGNER: KHS
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

KATHRYN H. SNIDER
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

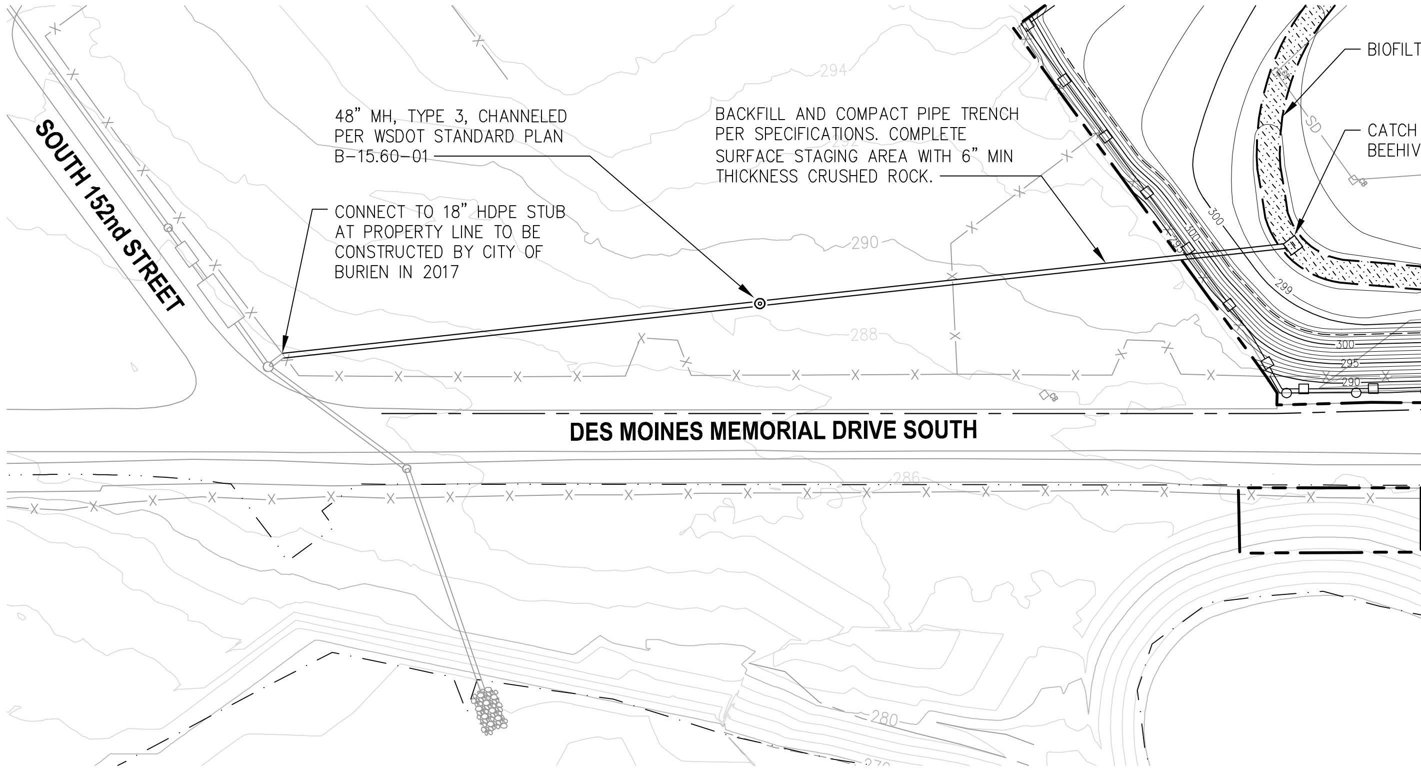
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

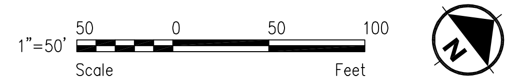
POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

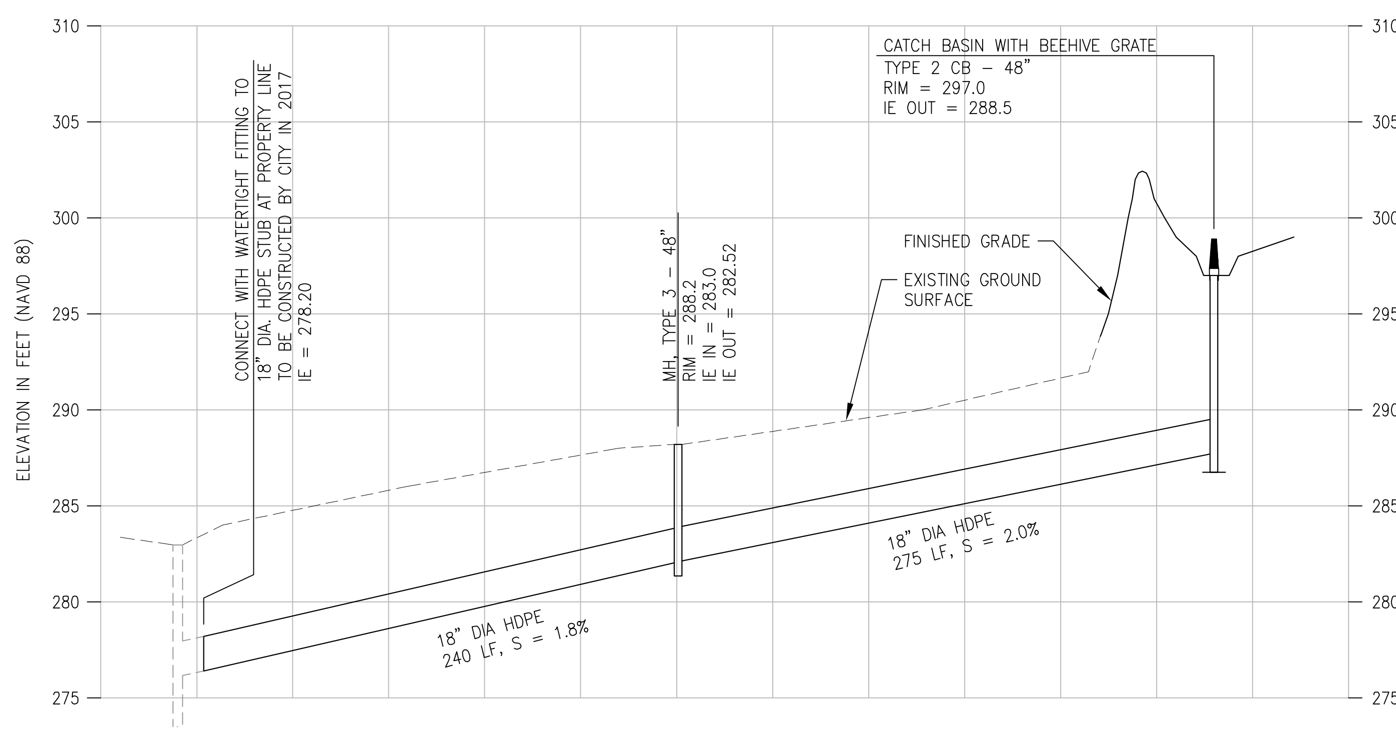
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA GRADING AND SURFACE COMPLETION PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG05.1

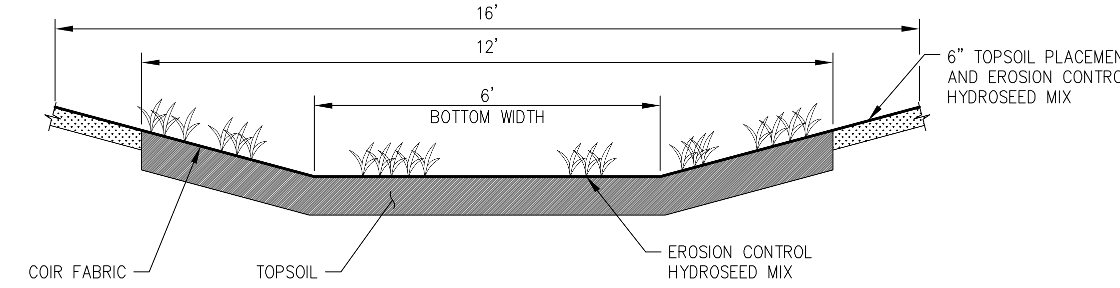


PLAN
STORM DRAIN CONNECTION TO S 152nd ST
SCALE: 1" = 50'

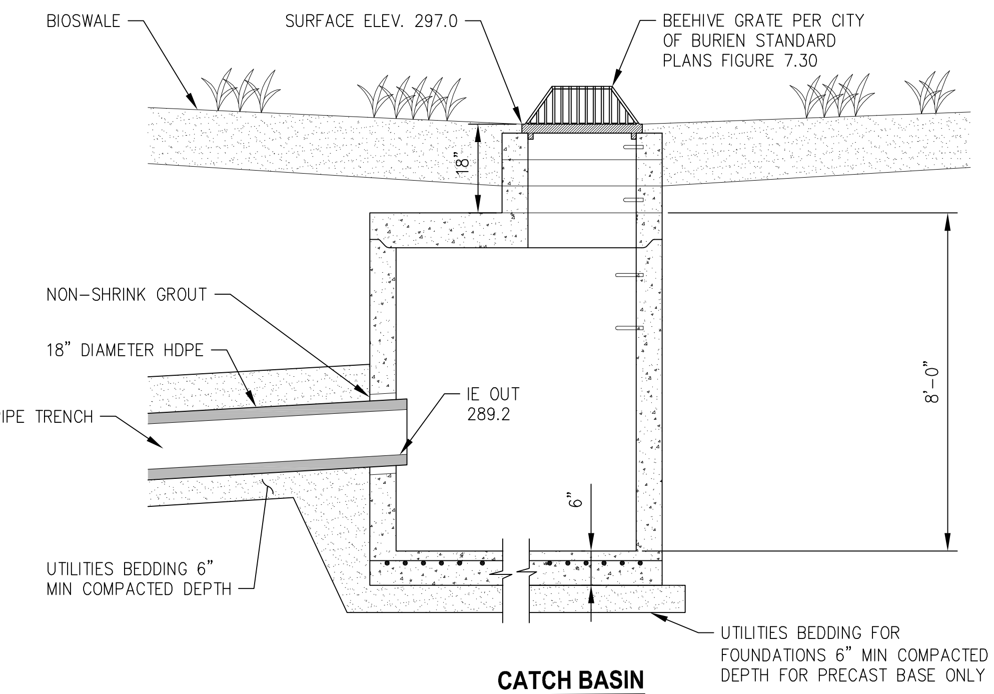




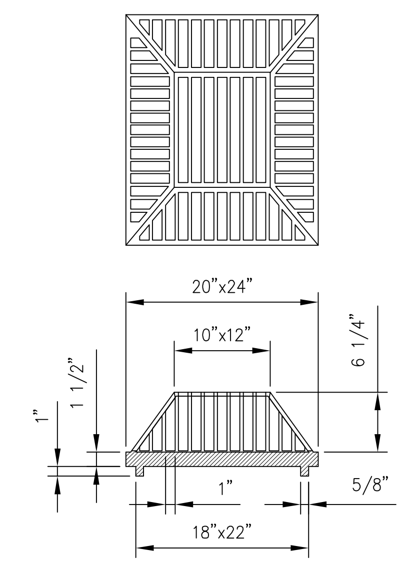
PROFILE
STORM DRAIN CONNECTION TO S 152nd ST
SCALE: H: 1" = 50'
SCALE: V: 1" = 5'



DETAIL 1 / CG5.01
BIO FILTRATION SWALE
SCALE: N.T.S

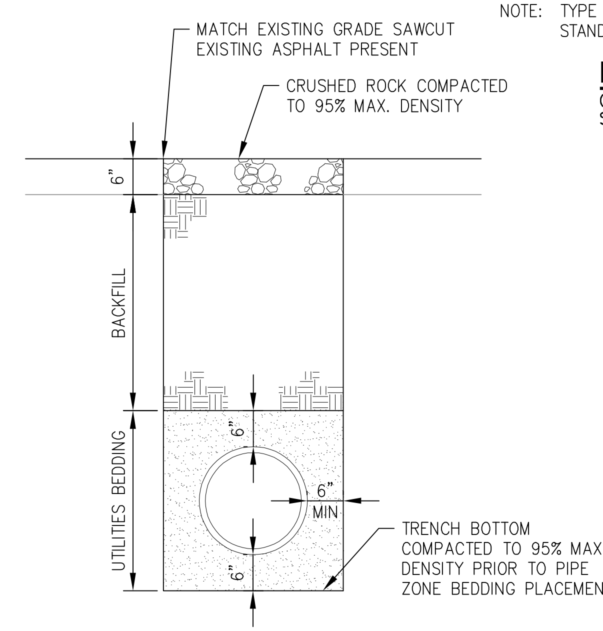


CATCH BASIN
NOTE: TYPE 2 CATCH BASIN PER WSDOT STANDARD PLAN B-10.20-01



BEEHIVE GRATE
NOTE: FOR USE WITH SM60 20"x24" FRAME

DETAIL 2 / CG5.01
CATCH BASIN WITH BEEHIVE GRATE
SCALE: N.T.S



DETAIL 3 / –
PIPE TRENCH
SCALE: N.T.S

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PROJECT ENGR./ARCH: KATHRYN SNIDER
DESIGNER: KHS
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

KATHRYN H. SNIDER – STATE OF WASHINGTON – 29338 – REGISTERED PROFESSIONAL ENGINEER

REVISIONS

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POS DRAFTER:
POS SCALE:
POS DATE:
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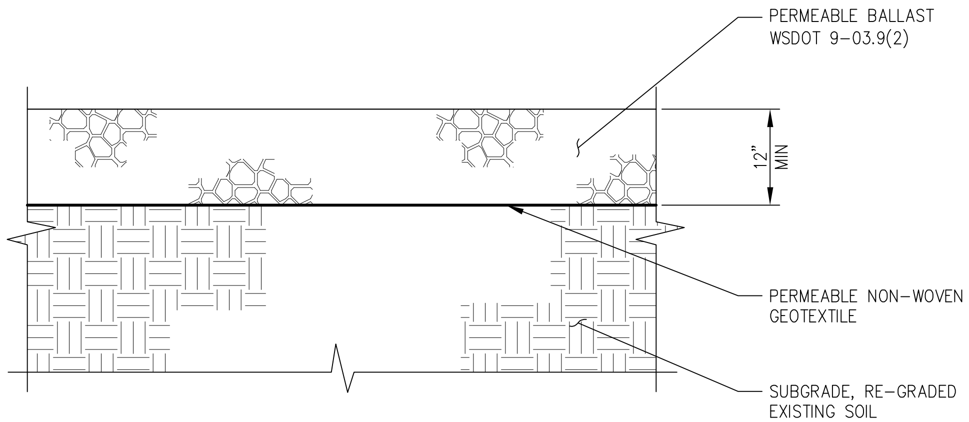
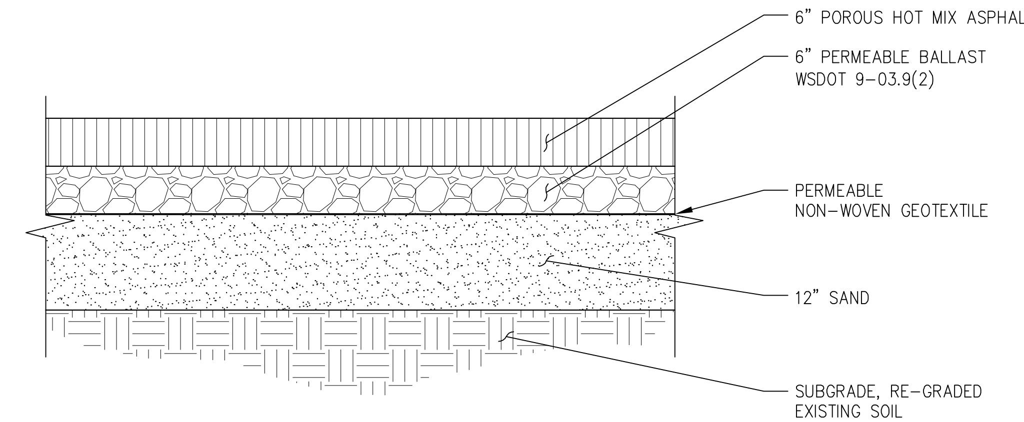
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA GRADING AND DRAINAGE DETAILS

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG05.2

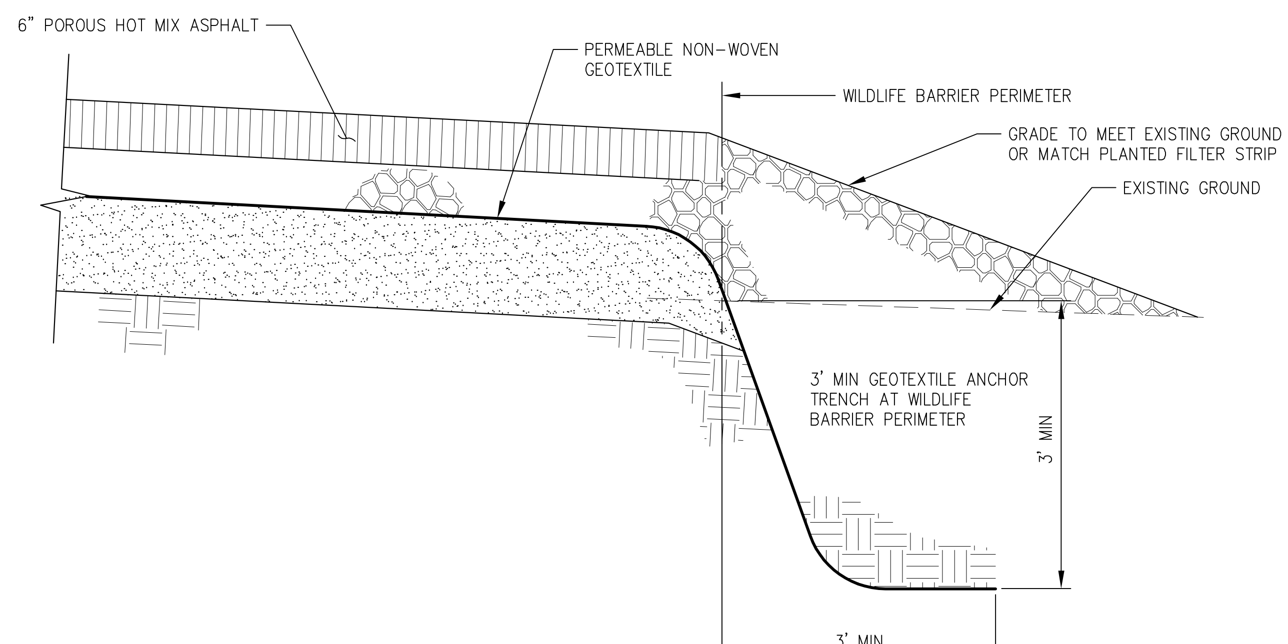


FOR USE IN HILLSIDE AREA WEST
OF ECOLOGY BLOCK WALL

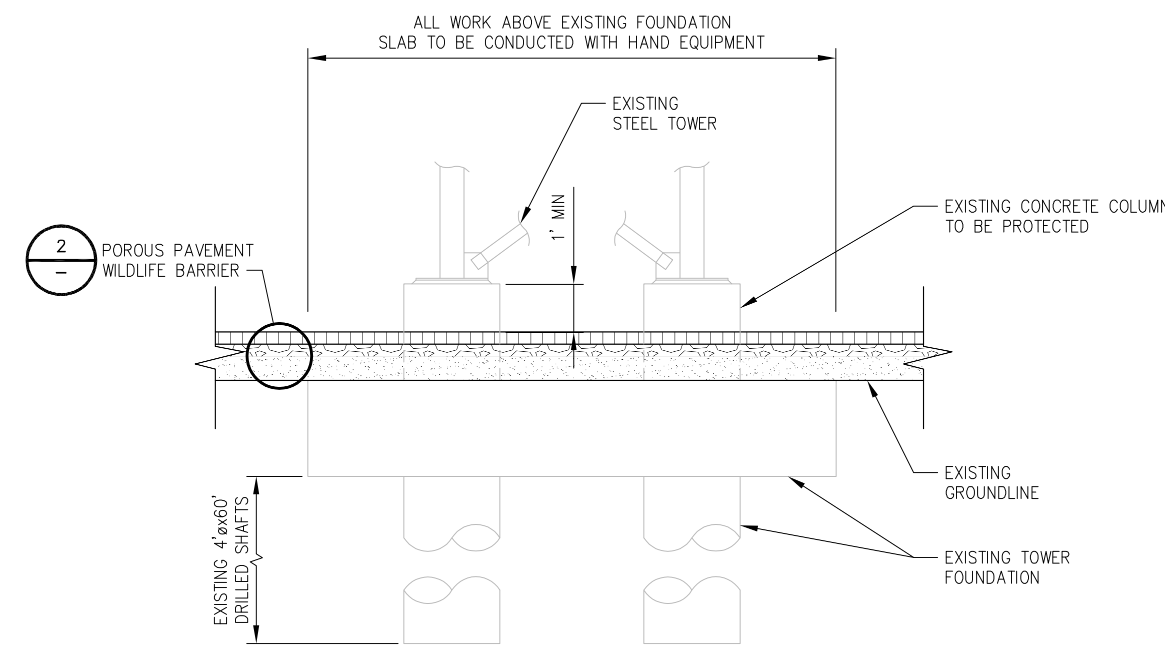
DETAIL 1 / CG03.1
DMCA CRUSHED ROCK WILDLIFE BARRIER
SCALE: NTS



DETAIL 2 / CG03.1
POROUS PAVEMENT WILDLIFE BARRIER
SCALE: NTS



DETAIL 3 / CG03.1
DMCA WILDLIFE BARRIER ANCHORING
SCALE: NTS



DETAIL 4 / CG03.1
POROUS PAVEMENT WILDLIFE BARRIER
ABOVE EXISTING LIGHTING SYSTEM FOUNDATION
SCALE: NTS

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PROJECT ENGR./ARCH: KATHRYN SNYDER
DESIGNER: KHS
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

KATHRYN H. SNIDER
STATE OF WASHINGTON
29336
REGISTERED
PROFESSIONAL ENGINEER

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

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POS DRAFTER:
POS SCALE:
POS DATE:
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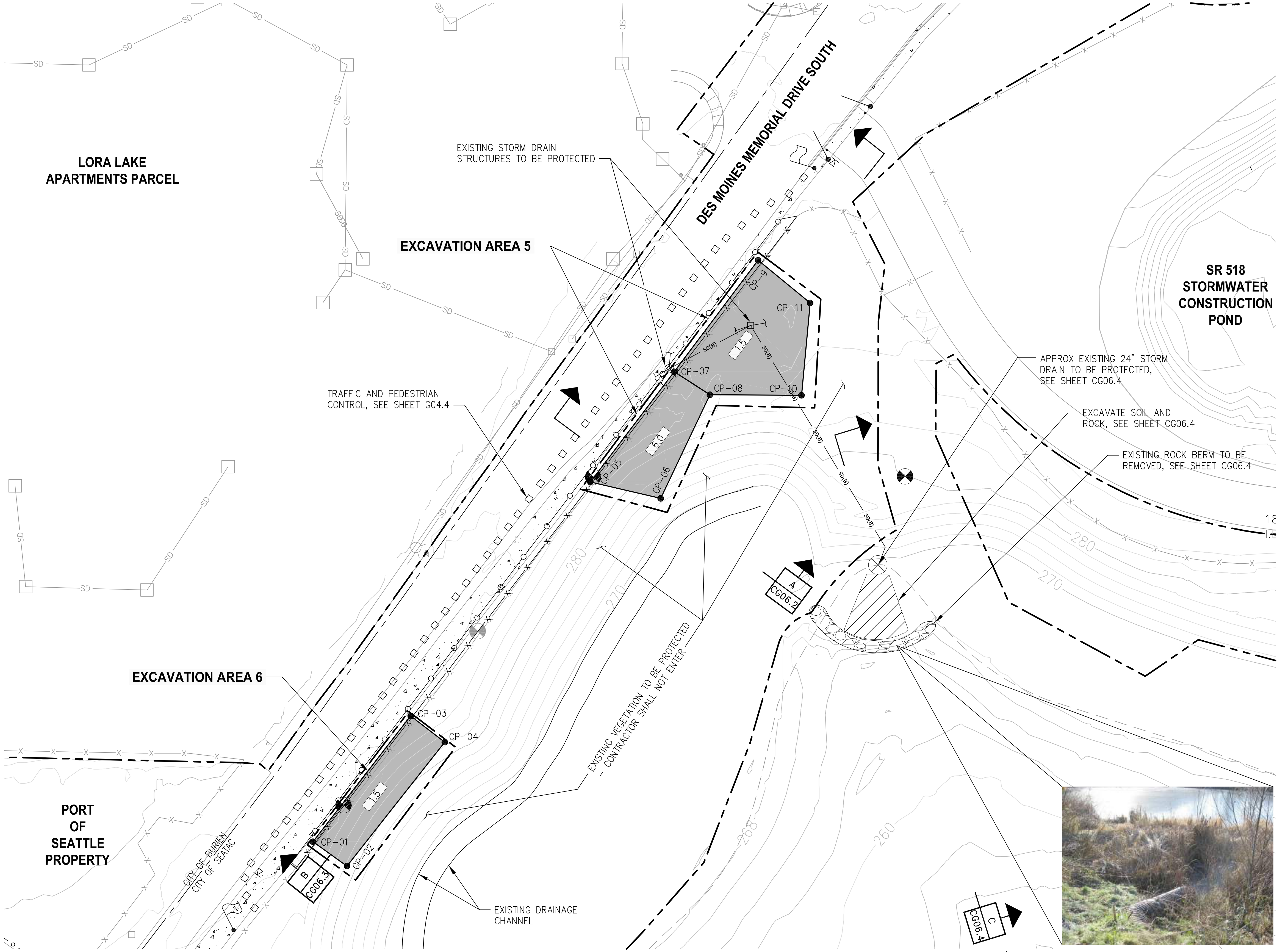
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: **2017 LORA LAKE APARTMENTS**
MTCA REMEDIATION PROJECTS
SHEET TITLE: **DMCA GRADING AND DRAINAGE DETAILS**

POS WORK PROJECT NUMBER
104396, 104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG05.3



PLAN

LL SEASON 1 EXCAVATION PLAN – AREAS 5 AND 6
SCALE: 1" = 30'

1"=30' 30 0 30 60
Scale Feet

N

NOTES:

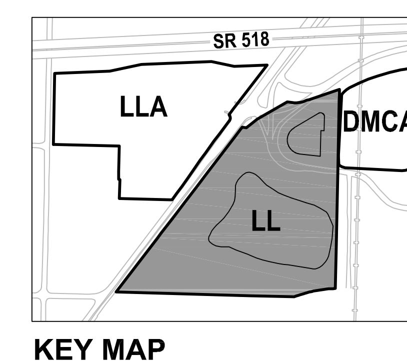
1. VEGETATION OUTSIDE OF IDENTIFIED ACCESS AND HAUL ROUTES AND SOIL EXCAVATION AREAS TO BE PROTECTED.
2. MONITORING WELLS TO BE DECOMISSIONED PRIOR TO START OF EXCAVATION.
3. ALL RIGHT OF WAY UTILITIES ASSUMED ACTIVE.

TABLE 1: SOIL EXCAVATION AREAS 5 AND 6 CONTROL POINTS

CONTROL POINT	NORTHING	EASTING
CP–01	174266.90	1272468.00
CP–02	174253.00	1272487.40
CP–03	174338.40	1272523.60
CP–04	174323.50	1272542.90
CP–05	174471.40	1272625.80
CP–06	174462.10	1272665.70
CP–07	174534.10	1272673.50
CP–08	174521.00	1272693.70
CP–09	174597.40	1272721.10
CP–10	174520.70	1272745.80
CP–11	174573.20	1272750.70

LEGEND:

- PROJECT WORK AREA LIMITS
- CONTAMINATED SOIL EXCAVATION AREA
- 1.5 — EXCAVATION DEPTH BELOW GROUND SURFACE (FEET)
- 270 — ELEVATION CONTOUR IN FEET (NAVD 88)
- LORA LAKE CLEANUP AREA
- EXISTING FENCE – TO BE REMOVED AND REPLACED FOLLOWING WORK COMPLETION
- EXISTING FENCE
- CP–XX — CONTROL POINT
- TEMPORARY CONSTRUCTION FENCE
- EXISTING MONITORING WELLS – TO BE DECOMISSIONED
- PAVED SIDEWALK – TO BE PROTECTED



KEY MAP

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PROJECT ENGR./ARCH:	JESSI MASSINGALE
DESIGNER:	JSM
DRAWN BY:	JKH
SCALE:	AS SHOWN
DATE:	8/29/2016
CHECKED BY:	MMK
CHECKED/APPROVED BY:	JSM

JESSICA S. MASSINGALE STATE OF WASHINGTON 46140 REGISTERED PROFESSIONAL ENGINEER
EXP. 10/29/18

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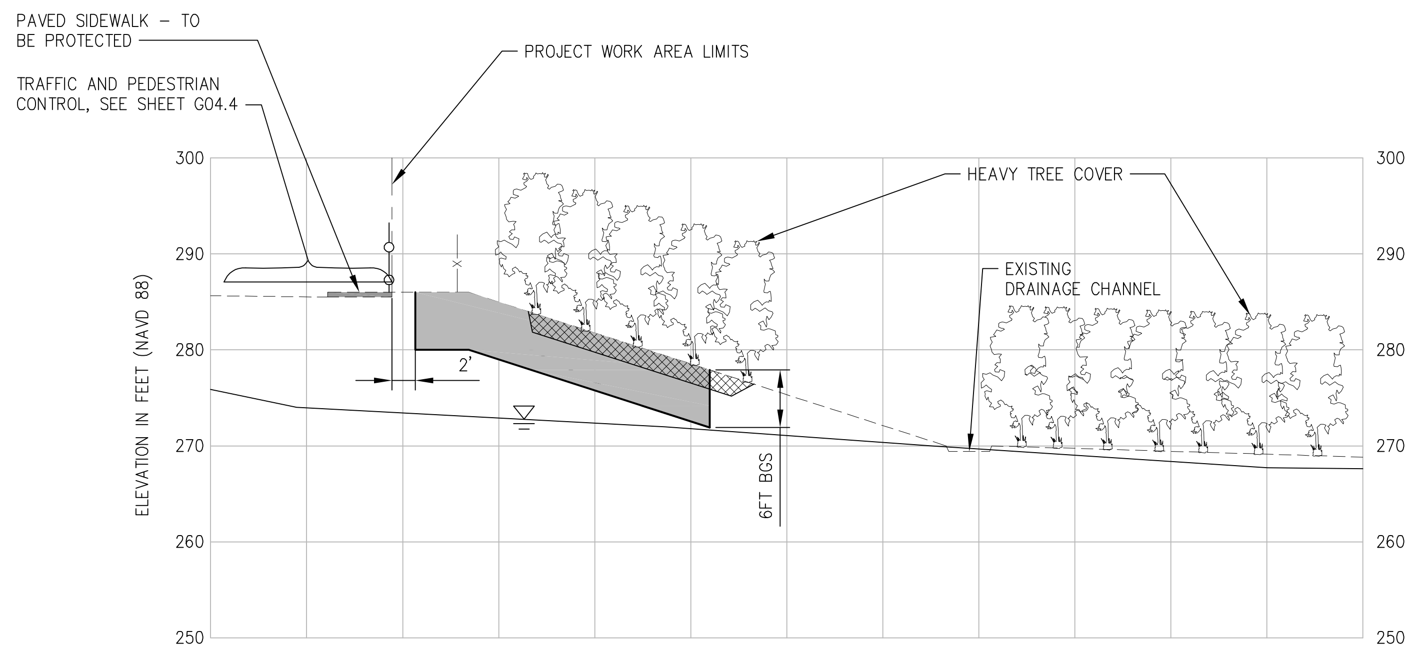
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 1 EXCAVATION PLAN - AREAS 5 AND 6

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG06.1



SECTION A / CG06.1
LL SEASON 1 EXCAVATION SECTION
SCALE: H: 1" = 10'
SCALE: V: 1" = 10'

1"=10' 10 5 0 10 20
Scale Feet

NOTES:

1. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.

LEGEND:

CONTAMINATED SOIL EXCAVATION AREA

APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)

EXISTING FENCE – TO BE REMOVED AND REPLACED

TEMPORARY CONSTRUCTION FENCE – TO BE INSTALLED DURING CONSTRUCTION

TREE ROOTS

EXISTING GROUND SURFACE

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PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM

JESSICA S. MASSINGALE
STATE OF WASHINGTON
46140
REGISTERED
PROFESSIONAL ENGINEER
exp. 10/29/18

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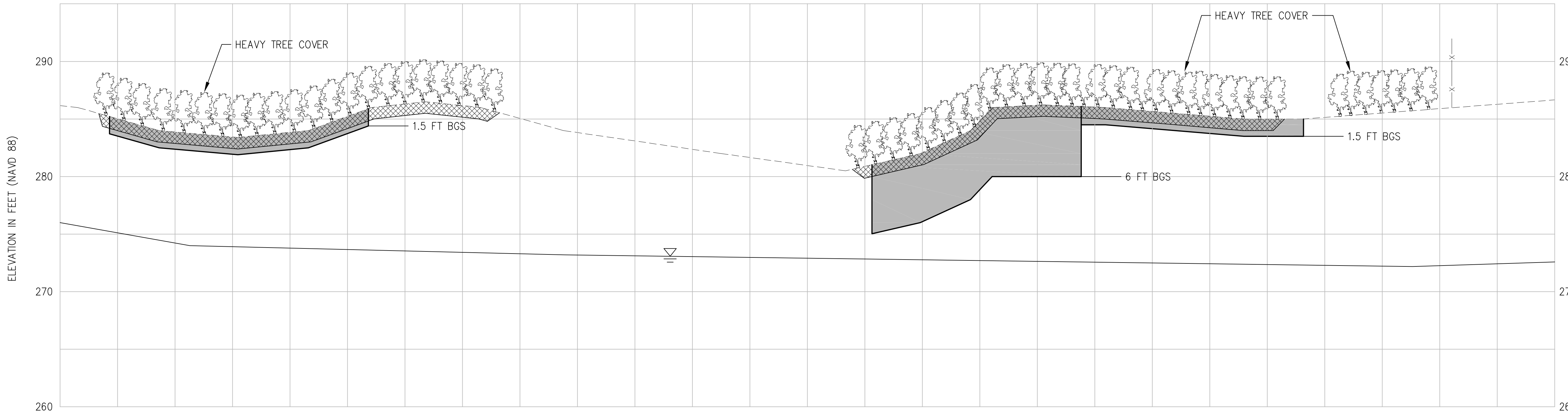
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 1 EXCAVATION SECTION A

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG06.2



SECTION

B

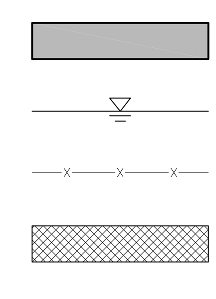
CG06.1

LL SEASON 1 EXCAVATION SECTION
SCALE: H: 1" = 20'
SCALE: V: 1" = 5'

NOTES:

1. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.

LEGEND:



CONTAMINATED SOIL EXCAVATION AREA

APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)

EXISTING FENCE – TO BE REMOVED AND REPLACED

TREE ROOTS

EXISTING GROUND SURFACE

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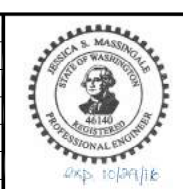
PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM



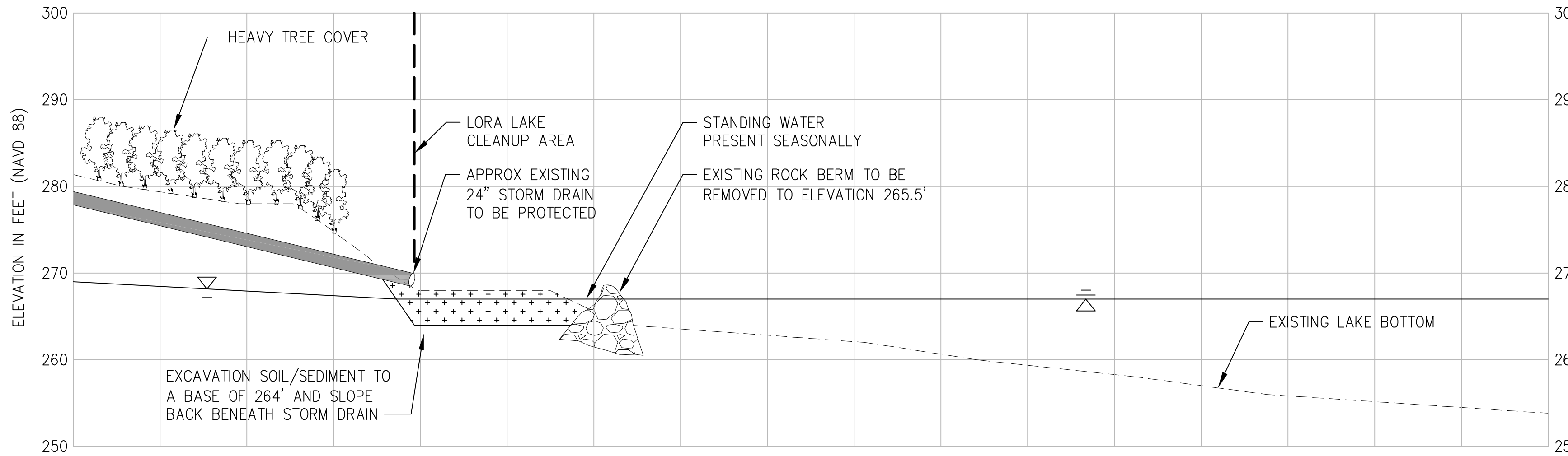
REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 1 EXCAVATION SECTION B

POS WORK PROJECT NUMBER
104396, 104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG06.3



SECTION C

CG06.1

LL EXCAVATION SECTION
SCALE: H: 1" = 20'
SCALE: V: 1" = 10'

1"=20' 20 0 20 40 Scale Feet

NOTES:

1. GROUNDWATER ELEVATIONS VARY SEASONALLY. GROUNDWATER ELEVATION SHOWN IS THE APPROXIMATE DRY SEASON ELEVATION.

LEGEND:

SOIL/SEDIMENT EXCAVATION EXTENT

APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)

APPROXIMATE SURFACE WATER ELEVATION IN FEET (NAVD 88) BEFORE FILL

EXISTING GROUND SURFACE

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PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM

JESSICA S. MASSINGALE STATE OF WASHINGTON 46140 REGISTERED PROFESSIONAL ENGINEER
exp. 10/29/18

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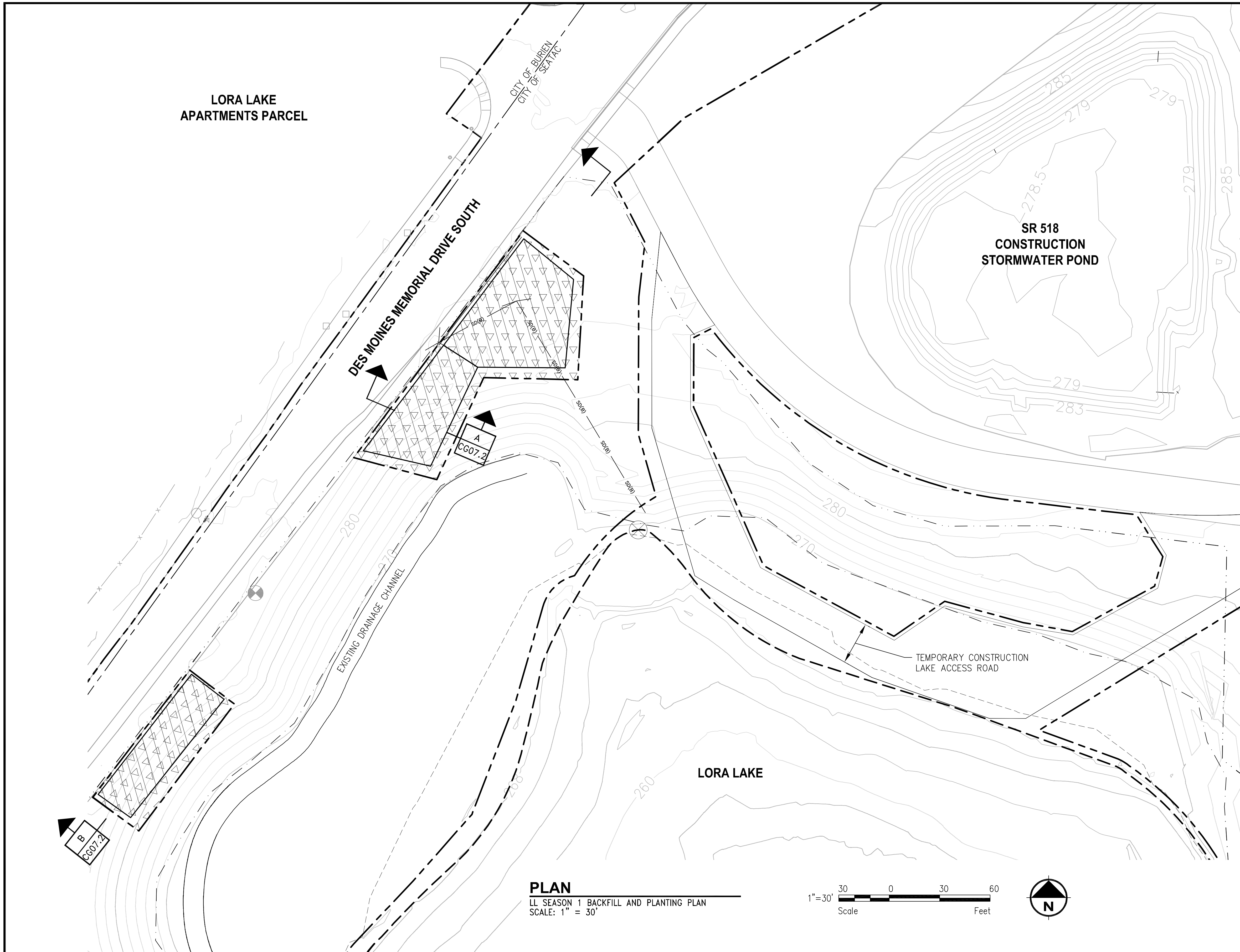
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 1 EXCAVATION SECTION C

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG06.4



PLAN

LL SEASON 1 BACKFILL AND PLANTING PLAN
SCALE: 1" = 30'

1"=30' 30 0 30 60
Scale Feet

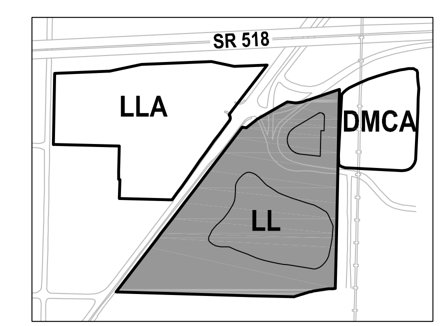
N

NOTES:

1. SOIL EXCAVATION AREAS WILL BE BACKFILLED AND REPLANTED AT THE END OF SEASON 1. SEE SHEET CG07.2 FOR BACKFILL DETAILS AND SHEET LZ01.1 FOR PLANTING SCHEDULE AND DETAILS.
2. THE TEMPORARY CONSTRUCTION LAKE ACCESS ROAD AND LORA LAKE WILL BE REPLANTED AT THE END OF SEASON 2. SEE SHEET LP01.1 FOR PLANTING EXTENTS AND SHEET LZ01.1 FOR PLANTING SCHEDULE AND DETAILS.

LEGEND:

- PROJECT WORK AREA LIMITS
- UPLAND BUFFER ZONE
- SOIL EXCAVATION AREAS – TO BE BACKFILLED AND REPLANTED
- LORA LAKE CLEANUP AREA
- ELEVATION CONTOUR IN FEET (NAVD 88) — 270
- RESTRICTIVE COVENANT BOUNDARY
- WETLAND BOUNDARY



KEY MAP

NTS

FLOYD | SNIDER
strategy • science • engineering
kpff

PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM

JESSICA S. MASSINGALE
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46140
REGISTERED
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REVISIONS

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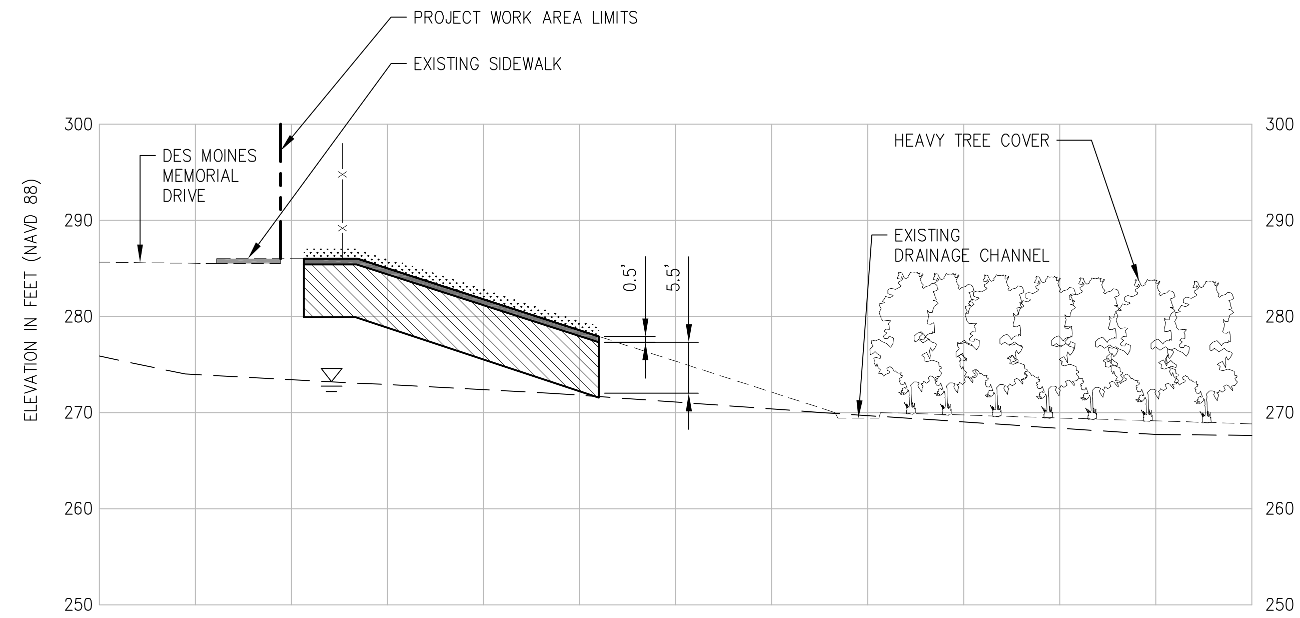
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 1 BACKFILL AND PLANTING PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG07.1



SECTION A / CG07.1

LL SEASON 1 BACKFILL AND PLANTING SECTION
SCALE: H: 1" = 10'
SCALE: V: 1" = 10'

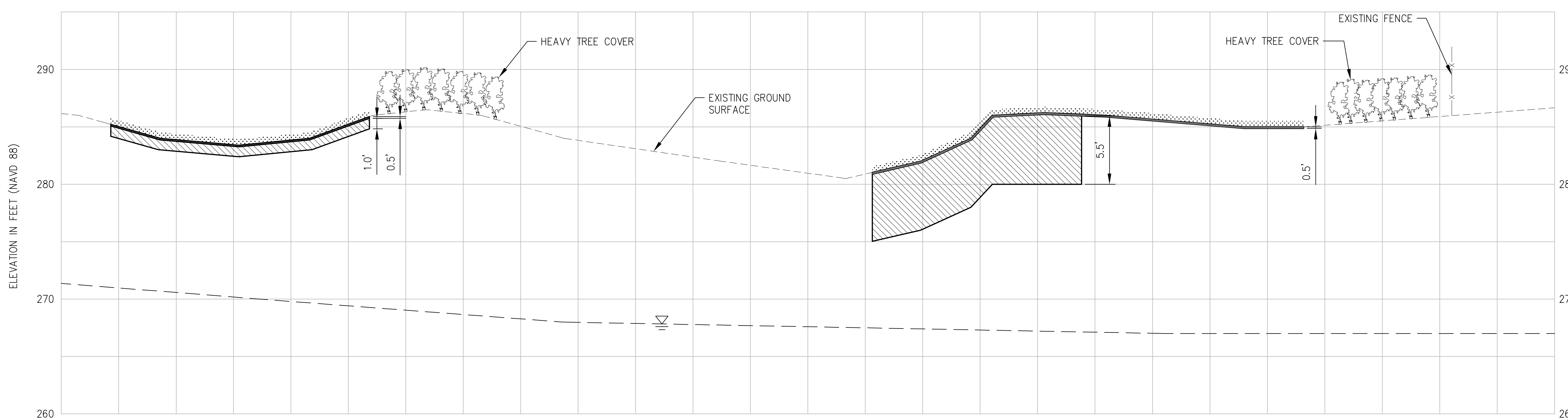
1"=10' 10 5 0 10 20 Scale Feet

LEGEND:

- PRE-DEWATERING APPROXIMATE GROUNDWATER ELEVATION IN FEET (NAVD 88)
- TOPSOIL
- IMPORTED COMMON BORROW
- UPLAND BUFFER ZONE.
- FENCE – TO BE INSTALLED
- EXISTING GROUND SURFACE

NOTES:

1. SEE SHEET LZ01.1 FOR UPLAND BUFFER ZONE PLANTING SCHEDULE AND DETAILS.



SECTION B / CG07.1

LL SEASON 1 BACKFILL AND PLANTING SECTION
SCALE: H: 1" = 20'
SCALE: V: 1" = 5'

1"=20' 20 0 20 40 Scale Feet

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PROJECT ENGR./ARCH.: JESSI MASSINGALE
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SCALE: AS SHOWN
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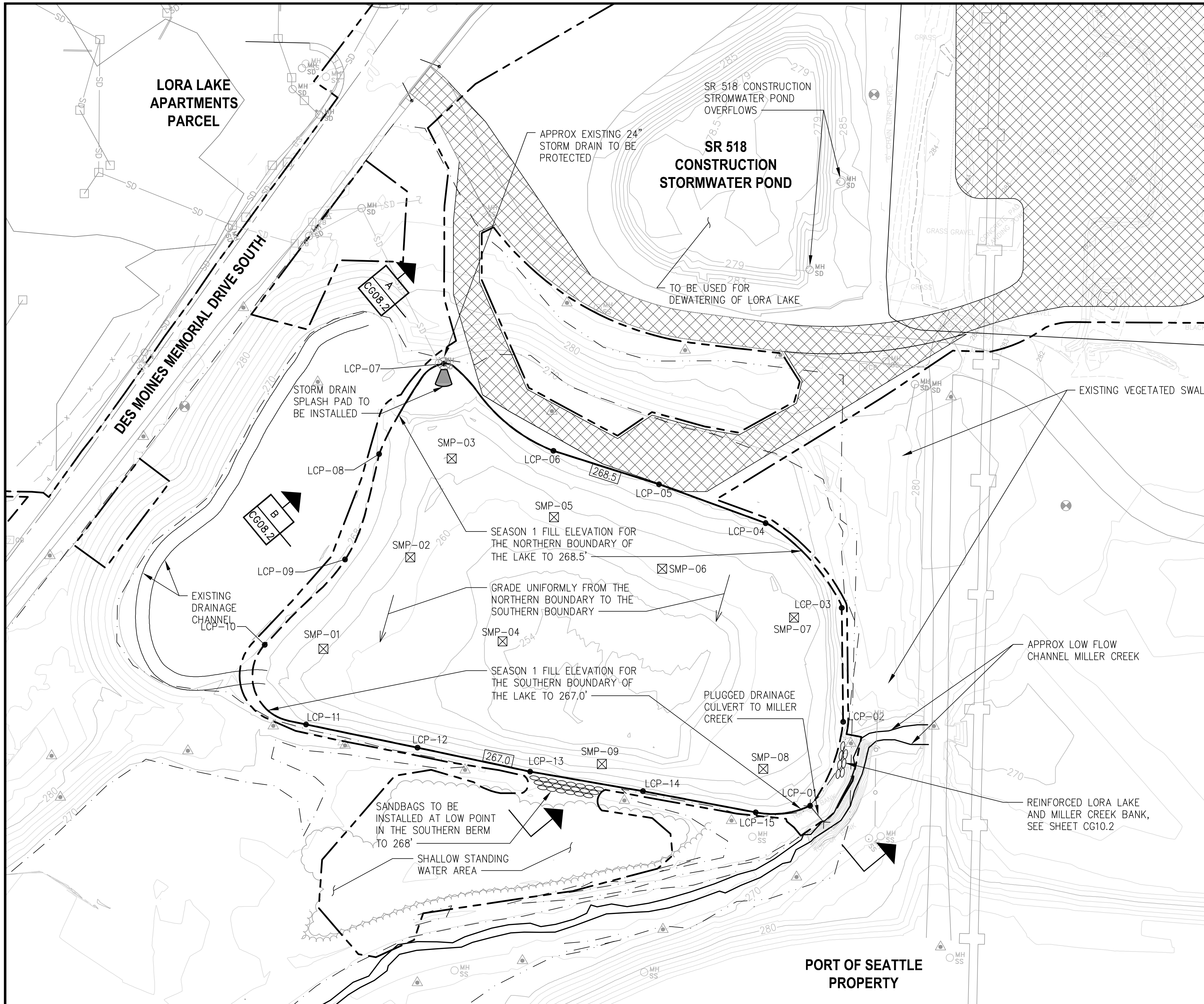
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 1 BACKFILL AND PLANTING SECTION

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG07.2



PLAN

LL DEWATERING, SEDIMENT CAP, AND FILL PLAN
SCALE: 1" = 50'

1"=50' Scale 50 0 50 100 Feet

N

NOTES:

1. CONTRACTOR MAY OPEN CUT THE ACCESS ROAD IN THIS AREA TO INSTALL DISCHARGE PIPING FOR PUMPING FROM LORA LAKE TO SR 518 CONSTRUCTION STORMWATER POND. REMOVE PIPE AFTER CONSTRUCTION AND RESTORE TO ORIGINAL OR BETTER CONDITION. SUBMIT INSTALLATION DRAWING AND CONSTRUCTION PLAN AT LEAST 30 DAYS PRIOR TO CUTTING ROAD.
2. SEE SHEET CG09.1 FOR SEASON 2 FILL ELEVATIONS.
3. INSTALL SUMP TO BE USED FOR DEWATERING DURING CONSTRUCTION. PREVENT LAKE WATER FROM ENTERING MILLER CREEK DURING LAKE CAPPING, FILLING, AND RAIN EVENTS.
4. PERFORM WEED REMOVAL ACTIVITIES WITHIN SHALLOW STANDING WATER AREA DURING SEASON 1.
5. ALL LAKE DEWATERING WATER WILL BE CHEMICALLY TREATED AND THEN DISCHARGED TO THE SR 518 CONSTRUCTION STORMWATER POND FOR INFILTRATION.

LEGEND:

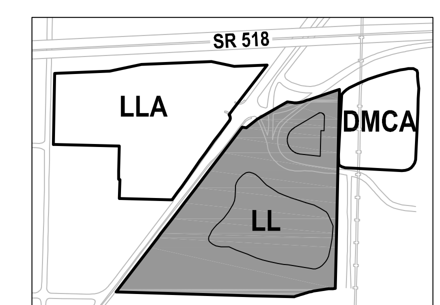
- PROJECT WORK AREA LIMITS
- CONSTRUCTION ACCESS AND STAGING AREA
- LORA LAKE CLEANUP AREA
- 270 — ELEVATION CONTOUR IN FEET (NAVD 88)
- RESTRICTIVE COVENANT BOUNDARY
- WETLAND BOUNDARY
- SETTLEMENT MONITORING POINT
- LCP-XX — CAP AND FILL CONTROL POINT

TABLE 1: CAP AND FILL CONTROL POINTS

CONTROL POINT	NORTHING	EASTING	EXISTING ELEVATION
LCP-01	174541.33	1272845.26	266.92
LCP-02	174110.10	1273139.13	267.60
LCP-03	174210.05	1273137.89	267.39
LCP-04	174284.37	1273071.19	268.10
LCP-05	174318.45	1272977.70	268.10
LCP-06	174347.73	1272885.09	267.25
LCP-07	174424.23	1272789.21	267.89
LCP-08	174344.94	1272732.23	267.47
LCP-09	174252.58	1272702.49	268.00
LCP-10	174177.71	1272632.00	267.47
LCP-11	174107.83	1272668.20	267.54
LCP-12	174087.48	1272765.94	267.49
LCP-13	174066.43	1272864.66	267.00
LCP-14	174049.33	1272963.59	267.47
LCP-15	174030.70	1273062.44	267.30

TABLE 2: FILL SETTLEMENT MONITORING POINTS

SETTLEMENT MONITORING POINT	NORTHING	EASTING
SMP-01	174174.11	1272683.46
SMP-02	174254.36	1272759.60
SMP-03	174340.94	1272795.97
SMP-04	174180.71	1272840.47
SMP-05	174289.60	1272885.52
SMP-06	174244.40	1272980.38
SMP-07	174201.54	1273096.02
SMP-08	174068.80	1273069.13
SMP-09	174073.11	1272927.60



KEY MAP
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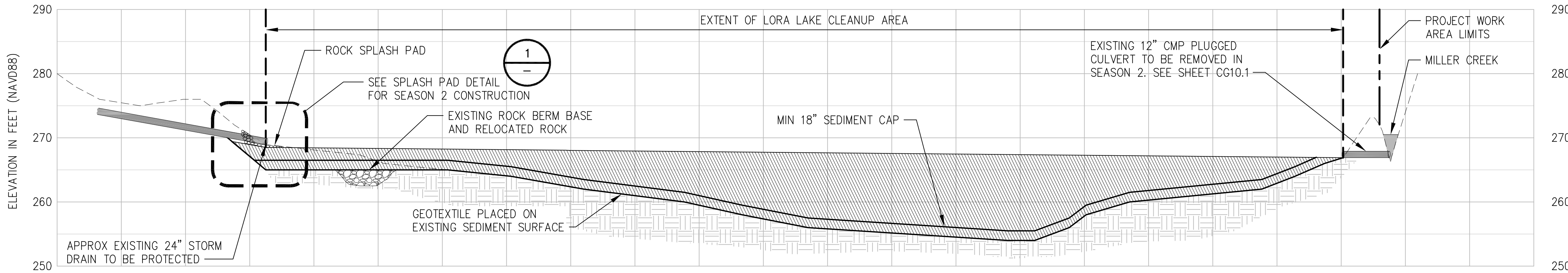
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL DEWATERING, SEDIMENT CAP, AND FILL PLAN

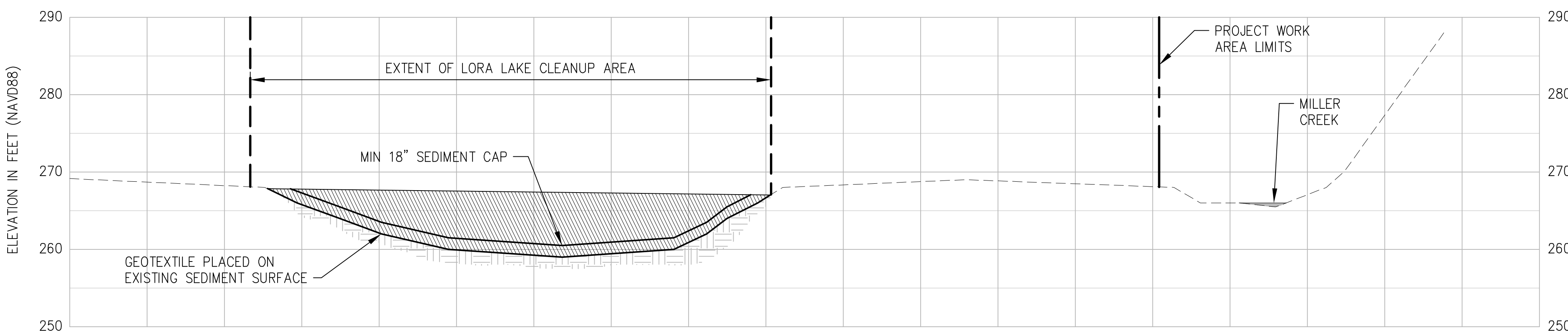
POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG08.1



SECTION A (CG08.1)

LL SEDIMENT CAPPING SECTION
SCALE: H: 1" = 30'
SCALE: V: 1" = 10'

1"=30' Scale 30 0 30 60 Feet



SECTION B (CG08.1)

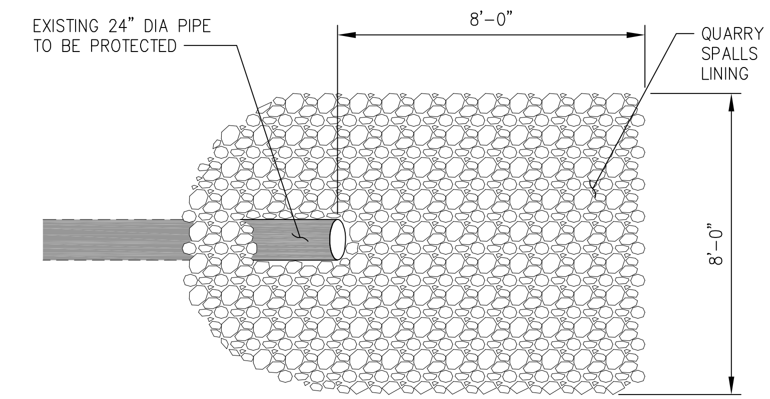
LL SEDIMENT CAPPING SECTION
SCALE: H: 1" = 30'
SCALE: V: 1" = 10'

1"=30' Scale 30 0 30 60 Feet

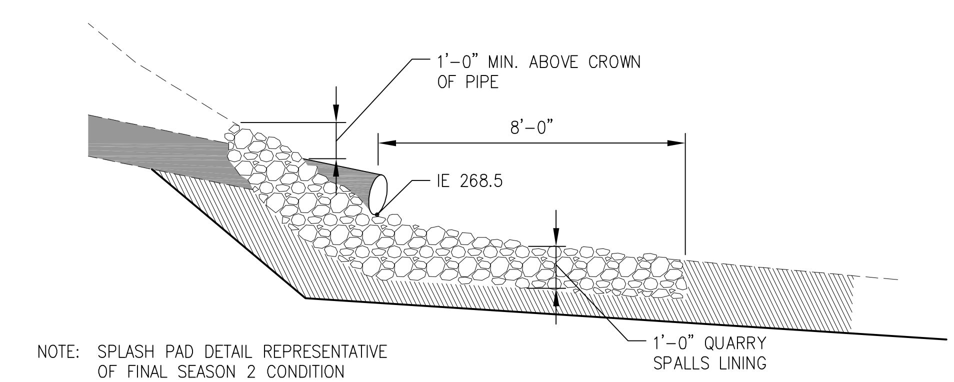
LEGEND:

- EXISTING GROUND SURFACE
- SEDIMENT CAP AND LAKE FILL SAND (CARBON–AMENDED)
- CONTAMINATED SEDIMENT
- GEOTEXTILE
- QUARRY SPALLS

NOTE: LL SEDIMENT CAPPING SECTIONS A+B REPRESENTATIVE OF FINAL SEASON 1 FILL ELEVATIONS. SEASON 2 FILL ELEVATION IS SHOWN ON SHEET CG04.1. SEASON 2 WETLAND TOPSOIL AND PLANTING SHOWN ON CG10.1 AND LD01.1.



PLAN



NOTE: SPLASH PAD DETAIL REPRESENTATIVE OF FINAL SEASON 2 CONDITION

SECTION

DETAIL 1 (–)

SPLASH PAD DETAIL
SCALE: NTS

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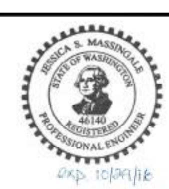
SCALE:	AS SHOWN
DATE:	8/29/2016
CHECKED BY:	MMK
CHECKED/APPROVED BY:	JSM



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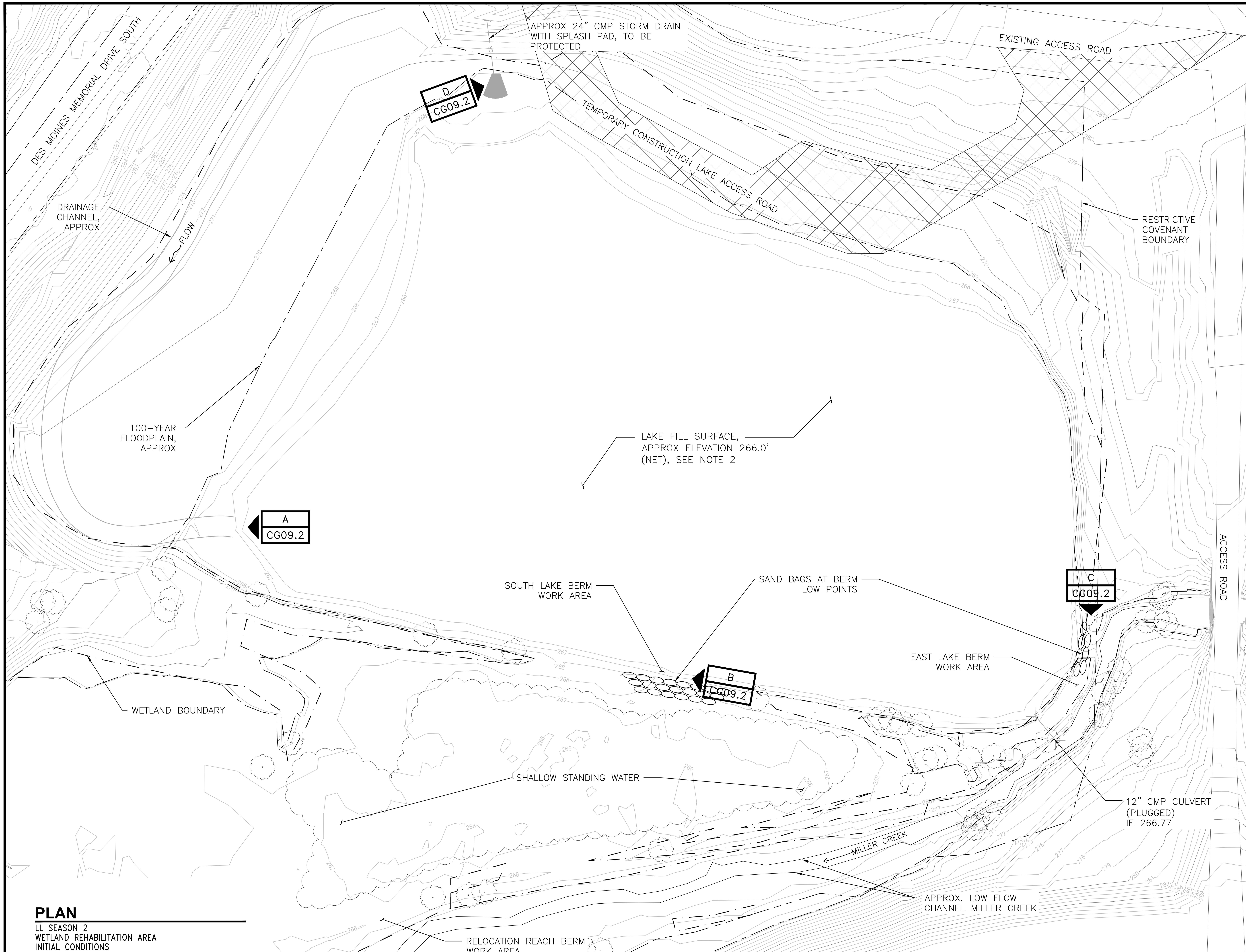
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEDIMENT CAP AND FILL SECTIONS

POS WORK PROJECT NUMBER
104396, 104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG08.2



PLAN

LL SEASON 2
WETLAND REHABILITATION AREA
INITIAL CONDITIONS

NOTES:

1. SEE SHEET V01.1 FOR SITE SURVEY CONTROL.
2. SEASON 2 INITIAL CONDITIONS WILL BE POST SEASON 1 SEDIMENT CAP AND FILL IN THE LORA LAKE REGION (APPROX EL 266 NAVD 88 AFTER SETTLEMENT). SEE SHEETS CG08.1 AND CU03.1. THE SEASON 2 INITIAL FILL SURFACE WILL BE GENERALLY FLAT.

LEGEND:

- CREEK
- RESTRICTIVE COVENANT BOUNDARY
- WETLAND BOUNDARY
- 100 YEAR FLOODPLAIN
- ACCESS ROAD
- 268 ELEVATION CONTOUR IN FEET (NAVD 88)
- CULVERT
- TREES, BRUSH
- SAND BAGS
- B / CG09.2 PHOTOGRAPH LOCATION SYMBOL

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CHECKED BY:	KEN VIGIL
CHECKED/APPROVED BY:	CURTIS LOEB

CURTIS J LOEB, STATE OF WASHINGTON, 47221, REGISTERED PROFESSIONAL ENGINEER

REVISIONS

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SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**

SHEET TITLE: **LL SEASON 2 WETLAND REHABILITATION AREA INITIAL CONDITIONS**

POS WORK PROJECT NUMBER	104396
CONSULTANT'S PROJECT NUMBER	POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER	STIA-1701
	CG09.1

PHOTO A/CG09.1
EXISTING DRAINAGE CHANNEL

PHOTO B/CG09.1
SOUTH LAKE BERM LOW SPOT

PHOTO C/CG09.1
EAST LAKE BERM AT CULVERT

PHOTO D/CG09.1
EXISTING STORMWATER OUTFALL

NOTES:

1. PHOTOS A, B, AND C WERE TAKEN ON 1/20/16. PHOTO D WAS TAKEN ON 9/02/15.

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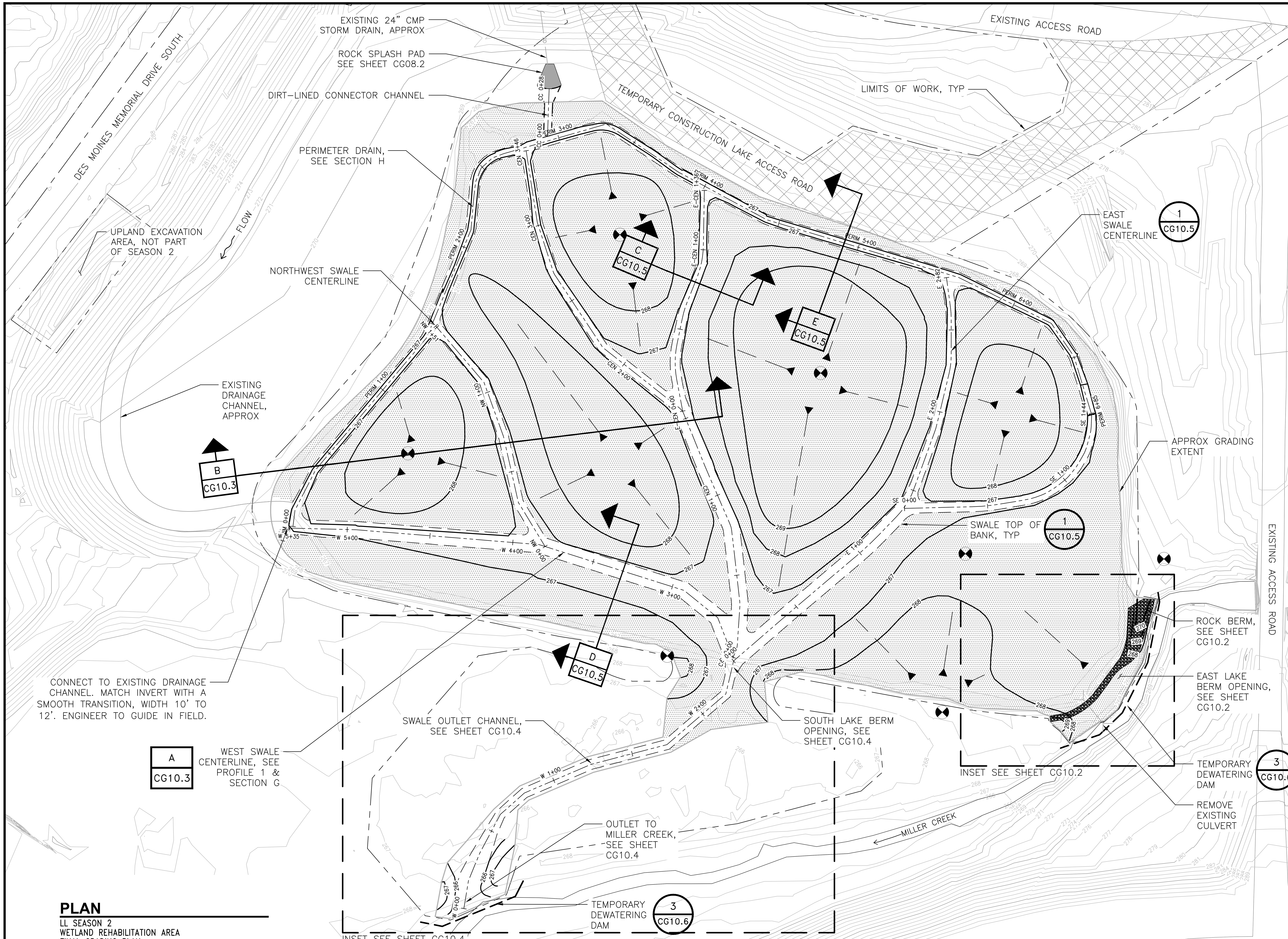
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS

SHEET TITLE: LL SEASON 2 WETLAND PHOTOS

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG09.2



PLAN

LL SEASON 2
WETLAND REHABILITATION AREA
FINAL GRADING PLAN

NOTES:

1. STAKE GRADES, EXCAVATION EXTENTS, AND CONTROL LINES FOR APPROVAL PRIOR TO EXCAVATION AND TOPSOIL PLACEMENT.
2. CLEAR AND GRUB WITHIN LIMITS OF GRADING.
3. THE SWALE CONTROL LINES SHOWN DEFINE THE CENTERLINE OF THE SWALES. CONSTRUCT SMOOTH CURVES BETWEEN DEFINED ALIGNMENT POINTS.
4. PLACE TOPSOIL AND CONSTRUCT GRAVEL SWALES PER PLAN HEREON, TYPICAL SECTIONS ON SHEETS CG10.3, CG10.4 AND CG10.5 AND PER TABLE 1 AND 2 SHEET CG10.5.
5. PLACE BIODEGRADABLE EROSION CONTROL FABRIC PER PLAN HEREON, AND INSTALL COIR LOGS AT THE TOP OF BANK ON ALL GRAVEL SWALES PER SWALE DETAIL 2 ON SHEET CG10.1 AND COIR LOG DETAIL 1 ON SHEET CG10.6.
6. KEY BIODEGRADABLE EROSION CONTROL FABRIC INTO FINISHED GRADE ALONG COIR LOG AND AT EDGE OF GRADING IN ALL LOCATIONS.
7. SEE SHEET LP01.1 FOR PLANTING PLAN.
8. PROTECT MONITORING WELLS FROM DAMAGE.
9. REMOVE EAST LAKE BERM PER SHEET CG10.2.

SWALE CONTROL LINE ABBREVIATIONS:

1.	WEST SWALE:	W
2.	NORTHWEST SWALE:	NW
3.	CENTRAL SWALE:	CEN
4.	EAST CENTRAL SWALE:	E_CEN
5.	EAST SWALE:	E
6.	SOUTHEAST SWALE:	SE
7.	PERIMETER DRAIN:	PERIM
8.	CONNECTOR CHANNEL:	CC

LEGEND:

- INSTALL BIODEGRADABLE EROSION CONTROL FABRIC ON TOPSOIL AND KEY IN EDGES
- MONITORING WELL, TO BE PROTECTED
- LIMITS OF WORK
- SLOPE MARKER, ARROW POINTS DOWNSLOPE
- APPROX GRADING EXTENT
- SWALE, TOP OF BANK
- 268 PROPOSED ELEV CONTOUR (NAVD 88)
- EXISTING ELEV CONTOUR (NAVD 88)
- TEMPORARY DEWATERING DAM

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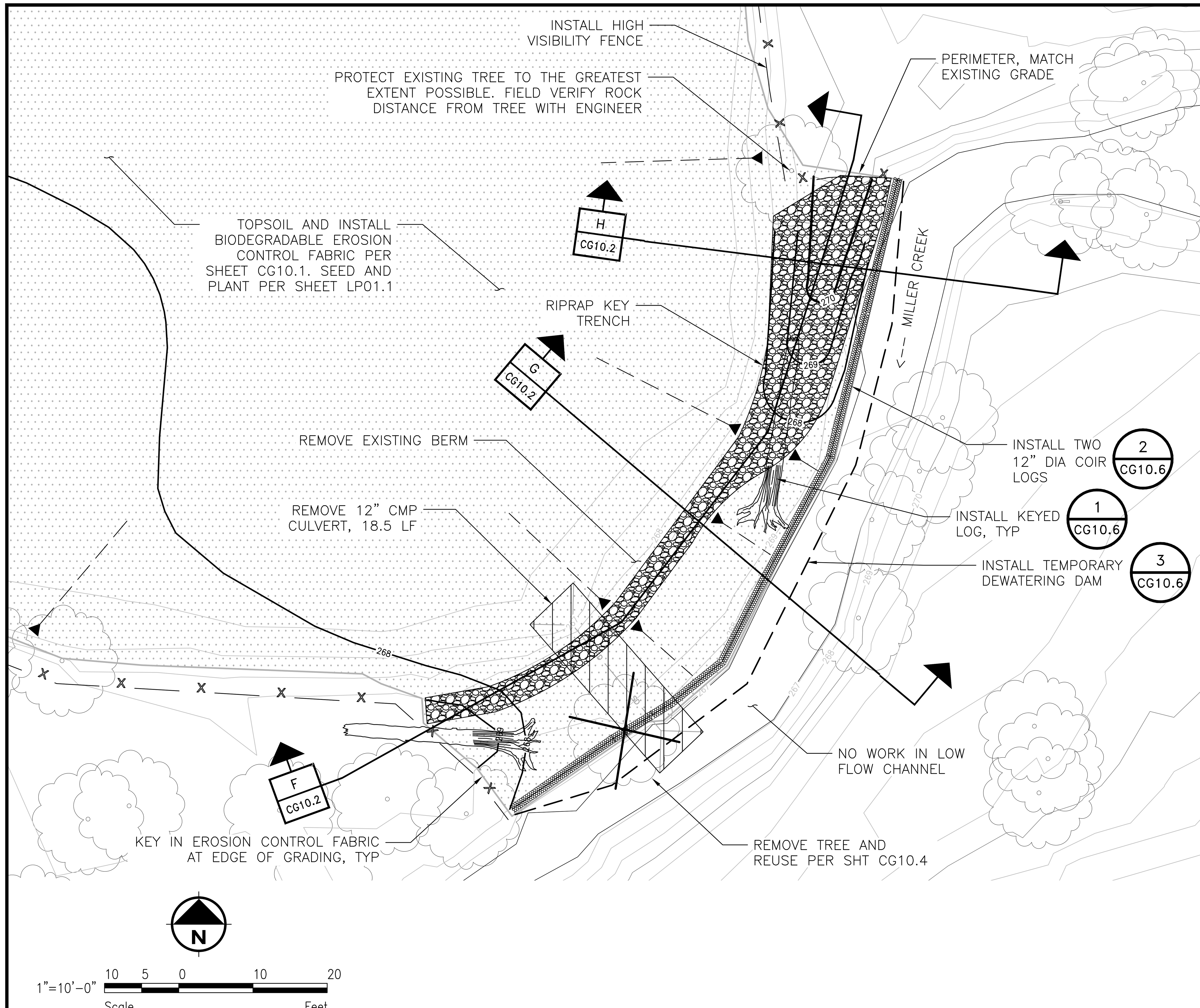
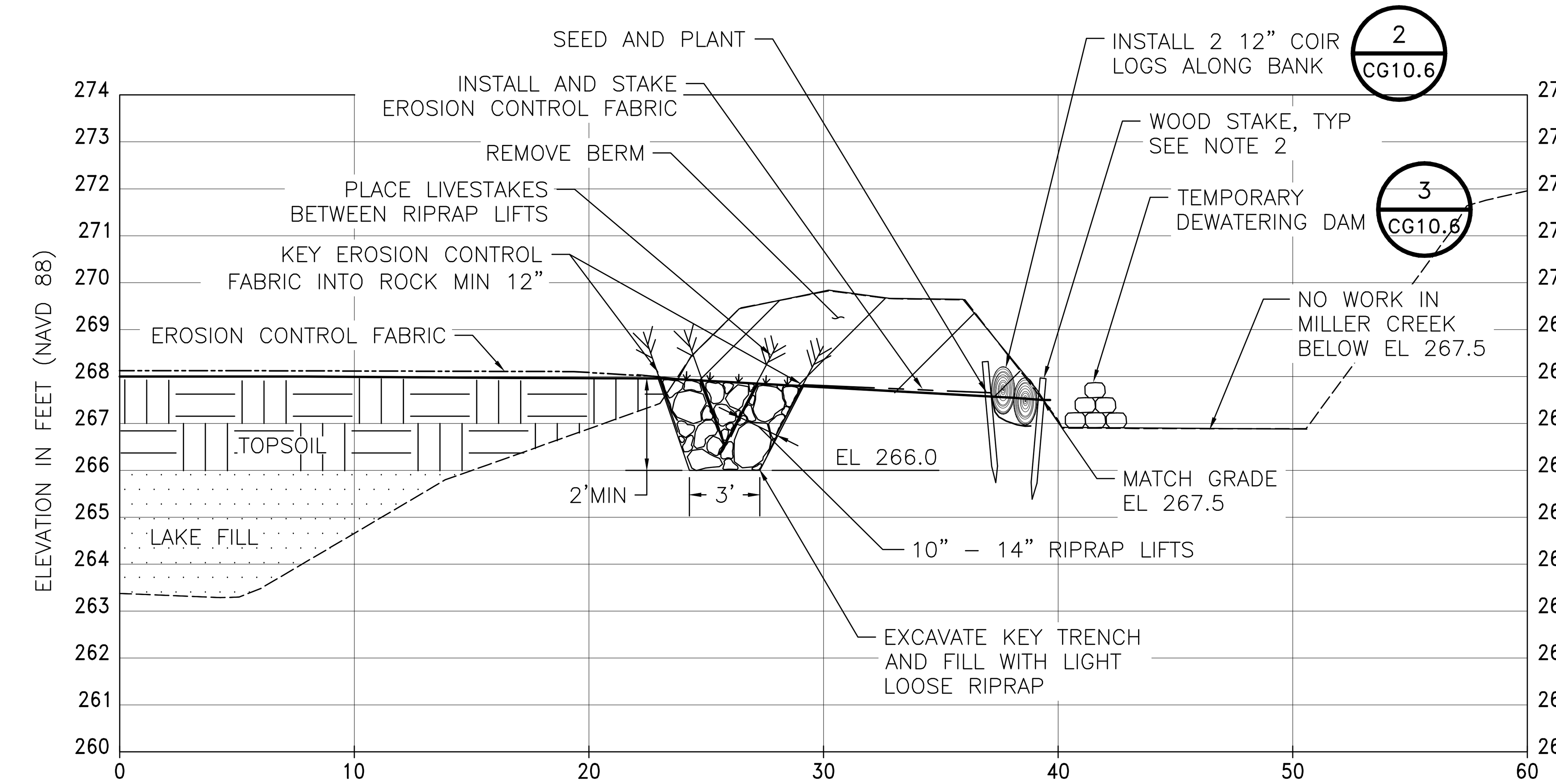
PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**

SHEET TITLE: **LL SEASON 2 WETLAND FINAL GRADING PLAN**

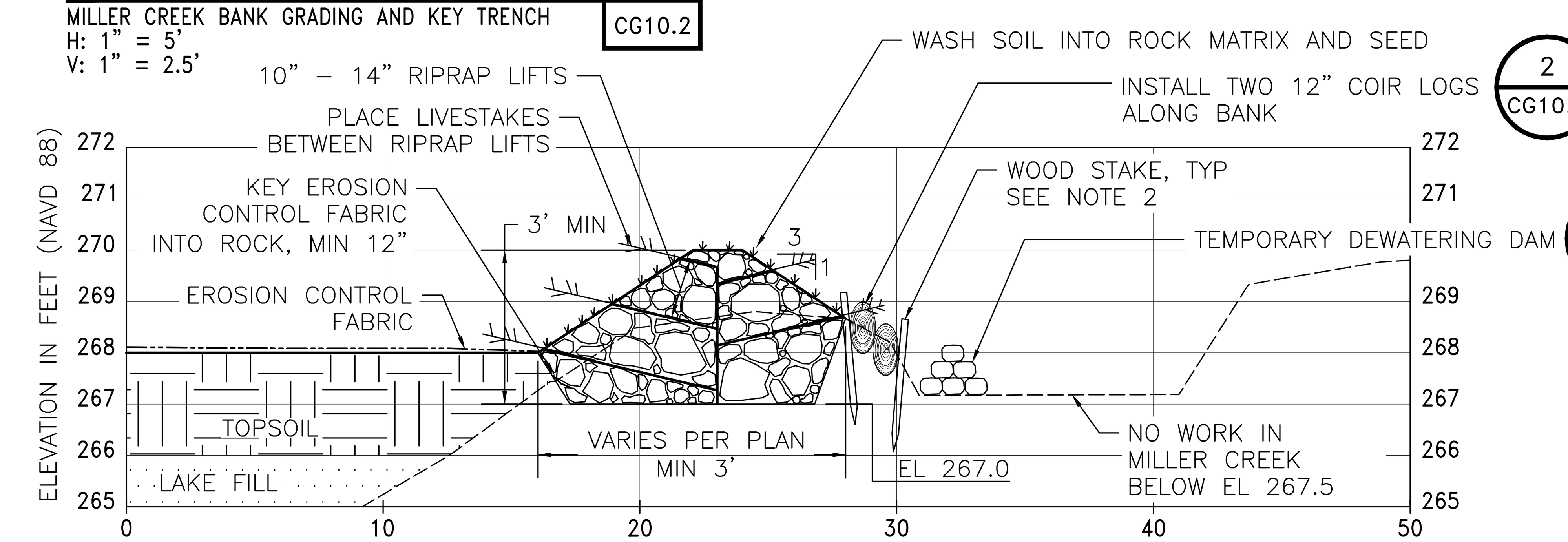
POS WORK PROJECT NUMBER	104396
CONSULTANT'S PROJECT NUMBER	POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER	STIA-1701 CG10.1





SECTION G CG10.2

MILLER CREEK BANK GRADING AND KEY TRENCH
H: 1" = 5'
V: 1" = 2.5'

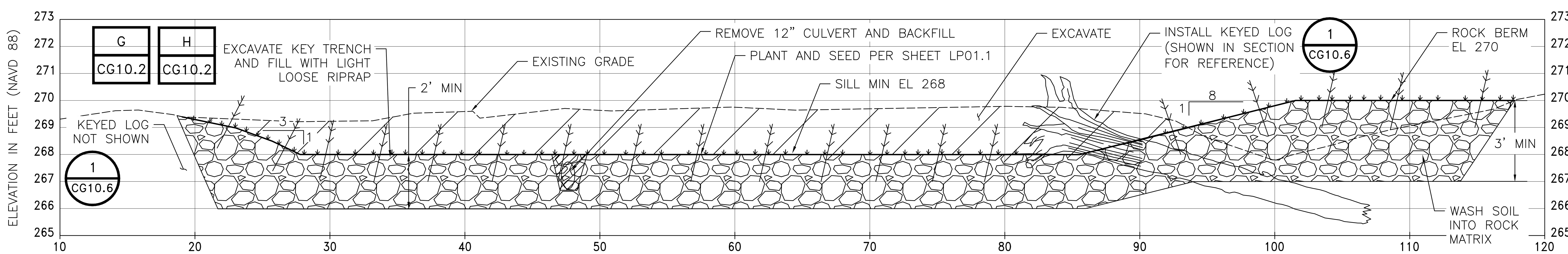


SECTION H CG10.2

MILLER CREEK BANK GRADING AND ROCK BERM
H: 1" = 5'
V: 1" = 2.5'

NOTES:

1. EXCAVATED BERM MATERIAL SHALL BE DISPOSED OF AS SUBTITLE D SOIL.
2. INSTALL TWO (2) 12" COIR LOGS ALONG THE BANK. WRAP BOTH COIR LOGS WITH COIR TWINE AND SECURE TO 30" WOOD STAKES PER DETAIL 2 ON SHEET CG10.6.
3. INSTALL RIPRAP IN 10" TO 14" LIFTS WITH LIVESTAKES BETWEEN LAYERS.
4. WASH SOIL INTO THE ROCK MATRIX AND SEED. FINAL ACCEPTANCE OF RIPRAP, WOOD STAKES, COIR LOGS, AND KEYED LOGS SHALL BE PER ENGINEER.



SECTION F CG10.2

MILLER CREEK BANK GRADING
H: 1" = 5'
V: 1" = 2.5'

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DATE: 8/19/2016
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REVISIONS

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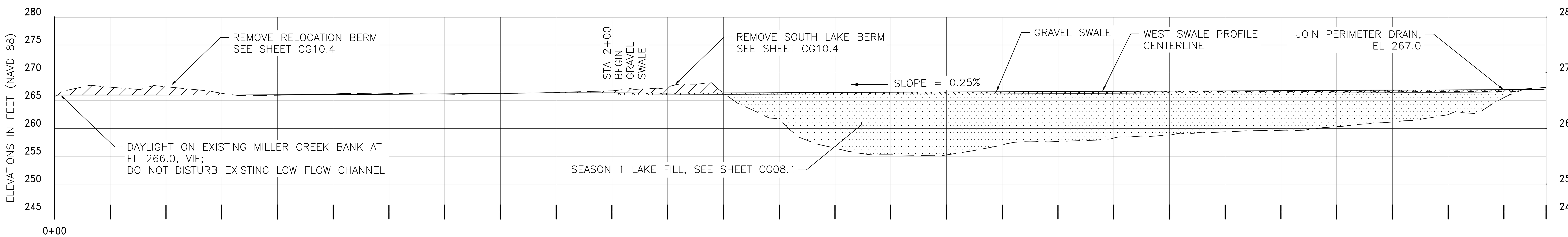
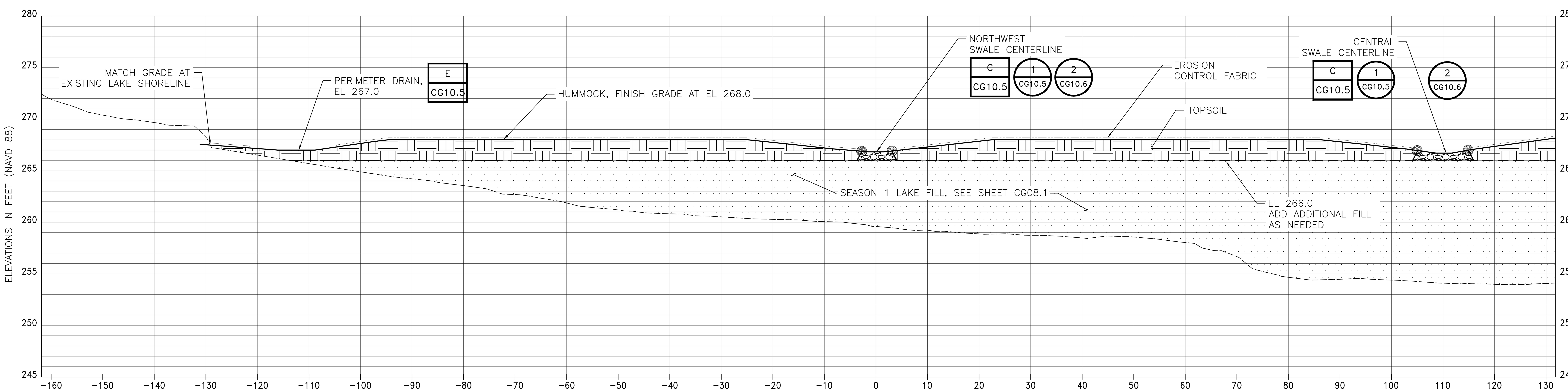
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 2 WETLAND EAST LAKE BERM OPENING

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG10.2



PROFILE A / CG10.1
WEST SWALE
H: 1" = 20'
V: 1" = 10'



SECTION B / CG10.1
WETLAND REHABILITATION, TYPICAL
H: 1" = 10'
V: 1" = 5'

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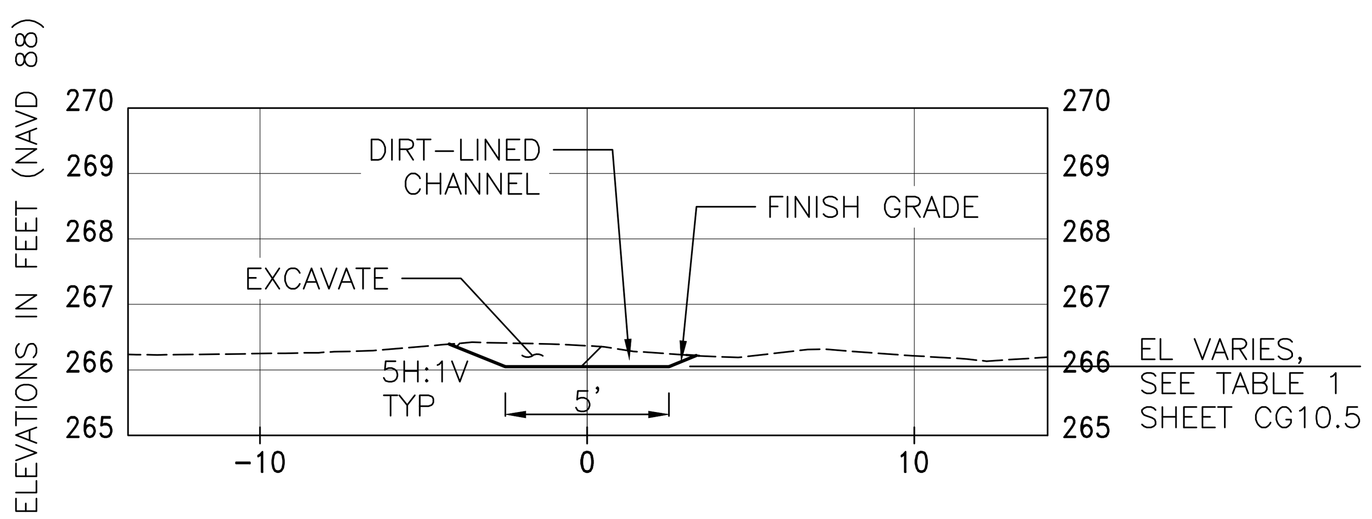
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 2 WETLAND GRADING SECTIONS

POS WORK PROJECT NUMBER
104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CG10.3

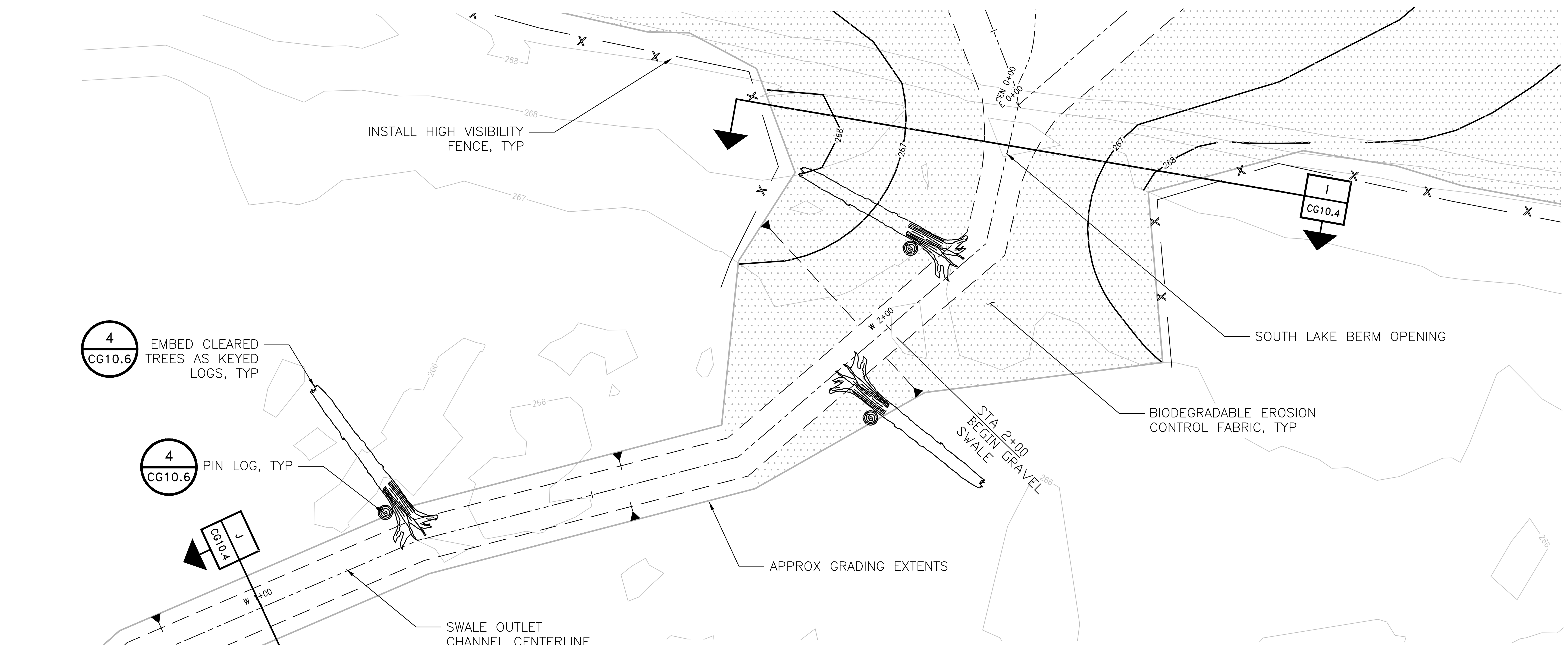
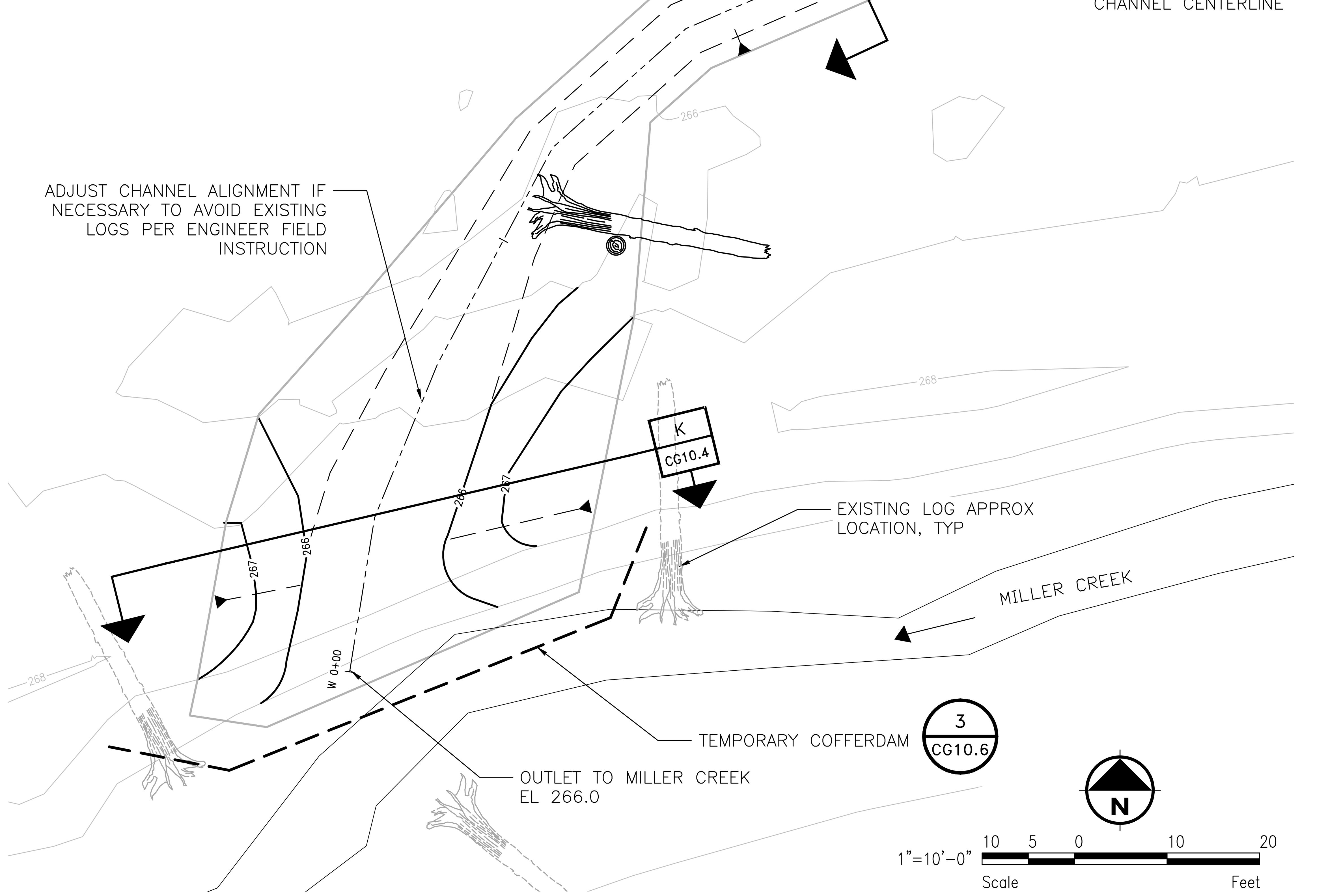


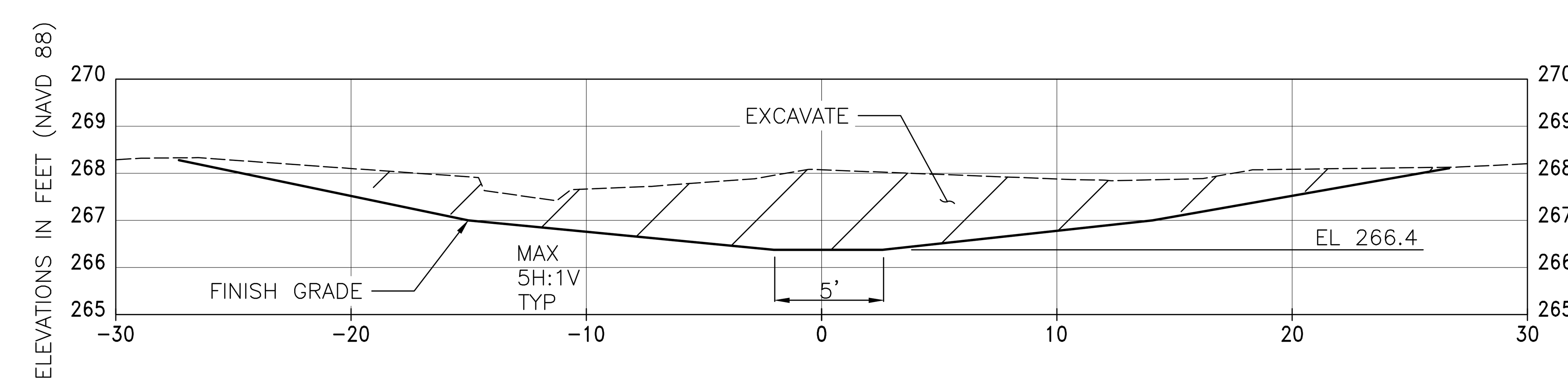
SECTION J CG10.4

SWALE OUTLET CHANNEL, TYP
H: 1" = 5'
V: 1" = 2.5'

NOTES:

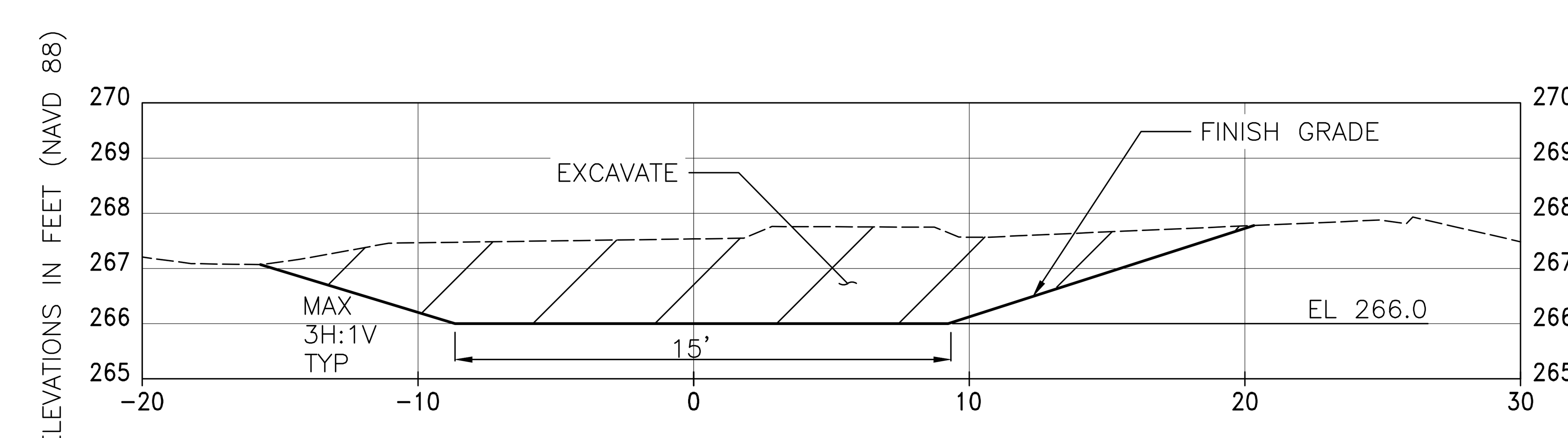
1. SALVAGE CLEARED TREES WITH ROOTWADS INTACT.
2. INSTALL CLEARED LOG PER SHEET CG10.6.
3. REDRESS ADJACENT CLEARED AREAS WITH SMALL LOGS AND DEBRIS.



SECTION I CG10.4

SOUTH LAKE BERM OPENING
H: 1" = 5'
V: 1" = 2.5'



SECTION K CG10.4

OUTLET TO MILLER CREEK
H: 1" = 5'
V: 1" = 2.5'

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PROJECT ENGR./ARCH:	CL
DESIGNER:	SW, CL
DRAWN BY:	EB, AJ
SCALE:	AS SHOWN
DATE:	8/19/2016
CHECKED BY:	KEN VIGIL
CHECKED/APPROVED BY:	CURTIS LOEB

CURTIS J LOEB STATE OF WASHINGTON 47221 REGISTERED PROFESSIONAL ENGINEER

REVISIONS

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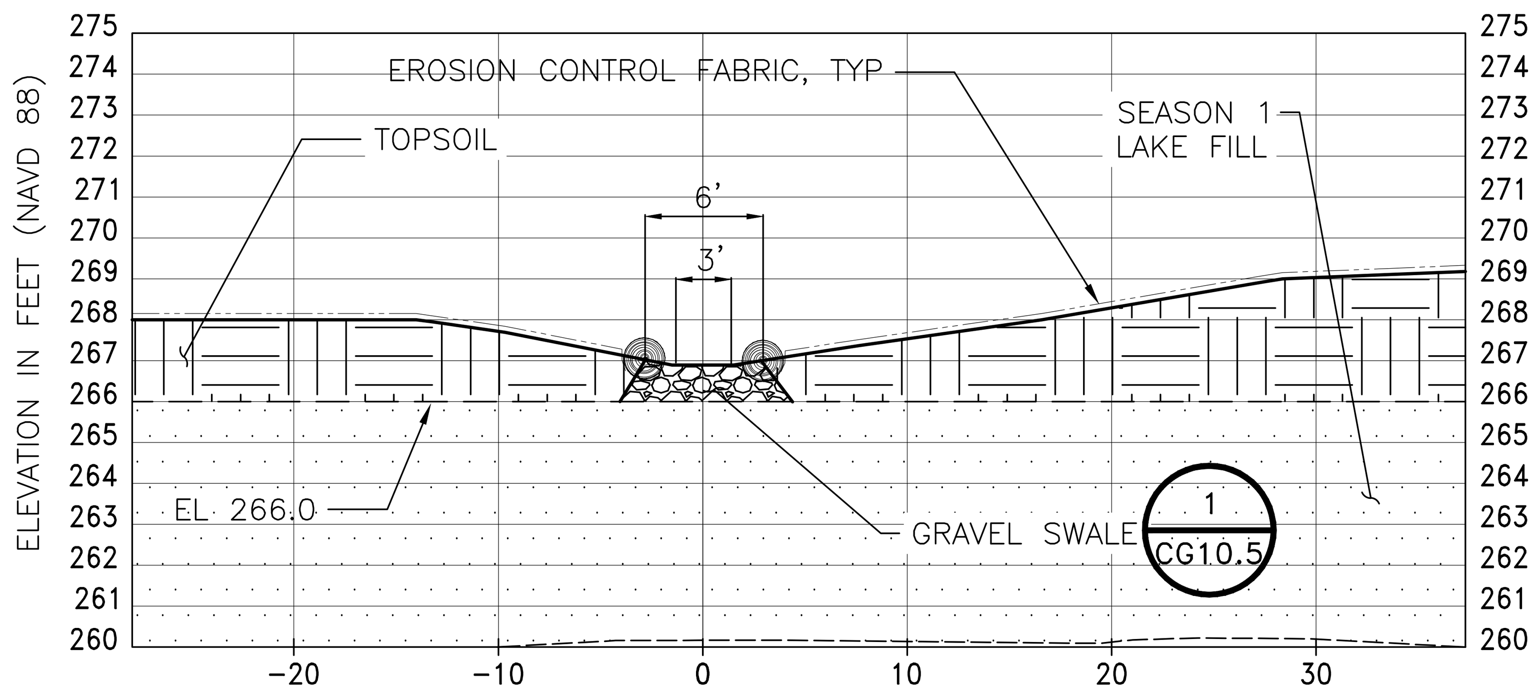
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

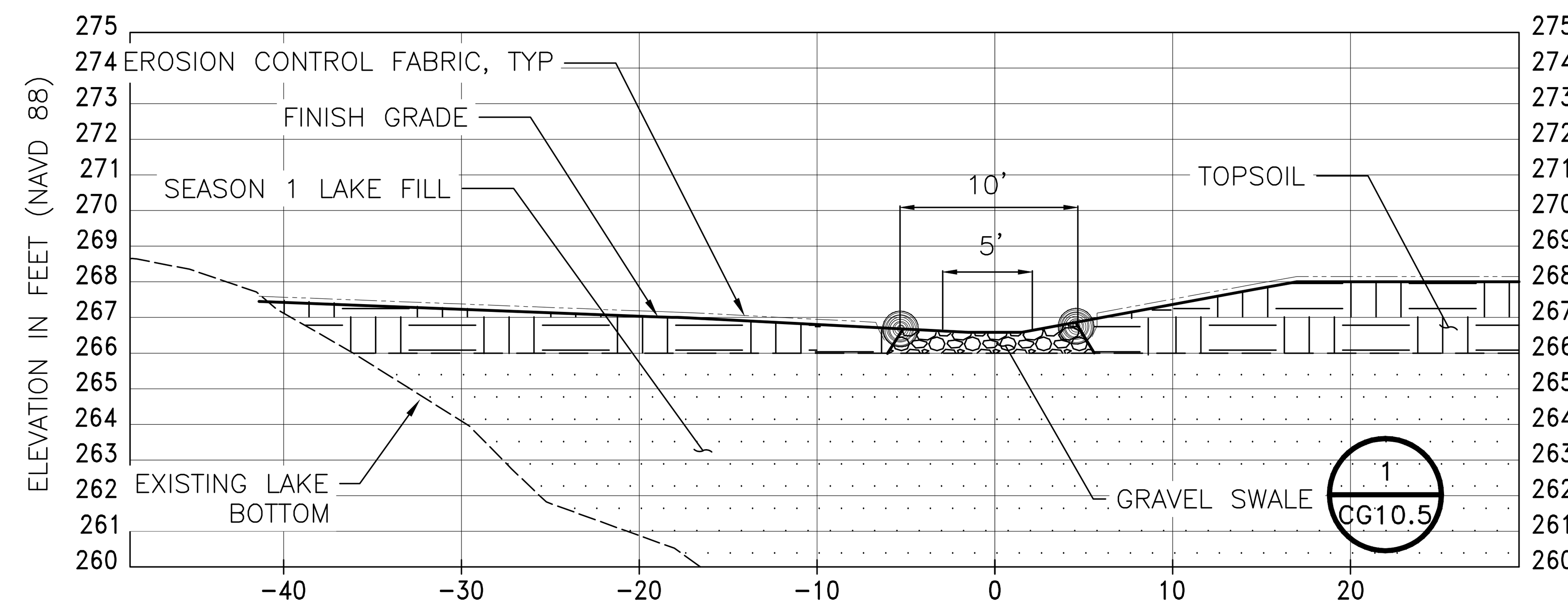
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS

SHEET TITLE: LL SEASON 2 WETLAND OUTLET TO MILLER CREEK

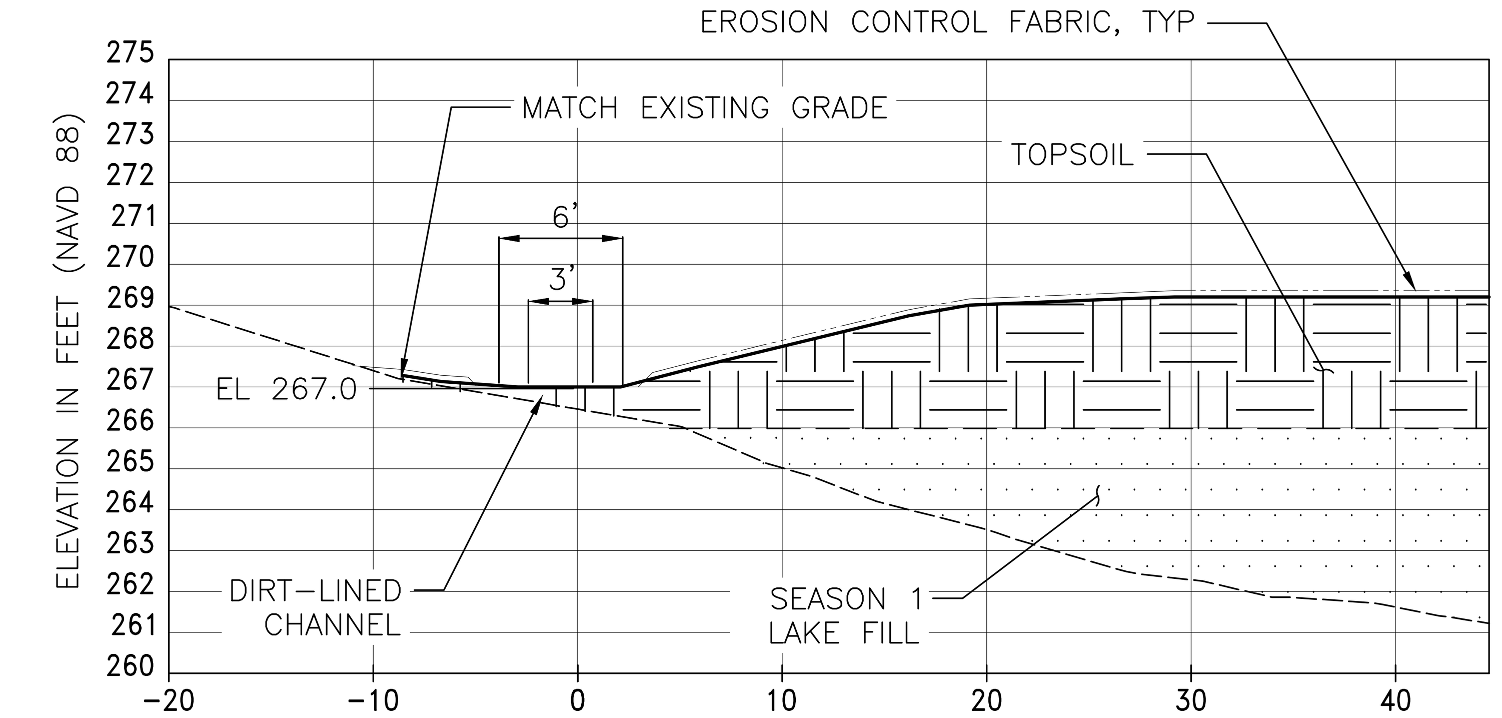
POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CG10.4



SECTION C
CG10.1
SMALL DRAINAGE SWALE, TYP
H: 1" = 8'
V: 1" = 4'



SECTION D
CG10.1
LARGE DRAINAGE SWALE, TYP
H: 1" = 8'
V: 1" = 4'



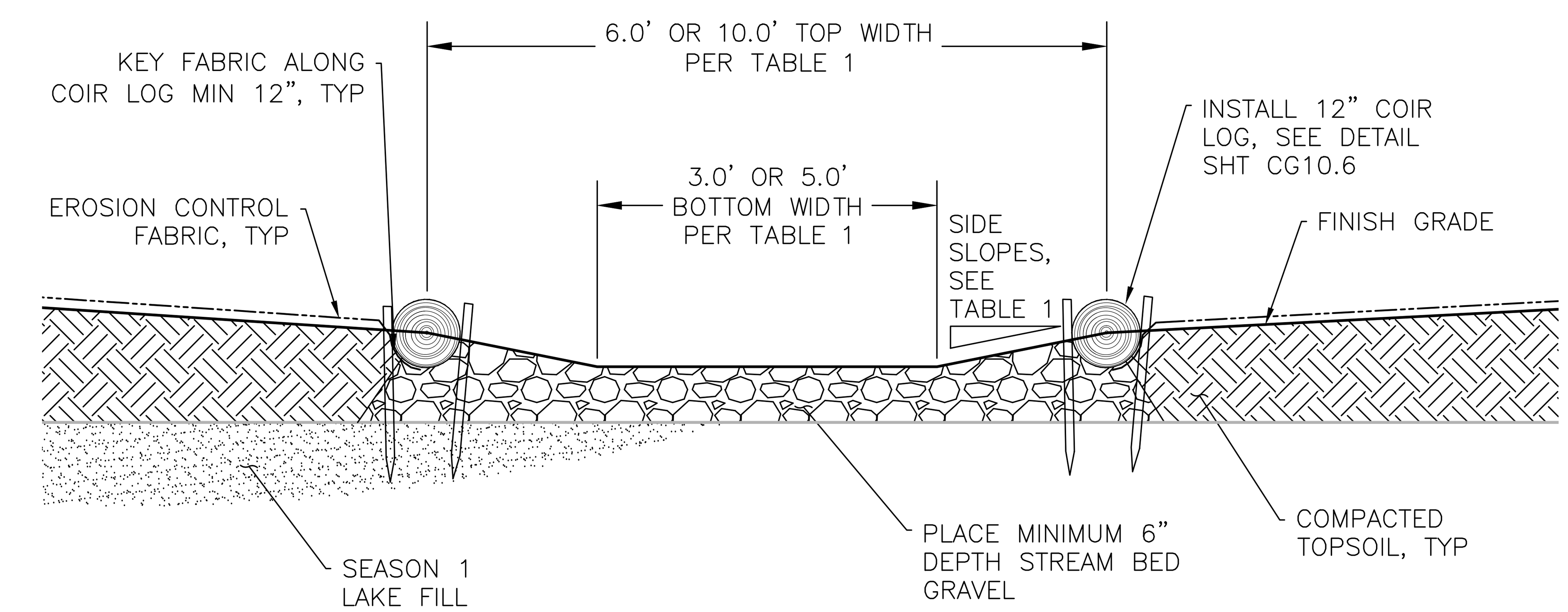
SECTION E
CG10.1
PERIMETER DRAIN, TYP
H: 1" = 8'
V: 1" = 4'

TABLE 1: GRAVEL SWALE SECTIONS

STATION	INVERT ELEVATION, FT NAVD 88	BOTTOM WIDTH, FT	TOP WIDTH, FT	SIDE SLOPE	NOTES
NW 1+51	267.0	3.0	6.0	3:1	INTERSECT PERIMETER DRAIN AT PERIM 1+50
NW 1+00	266.9	3.0	6.0	3:1	
NW 0+00	266.7	3.0	6.0	3:1	FLOW INTO WEST SWALE AT W 3+80
W 5+35	267.0	5.0	10.0	5:1	CONNECT TO DRAINAGE CHANNEL
W 5+32	267.0	5.0	10.0	5:1	INTERSECT PERIMETER DRAIN AT PERIM 0+00
W 5+00	266.9	5.0	10.0	5:1	
W 4+00	266.7	5.0	10.0	5:1	
W 3+80	266.7	5.0	10.0	5:1	NORTHWEST SWALE FLOWS IN
W 3+00	266.5	5.0	10.0	5:1	
W 2+40	266.4	5.0	10.0	5:1	CENTRAL AND EAST SWALES FLOW IN
W 2+00	266.3	5.0	10.0	5:1	TRANSITION FROM DIRT TO GRAVEL
W 1+00	266.1	5.0	10.0	5:1	DIRT LINED
W 0+00	266.0	5.0	10.0	5:1	OUTLET TO MILLER CREEK, DIRT LINED
CEN 3+46	267.0	3.0	6.0	3:1	INTERSECT PERIMETER DRAIN AT PERIM 2+79
CEN 3+00	266.9	3.0	6.0	3:1	
CEN 2+00	266.8	3.0	6.0	3:1	
CEN 1+55	266.7	5.0	10.0	5:1	EAST-CENTRAL SWALE FLOWS IN
CEN 1+00	266.6	5.0	10.0	5:1	
CEN 0+00	266.4	5.0	10.0	5:1	FLOWS INTO WEST SWALE AT W 2+40
E-CEN 1+36	267.0	3.0	6.0	3:1	INTERSECT PERIMETER DRAIN AT PERIM 4+00
E-CEN 1+00	266.9	3.0	6.0	3:1	
E-CEN 0+00	266.7	3.0	6.0	3:1	FLOWS INTO CENTRAL SWALE AT CEN 1+55
E 2+82	267.0	3.0	6.0	3:1	INTERSECT PERIMETER DRAIN AT PERIM 5+54
E 2+00	266.8	3.0	6.0	3:1	
E 1+38	266.7	5.0	10.0	5:1	SOUTHEAST SWALE FLOWS IN
E 1+00	266.6	5.0	10.0	5:1	
E 0+00	266.4	5.0	10.0	5:1	FLOWS INTO WEST SWALE AT W 2+40
SE 1+44	267.0	3.0	6.0	3:1	INTERSECT PERIMETER DRAIN AT PERIM 6+86
SE 1+00	266.9	3.0	6.0	3:1	
SE 0+00	266.7	3.0	6.0	3:1	FLOWS INTO EAST SWALE AT E 1+38

TABLE 2: PERIMETER DRAIN SECTIONS

STATION	INVERT ELEVATION, FT NAVD 88	BOTTOM WIDTH, FT	TOP WIDTH, FT	SIDE SLOPE	NOTES
PERIM 6+86	267.0	3.0	6.0	3:1	INTERSECT SOUTHEAST SWALE
PERIM 6+00	267.0	3.0	6.0	3:1	
PERIM 5+54	267.0	3.0	6.0	3:1	INTERSECT EAST SWALE
PERIM 5+00	267.0	3.0	6.0	3:1	
PERIM 4+00	267.0	3.0	6.0	3:1	INTERSECT EAST-CENTRAL SWALE
PERIM 3+00	267.0	3.0	6.0	3:1	
PERIM 2+93	267.0	3.0	6.0	3:1	INTERSECT CONNECTOR CHANNEL
PERIM 2+79	267.0	3.0	6.0	3:1	INTERSECT CENTRAL SWALE
PERIM 2+00	267.0	3.0	6.0	3:1	
PERIM 1+50	267.0	3.0	6.0	3:1	INTERSECT NORTHWEST SWALE
PERIM 1+00	267.0	3.0	6.0	3:1	
PERIM 0+00	267.0	3.0	6.0	3:1	INTERSECT WEST SWALE
CC 0+28	267.7	4.0	8.0	8:1	CONNECT TO SPLASH PAD, NOTE 2
CC 0+20	267.5	3.0	6.0	3:1	
CC 0+00	267.0	3.0	6.0	3:1	INTERSECT PERIMETER DRAIN



DETAIL 1
CG10.1
DRAINAGE SWALE
1" = 2'

NOTES:

1. SWALE SIDE SLOPES SHALL VARY PER TABLE 1 AND 2, AND PER PLAN ON SHEET CG10.1. SWALE SIDE SLOPES SHALL VARY WITHOUT ABRUPT CHANGES, IN A NATURALLY-VARYING MANNER. FINAL GRADING SHALL BE APPROVED BY OWNER'S REPRESENTATIVE.
2. FIELD FIT CONNECTOR CHANNEL INVERT ELEVATIONS TO MATCH SPLACH PAD ELEVATION AND PERIMETER DRAIN INVERT AND TO MAINTAIN A CONSTANT SLOPE.

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PROJECT ENGR./ARCH: CL
DESIGNER: SW, CL
DRAWN BY: EB, AJ
SCALE: AS SHOWN
DATE: 8/19/2016
CHECKED BY: KEN VIGIL
CHECKED/APPROVED BY: CURTIS LOEB

CURTIS J LOEB
STATE OF WASHINGTON
47227
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PROFESSIONAL ENGINEER

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

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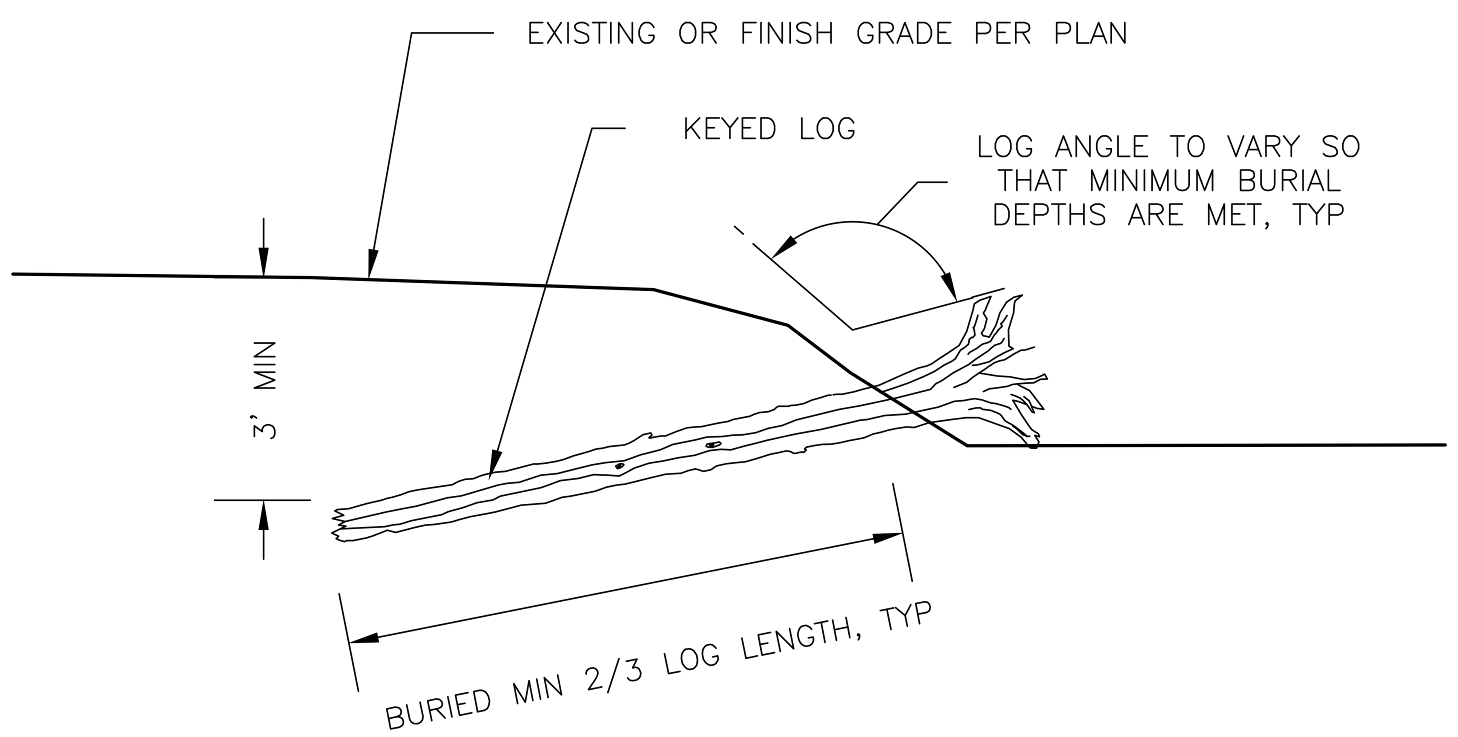
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

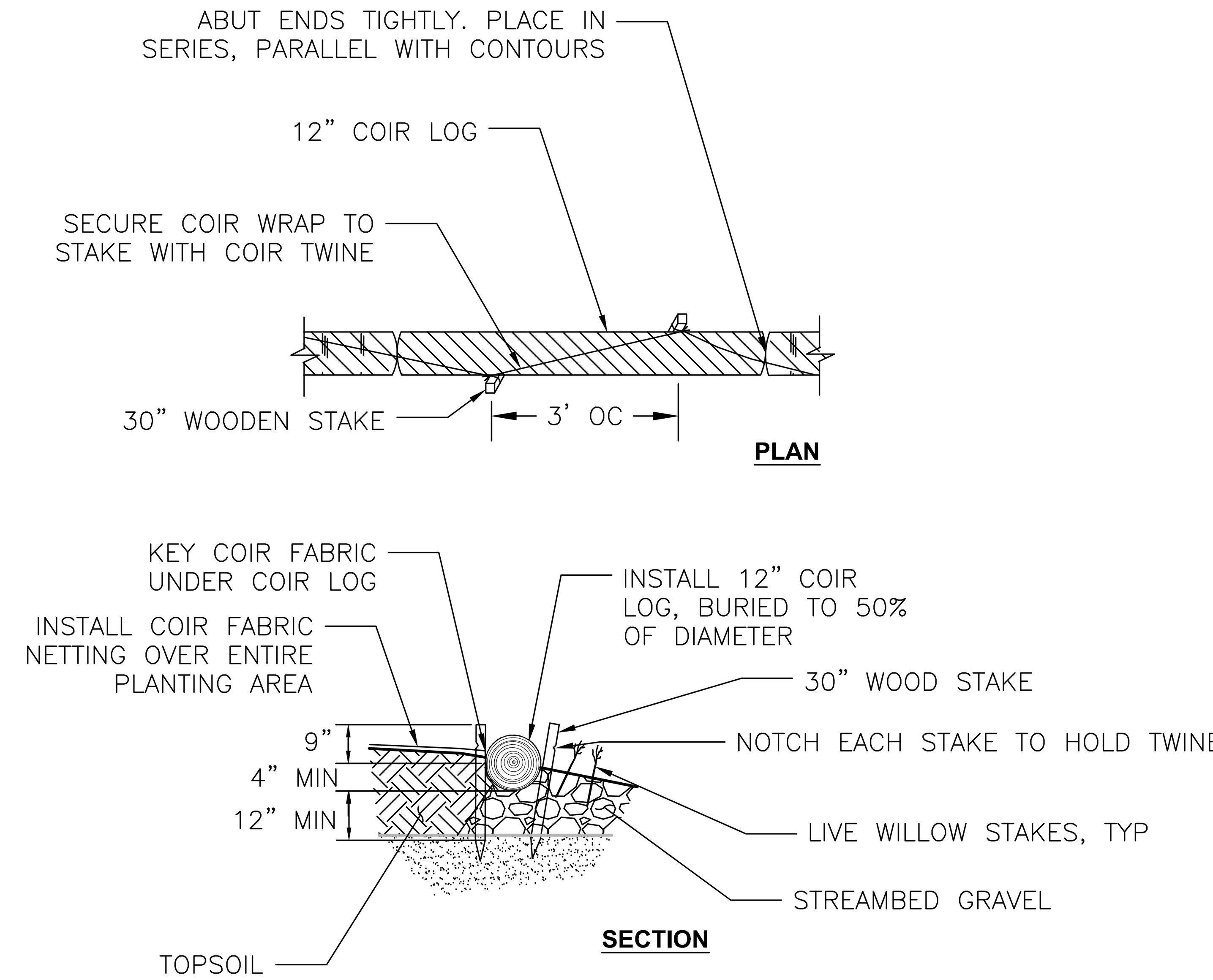
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL WETLAND SEASON 2 GRAVEL SWALE SECTIONS

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG10.5



DETAIL 1 CG10.2

LARGE WOOD INSTALLATION AT EAST BERM
NTS

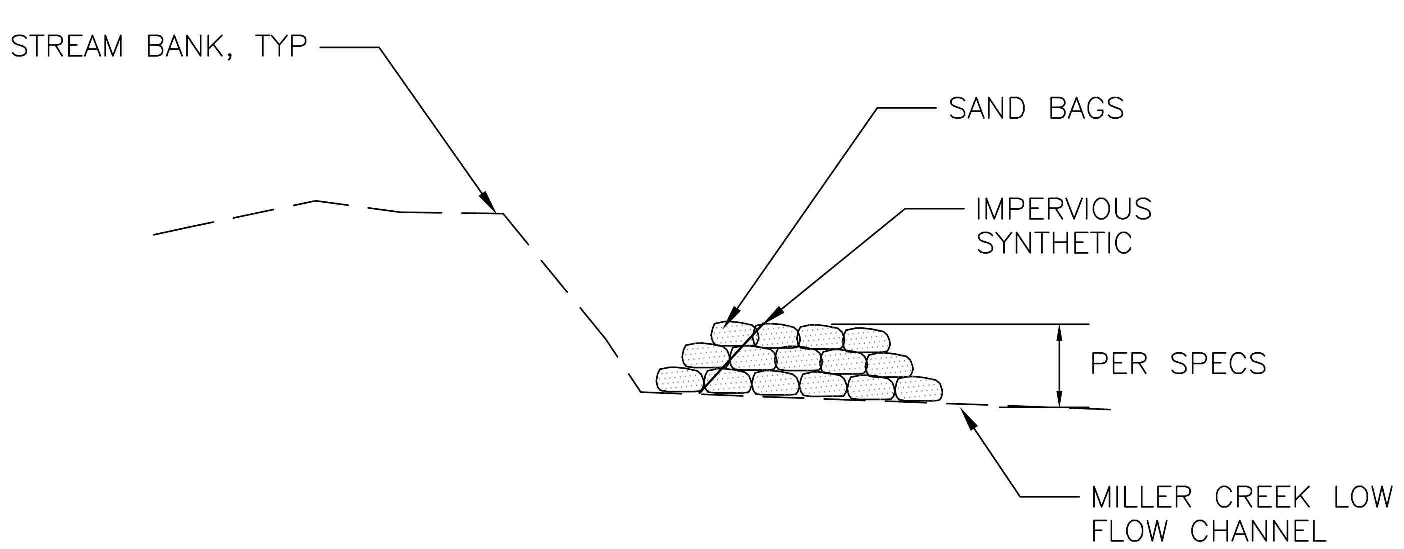


DETAIL 2 CG10.1

COIR LOG INSTALATION
NTS

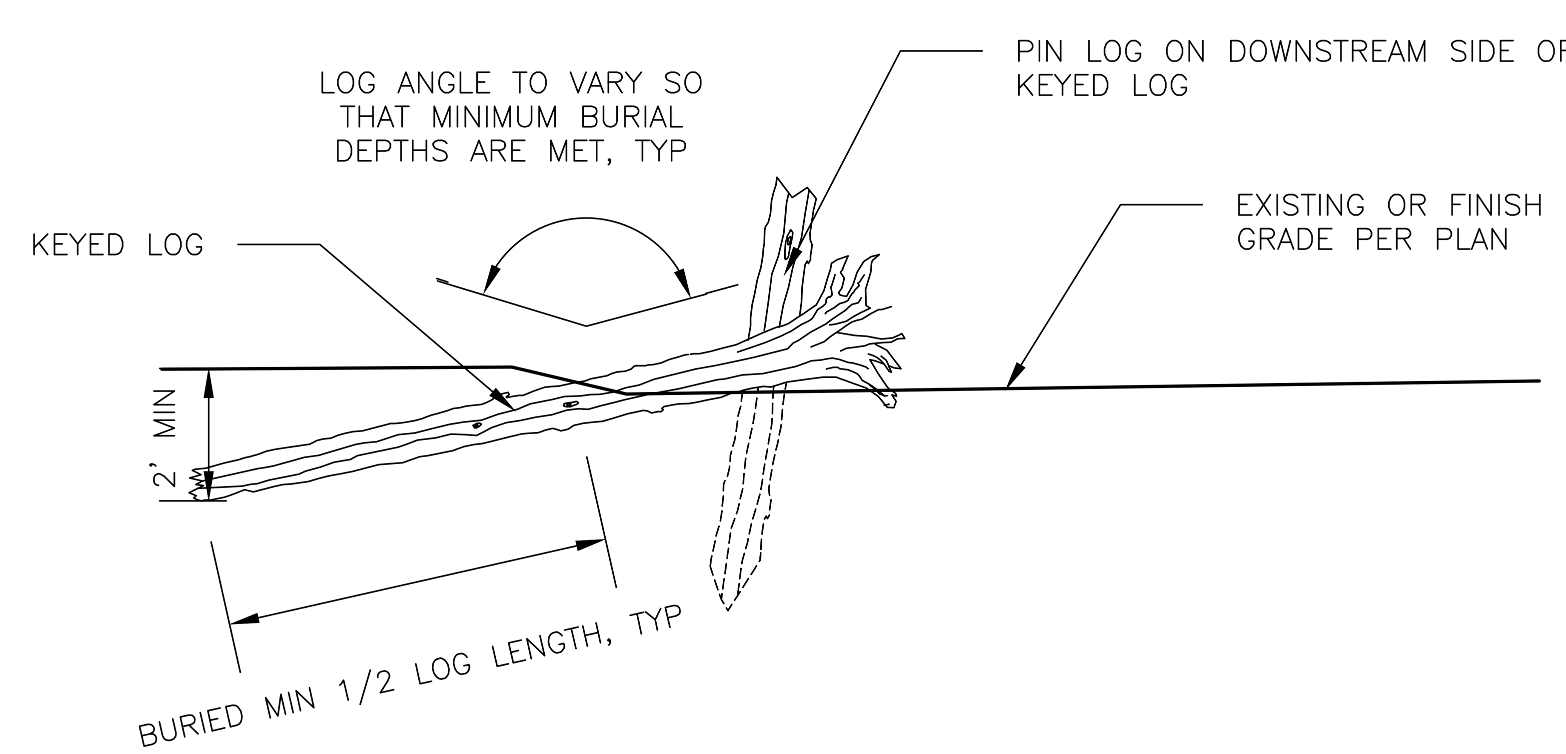
NOTES:

1. INSTALL 12" COIR LOGS AT THE TOP OF BANK ON BOTH SIDES OF THE GRAVEL SWALES. SECURE COIR LOG WITH WOOD STAKE AND COIR TWINE AS SPECIFIED.
2. KEY BIODEGRADABLE EROSION CONTROL FABRIC ALONG COIR LOGS AND AT EDGE OF GRADING AT ALL LOCATIONS AS SHOWN IN THE PLANS.
3. INSTALL DEWATERING DAMS AS SHOWN ON PLAN TO ISOLATE STREAM BANK WORK AREAS.
4. IN ADDITION TO SAND BAGS, USE AN IMPERVIOUS SYNTHETIC LINER TO REDUCE PERMEABILITY OF DEWATERING DAM.
5. HEIGHT OF THE DEWATERING DAMS SHALL BE HIGH ENOUGH TO PREVENT MILLER CREEK FLOWS FROM ENTERING THE WORK AREA.
6. DAM MATERIALS SHALL BE INCLUDED IN THE CONTRACTOR'S WETLAND REHABILITATION PLAN.
7. FULLY REMOVE DEWATERING DAMS AFTER THE AREA HAS BEEN STABILIZED.



DETAIL 3 CG10.1

DEWATERING DAM – SECTION
NTS



DETAIL 4 CG10.4

LARGE WOOD INSTALLATION AT MILLER CRK OUTLET
NTS

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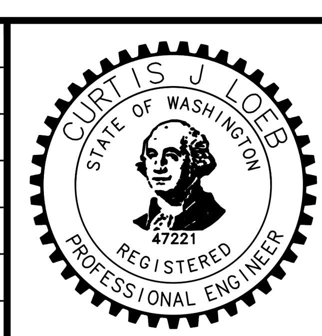
PROJECT ENGR./ARCH: CL
DESIGNER: CL
DRAWN BY: EB, AJ
SCALE: NA
DATE: 8/19/2016
CHECKED BY: KEN VIGIL
CHECKED/APPROVED BY: CURTIS LOEB



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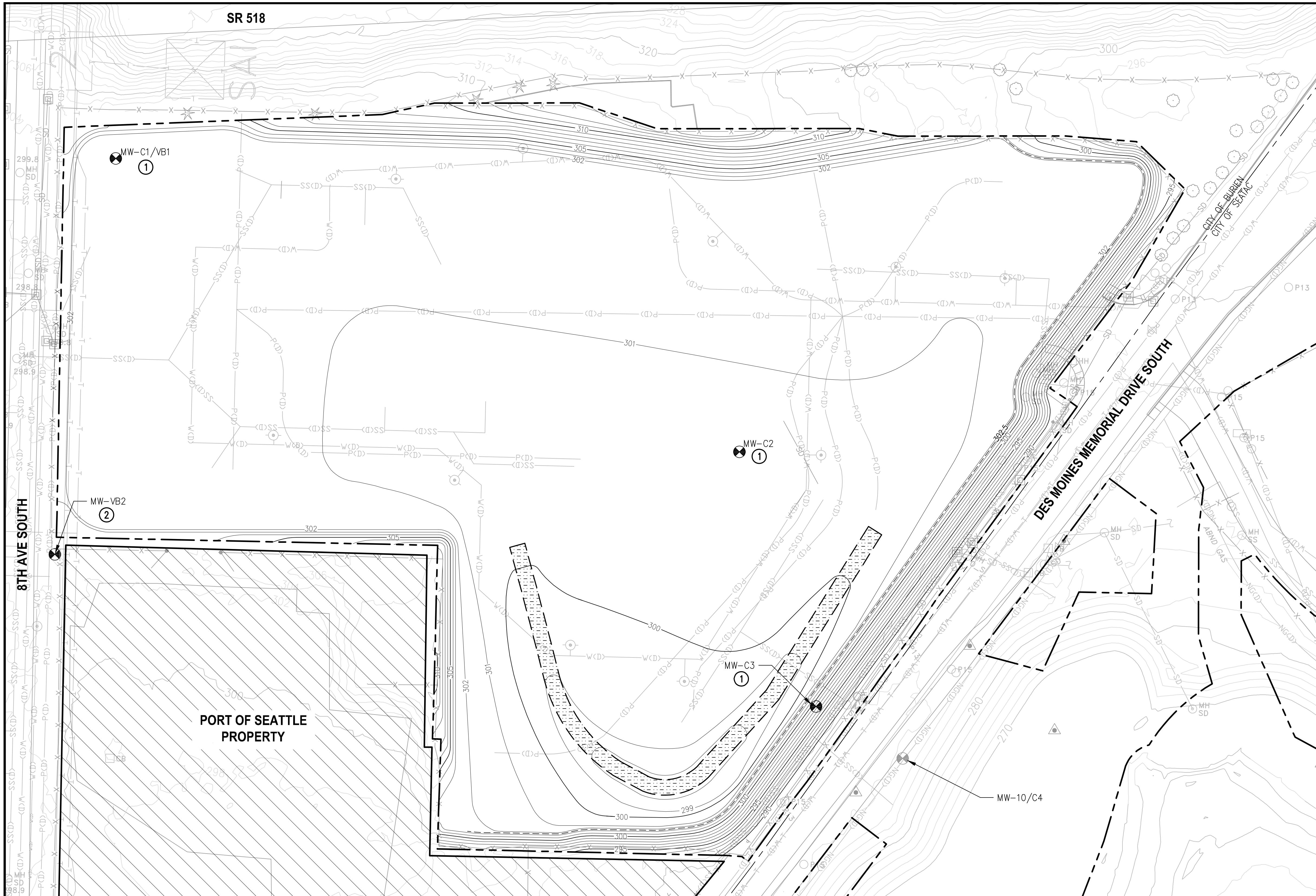
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 2 WETLAND DETAILS

POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CG10.6



MONITORING POINT LOCATIONS		
MONITORING POINT	NORTHING	EASTING
MW-C1/VB1	174848.80	1271956.00
MW-C2	174622.80	1272436.00
MW-C3	174426.60	1272495.00
MW-VB2	174543.83	1271909.11

NOTES:

1. GROUNDWATER MONITORING WELLS WILL BE INSTALLED PER DETAIL 1 ON CU02.2.
2. GROUNDWATER MONITORING WELL TO BE INSTALLED PER DETAIL 2 ON CU02.2
3. DEPTH OF INSTALLATION FOR GROUNDWATER MONITORING WELLS WILL BE A FIELD DECISION BASED ON GROUNDWATER DEPTH AT THE TIME OF DRILLING.
4. SEE SHEET CB01.2 FOR ON-SITE UTILITY DEMOLITION AND INFORMATION

LEGEND:

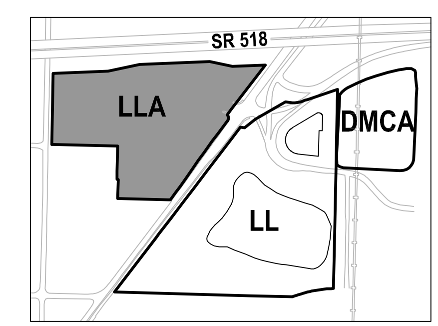
- FENCE
- PROJECT WORK AREA LIMITS
- 270 — ELEVATION CONTOUR IN FEET (NAVD 88)
- 310 — PROPOSED ELEVATION CONTOUR IN FEET (NAVD 88)
- MW-104 — GROUNDWATER MONITORING WELL TO BE INSTALLED
- EXISTING GROUNDWATER MONITORING WELL
- STAGING AREA
- BIOFILTRATION SWALE
- P(D) — POWER
- W(D) — WATER
- NG(D) — NATURAL GAS
- SS(D) — SANITARY SEWER
- T — TELEPHONE

PLAN

LLA GROUNDWATER MONITORING WELL INSTALLATION PLAN
SCALE: 1" = 40'

1"=40' Scale 40 0 40 80 Feet

N



KEY MAP

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PROJECT ENGR./ARCH: MEGAN KING
DESIGNER: MMK
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: JSM
CHECKED/APPROVED BY: MMK

MEGAN MARIE KING, STATE OF WASHINGTON, REGISTERED PROFESSIONAL ENGINEER 3/10/17

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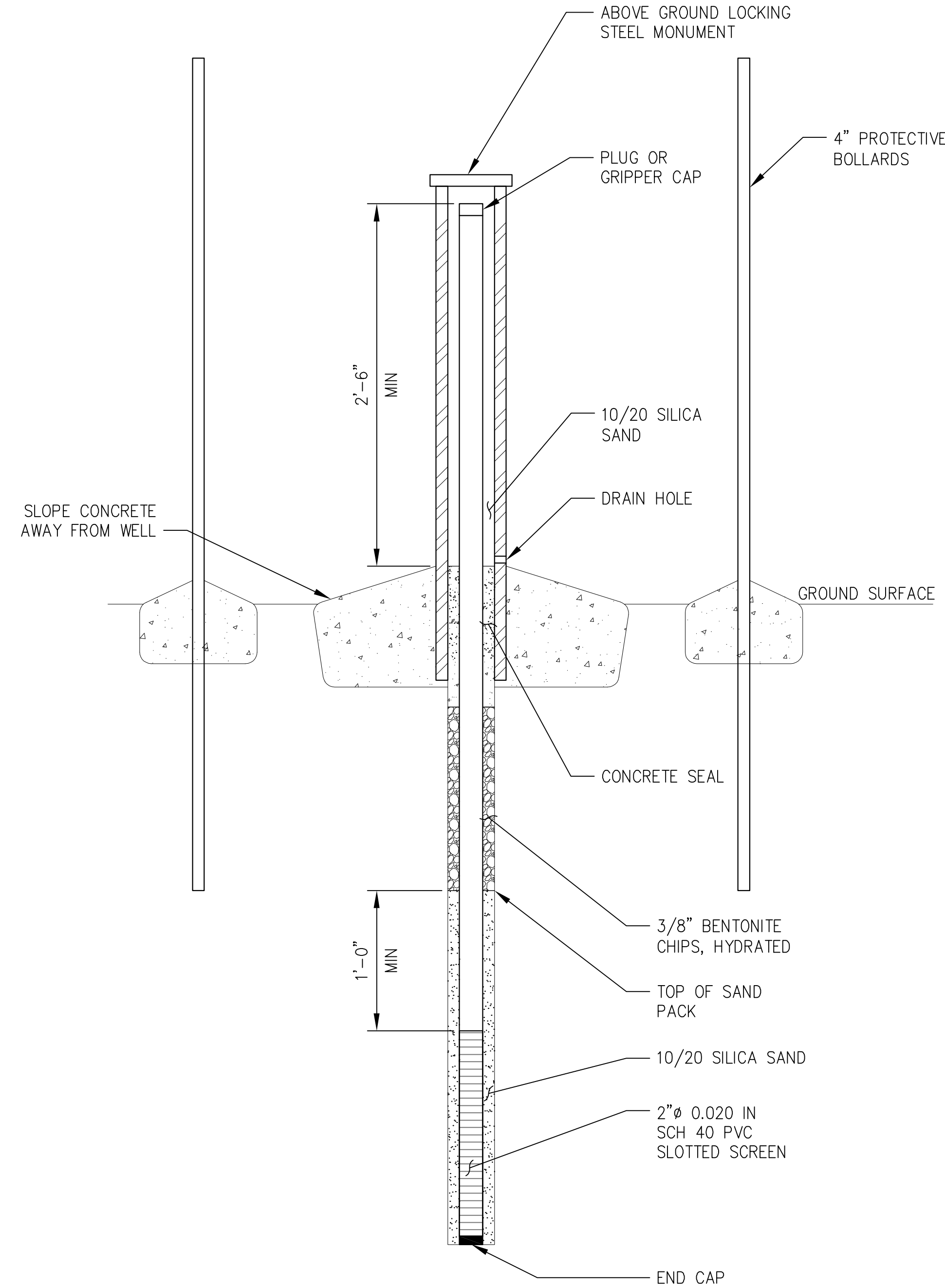
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

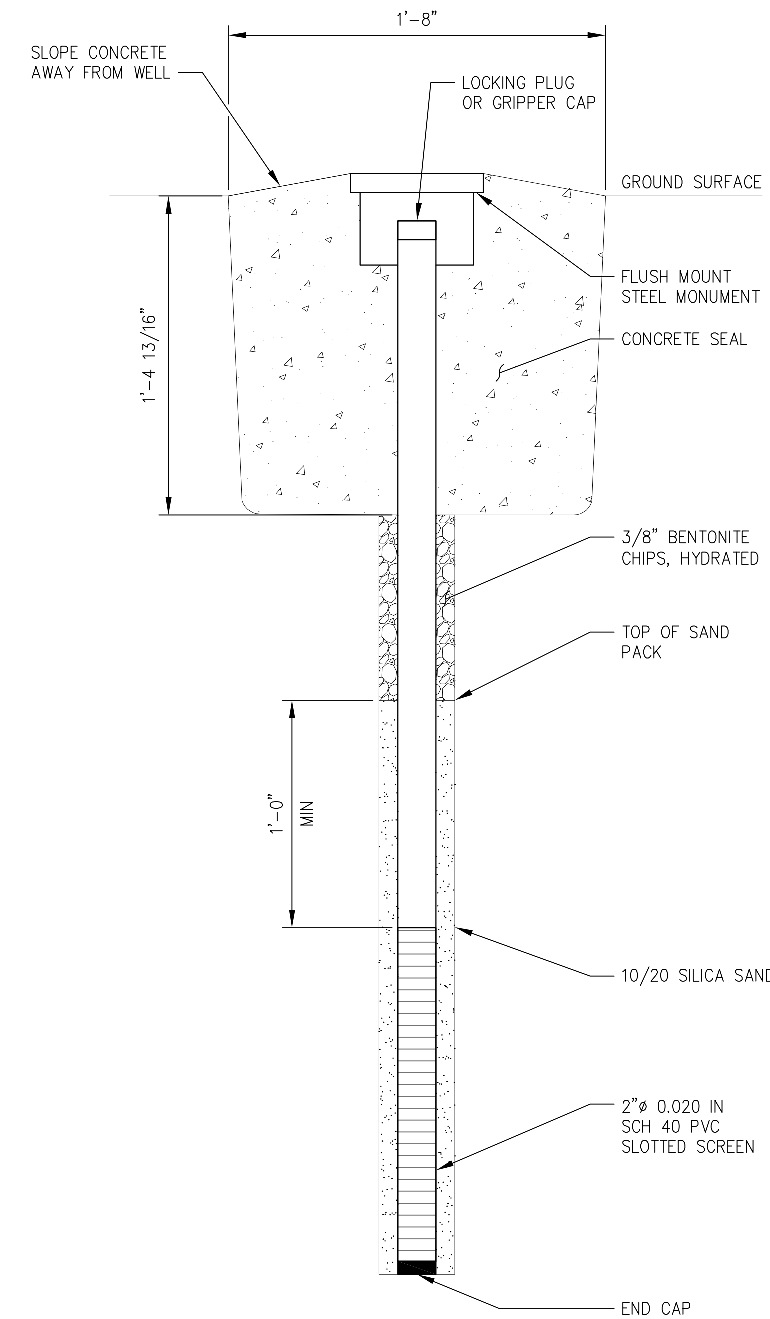
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LLA GROUNDWATER MONITORING WELL INSTALLATION PLAN

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701
CU02.1



DETAIL
GROUNDWATER MONITORING
WELL INSTALLATION – ABOVE GROUND
SCALE: NTS

1
CU02.1



DETAIL
GROUNDWATER MONITORING
WELL INSTALLATION – FLUSH MOUNT
SCALE: NTS

2
CU02.1

NOTE: SET MONUMENT 4" ABOVE SURROUNDING SURFACE AND SLOPE CONCRETE PAD SURFACE ELEVATION TO MATCH SURROUNDING SURFACE. WHERE EXISTING SURFACE IS CONCRETE OR ASPHALT, JOINT SEALING FILLER TO BE USED TO SEAL THE CONTACT JOINT. CONCRETE PAD TO BE REINFORCED WITH #3 AND #4 REBAR GRADE 60.

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PROJECT ENGR./ARCH: MEGAN KING
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POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
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POS DATE:
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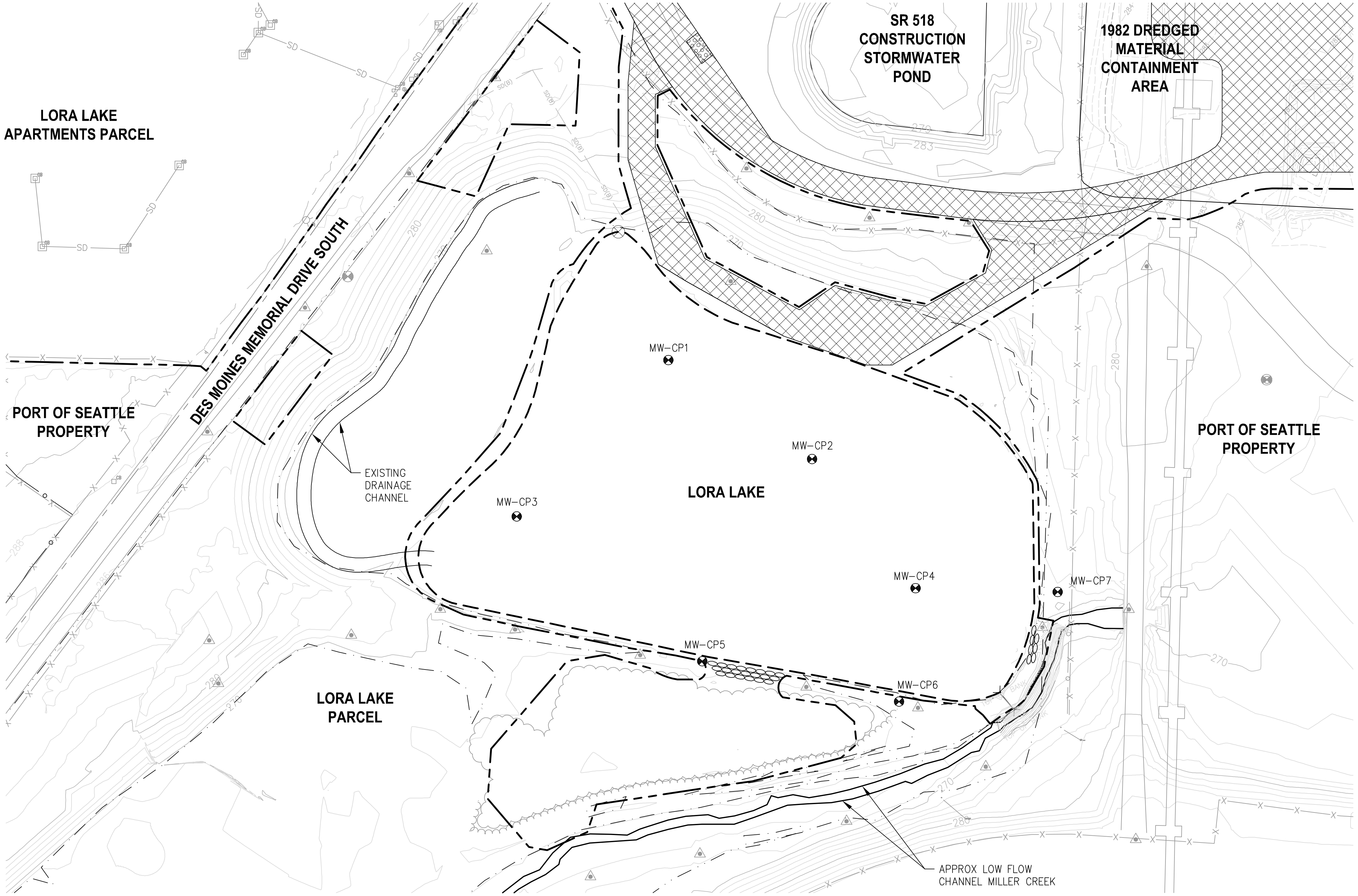
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**
SHEET TITLE: **LLA GROUNDWATER MONITORING WELL INSTALLATION DETAILS**

POS WORK PROJECT NUMBER
104396, 104396
CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER
STIA-1701 CU02.2



PLAN
LL SEASON 2 SEDIMENT CAP MONITORING WELL POINT INSTALLATION PLAN
SCALE: 1" = 50'

1"=50' 50 0 50 100 Scale Feet

N

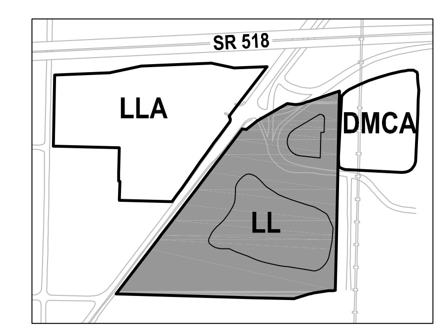
TABLE 1: INSTALLATION MONITORING WELL POINT LOCATIONS			
MONITORING POINT	NORTHING	EASTING	WELL MOUNT ELEVATIONS
MW-CP1	174316.28	1272831.30	270.5'
MW-CP2	174232.99	1272952.17	271.5'
MW-CP3	174184.65	1272703.71	270.5'
MW-CP4	174124.23	1273039.25	270.0'
MW-CP5	174062.78	1272859.80	270.5'
MW-CP6	174028.82	1273025.30	270.5'
MW-CP7	174121.07	1273158.76	270.5'

NOTES:

1. MONITORING WELL POINTS TO BE INSTALLED IN SEASON 2, FOLLOWING CAPPING AND FILLING, BUT PRIOR TO FINAL WETLAND GRADING AND PLANTING. SEE SHEET CU03.2.
2. SEASON 2 FILL ELEVATION FOLLOWING SETTLEMENT, PLACEMENT, AND GRADING IS 266 FEET (NAVD 88) INSIDE THE LORA LAKE CLEANUP AREA.

LEGEND:

PROJECT WORK AREA LIMITS
CONSTRUCTION ACCESS AND STAGING AREA
270 ELEVATION CONTOUR IN FEET (NAVD 88)
LORA LAKE CLEANUP AREA
RESTRICTIVE COVENANT BOUNDARY
WETLAND BOUNDARY
SEDIMENT CAP MONITORING WELL POINT
EXISTING FENCE



KEY MAP
NTS

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PROJECT ENGR./ARCH: JESSI MASSINGALE
DESIGNER: JSM
DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
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CHECKED/APPROVED BY: JSM

JESSICA S. MASSINGALE STATE OF WASHINGTON 46140 REGISTERED PROFESSIONAL ENGINEER
EXP. 10/29/18

REVISIONS									
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
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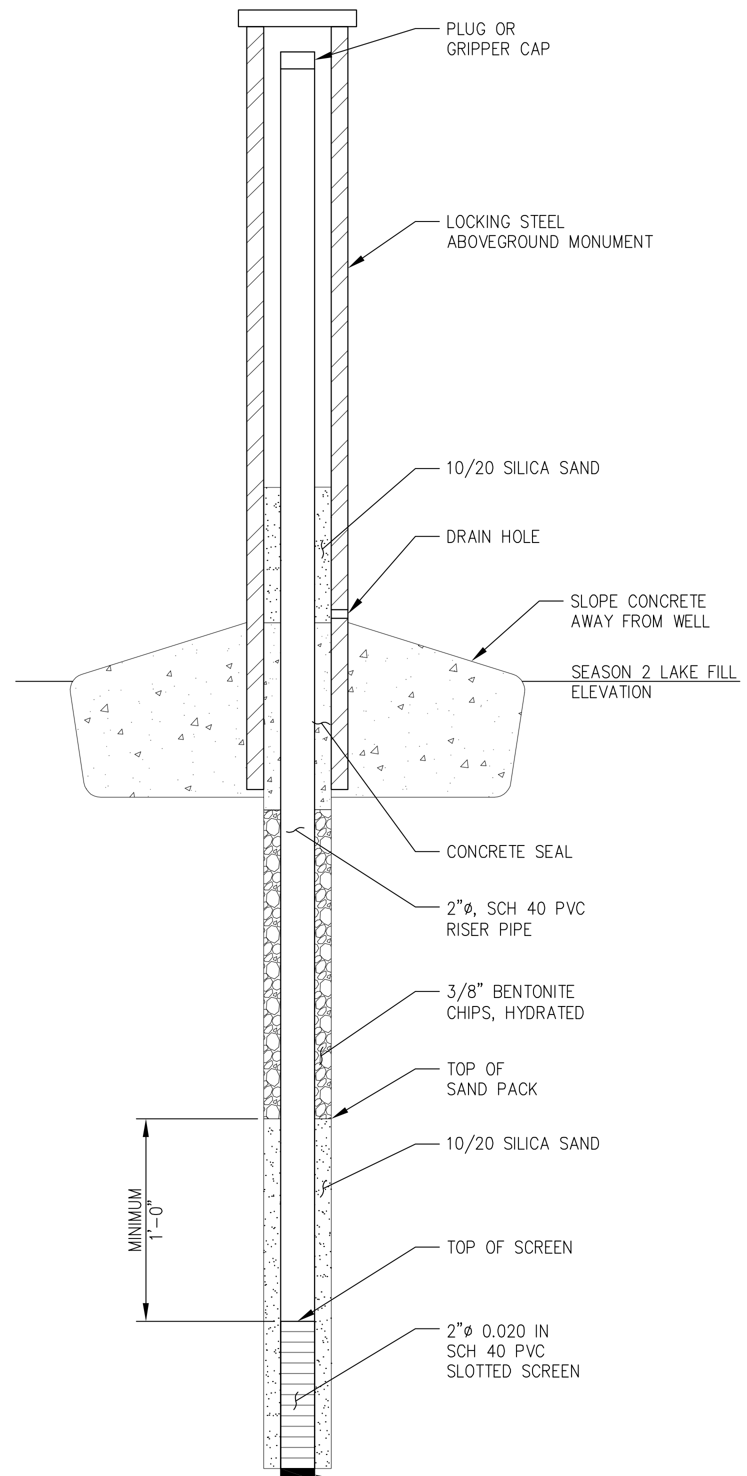
Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS
SHEET TITLE: LL SEASON 2 SEDIMENT CAP MONITORING WELL POINT INSTALLATION PLAN

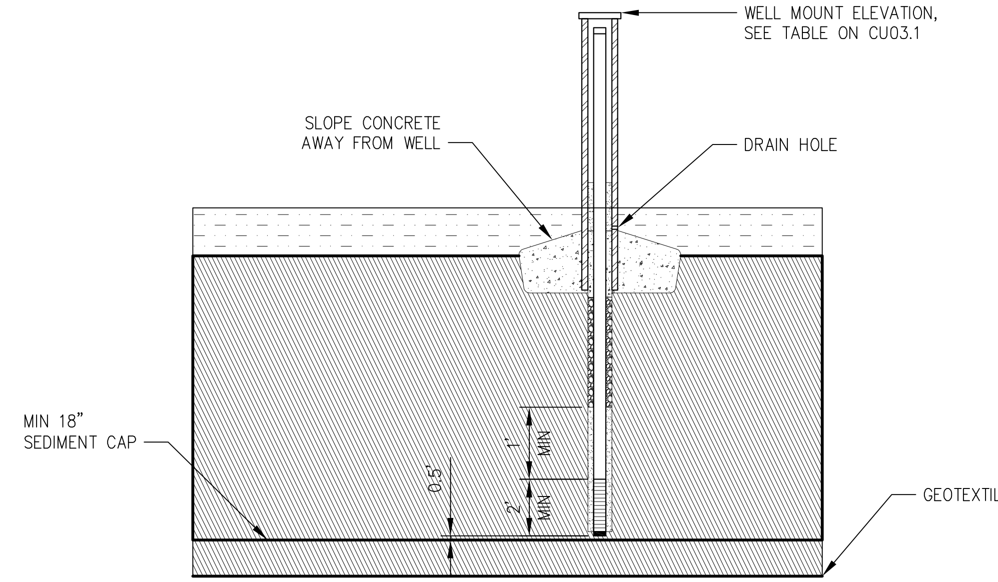
POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 CU03.1



DETAIL

1 / CU03.1

SEDIMENT CAP MONITORING WELL
POINT INSTALLATION
SCALE: NTS



SECTION

A / CU03.1

TYPICAL CAP AND FILL SECTION
WITH MONITORING WELL POINT INSTALLATION
SCALE: NTS

NOTE:

SEDIMENT CAP MONITORING WELL MOUNT ELEVATIONS ABOVE SEASON 2 LAKE FILL ELEVATIONS WILL VARY DEPENDENT ON LOCATION.

LEGEND:

SEDIMENT CAP AND LAKE FILL SAND (CARBON–AMENDED)

WETLAND PLANTING TOP SOIL

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PROJECT ENGR./ARCH: JESSI MASSINGALE
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DRAWN BY: JKH
SCALE: AS SHOWN
DATE: 8/29/2016
CHECKED BY: MMK
CHECKED/APPROVED BY: JSM

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STATE OF WASHINGTON
46140
REGISTERED
PROFESSIONAL ENGINEER
exp 10/29/18

REVISIONS									
NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

POS PROJECT MANAGER:
POS PROJECT ENGINEER:
POS DESIGN ENGINEER:
POS DRAFTER:
POS SCALE:
POS DATE:
POS CHECKED/APPROVED BY:

Port of Seattle

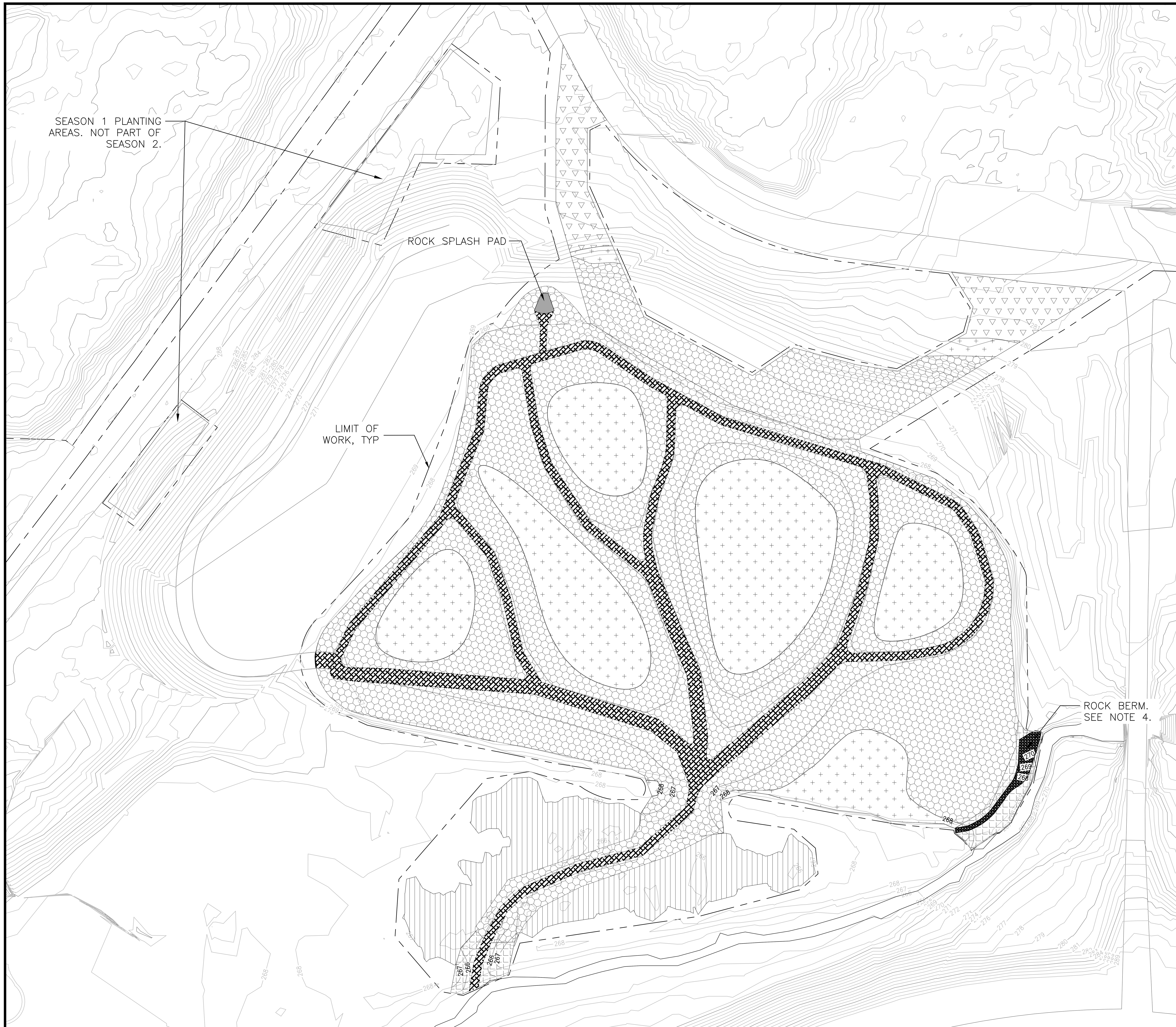
SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: 2017 LORA LAKE APARTMENTS
MTCA REMEDIATION PROJECTS

SHEET TITLE: LL SEASON 2 SEDIMENT CAP MONITORING WELL POINT INSTALLATION DETAIL AND TYPICAL SECTION

POS WORK PROJECT NUMBER: 104396, 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701

CU03.2



PLANTING LEGEND:

- RIPARIAN AND WETLAND
- MILLER CREEK RELOCATION
- ENHANCED EXISTING WETLAND PLANTING ZONE
- FLOODPLAIN ZONE #1
- UPLAND BUFFER ZONE
- SWALE PLANTING ZONE
- LIMIT OF WORK

NOTES:

1. SEE SHEET LZ01.1 FOR PLANT SCHEDULE AND TYPICAL PLANTING DETAILS.
2. SEE SHEETS CG03.1 AND CG07.1 FOR DETAILS ON SEASON 1 PLANTING AREAS.
3. SEE SHEET CG10.1 FOR BIODEGRADABLE EROSION CONTROL FABRIC EXTENTS.
4. SEE SHEETS CG10.2 AND LZ01.1 FOR ROCK BERM PLANTING.

N

1"=40'-0" 40 0 40 80
Scale Feet

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5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH:	CL
DESIGNER:	CL
DRAWN BY:	GB
SCALE:	1"=40'-0"
DATE:	8/19/2016
CHECKED BY:	KEN VIGIL
CHECKED/APPROVED BY:	CURTIS LOEB

STATE OF WASHINGTON LICENSED LANDSCAPE ARCHITECT
CURTIS LAPIERRE
LICENSE NO. 474
EXPIRES ON 06/30/2017

REVISIONS

NO.	DATE	BY	DESCRIPTION	APP'D	NO.	DATE	BY	DESCRIPTION	APP'D

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POS PROJECT ENGINEER:	
POS DESIGN ENGINEER:	
POS DRAFTER:	
POS SCALE:	
POS DATE:	
POS CHECKED/APPROVED BY:	

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

PROJECT NAME: **2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS**

SHEET TITLE: **LL SEASON 2 WETLAND PLANTING PLAN**

POS WORK PROJECT NUMBER
104396

CONSULTANT'S PROJECT NUMBER
POS-LLA/POS-LL

POS PROJECT TRACKING NUMBER
STIA-1701 LP01.1

PLANT SCHEDULE

UPLAND BUFFER ZONE (SEASON 1 & 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
TREES							
ABIES GRANDIS	GRAND FIR	4'-6' BARE ROOT	534	5%	9' OC	9	Plant spacing on rectangular grid. Bare root where specified, otherwise Container or B&B. Rooting shall be to side and bottom of can or burlap.
ACER MARCOPHYLLUM	BIGLEAF MAPLE	4'-6' HT.	300	15%	12' OC	28	
PICEA SITCHENSIS	SITKA SPRUCE	4'-6' BARE ROOT	534	5%	9' OC	9	
PINUS CONTORTA	SHORE PINE	4'-6' BARE ROOT	534	20%	9' OC	37	
POPULUS BALSAMIFERA SSP. TRICHOCARPA	BLACK COTTONWOOD	4'-6' HT.	300	10%	12' OC	19	
PSEUDOTSUGA MENZIESII	DOUGLAS-FIR	4'-6' BARE ROOT	534	30%	9' OC	56	
THUJA PLICATA	WESTERN REDCEDAR	4'-6' BARE ROOT	534	10%	9' OC	19	
TSUGA HETEROPHYLLA	WESTERN HEMLOCK	4'-6' BARE ROOT	534	5%	9' OC	9	
SHRUBS							
CEANOTHUS VELUTINUS	SNOWBRUSH	1 GAL.	4800	30%	3' OC	446	Plant spacing on rectangular grid.Container stock shall have rooting to side and bottom of can.
PHILDELPHUS LEWISII	MOCK ORANGE	1 GAL.	1200	30%	6' OC	446	
RIBES SANGUINEUM	REDFLOWER CURRANT	1 GAL.	4800	20%	3' OC	297	
ROSA GYMNOCARPA	BALDHIP ROSE	1 GAL.	4800	20%	3' OC	297	
SEED MIX							
	EROSION CONTROL SEED MIX	NA	SEE SPECS				SEE SPECIFICATIONS FOR DETAILS.

RIPARIAN AND WETLAND ZONE (SEASON 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
TREES							
FRAXINUS LATIFOLIA	OREGON ASH	4'-6' HT.	300	30%	12' OC	82	Plant spacing on rectangular grid.Bare root where specified, otherwise Container or B&B. Rooting shall be to side and bottom of can or burlap.
PICEA SITCHENSIS	SITKA SPRUCE	4'-6' BARE ROOT		30%	12' OC	82	
POPULUS BALSAMIFERA SSP. TRICHOCARPA	BLACK COTTONWOOD	4'-6' HT.		10%	12' OC	27	
THUJA PLICATA	WESTERN REDCEDAR	4'-6' BARE ROOT		30%	12' OC	82	
SHRUBS							
PHYSOCARPUS CAPITATUS	PACIFIC NINEBARK	1 GAL.	1200	15%	6' OC	163	Plant spacing on rectangular grid.Container stock shall have rooting to side and bottom of can.
ROSA NUTKANA	NOOTKA ROSE	1 GAL.	4800	25%	3' OC	1089	
SALIX LUCIDA SSP. LASISANDRA	PACIFIC WILLOW	1 GAL.	534	10%	9' OC	3	
SALIX SITCHENSIS	SITKA WILLOW	1 GAL.	1200	40%	6' OC	44	
SALIX SCOULERIANA	SCOULER WILLOW	1 GAL.	1200	10%	6' OC	3	
SEED MIX							
	WETLAND SEED MIX	NA	SEE SPECS				See specifications for details

FLOODPLAIN ZONE #1 (SEASON 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
SHRUBS							
SALIX HOOKERIANA	HOOKER'S WILLOW	1 GAL.	1200	25%	6' OC	580	Plant spacing on rectangular grid.Container stock shall have rooting to side and bottom of can. Live stakes shall be 36"-48" height, 1/2" to 1" diameter, with a minimum of 10 viable, undamaged buds on each stake. 5 buds shall be below grade.
SALIX LUCIDA SSP. LASISANDRA	PACIFIC WILLOW	LIVE STAKE	534	25%	9' OC	258	
SALIX SCOULERIANA	SCOULER WILLOW	1 GAL.	1200	10%	6' OC	232	
SALIX SITCHENSIS	SITKA WILLOW	LIVE STAKE	1200	30%	6' OC	696	
SPIRAEA DOUGLASII	HARDHACK SPIREA	LIVE STAKE	4800	10%	3' OC	639	
SEED MIX							
	WETLAND SEED MIX	NA	SEE SPECS				See specifications for details

ENHANCED EXISTING WETLAND (SEASON 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
SHRUBS							
ROSA PISOCARPA	SWAMP ROSE	1 GAL.	4800	10%	3' OC	167	Plant spacing on rectangular grid. Container stock shall have rooting to side and bottom of can. Live stakes shall be 36"-48" height, 1/2" to 1" diameter, with a minimum of 10 viable, undamaged buds on each stake. 5 buds shall be below grade.
SALIX HOOKERIANA	HOOKER'S WILLOW	LIVE STAKE	1200	10%	6' OC	42	
SALIX LUCIDA SSP. LASISANDRA	PACIFIC WILLOW	LIVE STAKE	534	25%	9' OC	46	
SALIX SITCHENSIS	SITKA WILLOW	LIVE STAKE	1200	10%	6' OC	42	
SPIRAEA DOUGLASII	HARDHACK SPIRAEA	1 GAL.	4800	25%	3' OC	416	
SEED MIX							
	WETLAND SEED MIX	NA	SEE SPECS				See specifications for details

MILLER CREEK RELOCATION ZONE (SEASON 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
TREES							
POPULUS BALSAMIFERA SSP. TRICHOCARPA	BLACK COTTONWOOD	4'-6' HT.	300	100%	12' OC	16	Plant spacing on rectangular grid.Container or B&B. Rooting shall be to side and bottom of can or burlap.
SHRUBS							
PHYSOCARPUS CAPITATUS	PACIFIC NINEBARK	1 GAL.	1200	40%	6' OC	20	Container stock shall have rooting to side and bottom of can.
ROSA GYMNOCARPA	BALDHIP ROSE	1 GAL.	4800	60%	3' OC	147	
SEED MIX							
	WETLAND SEED MIX						See specifications for details

SWALE PLANTING ZONE (SEASON 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
SHRUBS							
SALIX LUCIDA SSP. LASISANDRA	PACIFIC WILLOW	LIVE STAKE	1200	40%	6' OC	169	Live stakes shall be 36"-48" height, 1/2" to 1" diameter, with a minimum of 10 viable, undamaged buds on each stake. 5 buds shall be below grade.
SALIX SCOULERIANA	SCOULER WILLOW	LIVE STAKE	4800	30%	3 ' OC	507	
SALIX SITCHENSIS	SITKA WILLOW	LIVE STAKE	4800	30%	3 ' OC	507	

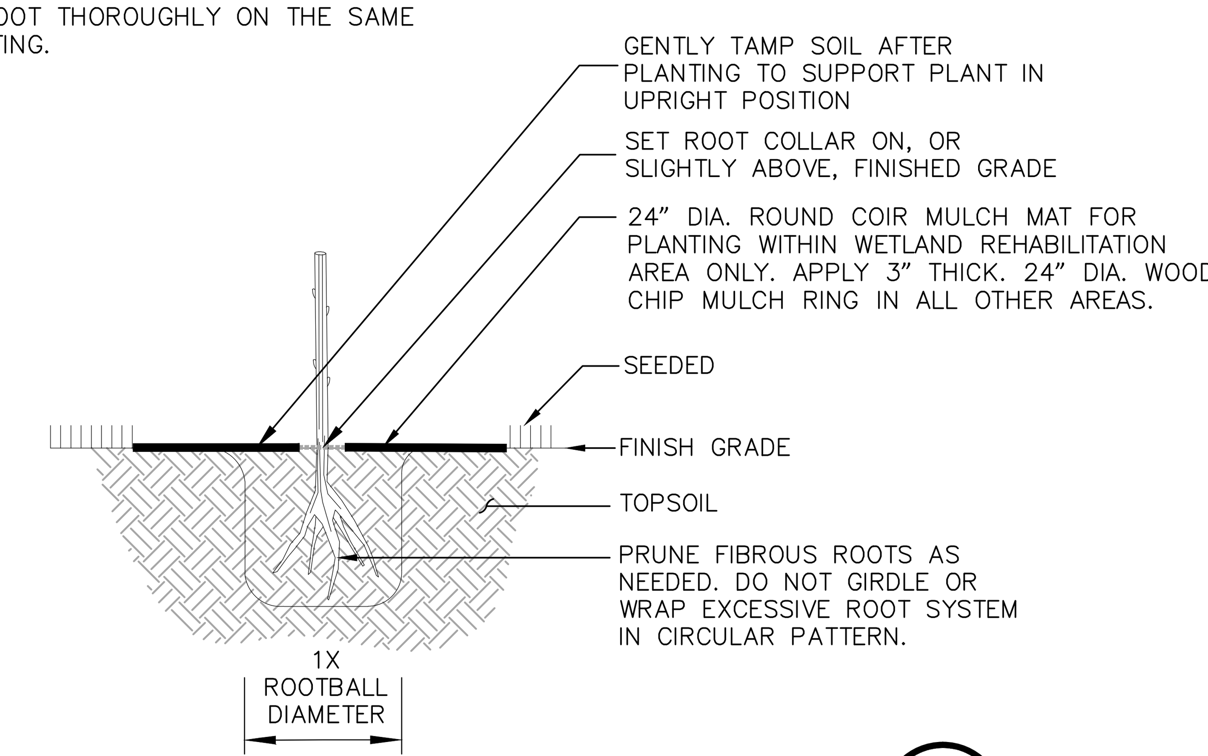
DMCA PLANTED FILTER STRIP (SEASON 2)							
SCIENTIFIC NAME	COMMON NAME	SIZE	PLANTS PER ACRE (rate)	DISTRIBUTION*	PLANT SPACING	PLANT QUANTITY	REMARKS
SHRUBS							
CEANOTHUS VELUTINUS	SNOWBRUSH	1 GAL.	4800	30%	3 ' OC	153	Container stock shall have rooting to side and bottom of can.
PHILDELPHUS LEWISII	MOCK ORANGE	1 GAL.	1200	30%	6' OC	38	
RIBES SANGUINEUM	REDFLOWER CURRANT	1 GAL.	4800	20%	3 ' OC	102	
ROSA GYMNOCARPA	BALHIP ROSE	1 GAL.	4800	20%	3 ' OC	102	
SEED MIX							
	EROSION CONTROL SEED MIX	NA	SEE SPECS				See specifications for details

NOTES:

1. SEE SPECIFICATIONS FOR DETAILS.
2. ROCK BERM SHALL BE PLANTED WITH WILLOW LIVE STAKES AND SEEDED WITH EROSION CONTROL SEED MIX.
3. SEE SCHEMATIC PLANTING LAYOUT ON SHEET LZ01.2 FOR PLANT LAYOUT AND CLUSTERING.
4. *DISTRIBUTION IS BY PERCENT OF TOTAL AREA PLANTED.

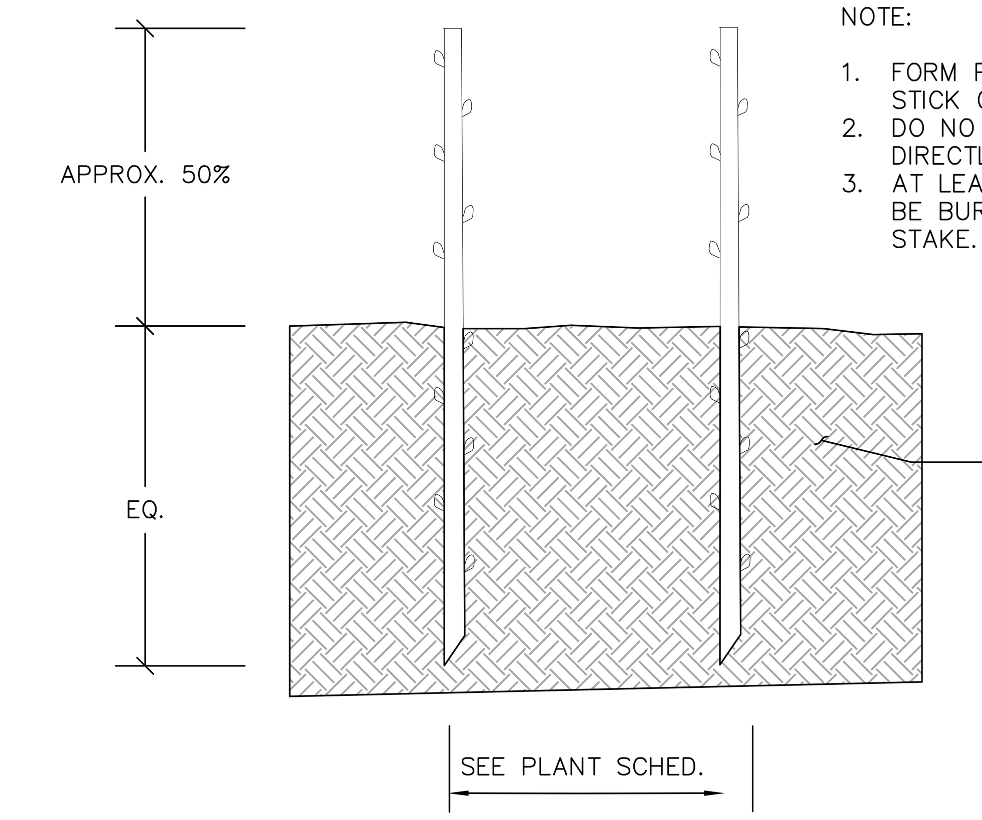
NOTE:

1. BAREROOT SHALL BE DORMANT AT THE TIME OF INSTALLATION.
2. WATER BAREROOT THOROUGHLY ON THE SAME DAY OF PLANTING.



DETAIL 1/LZ01.1

TYPICAL BARE ROOT PLANTING
NTS

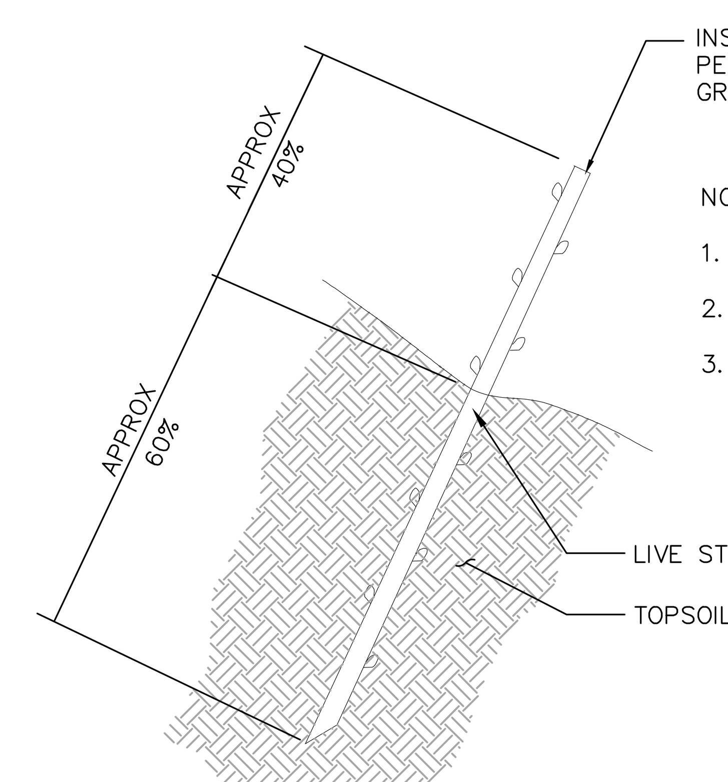


NOTE:

1. FORM PILOT HOLE USING A STICK OR REBAR.
2. DO NO HAMMER LIVESTAKE DIRECTLY TO GROUND.
3. AT LEAST 5 NODES SHALL BE BURIED ON EACH LIVE STAKE.

DETAIL 2/LZ01.1

TYPICAL LIVE STAKE PLANTING
NTS

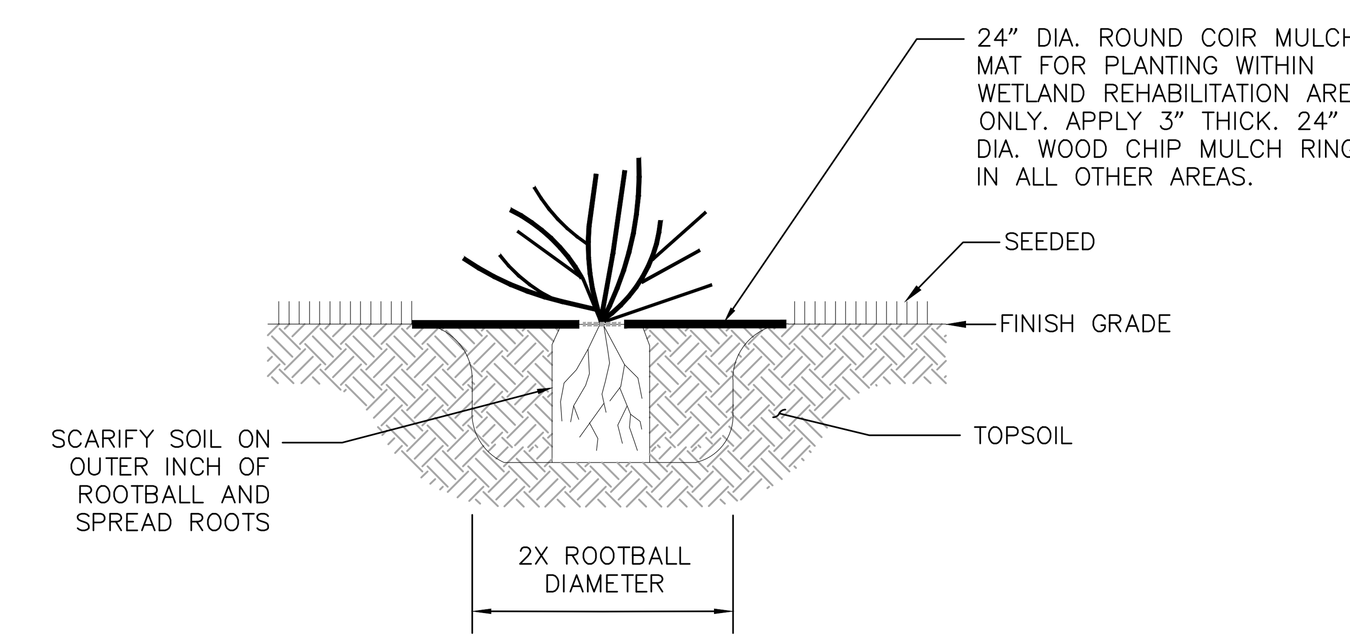


NOTE:

1. FORM PILOT HOLE USING A STICK OR REBAR.
2. DO NO HAMMER LIVESTAKE DIRECTLY TO GROUND.
3. AT LEAST 5 NODES SHALL BE BURIED ON EACH LIVE STAKE.

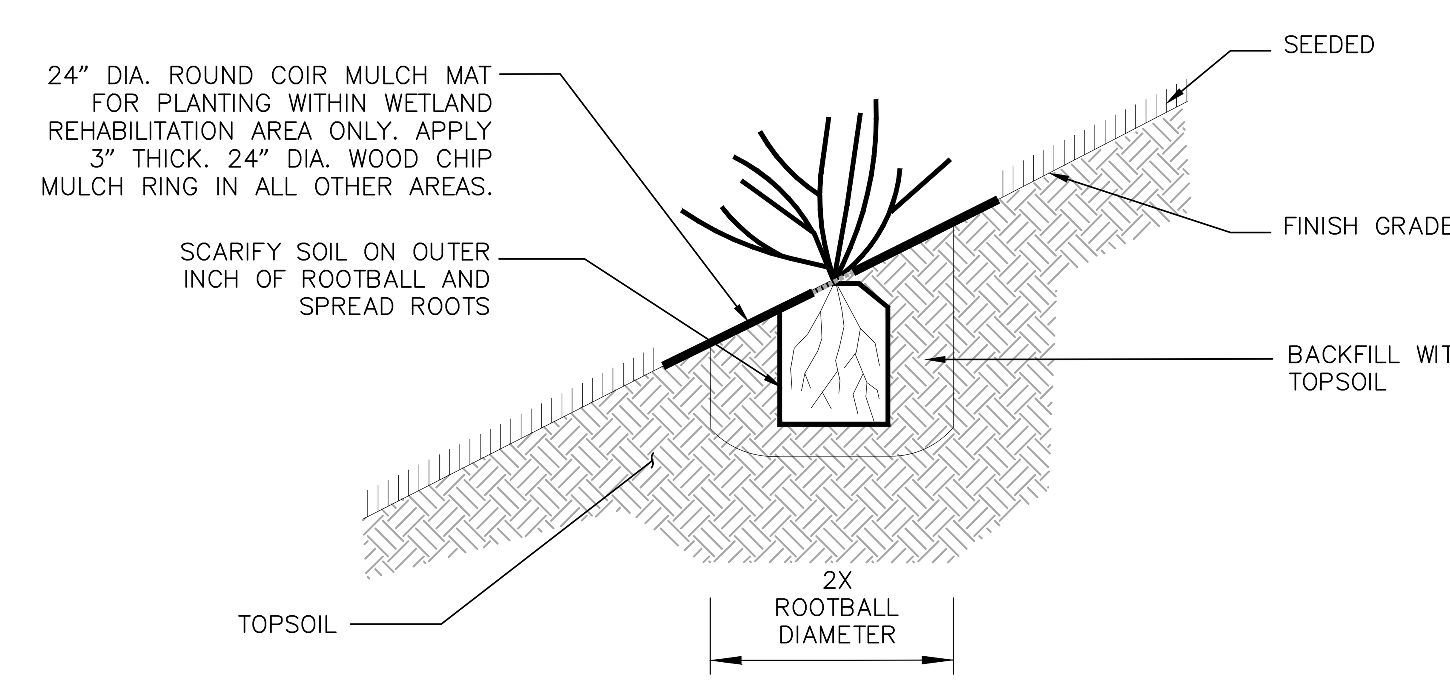
DETAIL 3/LZ01.1

TYPICAL LIVE STAKE PLANTING ON SLOPE
NTS



DETAIL 4/LZ01.1

TYPICAL CONTAINER OR BALL AND BURLAP PLANTING
NTS



DETAIL 5/LZ01.1

TYPICAL CONTAINER PLANTING ON SLOPE
NTS

ESA
5309 Shilshole Ave NW
Suite 200
Seattle, WA 98107
P: (206) 789-9658
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PROJECT ENGR./ARCH: CL
DESIGNER: CL
DRAWN BY: GB
SCALE: NA
DATE: 8/19/2016
CHECKED BY: KEN VIGIL
CHECKED/APPROVED BY: CURTIS LOEB

STATE OF WASHINGTON LICENSED LANDSCAPE ARCHITECT
CURTIS LAPIERRE
LICENSE NO. 474
EXPIRES ON 06/30/2017

REVISIONS									
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POS CHECKED/APPROVED BY:

Port of Seattle SEA-TAC INTERNATIONAL AIRPORT

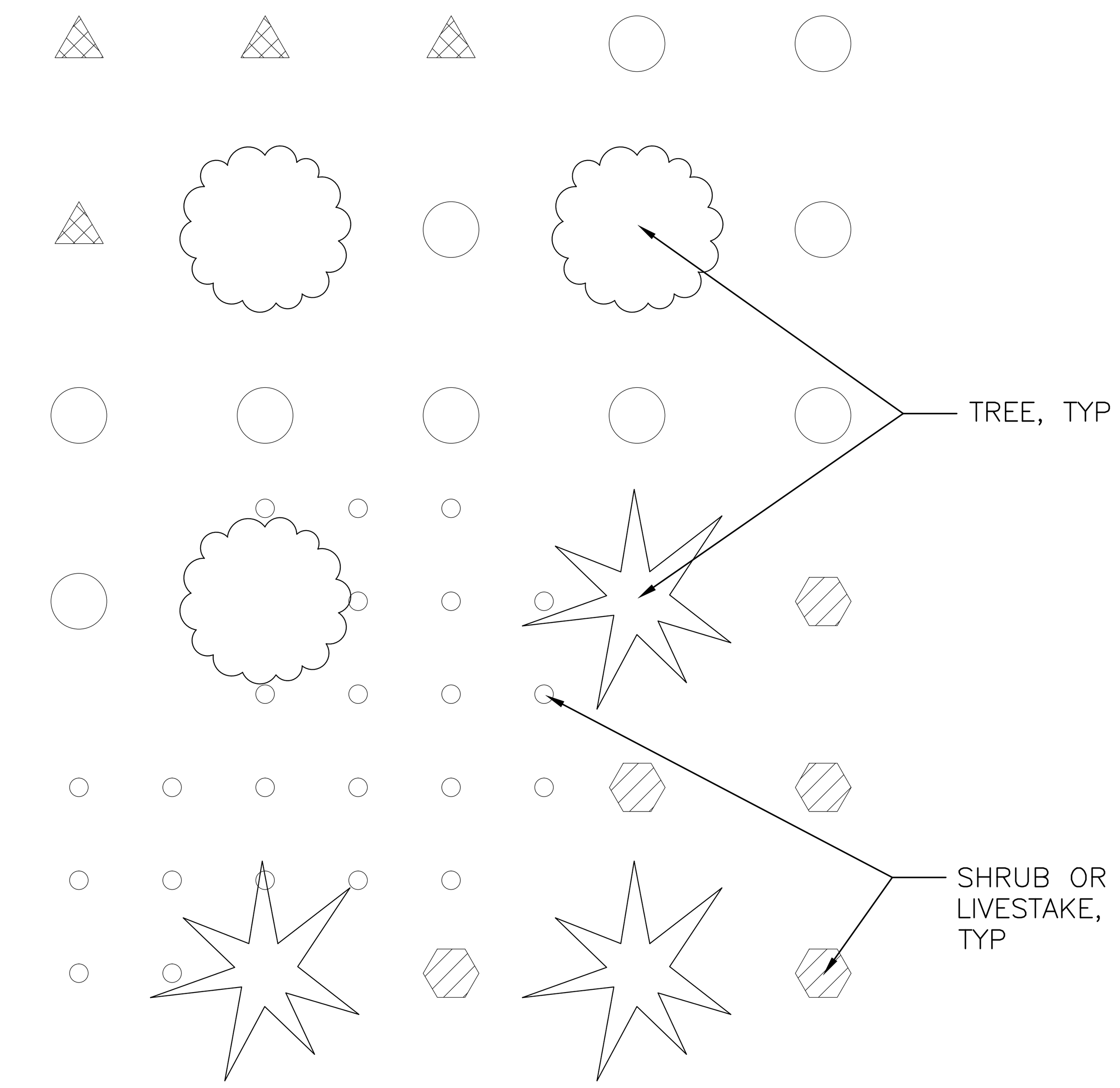
PROJECT NAME: 2017 LORA LAKE APARTMENTS MTCA REMEDIATION PROJECTS

SHEET TITLE: LL SEASON 2 WETLAND PLANT SCHEDULE AND PLANTING DETAILS

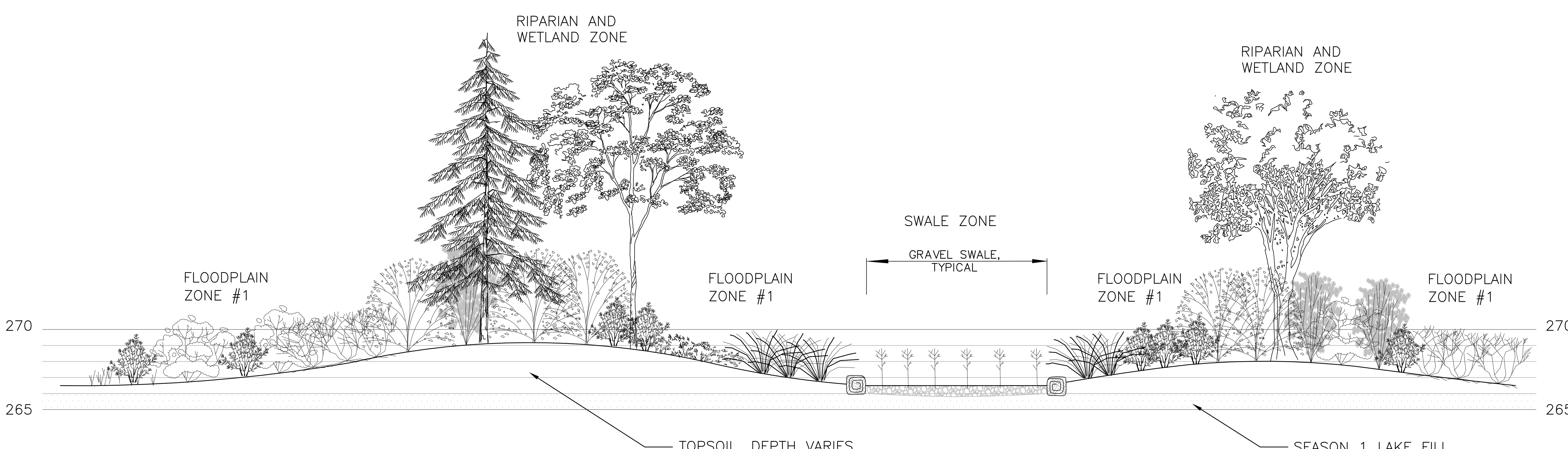
POS WORK PROJECT NUMBER: 104396
CONSULTANT'S PROJECT NUMBER: POS-LLA/POS-LL
POS PROJECT TRACKING NUMBER: STIA-1701 LZ01.1

NOTES:

1. ADJUST QUANTITY OF TREE SHRUBS AND LIVE STAKES AS NECESSARY TO ACHIEVE THE SPECIFIED RATE PER ACRE.
2. TREES SPACED AT 9' OR 12' O.C. UNIFORMLY THROUGHOUT THE PLANTING AREA. PLANT TREES IN CLUSTERS OF 3 TO 9.
3. SHRUBS OR LIVESTAKES SPACED AT 3', 6', OR 9' O.C. PLANT SHRUBS AND LIVESTAKES IN CLUSTERS OF 10 TO 30.
4. TREES ARE SHRUBS ARE PLANTED ON A RECTANGULAR GRID.



DETAIL 1 / LZ01.1
SCHEMATIC PLANTING LAYOUT
NTS



SECTION A / LP01.1
PROPOSED SOIL PROFILE AND PLANT COMMUNITIES
NTS

ESA
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Suite 200
Seattle, WA 98107
P: (206) 789-9658
F: (206) 789-9684

PROJECT ENGR./ARCH: CL
DESIGNER: CL
DRAWN BY: GB
SCALE: NA
DATE: 8/19/2016
CHECKED BY: KEN VIGIL
CHECKED/APPROVED BY: CURTIS LOEB

STATE OF WASHINGTON LICENSED LANDSCAPE ARCHITECT
CURTIS LAPIERRE

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Port of Seattle
SEA-TAC INTERNATIONAL AIRPORT
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SHEET TITLE: LL SEASON 2 WETLAND DETAILS

POS WORK PROJECT NUMBER: 104396
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LZ01.2