Moga Back-Channel Reconnection Project

Final Design Report

January 2016

Prepared For

Snohomish Conservation District

Moga Back-Channel Reconnection Project

Final Design Report

January 2016

Prepared for

Snohomish Conservation District

528 91st Ave NE, Lake Stevens, WA 98258

Tel 425 335 5634

snohomishcd.org

Prepared by

Cardno, Inc.

801 Second Avenue, Suite 700, Seattle WA 98104

Tel 206 269 0104 Fax 206 269 0098

www.cardno.com

Certificate of Engineer

The technical material and data contained in this report were prepared under the supervision and direction of the undersigned, whose seal as a registered professional engineer licensed to practice in the State of Washington is affixed below.

Sky Miller
Cardno

3/10/16

This page left blank intentionally.

Table of Contents

Chapter 1 Introduction 1

Chapter 2 Site Description 2

2.1 Watershed Characteristics and Hydrology 2

2.2 Initial Site Assessment and Base Topography 3

2.3 Limiting Factors for Salmonid Populations 8

Chapter 3 Project Objectives 9

Chapter 4 Conceptual Restoration Alternatives 9

4.1 Introduction 9

Chapter 5 Preliminary Design 10

Chapter 6 References 17

Appendices

Appendix A Final Design Plans

Appendix B Cost Estimate

Appendix C Site Photographs

Figures

Figure 1-1: Project location within the larger context of the Snohomish Watershed Resource Inventory Area. 1

Figure 2-1: Effective FEMA FIRM for the Project Area updated September 16, 2005 (FEMA 2005). 2

Figure 2-2: Project vicinity map. 4

Figure 2-3: Existing conditions plan showing location of existing culvert, channels, and ponded features (as observed on 3/11/2015) with respect to county parcel boundaries. 5

Figure 2-4: Existing conditions plan with Project site topographic basemap – composite of 2014 LiDAR and Cardno's 2015 ground survey with bathymetry. 6

Figure 2-5: Existing conditions side-channel alignment and longitudinal profile. Water Surface Elevations given for March 11, 2015, and are subject to fluctuation. 7

Figure 5-1: Aggradational potential of the Project site due to flood flows and relict point bar formation morphology. At left, flood velocity adapted from the geomorphic analysis (R2 Resource Consultants 2015) and, at right, LiDAR hillshade at a smaller scale showing the Project site on a relict scrolling point bar that grew from east to west as the main Snohomish River channel cut the river left bank. 12

Figure 5-2: Aerial view of the project site, showing its location relative to the outside bend of the Snohomish River where scour is ubiquitous (flow from left to upper right). 13

Figure 5-3: Project site, showing flow paths activated at 2-year (red), 5-year (orange), and 10-year (yellow) discharges. The flow path that is connected fully across the bar at 5-year and higher discharges, and which includes the path of the proposed channels at its downstream end, is roughly half the length of the main channel, suggesting that the gradients are likely twice as steep as in the main channel and are likely to have significant sediment-transport capacity under moderate and larger floods. 14

Figure 5-4: Sequential views of the primary pond at the project site in 1990 (left) and 2015 (right), showing no obvious effects of sedimentation in the intervening 25 years. 14

Chapter 1 Introduction

The Snohomish Conservation District (SCD) has engaged Cardno, Inc. (Cardno) to provide science and engineering services in support of the Moga Back-Channel Reconnection Project (Project). The Project site includes approximately 600 linear feet (LF) of river back-channel habitat and 17 acres of floodplain located at river mile 16.7 of the Snohomish River, adjacent to 15106 Shorts School Road near the town of Snohomish in Snohomish County, Washington (Figure 1-1). The Project lies within the Confluence Reach of the Snohomish River near the upstream extent of tidal influence.

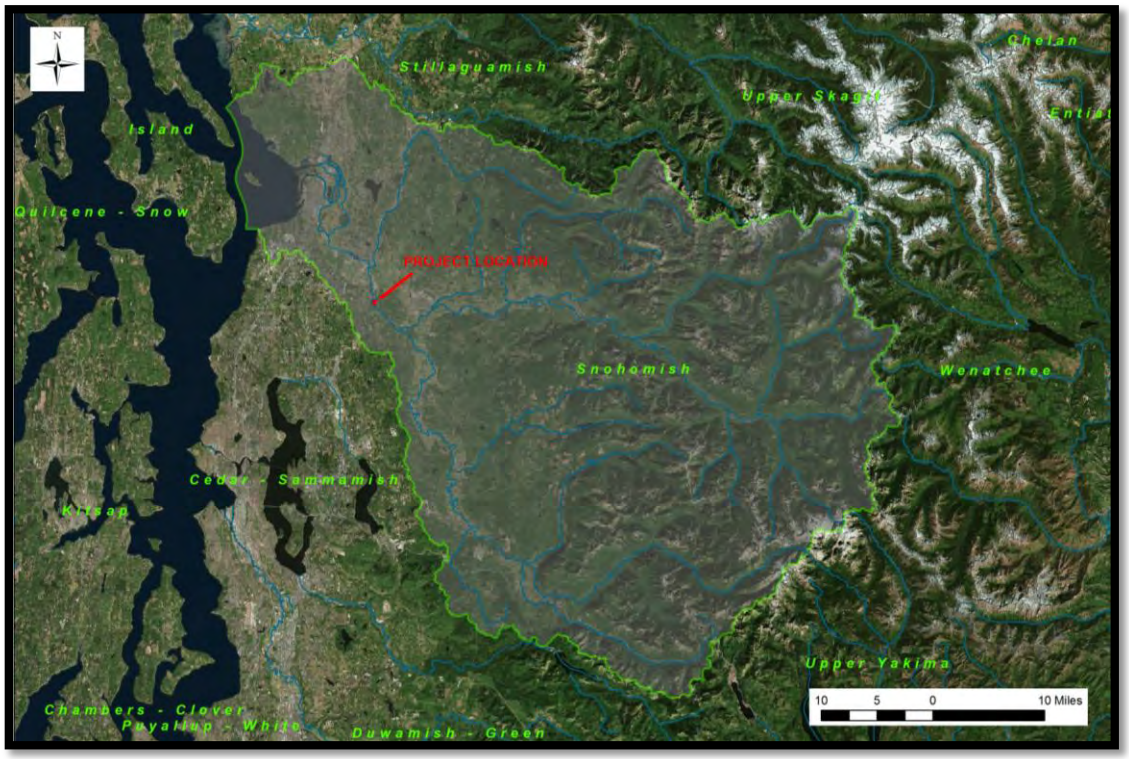


Figure 1-1: Project location within the larger context of the Snohomish Watershed Resource Inventory Area.

This report presents the preliminary investigation of existing site conditions and potential options for installation of new aquatic habitat enhancement work. The purpose of this Project is to improve the connection between the Snohomish River and a relict side-channel on the downstream end to create a back-channel for salmon rearing habitat. The Project site includes parcels, 27060600100700, and 27060600100400, and the portions of parcels 27060500200600 and 27060500200400.

The Project will reconnect the back-channel through replacement of the barrier crossing and improvements to the channel. This report provides a basic description of the Project site with respect to salmon recovery, identifies specific Project goals and objectives, describes preliminary design alternatives including stakeholder comments and concerns, and presents the preferred alternative with a concept level construction cost estimate. All elevations presented herein refer to the vertical datum NAVD88.

Chapter 2 Site Description

2.1 Watershed Characteristics and Hydrology

The Snohomish River drains 1,550 square miles of watershed above the Project site from the western Cascade slopes. The mean basin elevation is 2,430 feet, ranging from about 11.5 feet to a maximum elevation of 7,950 feet. The basin above the Project site has 65% area-weighted forest canopy as computed from the National Land Cover Database (NLCD) 2001 canopy dataset (U.S. Geological Survey [USGS] 2015). The Skykomish and Snoqualmie Rivers join to form the Snohomish River at river mile 20.4 or 3.7 miles upstream of the Project site. The Snohomish River flows through Everett into Port Gardner Bay and experiences tidal backwater effects as far as river mile 18.1 (Snohomish County 2003). The Project is located within the Confluence Reach, bounded by SR 522 and a natural floodplain constriction on the upper end and, on the lower end, an extensive system of levees.

The climate in the vicinity of the Project area is characterized by cool, dry summers and mild, wet winters. Due to the varied relief within the watershed, temperature and precipitation vary with elevation, but overall temperatures average 60 to 70 degrees Fahrenheit in the summer and 30 to 40 degrees Fahrenheit in the winter. Precipitation within the basin occurs primarily as rainfall, with snow at high elevations, resulting in peak flows during the winter months when heavier precipitation occurs. According to the USGS (2015), the average annual precipitation within the Snohomish River watershed is approximately 100 inches. The Project site is within the Federal Emergency Management Agency (FEMA) 100-year floodplain (Figure 2-1). The map in Figure 2-1 is the FEMA Flood Insurance Rate Map (FIRM), which is based on a 1-dimensional hydraulic model completed by FEMA in 2005.

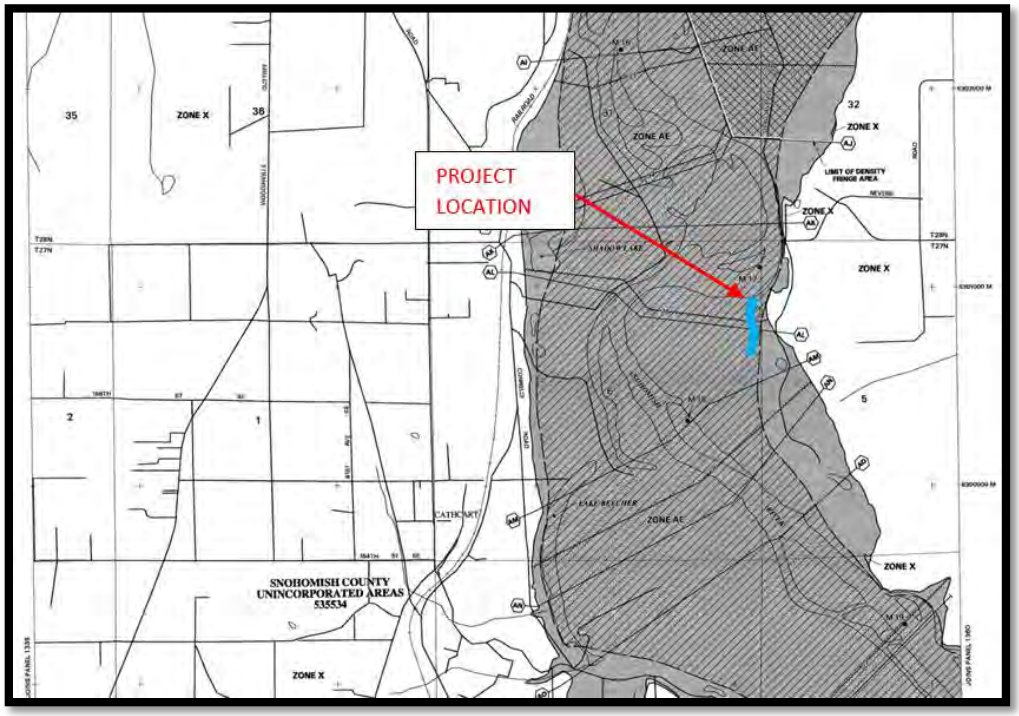


Figure 2-1: Effective FEMA FIRM for the Project Area updated September 16, 2005 (FEMA 2005).

A hydrologic analysis was completed in 2003 by Snohomish County for the Snohomish River near Monroe (USGS Station #12150800) at river mile ±19.9. Peak flood flow magnitudes in the Snohomish River system at the Project site are as follows: 62,800 cubic feet per second (cfs) at the 2-year recurrence interval (RI) (flows with a 50% probability of occurring in any given year), 92,500 cfs at the 5-year RI, 114,000 cfs at the 10-year RI, and 204,000 cfs at the 100-year RI (1% probability of occurring in any given year) based on data for the period of record 1964 to 2000 (Snohomish County 2003).

2.2 Initial Site Assessment and Base Topography

On March 11, 2015, the Cardno team completed an initial site assessment including a local hydrologic assessment and a ground-based topographic and bathymetric Real Time Kinematic (RTK) survey. Flow on the day of the survey was 3,600 cfs on the Snohomish River near Monroe (USGS Gage #12150800). Figure 2-2 shows the project vicinity. Figure 2-3 shows some of the existing features of the Project site relative to aerial photography from August 1, 2011 (Google Earth 2011).

Cardno also created a topographic basemap from a composite of our 2015 survey bathymetry and 2014 light detection and ranging (LiDAR) dataset available from the Puget Sound LiDAR Consortium (PSLC). This map is depicted in Figure 2-4. Project parcels are shown in light purple and were obtained from the County's parcel shapefile dataset. Property lines were not surveyed by the Cardno team. The colored regions on the map indicate elevations ranging from 10 to 37 feet NAVD88. The Cardno team was not able to capture the maximum depth of the ponds due to high water at the site. Clearly visible in this map are channels and other topographic depressions that may convey water. Colors ranging from pink to dark blue indicate the presence of the Project's side-channel feature cutting through the point bar region west of Shorts School Road. This feature is likely a remnant of the Snohomish River channel prior to all available maps and aerial photography based documentation including the 1877 General Land Office (GLO) plat maps. The map also shows the location of existing ponded water, parcel locations, an outlet culvert, and the location of the agricultural access road that crosses the side-channel forming a barrier. The ground-based RTK topographic and bathymetric data collection improved the accuracy of LiDAR, especially in areas under thick vegetative cover and under water.

Figure 2-4 clearly shows the levee along the right bank of the river. Figure 2-4 also shows a low point in the levee, which was confirmed on March 11, 2015 (Appendix C – Site Photos). No culvert was observed under the main agricultural access road.

On March 11, 2015, the Cardno team observed three active beaver lodges, two to four active river otter lodges, and a pair of agitated river otters swimming in Pond #2. That same day, lodge dwellings occupied elevations between 15 and 16 feet NAVD88, near Pond #2 water's edge. Pond #1 had a plethora of native northwestern salamander (*Ambystoma gracile*) egg sacks near the water's edge at a water surface elevation (WSEL) of approximately 13 feet (refer to Appendix C – Site Photos). Northwestern salamanders are the only species in this region that lays firm masses. Those observed were about half developed and likely hatched 2 weeks later. This species is unique among the native amphibians in this region in that it prefers permanent water and has the ability to stay in the larval stage for 1 year before metamorphosis (all other natives metamorphose in the summer following egg laying). The Cardno team expects that northwestern salamanders, native red-legged frogs, native turtles, and other amphibians may be present throughout the Project site.

Key to understanding the Project site are the relative elevations of the river, pond, and channel bottoms. Figure 2-5 shows the longitudinal profile of the existing side-channel from the northern outlet at the main river channel to the beginning of the Pond #2 Wetland Complex just south of the agricultural access road.

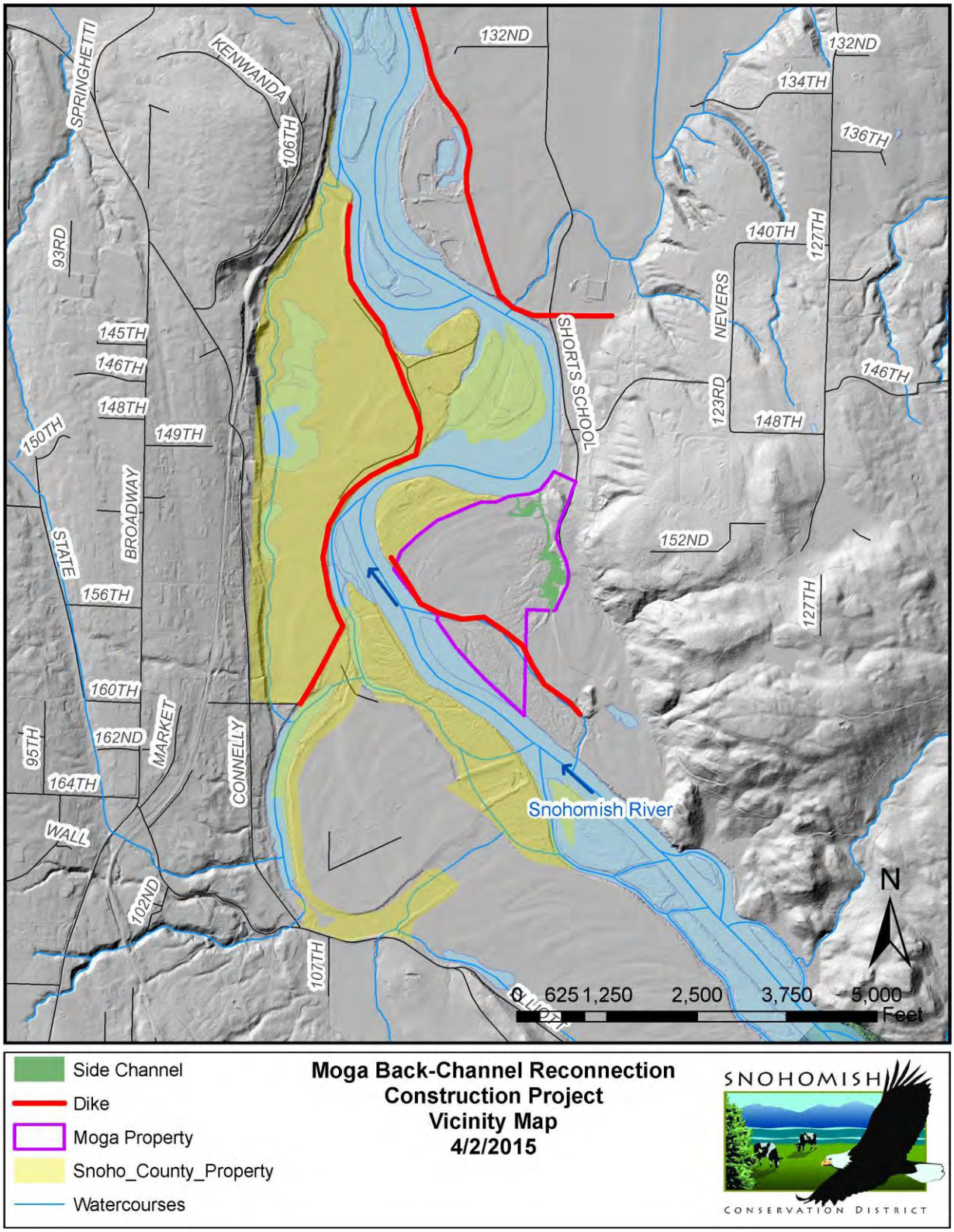


Figure 2-2: Project vicinity map.

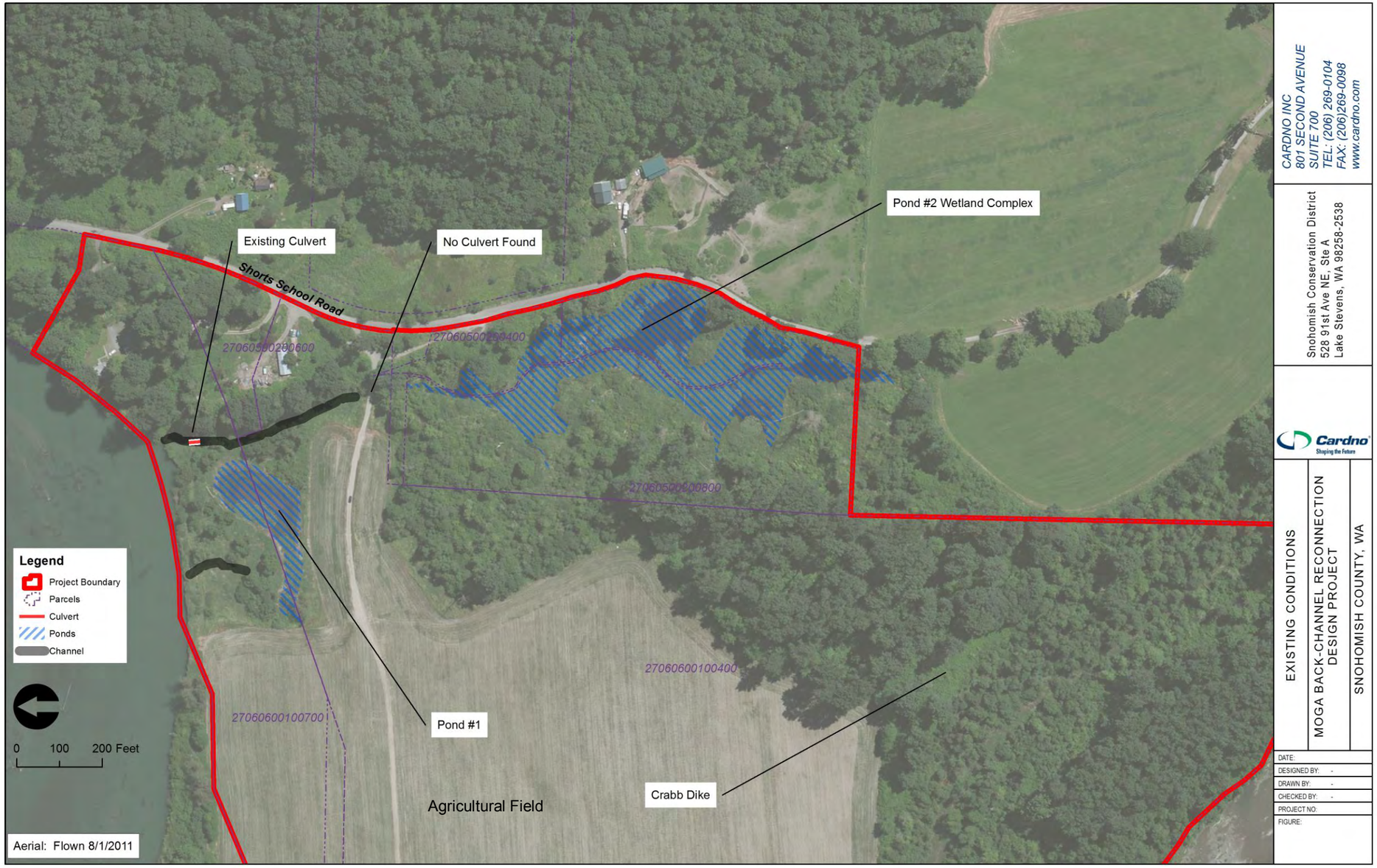


Figure 2-3: Existing conditions plan showing location of existing culvert, channels, and ponded features (as observed on 3/11/2015) with respect to county parcel boundaries.

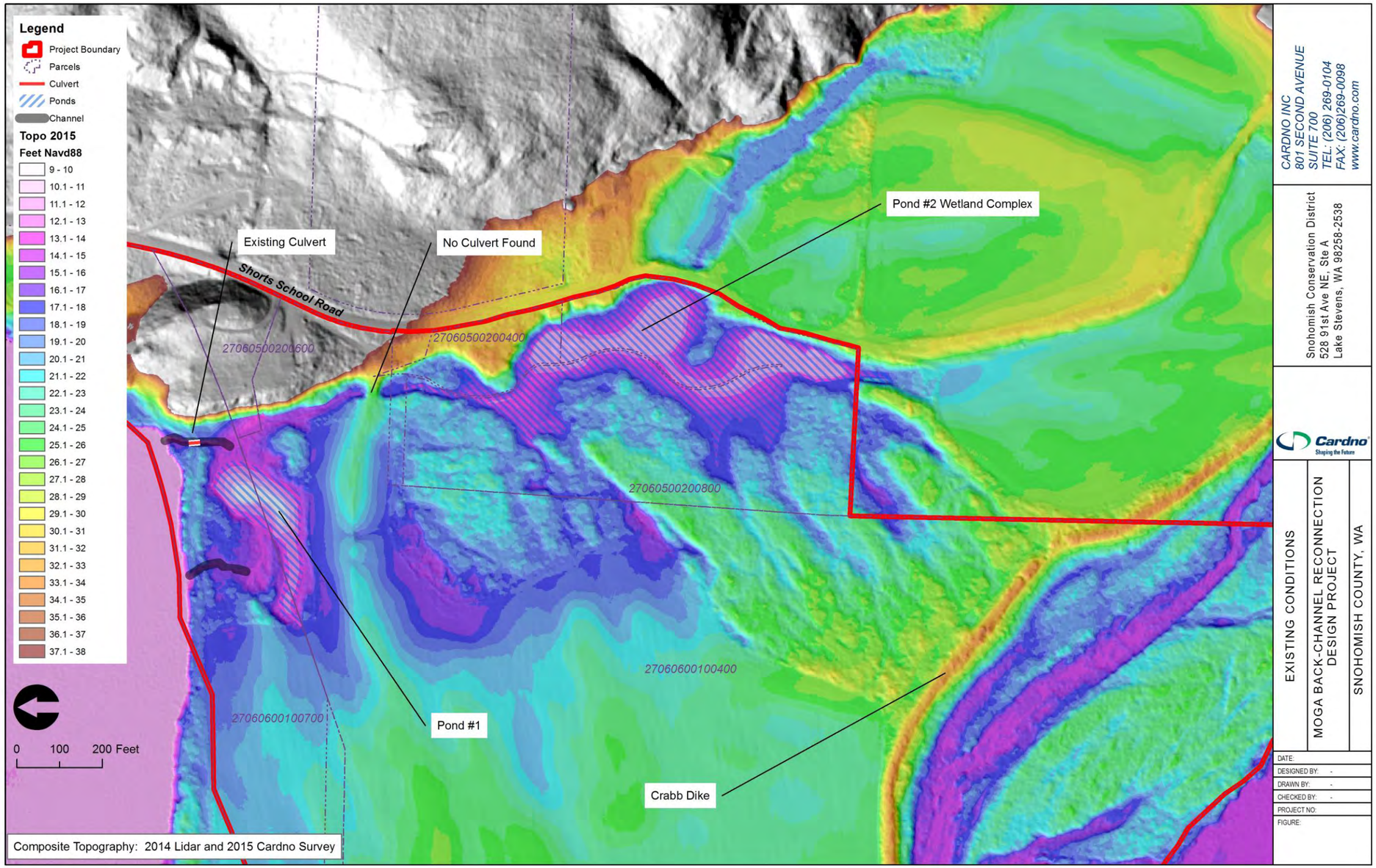


Figure 2-4: Existing conditions plan with Project site topographic basemap – composite of 2014 LiDAR and Cardno's 2015 ground survey with bathymetry.

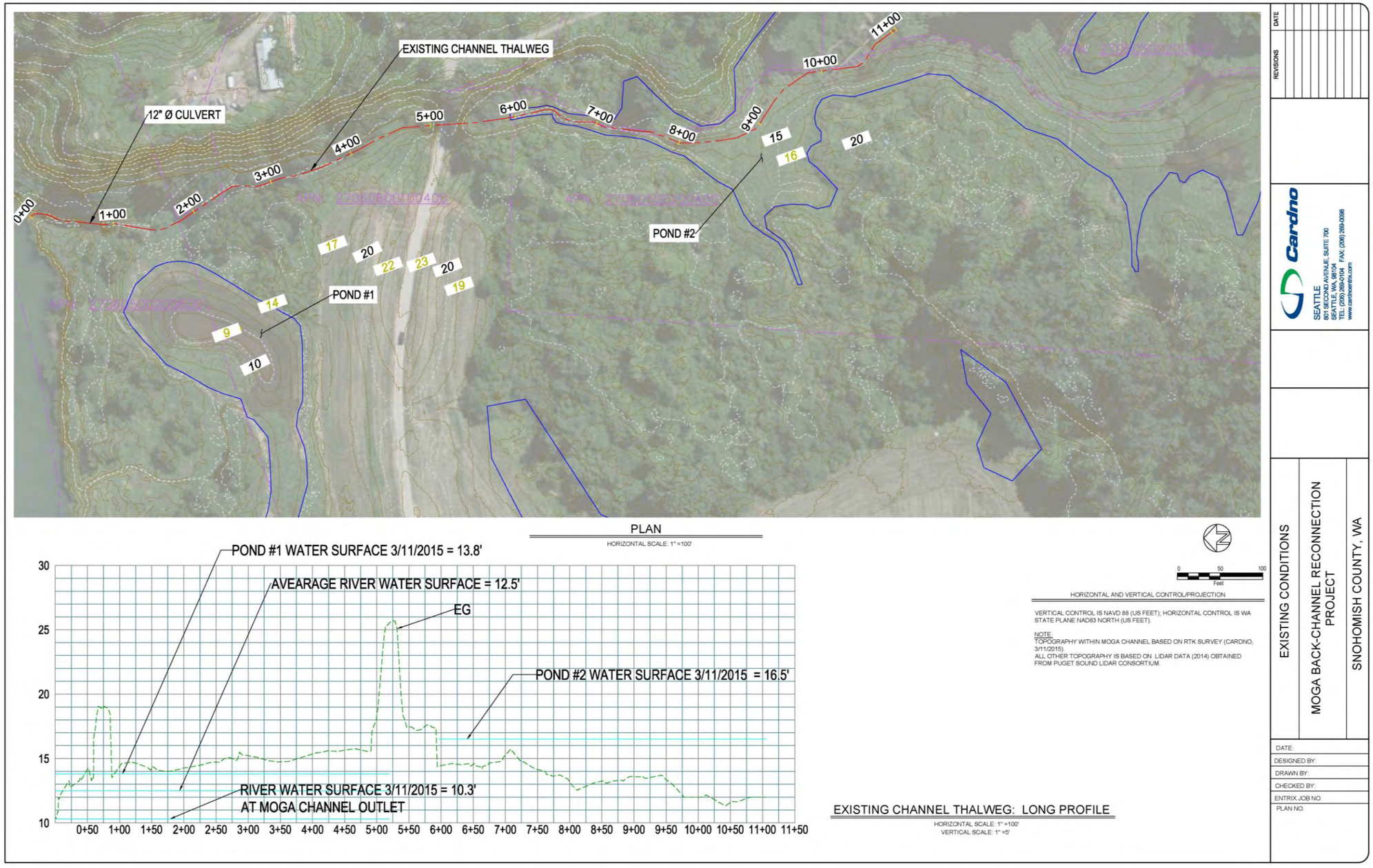


Figure 2-5: Existing conditions side-channel alignment and longitudinal profile. Water Surface Elevations given for March 11, 2015, and are subject to fluctuation.

This agricultural access road acts as a dam capable of maintaining a higher WSEL in the Pond #2 Wetland Complex as compared to the Pond #1 WSEL and main river channel WSEL. For example, during the site visit, the main river channel had a WSEL of 10.3 feet, Pond #1 had a WSEL of 13.8 feet, and the Pond #2 Wetland Complex had a WSEL of 16.5 feet.

Surface water inflows to Pond #2 were observed to be about 5 gpm on March 11, 2015. Cardno engineers do not expect consistent groundwater inflows to the Pond #2 Wetland Complex, and inflows may reduce to zero during later spring, summer, and fall months. Implications of groundwater inflows are discussed further in subsequent sections.

An average annual WSEL for the Project site was determined as an average annual flow of 9,600 cfs based on average monthly flows of the Snohomish River near Monroe (USGS Station #12150800). Mean monthly flows in winter and spring are generally of similar magnitude, suggesting that snowmelt runoff and winter rains approximately balance each other (Snohomish County 2003). The Cardno team established a correlation between the USGS gage height and WSEL at the Project site at river mile ±16.7. On March 11, 2015, the river WSEL was surveyed at 10.3 feet NAVD88 near the current Moga back-channel outlet for a Snohomish River flow of 3,600 cfs. On March 25, 2015, the river had a flow of 9,400 cfs (approximately the average annual flow) and river WSEL was observed to be 12.5 feet NAVD88. Consequently, a water surface elevation of 12.5 feet at the northeast channel outlet was adopted as the design condition. For comparison, a peak 2-year flood has a modeled WSEL of 34.6 feet NAVD88 based on 2015 two-dimensional hydraulic modeling results using the RMA2 platform (R2 Resource Consultants 2015).

2.3 Limiting Factors for Salmonid Populations

The Snohomish River basin is the second largest watershed for Chinook salmon habitat within Puget Sound's Endangered Species Unit (ESU). Chinook and Steelhead are listed as threatened under the Endangered Species Act (NOAA 2011). Reconnecting off-channel rearing habitat for salmonids is a goal of the Snohomish River Basin Salmon Conservation Plan (SRBSCP, 2005). The Confluence Reach is biologically significant for all West Coast salmonid species including Chinook, coho, chum, pink, steelhead, cutthroat, and native char for spawning, rearing, foraging, and migration. All of these species use off-channel ponds and side-channels as habitat and flood refuge areas. The Project site presents an opportunity for providing such habitat and refugia. As of 2003, the Confluence Reach was "Not Properly Functioning" with respect to providing quality habitat for fish due to the following conditions (Snohomish County 2003):

- Pool frequency does not meet standards and does not meet large woody debris (LWD) recruitment
- The reach has less than one piece of LWD/channel width
- Banks are actively eroding
- Shoreline hardening or overwater structures affect >20% of shorelines.

For more information see Table 1 and Section 2.1 of the 2003 *Snohomish River Confluence Analysis* for salmonid use of the reach by species and life history. Currently, the Project site has two main fish passage barriers: (1) the northernmost 12-inch culvert near the side-channel outlet that was clogged; and, (2) the main agricultural access road, which has no culverts.

Chapter 3 Project Objectives

The objective of the Project is to create a back-channel that will allow water from the Snohomish River to flow in and out of the Moga side-channel during normal winter flows. The design elements may be modified during the design phases, but include the following (Flint 2014):

- Removal or modification of a barrier that exists at a crossing that allows access to the agricultural field,
- Excavation of the lower channel near the mouth,
- Installation of LWD and potentially gravel in this newly constructed channel, and
- Planting a riparian zone.

Chapter 4 Conceptual Restoration Alternatives

4.1 Introduction

As depicted in the three conceptual designs contained in Appendix A, the alternatives represent a balance between wetland ponded areas and back-channel access throughout the site. Alternative 1 preserves the most wetland ponded areas with the least back-channel access for salmonids. The third and Preferred Alternative proposes to create the most back-channel salmonid access, which requires an adjustment and reduction in ponded wetland areas. Alternative 2 represents a middle option between Alternative 1 and the Preferred Alternative.

In all three alternatives, proposed channel thalwegs would have an elevation of 11.5 feet NAVD88 such that approximately 1 foot of water depth would occur for the average river WSEL of 12.5 feet. Proposed channels would have varying top widths of ±30 feet and overall longitudinal slopes of 0.0005 to 0.0008. The proposed channel slope was chosen to minimize lowering and compacting Pond #2 and to match the river gradient as determined in the 2015 geomorphic analysis (R2 Resource Consultants 2015). Channels of varied width and side slopes would increase habitat complexity. In all of the alternatives, the 12-inch-diameter culvert would be removed at the existing Moga side-channel outlet. A bridge or culvert is no longer needed at that location. All alternatives propose a side-channel that connects Pond #1 at average river flows. All channels would be enhanced with stable large woody material (LWD), complex edge habitat, and varied pool dimensions (Montgomery et al. 2003). A new, approximately 85-foot-long 12-foot-diameter culvert would be installed under the existing agricultural access road to provide fish passage and flow conveyance. This size was selected based on needed capacity and cost.

The Project objectives can be accomplished by any of the followings options (also depicted in the design plans contained in Appendix A):

- Alternative 1: This alternative creates side-channel habitat for salmonids in areas north of the existing agricultural access road. Snohomish River water would flow through the channel and through Pond #1 at average river levels. Furthermore, back-channel habitat would be created up to the agricultural access road and a new fish passable culvert would be installed. Step pools acting as grade controls would be installed to the south of the new culvert to maintain a maximum WSEL of 16 feet NAVD88 in the Pond #2 Wetland Complex. This would maintain and protect all

existing conditions in the pond and wetland habitat. Salmonids would only have access to the wetland complex when there are significant groundwater flows into Pond #2 and when floods flow through the Project.

- Alternative 2: This option consists of most of the same features as Alternative 1. However, no step pools or grade controls of any kind would be installed to the south of the new fish passable culvert. The proposed back-channel would connect from the main river channel to Pond #2, allowing salmonid access throughout Pond #2 and its associated wetland pond complex. The back-channel would tie into Pond #2 at an elevation of 11.5 feet. This alternative would reduce the Pond #2 Wetland Complex area and drain portions of Pond #2 under average river flow conditions.
- Alternative 3: This alternative provides maximum channel access for salmonids at average and higher river flows. It includes all of the same features as Alternative 2 including the side-channel flowing through Pond #1 and back-channel access to the Pond #2 Wetland Complex for a total of 1,380 LF. The preferred alternative includes a second 65-foot-long 12-foot diameter culvert crossing to the west of the first proposed agricultural access road culvert. This culvert and west channel would create a second 1,540-LF route to Pond #2 via a restored riparian and wetland forest pathway.

Chapter 5 Final Design

SCD and the technical advisory stakeholders met with Cardno engineers on April 7, 2015, in Mill Creek, and conducted a site visit on May 18, 2015. The group selected Alternative 3 as the Preferred Alternative to maximize habitat restoration goals in the Snohomish River Basin Salmon Conservation Plan (SRBSCP, 2005). Alternative 3 addresses project objectives and benefits salmonids in the following ways:

- Removal of fish passage barriers including the culvert near the river and the blockage associated with the agricultural access road,
- Channel excavation to maximize back-channel length totaling 2,920 LF,
- Maximum fish access and passage to the floodplain features of the Project site including Pond #1 and the Pond #2 Wetland Complex,
- Optimal diversity of back-channel pathways including ample LWD,
- Reduced existing conditions stranding hazard during receding peak flows, and
- Zones of riparian planting to enhance existing areas and add habitat and cover to new back-channel pathways.

Final design Drawings are included as Appendix A. Our geomorphologists and engineers conducted a field inspection to evaluate project design elements in the hydraulic and geomorphic setting of this reach of the Snohomish. Findings are included in the response to review panel questions below.

An updated engineer's cost estimate is included in Appendix B. The Final design has an estimated construction cost (including state sales tax) of $347,932.

The proposed project is expected to have an impact on the existing groups of amphibians, beavers, and river otters occupying the Pond #2 Wetland Complex by reducing the overall area and depth available to beavers, otters, and amphibians at lower flows, and increasing the variation of the pond levels since it will be directly connected to the river. However, WSELs will not drain lower than the proposed thalweg until summer evaporation exceeds groundwater inflows.

The Project does have the opportunity to benefit salmonids, turtles, and other still-water species. Salmonids prefer flowing, cool, shaded water, whereas emydids (pond turtles) prefer quiet, warm, open water (Stewart 2015:22). Both groups require side-channel and pool habitat in and near streams. The following habitat conditions benefit still-water amphibians (Holzer 2015):

- Hydroperiod: turtles need year-round deep water, amphibians need ponded water through mid-summer;
- Aquatic vegetation: turtles need feeding and refuge while amphibians need oviposition, refuge, and periphyton
- Silty bottom: turtles need a silty bottom for refuge and aestivation, while amphibians need it for refuge
- Wood: turtles need wood for basking, and amphibians in uplands need it to avoid desiccation
- Sun: turtles and amphibians bask in the sun
- Upland: turtles need open nesting areas while both amphibians and turtles need forest access for foraging, hibernation, and/or aestivation
- Movement: both turtles and amphibians need interconnected water bodies and uplands

The Preferred Alternative would have habitat zones benefiting both amphibians and salmonids. Southern quiescent portions of the Pond #2 Wetland Complex would provide still-water species wetland habitat including silty bottom and aquatic vegetation with salmonid access for refugia and foraging. Northern portions of the Project site near Pond #1 with the proposed interconnected channels would provide salmonid habitat and movement opportunities for amphibians, beavers, and otters. Furthermore, current and future expected beaver activity will promote still-water species habitat including amphibians (Holzer 2015). We intentionally designed the placement of LWD in orientation and location to attract future beaver dam building activity to more naturally control flows in and out of the off-channel rearing ponds.

The Final Design includes culvert crossings under the existing agricultural access road. Culverts would allow for cost-effective conveyance with the least potential for scour and erosion during high-flow events. A rail car bridge option was evaluated but we found that it would be prone to abutment and toe of slope erosion, which would necessitate abutment riprap protection. Furthermore, a geotechnical investigation would be required to assess the stability of the rail car bridge and abutments. Since the railcar bridge option would require 2:1 channel side slopes and the channel design has 8-foot bottom width, an 86-foot-long rail car bridge would be required. Thus, the Cardno team deems 12-foot-diameter culverts a more cost effective and suitable option.

The Project site is located on a relict aggradational scrolling point bar of the Snohomish River. This feature is evident when viewed with respect to peak flood events and the LiDAR hillshade topographic digital elevation model (Figure 4-1).

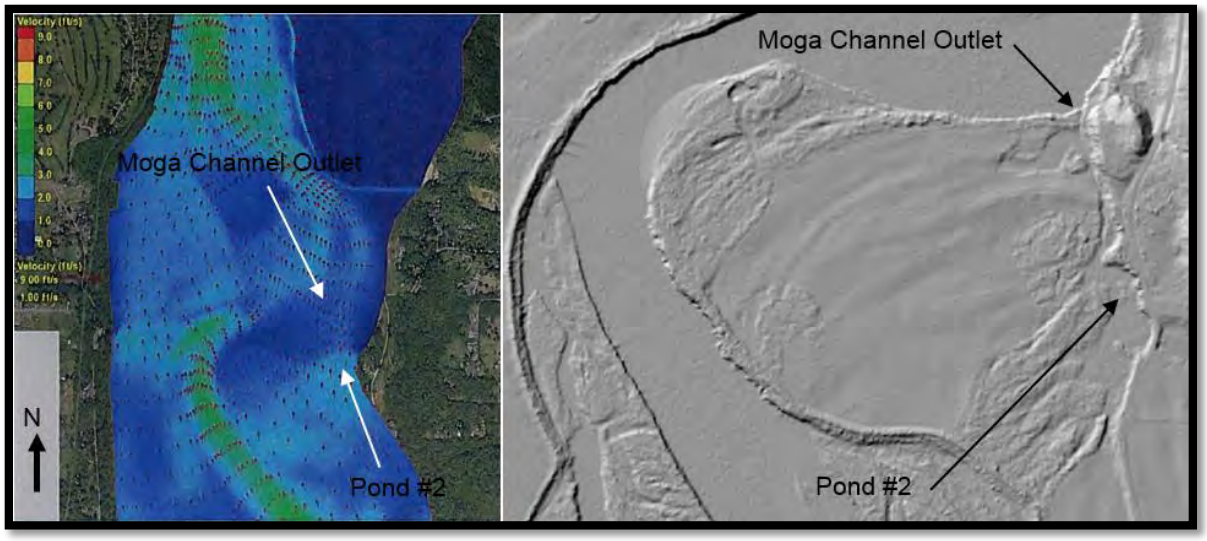


Figure 5-1: Aggradational potential of the Project site due to flood flows and relict point bar formation morphology. At left, flood velocity adapted from the geomorphic analysis (R2 Resource Consultants 2015) and, at right, LiDAR hillshade at a smaller scale showing the Project site on a relict scrolling point bar that grew from east to west as the main Snohomish River channel cut the river left bank.

The Salmon Recovery Funding Board Review Panel provided written comments stemming from review of conceptual alternatives and the site visit. These comments are provided below with responses.

1. **Recommended improvements to make this a technically sound project according to the SRFB's criteria:**

The overall project concept, as described in the Project 14-1404 Conceptual Design Report, appears to be technically sound and will likely provide substantial benefit to the targeted salmon species/life histories. As of the date of the site visit, the project design is not developed enough yet to provide certainty on some of the key design issues that are mentioned in the Conceptual Design Report. Two issues in particular need to be resolved: 1) how much the wetland will be allowed to drain during low river stage in order to balance preserving ecological functions for other native aquatic fauna (amphibians, turtles and mammals), preventing fish stranding, and discouraging infestation with warm water resident fish like bass; and 2) how to design the new channels to minimize the long term aggradation of fine sediment, so that the connection will be sustainable over a relatively long time frame. Until the design and permitting implications of these two issues are worked out, the construction cost estimate/grant budget cannot be determined accurately. The "25% contingency" place holder in the conceptual cost estimate is not an allowable substitute for an accurate construction budget and is not an eligible budget line item. (Note: we have removed this line item from the budget.)

Reply to Question 1: Lowering wetland surface

The wetland will be drained approximately 4 feet when the river is at average annual flow. However, the wetland will experience a much wider range of flows after the reconnection is made, fluctuating with the river. At some points in time the wetland will be higher than existing levels due to river levels after it is reconnected. We intentionally designed the placement of large woody debris in orientation and location to attract future beaver dam building activity to more naturally control flows in and out of the off-channel rearing ponds. We expect the reconnected areas to remain jurisdictional wetlands

but with a different flow regime. Instead of a blocked, dead-end pond with no outlet or connection to the river, this will be a fluctuating wetland and riparian area directly connected to the river.

Reply to Question 2: Likelihood of long-term aggradation

The likelihood of long-term aggradation in the proposed new channels is low, owing to the geomorphic setting and local flow hydraulics in the vicinity of the project site. Two issues are of potential concern:

What is the probability of outlet blockage by deposition from the main river, particularly given that the geomorphic report (R2 Resource Consultants 2015) predicts that the downstream segment ("16+17" by their terminology) is shown as "Moderate Aggradation" on their *Plate 3 - Snohomish River Bed Stability Rating*?

Airphoto inspection and our field visit both show that the outlet location is at a zone of persistent scour at moderate and high flows, lying at the outside of a prominent bend (Figure 5-2). Although at a whole-river scale this does appear to be a zone where some deposition occurs (R2 Resource Consultants 2015), the local hydraulics are not well-represented by the coarse granularity of R2 Resource Consultants' sediment-transport modeling. The outlet should remain well-scoured of potential sediment accumulations indefinitely into the future.

Figure 5-2: Aerial view of the project site, showing its location relative to the outside bend of the Snohomish River where scour is ubiquitous (flow from left to upper right).

What is the likelihood that overbank flows will deposit fine sediment into the excavated channels and pond complex, resulting in the long-term loss of these habitat features?

The hydraulic modeling suggests that the relict channels are inundated by 2- to 5-year discharges, and so the most obvious conclusion is that the ponds in their current configuration (which includes relatively poor outlet passage for floodwaters) have managed to persist for at least the last several decades with no systematic changes in size/appearance resulting from sedimentation. This is likely a consequence of the shortened flow path that floodwaters can take across the bar, relative to the

longer path around the bar at lower flows, resulting in locally steeper hydraulic gradients and thus a potentially enhanced ability to transport suspended sediment (Figures 5-3 and 5-4).

Figure 5-3: Project site, showing flow paths activated at 2-year (red), 5-year (orange), and 10-year (yellow) discharges. The flow path that is connected fully across the bar at 5-year and higher discharges, and which includes the path of the proposed channels at its downstream end, is roughly half the length of the main channel, suggesting that the gradients are likely twice as steep as in the main channel and are likely to have significant sediment-transport capacity under moderate and larger floods.

Figure 5-4: Sequential views of the primary pond at the project site in 1990 (left) and 2015 (right), showing no obvious effects of sedimentation in the intervening 25 years.

Persistence of the pond feature on the project site, observed over at least the last 25 years, is likely to be enhanced following project implementation, insofar as the excavation of the planned outlet channel should enhance downstream flow (and thus sediment transport) back out to the Snohomish River. No quantitative modeling of this condition appears to be necessary on the basis of both the empirical history and the nature of the proposed actions.

Manual 18 requires that proposals for construction projects with budgets exceeding $250,000 must provide all Appendix D-2 preliminary design deliverables by the final application date. If the schedule for completing the preliminary design deliverables under project No. 14-1404 cannot meet this deadline, then we recommend that this proposal for construction funding should be postponed until the next SRFB funding round. The construction proposal will be much stronger if the design grant deliverables are completed.

Reply:

We will include all the Appendix D-2 design deliverables by the deadline.

The review panel recommends that the final application include (typically pulled from the Preliminary design report) a comparative table of the design alternatives considered, and the relative fish habitat benefits of each for ease of comparison. The final application (and preliminary design report) should include the reach scale map that was used at the site visit that describes the relationships between the nearby dikes and levees that were referenced in the application. Please confirm that the current design won't preclude any future larger-scale floodplain restoration if those levees are no longer functional. Please provide the R2 Resource Consultants technical memo prepared for the County regarding the reach-scale geomorphic analysis that addresses the project reach.

Reply:

The final application and preliminary design report will include a comparative table of the design alternatives and the relative fish habitat benefits of each for comparison. (*note from final design: the alternative chosen for final design is the one most beneficial to mammals and salmonids) We will include the reach scale map, also. The current design won't preclude future large scale floodplain restoration; in fact, we have designed this project as a potential first phase of a larger project. We will include the R2 Resource Consultants technical memo as an attachment to the final application.

Please clarify how the project will provide for adult holding habitat for Chinook and coho as stated in the application. Is overwintering and winter flow refuge a more limiting habitat type than spring outmigrant or summer off-channel rearing habitat? It did not appear that temperature or water surface elevation dataloggers were deployed as part of the conceptual design – why not? What data is available for spring and summer temperatures in this reach of the Snohomish River?

Reply:

Adult holding areas are in the main channel. This project will not affect or improve adult holding. Overwintering off channel habitat and winter flow refuge is a key limiting habitat type in this reach and increases in this habitat are very beneficial to juvenile salmonids. Temperature dataloggers have been installed; these data will be included in the final application.

2. General Comments:

The review panel appreciates that the project proposal is being designed to consider other native fauna. This can result in a better balanced project if the needs of all species are taken into account and habitat for non-fish species can be incorporated if primary habitat objectives for the multiple species don't conflict. Balancing the interests of preserving the existing high value ecological function in the wetland versus providing access for salmonid rearing and refuge habitat is the key issue that will drive the project design and permitting. Depending on the permitting strategy (i.e. whether a

nationwide or an individual Section 404 permit), the sponsor will need to consult with the Army Corps of Engineers and potentially also the Washington Department of Ecology for guidance on how to minimize and/or mitigate impacts to the wetland. Section 106 cultural resources review and critical areas review under Snohomish County Shorelines Management Act and Critical Areas Ordinance will also be necessary. These conversations with regulators need to happen at the preliminary design stage. While the Manual 18 rules do not require permit applications to be submitted by the final application date, we strongly recommend that the final proposal include documentation of at least preliminary discussions with the County, Corps and potentially Ecology on the wetland impact issues.

Reply:

We will be having discussions with regulatory staff at the preliminary design phase to determine what information they will need to process the permits and to obtain guidance on how to minimize potential impacts to wetlands and/or regulated critical areas. We intend to discuss this project with Snohomish County Planning and Development Services, U.S. Army Corps of Engineers, and Washington State Department of Ecology. We will document these discussions and findings in our final application.

Chapter 6 References

Federal Emergency Management Administration (FEMA). 2005. Flood Insurance Rate Map for Snohomish County, WA and Incorporated Areas Map Number 53061C1355F. Effective September 16, 2005.

Flint, C. 2014. 2014 P*roject Proposal for Planning Projects: Monga Back-Channel Design*. Lake Stevens, WA: Snohomish Conservation District.

Google Earth. 2011. Aerial imagery, August 1, 2011. Available at http://earth.google.com.

Holzer, K. 2015. Natural History of Turtles and Still-water Amphibians. *Still-water Species and Salmon Restoration*. Gresham, OR: River Restoration Northwest Conference Proceedings.

Montgomery, D.R., B.D. Collins, K.M. Buffington, and T.B. Abbe. 2003. Geomorphic effects of wood in rivers. In Gregory S., K. Boyer, and A. Gurnell, A., eds. The Ecology and Management of Wood in World Rivers. American Fisheries Society, Symposium 37 Bethesda, Maryland, pp. 21–47.

National Oceanic and Atmospheric Administration (NOAA). 2011. ESA Salmon Listings. Available at http://www.nwr.noaa.gov/ESA-Salmon-Listings/.

Snohomish Basin Salmon Recovery Form (SBSRF). 2005. Snohomish River Basin Salmon Conservation Plan.

———. 2013. Three Year Work Plan.

Snohomish County. 2003. *Snohomish River Confluence Reach Analysis, Phase 1 Feasibility Study Final Report*. Everett, WA: Snohomish County Department of Public Works Surface Water Management.

Stewart, E. 2015. Case Study: River Island Restoration. Oregon Metro, River Restoration Northwest Conference Proceedings.

United States Geological Survey (USGS). 2015. Washington Stream Stats. Available at http://streamstatsags.cr.usgs.gov/wa_ss/.

R2 Resource Consultants, Inc. 2015. Reach Scale Geomorpic Analysis of Hydraulic, Hydrologic, and Sediment Conditions in the Snohomish river Between SR 522 and Ebey Slough. Redmond, WA: R2 Resource Consultants, Inc.

Appendix A

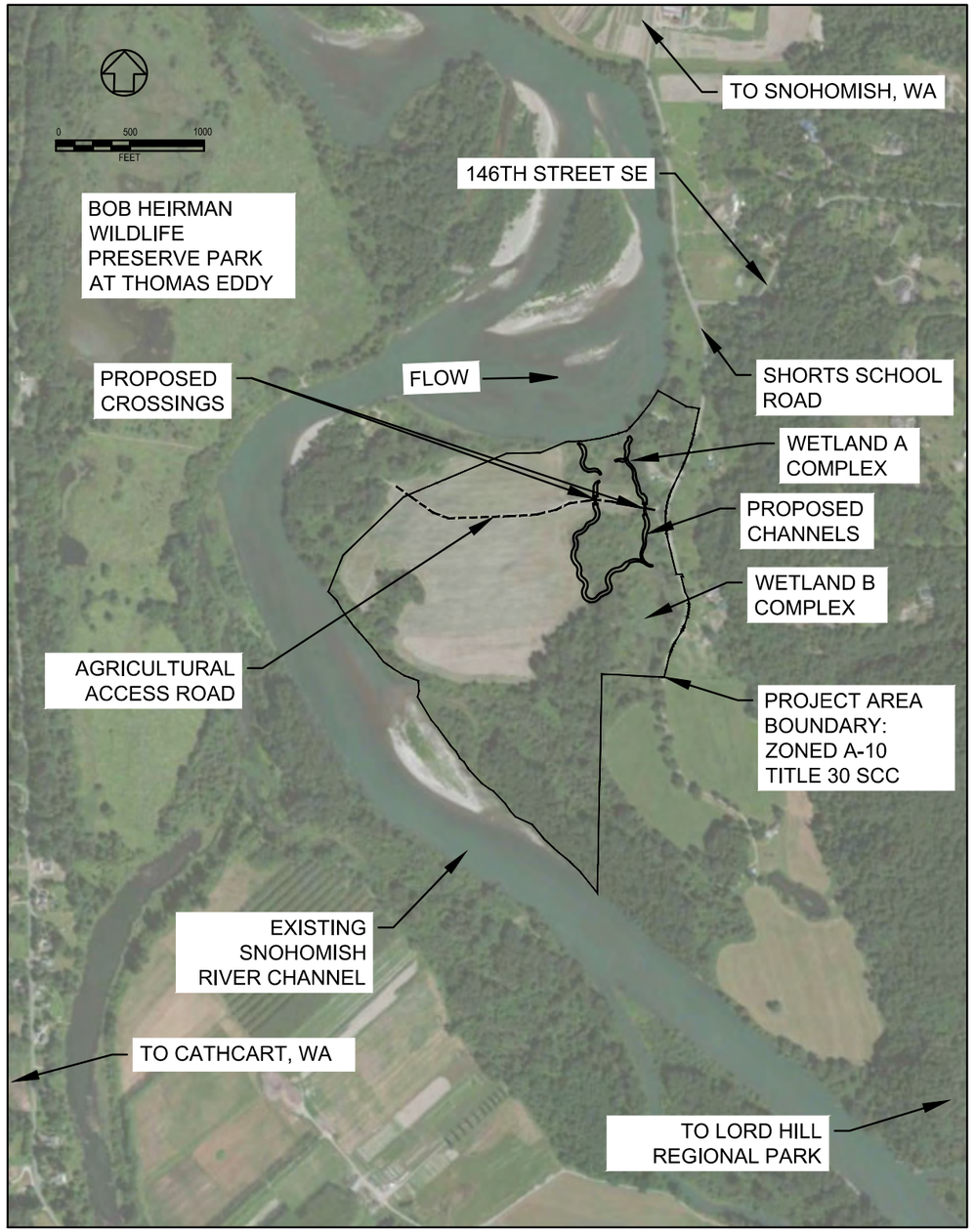
Final Design Plans

SNOHOMISH CONSERVATION DISTRICT

SECTION 6, TOWNSHIP 27, RANGE 06

MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WASHINGTON



Sheet List Table	
Sheet Number	Sheet Title
1	TITLE
2	CONSTRUCTION NOTES
3	ACCESS, STAGING & BMPS
4	PLAN - EAST
5	PLAN - WEST
6	PLAN - REVEGETATION & SITE STABILIZATION
7	LWD DETAILS - TYPE 1
8	LWD DETAILS - TYPE 2
9	LWD DETAILS - TYPE 3
10	DETAILS - CULVERT & CHANNEL
11	DETAILS - BMPS

USACE REFERENCE #: NWS-2015-723
APPLICANT: SNOHOMISH CONSERVATION DISTRICT
ADJACENT PROPERTY OWNERS:
1. APN: 27060500200700
2. APN: 27060500200600
3. APN: 27060500300200

LOCATION: APN 27060600100400, 27060600100700
27060500200600, 27060500200400
OWNER: MOGA
LAT/LONG: 47°51'27.3"N / 122°04'34.1"W
PROPOSED PROJECT:
CRITICAL OFF-CHANNEL HABITAT RECONNECTION

IN: RELICT SNOHOMISH RIVER CHANNEL
NEAR: SNOHOMISH & CATHCART
COUNTY: SNOHOMISH
STATE: WA

CESCL: DANIEL ELEFANT, CARDNO

SNOHOMISH COUNTY PLANNING DEPT. SERVICES APPROVED FOR CONSTRUCTION

BY:
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO:

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15

SKY D. MILLER
STATE OF WASHINGTON
REGISTERED PROFESSIONAL ENGINEER

ENGINEER: SKY MILLER
Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA, 98104
TEL: (206) 269-0104 FAX: (206) 269-0098
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

APPLICANT NAME:
CINDY DITTBRENNER
CINDY@SNOHOMISHCD.ORG
SNOHOMISH CONSERVATION DISTRICT
528 91ST AVE NE, LAKE STEVENS, WA 98258
PHONE: 425-377-7005

TITLE

MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	1
SHEET	1 of 11

GENERAL NOTES

GENERAL

1. ALL IMPROVEMENTS SHALL BE ACCOMPLISHED UNDER THE APPROVAL, INSPECTION, AND TO THE SATISFACTION OF THE SNOHOMISH CONSERVATION DISTRICT (SCD). IMPROVEMENT CONSTRUCTION SHALL COMPLY WITH THESE PLANS AND THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT) STANDARD PLANS, CURRENT EDITION. ALL REFERENCES TO THE "STANDARD SPECIFICATIONS" SHALL MEAN THE WASHINGTON STATE DEPARTMENT OF TRANSPORTATION (WSDOT) STANDARD SPECIFICATIONS FOR ROAD, BRIDGE AND MUNICIPAL CONSTRUCTION, CURRENT EDITION. CONSTRUCTION NOT SPECIFIED ON THESE PLANS SHALL CONFORM TO THE REQUIREMENTS OF THE STANDARD SPECIFICATIONS. THE CONTRACTOR IS OBLIGATED TO BE FAMILIAR WITH APPLICABLE SECTIONS OF THE STANDARD SPECIFICATIONS NOT DISCUSSED IN THE GENERAL NOTES. THE CONTRACT SPECIAL PROVISIONS SHALL SUPERSEDE THOSE OF THE STANDARD SPECIFICATIONS WHERE DISCREPANCIES OCCUR.

2. CONSTRUCTION HOURS SHALL BE WEEKDAYS BETWEEN 8:00 A.M. AND 6:30 P.M. UNLESS PRIOR APPROVAL IS RECEIVED FROM THE SCD. SEASONAL CONSTRUCTION WORK WINDOW WILL BE REQUIRED BY THE DEPT. OF FISH AND WILDLIFE. SEE HPA PERMIT.

3. THE CONTRACTOR AGREES TO ASSUME SOLE AND COMPLETE RESPONSIBILITY FOR JOB SITE CONDITIONS DURING THE COURSE OF CONSTRUCTION OF THIS PROJECT, INCLUDING SAFETY OF ALL PERSONS AND PROPERTY, AND FURTHER AGREES THAT THIS REQUIREMENT SHALL APPLY CONTINUOUSLY AND NOT BE LIMITED TO NORMAL WORKING HOURS IN ACCORDANCE WITH THE PROVISIONS OUTLINED BY THE PROJECT CONTRACT AND STANDARD SPECIFICATIONS.
4. IT IS THE RESPONSIBILITY OF THE CONTRACTOR AND HIS SUBCONTRACTOR(S) TO EXAMINE THE PROJECT SITE PRIOR TO THE OPENING OF BID PROPOSALS. THE CONTRACTOR SHALL BECOME FAMILIAR WITH THE CONDITIONS UNDER WHICH THE WORK IS TO BE PERFORMED, SUCH AS THE NATURE AND LOCATION OF THE WORK AND THE GENERAL AND LOCAL CONDITIONS, PARTICULARLY THOSE AFFECTING THE AVAILABILITY OF TRANSPORTATION, THE DISPOSAL, HANDLING, AND STORAGE OF MATERIALS, AVAILABILITY OF LABOR, WATER, ELECTRICITY, ROADS, THE UNCERTAINTIES OF WEATHER, THE CONDITIONS OF THE GROUND, SURFACE AND SUBSURFACE MATERIALS, THE EQUIPMENT AND FACILITIES NEEDED PRIMARILY FOR AND DURING THE PERFORMANCE OF THE WORK, AND THE COSTS THEREOF. ANY FAILURE BY THE CONTRACTOR AND SUBCONTRACTOR(S) TO ACQUAINT HIMSELF WITH ALL THE AVAILABLE INFORMATION WILL NOT RELIEVE HIM FROM RESPONSIBILITY FOR PROPERLY ESTIMATING THE DIFFICULTY AND COST OF SUCCESSFULLY PERFORMING THE WORK.

5. THE CONTRACTOR SHALL OBTAIN AT HIS OWN EXPENSE ALL PERMITS, LICENSES, INSURANCE POLICIES, ETC., NOT ALREADY OBTAINED BY SCD, AS MAY BE NECESSARY TO COMPLY WITH STATE AND LOCAL LAWS ASSOCIATED WITH THE PERFORMANCE OF THE WORK.

6. THE CONTRACTOR IS RESPONSIBLE TO REVIEW THE CONTRACT DOCUMENTS FOR ALL SUBMITTALS REQUIRED FOR SCD REVIEW AND ACCEPTANCE.

7. THE ENGINEER RESPONSIBLE FOR PREPARATION OF THESE PLANS AND SPECIFICATIONS WILL NOT BE RESPONSIBLE FOR, OR LIABLE FOR UNAUTHORIZED CHANGES TO OR USES OF THESE PLANS. ALL CHANGES TO THE PLANS MUST BE IN WRITING AND MUST BE APPROVED BY THE OVERSEEING ENGINEER RESPONSIBLE FOR PREPARATION OF THESE PLANS.

8. IF, DURING CONSTRUCTION, ARCHAEOLOGICAL REMAINS ARE ENCOUNTERED, CONSTRUCTION IN THE VICINITY SHALL BE HALTED, AND THE STATE OFFICE OF HISTORIC PRESERVATION, SCD AND A QUALIFIED ARCHEOLOGIST SHALL BE NOTIFIED IMMEDIATELY.

9. THE CONTRACTOR SHALL COMPLETE ALL WORK IN ACCORDANCE WITH ALL APPLICABLE FEDERAL, STATE, AND LOCAL REGULATIONS AS WELL AS ALL PERMIT REQUIREMENTS.

10. THE CONTRACTOR IS RESPONSIBLE FOR COMPLETING ALL FISH REMOVAL (DEFISH) AND DEWATERING AS PER SPECIFICATIONS.

TRAFFIC CONTROL

11. THE CONTRACTOR SHALL PROVIDE, PLACE, AND MAINTAIN ALL LIGHTS, SIGNS, BARRICADES, FLAG PERSONS, PILOT CAR, OR OTHER DEVICES NECESSARY TO CONTROL TRAFFIC IN THE CONSTRUCTION AREA AND FOR PUBLIC SAFETY IN ACCORDANCE WITH THESE PLANS, THE STANDARD SPECIFICATIONS, FEDERAL HIGHWAY ADMINISTRATION (FHWA) MANUAL ON UNIFORM TRAFFIC CONTROL DEVICES (MUTCD) 2003 EDITION.

TEMPORARY EROSION & SEDIMENT CONTROL

12. THE CONTRACTOR SHALL BE RESPONSIBLE FOR IMPLEMENTING ALL TEMPORARY EROSION CONTROL MEASURES. THE EROSION CONTROL MEASURES SHALL BE IN ACCORDANCE WITH SNOHOMISH COUNTY AND STATE REGULATIONS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE MAINTENANCE AND PERFORMANCE OF THE TEMPORARY EROSION CONTROL MEASURES THROUGHOUT THE DURATION OF THE PROJECT.

    ANY AREAS OF EXPOSED SOILS, INCLUDING ROADWAY EMBANKMENTS, THAT WILL NOT BE DISTURBED FOR TWO DAYS DURING THE WET SEASON OR SEVEN DAYS DURING THE DRY SEASON SHALL BE IMMEDIATELY STABILIZED WITH AN APPROVED ESC COVER METHOD

    ANY AREA NEEDING ESC MEASURES, NOT REQUIRING IMMEDIATE ATTENTION, SHALL BE ADDRESSED WITHIN SEVEN (7) DAYS

    THE ESC FACILITIES ON INACTIVE SITES SHALL BE INSPECTED AND MAINTAINED A MINIMUM OF ONCE PER MONTH OR WITHIN 24 HOURS OF A STORM EVENT

    PRIOR TO THE BEGINNING OF THE WET SEASON (OCT 1), ALL DISTURBED AREAS SHALL BE REVIEWED TO IDENTIFY THOSE TO BE SEEDED IN PREPARATION FOR WINTER RAINS. THESE AREAS SHALL BE SEEDED WITHIN ONE WEEK OF THE BEGINNING OF THE WET SEASON A MAP OF THOSE AREAS TO BE SEEDED AND THOSE TO REMAIN UNCOVERED SHALL BE SUBMITTED TO THE DDES INSPECTOR FOR REVIEW

13. GROUNDWATER CONDITIONS ON THE SITE WERE NOT EVALUATED BUT CONTRACTOR SHOULD EXPECT HIGH GROUNDWATER INFLOWS TO WORK AREAS. CONTRACTOR SHALL SUBMIT A DIVERSION & DEWATERING PLAN TO THE ENGINEER FOR APPROVAL IF FIELD CONDITIONS WARRANT.

    NOTE DEWATER - DEFISH SPECIFICATOIN IF NEEDED; CONSTRUCTION SEQUENCE #4 THIS SHEET

14. THE CONTRACTOR SHALL HAVE AN EMERGENCY SPILL KIT ONSITE AT ALL TIMES.

15. THE CONTRACTOR SHALL FURNISH AND IMPLEMENT A STORMWATER POLLUTION PREVENTION PLAN PER SECTION 8-01.3(1)

16. PERMIT CONDITIONS MAY CONTAIN SPECIFIC REQUIREMENTS FOR THE CONTROL OF OFF-SITE TURBIDITY FROM PROJECT OPERATIONS. TURBIDITY WILL BE MONITORED ON A FREQUENT BASIS BY THE PROJECT MANAGEMENT AND INSPECTION STAFF ON-SITE. TURBIDITY AMOUNTS IN EXCESS OF THE PERMITTED AMOUNT AND/OR DURATIONS WILL CAUSE WORK TO BE STOPPED UNTIL IMPROVED PRACTICES ARE IN EFFECT AND THE PROBLEMS CONTROLLED. THE CONTRACTOR IS COMPLETELY RESPONSIBLE FOR ANY PROJECT DELAYS THAT OCCUR BY NATURE OF THIS FAILURE TO ADEQUATELY CONTAIN SEDIMENT ON-SITE.

17. THE CONTRACTOR IS RESPONSIBLE TO ENSURE THAT NO PETROLEUM PRODUCTS, HYDRAULIC FLUID, SEDIMENTS, SEDIMENT-LADEN WATER, CHEMICALS, OR ANY OTHER TOXIC OR DELETERIOUS MATERIALS ARE ALLOWED TO ENTER OR LEACH INTO THE RIVER. CONTRACTOR SHALL COMPLY WITH THE STORMWATER POLLUTION PREVENTION PLAN (SWPPP) AND SPILL PREVENTION, CONTROL AND COUNTERMEASURES PLAN (SPCC).

18. THE CONTRACTOR IS RESPONSIBLE FOR LAYING ZONE 1 EROSION CONTROL FABRIC AND PLACING NATIVE WETLAND SEED MIX TO ZONE 1 AS SHOWN ON PLAN SHEET 6 - REVEGETATION.

UTILITIES

18. THE LOCATIONS AND EXTENT OF EXISTING UNDERGROUND UTILITIES IN THE WORK AREA AS SHOWN ARE APPROXIMATE AND ARE NOT NECESSARILY COMPLETE. A REASONABLE EFFORT HAS BEEN MADE TO LOCATE AND DELINEATE EXISTING UTILITIES BASED UPON AVAILABLE RECORDS. THE CONTRACTOR SHALL DETERMINE THE TYPE, LOCATION, SIZE, AND/OR DEPTH OF THE EXISTING UTILITIES WITHIN THE WORK AREA BEFORE COMMENCING WORK. THE CONTRACTOR OR ANY SUBCONTRACTOR FOR THIS CONTRACT SHALL BE FULLY RESPONSIBLE FOR ANY AND ALL DAMAGES WHICH MIGHT BE OCCASIONED BY THE FAILURE TO EXACTLY LOCATE AND PRESERVE ANY AND ALL UNDERGROUND UTILITIES. THE CONTRACTOR SHALL CONTACT UNDERGROUND SERVICE ALERT AT (800) 642-2444 AT LEAST 48 HOURS PRIOR TO ANY CONSTRUCTION. THE CONTRACTOR SHALL ASSUME COMPLETE RESPONSIBILITY FOR DAMAGED UTILITIES.

19. AT NO TIME SHALL THE CONTRACTOR UNDERTAKE TO CLOSE OFF ANY EXISTING UTILITY LINES OR OPEN VALVES OR TAKE ANY OTHER ACTION WHICH WOULD AFFECT THE OPERATION OF EXISTING WATER OR SEWER SYSTEMS WITHOUT PRIOR APPROVAL FROM THE UTILITY OWNER. APPROVAL SHALL BE REQUESTED AT LEAST 48 HOURS IN ADVANCE OF THE TIME THAT THE INTERRUPTION OF THE EXISTING SYSTEM IS REQUIRED. ANY INTERRUPTION OF SERVICE TO ACTIVE WATER OR SEWER SERVICES, INCLUDING FIRE HYDRANTS, WHETHER INTENTIONAL OR NOT, MUST BE KEPT TO A MINIMUM TIME PERIOD. IF SERVICE TO BUILDINGS IS TO BE OFF FOR MORE THAN FOUR HOURS, THE CONTRACTOR MUST ADVISE THE UTILITY OWNER.

SITE ACCESS

20. WITHIN THE CONSTRUCTION LIMITS, EXISTING VEGETATION SHALL BE PROTECTED TO THE EXTENT FEASIBLE. ALL EXISTING TREES SHALL BE PROTECTED UNLESS SHOWN ON THE PLANS TO BE REMOVED. ANY NATIVE TREES WITHIN GRADING LIMITS SHALL BE SALVAGED FOR USE AS LWD AND RACKING. ALL TREES CONFLICTING WITH GRADING SHALL BE TRIMMED. NO GRADING SHALL TAKE PLACE WITHIN THE DRIP LINE OF TREES NOT TO BE REMOVED UNLESS OTHERWISE APPROVED.

21. ALL EXTERNAL GREASE AND OIL SHALL BE PRESSURE-WASHED OFF THE EQUIPMENT PRIOR TO TRANSPORT TO THE SITE.

22. THE CONTRACTOR SHALL USE ONLY DESIGNATED SPECIFIC SITES FOR STORAGE OF EQUIPMENT AND MATERIALS AS SHOWN ON THESE PLANS. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE SECURITY OF ALL EQUIPMENT AND MATERIALS. HAUL ROUTES SHALL BE LIMITED TO THE AREAS APPROVED BY THE ENGINEER. THE CONTRACTOR SHALL DE-COMPACT AND REVEGETATE ALL HAUL ROADS AND STAGING AREAS PRIOR TO DEMOBILIZING FROM THE SITE.

SURVEY

23. UNLESS NOTED OTHERWISE ON THE PLANS, THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE PROTECTION OF ALL EXISTING SURVEY MONUMENTS AND OTHER SURVEY MARKERS DURING CONSTRUCTION.

24. ELEVATIONS SHOWN ON THE PLANS FOR PIPE INVERTS, TOPS OF BANKS,THALWEGS ,GRADE CONTROLS, ETC., ARE BASED UPON THE TOPOGRAPHIC INFORMATION SHOWN ON THE PLANS. THE CONTRACTOR SHALL VERIFY ALL NECESSARY SURFACE ELEVATIONS IN THE FIELD AND NOTIFY SCD OF ANY DISCREPANCIES, WHICH MIGHT AFFECT PROPER OPERATION OF THE NEW FACILITIES BEFORE BREAKING GROUND AND PRIOR TO FACILITY INSTALLATION. SCD SHALL BE CONTACTED IN THE EVENT ELEVATIONS ARE INCORRECT SO THAT THE PROPER ADJUSTMENTS CAN BE MADE PRIOR TO THE INSTALLATION OF THE FACILITIES, AS SET FORTH IN THE SPECIAL PROVISIONS.

ABBREVIATIONS

AC	ASPHALT CONCRETE
APN	ASSESSOR'S PARCEL NUMBER
APPROX	APPROXIMATE
BLDR	BOULDER
BLVD	BOULEVARD
BMP	BEST MANAGEMENT PRACTICE
CF	CUBIC FEET OR CURB FACE
CFS	CUBIC FEET PER SECOND
℄	CENTERLINE
CLF	CONSTRUCTION LIMIT FENCE
CLR	CLEAR
CO.	COUNTY
CONC	CONCRETE
CONST	CONSTRUCT
CMP	CORRUGATED METAL PIPE
CT	COURT
CY	CUBIC YARD
DET	DETAIL
DIAM OR Ø	DIAMETER
DR	DRIVE
D/W	DRIVEWAY
E	EAST
EA	EACH
EC	EROSION CONTROL
EG	EXISTING GRADE
ELEV	ELEVATION
ELEC	ELECTRIC
EX	EXISTING
F	FIR
FF	FILTER FENCE
FG	FINISHED GRADE
FH	FIRE HYDRANT
FL	FLOWLINE
FS	FINISH SURFACE
G	GAS
GB	GRADE BREAK
HORIZ	HORIZONTAL
INST	INSTALL
LF	LINEAR FEET
L	LEFT
LONG	LONGITUDINAL
LWD	LARGE WOODY DEBRIS
MIN	MINIMUM
MISC	MISCELLANEOUS
N	NORTH
NTS	NOT TO SCALE
OC	ON CENTER
PL	PROPERTY LINE
PP	POWER/UTILITY POLE
PRC	POINT OF REVERSE CURVATURE
PROP	PROPOSED
RD	ROAD
REF	REFERENCE
ROW	RIGHT-OF-WAY
R	RIGHT
S	SOUTH OR SLOPE
SD	STORM DRAIN
SF	SQUARE FEET
SHT	SHEET
SS	SANITARY SEWER
ST	SEDIMENT TRAP OR STREET
STA	STATION
TG	THALWEG
TOB	TOP OF BANK
TYP	TYPICAL
VERT	VERTICAL
W	WEST OR WATER
WA	WASHINGTON
W/	WITH
W/O	WITHOUT
WSDOT	WA STATE DEPARTMENT OF TRANSPORTATION
FO	FIBER OPTIC CABLE

LEGEND

*NOTE: LEGEND PROVIDED ON SHEET SUPERCEDES THIS LEGEND

EXISTING	PROPOSED
MAJOR CONTOUR	MAJOR CONTOUR
MINOR CONTOUR	MINOR CONTOUR
PROPERTY LINE	NEW CHANNEL ALIGNMENT
WETLAND BOUNDARY	

LWD STRUCTURE TYPE 1

LWD STRUCTURE TYPE 2

LWD STRUCTURE TYPE 3

CONSTRUCTION SEQUENCE

1. SUBMIT FOR WRITTEN APPROVAL AN ANTICIPATED SCHEDULE TO PROJECT MANAGER PRIOR TO START.
2. CALL FOR PRE-CONSTRUCTION MEETING WITH PROJECT MANAGER, ENGINEER AND OWNER
3. ESTABLISH TBM'S AND PERFORM CONSTRUCTION STAKING.
4. DE-WATER, DE-FISH SITE. CONTRACTOR MAY REFER TO SECTION 8-01.3(9)C IN SPECIFICATIONS OR SUBMIT PLAN TO PROJECT MANAGER AND ENGINEER FOR APPROVAL
   DE-FISHING SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR
5. BEGIN CONSTRUCTION ACTIVITIES

EROSION AND SEDIMENT CONTROL SEQUENCE

1. PRE CONSTRUCTION MEETING
2. FLAG OR FENCE CLEARING LIMITS
3. INSTALL PERIMETER PROTECTION
4. GRADE AND STABILIZE ACCESS ROADS
5. CONSTRUCT SURFACE WATER CONTROL SIMULTANEOUSLY WITH CLEARING AND GRADING FOR PROJECT DEVELOPMENT
6. MAINTAIN EROSION CONTROL MEASURES IN ACCORDANCE WITH SNOHOMISH COUNTY STANDARDS AND MANUFACTURER'S RECOMMENDATIONS
7. RELOCATE EROSION CONTROL MEASURES OR INSTALL NEW MEASURES AS SITE CONDITIONS CHANGE
8. STABILIZE ALL AREAS THAT REACH FINAL GRADE WITHIN SEVEN (7) DAYS
9. SEED OR SOD ALL AREAS TO REMAIN UNWORKED FOR 30 DAYS
10. UPON COMPLETION OF PROJECT, ALL DISTURBED AREAS MUST BE STABILIZED AND BMP'S REMOVED IF APPROPRIATE

UTILITIES

ELECTRIC	SNOHOMISH PUD, (425) 783-1000
SEWER & WATER	SNOHOMISH PUD, (425) 783-1000

HORIZONTAL AND VERTICAL CONTROL/PROJECTION

VERTICAL CONTROL IS NAVD 88; HORIZONTAL CONTROL IS WA STATE PLANE NAD 83, NORTH ZONE (US FEET).

BASE TOPOGRAPHY OBTAINED FROM THE FOLLOWING SOURCES.
-LIDAR DATA FROM PUGET SOUND LIDAR CONSORTIUM (2014)
-SITE TOPOGRAPHY FROM: CARDNO RTK SURVEY (2015)

QUANTITIES

EXCAVATION AND CULVERT BACKFILL = 1200 CY
EXCAVATION AND SPREAD = 7910 CY
EAST CULVERT 12 FT DIA.; 80 LF
WEST CULVERT 12 FT DIA; 54 LF

SNOHOMISH COUNTY PLANNING DEPT. SERVICES
APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15
SM	01.11.16

Cardno
SEATTLE
807 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104 FAX: (206) 269-0088
TEL: (206) 269-0104
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

USACE REFERENCE NUMBER:
NWS-2015-723

APPLICANT NAME:
SNOHOMISH CONSERVATION DISTRICT

CONSTRUCTION NOTES

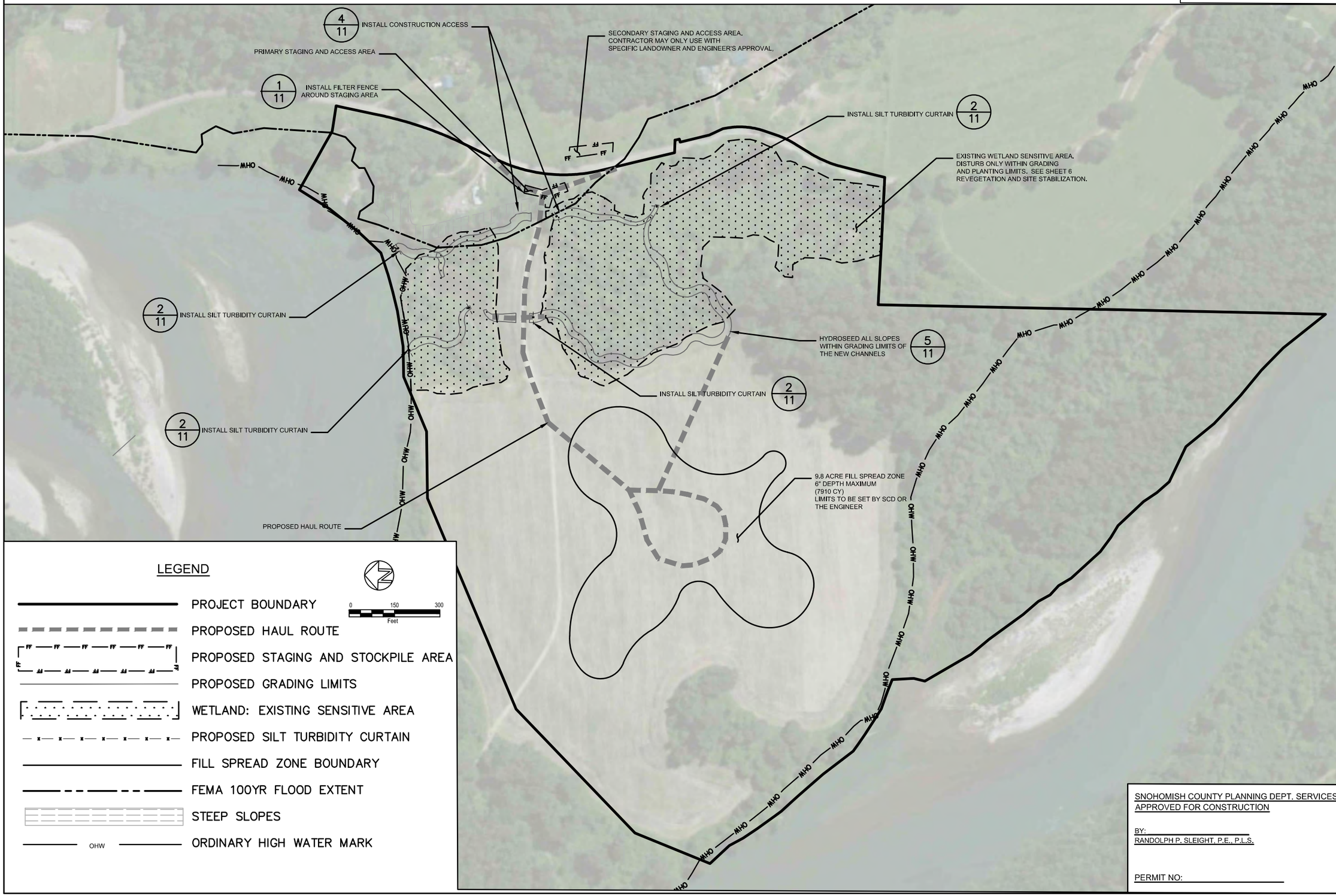
MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	2

SHEET 2 of 11

SECTION 6, TOWNSHIP 27, RANGE 06



SNOHOMISH COUNTY PLANNING DEPT. SERVICES APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
SM	12.28.15
SM	01.07.16
SM	01.11.16

SKY D. MILLER
STATE OF WASHINGTON
28591
REGISTERED PROFESSIONAL ENGINEER

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104 FAX: (206) 269-0098
TEL: (206) 269-0104
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

USACE REFERENCE NUMBER:
NWS-2015-723

APPLICANT NAME:
SNOHOMISH CONSERVATION DISTRICT

ACCESS, STAGING & BMPS

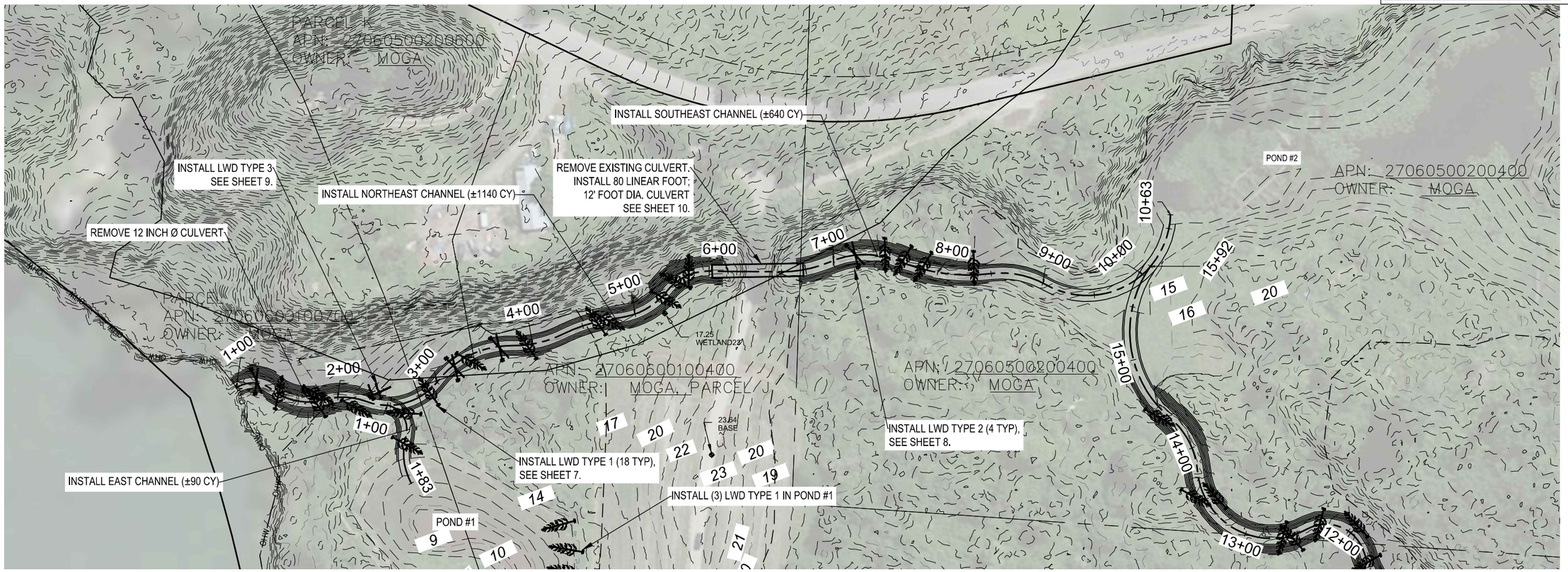
MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WASHINGTON

DATE:	DEC 15, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	3

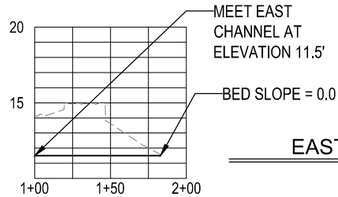
SHEET 3 of 11

SECTION 6, TOWNSHIP 27, RANGE 06



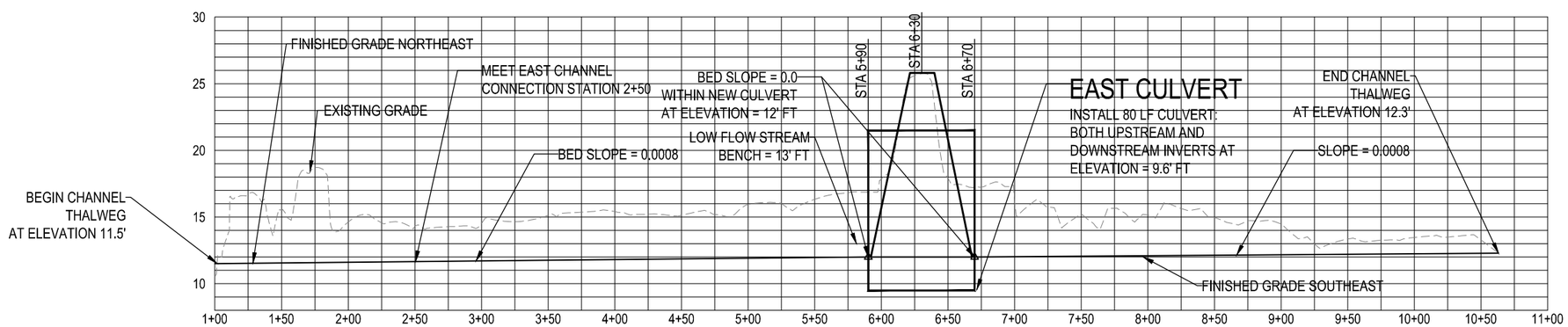
PLAN

HORIZONTAL SCALE: 1" =100'



EAST CHANNEL THALWEG: LONG PROFILE

HORIZONTAL SCALE: 1" =100'
VERTICAL SCALE: 10X HORIZONTAL



NORTHEAST & SOUTHEAST CHANNEL THALWEG: LONG PROFILE

HORIZONTAL SCALE: 1" =100'
VERTICAL SCALE: 10X HORIZONTAL

0 50 100
Feet

SURVEY CONTROL POINTS			
Point #	Elevation	Northing	Easting
WETLAND 23	17.25	315746.99	1335276.32
BASE	23.64	315703.22	1335144.34
EAST CULVERT D/S END; CENTERLINE	9.6	315702.92	1335315.58
EAST CULVERT U/S END; CENTERLINE	9.6	315617.94	1335317.21

SNOHOMISH COUNTY PLANNING DEPT. SERVICES
APPROVED FOR CONSTRUCTION

BY:
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO:

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15
SM	1/11/2016

SKY D. MILLER
STATE OF WASHINGTON
28581
REGISTERED
PROFESSIONAL ENGINEER

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA. 98104
TEL: (206) 269-0104 FAX: (206) 269-0098
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

PLAN - EAST

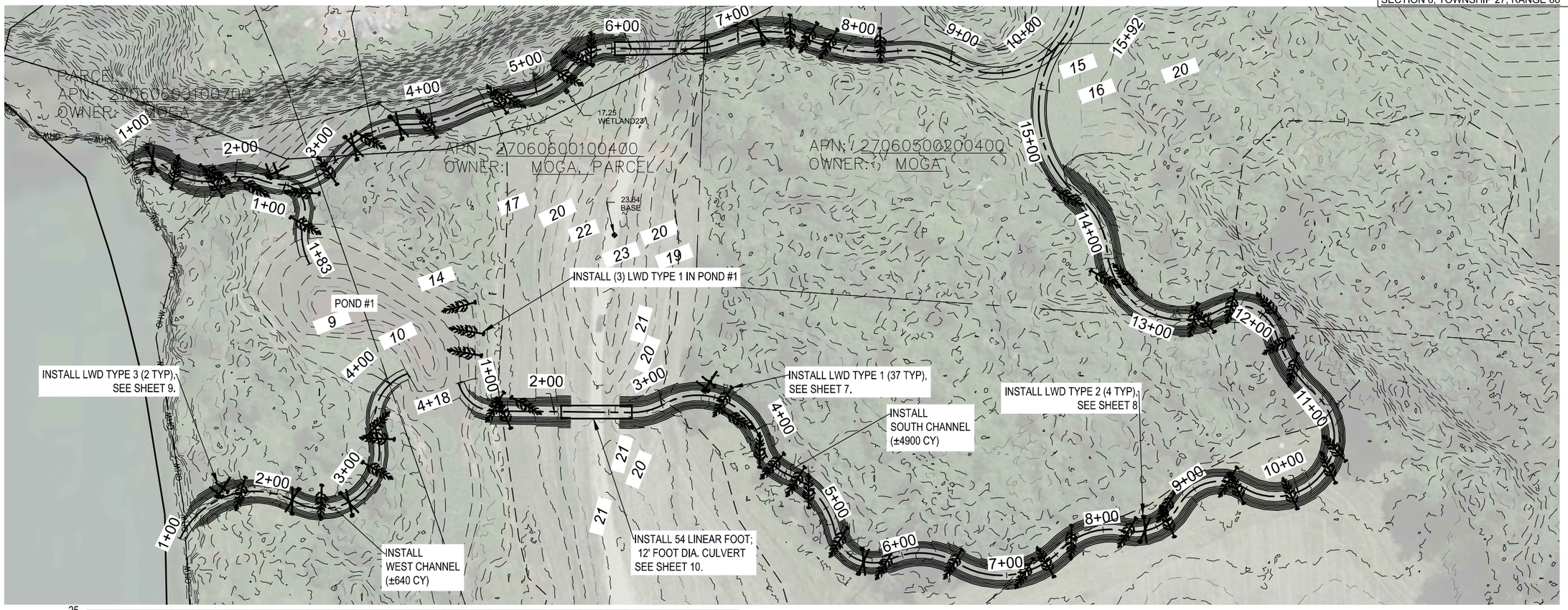
MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
ENTRIX JOB NO.	E515004000
PLAN NO.	4

SHEET 4 of 11

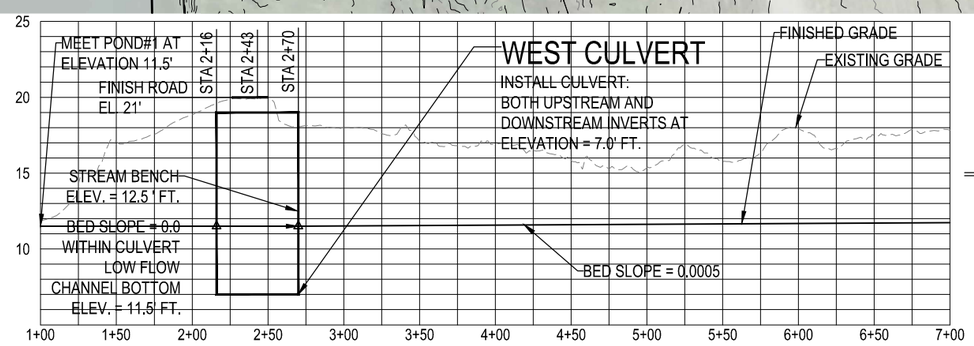
SECTION 6, TOWNSHIP 27, RANGE 06



PLAN

HORIZONTAL SCALE: 1" =100'

0 50 100 Feet



SOUTH CHANNEL THALWEG: LONG PROFILE STA 1+00 TO 7+00

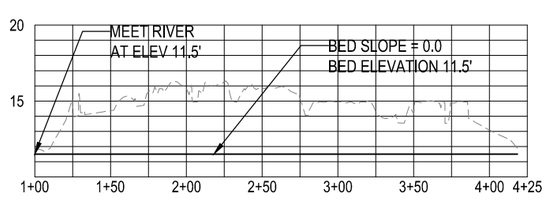
HORIZONTAL SCALE: 1" =100'
VERTICAL SCALE: 10X HORIZONTAL

SNOHOMISH COUNTY PLANNING DEPARTMENT SERVICES APPROVED FOR CONSTRUCTION

BY:
RANDOLPH P. SLEIGHT, P.E., P.L.S.

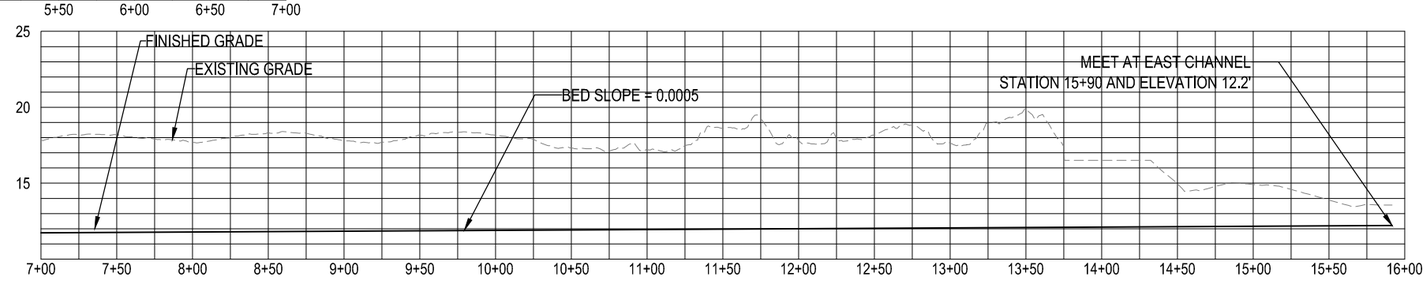
PERMIT NO:_____

SURVEY CONTROL POINTS			
Point #	Elevation	Northing	Easting
WETLAND 23	17.25	315746.99	1335276.32
BASE	23.64	315703.22	1335144.34
WEST CULVERT D/S END; CENTERLINE	7.0	315752.14	1334981.98
WEST CULVERT U/S END; CENTERLINE	7.0	315687.14	1334981.98



WEST CHANNEL THALWEG: LONG PROFILE

HORIZONTAL SCALE: 1" =100'
VERTICAL SCALE: 10X HORIZONTAL



SOUTH CHANNEL THALWEG: LONG PROFILE STA 7+00 TO 16+00

HORIZONTAL SCALE: 1" =100'
VERTICAL SCALE: 10X HORIZONTAL

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15
SM	1/11/16

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104
TEL: (206) 269-0104 FAX: (206) 269-0098
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

PLAN - WEST

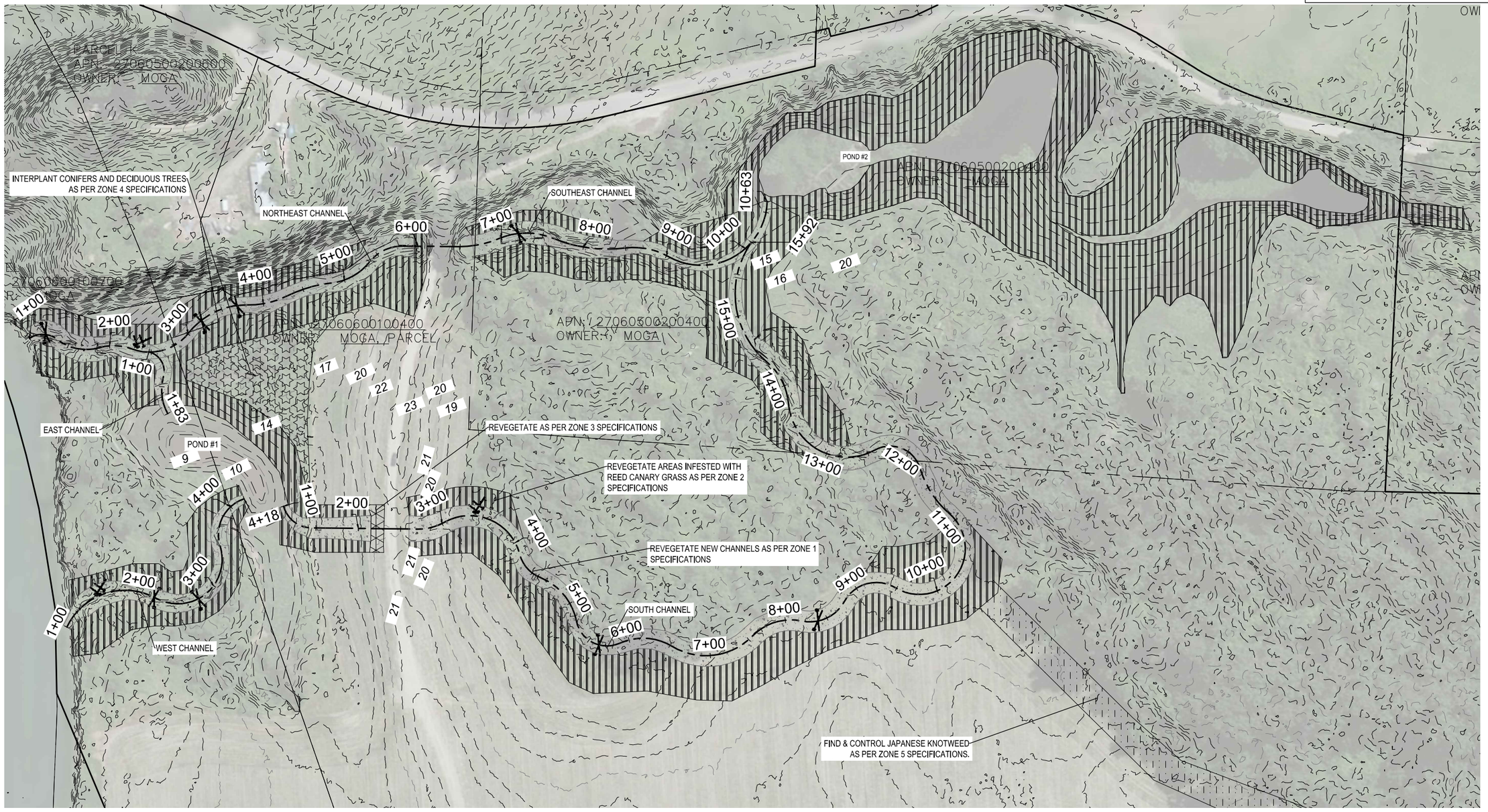
MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
ENTRIX JOB NO.	E515004000
PLAN NO.	5

SHEET 5 of 11

SECTION 6, TOWNSHIP 27, RANGE 06



NATIVE REVEGETATION SPECIFICATIONS

ZONE 1: HYDROSEED NEW ALCOVE CHANNELS PER 2014 WDOT SECTION 8-01.3(2)B WITH A NATIVE MIXTURE WETLAND GRASSES INCLUDING RED FESCUE, ROEMERS FESCUE, BLUE WILD RYE (ELYMUS GLAUCUS), MEADOW BARLEY (HORDEUM BRACHYANTHERUM), SLENDER HAIRGRASS (DESCHAMPSIA ELONGATE), TUFTED HAIRGRASS (DESCHAMPSIA CESPITOSA), NATIVE MANNA GRASSES (GLYCERIA SP), AND NATIVE FOXTAILS (ALOPECURUS SP).

ZONE 2: OVERLAP WITH ZONE 1 AND ZONE 3. CONTROL REED CANARY GRASS. LIVE STAKE THESE PERSISTENT WET AREAS WITH A DENSE MATRIX OF VARIOUS NATIVE SALIX SPECIES ON 2' CENTERS. INTER PLANT WETLAND SHRUBS SUCH AS LONICERA INVOLUCRATA, OEMLERIA CERASIFORMIS, PHYSOCARPUS CAPITATUS, ROSA SPECIES, RUBUS SPECTABILIS, SAMBUCUS RECEMOSA. ALSO, CONSIDER SPIREA DOUGLASII FOR PERSISTENT WET AREAS IMMEDIATELY ADJACENT TO PONDS.

ZONE 3: OVERLAP WITH ZONE 2. PLANT NATIVE RIPARIAN SHRUBS INCLUDING ACER CIRCINATUM, OEMLERIA CERASIFORMIS, PHYSOCARPUS CAPITATUS, ROSA SPECIES, RUBUS SPECTABILIS, SAMBUCUS RECEMOSA. INTER PLANT NATIVE RIPARIAN FOREST INCLUDING CONIFERS (PICEA SITCHENSIS, THUJA PLICATA, &TSUGA HETEROPHYLLA) AND DECIDUOUS TREES (ACER MACROPHYLUM, ALNUS RUBRA, AND POPULUS BALSAMIFERA).

ZONE 4: INTER PLANT NATIVE CONIFERS ON 10' TO 15' CENTERS (PICEA SITCHENSIS, THUJA PLICATA, &TSUGA HETEROPHYLLA) AND DECIDUOUS TREES (ACER MACROPHYLUM, ALNUS RUBRA, AND POPULUS BALSAMIFERA).

ZONE 5: LOCATE AND CONTROL JAPANESE KNOTWEED. DO NOT DISTURB EXISTING NATIVE VEGETATION. CONSIDER FOLIAR APPLICATION OF HERBICIDE AT THE HEIGHT OF THE GROWING SEASON (AUGUST) USING 1% IMAZAPAYR (AQUATIC FORMULATION - HABITAT OR POLARIS) WITH 1% COMPETITOR SURFACTANT. OTHER KNOTWEED CONTROL METHODS MAY ALSO BE SUITABLE SUCH AS STEM INJECTION.

PLANTING IN ZONES 2-5 TO BE COMPLETED BY SNOHOMISH CONSERVATION DISTRICT NOT BY CONTRACTOR DO NOT INCLUDE IN BID

0 60 120
Feet

SNOHOMISH COUNTY PLANNING DEPARTMENT SERVICES APPROVED FOR CONSTRUCTION

BY:
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO:

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15
SM	1/11/2016

SKY D. MILLER
STATE OF WASHINGTON
28561
REGISTERED PROFESSIONAL ENGINEER

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA. 98104
TEL: (206) 269-0104 FAX: (206) 269-0098
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

PLAN - REVEGETATION & SITE STABILIZATION

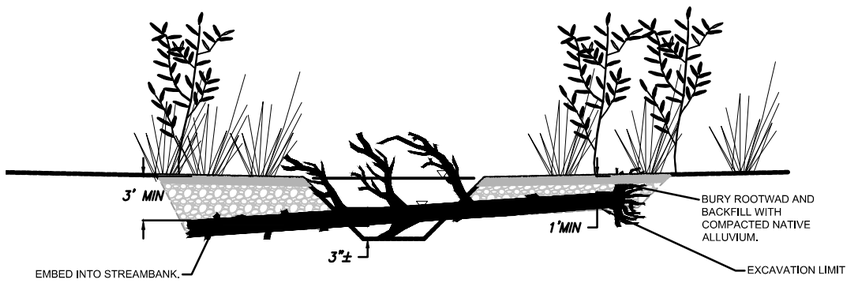
MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WA

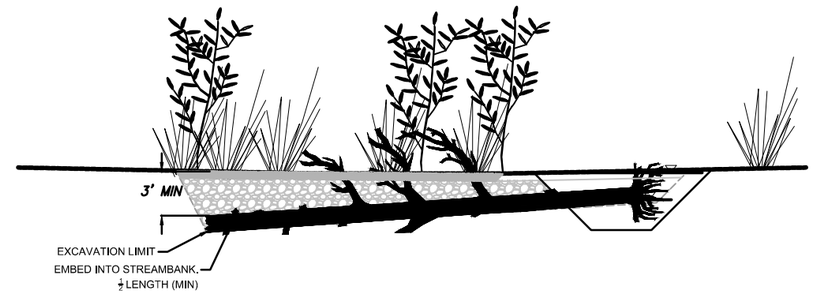
DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
ENTRIX JOB NO.	E515004000
PLAN NO.	6

SHEET 6 of 11

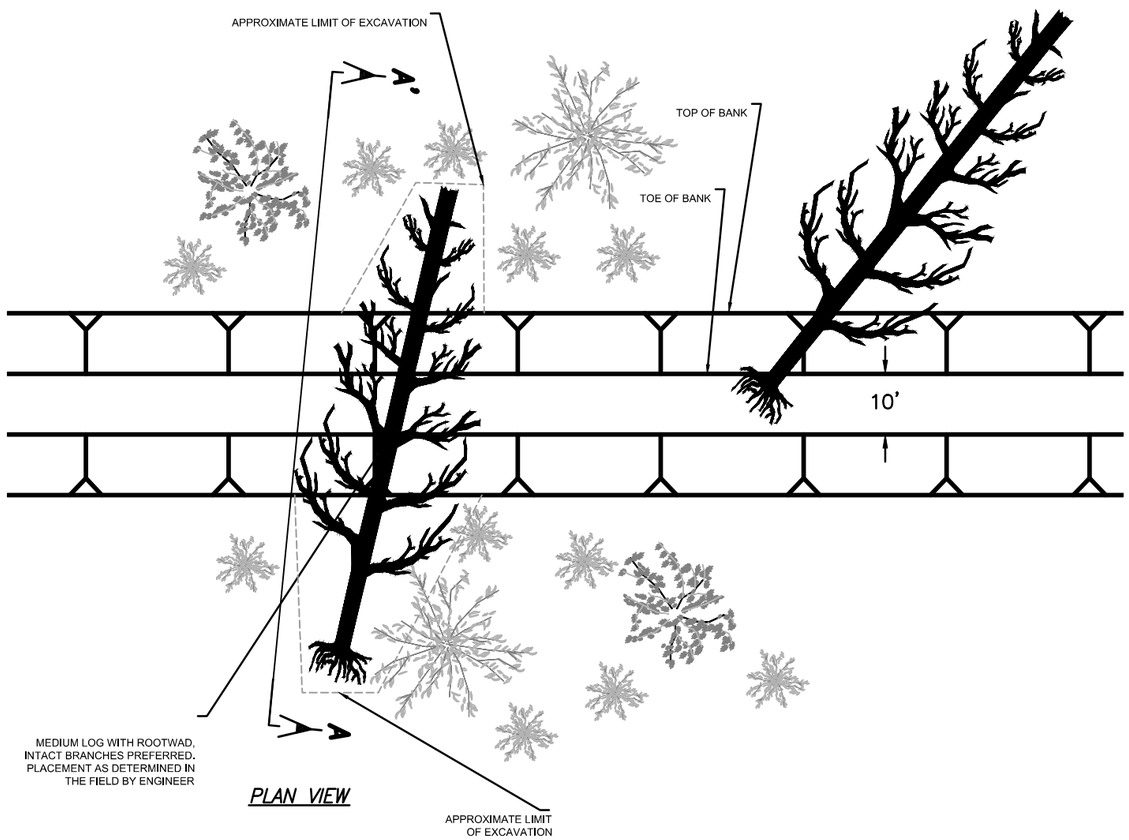
SECTION 6, TOWNSHIP 27, RANGE 06



SECTION A–A' BURIED ON BOTH ENDS (TYPE 1)
NOT TO SCALE



SECTION A–A' BURIED ON ONE END (TYPE 1)
NOT TO SCALE



TYPE 1 – CHANNEL SPANNING JAM (SINGLE LOG)
NOT TO SCALE

TYPE 1 - CHANNEL SPANNING JAM (SINGLE LOG)						
LOG TYPE	SIZE (DBH)	MIN. LENGTH (FT)	ROOTWAD	MIN. ROOTWAD DIAMETER (FT)	BRANCHES	QUANTITY
LARGE KEY	24"+					
KEY	18" - 24"					
MEDIUM	12" - 18"	30'	Optional	3'	Yes	1
SMALL	6" - 12"					
PINNING	6" - 8"					
SLASH	1" - 6"					
LARGE BOULDERS	> 24"					

NOTES:

1. TREES WITH BRANCHES INTACT PREFERRED.
2. STRUCTURE LOCATION WILL BE MARKED IN THE FIELD BY ENGINEER.
3. ALL LOG AND RACKING MATERIAL MUST BE TIGHT GRAIN, SOUND, UNTREATED NATIVE CONIFEROUS WOOD WITH NO ROT AND OF THE SIZE NOTED ON THE PLANS.

SNOHOMISH COUNTY PLANNING DEPT. SERVICES APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104 FAX: (206) 269-0098
TEL: (206) 269-0104
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

USACE REFERENCE NUMBER: NWS-2015-723

APPLICANT NAME: SNOHOMISH CONSERVATION DISTRICT

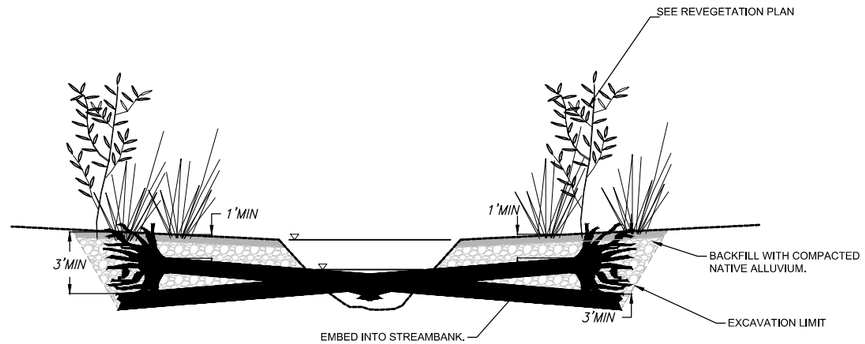
LWD DETAILS - TYPE 1

MOGA BACK-CHANNEL RECONNECTION PROJECT

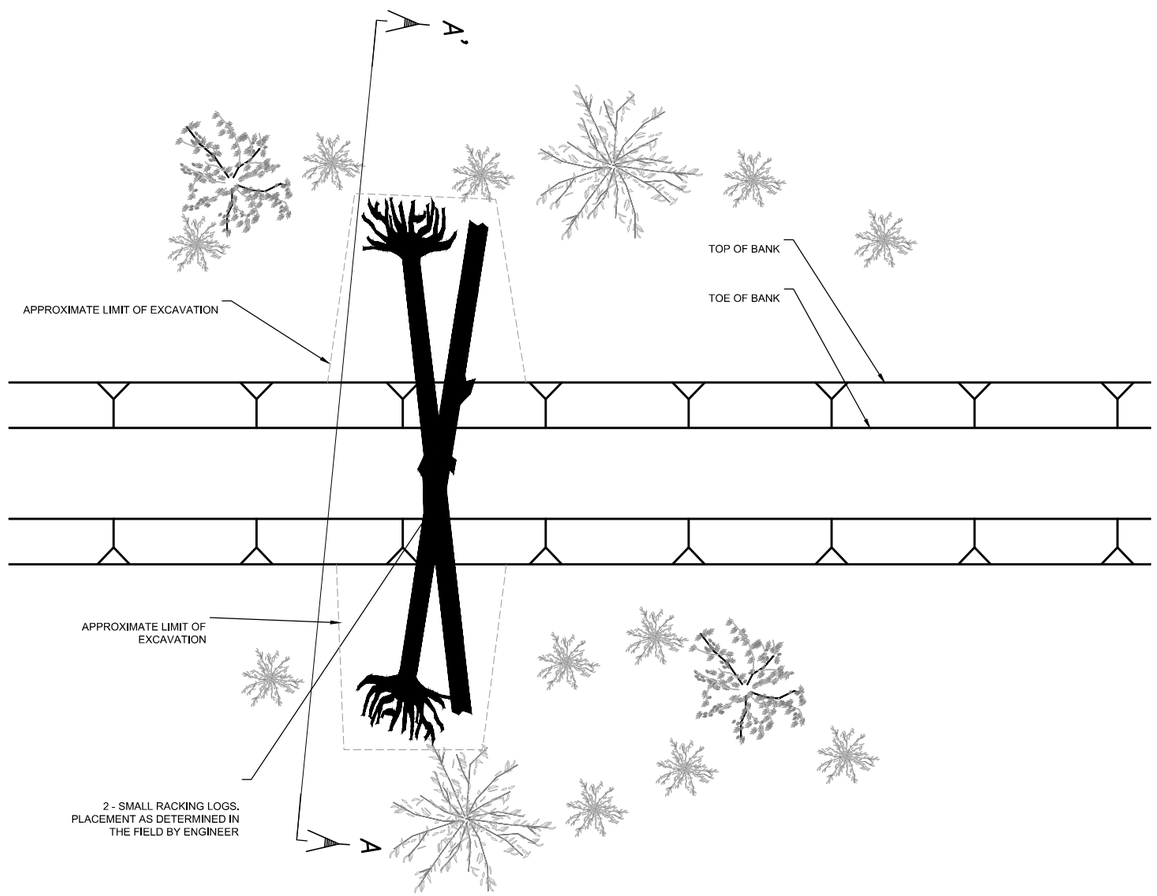
SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	7
SHEET	7 of 11

SECTION 6, TOWNSHIP 27, RANGE 06



SECTION A–A'
NOT TO SCALE



PLAN VIEW

TYPE 2 – CHANNEL SPANNING JAM (SCISSOR JAM)
NOT TO SCALE

TYPE 2 - CHANNEL SPANNING JAM (SCISSOR JAM)						
LOG TYPE	SIZE (DBH)	MIN. LENGTH (FT)	ROOTWAD	MIN. ROOTWAD DIAMETER (FT)	BRANCHES	QUANTITY
LARGE KEY	24"+					
KEY	18" - 24"					
MEDIUM	12" - 18"					
SMALL	6" - 12"	30'	Optional	3'	Yes	2
PINNING	6" - 8"					
SLASH	1" - 6"					
LARGE BOULDERS	> 24"					

NOTES:

1. TREES WITH BRANCHES INTACT PREFERRED.
2. STRUCTURE LOCATION WILL BE MARKED IN THE FIELD BY ENGINEER.
3. ALL LOG AND RACKING MATERIAL MUST BE TIGHT GRAIN, SOUND, UNTREATED NATIVE CONIFEROUS WOOD WITH NO ROT AND OF THE SIZE NOTED ON THE PLANS.

SNOHOMISH COUNTY PLANNING DEPT. SERVICES APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104
TEL: (206) 269-0104 FAX: (206) 269-0098
www.cardnoentrix.com

USACE REFERENCE NUMBER: NWS-2015-723

APPLICANT NAME: SNOHOMISH CONSERVATION DISTRICT

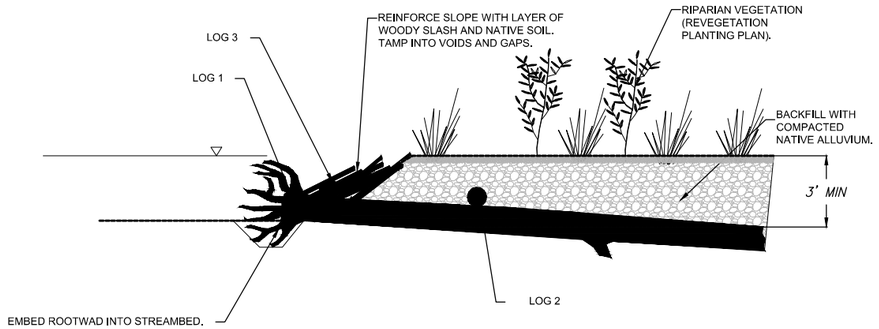
LWD DETAILS - TYPE 2

MOGA BACK-CHANNEL RECONNECTION PROJECT

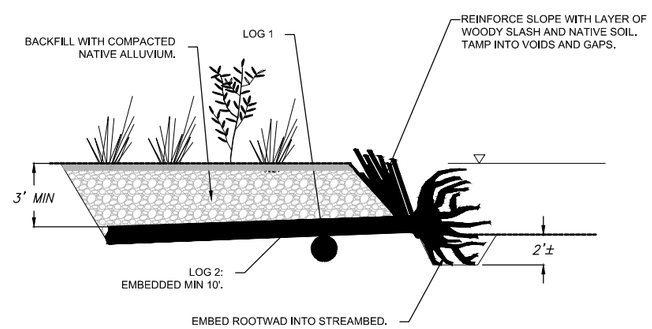
SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	8
SHEET	8 of 11

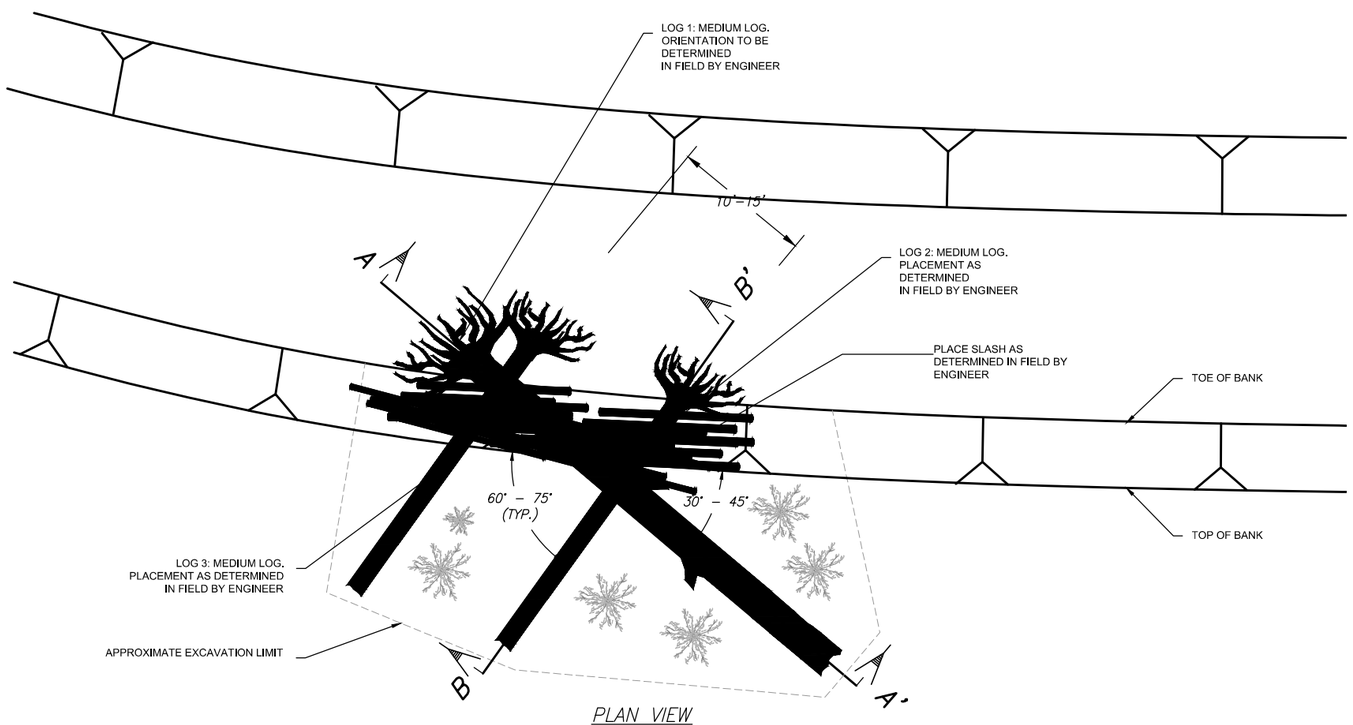
SECTION 6, TOWNSHIP 27, RANGE 06



SECTION A–A' TYPE 3
NOT TO SCALE



SECTION B–B' TYPE 3
NOT TO SCALE



PLAN VIEW

TYPE 3 – ANGLED CHANNEL MARGIN JAM
NOT TO SCALE

TYPE 3 - ANGLED CHANNEL MARGIN JAM						
LOG TYPE	SIZE (DBH)	MIN. LENGTH (FT)	ROOTWAD	MIN. ROOTWAD DIAMETER (FT)	BRANCHES	QUANTITY
LARGE KEY	24"+					
MEDIUM	12"-18"	20'	Yes	3'	Yes	1
MEDIUM	12" - 18"	20'	Yes	3'	No	2
SMALL	6" - 12"					
PINNING	6" - 8"					
SLASH	1" - 6"	5'				10 CY
LARGE BOULDERS	> 24"					

NOTES:

1. TREES WITH BRANCHES OR MULTIPLE TRUNKS PREFERRED.
2. LOG 1 SHALL BE PLACED SO ITS UPSTREAM END RESTS ON STREAM BED WITH ITS ROOTWAD EMBEDDED.
3. LOG 2 AND LOG 3 SHALL BE INSTALLED ON TOP OF LOG 1.
4. SLASH MATERIAL SHALL BE PLACED BETWEEN KEY MEMBERS.
5. STRUCTURE LOCATION WILL BE MARKED IN THE FIELD BY ENGINEER.
6. ALL LOG AND RACKING MATERIAL MUST BE TIGHT GRAIN, SOUND, UNTREATED NATIVE CONIFEROUS WOOD WITH NO ROT AND OF THE SIZE NOTED ON THE PLANS.

SNOHOMISH COUNTY PLANNING DEPT. SERVICES
APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104 FAX: (206) 269-0098
TEL: (206) 269-0104
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

USACE REFERENCE NUMBER:
NWS-2015-723

APPLICANT NAME:
SNOHOMISH CONSERVATION DISTRICT

LWD DETAILS - TYPE 3

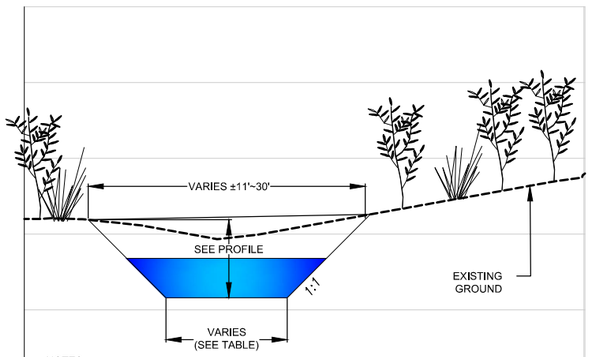
MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	9
SHEET	9 of 11

SECTION 6, TOWNSHIP 27, RANGE 06

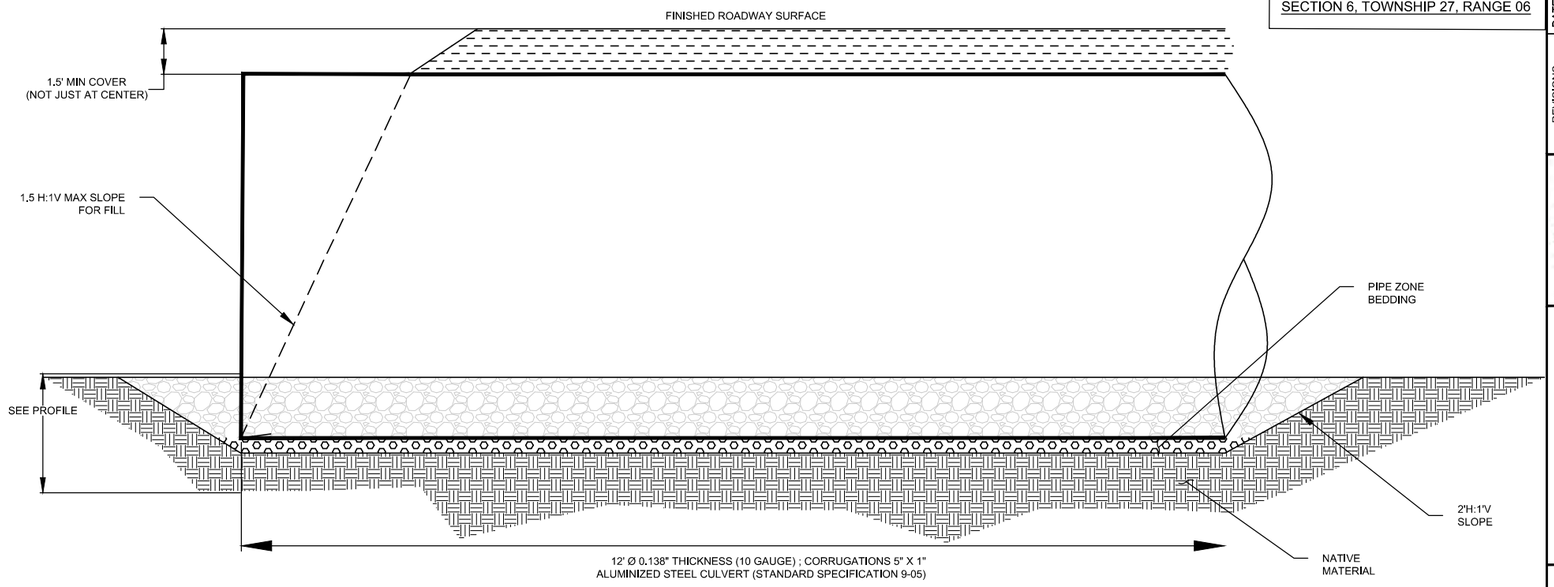
CHANNEL DIMENSIONS		
CHANNEL	BOTTOM WIDTH (FT)	TOP WIDTH (FT)
NE	9'	18'
SE	11'	30'
EAST	10'	16'
WEST	10'	25'
SOUTH	10'	25'



NOTES:
1. CONTRACTOR TO VARY BOTTOM WIDTH AND SIDE SLOPES FOR NATURAL APPEARANCE.

TYPICAL CHANNEL CROSS SECTION

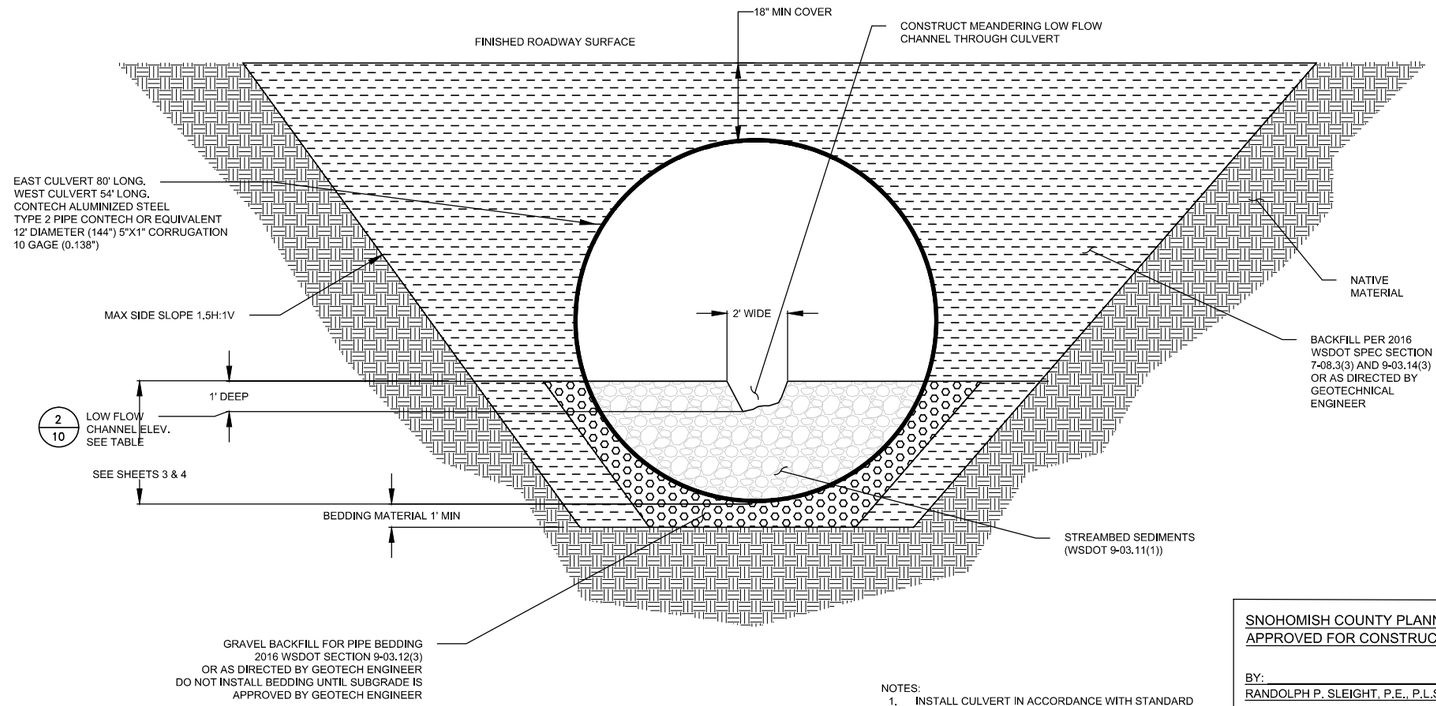
NTS



TYPICAL CULVERT TRENCH PROFILE

NTS

TABLE 2/10		
SPEC	EAST CULVERT	WEST CULVERT
DIAMETER	12' FT	12' FT
TYPE	CONTECH ALUMINIZED STEEL TYPE 2 OR EQUIV	CONTECH ALUMINIZED STEEL TYPE 2 OR EQUIV
CORRUGATION	5" IN X 1" IN	5" IN X 1" IN
GAUGE	10 GAUGE	10 GAUGE
LENGTH	80' FT	54' FT
STREAM BENCH ELEVATION	13.0' FT	12.5' FT
LOW FLOW CHANNEL ELEVATION	12.0' FT	11.5' FT
UPSTREAM INVERT ELEVATION	9.6' FT	7.0' FT
DOWNSTREAM INVERT ELEVATION	9.6' FT	7.0' FT



NOTES:
1. INSTALL CULVERT IN ACCORDANCE WITH STANDARD SPECIFICATIONS 7-02 AND 7-08.

CULVERT CROSS SECTION (TYP)

NTS

SNOHOMISH COUNTY PLANNING DEPT. SERVICES
APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
PRELIMINARY PLANS	10/23/15
90% PLANS	12/30/15

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104
TEL: (206) 269-0104 FAX: (206) 269-0038
www.cardnoentrix.com

SNOHOMISH CONSERVATION DISTRICT

USACE REFERENCE NUMBER:
NWS-2015-723

APPLICANT NAME:
SNOHOMISH CONSERVATION DISTRICT

DETAILS - CULVERT & CHANNEL

MOGA BACK-CHANNEL RECONNECTION PROJECT

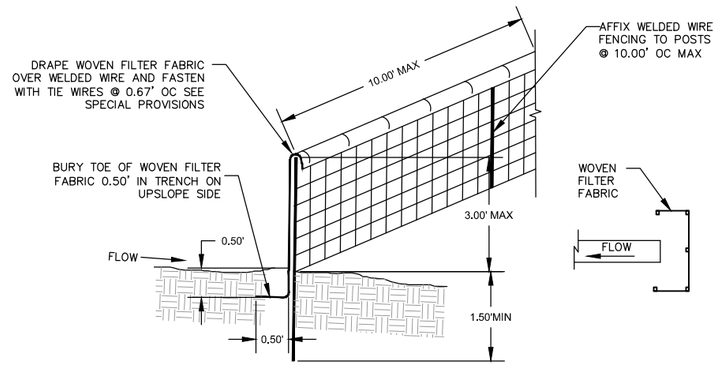
SNOHOMISH COUNTY, WA

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000

PLAN NO.
10

SHEET 10 of 11

SECTION 6, TOWNSHIP 27, RANGE 06

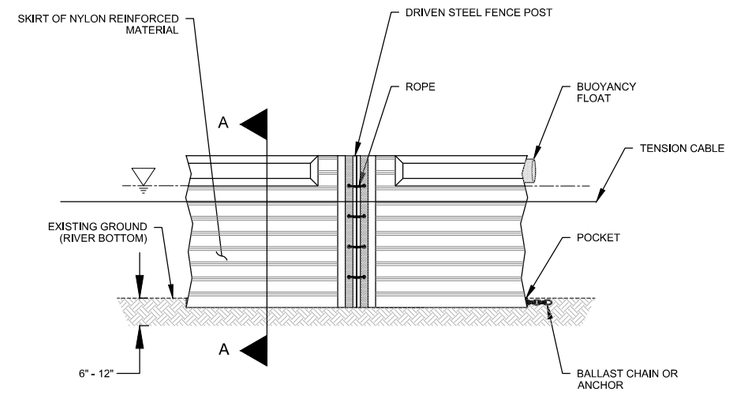


NOTES: 1. CONTRACTOR MAY USE PRE MANUFACTURED SEDIMENT CONTROL FENCE AS APPROVED BY THE ENGINEER. SEE SPECIAL PROVISIONS.

2. PLACE FENCING SUCH THAT STORM RUNOFF CANNOT PASS AROUND OR UNDER FENCE

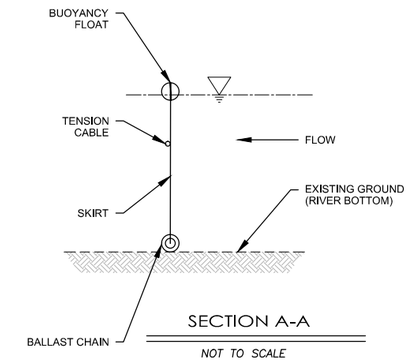
SILT FENCE (TYP.)

NOT TO SCALE — 1/11



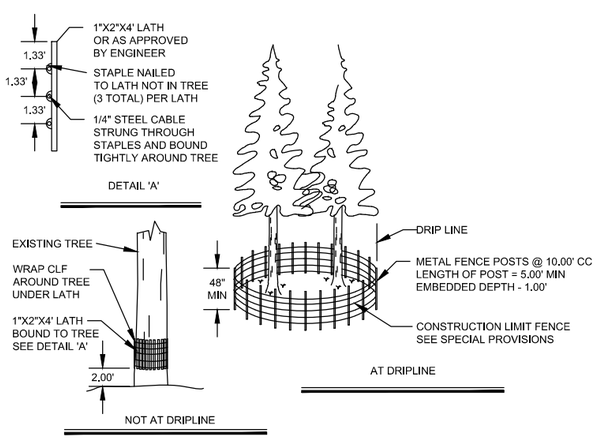
SILT TURBIDITY CURTAIN

NOT TO SCALE — 2/11



SECTION A-A

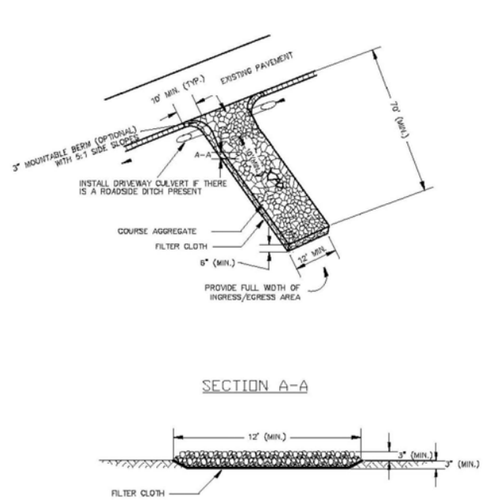
NOT TO SCALE



NOTE:
1. CLF AND TREE PROTECTION FENCE SHALL BE A MINIMUM OF 49" HIGH. FOR TREES WITH DRIPLINES THAT OVERHANG THE CONSTRUCTION AREAS, THE LOCATION OF THE TREE PROTECTION FENCE SHALL BE DETERMINED IN THE FIELD BY THE ENGINEER.
2. THE DETAIL SHOWN IS FOR TREE PROTECTION. MATERIAL AND SPACING SHOWN ALSO APPLIES TO CLF.

CONSTRUCTION LIMIT FENCE (TYP.)

NOT TO SCALE — 3/11



CONSTRUCTION ACCESS

NOT TO SCALE — 4/11

SNOHOMISH COUNTY PLANNING DEPT. SERVICES APPROVED FOR CONSTRUCTION

BY: _____
RANDOLPH P. SLEIGHT, P.E., P.L.S.

PERMIT NO: _____

REVISIONS	DATE
SM	12.28.15

Cardno
SEATTLE
801 SECOND AVENUE, SUITE 700
SEATTLE, WA 98104
TEL: (206) 269-0104 FAX: (206) 269-0038
www.cardnoentrix.com

USACE REFERENCE NUMBER: NWS-2015-723

APPLICANT NAME: SNOHOMISH CONSERVATION DISTRICT

DETAILS - BMPS

MOGA BACK-CHANNEL RECONNECTION PROJECT

SNOHOMISH COUNTY, WASHINGTON

DATE:	DEC 30, 2015
DESIGNED BY:	DE
DRAWN BY:	DE
CHECKED BY:	JB/SM
CARDNO JOB NO.	E515004000
PLAN NO.	11
SHEET	11 of 11

Appendix B

Cost Estimate

Engineer's Cost Estimate

ITEM NO.	Spec	WORK OR MATERIAL	QUANTITY	UNITS	UNIT PRICE	TOTAL COST
1	1-04.4	Force Account for Extra Work	1	EST	$10,000	$10,000
2	1-05	Construction Surveying	1	LS	$4,000	$4,000
3	1-05.4	Plans and Working Drawings	1	LS	$4,000	$4,000
4	1-09.7	Mobilization	1	LS	$25,376	$25,376
5	2-01	Clearing and Grubbing	3	ACRE	$2,500	$7,500
6	2-02	Structure Removal	1	EA	$500	$500
7	2-03.3(14)E	Unsuitable Foundation Removal	50	CY	$20	$1,000
8	2-03 7-08.3(3)	Excavation and Embankment Backfill	1200	CY	$12	$14,800
9	2-03	Excavation and Haul (and spread)	7910	CY	$8	$63,280
10	6-04	Log Construction (LWD Type 1)	55	EA	$1,500	$82,500
11	6-04	Log Construction (LWD Type 2)	8	EA	$1,500	$12,000
12	6-04	Log Construction (LWD Type 3)	3	EA	$1,500	$4,500
13	7-02 7-08.3(3)	East Culvert	80	LF	$500	$40,000
14	7-02 7-08.3(3)	West Culvert	54	LF	$500	$27,000
15	8-01	Erosion / Water Pollution Control	1	LS	$2,500	$2,500

16	8-01.3(1)A	TESC, SWPPP with SPCCP and CESCL	1	LS	$7,000	$7,000
17	8-01.3(1)C	Water Management	1	LS	$7,500	$7,500
18	8-01.3(2)B	Seeding	1.0	ACRE	$2,000	$2,000
19	9-03.11(1)	Streambed Sediment	110	TON	$60	$6,600
20	9-03.14	Gravel Borrow	50	CY	$20	$1,000
21		Misc.	1	LS		
		LS = Lump Sum CY = Cubic Yards LF = Linear Feet EA = Each EST = Estimate			**SUBTOTAL =**	$323,056
					WSST 7.7%	$24,875.31
					TOTAL =	$347931.31
BASE BID Subtotal $ **BASE BID TOTAL**						$347931.31

Appendix C

Site Photographs March 11, 2015

Looking east at agricultural access road.

Looking south (upstream) at pond #2 from agricultural access road. Water surface elevation about 16.5' NAVD88. No culvert observed under the road here.

Looking north (downstream) at existing channel from agricultural access road.

Looking at location of the mouth of the existing small channel. River is flowing up. Water surface of the river is elevation 10.3 at a flow of 3,600 cfs.

Mouth of the existing small channel with river about 2’ below the thalweg. Bank material is loose to dense silt.

Looking south (upstream) at existing channel and channel crossing. Channel is about 1’ wide and 1’ deep here. Crossing is fill and 12” culvert.

Looking north (downstream) at river with man at mouth of existing channel.

Looking upstream (west) at river. Man in mouth of existing channel.

Looking southeast at pond #1 and surrounding area.

Northwestern salamander egg mass along pond #1.

Looking north at northern end of pond #2.

Looking northwest at pond #2.

Looking west at pond #2.

Looking south at small breach in levee along river.