RH2 TECHNICAL

Memorandum

Client: City of Stanwood

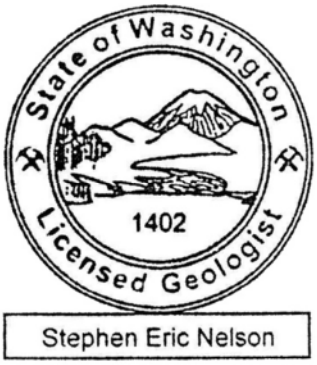
Project: Hatt Slough Springs

Project File: STA 413.016.01.101 **Project Manager:** Bret Beaupain, P.E.

Composed by: Steve Nelson, L.G., L.E.G., L.HG.

Subject: Site Access and Water Main Alternatives Analysis

Date: June 14, 2013



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EXECUTIVE SUMMARY

The Hatt Slough Springs access road is vulnerable to small slides of soil from an adjacent slope. The road is currently impassable. The access road traverses a generally stable platform that is not at significant risk to a large slide, but the slopes above the road will continue to release soil onto the road. Alternatives to mitigate the risk of slides onto the road include constructing drainage systems above and below the slope and constructing a substantial stabilizing wall. A new access road from the east would avoid the slide-prone slope but would require substantial permitting efforts. Constructing a drainage system along the base of the slope and possibly replacing a section of water main and burying it deeper into the access road bench would significantly reduce the risk of slides, although the road may still periodically experience small slides that may temporarily block the road.

INTRODUCTION

The City of Stanwood's (City) Hatt Slough Springs source of supply facility is located south of the City limits and Hatt Slough (**Figure 1**), near the base of a steep slope along the Stillaguamish River (**Figure 2**). The springs are situated on City-owned property in an undeveloped area that is accessed by a dirt road extending east from Marine Drive (**Figure 2**). Four spring collection areas are located within the fenced and secured City-owned property. Each collection area has an infiltration piping gallery that delivers water to an individual 300-gallon settling tank. Water is conveyed by gravity through pipes from each of the settling tanks to the pump building, which houses the mechanical, chlorination, and electrical equipment.

The Hatt Slough Springs source was constructed in 1934 and in 1939 was granted a maximum instantaneous (Qi) water right of 2.5 cubic feet per second (cfs) or 1,125 gallons per minute (gpm) under water right S1-02432CWRIS. However, the current maximum supply rate of the springs is approximately 250 gpm. Water rights evaluation by RH2 Engineering, Inc., (RH2) (2013) concluded that the perfected Qi is 505 gpm and the maximum annual withdrawal is 808 acre-feet per year (afy).

In the past several years, the access road to the Hatt Slough Springs facility has experienced several small slides from unstable slopes above the middle portion of the road; these slides have made the road currently impassable. The City requested RH2 to evaluate alternatives to improve the reliability of access to the springs. This report summarizes the local geologic and geotechnical conditions, evaluates the potential reliability of the access road, and feasibility of options for repairing or re-routing the access road in order to continue the City's operation of the Hatt Slough Springs Source.

This report evaluates two primary alternatives: repairing the existing access road to the spring collection system and stabilizing the slopes along the road; and constructing an alternate access road to the spring collection system that would avoid the slide prone area. Rerouting the water main along the new access road and around the slide area would require design and construction of 11,000 feet of new water main and acquiring several easements through private property (**Figure 2**). Constructing a new pipeline alternative may not be feasible due to access, but this report provides planning-level costs for a rerouted pipeline.

Site Conditions

RH2 reviewed available aerial photos, geologic and soil maps, topographic maps, and parcel boundaries to identify site conditions. On February 1, 2013, RH2 visited the existing access road, spring collection system and several springs, and the alternate access route. RH2 inspected geologic, topographic, and groundwater seepage conditions along the access road and along the potential alternate route.

Topography

The access road and water main extend from the spring collection system to Marine Drive, a distance of 2,300 feet (**Figures 2** and **3**). The road and water main traverse across a bench that is below a high bluff along the Stillaguamish River. The westernmost 1,400 feet of access road and water main extends from Marine Drive, traversing below a moderately steep slope along adjacent farm property, and then traverses 900 feet along a natural topographic bench approximately 30 feet in elevation above the Stillaguamish River and below the steepest portion of the bluff. The final 50 feet of the access road and water main traverse a moderately steep slope to the spring collection and pumping system. Topographic features described in this report include the upper slope above the access road, the bench upon which the road and water main are constructed, and the lower slope extending below the road to the Stillaguamish River shoreline. The spring collection area is constructed on relatively flat terrain below the upper slope. A high resolution LIDAR image of the spring area illustrates these site-specific areas and is shown on **Figure 4**, and a schematic profile of the topography along the current route is shown on **Figure 5**.

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Geology

The lower slope, access road bench, and the upper slope were developed from distinct geologic units identified as pre-glacial sediment which was deposited before the most recent glacial advance (Minard, 1985; Thomas et al, 1997; Franz and Kresch, 2004). After deposition, these layers were subsequently consolidated by the weight of several thousand feet of glacial ice. **Figure 5** identifies the geologic units along the bluff.

The upper slope unit consists of approximately 50 to 100 feet of dense stratified sandy silt with some minor layers of coarser sand and fine gravel. In places along the access road, the lower 30 to 50 feet of upper slope unit is near vertical (see site photos in **Appendix A**). The upper slope is partially covered with vegetation and small layers of loose soil. No evidence of groundwater seepage was discharging from the upper slope unit, but there was evidence of active seepage from the soil layer above the upper slope which flowed down the face of the upper slope.

The bench unit consists of approximately 10 to 20 feet of loose to moderately dense sand with gravel and silt, and was moist to wet at many locations. At the time of inspection, the loose soil along the bench was very wet and groundwater was visibly seeping from the lowest layers of loose soil at the level of the access road and also from the base of the bench unit a few feet below the elevation of the access road. Some loose soil covers portions of the bench unit above the access road and consists primarily of small blocks of upper slope unit material and loose slide debris of upper slope material mixed with some of the sand and gravel of the bench unit. The geologic materials comprising the access road surface consist of slightly compacted but moist sand and gravel. The sand and gravel bench unit appears to be a zone of groundwater discharge and is potentially the same unit that contributes to spring discharge from the Hatt Slough Springs further to the east.

The lower slope unit extending below the access road to the river shoreline consists of approximately 20 to 30 feet of very dense, stratified sandy silt. Portions of the lower slope unit are well exposed, and other portions are covered by slide debris of upper slope unit and bench unit. The lower slope unit is very dense and exhibited no groundwater seepage at the time of inspection in February 2013.

The area near the spring collection box consists of unconsolidated alluvial silt and sand deposited by the Stillaguamish River, and has been modified by erosion and deposition of sediment from river activity. The area is flat-lying and contains numerous ponds created by beaver activity, and small creeks discharging from spring runoff not collected by the collection system. Vegetation includes stands of drowned trees indicating that beaver pond flooding is relatively recent compared to the ages of mature trees.

Summary of Geologic Hazards and Slope Stability Issues

The access road extending east from Marine Drive and the access road near the collection and pumping system is at a low level of risk of sliding. Only the 900-foot-long middle section of the access road has experienced the recent and historic slope failures, primarily where the nearly vertical upper slope extends 30 to 50 feet above the road, and where portions of the moderately steep, lower slope extends down to the river. The slopes above the middle section of the access road exhibit toppling slope failure, loose soil landslides, and soil creep features, including small toppled block failures of the near-vertical slope that

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landed on the access road; small slides of loose soil originating from above the upper slope or from the face of the upper slope; tilted and randomly oriented trees; and exposed roots on trees clinging to the steep slope. The lower slopes below the middle section of the access road also exhibit leaning and toppled trees and small slides of loose soil. Loose material that has slid from the bench unit and upper slope onto the lower slope to the shoreline is apparently eroded by the river during high flows.

Upper Slope Above the Access Road

The upper slope exhibits frequent episodes of small block failure and minor slides which have been observed regularly for at least the past 10 years by City personnel. Slides and slope failure have primarily consisted of minor toppling and fracturing of small blocks of the dense upper slope from the top of the bluff, where the growth and toppling of trees along the bluff edge have weakened the upper portions of the upper slope unit. Less frequent but larger slides of loose soil in the last 2 years have made the access road currently impassable. These slides derive from zones of weakness in the lower portions of the upper slope, which likely have been influenced by groundwater seepage at the base of the upper slope.

Access Road Bench

Slides from the upper slope accumulate on the access road bench and persistent groundwater seepage at the base of the upper slope discharges from the lower portions of the upper slope onto the bench and from the sandy soil below the access road. The access road bench lies upon dense sandy silt of lower slope unit and is comparatively stable to the upper and lower slopes. In some locations, larger slides from the upper slope have extended across the access road bench and have partially eroded the edge of the bench. Persistent groundwater seepage discharging along the access road bench creates wet ground that is at risk from erosion and slides. The persistent seepage onto the bench has prevented the soil along the access road bench to consolidate into a stable surface for vehicle access.

Lower Slope below the Access Road

The lower slope has a low risk of erosion resulting from slides from the upper slope that may cut into and erode the lower slope. Much of the lower slope is covered by slide debris from the upper slope and by dense vegetation. The lower slope has a low to moderate risk of erosion by floodwater scouring by the Stillaguamish River. The river flows directly into and is deflected by a resistant knob of lower slope unit along the shoreline below the access road.

Risks to the Access Road and Water Main

The risk that the entire water main could be lost from the active geologic hazards (e.g., land sliding, river erosion, etc.) at the site is low. The lower slope unit is geologically stable and resistant to deep slides and river flooding. However, unchecked, the upper slope will continue to release small slides and periodically cover the access road. The base of the upper slope above the water main is a zone of potentially weak soil which likely contributes to slides onto the road. The access road will periodically be subjected to small to larger landslides, which will continue to make the access road periodically and temporarily inaccessible. The access road bench is a natural geologic feature along the bluff and has been stable since the Hatt Slough springs have been in use as a water supply for the past 80 years. The risk that a large failure of the upper slope that would cut through the bench unit and into the lower slope is low and the bench likely will remain stable for the foreseeable future.

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ALTERNATIVES ANALYSIS

Alternative 1 – Repair Existing Road

The upper slope will continue to shed soil and vegetation onto the access road; slide events will include small block failures and loose soil slides from the upper portions of the slope. To mitigate these slides, the upper slope could be stabilized by constructing a 40-foot-high soil nail wall along 900 feet of the access road to stabilize the active slide area. The wall would strengthen the upper slope by installing soil nails 40 feet deep into the upper slope unit and tying the nails to vertical piles driven or bored into the top of the lower slope unit along the access road. Permanent facing across the nail wall would tie the piles together. **Figure 6** illustrates a schematic of the soil nail wall.

In addition to retaining the upper slope, groundwater and surface water seepage at the top and base of the upper slopes would decrease soil moisture and reduce slide risk. A subsurface drain constructed along the base of the upper slope along the access road would effectively capture and reroute groundwater seepage from the base of the upper slope that would otherwise seep onto or below the access road.

Natural drainage on the upland area above the bluff is focused towards the upper slope above the access road. **Figure 4** illustrates the topography of the area above the upper slope. Constructing a surface water and shallow drainage system to collect seepage at the top of the upper slope and routing the water to a point further east where it can discharge near the spring collection system would reduce seepage cascading over the upper slope and onto the access road. This option would require negotiating site access and easements with the private landowners on the bluff.

<u>Option to Replace a Portion of the Water Main</u>

The water main was originally installed in a trench a few feet below the access road within the sandy soil of the bench unit. An additional measure to reduce the risk of slides disrupting the water main includes replacing the 900-foot section of the water main along the slide-prone area and burying it deeper into the access road into the top of the lower slope unit. The reconstructed water main would be deeper than probable slide surfaces and not disrupted by deeper seated slides.

This option could be considered preliminary to, or in place of, the soil nail wall. The cost and construction challenges of replacing the section of water main would be much lower than constructing the soil nail wall, although the access road would still be vulnerable to slides.

Because the access road traverses easements across private property, any significant construction may require re-negotiating the easements with the property owners. However, the current easements may allow for maintenance and repair of the water main.

<u>Option to Only Install Drainage</u>

Installing a shallow subsurface drain at the base of the upper slope along the access road would capture and convey groundwater seepage discharging onto the access road. This option would reduce the pore pressure in soil at the base of the slope and reduce slide potential. This option would be the least expensive mitigation, would occur within the

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existing water main and access road easement, and would likely provide an effective mitigation to excessive soil moisture at the base of the upper slope.

Summary

Installing a soil nail wall would mitigate much of the risk of small persistent slides onto the access road. However, the cost for a wall appears high relative to the risk and permitting, and easement negotiations may be too great for the amount of risk reduction that would be required. Adding a drainage system and reconstructing and deepening the portion of the water main along the slide prone section would reduce significantly reduce the risk and effects of small slides and reduce vulnerability of the water main and access road. These lower cost options could be implemented quickly and allow continued operation of Hatt Slough Springs. The access road would still be vulnerable to slides which could occasionally block or impede access along the road.

Alternate 2 – Construct New Access Road

Constructing a new access road would improve the reliability of access to the spring collection and pumping system by avoiding the current slide-prone route. The nearest access point to the spring collection and pumping system from the east is by way of an existing residential road that dead ends approximately 900 feet from the spring collection area (**Figures 2** and **3**). A new access road from the residential road would traverse a lowland area that is approximately 10 feet in elevation above the normal river level. The terrain of this lowland area consists of soft-ground wetlands that are periodically flooded by beaver activities, and small perennial creeks fed by spring discharge. This area is occasionally flooded in late winter and spring by the Stillaguamish River. The road would be constructed by removing vegetation down to a subgrade, placing large quarry spalls onto the native subgrade separated by geotextile layer, and overlaying the base layer with compacted layers of crushed gravel which would allow water seepage through the constructed road embankment. The new access road would include large culverts to allow flood and pond water to flow below road. The new access road would be considered a rough road that may experience minor settlement and would require some regular maintenance to add new gravel, clear brush and vegetation, and manage the effects of beaver activities. Much of the road would traverse City property, but construction and use of the road would require coordination and permission from the private landowner. Construction in wetland area will require extensive permitting and probably some significant mitigation to offset loss wetlands. A summary of permitting issues is included in **Appendix B**. **Figure 7** illustrates a schematic profile of the new access road.

Option for New Water Main Route

If the entire existing access road and water main were discontinued or lost due to a catastrophic slide or river flooding event, it may be possible to reroute the water main along the new access road and then traverse up and over the ridge south of the springs area through private properties for approximately 11,000 feet to Marine Drive. Construction of a new 6-inch water main would include costs for design and materials, for mitigating effects of traversing steep slopes, and negotiating private property easement and access. This alternative would be warranted only if the slide risk for the water main increased significantly or if the water main and access road was lost.

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Summary of Challenges, Costs, and Benefits

Table 1 summarizes the challenges, benefits, and planning-level costs for the two alternatives and options for the access road. The summary of costs for each estimate is attached in **Appendix C**.

Table 1. Summary of Challenges, Benefits, and Planning-level Costs

Alternative	Challenges and Benefits	Planning-level Cost
Improve Access Road Drainage		
Drainage on Access Road 900 feet	Typical challenges of construction. Greatly reduces seepage discharging from base of upper slope onto access road.	$160,000
		Total: $160,000
Repair Existing Access Road		
Soil Nail Wall 900 feet	Easements and property owners may not allow construction. Greatly reduces slope failure risk.	$4,680,000
Drainage Above Slope 900 feet	Easements and property owners may not allow construction. Greatly reduces seepage flowing down upper slope onto access road.	$160,000
Drainage on Access Road 900 feet	Typical challenges of construction. Greatly reduces seepage discharging from base of upper slope onto access road.	$160,000
Reconstruct Water Main 900 feet	Typical challenges of construction. Greatly reduces vulnerability of slide damage, but does not reduce potential for slope failures that may cover the access road.	$200,000
		Total: $5,200,000
Construct New Access Road		
Construct New Access Road 900 feet	Easements and property owners may not allow construction. Extensive permitting and wetland mitigation actions. Greatly improves year-round access.	$340,000
		Total: $340,000
Reroute Water Main		
Reconstruct Main 11,000 feet	Easements and property owners may not allow construction. Greatly reduces vulnerability from slides.	$2,500,000
		Total: $2,500,000

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REFERENCES

Franz, L.M., and Kresch, D.L., 2004, *Water Resources of the Tulalip Indian Reservation and Adjacent Area, Snohomish County, Washington, 2001-03*, United States Geological Survey, Scientific Investigations Report 2004-5166.

Minard, J.P., 1985, *Geologic Map of the Stanwood Quadrangle, Snohomish County, Washington*, United States Geological Survey Miscellaneous Field Studies Map MF-1741.

RH2 Engineering, Inc., 2013, *Hatt Slough Springs Alternatives Analysis Technical Memorandum*, prepared for City of Stanwood.

Thomas, B.E., Wilkinson, J.M., and Embrey, S.S., 1997, *The Ground-Water System and Ground-Water Quality in Western Snohomish County, Washington*, United States Geological Survey, Water-Resources Investigations Report 96-4312.

FIGURES

Figure 1 – Area Map
Figure 2 – Site Map
Figure 3 – Hatt Slough Springs Area
Figure 4 – Site Topography
Figure 5 – Profile along Existing Access Road
Figure 6 – Schematic Design of Soil Nail Wall
Figure 7 – Schematic Design of New Access Road Profile

APPENDICES

Appendix A – Site Photos
Appendix B – Permitting Summary
Appendix C – Planning-level Costs

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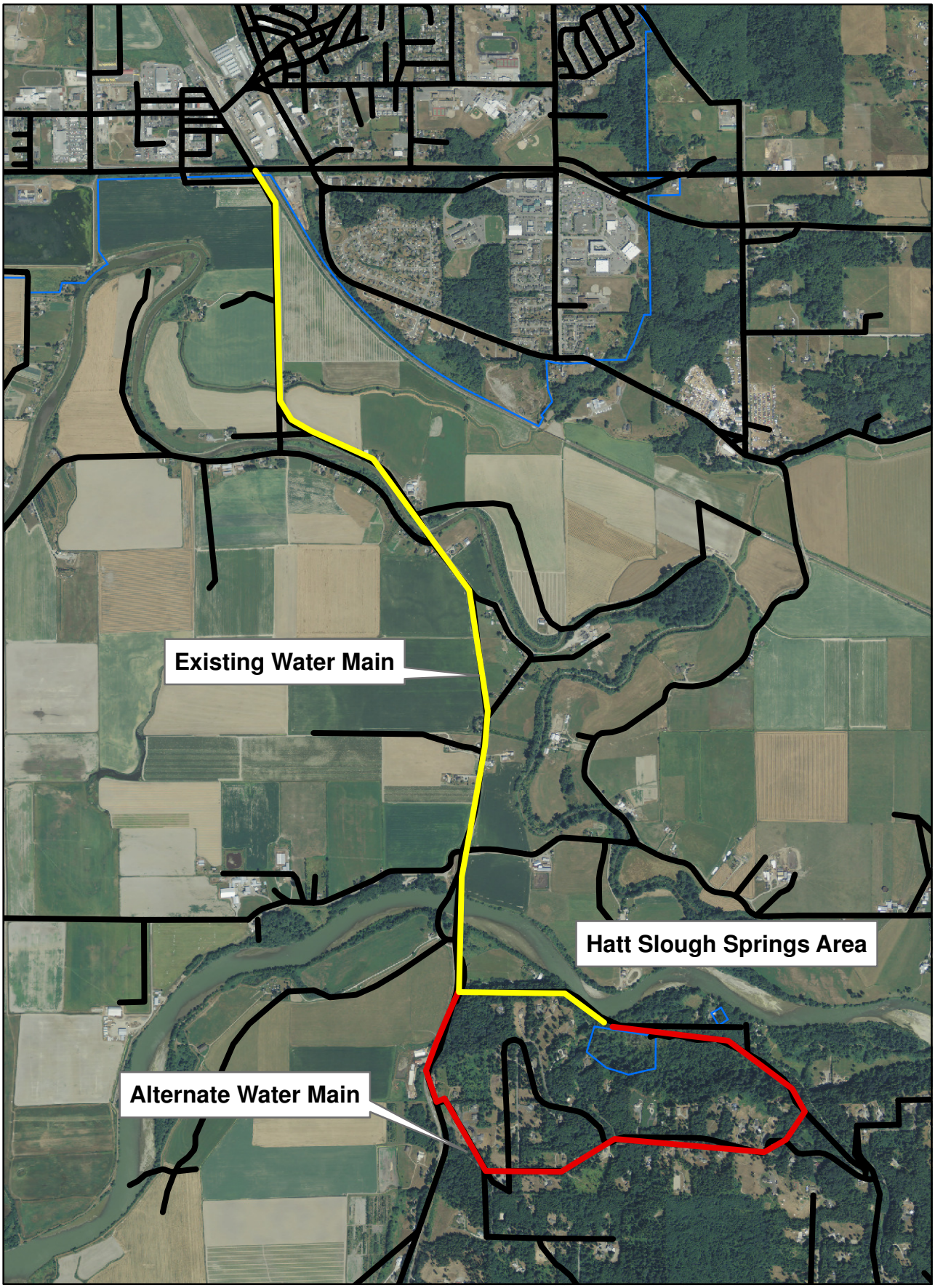
FIGURES

FIGURE 1
HATT SLOUGH SPRINGS AREA MAP
CIYT OF STANWOOD



0 0.25 0.5 1 Miles

RH2 ENGINEERING, INC.

FIGURE 2
HATT SLOUGH SPRINGS SITE MAP
CIYT OF STANWOOD

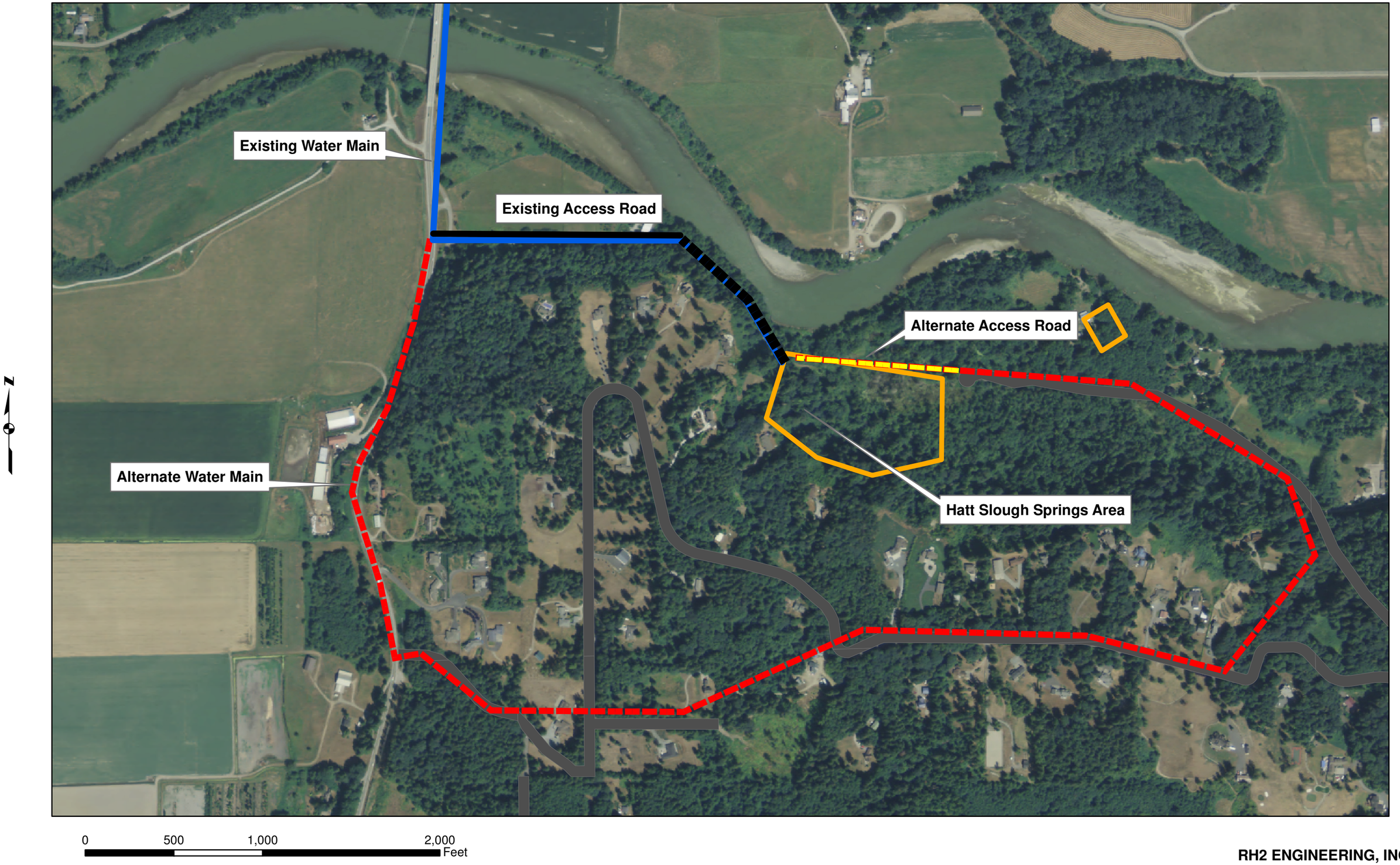


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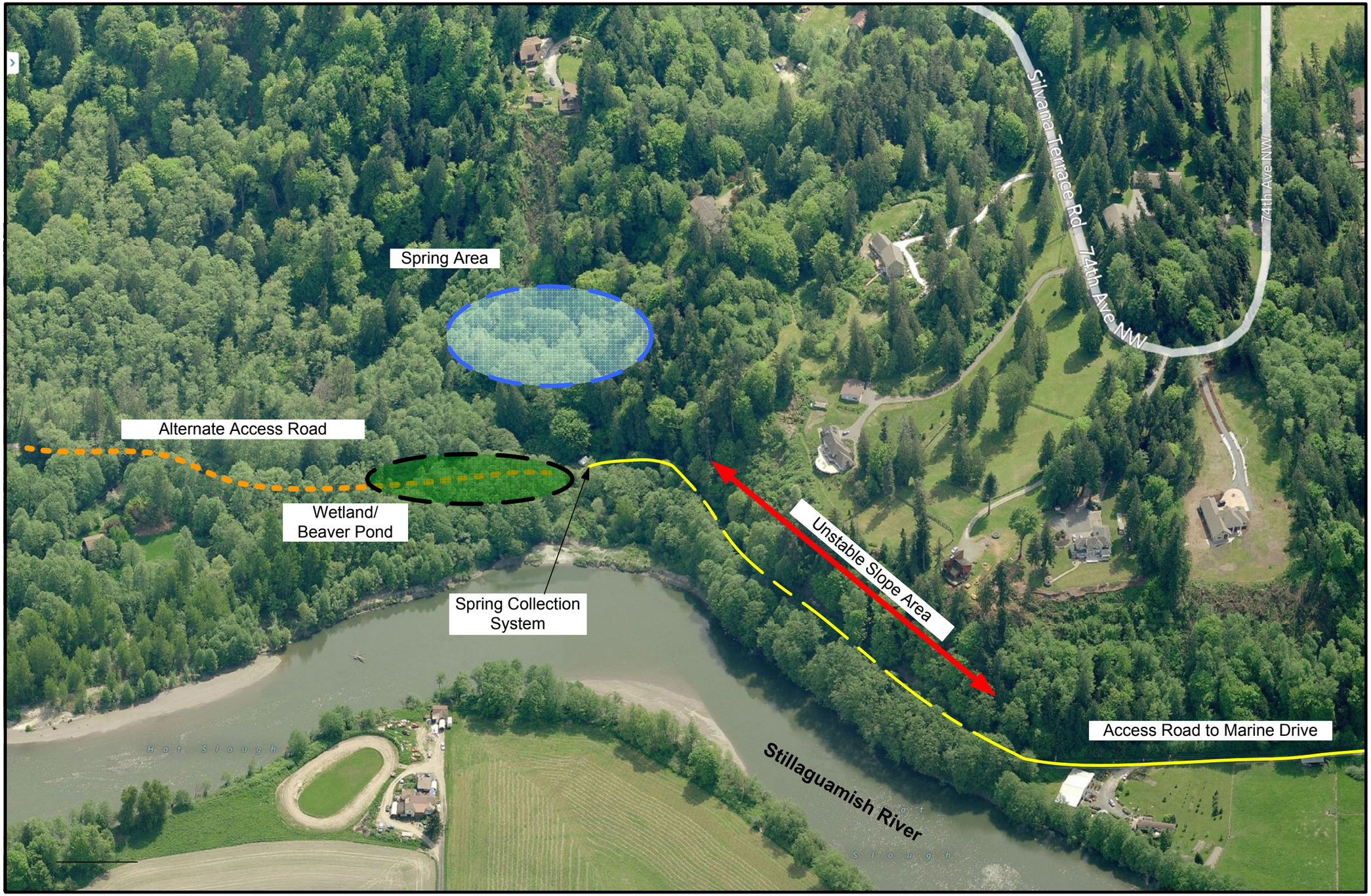
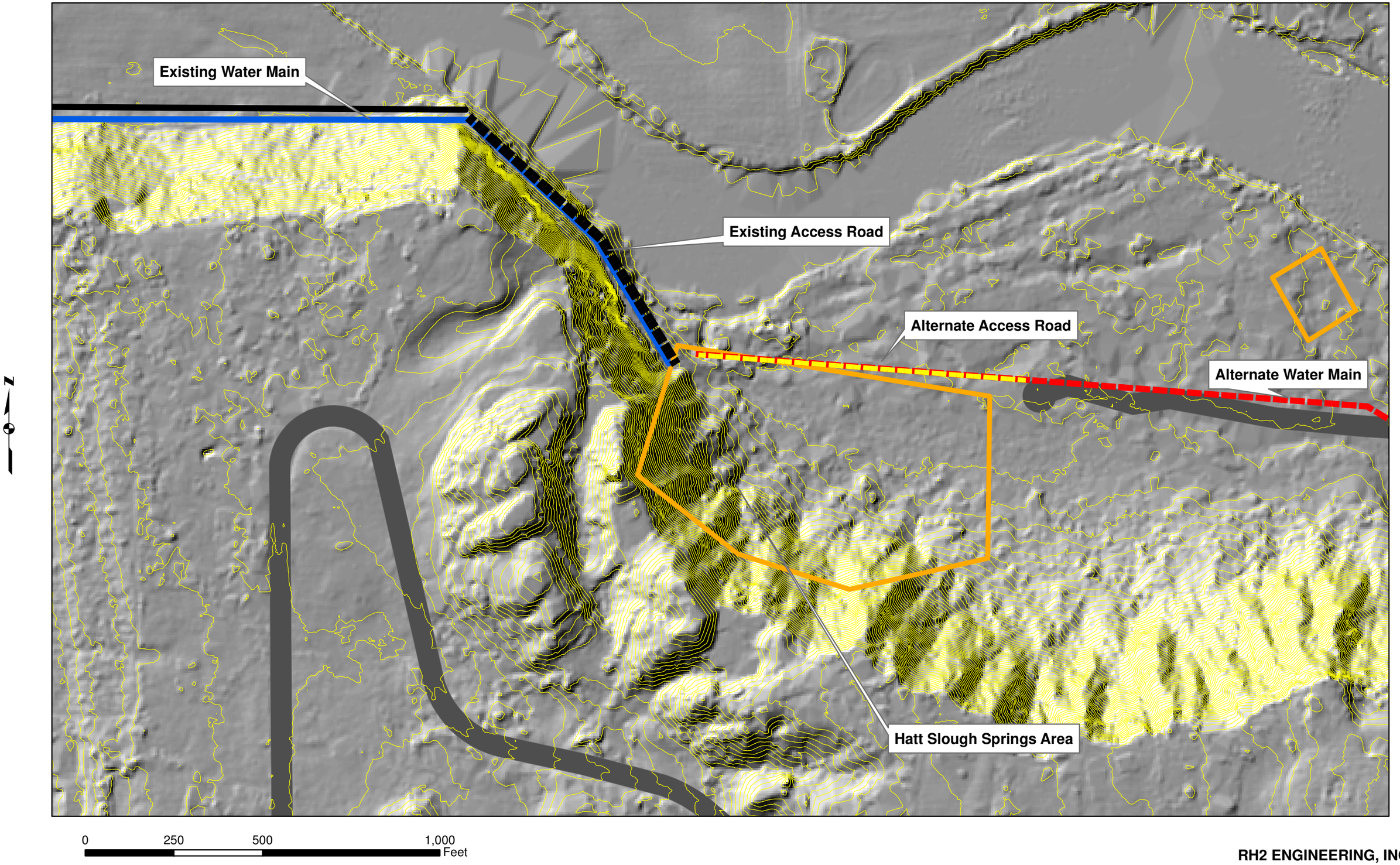
FIGURE 3
HATT SLOUGH SPRINGS AREA (looking South)



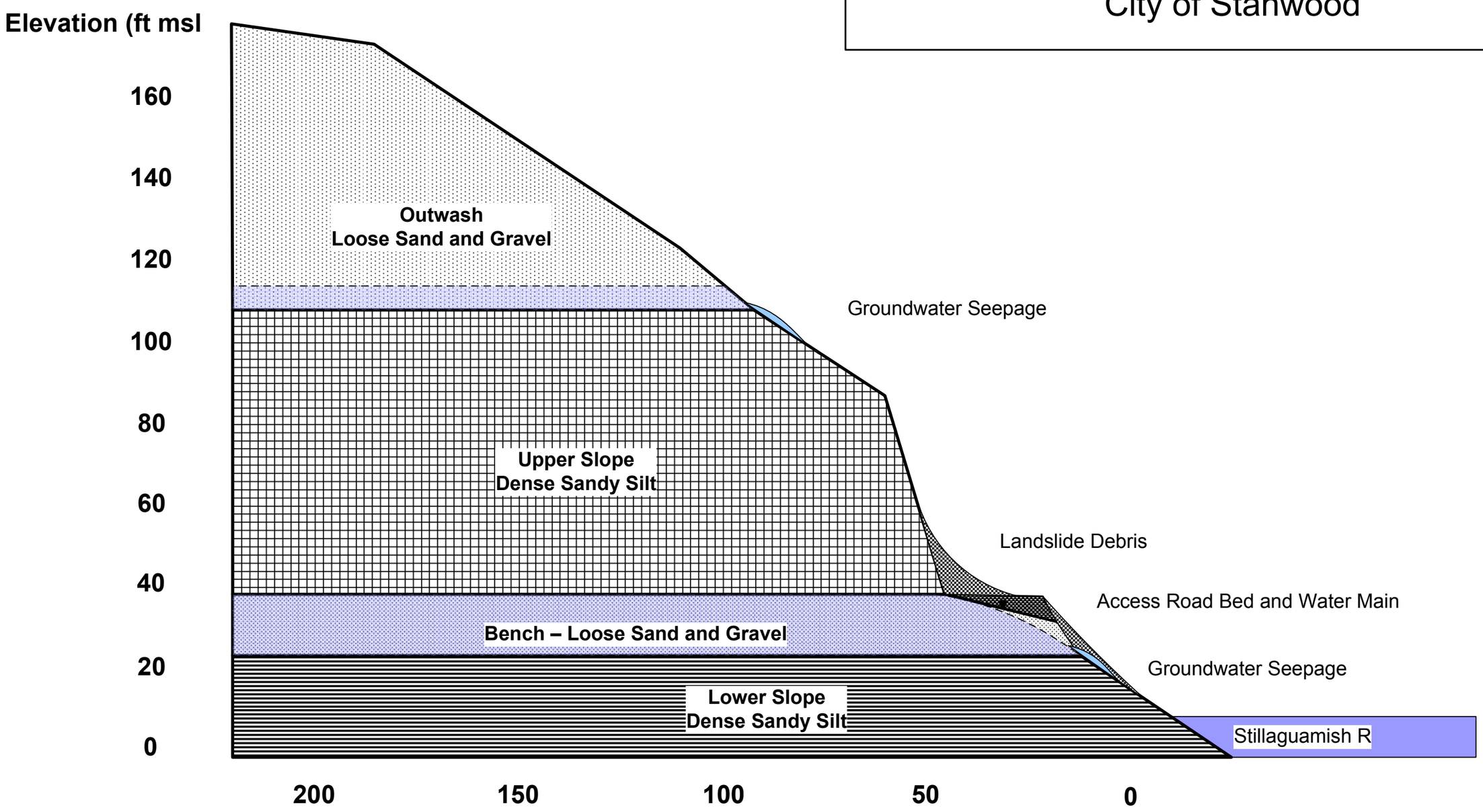
RH2 ENGINEERING, INC.

FIGURE 4
HATT SLOUGH SPRINGS SITE TOPOGRAPHY
CIYT OF STANWOOD



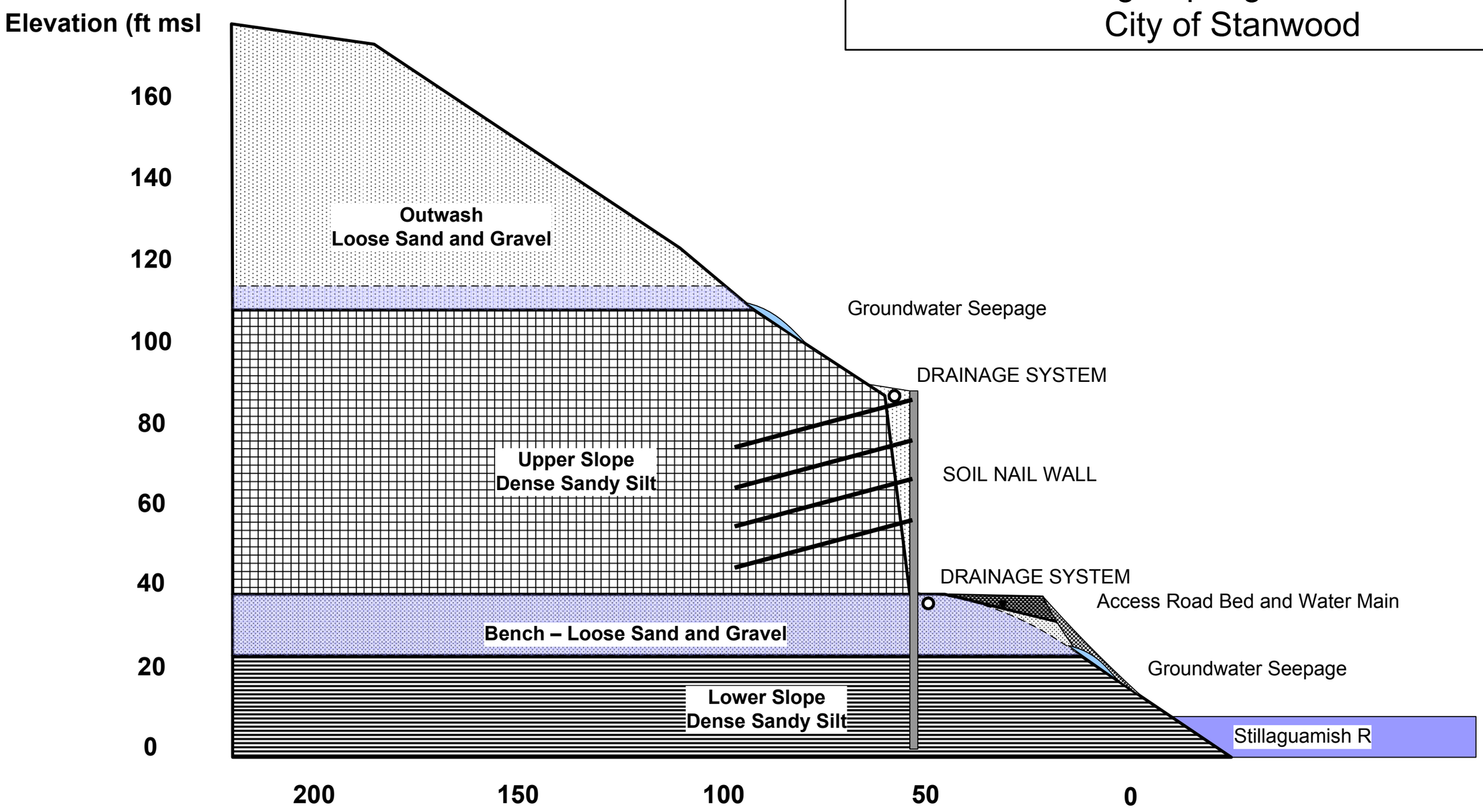
RH2 ENGINEERING, INC.

Figure 5
Profile of Hatt Slough Springs Access Road
City of Stanwood



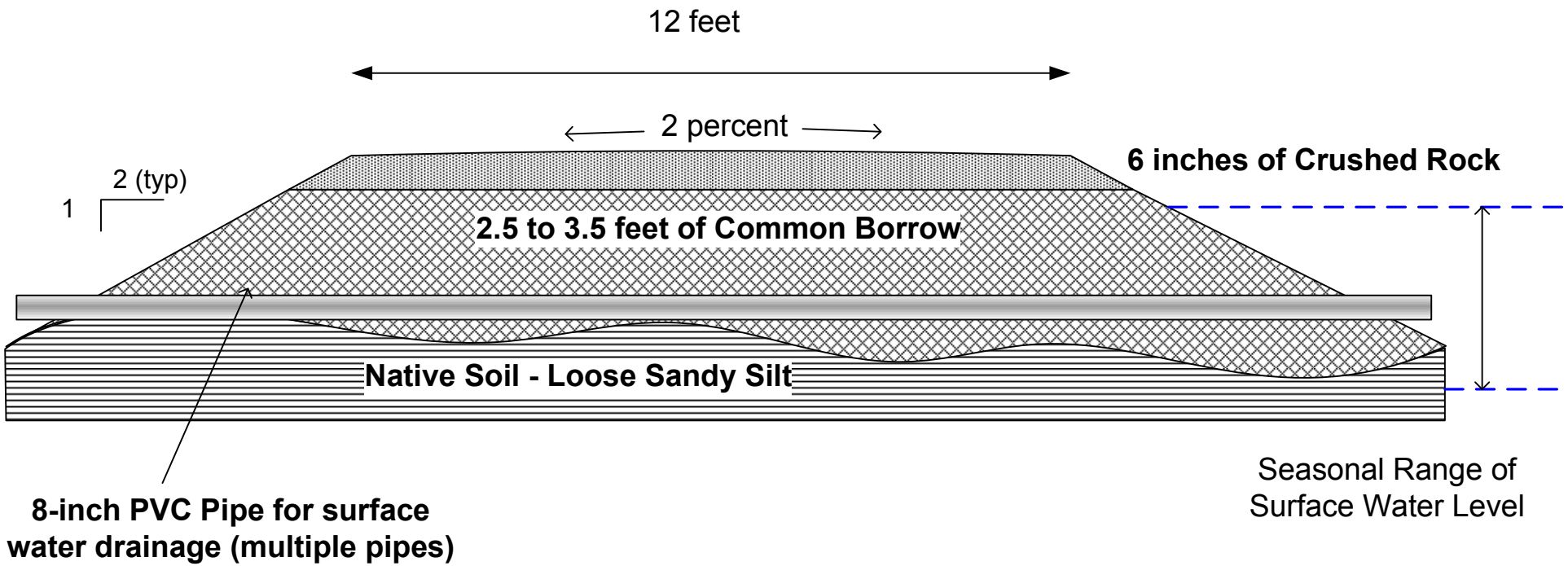
RH2 Engineering, Inc.

Figure 6
Proposed Soil Nail Wall and Drainage Systems
Hatt Slough Springs Access Road
City of Stanwood



RH2 Engineering, Inc.

Figure 7
Proposed New Access Road
Hatt Slough Springs
City of Stanwood



RH2 Engineering, Inc.

APPENDICES

Appendix A – Site Photos

STA Hatt Slough Access Road Photographs – February 2013

West End of Access Road

Middle Section of Access Road

Middle Section of Access Road

East End of Access Road

Appendix B – Permitting Summary

Hatt Slough Springs Permitting Summary

The City's Hatt Slough Springs facility is located adjacent to the Stillaguamish River, along a section of the river referred to as Hatt Slough. Hatt Slough is considered a Shoreline of Statewide Significance. In the project locale, the Slough has been designated a Rural Conservancy Shoreline by Snohomish County. The project locale is also known to contain cultural resources. The existing access road for this facility [from the west, off of 233rd Street NW] is located upslope of the ordinary high water line (OHWL) of the Stillaguamish River in an area of unstable slopes. The alternate access road for this facility would be constructed to the east, connecting to 60th Drive NW, and would need to be constructed across an existing forested, high-quality wetland and fish-bearing stream. The proposed location of the alternate access road is also located in an area of erodible slopes, and within the 100-year floodplain and channel migration zone (CMZ). Anticipated project permits and approval timing is included below.

	Existing Access Road	**Alternate Access Road**	**Timeframe for Approval**
LOCAL ***Snohomish County and/or City of Stanwood***	Pre-Development Conference (PDC)	PDC	15 days
	State Environmental Policy Act (SEPA)	SEPA	120 days (additional for appeal, as needed)
	Shoreline Substantial Development Permit (SSDP)	SSDP	180 days
		Floodplain Development and Habitat Management Plan [to comply with the NMFS BiOP for work in a FEMA Floodplain]	180 days
	Critical Areas Ordinance (CAO) compliance (for work in erosion hazard areas and stream buffers)	CAO compliance (for work in erosion hazard areas, wetlands, streams, CMZs, and stream and wetland buffers)	180 days
	Cultural Resources Survey (CRS) and Inadvertent Discovery Plan (IDP) – Coordination with the County, Tribes, and the Washington State Department of Archaeology and Historic Preservation (DAHP)	CRS and IDP – County, Tribes, and DAHP coordination. Since this alternative will involve federal approvals, the Corps will also be involved.	180 days
	Site Development Permit (SDP) - City	SDP	30 days
	Land Disturbing Activity (LDA) Permit - Grading, Clearing, and Drainage Review (project may apply for exemption or lesser compliance level – TBD by the County at PDC	LDA Permit - Grading, Clearing, and Full Drainage Review	120 days
	Documentation of Easements in lieu of	Right-of-Way Use Permit	15 days

	ROW Use Permit		
STATE ***Washington State Departments of Fish and Wildlife and Ecology***		Hydraulic Project Approval	45 days
		Section 401 Water Quality Certification	Varies, Tied to Section 404 Permit
		Coastal Zone Management Consistency	Varies, Tied to Section 404 Permit
		NPDES Construction Stormwater General Permit (includes SWPPP)	45 days
FEDERAL ***U.S. Army Corps of Engineers (Corps)***		Section 404 Individual or Nationwide Permit, Including: • Compensatory Wetland Mitigation • Endangered Species Act documentation • National Historic Preservation Act documentation • National Environmental Policy Act (NEPA) compliance	6 to 24 months for Individual; 3 to 12 months for Nationwide

Note: For the existing road, it is assumed that reconstruction of the roadway will involve drainage improvements; however, no new outfall, change in surface drainage flow, or additional impact to Hatt Slough will occur. Consequently, this alternative will not require a Hydraulic Project Approval.

From a permitting perspective, reconstruction of the existing access road will require far less effort and is a more viable solution for the continued access of this facility. Permitting for reconstruction of the existing access road is anticipated to involve primarily City and County permits, and has the potential to apply for permit exemptions depending on the extent of improvements selected by the City.

Permitting of the alternative access road for this facility will require a significant level of effort. Not only will this option require several permits, it will require multi-agency permitting (local, State, and federal) and coordinated permit reviews and approvals. The permit timeframes and cost estimates shown for this item are highly variable and may change depending on the extent of improvements selected by the City, and the general permit procedures of the regulatory agencies that would be involved. Since the alternate access road is located in the 100-year floodplain and the CMZ, this option would require compliance with Snohomish County's floodplain and critical areas development permitting, as well as specific-documentation to address the NMFS Biological Opinion (BiOP) for projects in FEMA Floodplains. For the Corps permit, construction through the forested wetland will likely require demonstration that no other feasible alternative exists, development of compensatory mitigation to account for the loss of wetland habitat, and additional documentation to ensure the project's compliance with NEPA. Based on discussions with Snohomish County Planning staff, the alternate access road permitting would be lengthy and involve numerous critical areas impacts.

It is also important to note with both of these options that there are known cultural resources nearby. Consequently, construction of the existing access road is anticipated to require coordination with the County, DAHP and the Tribes for cultural resources. The alternate access road will require coordination with the County, DAHP, the Tribes, and the Corps since the alternate access road will trigger federal permit approvals.

Planning level costs for permit compliance and associated construction impacts are included below.

	Existing Access Road	**Alternate Access Road**
Permitting Costs	$35,000	$75,000
Construction Costs	$5,000 (costs for TESC and restoration)	$55,000 (costs for mitigation and TESC)
Total	$40,000	$130,000

Note: Costs are planning level estimates of the effort involved in obtaining permits and associated construction costs for each alternative. These estimates are subject to change as project development and design is refined. Construction costs for the Alternate Access Road assume a 3:1 ratio for mitigation area, which is based on the category of the subject wetland and is an estimate only. Mitigation ratio costs could be greater.

Appendix C – Planning-level Costs

Hatt Slough Access Road - Planning Level Cost Estimates
City of Stanwood

Soil Nail Wall	*Element*	*Cost Per Unit*	*Unit*	*Total Units*	*Total Cost*
	Drilling	$5	lf	29,388	$146,939
	Verification Nails	$1,000	Ea	4	$4,000
	Nail and Grout	$600	Ea	735	$440,816
	Prefab Drainage Mat	15	SY	571	$8,571
	Temporary Facing	$18	SF	36,000	$648,000
	Lift Equipment	$12	SF	36,000	$432,000
	Permanent Facing	$30	SF	36,000	$1,080,000
	Subtotal				$2,761,000
	Tax	8.30%			$230,000
	Subtotal				$2,991,000
	Engineering and Administration	25%			$748,000
	Subtotal				$3,739,000
	Contingency	25%			$935,000
	Total				$4,680,000

	Element	*Cost Per Unit*	*Unit*	*Total Units*	*Total Cost*
Uphill and Road Drainage	*4 inch CPE perf pipe*	*$8*	*lf*	2160	*$17,280*
	6 inch HDPE downpipe	*$35*	*lf*	1640	*$57,400*
	Drain Rock	$25	*CY*	320	*$8,000*
	Pipe Anchorage	*$100*	*Ea*	82	*$8,200*
	Subtotal				$91,000
	Tax	8.30%			$8,000
	Subtotal				$99,000
	Engineering and Administration	25%			$25,000
	Subtotal				$124,000
	Contingency	25%			$31,000
	Total				$160,000

Grand Total	**$4,840,000**

New 6-inch Mair	*Element*	*Cost Per Unit*	*Unit*	*Total Units*	*Total Cost*
	6-inch DI Water Main	$120	LF	900	$108,000
	Tie ins	$2,000	EA	2	$4,000
	Subtotal				$112,000
	Tax	8.30%			$10,000
	Subtotal				$122,000
	Engineering and Administration	25%			$31,000
	Subtotal				$153,000
	Contingency	25%			$39,000
	Total				$200,000

40	ft	wall height
40	ft	Nail Length
Length Along River		
900	ft	

Hatt Slough Access Road Planning Level Cost Estimates
City of Stanwood

New Access Road	*Element*	*Cost Per Unit*	*Unit*	*Total Units*	*Total Cost*	
	Clear and Grub	$3	SY	2,400	$8,000	
	Common Borrow	$18	Ton	3,898	$71,000	
	Crushed Rock	$20	Ton	450	$10,000	
	6-inch Piping	$18	LF	468	$9,000	
	Mitigation Planting	$35,000	Acre	1.07	$38,000	Assumes 2x road area
	Subtotal				$136,000	
	Tax	8.30%			$12,000	
	Subtotal				$148,000	
	Permitting	50%			$74,000	
	Engineering and Administration	30%			$45,000	
	Subtotal				$267,000	
	Contingency	25%			$67,000	
	Total				$340,000	

New 6-inch Main	*Element*	*Cost Per Unit*	*Unit*	*Total Units*	*Total Cost*
	6-inch DI Water Main	$120	LF	11,000	$1,320,000
	Steep Slope additional cost	10%	%		$132,000
	Tie ins	$2,000	EA	2	$4,000
	Subtotal				$1,456,000
	Tax	8.30%			$121,000
	Subtotal				$1,577,000
	Engineering and Administration	25%			$395,000
	Subtotal				$1,972,000
	Contingency	25%			$493,000
	Total				$2,470,000

900 ft Road Length