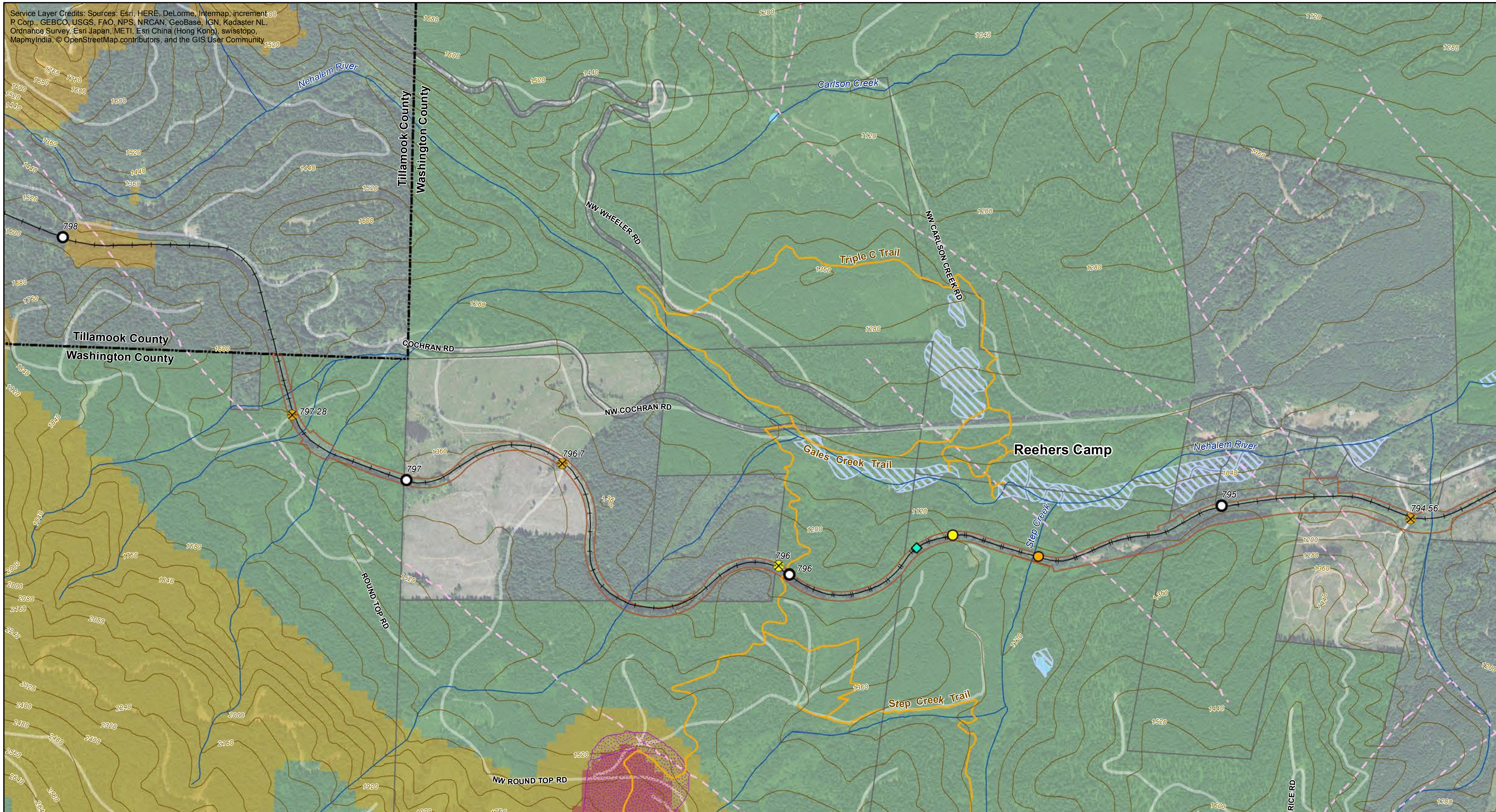
Appendix A

Valley Segment Base Conditions Maps



Parametrix

Source: USFDW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

0 500 1,000 2,000 Feet

1 inch = 1,000 feet (plotted at 11x17)

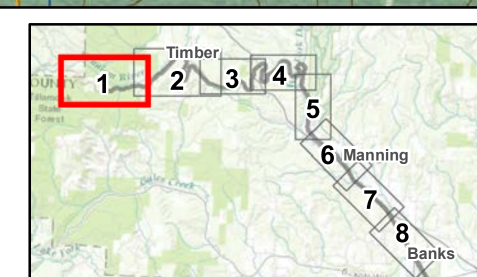
- Mileposts
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- County Line
- Contour
- Stream/River
- Wetland
- Waterbody
- Park/Open Space
- Historic Landslide
- Observed Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High

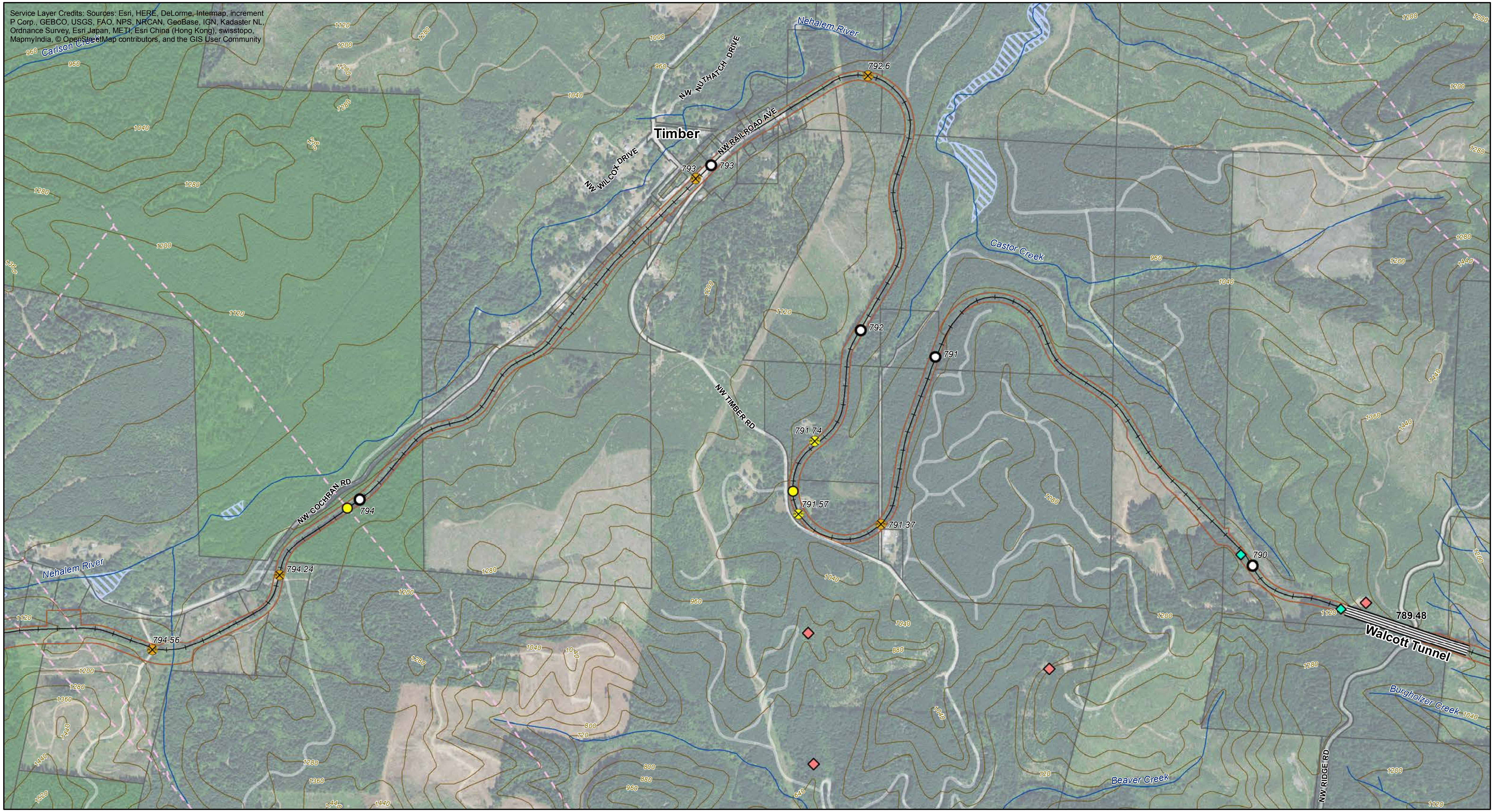
Concept Plan

- Mild Damage Point
- Moderate Damage Point



Salmonberry Trail Valley Segment Study
BASE CONDITIONS

Figure 1: Cochran Road Crossing of Rail Corridor (MP 797.28) to MP 794.56



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

0 500 1,000 2,000 Feet

1 inch = 1,000 feet (plotted at 11x17)

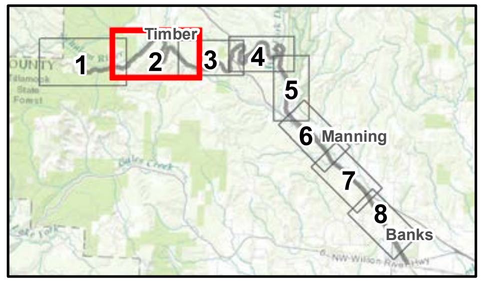
- Mileposts
- Tunnel
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Rail Right-of-Way
- Tax Lot
- Contour
- Stream/River
- Wetland
- Park/Open Space
- Historic Landslide
- Observed Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High

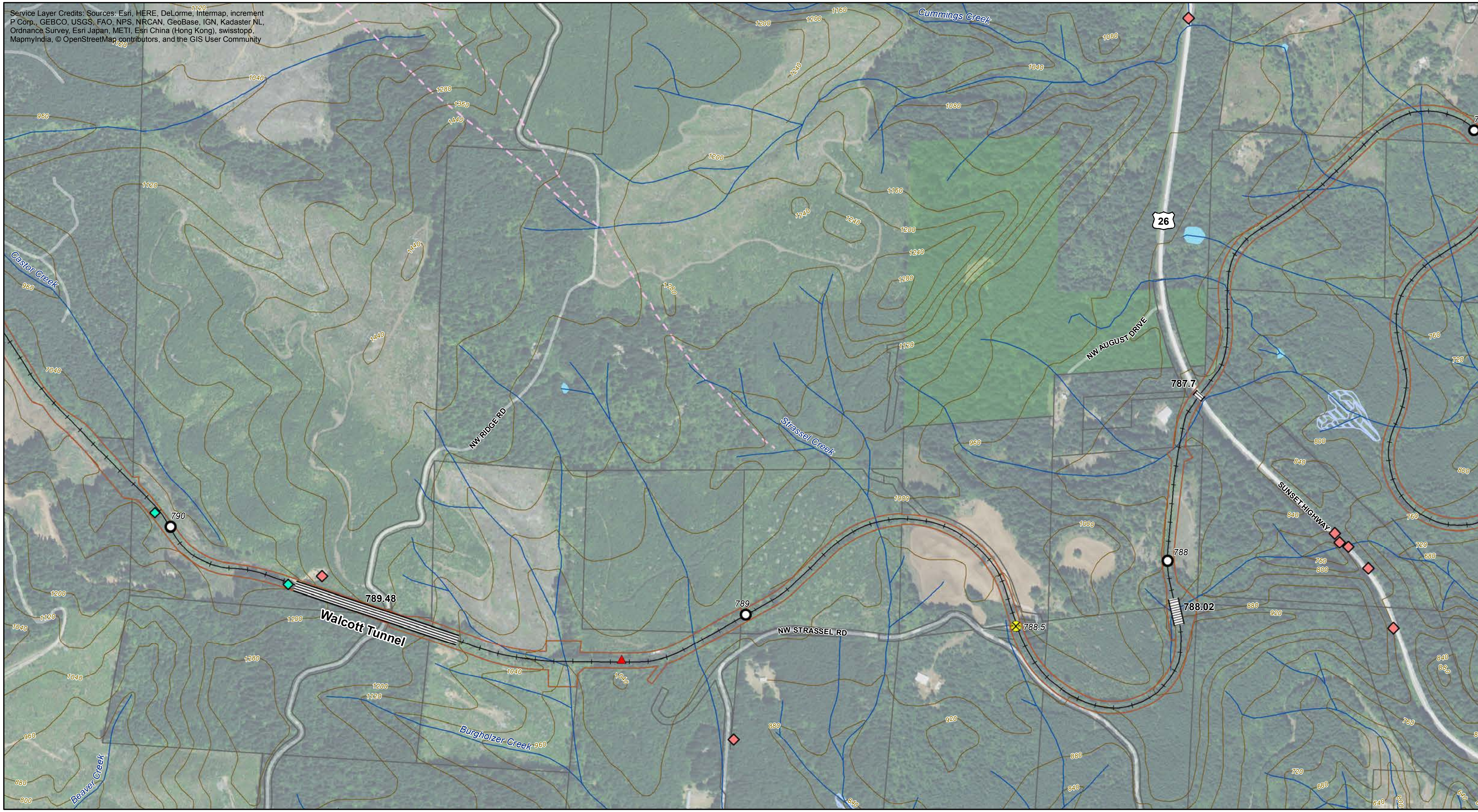
Concept Plan

- Mild Damage Point



Salmonberry Trail Valley Segment Study BASE CONDITIONS

Figure 2: MP 794.56 to west of Walcott Tunnel (MP 790), including the community of Timber



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

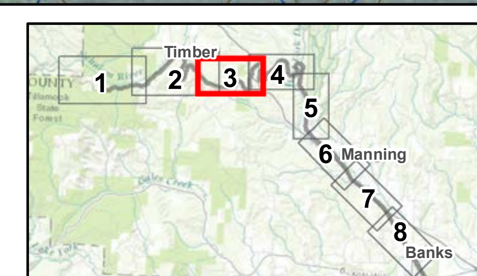
Mileposts
Trestle/Bridge
Tunnel
Rail Crossing (Driveway/Field)
Rail
Rail Right-of-Way

Tax Lot
Contour
Stream/River
Wetland
Waterbody
Park/Open Space

Historic Landslide
Observed Washout
Observed Landslide
Landslide Deposit
Scarp/Flank
Fold
Fault

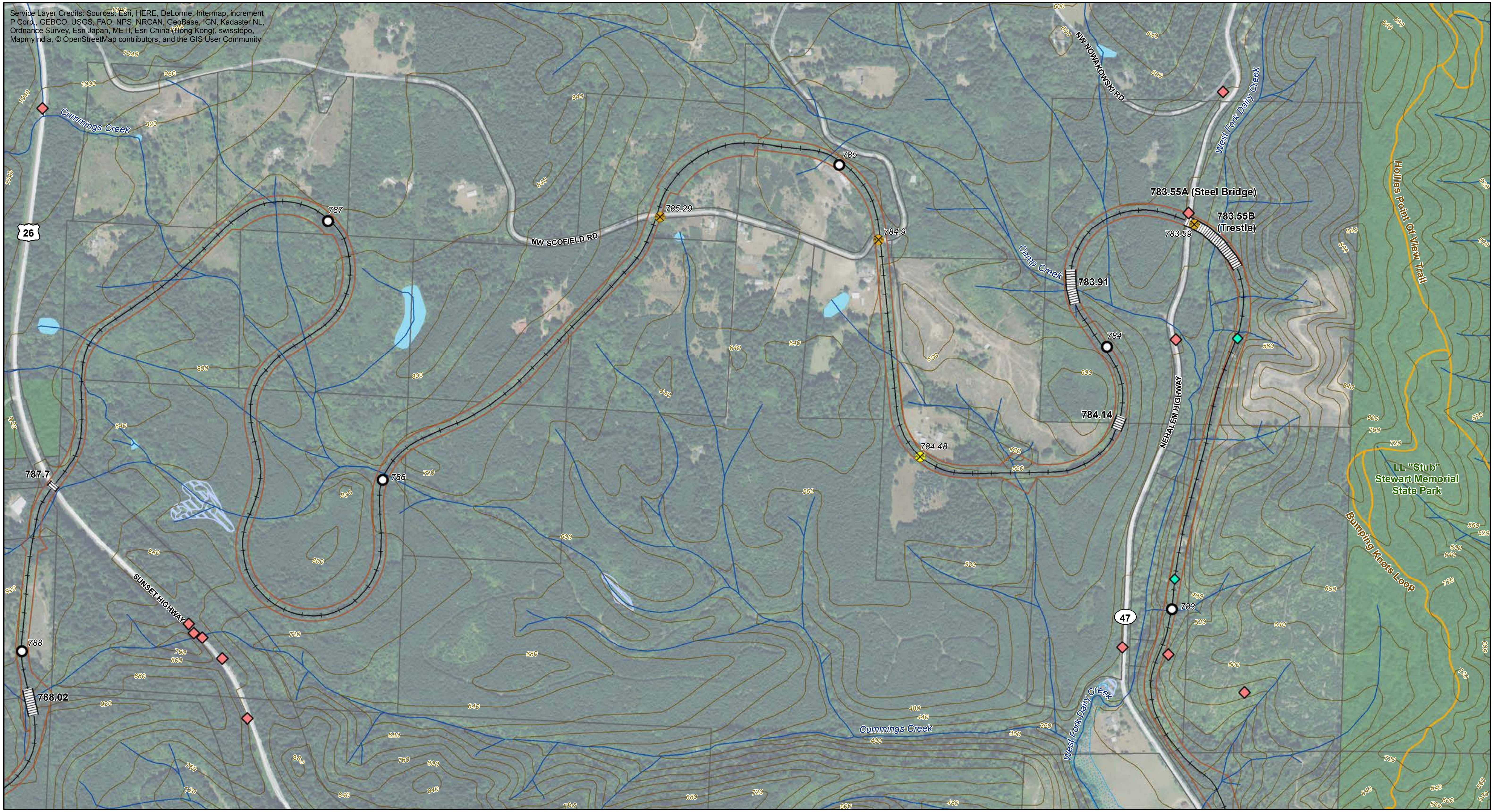
Landslide Susceptibility

Very Low - Med (Not Displayed)
High
Very High



Salmonberry Trail Valley Segment Study
BASE CONDITIONS

Figure 3: Walcott Tunnel to US 26 (MP 787.7), including the Tunnel and existing rail bridge crossing of US 26



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

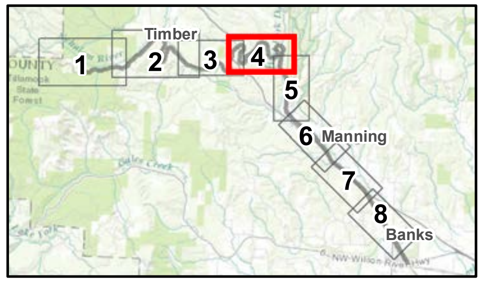
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Contour
- Stream/River
- Wetland
- Waterbody
- 100-Year Floodplain
- Park/Open Space
- Historic Landslide
- Observed Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

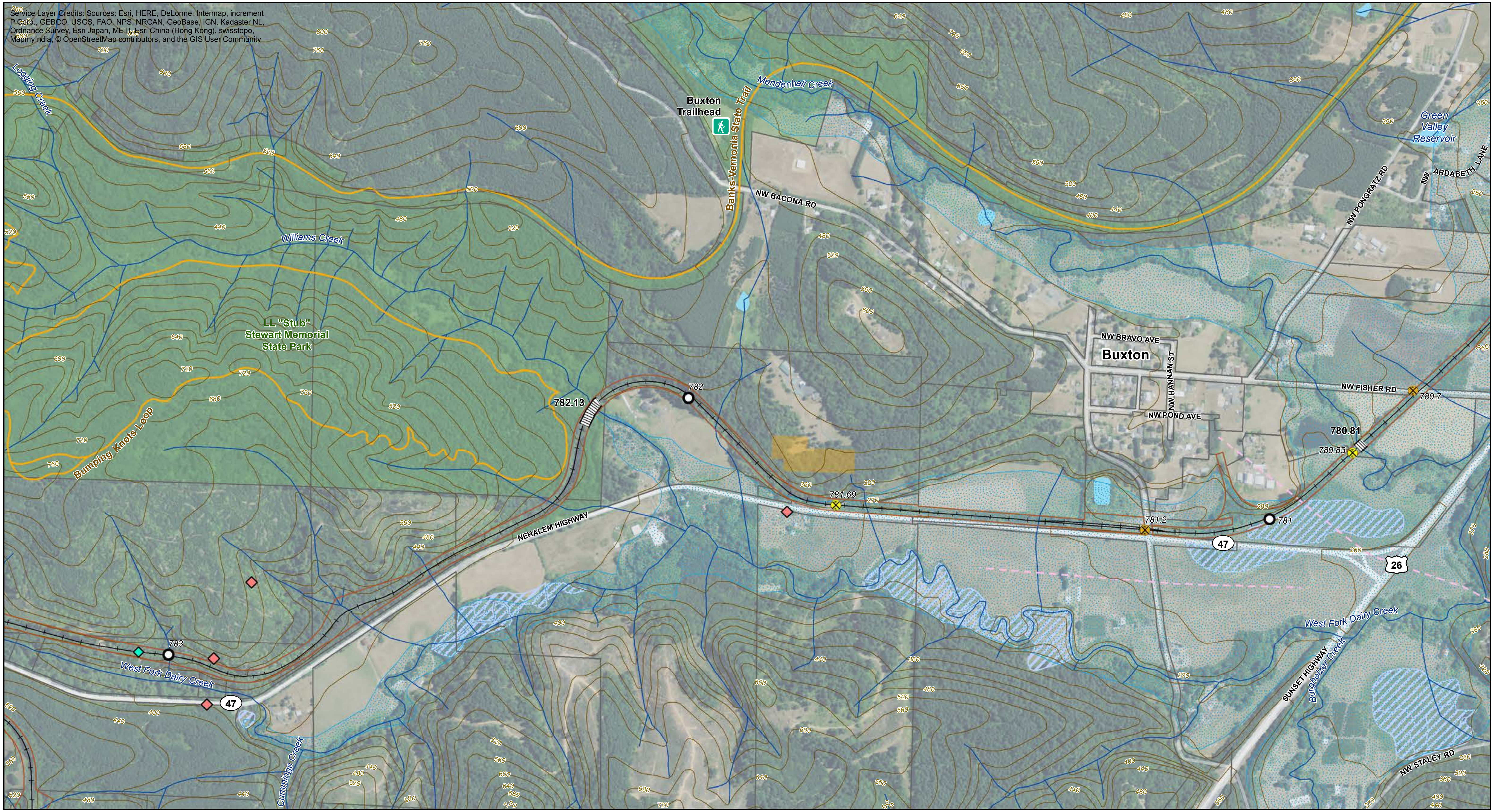
Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High



Salmonberry Trail Valley Segment Study
BASE CONDITIONS

Figure 4: US 26 to West Fork Dairy Creek (MP 783), including the existing rail bridge/trestle crossing of OR 47



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

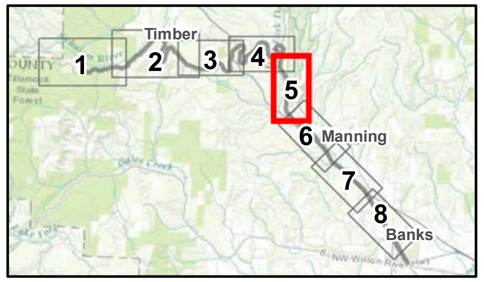
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Contour
- Stream/River
- Wetland
- Waterbody
- 100-Year Floodplain
- Park/Open Space
- Historic Landslide
- Observed Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

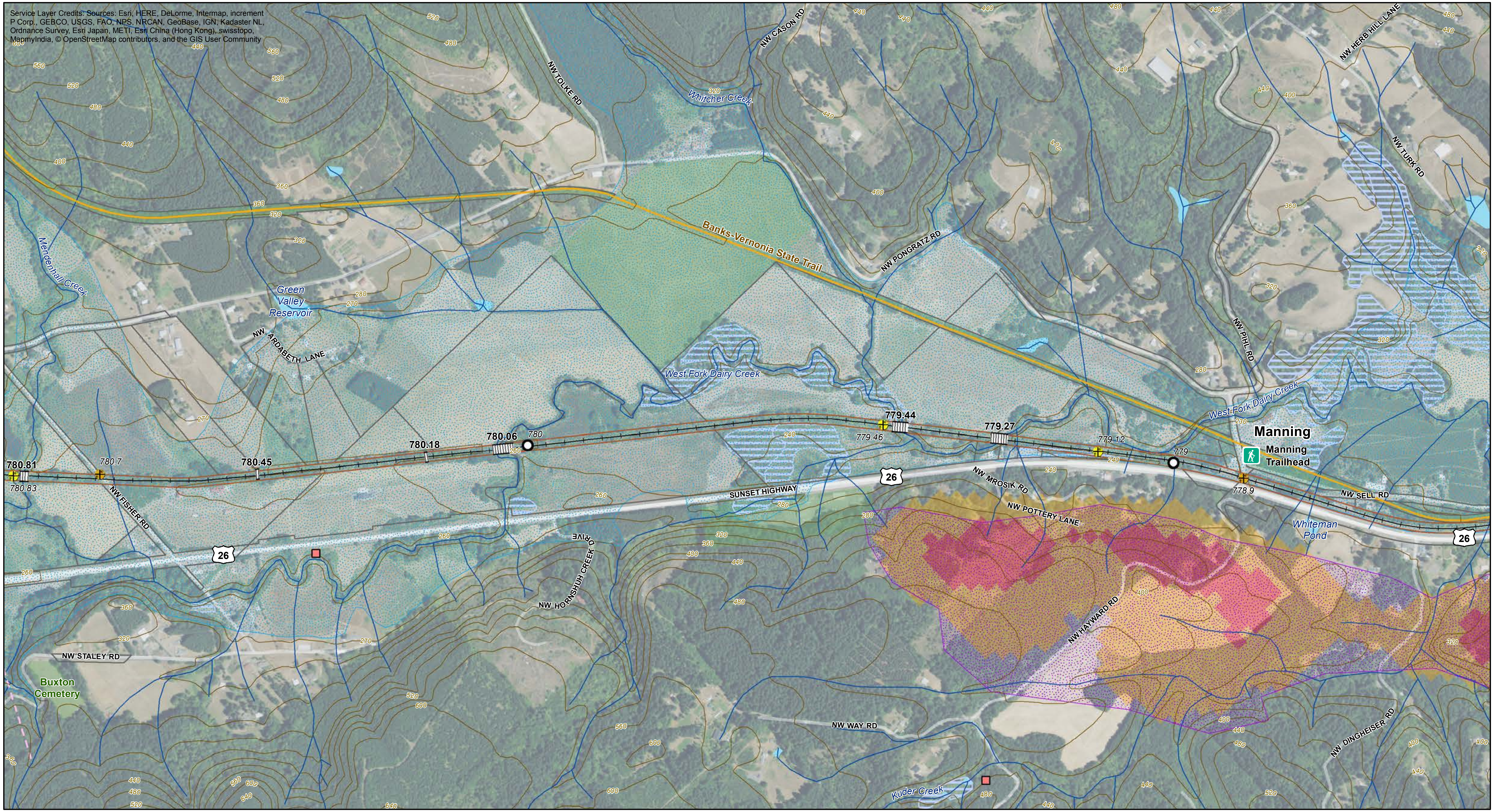
Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High



Salmonberry Trail Valley Segment Study
BASE CONDITIONS

Figure 5: MP 783 to NW Fisher Road near Buxton (MP 780.7), including the community of Buxton



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
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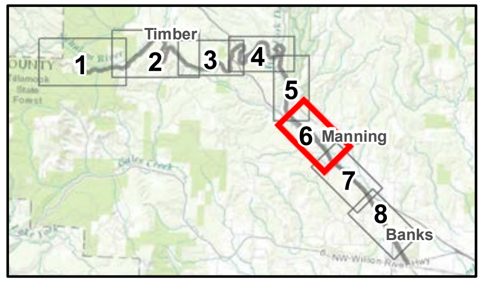
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Contour
- Stream/River
- Wetland
- Waterbody
- 100-Year Floodplain
- Park/Open Space
- Historic Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

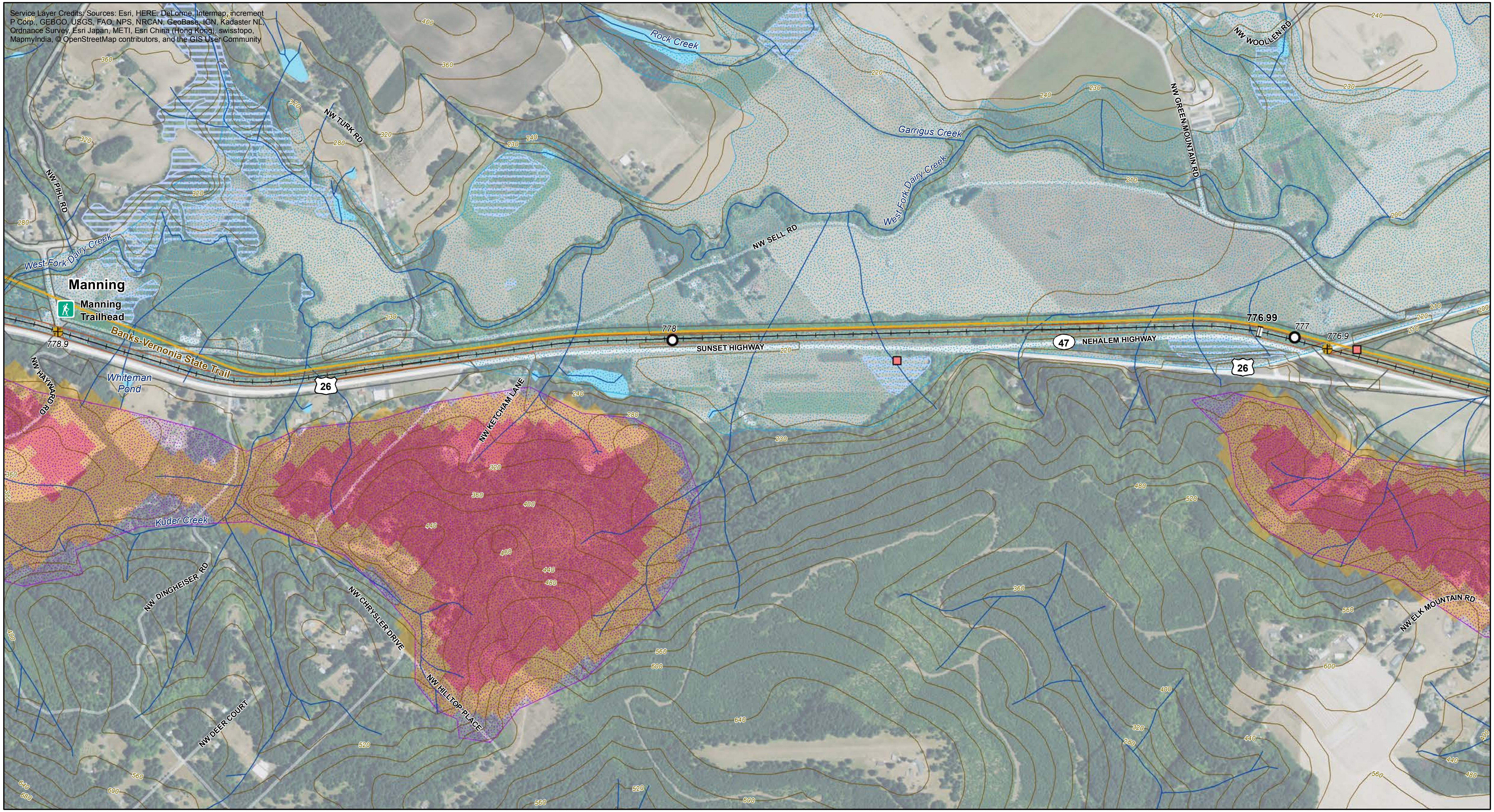
Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High



Salmonberry Trail Valley Segment Study BASE CONDITIONS

Figure 6: MP 780.7 to Manning (MP 778.9), including the community of Manning



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

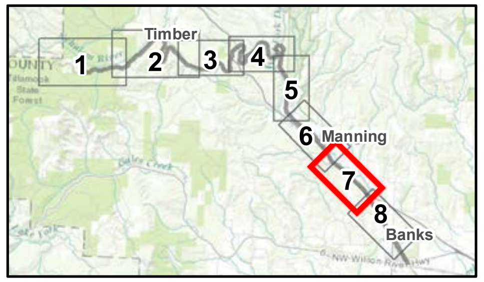
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Contour
- Stream/River
- Wetland
- Waterbody
- 100-Year Floodplain
- Park/Open Space
- Historic Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

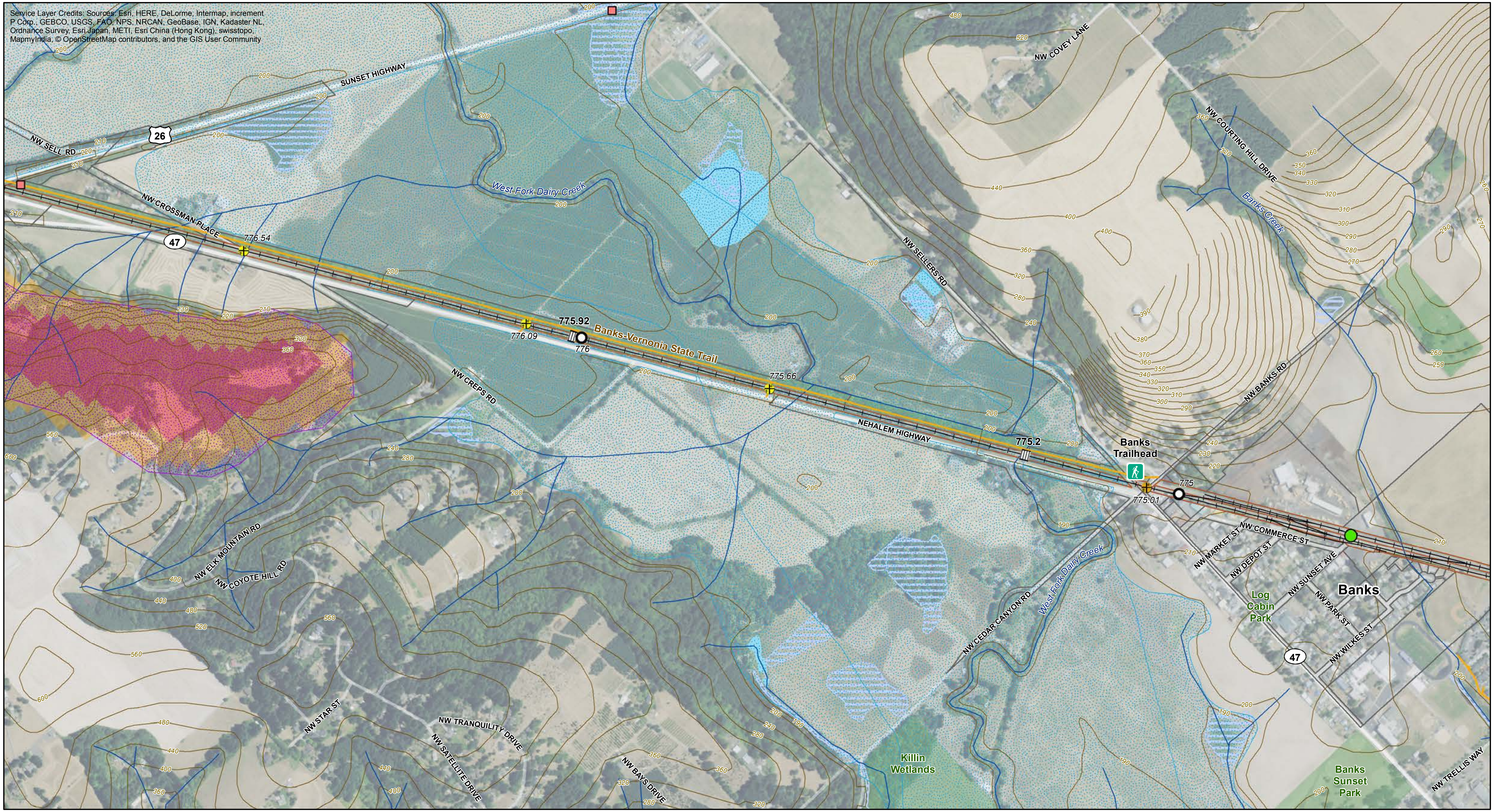
Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High



Salmonberry Trail Valley Segment Study
BASE CONDITIONS

Figure 7: MP 778.9 to US 26/OR 47 Interchange (OR 776.99)



Parametrix

Source: USDFW (NWI), RLIS, ODOT, DOGAMI, USGS (NHD), USDA (NAIP 2016 Aerial)

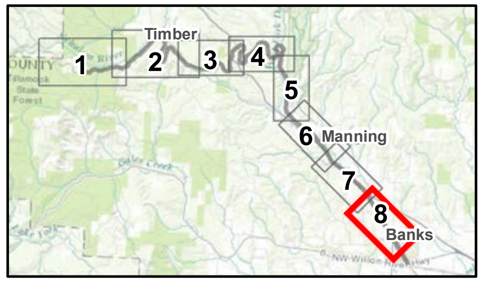
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Contour
- Stream/River
- Wetland
- Waterbody
- 100-Year Floodplain
- Park/Open Space
- Historic Landslide
- Landslide Deposit
- Scarp/Flank
- Fold
- Fault

Landslide Susceptibility

- Very Low - Med (Not Displayed)
- High
- Very High
- DEQ Env. Cleanup Site



Salmonberry Trail Valley Segment Study
BASE CONDITIONS

Figure 8: MP 776.99 to north end of City of Banks (MP 775)

Appendix B

Preliminary Geotechnical Evaluation of Rehabilitation of the Walcott Tunnel

GRI
9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
p | 503-641-3478 f | 503-644-8034

MEMORANDUM

To: Jim Rapp / Parametrix

Date: August 31, 2017

GRI Project No.: 6030

From: Michael Zimmerman, PE, GE, CEG ;Michael S. Marshall, CEG; and George Freitag, CEG

Re: **Preliminary Geotechnical Evaluation**
Rehabilitation of Walcott Rail Tunnel
Salmonberry Trail
Valley Segment MP 789.48 to 789.75
Washington County, Oregon

DRAFT

As requested, GRI conducted a preliminary geotechnical evaluation of the Walcott Rail Tunnel (Tunnel #25) as part of the above-referenced multi-use trail project. The scope of our evaluation included a site reconnaissance by a geotechnical engineer and engineering geologist from GRI, limited engineering evaluations, and development of preliminary design concepts for rehabilitation of the tunnel support system. A "sense of magnitude" cost estimate was developed for this preliminary tunnel rehabilitation design. This memorandum describes the work accomplished and summarizes our findings.

PROJECT DESCRIPTION

The existing tunnel is located from milepost (MP) 789.48 to MP 789.75 of the Port of Tillamook Bay (POTB) railway. The POTB rail line connecting Banks to Tillamook was constructed between 1906 and 1911, and the tunnel was constructed sometime during this period. In December 2007, a landslide buried the west portal of the tunnel during a catastrophic storm that damaged significant portions of the rail line. The POTB eventually decided not to repair the storm damage, although the landslide debris was cleared from the tunnel some time after September 2008. A trail for hiking, biking, and equestrian use is being proposed to replace the railroad. Conceptual planning is being conducted to provide evaluation of rehabilitation measures needed for trail development. Improvements to the tunnel lining and portals will be needed before the tunnel can be opened to trail users.

SITE DESCRIPTION

Geology

Published geologic maps indicate the Walcott Tunnel was constructed in an area underlain by Eocene-age marine sedimentary rock of the Keasey Formation (Newton and Van Atta, 1976). The sedimentary rock of the Keasey Formation consists of approximately 2,000 ft of stratified, gray marine siltstone and shale with some micaceous siltstone, sandstone, and dark micaceous shale. The Keasey Formation contains abundant concretionary limestone and fossil shells.

Site Conditions

In August 2017, a geotechnical engineer and engineering geologist from GRI visited the site to evaluate the existing tunnel. Starting from the east portal, about 550 ft of timber liner remains in place. The remainder of the tunnel has been covered with a thin coating of shotcrete. Wire reinforcement for shotcrete was not observed. Near the midpoint of the tunnel, about 55 ft of the tunnel length is supported with steel sets. Wood cribbing is visible between the rock and the timber liner. At the east portal and the section supported by steel sets, the wood cribbing appears to consist of quarter-rounds that fill the space between the structures and the rock.

Several large sections of shotcrete lining have failed within the tunnel, including about 200 ft of the north wall of the tunnel near the west portal and a section about 50 ft long near the tunnel midpoint where the entire shotcrete lining has fallen from the crown of the tunnel. No rock reinforcement bolts or drainage are evident behind the shotcrete. Using condition codes defined in the Highway and Rail Transit Tunnel Inspection Manual (Federal Highway Administration, 2005), the shotcrete lining that remains in place can be described as "poor" to "serious" (ratings of 3 and 2, respectively, on a scale of 0 to 9). The condition codes are defined in the following table.

TUNNEL CONDITION CODE SUMMARY

Rating	General Description	Shotcrete Liner	Timber Liner
9	Newly completed construction	Newly completed construction	Newly completed construction
8	**Excellent Condition**	No defects found	No defects found
7	**Good Condition:** No repairs necessary. Isolated defects found.	Shotcrete liner contains minor circumferential cracks at greater than 10-ft intervals with a minor presence of efflorescence.	No repairs necessary. Timber exhibits isolated condition locations of minor checks, minor decay, and minor water leakage.
6	Condition between 5 and 7.	Condition between 5 and 7.	Condition between 5 and 7.
5	**Fair Condition:** Minor repairs required but element is performing as originally designed. Minor, moderate, and isolated severe defects are present.	Shotcrete contains minor circumferential cracks at 5- to 10-ft intervals, not more than one longitudinal moderate crack, moderate presence of efflorescence, and minor to moderate active leakage. Minor delamination, spalls, map cracking, and staining are present, but no reinforcement is exposed.	Timber exhibits numerous minor defects and isolated moderate decay, checks, and moderate leakage. Isolated timber members contain splits.
4	Condition between 3 and 5.	Condition between 3 and 5.	Condition between 3 and 5.
3	**Poor Condition:** Major repairs are required and element is not functioning as originally designed. Severe defects are present.	Shotcrete lining has extensive longitudinal and circumferential cracks with extensive efflorescence, leakage, and staining. Delaminations and spalls are present over 50% of the lining surface and exposed reinforcement steel has up to 15% section loss.	Liner elements have numerous moderate defects of decay, checks, splits, and leakage over 50% of the liner area.
2	**Serious Condition:** Major repairs required immediately to keep structure open to the public.	Shotcrete lining has extensive severe cracks, delaminations, spalls, and active leakage. Exposed reinforcement steel has up to 40% section loss.	Timber contains extensive severe decay, checks, splits, and leakage over 50% of the timber surface. Numerous timber members are completely deteriorated.
1	**Critical Condition:** Immediate closure required. Study should be performed to determine the feasibility of repairing the structure.	Shotcrete lining has cracked and deflected significantly. The lining has lost all capacity to sustain design loads.	Timber lining has extensively cracked and deflected significantly. The lining has lost all capacity to sustain design loads.
0	**Critical Condition**	Structure is closed and beyond repair.	Structure is closed and beyond repair.

Note: Table contents and language based on FHWA 2005.

The condition of the remaining timber lining within the tunnel varies. Some portions of the timber lining could be considered to be in "fair" condition (5 on a scale of 0 to 9) and only need minor repairs to remain functional. However, the majority of the timber lining can be characterized as "poor" condition (3 on a scale of 0 to 9), with multiple timber support foundations decomposing causing support beam rotation into the tunnel. Portions of the timber lining have significant decay visible in some timbers and lagging and can be characterized as "serious" to "critical" condition (0 to 2 on a scale of 0 to 9). For an approximate 150-ft section, the sides of the timber lining appear to be squeezing in towards the center of the tunnel, which is likely due to pressure from debris retained by the liner. This section of timber liner can be characterized as "critical" condition (rating of 0 to 1 on a scale of 0 to 9).

Areas of minor seepage were evident at the time of our visit to the site. However, several inches of silty sediment are present toward the west end of the tunnel, and based on staining of the timbers, the water was 4 to 6 in. deep against the timbers. In some locations, it appears the flowing water is washing sediment from behind the timber liner. Additionally, shotcrete near the west portal has many defects characteristic of shotcrete placed when seepage was actively dripping from the roof of the tunnel.

During our reconnaissance of the site, we observed indications of rockfall from the near-vertical rock faces around both portals and above the area of the west tunnel portal. Based on our observations near the area of the tunnel, rockfall appears to be caused by spalling of rock from near-vertical local rock faces.

CONCLUSIONS AND RECOMMENDATIONS

Preliminary Tunnel Rehabilitation Concept

Several large failures of the shotcrete liner have occurred. The relatively thin layer of shotcrete has no wire mesh reinforcement, no drainage to relieve the buildup of water pressure behind the shotcrete, and no rock anchors to support the shotcrete. This minimalist construction lacking these key details likely led to the shotcrete liner failures. In our opinion, the shotcrete lining that remains in place is a significant fall hazard to tunnel users because it was constructed without support anchors drilled into the rock and is too thin to act as an arched structure. Portions of the existing shotcrete, if not all the shotcrete, should be removed to allow construction of suitable drainage behind a new tunnel lining.

The wood tunnel liner is in varying condition. However, enough of the timber is in "poor" to "critical" condition that repair of the liner would require extensive work to return the wood structure to a "good" condition suitable for use by the public. The existing wood structure at the east portal has significant rot and will need to be replaced.

In our opinion, the most practical roof support system for the rock conditions existing at this tunnel consists of a pattern of rock anchors covered with a shotcrete lining. This method of roof support takes advantage of the inherent strength of the rock. We anticipate there should be sufficient stand-up time of the exposed rock to allow removal of the existing shotcrete cover before placing the new shotcrete liner.

The conceptual bolting pattern proposed for preliminary estimating purposes is composed of 10-ft-long rock dowels with a 4-ft center-to-center spacing across the crown of the tunnel. For an 18-ft-wide tunnel, alternating rows in the proposed offset bolting pattern will have six or seven rock dowels in the crown of the tunnel. The shotcrete covering the sides of the tunnel should be supported with rock anchors. We have assumed two rows per side of 5-ft-long anchors spaced at 4 ft center-to-center should be suitable to support the wall shotcrete. For preliminary planning and budgeting, we recommend a contingency be made for additional rock anchor support covering about one-tenth of the length of the tunnel. This contingency is included in the preliminary cost estimate discussed below.

A shotcrete lining should be applied to the crown and walls of the tunnel following placement of the pattern bolting. The shotcrete should contain steel fibers and be placed in a minimum of two lifts. The total thickness of shotcrete with steel fibers should not be less than 6 in. A third lift of shotcrete without steel fibers should be applied to cover the walls of the tunnel to a minimum height of 9 ft. This final lift is intended to cover the steel fibers, which are very abrasive and pose a hazard to the public if left uncovered. Due to the likely irregular rock surface of the tunnel, we recommend a contingency of at least 20% is assumed for the volume of shotcrete needed to provide structural support. This contingency has been applied to the preliminary cost estimate discussed in a subsequent section.

Drainage consisting of a commercially available drain-board product should be provided behind the shotcrete. Drain boards should extend down the sides of the tunnel to the floor, where the seepage should be collected. For preliminary cost estimating purposes, we have estimated the drain board will cover 10% of the roof and sides of the tunnel. Water may be collected in a low-profile gutter along the sides of the tunnel. However, considering the indications of sediments moved by significant amounts of water flow in the tunnel, it may be prudent to collect the water in a pipe instead of the gutter system. We anticipate a piping system can be installed by chipping a channel into the floor of the tunnel to make room for the pipe or by raising final grades for the trail surface in the tunnel.

Rockfall

Indications of rockfall were noted from the near-vertical rock faces around both portals and above the area of the west tunnel portal. Based on our observations near the area of the tunnel, rockfall appears to be caused by spalling of rock from near-vertical rock faces. In general, rockfall is more likely to occur during periods of heavy rain or freeze-thaw cycles. The frequency of rockfall events and amount of rockfall in each event is difficult to quantify through a short-term study such as that completed for this project. However, considering the low volume of rockfall debris observed at both portals and the length of time since the last maintenance of the tunnel, the rate of rockfall appears to be relatively low. Based on the observed conditions at both portals, significant rockfall events should be anticipated at these locations.

It appears possible to reduce the risk of rockfall at the west portal by constructing a portal structure extending beyond the rockfall zone, similar to the existing timber portal structure that remains at the east portal. Additionally, steel mesh may be draped over the rock face and anchored in place to support the rock face above the west portal. The anchored mesh would reduce the risk of rockfall from larger fragments. However, the mesh will not retain all rock fragments that are gravel size and smaller.

It should be noted a detailed study addressing the rockfall hazard is not included in this study. In our opinion, the agencies responsible for owning and operating this facility will have to make decisions regarding management of the rockfall hazard and what level of risk is deemed acceptable. These decisions will determine the appropriate construction details at both portals.

Preliminary Cost Estimate

This preliminary cost estimate has been prepared based on the geologic assessment of tunnel conditions described above, a review of current tunnel practices, and our experience with similar recent tunnel rehabilitation projects. It is our understanding this information will be used to develop a project budget. Although the cost estimate is preliminary, it is our opinion it is reasonable for budgeting and feasibility studies on this project. The intent of the cost estimate presented below is to furnish a reasonable order of magnitude construction costs for the proposed tunnel.

The following cost estimate is based on the conceptual design consisting of a support system of rock dowels and fiber-reinforced shotcrete for the length of the tunnel. Based on conditions observed within the tunnel, we anticipate additional support will be required for portions of the tunnel. We have included in our estimate an extra 10% for rock anchors. We anticipate the tunnel lining can be constructed using steel-fiber-reinforced shotcrete with a minimum average thickness of 6 in. A contingency of 20% has been applied to the estimated cost of shotcrete. The cost estimate assumes excavated material and existing shotcrete lining removed will be disposed of on site, outside the east portal.

We recommend applying a contingency of 30% to the total estimated construction costs, including mobilization. For design, permitting, and construction management, we recommend budgeting 25% of the construction costs, excluding the 30% contingency, due to the type, details, and inherent uncertainty of the project. Based on the above criteria and assumptions, we recommend budgeting $5,700,000 to rehabilitate the lining of this tunnel to a condition suitable for public use.

The above cost estimate does not include the finishing details within the tunnel, such as drainage, paving, and the reconstruction of timber structures at the tunnel portals. Due to the relatively short length of the tunnel and the intended use, we anticipate lighting and ventilation will not be required. Additionally, this cost estimate does not include escalation factors for labor or materials.

LIMITATIONS

This memorandum has been prepared to aid in the preliminary assessment and budgeting for this project. The scope is limited to the specific project and location described herein. Our description of the project represents our understanding of the significant aspects of the project relevant to the feasibility of rehabilitating the tunnel by constructing a new tunnel lining. The recommendations provided are for preliminary assessment only and are not intended for design or construction of the actual tunnel.

The conclusions and recommendations in this memorandum are based on the limited data obtained from the surface mapping of features visible within and around the location of the tunnel. Geologic conditions are obscured in most of the tunnel by shotcrete or the remaining timber liner. Variations in geologic conditions may occur between outcrops/exposures, some of which may not become evident until further study or exposure during construction. Additional geotechnical investigations will be necessary to develop the preliminary and final designs for this project.

Submitted for GRI,

George A Freitag, CEG Principal	Michael S. Marshall, CEG Project Geologist	Michael J. Zimmerman, PE, GE, CEG Senior Engineer/Geologist

This document has been submitted electronically.

References

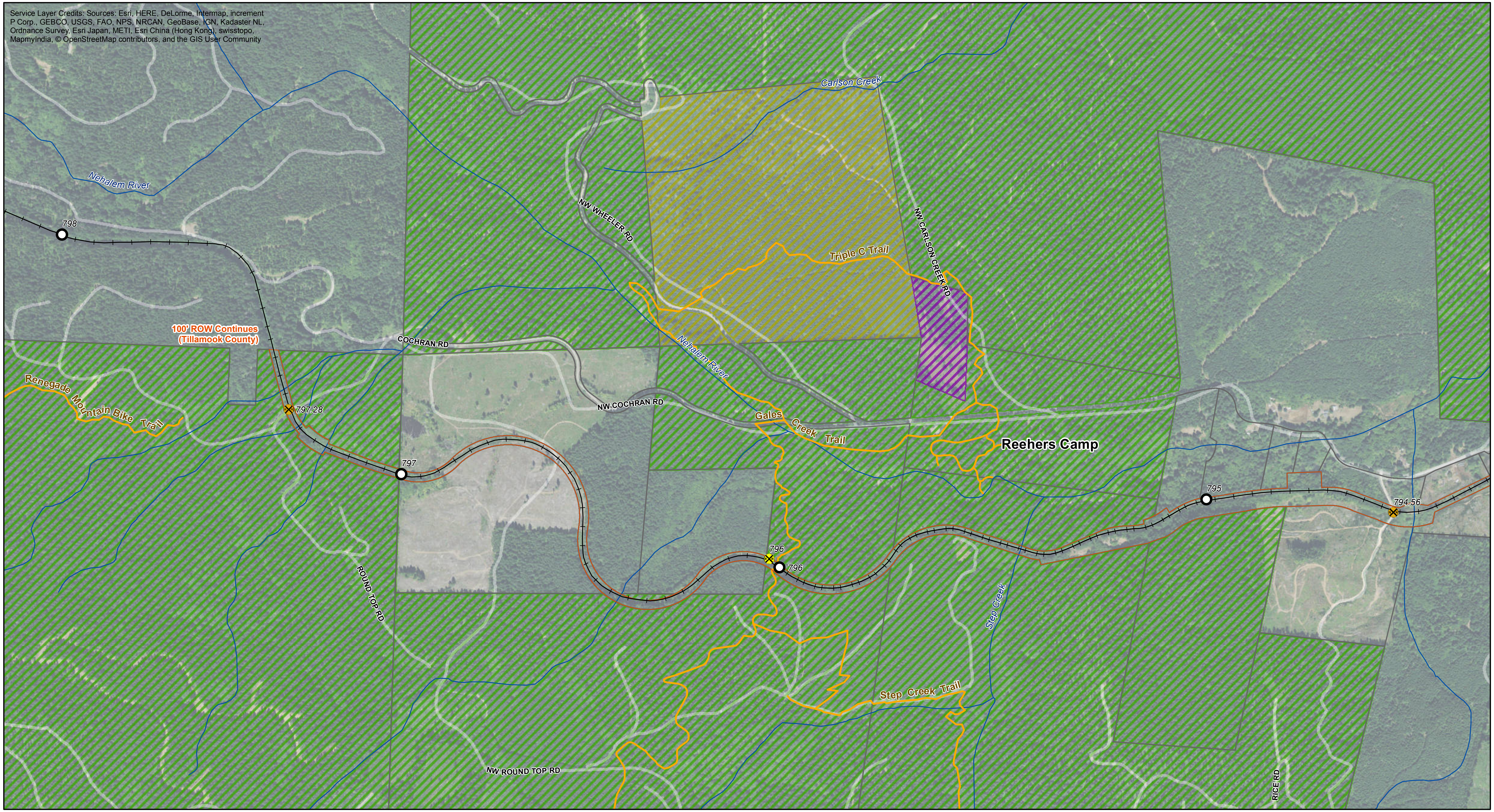
Federal Highway Administration (FHWA), 2005, Highway and rail transit tunnel inspection manual, U.S. Department of Transportation, Federal Highway Administration and Federal Transit Administration.

Newton, V.C., and Van Atta, R.O., 1976, Prospects for natural gas production and underground storage of pipe-line gas in the Upper Nehalem River Basin Columbia-Clatsop Counties, Oregon, Oregon Department of Geology and Mineral Industries, Oil and Gas Investigations 5.

6030 WALCOTT TUNNEL REHAB MEMO

Appendix C

Valley Segment Property Ownership Maps



Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

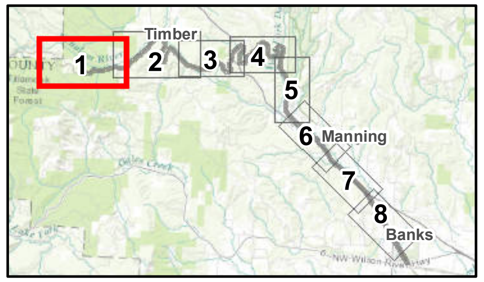
0 500 1,000 2,000 Feet

1 inch = 1,000 feet (plotted at 11x17)

- Mileposts
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Stream/River

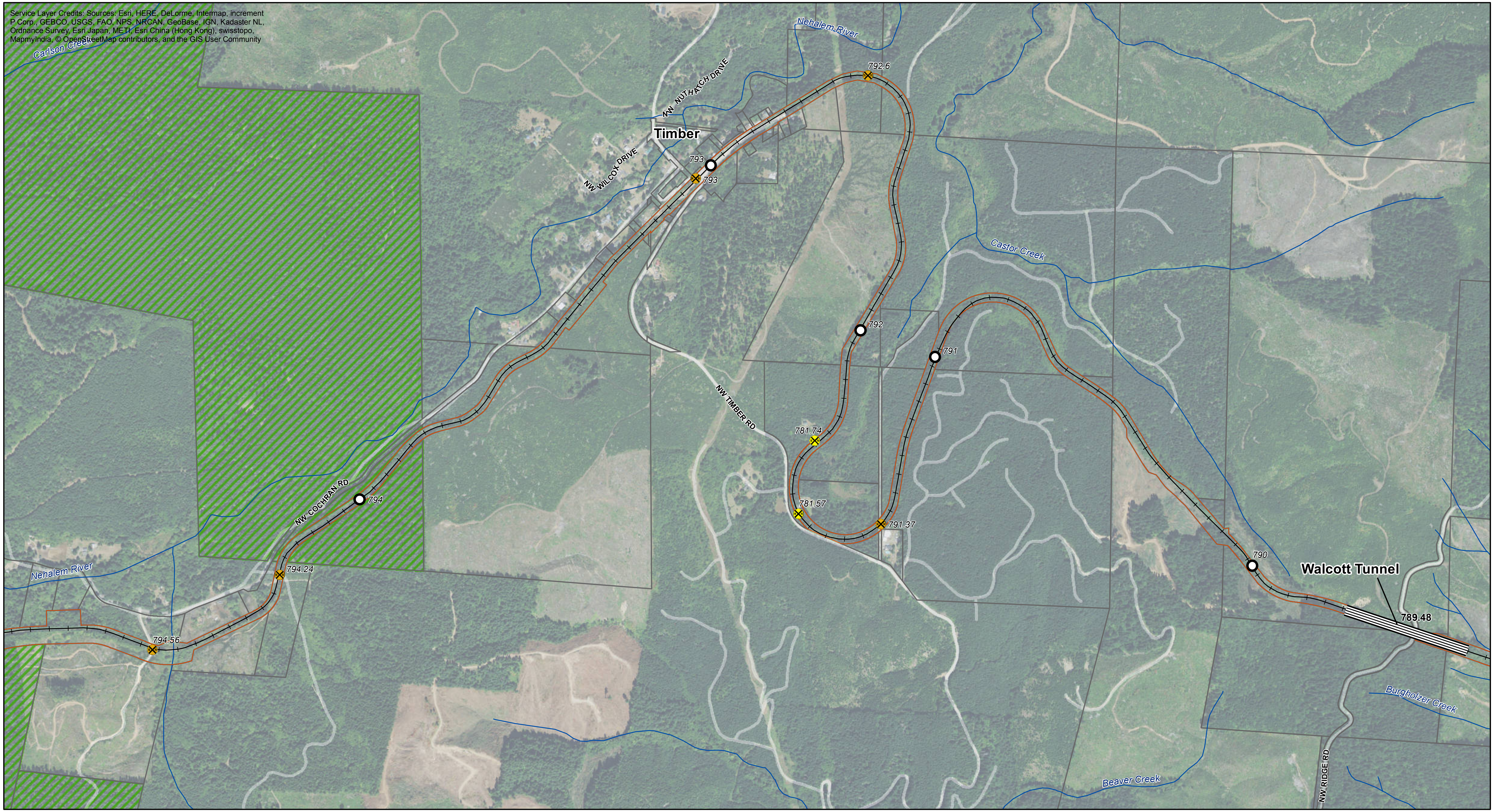
Ownership

- State of Oregon Department of Forestry
- State of Oregon Department of State Lands
- Washington County



Salmonberry Trail Valley Segment Study
OWNERSHIP

Figure 1: Cochran Road Crossing of Rail Corridor (MP 797.28) to MP 794.56



Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

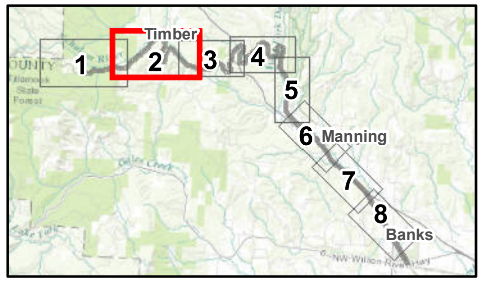
0 500 1,000 2,000 Feet

1 inch = 1,000 feet (plotted at 11x17)

- Mileposts
- Tunnel
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Rail Right-of-Way
- Tax Lot
- Stream/River

Ownership

- State of Oregon Department of Forestry



Salmonberry Trail Valley Segment Study
OWNERSHIP

Figure 2: MP 794.56 to west of Walcott Tunnel (MP 790), including the community of Timber

Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

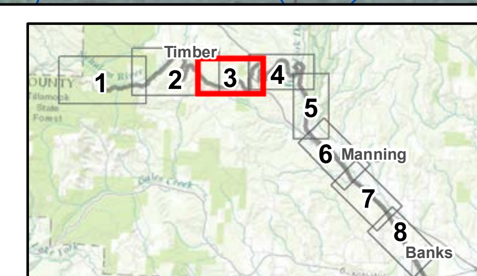
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Tunnel
- Rail Crossing (Driveway/Field)
- Rail
- Rail Right-of-Way
- Tax Lot
- Stream/River

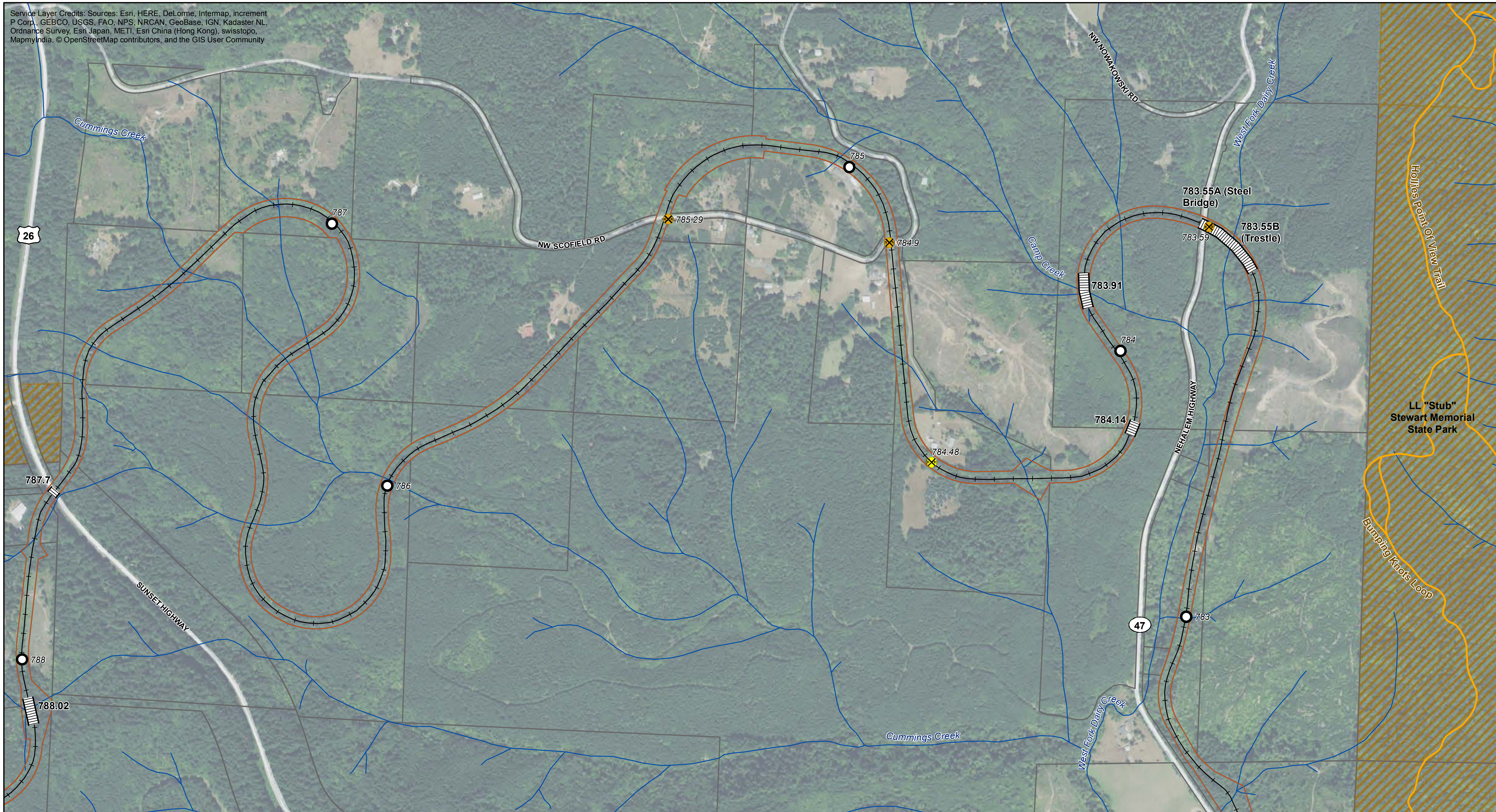
Ownership

- State of Oregon Parks & Recreation Department



Salmonberry Trail Valley Segment Study
OWNERSHIP

Figure 3: Walcott Tunnel to US 26 (MP 787.7), including the Tunnel and existing rail bridge crossing of US 26



Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

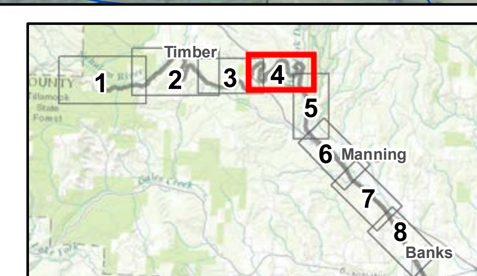
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Stream/River

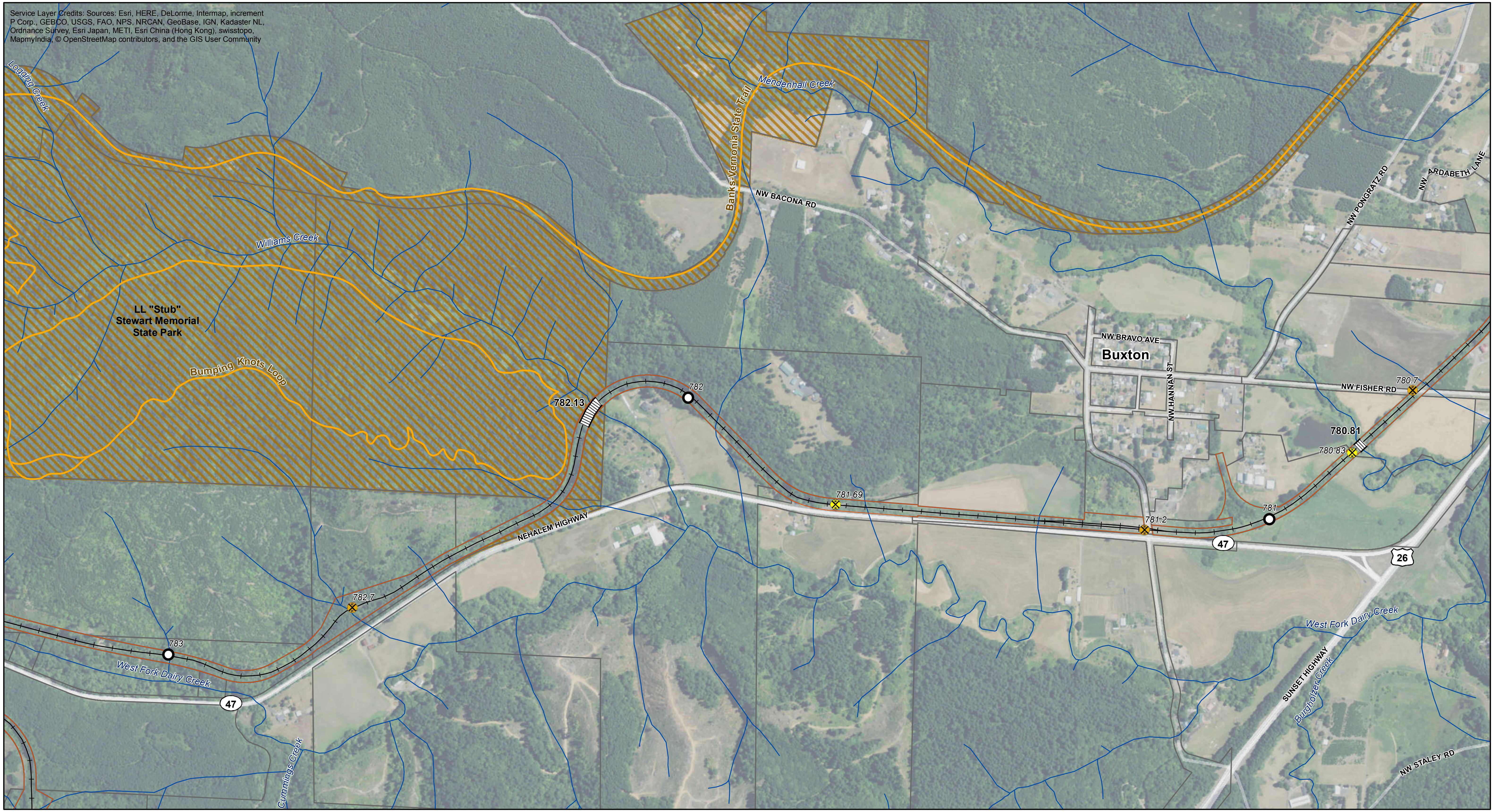
Ownership

- State of Oregon Parks & Recreation Department



Salmonberry Trail Valley Segment Study OWNERSHIP

Figure 4: US 26 to West Fork Dairy Creek (MP 783), including the existing rail bridge/trestle crossing of OR 47



Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

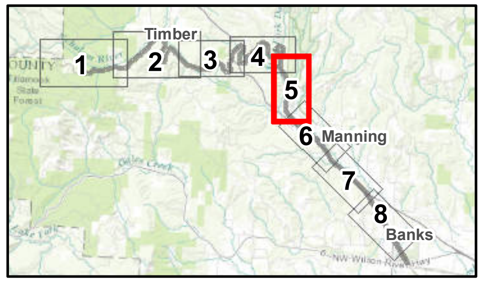
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Stream/River

Ownership

- State of Oregon Parks & Recreation Department



Salmonberry Trail Valley Segment Study
OWNERSHIP

Figure 5: MP 783 to NW Fisher Road near Buxton (MP 780.7), including the community of Buxton

Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

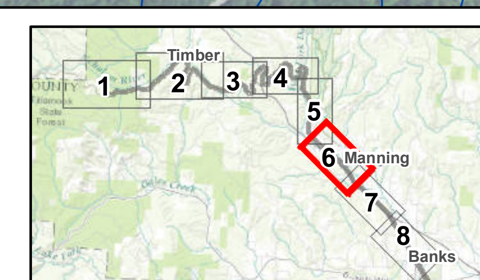
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Stream/River

Ownership

- State of Oregon Department of Transportation
- State of Oregon Parks & Recreation Department



Salmonberry Trail Valley Segment Study
OWNERSHIP

Figure 6: MP 780.7 to Manning (MP 778.9), including the community of Manning

Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

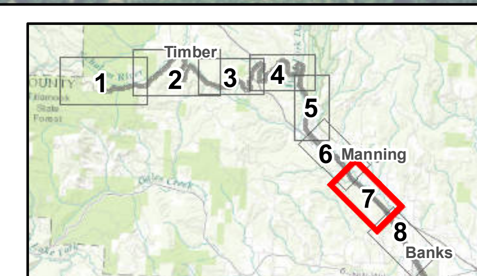
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Stream/River

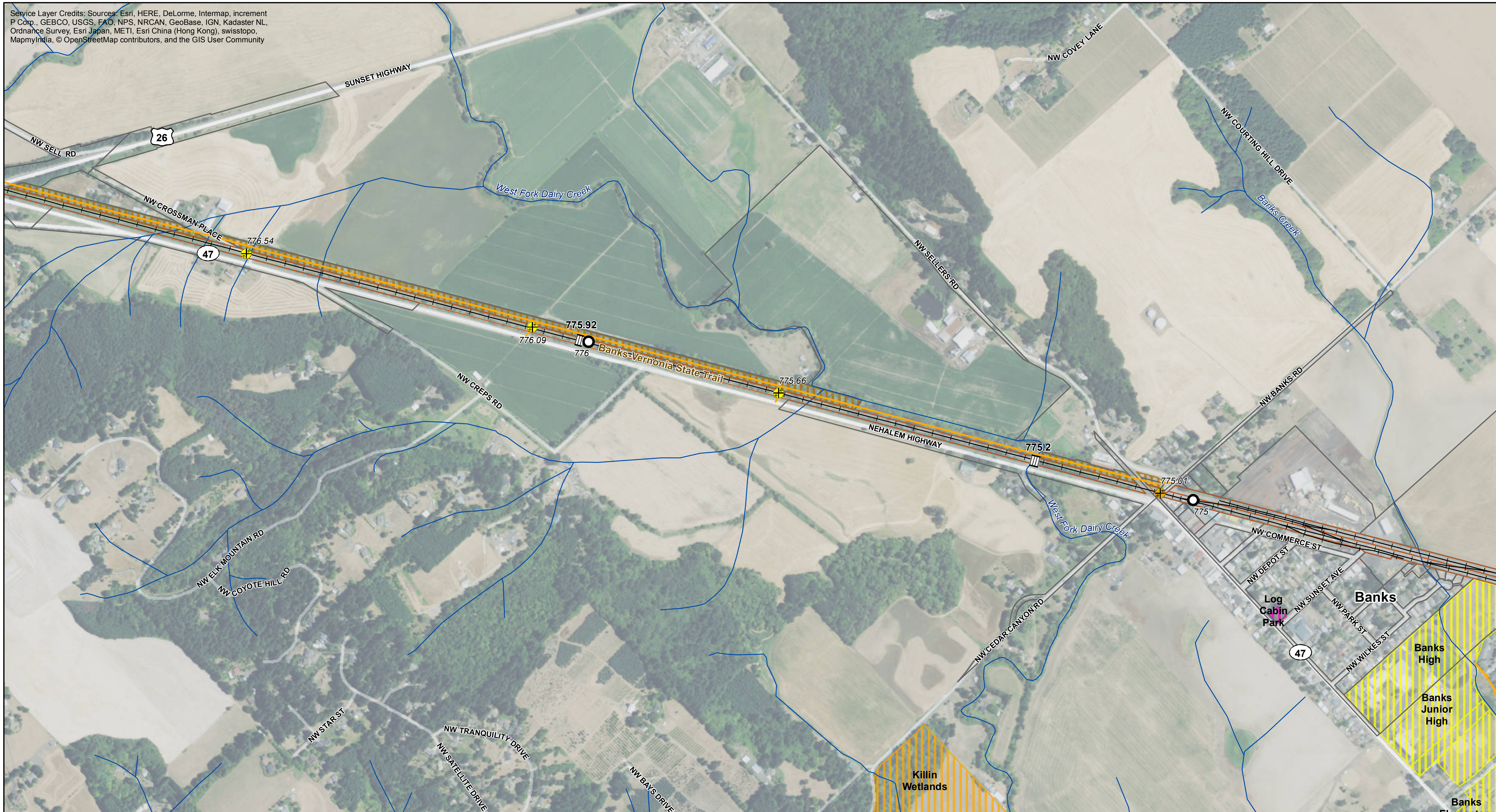
Ownership

- State of Oregon Parks & Recreation Department



Salmonberry Trail Valley Segment Study
OWNERSHIP

Figure 7: MP 778.9 to US 26/OR 47 Interchange (OR 776.99)



Parametrix

Source: USDFW (NWI), RLIS, ODOT, USGS (NHD), USDA (NAIP 2016 Aerial)

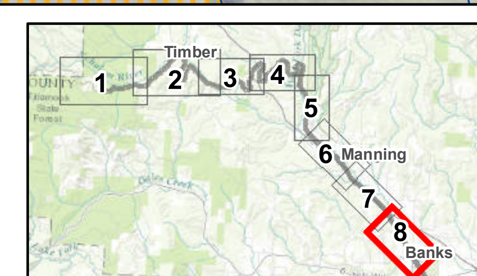
0 375 750 1,500 Feet

1 inch = 750 feet (plotted at 11x17)

- Mileposts
- Trestle/Bridge
- Rail Crossing (Road)
- Rail Crossing (Driveway/Field)
- Rail
- Existing Trail
- Rail Right-of-Way
- Tax Lot
- Stream/River

Ownership

- Banks School District
- City of Banks
- Metro
- State of Oregon Parks & Recreation Department



Salmonberry Trail Valley Segment Study OWNERSHIP

Figure 8: MP 776.99 to north end of City of Banks (MP 775)

Appendix D

Notes from meeting with representatives of Oregon Equestrian Trails NW Chapter

Meeting with representatives of Oregon Equestrian Trails (OET) NW Chapter
Monday, June 26, 2017
Oregon Department of Forestry - Forest Grove Offices

Topic: Planning for Equestrian Trail Facilities in the Valley Segment (Banks to Reehers Camp) of the proposed Salmonberry Trail.

Attendees:

- Dennis Wiley, OPRD, Salmonberry Trail Planning Project Manager
- Jim Rapp, Parametrix, Valley Segment Plan, Consulting Project Manager
- Becky Babcock, Steve Emory, Shari Woodcock, Micheale Gordon, OET members

Planning Project Scope: Equestrian facility feasibility is included in the current consulting contract with Parametrix for development of the Valley Segment Plan. Limitations are:

- Trailheads may be shared-use or equestrian-only, depending on site capacity (*note: study is limited to examining trailheads at Banks, Manning, Timber, and Reehers Camp only*).
- Development of a viable bike/ped facility is the primary goal of the Valley Segment study.
- Equestrian trail must fit within the existing rail right-of-way and parallel the planned bike/ped trail (ROW varies from 80 to 100 feet wide in study area, with some intermittent wider areas).
- Equestrians will share use of existing rail bridges and trestles (and one tunnel) with the bike/ped trail.

Desired Outcomes: Understanding OET concerns and desires re:

- Standards for shared-use and equestrian-only trailheads.
- Shared-use of trails with bicyclists and pedestrians.
- Standards for an equestrian-only trail (trail surface and width, separations from bike/ped traffic).
- Feasibility of equestrians using and sharing bridges/trestles (and one tunnel).

Dennis opened with a short description of the overall Salmonberry Trail project, the intent of the Valley Segment Plan, and the organization and management of this regional multiuse trail effort. He also reviewed the Segment Plan schedule, and indicated that OET will be asked to select a representative on the project's Valley Segment planning advisory committee, which will meet 3 times in the course of the study.

Trailheads

Lots of concerns were expressed with the very limited number of trailheads in the region (and the Banks-Vernonia Trail in particular) with adequate capacity and improvements for horses and horse trailers. Steve stated that his truck/trailer rig is 45 feet long, others suggested a combination along the lines of 24 feet long as being more usual. **NOTE:** *In a subsequent correspondence, the equestrian group corrected this typical measurement, and indicated that a truck/trailer space of no less than **34'** was needed.* All stated that a major problem is bike/ped users "taking over" or blocking horse rig spaces, even at nominally equestrian-only facilities. In general, the group expressed opposition to any Valley trail plan that ended up recommending shared-use without expansion of the overall number and size of trailheads.

- The Banks-Vernonia (BV) Trailhead in Banks does not currently allow horse trailers, and the Manning Trailhead has no space for same.

- For Reehers Camp, the current gravel parking lot west of Reehers Camp has limited capacity, and the turning radius when re-entering Cochrane Road is very challenging. Conflicts with bike/ped user vehicles parking in this lot is also a problem.
- Group was clear that any modification to the actual Reehers Camp area for any trailhead facilities would be totally unacceptable to them.
- Group felt that the development of the trail, and any improvements to the unpaved portions of Cochrane Road between Reehers and Timber, would only further overwhelm the Camp.
- Group cited 3 existing trailheads on the BV Trail as examples of problems, particularly on weekends - Buxton, Top Hill, and Beaver Creek. Issues are too many users for the size of the facility, and that equestrian-only spaces are not respected by bike/ped users.

The group preferred that:

- Bike/ped and equestrian trailheads should be totally separate facilities, including access and egress; but close enough so that bike/ped users don't use the equestrian facility anyway.
- Basic equestrian trailhead parking lot should provide 6 to 8 vehicle/trailer parking spaces, space to tether horses, and adequate turning radius for truck and trailer rigs to get in and out of the lot (*Note: later input from OPRD indicate a 6 to 8 space parking lot could require up to ¾ acre*).

In conclusion, the OET group felt that if trailhead facilities continued to be in short supply, and were otherwise inadequate for equestrian needs, that a Salmonberry Equestrian Trail would simply not be used much.

Equestrian Trail

The base bike/ped trail standard for the Valley Segment will be 10-foot-wide paved asphalt surface with 2-foot wide gravel shoulders. A soft-surface alternative will also be costed. The new bike/ped trail will re-use existing rail bridges, trestles, and tunnels, unless project analysis reveals structural issues necessitating replacement. The Valley Segment study also will produce a cost estimate for paving Cochrane Road from the west edge of Timber to Reehers Camp. Cochrane is the vehicular access to Reehers Camp.

Jim stated that OPRD and his team rely on official ODOT standards for the bike/ped trail, but that here is no official equivalent for equestrians. An equestrian trail development manual acquired by the group was passed around. Jim Rapp also had a copy of same. It was generally agreed that the book was a great design resource but did not contain standards as such (in the sense the Oregon DOT has a concise set of multiuse regional bike/ped trail standards that must be met to secure State trail construction funding).

Jim stated that one of the key reasons for today's meeting was to get OET to define their preferred "standard", so his team could use it as a consistent benchmark in examining equestrian trail feasibility in the Valley Segment. Comments from the group were:

- Mountain bikers and equestrians have few conflicts on shared-use trails, and mountain bikers are fine with the types of soft-surface/light gravel pathways that equestrians prefer. Comments were made about being sure that rail berm basalt rock was removed from the equestrian trail.
- Pedestrians are also usually OK for shared-use with equestrians, although pedestrians with dogs create frequent problems with horses.
- The most persistent ongoing problem is shared-use with street bikes, particularly when bikers are traveling downhill at higher speeds. This can create very dangerous conditions for bicyclists and equestrians (as well as pedestrians).

- Paved pathways were definitely not the preferred surface for equestrians.

After much discussion, the group came to general agreement on a preferred equestrian trail cross-section:

- Pathway Surface — Soft (dirt tread or light gravel)
- Trail Width — 8 feet (providing for two-way travel)
- Overhead clearance (overhanging trees, etc.) — 10 feet
- Buffer from bike/ped trail: — 6 feet
- Buffer Treatment: — Physical demarcation* preferred

**Vegetation, low curbs, low mound. A barrier fence was not preferred.*

Jim stated that the Valley Segment study will note where the above cross-section factors cannot be met without the use of new cut and fill, retaining walls, or other special structures and treatments, and/or a reduction in preferred equestrian trail width and/or buffering.

He noted, by way of example, a 300-foot-long section of the proposed Salmonberry Trail south of Rockaway Beach that was identified by the 2017 Coast Segment plan. This 300-foot-long section is highly constrained between a coastal riprap wall and a US 101 retaining wall. The only alternative was sending bikes/peds up a ¾ mile long section of the highway with steep grades, short sight lines, and no shoulders. The recommendation was to narrow the 300 feet of trail pathway down to 6 feet wide, eliminate shoulders and most of the separation between the rail line and the trail, and use special controls to keep bike/peds out of the area when train were passing.

<u>Bridges and Trestles (and Walcott Tunnel)</u>

Micheale had conducted a quick survey of OET NW Chapter members to see what they thought:

- 52% said they wanted a barrier between horses and bikes/peds.
- 89% said they would be OK with sharing bridges/trestles.
- 78% said they would be OK with sharing the tunnel.

There was a discussion around the group's personal experiences in taking horses across shared-use bridges and trestles. Micheale said that before it was closed to horses, she had gone across the BV Trail's Buxton trestle (735 feet long) and had had no problems (but it was still not the best situation). Other members of the group said they often elected to simply dismount and walk their horses across bridges. To encourage this, it was suggested that for the Valley Segment that horse mounting/dismounting blocks be sited at each end of the bridge/trestle/tunnel, and that signage be placed encouraging dismounting and walking horses across or through the structures.

Jim clarified that the probable width of the re-decked bridges and trestles would be 14 feet. Neither he nor Dennis knew off-hand what the width of the tunnel was, although the length of the tunnel, based on POTB records, is 1,417 linear feet (*note: a later site visit found that the tunnel varied between 16 and 18 feet wide*).

Safety rails/barriers will be installed as part of all bridge/trestle re-decking. The railing for bike/ped purposes would be 4 to 5 feet high. OET members expressed concern that this would be too low where horses and riders were involved. An additional 3 to 4 feet of chain link or the like was suggested. Everyone generally agreed the fence height and construction may all in the end be governed by State or County safety codes.

Appendix E

Preliminary Landslide Hazard Assessment

GRI
9750 SW Nimbus Avenue
Beaverton, OR 97008-7172
p | 503-641-3478 f | 503-644-8034

August 30, 2017 6030 LANDSLIDE HAZARD RPT

Parametrix
700 NE Multnomah Street, Suite 1000
Portland, OR 97232

DRAFT

Attention: Jim Rapp

SUBJECT: Preliminary Landslide Hazard Assessment
Salmonberry Trail
Valley Segment
Washington County, Oregon

INTRODUCTION

As requested, GRI conducted a preliminary landslide hazard assessment along the Valley Segment of the proposed Salmonberry Trial located in Washington County, Oregon. The Vicinity Map, Figure 1, shows the general location of the proposed trail alignment. This assessment of landslide hazards was conducted to identify areas along the proposed Salmonberry Trial Valley Segment that could potentially affect the geotechnical engineering considerations for design and construction of the proposed trail project. The assessment included a review of existing geological information, evaluation of remotely sensed data, limited field observations, and preparation of this report. This report describes the work accomplished and presents our findings regarding landslide hazards along the Salmonberry Trail Valley Segment alignment. Our work was completed in accordance with our services agreement dated August 14, 2017.

PROJECT DESCRIPTION

The Port of Tillamook Bay (POTB) railroad connected the Willamette Valley to the Oregon Coast by an 86-mile rail corridor extending from Banks to Tillamook. A catastrophic storm in December 2007 damaged much of the line and the POTB decided not to repair the damage. A trail for a hiking, biking, and equestrian use is being proposed to replace the abandoned railroad. Conceptual planning is being conducted to provide evaluation of rehabilitation measures needed for trail development. The Valley Segment of the Salmonberry Trail includes a 22-mile corridor from the north end of Banks, Oregon, at milepost (MP) 775 to just past Reehers Camp in the Tillamook State Forest at MP 797.3. The primary purpose of the work described in this report is to identify landslides areas of potential slope instability along the proposed trail alignment.

LANDSLIDE HAZARD ASSESSMENT

GRI compiled information on the type and occurrence of landslides from a review of the Oregon Geologic Database Compilation Version 6 (OGDC-6), Statewide Landslide Database for Oregon Version 3 (SLIDO-3.2), and remotely sensed data, including aerial photographs and lidar data.

Geology. The project is located in the Oregon Coast Range, which is a belt of uplifted sedimentary and volcanic rocks along the western edge of Oregon near the Pacific Ocean. The uplift is a result of tectonic plate convergence associated with the Cascadia Subduction Zone (CSZ) system that has compressed and folded the geologic units of the northern Oregon Coast Range into a broad, northward-trending, anticlinal form along the crest of the mountain range.

The OGDC-6 was used to identify geologic units along the alignment (Smith and Roe, 2015). The geologic units mapped along the project alignment generally consist of weak marine sedimentary rock (sandstone and siltstone) and Quaternary deposits (alluvial and landslide deposits). Formations along the alignment include, from east to west, Missoula Flood deposits, the Scappoose Formation, the Pittsburg-Bluff Formation, the Keasey Formation, the Cowlitz Formation, and the Nestucca Formation.

Landslides. Landslide hazard areas are defined as areas susceptible to strength failure of the underlying soil or rock and subsequent downhill movement of the debris. These areas are susceptible to landslides due to a combination of factors, including slope inclination, material type and strength characteristics, geologic structure, and presence of water.

SLIDO 3.2 consists of a compilation of previously mapped landslides from published and unpublished geologic and hazard maps (Burns and Watzig, 2014). The source data composing SLIDO 3.2 vary widely in mapping scale, methods, and scope. The variation in mapping methods results in a range of accuracy and precision for where landslides were mapped. Landslides inventoried in the SLIDO-3.2 database that appear capable of reaching the Valley Segment right-of-way with continued landslide movement were identified within 2,500 ft of the alignment.

Lidar data were used to generate a Digital Elevation Model (DEM) and hill-slope raster that were evaluated using methods described in Oregon Department of Geology and Mineral Industries (DOGAMI) Special Paper 42 (Burns and Madin, 2009). Suspected landslide hazard areas were identified based on geomorphic expression of landslide topography. For the purpose of discussion in this report, the term "landslide topography" includes debris flow fans and initiation areas, landslide debris deposits (hummocky topography), landslide headscarps (areas of concave slope), (closed) depressions, and transverse ridges, snouts, and toes. Landslide topography was mapped if the feature is located within 2,500 ft of the proposed alignment and appears capable of reaching the Valley Segment right-of-way with continued landslide movement. The areas identified as landslide topography were prepared at a scale of 1:4,800 in an ESRI geographic information system (GIS) format database. The geometries of landslides identified from lidar data for this project may differ from those presented in the SLIDO-3.2 database because the landslides mapped for this assessment are based on landslide geomorphology visible in the lidar data imagery, which was unavailable at the time of the geologic mapping summarized in the SLIDO-3.2 database.

Surface Reconnaissance. Portions of the alignment from MP 783 to MP 784 and MP 791.5 to MP 796 were assessed by an experienced certified engineering geologist from GRI for indications of potential slope instability. The reconnaissance included physical evaluation of features typically associated with landslides, such as scarps, hummocky topography, ground cracks, trees in leaning or distressed orientations, exposed soil and rock, and groundwater seeps or springs. Areas that appeared to have recent instability or showed indications of impending instability were noted during the site reconnaissance. Heavy vegetation made visual observation difficult in some areas and, consequently, it is likely there are additional areas of instability along the alignment that could not be observed.

FINDINGS

General

The assessment included a review of existing geological information, evaluation of remotely sensed data, and generation of landslide hazard data. Information on the general condition of the alignment, including topography (slope), geologic unit, and previously identified slope hazards near the alignment, was collected to identify landslide hazards.

Salmonberry Trail Landslide Hazards

The review of the DOGAMI SLIDO-3.2 database indicates four landslides have been previously mapped within 2,500 ft of the project alignment. Two of these landslides mapped near MP 796 are located in a tributary valley to the Nehalem River and do not appear capable of reaching the project alignment with continued movement (Wells et al., 1995). The other two landslides were mapped between MP 776 and 780 at a map scale of 1:100,000 (Yeats et al., 1996). The mapped geometries for these two landslides do not appear to coincide with landslide topography interpreted from lidar data. Three historical landslides identified in the DOGAMI database are within 100 ft of the trail alignment.

Lidar evaluation by GRI disclosed an additional 60 previously unidentified areas of landslide topography within 2,500 ft of the project alignment that appear capable of reaching the right-of-way with continued movement. Of the 60 lidar-identified landslides, approximately 22 intersect the project right-of-way. Based on geomorphic interpretation, the majority of the landslide topography identified to intersect the project appears to be dormant-mature to old, deep-seated landslides (McCalpin, 1984). Thirteen of the intersecting landslides are between about 25,000 sq ft and 11,000,000 sq ft in area. The remaining nine smaller landslides (<20,000 sq ft) intersecting the right-of-way appear to be shallow and likely some deep-seated landslides associated with failing cut slopes.

GRI reconnaissance identified six potential rockfall hazard areas through on-site observations. In general, rockfall hazard areas were observed where cut slopes in the weak marine sedimentary rocks were constructed for the railroad alignment. Root systems for vegetation at the top of the cut slopes appear to result in near-vertical and overhanging slopes where root jacking can loosen blocks of rock. The resulting debris accumulates on or adjacent to the alignment. Debris material could be observed nearly reaching and covering the existing tracks at several locations during the reconnaissance. One of the larger rockfall hazard areas observed between MP 783 and 784 near the west fork of Dairy Creek during the reconnaissance appeared to have recurring rock slope failures indicated by overlapping debris. Debris flow deposits and a debris flow chute were observed in this area. Preliminary mitigation concepts developed in the field for this area include rock scaling, tree removal, and debris haul and disposal. Debris flow mitigation is not included. The estimated conceptual mitigation costs for this site are approximately $50,000 to $60,000. However, continued observation and maintenance of this slope will likely be needed following mitigation. Additional site-specific evaluation will be required to obtain the geotechnical data necessary for development of design recommendations. Additional hazard reduction in this area may require draped wire mesh, rock bolts, and flexible debris flow barriers at an estimated conceptual mitigation cost of approximately $400,000 to $500,000.

Multiple cut slopes along the alignment expose sedimentary rock to decomposition that could be the source for rockfall debris that reaches the trail. Additional areas of rockfall hazard may be identified as vegetation is cleared for the project, revealing hazard areas visually concealed by vegetation during the reconnaissance.

The potential for landslide triggering depends on several factors, including steepness of slope, bedrock type and weathering, rainfall, geologic structure, and modification of the slope for construction. Landslides in the Pacific Northwest typically occur following long periods of precipitation and intense rainfall. The majority of the landslides identified in this assessment consist of large, deep-seated landslides that likely are dormant or very slow moving. Damage to the trail caused by landslide movement is related to the size, location, and velocity of movement. Material accumulation from small landslide failures can generally be addressed by post-storm maintenance. Larger landslides may displace more of the trail alignment and result in greater repair costs, but movement of larger landslides typically occurs at slower displacement rates and at less frequent time intervals than smaller landslides. In the case of very large, slow-moving landslides, damage requiring repair to the alignment may be limited to near the boundaries of the landslide while the majority of the alignment crossing the areas of slope instability moves without apparent damage. Large movements can accumulate slowly and may require ongoing maintenance, while small-volume, rapidly moving landslides can quickly accumulate material in the right-of-way. In general, large, deep-seated landslides are less likely to move rapidly or have significant displacement in any one episode of movement, although large movements can occur on previously slow-moving landslides. However, detailed geotechnical investigations into the type and occurrence of landslides along the alignment will be necessary to develop appropriate mitigation strategies for the project.

It should be noted that none of the landslides identified as part of this project have been monitored with instrumentation to detect potentially small subsurface movements not apparent in the lidar data or at ground level. Detailed mapping of landslide features, such as landslide type, length, width, area, scarp height, slope, volume, probable cause, and geology, was not completed. In this regard, some landslides considered dormant at this time could be determined to be active with additional surface mapping, instrumentation, and assessment.

LIMITATIONS

This report has been prepared to aid Parametrix and the Oregon Parks and Recreation Department in the evaluation of landslide hazards. The scope is limited to the specific locations and evaluation methods described herein. The findings submitted in this report are based on the data obtained from the literature review, digital image analysis and interpretation, surface reconnaissance completed at the locations indicated in this report, and other sources of information discussed herein. Areas identified with some level of hazard are based on the information available at the time the work was completed and observations made during the site reconnaissance. Areas susceptible to landslide may not have been identified by the methods outlined above due to underlying site conditions not disclosed by the methods discussed herein or by changes in surface conditions during this project.

Submitted for GRI,

George A. Freitag, CEG
Principal

Michael J. Zimmerman, PE, GE, CEG
Senior Engineer / Geologist

Michael S. Marshall, CEG
Project Geologist

This document has been submitted electronically.

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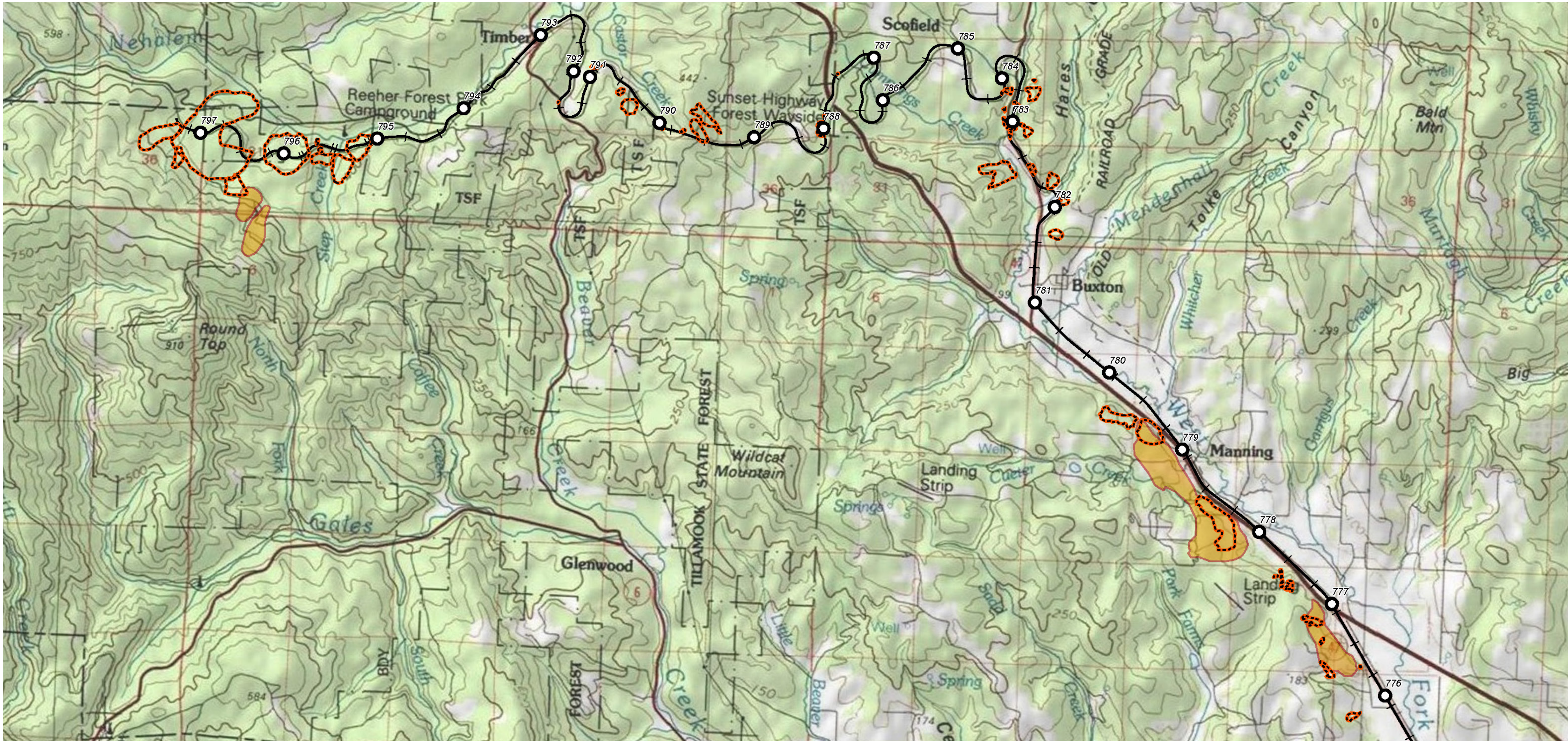

USGS TOPOGRAPHIC MAP
TIMBER, OREG. (1979)
BUXTON, OREG. (1979)

North

0 4,400 8,800 FT

MAP LEGEND

- MILEPOSTS
- LANDSLIDE HAZARD
- SLIDO 3.2
- SALMONBERRY TRAIL

GRI

PARAMETRIX
SALMONBERRY TRAIL LANDSLIDE HAZARD ASSESSMENT

VICINITY MAP

AUG. 2017 JOB NO. 6030 FIG. 1