Southwest Washington I-5 Wildlife Crossings Alternatives Analysis Report

Prepared for

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1 Introduction

1.1 Scope of Study

Conservation Northwest (CNW) retained Samara Group, LLC (SG) and River Design Group, Inc. (RDG) to perform an alternatives analysis and conceptual design for potential wildlife crossings along Interstate 5 (I-5) in two zones: the Southern Linkage Zone (SLZ) from the Toutle River bridge (MP 51.7) to the Cowlitz River Bridge (MP 59.1) and the Northern Linkage Zone (NLZ) from the Scatter Creek bridge (MP 90.4) to an unnamed tributary of (UNT) Salmon Creek (MP 98.1) (**Figure 1-1**). The goal of this work is to increase the overall permeability for wildlife to move between areas east and west of the highway and to reduce wildlife-vehicle collisions (WVCs) which are dangerous to drivers and wildlife populations alike.

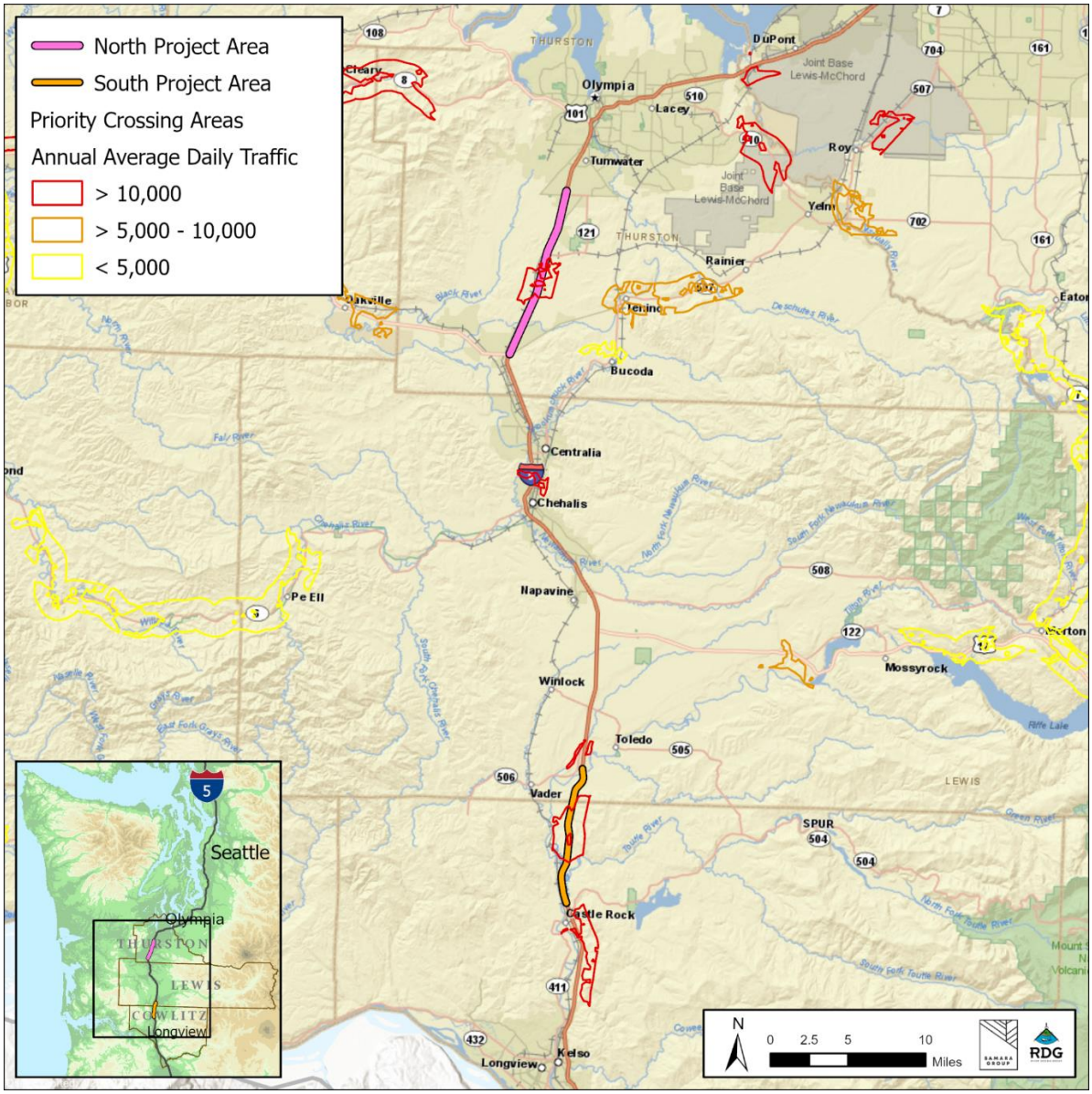

Figure 1-1. *Vicinity Map showing the project areas within the WSDOT priority crossing areas along Interstate Highway 5.*

This alternatives analysis report presents a summary of Task 1 (kickoff and review of existing information), Task 2 (project partner interviews), Task 3 (corridor analysis and preliminary site selection), Task 4 (design context), and the preferred wildlife passage alternatives (Task 5). Preferred alternatives were selected during Design Workshop 2 on May 14, 2024. The design alternatives include a relative evaluation of project benefits and risks, anticipated costs, and schedule. The preferred alternatives will be advanced into conceptual design.

This report follows the first design workshop as well as interviews and background research. The draft report was reviewed by the SW WA I-5 wildlife crossings steering committee (SC) and technical advisory group (TAG). The report was informed by the second design workshop which included the preferred alternative selection to develop this alternatives analysis report (**Figure 1-2**).

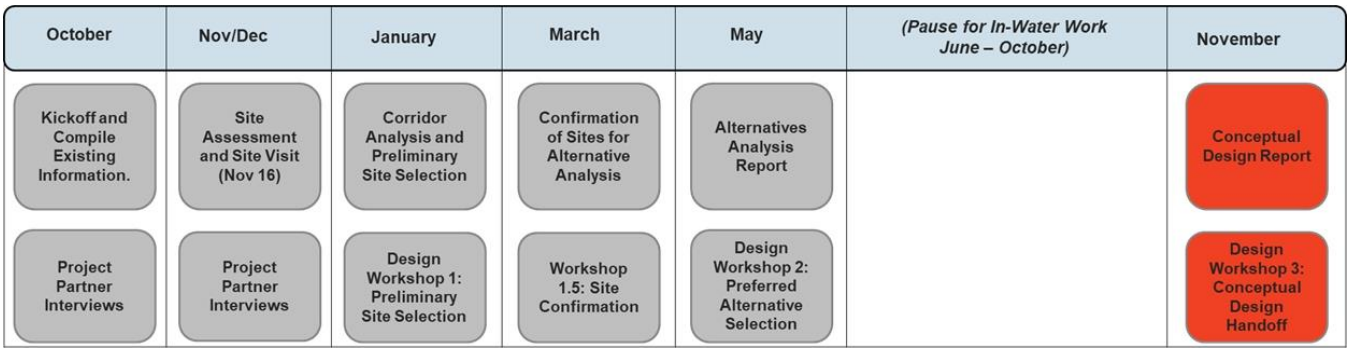

***Figure 1-2**. Progress in the Project Timeline.*

1.2 Project Partner Engagement

Improving wildlife movement across I-5 is an important mission that affects many varied species, including humans. Multiple organizations and agencies have a vested interest in creating or restoring crossing structures in southwest Washington. It was therefore essential to include project partners throughout the decision-making process. It is important to consider different perspectives, experiences, and approaches for this kind of project. A kickoff meeting gave members of the SC and TAG an outline of how each site would be evaluated, where new potential crossings may be considered and the process for evaluating alternatives for each site to advance the design to a conceptual level with sufficient detail to begin preliminary design. Members of the SC and TAG are invited to participate in this decision-making process (**Figure 1-3**) through a series of interviews and workshops.

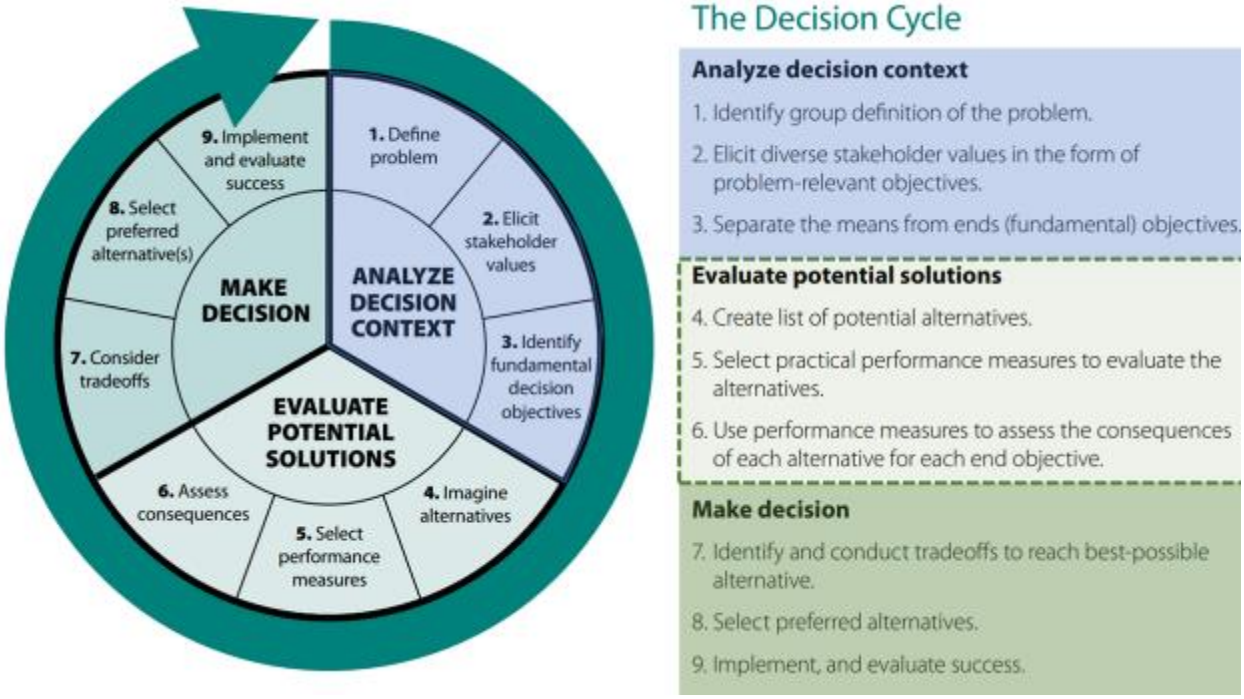

***Figure 1-3**. Overview of the structured decision-making process (Wilson & Arvai, 2011).*

1.3 Interviews

Following the kickoff meeting, individual, or small group interviews were conducted with members of the coalition to gauge priorities and perspectives across agencies. A total of 15 interviews were conducted with 26 individuals from 11 different organizations/agencies (Appendix A). All interviews were held between October 2023 and December 2023.

Interviewees were asked the following questions/prompts:

- When/how did you get involved or otherwise connected with the SW WA I-5 wildlife crossings?
- What are your expectations for this phase of the work? What are your goals/outcomes for you or your organization/agency? What are your top priorities for a final crossing structure design?
- What do you see as potential roadblocks to reaching the goals/outcomes stated above?
- Are there any other considerations or things we should know?

Responses from the interviews were analyzed to understand common themes and identify all opportunities and constraints of potential crossing structures that group members brought attention to. From these interviews a draft decision matrix was prepared that highlighted species of concern and potential constructions or retrofits to crossing structures that could benefit wildlife movement. This information was used to guide the full partner workshops.

1.4 Workshops

A series of design workshops helped to inform the engineering basis of design. The outcome of these workshops is to collaboratively develop design alternatives and conceptual designs. This process involves building the project knowledge base and providing opportunity for feedback from the project partners as designs advance.

January 16, 2024 | Virtual Baseline Conditions, Opportunities and Constraints Workshop:

This meeting covered the main takeaways and outcomes from the project partner interviews, reviewed baseline conditions in the corridor, and identified preliminary sites selected for the alternatives analysis. The different perspectives from the interviews gave essential insights into the planning of potential crossing structures and highlighted wildlife species of concern. Overall, the consensus was to prioritize permeability and movement for this entire stretch of I-5 in the two zones. There were four recurring priority categories discussed, each of which had their own opportunities and challenges. The following priorities were used to outline the draft decision matrix: species of special concern; landscape context; human disturbance potential; and multiple benefit locations. Coalition members had the opportunity to comment on or ask questions about the draft decision matrix. We reviewed the corridor context from available spatial data and site assessment observations from the site visit in November 2023. A site-by-site review was presented, details of which are in Section 2, Baseline Conditions. Preliminary sites for the alternatives analysis were discussed and members were invited to provide additional feedback and site recommendations after the workshop. The sites selected for this alternatives analysis are discussed in Section 3, Wildlife Passage Alternatives.

March 19, 2024 | Hybrid Site Confirmation Workshop:

This workshop reconvened the SC and TAG members to confirm the site selection for the alternatives analysis. Feedback from workshop 1 indicated that the group members needed additional time for comment and consideration of the sites before moving into the alternatives analysis. SG and RDG presented the original sites from workshop 1 and additional sites suggested by SC and TAG members via a poll conducted prior to the workshop. Eleven sites were selected during this workshop for consideration in the alternatives analysis (see Section 3 of this report for discussion of the sites selected).

May 14, 2024 | Virtual Preferred Alternative Selection and Conceptual Design Kickoff Workshop:

The purpose of this workshop was to select preferred alternatives for advancement into conceptual design. SG and RDG presented a summary of the draft alternatives analysis report and made preliminary recommendations of a preferred alternative at each site. Their recommendations were based on the Draft Decision Matrix developed during the project partner interviews. They facilitated discussion and solicited feedback from the project partners to reach consensus on one preferred alternative for each site. These decisions are documented in Section 4 of this report.

December 4, 2024 (not yet completed) | Virtual Conceptual Design Review and Decision Matrix Workshop:

The purpose of this workshop is to confirm the relative ranking of the preferred alternative conceptual design for each crossing site. SG and RDG will present a summary of the draft conceptual design report and the relative ranking of each site based on the final Decision Matrix. This will be our last meeting with the SC and TAG before the conclusion of their scope of work. This meeting is an important chance to receive any additional input, ideas, or concerns from the partners for inclusion in the conceptual designs which will become the basis for further design and implementation. We want to make sure that all voices are heard and ideas are not lost during the rest of the design development process, which may be less open to input.

1.5 Standard of Practice

This alternatives analysis was performed or directed by a Professional Engineer (PE) and Registered Geologist (RG) licensed to practice civil engineering and geology in the State of Washington with over 10 years of experience with fish passage, river restoration, and transportation improvement projects and a wildlife ecologist with over 15 years of experience in habitat connectivity assessment and modeling, wildlife crossing monitoring, and transportation ecology study. The standard of care used to develop this study meets those of a planning level, alternatives study based on available budget constraints and existing data provided to RDG and SG from CNW, WSDOT, Washington Department of Fish and Wildlife (WDFW), Wildlands Network (WN), Panthera, Washington Department of Natural Resources (WDNR), iNaturalist, Open Street Maps, Lewis County, Cowlitz County, Thurston County, and other publicly available datasets.

2 Baseline Conditions

The design team visited several sites on November 16 and 17, 2023 to observe baseline conditions and begin discussion of potential wildlife crossing improvements with members of the SC and TAG. They visited six sites on day 1 (**Figure 2-1**) and six sites on day 2 (**Figure 2-2**) with the menu of wildlife crossing improvement opportunities (**Appendix B**) in mind. Observations for each site are discussed in this section. **Table 2-1** summarizes the baseline conditions for existing structures observed within the SW WA I-5 project corridor.

Species' presence and use of existing structures will be updated in the conceptual design report (Task 6) with the results of WSDOT's camera monitoring of the corridor.

***Table 2-1**. Summary of baseline conditions for existing structures.*

Site	Existing Structure	Existing Species Use
MP 51.7 Toutle River	Single-span steel tied arch bridges (one structure each northbound and southbound), constructed in 1969, "fair" condition	Likely to occasionally pass highly habituated species such as resident deer, and/or those with high tolerance for human presence such as raccoon and coyote.
MP 53.9 UNT Cowlitz River	2 ft corrugated metal pipe culvert, very long (approximately 700 ft) diagonal under highway	Currently unable to pass any species
MP 56 UNT Hill Creek	10 ft x 10 ft concrete box culvert at inlet transitioning to 10 ft diameter corrugated metal pipe culvert at outlet	Likely passing bear, deer, raccoon, and other species comfortable with wading through water.
MP 58.5 Foster Creek	8 ft tall x 10 ft wide concrete box culvert, outlet apron detached from culvert structure	Likely passing bear, deer, raccoon, and other species comfortable with wading through water.
MP 59.1 Cowlitz River	Two-span steel truss bridges (one structure each northbound and southbound) supported on concrete T-beams, constructed in 1953, "fair" condition	Likely to occasionally pass highly habituated species such as resident deer, and/or those with high tolerance for human presence such as raccoon and coyote.
MP 90.4 Scatter Creek	Single-span concrete slab bridge (one structure for both northbound and southbound), constructed in 2010, "good" condition	During low flows, this structure likely accommodates most terrestrial species but may be difficult for terrestrial amphibians because of extensive riprap. Lack of habitat structure may also discourage some small mammal movement, although cover may be available in larger sized rock. High flow periods prohibit most terrestrial species movement, except for small species able to use narrow steep margins at the end of the structure. Salmonids have been observed and Lamprey and other fish are likely to pass easily during high flows.
MP 92.5/92.7 Vets Farm and Maytown	N/A no existing structures	Unknown, but wildlife activity noted nearby including elk and bear. Not an aquatic passage so not suitable for fish.
MP 96.1 Basalt Roadcut	N/A no existing structures	Unknown, but wildlife activity noted nearby including deer and cougar. Not an aquatic passage so not suitable for fish.

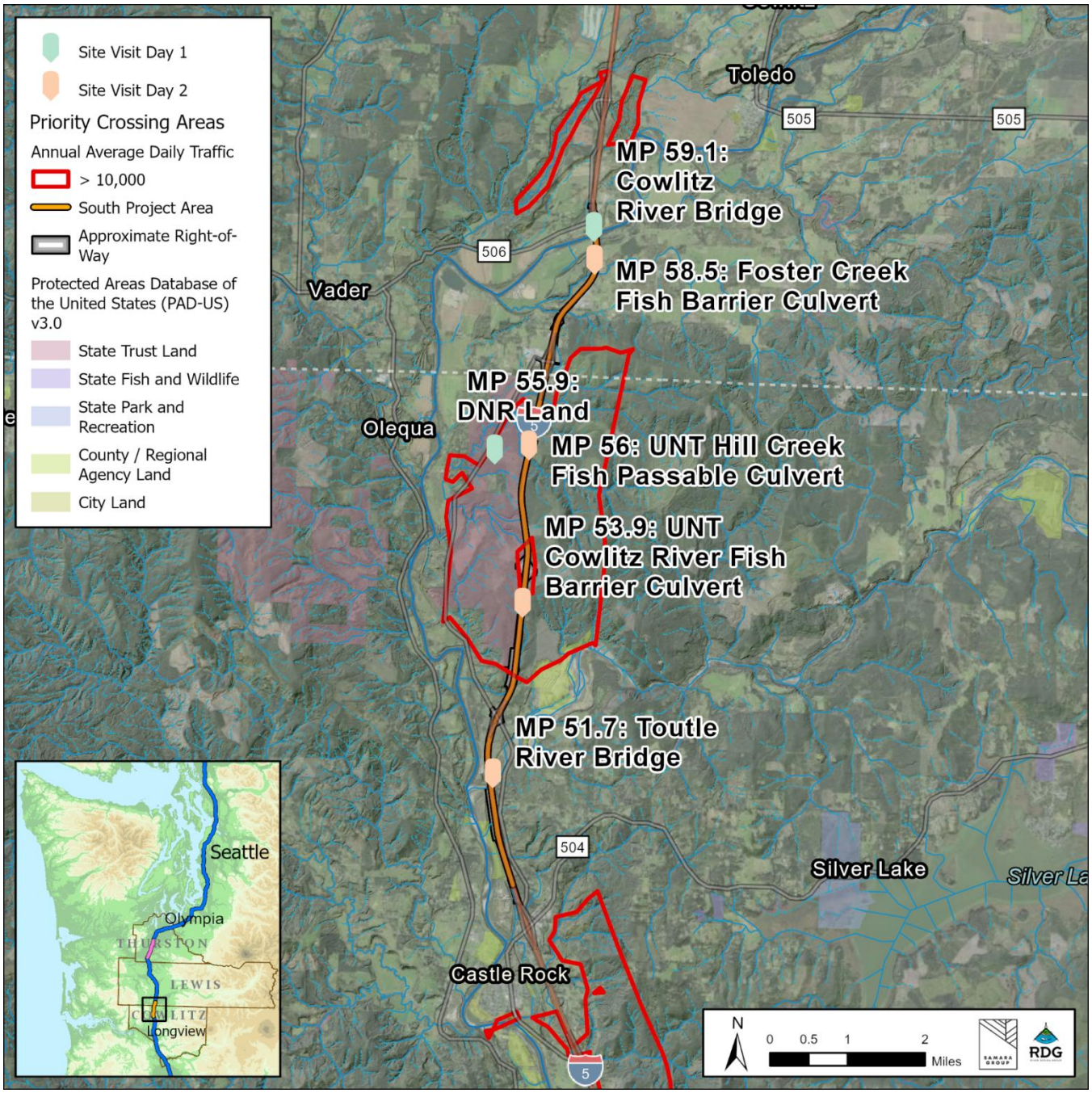

***Figure 2-1**. South zone site assessment stops.*

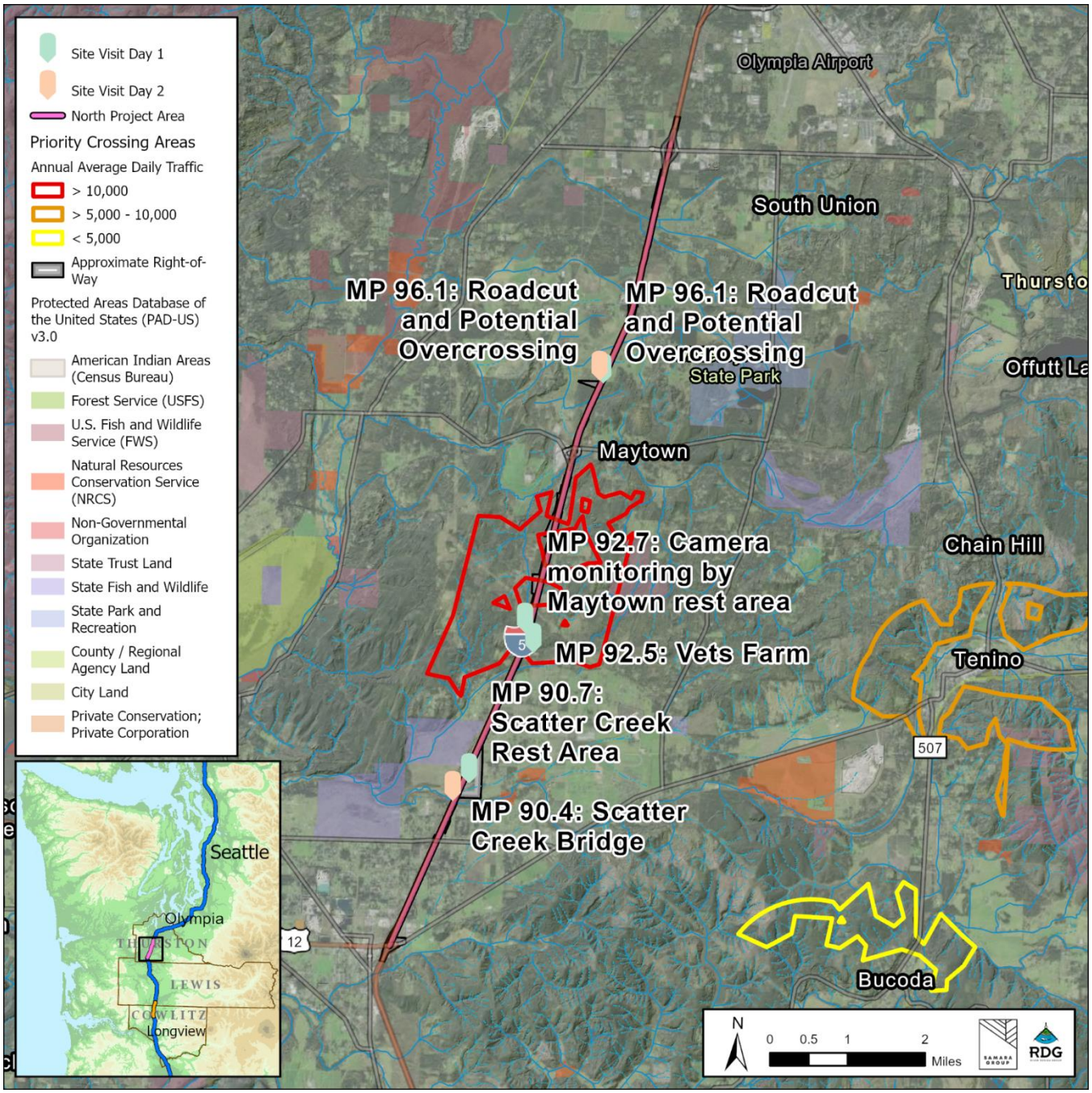

***Figure 2-2**. North zone site assessment stops.*

In addition to site-specific conditions, general roadway baseline conditions affect crossing structure layouts (**Appendix C)** and the applicable engineering design criteria (**Appendix D**).

Roadway baseline conditions for I-5 in the project area include:

- Posted speed of 70 mph
- Roadway widths vary:

  - MP 51.7 to 56: three 12-ft lanes in each direction with 10-ft paved shoulders and variable-width paved median (total roadway width varies from approximately 60 ft to 100 ft)
  - MP 56 to 59.2: two 12-ft lanes in each direction with 10-ft paved shoulders and variable-width paved median (total roadway width varies from approximately 50 ft to 65 ft)
  - MP 90 to 98.1: three 12-ft lanes in each direction with 10-ft paved shoulders and variable-width paved median and climbing lanes (total roadway width varies from approximately 70 ft to 120 ft)
- Functional class designation: Rural Interstate
- T-1 freight and goods transportation system truck corridor (more than 10 million annual tons)
- Traffic flow (average annual daily traffic (AADT)) as of December 31, 2022:
  - MP 51.7 to 59.1: 44,000
  - MP 90.4 to 98.1: 68,000
- Truck flow (AADT) as of December 31, 2022:
  - MP 51.7 to 59.1: 12,000
  - MP 90.4 to 98.1: 12,000

2.1 MP 51.7: Toutle River Bridge

The existing bridges over the Toutle River at MP 51.7 (WSDOT structure IDs 0008335A and 0008335B) are single-span steel tied-arch bridges carrying northbound and southbound traffic separately (**Figure 2-3**). The bridge spans (perpendicular to the direction of animal movement) are between 304 ft and 309 ft. The total width (in the direction of animal movement) is approximately 100 ft for both bridges. The bridges were constructed in 1969 and have a 'fair' condition rating from the bridge inspections. The right-of-way on the south side includes the railroad and does not include the railroad on the north side.

A trail crosses under the bridge on the south (river-left) side and informal trails are present on the north (river-right) side (**Figure 2-4**). The channel of the Toutle River appears well-connected to overbank areas with areas of sediment deposition and channel widening observed at the confluence with the Cowlitz River downstream. This condition reflects the recent volcanic deposits of Mount St. Helens in the watershed and sediment deposition is likely to continue. No wetlands mapped in the national wetland inventory are present other than the river channel.

The existing bridge has high human activity and very loud road noise from existing traffic. Because of these disturbances it is unlikely that more sensitive species such as large carnivores will frequent the area. It is likely that the Toutle River Bridge does occasionally pass highly habituated species such as resident deer, and/or those with high tolerance for human presence such as raccoon and coyote. These species are mostly likely to use the structure during periods of low traffic volume and reduced human presence. The vegetation cover is well established throughout the passage area and vegetation is likely to provide connectivity for small mammals, amphibians, and reptiles. This again assumes use by species that are not sensitive to noise and human presence and/or are able to use the structure when

traffic and human activity is low. The bridge is not included in the WDFW state fish passage database and is passable.

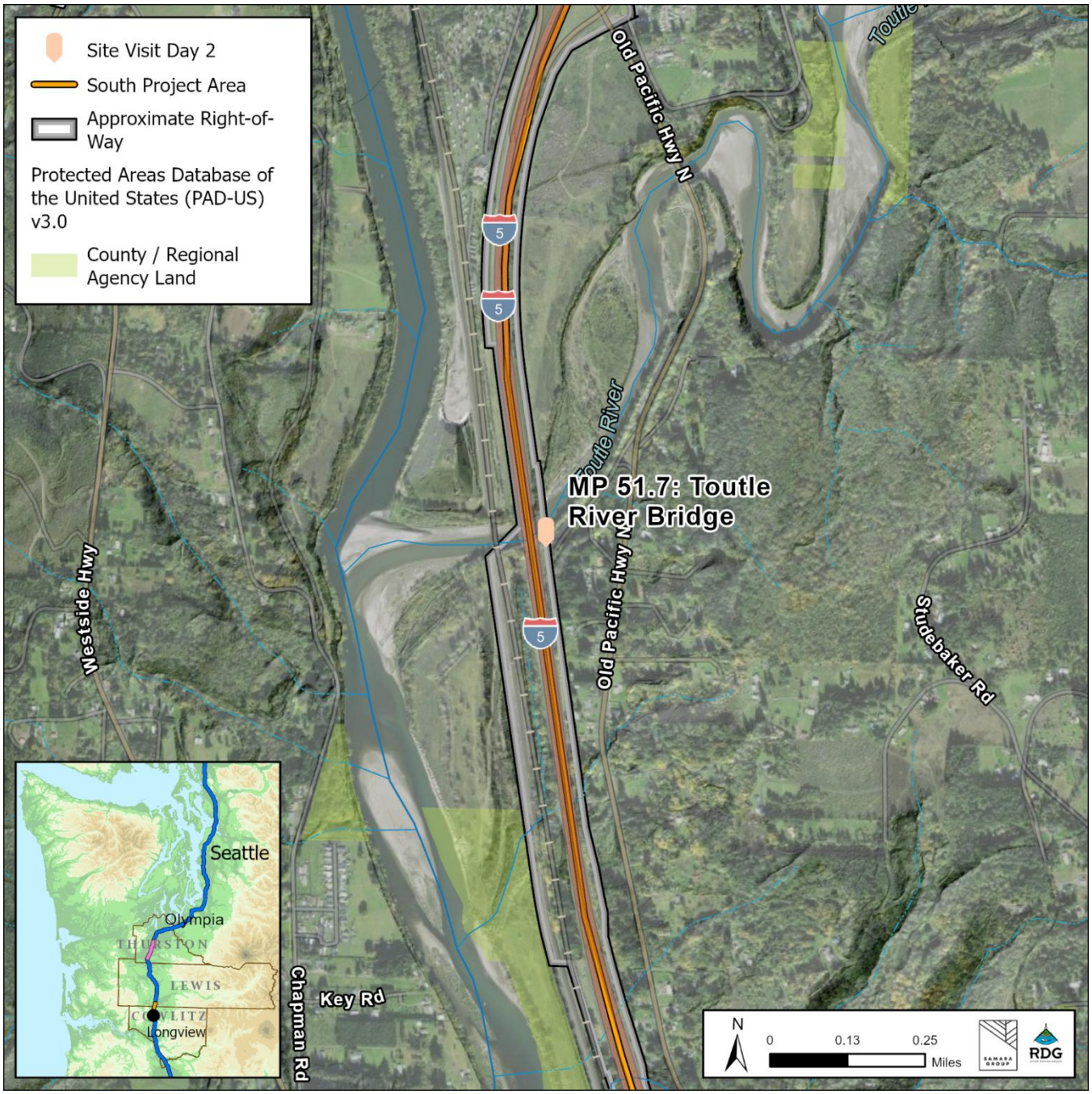

***Figure 2-3**. MP 51.7 Toutle River bridge site assessment stop.*

***Figure 2-4**. Trail on south (left) bank of Toutle River under southbound bridge.*

2.2 MP 53.9: Unnamed Tributary of (UNT) Cowlitz River Culvert

The existing culvert conveying the unnamed tributary (UNT) of the Cowlitz River at MP 53.9 is a 36-inch diameter corrugated metal pipe culvert (**Figure 2-5**). The existing pipe alignment is diagonal under I-5 and approximately 700 ft long. Other stormwater pipes may enter the culvert at a manhole near the inlet. The outlet was not located during the November 2023 site assessment due to dense vegetation and woody material (**Figure 2-6**). No mapped wetlands are present other than the creek channel.

WSDOT fish passage staff located the culvert outlet and inlet in December 2023 and observed a water surface drop that would indicate a fish passage barrier. The culvert is in the WDFW fish passage database (site ID 992608) and classified as a 100% physical barrier. Potential species using the UNT Cowlitz River include coho salmon, steelhead, sea-run cutthroat trout, and resident trout. The upstream potential habitat gain is reported as 667 m (approximately 0.4 mi).

The current size (36 inches) and length (700ft) make it unlikely to pass most species, but it may be used by habituated species that are comfortable with small dark spaces such as raccoon, coyote, and possibly mustelids and foxes.

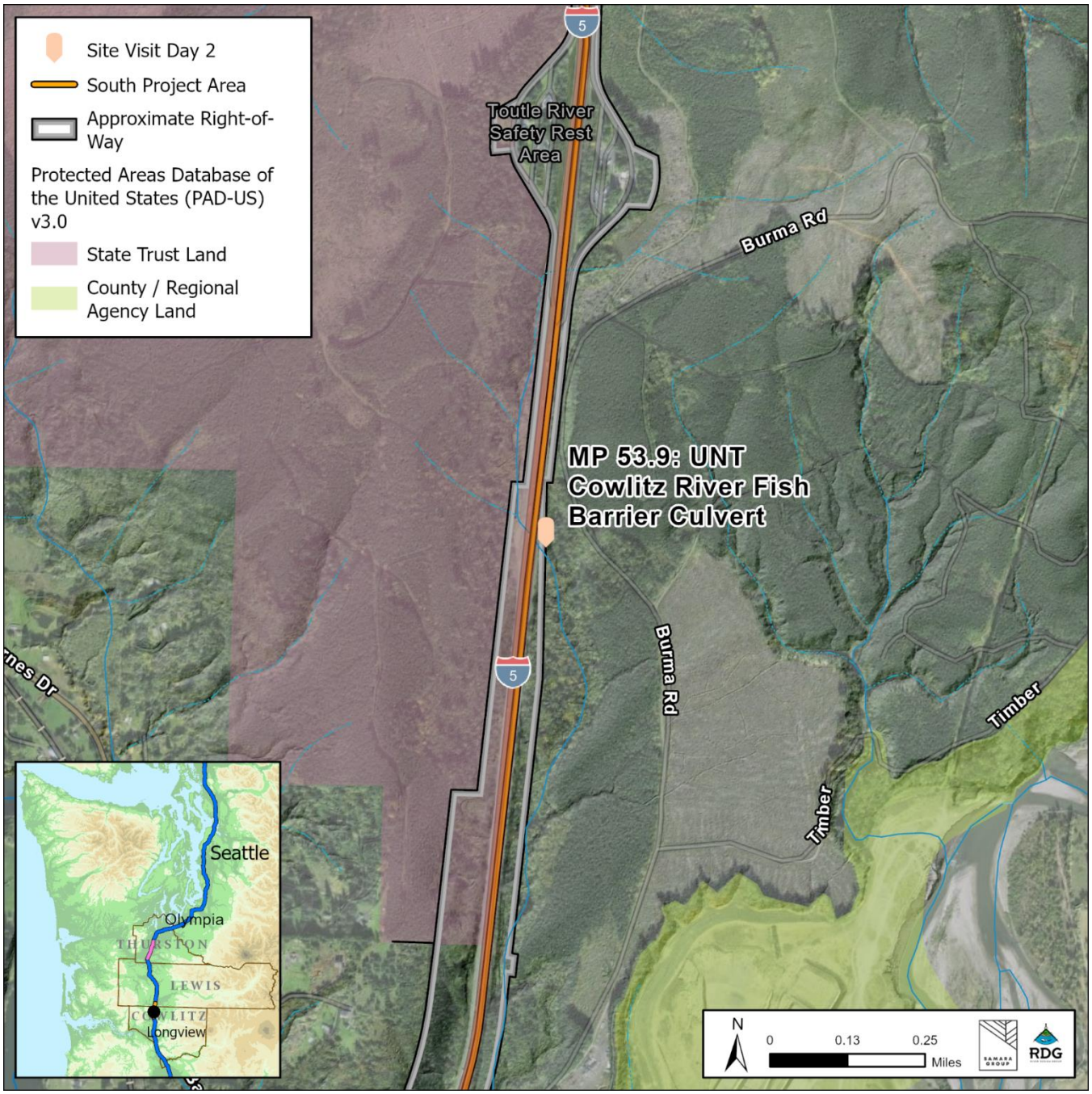

***Figure 2-5**. MP 53.9 UNT Cowlitz River culvert site assessment stop.*

Figure 2-6. *Channel downstream of the MP 53.9 culvert (culvert outlet not located during site assessment).*

2.3 MP 56: UNT Hill Creek Culvert and WDNR Land

The existing culvert conveying UNT of Hill Creek at MP 56 is a 10 ft by 10 ft concrete box culvert at the inlet and a 10 ft diameter corrugated metal pipe culvert at the outlet (**Figure 2-7**). The existing pipe alignment is straight under I-5 and approximately 300 ft long with light visible through it from the inlet during the November site assessment (**Figure 2-8**). No wetlands mapped in the national wetland inventory are present other than the creek channel.

The culvert is in the WDFW fish passage database (site ID 991594) and classified as 100% passable. Potential species using the UNT Hill Creek include chum salmon, coho salmon, steelhead, sea-run cutthroat trout, and resident trout. WSDOT fish passage staff visited the site in December 2023 and recommended an updated passage assessment (it was last assessed in 2000).

This structure is relatively quiet and not located in a high traffic human area. The culvert likely provides passage for large and medium mammals that are comfortable with wading through water such as bear, deer, and raccoon. Small mammals are unlikely to attempt to

use this structure as it is fully wet. At the time of observation, flow was slow and could be suitable for aquatic amphibians or reptiles such as garter snakes that are comfortable with swimming. The structure is undersized for elk passage.

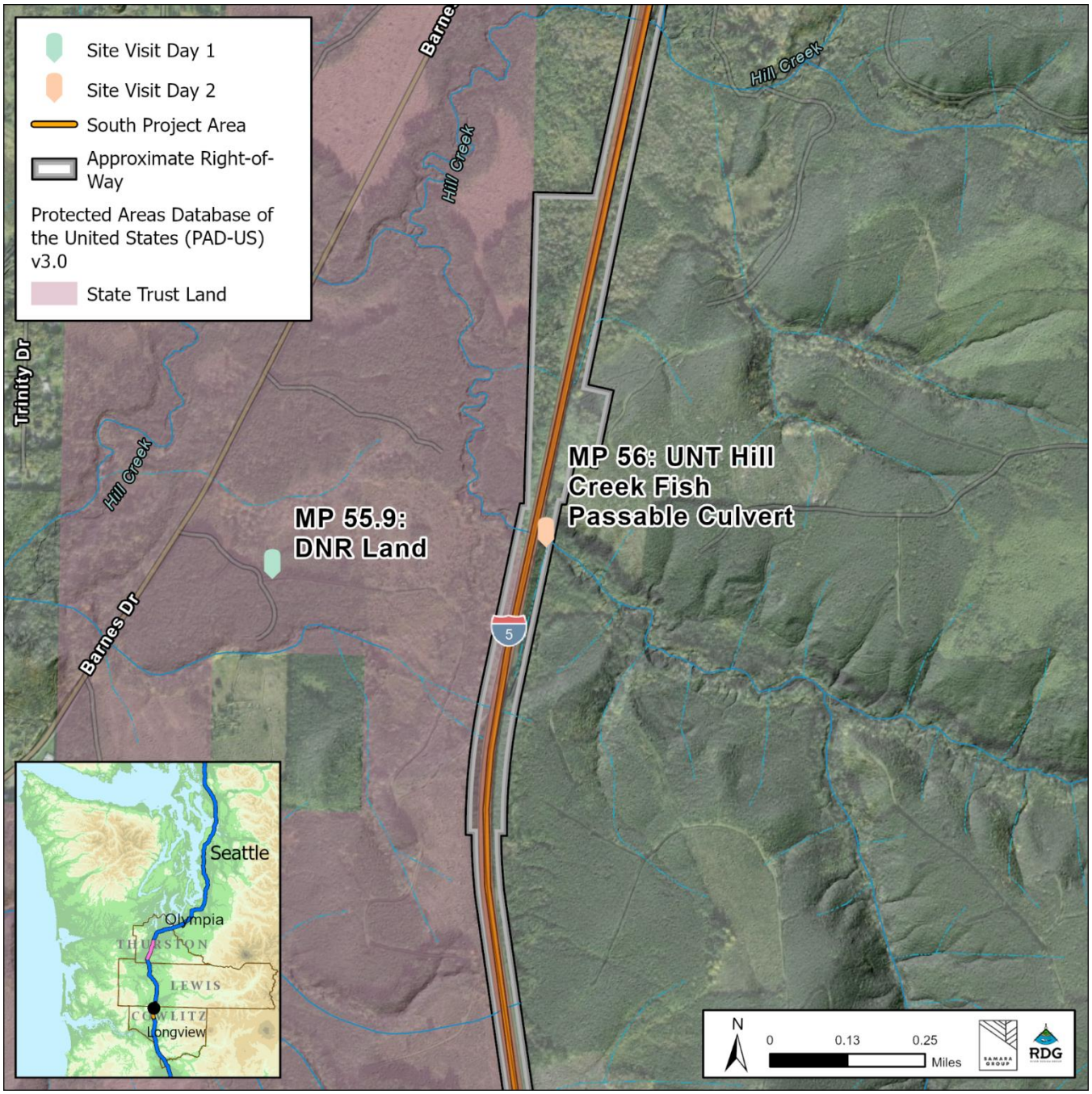

***Figure 2-7**. MP 56 UNT Hill Creek culvert and WDNR land site assessment stop.*

***Figure 2-8**. MP 56 UNT Hill Creek culvert inlet during November 2023 site assessment.*

2.4 MP 58.5: Foster Creek Culvert

The existing culvert conveying Foster Creek at MP 58.5 is an 8 ft wide by 10 ft tall concrete box culvert approximately 170 ft long with light visible through it from the inlet during the November site assessment (**Figure 2-9, Figure 2-10**). No wetlands mapped in the national wetland inventory are present other than the creek channel.

The culvert is in the WDFW fish passage database (site ID 990152) and classified as 33% passable. Potential species using the UNT Hill Creek include coho salmon, steelhead, sea-run cutthroat trout, and resident trout. The upstream potential habitat gain is reported as 6,939 m (approximately 4.3 mi). WSDOT fish passage staff visited the site in December 2023 and observed that the culvert apron at the outlet has detached (**Figure 2-11**) and may be a total passage barrier; they recommended an updated passage assessment (it was last assessed in 2000).

This structure is relatively quiet and not located in a high traffic human area. The structure likely provides passage for large and medium mammals that are comfortable with wading through water such as bear, deer, and raccoon. Small mammals are unlikely to attempt to use this structure as it is fully wet. At the time of observation, flow was slow and could be suitable for aquatic amphibians or reptiles such as garter snakes that are comfortable with swimming. The structure is undersized for elk passage.

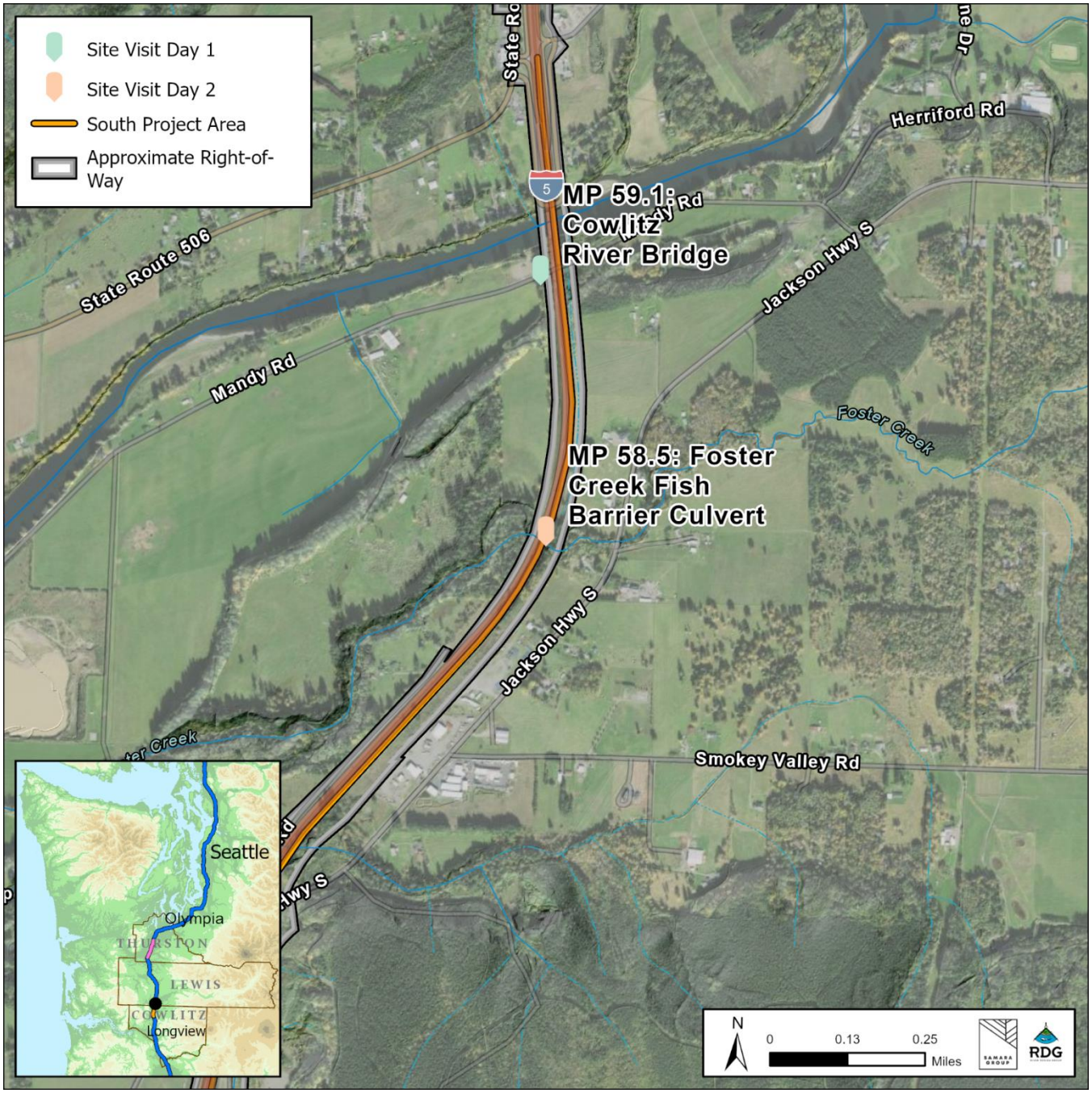

***Figure 2-9**. MP 58.5 Foster Creek culvert site assessment stop.*

***Figure 2-10**. MP 58.5 Foster Creek culvert inlet from November 2023 site assessment.*

***Figure 2-11**. MP 58.5 Foster Creek culvert outlet from December 2023 WSDOT fish passage assessment.*

2.5 MP 59.1: Cowlitz River Bridge

The existing bridges over the Cowlitz River at MP 59.1 (WSDOT structure IDs 0004367A and 0004367B) are multi-span steel truss bridges on concrete t-beams carrying northbound and southbound traffic separately (**Figure 2-12**). The total bridge span (perpendicular to the direction of animal movement) is 760 ft with maximum spans of 240 ft. The total width (in the direction of animal movement) is approximately 70 ft for both bridges. The bridges were constructed in 1953 and have a 'fair' condition rating from the bridge inspections. The right-of-way does not include the parking lot or boat launch on the downstream river-left side of the bridges.

Mandy Road and a trail crosses under the bridge on the south (river-left) side and Cowlitz Loop road crosses under the bridge on the north (river-right) side (**Figure 2-13**). The channel of the Cowlitz River appears disconnected from overbank areas with no observed areas of scour, sediment deposition, or channel widening. The distant headwaters of the Cowlitz River are on Mt. Rainier and the volcanic and glacial sediments are likely to be transported through the river network in the future. Freshwater emergent and forested/shrub wetlands are mapped in the national wetland inventory in addition to the river channel.

The existing bridge has high human activity and very loud road noise from existing traffic. Because of these disturbances it is unlikely that more sensitive species such as large carnivores will frequent the area. It is likely that the Cowlitz River Bridge does occasionally pass highly habituated species such as resident deer, and/or those with high tolerance for human presence such as raccoon and coyote. These species are mostly likely to use the structure during periods of low traffic volume and reduced human presence. The vegetation cover is well established throughout the passage area and is likely to provide connectivity for small mammals, amphibians, and reptiles. This again assumes use by species that are not sensitive to noise and human presence and/or are able to use the structure when traffic and human activity is low. The bridge is not included in the WDFW state fish passage database and is assumed to be passable.

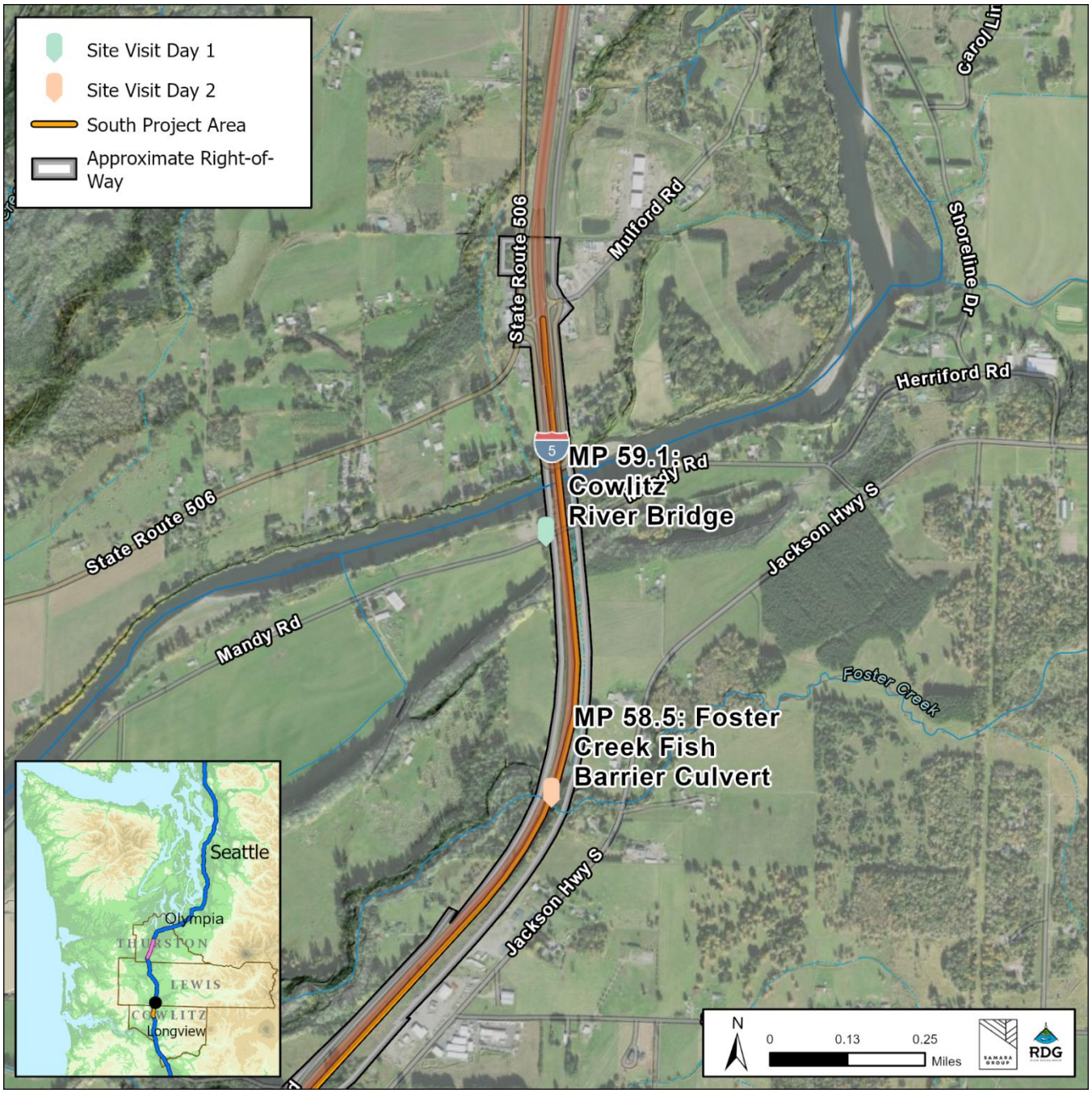

***Figure 2-12**. MP 59.1 Cowlitz River bridge site assessment stop.*

***Figure 2-13**. Existing bridge over the Cowlitz River; photo taken from south (river-left) bank looking north.*

2.6 MP 90.4/90.7: Scatter Creek Bridge and Rest Area

The existing bridge over Scatter Creek at MP 90.4 (WSDOT structure ID0017465C) is a single-span concrete slab bridge carrying both northbound and southbound traffic (**Figure 2-14**). The bridge span (perpendicular to the direction of animal movement) is 85 ft. The total width (in the direction of animal movement) is approximately 120 ft. The bridge was constructed in 2010 and has a 'good' condition rating from the bridge inspections. The right-of-way does not include the adjacent railroad.

Scatter Creek is in glacial outwash deposits with a broad low-gradient floodplain. The channel bed under the bridge is composed of rounded cobbles and gravels with margins of scour protection rock. The channel was dry during the November 2023 site assessment (**Figure 2-15**) with approximately 8 ft of vertical clearance from the channel bottom to the low chord of the bridge. WSDOT staff provided a photo from December 2023 showing the channel at half bankfull flow and approximately 5 ft of vertical clearance above the scour protection rock margins (**Figure 2-16**). Freshwater emergent and forested/shrub wetlands are mapped in the national wetland inventory in addition to the river channel.

During low flows, the existing bridge is dry and likely accommodates most terrestrial species but may be difficult for terrestrial amphibians because of extensive scour protection rock. Lack of habitat structure may also discourage some small mammal movement, although cover may be available in larger sized rock. High flow periods prohibit most terrestrial species movement, except for small species able to use narrow steep margins at the end of the structure. This structure is undersized for elk passage. The bridge is included in the WDFW state fish passage database (site ID 996725) and is 100% passable. Potential species using Scatter Creek include coho salmon, sea-run cutthroat trout, and resident trout.

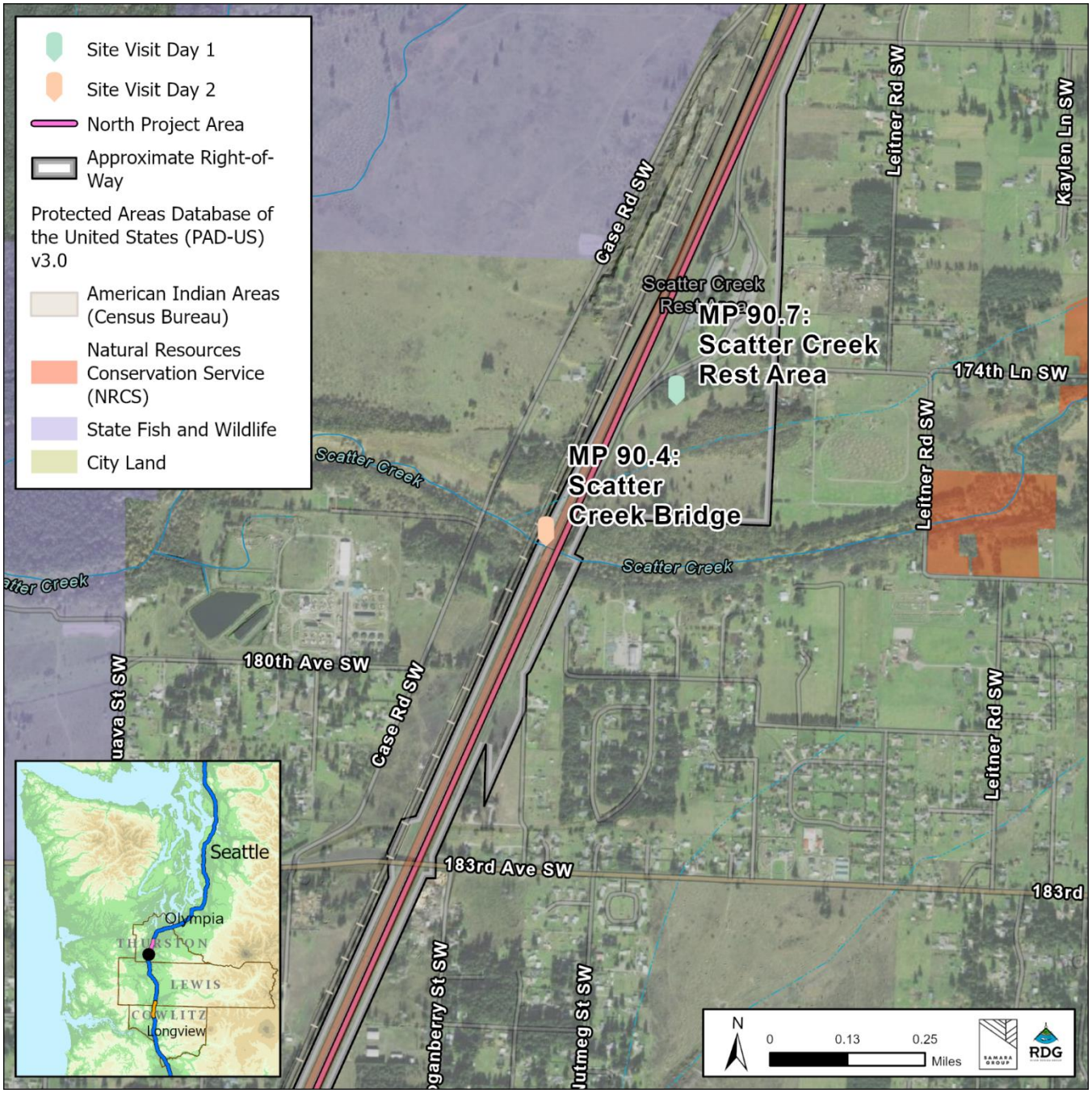

***Figure 2-14**. MP 90.4/90.7 Scatter Creek site assessment stops.*

Figure 2-15. *Dry Scatter Creek channel and bridge during November 17, 2023 site assessment.*

Figure 2-16. *Scatter Creek bridge in December 2023. The channel bottom is fully wetted with approximately 5 ft of vertical clearance above the dry margin of scour protection rock.*

2.7 MP 92.6/92.7/92.8: Vets Farm and Maytown

There is no existing structure at this location to provide wildlife movement across the highway (**Figure 2-17**); however, wildlife activity has been noted nearby including elk, bears, cougars and a bobcat. The area around Vets farm on the east side of the highway is managed as a combination of pasture, ponds, and forest (**Figure 2-18**). The site visit on the west side near the Maytown rest area identified open woodland with areas of emergent vegetation (**Figure 2-19**).

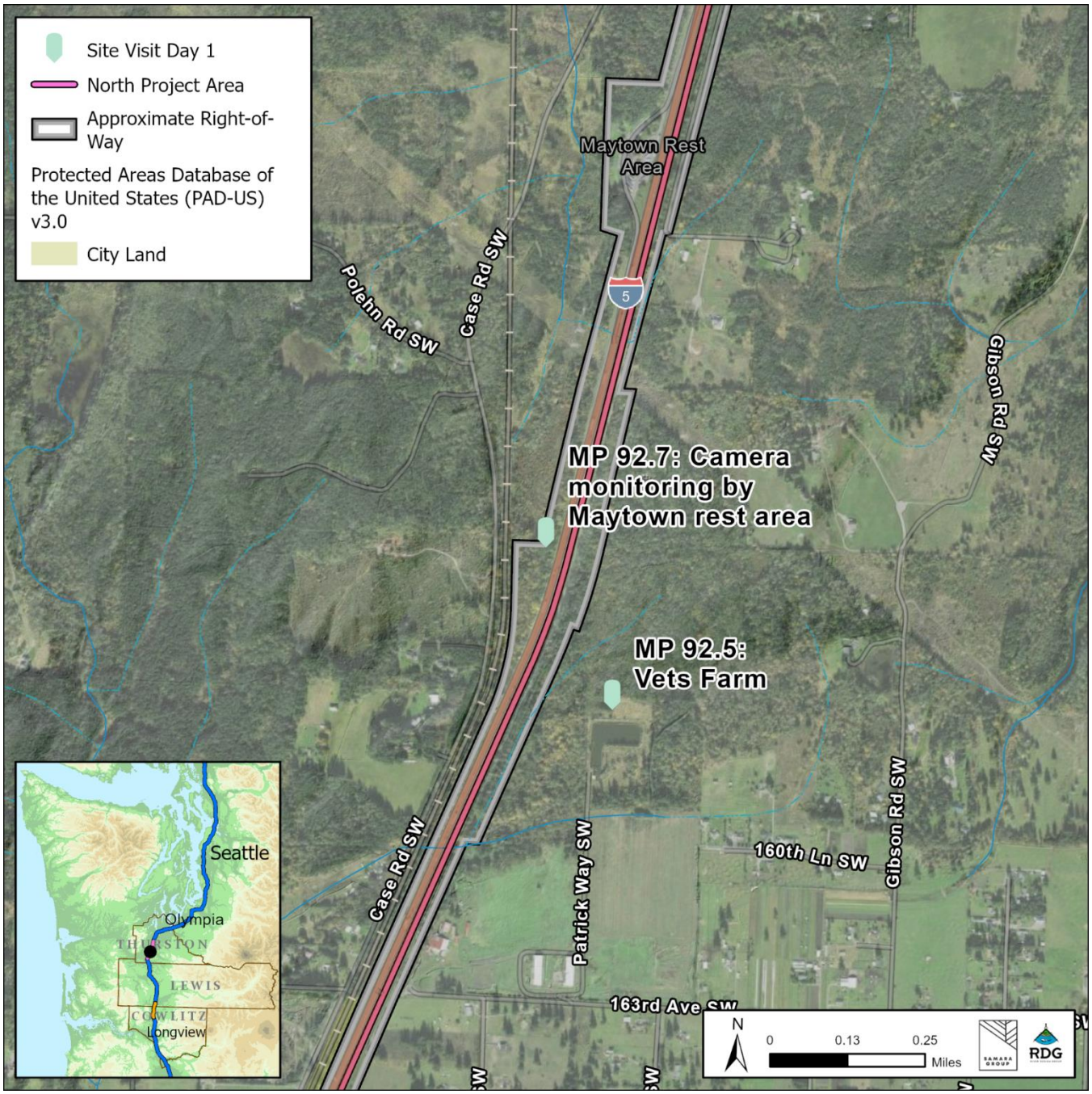

***Figure 2-17**. MP 92.5/92.7 Vets farm and Maytown site assessment stops.*

Figure 2-18. *Pasture near Vets farm looking east towards I-5 embankment.*

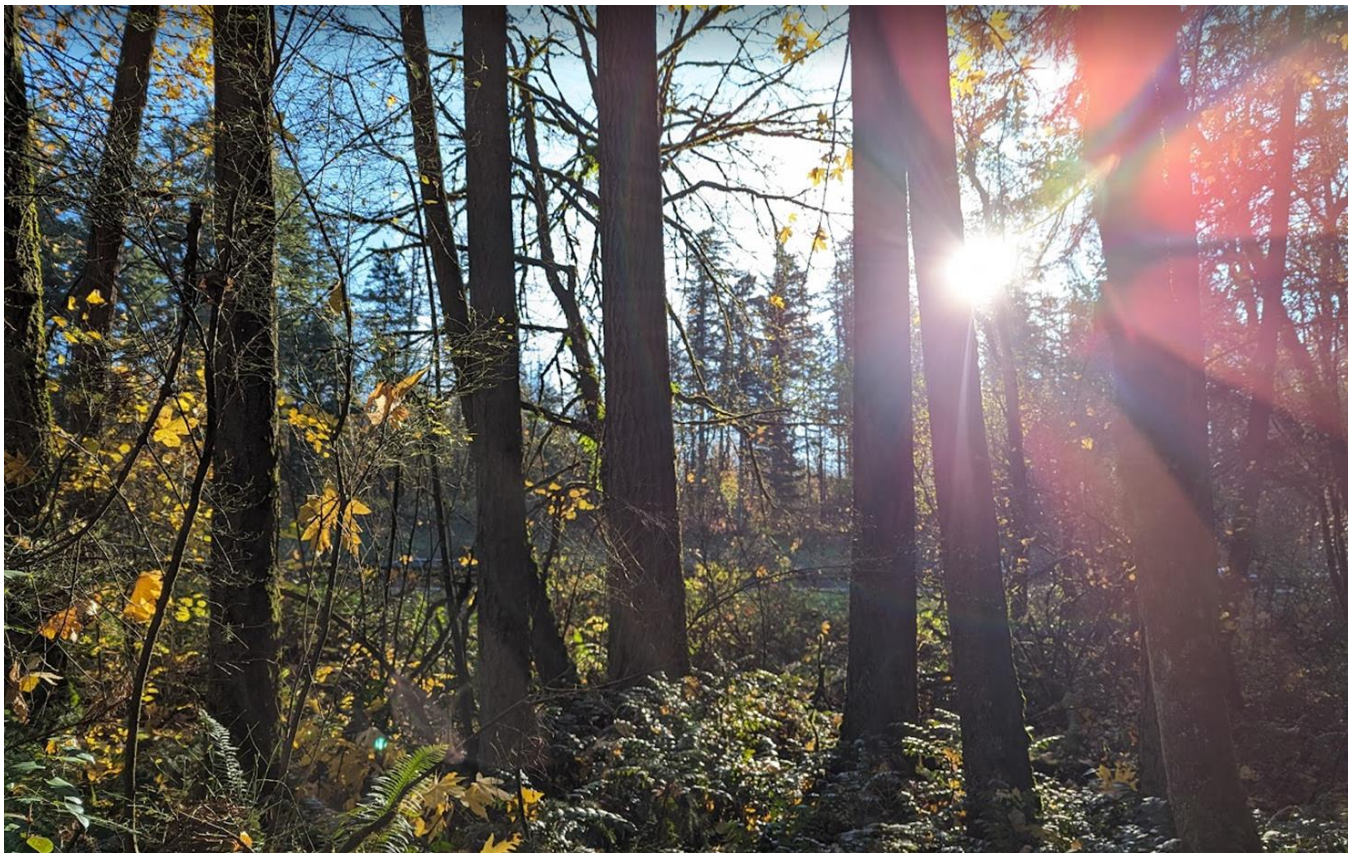

Figure 2-19*. Wooded area at site assessment stop near Maytown, looking east towards I-5 and minor roadcut.*

2.8 MP 96.1: Basalt Roadcut

The roadcut at MP 96.1 is an exposure of Eocene basalt above the glacial outwash sediments with a wide WSDOT right-of-way around a stormwater facility on the west side of the highway (**Figure 2-20**). The top of the roadcut is approximately 40 ft above the existing roadway surface (**Figure 2-21**) which is suitable vertical clearance for an overcrossing. No mapped wetlands are present.

There is no existing structure here to provide wildlife movement across the highway; however, wildlife activity has been observed nearby including deer, cougar, and elk.

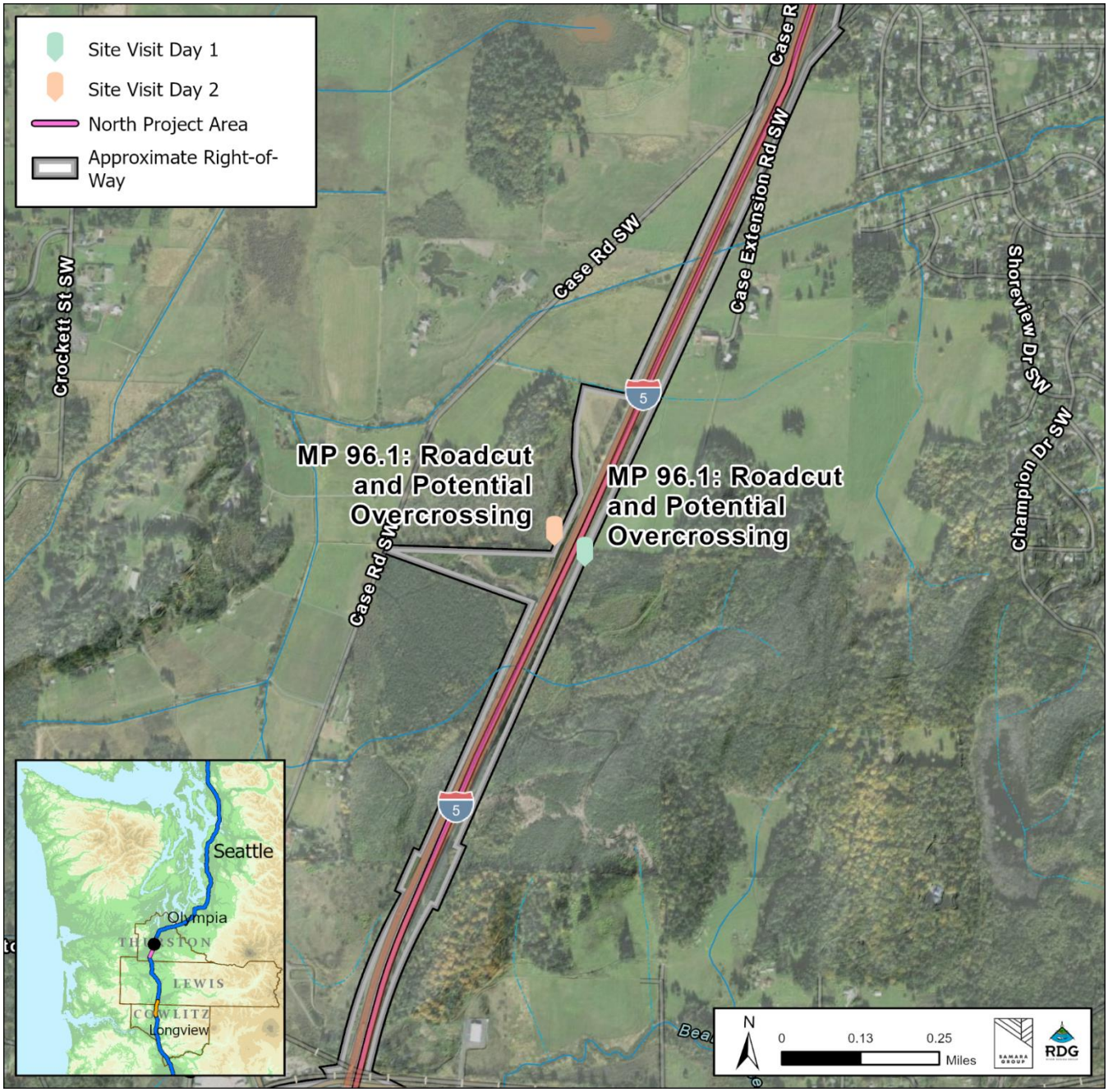

Figure 2-20. *MP 96.1 basalt roadcut site assessment stops.*

Figure 2-21. *Basalt roadcut at MP 96.1 approximately 40 ft above existing road surface. Photo taken from west side of highway looking east during November 2023 site assessment.*

3 Wildlife Passage Alternatives

Design alternatives to improve wildlife passage were developed collaboratively with SC and TAG members, SG and RDG. Design options included retrofits within the existing structure, replacement of the existing structure with a new crossing structure, and enhancement of conditions outside of the existing structure and/or new structure. **Appendix B** contains an illustrated 'menu of options' shared during the alternatives analysis workshop to visualize what these design features look like. Site plan maps of each alternative are included in **Appendix C**.

Sites for consideration of potential crossing structures were identified through corridor analysis, interviews with project partners, and the site assessment. SG and RDG presented 11 potential sites for consideration during the baseline conditions, opportunities, and constraints workshop in January 2024 (**Table 3-1**).

***Table 3-1**. Preliminary Sites considered for Alternatives Analysis*

Zone	Milepost	Structure Type	Rationale
South	51.7	Toutle River Bridge	Tall bridge, open sightlines, possible noise reduction until replacement
South	53.1	New Overcrossing?	Potentially suitable geology, wide right-of-way
South	53.9	UNT Cowlitz River Culvert	Riparian corridor protection, tall embankment, crossing will be replaced for fish passage
South	55.6	New Overcrossing	Potentially suitable grades, near DNR lands, moderate right-of-way widths
South	56	UNT Hill Creek Culvert	Wide riparian corridor protection, near DNR lands, tall embankment, crossing may be a fish passage barrier
South	58.5	Foster Creek Culvert	Riparian corridor protection, tall embankment, crossing will be replaced for fish passage
South	59.1	Cowlitz River Bridge	Tall bridge, open sightlines, possible noise reduction until replacement
North	90.4	Scatter Creek Bridge	Moderately large undercrossing in north zone, unlikely to be replaced soon
North	92.6	New Overcrossing	Near Vets farm and protected lands, potentially suitable grade to east (maybe unsuitable to west), moderate right-of-way width
North	93.2	New Undercrossing	Potentially suitable embankment height, near Vets farm
North	96.2	New Overcrossing	Suitable geology and roadcut geometry, near known cougar crossing location

The preliminary sites were discussed and refined during the site confirmation workshop (workshop 1.5) in March 2024. The group agreed to add an undercrossing option at MP 53.07, an overcrossing near MP 90.5 at Scatter Creek, add two additional overcrossing options near MP 93 (adding MP 92.6 and 92.8 to the MP 92.7 site), and consider an overcrossing at MP 93.1. A fish passage barrier on an unnamed tributary to Salmon Creek is being replaced at MP 98.1 and there are opportunities to propose amphibian crossing enhancements as a retrofit to the fish passage structure.

The group considered and chose not to proceed with a potential overcrossing at MP 92.2 due to the adjacent existing development and proximity of the railroad and Case Road. The group also discussed and chose not to proceed with an alternative to replace the Maytown rest area with a crossing due to the land acquisition and utility relocation work required to relocate the rest area.

Table 3-2 summarizes the sites selected for the alternatives analysis with new sites in bold. **Figure 3-1** and **Figure 3-2** show the locations of the sites selected for alternatives analysis.

Table 3-2. *Sites selected for Alternatives Analysis*

Zone	Milepost	Structure Type	Rationale
South	51.7	Toutle River Bridge	Tall bridge, open sightlines, possible noise reduction until replacement
South	53.07 **(new)**	UNT Cowlitz River Culvert	Fish passage barrier downstream of MP 53.9 crossing on same creek, removal of both barriers necessary to restore fish passage
South	53.1	New Overcrossing	Potentially suitable geology, wide right-of-way
South	53.9	UNT Cowlitz River Culvert	Riparian corridor protection, tall embankment, crossing will be replaced for fish passage
South	55.6	New Overcrossing	Potentially suitable grades, near DNR lands, moderate right-of-way widths
South	56	UNT Hill Creek Culvert	Wide riparian corridor protection, near DNR lands, tall embankment, crossing may be a fish passage barrier
South	58.6	Foster Creek Culvert	Riparian corridor protection, tall embankment, crossing will be replaced for fish passage
South	59.1	Cowlitz River Bridge	Tall bridge, open sightlines, possible noise reduction until replacement
North	90.4	Scatter Creek Bridge	Large(ish) undercrossing in north zone, unlikely to be replaced soon
North	TBD **(new)**	Scatter Creek Overcrossing	To provide passage when existing bridge is full flowing
North	**92.6**/92.7/**92.8**	New Overcrossing	Near Vets farm and protected lands, potentially suitable grade to east (maybe unsuitable to west), moderate right-of-way width
North	93.1	New Undercrossing or **New Overcrossing**	Potentially suitable embankment height, powerline corridor could be greenway in future developed conditions
North	96.1	New Overcrossing	Suitable geology and roadcut geometry, near known cougar crossing location
North	98.1 **(new)**	UNT Salmon Creek	Amphibian crossing enhancement (retrofit to fish passage barrier removal already in design)

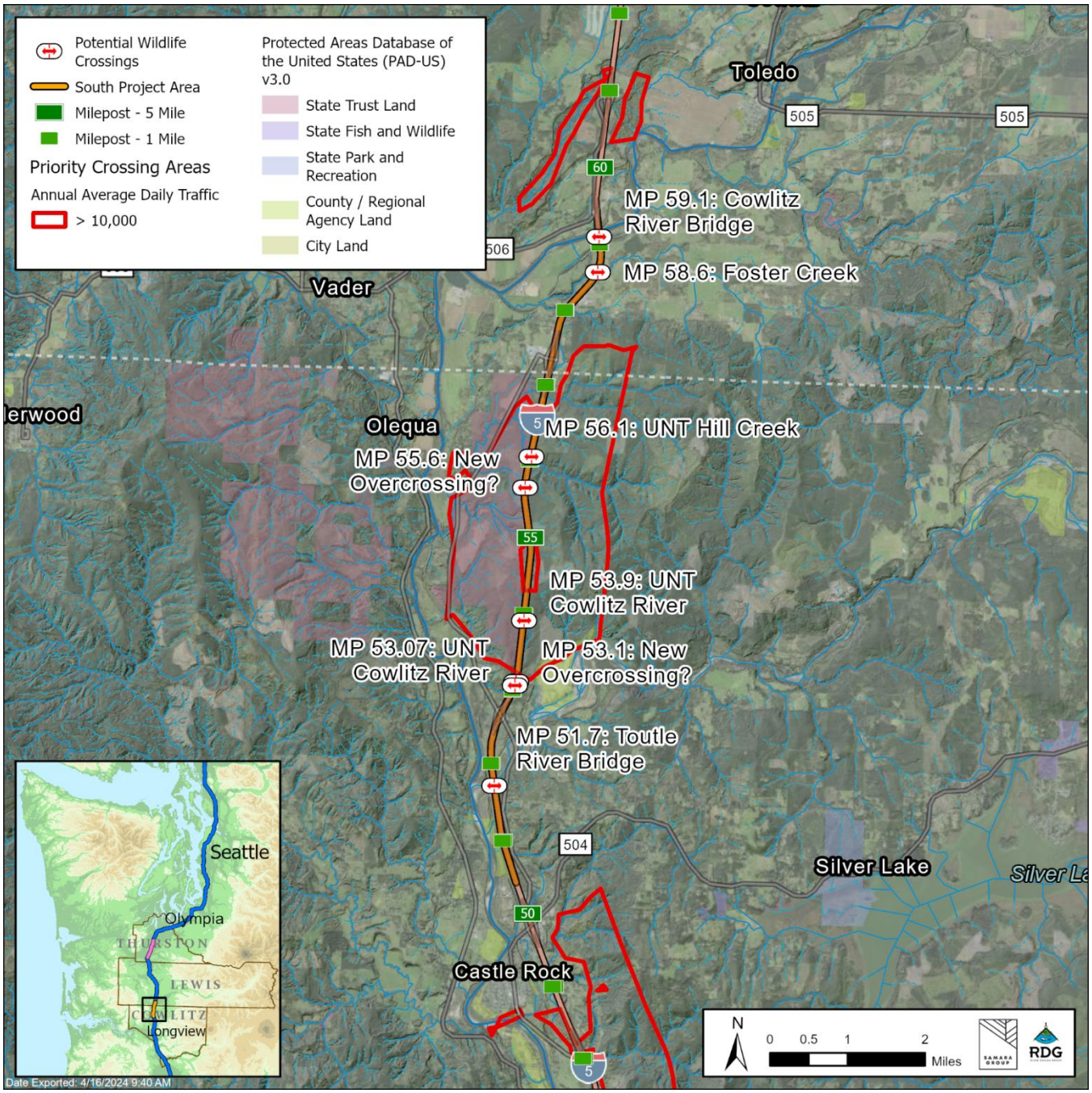

***Figure 3-1**. Sites selected for alternatives analysis in the south zone.*

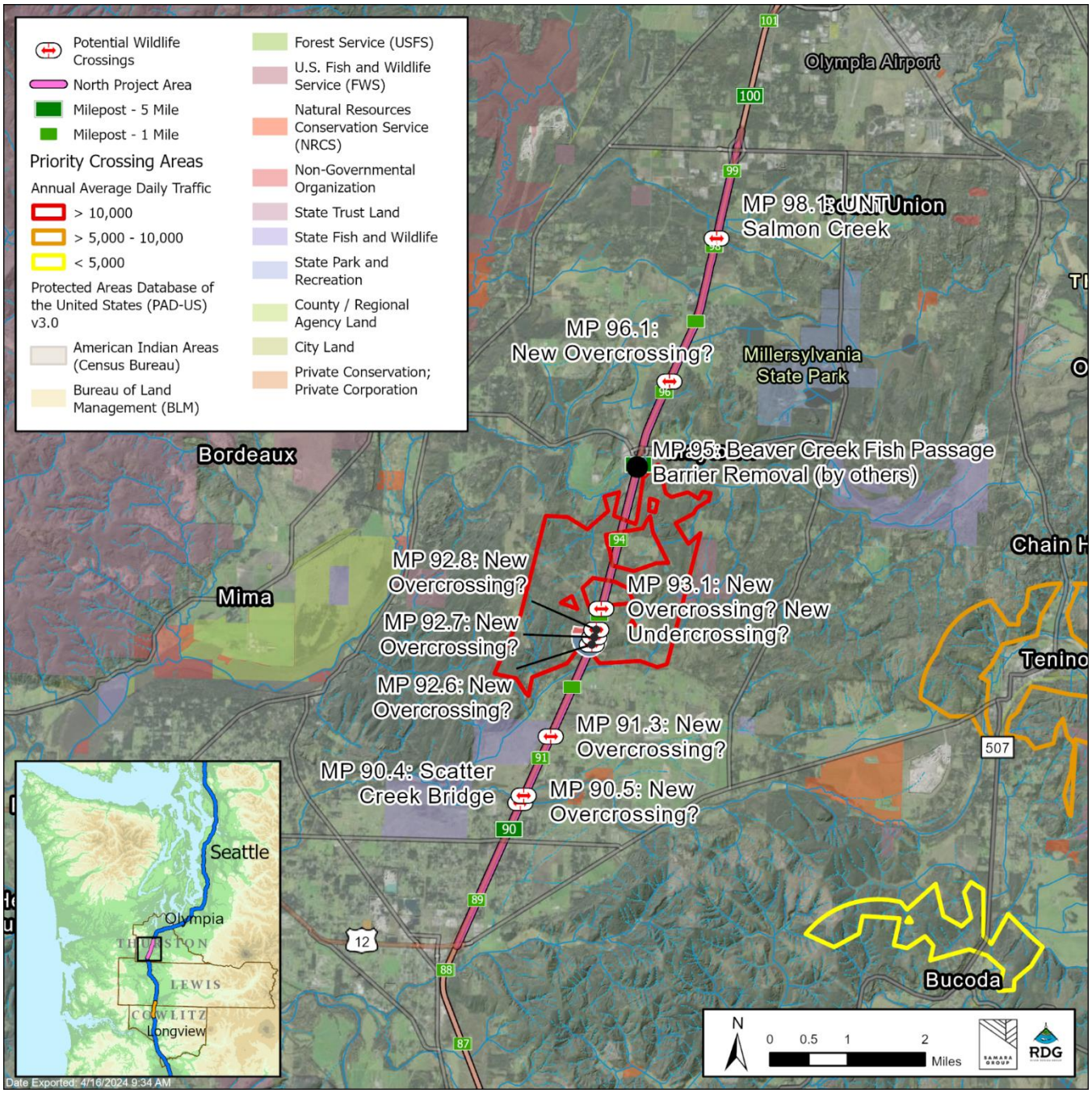

***Figure 3-2**. Sites selected for alternatives analysis in the north zone.*

Six sites are being considered in the southern linkage zone and five sites are being considered in the northern linkage zone. The Beaver Creek fish passage barrier removal (MP 95) is not included in this report as it is already under design by others through the fish passage process and the planning effort includes a recommendation to incorporate terrestrial wildlife passage.

The sites for the alternatives analysis are broadly grouped in project areas by milepost. Some sites have only one design proposed while others have up to three alternatives (**Figure 3-3**). One preferred alternative for each site will be selected for advancement into conceptual design during the preferred alternative selection workshop (May 2024).

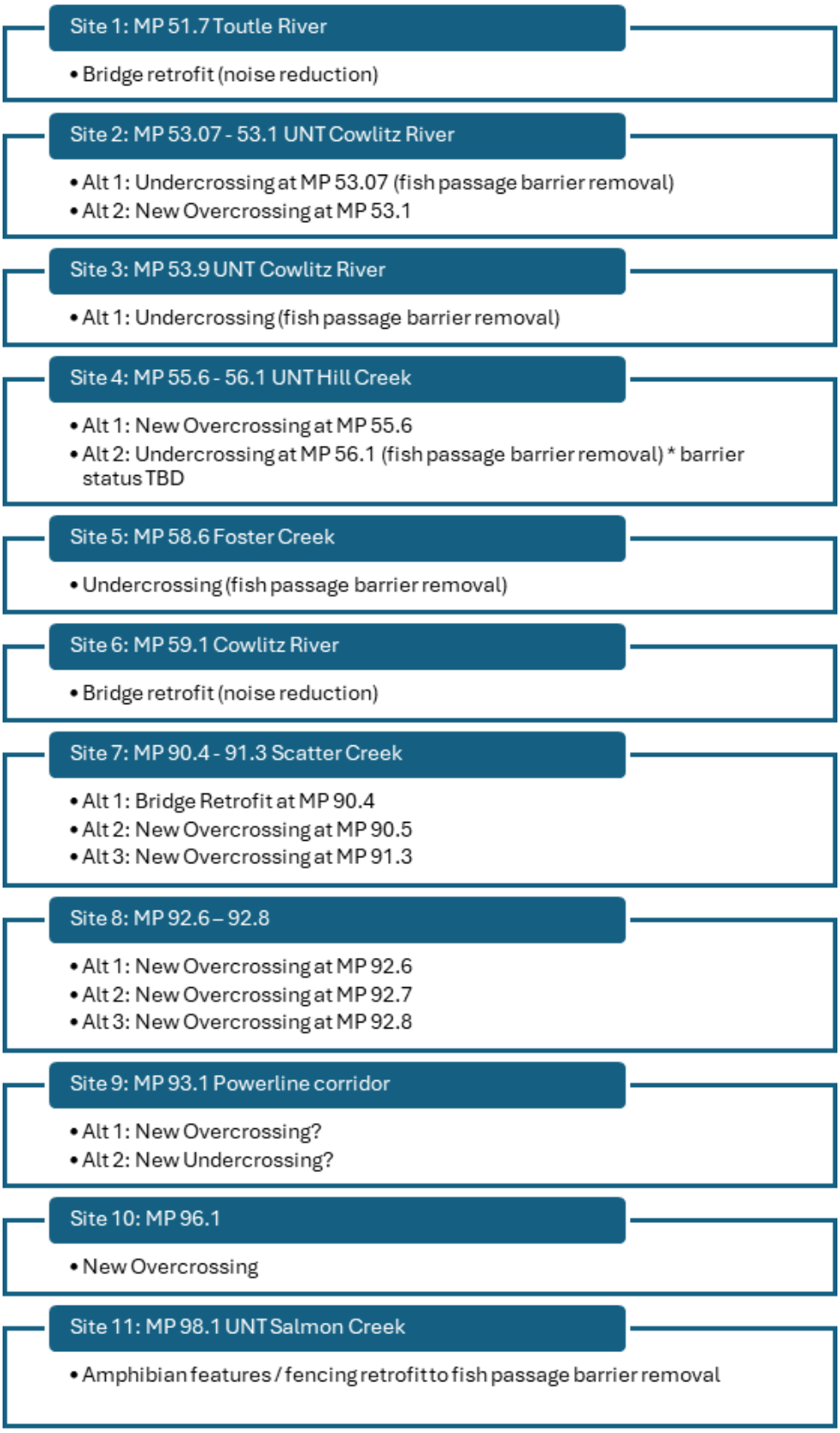

***Figure 3-3**. Summary of wildlife crossing alternatives.*

Proposed new structures include undercrossings and overcrossings. The layout and geometry of each crossing depends on the adjacent terrain and roadway configuration. All alternatives assume there will be no modification of the existing road geometry. Future design phases will need to consider the potential for roadway widening, guardrail installation, or other road modifications. All structures with spans (measured along roadway centerline) greater than 20 ft would likely be added to the national bridge inventory and require regular bridge inspections. See **Appendix C** for layouts of each crossing alternative.

Fencing and the addition of vegetation surrounding crossing structures will be considered across all alternatives. Fencing especially presents many complications as the paths to the crossing structures encounter barriers such as side roads, private property, creek crossings, and existing culverts. The addition or removal of fencing will be considered in the conceptual design phase. The conceptual design report will contain additional details including design data needs, anticipated permit requirements, and costs for each crossing.

3.1 General Undercrossing Design

The undercrossings are intended to provide passage for fish, amphibians and small or medium sized animals with a minimum vertical clearance (within the crossing structure) of 15 ft above the dry bench which is a minimum of 5 ft above the bottom of the channel. The undercrossing may pass large animals such as elk if the behavioral conditions for approach are suitable. An undercrossing is unlikely to change plant community connectivity compared to baseline conditions. Openness ratios (calculated as the product of width and height divided by crossing length) for all undercrossings are provided in **Appendix C**. Undercrossing designs would restore the existing highway geometry after the crossing is constructed (no change to roadway geometry).

The proposed undercrossings were sized to accommodate the bankfull channel width including the potential for lateral migration. A dry bench is included above the likely active floodplain. Detailed hydrologic, hydraulic, and geomorphic analysis will be completed in future design phases (beyond conceptual design) to refine the channel design if an undercrossing is selected for implementation.

3.2 General Overcrossing Design

The overcrossings are intended to provide passage to terrestrial wildlife species of all sizes including deer and elk, a pathway for invertebrate travel safe from vehicle strikes, connectivity for the plant community through vegetation over the crossing, and support safer routes for low flying and more terrestrially based bird species. The overcrossing may also provide passage to amphibians by including microtopography that would support temporary ponding during snowmelt and precipitation events. Sidewalls and vegetation on the structure may also mitigate potential wildlife behavioral impacts caused by noise, smell, wind turbulence, and artificial light generated by the highway below.

The overcrossing would be a minimum of 150 ft wide (perpendicular to wildlife movement). The low chord would be approximately 20 ft (minimum above the pavement surface) to provide clearance for high freight traffic. The total length of the overcrossing and total area of impact depends on how the overcrossing ties into the adjacent terrain and roadway

geometry. **Figure 3-4** illustrates typical overcrossing configurations. Retaining walls may be required to support the approaches for overcrossings that are not located in existing roadcuts. This detail will be refined during future design phases. Noise barrier berms or walls could be added to extend the noise, light, and smell mitigation further along the highway by the approaches to the crossing.

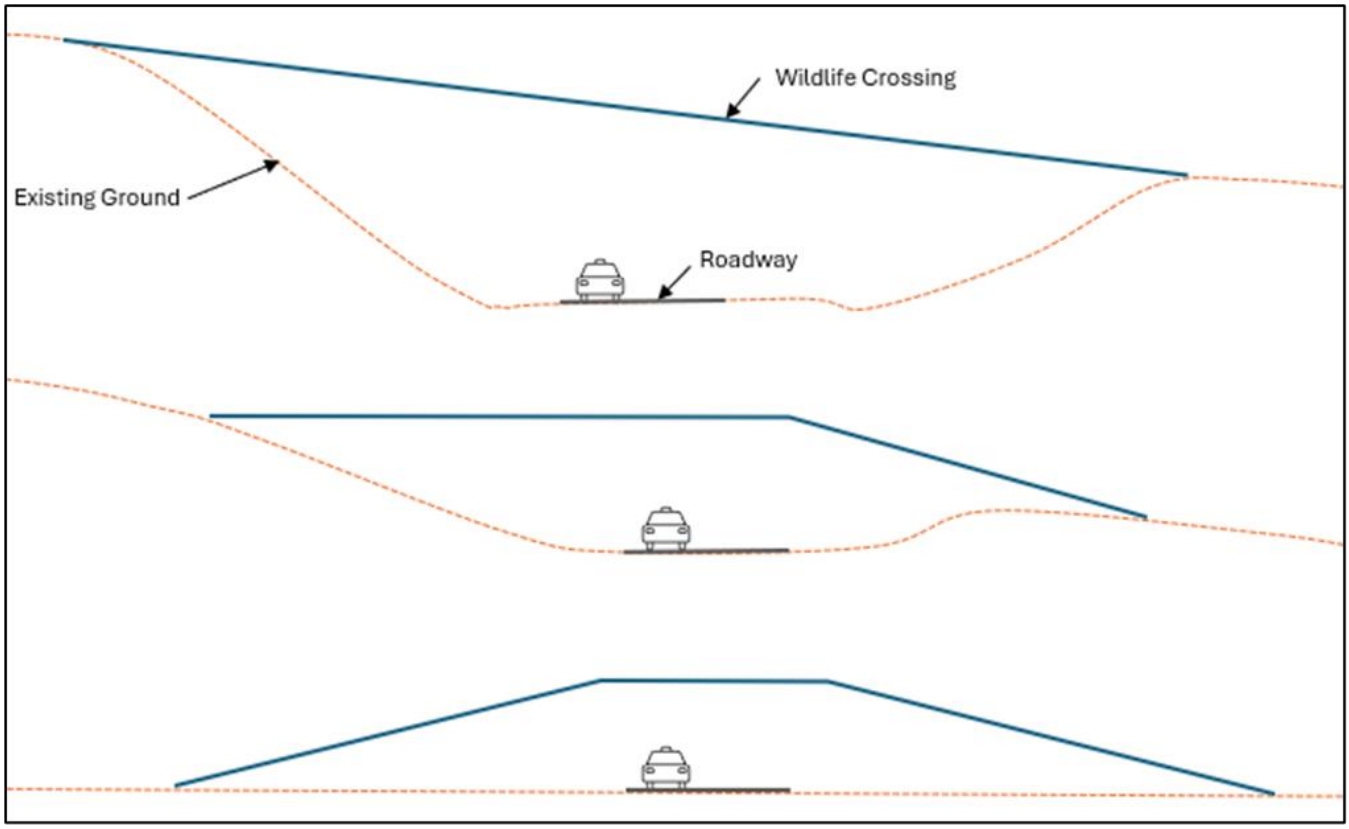

Figure 3-4. *Three typical overcrossing sections, viewed from a driver's perspective. Overcrossings may tie into existing road cuts or high ground on one or both sides of the road (middle and top sections) or may be constructed in relatively flat areas with no road*

Vegetation on the overcrossing structure will provide browse and cover to attract wildlife to the crossing and buffer wildlife from noise, light, and vehicle exhaust. Vegetation would include a mix of deciduous and evergreen understory trees or large shrubs along the perimeter with increasingly shorter vegetation towards the center (native understory and floral species). Woody material, rock piles with good solar exposure, and scattered boulders would provide cover for smaller species using the crossing. Small depressions in the soil could create temporary areas of ponded water during snowmelt which could be attractive to amphibians. Solid walls at the edge of the crossing (a minimum of 8 ft tall) would buffer wildlife from road noise, lights and smells and maintain safety to avoid items falling onto the roadway.

3.3 Alternatives Evaluation

We developed a matrix for each site to evaluate the anticipated relative benefits, risks, order-of-magnitude costs, and schedule considerations for each alternative. The matrix is populated based on professional experience with similar projects and scoring is based on the alternative's relative impact in each category compared to the other alternatives or baseline

conditions if only one alternative is being considered. A simple scoring system is provided where a "+" has an overall positive impact, "/" is neutral with no net impact, and "–" is an overall negative impact based on the item under consideration.

Scoring considerations for each item are summarized in **Table 3-3**.

***Table 3-3**. Scoring considerations for the alternatives evaluation matrix items.*

Project Benefits
Multi-Species Passage *Which alternative provides greater passage opportunity for the most species (with special consideration for cougar, bear, elk, black-tailed deer, Columbia white-tailed deer, Mazama pocket gopher, Oregon spotted frog, Western gray squirrel, Cascade torrent salamanders, Dunn's salamander, Pacific lamprey, and various bat species).*
Plant Community Connectivity *Does the alternative improve plant community connectivity? + if yes, - if no*
Mitigates Behavioral Considerations *Does the crossing structure mitigate for disturbance such as road noise, light, smells? + if yes, - if no*
Proximity to Conserved Lands *Is the crossing located near publicly owned or conserved lands? + if yes, - if no*
Potentially Eligible for Multiple Funding Sources *Is the crossing structure potentially eligible for Fish Passage or other funds? + if yes, – if no*
Project Risks
Human Disturbance Potential *Is the crossing structure close to existing human use areas? – if yes, + if no*
Proximity to Development and Other Roads *Is the crossing structure close to other developments and roads? – if yes, + if no*
Temporary Traffic Control *Does the crossing structure construction require interruption of traffic or detours on I-5? – if yes, + if no*
Schedule Considerations
Construction Easements/Landowner Agreements *Does the crossing structure require work outside of the WSDOT right-of-way and need easements or agreements from other landowners? – if yes, + if no*
Excavation and Embankment *Are large volumes of excavation and/or embankment needed? – if yes, + if no*
Structure Installation *Will the structure installation take several months or longer (typically for cast-in-place concrete)? – if yes, + if no*

Order-of-Magnitude Costs
Design *Survey, technical analyses, reporting, design drawings and specifications*
Permitting *Local, state, and Federal permits; land acquisitions or easements; public engagement.*
Construction *Procurement, construction administration and construction engineering.*
Monitoring and Maintenance *Including plant establishment, fish passage monitoring, and bridge inspections (if applicable)*

The order-of-magnitude costs range from:

- $ (no engineering design needed, could be constructed as part of maintenance operations, anticipated to be thousands of dollars),
- $$ (straightforward engineering design and permitting, single year construction, anticipated to be hundreds of thousands of dollars), to
- $$$ (multi-year, multi-discipline engineering design and permitting, anticipated to be millions of dollars). Detailed cost estimates will be developed for the preferred alternative at each site in the conceptual design report.

Detailed cost estimates will be developed for the preferred alternative at each site in the conceptual design report.

The evaluation matrices consider the crossing structure itself and do not evaluate any proposed fencing. Fencing will be considered for nearly all alternatives and generally has moderate-high design and construction costs with moderate-high maintenance costs. Fencing layouts and costs will be included in the conceptual design for the preferred alternative at each site.

3.4 MP 51.7: Toutle River Bridge

The geometry of the existing Toutle River bridge at MP 51.7 is suitable for passage of large mammals (**Figure 3-5**), however, the noise and level of human use may deter animals from approaching the bridge. The scope of this project does not change the human use of this site. Two potential noise mitigation alternatives are being considered:

1. Dense mixed vegetation to reduce noise at the bridge approaches
2. Engineered flexible foam structures in the bridge expansion joints

Noise-dampening panels and other structures on the bridge are not proposed due to the conflict with the need for bridge inspections (clear line of sight to the bridge structure).

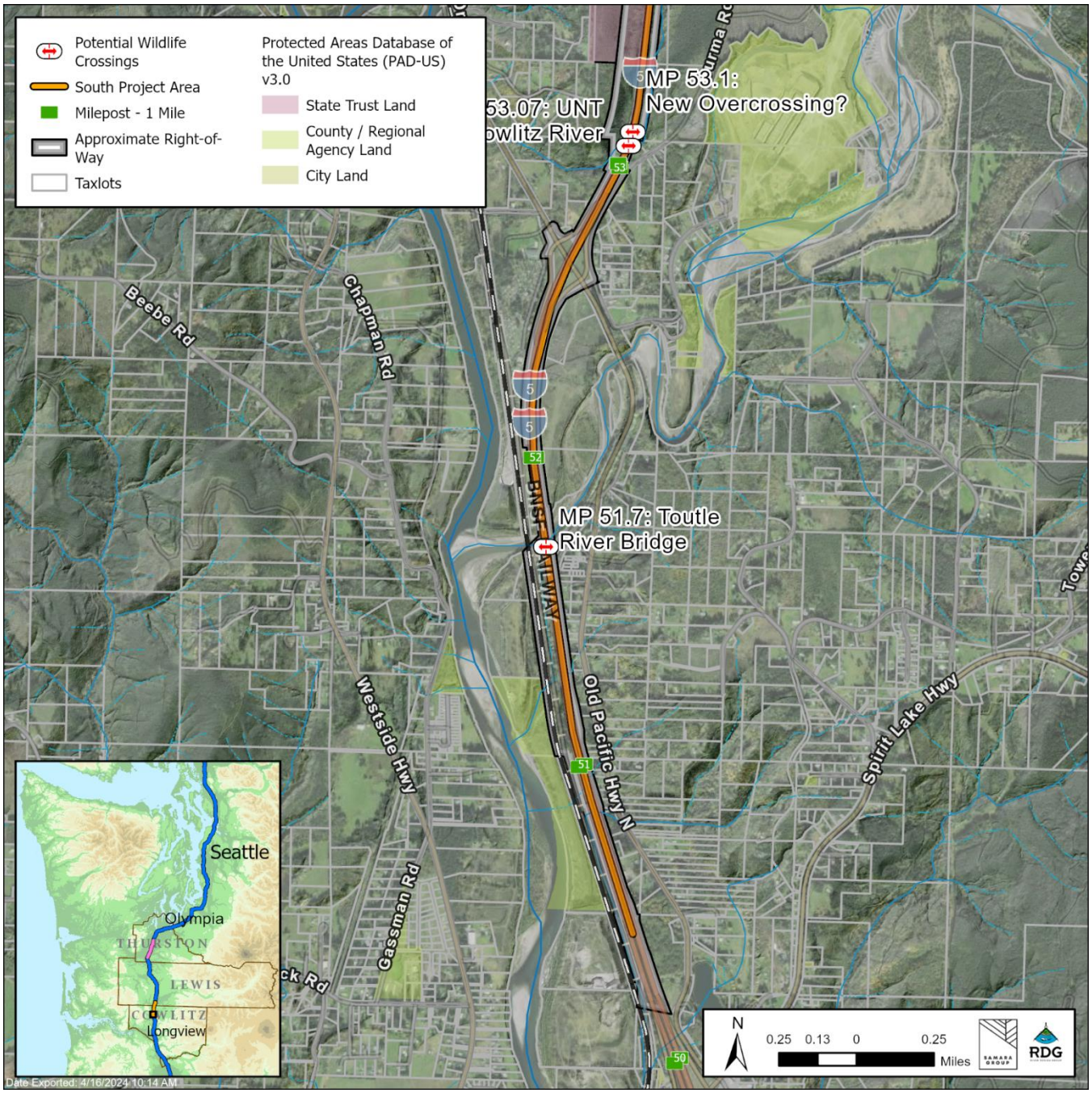

***Figure 3-5**. MP 51.7 Toutle River Bridge site.*

The details of the alternatives are discussed below, and preliminary layouts are included in **Appendix C**.

3.4.1 Alternative 1: Dense mixed vegetation

A study of noise pollution reduction in an urban forest park (Maleki and Hosseini, 2011) showed effective reduction of noise from roads and industrial activities with a dense mixed stand of pine and black locust trees. Current WSDOT guidance for noise barriers along the highway is that "Trees and shrubs can decrease highway-traffic noise levels if high enough, wide enough,

and dense enough (cannot be seen through), but are often impractical. It would take at least 100 feet of dense vegetation to provide the same benefit as our smallest feasible noise wall. Trees do provide a visual shield and some psychological benefit. The Federal Highway Administration has not approved using vegetation for noise abatement" (WSDOT, n.d.).

Dense mixed native vegetation in the bridge approaches within the right-of-way would have multiple benefits of reducing the bridge noise while providing cover for small and medium wildlife. The vegetation should have multiple canopy levels and a variety of deciduous and coniferous species to disrupt the sound waves (Attal et al., 2021).

This alternative would improve multi-species passage conditions, plant connectivity, and the alternative may mitigate some of the behavioral considerations related to noise, smell, and lights. The bridge is not proximate to conserved lands and the retrofit is unlikely to be eligible for multiple funding sources. This alternative would not change the human disturbance potential or proximity to development and other roads.

This retrofit would not require traffic disruption as all construction would occur outside of the existing roadway. The retrofit could occur entirely within the existing right-of-way and would not require excavation, embankment, or new structure installation.

Design and permitting would need to include hydraulic analysis of flood capacity with the addition of vegetation. Maintenance of the vegetation may be challenging due to the frequent human use and replanting may be required if vegetation is damaged or removed.

3.4.2 Alternative 2: Engineered structures in expansion joints

Expansion joints between bridge spans may be contributing to the noise pollution at the existing bridge. A University of Washington study of the SR 520 floating bridge identified potential retrofits for the expansion joints to reduce noise pollution (Reinhall et al., 2022). The two-month study evaluated two types of flexible foam structures added to the existing expansion joints and concluded with a more than 70 percent reduction in road noise at a distance of 160 ft. The retrofit structures are experimental and would require additional design and testing for durability.

This alternative would not change multi-species passage conditions or plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The bridge is not proximate to conserved lands and the retrofit is unlikely to be eligible for multiple funding sources. This alternative would not change the human disturbance potential or proximity to development and other roads.

Installation of the retrofit would require temporary disruption of traffic on the bridge. The retrofit could occur entirely within the existing right-of-way and would not require excavation, embankment, or new structure installation.

Design and permitting costs are high for this alternative due to the experimental nature. The retrofit structures would need to be inspected and monitored. This monitoring may be in addition to the regular bridge inspections.

3.4.3 MP 51.7 Toutle River Bridge Retrofit Alternatives Evaluation

Table 3-4 summarizes the alternative evaluation for MP 51.7 Toutle River bridge.

Table 3-4. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for retrofit alternatives at MP 51.7 Toutle River Bridge (excluding fencing).*

	Alt 1: Dense mixed vegetation	Alt 2: Engineered structures in expansion joints
Project Benefits		
Multi-Species Passage	+	/
Plant Community Connectivity	+	-
Mitigates Behavioral Considerations	+	/
Proximity to Conserved Lands	-	-
Potentially Eligible for Multiple Funding Sources	-	-
Project Risks		
Human Disturbance Potential	-	-
Proximity to Development and Other Roads	-	-
Temporary Traffic Control	+	-
Schedule Considerations		
Construction Easements/Landowner Agreements	+	+
Excavation and Embankment	+	+
Structure Installation	N/A	+
Order-of-Magnitude Costs		
Design	$$	$$$
Permitting	$$	$$$
Construction	$$	$$
Monitoring and Maintenance	$$$	$$$

3.5 MP 53.07 - 53.1: UNT Cowlitz River

Two alternatives are considered for the MP 53.07 - 53.1 UNT Cowlitz River site (**Figure 3-6**):

1. MP 53.07: Undercrossing (fish passage barrier removal)
2. MP 53.1: New Overcrossing

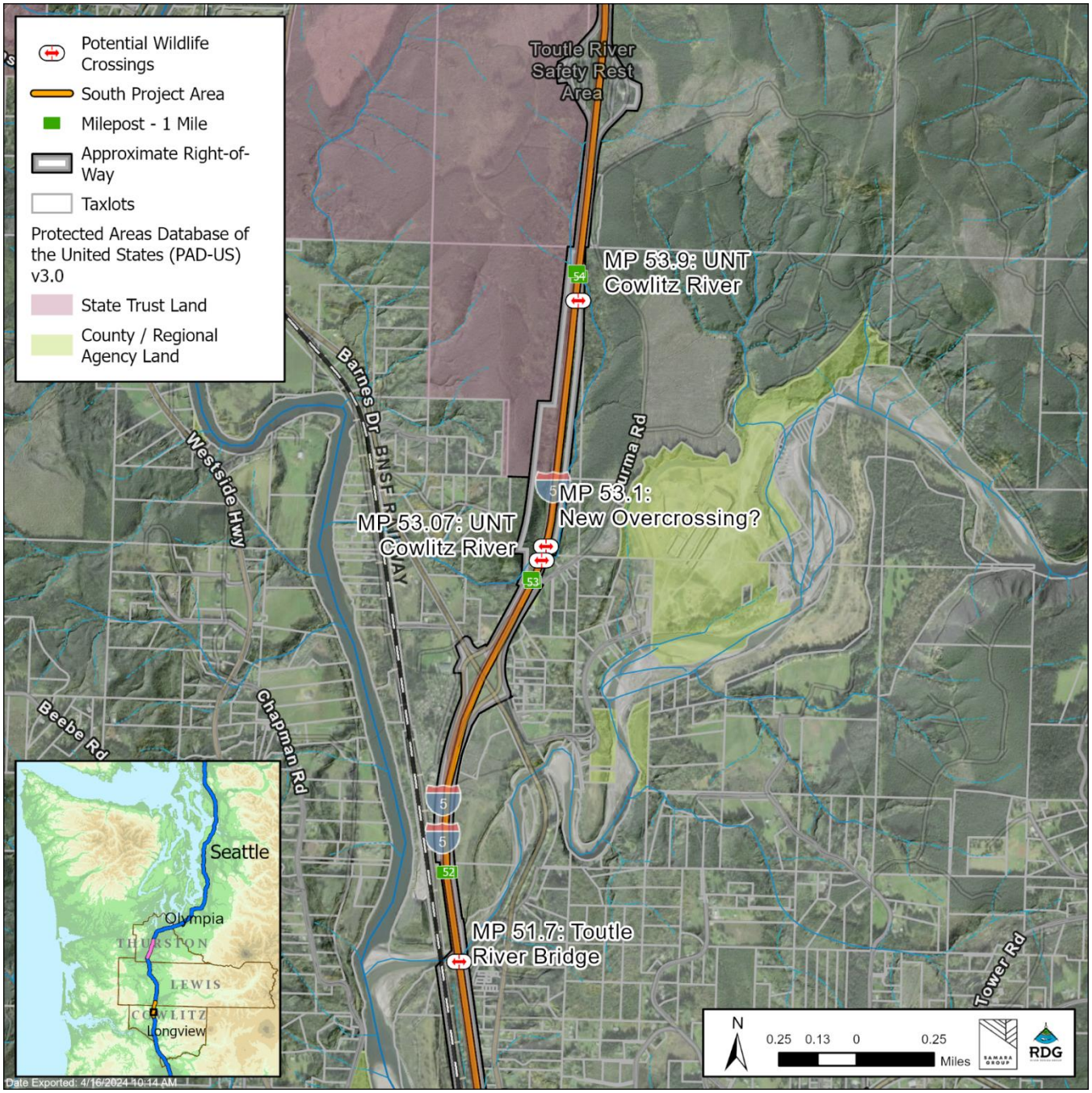

***Figure 3-6**. MP 53.07 - 53.1 UNT Cowlitz River potential wildlife crossings.*

The details of the alternatives are discussed below, and preliminary layouts are included in **Appendix C**.

3.5.1 Alternative 1: MP 53.07: UNT Cowlitz River Culvert Replacement

A proposed wildlife undercrossing replacing the existing culvert (fish passage barrier) on the Unnamed Tributary to the Cowlitz River would be approximately 230 ft long, 138 ft wide, and 38 ft tall with an openness ratio of 18. Construction of this crossing would extend beyond the WSDOT right-of-way on the east side and be within the existing right-of-way on the west side. Construction would likely impact approximately 0.3 acres beyond the structure itself.

This alternative would improve multi-species passage conditions, would not improve plant connectivity, and may mitigate some of the behavioral considerations related to noise, smell, and lights. The bridge is not proximate to conserved lands. This crossing may be eligible for multiple funding sources including fish passage barrier removal. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the undercrossing would require disruption of the existing roadway and likely lane closures to excavate the new crossing. Construction extends beyond the existing right-of-way and will require landowner agreements or lang acquisition. This alternative requires extensive excavation and structure installation.

The channel of the UNT Cowlitz River would be impacted during construction and require temporary water management. Construction will likely be limited to the approved in-water work windows. Design and permitting costs include the geomorphic, hydrologic, and hydraulic analyses for fish passage and hydraulic project approval prior to construction. Construction costs are high due to the amount of excavation and associated traffic impacts. The undercrossing would be added to the national bridge inventory and require bridge inspections in addition to fish passage inspections.

3.5.2 Alternative 2: MP 53.1 Overcrossing

An overcrossing is being considered at an existing minor roadcut at MP 53.1. The adjacent ground is approximately 15 ft above the existing roadway on the east and drops away to the west. The crossing structure length is approximately 120 ft and construction would likely impact approximately 0.7 acres beyond the structure itself if using retaining walls to retain the structure abutments. This structure could be constructed entirely within the WSDOT right-of-way.

This alternative would improve multi-species passage conditions and plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The overcrossing is not proximate to conserved lands. This crossing is unlikely to be eligible for multiple funding sources because it is a new structure. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the crossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. No mapped wetlands are present at the site, however, drainages adjacent to the highway would need to be routed through the crossing abutments. Permitting costs are lower than the undercrossing because this alternative does not impact the channel of the UNT Cowlitz River. The overcrossing would likely be added to the national bridge inventory and require bridge inspections.

3.5.3 MP 53.07 - 53.1 Alternatives Evaluation

Table 3-5 summarizes the alternative evaluation for MP 53.07-53.1 UNT Cowlitz River.

Table 3-5. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for each alternative at MP 53.07 - 53.1 UNT Cowlitz River (excluding fencing).*

	Alt 1: MP 53.07 Undercrossing	Alt 2: MP 53.1 Overcrossing
Project Benefits		
Multi-Species Passage	+	+
Plant Community Connectivity	-	+
Mitigates Behavioral Considerations	+	+
Proximity to Conserved Lands	-	-
Potentially Eligible for Multiple Funding Sources	+	–
Project Risks		
Human Disturbance Potential	+	+
Proximity to Development and Other Roads	+	+
Temporary Traffic Control	-	+
Schedule Considerations		
Construction Easements/Landowner Agreements	-	+
Excavation and Embankment	-	+
Structure Installation	-	+
Order-of-Magnitude Costs		
Design	$$$	$$$
Permitting	$$$	$$
Construction	$$$	$$$
Monitoring and Maintenance	$$$	$$$

3.6 MP 53.9: UNT Cowlitz River

Two alternative alignments are being considered for the MP 53.9 UNT Cowlitz River undercrossing (**Figure 3-7**). Alternative 1 follows the existing alignment of the fish passage barrier and alternative 2 follows a shorter alignment across the highway to reduce the crossing length. Both alternatives would provide fish passage in addition to terrestrial wildlife passage.

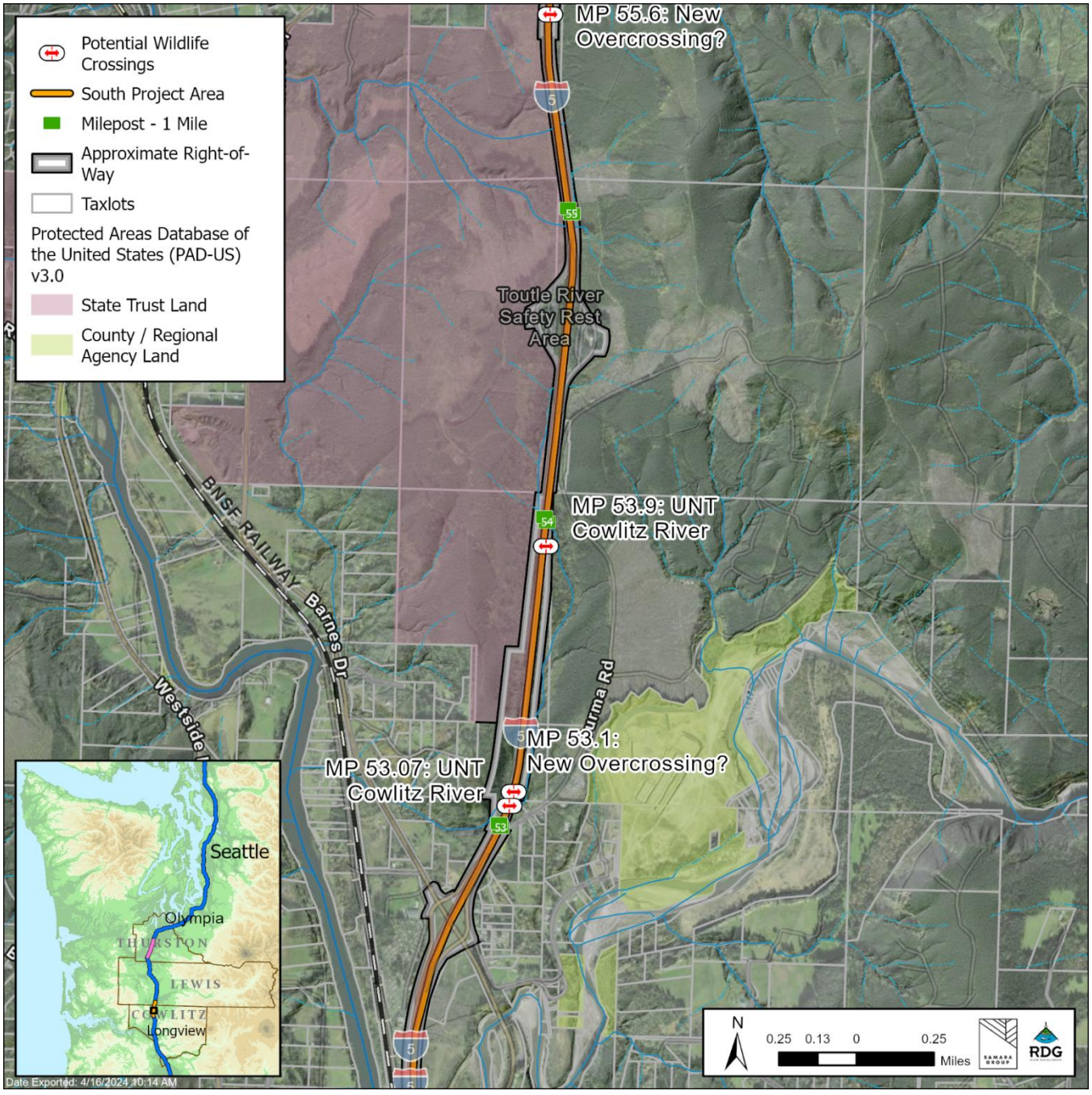

***Figure 3-7**. MP 53.9 UNT Cowlitz River potential wildlife crossings.*

The details of the alternatives are discussed below, and preliminary layouts are included in **Appendix C**.

3.6.1 Alternative 1: Longer crossing following existing culvert alignment.

Following the existing culvert alignment results in a 620 ft long, 100 ft wide, 40 ft tall undercrossing structure with an openness ratio of 6. The crossing structure span (measured align the road centerline) is approximately 280 ft due to the skew of the crossing. This undercrossing would require grading outside of the WSDOT right-of-way on the east side and would likely impact approximately 0.4 acres outside of the footprint of the crossing structure.

This alternative may improve multi-species passage conditions, would not improve plant connectivity, and may mitigate some of the behavioral considerations related to noise, smell, and lights. The length of the crossing may deter some species from using it. The crossing is proximate to conserved lands (WADNR) on the west side. This crossing may be eligible for multiple funding sources including fish passage barrier removal. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the undercrossing would require disruption of the existing roadway and likely lane closures to excavate the new crossing. Construction extends beyond the existing right-of-way and will require landowner agreements or land acquisition. This alternative requires extensive excavation and structure installation due to the undercrossing's length.

The channel of the UNT Cowlitz River would be impacted during construction and require temporary water management. Construction will likely be limited to the approved in-water work windows. Design and permitting costs include the geomorphic, hydrologic, and hydraulic analyses for fish passage and hydraulic project approval prior to construction. Construction costs are high due to the amount of excavation and associated traffic impacts. The undercrossing would be added to the national bridge inventory and require bridge inspections in addition to fish passage inspections.

3.6.2 Alternative 2: Shorter crossing with new alignment.

A shorter alignment ties into the existing UNT Cowlitz River on the west (upstream) side and to a tributary channel on the east (downstream) side approximately 1000 ft upstream of the existing culvert outlet. This undercrossing would be approximately 265 ft long, 100 ft wide and 40 ft tall with an openness ratio of 15. The crossing structure span (measured along the road centerline) is approximately 115 ft due to the reduced skew angle compared to alternative 1. This undercrossing would require more work outside of the existing WSDOT right-of-way on the east side compared to alternative 1 and would likely impact approximately 0.7 acres outside the footprint of the crossing structure.

This alternative would improve multi-species passage conditions, would not improve plant connectivity, and may mitigate some of the behavioral considerations related to noise, smell, and lights. The crossing is proximate to conserved lands (WADNR) on the west side. This crossing may be eligible for multiple funding sources including fish passage barrier removal. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the undercrossing would require disruption of the existing roadway and likely lane closures to excavate the new crossing. Construction extends beyond the existing right-of-way and will require landowner agreements or land acquisition. This alternative requires excavation and structure installation.

The channel of the UNT Cowlitz River would be impacted during construction and require temporary water management. Construction will likely be limited to the approved in-water work windows. Design and permitting costs include the geomorphic, hydrologic, and hydraulic analyses for fish passage and hydraulic project approval prior to construction. Construction costs are high due to the amount of excavation and associated traffic impacts. The undercrossing would be added to the national bridge inventory and require bridge inspections in addition to fish passage inspections.

3.6.3 MP 53.9 Alternatives Evaluation

Table 3-6 summarizes the alternative evaluation for MP 53.9 UNT Cowlitz River.

Table 3-6. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for each alternative at MP 53.9 UNT Cowlitz River (excluding fencing).*

	Alt 1: Long Undercrossing	Alt 2: Shorter Undercrossing
Project Benefits		
Multi-Species Passage	-	+
Plant Community Connectivity	-	-
Mitigates Behavioral Considerations	-	+
Proximity to Conserved Lands	+	+
Potentially Eligible for Multiple Funding Sources	+	+
Project Risks		
Human Disturbance Potential	+	+
Proximity to Development and Other Roads	+	+
Temporary Traffic Control	-	-
Schedule Considerations		
Construction Easements/Landowner Agreements	-	-
Excavation and Embankment	-	-
Structure Installation	-	-

	Alt 1: Long Undercrossing	Alt 2: Shorter Undercrossing
Order-of-Magnitude Costs		
Design	$$$	$$$
Permitting	$$$	$$$
Construction	$$$	$$$
Monitoring and Maintenance	$$$	$$$

3.7 MP 55.6 - 65.1: UNT Hill Creek

Two alternatives are considered for the MP 55.6- 56.1 UNT Hill Creek site (**Figure 3-8**):

1. MP 55.6: New Overcrossing
2. MP 56.1: Undercrossing (potential fish passage barrier removal)

3.7.1 Alternative 1: MP 55.6 Overcrossing

An overcrossing is being considered at an existing roadcut at MP 55.6. The adjacent ground is approximately 35 ft above the existing roadway on the east side of the roadway, and 30 ft above the existing roadway on the west side of the roadway. The crossing structure length is approximately 110 ft and construction would likely impact approximately 0.8 acres beyond the structure itself if retaining walls are necessary to retain the structure abutments. This structure could be constructed entirely within the WSDOT right-of-way.

This alternative would improve multi-species passage conditions and plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The overcrossing is proximate to conserved lands (WADNR) on the west side of the roadway. This crossing is unlikely to be eligible for multiple funding sources because it is a new structure. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the crossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. No mapped wetlands are present at the site, however, drainages adjacent to the highway would need to be routed through the crossing abutments. Permitting costs are lower than the undercrossing because this alternative does not impact the channel of the UNT Hill Creek. The overcrossing would likely be added to the national bridge inventory and require bridge inspections.

The details of the alternatives are discussed below, and preliminary layouts are included in **Appendix C**.

3.7.2 Alternative 2: MP 56.1: UNT Hill Creek Culvert Replacement

A proposed wildlife undercrossing replacing the existing culvert (potential fish passage barrier) on the Unnamed Tributary to Hill Creek would be approximately 230 ft long, 140 ft wide, and 42 ft tall with an openness ratio of 26. Construction of this crossing would extend beyond the WSDOT right-of-way on both sides. Construction would likely impact approximately 0.4 acres beyond the structure itself.

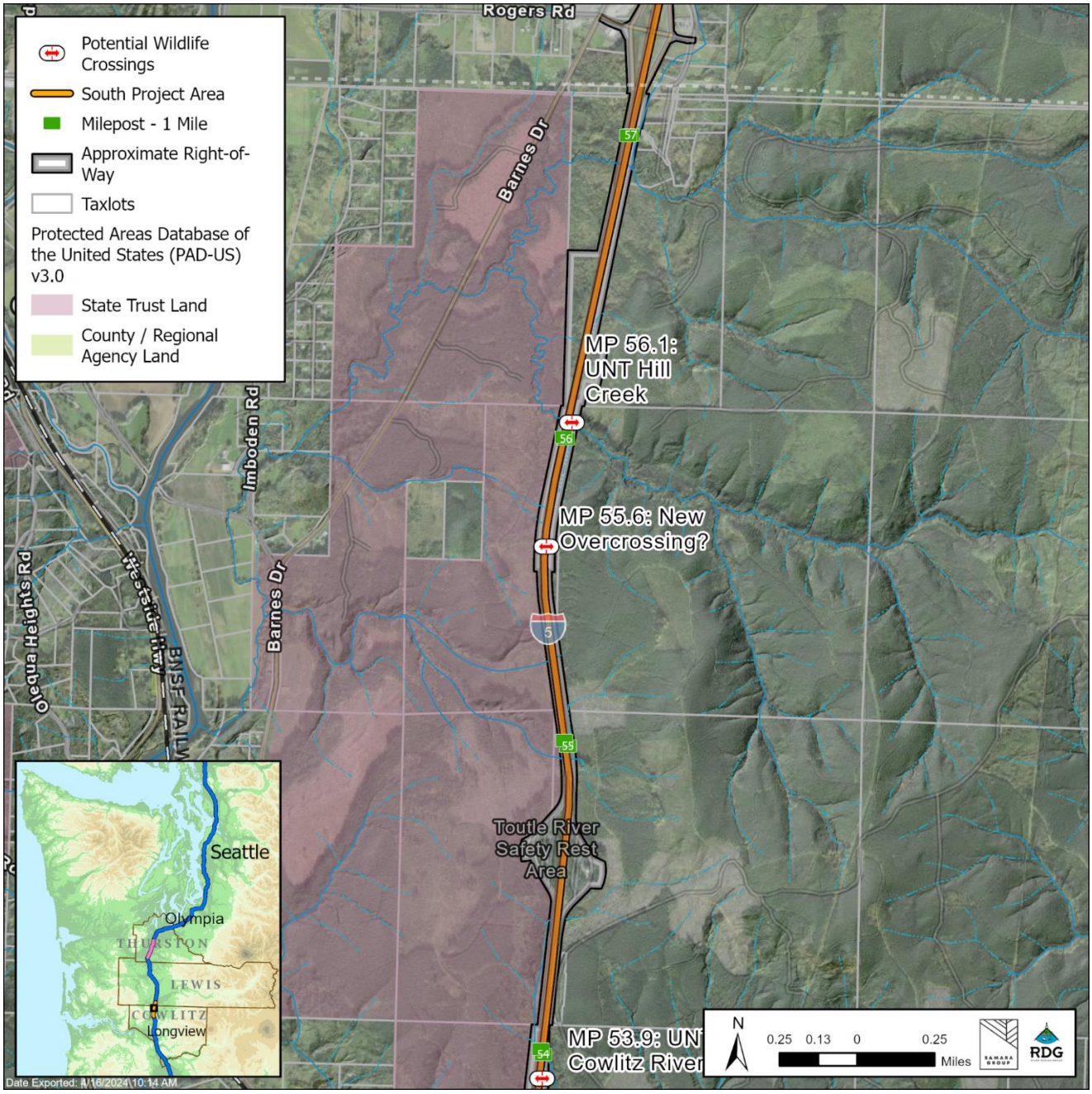

Figure 3-8. *MP 56 UNT Hill Creek potential wildlife crossings.*

This alternative would improve multi-species passage conditions, would not improve plant connectivity, and may mitigate some of the behavioral considerations related to noise, smell,

and lights. The crossing is proximate to conserved lands (WADNR) on the west side of the roadway. This crossing may be eligible for multiple funding sources including fish passage barrier removal if the existing culvert is determined to be a barrier. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the undercrossing would require disruption of the existing roadway and likely lane closures to excavate the new crossing. Construction extends beyond the existing right-of-way and will require landowner agreements or land acquisition. This alternative requires excavation and structure installation.

The channel of the UNT Hill Creek would be impacted during construction and require temporary water management. Construction will likely be limited to the approved in-water work windows. Design and permitting costs include the geomorphic, hydrologic, and hydraulic analyses for fish passage and hydraulic project approval prior to construction. Construction costs are high due to the amount of excavation and associated traffic impacts. The undercrossing would be added to the national bridge inventory and require bridge inspections in addition to fish passage inspections.

3.7.3 MP 55.6 - 56.1 UNT Hill Creek Alternatives Evaluation

Table 3-7 summarizes the alternative evaluation for MP 55.6 - 56.1 UNT Hill Creek.

Table 3-7. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for each alternative at MP 55.6 - 56.1 UNT Hill Creek (excluding fencing).*

	Alt 1: MP 55.6 Overcrossing	Alt 2: MP 56.1 Undercrossing
Project Benefits		
Multi-Species Passage	+	+
Plant Community Connectivity	+	-
Mitigates Behavioral Considerations	+	/
Proximity to Conserved Lands	+	+
Potentially Eligible for Multiple Funding Sources	-	+
Project Risks		
Human Disturbance Potential	+	+
Proximity to Development and Other Roads	+	+
Temporary Traffic Control	+	-
Schedule Considerations		
Construction Easements/Landowner Agreements	+	-

	Alt 1: MP 55.6 Overcrossing	Alt 2: MP 56.1 Undercrossing
Excavation and Embankment	+	-
Structure Installation	+	-
Order-of-Magnitude Costs		
Design	$$$	$$$
Permitting	$$	$$$
Construction	$$$	$$$
Monitoring and Maintenance	$$$	$$$

3.8 MP 58.6: Foster Creek

One alternative is being considered for the undercrossing at MP 58.6 Foster Creek removing and replacing the existing fish passage barrier (**Figure 3-9**). The proposed wildlife undercrossing replacing the existing culvert (fish passage barrier) on Foster Creek would be approximately 160 ft long, 130 ft wide, and 20 ft tall with an openness ratio of 16. Construction of this crossing would extend beyond the WSDOT right-of-way on the east side and be within the existing right-of-way on the west side. Construction would likely impact approximately 0.4 acres beyond the structure itself.

This alternative would improve multi-species passage conditions, would not improve plant connectivity, and may mitigate some of the behavioral considerations related to noise, smell, and lights. The crossing is not proximate to conserved lands. This crossing may be eligible for multiple funding sources including fish passage barrier removal. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the undercrossing would require disruption of the existing roadway and likely lane closures to excavate the new crossing. Construction extends beyond the existing right-of-way and will require landowner agreements or lang acquisition. This alternative requires excavation and structure installation.

The channel of Foster Creek would be impacted during construction and require temporary water management. Construction will likely be limited to the approved in-water work windows. Design and permitting costs include the geomorphic, hydrologic, and hydraulic analyses for fish passage and hydraulic project approval prior to construction. Construction costs are high due to the amount of excavation and associated traffic impacts. The undercrossing would be added to the national bridge inventory and require bridge inspections in addition to fish passage inspections.

Table 3-8 summarizes the undercrossing evaluation for MP 58.6 Foster Creek.

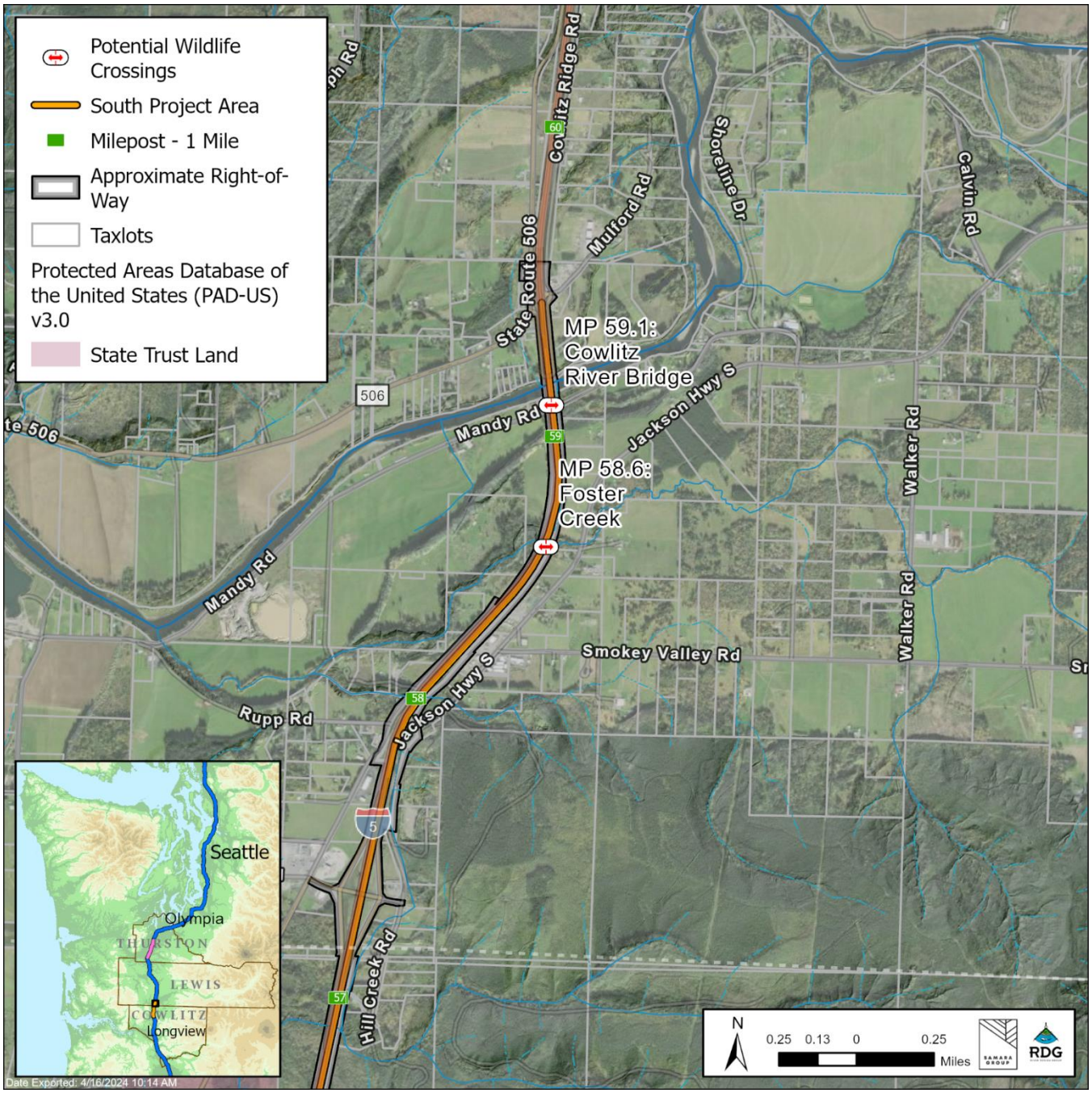

Figure 3-9. *MP 58.5 Foster Creek culvert potential wildlife crossing.*

Table 3-8. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for undercrossing at MP 58.6 Foster Creek (excluding fencing).*

	Alt 1: MP 58.6 Undercrossing
Project Benefits	
Multi-Species Passage	+
Plant Community Connectivity	-
Mitigates Behavioral Considerations	+
Proximity to Conserved Lands	-
Potentially Eligible for Multiple Funding Sources	+
Project Risks	
Human Disturbance Potential	+
Proximity to Development and Other Roads	-
Temporary Traffic Control	-
Schedule Considerations	
Construction Easements/Landowner Agreements	-
Excavation and Embankment	-
Structure Installation	-
Order-of-Magnitude Costs	
Design	$$$
Permitting	$$$
Construction	$$$
Monitoring and Maintenance	$$$

3.9 MP 59.1: Cowlitz River Bridge

Similarly to the MP 51.7 Toutle River bridge, the Cowlitz River bridge has high levels of human use and noise (**Figure 3-10**). Noise reduction retrofits may be beneficial though they would not change the frequency or character of human use (see discussion in Section 3.4 MP 51.7 Toutle River bridge).

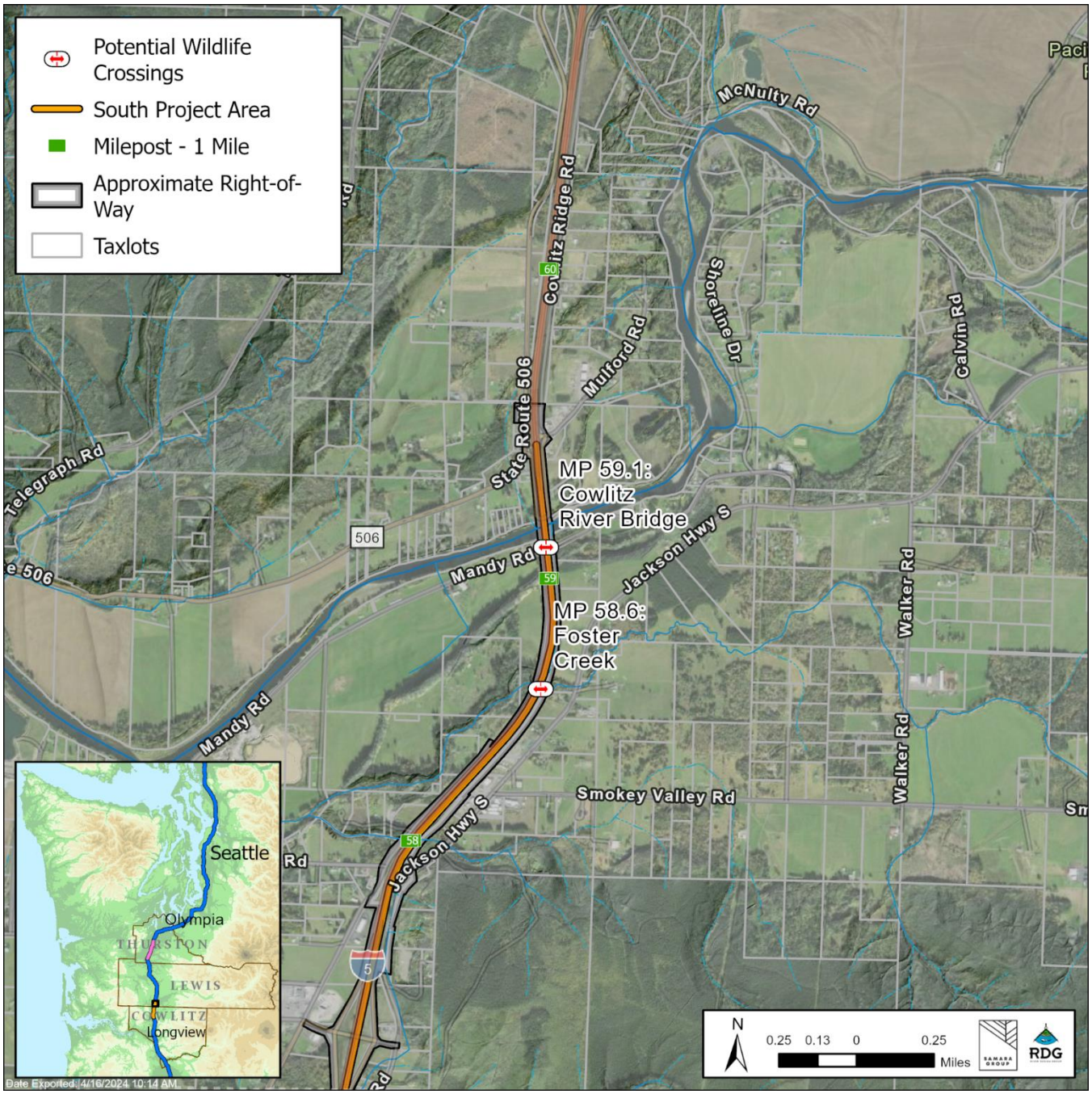

***Figure 3-10**. MP 59.1 Cowlitz River bridge retrofit.*

3.10 MP 90.4 - 91.3: Scatter Creek

Three alternatives are considered for the MP 90.4 - 91.3 Scatter Creek site (**Figure 3-11**):

1. MP 90.4 Bridge retrofit
2. MP 90.5 New overcrossing
3. MP 91.3: New overcrossing

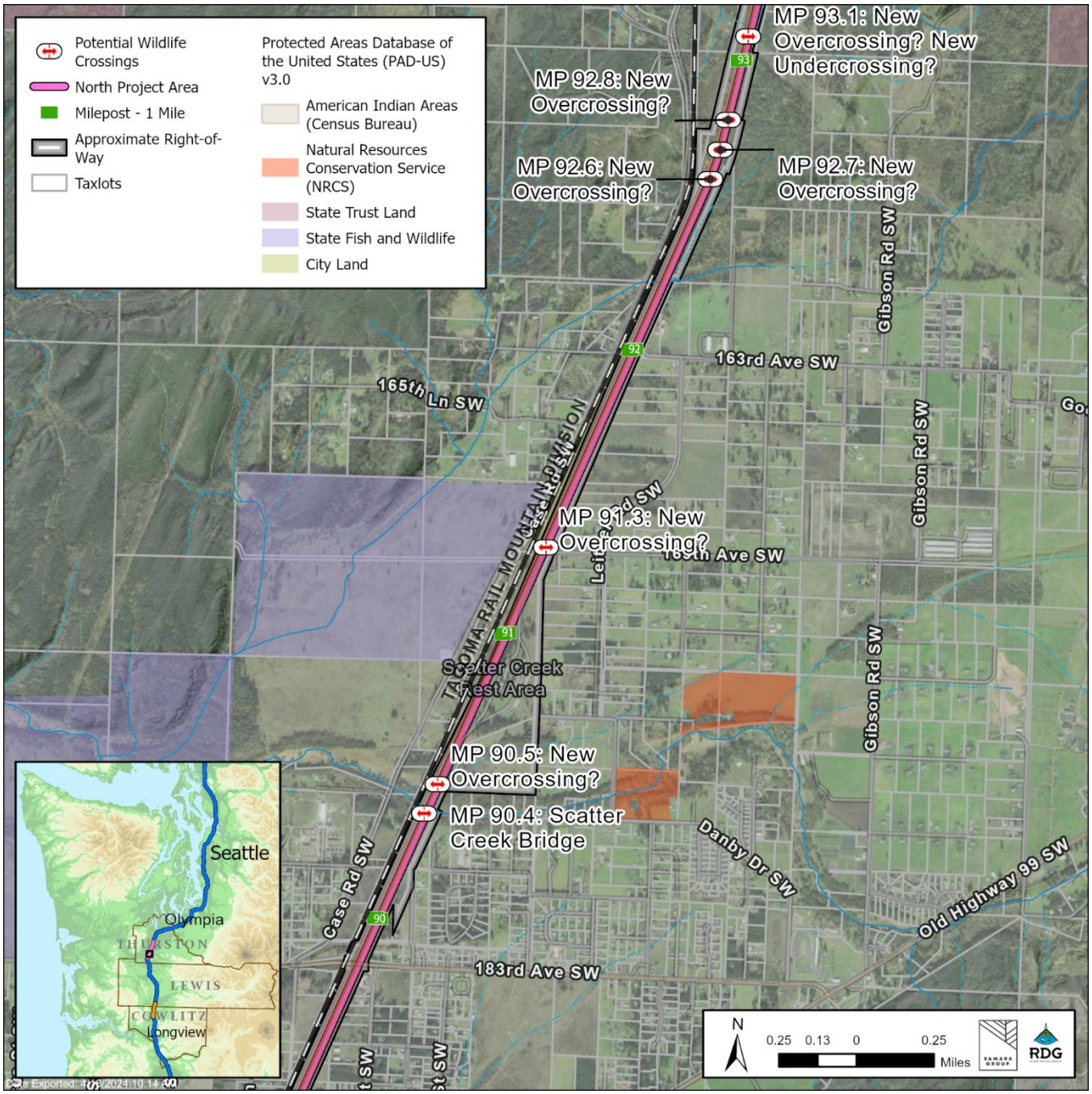

***Figure 3-11**. MP 90.4 - 91.3 Scatter Creek wildlife crossings.*

The details of the alternatives are discussed below, and preliminary layouts are included in **Appendix C**.

3.10.1 Alternative 1: MP 90.4 Bridge retrofit

The existing Scatter Creek channel under the bridge at MP 90.4 is fully wetted with little opportunity for dry passage. The addition of dry benches (above the ordinary high water elevation) could provide pathways for small and medium terrestrial species when the creek is flowing at frequently occurring flow events (see example in **Appendix B**). The benches would likely be submerged during high-magnitude low-frequency flood events.

A detailed hydrologic and hydraulic analysis would be required during future design to check that the retrofit does not reduce the bridge conveyance capacity and freeboard below the design standards. The benches would need to be monitored and maintained and these inspections may be in addition to the regular bridge inspections.

This alternative would not change the existing road geometry or require disruption of traffic during construction and the work would be within the existing WSDOT right-of-way. Construction could be completed with hand tools and would not require machinery in the Scatter Creek channel.

3.10.2 Alternative 2: MP 90.5 Overcrossing

An overcrossing is being considered at MP 90.5 near the existing Scatter Creek bridge. The adjacent terrain is mostly level and the overcrossing would be built up above existing ground. The crossing structure length is approximately 150 ft and construction would likely impact approximately 1.2 acres beyond the structure itself if using retaining walls to retain the structure abutments. This structure extends beyond the WSDOT right-of-way on the east side and is within the WSDOT right-of-way on the west side. Construction on the east side may be within the Tacoma Rail right-of-way but does not impact the actual railroad. Forested lands along Scatter Creek within the WSDOT right-of-way are present to the east.

This alternative would improve multi-species passage conditions and plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The overcrossing is proximate to conserved lands. This crossing is unlikely to be eligible for multiple funding sources because it is a new structure. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the crossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. The crossing grading extents impact a mapped freshwater forested/shrub wetland on the east side.

3.10.3 Alternative 3: MP 91.3 Overcrossing

An overcrossing is being considered at MP 90.5 near the existing Scatter Creek bridge. The adjacent terrain is mostly level and the overcrossing would be built up above existing ground. The crossing structure length is approximately 135 ft and construction would likely impact approximately 1.2 acres beyond the structure itself if using retaining walls to retain the

structure abutments. This structure extends beyond the WSDOT right-of-way on the east side and is within the WSDOT right-of-way on the west side. Construction on the east side may be within the Tacoma Rail right-of-way but does not impact the actual railroad. Existing low-density residential development is present to the west.

This alternative would improve multi-species passage conditions and plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The overcrossing is not proximate to conserved lands. This crossing is unlikely to be eligible for multiple funding sources because it is a new structure. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the crossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. No mapped wetlands are present at the site, however, drainages adjacent to the highway would need to be routed through the crossing abutments. The overcrossing would likely be added to the national bridge inventory and require bridge inspections.

3.10.4 MP 90.4 - 91.3 Scatter Creek Alternatives Evaluation

Table 3-9 summarizes the alternative evaluation for MP 90.4 - 91.3 Scatter Creek.

Table 3-9. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for each alternative at MP 90.4 - 91.3 Scatter Creek (excluding fencing).*

	Alt 1: MP 90.4 Bridge Retrofit	Alt 2: MP 90.5 Overcrossing	Alt 3: MP 91.3 Overcrossing
Project Benefits			
Multi-Species Passage	/	+	+
Plant Community Connectivity	-	+	+
Mitigates Behavioral Considerations	-	+	+
Proximity to Conserved Lands	+	+	-
Potentially Eligible for Multiple Funding Sources	+	-	-
Project Risks			
Human Disturbance Potential	+	+	-
Proximity to Development and Other Roads	+	+	-
Temporary Traffic Control	+	+	+
Schedule Considerations			

	Alt 1: MP 90.4 Bridge Retrofit	Alt 2: MP 90.5 Overcrossing	Alt 3: MP 91.3 Overcrossing
Construction Easements/Landowner Agreements	+	-	-
Excavation and Embankment	+	-	-
Structure Installation	N/A	+	+
Order-of-Magnitude Costs			
Design	$	$$$	$$$
Permitting	$$	$$$	$$
Construction	$	$$$	$$$
Monitoring and Maintenance	$$$	$$$	$$$

3.11 MP 92.6 - 92.8: New Overcrossing

Three alternatives are considered for the MP 92.6 - 92.8 site (**Figure 3-12**):

1. MP 92.6 New overcrossing
2. MP 92.7 New overcrossing
3. MP 92.8 New overcrossing

Project benefits, risks, schedule considerations and order-of-magnitude costs are similar across all alternatives. The difference between alternatives is the proximity to existing development and other roads with alternative 1 (MP 92.6) being closest and alternative 3 (MP 92.8) being furthest. The area of grading impact also varies slightly between alternatives due to the adjacent topography (see **Appendix C**).

All of the overcrossings could be constructed within the existing WSDOT right-of-way. Freshwater forested-shrub wetlands are mapped near the railroad west of the crossing and drainages adjacent to the highway would need to be routed through the crossing abutments. Construction of the overcrossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. The overcrossing would likely be added to the national bridge inventory and require bridge inspections.

The details of the alternatives are discussed below, and preliminary layouts are included in **Appendix C**.

3.11.1 Alternative 2: MP 92.6 Overcrossing

An overcrossing is being considered at MP 92.6. The adjacent ground is approximately 10 ft above the existing roadway on the west and drops away to the east. The crossing structure length is approximately 115 ft and construction would likely impact approximately 1.1 acres

beyond the structure itself if using retaining walls to retain the structure abutments. This structure is within the WSDOT right-of-way on both sides. The west end of the crossing is approximately 250 ft from the Tacoma Mountain railroad and 350 ft from Case Rd.

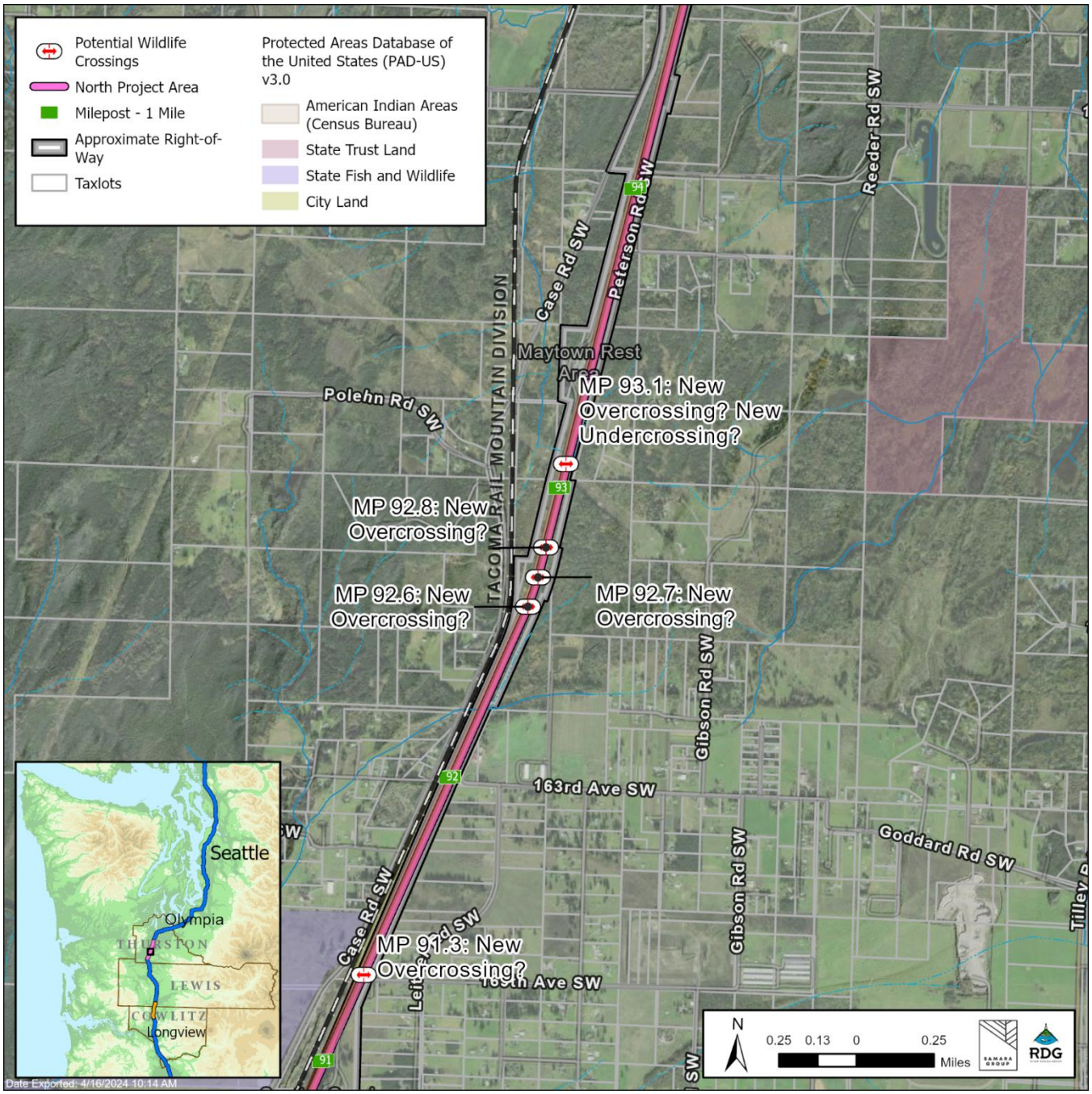

***Figure 3-12**. MP 92.6 - 92.8 site.*

3.11.2 Alternative 2: MP 92.7 Overcrossing

An overcrossing is being considered at MP 92.7. The adjacent ground is approximately 15 ft above the existing roadway on the west and drops away to the east. The crossing structure length is approximately 110 ft and construction would likely impact approximately 1.4 acres

beyond the structure itself if using retaining walls to retain the structure abutments. This structure is within the WSDOT right-of-way on both sides. The west end of the crossing is approximately 400 ft from the Tacoma Mountain railroad and 500 ft from Case Rd.

3.11.3 Alternative 3: MP 92.8 Overcrossing

An overcrossing is being considered at MP 92.8. The adjacent ground is approximately 15 ft above the existing roadway on the west and drops away to the east. The crossing structure length is approximately 120 ft and construction would likely impact approximately 0.9 acres beyond the structure itself if using retaining walls to retain the structure abutments. This structure is within the WSDOT right-of-way on both sides. The west end of the crossing is approximately 500 ft from the Tacoma Mountain railroad and 600 ft from Case Rd.

3.11.4 MP 92.6 - 92.8 Alternatives Evaluation

Table 3-10 summarizes the alternative evaluation for MP 92.6 - 92.8.

***Table 3-10**. Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for each alternative at MP 92.6 - 92.8 (excluding fencing).*

	Alt 1: MP 92.6 Overcrossing	Alt 2: MP 92.7 Overcrossing	Alt 3: MP 92.8 Overcrossing
Project Benefits			
Multi-Species Passage	+	+	+
Plant Community Connectivity	+	+	+
Mitigates Behavioral Considerations	+	+	+
Proximity to Conserved Lands	-	-	-
Potentially Eligible for Multiple Funding Sources	-	-	-
Project Risks			
Human Disturbance Potential	/	/	/
Proximity to Development and Other Roads	-	+	+
Temporary Traffic Control	+	+	+
Schedule Considerations			
Construction Easements/Landowner Agreements	+	+	+
Excavation and Embankment	-	-	-

	Alt 1: MP 92.6 Overcrossing	Alt 2: MP 92.7 Overcrossing	Alt 3: MP 92.8 Overcrossing
Structure Installation	+	+	+
Order-of-Magnitude Costs			
Design	$$$	$$$	$$$
Permitting	$$	$$	$$
Construction	$$$	$$$	$$$
Monitoring and Maintenance	$$$	$$$	$$$

3.12 MP 93.1 Powerline Corridor

Two alternatives (undercrossing and overcrossing) were initially considered for the MP 93.1 Powerline corridor site (**Figure 3-13**), however, an undercrossing with a clear line of sight is not feasible without modifying the existing road grade. The undercrossing alternative was dropped from further analysis.

An overcrossing is being considered at MP 93.1 near the powerline corridor. The adjacent terrain is sloped from east to west and the overcrossing would be built up above existing ground. The crossing structure length is approximately 125 ft and construction would likely impact approximately 1.1 acres beyond the structure itself if using retaining walls to retain the structure abutments. This structure is within the WSDOT right-of-way on both sides. Construction near the powerlines would require permission from Bonneville Power Administration (BPA).

This alternative would improve multi-species passage conditions and plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The overcrossing is not proximate to conserved lands. This crossing is unlikely to be eligible for multiple funding sources because it is a new structure. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the crossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. The crossing does not impact the mapped wetlands to the east outside of the WSDOT right-of-way. The overcrossing would likely be added to the national bridge inventory and require bridge inspections.

Table 3-11 summarizes the overcrossing evaluation for MP 93.1.

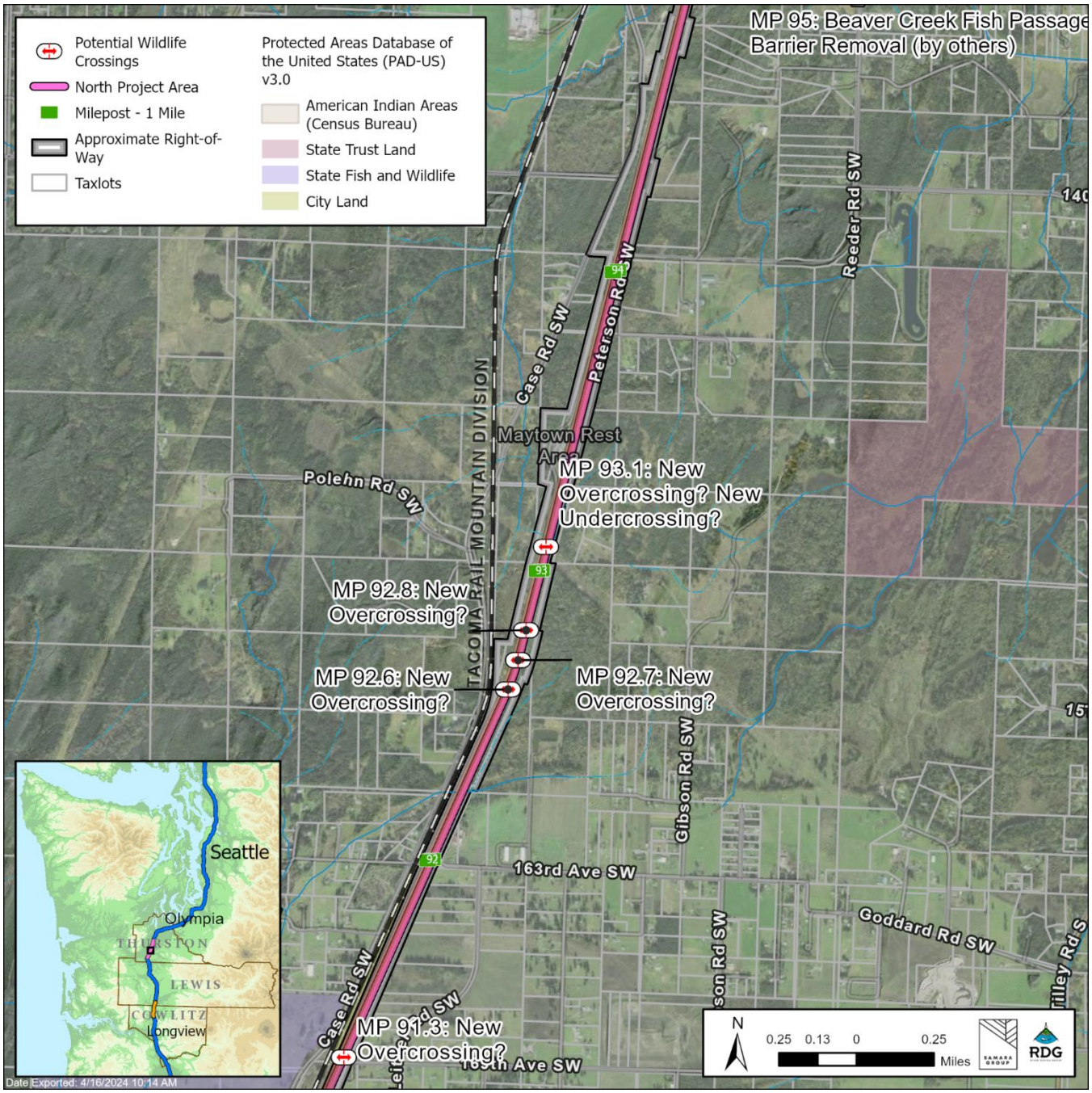

***Figure 3-13**. MP 93.1 powerline corridor site.*

Table 3-11. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for the overcrossing at MP 93.1 Powerline corridor (excluding fencing).*

	Alt 1: Overcrossing
Project Benefits	
Multi-Species Passage	+
Plant Community Connectivity	+
Mitigates Behavioral Considerations	+
Proximity to Conserved Lands	-
Potentially Eligible for Multiple Funding Sources	-
Project Risks	
Human Disturbance Potential	-
Proximity to Development and Other Roads	-
Temporary Traffic Control	+
Schedule Considerations	
Construction Easements/Landowner Agreements	-
Excavation and Embankment	-
Structure Installation	+
Order-of-Magnitude Costs	
Design	$$$
Permitting	$$
Construction	$$$
Monitoring and Maintenance	$$$

3.13 MP 96.1: New Overcrossing

An overcrossing is being considered at an existing roadcut at MP 96.1 (**Figure 3-14**). The adjacent ground is approximately 40 ft above the existing roadway on the east 30 ft above the existing roadway on the west. The crossing structure length is approximately 155 ft and construction would likely impact approximately 0.5 acres beyond the structure itself if using retaining walls to retain the structure abutments. This structure is within the WSDOT right-of-way on the east side and extends beyond the WSDOT right-of-way on the west side.

This alternative would improve multi-species passage conditions and plant connectivity and may mitigate some of the behavioral considerations related to noise, smell, and lights. The overcrossing is not proximate to conserved lands. This crossing is unlikely to be eligible for multiple funding sources because it is a new structure. This alternative would not change the human disturbance potential or proximity to development and other roads.

Construction of the crossing would not require disruption of the existing roadway and may be completed with likely partial lane closures depending on the type of structure selected. No mapped wetlands are present at the site, however, drainages adjacent to the highway would need to be routed through the crossing abutments. The overcrossing would likely be added to the national bridge inventory and require bridge inspections.

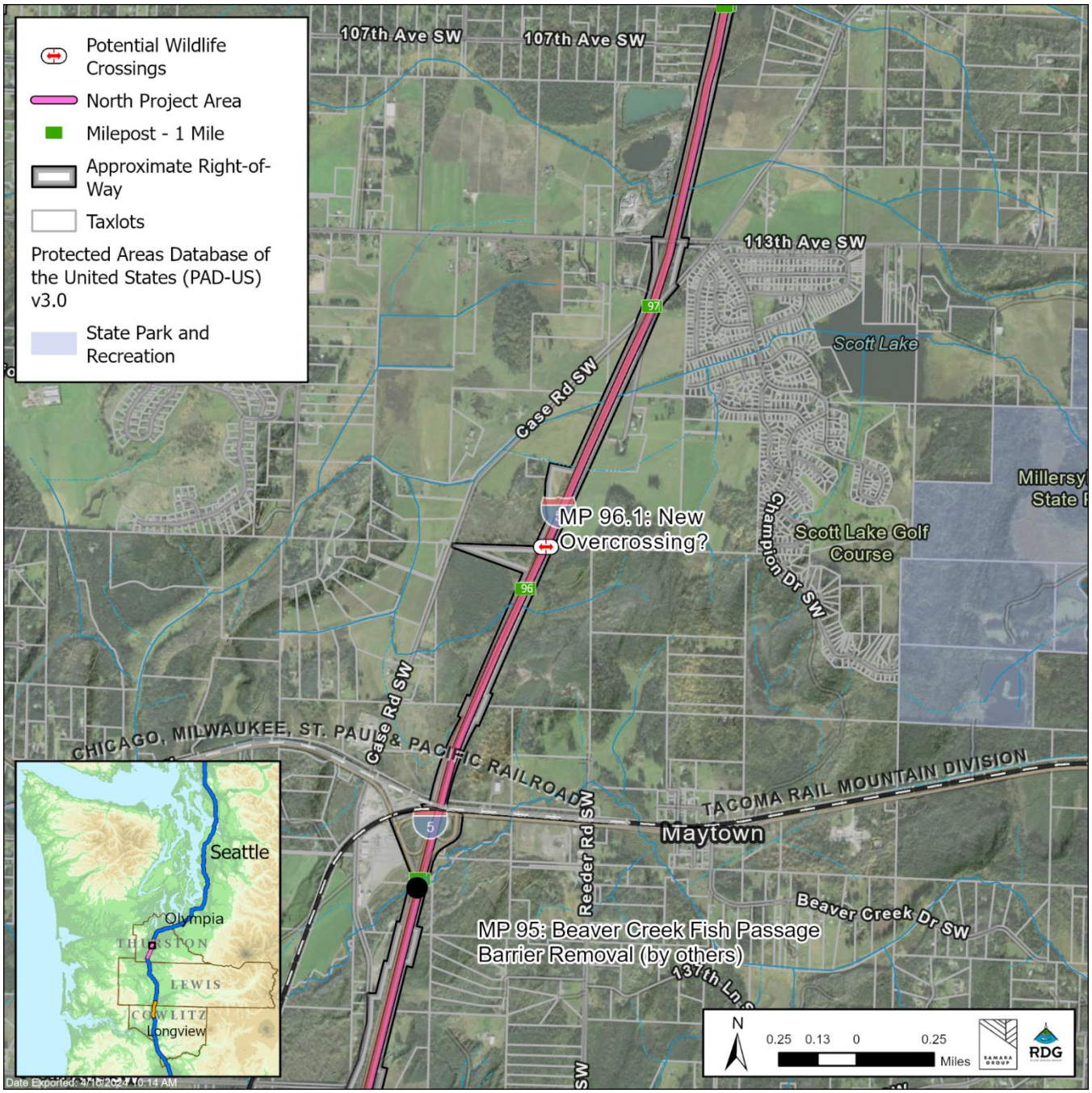

***Figure 3-14**. MP 96.1 basalt roadcut site.*

Table 3-12 summarizes the overcrossing evaluation for MP 96.1.

Table 3-12. *Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for the overcrossing at MP 96.1 (excluding fencing).*

	Alt 1: Overcrossing
Project Benefits	
Multi-Species Passage	+
Plant Community Connectivity	+
Mitigates Behavioral Considerations	+
Proximity to Conserved Lands	-
Potentially Eligible for Multiple Funding Sources	-
Project Risks	
Human Disturbance Potential	-
Proximity to Development and Other Roads	+
Temporary Traffic Control	+
Schedule Considerations	
Construction Easements/Landowner Agreements	-
Excavation and Embankment	-
Structure Installation	+
Order-of-Magnitude Costs	
Design	$$$
Permitting	$$
Construction	$$$
Monitoring and Maintenance	$$$

3.14 MP 98.1: UNT Salmon Creek

The existing fish passage barrier on the UNT Salmon Creek at MP 98.1 is being removed and replaced with a passable crossing (**Figure 3-15**). The crossing design is underway by others. This project proposes directional fencing specific to amphibians as a retrofit to increase amphibian use of the crossing structure.

Per current guidance from CalTrans (Brehme and Fisher, 2021), the directional fencing should extend beyond the crossing structure between 40 m and 50 m (approximately 130 ft and 160 ft). These distances are derived from species specific data (California tiger salamanders in Stanford, CA, and Yosemite toads in the Sierra National Forest) and should be evaluated for the species found in the UNT Salmon Creek area. The fence material should be solid to prevent small amphibians from crossing through and decrease the chance that animals will spend energy and time attempting to go "through" the fencing. Additionally, the fence ends should have hooked turnarounds to guide animals back towards the crossing structure. The final design of the amphibian fence should include soil ramp jumpouts on the road side of the fence to allow access back to the wetlands for any amphibians that may have bypassed the fence.

A conceptual layout is provided in **Appendix C** following the existing channel of the UNT Salmon Creek. The final design should be adjusted to match the new fish passage structure**.**

This retrofit could improve conditions for amphibian passage without affecting other species' usage, plant connectivity, or behavioral considerations. The retrofit would not change the proximity to conserved lands, other development and roads, or human disturbance potential. The retrofit may be eligible for multiple funding sources if sensitive species are present.

This retrofit would not require traffic disruption as all construction would occur outside of the existing roadway. The retrofit could occur entirely within the existing right-of-way and would not require excavation, embankment, or new structure installation. Design and permitting costs would need to include analysis of impacts to the adjacent wetlands including any temporary access during construction. The fence will require monitoring and maintenance especially to trim back vegetation which may 'bridge' over the fence allowing amphibians to bypass the crossing and enter the roadway.

Table 3-13 summarizes the retrofit evaluation for MP 98.1 UNT Salmon Creek.

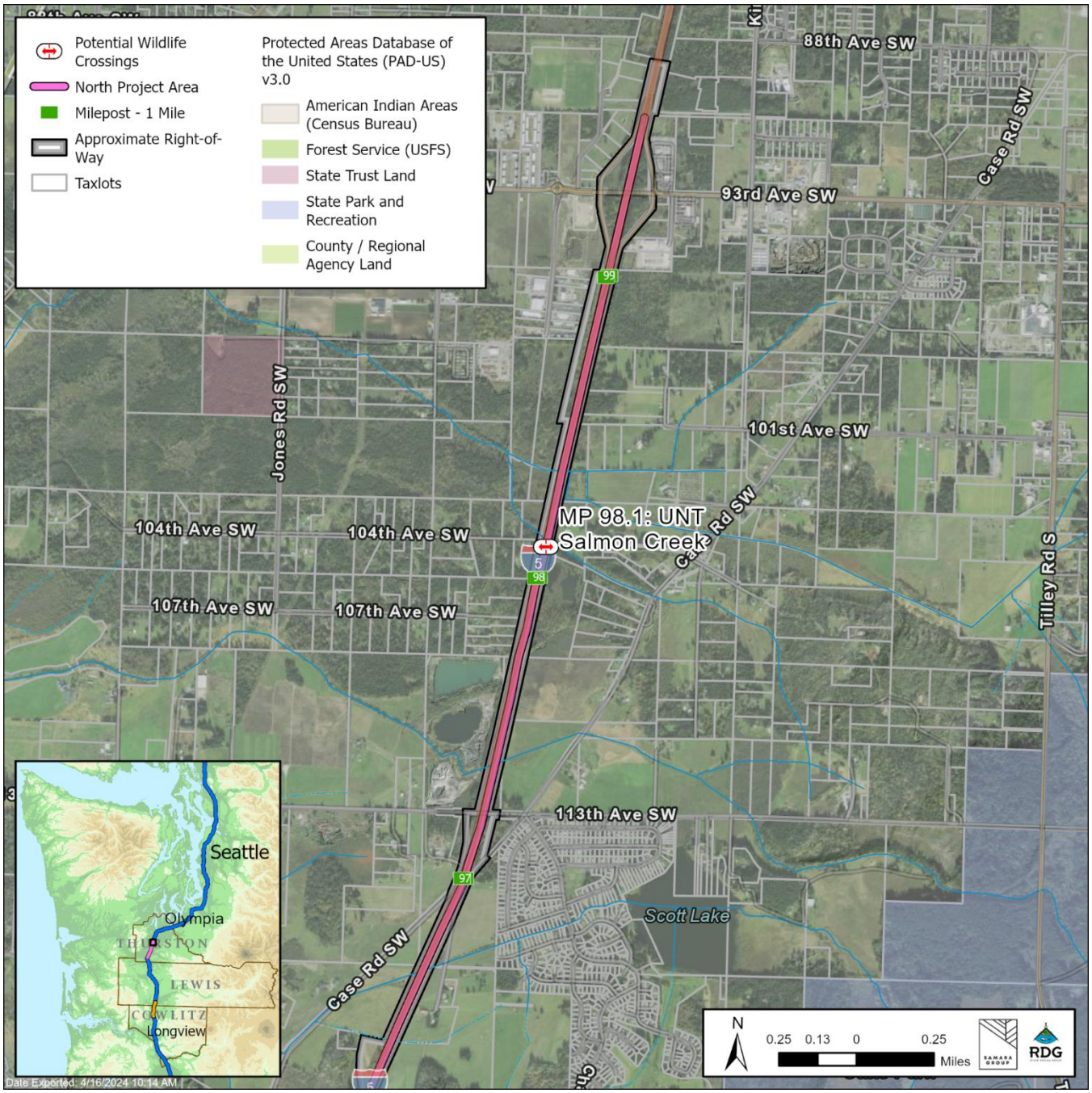

Figure 3-15. *MP 98.1 UNT Salmon Creek site.*

***Table 3-13**. Summary matrix of relative project benefits, risks, order-of-magnitude costs, and schedule considerations for the retrofit at MP 98.1 UNT Salmon Creek.*

	Alt 1: Amphibian Fence Retrofit
Project Benefits	
Multi-Species Passage	+
Plant Community Connectivity	/
Mitigates Behavioral Considerations	/
Proximity to Conserved Lands	/
Potentially Eligible for Multiple Funding Sources	+
Project Risks	
Human Disturbance Potential	/
Proximity to Development and Other Roads	/
Temporary Traffic Control	+
Schedule Considerations	
Construction Easements/Landowner Agreements	+
Excavation and Embankment	+
Structure Installation	+
Order-of-Magnitude Costs	
Design	$$
Permitting	$$
Construction	$$
Monitoring and Maintenance	$$

4 Preferred Alternatives

SG and RDG made recommendations in the draft alternatives analysis report and the preferred alternatives were selected by the SC and TAG members during design workshop 2. SG and RDG's recommendations were based on their professional experience considering the balance of project benefits, risks, cost, and schedule consideration. The preferred alternatives This section of the report summarizes the preferred alternatives selected and the rationale for consideration at each site.

Table 4-1 summarizes the preferred alternatives selected during design workshop 2 with notes for modifications during conceptual design.

***Table 4-1**. Preferred alternatives summary.*

Site	Preferred Alternative(s)	Anticipated Species Usage
MP 51.7 Toutle River	1: MP 51.7 Bridge retrofit with dense mixed vegetation and 2: Engineered structures in expansion joints	Aquatic species, small and medium mammals
MP 53.07 - 53.1 UNT Cowlitz River	1: MP 53.07 Undercrossing	Aquatic species, small and medium mammals, large mammals if approach conditions are suitable
MP 53.9 UNT Cowlitz River	2: MP 53.9 Shorter alignment undercrossing with increased width (targeting openness ratio of 18, preferably 23)	Aquatic species, small and medium mammals, large mammals if approach conditions are suitable
MP 55.6 - 56.1 UNT Hill Creek	1: MP 55.6 Overcrossing and 2: MP 56.1 Undercrossing	Overcrossing: Terrestrial species including vegetation, invertebrates, and birds Undercrossing: Aquatic species, small and medium mammals, large mammals if approach conditions are suitable
MP 58.6 Foster Creek	1: MP 58.6 Undercrossing	Aquatic species, small and medium mammals, large mammals if approach conditions are suitable
MP 59.1 Cowlitz River	1: MP 59.1 Bridge retrofit with dense mixed vegetation and 2: Engineered structures in expansion joints	Aquatic species, small and medium mammals
MP 90.4 - 91.3 Scatter Creek	2: MP 90.5 Overcrossing	Terrestrial species including vegetation, invertebrates, and birds
MP 92.6 - 92.8	3: MP 92.8 Overcrossing	Terrestrial species including vegetation, invertebrates, and birds
MP 93.1 Powerline Corridor	No crossing, include within fencing limits of MP 92.8 overcrossing	None.

MP 96.1	1: MP 96.1 Overcrossing	Terrestrial species including vegetation, invertebrates, and birds
MP 98.1 UNT Salmon Creek	1: MP 98.1 UNT Salmon Creek Amphibian Retrofit	Aquatic species, small and medium mammals, large mammals if approach conditions are suitable

4.1 MP 51.7: Toutle River Bridge Retrofit - Alternative 1 (Dense Mixed Vegetation) and Alternative 2 (Engineered Structures in Expansion Joints)

The group chose to move both alternatives (dense mixed vegetation and engineered structures in expansion joints) forward to conceptual design. The mixed vegetation will decrease noise in the approach but not under the crossing whereas the engineered structures may reduce noise directly under the crossing. The addition of native vegetation could have benefits in addition to noise reduction including enhancement of plant community and pollinator connectivity. The mechanical structures (alternative 2) are experimental and may not be permitted by the Federal Highways Administration on interstate bridges.

4.2 MP 53.07/53.1: UNT Cowlitz River – Alternative 1 (MP 53.07 Undercrossing)

The group agreed with SG and RDG's recommendation for alternative 1 at this site. Removal of the fish passage barrier at MP 53.07 on the UNT Cowlitz River is recommended in concert with the fish passage barrier removal at MP 53.9. The barriers are on the same stream. Removal of the barrier at MP 54.9 would not be effective without removal of the downstream barrier at MP 53.07.

4.3 MP 53.9: UNT Cowlitz River – Alternative 2 (Shorter Alignment Undercrossing) with Increased Width

The group agreed with SG and RDG's recommendation of Alternative 2 with a note to increase the crossing width targeting an openness ratio of at least 18 (preferably 23). Removal of the fish passage barrier on the UNT Cowlitz River at MP 53.9 would benefit from realigning the existing culvert to a shorter undercrossing. The longer undercrossing (alternative 1) may deter some species from its use due to the extreme length and low openness ratio.

4.4 MP 55.6/56.1: UNT Hill Creek – Alternative 1 (MP 55.6 Overcrossing) and Alternative 2 (MP 56.1 Undercrossing)

The group chose to move both alternatives forward to conceptual design. The proximity to WADNR lands to the west and private timberlands to the east make this an attractive area. The riparian corridor along the UNT Hill Creek would be protected from future development and a paired overcrossing would provide a route for species who do not prefer undercrossings. Fencing would extend between both crossings to increase usage. There may be opportunities to save cost during construction by implementing both crossings concurrently as they are within one half-mile of each other. Mobilization, and staging areas and traffic management plans could be developed for both crossings concurrently.

An overcrossing at MP 55.6 would provide connectivity for multiple species including large animals such as elk while enhancing plant community, invertebrate, and pollinator connectivity.

The existing culvert at MP 56.1 is not currently considered a fish passage barrier and would continue to provide passage to animals already using it. The conceptual design for the wildlife undercrossing is being developed to be ready when the existing culvert eventually needs to be replaced. The undercrossing may become eligible for fish passage barrier removal funding if its passability status is revised.

4.5 MP 58.6: Foster Creek Undercrossing

The group agreed with SG and RDG's recommendation for the MP 58.6 Foster Creek undercrossing. Removal of the fish passage barrier on Foster Creek at MP 58.6 and replacement with a wildlife passage structure would connect to a broad riparian corridor pathway south of the Cowlitz River.

4.6 MP 59.1: Cowlitz River Bridge Retrofit - Alternative 1 (Dense Mixed Vegetation) and Alternative 2 (Engineered Structures in Expansion Joints)

See discussion of retrofit at MP 51.7 Toutle River bridge. The group noted during workshop 2 that revegetation efforts are already underway at this site and there may not be many opportunities for additional dense mixed vegetation.

4.7 MP 90.4/90.5/91.3: Scatter Creek – Alternative 2 (MP 90.5 Overcrossing)

The group agreed with SG and RDG's recommendation at this site. The dry benches possible at the crossing are unlikely to provide passage to species not already using it due to the height limitations of the existing bridge. The existing Scatter Creek bridge may pass most species when dry, but will not provide passage for elk, and may not support movement for most terrestrial amphibians. The dry bench retrofit may support enhanced movement for small and medium species during low flows.

The addition of an overcrossing at MP 90.5 near the bridge would connect the movement paths along the Scatter Creek riparian corridor and the existing railroad undercrossing to the west of the highway. The impacts to the wetlands may require mitigation. WSDOT staff noted that this crossing location is within the service area of the North Fork Newaukum Wetland Mitigation Bank.

Alternative 3 (MP 91.3 Overcrossing) avoids wetland impacts but is near existing development to the east which may limit animal movement. The group did not support a crossing in this area of existing development.

4.8 MP 92.6/92.7/92.8: Alternative 3 (MP 92.8 Overcrossing)

The group agreed with SG and RDG's recommendation of alternative 3. The alternative 3 (MP 92.8) overcrossing is furthest from existing development and roads to the west and large undeveloped forested parcels to the east. The 92.8 location also minimizes potential impact to large (old) coniferous trees which are present further south. The fencing associated with this crossing would extend to the Vets farm property to the south and past MP 93.1 to the north.

4.9 MP 93.1: No New Crossing

No crossing was selected at this site due to safety concerns working under the powerlines and the probability of human recreational vehicle use (motorcycles, all-terrain vehicles and 4-wheelers) in the powerline corridor. The fencing from MP 92.8 overcrossing will encompass this area to direct any wildlife moving through the corridor to the overcrossing to the south.

4.10 MP 96.1: New Overcrossing

The group agreed with SG and RDG's recommendation for the overcrossing at MP 96.1. The overcrossing at MP 96.1 would provide terrestrial connectivity near the fish passage barrier removal on Beaver Creek at MP 95. The existing roadcut geometry and geology is well-suited to an overcrossing with minimal impacts outside of the existing right-of-way compared to other overcrossing in the north zone.

4.11 MP 98.1: UNT Salmon Creek Amphibian Retrofit

The group agreed with SG and RDG's recommendation of amphibian retrofit at MP 89.1 UNT Salmon Creek. The preliminary crossing structure's minimum hydraulic opening is 30 feet and will be used to set the limits of the fencing in the conceptual design. The addition of amphibian-specific fencing to the future fish and wildlife passage crossing on UNT Salmon Creek at MP 98.1 could increase effectiveness in amphibian utilization of the crossing. This retrofit would not detract from efficacy for fish passage or other species' utilization.

5 References

Brehme, CS and RN. Fisher. 2021. Research to Inform Caltrans Best Management Practices for Reptile and Amphibian Road Crossings. USGS Cooperator Report to California Department of Transportation, Division of Research, Innovation and System Information, 65A0553.

Maleki, K., & Hosseini, S. M. (2011). Investigation of the effects of leaves, branches, and canopies of trees on noise pollution reduction. Annals of Environmental Science, 5(1), 13-21.

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Wilson, R. S., & Arvai, J. L. (2011). Structured decision making. *Corvallis, Ore.: Oregon Sea Grant*.

WSDOT, n.d. Noise walls & barriers. https://wsdot.wa.gov/construction-planning/protecting-environment/noise-walls-barriers. Accessed February 2024.

6 Appendices

A) Summary of Interviews
B) Illustrated Menu of Passage Improvement Options
C) Conceptual Site Plans for Alternatives
D) Engineering Design Matrices

Appendix A

Summary of Interviews

Full List of Interviewees

Name	Affiliation	Date of Interview
Alan Yanahan	USFWS	10/30/2023
Anna Arensmeyer	WSDOT	11/30/2023
Frazer Shilling	UC Davis Road Ecology	10/30/2023
Glen Kalisz	WSDOT	10/30/2023
Marc Hershfield	WSDOT	10/31/2023
Mark Elbroch	Panthera	11/20/2023
Bob Armine	Lewis County	12/1/2023
Brian Calkins	WDFW	11/27/2023
Brian Stewart	CNW	11/20/2023
C Donehower	Cowlitz Tribe	12/1/2023
Chris.Mongeon	DNR	11/20/2023
Dalton Fry	Cowlitz Tribe	12/1/2023
David Howe	WDFW	11/27/2023
Elliot Winter	WDFW	11/27/2023
Eric Holman	WDFW	11/27/2023
George Fornes	WDFW	11/27/2023
James Blacklaw	Contractor	11/29/2023
Jeff Azerrad	WDFW	11/27/2023
Jeremy Romero	NWF	11/29/2023
Jerry Mizar	DNR	11/20/2023
Julia Michalak	WDFW	11/27/2023
Michelle Tirhi	WDFW	11/27/2023
Noll Steinweg	WDFW	11/27/2023
Renee Wend	DNR	11/20/2023
Sandra Jonker	WDFW	11/27/2023
Madeline Nolan	WDFW	11/27/2023

Appendix B

Illustrated Menu of Passage Improvement Options

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Vegetation Management/Additions

Fencing

Fencing Associated Features

Habitat Structure in Crossing

Dry Bench / Shelf

Full Culvert Replacement and/or Conversion to Bridge

Overcrossing

Appendix C

Conceptual Site Plans for Alternatives

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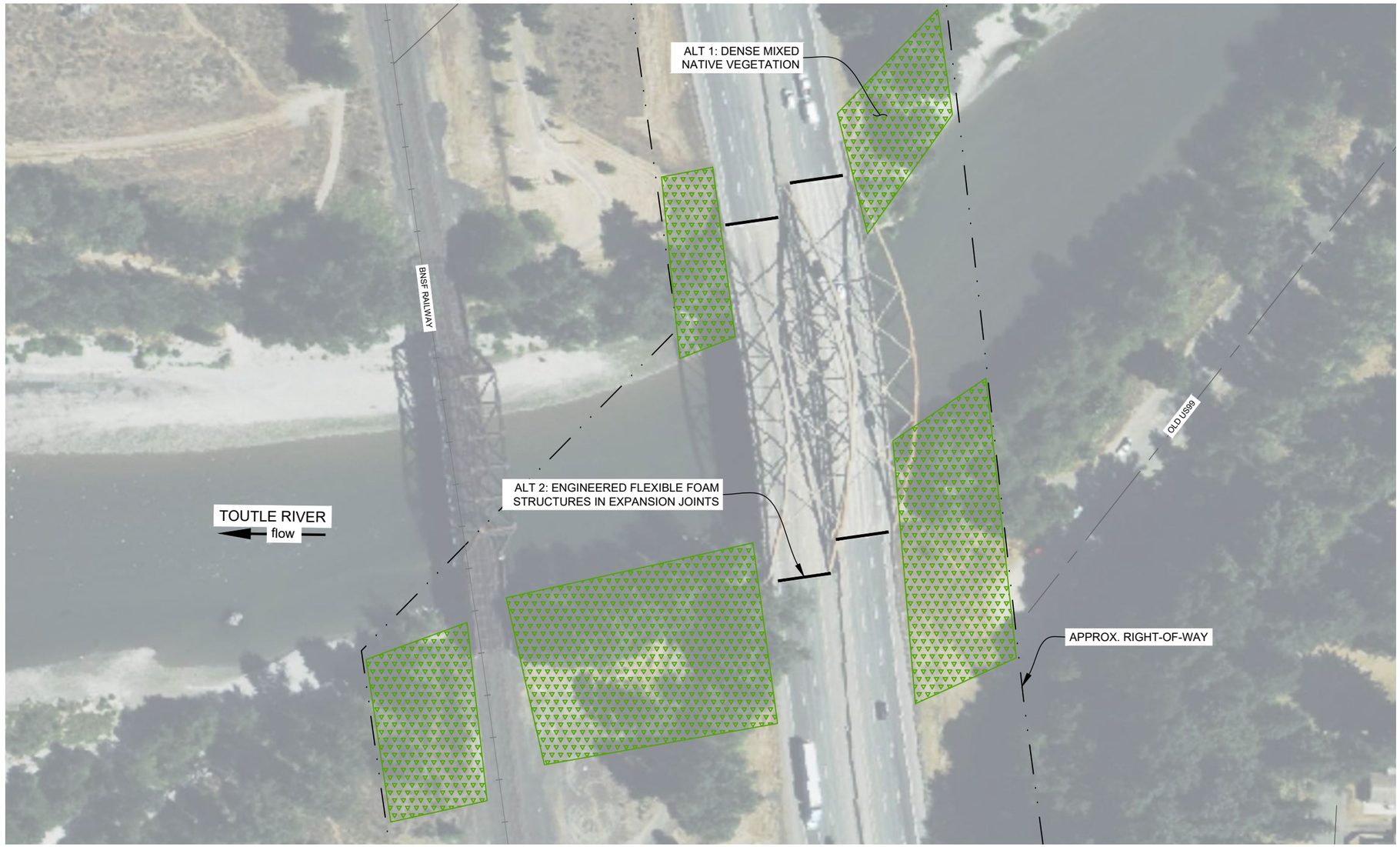

1 MP 51.7 BRIDGE RETROFIT LAYOUT

1" = 100'

BRIDGE RETROFIT NOTES

1. THE PURPOSE OF THE RETROFIT IS TO REDUCE BRIDGE AND ROAD NOISE FOR WILDLIFE APPROACHING AND CROSSING UNDER THE BRIDGE. THE BRIDGE GEOMETRY WILL NOT BE ALTERED.
2. ALTERNATIVE 1 CONSISTS OF DENSE MIXED NATIVE VEGETATION TO REDUCE NOISE AT THE BRIDGE APPROACHES. NO VEGETATION IS PROPOSED DIRECTLY BENEATH THE BRIDES.
3. ALTERNATIVE 2 CONSISTS OF ENGINEERED FLEXIBLE FOAM STRUCTURES IN THE EXISTING BRIDGE EXPANSION JOINTS.

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MP 51.7 TOUTLE RIVER BRIDGE RETROFIT

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
RDG-23-231

DRAWING NUMBER
1.0

Drawing 1 of 12

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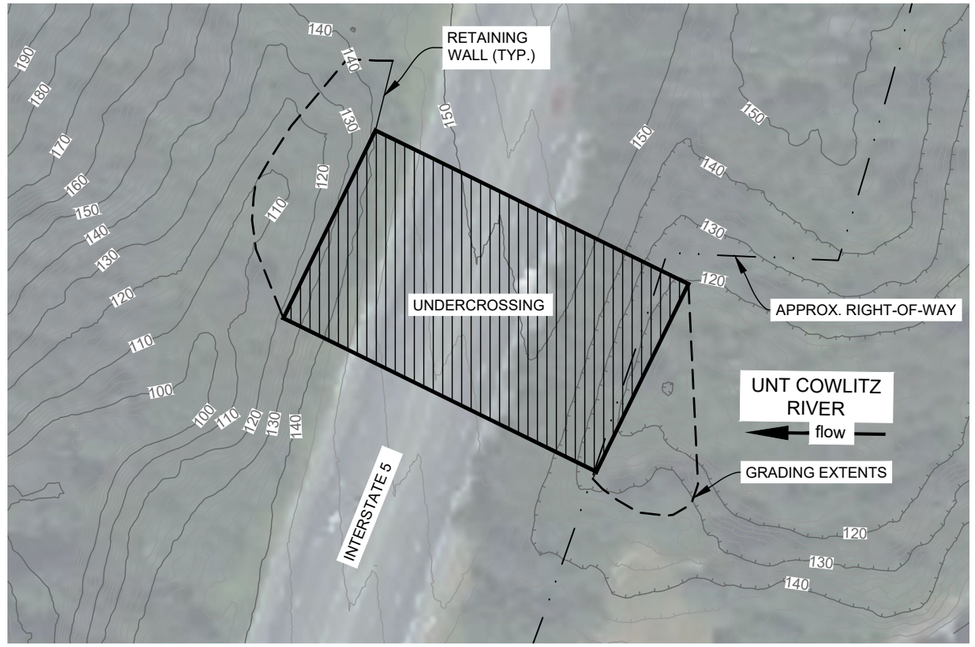
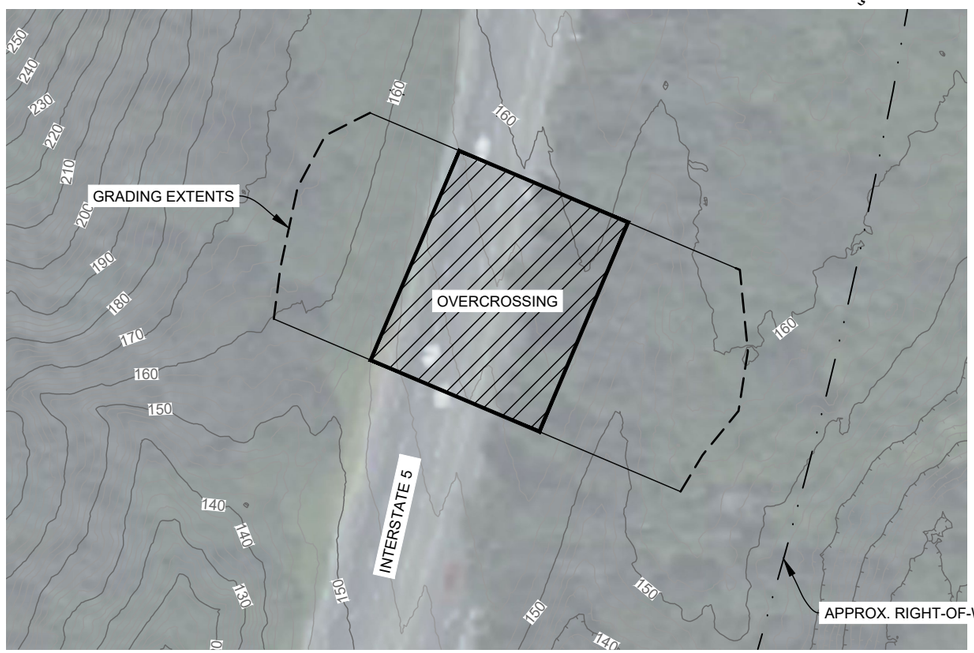


1 MP 53.07 UNDERCROSSING LAYOUT

1" = 100'



2 MP 53.1 OVERCROSSING LAYOUT

1" = 100'

CROSSING ALTERNATIVES NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRIES

	MP 53.07 UNDERCROSSING	MP 53.1 OVERCROSSING
CROSSING LENGTH (FT)	230	120
CROSSING WIDTH (FT)	138	150
CROSSING HEIGHT (FT)	38	N/A
OPENNESS RATIO	18	N/A
GRADING AREA WEST (AC)	0.2	0.3
GRADING AREA EAST (AC)	0.1	0.4
STRUCTURE SPAN (FT)	140	152

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MP 53.07-53.1 UNT COWLITZ RIVER

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
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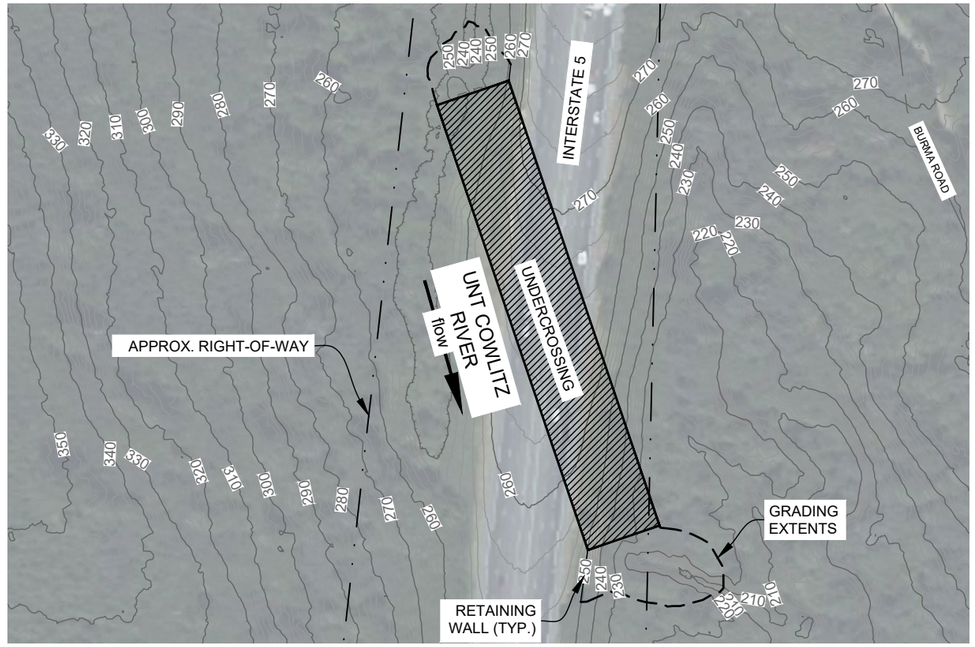
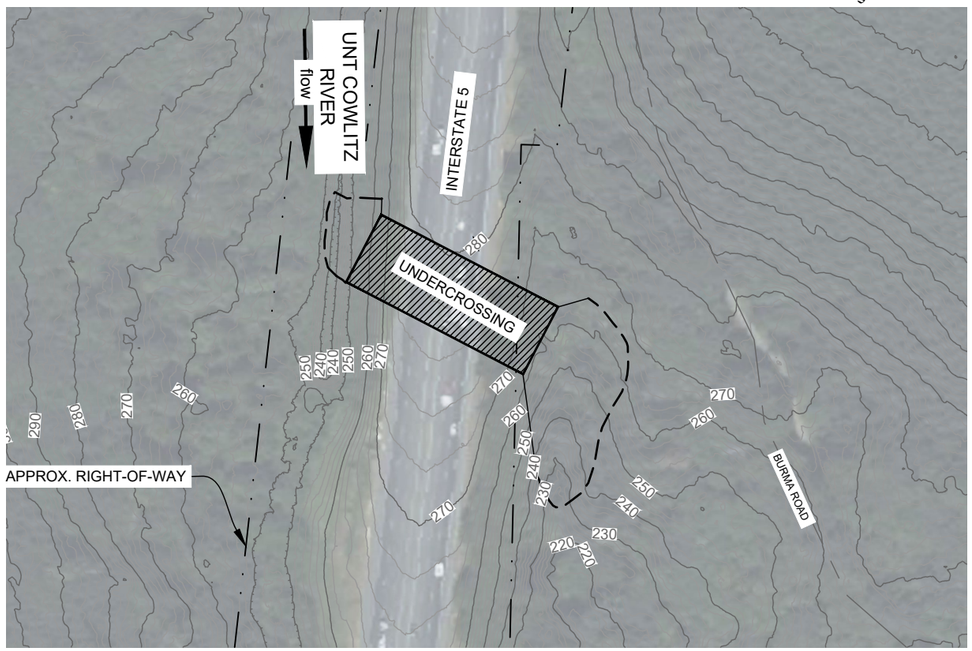


1 MP 53.9 UNDERCROSSING LAYOUT 1

1" = 200'



2 MP 53.9 UNDERCROSSING LAYOUT 2

1" = 200'

CROSSING ALTERNATIVES NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRIES

	MP 53.9 UNDERCROSSING 1	MP 53.9 UNDERCROSSING 2
CROSSING LENGTH (FT)	620	265
CROSSING WIDTH (FT)	100	100
CROSSING HEIGHT (FT)	40	40
OPENNESS RATIO	6	15
GRADING AREA WEST (AC)	0.1	0.1
GRADING AREA EAST (AC)	0.3	0.6
STRUCTURE SPAN (FT)	280	115

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MP 53.9 UNT COWLITZ RIVER

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
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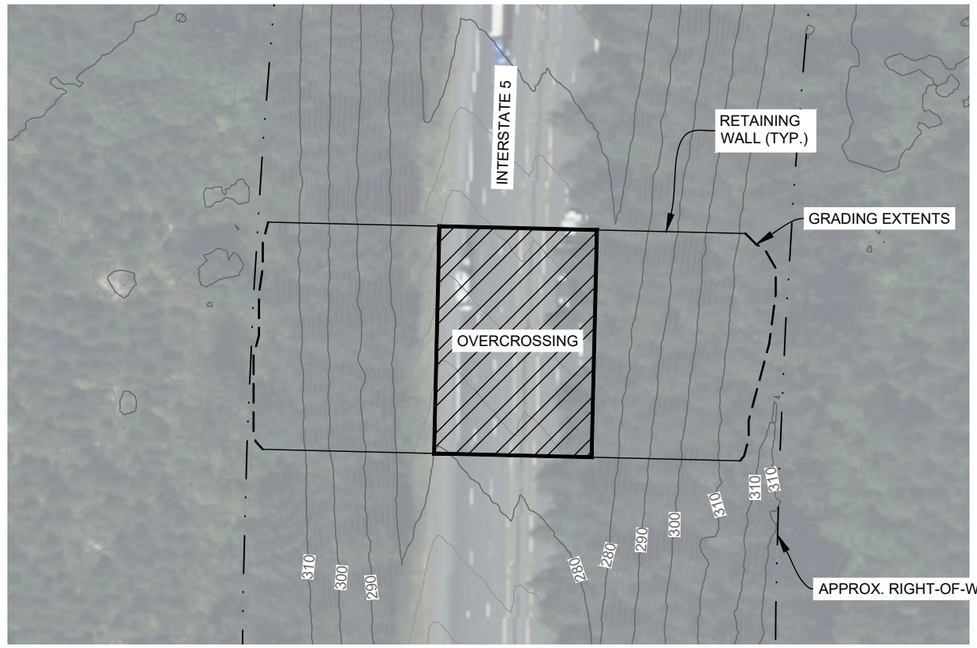
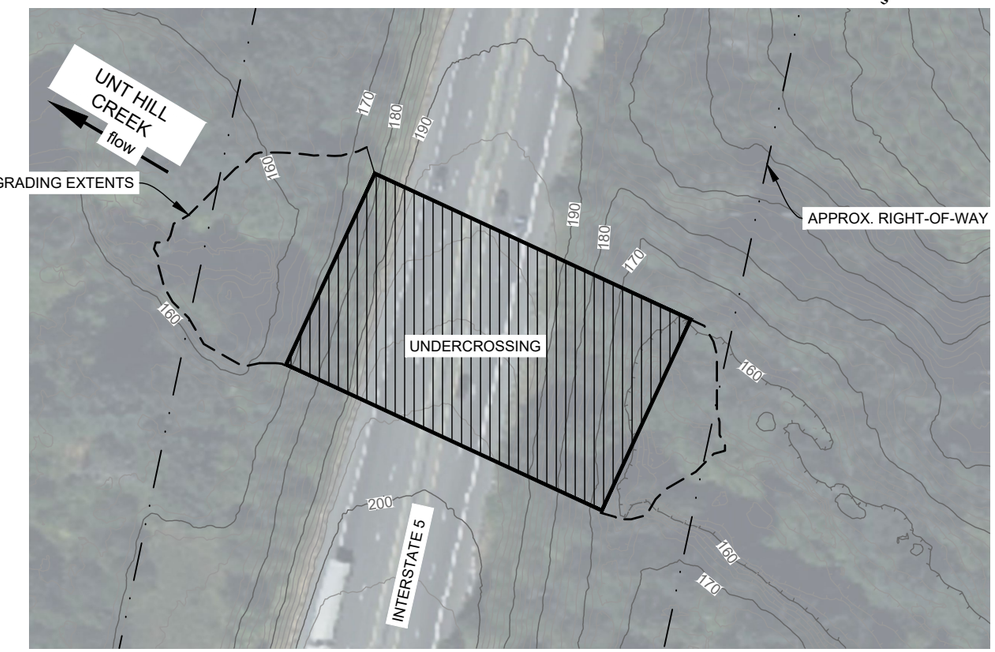


1 MP 55.6 OVERCROSSING LAYOUT

1" = 100'



2 MP 56.1 UNDERCROSSING LAYOUT

1" = 100'

CROSSING ALTERNATIVES NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRIES

	MP 55.6 OVERCROSSING	MP 56.1 UNDERCROSSING
CROSSING LENGTH (FT)	110	230
CROSSING WIDTH (FT)	150	140
CROSSING HEIGHT (FT)	N/A	42
OPENNESS RATIO	N/A	26
GRADING AREA WEST (AC)	0.4	0.3
GRADING AREA EAST (AC)	0.4	0.1
STRUCTURE SPAN (FT)	150	140

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MP 55.6 - 56.1 UNT HILL CREEK

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
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Drawing 4 of 12

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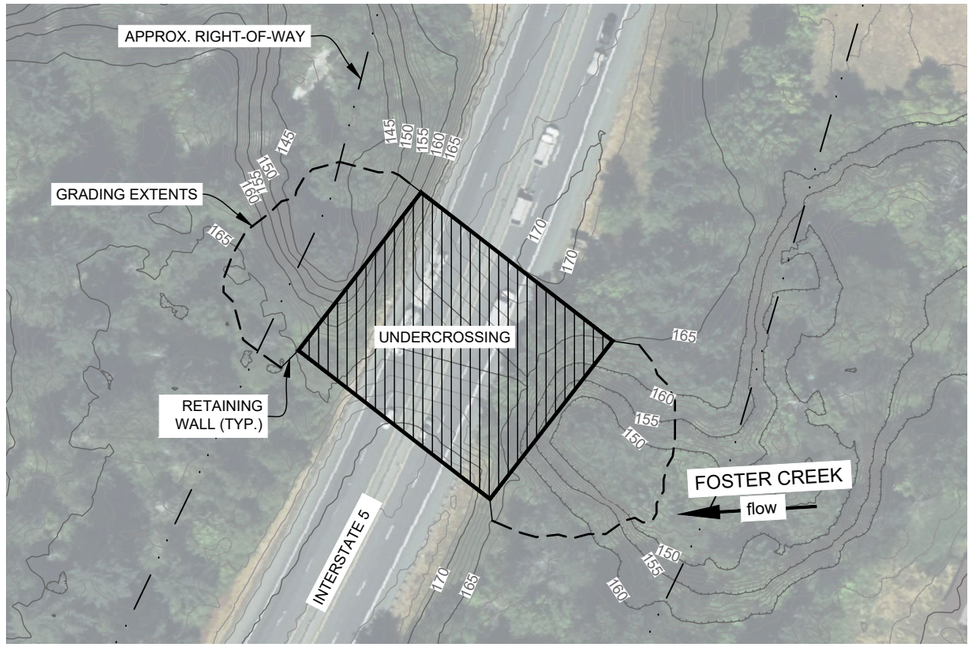

1 MP 58.6 UNDERCROSSING LAYOUT

1" = 100'

CROSSING NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRY

	MP 58.6 UNDERCROSSING
CROSSING LENGTH (FT)	160
CROSSING WIDTH (FT)	130
CROSSING HEIGHT (FT)	20
OPENNESS RATIO	16
GRADING AREA WEST (AC)	0.2
GRADING AREA EAST (AC)	0.2
STRUCTURE SPAN (FT)	135

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MP 58.6 FOSTER CREEK

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

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PROJECT NUMBER
RDG-23-231

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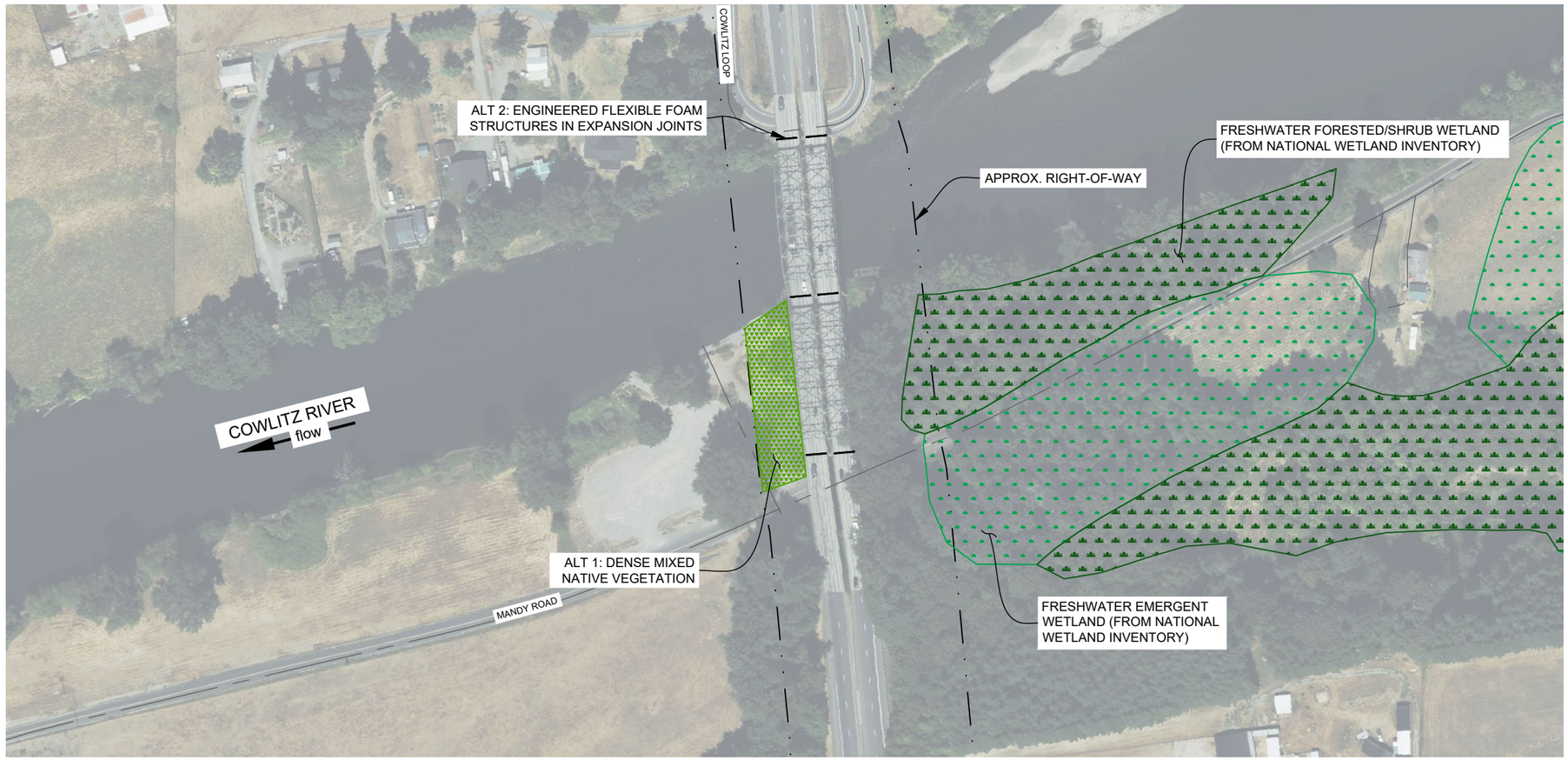

1 MP 59.1 BRIDGE RETROFIT LAYOUT

1" = 200'

BRIDGE RETROFIT NOTES

1. THE PURPOSE OF THE RETROFIT IS TO REDUCE BRIDGE AND ROAD NOISE FOR WILDLIFE APPROACHING AND CROSSING UNDER THE BRIDGE. THE BRIDGE GEOMETRY WILL NOT BE ALTERED.
2. ALTERNATIVE 1 CONSISTS OF DENSE MIXED NATIVE VEGETATION TO REDUCE NOISE AT THE BRIDGE APPROACHES. NO VEGETATION IS PROPOSED DIRECTLY BENEATH THE BRIDES.
3. ALTERNATIVE 2 CONSISTS OF ENGINEERED FLEXIBLE FOAM STRUCTURES IN THE EXISTING BRIDGE EXPANSION JOINTS.

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MP 59.1 COWLITZ RIVER BRIDGE RETROFIT

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
RDG-23-231

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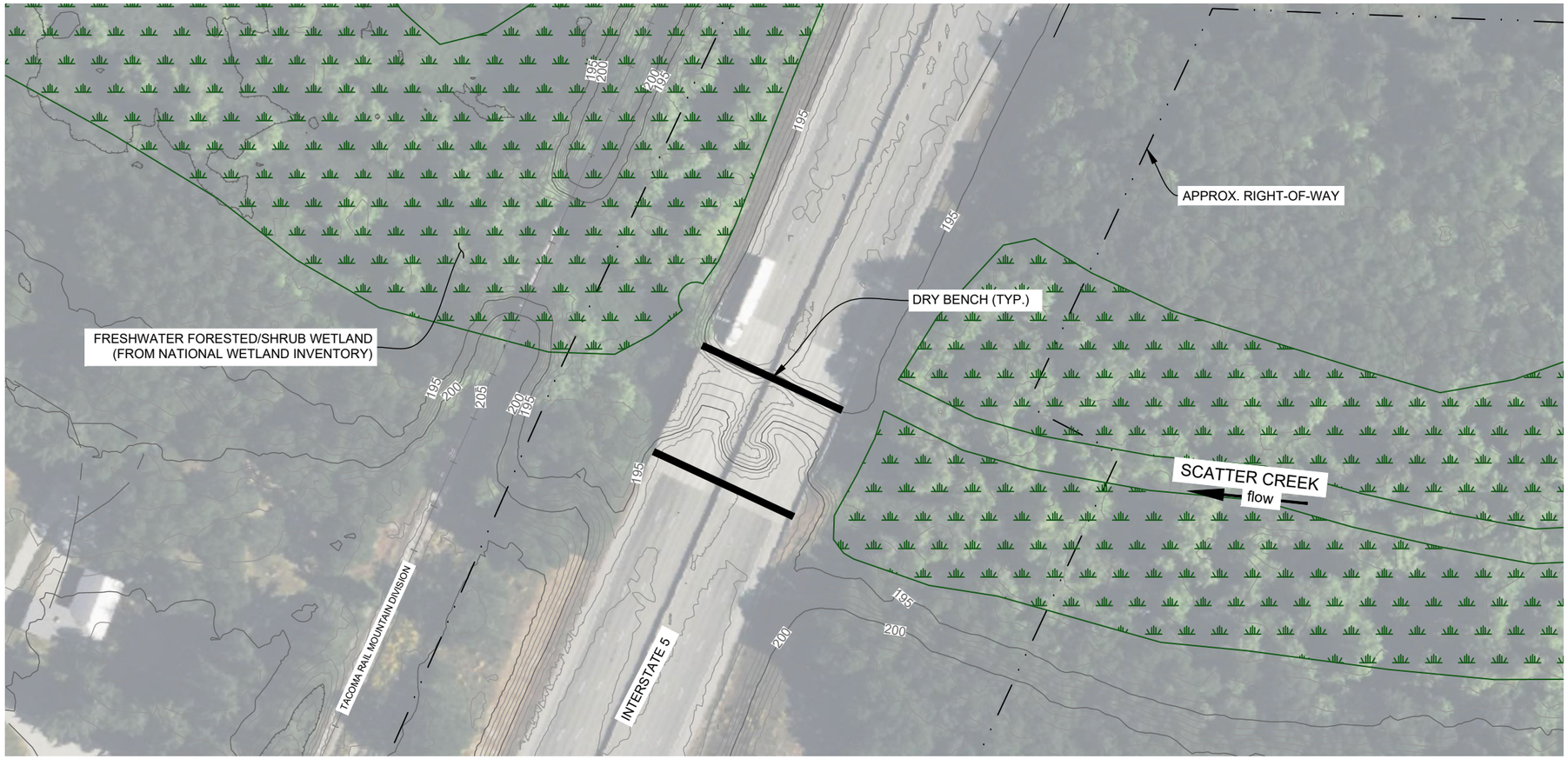

1 MP 90.4 BRIDGE RETROFIT LAYOUT

1" = 100'

BRIDGE RETROFIT NOTES

1. THE PURPOSE OF THE RETROFIT IS TO PROVIDE A DRY PASSAGE PATHWAY DURING FREQUENTLY-OCCURRING FLOWS IN SCATTER CREEK. THE BRIDGE GEOMETRY WILL NOT BE ALTERED.
2. THE ADDITION OF A DRY BENCH WILL REQUIRE HYDRAULIC AND STRUCTURAL ANALYSES TO EVALUATE FLOOD CARRYING CAPACITY, FREEBOARD, SCOUR, AND STRUCTURAL STABILITY.

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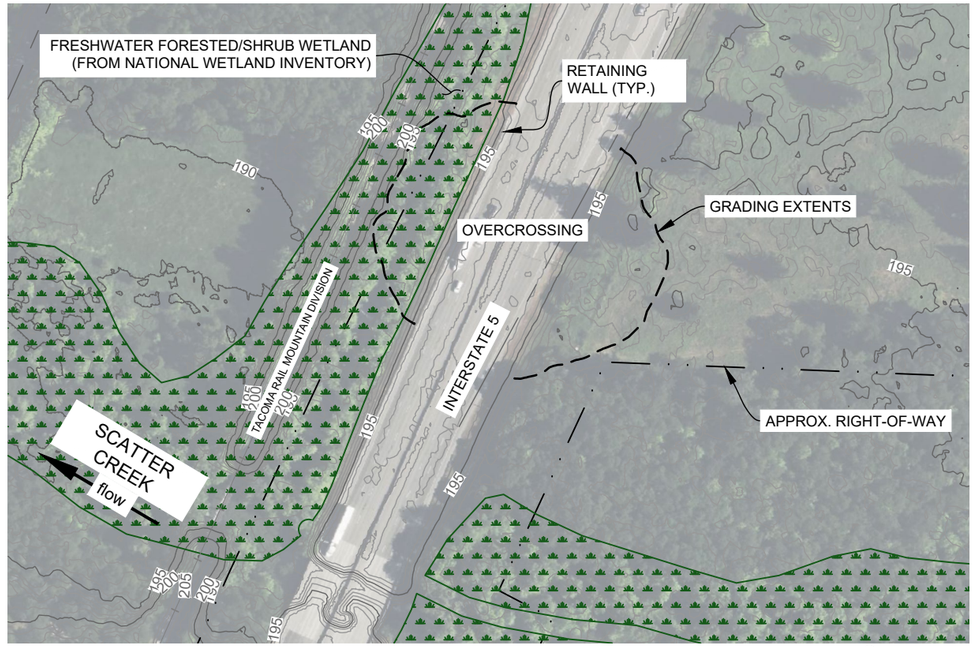
MP 90.4 SCATTER CREEK BRIDGE RETROFIT

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

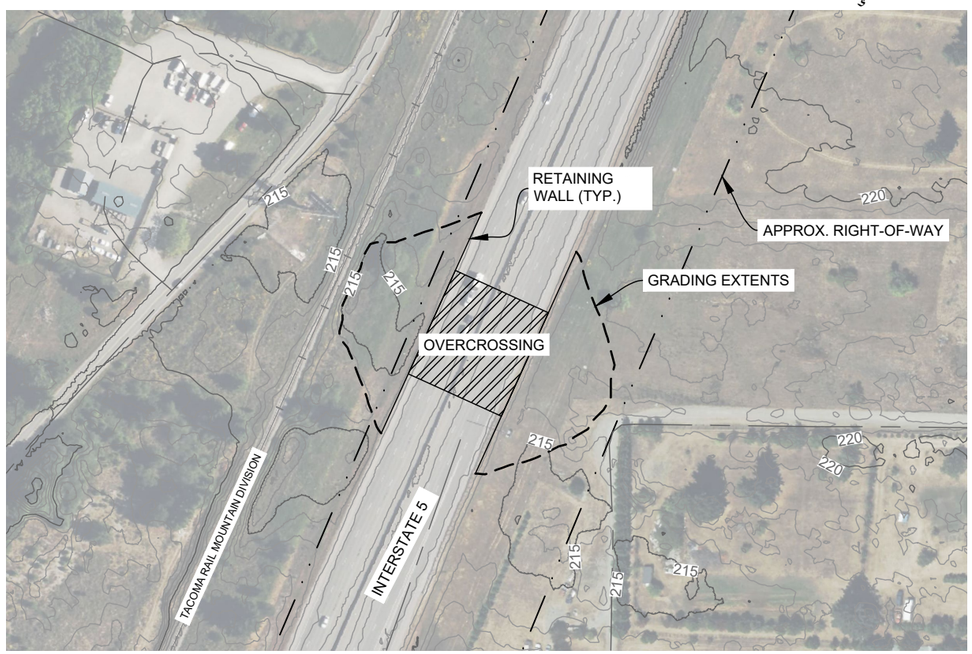
PROJECT NUMBER
RDG-23-231

DRAWING NUMBER
7.0



1 MP 90.5 OVERCROSSING LAYOUT

1" = 200'



2 MP 91.3 OVERCROSSING LAYOUT

1" = 200'

CROSSING ALTERNATIVES NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRIES

	MP 90.5 OVERCROSSING	MP 91.3 OVERCROSSING
CROSSING LENGTH (FT)	150	135
CROSSING WIDTH (FT)	150	150
CROSSING HEIGHT (FT)	N/A	N/A
OPENNESS RATIO	N/A	N/A
GRADING AREA WEST (AC)	0.6	0.6
GRADING AREA EAST (AC)	0.6	0.6
STRUCTURE SPAN (FT)	150	150

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MP 90.5 AND 91.3 SCATTER CREEK OVERCROSSINGS

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
RDG-23-231

DRAWING NUMBER
7.1

Drawing 8 of 12

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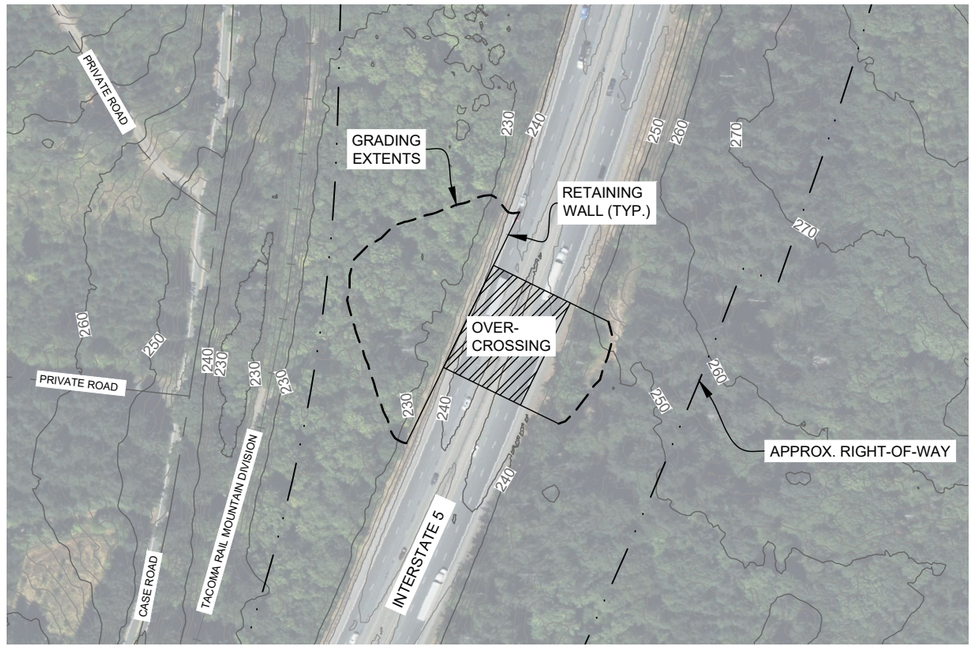
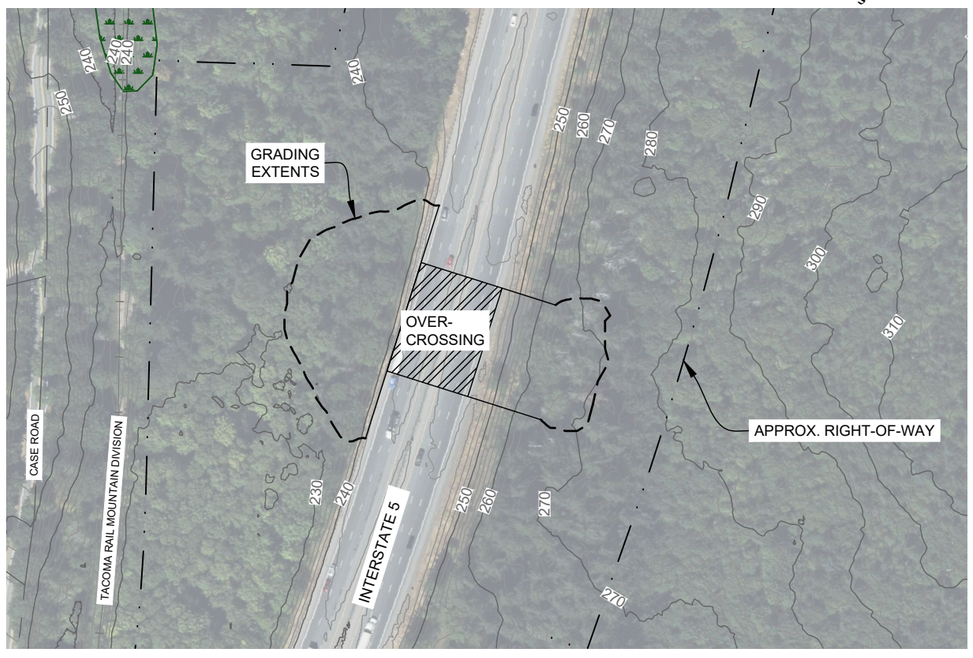


1 MP 92.6 OVERCROSSING LAYOUT

1" = 200'



2 MP 92.7 OVERCROSSING LAYOUT

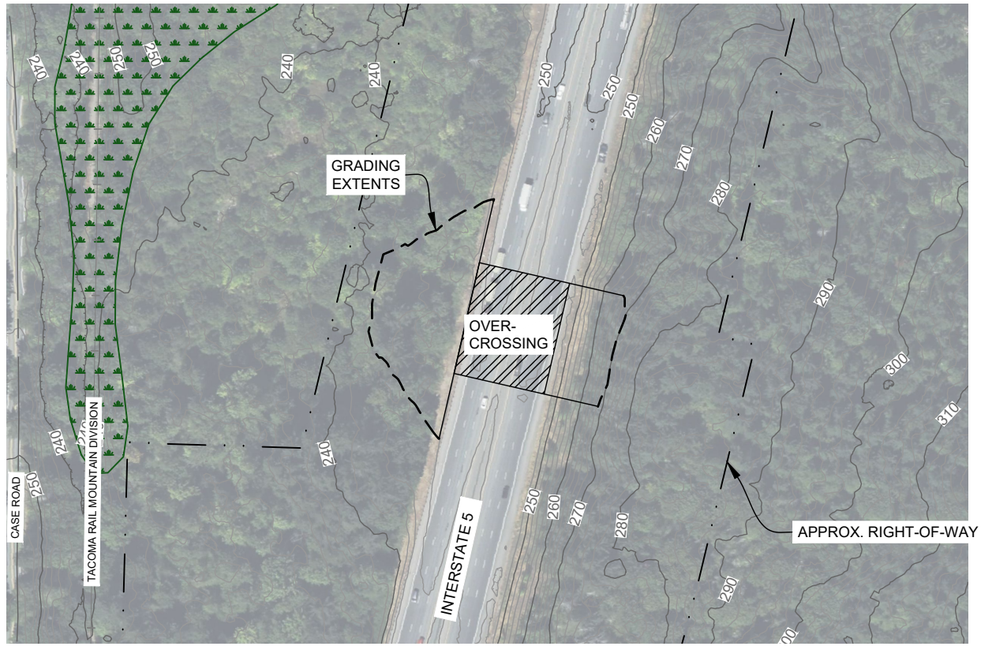
1" = 200'

CROSSING ALTERNATIVES NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRIES

	MP 92.6 OVERCROSSING	MP 92.7 OVERCROSSING	MP 92.8 OVERCROSSING
CROSSING LENGTH (FT)	115	110	120
CROSSING WIDTH (FT)	150	150	150
CROSSING HEIGHT (FT)	N/A	N/A	N/A
OPENNESS RATIO	N/A	N/A	N/A
GRADING AREA WEST (AC)	0.9	0.9	0.6
GRADING AREA EAST (AC)	0.2	0.5	0.3
STRUCTURE SPAN (FT)	150	150	150



3 MP 92.8 OVERCROSSING LAYOUT

1" = 200'

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MP 92.6 - 92.7 - 92.8 OVERCROSSING

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
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DRAWING NUMBER
8.0

Drawing 9 of 12

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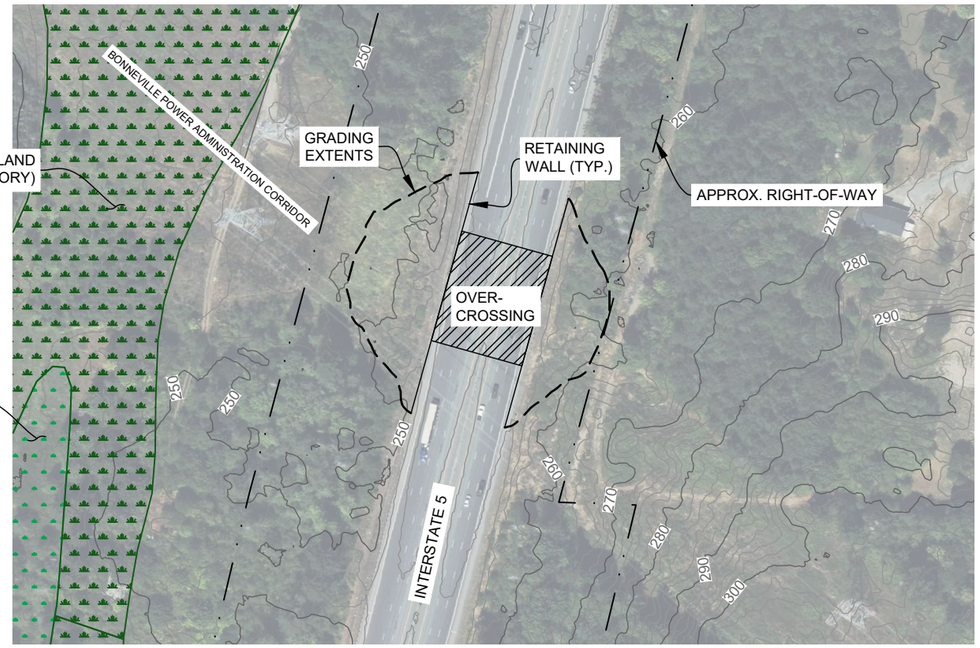

1 MP 93.1 OVERCROSSING LAYOUT

1" = 200'

CROSSING NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRY

CROSSING LENGTH (FT)	125
CROSSING WIDTH (FT)	150
CROSSING HEIGHT (FT)	N/A
OPENNESS RATIO	N/A
GRADING AREA WEST (AC)	0.7
GRADING AREA EAST (AC)	0.4
STRUCTURE SPAN (FT)	150

DRAFT

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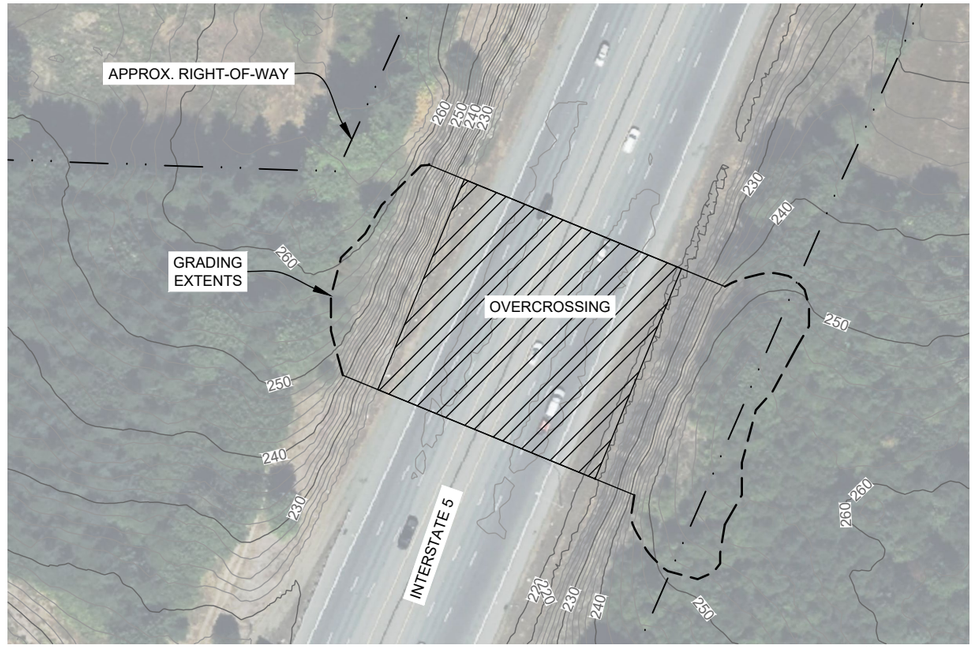
MP 93.1 OVERCROSSING

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
RDG-23-231

DRAWING NUMBER
9.0



1 MP 96.1 OVERCROSSING LAYOUT

1" = 100'

N W E S

CROSSING NOTES

1. ALL CROSSING DIMENSIONS ARE APPROXIMATE AND WILL BE REFINED IF SELECTED FOR ADVANCEMENT INTO CONCEPTUAL DESIGN.
2. CROSSING LENGTH, WIDTH AND HEIGHT ARE MEASURED RELATIVE TO DIRECTION OF WILDLIFE MOVEMENT.
3. OPENNESS RATIO CALCULATED AS PRODUCT OF WIDTH AND HEIGHT DIVIDED BY LENGTH.
4. GRADING AREAS ESTIMATE THE PERMANENT IMPACTS OUTSIDE OF THE PROPOSED CROSSING STRUCTURE AND EXCLUDE TEMPORARY EXCAVATIONS OR EMBANKMENTS.
5. STRUCTURE SPAN MEASURED ALONG ROADWAY CENTERLINE.

CROSSING GEOMETRY

CROSSING LENGTH (FT)	155
CROSSING WIDTH (FT)	150
CROSSING HEIGHT (FT)	N/A
OPENNESS RATIO	N/A
GRADING AREA WEST (AC)	0.2
GRADING AREA EAST (AC)	0.3
STRUCTURE SPAN (FT)	150

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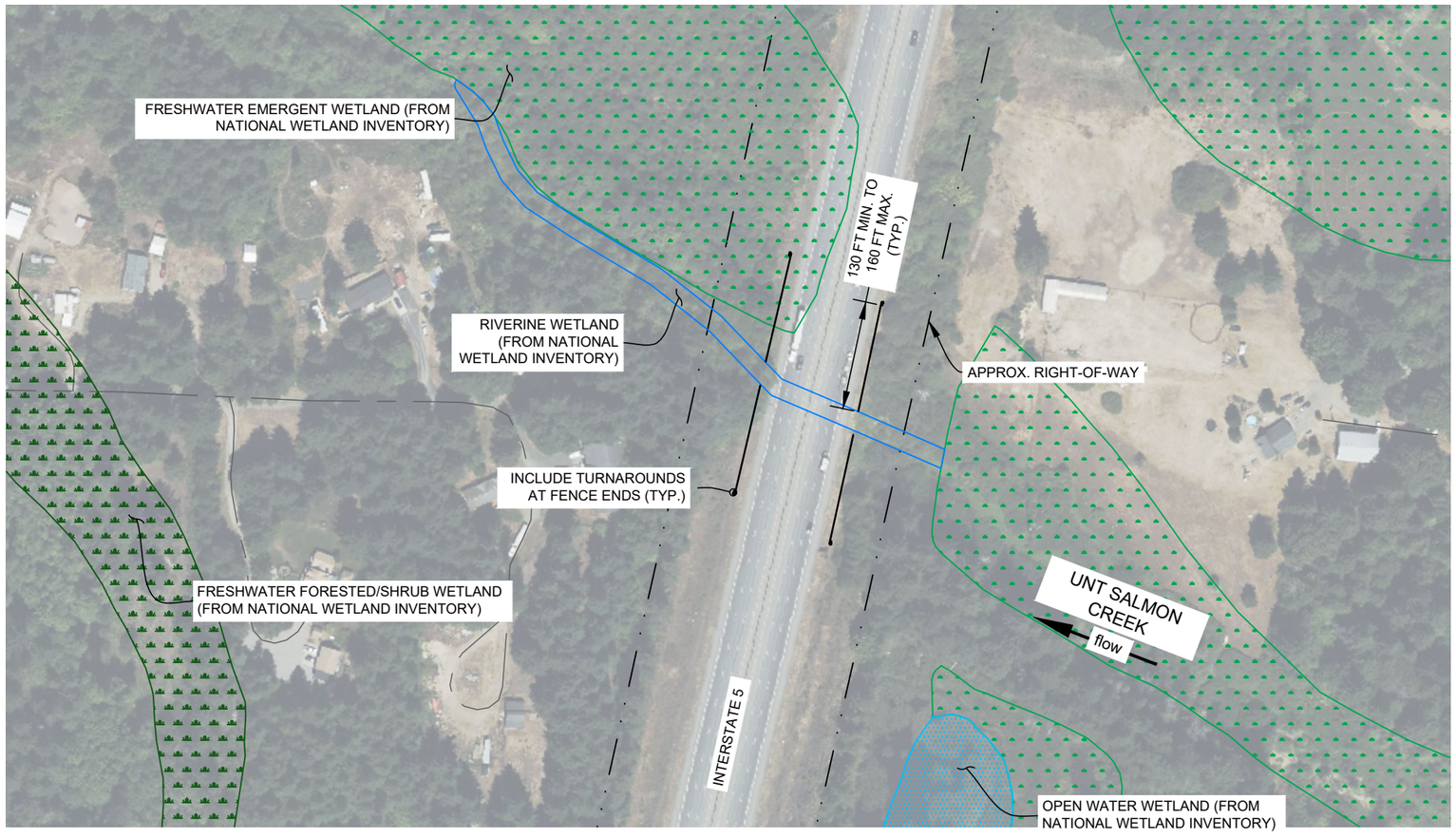
MP 96.1 OVERCROSSING

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
RDG-23-231

DRAWING NUMBER
10.0



1 MP 98.1 RETROFIT LAYOUT

1" = 200'

AMPHIBIAN FENCE RETROFIT NOTES

1. THE PURPOSE OF THE RETROFIT IS TO PROVIDE DIRECTIONAL FENCING TO THE NEW CROSSING FOR AMPHIBIANS (CROSSING STRUCTURE TBD BY OTHERS).
2. THE FENCING SHALL EXTEND A MINIMUM OF 130 FT AND A MAXIMUM OF 160 FT PAST THE CROSSING STRUCTURE ON BOTH SIDES.
3. THE FENCE SHALL BE CONSTRUCTED OF A SOLID MATERIAL WITH A MINIMUM HEIGHT OF 3 FT.
4. PROVIDE JUMP-OUTS ON THE ROAD SIDE TO PROVIDE ACCESS TO THE HABITAT SIDE IF AN ANIMAL BYPASSES THE FENCE.
5. INCLUDE TURNAROUNDS AT FENCE ENDS TO GUIDE ANIMALS BACK TOWARDS CROSSING.

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MP 98.1 UNT SALMON CREEK RETROFIT

SW WA I-5 WILDLIFE CROSSINGS
WASHINGTON STATE

NO.	DATE	BY	DESCRIPTION	CHK
*	4/30/24	MCK	ALTERNATIVES	LBK

PROJECT NUMBER
RDG-23-231

DRAWING NUMBER
11.0

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Appendix D

Engineering Design Matrices

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SW WA Wildlife Crossings Design Criteria Summary

This workbook summarizes the appliable design criteria for the proposed wildlife crossings along I-5 in SW WA.
This summary was prepared for project scoping and conceptual design purposes and is not inclusive of all design requirements.

Prepared By: Melanie C. Klym, PE, LG - River Design Group, Inc.
Date: 29-Dec-23

Key Definitions	
Standard	Required design element (typically using the words "shall" or "must")
Guidance	Recommended design element (not required, typically using the words "should" or "may")
Deviation or Exception	Design elements not meeting Standards (requires approval by region/state/federal authorities)
Span	Structure width (perpendicular to movement traffic) measured along roadway centerline.
Cover	Depth of material (roadway pavement, subgrade, and embankment) over the top of a buried structure (culvert, bridge)
Vertical Clearance	Least available height from lower roadway surface (including usable shoulders) to the bottom of the bridge
Sight Distance	(for stopping): The distance traveled during perception / reaction time and the distance to stop the vehicle
Clear Zone	Clear roadside border area beginning at the edge of the traveled way for a vehicle driver or bicyclist to recover when their path is altered due to environmental, human, or vehicle/bicycle factors.

Key Acronyms	
AASHTO	American Association of State Highway and Transportation Officials - source of many design standards.
ABC	Accelerated Bridge Construction
ADT	Average daily traffic (how many vehicles use a segment of roadway)
FHWA	Federal Highways Administration - source of many design standards and funding.
HQ	Headquarters
LRFD	Load Rating Factor Design
NBI	National Bridge Inventory
NCHRP	National Cooperative Highway Research Program
PEL	Planning and Environmental Linkages

Links	**Manuals Accessed September - December 2023.**
Design Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/design-manual
Roadside Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/roadside-manual
Environmental Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/environmental-manual
Bridge Design Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/bridge-design-manual-lrfd
Geotechnical Design Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/geotechnical-design-manual
Project Management Guide	https://wsdot.wa.gov/engineering-standards/project-management-training/project-management/project-management-guide
Project Delivery Methods	https://wsdot.wa.gov/business-wsdot/how-do-business-us/project-delivery-methods
Design Bulletin 2022-03	https://wsdot.wa.gov/sites/default/files/2022-10/Vertical-Clearance-Considerations-Design-Bulletin-2022-03.pdf
Hydraulics Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/hydraulics-manual
Maintenance Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/maintenance-manual
Right of Way Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/right-way-manual
Roadside Policy Manual	https://wsdot.wa.gov/engineering-standards/all-manuals-and-standards/manuals/roadside-policy-manual

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Standard	Project Delivery	Nonstandard bid item use requires HQ approval	Design Manual	300
All Crossings	Standard	Project Delivery	Special Provisions require HQ approval	Design Manual	300
Overcrossings	Standard	Project Delivery	Preliminary bridge plans for Unusual/Complex Bridges on the Interstate require FHWA Approval	Design Manual	300
All Crossings	Guidance	Fencing	Locate fencing on, or depending on terrain, 12 inches inside right of way line	Design Manual	560.02(1)
All Crossings	Standard	Fencing	Fencing is mandatory on highways with full and partial limited access control	Design Manual	560.02(2)
All Crossings	Standard	Fencing	Type 3 fencing may be used within the Design Clear Zone	Design Manual	560.03(1)(a)
All Crossings	Standard	Fencing	All new gates must be approved on limited access highways by FHWA	Design Manual	560.04
All Crossings	Guidance	Project Delivery	WSDOT HQ geotechnical office and regional materials engineer will provide information about subsurface materials and geotechnical investigation needs for design	Design Manual	610.01
All Crossings	Guidance	Bridge	Submit structure site data to HQ for all bridges defined as structures with a clear span of 30 feet or greater measured along the roadway alignment, including buried structures	Design Manual	710.02
All Crossings	Guidance	Bridge	Definition of bridge: structure with opening greater than 20 feet measures along the roadway alignment, including buried structures.	Design Manual	720.01
Overcrossings	Standard	Roadway Clearance	Maintain 16.5 ft of vertical clearance for all falsework (temporary construction supports)	Design Manual	720.03(5)(a)
Undercrossings	Standard	Roadway Clearance	large objects are approved to be placed beneath the	Design Manual	720.03(5)(b)(iv)
Undercrossings	Standard	Hydraulic Conveyance	debris, under or inside water crossing structures are	Design Manual	720.03(5)(b)(iv)
Overcrossings	Standard	Roadway Clearance	Vertical clearance over interstates >16.5 ft	Design Manual	Exhibit 720-3
All Crossings	Guidance	Geometry	Summary of mechanically stabilized earth gravity wall/slope options	Design Manual	Exhibit 730-1

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Guidance	Roadside	"WSDOT is committed to highway designs that meet the transportation needs in a way that reduces the potential for fatal and injury crashes, is cost-effective, ecologically appropriate, context appropriate, and maintainable by managing roadsides that balance the natural and environmental functions within the right of way."	Design Manual	900.01
All Crossings	Standard	Project Delivery	Region Landscape Architect designs, supervises, has approval authority over, and stamps plans for wetland mitigation, roadside restoration, and revegetation; provides visual discipline reports for environmental documents, coordinates the visual elements within highway corridors with the State Bridge and Structures Architect	Design Manual	900.02(1)
All Crossings	Standard	Vegetation	A minimum of 3 years of plant establishment is required for all planted areas in western WA	Design Manual	900.02(4)
All Crossings	Guidance	Vegetation	5 years of plant establishment may be needed in situations where it is important to provide a full cover of vegetation to achieve the environmental or operational functions	Design Manual	900.02(4)
All Crossings	Guidance	Vegetation	Plant establishment may take up to 10 years if using woody vegetation	Design Manual	900.02(4)
All Crossings	Guidance	Project Delivery	Safe System Approach: eliminate death and serious injuries, support safe road use, reduce large crash forces, share responsibility, strengthen all part, safety is proactive	Design Manual	1100.02(2)
All Crossings	Guidance	Project Delivery	Determine project baseline need and contextual needs	Design Manual	1100.04(3)
All Crossings	Guidance	Project Delivery	Baseline need is primary reason a project has been proposed at a location, usually evolves from WSDOT planning and/or priority programming processes	Design Manual	1101.02

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Guidance	Project Delivery	Contextual needs are opportunities that may be addressed during project delivery and are not expected to add significant cost to the project	Design Manual	1101.05
All Crossings	Guidance	Project Delivery	Design controls: design year, modal priority, access control, design speed, terrain classification	Design Manual	1103.01
All Crossings	Standard	Project Delivery	Required Design Elements	Design Manual	Exhibit 1105-1
All Crossings	Standard	Safety	Sight distance broken out as stopping sight distance, passing sight distance, and decision sight distance	Design Manual	1260.01
All Crossings	Standard	Safety	Design Stopping Sight Distance is calculated using the design speed and a constant deceleration of 11.2 ft/second and a perception/reaction time of 2.5 seconds.	Design Manual	1260.03(1)(1)
All Crossings	Standard	Safety	Table of design stopping sight distances by design speed and vertical curves	Design Manual	Exhibit 1260-1 and Exhibit 1260-2
All Crossings	Standard	Safety	Existing stopping sight distances may be used if there is no identified collision trend, the existing vertical and horizontal alignment is retained, the existing roadway pavement is not reconstructed, the roadway will not be widened, the sightline obstruction is existing, and roadway improvements to sight distance are within existing right of way	Design Manual	1260.03(7) and Exhibit 1260-10
All Crossings	Standard	Safety	Clear zone graphics	Design Manual	Exhibit 1600-1
All Crossings	Standard	Safety	Conduct Clear Zone Inventory: document all roadside and median features within clear zone, whether they are existing or proposed, the corrective actions considered, estimated cost to correct, and if the correction is planned or not	Design Manual	1600.02
All Crossings	Guidance	Roadside	Roadside environmental functions include habitat connectivity	Roadside Manual	Exhibit 110-2

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Standard	Roadside	Roadside has three zones: 1) pavement edge zone with mowed veg, 2) operational zone with no vegetation stem >4" diameter typically includes clear zone, zone 3) buffer with native vegetation	Roadside Manual	Exhibit 110-3
All Crossings	Guidance	Roadside	Sustainable Roads: 20-year planning horizon; projected life cycle costs; utilize, protect and support the roadway and roadside infrastructure; continued cooperative involvement	Roadside Manual	120.05
All Crossings	Guidance	Regulatory	List of Federal Environmental Preservation and Protection acts	Roadside Manual	210.02
All Crossings	Guidance	Regulatory	Executive order 13514 …federal agencies conduct transportation…missions in an environmentally, economically, and fiscally sound, integrated, continuously improving, efficient and sustainable manner.	Roadside Manual	210.02(10)
All Crossings	Guidance	Regulatory	Presidential Memorandum on Environmentally Beneficial Landscaping directs federal agencies (including federally funded projects) to use regionally native plants, construct with minimal impact to habitat, reduce use of fertilizers/pesticides/other chemicals, use water-efficient and runoff-reduction practices, use demonstration projects employing these practices	Roadside Manual	210.02(12)
All Crossings	Guidance	Regulatory	List of Federal Visual Quality and Scenic Enhancement acts	Roadside Manual	210.03
All Crossings	Standard	Regulatory	RCW 4740.010 establishes that "the planting of any shrubs, trees, hedges or other domestic or native ornamental growth, the improvement of roadside facilities and view points, and the correction of unsightly conditions, upon the right-of-way of any state highway is hereby declared to a proper state highway purpose."	Roadside Manual	220.02(1)
All Crossings	Standard	Regulatory	State Environmental Policy Act (SEPA)	Roadside Manual	220.03(1)
All Crossings	Standard	Regulatory	WA Water Quality Rules	Roadside Manual	220.03(2)

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Standard	Regulatory	WA Biology/Wetlands Rules	Roadside Manual	220.03(3)
All Crossings	Standard	Regulatory	WA Noise Rules	Roadside Manual	220.03(4)
All Crossings	Standard	Regulatory	WA Visual Quality Rules	Roadside Manual	220.03(5)
All Crossings	Guidance	Vegetation	"It is necessary to have healthy soil to revegetate a site. Revegetation is necessary to provide slope stabilization, erosion control, biofiltration and infiltration for water quality, screening, local climate modification, habitat, and so forth. Revegetation might also be necessary to meet permit or environmental requirements. As a result, healthy topsoil is an important component of a construction project."	Roadside Manual	700
All Crossings	Guidance	Vegetation	Table of recommended practices for preserving and enhancing soils along the roadside	Roadside Manual	Figure 700.2
All Crossings	Guidance	Vegetation	Structural soils to support vegetation and loads/compaction	Roadside Manual	700-7
All Crossings	Guidance	Roadside	Contour grading for roadside berms	Roadside Manual	720
All Crossings	Guidance	Roadside	Earth berms	Roadside Manual	Figure 720.5
All Crossings	Guidance	Vegetation	Wildlife habitat included in functions for vegetation	Roadside Manual	800-6
All Crossings	Standard	Vegetation	Minimum setbacks from traffic barriers: 2 ft for shrubs, 6 ft for trees	Roadside Manual	800-10
All Crossings	Standard	Vegetation	Do not use herbs in roadside seed mixes where there are deer	Roadside Manual	800-11
All Crossings	Standard	Vegetation	Consider ability to maintain or enhance habitat values for wildlife, where this is desirable. This is determined on a site specific basis in conjunction with the region's environmental office	Roadside Manual	800-11
Undercrossings	Guidance	Vegetation	Restoration of vegetation for fish passage projects	Roadside Manual	830

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
Overcrossings	Guidance	Bridge	Design enhancement for tunnel portals, bridges, noise walls, etc. "It may consist of a landform, water feature, wall or barrier texture, color, pavement type, brick variation, site furnishings, or a combination of elements. "	Roadside Manual	910
Overcrossings	Standard	Bridge	Design enhancement cost is above and beyond WSDOT obligation for structural costs	Roadside Manual	910
All Crossings	Guidance	Regulatory	Secretary's Executive Order on Protections and Connections for High Quality Natural Habitats (E 1031.02) directs WSDOT to promote and support processes that identify potentially affected fish and wildlife habitats as early as possible.	Environmental Manual	200.02
All Crossings	Guidance	Regulatory	Likely to be NEPA Class I project and require an environmental impact statement (EIS)	Environmental Manual	300.04
All Crossings	Guidance	Regulatory	Likely to have SEPA Determination of Significance (DS) and require an EIS	Environmental Manual	300.05
Undercrossings	Guidance	Regulatory	Policies for working in/around wetlands and other waters of the state or United States	Environmental Manual	431
Undercrossings	Guidance	Regulatory	Policies for working in/around special flood hazard areas AKA FEMA floodplains	Environmental Manual	432
All Crossings	Guidance	Regulatory	Policies for working in/around sensitive wildlife, fish, plants and their habitats	Environmental Manual	436
All Crossings	Guidance	Regulatory	Noise regulations	Environmental Manual	446
All Crossings	Standard	Roadside	Any noise abatement constructed is required to be maintained in perpetuity.	Environmental Manual	446.08
All Crossings	Guidance	Regulatory	Cultural resources policies	Environmental Manual	456
All Crossings	Guidance	Regulatory	Department of Transportation Act of 1966 Section 4(f) "to preserve the natural beauty of the countryside, public park and recreation land, wildlife and waterfowl refuges, and historic sites"	Environmental Manual	457
All Crossings	Guidance	Regulatory	Visual impacts policies	Environmental Manual	459
Overcrossings	Standard	Bridge	FHWA requires a Type, Size & Location (TS&L) report for 'major or unusual bridges'	Bridge Design Manual	2.1.5

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
Overcrossings	Standard	Bridge	End of bridge deck set 3 ft min back from top of embankment slope	Bridge Design Manual	Figure 2.3.1-3
Overcrossings	Standard	Bridge	Design bridges to minimize risk of catastrophic collapse by using redundant supporting elements (columns and girders)	Bridge Design Manual	2.3.1.H
Overcrossings	Guidance	Bridge	Bridge types - prestressed concrete girder sections have a variety of lengths, including up to 250 ft	Bridge Design Manual	2.4.1.E
Overcrossings	Guidance	Bridge	Composite steel plate girder /composite steel box girder up to 400 ft and relatively low dead load compared to concrete	Bridge Design Manual	2.4.1.F / 2.4.1.G
Overcrossings	Guidance	Bridge	Steel truss 300' to 1200' spans and construction by cantilever	Bridge Design Manual	2.4.1.H
Overcrossings	Guidance	Bridge	Segmental concrete box girder 200' to 700' spans and construction by cantilever	Bridge Design Manual	2.4.1.I
All Crossings	Guidance	Bridge	Accelerated bridge construction methods: "In general, where time on a job site ought to be minimized, ABC would make a good choice to consider."	Bridge Design Manual	14
All Crossings	Guidance	Bridge	Examples of accelerated and innovative bridge construction	Bridge Design Manual	14.7
All Crossings	Guidance	Bridge	Seismic design considers the safety evaluation earthquake per bridge design manual and functional evaluation earthquake (for essential/critical bridges)	Geotechnical Manual	6-1.2.1

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Guidance	Bridge	"Bridge approach embankments and fills through which cut-and-cover tunnels are constructed should be designed to remain stable during the design seismic event because of the potential to contribute to collapse or inadequate performance of the structure should they fail or deform excessively. The aerial extent of approach embankment (and embankment surrounding cut-and-cover tunnels) seismic design and mitigation (if necessary) should be such that the structure is protected against instability or loading conditions that could result in collapse or inadequate performance. The typical distance of evaluation and mitigation is within 100 feet of the abutment or tunnel wall, but the actual distance should be evaluated on a case-by-case basis."	Geotechnical Manual	6-1.2.1
All Crossings	Standard	Bridge	"All retaining walls and abutment walls, including reinforced slopes steeper than 0.5H:1V, which shall be considered to be a wall (see Section 15-5.6), shall be evaluated and designed for seismic stability internally and externally (i.e. sliding, eccentricity, and bearing capacity), with the exception of walls that meet the AASHTO LRFD Bridge Design Manual "No Seismic Analysis" provisions in AASHTO Article 11.5.4.2. Noise walls, as well as reinforced slopes steeper than 1.2H:1V, shall also be evaluated for seismic stability."	Geotechnical Manual	6-1.2.1
All Crossings	Standard	Bridge	Spread footings are best suited for dense, nonliquifiable soils. Deep foundations are best when spread footings cannot be founded on competent soils or rock at a reasonable cost.	Geotechnical Manual	8.4

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
Overcrossings	Guidance	Bridge	The WSDOT Standard Specifications define rock embankment as “all or any part of an embankment in which the material contains 25 percent or more by volume of gravel or stone 4 inches or greater in diameter.”	Geotechnical Manual	9-2.1.1
Overcrossings	Guidance	Bridge	Three types of materials are commonly used in WSDOT earth embankments, including common, select, and gravel borrow. Bridge approach embankments should be constructed from select or gravel borrow, although common borrow may be used in the drier parts of the State, provided it is not placed below a structure foundation or immediately behind an abutment wall.	Geotechnical Manual	9-2-1.2.
Overcrossings	Standard	Bridge	Any fill placed near or against a bridge abutment or foundation, or that can impact a nearby buried or above-ground structure, will likewise require stability analyses by the geotechnical designer.	Geotechnical Manual	9-2.3
Overcrossings	Standard	Project Delivery	All abutments, retaining walls, and reinforced slopes within WSDOT Right of Way or whose construction is administered by WSDOT shall be designed in accordance with the Geotechnical Design Manual (GDM) and the following documents: • Bridge Design Manual (LRFD) M 23-50 • Design Manual M 22-01 • AASHTO LRFD Bridge Design Specifications, U.S	Geotechnical Manual	15-1
Undercrossings	Guidance	Hydraulic Conveyance	Two elements determine vertical clearance under bridges and inside buried structures: hydraulic design freeboard and maintenance clearance.	Design Bulletin 2022-03	
Undercrossings	Guidance	Maintenance	Initial maintenance clearance target: 6 ft from the highest ground elevation to the controlling top elevation of the structure	Design Bulletin 2022-03	

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
Undercrossings	Guidance	Maintenance	10 ft maintenance clearance for machinery access	Design Bulletin 2022-03	
Undercrossings	Guidance	Geometry	Structure free zone is measured from the highest ground elevation to the controlling top elevation. Can be used to increase clearance beyond freeboard and maintenance clearance, for example wildlife connectivity	Design Bulletin 2022-03	
Undercrossings	Standard	Geometry	Minimum structure-free zone width can never be less than the hydraulic width and will be established by the WSDOT engineer before (design-build) request for proposal (RFP)	Design Bulletin 2022-03	
Undercrossings	Guidance	Geometry	Minimum structure-free zone height needs to consider whether roadway profile must be raised or if less freeboard or maintenance clearance is acceptable	Design Bulletin 2022-03	
Undercrossings	Guidance	Hydraulic Conveyance	Boulders should be stable and placed in a way to promote localized scour/pool development	Hydraulics Manual	7-4.10.1
Undercrossings	Standard	Geometry	When a buried structure is used as the crossing structure, wing walls shall be used to minimize the overall length of the buried structure. Wing walls can also increase the efficiency of the crossing structure. Wing walls shall be a minimum of 10 feet in length designed for scour and shall be increased based on the potential impacts of lateral migration as assessed by the hydraulics engineer of record.	Hydraulics Manual	7-4.6
Undercrossings	Standard	Geometry	Minimum hydraulic opening = greater of (1.2 * BFW + 2 ft OR 1.3* BFW). BFW = bankfull width	Hydraulics Manual	7-4.4
Undercrossings	Standard	Hydraulic Conveyance	Design floods for crossings	Hydraulics Manual	Table 7-1
Undercrossings	Standard	Hydraulic Conveyance	Design freeboard requirements for buried structures	Hydraulics Manual	Table 7-2
Undercrossings	Guidance	Geometry	Structure-free zone may be increased to accommodate wildlife connectivity	Hydraulics Manual	7-4

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Standard	Bridge	"The Bridge and Structures Office is concerned with the placement of temporary or permanent wildlife habitat structures (peregrine falcon platforms, bat boxes, etc.) on state bridges due to their potential negative impact to inspections of all bridges in accordance with the federally-mandated National Bridge Inspection Standards and the potential negative affects to maintain the bridge structure itself. **The Bridge and Structures Office discourages the practice of placing these habitat structures on state bridges.** Therefore, all plans to place temporary or permanent wildlife habitat structures on state bridges are to be reviewed by the Bridge Preservation Engineer. This is consistent with the review process for all other attachments to bridges."	Maintenance Manual	5-7
All Crossings	Guidance	Roadside	Roadside functional zones 2 and 3 include "provide wildlife habitat where compatible with roadway traffic" (zone 2) and "preserve wetlands and wildlife habitat" (zone 3)	Maintenance Manual	Exhibit 6-3
All Crossings	Standard	Roadside	"Studies have shown that wildlife warning reflector systems are ineffective at reducing the accident potential for motor vehicle/wildlife collisions. **WSDOT policy is to no longer design, place, or maintain wildlife reflectors.**"	Maintenance Manual	8-16
All Crossings	Standard	Maintenance	For maintenance purposes, major structures are identified as those bridges included in the Bridge List M 23-09. The State Bridge and Structures Engineer is the responsible authority for these structures and must be contacted prior to any major maintenance or modifications to them. The designated contact in Olympia is the Bridge Preservation Engineer.	Maintenance Manual	5-2

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Standard	Maintenance	For maintenance purposes, minor structures are identified as those drainage structures (culverts, etc.), retaining walls, acoustical barriers, cribbing, etc., that are not listed in the Bridge List. The Region Maintenance Engineer is the responsible authority for minor structures.	Maintenance Manual	5-3
All Crossings	Standard	Bridge	Modifications to bridges need to be detailed in drawings and submitted to the Bridge Preservation Engineer for as-built documentation and future reference. All bridge structural as-built information is maintained at the Bridge Preservation Office	Maintenance Manual	5-4
All Crossings	Standard	Roadside	Integrated Roadside Vegetation Management (IVRM) Plans are updated and published annual for all regions and areas of the state	Maintenance Manual	6-2
All Crossings	Standard	Roadside	... agency policy dictates (Section 1.1 of the Roadside Policy Manual) that **design coordinate with local maintenance managers on roadside planting design**. Once roadsides have been redesigned and constructed following highway improvement projects, the plans for ongoing management are added to the locally adapted Region/Area IRVM plans.	Maintenance Manual	6-5
All Crossings	Guidance	Roadside	The integrated vegetation management (IVM) process relies on Highway Activity Tracking System (HATS) and the IRVM Plans, in combination with annual crew training to deliver the most practical and long-term sustainable solutions to roadside vegetation management challenges throughout the state.	Maintenance Manual	6-7

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Standard	Maintenance	"The remains of animals killed by motor vehicles should be removed promptly and buried at convenient locations. If license tags are present on domestic pets, notification of appropriate city or county is encouraged. A HATS record must be completed for this activity. This record of killed wildlife aids in the placement of signing and other preventive measures"	Maintenance Manual	6-9
All Crossings	Standard	Regulatory	Pursuant to RCW 47.52.050, WSDOT shall acquire fee title to all property acquired for a limited access facility.	Right of Way Manual	6-5.1
All Crossings	Guidance	Regulatory	WSDOT may acquire an easement when it needs a nonexclusive right to enter upon the property of another. The easement will set forth WSDOT's right to the use of the property under specified circumstances.	Right of Way Manual	6-5.1
Overcrossings	Standard	Vegetation	**Provide permanent irrigation** for lawns, ornamental plantings, public art or gateway areas or permanent flower displays **only where the initial cost, ongoing cost, and maintenance are provided by a local jurisdiction, unless roadside planting would be impossible without it (raised planting areas, freeway lids, etc.).**	Roadside Policy Manual	2-2.8
Overcrossings	Guidance	Roadside	Visual design / scenic considerations for all structures	Roadside Policy Manual	2.3.3
Overcrossings	Guidance	Roadside	Textural / architectural considerations for structures	Roadside Policy Manual	4.2.3
Overcrossings	Guidance	Regulatory	Chapter 4 - roadside restoration toolkit	Roadside Policy Manual	4

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Guidance	Project Delivery	Initiation is the process of defining and authorizing the project or phase, selecting the project manager and identifying the project team. Region or organization management provides the team with the initial project information, project phase, legislative milestone commitments and project boundaries (limits).	Project Management Guide	
All Crossings	Standard	Regulatory	Project Management (E.O. 1032.02) - Directs the use of the WSDOT project management process and clarifies the requirements for executives, project managers, project team members, and others in WSDOT who participate in project management.	Project Management Guide	
All Crossings	Guidance	Project Delivery	Project delivery methods: A+B bidding, Design-build, Flexible start date, Interim completion date, Lump sum traffic control	Project Delivery Methods	
All Crossings	Guidance	Project Delivery	A+B bidding is a cost-plus-time bidding procedure. By providing a cost for each working day, the contract combines the cost to perform the work (A component) with the cost of the impact to the public (B component) to provide lowest cost to the public.	Project Delivery Methods	
All Crossings	Guidance	Project Delivery	Design-build is a method of project delivery in which WSDOT executes a single contract with one entity (the design-builder) for design and construction services to provide a finished product. This may save time compared to the design-bid-build process by eliminating the bidding phase of project delivery.	Project Delivery Methods	
All Crossings	Guidance	Project Delivery	Flexible start date: "Projects that have a fast track schedule, requiring completion as soon as possible, or where there is no likelihood of efficiencies being realized from this method should not be considered for this provision."	Project Delivery Methods	

Crossing	Standard/Guidance	Type	Requirement	Source	Section
All Crossings	Guidance	Project Delivery	Interim completion dates are a method of providing the contractor with an incentive or disincentive to expedite the completion of specific portions of a contract. This is done by requiring a portion of the contract to be accomplished within a set duration or by a specified date. The portion requiring an interim completion may also include a prescribed start date.	Project Delivery Methods	
All Crossings	Guidance	Project Delivery	On some projects, the traffic control solution may vary significantly due to a contractor's proposed solution. Requiring a lump sum bid encourages the contractor to consider the direct traffic control cost in determining the most cost-effective solution. The fixed final traffic control cost offers a built-in advantage for the more organized contractor who is able to schedule all work efficiently into the smallest traffic control window. There is also a built-in incentive for the contractor keep costs low. This could potentially lead to more efficient use of the work force and more coordination between the prime contractor and the traffic control subcontractor.	Project Delivery Methods	

SW WA Wildlife Crossings Design Criteria Summary

Crossing	Standard/Guidance	Source	Type	Requirement
All Crossings	Guidance	FHWA	Geometry	See European Wildlife Traffic handbook: https://handbookwildlifetraffic.info/handbook-wildlife-traffic/
Overcrossings	Guidance	FHWA	Geometry	"If large species are involved that are sensitive to human disturbance, or if multiple habitats have to be provided for on an overpass, wildlife overpass structures are generally recommended to be at least 50–70 m (164–230 ft) wide"
Overcrossings	Guidance	NCHRP	Structure	Combined mitigation measures (over/underpasses and fencing) is more successful for a suite of species than a single design.
All Crossings	Guidance	FHWA	Noise	See https://www.fhwa.dot.gov/environMent/noise/regulations_and_guidance/polguide/