REPORT

ADDENDUM: FEASIBILITY REPORT
MEADOWDALE BEACH COUNTY PARK FEASIBILITY STUDY

Prepared for

Snohomish County Department of Parks and Recreation

Prepared by

Anchor QEA, LLC

1605 Cornwall Avenue

Bellingham, Washington

April 2016

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1 PURPOSE OF REPORT ADDENDUM

The work summarized in this Addendum to the Feasibility Report for the Meadowdale Beach County Park Feasibility Study Project (Project) provides additional information on alternatives that were not considered or fully evaluated as part of the initial feasibility work (Anchor QEA 2016) and further refines the conceptual cost estimate as well as BNSF Railway (BNSF) work windows required for the Preferred Alternative. The alternatives considered in this Addendum were deemed inconsistent with specific goals that Snohomish County (County), the public, and other stakeholders developed for the Project. The County directed the Anchor QEA, LLC consultant team (Anchor QEA team) to move forward with evaluating these additional alternatives based on cost and constructability concerns associated with the four-span bridge documented in the Draft Feasibility Report (referred to as the preferred alternative). This Addendum summarizes the evaluation, including schematics and cost estimates, for two additional alternatives:

1. An Americans with Disabilities Act (ADA)-accessible pedestrian overpass (ramp and elevator options)
2. A tunnel(s) constructed through the railroad berm (single and multiple tunnel options)

An on-site constructability review was a conducted with a railroad construction contractor familiar with railroad bridge construction and BNSF requirements to vet mobilization issues and construction methods for the Preferred Alternative as well as provide input on work windows needed for all concepts. The constructability review also included a desktop study of both the existing condition of the existing access road and potential to improve the road for construction access, which was also used to inform all conceptual level opinion of probable construction costs.

Therefore, the purpose of this Addendum is twofold: first, to document the additional information gathered to refine the existing conceptual opinion of probable construction cost for the preferred alternative; and second, to document costs for the pedestrian overpass and tunnel concepts.

2 ORGANIZATION OF REPORT

The main body text of this Addendum includes a description (Section 3) and summary of conceptual opinions of probable construction costs (Section 5) for the pedestrian overpass and tunnel options developed as part of this work, a summary of revised conceptual opinions of probable construction costs for the preferred alternative (Section 5), and a discussion of how the pedestrian overpass and tunnel options perform in relation to the evaluation criteria (Anchor QEA 2016) developed for the project (Section 6). A brief overview of the constructability review is also provided in Section 4 of this report.

Additional detail on the evaluations conducted as part of this work are provided in a series of appendices to this report Addendum, as outlined below:

- Appendix A: Meeting Summary of On-site Constructability Review
  - This appendix provides a detailed description of the constructability discussion that occurred at the project site on December 8, 2015. The information summarized in this appendix was used to refine preliminary costs for the preferred alternative and develop preliminary costs for the pedestrian overpass and tunnel options.
- Appendix B: Preliminary Geotechnical Assessment Addendum (developed by Shannon & Wilson)
  - This appendix provides preliminary geotechnical assessments of the park maintenance access road for construction access purposes, foundations for a pedestrian overpass option, and a BNSF embankment tunneling option.
  - The information in this appendix was used to develop the tunnel options and develop or refine preliminary costs for proposed alternatives.
- Appendix C: Conceptual Opinions of Probable Construction Cost
  - This appendix provides detailed conceptual opinions of probable construction cost for the preferred alternative (four-span bridge), which was refined based on the constructability discussion outlined in Appendix A. This appendix also includes detailed conceptual opinions of probable construction cost for the tunnel and for the pedestrian overpass structure developed by TKDA.

- Appendix D: County Review Meeting Summary
  - This appendix includes a detailed summary of the discussion that the Anchor QEA team held with the County to review the information outlined in this report Addendum.

3 DEVELOPMENT OF ADDITIONAL ALTERNATIVES

Two pedestrian overpass and two tunnel options were developed as part of this work, as described in the following sections.

3.1 Pedestrian Overpass Options

A pedestrian overpass concept was discussed as part of the initial feasibility work completed for the project (Anchor QEA 2016), but it was not evaluated because, apart from providing safe public access, it did not address the other stated goals of the project. Due to the estimated cost of the preferred alternative, this concept was reconsidered at the County's request. Two options were developed based on this concept, a pair of elevator/stair towers (Option A) and a pair of stair/ramp towers (Option B), both of which access an overpass bridge spanning the railroad tracks. Both options provide for safe, ADA-accessible access to the beach for park visitors. However, neither option addresses other Project goals, such as flooding and sediment impoundment issues in the creek or salmon habitat issues related to the existing undersized culvert at the railroad berm.

The general design requirements used to develop the pedestrian overpass options included the following:

- 20 feet of separation between track center lines (this is larger than current separation, but is current BNSF preference)
- 25-foot offset from toe of railroad embankment to the tower structures for the overpass (BNSF requirement)
- 23-foot, 4-inch vertical clearance above the rail elevation to the lowest structural member of the pedestrian overpass bridge (BNSF requirement)
- Structure must meet current federal ADA access guidelines
- If possible, tower structure built on water-side of the tracks should be located above the mean higher high water (MHHW) elevation

Figures 1, 2, and 3 show a plan view and two section views (respectively) for Option A for the pedestrian overpass (stairs/elevators), and Figures 4 through 6 show the same views for Option B (stairs/ramps). The required vertical and horizontal offsets from the tracks result in a relatively large structure for the pedestrian overpass. The overpass bridge is approximately

80 feet long and the deck is located at approximately 46 feet North American Vertical Datum of 1988 (NAVD88), and the total height of the structure relative to the base of the railroad berm is approximately 50 feet. For Option B, the ramps required to meet ADA access requirements are approximately 800 feet long in total to get from the park to the beach. The tower on the beach side of the tracks is located approximately 40 to 60 feet from the ordinary high water mark (OHWM)/MHHW.

The Snohomish County Shoreline Management Program (SMP) designation at the project location is Urban Conservancy (Snohomish County 2012a). According to the Snohomish County SMP, in the Urban Conservancy shoreline environment, maximum building height is 35 feet (per SCC 30.67.460) with a 150-foot buffer/setback (Table 6 of Snohomish County 2012b) from the OHWM. Based on these requirements, both of the pedestrian overpass options are out of compliance; however, there are options available to address these concerns (provided in the fine print associated with these requirements in Table 6 of Snohomish County 2012b):

- Height: Per SCC 30.67.460, any building or structure within 200 feet of the ordinary high water mark in excess of 35 feet in height above average grade level shall provide data showing that it will not obstruct the view of a substantial number of residences in the areas adjoining such shorelines.
- Buffer: For a water-dependent, water-related, or water-enjoyment use, the buffer setback can be modified as long as the no net loss of ecological function requirement is satisfied.

3.2 Tunnel Options

As part of this additional work, two potential concepts were considered for constructing a tunnel (or tunnels) under the railroad tracks to provide ADA-compliant pedestrian access and increased conveyance for the creek under the railroad tracks. One concept involved jacking a pre-cast concrete rectangular tunnel through the railroad embankment. This concept would require the tunnel to be pre-cast on site to its full length and depth of embedment and then pushed through the railroad berm a bit at a time. The other concept entails jacking sections of a 12-foot-diameter smooth steel pipe through the railroad embankment. This concept would require excavation of the tunnel section to its final embedment depth prior to installation, but the pipe could be pushed through the embankment in smaller sections, adding on additional sections as progress was made through the embankment. Shannon & Wilson conducted a detailed preliminary evaluation of the proposed tunnel concepts as part of the Preliminary Geotechnical Evaluation Addendum provided in Appendix B.

The initial evaluation of both concepts suggested that the first concept (pre-cast concrete rectangular tunnel) would be prohibitively expensive due the amount of excavation needed to pre-cast it on site (to the required embedment depth) and this concept was not developed further. Therefore, the second concept of using the smooth steel pipe (12-foot-diameter) to construct a tunnel or tunnels through the railroad berm was further developed into two tunnel options:

- Tunnel Option A: Use of a single 12-foot-diameter smooth steel pipe constructed to the north of the existing culvert; the existing culvert would be separated from the creek and used for pedestrian access only.
- Tunnel Option B: Use of three 12-foot-diameter smooth steel pipes constructed to the north of the existing culvert for the creek; the existing culvert would be separated from the creek and used for pedestrian access only.

Figures 7 and 8 show a plan view and section view (respectively) for Tunnel Option A, and Figures 9 and 10 provide the same views for Tunnel Option B.

The required depth of fill over the top of the tunnel is approximately 7 feet in order to account for weight distribution from the rail loading on the tunnel and to facilitate jacking of the culvert through the embankment. Since the elevation of the top of the rail is approximately 20 feet NAVD88, the maximum elevation of the top of the tunnel will be approximately 13 feet NAVD88. At MHHW elevation (9 feet NAVD88); only 4 feet of vertical clearance will be available in the tunnel. This is the reason the new tunnels cannot be used for pedestrian access and the original culvert is retained for pedestrian use in both tunnel options. The bottom of the tunnel(s) would be set to +1 foot NAVD88 and filled with appropriate creek substrate to an approximate elevation of +8 feet NAVD88.

The single tunnel option (Tunnel Option A) would only provide 12 feet of bank-full width for the creek. This is twice as large as is currently provided by the existing culvert but is still less than the natural bank-full width of the creek, which was determined to be about 30 feet (Anchor QEA 2016). The three-tunnel option (Tunnel Option B) would provide almost 36 feet of combined width for the creek. Both options would require the creek to be re-routed to the north of its current alignment in order to retain the existing culvert for use by pedestrians. In addition, the tunnel options have limited capacity for sediment deposition and are vulnerable to impacts from sea level rise due to the limited clearance available from the proposed channel bed elevation (+8 feet NAVD88) and the top of the tunnel (+13 feet NAVD88).

4 ON-SITE CONSTRUCTABILITY REVIEW

An on-site constructability review was conducted by Bob Hirte of Hamilton Construction on December 8, 2015, at Meadowdale Beach County State Park to discuss construction options for the preferred alternative and the proposed pedestrian overpass and tunnel options. The purpose of this on-site review was to refine the initial preliminary construction cost estimate for the preferred alternative developed for the Feasibility Report (Anchor QEA 2016) and to develop preliminary cost estimates for the pedestrian overpass and tunnel options. The constructability review also included discussion on required work windows for each of these alternatives in order to identify construction work windows and other coordination requirements with BNSF that would be required to construct proposed alternatives.

A detailed summary of the constructability review is provided in Appendix A. This information was used to develop preliminary construction cost estimates and to inform a comparison of alternatives provided in Section 6 of this report. A brief overview of constructability issues associated with the preferred alternative, pedestrian overpass, and tunnel options is provided in the summary discussion in Section 6 of this report.

Appendix B provides a detailed discussion of the preliminary geotechnical assessment of the existing condition of the park access road and improvements needed to utilize the road as construction access for the project that was developed by Shannon & Wilson. Conclusions from this study are summarized below:

- A surface survey of the park entrance road occurred on December 23, 2015. Evidence of sliding and bulging was observed and historical slides have been documented.
- Two historical slide areas have been repaired in the past:
  - MSE repair (designed by County PE and LG)
  - Wood soldier pile and lagging (no design or details uncovered)
- The entrance road generally appears to be suitable for construction access if the following are addressed:
  - Leaning hazard trees that may promote instability should be cut leaving the stump.
  - Shoulder distress near the entrance requires repair.

  - Local yielding near the wood wall may require mitigation for large construction loads.
  - Large load access may not be feasible during periods of heavy rain.
  - Additional geotechnical investigation is needed to finalize evaluation.

- The cost of additional investigation (geotechnical and survey) and remedies anticipated to improve the access road for use as construction access is anticipated to be significantly lower than the costs for temporary rail or marine access.

5 CONCEPTUAL OPINIONS OF PROBABLE CONSTRUCTION COST AND BNSF CONSIDERATIONS

Based on the information gained from the on-site constructability review (see Appendix A), conceptual opinions of probable construction cost were refined for the preferred alternative (Anchor QEA 2016) and developed for the pedestrian overpass and tunnel options. A summary of these costs and associated constructability issues for each of these alternatives is provided in the following sections.

5.1 Preferred Alternative, Four-span Bridge

Detailed revised conceptual opinions of probable construction cost for the preferred alternative are provided in Appendix C. The cost for the bridge structure itself (not including recreation or habitat improvements) is estimated to be approximately $8.4 million. The cost for the entire project, including anticipated park and habitat improvements and 1% for the arts, is approximately $11.2 million.

This cost is approximately the same as those shown in Table 14 of the Feasibility Report (Anchor QEA 2016) for the preferred alternative, but the cost analysis provides greater detail and modifications to anticipated mobilization cost and contingencies. A railroad flagger has been added along with a line item for access contingency related to road improvements, marine access, or rail access. Fencing improvements along the railroad right of way and some modifications to unit prices associated with recreational improvements are also included. One percent for the arts has also been taken into consideration due to its significance. The mobilization cost factor has been reduced from 30% to 20% of construction costs as a result of including a line item for site access. The overall contingency factor remains at 40% of construction costs. This cost does not include a maintenance fee that BNSF would require the County to pay as part of the up-front construction costs for the bridge structure; this cost is determined by BNSF and is currently unknown but could be in the millions of dollars.

Construction of the preferred alternative will require construction work windows from BNSF in order to complete the work. Work windows of 3.5 hours (duration suggested by BNSF for this section of the railroad line) would be adequate for pile driving. However, the actual setting of the bridge components would require longer track windows; for example a single 16-hour window, two 10-hour windows, or even three 8-hour windows per bridge. As the work windows get shorter, less work can be done within the same time period due to mobilization and demobilization work that has to occur during each construction window.

5.2 Pedestrian Overpass Options

Detailed conceptual opinions of probable construction cost for the pedestrian overpass Options A and B (see Figures 1 through 6) are provided in Appendix C. The cost for Option A (stairs/elevators) is approximately $3.8 million for the structure alone. The cost for Option A including park and habitat improvements is approximately $5.5 million. Costs for Option B (stairs/ramps) are approximately $2.7 million for the structure and $4.3 million for the total project cost, including recreation and habitat improvements. Mobilization, contingency, and sales tax costs are the same as assumed for the preferred alternative (four-span bridge) options. Appendix C provides additional information from TKDA, which includes quantities and assumptions used to develop the conceptual opinion of probable construction cost for the pedestrian overpass structures. Costs assume that the structure will be concrete; if the structure were constructed with a different material (such as steel), construction costs could be much higher.

Construction of the pedestrian overpass structure may be possible within the 3.5-hour work windows suggested by BNSF as potentially available along this section of the line. However, depending on the final design of the overpass, a larger work window may be required to set the bridge span. In addition, BNSF may require the structure span the entire right of way instead of meeting the required offset distance of 25 feet from the toe of the embankment. This could increase the span of the overpass by approximately 25 feet into the park (east). This would increase the cost somewhat but not significantly. It is anticipated that the County would own and maintain an overpass structure; therefore, BNSF is not expected to require a maintenance fee as described for the preferred alternative.

5.3 Tunnel Options

Detailed conceptual opinions of probable construction costs for the Tunnel Options A and B (see Figures 7 through 10) are provided in Appendix C. The cost for a single 12-foot smooth steel tunnel (Tunnel Option A) is approximately $5.5 million. The cost for the single tunnel including park and habitat improvements is approximately $7.4 million. Costs for Tunnel Option B (three 12-foot tunnels) are approximately $9.4 million for the tunnels and $11.9 million for the total project cost, including recreation and habitat improvements. Mobilization, contingency, and sales tax costs are the same as assumed for the preferred alternative options.

Construction of the tunnel options may be possible within the 3.5-hour work windows suggested by BNSF as potentially available along this section of the line. It is anticipated that BNSF will require a lower maintenance fee to be paid as part of the construction costs for the tunnel options compared to the preferred alternative, four-span bridge structure.

6 SUMMARY

The pedestrian overpass and the three tunnel options were evaluated based on the final project evaluation criteria as documented in Section 4, Table 1 in the Feasibility Report (Anchor QEA 2016). The single tunnel option was not included because it would not be permittable due to not meeting Washington Department of Fish and Wildlife bank-full width requirements. For each of the evaluation criteria, options were ranked according to one of four designations as shown in Table 1:

- The alternative optimally meets all specified criteria in stated category (++++)
- The alternative generally meets all or most specified criteria in stated category (+++)
- The alternative partially meets most criteria in stated category (++)
- The alternative fails to meet most criteria in stated category (+)

The preferred alternative was also ranked in Table 1 for ease of comparison with the pedestrian overpass and tunnel option developed as part of this Addendum.

As shown in Table 1, the pedestrian overpass options are less expensive (based on conceptual opinions of probable construction cost) than the preferred alternative and tunnel option. However, BNSF may require a bridge that spans the entire right of way, increasing costs. The pedestrian overpass only addresses public safety, and to a lesser extent parks and recreation goals, and does not provide any added educational benefit for the project. Sediment and flooding concerns for the creek, habitat restoration opportunities, and sustainability are also not addressed by the pedestrian overpass options, which reduces opportunities for funding for the project. BNSF coordination is expected to be a more straight forward process compared to the other options; however, permitting would likely be more challenging due to the permanent encroachment in the shoreline, and certain agencies may have concerns with not addressing sediment issues at the culvert. The elevator has long-term maintenance issues, and a potential malfunction could strand a disabled person on the beach. There is also a concern that the public may continue to utilize the culvert for beach access to circumvent the long ramps or waiting for an elevator. Because a suitable walking surface would not be available in the culvert, this potential continued pedestrian usage represents a concern for public safety and fish impacts.

The tunnel option is approximately the same magnitude of cost as the preferred alternative (four-span bridge). The three-tunnel culvert provides some improvement to flooding/ sediment issues compared to the existing culvert and provides some opportunities for habitat restoration; however, it requires use of the existing pedestrian tunnel for access to the beach, which does not meet ADA requirements. The tunnel option is not sustainable in the long term (impacts from sea level rise) due to the limited vertical clearance available in the tunnels between the creek bed and the top of the culvert (approximately 4 to 5 feet based on current sea levels). Monitoring for settlement over the tunnel is also a concern, and it is unclear what steps BNSF would require to address this concern.

A meeting between the Anchor QEA team and Snohomish County Parks and Recreation and Surface Water Management was held on January 8, 2016, to review the information summarized in this Addendum. A meeting summary that documents the discussion is provided in Appendix D. Based on information gathered from the work performed for this Addendum and the discussion during the meeting, the preferred alternative (four-span bridge) previously documented in the Feasibility Report developed by the Anchor QEA team for the Project (Anchor QEA 2016) was still selected as the most suitable option to address the existing access and barrier issues at Meadowdale Beach County Park.

Table 1

Conceptual Alternatives Comparison Using Project Evaluation Criteria

Evaluation Criteria	Pedestrian Overpass B	Pedestrian Overpass A	Tunnel Option B: Three Culverts	Preferred Alternative[a]
	Ramps	*Elevators*	*+ Existing Tunnel*	
Public Safety	+++	+++	+	++++
Parks and Recreation / Educational Use	++	++	+	++++
Sediment Transport and Coastal Processes	+	+	++	++++
Habitat Restoration	+	+	++	++++
BNSF Coordination[b]	++++	++++	+++	++++
Funding Opportunities	+	+	++	++
Sustainability	+	+	++	++++
Conceptual Opinion of Probable Construction Cost ($million)[c]	$4.1	$5.3	$11.9	$11.1

Notes:

a. Preferred Alternative is a four-span bridge documented in the Feasibility Report (Anchor QEA 2016).

b. Primary source of uncertainty associated with cost and constructability.

c. Does not include 1% for the arts.

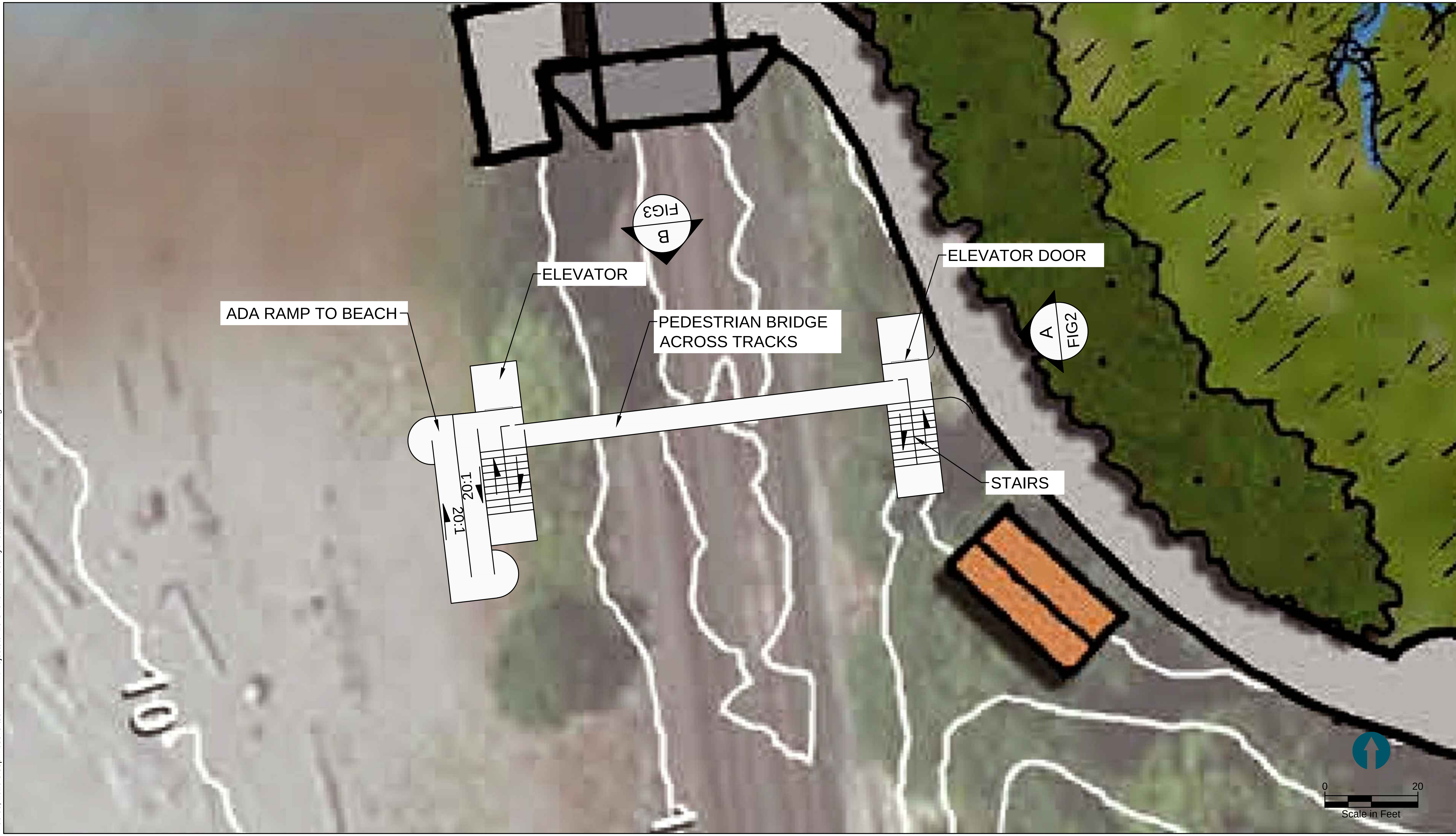
7 REFERENCES

Anchor QEA, LLC (Anchor QEA), 2016. *Feasibility Study, Meadowdale Beach County Park.* Developed for Snohomish County Parks and Recreation, January 2016 (DRAFT).

Snohomish County, 2012a. *Snohomish County Shoreline Environment Designations Map*. Prepared by Snohomish County. July 27, 2012.

Snohomish County, 2012b. *Snohomish County Shoreline Management Program: Shoreline Environment Designations, Policies and Regulations*. Prepared by Snohomish County Planning and Development Services. July 13, 2012.

FIGURES



Feb 03, 2016 3:53pm bsevertsen K:\Projects\0723-Snohomish County\Meadowdale Park\0723-RP-001.dwg FIG1

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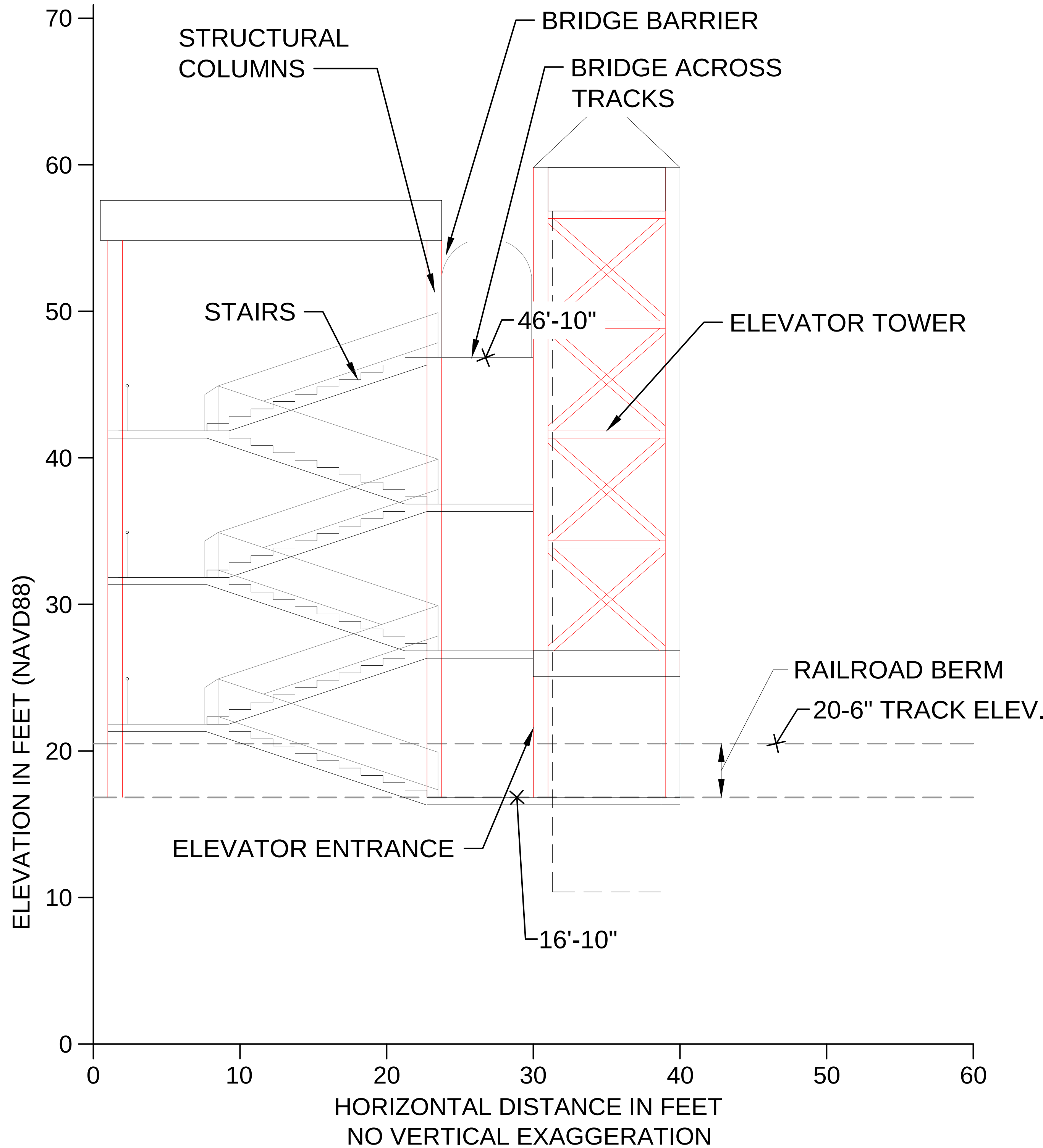
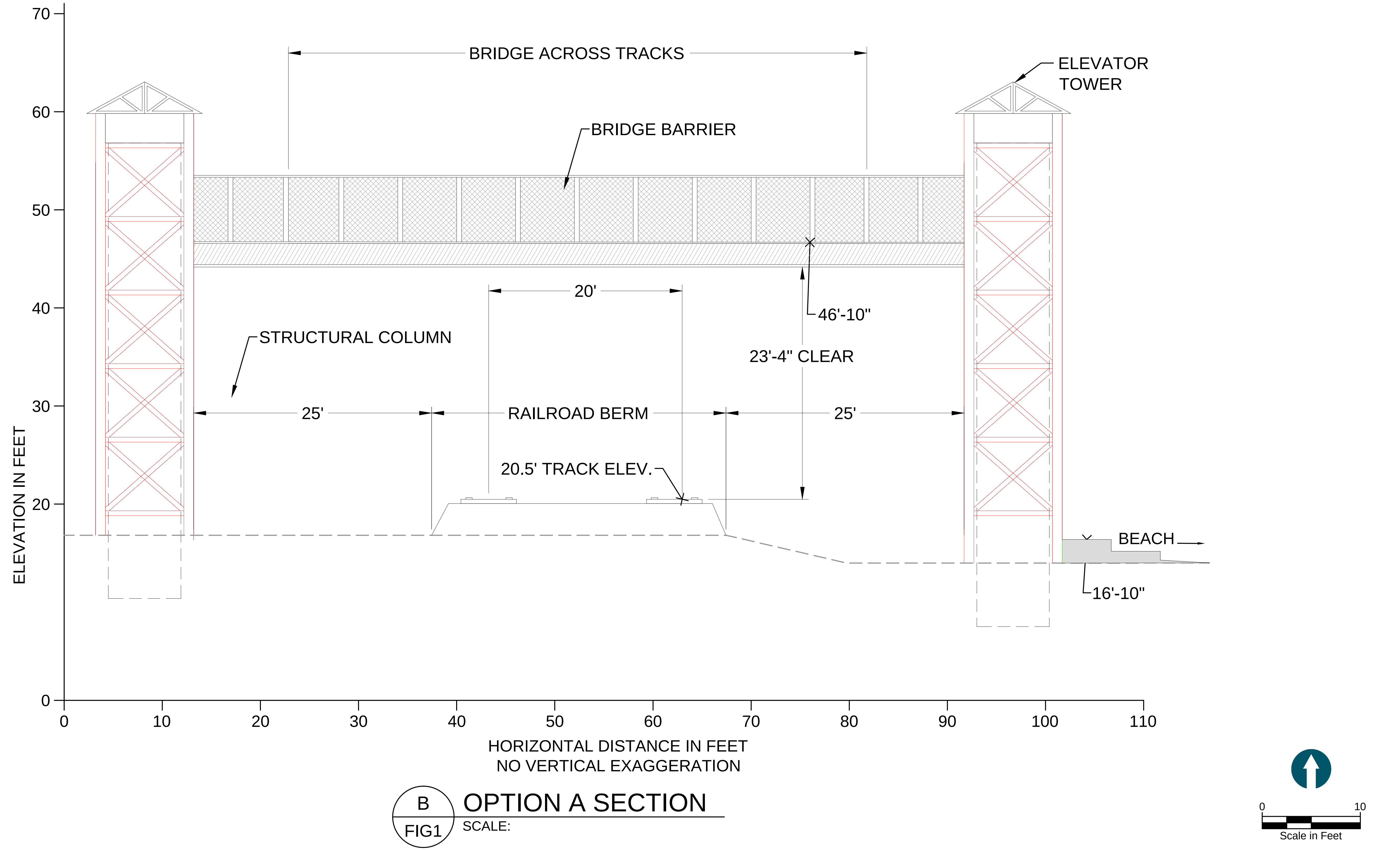
Figure 1
Plan View of Pedestrian Overpass Option A
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation



A
FIG1
OPTION A ELEVATION
SCALE:

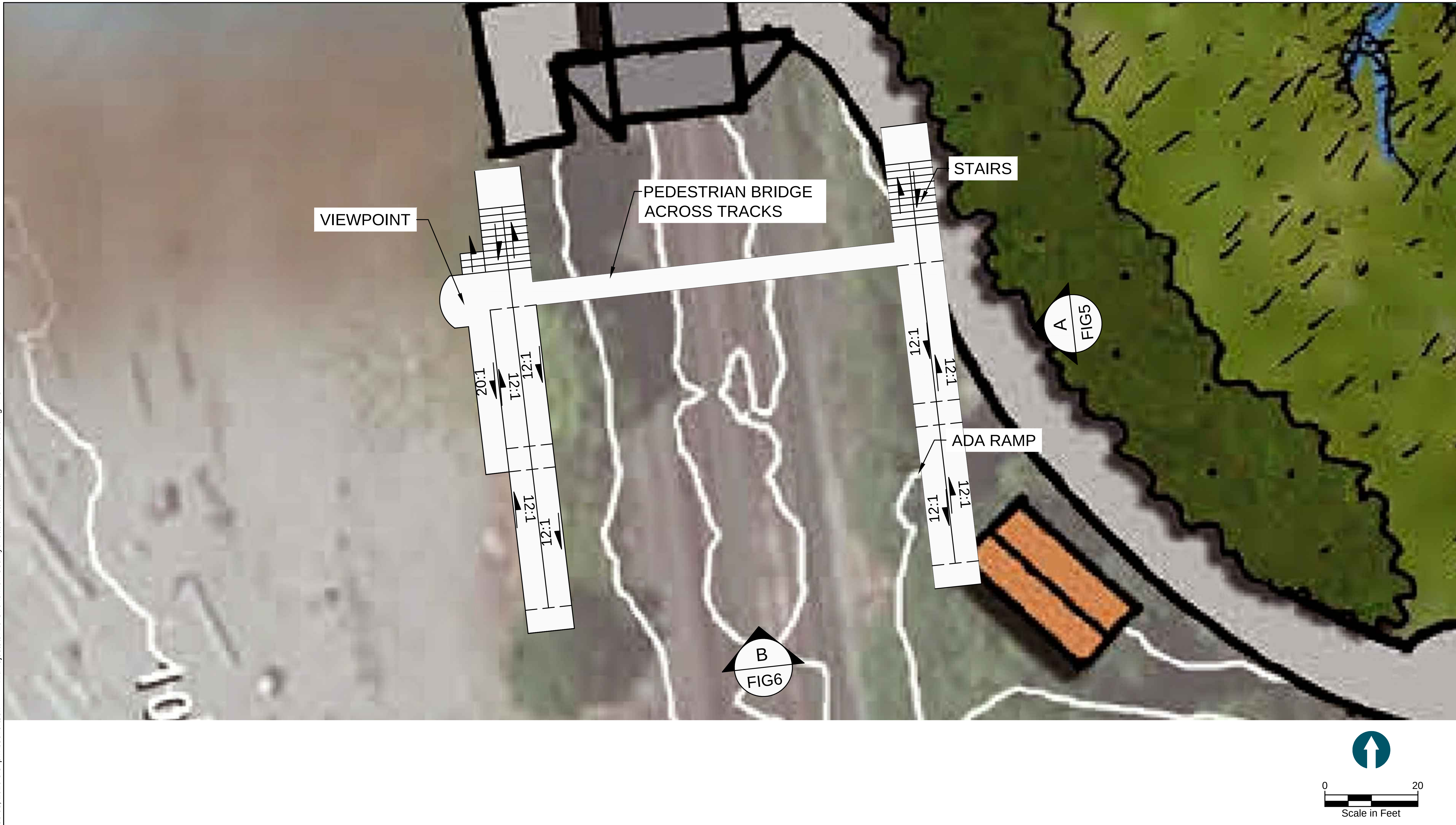
ANCHOR QEA

Figure 2
Elevation View of Pedestrian Overpass Option A
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation



ANCHOR QEA

Figure 3
Section View of Pedestrian Overpass Option A
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation



Feb 03, 2016 3:54pm bsevertsen K:\Projects\0723-Snohomish County\Meadowdale Park\0723-RP-002.dwg FIG 4

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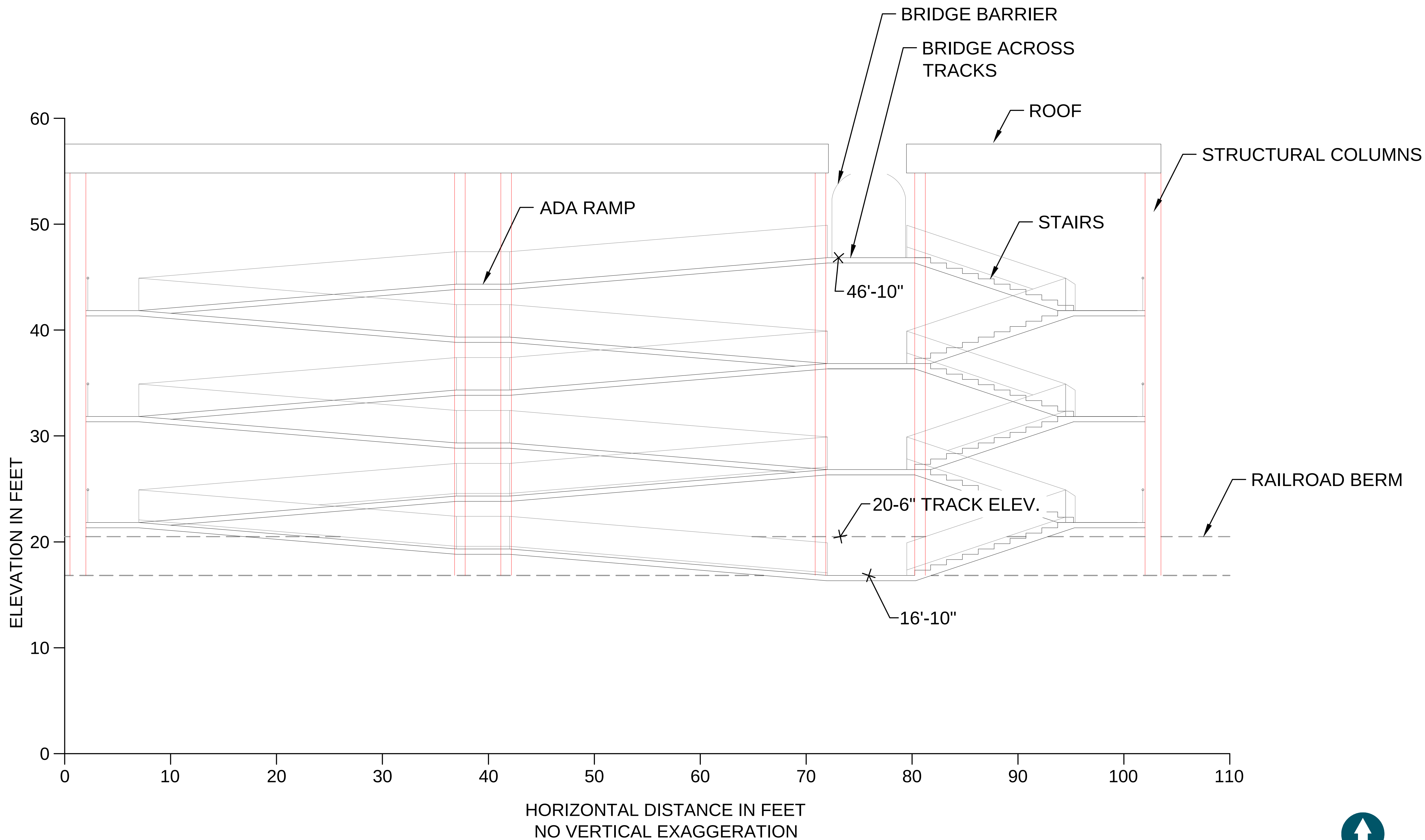
Figure 4
Plan View of Pedestrian Overpass Option B
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation

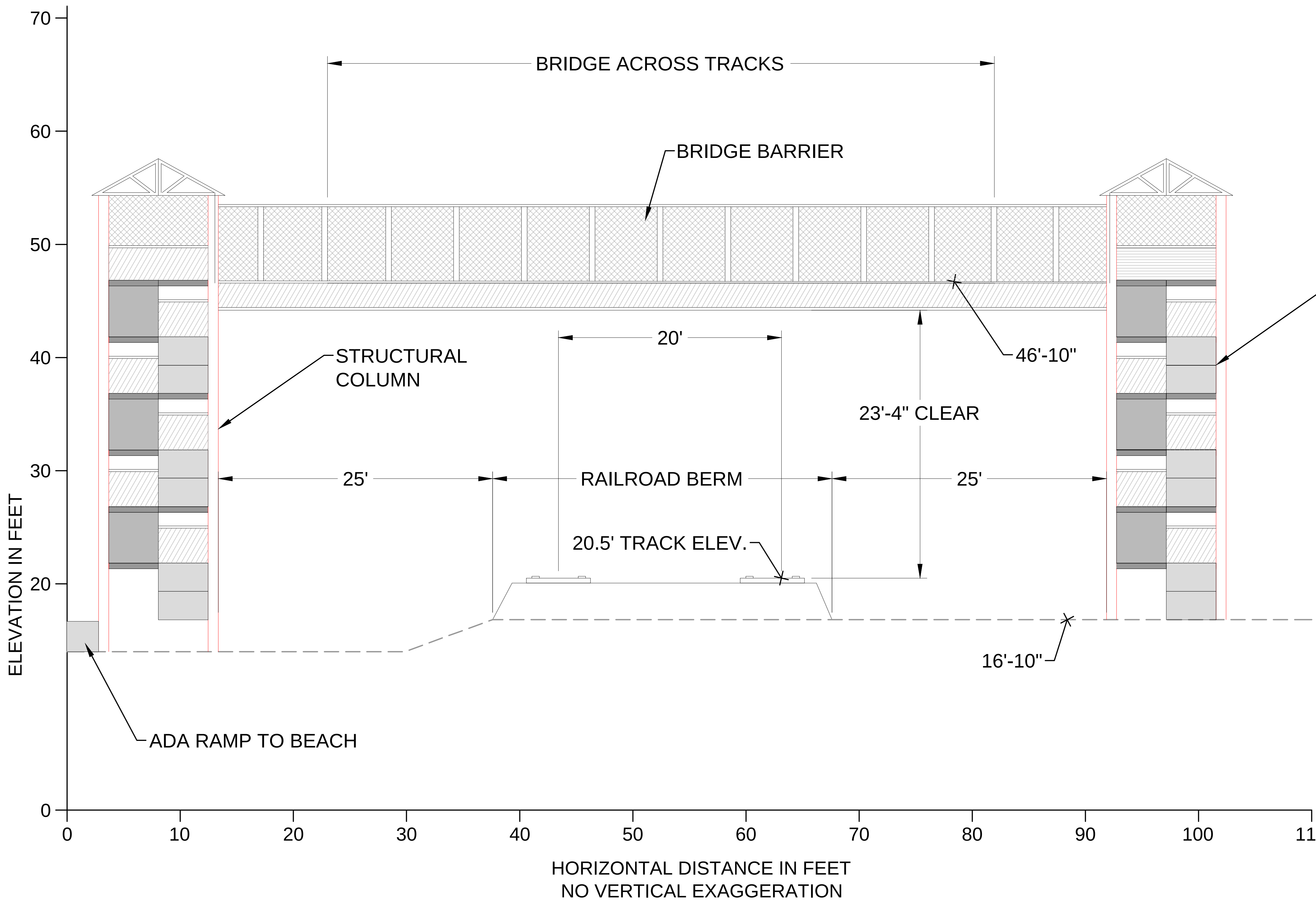


A
-
OPTION B ELEVATION
SCALE:

0 10
Scale in Feet

ANCHOR QEA

Figure 5
Elevation View of Pedestrian Overpass Option B
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation



B
-

OPTION B SECTION

SCALE:

0 10
Scale in Feet

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Figure 6
Section View of Pedestrian Overpass Option B
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation

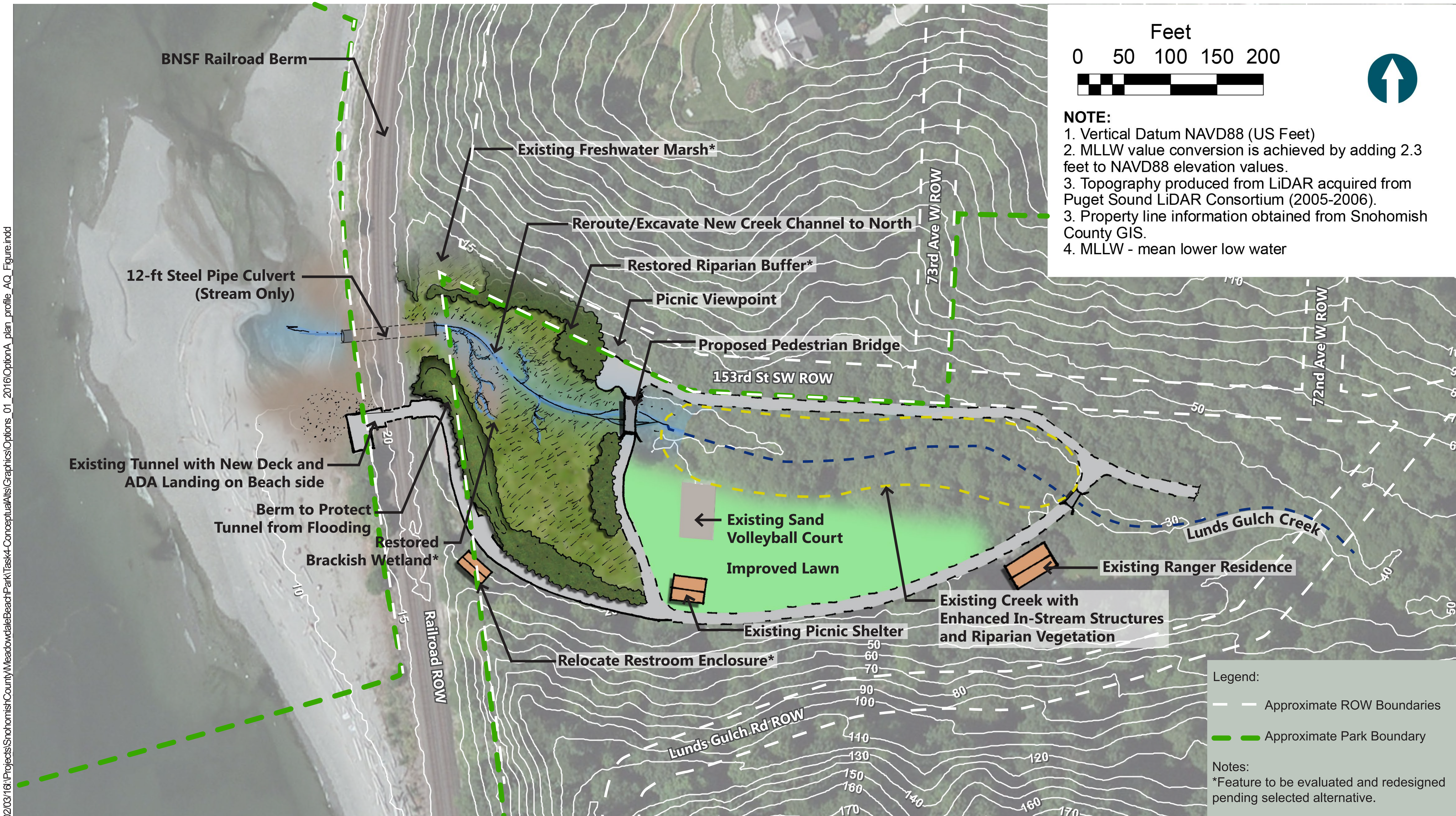

Figure 7
Plan View of Tunnel Option A
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation

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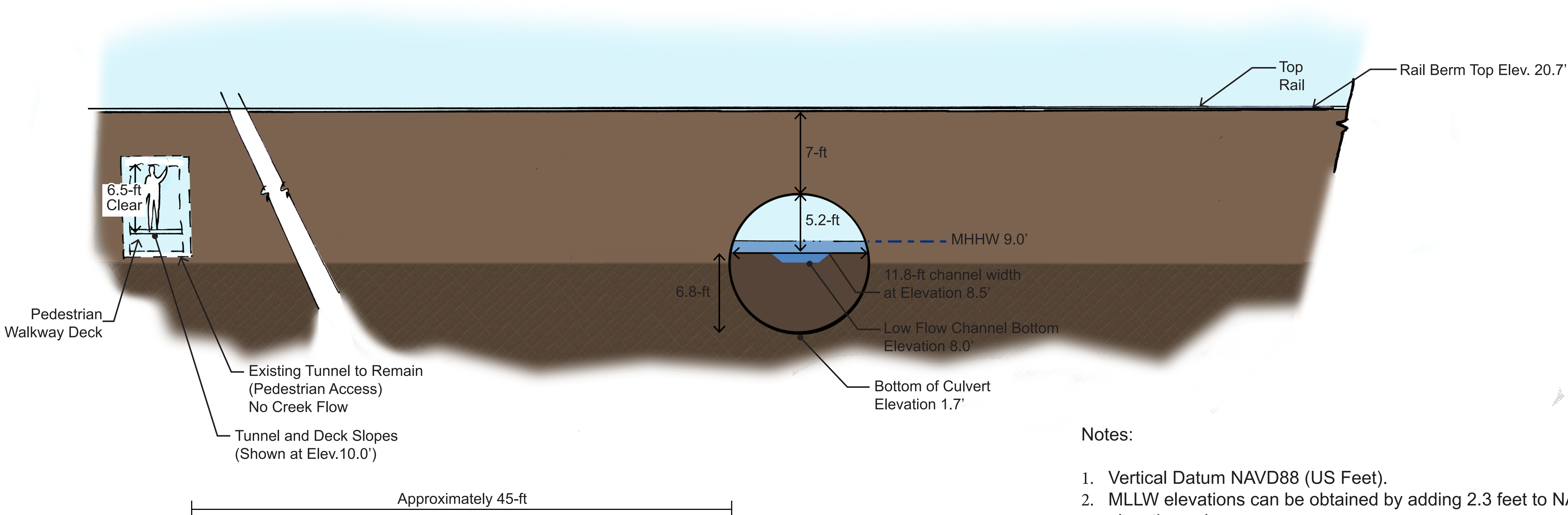

Elevation Looking West

Notes:

1. Vertical Datum NAVD88 (US Feet).
2. MLLW elevations can be obtained by adding 2.3 feet to NAVD88 elevation values.
3. Topography produced from LiDAR acquired from Puget Sound LiDAR Consortium (2005-2006)
4. Geometry of existing culvert taken from Puget Sound Tributaries Drainage Needs Report (Snohomish County, 2002)
5. MLLW - mean lower low water
6. MHHW - mean higher high water
7. Channel elevations shown are conceptual and may be modified based on results of hydraulic modeling or during project design.

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Figure 8
Elevation View of Tunnel Option A
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation

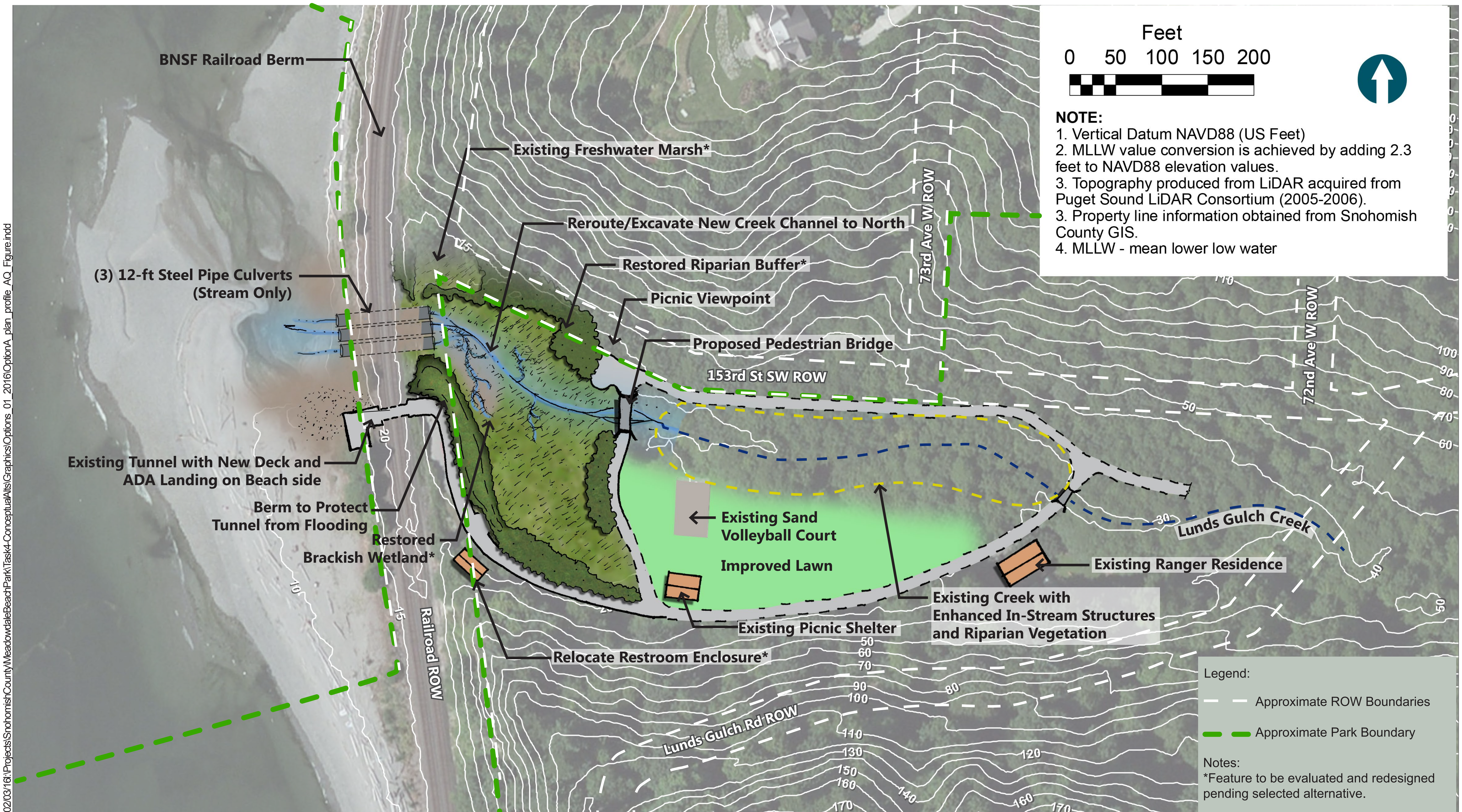

Figure 9
Plan View of Tunnel Option B
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation

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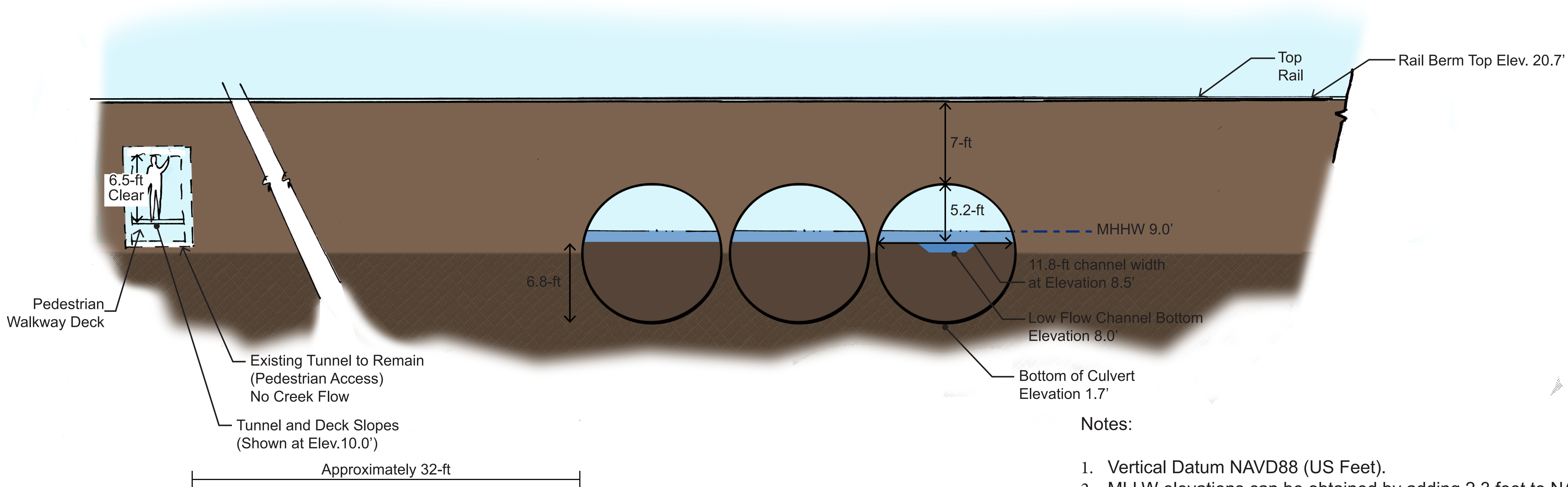

Elevation Looking West

Notes:

1. Vertical Datum NAVD88 (US Feet).
2. MLLW elevations can be obtained by adding 2.3 feet to NAVD88 elevation values.
3. Topography produced from LiDAR acquired from Puget Sound LiDAR Consortium (2005-2006)
4. Geometry of existing culvert taken from Puget Sound Tributaries Drainage Needs Report (Snohomish County, 2002)
5. MLLW - mean lower low water
6. MHHW - mean higher high water
7. Channel elevations shown are conceptual and may be modified based on results of hydraulic modeling or during project design.

Figure 10
Elevation View of Tunnel Option B
Meadowdale Beach County Park
Snohomish County Department of Parks and Recreation

APPENDIX A
MEETING SUMMARY OF ON-SITE CONSTRUCTABILITY REVIEW

1605 Cornwall Avenue
Bellingham, Washington 98225
Phone 360.733.4311
www.anchorqea.com

MEMORANDUM

Re:	Constructability Site Visit Summary	**Visit Date:**	December 8, 2015
Attendees:	Bob Hirte, Hamilton Construction Logan Daniels, Snohomish County Matthew Gibson, Shannon and Wilson Red Robison, Shannon and Wilson Kathy Ketteridge, Anchor QEA Izaak Fox, Anchor QEA		

This memorandum summarizes discussions held during the December 8, 2015, site visit to Meadowdale Beach County Park to evaluate the preferred alternative (bridge) and two additional alternatives (pedestrian overpass and tunnel) for replacement of the existing culvert with an emphasis on constructability and cost. This summary was developed in advance of the report addendum that Anchor QEA will be preparing, and is not intended to be a stand-alone document. The report addendum will provide a complete discussion of the proposed concepts, including conceptual level costs, concept constructability review and specific list of pros and cons associated with each alternative. The information provided in this summary will be folded into the Draft Report Addendum; which will be submitted to the County in January 2016.

During the site visit, the group walked the site, focusing on the areas adjacent to the railroad berm and access road, to evaluate existing conditions and discuss constructability issues associated with the three proposed concepts. Bob Hirte of Hamilton Construction attended the meeting to provide constructability expertise and Red Robinson of Shannon and Wilson provided tunnel expertise.

This summary breaks down the topics discussed into the following categories:

1. Site access issues that impact all alternatives
2. Specific discussion for each of the three alternatives being considered

1. SITE ACCESS

Site access must either be obtained by the park entrance road, by rail or by water and all construction alternatives are impacted similarly.

Road Access

Access on the park entrance road will require investigation and possible improvement as the stability and bearing capacity of the road is questionable. Bob confirmed that it would be possible to get reasonably sized loads of equipment and materials delivered within the existing footprint of the road although some tree trimming would be required (this should be verified by survey). As a lowboy cannot navigate the turns of the access road, large equipment such as the crane would have to be "walked" on the road causing damage to existing roadway surface. Bob cautioned that the crane Hamilton would most likely utilize is a 110-ton crawler crane weighing 120,000 pounds partially assembled.

The stability of the road was discussed and Shannon and Wilson will conduct a limited analysis of the roadway to evaluate its use. This evaluation is necessary as rail or marine options both require materials and equipment be delivered on the park access road to develop support infrastructure. Depending on the integrity of the roadway, repairs or improvements may be required to meet the project requirements as well as long term stability needs. These expenses will permanently improve the park access road and may eliminate large expenses involved with building temporary rail or marine access.

Rail Access

Rail access is the preferred alternative for delivering heavy equipment to the site but also the most difficult to coordinate and subject to impacts due to BNSF operations. The uncertainty with coordination with BNSF for delivery by rail could add cost to the project. In addition to these uncertainty costs, a temporary offloading platform must be constructed. Materials for this platform and the majority of other project materials would need to be brought to the site using either marine access or road access.

Marine Access

Marine access is a possible alternative to deliver equipment and materials to the project site but includes both significant expenses and permitting challenges.

- The shallow gradient of the beach would likely require a long pier potentially extending over 100 yards into the water. Such a pier will require an extensive permitting effort and include a large cost for a temporary structure (estimated at about $500,000 without contingency in the Feasibility Study).
- It may be possible to access the beach at high tide by barge but this would require an extensive permitting effort and working around the tides. Barge access would likely require two barges aligned end to end with one or both becoming partially grounded during the offloading. Partial grounding may compromise the structural integrity of the barge(s) limiting the weight of loads that can be delivered. The feasibility of this approach would require additional evaluation, but has been used on other projects of which Anchor QEA is aware.

Railroad Traffic Impacts

Bob stated that it is reasonable to plan construction work based on two 2-hour windows per day although it frequently occurs that no windows are provided to a contractor. On days when no windows are provided, no productive work is performed and this can impact project costs. For the preferred bridge alternative, Bob suggested that two 10-hour work windows would be needed to place bridge spans for both tracks (one for each span).

Work adjacent the track which does physically disturb the track can occur more reliably during the construction shift but equipment or suspended loads must be secured prior to rail traffic transiting the site. All design alternatives include some work which will require work windows. However, some alternatives may require less or shorter work windows to construct.

Existing Site Conditions

If the existing railroad embankment contains either a buried trestle or a majority of oversized rip rap, construction of the railroad bridge or tunnel options could be significantly impacted. Either possible obstruction may impact pile driving, excavation or tunneling work at a significant cost depending on the nature and location of the obstructions. Accordingly, geotechnical exploration of the embankment in the vicinity of anticipated piles or tunnels is necessary early in the design process. Exploration by ground penetrating radar (GPR) supplemented with horizontal borings may be employed incrementally to limit costs of the investigation during initial design. Type and extent of debris within the embankment is most critical to the tunnel/jack culvert alternatives. Shannon and Wilson will provide a budget for this exploratory work to be included in the Report addendum.

2. DESIGN ALTERNATIVES DISCUSSED

Railroad Bridge (Preferred Alternative from Feasibility Study)

Construction of a railroad bridge at the existing culvert is the Stakeholder and County's preferred alternative for achieving public access and fish passage. Constructability considerations discussed on site associated with this work include:

- A majority of the work for the structures must be performed within work windows of not less than 2 hours, which will need to be scheduled with BNSF.
    - Longer work windows, if available, would likely decrease costs and duration of construction but cannot be planned with BNSF with certainty.
    - A 10-hour window is desired to install the bridge girders but this window may not be obtainable along this stretch of track (Rick Wagner mentioned 3.5-hour work windows along this stretch of track during the BNSF coordination meeting). Bob was optimistic that work could still be accomplished in smaller amounts of time if necessary but at a higher cost. Anchor QEA will follow up with Bob to discuss this further.
- Construction will require temporary leveling or work bridges parallel to the tracks.
- This alternative can likely be constructed with access by any of the options discussed in #1 above, although the park entrance road will be required for bringing in bulk materials needed for constructing support infrastructure such as a temporary offload platform.
    - The 110-ton crawler crane anticipated for use could most easily be delivered by rail to a temporary platform built adjacent the track.
        - A combination of rail and road access are the preferred access alternatives.

- The railroad may require a shoe-fly for this work (determined in the FS a low-speed shoe fly would be most cost effective at this site), which would significantly increase cost. This may reduce the number of required construction work windows for the eastern bridge.
- Generic pricing for railroad bridges of the type under consideration range between $8,000 per linear foot (LF) of bridge constructed under optimal conditions and $12,500 per LF for construction under poor conditions.
    - This cost is per LF of bridge and this project requires a bridge for each track.
    - Length and frequency of work windows available during construction, railroad O&M cost requirements, difficulty of site access, exact design and market pricing will affect final costs and may well exceed $12,500 per LF.
    - These costs do not include expenses associated with restoration or additional site improvements.
- Generic durations for constructing two bridges range between 14 and 16 weeks.
    - Actual duration will be highly dependent upon final design, length and frequency of work windows available during construction, and site access.
    - Significant variance in construction duration should be considered during permitting.

Jack and Bore Tunnel: Concrete Culvert or Solid Steel Pipe

Construction of a tunnel or a series of tunnels under the tracks for both pedestrians and the stream is not the preferred option by the County. This option was disregarded during early in the feasibility study due to perceived high construction costs associated with potential for debris located within the railroad berm and concerns that tunnel options would not meet habitat restoration goals or be sustainable in the long term. Due to anticipated constructability challenges and high conceptual opinion of probable cost associated with preferred alternative (bridge), tunnel options were more thoroughly investigated to ensure the most economically feasible alternatives were presented for consideration. In addition, alternative technologies for the tunnel option was discussed on site. Factors affecting construction of any tunnel are as follows (specific tunnel alternatives are discussed in a later section):

- Any tunnel alternative would be adversely affected by the presence of large armor rock throughout the embankment.

  - Such rock is difficult to demolish and any work to do so would pose a settlement risk to the tracks.
- The presence of an existing wooden trestle within the embankment would impact tunnel alternatives but could reasonably be accommodated.
- Work to install a tunnel will not impact railroad operations as significantly as construction of the bridge, although BNSF will be concerned about the integrity of their track with this approach. At a minimum the railroad will likely operate under a "slow order" (a reduced speed limit) and require continuous settlement monitoring. Work windows would still be required during the actual "jacking" process; however, the work windows required are likely within the 3.5-hour work windows Rick Wagner suggested may be possible along this stretch of track. BNSF should be consulted to get insight into their position on tunnel construction along this stretch of track.
- Tunnel options can likely be constructed with access by any of the options discussed in #1 above, although the park entrance road will be required for bringing in bulk materials needed for constructing support infrastructure such as a temporary rail offload platform.
  - Construction of a tunnel would likely not require a large crane although other large construction equipment would be mobilized including excavators, dump trucks and possibly concrete trucks.
    - Such equipment would likely not weigh as much as the 110-ton crawler crane required for a railroad bridge.
- The railroad is unlikely to require a shoe-fly for this work as both tracks should remain operational except for during work windows required for the jacking process.
- Tunnel options may require a lower Operations and Maintenance (O&M) cost required by the railroad for long-term maintenance of the tunnel, compared to the O&M cost for the bridge.
- Tunnel options are unlikely to be wide enough to meet the desired bank full stream width for habitat restoration considerations. Multiple tunnels are likely required to meet desired stream width.

Concrete Culvert (specific considerations)

Red Robinson of Shannon and Wilson presented several different options for constructing a tunnel under the BNSF tracks. One option involved using ground freezing to stabilize the embankment and then jacking a concrete box culvert which is cast onsite through the embankment. Considerations for this work include:

- The precast culvert must be built onsite in a monolithic section exactly on the tunnel alignment and grade.
    - This will require a significant excavation within the park to construct and position the culvert (as a single section > 100 feet in length) prior to installation.
    - Work may be required to re-align the stream if the new culvert is significantly offset from the existing culvert for any reason.
    - There is a limited depth of cover (only about 4 to 5 feet of fill) above the culvert. Additional geotechnical evaluation would need to be conducted to ensure that this is adequate to support the "jacking" process without displacing the tracks above.

Steel Pipe Culvert (specific considerations)

Due to the limitations of concrete culverts and high associated costs, Bob suggested smooth steel pipe as an alternative material for the culvert. Considerations of this work include:

- Steel pipe culverts may not require ground freezing or other stabilization due to the relative thinness of the wall compared to that of a concrete culvert. Additional review is required to make an official determination of requirements for ground stabilization.
- Steel pipe could be imported to the site in short sections about 10 feet long and welded together as the tunnel is jacked under the tracks.
    - Short pipe sections would increase feasibility of the park entrance road for material delivery. The shorter pipe sections could potentially be "jacked" through the embankment in the shorter work windows potentially available along this stretch of track.
    - The bore pit excavation to jack the culvert would not be as extensive as the pit required for a concrete culvert

- The limited depth of cover available for a culvert may eliminate steel as an option due to the direct load path of train traffic on the culvert. This limitation will be evaluated early in the design process.
  - Internal reinforcement could provide a remedy but would likely restrict the interior height of the tunnel and eliminate pedestrian access.
  - As with the concrete culvert, additional geotechnical evaluation would need to be conducted to ensure that the depth of cover is adequate to support the "jacking" process without displacing the tracks above.
- Steel pipe would likely not be available large than 12 feet in diameter due to material cost and transportation considerations and therefore up to three culverts (at minimum) would be required to accommodate streamflow and pedestrian access.
- Potential costs are under analysis but it is possible that a series of steel pipe culverts may be the least expensive alternative with the shortest construction duration.
- The construction duration for steel pipe culverts is under review but may prove to be shortest of the design alternatives.

Pedestrian Overpass with Elevator or ADA Ramps

The pedestrian overpass partially accomplishes the project's goals in that it will secure safe access for park users but does not address flooding or habitat goals established for the project. Considerations affecting any overpass option work include:

- At this time, the proposed overpass concepts represent BNSF required vertical and horizontal offsets from the existing tracks. It is possible that BNSF could ask the County to expand the overpass length span the entire BNSF Right of Way (ROW). This would increase the cost of the structure; this potential increase in cost will be presented in the report addendum.
- Work to construct the overpass occurring within 25 feet of the track (or when elements of the work such as an excavator or a crane have the potential to swing into the tracks) will require BNSF Flagman when trains transit the site.
  - Construction duration/schedule may still be significantly impacted if rail traffic is continuous.
  - Certain activities such as setting the overpass bridge deck will likely require extended work windows of several hours or more. The duration of time required will be influenced by the final design and contractor's methods.

- Overpass options can likely be constructed with access by any of the options discussed in #1 above, although the park entrance road will be required for bringing in bulk materials needed for constructing support infrastructure such as a temporary rail offload platform.
    - Construction of an overpass will require a crane and other large construction equipment be mobilized including excavators, dump trucks and concrete trucks.
        - The crane in particular may require rail or marine delivery but this will be dictated by the overpass design selected.
    - Depending on the design selected, the overpass bridge deck size may exceed the capacity of the road necessitating rail or marine delivery.
        - This can be avoided if the deck is a modular design which can be assembled on site.
- The railroad is highly unlikely to require a shoe-fly for this work as both tracks will remain operational at all times.

Overpass with ADA Ramps versus an Elevator

The design of any pedestrian overpass must comply with the American's with Disabilities Act (ADA). Achieving ADA compliance requires either an elevator or switchback ramps (with not more than a 5% slope). Considerations for these alternatives include:

- A structure with ramps will likely be less expensive than one with an elevator.
- Required rail clearances dictate the overpass be at a height which requires approximately 800 LF of ramps to provide beach access.
    - Park patrons who use ADA features may be deterred by such a distance.
- The total overpass structure with ramps will be over 100 LF wide parallel to the train tracks and 45 feet tall, which will substantially alter the view from the park's picnic area.
- Inclusion of an elevator in the overpass will eliminate the long ramps and reduce the view obstruction although such improvements will likely include a substantial cost increase.
- Aside from the cost of an elevator system, inclusion of the elevator requires foundational and structural elements be designed to commercial building standards.

- The maintenance costs of the elevator over may be a significant factor in the lifetime cost of the structure.
    - At a minimum, the elevator and surrounding structure will be subjected to salt water spray.

APPENDIX B
PRELIMINARY GEOTECHNICAL ASSESSMENT ADDENDUM

(Developed by Shannon & Wilson)

Meadowdale Beach Park
Feasibility Study
Preliminary Geotechnical Assessment Addendum
South Snohomish County, Washington

February 3, 2016

SHANNON & WILSON, INC.

GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

Excellence. Innovation. Service. Value.

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February 3, 2016

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Attn: Ms. Kathy Ketteridge

RE: MEADOWDALE BEACH PARK FEASIBILITY STUDY, PRELIMINARY GEOTECHNICAL ASSESSMENT ADDENDUM, SOUTH SNOHOMISH COUNTY, WASHINGTON

This letter presents an addendum to our previous feasibility study dated January 23, 2015, for the Meadowdale Beach Park Feasibility Study. Project and general geologic descriptions are presented in the previous study. The purpose of this addendum is to provide preliminary geotechnical assessments of the park maintenance access road for construction access purposes, foundations for a pedestrian overpass option, and a BNSF Railway Company (BNSF) embankment tunneling option.

We understand that the assessments and engineer's estimates provided in this report will be incorporated into an evaluation to be conducted by Anchor QEA (Anchor). We understand that Anchor will perform the evaluation of the amount of contingencies to carry for all aspects of the project. The estimates provided in this report DO NOT include contingency cost that would cover uncertainties and risks associated with, but not limited to, construction coordination and approval by BNSF, unanticipated subsurface conditions, permitting, and design objectives. In addition, the estimates do not include the portals, tunnel architectural liner, railroad flagman, special environmental permits, lighting (if needed), paved inverts or formed concrete walkways along the wall of the tunnel, control of the existing stream, silt fences, and other means for fish protection, etc.

EXISTING PARK ACCESS ROAD ASSESSMENT

In the initial assessments of project costs by Anchor, the project team determined that construction access either completely by rail or by water would add significant costs to the project. For this reason, Anchor requested that Shannon & Wilson, Inc. (Shannon & Wilson) evaluate the use of the existing southern park access road for construction access. Based on discussions with Anchor and general contractor Bob Hirte representing Hamilton Construction, the access road would need to support numerous trips by large vehicles such as dump trucks, concrete trucks, and flatbed trucks. In addition, occasional oversized loads such as tracked vehicles weighing upwards of 65 tons would need to be accommodated. Our preliminary assessment consisted of a review of historical documents provided to us by Anchor, a site reconnaissance conducted by Shannon & Wilson, and our experience with similar projects in the region.

Review of Historical Documents

Historical documents pertaining to past assessments of the access road stability were provided to Shannon & Wilson by Anchor. A summary of those documents is provided below.

Report of Roadway Evaluation Meadowdale Park Service Road, Snohomish County, Washington, Dames & Moore, August 8, 1972

This study consisted of a geologic reconnaissance along the existing access road, backhoe excavated test pits, evaluation of the overall stability of the road, and recommendations for further use. The study was prompted by severe road damage and partial burial of the road by landslides occurring before 1969. The following notes are taken from the study:

- The existing road was constructed by side hill cut-and-fill methods that result in steeper slope angles above and below the road.
- The site reconnaissance detected five separate landslides affecting the road.
- Recommendations were made to improve drainage, promote vegetation on the slopes, flatten some slopes, and provide buttressing in some landslide areas.

It is unknown from the records provided to us as to what extent, if any, these recommendations were acted upon.

Embankment Repair Recommendations, Meadowdale Park Road, Snohomish County, July 28, 2008

This study consisted of a subsurface investigation and geotechnical analysis related to a segment of road damaged by a landslide during a storm event in December 2007. Hand-augered boreholes were conducted to investigate the landslide area. Recommendations were made to replace an existing slurry/ecology block wall with a mechanically stabilized earth (MSE) wall. The design called for an excavation deep below the road that would be rebuilt with geogrid and compacted fill to improve the local stability of the roadway. We observed this structure during our reconnaissance, but have not confirmed whether or not it was constructed as shown in the design sketch.

Site Reconnaissance

On December 23, 2015, William Laprade (engineering geologist) and Matthew Gibson (geotechnical engineer) performed a site reconnaissance of the existing park access road. The reconnaissance consisted of walking along the road from the American with Disabilities Act (ADA) parking area to the entrance gate and making visual observations of the hill slopes and existing retaining structures. The park ranger indicated that landslides above and below the road are not uncommon. Photographs and notes taken during the site reconnaissance are shown on a Light Detection and Ranging map of the road (Figure 3) and summarized below:

Location 1 - Outboard road instability (Figure 4): Approximately 30 feet of pavement distress were observed near the entrance to the maintenance park road. The distress was located on the downslope side of the road. Repeated loading by heavy vehicles such as construction equipment could cause further deterioration of the pavement.

Location 2 - Overhanging trees (Figure 5): Overhanging trees such as shown in Figure 5 were observed on the slopes above the road. These trees pose risk to passing vehicles and to the stability of the slope if they were to fall. When a tree falls on a slope, the root wad is dislodged from the slope creating a large cavity. This cavity itself becomes unstable and promotes further erosion of the slope. This is a naturally occurring process throughout the slopes in Lund’s Gulch.

Location 3 - Existing wood soldier pile and lagging wall (Figure 6): The construction details of the wood soldier pile and lagging wall are unknown. Relatively small settlement (less than an inch) of the pavement and shoulder was observed behind the wall. This settlement may be associated with deflection of the wall after it was built or observed spacing between some lagging boards that would allow for soil loss behind the wall. Based on visual observations, the wall appears to be performing satisfactory under current vehicle loading conditions.

Location 4 - Guard rail rotated downslope (Figure 7): A portion of the guard rail has experienced back rotation down slope. The rotation is likely associated with incremental/ periodic deformation of the slope. This deformation could be an indicator of larger future slope deformation or landsliding.

Location 5 - Existing MSE slope (Figure 8): The geogrid and gravel backfill of the existing MSE slope was observed. Substantial vegetation has grown up and around the reinforcement. Based on visual observations, the MSE slope appears to be performing satisfactory under current vehicle loading conditions.

Location 6 - Colluvium and landslide scarp evidence from previous landslides: Evidence of previous landslides was observed from a vantage point near the existing residence. This evidence was in the form of a landslide scarp up the slope near the roadway and colluvium that had collected on the lower half of the slope. Similar scarps and colluvium have been observed throughout Lund's Gulch.

Location 7 - Source areas for previous landslides: This location identifies source areas for likely previous landslides that have occurred.

Location 8 - Groundwater spring on uphill side of road (Figure 9): Groundwater was observed seeping out of a gravelly stratum in the slope. It is likely that more springs similar to the one observed exist all along the road. The groundwater flow is likely to increase during and after periods of rain and decrease during dry weather periods.

Park Road Conclusions and Recommendations

Based on the observations of the site reconnaissance and for planning purposes, we make the following preliminary conclusions and recommendations for use of the park road as construction access:

- Trees that are leaning over the roadway should be cut approximately 2 feet above the ground, leaving the stump and root structure to reduce the risk of tree fall induced erosion of the slope.
- If the park road is used for construction access with large vehicles (not ordinarily highway legal) then subgrade improvements should be implemented near Locations 1, 3, and 4 and any other road areas showing pavement distress or ground

movement. In addition, weight restrictions may be required during periods of heavy rain.

- Details of subgrade improvements will require geotechnical investigation and design by a professional engineer. We anticipate that this improvement could likely consist of about 2 feet of overexcavation followed by a build back of the road subgrade with geogrid reinforced, compacted fill. Additional subsurface explorations and engineering analyses are required for final design, which, depending on the subsurface conditions encountered, could result in more substantial improvements being required.
- We estimate that construction costs associated with subgrade improvements (2 feet of overexcavation plus build back for the areas shown in Figure 3) to be in the range of $100,000 to $200,000.

PEDESTRIAN OVERPASS OPTION

We understand that the pedestrian overpass options consist either of a short structure with an elevator (Alternative 1) or relatively long structure supporting an ADA ramp (Alternative 2. Geotechnical explorations suitable for foundation design are not available for this site. For planning purposes, we make the following assumptions and estimates:

- It is assumed that the near-surface soils are not suitable for shallow foundations and that the structure will require support by pile foundations.
- Based on our experience design similar structures in the Puget Sound, we estimate that 18- or 24-inch pipe pile foundations on the order of 120 feet long would be suitable for the pedestrian overpass structure. These piles would have geotechnical capacity on the order of 200 to 400 kips allowable.
- For Alternative 1, we assumed that the beach-side and park-side structure could be supported by a total of approximately 16 piles.
- For Alternative 2, we assumed that the beach-side and park-side structure could be supported by a total of approximately 24 piles.
- Based on an estimated installation cost of $85 per foot of pile length, we estimate the costs of Alternatives 1 and 2 to be approximately $165,000 and $330,000, respectively.

BNSF RAILWAY COMPANY (BNSF) EMBANKMENT TUNNEL OPTIONS

Given the costs and uncertainty associated with constructing a bridge on an active mainline railroad tracks, we have evaluated several embankment tunneling alternatives. The multi-use tunnels would be used to convey the Lund's Gulch Creek and/or pedestrian traffic beneath the railway. The options evaluated are typically capable of excavating 10- to 15-foot-diameter tunnels. These alternatives are discussed below.

Option 1 - Jacking of a precast rectangular tunnel section.

This option has been used for constructing culverts for stream passages, pedestrian paths and even for two-lane or larger underpass tunnels beneath active railroad tracks. Jacked precast rectangular sections have been utilized on several other projects around the world, and most recently on the "Mousehole" multiple use pedestrian path (MUP) tunnel project beneath the Union Pacific Railroad (UPRR) mainline. This section of the mainline passes through Truckee, California, on the way to Donner Pass and the California Central Valley. The Truckee MUP Tunnel is a 120-foot-long, 15-foot-wide by 16-foot-high rectangular, reinforced concrete section that was cast on site adjacent to the tunnel portal and railroad embankment, as shown in Figure 10.

Generally, these methods require the embankment soil to be stabilized to minimize settlements. Soil stabilization is discussed in a subsequent section. Once the soil is suitably stabilized, the pre-cast rectangular pipe is jacked forward through the embankment. If ground freezing is used to stabilize granular soils, then the lubricant must have a low enough freezing point to allow the pipe to move easily forward through the frozen ground without seizing up. During the jacking process, the embankment soils are removed from inside the pipe with a small excavator. The leading edge of the cast box section is fitted with a heavily reinforced steel cutting shield with the leading edge or face canted forward by about 30 degrees from vertical. This shield provides a protective hood over the workers, as well as helping to stabilize the cut soil surface, near its angle of repose. In the event that unfrozen running soils are encountered, then the face can also be supported with timber or steel lagging, braced off brackets inside the shield, and steel "sand shelves" fitted into the leading edge of the shield to help support any unfrozen granular soils. After the rectangular pipe has been cast on site and the soil freeze is considered complete, then the pipe is incrementally thrust forward, reaching the exit portal. For the Truckee MUP tunnel project, the ground took about one month to freeze, and the jacking process took place over a period of about a week (seven days). Obstructions, such as boulders and the remnants of a timber trestle, temporarily stopped forward advance of the precast section, while obstructions were cut up and removed from the frozen ground. However, the stable nature of the frozen soils generally precludes excessive ground losses and surface settlements during obstruction removal. Gaps excavated around the advancing pipe are typically backfilled with grout once the pipe reaches the target portal. Settlement of the overlying track for the MUP project was less than 0.1 inch.

Sufficient room would be required to either side of the embankment to accommodate casting and jacking the full length rectangular box section. Reaction for the jacking process could consist of battered piles driven into the subgrade or a temporary embankment of soil to provide passive resistance for the jacking system. Jacking of a 15-foot-wide by 16-foot-high opening would require 2 to 4 tons of thrust per foot of tunnel or about 200 to over 400 tons of total thrust. A specialized non-freezing lubricant should be used to fully coat the box section to prevent the frozen ground from prematurely adhering to the concrete box and freezing it prematurely in place as it is advanced through the embankment.

Based on recent construction costs for the Truckee MUP Tunnel project, the cost of just casting and jacking a 15-foot-square precast box section would be on the order of about $19,000 per foot of alignment. This price does not include the cost of embankment soil stabilization, which is covered in a subsequent section. For the Truckee MUP Tunnel project, the casting, jacking, and ground freezing totaled about $3,000,000.

Option 2 - Jacking of welded steel pipe or flush bell and spigot precast concrete pipe sections in 8- to 10-foot lengths.

This method is similar to Option 1 except the jacked box is replaced with a large-diameter steel or concrete pipe, which is more commonly used for constructing culverts or pathways beneath railroads and highways. Steel pipe has been used in jacking large-diameter initial casing pipes for numerous sewers and water mains, and generally has good longevity in soil and non-saline groundwater, but would be susceptible to long-term corrosion in salt water. We have participated in the design and construction of several large-diameter precast concrete and steel pipe-supported pedestrian paths and utilidors beneath active railroads.

Generally, these methods require the embankment soil to be stabilized to minimize settlements. Soil stabilization is discussed in a subsequent section. Once the soil is suitably stabilized, the pre-cast pipe is jacked forward through the embankment. The leading edge of the initial concrete or steel pipe section is generally fitted with a heavily reinforced cutting shoe or shield, as discussed for Option 1, and the pipe string is jacked forward in 8- to 10-foot increments. For each jacking increment, the next pipe section is lined up, and usually welded in the case of steel, or brought together with an O-ring gasket in the case of precast concrete pipe. Any gap around the outside of the pipe is typically filled with thick, viscous bentonite mud to provide lubrication for advancing the pipe and also to fill the typically 0.5- to 1-inch overcut annular gap around the pipe.

The diameter and length of individual pipe sections is a function of availability from a supplier and the ability to transport the pipe, typically on flat-bed trucks from the manufacturer to the construction site on public roads with overpass and lane width limitations. This jack and bore method has the advantage over Option 1 of requiring a smaller, more compact, pipe assembly and launching/jacking pit area.

Jack and bore tunneling with more conventional and readily available steel or concrete pipe sections typically cost between $500 and $900 per diameter foot per foot of pipe length, or about $6,000 to $11,000 per foot of 12-foot-diameter pipe.

Option 3 – Excavation of a full face opening in 2-foot intervals with rapid installation of a bolted and gasketed steel pan liner beneath a grouted "pipe canopy" or "pipe arch."

This tunneling method involves the excavation and support of 18 to 24 inches of tunnel length, followed immediately by the installation of 16- to 24-inch-wide rings of gasketed, bolted, rectangular liner plates reinforced with steel ribs, as shown in Figure 11. Due to the tendency of the dry granular soils to ravel and flow when disturbed by train traffic and construction activity, the arch and sidewalls of the tunnel would likely be pre-supported with a grouted pipe arch or possibly by freezing. A pipe arch would consist of 4- to 6-inch-diameter perforated steel pipes, installed at 12- to 18-inch intervals around the tunnel perimeter for the full length of the tunnel, and pressure grouted prior to tunnel excavation.

If the embankment soils are granular, then the excavated arch and face of the advancing tunnel will also tend to ravel and flow when disturbed and, consequently, these soils should be penetration-grouted to maintain their stability. Grout that has penetrated the granular soils during pressure grouting of the perforated "pipe arch" would assist in stabilizing the face In granular soils, some additional stabilization of face soils, using localized drilled-in perforated pipes used for grout injection may also be required to minimize ground losses and settlements.

If the embankment soils are clayey, then the face and any annular gap around the pipe may have sufficient standup time to allow the steel liner plate to be installed incrementally and backfilled with grout while requiring minimal face support.

A recent Shannon & Wilson project in Bremerton, Washington, involved the drilling of pipes for a grouted pipe arch over a planned tunnel length of 260 feet. The pipe arch consisted of twenty-five, 6-inch-diameter pipes drilled horizontally from portal to portal around the perimeter of the planned tunnel. The soils around each pipe were pressure-grouted through perforations in the pipes.

Based on our experience, the cost of this method would be of the same order of magnitude as Option 1.

Pre-stabilization of Granular Embankment Soils

Although no borings have been drilled to sample the embankment soils at Meadowdale Park, it is possible that that the embankment soils are either granular, cohesive or some combination of both. It is also possible cobbles and boulders have been used in constructing the embankment and that a wood trestle was constructed prior to placement of the embankment. If the embankment soils are granular rather than clayey, then some form of ground stabilization such as freezing, or possibly grouting will be required to prevent excessive ground losses around, ahead of, and above the advancing tunnels.

Pre-stabilization of the dry, cohesionless granular soils will be an essential aspect of tunnel construction. Three ground improvement techniques may be applicable, based on our assumptions regarding the presence of granular soils in the embankment: ground freezing, permeation grouting, and grouted pipe arch.

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Ground Freezing

Ground freezing has been used successfully on many projects to create a stable 3- to 5-foot-thick arch of frozen ground. If the embankment is dry, water would have to be introduced either with a sprinkler system or perforated pipes embedded in the embankment or during drilling of the individual freeze pipes. Infiltration of the introduced water could be spotty if variable silt and clay contents are encountered that would result in variable soil permeability. Tunneling should not begin until it is verified with several horizontal monitoring pipes containing thermocouples that the ground is frozen. A freezing plant would need to be operated and maintained during the tunneling operation and until the tunnel is fully excavated and lined. Typical schedules for ground freezing are on the order of several months.

If the groundwater in the embankment is revealed by the explorations to be chemically contaminated or contain salt water, then rather than a salt brine coolant it may be necessary to use a liquid nitrogen coolant that has a low enough temperature to enable the freezing of salt water. Drilling explorations of the embankment and foundation soils may indicate if these soils are relatively clean (with less than 10 to 15 percent fine grained soil such as silt and clay), which would also make these soils groutable with either cementitious grout or chemical grout.

For example, for the recent Truckee MUP Tunnel, the UPRR embankment consisted of bouldery fill soils. The granular soils in the UPRR embankment were dry, clean to silty sands and gravels located well above the groundwater table. Consequently, to enable freezing to work, water was introduced into the embankment during the drilling of the two dozen freeze pipes installed horizontally through the embankment. The embankment soils were frozen to create a strong cohesive mass that would not flow or ravel into the advancing tunnel section, thus greatly reducing the potential for excessive ground loss and resulting track settlement. The embankment was frozen over a two month period using cooled brine circulated through the freeze pipes.

Grouting

If the soils are clean (less than 15 percent silt and/or clay content), then grouting may be an alternative solution for stabilizing the embankment soils. Grouting has also been used successfully to penetrate or permeate clean sands and gravels to create a 3- to 5-foot-thick arch of stabilized soil, as well as stabilize the excavation heading. However, successful permeation grouting requires that the soils be highly permeable, with less than 15 percent silt and clay. If the fill soils at the project site are variable (with silt contents of 15 percent or greater), the continuity and thickness of a grouted arch in these soils would be less reliable. Explorations will be needed to determine the grain size distributions of the embankment soils at several locations in order to assess whether permeation grouting is likely to be effective. Also, environmental restrictions on grout movement into streams or the tidal zone, could make grouting impractical in a park setting with environmentally sensitive areas.

Grouted Pipe Arch

A grouted pipe arch or pipe canopy has proven effective on several projects in clean to clayey soils. The grouted steel pipe arch generally consists of 4- to 6-inch-diameter steel pipes drilled horizontally through the embankment around the upper two-thirds of the proposed tunnels, on a spacing of 12 to 18 inches. The cased drilling method is capable of drilling through boulders and timber obstructions, as demonstrated by the drilling of the cased horizontal exploratory borings and freeze pipes on the Truckee MUP Project, without losing ground or causing settlement of the overlying track. Grout would be injected into the ground through perforations spaced 6 to 12 inches along the pipes. Injection points would be isolated between pairs of movable, inflatable packers spaced 5 to 10 feet apart that are incrementally pushed through and grouted along the length of each of the pipes. Grout would be injected under controlled pressure and volume constraints to minimize grouting of the railroad ballast or other areas outside of the desired grout envelope. Under high pressure, the chemical (likely to be sodium silicate or polyurethane) grouts will fracture and penetrate even silty or clayey soils to densify and solidify the ground around the pipes. The steel pipes and grout will result in a canopy of reinforced ground capable of supporting soil and rail loads over excavated spans of 3 to 6 feet.

Without field exploration data, we are uncertain as to whether freezing, permeation grouting or a grouted pipe arch is the best method for supporting the embankment soils. In clean granular soils, the grouted pipe arch would provide an effective means for stabilizing the soils while dealing with obstructions such as boulders and timber trestle. However, in silty or clayey soils, the grout injected through the perforations is unlikely to penetrate more than a couple of inches and consequently the pipe arch might notes unlikely to effectively pre-stabilize and pre-support the ground ahead of the advancing jacked pipe.

Stabilization Costs

Ground freezing for a 90- to 120-foot-long, 10- to 12-foot-diameter pipe would likely cost on the order of $500,000 to $700,000. For planning purpose, this cost should be carried for the other stabilization methods.

Dewatering

The pipe jacking launching and receiving pits will require 7- to 10-foot deep excavations that would extend below the creek level, which is likely representative of the groundwater level near the embankment. Dewatering in granular soils could be accomplished with dewatering wells at each pit location capable of pumping large quantities of water. If the subsurface soils are cohesive, then a vacuum/well point system will likely be required. Since clayey soils have lower permeability, well points are required to be closely spaced to cut-off groundwater flow even though groundwater flow volumes are less. Dewatering may also cause consolidation of the soils and settlement of the embankment. We would expect the settlement to occur over a broader area than tunneling operations and thus would carry less risk to impacting train operations. However, leveling of the tracks would still need to be performed periodically. Based on our experience, dewatering costs could be on the order of $250,000 to $500,000.

CLOSURE

The preliminary conclusions and recommendations in this letter report are based on a visual examination of the surface conditions as they existed during the time of our field reconnaissance and review of historical documents. No subsurface explorations were performed for this study. The road stability assessment has been performed using practices consistent with geologic and geotechnical industry standards in the region for geotechnical engineering; however, prediction of slope movement with absolute certainty is not possible with the currently limited available information on ground conditions. As with any steep slope, there are always risks of instability that present and future owners must accept. Such risks include poor road construction and maintenance, extreme or unusual storm events, and forest fire, among others. If conditions described in this letter report change, we should be advised immediately so that we can review those conditions and reconsider our conclusions and recommendations. The pedestrian overpass and tunnel assessments have been performed using practices consistent with the geotechnical industry standards in the region; however, subsurface explorations required for final design may require changes to some or all of the conclusions and recommendations presented in this assessment.

Recommendations included in this letter report are presented to assist Anchor and Snohomish County in the planning of the road. Shannon & Wilson has included the enclosed "Important Information About Your Geotechnical/ Environmental Report" to assist you and others in understanding the use and limitations of our reports.

We appreciate the opportunity to be of service. If you have any questions or comments, please contact me.

Sincerely,

SHANNON & WILSON, INC.

Matthew D. Gibson, Ph.D., P.E.
Senior Engineer

William T. Laprade, L.E.G.
Senior Vice President

Robert A. (Red) Robinson, L.E.G., L.G.
Senior Vice President

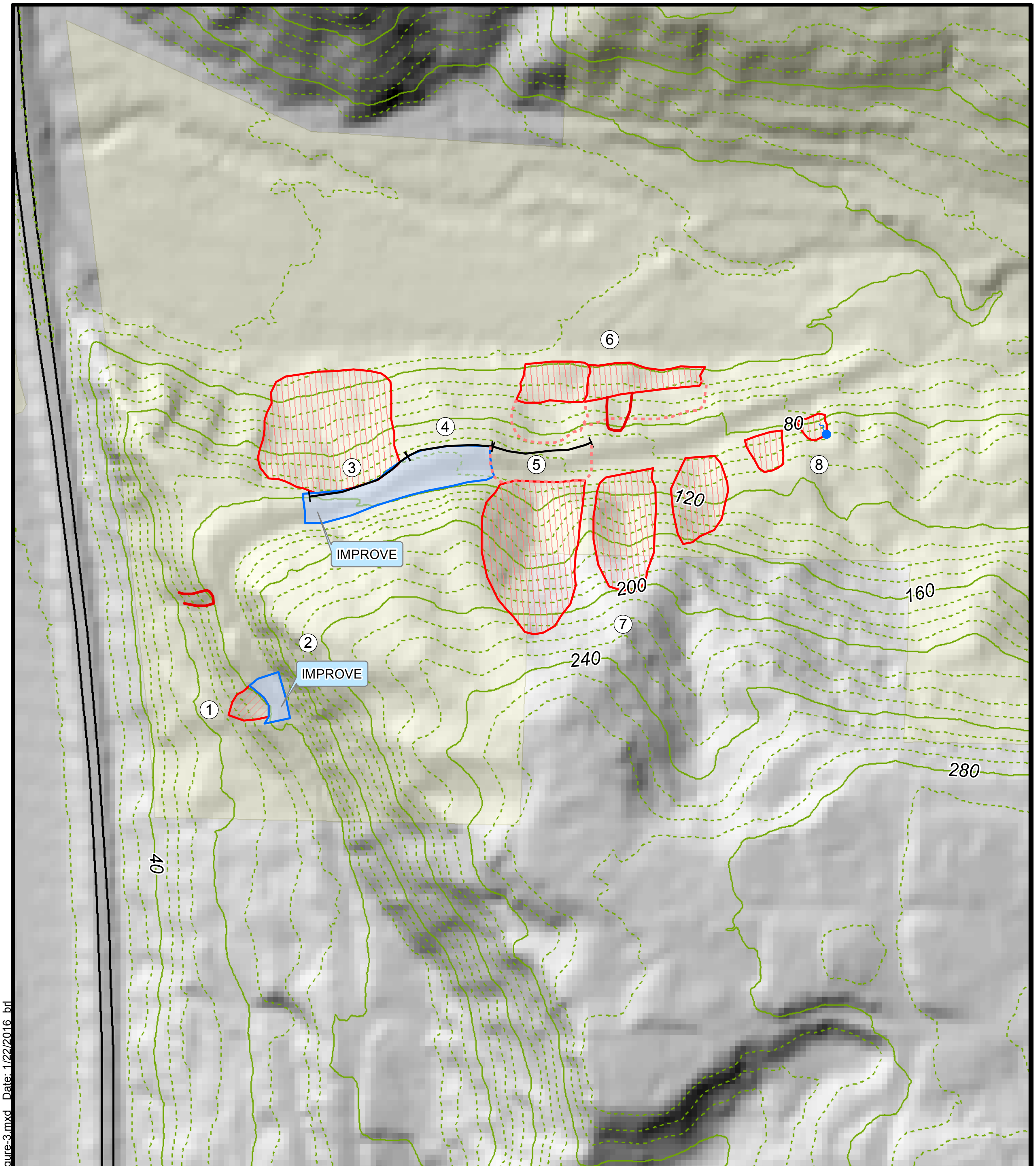
MDG:NDM:WTL:RAR/mdg

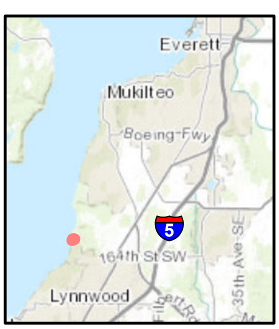
Access road assessment was prepared under the direct supervision of Matthew D. Gibson, Ph.D., P.E., and William T. Laprade, L.E.G.
Pedestrian bridge overpass and dewatering for the railroad embankment tunnels launch and receiving pits were prepared under the direct supervision of Matthew D. Gibson, Ph.D., P.E.
Railroad embankment tunnel information was prepared under the direct supervision of Robert A. (Red) Robinson, L.E.G., L.G.

SHANNON & WILSON, INC.

Enc: Figure 3 – Site and Reconnaissance Plan
Figure 4 – Location 1 Pavement Distress
Figure 5 – Location 2 Overhanging Tree
Figure 6 – Location 3 Existing Soldier Pile Wall
Figure 7 – Location 4 Rotated Guard Rail
Figure 8 – Location 5 Existing MSE Slope
Figure 9 –Location 8 Upslope Spring
Figure 10 – Tunnel Option 1 Example, Jacked Precast Square Concrete Segment
Figure 11 – Tunnel Option 3 Example, Rapid Open Face Excavation With Pipe Canopy

Important Information About Your Geotechnical/Environmental Report





Legend

- Landslide Evidence
- Possible Improvements
- (1) Observation Index

N W E S

0 150

Feet

Meadowdale Beach Park Feasibility Study
Geotechnical Assessment and Addendum
Snohomish County, Washington

SITE AND RECONNAISSANCE PLAN

January 2016 21-1-22034-001

SHANNON & WILSON, INC.
GEOTECHNICAL AND ENVIRONMENTAL CONSULTANTS

FIG. 3

Filename: T:\21-1\22034_MeadowdaleAV_mxd\Figure-3.mxd Date: 1/22/2016 brl

Note:
1. Photograph taken by Matthew Gibson or William Laprade during a site reconnaissance on December 23, 2015.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

LOCATION 1
PAVEMENT DISTRESS

January 2016 | 21-1-22034-001

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FIG. 4

Note:
1. Photograph taken by Matthew Gibson or William Laprade during a site reconnaissance on December 23, 2015.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

LOCATION 2
OVERHANGING TREE

January 2016 21-1-22034-001

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FIG. 5

Note:
1. Photograph taken by Matthew Gibson or William Laprade during a site reconnaissance on December 23, 2015.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

LOCATION 3
EXISTING SOLDIER PILE WALL

January 2016 | 21-1-22034-001

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FIG. 6

Note:
1. Photograph taken by Matthew Gibson or William Laprade during a site reconnaissance on December 23, 2015.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

LOCATION 4
ROTATED GUARD RAIL

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FIG. 7

Note:
1. Photograph taken by Matthew Gibson or William Laprade during a site reconnaissance on December 23, 2015.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

LOCATION 5
EXISTING MSE SLOPE

January 2016 | 21-1-22034-001

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FIG. 8

Note:
1. Photograph taken by Matthew Gibson or William Laprade during a site reconnaissance on December 23, 2015.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

LOCATION 8
UPSLOPE SPRING

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FIG. 9

Note:
1. Jacking of a 15-foot-wide by 16-foot-high by 120-foot-long precast square pipe through frozen soils beneath the mainline double-track UPRR alignment at Truckee, California.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

TUNNEL OPTION 1 EXAMPLE JACKED PRECAST SQUARE CONCRETE SEGMENT

January 2016 21-1-22034-001

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FIG. 10

Notes:
1. Top Photo: Steel rib reinforced, gasketed, bolted flanged steel plates in a 20-foot wide tunnel through silty to clayey granular railroad embankment fill.
2. Bottom Photo: Installation of bolted, flanged steel liner plates beneath a grouted pipe-arch canopy.

Meadowdale Beach Park Feasibility Study
Geotechnical Assesment Addendum
Snohomish County, Washington

TUNNEL OPTION 3 EXAMPLE RAPID OPEN FACE EXCAVATION WITH PIPE CANOPY

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FIG. 11

SHANNON & WILSON, INC.
Geotechnical and Environmental Consultants

Attachment to and part of Report 21-1-22034-001

Date: February 3, 2016
To: Anchor QEA, LLC
Attn: Ms. Kathy Ketteridge

IMPORTANT INFORMATION ABOUT YOUR GEOTECHNICAL/ENVIRONMENTAL REPORT

CONSULTING SERVICES ARE PERFORMED FOR SPECIFIC PURPOSES AND FOR SPECIFIC CLIENTS.

Consultants prepare reports to meet the specific needs of specific individuals. A report prepared for a civil engineer may not be adequate for a construction contractor or even another civil engineer. Unless indicated otherwise, your consultant prepared your report expressly for you and expressly for the purposes you indicated. No one other than you should apply this report for its intended purpose without first conferring with the consultant. No party should apply this report for any purpose other than that originally contemplated without first conferring with the consultant.

THE CONSULTANT'S REPORT IS BASED ON PROJECT-SPECIFIC FACTORS.

A geotechnical/environmental report is based on a subsurface exploration plan designed to consider a unique set of project-specific factors. Depending on the project, these may include: the general nature of the structure and property involved; its size and configuration; its historical use and practice; the location of the structure on the site and its orientation; other improvements such as access roads, parking lots, and underground utilities; and the additional risk created by scope-of-service limitations imposed by the client. To help avoid costly problems, ask the consultant to evaluate how any factors that change subsequent to the date of the report may affect the recommendations. Unless your consultant indicates otherwise, your report should not be used: (1) when the nature of the proposed project is changed (for example, if an office building will be erected instead of a parking garage, or if a refrigerated warehouse will be built instead of an unrefrigerated one, or chemicals are discovered on or near the site); (2) when the size, elevation, or configuration of the proposed project is altered; (3) when the location or orientation of the proposed project is modified; (4) when there is a change of ownership; or (5) for application to an adjacent site. Consultants cannot accept responsibility for problems that may occur if they are not consulted after factors which were considered in the development of the report have changed.

SUBSURFACE CONDITIONS CAN CHANGE.

Subsurface conditions may be affected as a result of natural processes or human activity. Because a geotechnical/environmental report is based on conditions that existed at the time of subsurface exploration, construction decisions should not be based on a report whose adequacy may have been affected by time. Ask the consultant to advise if additional tests are desirable before construction starts; for example, groundwater conditions commonly vary seasonally.

Construction operations at or adjacent to the site and natural events such as floods, earthquakes, or groundwater fluctuations may also affect subsurface conditions and, thus, the continuing adequacy of a geotechnical/environmental report. The consultant should be kept apprised of any such events, and should be consulted to determine if additional tests are necessary.

MOST RECOMMENDATIONS ARE PROFESSIONAL JUDGMENTS.

Site exploration and testing identifies actual surface and subsurface conditions only at those points where samples are taken. The data were extrapolated by your consultant, who then applied judgment to render an opinion about overall subsurface conditions. The actual interface between materials may be far more gradual or abrupt than your report indicates. Actual conditions in areas not sampled may differ from those predicted in your report. While nothing can be done to prevent such situations, you and your consultant can work together to help reduce their impacts. Retaining your consultant to observe subsurface construction operations can be particularly beneficial in this respect.

A REPORT'S CONCLUSIONS ARE PRELIMINARY.

The conclusions contained in your consultant's report are preliminary because they must be based on the assumption that conditions revealed through selective exploratory sampling are indicative of actual conditions throughout a site. Actual subsurface conditions can be discerned only during earthwork; therefore, you should retain your consultant to observe actual conditions and to provide conclusions. Only the consultant who prepared the report is fully familiar with the background information needed to determine whether or not the report's recommendations based on those conclusions are valid and whether or not the contractor is abiding by applicable recommendations. The consultant who developed your report cannot assume responsibility or liability for the adequacy of the report's recommendations if another party is retained to observe construction.

THE CONSULTANT'S REPORT IS SUBJECT TO MISINTERPRETATION.

Costly problems can occur when other design professionals develop their plans based on misinterpretation of a geotechnical/environmental report. To help avoid these problems, the consultant should be retained to work with other project design professionals to explain relevant geotechnical, geological, hydrogeological, and environmental findings, and to review the adequacy of their plans and specifications relative to these issues.

BORING LOGS AND/OR MONITORING WELL DATA SHOULD NOT BE SEPARATED FROM THE REPORT.

Final boring logs developed by the consultant are based upon interpretation of field logs (assembled by site personnel), field test results, and laboratory and/or office evaluation of field samples and data. Only final boring logs and data are customarily included in geotechnical/environmental reports. These final logs should not, under any circumstances, be redrawn for inclusion in architectural or other design drawings, because drafters may commit errors or omissions in the transfer process.

To reduce the likelihood of boring log or monitoring well misinterpretation, contractors should be given ready access to the complete geotechnical engineering/environmental report prepared or authorized for their use. If access is provided only to the report prepared for you, you should advise contractors of the report's limitations, assuming that a contractor was not one of the specific persons for whom the report was prepared, and that developing construction cost estimates was not one of the specific purposes for which it was prepared. While a contractor may gain important knowledge from a report prepared for another party, the contractor should discuss the report with your consultant and perform the additional or alternative work believed necessary to obtain the data specifically appropriate for construction cost estimating purposes. Some clients hold the mistaken impression that simply disclaiming responsibility for the accuracy of subsurface information always insulates them from attendant liability. Providing the best available information to contractors helps prevent costly construction problems and the adversarial attitudes that aggravate them to a disproportionate scale.

READ RESPONSIBILITY CLAUSES CLOSELY.

Because geotechnical/environmental engineering is based extensively on judgment and opinion, it is far less exact than other design disciplines. This situation has resulted in wholly unwarranted claims being lodged against consultants. To help prevent this problem, consultants have developed a number of clauses for use in their contracts, reports, and other documents. These responsibility clauses are not exculpatory clauses designed to transfer the consultant's liabilities to other parties; rather, they are definitive clauses that identify where the consultant's responsibilities begin and end. Their use helps all parties involved recognize their individual responsibilities and take appropriate action. Some of these definitive clauses are likely to appear in your report, and you are encouraged to read them closely. Your consultant will be pleased to give full and frank answers to your questions.

The preceding paragraphs are based on information provided by the
ASFE/Association of Engineering Firms Practicing in the Geosciences, Silver Spring, Maryland

APPENDIX C
CONCEPTUAL OPINIONS OF PROBABLE CONSTRUCTION COST

Conceptual Cost Estimate for Construction Alternative Preferred Alt. - 4 span

Conceptual Opinion of Probable Construction Cost - Meadowdale Restoration Project				
Total Estimate				
Item	**Qty**	**Unit**	**Unit Cost**	**Subtotal**
1. Temporary Facilities				
a. Temp. const. fencing	250	LF	$8.00	$ 2,000
b. Tree protection fencing	1,210	LF	$8.00	$ 9,680
c. Upland silt fencing	220	LF	$7.00	$ 1,540
d. Stream diversion and pumping	1	LS	$50,000.00	$ 50,000
e. Railroad flagger	100	DAY	$1,000.00	$ 100,000
Subtotal Temporary Facilities				**$ 163,220**
2.Demolition & Clearing				
a. Clear and grub vegetation	144800	SF	$0.25	$ 36,200
b. Sawcut asphalt pavement	50	LF	$2.50	$ 125
c. Rotomill AC pavement and stockpile	11,000	SF	$0.50	$ 5,500
d. Picnic shelter demolition	1	LS	$8,000.00	$ 8,000
e. 2' of subsurface debris removal and disposal including all of abandoned pool	300	CY	$150.00	$ 45,000
Subtotal Demolition & Clearing				**$ 94,825**
3. Earthwork				
a. Cut and fill on-site	3,011	CY	$10.00	$ 30,111
b. Stockpile material for reuse	911	CY	$4.00	$ 3,643
c. Off-site disposal	2,100	CY	$35.00	$ 73,517
d. Channel substrate (extends to existing ped bridge)	1,283	Tons	$70.00	$ 89,833
Subtotal Earthwork				**$ 197,104**
4. Railroad Bridge - 130 FT x 4 Spans				
a. Railroad bridge construction with shoo-fly (add 20% for work provided by BNSF)	1	LS	$4,091,455.00	$ 4,091,455
b. Access contingency - road improvement, marine access or rail access	1	LS	$500,000.00	$ 500,000
c. Access contingency - temporary trestle for un and off-loading	1	LS	$500,000.00	$ 500,000
d. Permanent fencing	1	EST	$20,000.00	$ 20,000
Subtotal Railroad Bridge				**$ 5,111,455**
5. Recreation Items				
a. Crushed rock trail (7" depth)	122	CY	$35.00	$ 4,278
b. Crushed gravel for asphalt base	60	Ton	$35.00	$ 2,100
c. Asphalt paving of trail	120	Ton	$150.00	$ 18,000
d. Picnic viewpoints	4	EA	$4,500.00	$ 18,000
e. New restroom enclosure	1	LS	$65,623.02	$ 65,623
f. Pedestrian bridge	1	LS	$170,000.00	$ 170,000
Subtotal Recreation Items				**$ 278,001**
6. Planting & Irrigation				
a. Native deciduous tree (5 gal.), 12' O.C.	172	EA	$65.00	$ 11,180
b. Native coniferous tree (5 gal.), 12' O.C.	172	EA	$85.00	$ 14,620
c. Native coniferous tree (5 gal.), 30' O.C.	27	EA	$85.00	$ 2,295
d. Native shrubs (2 gal.), 6' O.C.	344	EA	$28.00	$ 9,632
e. Riparian groundcovers (1 gal), 4' O.C.	690	EA	$20.00	$ 13,800
f. Marsh groundcovers (10-inch plugs), 2' O.C.	19,900	EA	$4.00	$ 79,600
g. Hydroseed remaining lawn area	24,587	SF	$0.30	$ 7,376
h. Organic soil amendment (3" depth)	1035	CY	$35.00	$ 36,231
i. Mulch (3" depth)	1035	CY	$35.00	$ 36,231
j. Temporary irrigation (riparian areas and marsh buffer)	64,500	SF	$1.10	$ 70,950
k. Imported Large Woody Material in stream channel (1 piece every 10-L.F. of channel+20%)	96	EA	$800.00	$ 76,800
i. Anchoring of half Large Woody Material in stream channel	48	EA	$300.00	$ 14,400
Subtotal Planting & Irrigation				**$ 373,116**
Subtotal Site Development Construction - Items 1, 2, 3, 5, 6				**$ 1,106,266**
Subtotal Beach Access Structure - Item 4				**$ 5,111,455**
Subtotal All Construction				**$ 6,217,721**
Mobilization - Site Development Construction (20%)				**$ 221,253.14**
Mobilization - Beach Access Structure (20%)				**$ 1,022,291.00**
Subtotal Construction + Mob.				**$ 7,461,265**
Design & Construction Contingency - Site Development Construction (20%)				**$ 265,503.76**
Design & Construction Contingency - Beach Access Structure (40%)				**$ 2,453,498.40**
Subtotal Const.+ Mob.+ Conting.				**$ 10,180,267**
Allowance for the Arts (1.0%)				**$ 101,803**
Subtotal Const. + Mob + Conting. + Tax				**$ 10,282,070**
Sales Tax (8.6%)				**$ 884,258**
Subtotal Const. + Mob + Conting. + Tax				**$ 11,166,328**
Total Cost*				**$ 11,167,000**

In providing opinions of probable construction cost, the Client (Snohomish County) understands that the Consultant (Anchor QEA) has no control over the cost or availability of labor, equipment or materials, or over market condition or the Contractor's method of pricing, and the consultant's opinions of probable construction costs are made on the basis of the Consultant's professional judgment and experience. The Consultant makes no warranty, expressed or implied, that the bids or the negotiated cost of the Work will not vary from the Consultant's opinion of probable construction cost.

*All costs are in 2015 dollars. Costs do not include Monitoring.

Conceptual Cost Estimate for Construction Alternative Ped Overpass A - Elev

Conceptual Opinion of Probable Construction Cost - Meadowdale Restoration Project				
Total Estimate				
Item	**Qty**	**Unit**	**Unit Cost**	**Subtotal**
1. Temporary Facilities				
a. Temp. const. fencing	250	LF	$8.00	$ 2,000
b. Tree protection fencing	1,210	LF	$8.00	$ 9,680
c. Upland silt fencing	150	LF	$7.00	$ 1,050
d. Stream diversion and pumping	0	LS	$40,000.00	$ -
e. Railroad flagger	100	DAY	$1,000.00	$ 100,000
Subtotal Temporary Facilities				**$ 112,730**
2.Demolition & Clearing				
a. Clear and grub vegetation	105400	SF	$0.25	$ 26,350
b. Sawcut asphalt pavement	50	LF	$2.50	$ 125
c. Rotomill AC pavement and stockpile	11,000	SF	$0.50	$ 5,500
d. Picnic shelter demolition	1	LS	$8,000.00	$ 8,000
e. 2' of subsurface debris removal and disposal including all of abandoned pool	150	CY	$150.00	$ 22,500
Subtotal Demolition & Clearing				**$ 62,475**
3. Earthwork				
a. Cut and fill on-site	1,448	CY	$10.00	$ 14,481
b. Stockpile material for reuse	1,448	CY	$4.00	$ 5,793
c. Off-site disposal	0	CY	$35.00	$ -
d. Channel substrate (extends to existing ped bridge)	1,383	Tons	$70.00	$ 96,833
Subtotal Earthwork				**$ 117,107**
4. Pedestrian Overpass with Elevator				
a. Pedestrian overpass with elevator	1	LS	$1,358,725.00	$ 1,358,725
b. Foundation	1	EST	$350,000.00	$ 350,000
c. Utilities, Lighting and Fencing	1	EST	$175,000.00	$ 175,000
d. Access contingency - road improvement, marine access or rail access	1	EST	$500,000.00	$ 500,000
Subtotal Pedestrian Overpass				**$ 2,383,725**
5. Recreation Items				
a. Crushed rock trail (7" depth)	156	CY	$35.00	$ 5,444
b. Crushed gravel for asphalt base	60	Ton	$35.00	$ 2,100
c. Asphalt paving of trail	120	Ton	$150.00	$ 18,000
d. Picnic viewpoints	3	EA	$4,500.00	$ 13,500
e. New restroom enclosure	1	LS	$65,623.02	$ 65,623
f. Pedestrian bridge	1	LS	$170,000.00	$ 170,000
Subtotal Recreation Items				**$ 274,667**
6. Planting & Irrigation				
a. Native deciduous tree (5 gal.), 12' O.C.	90	EA	$65.00	$ 5,850
b. Native coniferous tree (5 gal.), 12' O.C.	90	EA	$85.00	$ 7,650
c. Native coniferous tree (5 gal.), 30' O.C.	40	EA	$85.00	$ 3,400
d. Native shrubs (2 gal.), 6' O.C.	180	EA	$28.00	$ 5,040
e. Riparian groundcovers (1 gal), 4' O.C.	360	EA	$20.00	$ 7,200
f. Marsh groundcovers (10-inch plugs), 2' O.C.	7,110	EA	$4.00	$ 28,440
g. Hydroseed remaining lawn area	53,564	SF	$0.30	$ 16,069
h. Organic soil amendment (3" depth)	438	CY	$35.00	$ 15,336
i. Mulch (3" depth)	438	CY	$35.00	$ 15,336
j. Temporary irrigation (riparian areas and marsh buffer)	34,011	SF	$1.10	$ 37,412
k. Imported Large Woody Material in stream channel (1 piece every 10-L.F. of channel+20%)	80	EA	$800.00	$ 64,000
i. Anchoring of half Large Woody Material in stream channel	40	EA	$300.00	$ 12,000
Subtotal Planting & Irrigation				**$ 217,734**
Subtotal Site Development Construction - Items 1, 2, 3, 5, 6				**$ 784,714**
Subtotal Beach Access Structure - Item 4				**$ 2,383,725**
Subtotal All Construction				**$ 3,168,439**
Mobilization - Site Development Construction (20%)				**$ 156,942.83**
Mobilization - Beach Access Structure (20%)				**$ 476,745.00**
Subtotal Construction + Mob.				**$ 3,802,127**
Design & Construction Contingency - Site Development Construction (20%)				**$ 188,331.39**
Design & Construction Contingency - Beach Access Structure (40%)				**$ 1,144,188.00**
Subtotal Const.+ Mob.+ Conting.				**$ 5,134,646**
Sales Tax (8.6%)				**$ 441,580**
Subtotal Const. + Mob + Conting. + Tax				**$ 5,576,226**
Total Cost*				**$ 5,577,000**

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*All costs are in 2015 dollars. Costs do not include Monitoring.

Conceptual Cost Estimate for Construction Alternative Ped Overpass B - Ramp

Conceptual Opinion of Probable Construction Cost - Meadowdale Restoration Project				
Total Estimate				
Item	**Qty**	**Unit**	**Unit Cost**	**Subtotal**
1. Temporary Facilities				
a. Temp. const. fencing	250	LF	$8.00	$ 2,000
b. Tree protection fencing	1,210	LF	$8.00	$ 9,680
c. Upland silt fencing	150	LF	$7.00	$ 1,050
d. Stream diversion and pumping	0	LS	$40,000.00	$ -
e. Railroad flagger	100	DAY	$1,000.00	$ 100,000
Subtotal Temporary Facilities				**$ 112,730**
2.Demolition & Clearing				
a. Clear and grub vegetation	105400	SF	$0.25	$ 26,350
b. Sawcut asphalt pavement	50	LF	$2.50	$ 125
c. Rotomill AC pavement and stockpile	11,000	SF	$0.50	$ 5,500
d. Picnic shelter demolition	1	LS	$8,000.00	$ 8,000
e. 2' of subsurface debris removal and disposal including all of abandoned pool	150	CY	$150.00	$ 22,500
Subtotal Demolition & Clearing				**$ 62,475**
3. Earthwork				
a. Cut and fill on-site	1,448	CY	$10.00	$ 14,481
b. Stockpile material for reuse	1,448	CY	$4.00	$ 5,793
c. Off-site disposal	0	CY	$35.00	$ -
d. Channel substrate (extends to existing ped bridge)	1,383	Tons	$70.00	$ 96,833
Subtotal Earthwork				**$ 117,107**
4. Pedestrian Overpass with Ramp				
a. Pedestrian overpass with ramp	1	LS	$796,560.00	$ 796,560
b. Foundation	1	EST	$225,000.00	$ 225,000
c. Utilities, Lighting and Fencing	1	EST	$175,000.00	$ 175,000
d. Access contingency - road improvement, marine access or rail access	1	EST	$500,000.00	$ 500,000
Subtotal Pedestrian Overpass				**$ 1,696,560**
5. Recreation Items				
a. Crushed rock trail (7" depth)	156	CY	$35.00	$ 5,444
b. Crushed gravel for asphalt base	60	Ton	$35.00	$ 2,100
c. Asphalt paving of trail	120	Ton	$150.00	$ 18,000
d. Picnic viewpoints	3	EA	$4,500.00	$ 13,500
e. New restroom enclosure	1	LS	$65,623.02	$ 65,623
f. Pedestrian bridge	1	LS	$170,000.00	$ 170,000
Subtotal Recreation Items				**$ 274,667**
6. Planting & Irrigation				
a. Native deciduous tree (5 gal.), 12' O.C.	90	EA	$65.00	$ 5,850
b. Native coniferous tree (5 gal.), 12' O.C.	90	EA	$85.00	$ 7,650
c. Native coniferous tree (5 gal.), 30' O.C.	40	EA	$85.00	$ 3,400
d. Native shrubs (2 gal.), 6' O.C.	180	EA	$28.00	$ 5,040
e. Riparian groundcovers (1 gal), 4' O.C.	360	EA	$20.00	$ 7,200
f. Marsh groundcovers (10-inch plugs), 2' O.C.	7,110	EA	$4.00	$ 28,440
g. Hydroseed remaining lawn area	53,564	SF	$0.30	$ 16,069
h. Organic soil amendment (3" depth)	438	CY	$35.00	$ 15,336
i. Mulch (3" depth)	438	CY	$35.00	$ 15,336
j. Temporary irrigation (riparian areas and marsh buffer)	34,011	SF	$1.10	$ 37,412
k. Imported Large Woody Material in stream channel (1 piece every 10-L.F. of channel+20%)	80	EA	$800.00	$ 64,000
i. Anchoring of half Large Woody Material in stream channel	40	EA	$300.00	$ 12,000
Subtotal Planting & Irrigation				**$ 217,734**
Subtotal Site Development Construction - Items 1, 2, 3, 5, 6				**$ 784,714**
Subtotal Beach Access Structure - Item 4				**$ 1,696,560**
Subtotal All Construction				**$ 2,481,274**
Mobilization - Site Development Construction (20%)				**$ 156,942.83**
Mobilization - Beach Access Structure (20%)				**$ 339,312.00**
Subtotal Construction + Mob.				**$ 2,977,529**
Design & Construction Contingency - Site Development Construction (20%)				**$ 188,331.39**
Design & Construction Contingency - Beach Access Structure (40%)				**$ 814,348.80**
Subtotal Const.+ Mob.+ Conting.				**$ 3,980,209**
Sales Tax (8.6%)				**$ 342,298**
Subtotal Const. + Mob + Conting. + Tax				**$ 4,322,507**
Total Cost*				**$ 4,323,000**

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Conceptual Cost Estimate for Construction Alternative Tunnel A - Single Culvert

Conceptual Opinion of Probable Construction Cost - Meadowdale Restoration Project				
Total Estimate				
Item	**Qty**	**Unit**	**Unit Cost**	**Subtotal**
1. Temporary Facilities				
a. Temp. const. fencing	250	LF	$8.00	$ 2,000
b. Tree protection fencing	1,210	LF	$8.00	$ 9,680
c. Upland silt fencing	150	LF	$7.00	$ 1,050
d. Stream diversion and pumping	1	LS	$40,000.00	$ 40,000
e. Railroad flagger	100	DAY	$1,000.00	$ 100,000
Subtotal Temporary Facilities				**$ 152,730**
2.Demolition & Clearing				
a. Clear and grub vegetation	105400	SF	$0.25	$ 26,350
b. Sawcut asphalt pavement	50	LF	$2.50	$ 125
c. Rotomill AC pavement and stockpile	11,000	SF	$0.50	$ 5,500
d. Picnic shelter demolition	1	LS	$8,000.00	$ 8,000
e. 2' of subsurface debris removal and disposal including all of abandoned pool	150	CY	$150.00	$ 22,500
Subtotal Demolition & Clearing				**$ 62,475**
3. Earthwork				
a. Cut and fill on-site	1,448	CY	$10.00	$ 14,481
b. Stockpile material for reuse	1,448	CY	$4.00	$ 5,793
c. Off-site disposal	0	CY	$35.00	$ -
d. Channel substrate (extends to existing ped bridge)	1,383	Tons	$70.00	$ 96,833
Subtotal Earthwork				**$ 117,107**
4. Steel Culvert - Jacked 12' Steel Pipe x 1				
a. Jacked steel pipe for stream culvert, 12' diameter	100	LF	$11,000.00	$ 1,100,000
b. Embankment pre-stabilization	1	EST	$1,500,000.00	$ 1,500,000
c. Construction dewatering	1	EST	$250,000.00	$ 250,000
d. Fencing	1	EST	$20,000.00	$ 20,000
d. Access contingency - road improvement, marine access or rail access	1	EST	$500,000.00	$ 500,000
Subtotal Pedestrian Overpass				**$ 3,370,000**
5. Recreation Items				
a. Crushed rock trail (7" depth)	156	CY	$35.00	$ 5,444
b. Crushed gravel for asphalt base	60	Ton	$35.00	$ 2,100
c. Asphalt paving of trail	120	Ton	$150.00	$ 18,000
d. Picnic viewpoints	3	EA	$4,500.00	$ 13,500
e. New restroom enclosure	1	LS	$65,623.02	$ 65,623
f. Pedestrian bridge	1	LS	$170,000.00	$ 170,000
Subtotal Recreation Items				**$ 274,667**
6. Planting & Irrigation				
a. Native deciduous tree (5 gal.), 12' O.C.	90	EA	$65.00	$ 5,850
b. Native coniferous tree (5 gal.), 12' O.C.	90	EA	$85.00	$ 7,650
c. Native coniferous tree (5 gal.), 30' O.C.	40	EA	$85.00	$ 3,400
d. Native shrubs (2 gal.), 6' O.C.	180	EA	$28.00	$ 5,040
e. Riparian groundcovers (1 gal), 4' O.C.	360	EA	$20.00	$ 7,200
f. Marsh groundcovers (10-inch plugs), 2' O.C.	7,110	EA	$4.00	$ 28,440
g. Hydroseed remaining lawn area	53,564	SF	$0.30	$ 16,069
h. Organic soil amendment (3" depth)	438	CY	$35.00	$ 15,336
i. Mulch (3" depth)	438	CY	$35.00	$ 15,336
j. Temporary irrigation (riparian areas and marsh buffer)	34,011	SF	$1.10	$ 37,412
k. Imported Large Woody Material in stream channel (1 piece every 10-L.F. of channel+20%)	80	EA	$800.00	$ 64,000
i. Anchoring of half Large Woody Material in stream channel	40	EA	$300.00	$ 12,000
Subtotal Planting & Irrigation				**$ 217,734**
Subtotal Site Development Construction - Items 1, 2, 3, 5, 6				**$ 824,714**
Subtotal Beach Access Structure - Item 4				**$ 3,370,000**
Subtotal All Construction				**$ 4,194,714**
Mobilization - Site Development Construction (20%)				**$ 164,942.83**
Mobilization - Beach Access Structure (20%)				**$ 674,000.00**
Subtotal Construction + Mob.				**$ 5,033,657**
Design & Construction Contingency - Site Development Construction (20%)				**$ 197,931.39**
Design & Construction Contingency - Beach Access Structure (40%)				**$ 1,617,600.00**
Subtotal Const.+ Mob.+ Conting.				**$ 6,849,188**
Sales Tax (8.6%)				**$ 589,030**
Subtotal Const. + Mob + Conting. + Tax				**$ 7,438,219**
Total Cost*				**$ 7,439,000**

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Conceptual Cost Estimate for Construction Alternative Tunnel B - Triple Culvert

Conceptual Opinion of Probable Construction Cost - Meadowdale Restoration Project				
Total Estimate				
Item	**Qty**	**Unit**	**Unit Cost**	**Subtotal**
1. Temporary Facilities				
a. Temp. const. fencing	250	LF	$8.00	$ 2,000
b. Tree protection fencing	1,210	LF	$8.00	$ 9,680
c. Upland silt fencing	150	LF	$7.00	$ 1,050
d. Stream diversion and pumping	1	LS	$40,000.00	$ 40,000
e. Railroad flagger	100	DAY	$1,000.00	$ 100,000
Subtotal Temporary Facilities				**$ 152,730**
2.Demolition & Clearing				
a. Clear and grub vegetation	105400	SF	$0.25	$ 26,350
b. Sawcut asphalt pavement	50	LF	$2.50	$ 125
c. Rotomill AC pavement and stockpile	11,000	SF	$0.50	$ 5,500
d. Picnic shelter demolition	1	LS	$8,000.00	$ 8,000
e. 2' of subsurface debris removal and disposal including all of abandoned pool	150	CY	$150.00	$ 22,500
Subtotal Demolition & Clearing				**$ 62,475**
3. Earthwork				
a. Cut and fill on-site	1,448	CY	$10.00	$ 14,481
b. Stockpile material for reuse	1,448	CY	$4.00	$ 5,793
c. Off-site disposal	0	CY	$35.00	$ -
d. Channel substrate (extends to existing ped bridge)	1,383	Tons	$70.00	$ 96,833
Subtotal Earthwork				**$ 117,107**
4. Steel Culvert - Jacked 12' Steel Pipe x 3				
a. Jacked steel pipe for stream culvert, 12' diameter	300	LF	$11,000.00	$ 3,300,000
b. Embankment pre-stabilization	1	EST	$1,500,000.00	$ 1,500,000
c. Construction dewatering	1	EST	$500,000.00	$ 500,000
d. Fencing	1	EST	$20,000.00	$ 20,000
d. Access contingency - road improvement, marine access or rail access	1	EST	$500,000.00	$ 500,000
Subtotal Pedestrian Overpass				**$ 5,820,000**
5. Recreation Items				
a. Crushed rock trail (7" depth)	156	CY	$35.00	$ 5,444
b. Crushed gravel for asphalt base	60	Ton	$35.00	$ 2,100
c. Asphalt paving of trail	120	Ton	$150.00	$ 18,000
d. Picnic viewpoints	3	EA	$4,500.00	$ 13,500
e. New restroom enclosure	1	LS	$65,623.02	$ 65,623
f. Pedestrian bridge	1	LS	$170,000.00	$ 170,000
Subtotal Recreation Items				**$ 274,667**
6. Planting & Irrigation				
a. Native deciduous tree (5 gal.), 12' O.C.	90	EA	$65.00	$ 5,850
b. Native coniferous tree (5 gal.), 12' O.C.	90	EA	$85.00	$ 7,650
c. Native coniferous tree (5 gal.), 30' O.C.	40	EA	$85.00	$ 3,400
d. Native shrubs (2 gal.), 6' O.C.	180	EA	$28.00	$ 5,040
e. Riparian groundcovers (1 gal), 4' O.C.	360	EA	$20.00	$ 7,200
f. Marsh groundcovers (10-inch plugs), 2' O.C.	7,110	EA	$4.00	$ 28,440
g. Hydroseed remaining lawn area	53,564	SF	$0.30	$ 16,069
h. Organic soil amendment (3" depth)	438	CY	$35.00	$ 15,336
i. Mulch (3" depth)	438	CY	$35.00	$ 15,336
j. Temporary irrigation (riparian areas and marsh buffer)	34,011	SF	$1.10	$ 37,412
k. Imported Large Woody Material in stream channel (1 piece every 10-L.F. of channel+20%)	80	EA	$800.00	$ 64,000
i. Anchoring of half Large Woody Material in stream channel	40	EA	$300.00	$ 12,000
Subtotal Planting & Irrigation				**$ 217,734**
Subtotal Site Development Construction - Items 1, 2, 3, 5, 6				**$ 824,714**
Subtotal Beach Access Structure - Item 4				**$ 5,820,000**
Subtotal All Construction				**$ 6,644,714**
Mobilization - Site Development Construction (20%)				**$ 164,942.83**
Mobilization - Beach Access Structure (20%)				**$ 1,164,000.00**
Subtotal Construction + Mob.				**$ 7,973,657**
Design & Construction Contingency - Site Development Construction (20%)				**$ 197,931.39**
Design & Construction Contingency - Beach Access Structure (40%)				**$ 2,793,600.00**
Subtotal Const.+ Mob.+ Conting.				**$ 10,965,188**
Sales Tax (8.6%)				**$ 943,006**
Subtotal Const. + Mob + Conting. + Tax				**$ 11,908,195**
Total Cost*				**$ 11,909,000**

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*All costs are in 2015 dollars. Costs do not include Monitoring.

TKDA ESTIMATE OF PROBABLE CONSTRUCTION COSTS

Project: Meadowdale Overpass
Stair Tower With Elevator Option

Proj. No.:
By: RDC/MJC
Date: 1/4/2015

Item #		Description	Labor and Material			
			Quantity	Unit	Unit Cost	Total
		General Requirements				
		Mobilization, Office, Permit, Etc.	1	LUMP	$170,000.00	$170,000
		Stair Tower, Elevator and Ramp				
		Stairs (3-Story, CIP Concrete, 6'-0" Wide, 2 Stairs)	720	LF Nose	$50.00	$36,000
		Stair Landings (CIP Concrete, 10'-0"x12'-0", 2 Stairs)	44	CY	$1,100.00	$48,869
		Stair Roof (Structural Steel)	7000	LB	$2.50	$17,500
		Stair Roof (Standing Seam Metal)	6.16	Sq	$1,500.00	$9,240
		Stair Handrail/Guardrail	660	LF	$125.00	$82,500
		Stair Columns	42	CY	$2,200.00	$92,165
		Elevator (Hydraulic, 2 Floors, 100 FPM, 4000 LBS)	2	LUMP	$80,000.00	$160,000
		Elevator Tower Framing	45584	LB	$2.50	$113,960
		Elevator Tower Roof	2.88	Sq	$1,500.00	$4,320
		Elevator Tower Wall (Average Curtain Wall System)	3840	SF	$150.00	$576,000
		Ramp (CIP Concrete, 6'-0" Wide)	499	SF	$200.00	$99,770
		Pedestrian Bridge (CIP Concrete, 8'-0" Wide)	640	SF	$185.00	$118,400
		Sitework				
		Excavation	0	CY	$13.00	$0
		Backfill & Compaction	0	CY	$15.00	$0
		SUBTOTAL				**$1,528,725**
		CONTINGENCY (30%)				$458,618
		TOTAL				**$1,987,343**

TKDA ESTIMATE OF PROBABLE CONSTRUCTION COSTS

Project: Meadowdale Overpass
Stair Tower With Ramp Option

Proj. No.:
By: RDC/MJC
Date: 1/4/2015

Item #		Description	Labor and Material			
			Quantity	Unit	Unit Cost	Total
		General Requirements				
		Mobilization, Office, Permit, Etc.	1	LUMP	$100,000.00	$100,000
		Stair Tower, Elevator and Ramp				
		Stairs (3-Story, CIP Concrete, 6'-0" Wide, 2 Stairs)	720	LF Nose	$50.00	$36,000
		Stair Landings (CIP Concrete, 10'-0"x12'-0", 2 Stairs)	44	CY	$1,100.00	$48,869
		Stair Roof (Structural Steel)	7000	LB	$2.50	$17,500
		Stair Roof (Standing Seam Metal)	6.16	Sq	$1,500.00	$9,240
		Stair Handrail/Guardrail	660	LF	$125.00	$82,500
		Stair Columns	42	CY	$2,200.00	$92,165
		Ramp (CIP Concrete, 6'-0" Wide)	1959	SF	$200.00	$391,885
		Pedestrian Bridge (CIP Concrete, 8'-0" Wide)	640	SF	$185.00	$118,400
		Sitework				
		Excavation	0	CY	$13.00	$0
		Backfill & Compaction	0	CY	$15.00	$0
		SUBTOTAL				**$896,560**
		CONTINGENCY (30%)				$268,968
		TOTAL				**$1,165,528**

APPENDIX D
COUNTY REVIEW MEETING SUMMARY

Minutes: County Meeting on Additional Options

MEADOWDALE BEACH COUNTY PARK FEASIBILITY STUDY

Meeting Date and Time: Friday, January 8, 2016, 9:00 am to 1:00 pm

Attendees

Snohomish County Staff

- Logan Daniels
- Sharon Swan
- Kathleen Herrmann
- Dave Lucas
- James Yap
- Tom Teigen

Anchor QEA, Consultants

- Kathy Ketteridge
- Peter Hummel
- Izaak Fox (via conference line)

Shannon and Wilson, Consultants

- Matt Gibson

TKDA, Consultants

- Matt Christianson (via conference line)

Introductions and Purpose of Meeting

Each participant introduced themselves. Kathy informed the group that she had a presentation prepared that would summarize the additional work conducted by the Anchor QEA team, and that then there would be a round-robin discussion to answer questions and get input from County staff. Kathy and Peter took notes during the meeting, including the round-robin discussion. The PowerPoint presentation shown during the meeting is provided as Attachment 1 to these meeting minutes.

Scope of Additional Work

Kathy described the scope of the additional work to be discussed during the meeting. Work included an on-site constructability review with Bob Hirte from Hamilton Construction, re-evaluation of costs for the preferred bridge alternative, precursory evaluation to determine if the access road could be used for construction access, and development of conceptual level costs for the pedestrian overpass and tunnel (through the railroad berm) options for the project.

On-site Constructability Review

Kathy presented the highlights of the constructability review, which are included in the PowerPoint presentation in Attachment 1 to this summary. A more in-depth summary of the on-site constructability review is provided as Appendix A to the Meadowdale Beach County Park Feasibility Study Report Addendum.

Use of Access Road in Construction

Matt Gibson from Shannon and Wilson summarized his preliminary on-site evaluation of the access road to determine if the road may be used for construction access (see summary in Attachment 1). The conclusion of the evaluation was, based on the limited information on hand and field observations, it appears the road could be used for construction access (equipment and materials) but may need some improvements for large construction equipment. However, the cost for detailed investigation, design, and improvements to the road is expected to be significantly lower than the cost for a temporary pier for marine construction access. The road access would likely be easier to permit (in terms of environmental constraints). Use of the railroad in combination with the road would be the ideal construction access approach. However in the event BNSF will not allow mobilization via rail, marine access may still be required.

Geotechnical Investigation Costs for Design (for All Options)

Matt Gibson from Shannon and Wilson summarized his preliminary costs for geotechnical investigations that would be needed to determine the nature and extent of debris in the railroad berm, which will impact the ability to drive sheetpile between the tracks, drive foundation piles, and construction windows to excavate berm material. In addition, geotechnical investigations will be required to determine sub-surface conditions to inform foundation design.

Preliminary costs for investigation were estimated to be $25,000 for geophysics (ground penetrating radar), $75,000 per hole for horizontal drilling through the railroad berm, and $35,000 for vertical drilling for foundations. These costs include work associated coordinating with BNSF and working on an active railroad track. Additional information is provided in the PowerPoint presentation (Attachment 1).

Bridge Options Revisited

The costs for the bridge were revised based on insight gained from the on-site constructability review and evaluation of the access road. Bridge options evaluated included Alternative 1 (Option A) and Alternative 3 (Option C) from the feasibility evaluation, where Option C is the preferred alternative for the project. A summary of this discussion is below:

- Revised costs based on constructability discussion and potential to use access road and BNSF for construction mobilization with low speed shoo fly:
  - Bridge Option A (80 feet): $6.7 million ($8 million project including all other project site amenities)
  - Bridge Option C (130 feet): $8.4 million ($10 million project including all other project site amenities)
- Does not include the maintenance fee that BNSF will require as part of the construction cost.
- Both bridge options meet project goals; larger bridge offers more habitat restoration opportunities, was more sustainable in long-term, and was preferred alternative.
- Work windows greater than the 3.5 hours suggested by BNSF will likely be required to construct either bridge option. Smaller bridge would require fewer work windows.

Kathy and Izaak followed up with Bob Hirte after the meeting. Work windows of 3.5 hours (duration suggested by BNSF for this section of the railroad line) would be adequate for pile driving. However, the actual setting of the bridge components would require longer track windows; for example a single 16-hour window, two 10-hour windows, or even 3 8-hour windows per bridge. As the work windows get shorter, less work can be done within the same time period due to mobilization and demobilization work that has to occur during each construction window. Six (6)-hour work windows will not provide contingency time that may be needed for the work; an 8-hour work window was suggested for this reason.

Tunnel/Culvert Options

Two tunnel options were evaluated as part of this work: a single 12-foot steel culvert (Tunnel Option A) and three 12-foot steel culverts (Tunnel Option B), which would be jacked through the railroad embankment. Logan pointed out that a single culvert would not be permittable since it does not reflect the bank-full width of the creek. Both tunnel options would be used to convey the creek flow and sediments, and not for pedestrian access. This limitation on use is due to required 7-foot cover depth over the culvert, resulting in inadequate overhead clearance available for pedestrians inside the culvert. All tunnel options would utilize the existing tunnel/culvert for pedestrian access to the beach. A summary of the tunnel discussion is below:

- Costs for Tunnel/Culvert Options:
  - Culvert Option A (single): $6.1 million ($7.4 million project including all other project site amenities)
  - Culvert Option B (130 feet): $8.4 million ($10 million project)
- Fill required over tunnel approximately 7 feet—will not allow enough clearance for pedestrian use (use for stream only).
- Geotechnical investigation to determine nature and extent of debris in berm required for evaluation and design of tunnel options and to refine the conceptual opinion of probable construction cost outlined in this report.
- Anticipate BNSF maintenance fee may be less than bridge.
- Work windows of 3.5 hours may be adequate for construction.

Kathy and Izaak followed up with Bob Hirte after the meeting, and he suggested that the cost for the culverts could be higher than presented during the meeting depending on size of equipment needed to jack the culverts through the embankment (based on results of geotechnical investigation and design of tunnel options not yet completed) and allowable access routes to the site).

Pedestrian Overpass Options

Two pedestrian overpass options were evaluated as part of this work; one using elevators combined with a staircase on each side of the railroad and one using a set of ramps on each side of the railroad to meet ADA requirements. A summary of the pedestrian overpass discussion is below:

- Cost Summary:
  - Overpass Option A (elevators/stairs): $4 million ($5.2 million project including all project site amenities)
  - Overpass Option B (ramps): $2.8 million ($4.1 million project including all project site amenities)
- BNSF may require the structure span the entire right of way. This could increase the span of the overpass by approximately 25 feet into the park (east). This would increase the cost somewhat, but not significantly.
- Anticipate BNSF will not require a maintenance fee for overpass because County would retain ownership and maintenance responsibility.
- Work windows of 3.5 hours are likely adequate for construction.
- The overpass does not address habitat restoration goals, sediment, flooding, and maintenance issues, or fully address recreation/education use goals for the park.
- Ramp option is likely more sustainable than elevator option but would have a greater aesthetic cost.

Kathy and Izaak followed up with Bob Hirte after the meeting, and he suggested that the cost for the pedestrian overpass could be substantially higher if the bridge is required to be an all-steel structure. He also suggested that required work windows of greater than 3.5 hours would likely be required to set the overpass span due to the size of the lift; although the number of windows is still expected to be less than those required for the railroad bridge options.

Summary of Costs, Benefits, and Risks for Proposed Options

Summary of costs and preliminary benefits comparison was provided to County staff. This table has been included as Table 1 (Section 6) of the Meadowdale Beach County Park Feasibility Study Report Addendum.

Round Robin Discussion Summary (Chronological Order)

Matt C.: Important to move forward with geotechnical investigation at this point in process to determine more accurate costs and design considerations.

Matt G.: Agrees with Matt C., as the geotechnical information will impact the cost for the project and potentially the final location of the engineered opening. Group discussed whether the geotechnical investigation is needed to determine a preferred alternative, or to support subsequent design and cost estimating. The Anchor QEA Team and County agreed that the latter (needed as part of subsequent design work) is appropriate based on existing and available information and County can settle on a preferred alternative with the information provided.

Tom: Based on information provided, not unlikely that the preferred alternative of a 4-span bridge project could be in the range of $14 to $16 million given the uncertainties with costs associated with railroad.

Dave: Prefers the bridge Option C (preferred alternative). Tunnels are not sustainable in the long term (i.e., sea level rise and sediment issues) and overpass does not address all problems or project goals. Dave feels that the work windows required for bridge construction could be worked out with BNSF.

Tom: The large bridge option would not have a short-term solution for people to get to the beach. The short-term option would be to build the overpass and then let BNSF take over the culvert, but there is no guarantee that this option could be permitted quickly; it just represents an option that is less expensive than the preferred alternative. Also, BNSF will not likely be concerned with flooding or habitat concerns associated with the culvert; so sediment and flooding concerns within the park would not be addressed with this option. In regards to funding, the County needs to weigh the potential of a project that has a habitat/fish component(bridge) which would have greater number of grants available or other stakeholder support vs a project with limited outside funding opportunities (overpass option).

Sharon: Reminded the group that people within her group at the first public meeting as well as some audience discussion indicated that a solution that would provide safe access to the beach with the shortest timeline was their priority. They were interested in habitat improvements, if possible, but really just wanted to get to the beach. The elevator option for the pedestrian overpass should not be considered, but the ramp version could be considered. Perhaps the overpass could be constructed and then the bridge constructed later.

Sharon: Added that the pedestrian overpass, particularly the ramp option, was likely more "doable" based on cost and could be made to be a pleasing experience, with great views, as part of the Park.

Peter: Pointed out that Anchor QEA will follow up on verifying how the pedestrian overpass options do or do not comply with the County's shoreline management regulations. These shoreline regulations deal with allowable uses and development within certain distances from Ordinary High Water, and include significant height restrictions. He also mentioned that people would likely go under the bridge to the beach (via the culvert) since it would be a shorter path than the overpass.

Post Meeting Note: Based on regulations it is likely that the pedestrian overpass options do not comply, and would require a variance. This information is provided in Section 3.1 of the Meadowdale Beach County Park Feasibility Report Addendum.

James: Asked whether costs for access road improvements were included in cost estimates. Anchor QEA responded that yes they have been included. Would prefer the larger railroad bridge, Option C, to be implemented. But, if we do move forward with bridge, what is short-term option for access to beach?

Tom: Parks would prefer to fix the entire problem, and not implement a short-term "Band-Aid" solution, which is consistent with a majority of the public opinion expressed at public meeting. There may be some time where the park is closed to pedestrian access as the County goes through the design, permitting, and construction for the bridge option.

Kathleen: Supports the larger railroad bridge Option C for the site. She feels that shoreline management permitting for the pedestrian overpass beach side tower would be very challenging and that it would be a large cost to the County to maintain. Concerns about vandalism were also mentioned. There is the possibility that the County would eventually have to build a bulkhead to protect the beach side tower due to sea level rise and that is not in line with restoration goals. She stated the pedestrian overpass would be an eyesore to the park, and detract from its natural character. Kathleen stated her group at the second public meeting unanimously opted for a longer term solution that would address habitat.

Tom: There is the possibility that Lynnwood would take over control of the park at some point in the next 5 years. Bridge is the best option, and he supports the choice of the larger railroad bridge, Option C, as preferred alternative for the Park. This project could set the stage for future projects at other locations. Construction of a bridge at the site could potentially be coordinated with other work along the same BNSF line.

Logan: Stated that WDFW may not be supportive of permitting the overpass given the sediment issue at the culvert and given the fact that people are likely to continue using the culvert for beach access rather than traverse the ramp. Logan concurred that her group at the second public meeting also was habitat focused preferring the bridge option that would provide the greater estuary potential. Building only the pedestrian overpass does not deal with the sediment, maintenance, and sustainability project goals. If the county goes with any other option besides the preferred alternative the grant would not be applicable and we would need to go back to Stakeholders and Community for input.

Logan: Verified that Tom has enough information after this meeting to move forward with discussions with the Executive and Council.

Sharon: Indicated that the County would need to make some decisions about beach access at this park until the project is constructed.

Meeting summary prepared by	*Kathy Ketteridge and Peter Hummel, Anchor QEA, LLC*	*January 2016*

Communicate any discrepancies in these meeting minutes, in writing, to Kathy Ketteridge (kketteridge@anchorqea.com) within 7 days.

Attachments

1- PowerPoint Presentation