REPORT

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

June 2016

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LIST OF ACRONYMS AND ABBREVIATIONS

ADA	Americans with Disabilities Act
BNSF	Burlington Northern Santa Fe Railway
cfs	cubic foot per second
County	Snohomish County Parks and Recreation
ESA	Endangered Species Act
HEC-RAS	Hydrologic Engineering Centers River Analysis System
MHHW	mean higher high water
NAVD88	North American Vertical Datum of 1988
NOAA	National Oceanic and Atmospheric Administration
ORAR	Outdoor Recreation Access Route
Park	Meadowdale Beach County Park
RCO	Recreation and Conservation Office
ROW	right-of-way
sf	square foot
WAC	Washington Administrative Code

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Snohomish County

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EXECUTIVE SUMMARY

Snohomish County Parks and Recreation (County) contracted with the Anchor QEA, LLC, team to conduct a feasibility analysis and alternatives evaluation to develop a preferred conceptual design plan to address beach access, flooding, maintenance, and fish barrier issues associated with sediment deposition within the 6-foot-wide culvert for Lund's Gulch Creek under the BNSF railroad at Meadowdale Beach County Park (Figure 1). The focus of the feasibility study is to address public safety issues involving the existing railroad crossing, improve Americans with Disabilities Act (ADA) access to the beach, and improve habitat conditions for salmon in the lower creek and creek delta. The feasibility study included completion of numerous scientific and engineering studies and a significant stakeholder review process, providing several opportunities throughout the process for the community, local organizations and municipalities, tribes, permitting agencies, and Burlington Northern Santa Fe Railway (BNSF) to provide input and comment. Separate meetings were held with BNSF and appropriate permitting agencies to review the preferred conceptual design alternative.

Three conceptual alternatives were developed for the project, including replacement of the existing culvert with bridges of varying lengths for the creek channel, and construction of a pedestrian pathway under the bridge to provide more sustainable and environmentally friendly access for the public to the beach. One alternative looked at retaining the culvert for pedestrian access but moving the creek outlet to a bridged opening to the north of the current outlet location. The preferred alternative was chosen through a collaborative process with the County, consultant team, agency/organization stakeholders, and the community. The preferred alternative includes a 120-foot, 4-span bridge, conversion of approximately half of the lower lawn area to fish and wildlife habitat, significantly improved year-round beach access, and various other path and recreation facility improvements. Construction costs for the preferred alternative are estimated to be $11 million dollars, excluding costs associated with construction management, maintenance, indemnification agreements with BNSF, and BNSF coordination and review. The majority of these costs are associated with a new railroad bridge.

Continued coordination with BNSF during design and construction will be critical to success of the project. A preliminary constructability review of the preferred alternative suggested that 6-hour BNSF work windows would be required to construct the project. BNSF has stated in an initial meeting (see Appendix L) that 3.5-hour work windows are more likely what will be available for construction of the project. However, it is unknown at this time what BNSF operations will be at the time of construction. It is possible that work can be scheduled around other BNSF shutdowns, or coordinating with community transit may provide opportunities. 3.5-hour work windows are not long enough to construct the preferred alternative as currently defined, so additional negotiating and coordination will be required during design. Next steps for this project include completing an on-site constructability review and developing a submittal for review and comment by BNSF operations and engineering divisions to evaluate the design and provide additional information to the County regarding potential work windows available at the project site. Geotechnical information regarding subsurface conditions, such as locations of debris and/or buried timber structures within the railroad berm, are recommended to address project uncertainties. These recommendations will help to inform design of the proposed bridge and provide the County with options to reduce the costs and uncertainties associated with this project.

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1 PURPOSE OF THE FEASIBILITY STUDY

Snohomish County Parks and Recreation (County) contracted with the Anchor QEA team to conduct a feasibility analysis and alternatives evaluation to develop a preferred conceptual design plan to address beach access, flooding, maintenance, and fish barrier issues associated with sediment deposition within the 6-foot-wide culvert for Lund's Gulch Creek under the Burlington Northern Santa Fe Railway (BNSF) railroad at Meadowdale Beach County Park (Park), as shown in Figure 1. The existing railroad crossing consists of a concrete box culvert that conveys creek flow, sediment, and pedestrian traffic to the beach at the creek delta on Puget Sound. Deposition of sediments within and immediately upstream of the existing shared use culvert/pedestrian tunnel and resulting high water in the tunnel periodically causes flooding, which inundates the area around the restroom enclosure. This combination of sediment deposition and high water conditions severely impacts beach access and fish passage and requires significant park resources to conduct maintenance in a sensitive aquatic environment. The water and sediment conditions also create railroad crossing safety and Americans with Disabilities Act (ADA) compliance issues for public access to the beach. The focus of the feasibility study is to address public safety issues involving the existing railroad crossing, improve ADA access to the beach, and improve habitat conditions for salmon in the lower creek and creek delta. The lower creek and delta are habitat for Endangered Species Act (ESA)-listed species including juvenile Puget Sound Chinook, coho, and chum salmon, as well as cutthroat trout.

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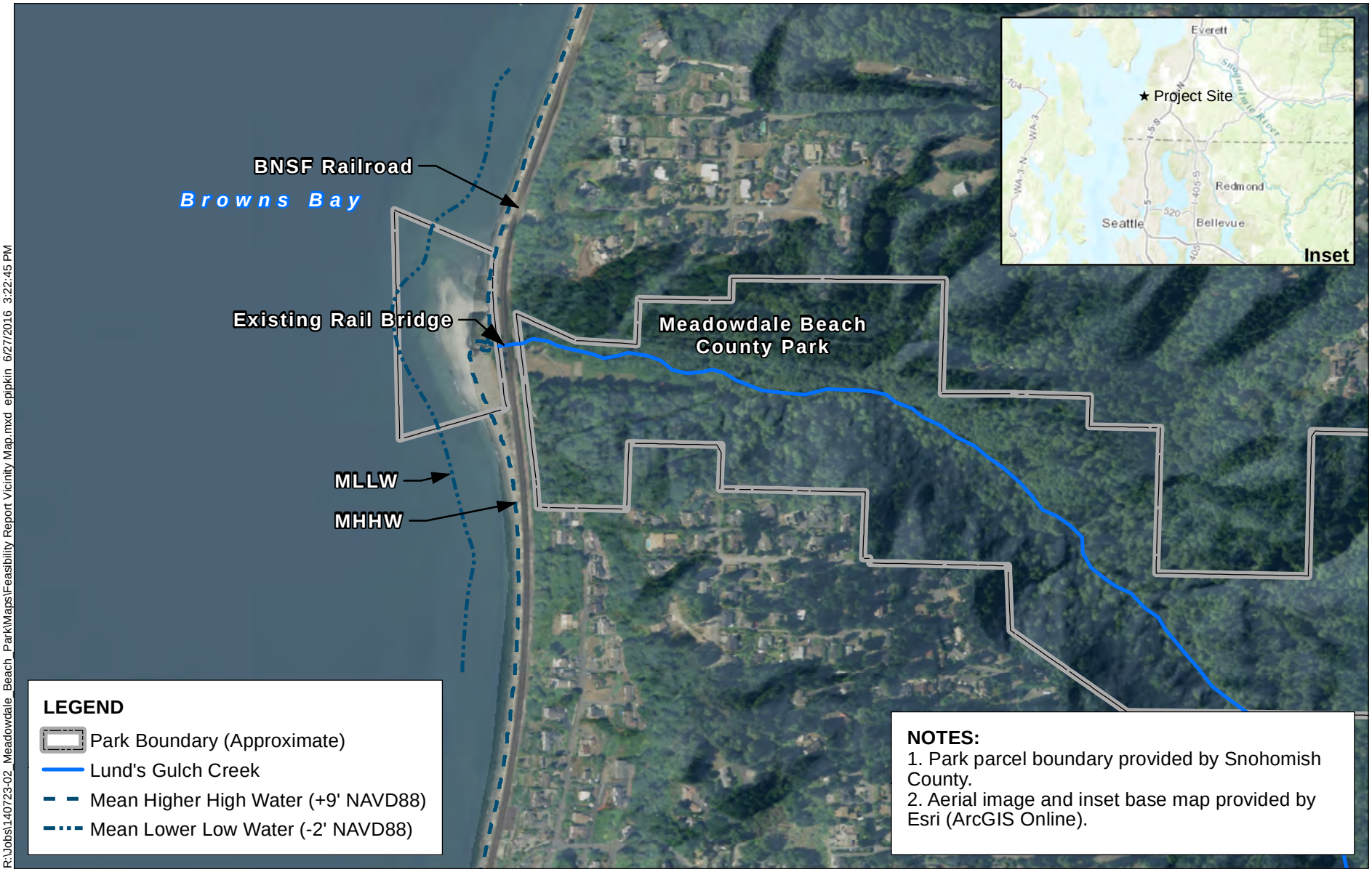

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Figure 1
Vicinity Map
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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2 SITE DESCRIPTION AND PROJECT BACKGROUND

Meadowdale Beach County Park is located at 6026 156th SW, Edmonds, Washington 98036, as shown in Figure 1. The 108-acre Park consists of several parcels and is owned by Snohomish County with Snohomish County Parks and Recreation as the custodial operator. The park extends from the rim of Lund's Gulch down to tidelands at the northern end of Browns Bay on Puget Sound (Figure 2). Lund's Gulch was first homesteaded by John Lund in 1878. The gulch saw many subsequent landowners and was logged prior to eventually being acquired by the Meadowdale Country Club. The country club was a much more intensively developed facility than the current Park and was located in what is now the lower creek and lawn area. Repeated landslides, which damaged the access road, and other factors resulted in the closure of the club in the late 1960s. In 1971, Snohomish County Parks acquired the land for the purpose of developing a public park with beach access. During a 15-year period, following the County's purchase of the property, the Park was undeveloped and attracted a wide range of unsanctioned activities including firearms use, motorcycle riding, and large parties (Bruce Dees 1986; Snohomish County 2015). The Park was closed in the late 1980s due to a slide on the access road. Planning and development of the Park commenced in 1986 and included extensive public involvement with the following key issues identified:

- Developing a park access arrangement that addressed surrounding neighborhood traffic concerns and disabled access requirements
- Creating a safe environment for the general public to recreate in
- Preserving and restoring the natural environment
- Building recreation facilities that supported passive recreation use

The Park was closed again briefly in 1996 due to excessive storm damage from flooding and re-opened in 1997. The Park's natural forests, stream, and beach and path access are the main attractions and are popular with residents throughout Snohomish County, with daily use by local residents of Lynnwood and Edmonds. The beach access is currently one of two available access points between downtown Edmonds and Mukilteo, including Picnic Point County Park. The Park is also extensively used for environmental education by local schools, Boy and Girl Scouts, and Edmonds Community College (Dailer 2015).

The Park's main access is an earthen trail from the upper parking lot that generally follows Lund's Gulch Creek as it flows through a deeply incised forested ravine with very steep side slopes, exceeding 40% in places. The trail terminates in a paved loop path at the lawn area, and beach access is provided via the concrete box culvert, which also conveys Lund's Gulch Creek, sediment, and the only fish access under the BNSF railroad berm.

The railroad was constructed in the late 1800s. It is assumed that the railroad tracks were supported in the ravine bottom by a timber trestle (personal communication, Shannon & Wilson 2015). The approximately 6-foot-wide, 7-foot-high, 60-foot-long box culvert appears to have been installed later when the railroad berm was constructed, over the assumed trestle structure in order to convey Lund's Gulch Creek. The culvert was subsequently retrofitted with a wooden deck, placed approximately 2 feet above the bottom of the culvert, to accommodate public access and maintenance when the Park was constructed. Lund's Gulch Creek and fish passage were provided below the decking. The culvert currently has a grated steel deck combined with an 18-inch-wide concrete walking surface. This deck and concrete surfaces provide the only public access to the beach including maintenance, operations, and emergency access. The portion of the culvert that is steel decked also provides passage for migrating fish, including juvenile Chinook, coho, and chum salmon and cutthroat trout, between Lund's Gulch Creek and Puget Sound. The culvert does not meet ADA guidelines for horizontal or vertical clearance (United States Access Board 2014). The lower half of the combined steel and concrete surfaces are typically covered in standing water from the stream year round. The culvert is also seasonally closed for maintenance during the late fall/winter when the grating is removed during the winter time to allow for fish passage and for winter-time storm creek flows to flush sediment out to the beach (Dailer 2015).

Facilities at the lower Park include paved and unpaved, looped walking paths, a sand volleyball court, picnic shelter, five uncovered picnic tables on concrete pads, a lawn area, pedestrian bridge, ADA parking, portable toilets, and a ranger residence. The Park is also an official Washington Water Trails campsite providing beach camping to any person using a non-motorized watercraft. The upper portion of the Park includes a small playground, toilets, trailhead, and the main public parking area with 30 stalls. The main recreational activities at the Park are beach access, walking, picnicking, bird watching/nature enjoyment, and environmental education programs.

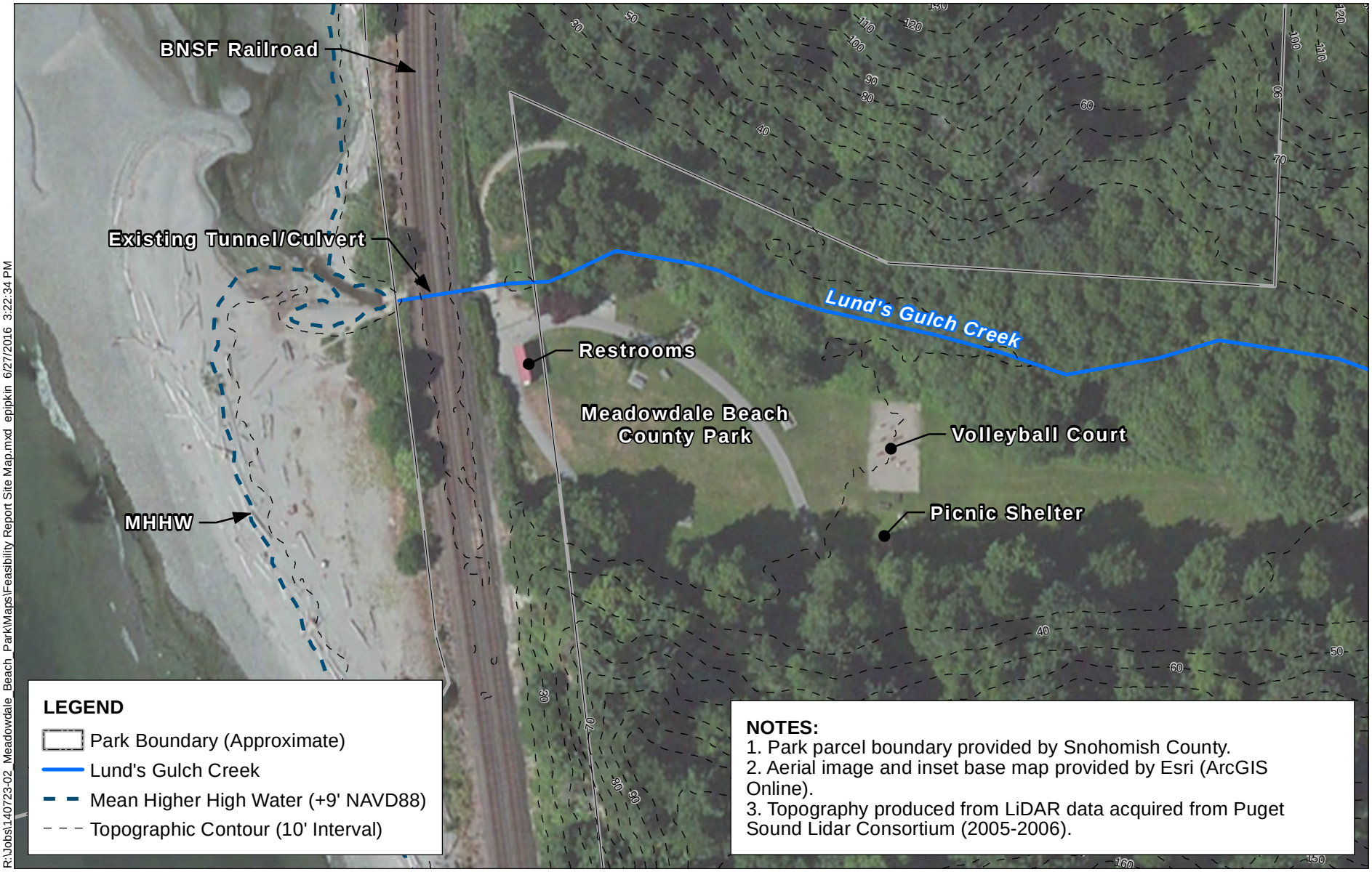

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Figure 2
Site Map
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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3 STAKEHOLDER AND PUBLIC REVIEW PROCESS

The feasibility study included opportunities throughout the feasibility study process for the community, local organizations, municipalities, tribes, permitting agencies, and BNSF to provide input and comment. Two meetings were held with agency/organization stakeholders to review evaluation criteria developed for the project, review proposed alternatives, and provide input into selection of the preferred alternative. Two community stakeholder meetings were also held to solicit the same information from the general public. Separate meetings were held with BNSF and appropriate permitting agencies to review the preferred conceptual design alternative for the project to gain insight into their concerns and outline future coordination efforts with each participating group. Meeting summaries for each of these meetings are provided in Appendices A and L. Input from the meetings is included in sections of this report, as warranted.

4 CONCEPTUAL ALTERNATIVES

A set of evaluation criteria was developed to evaluate the conceptual alternatives, and to facilitate selection of the preferred alternative. All the alternatives developed for the project aimed to improve safe and ADA-compliant beach access and address the flooding, sediment, fish passage, and maintenance issues associated with the undersized multi-purpose culvert.

The following sub-sections provide a description of the evaluation criteria developed for the project, an overview of the process through which three conceptual alternatives were developed, and an in-depth description of the three conceptual alternatives, including plan and section figures and costs.

4.1 Evaluation Criteria

An initial list of draft evaluation criteria was developed by the Anchor QEA team and discussed in detail with the County during a meeting held on November 11, 2014 (see Appendix A for initial list of evaluation criteria and meeting summary). The outcome of this meeting was a revised and refined set of draft evaluation criteria, which is provided in Table 1.

Table 1
Evaluation Criteria for Conceptual Alternatives

Category	Criteria
Public Safety	• Beach Access Across BNSF Right-of-Way
Support for Project	• Stakeholders • Permitting Agencies
Parks and Recreation	• Pedestrian / ADA Access and Circulation • Balance Public Access Opportunities with Habitat Protection • Conversion of Lower Lawn Areas to Habitat • Facility Relocation • Operations and Maintenance • Ability to Provide Suitable Use Areas for Current and Anticipated Programs and User Groups, including Education Uses • Views
Sediment Transport and Coastal Processes	• Sediment Transport Capacity of Opening, for Creek Sediment Loads • Potential for Channel Migration and Meandering • Shoreline Wave and Erosion Affecting Park and Railroad • Sediment Transport Distribution on Delta

Category	Criteria
Habitat Restoration	• Quantity and Diversity of Nearshore Habitat Waterward of Railroad Crossing • Juvenile Salmon Fish Passage Conditions into Lower Creek • Size of Transition Zone between Saline and Freshwater Habitats • Quality of Lund's Gulch Creek Habitat • Quantity and Quality of Riparian Vegetation along Stream and Nearshore • Quality of Freshwater Wetland • Habitat Connectivity for Non-fish Species
BNSF Coordination	• Consistent with Railroad Engineering Standards • Constructible within BNSF Work Windows • Meets BNSF Operations and Maintenance Standards
Funding Opportunities	• Probability to Obtain Grants • Additional Fundraising and Partnership Opportunities
General	• Sustainability (Sea Level Rise Only) • Costs/Benefit Considerations

Notes:
ADA = Americans with Disabilities Act
BNSF = Burlington Northern Santa Fe Railway

The draft evaluation criteria listed in Table 1 were presented, along with an overview of the project, to Agency/Organization and Community (e.g., general public) Stakeholders at two meetings. The Agency/Organization Stakeholder meeting was held on December 11, 2014, and the Community Stakeholder Meeting was held on December 15, 2014. Meeting summaries, including exhibits provided at the meeting and documented comments by Stakeholders, are provided in Appendix A. In addition to consensus of the Evaluation Criteria presented, the following provides a summary of the key discussion points from these meetings:

- Safe access for the public to the beach at the Park is a priority. The access to the beach is a highlight of the park and the primary reason most visitors come to the Park.
- Separation of the creek and people is a primary concern.
- Some modifications to the size of the lawn area to improve habitat should be considered because some parts of it are shady and wet most of the year.
- Support for habitat restoration should be considered, especially if it brings funding for the project. Most visitors come to experience the natural habitat.

- Ability to solve multiple issues with one alternative opens up more opportunities for funding.
- Consider sea level rise as part of the sustainability discussion. Define sustainability for this project, as part of the goals (BNSF considerations, track elevations, etc.)
- Washington Water Trails, Edmonds Community College, adopt stream, and Tulalip Tribes could offer assistance and support for this project, including monitoring.

These key points were taken into consideration in development of the conceptual alternatives for the project, as discussed in Section 4.2.

4.2 Development of Conceptual Alternatives

Seven initial concepts for alternatives, including bridges, an overpass, and culvert, were developed by the Anchor QEA team and presented to the County on January 15, 2015. A meeting summary and sketches of these initial concepts are included in Appendix G. Section 4.2.5 provides a summary of why some of the initial concepts were not considered viable. Three final conceptual alternatives were then developed for further evaluation based on the evaluation criteria and input from County staff, agency/organization, and community stakeholders. The following elements were all considered during the conceptual design process: a preliminary hydraulic evaluation, which was used to determine opening sizes, balancing habitat restoration and recreational uses, providing ADA-compliant beach access, BNSF structure standards, and anticipated coordination requirements with BNSF during construction.

4.2.1 Evaluation of Creek Outlet Width

The hydraulic evaluation was used to determine appropriate opening sizes based on extreme flows and sediment loads predicted in Lund's Gulch Creek. The one-dimensional hydraulic model Hydrologic Engineering Centers River Analysis System (HEC-RAS) developed by the U.S. Army Corps of Engineers (Brunner 2010a, 2010b) was used to estimate hydraulic conditions in Lund's Gulch Creek in order to evaluate the required size of the new opening. The HEC-RAS model was developed for the lower 1,900 feet of Lund's Gulch Creek using existing site topography data from Light Detection and Ranging (LiDAR), survey information for the existing culvert obtained specifically for this project, roughness coefficients based on surface conditions (see Table 2), hydrology available for the creek (see Table 3), and tidal and regional sea level rise

information (see Table 4). Sediment loads from Lund's Gulch Creek were estimated by Shannon & Wilson as part of this project (see Appendix C for complete Geotechnical Evaluation). The loads were estimated to be approximately 80 cubic yards per year (on average) due to discrete landslide events and streamside erosion. However, it was also estimated that three significant storm events delivered approximately 400 cubic yards to the system during each storm (on average). Therefore, sediment input to the system is episodic in nature.

An existing model developed by Snohomish County for this lower portion of the creek was also used to assist with the development of the new model. The model output includes predictions of water surface elevations, cross-sectional-depth-averaged velocities, and bed shear stresses at identified cross-sections along the creek alignment. A detailed description of model development, input parameters, and results is provided in Appendix B.

Table 2
Existing Box Culvert Opening Information

Model Element	Geometry
Culvert Geometry (H by W)	6 by 7 feet
Low Flow Fishway Geometry (H by W)	1 by 4.5 feet
Upstream Invert Elevation	9.59 feet NAVD88
Downstream Invert Elevation	9.07 feet NAVD88
Bottom Roughness Value	0.015
Sidewall Roughness Value	0.015

Notes:
H by W = height by width; NAVD88 = North American Vertical Datum of 1988

Table 3
Lund's Creek Hydrology

Peak Flow Event	Discharge (cfs)
2-year[a]	57
10-year[a]	89
25-year[a]	106
100-year[a]	135

Notes:
a. Taken from Snohomish County 2002
cfs = cubic foot per second

Table 4
Existing and Future Tidal Information at the Site

Datum	2015[a]	2030[c]	2050[c]	2100[c]
	Elevation (feet, NAVD88[a] / *feet, MLLW[b] 2015*)			
Highest Astronomical Tide (HAT)[d]	10.5 / *12.5*	10.7 / *12.7*	11.1 / *13.1*	12.5 / *14.5*
Mean Higher High Water (MHHW)	9.0 / *11.0*	9.2 / *11.2*	9.6 / *11.6*	11.0 / *13.0*
Mean High Water (MHW)	8.1 / *10.1*	8.4 / *10.4*	8.8 / *10.8*	10.2 / *12.2*
Mean Sea Level (MSL)	4.4 / *6.4*	4.6 / *6.6*	5.0 / *7.0*	6.4 / *8.4*
Mean Low Water (MLW)	0.7 / *2.7*	1.0 / *3.0*	1.4 / *3.4*	2.8 / *4.8*
North American Vertical Datum of 1988 (NAVD88)[a]	0 / *2.0*	0.2 / *2.2*	0.6 / *2.6*	2.0 / *4.0*
Mean Lower Low Water (MLLW)	-2.0 / *0*	-1.8 / *0.2*	-1.4 / *0.6*	0.0 / *2.0*

Notes:
a. Tidal datums and conversions between MLLW and NAVD88 datum at the site taken from the National Oceanic and Atmospheric Administration (NOAA) VDatum (http://vdatum.noaa.gov/). The project site is located about halfway between tidal benchmarks in Seattle (No. 9447130) and Everett (No. 9447659).
b. To convert to elevations relative to MLLW (2015), add 2.0 feet to elevations in NAVD88 datum.
c. Sea level rise estimates are taken from NRC (2012) and are mid-range estimates for each target year: 2030 (0.3 foot), 2050 (0.7 foot), and 2100 (2.1 feet).
d. Highest astronomical tide (also known as King Tide elevation) was taken as the annual maximum (99% exceedance) tidal elevation based on Seattle NOAA tide gage No. 9447130.

The results of this model evaluation illustrate that the existing culvert causes the creek to backwater at higher flows (see Figure 2 in Appendix B), which reduces the ability of the creek to mobilize and move sediment starting at a point just upstream of the culvert location. This causes sedimentation just upstream of the culvert, as has been observed at the site. The model was modified to represent openings of 20 feet, 30 feet, and 40 feet; hydraulics within the proposed openings for a variety of high flow conditions were compared to existing hydraulics with the culvert in place. In addition to flows associated with the 2-year through 100-year predicted flows in the creek, flows from 200 cubic feet per second (cfs) to 550 cfs were also considered in the modeling effort to take into account uncertainty in predicted hydrology for the creek and potential increase in discharge to the creek from upland storm water.

The model results for the 20-foot opening (see Figure 3 in Appendix B) show no backwatering (and no decrease in sediment transport capacity) for flows up to 300 cfs. At 400 cfs, the creek begins to backwater and the model predicts that sediment will begin to deposit upstream of the opening. For the 30-foot opening (see Figure 4 in Appendix B) the

model results show that the opening does not cause backwatering nor does it decrease sediment transport capacity for all modeling flows up to 550 cfs. Based on this evaluation, a 30-foot opening would be required, at a minimum, to provide adequate sediment transport capacity through the opening during higher flows above 300 cfs for both current and future predicted sea levels through 2100. Therefore, alternatives that did not provide at least a 30-foot clear span opening were not considered.

4.2.2 Public Access and Recreational Use Considerations

Providing safe and accessible beach access for Park users of all abilities across the BNSF right-of-way (ROW) is the main objective for the project from a public access and recreational use standpoint. Currently, the only pedestrian access to the beach is via the box culvert under the railroad. Year-round creek backwatering, high winter tides and stream flows, and sand and gravel deposition frequently render the culvert inaccessible. In addition, as previously mentioned, grates are pulled in the fall to permit fish passage. Without the grates installed, there is not a suitable walking surface for pedestrian access to the beach within the culvert. The desire to get to the beach is so great that people aggressively seek alternatives, including crossing the fenced BNSF railroad tracks, in spite of the signage prohibiting trespassing. All three alternatives are proposing to improve beach access to address safety issues and provide a path that is dry and accessible for users of all abilities most or all of a normal year through the year 2050.

The size and location of the openings in the railroad berm proposed to convey stream flows and provide beach access directly affect the conditions of the lower Park lawn areas east of the railroad berm. All three alternatives will convert a portion of the lawn to habitat; the current lower Park area includes an open lawn in the ravine on the south side of the lower creek. The western half is drier and sunnier and is used in the summer by Park patrons for active and passive recreation, including informal games such as Frisbee, playing catch, and volleyball. These uses are generally associated with the picnic shelter, which serves larger groups. The eastern lawn area is generally shadier and wetter. Walking and nature viewing is one of the main attractions at the Park, in addition to beach activities. Therefore, some limited shifting of the balance between lawn and habitat areas does not represent a drastic change in use. Opinions at the public meetings varied; some Park users desired to keep the lawn area, while others were more in favor of habitat restoration at the expense of lawn. The latter sentiment will provide

additional opportunities for nature observation and viewing for Park users. The size of the lawn area that would be converted to habitat is partly related to the size and location of the bridge opening, which varies by alternative. The remaining lawn could potentially be enhanced to promote better drainage to allow greater use than historically reported.

It is the intent that elements included in the redevelopment of the Park must meet current ADA guidelines (see Table 5 and Appendix D). The paths, pedestrian bridge, picnic areas, and viewpoint areas are the main recreation elements that are proposed to meet these guidelines.

A range of educational and volunteer activities occur at the Park involving a variety of groups including Girl and Boy Scouts, YMCA programs, K–12 and college students, and senior citizens. Activities include native plant restoration, fish and wildlife conservation, and nature walks and talks led by the Park Ranger and others. These groups typically use the beach, forested paths, lawn area, and the picnic shelter for gatherings. While the conversion of lawn to habitat reduces the available lawn area, it will still be sufficiently large to accommodate educational and volunteer activities at the Park. The more complex habitat that would be created by the project, as well as the restoration effort itself, provides opportunities for stewardship/restoration, interpretation, and learning experiences.

Conversion of Park area to habitat will also affect picnic areas, paths, and the restroom enclosure. All three alternatives are displacing existing picnic areas, but not the existing picnic shelter, and propose varying numbers of picnic viewpoints generally located west of the relocated loop path bridge across Lund's Gulch Creek, providing varying degrees of visual access to the restoration area. The restroom enclosure for portable toilets will be relocated further away from the railroad berm, closer to the shelter. All three alternatives would maintain a loop trail and include an additional pedestrian footbridge over the creek, but the length of the loop will vary by alternative.

Table 5

Key ADA Guidelines Affecting Feasibility

	Trails	Outdoor Recreation Access Route (ORARs)	Beach Access Routes (Removable)	Outdoor Constructed Features	Picnic Facility	Viewing Area
Clear Width	44 inches (WAC)	Same as Trails	60 inches	Picnic tables: 36 inches on all usable sides; Fire rings/grills: 48 by 48 inches on all usable sides; Receptacles: 36 by 48 inches where there is a forward approach, 30 by 60 inches where user approaches parallel to receptacle opening; Benches: 36 by 48 inches positioned near the bench with one side of the space adjoining circulation route.	See Outdoor Constructed Features	Clear ground space of at least 36 by 48 inches at each distinct viewing location; one side of space must adjoin or overlap ORAR, trail, or other clear ground space.
Passing or Turning Spaces (required for path widths < 60 inches)	One every 1,000 feet and/or at the end of ADA segment. 60 by 60 inches or T-shaped.	One every 200 feet. 60 by 60 inches or T-shaped.	Not required	NA	NA	Turning space of a least 60 inches in diameter, or T-shaped.
Running Slope	1:20 (5 percent)	Same as Trails	Removal routes are not required to comply with requirements.	Same as Trails (for clear ground space)	NA	NA

	Trails	Outdoor Recreation Access Route (ORARs)	Beach Access Routes (Removable)	Outdoor Constructed Features	Picnic Facility	Viewing Area
Steeper Sloped Trail Segments	5–8.33% = 200 feet max length, 8.33–10% = 30 feet max length, 10–12% = 10 feet max length	5–8.33% = 50 feet max length, 8.33–10% = 30 feet max length	Removal routes are not required to comply with requirements.	NA	NA	NA
Cross slope: Concrete, asphalt, or boards	2% max	Same as Trails	Removal routes are not required to comply with requirements.	Same as Trails (for clear ground space)	Same as Trails (for clear ground space)	Same as Trails (for clear ground space)
Cross slope: All other materials	5% max	Same as Trails	Removal routes are not required to comply with requirements.	Same as Trails (for clear ground space)	Same as Trails (for clear ground space)	Same as Trails (for clear ground space)

Notes:
ADA = Americans with Disabilities Act
ORAR = Outdoor Recreation Access Route
WAC = Washington Administrative Code

Views in most areas of the Park are limited by the steep, densely wooded side slopes of the ravine and the forest within it. Views from the lawn area of Puget Sound are blocked by the railroad berm. The views of Puget Sound and the Olympic Mountains available on the water side of the railroad berm are one of the primary attractions to the Park. The length and depth of the railroad bridge alternatives directly affects these views, with larger openings potentially providing more views from the lawn area. However, the amount of lawn to habitat conversion and location of viewpoints/picnic pads will also affect the availability of these potential newly created views. Woody riparian vegetation on the south side of the creek could potentially block views of Puget Sound from the land side of the railroad berm.

Under current conditions, extensive maintenance and administrative staff time is required to remove sediments and to obtain the necessary permits for this work. The three alternatives will reduce or prevent flooding and sediment deposition affecting recreation facilities to varying degrees. The intent is to designate areas for habitat where these processes can occur without impacting recreation facilities, thereby reducing staff time required for maintenance and permitting, and to prevent public beach access safety issues, closures, and restrictions. However, any re-use of the existing culvert as the primary beach access for recreation and ADA access is the most susceptible to more burdensome long-term maintenance to keep it operational.

The proposed habitat restoration areas in all three alternatives require weeding and irrigation until vegetation is established; however, lawn area to be mowed is reduced in all three alternatives.

4.2.3 BNSF Considerations

BNSF operates on two mainline tracks through the Meadowdale Beach Park area: Main 1 track (west track) and Main 2 track (east track). The corridor, a segment of the BNSF Scenic Subdivision (LS 50, MP 21.8; Seattle, Washington, to Wenatchee, Washington), has a high daily volume of railroad traffic. The allowable track speed is 45 miles per hour and may not be reduced in any new track alignment. In preliminary discussions, BNSF indicated that, due to the high volume of traffic, work windows will be limited to a maximum of 6 hours, and may be as short as 3.5 hours. This limits the feasibility of constructing new larger box

culverts at the project site, because these require up to a 24-hour work window to construct and BNSF would most likely not allow open-cutting the embankment (see Appendix F). Therefore, a bridged opening was considered in development of the three conceptual alternatives for the project.

BNSF requires a 20-foot distance between track centerlines for the length of any proposed bridge. Due to the constraint of the Puget Sound, it is assumed that the railroad embankment cannot be expanded to the west. Based on available aerial photography for the site, the existing track center line at the project site is approximately 14 feet. To gain the required track centers at the proposed new railroad crossing, the east track will have to be moved to the east approximately 6 feet for the proposed new opening. The realignment of the east track will also require widening the existing embankment towards the east along the entire length of the berm.

There are multiple superstructure types that would work for the proposed bridge. Steel is an option but is more expensive than concrete and the marine environment would be problematic. BNSF has multiple standard concrete structures that are feasible for use at the project location. The bridge layouts considered for the conceptual alternatives took into consideration horizontal clearance (required for creek flows), vertical clearances (required for pedestrian access underneath), cost, and speed of construction. More detail on railroad infrastructure considerations is provided in Appendix F.

4.2.4 Grant Opportunities

Opportunities for grant funding for the project are available from the State of Washington's Recreation and Conservation Office (RCO; http://www.rco.wa.gov/grants/index.shtml) through multiple programs. A project that is multi-faceted (i.e., includes recreational, ADA, water access, salmon, and habitat components) has a greater chance of securing funding from multiple sources. Therefore, the concepts were designed to provide multiple benefits. The goals of this Project fit well with many of the RCO grant funding opportunities. RCO grant funding programs that provide funding for habitat and recreational elements of the Project are listed in Table 6.

Table 6

RCO Grant Funding Opportunities Applicable to the Project

Grant Name	Grant Type	Years Available
Land and Water Conservation Fund-Water Access Category	Recreation-Waterfront Access	Even Numbered Years
Washington Wildlife and Recreation Program-Local Parks, Water Access, and Critical Habitat Categories	Recreation-Waterfront Access and Fish and Wildlife Habitat	Even Numbered Years
Aquatic Land Enhancement Account	Recreation-Waterfront Access and Fish and Wildlife Habitat	Even Numbered Years
Salmon Recovery Funding Board	Salmon Recovery-Statewide, marine and freshwater	Annually
Estuary and Salmon Restoration Program	Puget Sound and Strait of Juan De Fuca shoreline habitat protection and restoration	Annually

Addressing several of these elements within a proposed alternative would increase grant opportunities compared to addressing only a single element. A schedule with approximate time frames for relevant grant opportunities is provided as Figure 3.

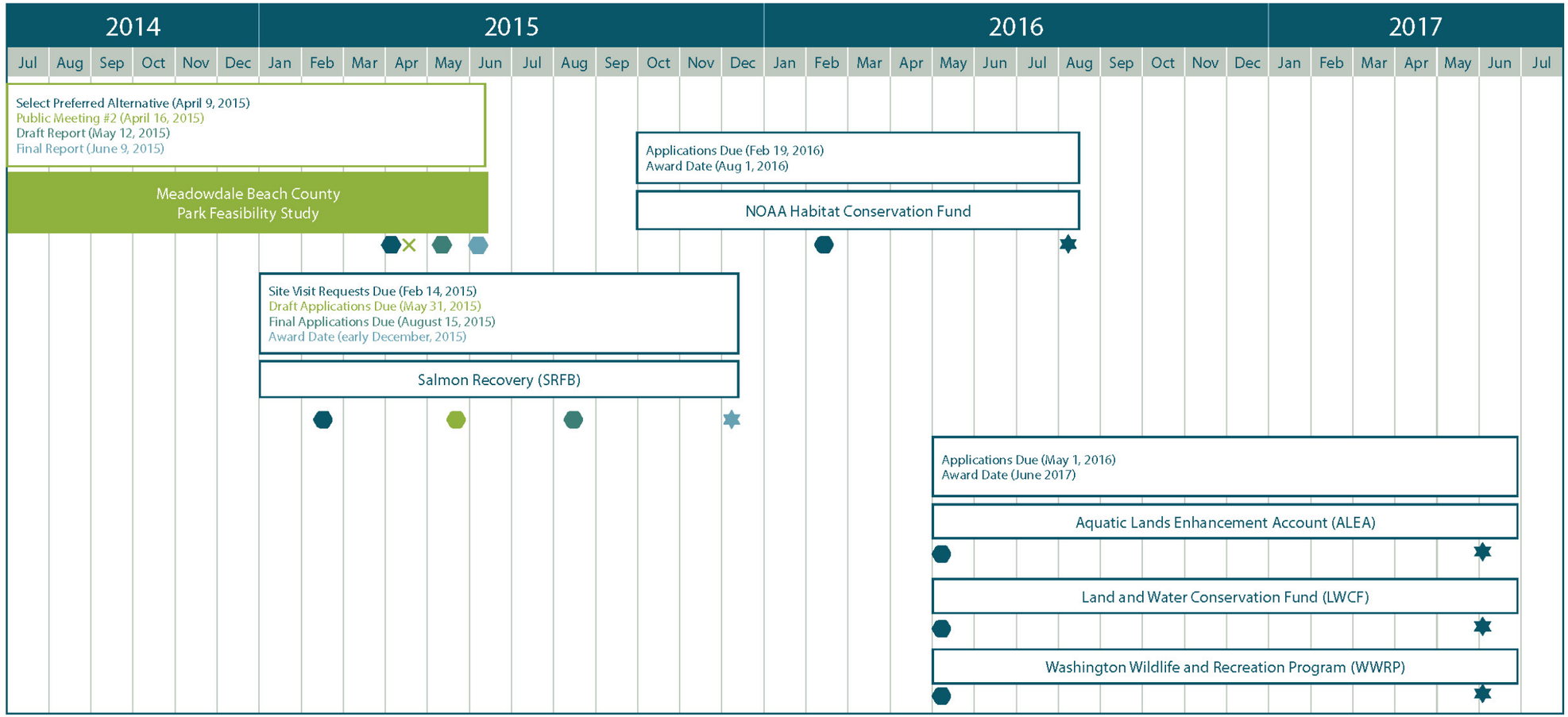
4.2.5 Alternatives Considered but Not Evaluated

The Anchor QEA team had two meetings with the County to review considerations for the proposed alternatives and discuss a range of potential solutions and improvements for the Park. Meeting summaries for these meetings are provided in Appendix G. As part of this discussion, several alternatives were considered but not chosen as one of the three conceptual alternatives moved forward in the feasibility evaluation. These options are described below, as well as reasons for not considering them further in this evaluation:

- Full restoration alternative, which would include construction of a 400-foot-wide bridge to remove the embankment along the entire length of the Park fronting Puget Sound: This alternative was considered too expensive to be feasible at this location. In addition, based on the results of the hydraulic analysis (Appendix B), a smaller opening size would be adequate to restore more natural flow and sediment transport conditions in the creek, as well as provide fish passage into creek.

- Additional larger box culverts: This alternative was not considered because it would require an open cut in the existing tracks/embankment to construct, as well as an approximate 24-hour work window to complete. This is not in-line with anticipated BNSF work windows allowed along this stretch of the line, which are expected to be between 3.5 and 6 hours.
- Pedestrian overpass: This alternative included a smaller bridge opening to address sediment flow and fish issues related to the existing culvert in order to meet the goals of the Project, in addition to the pedestrian overpass. In addition, due to topography at the site, the structure would be very tall, and would require a significant spiral-type ramp system to allow ADA-compliant access to the beach for pedestrians. The structure could be so large, and access inconvenient on the land side, that pedestrians may still go over the tracks to avoid using it. It would also carry a significant cost to construct and the pedestrian overpass by itself would not address many of the Project goals, such as habitat and sediment delivery/maintenance issues. It would also require construction of a platform on the beach close to or below ordinary high water, which could be a challenge to permit.

Grant Funding - Projected Schedule



Due Date
Grant Award Date
Meeting Date

Sources:

- NOAA: Deadlines projected based on 2012 Federal Funding Announcement (http://www.habitat.noaa.gov/pdf/NOAA_NMFS_HCPO_2013_2003587_Funding_Opportunity.pdf)
- SRFB: http://www.rco.wa.gov/grants/schedules/salmon.shtml
- ALEA, LWCF, WWRP: http://www.rco.wa.gov/grants/schedules.shtml

Meadowdale Beach County Park Feasibility Study

Snohomish County
Parks & Recreation Department and
Surface Water Mgt. Div./Public Works

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Figure 3
Grant Opportunities Matrix
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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4.3 Description of Conceptual Alternatives

The three conceptual alternatives for the project site are described in detail in the following sub-sections. All of the improvements described are proposed to occur within either the Park property boundary (which includes parcels within both unincorporated Snohomish County and the City of Edmonds) or the BNSF ROW, except for the restoration of the existing freshwater wetland north of Lund's Gulch Creek, which is located within a Snohomish County road ROW that will never be used for road purposes.

4.3.1 Alternative 1: Three-span Bridge, Combined Creek and Pedestrian Access Route

This alternative provides the minimum bridge opening and the least change in terms of lawn area conversion and other recreation-related changes to the lower Park. It consists of a three-span bridge, with a 30-foot clear center span, and two 25-foot abutment spans centered on the location of the current tunnel and creek outlet alignment. The north abutment span will require 15 feet for the rock-slope abutment for the bridge and allow 10 feet of additional width for the creek channel. The south abutment span will also require 15 feet for the rock-slope abutment for the bridge but will provide a 10-foot-wide path for pedestrian access to the beach. The pedestrian access path will be set to an elevation approximately 1.2 feet above current mean higher high water (MHHW) and will provide 80 inches of vertical clearance (meeting ADA requirements) from the path to the overhead bridge span.

A portion of the lower lawn area (16,100 square feet [sf]) will be converted to stream, marsh, and riparian habitat, and another 35,900 sf of habitat area will be restored by enhancing riparian vegetation and in-stream structures for a total restored habitat area of 52,000 sf, as shown in Figure 4. In addition, 7,650 sf of existing habitat will be enhanced upstream of the existing pedestrian footbridge across Lund's Gulch Creek by installing in-stream structures consisting of large woody debris, and by enhancing existing riparian vegetation. The loop path north of the proposed marsh will be truncated in order to avoid habitat fragmentation, and three picnic viewpoints will be established at the new path terminus. A new pedestrian bridge will be installed across the restored stream channel downstream of the existing pedestrian bridge, as shown in Figure 4. Drainage of the remaining lawn areas north of the existing volleyball court, as shown in Figure 4, will be improved by a combination of

subsurface drainage and regrading. Figure 4 shows a plan view of proposed improvements and Figure 5 shows a section/elevation view of the proposed opening.

4.3.2 Alternative 2: Existing Tunnel and Three-span Bridge to the North, Separated Creek and Pedestrian Access Routes

This alternative represents a midway between Alternatives 1 and 3 in terms of bridge size and extent of habitat restoration in the lower creek, as well as changes to the lawn area and recreation in the lower Park. It proposes a three-span bridge, with a 40-foot clear center span, and two 25-foot abutment spans located north of the current culvert location and creek outlet alignment. This will require re-alignment of the lower portion of the creek to accommodate the new location for the outlet. Both the north and south abutment spans will require 15 feet for the rock-slope abutment for the bridge and allow 10 feet of additional width (20 feet total) for the creek channel. The existing culvert will be separated from the creek channel alignment and modified for pedestrian access only with similar overhead clearance as currently exists on site. The pedestrian access path will be set to an elevation of approximately 10 feet North American Vertical Datum of 1988 (NAVD88), which is similar to its current elevation at the upstream end of the existing walkway. This configuration will not meet the ADA 80-inch vertical clearance requirement. Standing water may cover the path at tidal elevations higher than 10 feet NAVD88, which is a safety and ADA compliance issue. Removal of this water and any associated sediment will be difficult because the lower end will be a closed depression. All of the lower lawn area, 30,600 sf, will be converted to stream, marsh, and riparian habitat, and another 31,000 sf of habitat area will be restored by enhancing riparian vegetation and in-stream structures, for a total restored habitat area of 61,600 sf, as shown in Figure 5. In addition, 9,300 sf of existing habitat will be enhanced upstream of the existing pedestrian footbridge across Lund's Gulch Creek by installing in-stream structures consisting of large woody debris, and by enhancing existing riparian vegetation.

A new pedestrian bridge will be installed across the restored stream channel downstream of the existing pedestrian bridge. The northern path will be terminated just north of the proposed pedestrian bridge. A widened path section at the new terminus will accommodate a picnic viewpoint. Drainage of the remaining upper lawn area will be improved. Figure 6

shows a plan view of proposed improvements and Figure 7 shows a section/elevation view of the proposed opening.

4.3.3 Alternative 3: Four-span Bridge, Combined Creek and Pedestrian Access Route

This alternative represents the largest bridge span and provides the most conversion of lawn to natural habitat in the lower Park of the three alternatives presented. It consists of a four-span bridge, with two 40-foot clear center spans, and two 25-foot abutment spans centered on the location of the current culvert and creek outlet alignment. The north abutment span will require 15 feet for the rock-slope abutment for the bridge and allow 10 feet of additional width for the creek channel. The south abutment span will also require 15 feet for the rock-slope abutment for the bridge but will provide a 10-foot-wide path for pedestrian access to the beach. The pedestrian access path will be set to an elevation approximately 1.9 feet above MHHW and will provide 6 feet of vertical clearance from the path to the overhead bridge span, which is less than the 80-inch minimum required for ADA vertical clearance.

All of the lower and part of the upper lawn area (42,850 sf) will be converted to stream, marsh, and riparian habitat, with another 58,150 sf of habitat area restored by enhancing riparian vegetation and in-stream structures, for a total restored habitat area of 101,000 sf, as shown in Figure 8. In addition, 7,200 sf of existing habitat will be enhanced upstream of the existing pedestrian footbridge across Lund's Creek Gulch by installing in-stream structures consisting of large woody debris, and by enhancing existing riparian vegetation.

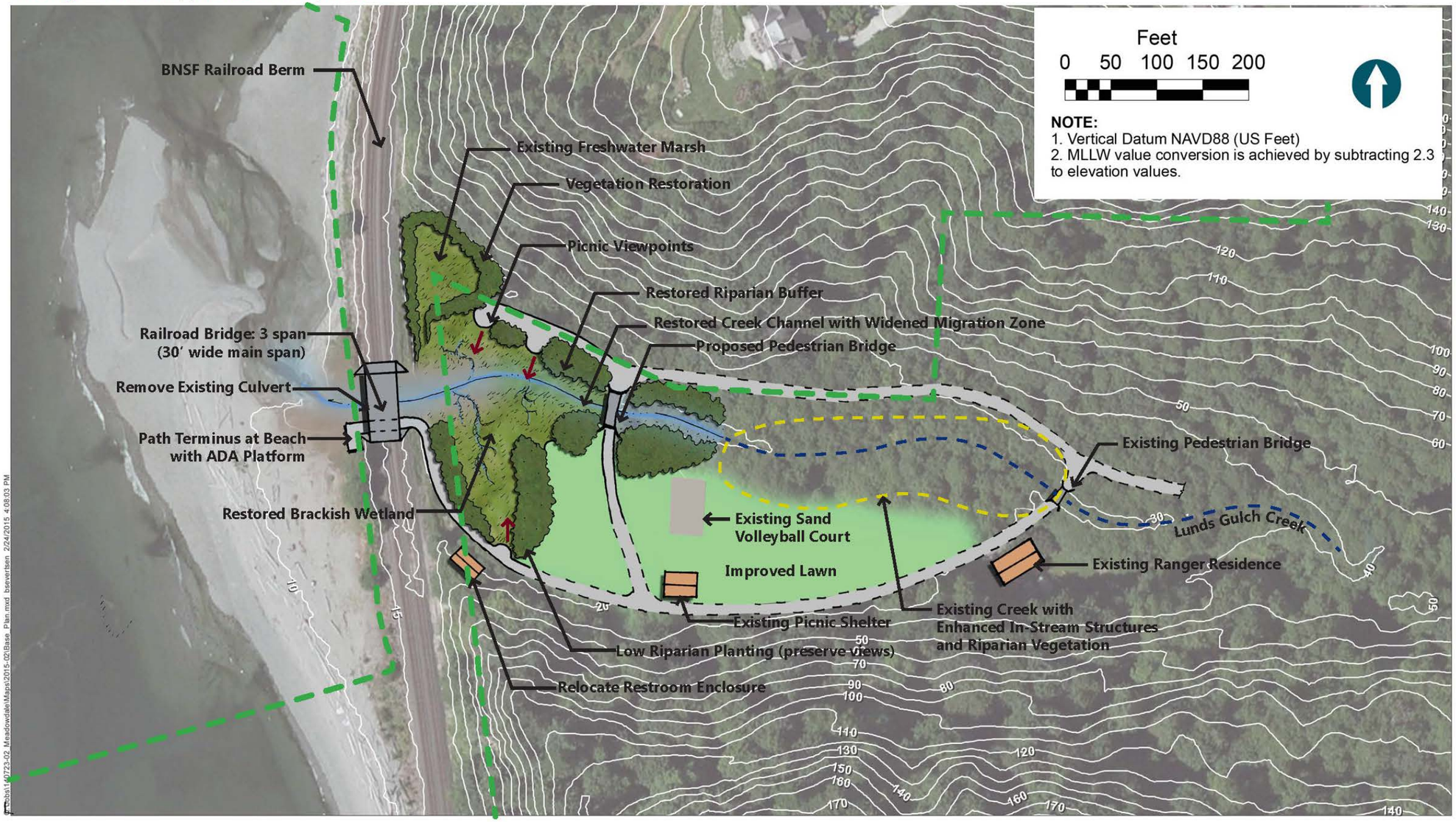
A new pedestrian bridge will be installed across the restored stream channel downstream of the existing pedestrian bridge. The path connecting the picnic shelter to the northern path will be partially realigned, and the loop path north of the proposed marsh will be truncated in order to avoid habitat fragmentation. Two picnic viewpoints will be established at the new path terminus. Drainage of remaining lawn areas will be improved and the volleyball court will be converted to lawn area. Figure 8 shows a plan view of proposed improvements and Figure 9 shows a section/elevation view of the proposed opening.

4.4 Conceptual Cost Estimates

Conceptual opinions of probable costs were developed for each of the three conceptual alternatives and are provided in Tables 7 through 9. These costs do not include costs associated with delays due to issues related to BNSF coordination (e.g., work windows being taken away during construction), construction management, monitoring, insurance and indemnification, railroad involvement during design and construction, and facility maintenance and ownership requirements. In addition, these costs do not reflect additional mobilization or other costs associated with constructability issues, which will be taken into consideration during refinement of the preferred alternative discussed in Section 5. These costs are appropriate for comparison of relative cost between the three proposed alternatives.

MEADOWDALE BEACH COUNTY PARK FEASIBILITY STUDY

Exhibits were prepared by Anchor QEA, LLC for Snohomish County for the "Conceptual Alternatives Discussion Meeting" on February 26, 2015.
Renderings were revised on 3/9/2015 based on County feedback.



Alternative 1: Three Span Bridge, Combined Creek and Pedestrian Access Route, 50% of Lower Lawn Converted to Habitat

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Figure 4
Plan View of Alternative 1
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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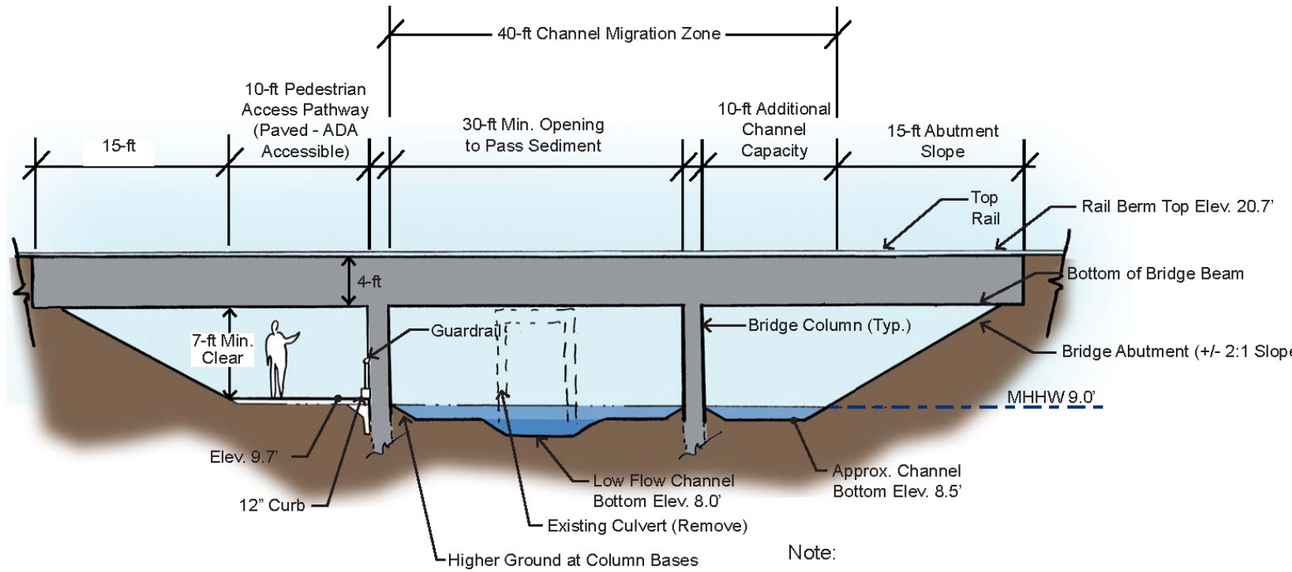

Elevation Looking West

Note:

1. The vertical datum is NAVD 88.
2. Channel elevations shown are conceptual, and will be verified or modified based on the results of the final hydraulic modeling study being completed as part of this work.

Alternative 1: Three Span Bridge, Combined Creek and Pedestrian Access Route, 50% of Lower Lawn Converted to Habitat

Figure 5
Section View of Proposed Opening for Alternative 1
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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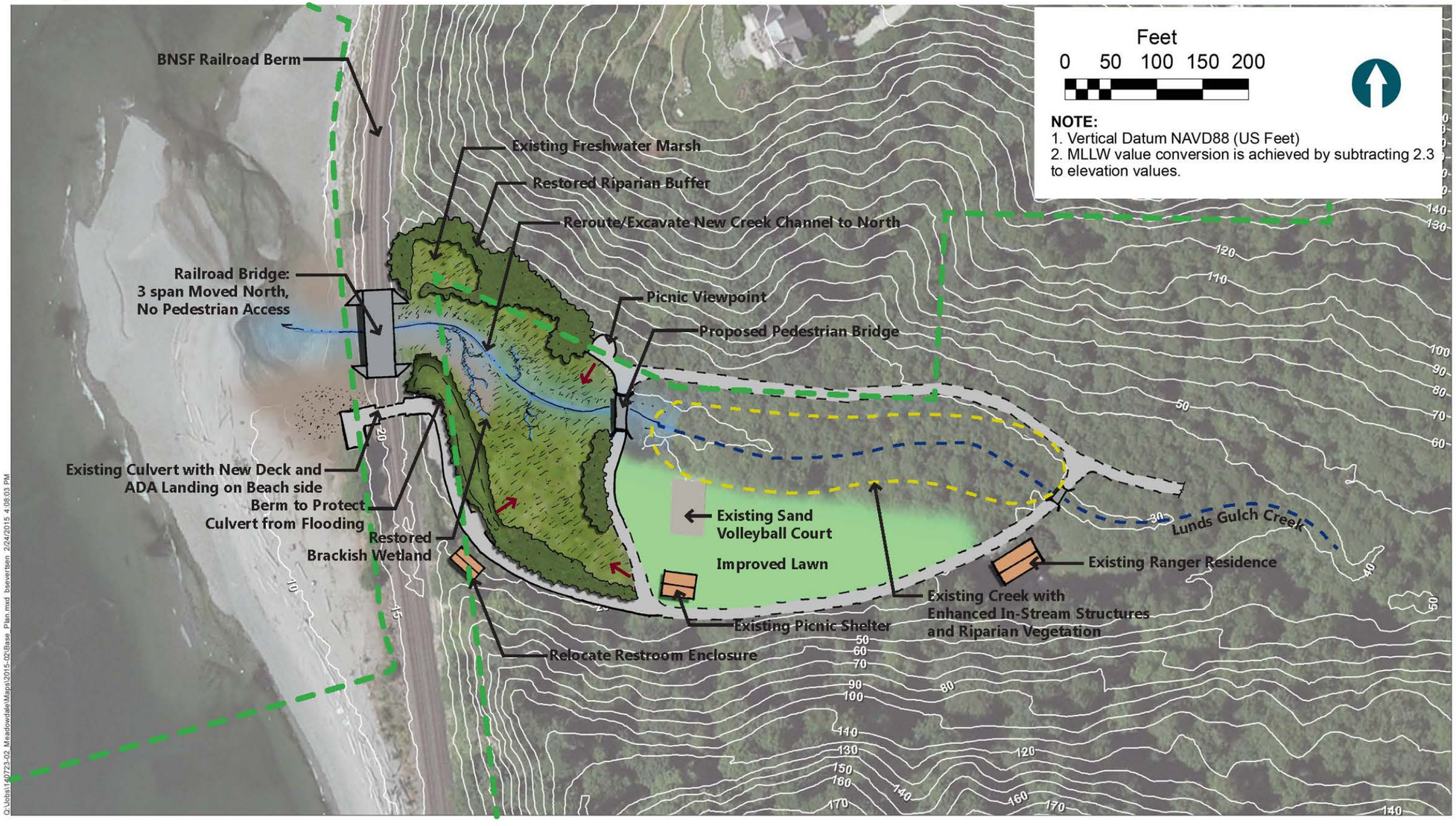

Alternative 2: Existing Tunnel and Three Span Bridge, Separated Creek and Pedestrian Access Routes, 100% of Lower Lawn Converted to Habitat

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Figure 6
Plan View of Alternative 2
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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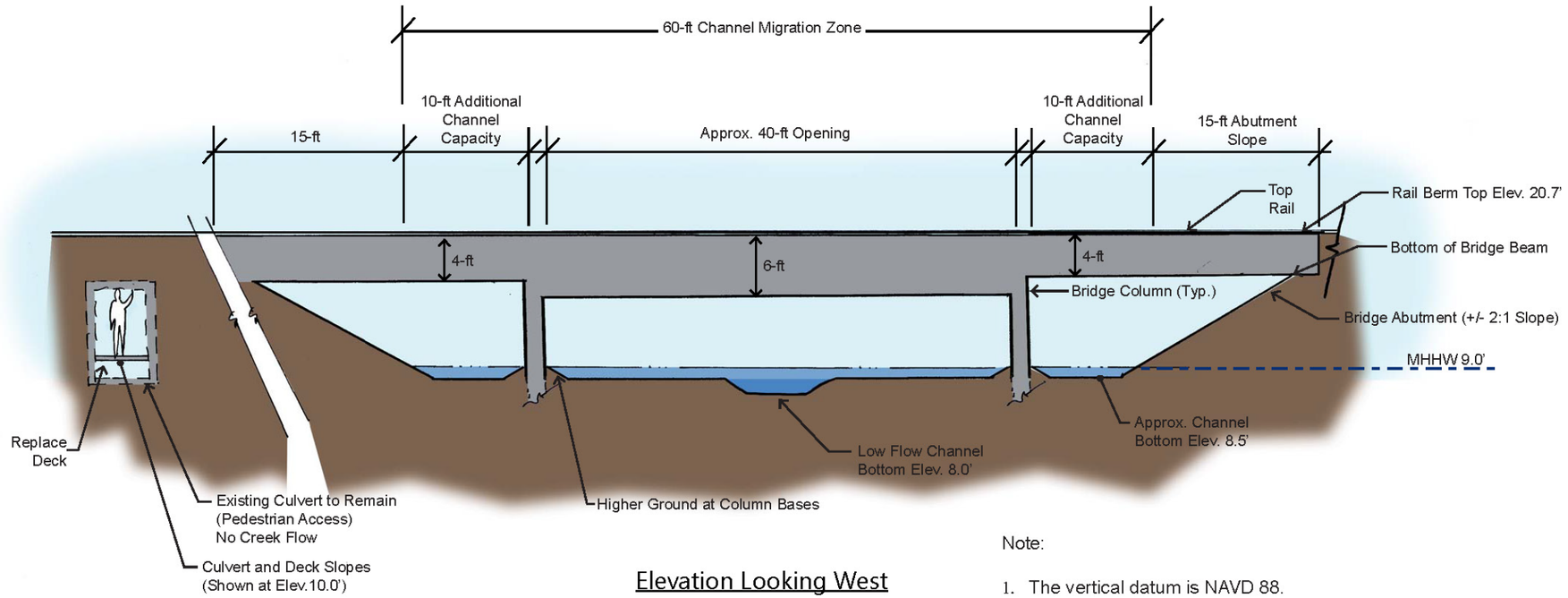

Elevation Looking West

Note:

1. The vertical datum is NAVD 88.
2. Channel elevations shown are conceptual, and will be verified or modified based on the results of the final hydraulic modeling study being completed as part of this work.

Alternative 2: Existing Tunnel and Three Span Bridge, Separated Creek and Pedestrian Access Routes, 100% of Lower Lawn Converted to Habitat

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MEADOWDALE BEACH COUNTY PARK FEASIBILITY STUDY

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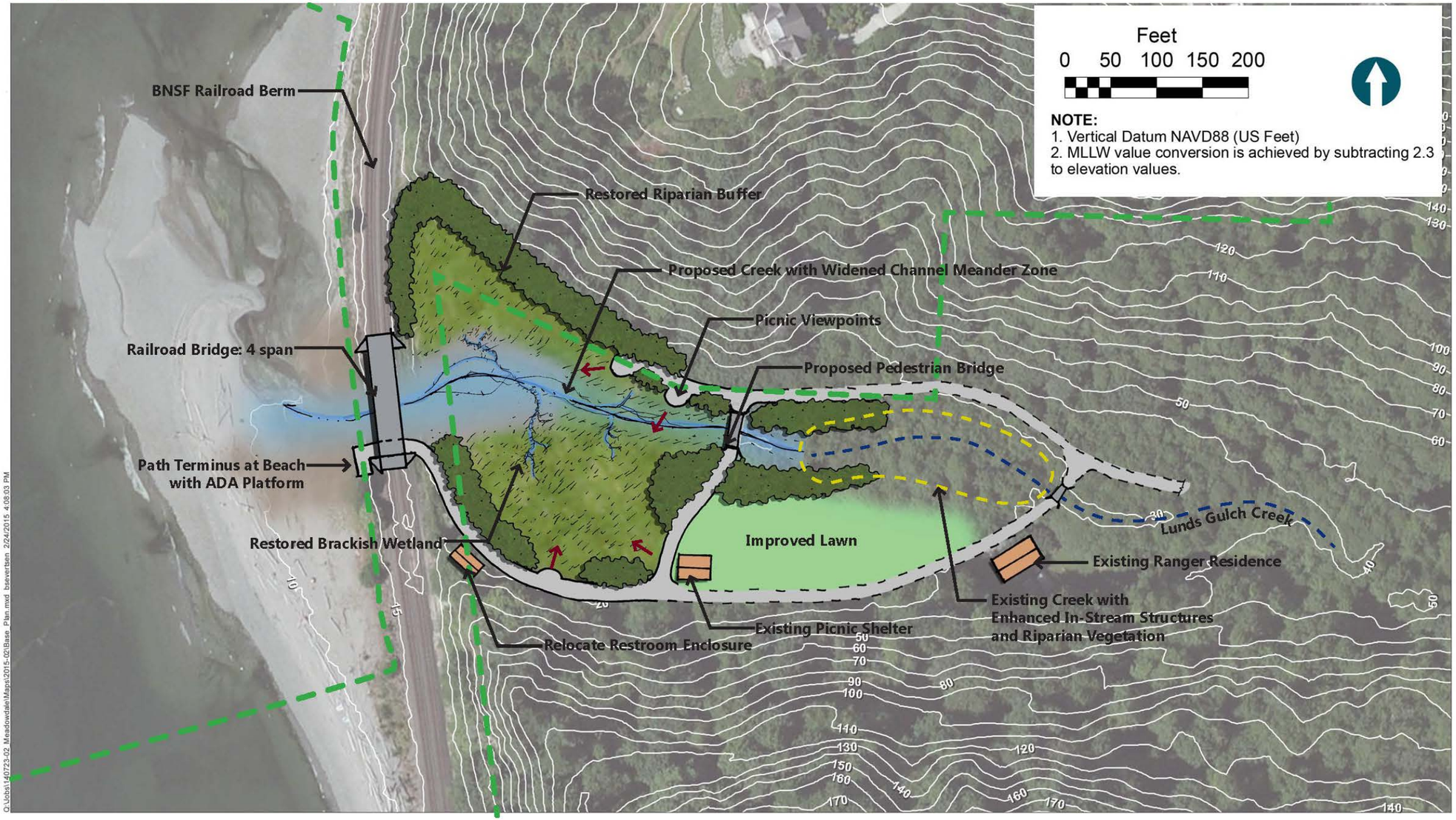

Alternative 3: Four Span Bridge, Combined Creek and Pedestrian Access Route, 100% of Lower Lawn and 30% Upper Lawn Converted to Habitat

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Figure 8
Plan View of Alternative 3
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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MEADOWDALE BEACH COUNTY PARK FEASIBILITY STUDY

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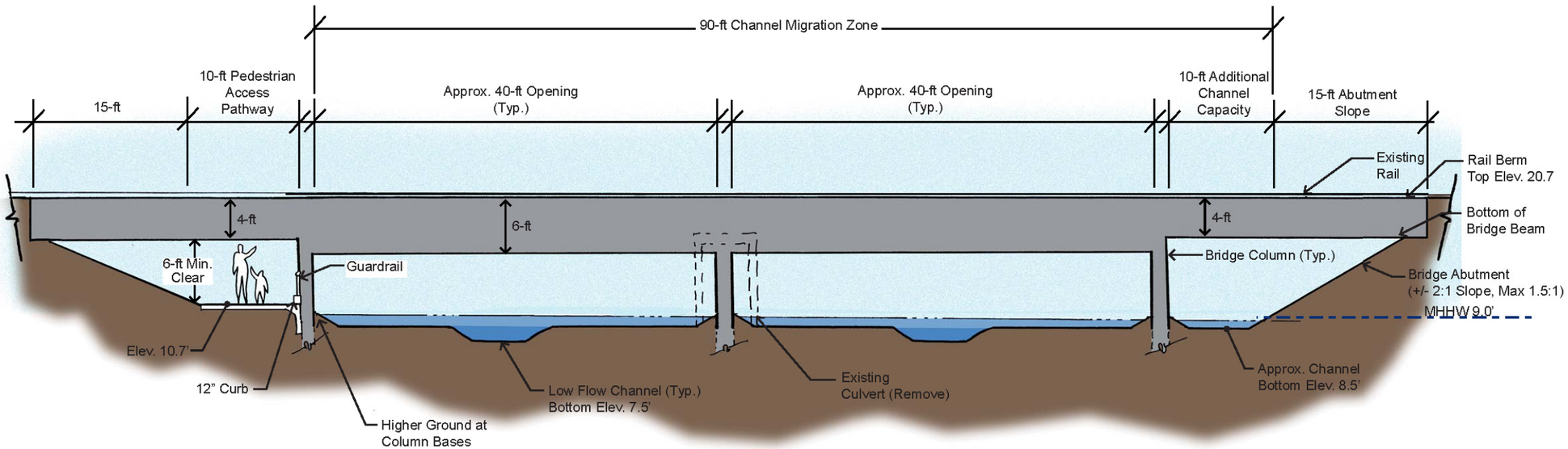

Elevation Looking West

Note:

1. The vertical datum is NAVD 88.
2. Channel elevations shown are conceptual, and will be verified or modified based on the results of the final hydraulic modeling study being completed as part of this work.

Alternative 3: Four Span Bridge, Combined Creek and Pedestrian Access Route, 100% of Lower Lawn and 30% Upper Lawn Converted to Habitat

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Figure 9
Section View of Proposed Opening for Alternative 3
Feasibility Report
Meadowdale Beach County Park Feasibility Study

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Table 7
Conceptual Opinion of Cost for Alternative 1

Alternative 1 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
Subtotal Temporary Facilities				**$ 52,730**
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 half 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. Railroad Bridge				
a. Railroad Bridge construction with shoo-fly (add 20% for work provided by BNSF)	1	LS	$3,181,455.00	$ 3,181,455
Subtotal Railroad Bridge				**$ 3,181,455**
5. Recreation Items				
a. Crushed rock trail (7" depth)	156	CY	$35.00	$ 5,444
b. Crushed gravel for asphalt base	60	Ton	$19.00	$ 1,140
c. Asphalt paving of trail	120	Ton	$70.00	$ 8,400
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				**$ 264,107**
6. Planting, Irrigation, and Large Woody Material				
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)	80	EA	$800.00	$ 64,000
i. Anchoring of half Large Woody Material in stream channel (1 piece every 20-ft of channel)	40	EA	$300.00	$ 12,000
Subtotal Planting, Irrigation, and Large Woody Material				**$ 217,734**
			Subtotal Construction	**$ 3,895,609**
			Mobilization 10%	**$ 389,560.91**
			Subtotal Construction + Mob.	**$ 4,285,170**
			Design & Construction Contingency (30%)	**$ 1,285,551**
			Subtotal Const.+ Mob.+ Conting.	**$ 5,570,721**
			Sales Tax (8.6%)	**$ 479,082**
			Subtotal Const. + Mob + Conting. + Tax	**$ 6,049,803**
			Total Cost*	**$ 6,050,000**

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, Insurance and Indemnification, Railroad Involvement during Design and Construction, Legal Costs associated with negotiating a Railroad Agreement, and Facility Maintenance and Ownership requirements.

Table 8
Conceptual Opinion of Cost for Alternative 2

Alternative 2 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	200	LF	$7.00	$ 1,400
d. Stream diversion and pumping	1	LS	$45,000.00	$ 45,000
Subtotal Temporary Facilities				**$ 58,080**
2.Demolition & Clearing				
a. Clear and grub vegetation	100900	SF	$0.25	$ 25,225
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	275	CY	$150.00	$ 41,250
Subtotal Demolition & Clearing				**$ 80,100**
3. Earthwork				
a. Cut and fill on-site	2,289	CY	$10.00	$ 22,889
b. Stockpile material for reuse	1,466	CY	$4.00	$ 5,864
c. Off-site disposal	823	CY	$35.00	$ 28,800
d. Channel substrate (extends to existing ped bridge)	1,333	Tons	$70.00	$ 93,333
Subtotal Earthwork				**$ 150,886**
4. Railroad Bridge				
a. Railroad Bridge construction with shoo-fly (add 20% for work provided by BNSF)	1	LS	$3,391,455.00	$ 3,391,455
Subtotal Railroad Bridge				**$ 3,391,455**
5. Recreation Items				
a. Crushed rock trail (7" depth)	133	CY	$35.00	$ 4,667
b. Crushed gravel for asphalt base	60	Ton	$19.00	$ 1,140
c. Asphalt paving of trail	120	Ton	$70.00	$ 8,400
d. Picnic viewpoints	2	EA	$4,500.00	$ 9,000
e. New restroom enclosure	1	LS	$65,623.02	$ 65,623
f. Pedestrian bridge	1	LS	$170,000.00	$ 170,000
Subtotal Recreation Items				**$ 258,830**
6. Planting & Irrigation				
a. Native deciduous tree (5 gal.), 12' O.C.	118	EA	$65.00	$ 7,670
b. Native coniferous tree (5 gal.), 12' O.C.	118	EA	$85.00	$ 10,030
c. Native coniferous tree (5 gal.), 30' O.C.	46	EA	$85.00	$ 3,910
d. Native shrubs (2 gal.), 6' O.C.	236	EA	$28.00	$ 6,608
e. Riparian groundcovers (1 gal), 4' O.C.	470	EA	$20.00	$ 9,400
f. Marsh groundcovers (10-inch plugs), 2' O.C.	12,400	EA	$4.00	$ 49,600
g. Hydroseed remaining lawn area	39,583	SF	$0.30	$ 11,875
h. Organic soil amendment (3" depth)	669	CY	$35.00	$ 23,398
i. Mulch (3" depth)	669	CY	$35.00	$ 23,398
j. Temporary irrigation (riparian areas and marsh buffer)	43,950	SF	$1.10	$ 48,345
k. Imported Large Woody Material in stream channel (1 piece every 10-L.F. of channel+10%)	88	EA	$800.00	$ 70,400
i. Anchoring of half Large Woody Material in stream channel	44	EA	$300.00	$ 13,200
Subtotal Planting & Irrigation				**$ 277,834**
			Subtotal Construction	**$ 4,217,185**
			Mobilization 10%	**$ 421,718.51**
			Subtotal Construction + Mob.	**$ 4,638,904**
			Design & Construction Contingency (30%)	**$ 1,391,671**
			Subtotal Const.+ Mob.+ Conting.	**$ 6,030,575**
			Sales Tax (8.6%)	**$ 518,629**
			Subtotal Const. + Mob + Conting. + Tax	**$ 6,549,204**
			Total Cost*	**$ 6,550,000**

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.

Table 9
Conceptual Opinion of Cost for Alternative 3

Alternative 3 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
Subtotal Temporary Facilities				**$ 63,220**
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				
a. Railroad Bridge construction with shoo-fly (add 20% for work provided by BNSF)	1	LS	$4,091,455.00	$ 4,091,455
Subtotal Railroad Bridge				**$ 4,091,455**
5. Recreation Items				
a. Crushed rock trail (7" depth)	122	CY	$35.00	$ 4,278
b. Crushed gravel for asphalt base	60	Ton	$19.00	$ 1,140
c. Asphalt paving of trail	120	Ton	$70.00	$ 8,400
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				**$ 267,441**
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 Construction	**$ 5,087,161**
			Mobilization 10%	**$ 508,716.07**
			Subtotal Construction + Mob.	**$ 5,595,877**
			Design & Construction Contingency (30%)	**$ 1,678,763**
			Subtotal Const.+ Mob.+ Conting.	**$ 7,274,640**
			Sales Tax (8.6%)	**$ 625,619**
			Subtotal Const. + Mob + Conting. + Tax	**$ 7,900,259**
			Total Cost*	**$ 7,901,000**

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.

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5 SELECTION OF PREFERRED ALTERNATIVE

Each of the three conceptual alternatives were evaluated against the project evaluation criteria (Table 1) through a series of studies, which included the following:

- Parks and Recreation ADA Access and Public Safety Evaluation (Section 5.1.1)
- Hydraulic and Sediment Analysis (Appendix B)
- Geotechnical/Geologic/Sediment Loading Evaluation (Appendix C)
- Fisheries and Habitat Evaluation (Appendix E)
- Railroad Infrastructure Evaluation (Appendix F)
- Coastal Analysis (Appendix H)
- Cultural Resources Evaluation (Appendix I)
- Phase 1 Environmental Evaluation (Appendix J)

The results of these studies are summarized in Section 5.1. Additional stakeholder meetings were held to solicit input from agencies, organizations, and the community on the proposed alternatives, as summarized in Section 5.2. Section 5.3 provides a qualitative ranking of the three conceptual alternatives based on each of the evaluation criteria, and Section 5.4 discusses selection and refinement of the preferred alternative for the project.

5.1 Results of Project Studies

This section provides a summary of the results of each of the studies conducted as part of the feasibility evaluation.

5.1.1 Parks and Recreation, ADA Access, and Public Safety

The three alternatives provide differing levels of safety, beach access improvements, and recreational opportunities. They will also reduce maintenance requirements and associated costs to differing degrees, but all of them will improve conveyance of stream flows and sediment through appropriately sized openings. Accommodating these processes will restore habitat for salmon, but also convert lower Park area, specifically lawn area, to habitat displacing some of the current lawn area and associated uses.

Table 10 analyzes the improvements for each of the park and recreation-related criteria established for the project to determine how effectively the objectives were met. Symbols used to compare the alternatives are as follows: + (meets objectives to a lesser degree), ++ (meets objectives to an intermediate degree) and +++ (meets objectives to the greatest degree).

Table 10
Summary of Parks and Recreation Study

Criterion	Alternative 1	Alternative 2	Alternative 3
Public Safety: Beach Access Across BNSF Right-of-Way	**++** The existing culvert will be replaced with a 3-span bridge that accommodates creek flows and a separate 10-foot-wide paved pedestrian path with an 80-inch clearance within the southern bridge abutment. Providing a path away from the main creek channel that is accessible for people of all abilities throughout the majority of the year will significantly improve pedestrian safety because there will not be the need to seek alternative means of accessing the beach. The surface elevation is 10.4 feet NAVD88, approximately 1.4 feet above MHHW elevation (2015). The path is anticipated to be passable in the dry during typical and high creek flows most of the year, except at tidal elevations higher than approximately 10.4 feet NAVD88, which is approximately 0.6% of the year (see Section 5.1.2.1).	**+** The creek will be rerouted to the north, which allows for the existing culvert to be used as a pedestrian access only. The culvert would no longer be subject to flooding and gravel deposition caused by creek flows, but would be impacted by inundation from higher tides from Puget Sound. The walkway is anticipated to be passable in the dry during most of the year, except at tidal elevations higher than 10 feet NAVD88, which is approximately 1.3% of the year (see Section 5.1.2.1). This separation of the beach access from the creek flow allows beach access for Park users in the dry for extended periods of time compared to existing conditions.	**+++** The existing culvert will be replaced with a 4-span bridge to convey creek flows and will include a 10-foot-wide pedestrian path with 6 feet of clearance to the overhead bridge span. The surface elevation of the proposed access path is 11.1 feet NAVD88, which is approximately 1.9 feet above the MHHW (2015) elevation. The path is anticipated to be passable in the dry during typical and high creek flows most of the year, except at tidal elevations higher than 11.1 feet NAVD88, which is approximately 0.3% of the year (see Section 5.1.2.1).
Pedestrian / ADA Access and Circulation	**++** Access to the beach under the proposed railroad bridge south abutment span includes a 10-foot-wide path, with a 6.7-foot (80-inch) minimum vertical clearance; these dimensions appear to provide an ADA-accessible route to the beach that is wide enough to allow disabled users to pass and/or turn around before reaching the path terminus on the beach-side of the railroad berm. However, because this path elevation is just slightly higher than the existing deck elevation within the existing culvert, water can flow onto the path at times, creating an obstruction for all users. The path terminus on the beach includes a 10- by 20-foot paved viewpoint that allows disabled visitors to enjoy the view, transfer to the beach, and not block the main path.	**+** Access to the beach is provided by the existing culvert that will have an improved deck, reflecting its purpose of moving people, rather than water. Even though this route will provide a 44-inch-wide access route, it appears that it will not be ADA-accessible because the current vertical clearance within the culvert will be less than 80 inches high. The width of the culvert will also preclude passing or turning around by mobility-disabled users, who will need to turn around or pass others at the terminus of the path on the beach-side.	**++** Access to the beach includes a 10-foot-wide path, with a 6-foot minimum vertical clearance. While this width appears to allow mobility-disabled users to pass and/or turn around before reaching the path terminus on the beach-side, the vertical clearance is not enough to provide ADA access for visually disabled Park users. However, the path elevation is higher than Alternative 1, which decreases frequency that channel sediment and/or water may flow onto the path, creating an obstruction for all users.
Integration of Habitat with Park Use (*The following criteria are combined under this criterion*:) ***Balance Public Access Opportunities with Habitat Protection (Conversion of Lower Lawn Areas to Habitat)***	**+** The habitat restoration area is the smallest with the most lawn area remaining. More than half (16,100 sf) of the existing lower lawn area will be converted to stream, marsh, and riparian habitat for a total habitat restoration area of (52,000 sf); 14,500 sf of the lower lawn area will remain; all of the upper lawn area will remain (see Figure 4). Drainage of the seasonally wet lawn area will be	**++** All of the lower lawn area (30,600 sf) will be converted to stream, marsh, and riparian habitat for a total habitat restoration area of (61,600 sf). All of the upper lawn area will remain and drainage of the seasonally wet lawn area will be improved extending its use beyond either end of the summer dry season (see Figure 6).	**+++** The habitat restoration area is the largest of the three alternatives and lawn area is reduced the most. The habitat conversion will extend beyond the existing path west of the picnic shelter and further upstream to the northeast, providing 101,000 sf of restored habitat area. All of the lower (30,600 sf) and part of the upper lawn area (12,200 sf; approximately 30%) will be converted

Criterion	Alternative 1	Alternative 2	Alternative 3
	improved extending its use beyond either end of the summer dry season.		to stream, marsh, and riparian habitat, and the volleyball court will be converted to lawn area (see Figure 8). The majority (25,800 sf) of the upper lawn area will remain, and drainage of the seasonally wet upper lawn area will be improved extending its use beyond either end of the summer dry season.
Ability to Provide Suitable Use Areas for Current and Anticipated Programs and User Groups, including Education Uses	**++** The proposed habitat restoration will provide the smallest increase in opportunities for educational and volunteer activities of the three alternatives. The limited scale expansion of marsh and riparian habitat provides equally limited opportunities for several of the related programs and uses that are occurring at the Park. However, the new beach access path will better accommodate group access to the beach, and the remaining seasonally wet lawn area would continue to accommodate gatherings of larger groups including gatherings for educational and volunteer activities.	**+** The proposed habitat restoration will increase opportunities for educational activities by providing more habitat complexity, benefiting the programs and uses that are occurring at the Park. More than half of the existing lawn area would remain to accommodate gatherings of larger groups. In addition, improving the drainage of the remaining seasonally wet lawn area will extend seasonal use of the area for gathering compared to existing conditions. However, group access via the existing culvert will still be a limiting factor, especially considering ADA access.	**+++** The proposed habitat restoration provides the largest increase in educational opportunities of the three alternatives in terms of the quantity, quality, and complexity of habitat to support the current and future programs and uses at the Park. The new beach access path will better accommodate group access to the beach, and the remaining lawn area will still provide enough space to accommodate gatherings of larger groups, especially if drainage is improved and the volleyball court is converted to lawn area.
Longer Paths, Less Conversion of Lawn	**+++** This alternative provides the longest paths, 120 feet longer than the paths for Alternative 2, and 50 feet longer than the paths for Alternative 3. The northern path will be terminated north of the marsh area and will be ADA accessible. Three picnic viewpoints are proposed within 100 and 150 feet from the new 3-span railroad bridge, and one picnic viewpoint is proposed west of the pedestrian bridge over the creek. The number of picnic spots in the lower park area will be maintained. All five picnic tables will either be relocated to the picnic viewpoints north of the marsh, or remain in the lower lawn area.	**+** This alternative provides the shortest path length, 120 feet less than Alternative 2, and 50 feet less than Alternative 3. A widened path section at the new terminus of the northern path just north of the proposed pedestrian bridge over the creek, will accommodate a picnic viewpoint with a picnic table. Two other picnic tables will be relocated at the upper lawn area just east of the path to the picnic shelter; two picnic spots would be eliminated.	**++** Alternative 3 provides 70 feet less path length than Alternative 1, but 50 feet more than Alternative 2. The northern path will be terminated north of the marsh area. This section of the path adjacent to the marsh will be ADA accessible. Two picnic viewpoints are proposed at the new path terminus within 200 and 250 feet of the new 4-span bridge opening. Two of the existing picnic tables will be relocated to these picnic viewpoints. Two other picnic tables will be relocated to the upper lawn area just east of the path to the picnic shelter; one picnic spot would be eliminated.
Views	**++** The proposed railroad bridge opening is the shortest of the three alternatives, but still offers attractive views of the marsh area and the creek as it flows through the opening to the beach. This can be viewed from paths, the pedestrian bridge, and the proposed picnic viewpoints north of the marsh, as well as from the beach looking back into the marsh. The proposed picnic viewpoints north of the marsh will be elevated and provide scenic views across the marsh towards Puget Sound.	**+** For Alternative 2, the restored creek can be viewed from the pedestrian path bridge and the adjacent picnic viewpoint, but there are no elevated picnic viewpoints and the path is furthest from the bridge, resulting in the fewest viewing opportunities of the three alternatives. While the proposed railroad bridge is longer than the one in Alternative 1, the top beam is thicker, obscuring part of the view towards the beach. This alternative contains more riparian buffer plantings around the proposed marsh, and a planted berm is proposed between the marsh and the beach access culvert. As a result, views will be less open than in Alternative 1. A view corridor through the riparian buffer is	**+++** Alternative 3 provides the longest bridge opening and will provide Park personnel with a wider view corridor of the beach activity. The picnic viewpoints north of the marsh and the pedestrian path bridge allow for views of the creek as it meanders through the marsh area and underneath the proposed 4-span railroad bridge to the shoreline. Equally, the creek and the marsh area can be viewed from the beach through the bridge opening. Breaks in the riparian buffer vegetation allow for views from the picnic shelter and the path west of it. The proposed picnic viewpoints north of the marsh will be elevated and provide scenic views across the marsh towards Puget Sound.

Criterion	Alternative 1	Alternative 2	Alternative 3
		proposed to provide open views of the marsh from the picnic shelter.	
Facility Relocation	**+++** The existing restroom enclosure will be relocated from its current location near the existing culvert to a flat area that is relatively dry at the toe of the slope on the southern side of the ravine adjacent to the existing path and railroad berm. This area is considerably higher than the current location.	**+++** The existing restroom enclosure will be relocated from its current location near the existing culvert to a flat area that is relatively dry at the toe of the slope on the southern side of the ravine adjacent to the existing path and railroad berm. This area is considerably higher than the current location.	**+++** The existing restroom enclosure will be relocated from its current location near the existing culvert to a flat area that is relatively dry at the toe of the slope on the southern side of the ravine adjacent to the existing path and railroad berm. This area is considerably higher than the current location.
Operations and Maintenance	**++** The wider opening for creek flows under the 3-span railroad bridge proposed in Alternative 1 is expected to considerably reduce maintenance efforts and associated staff time. The pedestrian path may at times be covered with standing water (due to extreme high tides and creek flows, see Section 5.1.2.1) and associated sediment due to the surface elevation of the path that was set to achieve an 80-inch overhead clearance to meet ADA access requirements. The path is designed to drain as water levels recede, but some sediment may remain and would need to be removed. Beach access for maintenance equipment and emergency vehicles will be improved. Alternative 1 retains more lawn area to be mowed. The lawn along with the volleyball court will also continue to require maintenance associated with Lund's Creek Gulch overflowing its banks upstream of the restoration area.	**+** For Alternative 2, the box culvert continues to provide the only beach access. The low bottom elevation of the culvert leaves it vulnerable to water entering during higher tidal levels, but will be separated from water level due to higher creek flows; berms at both ends of the culvert are proposed to prevent creek overflow from entering. However, this measure will also prevent water and sediment from clearing the culvert if flooding does occur during an extreme flood event. Maintenance to remove water and sediment from the culvert's bottom would be required. Maintenance and emergency access to the beach will continue to be limited to the existing culvert and will not be improved over existing conditions. Alternative 2 proposes a larger habitat restoration area retaining less lawn area to be mowed than Alternative 1 but also retains the volleyball court. The lawn area and the volleyball court will continue to require maintenance associated with Lund's Gulch Creek occasionally overflowing its banks upstream of the restoration area.	**+++** The opening under the 4-span railroad bridge proposed in Alternative 3 is expected to considerably reduce the frequency of maintenance efforts and associated staff time to clear sediments for beach access. Similar to Alternative 1, the path is designed to drain as water levels recede, but some sediment may remain and would need to be removed. The path is set at a higher elevation than the path in Alternative 1 and, while this reduces overhead clearance to 6 feet, the path is expected to be covered with standing water and require maintenance less frequently than Alternative 1. Beach access for maintenance equipment and emergency vehicles will be greatly improved over existing conditions similar to Alternative 1. Alternative 3 retains the least lawn area to be mowed of all three alternatives. The volleyball court will be removed and the upper lawn area is further reduced and converted to habitat, reducing maintenance associated with high flow events in Lund's Gulch Creek.

Notes:
ADA = Americans with Disabilities Act
BNSF = Burlington Northern Santa Fe Railway
MHHW = mean higher high water
NAVD88 = North American Vertical Datum of 1988
sf = square foot

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5.1.2 Hydraulic Analysis, Sediment Transport, Coastal Processes, and Sea Level Rise

The hydraulic model used to evaluate the required opening size for the project (see Section 4.2.1) was used to evaluate the hydraulics of each proposed alternative. Table 11 provides a summary of the geometry of the opening in the model for each of the proposed alternatives.

Table 11
Railroad Bridge Opening Input Summary

Proposed Condition[a]	High Flow Channel Width (feet)	No. of Piers	Elevation of Pedestrian Walkway Under Bridge (feet NAVD88)[c]
Alternative 1	50[b]	2	10.4
Alternative 2	60	2	10.0 (Separated Access, influenced by tidal elevations only)
Alternative 3	100[b]	3	11.1

Notes:
a. See Figures 4 through 9 for plan and section views of proposed alternatives.
b. An additional 10 feet of high flow channel width is assumed, to include the flooded pedestrian walkway.
c. Mean higher high water elevation is 9.0 feet NAVD88; annual maximum tide is 10.7 feet NAVD88.
N/A = not applicable; NAVD88 = North American Vertical Datum of 1988

5.1.2.1 Inundation of Proposed Pedestrian Walkway

Inundation of the proposed pedestrian walkway was evaluated based on tidal elevations for all alternatives and a combination of tidal elevations and higher flows in Lund's Gulch Creek for Alternatives 1 and 3. Alternative 2 utilizes the existing culvert for pedestrian access but separates it completely from the creek flow; thus, it is only vulnerable to tidal inundation from Puget Sound. The elevations of the pedestrian walkway under the proposed railroad bridge for Alternatives 1, 2, and 3 are provided in Table 11, and are 10.4, 10.0, and 11.1 feet NAVD88, respectively. Historical, and current, hourly tidal data are available for the National Oceanic and Atmospheric Administration (NOAA) tide gage at Seattle (No. 9447130).[1] Evaluation of these hourly tide data over one year (2014) suggests that tides are greater than 10.4 feet NAVD88 (12.4 feet MLLW) approximately 0.6% of the year,

[1] Mean higher high water is 9.0 feet NAVD 88 (11.0 feet MLLW) based on the Seattle tide gage.

greater than 10.0 feet NAVD88 (12.0 feet MLLW) 1.3% of the year, and greater than 11.1 feet NAVD88 (13.1 feet MLLW) approximately 0.3% of the year.

Model results suggest that the existing culvert's pedestrian walkway is currently inundated by over 1 foot during a 100-year discharge at MHHW and would continue to inundate as sea levels rise. Results show that Alternative 1 currently maintains freeboard during a 100-year event but is inundated slightly at annual maximum tide. By 2050, inundation during a 100-year event at the annual maximum tide would increase to approximately three quarters of a foot in depth. Alternative 3 maintains freeboard during a 100-year event at MHHW and the annual maximum tide for every scenario modeled through the year 2050. By the year 2100, all proposed alternatives will begin to become inundated by the tide alone (regardless of creek discharge) at MHHW and will be significantly inundated (a minimum of 1.0 foot) at annual maximum tide (regardless of creek discharge).

5.1.2.2 Sediment Transport Potential Through the Proposed Opening

At the 2-year flow, the wider opening proposed for all three alternatives will allow sediment from the creek to accrete within the new opening as the estuary expands upstream of the railroad berm once the constriction at the mouth of the creek is removed. At higher flows (10-year and 25-year), the sediment transport potential in the creek is increased compared to existing conditions. This indicates improved sediment transport capacity through this reach due to proposed alternatives; similar improvements are predicted for all alternatives within the precision of the evaluation. However, the model results also indicate that the wider the opening, the lower the average channel sediment transport capacity. The lower average channel sediment transport capacity would more likely result in a dynamic channel through the opening because the sediment supply is more likely to periodically exceed the transport capacity.

5.1.2.3 Impacts to Coastal Processes

Impacts to existing coastal processes were evaluated for each of the proposed alternatives, specifically potential for channel migration, sediment transport and distribution on the delta, and wave impacts inside the Park (landward of the existing railroad berm).

Potential for Channel Migration

Alternative 1 increases the width of the channel at the mouth from 6 feet (existing culvert tunnel) to 40 feet, providing a larger area for the creek to migrate. Based on results of the Hydrology and Hydraulics Study, sediment load from Lund's Gulch Creek will accumulate just upstream and within the new opening, as well as downstream of the opening on the delta. At higher flows, the accumulated sediment within the creek mouth will be mobilized in the flow and transported farther out onto the delta. This ongoing process of sediment accumulation and transport will allow for more complexity in the channel alignment at the mouth, including the potential for multiple or braided channels to form. The flowpaths, size, and number of channels formed at the mouth will be dynamic over time and dependent on recent sediment supply and deposition from upstream, tides, and storm waves from Puget Sound. Alternative 2 increases the width of the channel at the mouth from 6 feet (existing culvert tunnel) to 50 feet. The impacts on channel migration potential for this alternative are in line with those for Alternative 1. However, the creek will be re-aligned to the north of its current (and historical) alignment as part of this alternative. This would require additional modifications to the creek farther upstream than for Alternative 1 in order to develop a sustainable new alignment for the channel at the creek mouth, and there is a potential that the creek could migrate back to the original location. Alternative 3 increases the width of the channel at the mouth from 6 feet (existing culvert tunnel) to 90 feet, providing a significantly larger area for the creek to migrate. The impacts on channel migration potential for this alternative are also in line with those for Alternative 1. However, the significantly larger opening for the creek (compared to Alternatives 1 and 2) will provide opportunity for significantly more complex channel formation at the mouth.

Sediment Transport and Distribution on the Delta

Alternative 1 will allow all of the sediment load from the creek to stay within the creek migration zone at the mouth and eventually be transported to the delta and beach. At present, much of this sediment load is impounded upstream of the existing culvert/tunnel and removed from the system in order to maintain pedestrian access to the beach. Sediment that can be transported though the culvert is deposited on the delta within a narrow reach downstream of the culvert. The wider opening proposed for Alternative 1 will allow sediment to be deposited within a wider area at the mouth, but upstream and within the

opening and downstream on the delta. The changes to sediment transport patterns will allow the delta to grow inland (as well as waterward) and will likely extend upstream of the new opening into the Park area. In addition, lack of directed flow out of the culvert during high-flow events may alter the creek migration patterns on the delta. The energy from high flows in the creek will be distributed over a greater area, and it will likely require a larger flow to breach the berm on the delta and create a straight channel. The location and orientation of the berm on the beach may also change as sediment is deposited in different areas of the delta, as opposed to primarily in front of the existing culvert/tunnel.

The sediment load estimated for Lund's Gulch Creek is 80 cubic yards annual average; however, sediment delivery to the creek is episodic with an average of 400 cubic yards transported through the creek for a single large rainfall event. Using the lower end of the probable range of littoral drift rates for the site (150 to 300 cubic yards per year); sediment from one large rainfall event (400 cubic yards) could be retained on the delta for up to 2.5 years. Depending on the frequency and timing of large rainfall events and larger wind-wave events, the delta is likely to go through periods of growth and erosion oscillating around an average shoreline location.

Alternative 2 will have similar impacts to sediment transport and deposition on the delta as Alternative 1. The main difference is that the creek outlet will be moved north of its current (and historical) condition. The sediment depositional area on the delta will therefore be moved to the north, and the delta will likely go through a transition phase following construction of Alternative 2. Sediment on the southern portion of the delta may begin to erode due to lack of replenishment from upstream and the net littoral drift to the north. The northern portion of the delta will expand as sediment is deposited directly in that area from upstream creek flow. The net littoral drift to the north may also move the extent of the delta farther to the north than its current extent. Over time, the entire delta will likely shift somewhat to the north.

Alternative 3 will have similar impacts to sediment transport and deposition on the delta as for Alternative 1. As with potential for channel migration, the much larger opening will provide opportunity for sediment distribution and transport over a much larger area than either Alternatives 1 or 2. This growth of the delta upstream of the opening will most likely

be larger (across channel) than for the other alternatives. In addition, sediment deposited in some areas of the mouth may have a higher retention time in the opening compared to Alternatives 1 and 2 because this opening is much larger than is required for efficient sediment transport at high flows. It is possible over time that sediment deposited during a high-flow event will remain outside the influence of the creek channel long enough to become vegetated. This could result in permanent filling in of portions of the creek mouth if the entire width of the creek migration zone under Alterative 3 is not required to support creek hydraulics.

Potential for Wave Impacts Inside the Park

Storm waves from Puget Sound move sediment on the outer portions of the delta forming berms at or near the MHHW line. These berms act as natural wave breaks for storm waves, thus protecting the backshore areas of the delta from erosion due to direct wave impact. Alternative 1 should allow for continued formation of these berms and may be beneficial to berm formation due to increased sediment load reaching the nearshore area. In addition, the elevations of the backshore area of the delta are at or above MHHW elevation (including the current channel thalweg). Sediment deposition within the opening and out onto the delta is expected to keep elevations in these areas above MHHW. Therefore, the wider opening constructed as part of Alternative 1 is not expected to increase potential for wave impacts inside the Park. Alternative 2 will behave similarly to Alternative 1 in terms of storm wave impacts. It is not expected that Alternative 2 will increase potential for wave impacts inside the Park. Alternative 3 will behave similarly to Alternatives 1 and 2 in terms of storm wave impacts. However, if sediment is retained within the opening for longer periods of time than the other alternatives (or indefinitely), there may be less sediment being transported out on the delta. This could result in decreased berm formation and subsequent increase in impacts to backshore areas of the delta from direct wave impact, but that energy would likely be attenuated by the larger estuary.

5.1.2.4 Sea Level Rise

The elevations of the backshore area of the delta are approximately 1 to 3 feet above current MHHW (see Table 1). Elevations of low-lying areas just upstream of the opening are approximately 3.5 to 4 feet above current MHHW (2015). For mid-range sea level rise

predictions for 2030 (0.2 foot), no significant changes to coastal processes or creek function are expected. By 2050, the increase in sea levels is predicted to be just over 0.5 foot, which will result in increased flooding in the Park area during higher tides and some landward movement of the shoreline of the delta. The delta could potentially expand into the Park through and upstream of the opening in order to retain backshore beach area. In 2100, mid-range sea levels are expected to be 2 feet higher than the present. This will have a significant impact to the delta because much of the existing delta will be submerged at higher tides. Flooding in the lower reaches of the Park near the mouth will likely be severe; the restored estuary area inside the Park (shown in Figures 4 through 9) for all alternatives will become larger by 2100 and the recreational area within the Park and on the beach will be significantly depleted. It is possible that continued sediment loads from Lund's Gulch Creek will build up the mouth upstream of the opening, and a pocket beach area will form within the mouth and lower reaches of the Park. However, this assumes sediment loads remain the same or increase in the future.

5.1.2.5 Summary

A relative comparison of each alternative to meet evaluation criteria related to hydraulics, sediment transport, coastal processes, and sea level rise is provided in Table 12. As the alternative with the widest bridge opening and the largest transition zone, Alternative 3 provides the greatest benefits for the habitat criteria evaluated and will best restore stream, estuarine, and nearshore processes in the project area (as summarized in Table 12).

Table 12
Summary of Relative Hydraulic and Coastal Process Benefits of Each Alternative

Criterion	Alternative[a]		
	1	2	3
Sediment Transport Through the Opening (Within the Creek)	+++	+++	+++
Potential for Channel Migration	++	+	+++
Sediment Transportation and Distribution on the Delta	++	+	+++
Ability to Adapt to Sea Level Rise	++	+	+++

Note:
a. The relative benefits of the three alternatives were summarized symbolically by assigning + (least benefit), ++ (intermediate benefit), or +++ (greatest benefit).

5.1.3 Habitat Restoration Opportunities

All three alternatives entail restoring the Lund's Gulch Creek connection to Puget Sound by constructing a railroad bridge that will alleviate the flooding and sediment impoundment problems that currently exist due to the significantly undersized culvert. Each alternative also includes restoration of the upper estuary (transition zone), lower creek, and riparian corridor. As a result, all three alternatives would significantly improve habitat conditions in Lund's Gulch Creek, its estuary, and the nearshore. The differences in the benefits for ecological restoration and fish habitat are primarily related to the size of the bridge opening and the size of the restored transition zone. Habitat benefits are of greater magnitude and higher certainty with a wider bridge opening and a larger transition zone. As the alternative with the widest bridge opening and the largest transition zone, Alternative 3 provides the greatest benefits for the habitat criteria evaluated and will best restore stream, estuarine, and nearshore processes in the project area (summarized in Table 13). The width of the bridge opening and the large transitions zone included in Alternative 3 provide the highest degree of certainty that there is sufficient area for the restored habitats to naturally evolve and adapt to changing conditions over time, such as increased tidal inundation resulting from sea level rise. Alternative 3 would provide the greatest resilience for the park to adapt to changes associated with sea level rise and a changing climate.

Table 13
Summary of Relative Habitat Benefits of Each Alternative

Criterion	Alternative[a]		
	1	2	3
Quantity and Diversity of Nearshore Habitat Waterward of Railroad Crossing	++	+	+++
Juvenile Salmon Fish Passage Conditions into Lower Creek	+++	+++	+++
Size of Transition Zone between Saline and Freshwater Habitats	+	++	+++
Quality of Lund's Gulch Creek Habitat	+++	+++	+++
Quantity and Quality of Riparian Vegetation along Stream and Nearshore	+++	+++	+++
Quality of Freshwater Wetland	+	+++	++
Habitat Connectivity for Non-fish Species	+	++	+++

Note:
a. The relative benefits of the three alternatives were summarized symbolically by assigning + (least benefit), ++ (intermediate benefit), or +++ (greatest benefit).

The possible relocation of the creek mouth to a more northerly location as shown in Alternative 2 is not justified for habitat purposes. The proposed relocation does not restore the creek to a historic alignment. The relocation would be expected to have a negative impact on habitat conditions waterward of the railroad because it would shorten an estuarine channel system that currently provides more productive rearing habitat for juvenile salmonids. Overall, the project provides a meaningful opportunity to restore habitats and ecosystem processes. In addition to providing significant habitat benefits, restoration in Park settings offers exceptional opportunities to educate people on the natural resources of the Park, the purposes of individual habitat components, and the importance of self-sustaining designs.

5.1.4 Railroad Infrastructure Evaluation

TKDA conducted a structural evaluation based on proposed project alternatives. Much of this work was done as part of the alternatives development phase of the work, to ensure proposed alternatives were in line with BNSF standards (see Section 4.2.3). The detailed structural analysis conducted by TKDA is provided in Appendix F. A summary of that evaluation, as it applies to choice of preferred alternative, is provided in this section.

Bridges proposed for all three alternatives meet BNSF standards and would be subject to the same constraints on construction access and requirements for BNSF coordination. TKDA had preliminary discussions regarding the proposed bridge with BNSF Railway staff to determine their design requirements and possible flexibility in applying these design guidelines. This discussion resulted in two comments that impact the design:

- Windows for interrupting railroad traffic will be limited to a maximum of 6 hours, and could be as short as 3.5 hours.
- 20-foot tracks centers are required at the bridge.

There are multiple superstructure types that would work for the proposed bridge. Steel is an option but is more expensive than concrete. BNSF has multiple standard concrete structures that are feasible. Our evaluation of the crossing, taking into consideration horizontal and vertical clearances, cost, and speed of construction, resulted in our recommendation for the

use of prestressed concrete superstructures. Three bridge layouts were developed; plan views and sections for each bridge are also provided in Appendix F:

- Alternative 1: Three-span bridge with 30-foot main span
  - Main span: 30-inch double cell box beams
    - The structure depth from top of tie to low chord: 45 inches
  - First/last spans: 20-inch concrete slab beams
    - The structure depth from top of tie to low chord: 35 inches
- Alternative 2: Three-span bridge with 40-foot main span
  - Main span: 36-inch single cell box beams
    - The structure depth from top of tie to low chord: 51 inches
  - First and last spans: 20-inch concrete slab beams
    - The structure depth from top of tie to low chord: 35 inches
- Alternative 3: Four-span bridge with two 40-foot main spans
  - Main spans: 36-inch single cell box beams
    - The structure depth from top of tie to low chord: 51 inches
  - First and last spans: 20-inch concrete slab beams
    - The structure depth from top of tie to low chord: 35 inches

There are two options available to construct any of the bridges proposed in the conceptual alternatives. The first option would use shoo-fly tracks. (A shoo-fly track temporarily relocates tracks to allow for conventional and uninterrupted bridge construction. In this specific application, the proximity of Puget Sound waterward of the existing track alignment, as well as the adjacent steep bluffs landward of the existing track alignment, diminishes the constructability of a shoo-fly track). The second option would not use shoo-fly tracks and would require construction during multiple 6-hour work windows. Constructing a high speed shoo-fly track along the landward side of the existing railroad embankment is challenging because of the adjacent steep bluffs. These bluffs would need to be excavated to construct the shoo-fly track, and this would be both risky and cost prohibitive (see Geotechnical Evaluation, Appendix C). Construction of the shoo-fly track on the water-ward side of the tracks would be very difficult to permit due to encroachment of the

constructed berm below ordinary high water. A relative comparison of each alternative based on evaluation criteria relative to railroad infrastructure is provided in Table 14.

Table 14
Summary of Relative Railroad Infrastructure Benefits of Each Alternative

Criterion	Alternative[a]		
	1	2	3
Consistent with BNSF Standards	+++	+++	+++
Constructible within BNSF Available Work Windows	++	++	+
Meets Operations and Maintenance Requirements	+++	++	+++

Note:
a. The relative benefits of the three alternatives were summarized symbolically by assigning + (least benefit), ++ (intermediate benefit), or +++ (greatest benefit).

5.1.5 Geotechnical Evaluation

Shannon & Wilson conducted a geotechnical engineering evaluation to determine implications to design of a railroad bridge for this project site; the full evaluation can be found in Appendix C. A brief summary of the evaluation is provided in this section.

It is anticipated that the subsurface conditions will consist of loose and soft soil overlying dense and stiff, glacially overconsolidated soil. The depth to the dense and stiff, glacially overconsolidated soil is variable in Puget Sound, and borings will be required during design to determine foundation depths. Loose and soft soil is often susceptible to liquefaction, lateral spreading, and bearing capacity failure during the longer return period earthquake ground motions (> 100-year earthquake) and thus will not likely be suitable for support of the bridge on shallow foundations. Therefore, support of the railroad bridge by deep foundations should be expected. Based on Shannon & Wilson's experience with typical railroad construction practices, the preferred deep foundations will be steel H-sections.

The extent of loose and soft soil and the axial and lateral deep foundation resistance that the site soil profile could provide is unknown and requires borings at the site. However, for the purposes of this feasibility evaluation, it has been assumed that the loose and soft soil is 50 feet thick and is underlain by glacially consolidated soil in which deep foundations are

typically founded throughout the region. For these assumed subsurface conditions, it is estimated that pile embedment of about 100 to 150 feet would be required for all alternatives. Detailed analysis beyond the potential foundation lengths would be performed during a subsequent project phase and was not conducted for this feasibility study.

Details of the existing BNSF railway embankment construction are not available. Based on our experience, embankments similar to these were possibly constructed as a wood trestle bridge. Subsequently, the void space between the structural members is filled, forming an embankment. In addition, the fill of the embankment is undocumented and may consist of large objects such as riprap or large debris. If the existing embankment has a similar construction history or contains large objects, then the construction time of the railway bridge should be increased. Further analysis and consultation with BNSF is required to estimate the potential impacts to construction and design.

5.1.6 Cultural Resources Assessment

All three alternatives include demolition or modification to two existing structures: the restroom enclosure and the tunnel. The restroom enclosure is a recent addition to the Park. The date of construction of the existing tunnel is currently unknown. Therefore, there is only potential to impact historic structures if the existing tunnel is older than 50 years. Unless tribal consultation identifies traditional cultural properties, the potential to affect cultural resources is limited to disturbance of archaeological materials.

The Park's location in a fairly protected location near a year-round stream has the potential for precontact archaeological materials. A number of historic activities have occurred at the Park that may also be represented archaeologically, including railroad construction, homesteading by the Lund family, and the Meadowdale Country Club. These historic activities may have disturbed any precontact or previous historic archaeological materials, but portions of earlier deposits can remain intact even in disturbed areas. Where Holocene sediments are present anywhere in the Park, outside the limits of recent disturbance, archaeological potential should be considered moderate to high.

It is currently unknown whether any significant archaeological materials exist in the Park. Therefore, potential to affect resources must be estimated by comparing the breadth and depth of ground disturbance. In general, the three alternatives have very similar footprints of ground disturbance. Alternative 3 has the greatest area of deep ground disturbance, because there are more pilings than the smaller bridge spans, and it should be considered the alternative with the greatest potential to impact archaeological resources. It is followed by Alternative 2, then Alternative 1, which has the least potential to affect cultural resources.

The cultural resources review process will be determined by the regulatory context. Assuming the project will require a permit from the U.S. Army Corps of Engineers, review under Section 106 of the National Historic Preservation Act would be required. It is recommended that an archaeological survey be conducted when an alternative has been selected, and design is sufficiently advanced that the depth and extent of ground disturbance is finalized. The survey should meet standards and guidelines set by the U.S. Army Corps of Engineers, the Washington Department of Archaeology and Historic Preservation, and the Secretary of the Interior.

5.1.7 Phase 1 Environmental Site Phase 1

Shannon & Wilson, Inc. completed a Phase 1 Environmental Site Assessment for a portion of the Meadowdale Beach Park (the subject property). This study was conducted in anticipation of renovations to portions of the subject property that will require some earthwork.

The assessment revealed the presence of one Recognized Environmental Condition on the subject property: potential contaminants associated with the presence of railroad tracks on the subject property. This assessment revealed no Controlled Recognized Environmental Conditions in connection with the subject property and no Historical Recognized Environmental Conditions in connection with the subject property. However, since the railroad constitutes a potential source of contaminants, the risks of environmental cleanup increase based on the amount of disturbance to the railroad berm. This translates to the greatest potential environmental cleanup risk and associated costs for Alternative 3, and the lowest for Alternative 1.

5.2 Stakeholder and Public Input

Additional meetings were held with Agency/Organization Stakeholders and Community stakeholders in March/April 2015 to review the conceptual alternatives and the results of the studies. The purpose of the meeting was to solicit input from these stakeholders to assist with selection of the preferred alternative. Appendix A provides meeting summaries for each of those meetings. In general, all of the agency and organization stakeholders, and the majority of community stakeholders, preferred Alternative 3.

5.3 Select and Refine Preferred Alternative

A final meeting was held in May 2015 to review the results of the stakeholder meeting, technical dates presented in the reports, and how each of the three conceptual alternatives met the evaluation criteria and satisfied the overall goals stated for this project. Meeting minutes are included in Appendix A.

The area of habitat restoration and conversion of lawn to habitat varies greatly between the three alternatives. Since the Park's main attraction is its natural habitat, walking, and being in a natural environment, some degree of conversion is in keeping with the main intent of the recreational and educational use. A key issue includes mitigating for the loss of picnic areas that are currently located in areas to be converted to habitat. This mitigation can be provided by an equal number of relocated picnic areas that provide views of the restored marsh and potentially under the proposed bridge to Puget Sound, thus enhancing the Park user experience. Alternatives 1 and 3 come closest to meeting this objective. One key difference between the three alternatives from the perspective of parks and recreation use is beach access. Alternative 2 provides the least desirable beach access by keeping the existing culvert, which has numerous inherent limitations. Alternatives 1 and 3 provide the best beach access due to the size of the opening and the width of the path. There are differences in the path surface elevation under the railroad bridge that provide a tradeoff between vertical clearance meeting ADA guidelines and long-term access in terms of inundation from high tides and/or creek flows considering sea level rise. Alternative 3 provides the highest path elevation, making it the least susceptible to tidal inundation, but it does not meet the 80-inch ADA vertical clearance. With slight modifications related to vertical clearance under the railroad bridge, Alternative 3 can provide an ADA accessible route to the beach

but will be somewhat more subject to flooding and sediment deposition during high tide and creek flow events over the long term. Alternative 3 also provides the largest habitat area, which was supported by all of the agency and organization stakeholders and the majority of public participants in meetings.

5.3.1 BNSF and Permitting Agency Coordination

The County and Anchor QEA team met with BNSF representatives on June 18, 2015, and permitting agency representatives on July 28, 2015, to review the preferred alternative and solicit their input and comment. BNSF provided comment on the proposed bridge structure, as well as required coordination with BNSF during design and construction. This information is summarized in the meeting minutes in Appendix L. Representatives from the Washington Department of Fish and Wildlife, Washington State Department of Ecology, and Snohomish County Planning Department met with the design team on site and provided input on permitting requirements for the preferred alternative. Information gained from this meeting is summarized in the meeting minutes provided in Appendix L.

5.3.2 Constructability Considerations

In order to refine the opinion of cost for the preferred alternative (Alternative 3), a high level constructability review was conducted. This review included a desk top evaluation of constructability issues by Bob Hirte, of Hamilton Construction, who is experienced with construction of similar projects for BNSF. A summary of this evaluation follows.

Work Windows and Bridge Type/Span Length

- A 6-hour work window would be required to construct a new railroad bridge (of any span length) at the project site. The limiting construction elements for work windows are the pier cap installation and the placement/track installation for each bridge span. Pier cap installation (once piles are installed) and installation of each bridge span require a 6-hour work window. The time required to drive each pile would need to be verified as part of the geotechnical data collection/evaluation to ensure that they could be driven within the 6-hour work window.
- Using a 30-inch double box bridge structure, instead of the currently proposed single-box structure, for the railroad bridge (see Figure 2) could allow the bridge to be

pre-assembled on the ground in two pieces and simplify construction within the 6-hour work window. The single-box structure requires more than two lifts and some additional assembly/construction work once lifted into place.

- Use of a low-speed shoo-fly would allow one of the bridges to be constructed without the limitations of work windows, other than the few work windows required to connect the shoo-fly track to the main-line track. However, the reach of the crane would likely be limited by the shoo-fly track for construction of the second bridge, and the second bridge would likely need to be constructed using 6-hour work windows without the use of the shoo-fly track.
- Meeting minutes from the BNSF coordination meeting (Appendix L) provide documentation that 3.5-hour work windows are what may be available at the project location (at the present time), and these are not long enough to facilitate construction of the project. Next steps for the project (see Section 6) include a formal submittal to BNSF for review and comment from BNSF operations personnel that includes a request for 6-hour work windows for construction of the preferred alternative.

Site Access

- It would be preferable to bring in the crane and larger equipment to the site using rail access (if possible) and other smaller/lighter materials and equipment via barge.
- A temporary pier would likely be the most efficient way to offload the barge, as opposed to grounding the barge and using an offloading ramp.
- It would be preferable if smaller equipment and materials could be brought in via the existing access road. However, a geotechnical evaluation to determine the feasibility of using the existing road for this purpose will be required as part of the next steps for the project.

5.3.3 Refined Opinion of Cost

The opinion of cost presented in Table 9 is refined in this section to attempt to estimate undetermined costs associated with uncertainties in mobilization and access for this Project. Mobilization and access issues include whether or not BNSF will allow rail access to bring in larger equipment to the site throughout the project, uncertainties regarding load capacities of the existing access road into the Park, and ability and methodology to bring in the larger

equipment (100-ton crane) via barge (instead of by rail). Uncertainties and costs associated with BNSF coordination—including work windows being taken away due to BNSF operation issues, construction management and monitoring, insurance indemnification, railroad involvement during design and construction, facility maintenance and ownership requirements, and other County labor costs—are not included in the opinion of cost provided in this report.

Assumptions used to develop the conceptual opinion of cost for the preferred alternative are summarized as follows:

- The work will be conducted utilizing a slow-speed shoo-fly track and 6-hour work windows.
- Each pile can be driven within the allotted 6-hour work window.
- Results of geotechnical investigation will not significantly alter the proposed conceptual design or assumed work windows for the project.
- Permitting requirements will not significantly increase the cost of the project beyond what is typical for in-water work in the area.
- Construction of each pile cap and bridge span can be completed within the allotted 6-hour work window.
- Bridge span is assumed to be a 36-foot 30-inch double cell box structure that can be pre-assembled into two pieces prior to lifting into place during the allotted 6-hour work window.
- The crane will be brought to the site via rail access.
- Materials and equipment required to construct the offload platform for the crane (from the rail) on the east side of the tracks can be brought into the site via the existing access road with no roadway improvements.
- Other materials and equipment will be brought into the site via waterside access. A temporary trestle will be required to facilitate offloading of the barge at the site. The trestle is assumed to be a maximum of 500 linear feet in length.
- Costs associated with delays due to issues related to BNSF coordination (e.g., work windows being taken away during construction) are not reflected in this cost estimate.

- Costs do not include Construction Management, Monitoring, Insurance and Indemnification, Railroad Involvement during Design and Construction, and Facility Maintenance and Ownership requirements or other County labor costs.

The cost estimate provided in Table 15 has a high level of uncertainty due to BNSF coordination issues and constructability issues related to access concerns. These should be adequate for the grant process (within stated assumptions), but it is recommended that these costs be vetted more thoroughly with a contactor because the construction methods used here will be outside of standard practice.

Additional information regarding road capacity and barge access for larger equipment may be obtained during design (see Section 6, Next Steps). However, questions regarding BNSF work windows and allowable rail access will likely not be resolved early in the design process, but will continue to be a point of negotiation through final design and construction. In addition, costs associated with insurance and indemnification and Facility Maintenance and Ownership requirements cannot be fully vetted until further into the process, but costs are anticipated to be high based on discussions with BNSF and experience of other municipalities for completed similar projects.

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Table 15
Conceptual Cost Estimate for Preferred Alternative

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
Subtotal Temporary Facilities				**$**	**63,220**
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					
a. Railroad Bridge construction with shoo-fly (add 20% for work provided by BNSF)	1	LS	$4,091,455.00	$	4,091,455
b. Temporary trestle for un- and off-loading barged in materials and equipment	1	LS	$500,000.00	$	500,000
Subtotal Railroad Bridge				**$**	**4,591,455**
5. Recreation Items					
a. Crushed rock trail (7" depth)	122	CY	$35.00	$	4,278
b. Crushed gravel for asphalt base	60	Ton	$19.00	$	1,140
c. Asphalt paving of trail	120	Ton	$70.00	$	8,400
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				**$**	**267,441**
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				**$**	**373,116**
			Subtotal Construction	**$**	**5,587,161**
			Mobilization 30%	**$**	**1,676,148.20**
			Subtotal Construction + Mob.	**$**	**7,263,309**
			Design & Construction Contingency (40%)	**$**	**2,905,324**
			Subtotal Const.+ Mob.+ Conting.	**$**	**10,168,632**
			Sales Tax (8.6%)	**$**	**874,502**
			Subtotal Const. + Mob + Conting. + Tax	**$**	**11,043,135**
			Total Cost*	**$**	**11,044,000**
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, equi,pment 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.					

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6 NEXT STEPS

Snohomish County has applied for a Salmon Recovery Foundation Board grant for final design of the preferred alternative. Prior to commencing with design for the project, additional coordination with BNSF and collection of additional site-specific information should be used to define the scope and cost of the preferred alternative.

6.1 Additional Coordination with BNSF

A formal submittal for review by BNSF is recommended that includes a standard BNSF submittal cover letter, description of the project, figures showing the proposed design of BNSF-related project elements, proposed construction sequence, and required coordination with BNSF for design and construction (e.g., required construction work windows). This submittal is reviewed by engineering and operations divisions within BNSF. Input and comment provided by BNSF on the submittal is expected to provide additional information on potential work windows available at the project site. All the materials required for this submittal have been developed as part of this feasibility study, except for the submittal cover letter.

6.2 Data Gaps for Design of Preferred Alternative

Geotechnical information is the primary data gap that needs to be collected prior to start of design work on the project. An additional site survey of the BNSF track, railroad berm, and park area along the length of the project is important to have on hand prior to starting design. Geotechnical information includes borings at the location of the proposed bridge, investigation of debris or other timber structure present inside the railroad berm, and investigations required to evaluate the stability and load capacity of the existing road and/or the ability to improve the road for use as construction access for smaller equipment/lighter materials. Also, an on-site constructability review by a railroad and marine contractor is recommended to refine our understanding of the construction means and methods for the preferred alternative and associated costs. The potential for jacking culverts through the railroad berm may also be reconsidered as a potential solution for the site once this information is in hand, and review comments from the BNSF submittal document (Section 6.1) are in hand.

7 REFERENCES

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APPENDIX A
SNOHOMISH COUNTY, COMMUNITY, AND AGENCY/ORGANIZATION STAKEHOLDER MEETING SUMMARIES

APPENDIX B
HYDRAULIC AND SEDIMENT ANALYSIS OF LUND'S GULCH CREEK MEMORANDUM

APPENDIX C
GEOTECHNICAL/GEOLOGIC ASSESSMENT/SEDIMENT LOADING EVALUATION MEMORANDUM

APPENDIX D
ADA REGULATIONS AND GUIDELINES

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