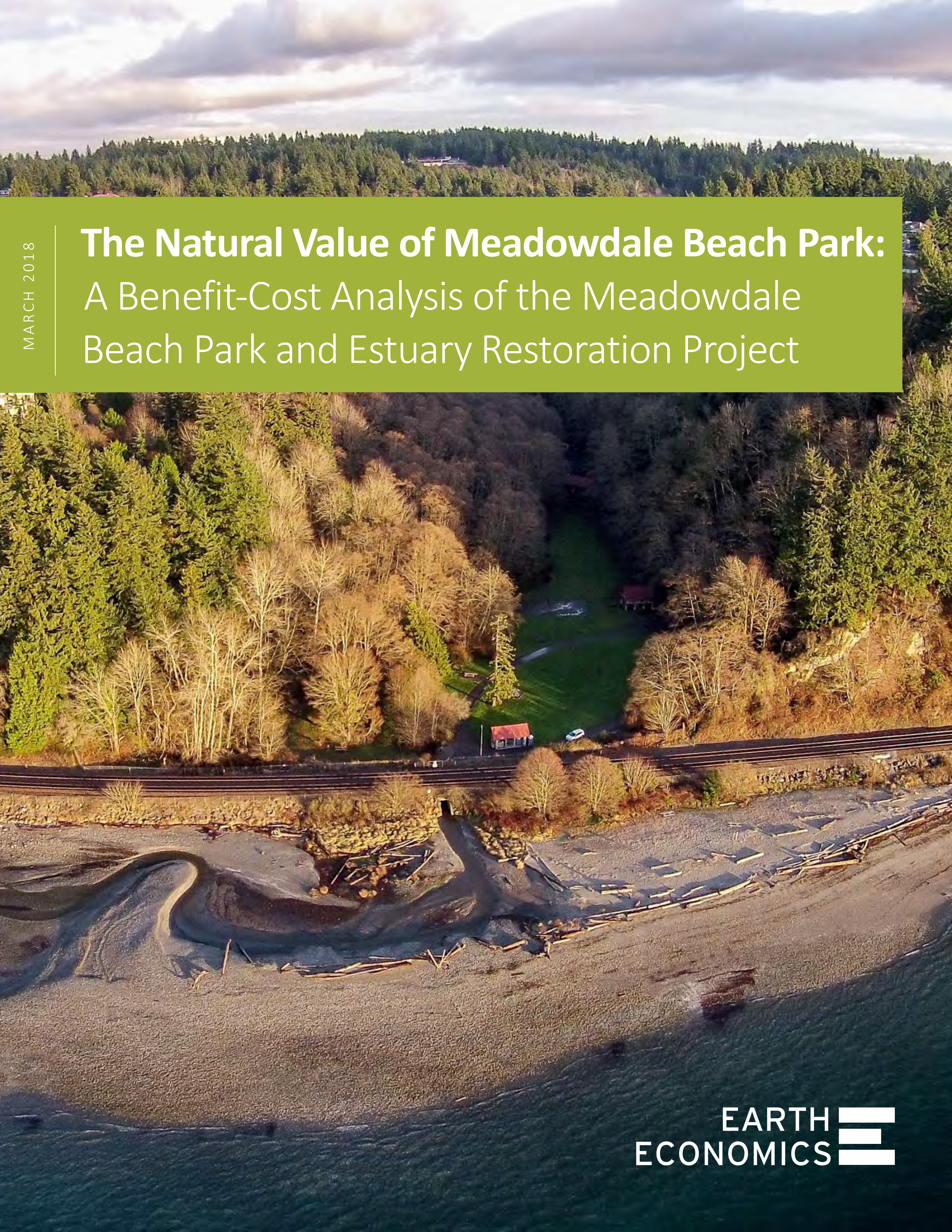

MARCH 2018

The Natural Value of Meadowdale Beach Park:

A Benefit-Cost Analysis of the Meadowdale Beach Park and Estuary Restoration Project

EARTH ECONOMICS

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Acronyms

ADA	Americans with Disabilities Act
BCA	Benefit-Cost Analysis
BCR	Benefit-Cost Ratio
ESA	Endangered Species Act
ESV	Ecosystem Services Valuation
MBPERP	Meadowdale Beach Park and Estuary Restoration Project
MRC	Snohomish County Marine Resources Committee
SCPR	Snohomish County Parks and Recreation
SWM	Snohomish County Surface Water Management Division
WSOFM	Washington State Office of Financial Management

Executive Summary

Meadowdale Beach Park is a natural asset that provides a broad range of public benefits to Snohomish County residents. The ecosystems provide habitat for an array of species, the trails and beach are a huge draw for recreational visitors, and the park setting supports a variety of environmental and recreation-based education programs for groups who incorporate park visits into their curriculum. However, the lower park is also frequently flooded and beach access cut off due to the railroad embankment and under-sized box culvert; the only passageway between upland park areas and the beach. To enhance public safety, address maintenance and flooding issues, and restore natural sediment processes and habitat critical for native species, including Endangered Species Act (ESA) listed Chinook salmon, Snohomish County Parks and Recreation lead a collaborative effort to put forth an alternative park design, the Meadowdale Beach Park and Estuary Restoration Project (MBPERP).

This report presents a benefit-cost analysis of the MBPERP. To assess the impacts of the project, Earth Economics estimates the park's environmental, recreational, educational, and economic value following completion of the MBPERP. These results are compared against a no action scenario. **Our analysis reveals that investing in the MBPERP would result in net gains for Snohomish County. The $60.9 million in public benefits anticipated from the project over the next 100 years far outweigh the $14 million in estimated construction costs, resulting in a benefit-cost ratio of 4.35 when using a 2.5 percent discount rate. In other words, Snohomish County can expect about $4.35 in public benefits for every dollar it invests in the MBPERP.**

Project Background

Meadowdale Beach Park, 6026 156th St SW, Edmonds, WA 98026, is a 108-acre park located in a gulch that extends downward to the tidelands of Puget Sound. The majority of the park is located in unincorporated Snohomish County with a portion of the site within Edmonds city limits. The Lund family homesteaded the site in late 1800's with multiple landowners and uses until the Meadowdale Country Club purchased the property in the 1960's. This venture failed, partially due to the failure of the access road. In 1971, Snohomish County acquired the park site using bond and grant monies, but the site closed shortly thereafter due to the condition of the access road. After significant investments to remove abandoned buildings, construct amenities, and create sustainable public access to the entire park, the park re-opened to the public in 1988.

Meadowdale Beach Park is hike-in only except for emergency, Americans with Disabilities Act (ADA), Ranger, and maintenance vehicle access by way of the gated access point on 75th Place West. The park's lower area includes a paved looped trail, natural surface trails, a pedestrian bridge crossing, picnic area, lawn, portable restrooms, and other amenities, and draws roughly 65,000 visitors a year. Some of these visitors access the park by non-motorized watercraft as Meadowdale Beach Park is one of only two parks in the county offering Water Trail Camping along Puget Sound. The park also provides educational opportunities for various groups, which spend over 4,000 hours in the park each year.

Figure 1: Meadowdale Box Culvert

The double track BNSF Railway (railroad), which runs on top of a rock embankment, separates the lower park and upland areas of the park from Puget Sound and the adjoining beach, a major destination for park visitors. The only legal public beach access within the park is via the six-foot-wide concrete box culvert (i.e. tunnel) under the railroad berm (Figure 1). The culvert conveys the year-round flow of Lund's Gulch Creek to Puget Sound and provides a passageway for fish and other wildlife moving between salt and freshwater. Due to the narrow opening of the culvert, sediment carried by the creek accumulates in the passageway, causing frequent flooding in the culvert and surrounding area. This flooding reduces beach access for park visitors, limits salmon use of the creek, and restricts sediments, which support biodiverse marine life, from reaching the beach. As one of the few areas in South Snohomish County with public beach access, some visitors risk crossing over the railroad berm, bypassing fences on both sides of the railroad tracks. Trespassing on railroad property to reach the beach is both illegal and dangerous. Fast and quiet modern trains, combined with the curve of the tracks, puts trespassers at risk.[1]

Public Beach Access in Snohomish County

Meadowdale Beach Park is one of 27 public beaches in Snohomish County. When compared to King and Skagit County, Snohomish County has far fewer public beaches with King and Skagit County offering 99 and 50 public beaches respectively

In recent years, Snohomish County Parks and Recreation (SCPR) has received permits to clean out the culvert and remove built-up sediment that causes flooding. However, this process is expensive, increasingly difficult to permit, and time consuming, prompting SCPR to look for a long term, sustainable solution to the sediment problem. In 2014, SCPR partnered with Snohomish County Surface Water Management Division (SWM), and Snohomish County Marine Resources Committee (MRC), and contracted with Anchor QEA, LLC, to conduct a feasibility study for alternative park designs that would address the long-standing issues associated with the railroad berm and undersized culvert. The conceptual designs aimed to improve beach access, enhance public safety, and restore habitat critical for native Endangered Species Act (ESA) listed salmon species, specifically native Chinook salmon. In 2016, after soliciting feedback from the local community, local organizations, and the County, designed commenced on a preferred alternative park design, the Meadowdale Beach Park and Estuary Restoration Project (MBPERP).

Because of the significant investment needed to initiate the MBPERP, Snohomish County contracted with Earth Economics to perform a benefit-cost analysis (BCA) of the project and its broad impacts on Meadowdale Beach Park. Earth Economics specializes in ecosystem services valuations (i.e., monetizing the value of nature) and performing holistic BCAs. Whereas some BCAs only include revenue, savings, and expenditures in the analysis, a holistic BCA also includes the value of non-market benefits to ensure projects truly yield net benefits. To that end, Earth Economics' benefit-cost analysis considers the (1) environmental, (2) recreational, (3) educational, and (4) economic value of Meadowdale Beach Park under two scenarios:

Scenario 1.0 – MBPERP

The MBPERP proposes the removal of 130 feet of railroad embankment and the construction of a five-span railroad bridge to replace the existing culvert and enhance the connection between the park and shoreline. Under the plan, pedestrian beach access, constructed under one of the bridge spans, would be improved to meet ADA accessibility requirements and remain entirely separate from the creek. The additional four spans would be used to accommodate naturally occurring patterns of the creek's flow, and would provide an opening wide enough for the creek to carry nourishing sediment beyond the estuary and into the Puget Sound.

Train Safety at Meadowdale Beach Park

Some visitors choose to risk crossing the railroad berm when the culvert is flooded in spite of fencing and signage. In 2016 alone, trespassing on railroad property across the United States resulted in nearly 500 deaths, making pedestrian trespassers the largest proportion of rail related fatalities in the country.[1]

In addition to improving the connection between the park and shoreline, the MBPERP also proposes the creation of approximately two acres of restored estuary and riparian habitat to improve the natural and aesthetic value of the park. The project would also lead to the creation of a highly valuable pocket estuary. In 2016 and 2017, high flows blew out a four-foot high delta and reconfigured the creek in a way that bypassed the pocket estuary on the beach side of the tracks. Re-creating the estuary in this scenario will provide critical habitat for juvenile ESA-listed Chinook salmon and other native species that thrive in tidal marshes and freshwater wetlands. Proposed park features, such as paths, picnic areas, and the portable restrooms, would be relocated to accommodate the expanding estuary, capitalize on new viewpoints and educational signage, and improve the overall experience of park visitors who are attracted to the park's natural environment.

Scenario 2.0 – No Action

Under this scenario, which serves as the baseline for Earth Economics' analysis, Meadowdale Beach Park would continue to operate as is. However, the multitude of issues surrounding the under-sized culvert may necessitate closure of the culvert and additional fencing resulting in no public beach access except via non-motorized watercraft.

Study Site Maps

Figure 2: Existing Configuration of Meadowdale Beach Park

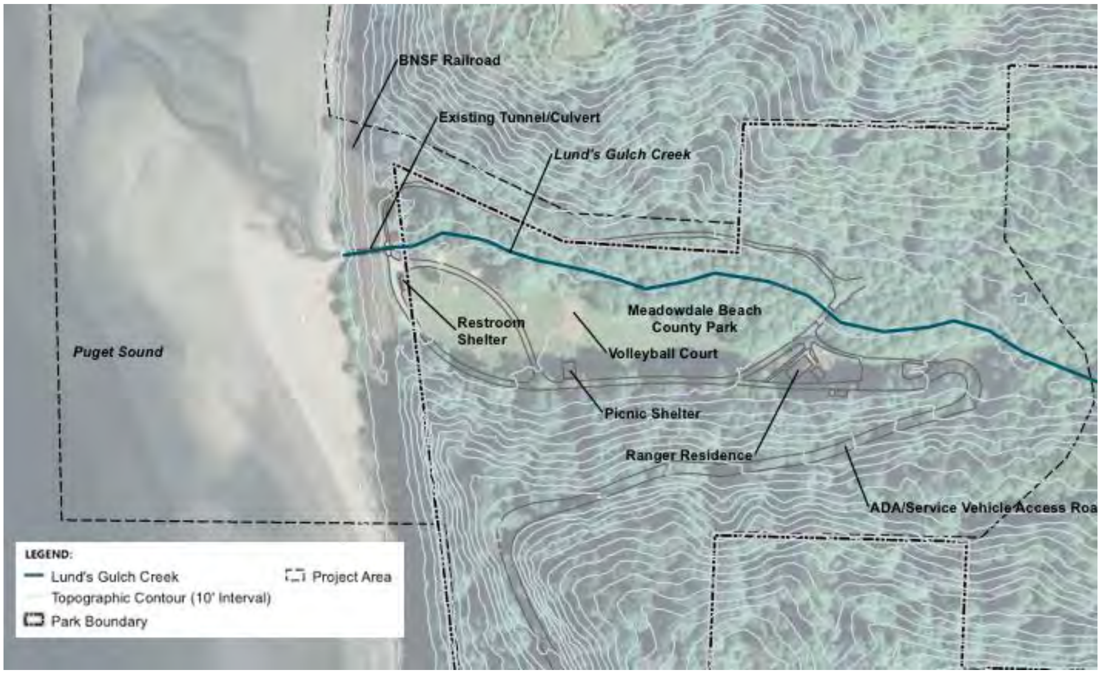
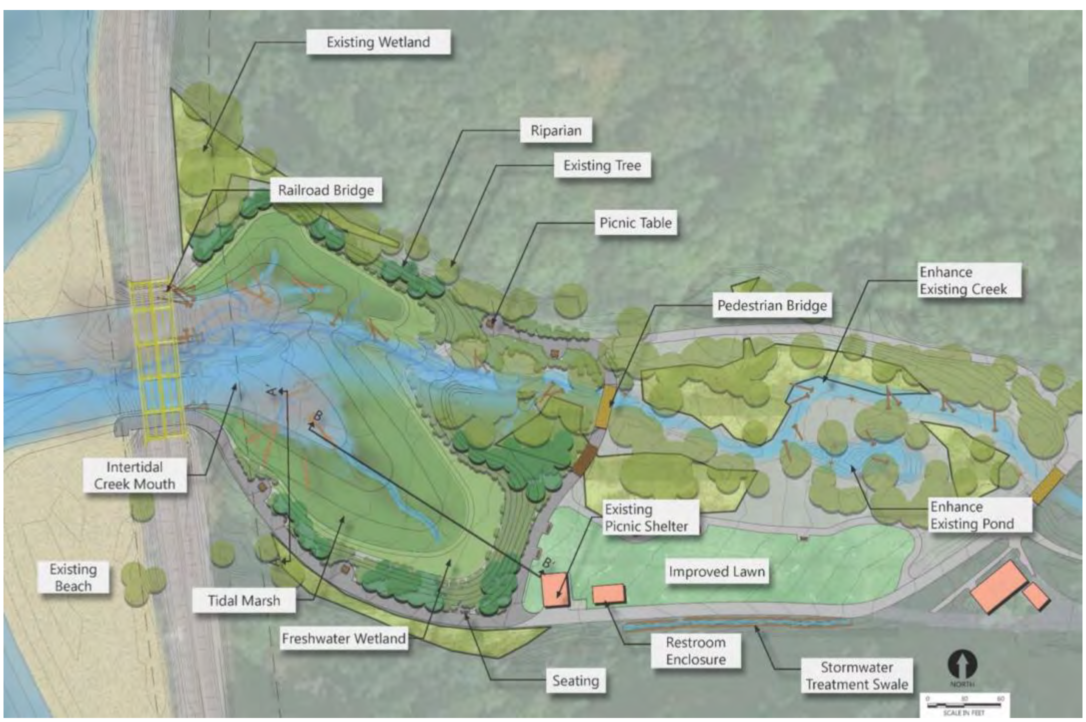


Figure 3. Meadowdale Beach Park and Estuary Restoration Project Map



Benefit-Cost Analysis Framework

Many BCAs are framed to exclude all benefits and costs that occur outside of a traditional market. However, it is critical that non-market benefits (e.g., environmental, recreational, and educational benefits) be incorporated into a decision making process because ultimately, non-market benefits are just as tangible as economic benefits.[2] Among others, this view is shared by the U.S. Forest Service, which recently reported that accounting for the non-market benefits of federal land was in line with the economic objectives of federal land management, which require that lands are managed to "maximize net public benefits".[3]

A holistic BCA is key to understanding the broad range of benefits that will be provided by the MBPERP. Incorporating into a BCA environmental, recreational, and educational benefits, In addition to traditional economic benefits, provides a more comprehensive perspective of what Snohomish County residents value, and what they stand to gain when the project is completed. This perspective also supports more informed decision making by county officials who are ultimately responsible for determining how public dollars are invested.

The sections that follow detail the methodology and results of Earth Economics' valuation of the (1) environmental, (2) recreational, (3) educational, and (4) economic value of Meadowdale Beach Park under Scenario 1.0 – MBPERP and Scenario 2.0 – No Action. The marginal increase in benefits that would result from Scenario 1.0 – MBPERP, relative to the no action scenario, were subsequently included in a holistic benefit-costs analysis of the project. Both the valuations and the BCA consider benefits and costs over a 100-year timeframe; used in this context to match a conservative estimate of the life span of the capital built in the MBPERP.

Environmental Valuation

Ecosystem Service Valuation Methodology

Ecosystem services are the goods and services that humans receive from nature, including breathable air, drinkable water, nourishing food, and climate stabilization. While the services provided by nature are as diverse as ecosystems themselves, the bottom line is that humans benefit from these services and value them.

The goods and services provided by an ecosystem are similar to the goods and services provided in a traditional market in that they can be valued as a dollar figure. In the same way that economists can determine the value of a home as a private asset, economists can also determine the value of ecosystems as a natural public asset. The process of valuing the goods and services provided by an ecosystem is called ecosystem services valuation (ESV). Building on decades of research that values ecosystem services, this study involves four major steps:

Step 1. Identification and Quantification of Land Cover Classes: Geographic Information Systems (GIS) data, including land cover data provided by Snohomish County and Anchor QEA, were used to calculate the extent of each land cover type (e.g. wetland, forest, estuary) within the study area for both scenarios. The base land cover for this analysis is Snohomish County's 2007 CAR 8CLASS data, which provides 2.44x2.44m resolution categorization of land cover. Earth Economics also overlaid additional datasets, provided by Anchor QEA, to provide specificity for the land cover at the project site. The results of our analysis for both scenarios are presented in Table 1. For detailed land cover maps please see Appendix B.

Table 1. Land Cover Acreages for Meadowdale Beach Park

	Scenario 1.0 MBPERP	Scenario 2.0 No Action
Forests		
Forests	76.8	76.9
Forest (Riparian)	11.3	11.6
Grassland		
Lawn	2.6	3.5
Shrublands		
Shrubland	1.1	1.1
Water		
Pond	0.1	0.1
Creek	2.6	2.6
Wetlands and Estuary		
Estuary	1.3	0
Wetlands (Freshwater)	1.1	0.9
Subaquatic		
Eelgrass	2.8 +[i]	2.8
Beach		
Beach	1.4[ii]	1.7
Paths and Pavement		
Impervious Material, Gravel	9.9	9.8
Totals	**111 +**	**111**

Step 2. Identification and Valuation of Ecosystem Services: For each land cover type, the ecosystem services provided by that land cover were identified. For example, forests

[i] Under the MBPERP, eelgrass coverage is anticipated to increase by approximately 20 percent over the course of 25 years following the project, with an additional 5 percent increase between years 25 to 50. (See Appendix D).

[ii] Scenario 1.0 – MBPERP shows fewer acres of beach as portions of the beach will be converted to wetlands and estuary during the park's restoration.

comprise a large portion of Meadowdale Beach Park, and each acre of forest provides a suite of ecosystem services unique to that land cover (e.g., water quality, carbon sequestration, habitat).[iii]

Earth Economics then valued these services using the benefit transfer method (BTM). BTM is broadly defined as "the use of existing data or information in settings other than for what it was originally collected." BTM begins by identifying peer reviewed studies that value ecosystem services in locations similar to Meadowdale Beach Park using a variety of well accepted valuation methods.[iv] Each value estimate in these studies is then transformed into a dollars-per-acre-per-year format to ensure "apples-to-apples" comparisons, as these estimates are "transferred" to the study site. In this sense, BTM is similar to a home appraisal, in which the features and pricing of similar nearby homes are used to estimate the appraised value of other homes. While neither process is perfect, they are able to quickly and efficiently generate reasonable values for policy and project analysis.

Table 2 reports which ecosystem services could be valued for each land cover type. Where valuation estimates for particular ecosystem service–land cover combinations were not available, the cell has been left blank (i.e. beach). This is not meant to suggest that such ecosystem services contribute no value at all—only that rigorous research on those contributions provided by specific land cover types were not available at the time research was conducted.

[iii] For a comprehensive list of possible ecosystem services, please see Appendix A.
[iv] For a comprehensive list of valuation methods, please see Appendix B.

Table 2. Ecosystem Services by Land Cover Type

	Carbon Storage	Carbon Sequestration	Cultural Value	Disaster Risk Reduction	Food	Habitat	Soil Retention	Water Capture	Water Quality	Water Storage
Forests										
Forests	x	x				x	x	x	x	
Forest (Riparian)	x	x		x		x	x	x	x	
Grassland										
Lawn	x	x						x	x	
Shrublands										
Shrubland	x	x				x	x			
Water										
Pond	x	x						x	x	x
Creek	x	x				x		x	x	x
Wetlands and Estuary										
Estuary	x	x		x		x				
Wetlands (Freshwater)	x	x		x	x			x	x	
Subaquatic										
Eelgrass	x	x	x	x		x				
Beach										
Beach[v]										

Step 3. Annual Value of Ecosystem Services: The sum of all annual estimates for the ecosystem services provided per-acre by each land cover type was then scaled by the extent of corresponding land cover classes within the study area to calculate the total annual contribution of ecosystem services within the study area. The annual contributions of all land cover types were then combined to calculate the total annual value contributed by ecosystem services to the local economy.

Ecosystem Services Valuation Results

For this analysis, ten ecosystem services were valued across nine land cover types present at Meadowdale Beach Park (Table 2). While "beach" as a land cover type contributes significantly to the natural function of an ecosystem, the majority of peer reviewed studies estimate beaches value based on their contribution to recreation activities. So, for this analysis, the value of the

[v] Beach as a land cover type is valued in the recreation valuation of Meadowdale Beach Park as the studies used to estimate a beach's value primarily rely on their contribution to recreation, not ecological functions.

beach area is captured as a recreation value rather than one of the ten ecosystem services used to value the other land cover types (see Recreation Valuation section). Impervious material and gravel includes the parking lots, maintenance road, and gravel paths present at Meadowdale Beach Park. They were not valued as a part of this study.

Table 3 summarizes the values of ecosystem services across all land cover types under Scenario 1.0 – MBPERP. The values reported are the aggregate of all ecosystem service values associated with a given land cover. In this scenario, the services provided by Meadowdale Beach Park each year are valued between $111,000 and $412,000. **As such, Meadowdale Beach Park is expected to provide between $11.1 million and $41.2 million worth of ecosystem services over the course of 100 years under Scenario 1.0 - MBPERP.**

Table 3. Value of Ecosystem Services – Scenario 1.0 MBPERP (acre/year)

Scenario 1.0 - MBPERP			
	Acres	USD/year	
		Low	High
Forests			
Forests	76.8	$90,096	$229,058
Forest (Riparian)	11.3	$8,468	$69,748
Grassland			
Lawn	2.6	$1,187	$1,188
Shrublands			
Shrubland	1.1	$12	$12
Water			
Pond	0.1	$4	$80
Creek	2.6	$9,385	$10,982
Wetlands and Estuary			
Estuary	1.3	$678	$10,039
Wetlands (Freshwater)	1.1	$638	$33,784
Subaquatic			
Eelgrass	2.8+ [vi]	$685	$57,894
Beach			
Beach[vii]	1.4	-	-
Paths and Pavement			
Impervious Material, Gravel	9.9	$0	$0
Totals	**111+**	**$111,100**	**$412,784**

[vi] Under the MBPERP, eelgrass coverage is anticipated to increase by approximately 2 percent over the course of 25 years following the project, with an additional 5 percent increase between years 25 to 50. (See Appendix F). The low value reported presents the value associated with the 2.8 acres that currently exists. The high value reported presents the value associated with the 3.54 acres of eelgrass expected to exist 50 years after the project is complete .

[vii] Beach as a land cover type is valued in the recreation valuation of Meadowdale Beach Park as the studies used to estimate a beach's value primarily rely on their contribution to recreation, not ecological functions.

Table 4 summarizes the values of ecosystem services across all land cover types under Scenario 2.0 – No Action. In this scenario, the services provided by Meadowdale Beach Park each year are only valued between $105,000 and $356,000. As such, Scenario 2.0 – No Action would provide $600,000 to $5.6 million *less* than Scenario 1.0 – MBPERP in ecosystem services over the next 100 years.

Table 4. Value of Ecosystem Services – Scenario 2.0 – No Action (acre/year)

Scenario 2.0 - No Action			
	Acres	USD/year	
		Low	High
Forests			
Forests	76.9	$87,422	$222,258
Forest (Riparian)	11.6	$8,063	$66,415
Grassland			
Lawn	3.5	$1,183	$1,183
Shrublands			
Shrubland	1.1	$10	$10
Water			
Pond	0.1	$1	$24
Creek	2.6	$8,374	$9,799
Wetlands			
Estuary	0	$0	$0
Wetlands (Freshwater)	0.9	$197	$10,442
Subaquatic			
Eelgrass	2.8	$621	$45,948
Beach			
Beach[viii]	1.7	-	-
Paths and Pavement			
Impervious Material, Gravel	9.8	$0	$0
Totals	**111**	**$105,249**	**$356,079**

In addition to increasing the annual value of ecosystem services throughout the park, the MBPERP would also lead to the creation of a new land cover type not present in the no action scenario: estuary. More specifically, the MBPERP would lead to the creation of a pocket estuary. Pocket estuaries provide especially important benefits and habitat diversity in areas where the shoreline is highly developed, such as the extent altered by the railroad from Seattle to Everett. Pocket estuaries consist of saltwater and freshwater inputs in an area bound by a barrier which provides an area less exposed to wave energy. Key functions of pocket estuaries include providing critical rearing habitat, growth opportunity, and refuge from larger predatory fish for juvenile

[viii] Beach as a land cover type is valued in the recreation valuation of Meadowdale Beach Park as the studies used to estimate a beach's value primarily rely on their contribution to recreation, not ecological functions.

salmonids. Studies have shown that juvenile Chinook and coho use the pocket estuary habitats of stream systems other than those the fish originated from (i.e., non-natal streams).[4,5] Studies also show that juvenile Chinook salmon use pocket estuary habitats in higher densities than adjacent habitats. In addition, juvenile Chinook salmon will even move into the freshwater portions of non-natal streams to rear, including Lund's Gulch Creek, in this portion of Puget Sound.[6] Pocket estuaries also provide habitat and foraging for birds, various fish species, and other terrestrial wildlife found at Meadowdale Beach Park.

Forage Fish at Meadowdale Beach Park

Forage Fish are small fish which are preyed upon by larger fish and other animals. Sand lance are a common species, which require sandy beaches for spawning, and have been recorded using Meadowdale Beach as one of their spawning grounds. Forage fish are an important link the marine food web. Juvenile Chinook salmon depend on sand lance for 60 percent of their diet.

Recreation Valuation

Recreation Valuation Overview

Economists can measure the value of recreating at a park by measuring a consumer's surplus. Consumer surplus is calculated by estimating a park visitor's willingness to pay for recreation and subtracting the actual cost incurred. For example, assume a Snohomish County resident is willing to pay of $50 for a permit for Water Trail Camping at Meadowdale Beach Park. If the permit only costs $10, the consumer surplus for that park visitor is $40. While consumer surplus studies to value recreation specifically at Meadowdale Beach Park do not exist, Earth Economics' analysis relies on consumer surplus values from studies that value recreation at similar regional parks throughout the Pacific Northwest.

SCPR estimates a current visitation rate of 65,000 visits per year. A large majority of park visitors, over 90 percent, cross through the culvert to visit the beach while at Meadowdale Beach Park. Nearly all visitors to the park use the hiking trails, with the exception of some visitors arriving by water craft.

Earth Economics' estimates that the consumer surplus value associated with recreation at Meadowdale Beach Park is $21.12 per visit in 2017 dollars.[7] This value is derived from the consumer surplus associated with hiking in national forests in the Pacific Northwest. Hiking in Pacific Northwest national forests holds a consumer surplus value of $86.57 (2017 USD). The average National Forest visitor spends 3.9 hours hiking per visit, or $22.19 per hour. Assuming that the average length of stay for a participant at Meadowdale Beach Park is 25 percent that of a National Forest visitor (roughly 1 hour), Earth Economics arrived at a consumer surplus value of $21.12 per visit. This valuation methodology is similar to the methodology used in the 2015 report, *Economic Analysis of Outdoor Recreation in Washington State*, commissioned by the Washington State Recreation and Conservation Office.

Recreation Valuation Results

Under Scenario 1.0 - MBPERP, Snohomish County estimates that visitation will increase by 15 percent over current use because of improved beach access. Multiplying the anticipated visitation by a consumer surplus value of $21.12, Meadowdale Beach Park would initially provide an additional $929,000 in recreation benefits every year. According to the Washington State Office of Financial Management (WSOFM), Snohomish County is expected to continue to grow, conservatively, at 1 percent per year.[8] As population grows, visitation to local parks can be expected to follow similar use trends. As a result, **Meadowdale Beach Park is expected to provide over $239 million in recreation benefits over the course of 100 years under Scenario 1.0 - MBPERP.**

Alternatively, SCPR estimates that eliminating beach access under Scenario 2.0 - No Action would cause a 50 percent decrease in park visitation. Under this scenario, it is estimated that annual visitation would initially slump to 32,500 visitors. Using the consumer surplus value associated with local park visitation, and population growth estimates from the WSOFM, Meadowdale Beach Park is expected to provide roughly $105 million in recreation benefits over the course of 100 years, or, $134 million *less* than the park would provide under Scenario 1.0 – MBPERP.

Education Valuation

Education Valuation Overview

Estimates of the education value of student time at Meadowdale Beach Park are based on the hourly value of public education in Washington State. Census Bureau data for Washington shows that on average it costs $10,465 per year to educate a pupil in the public-school system. $6,327 of this expense is associated with salaries and benefits. Non-salary, per-pupil expenditures are therefore assumed to be $4,138. To calculate an hourly per-pupil value, the non-salary, per-pupil expenditure is divided by the total number of hours in a school year, 1,138. This figure is then used to estimate the educational value a student receives by participating in one hour of educational programing at Meadowdale Beach Park. SCPR identified 16 different programs that currently use Meadowdale Beach Park for educational purposes. Program sizes range from 4 students in AP science classes to 200 students for educational camps. In total, over 4,000 hours of education currently take place within the park.

Education Valuation Results

SCPR estimates that improving beach access will allow for greater educational opportunities. Under Scenario 1.0 - MBPERP, it is estimated that educational use will increase by 30 percent over current use. Using the hourly per-pupil value associated with educational park visits, the public benefit provided by Meadowdale Beach Park under this scenario would initially be $20,000 per year. Factoring in population growth projections from WSOFM, **Meadowdale Beach Park is expected to provide roughly $2.9 million in education benefits over the course of 100 years under Scenario 1.0 - MBPERP.**

Under Scenario 2.0 - No Action, education opportunities would significantly decrease with SCPR estimating an 80 percent decrease in educational use. Using an hourly per-pupil value associated with educational park visits, the public benefit provided by Meadowdale Beach Park would be roughly $500,000 over the next 100 years, or $2.4 million *less* than Scenario 1.0 – MBPERP.

Economic Valuation

Economic Valuation Overview

In addition to providing ecosystem services, parks also bolster residential property values for nearby homes, proving an opportunity to measure one component of the total economic value of a park. Consider the following scenario: A homebuyer is considering purchasing one of two homes on the market. The properties have the same number of bedrooms, lot size, and amenities. However, one of the homes is across the street from the entrance to Meadowdale Beach Park. On average, a consumer is willing to pay more for the home that is near a park because the park is considered a desirable amenity. Studies suggest that on average 4.84 percent of a home's total value can be attributed to a park, if the park and the home are within 2,000 feet of each other.[9]

Economic Valuation Results

To understand the contribution of Meadowdale Beach Park to the local real-estate market, GIS data was used to select all properties within 1000 feet of the park. The more conservative, 1000-foot buffer was used to ensure the analysis did not overstate the park's effect on residential property values. Using the assessed value of the properties selected (2017 dollars), provided by the Snohomish County Assessor's Office, and a 4.86 percent attribute rate, we estimate that Meadowdale Beach Park currently supports $10.8 million worth of value in the local housing market.

Studies also suggest that a park's impact on residential property values increases as the quality of a park improves. Using an index that measures improvements in environmental quality and the corresponding increases in residential property value, **Earth Economics estimates that homes within 1000 feet of Meadowdale Beach Park are predicted to increase in value by 6.2 percent, or $812,000, in 2021, the year the project anticipated to be completed.[10] This increase in home value will also lead to a marginal increase in property taxes collected by Snohomish County, totaling $20.1 million over the next 100 years.**

Without a relevant study to predict how home prices will react to the beach closure under Scenario 2.0 – No Action, the contribution of the park to home prices could not be calculated. However, it is likely that closing the beach at Meadowdale Beach Park would negatively impact home prices, causing them to grow at a slower rate than they would under Scenario 1.0 – MBPERP and reducing the property tax collected by Snohomish County.

Benefit-Cost Analysis Results

Discount Rates (0%, 2.5%)

Earth Economics' BCA of the Scenario 1.0 - MBPERP includes the environmental, recreational, education, and economic benefits outlined above, as well as the costs associated with the operation and maintenance of the park. Earth Economics' BCA values these benefits and costs over a 100-year timeline as the annual benefits of the MBPERP will continue far into the future. By thinking about how much future benefits are worth today, decision makers can compare benefits that are produced at various points in time. This process of converting the value of all future benefits into present terms is called discounting.

Discounting requires the careful selection of a discount rate which determines to what extent the value of future benefits will be reduced when translating them into present terms. Public and private agencies vary in their standards for discount rates. However, many federal agencies, including the Congressional Budget Office, recommend a discount rate between 1.5 percent and 3 percent.[11] The choice of discount rate is critical as it heavily influences the outcome of the present values of benefits and costs which occur over a long period of time.

This report uses two discount rates to calculate the benefit-cost ratio: a 2.5 percent and 0 percent discount rate. The 0 percent rate is included to demonstrate the long-term value of Meadowdale Beach Park under Scenario 1.0 – MBPERP and provides a point of comparison for the standard 2.5 percent rate. The 0 percent discount rate also presents results from the perspective that decision makers today care just as much about future costs and benefits as those that will be incurred in the immediate future.

Benefit and Cost Estimates

The BCA completed by Earth Economics accounted for the costs associated with the MBPERP that will be incurred over a 100 year timeline, including:

- MBPERP construction costs, including a one-time payment to BNSF Railway[ix]
- MBPERP construction management
- Park operations and maintenance costs

The BCA also accounts for the marginal increase in market and non-market benefits of the park under Scenario 1.0 - MBPERP, over those already present in Scenario 2.0 – No Action. These benefits include:

- Improved ecosystem services
- Increased recreation visitation
- Increased educational visitation
- Increased residential property values in the immediate area surrounding the park
- Increased tax-revenue due to higher residential property values
- Avoided costs of installing and maintaining a fence to restrict pedestrian beach access
- Increased park revenue from Water Trail Camping and facility rentals

Cost estimates were provided by SCPR. Valuations of the benefits offered by the park were provided by Earth Economics, with support from SCPR, MRC, SWM, and Anchor QEA.

Benefit-Cost Ratios

The benefit-cost ratios presented below measure the additional public benefits that will result in the implementation of the MBPERP, when compared to those that will be provided in a no action scenario. Earth Economics' analysis shows that the cost of implementing the MBPERP is outweighed by a significant increase in public benefits provided by the park. **The MBPERP has a benefit-cost ratio of 4.35 when using a 2.5 percent discount rate (Table 5). In other words, Snohomish County can expect about $4.35 in benefits for every dollar it invests in the MBPERP.**

[ix] Estimates are based on the feasibility study conducted by Anchor QEA. At the time this report was published, BNSF had not agreed to a specific operation and maintenance cost payment.

Table 5. Marginal Benefits and Costs of MBPERP ($2017)

Scenario 1.0 - MBPERP		
	NPV (0%)	NPV (2.5%)
Total Benefits	$248,937,472	$60,868,670
Total Costs	$15,140,000	$13,980,251
Benefit-Cost Ratio	**16.44**	**4.35**

Additional Benefits

The BCA conducted for this report does not provide a complete estimate of all potential benefits that would result from the MBPERP due to data limitations. Listed below are several significant benefits of the MBPERP that could not be valued in this study.

1. **Increasing Fish Populations**
   The BCA does not include values associated with increases in salmon populations as predicting salmon population growth that would result from the MBRPERP is outside the scope of this project. However, studies estimate that in areas where salmon are threatened, a single ESA listed salmon can be valued up to $16,000 (2017), meaning that a small increase in a threatened salmon population can represent significant value.[12]
   The BCA is also unable to capture the significant benefits the MBPERP will produce for forage fish.

2. **Avoided Cost of Procuring and Placing Fine Sediment**
   Under Scenario 1.0 – MBPERP, the restored configuration of the creek, pocket estuary, and railroad bridge will provide improve sediment transport from the park to the beach and nearshore area. This sediment is critical for salmon and forage fish. This study does not value the avoided cost of procuring and placing fine sediment in the nearshore area. However, it is possible that SCPR or another stakeholder would be completing that task.

3. **Avoided Cost of Purchasing Another Beach Front Property**
   Under Scenario 2.0 – No Action, SCPR would construct a barrier to restrict beach access for park visitors. If SCPR were to also restrict beach access for visitors accessing the beach by non-motorized watercraft, it is likely that the Washington Recreation and Conservation Department would see this as a violation of a grant agreement made when the park was purchased. That agreement stated that public beach access would be offered in

perpetuity, meaning that a full beach closure could result in SCPR being required to purchase another beach front property at a significant cost.

4. **Risk Reductions**
   Under Scenario 1.0 – MBPERP, there is a significant reduction in the risk of a railway injury or fatality at the park because the proposed ADA accessible path will be separated from the main creek channel and because a significantly wider opening is provided to accommodate sea level rise, increased creek flows, and sediment. Reductions in risk can be valued by multiplying the probability of an incident by the Value of a Statistical Life (VSL). The U.S. Department of Transportation estimates the VSL at $9.6 million.[13] Without the ability to precisely predict the probability of an incident occurring under either scenario, the value of reducing the risk of a railway injury or fatality was not included in the analysis.

5. **Additional Ecosystem Services**
   The ecosystem services values used in the BCA are likely to underestimate the true value of the benefits that the ecosystems at Meadowdale Beach Park provide. Because Earth Economics is only able to present values for ecosystem services that have been valued through peer reviewed studies at similar sites, some ecosystem services were not valued in our analysis.

Conclusion

This report provides a valuation of Meadowdale Beach Park, with emphasis on the non-market benefits that the park provides, under two scenarios. Earth Economics' valuations shows that under Scenario 1.0 – MBPERP, the park provides significantly more public benefits. **Comparing the additional benefits that will be gained by implementing the MBPERP to the project's costs, Earth Economics' analysis shows that the MBPERP will have a significant return on investment with a BCR of 4.35 when using a 2.5 percent discount rate over a 100 year timeframe. In other words, Snohomish County can expect about $4.35 in benefits for every dollar it invests in the MBPERP.**

Any decision with the potential to affect the environmental, recreational, educational, or economic value of a public asset must consider the entire range of benefits and costs associated with that decision. The valuations outlined above, and subsequent benefit-cost analysis, show that there is much to be gained by investing in the MBPERP. Ultimately, Meadowdale Beach Park is a public asset—one that is worth protecting, and investing in.

Appendix A. Ecosystem Services and Contributions

Table 6. Ecosystem Services and Contributions [14, 15]

Good/Service	Economic Benefit to People
Provisioning Services	
Food	Producing crops, fish, game, and fruits
Medicinal Resources	Providing traditional medicines, pharmaceuticals, and assay organisms
Ornamental Resources	Providing resources for clothing, jewelry, handicrafts, worship, and decoration
Energy and Raw Materials	Providing fuel, fiber, fertilizer, minerals, and energy
Water Storage	The quantity of water held by a water body (surface or ground water) and its capacity to reliably supply water
Regulating Services	
Air Quality	Providing clean, breathable air
Biological Control	Providing pest and disease control
Climate Stability	Supporting a stable climate at global and local levels through carbon sequestration and other processes
Disaster Risk Reduction	Preventing and mitigating natural hazards such as floods, hurricanes, fires, and droughts
Pollination and Seed Dispersal	Pollination of wild and domestic plant species
Soil Formation	Creating soils for agricultural and ecosystems integrity; maintenance of soil fertility, sediment transport for fish spawning areas
Soil Quality	Improving soil quality by decomposing human and animal waste and removing pollutants
Soil Retention	Retaining arable land, slope stability, and coastal integrity
Water Quality	Improving water quality by decomposing human and animal waste and removing pollutants
Water Capture, Conveyance, and Supply	Providing natural irrigation, drainage, groundwater recharge, river flows, drinking water supply, and water for industrial use
Navigation	Maintaining water depth that meets draft requirements for recreational and commercial vessels
Supporting Services	
Habitat and Nursery	Maintaining genetic and biological diversity, the basis for most other ecosystem functions; promoting growth of commercially harvested species
Information Services	
Aesthetic Information	Enjoying and appreciating the presence, scenery, sounds, and smells of nature
Cultural Value	Using nature as motifs in art, film, folklore, books, cultural symbols, architecture, media, and for religious and spiritual purposes
Recreation and Tourism	Experiencing the natural world and enjoying outdoor activities
Science and Education	Using natural systems for education and scientific research

Appendix B. Valuation Methods

The primary studies from which values are drawn employ a range of valuation techniques depending on the specific circumstances, including:

- **Market Pricing:** The current market value of goods produced within an ecosystem (e.g., food, fiber).
- **Replacement Cost:** The cost of replacing the services provided by functional natural systems with man-made infrastructure (e.g. a water treatment plant to replace natural water filtration).
- **Avoided Cost:** Ecosystem services can help communities avoid harm that would have incurred in the absence of those services (e.g. flooding reduction by wetlands and riparian buffers).
- **Production Approaches:** Ecosystem services which enhance output (e.g. rain-fed irrigation can increase crop productivity).
- **Travel Cost:** Demand for some ecosystem services may require travel, the cost of which reflects the implicit value of those services.
- **Hedonic Pricing:** Property values vary by proximity to some ecosystem services (e.g., homes with water views often sell for higher prices than similar homes without such views).
- **Contingent Valuation:** Estimates of value based on surveys of the values assigned to certain activities (e.g., willingness-to-pay to protect water quality).

The valuation of some ecosystem services is well-understood and straightforward. For others, no generally accepted methodologies exist, although their significance may be described qualitatively.

Appendix C. Study Limitations

The benefit transfer method (BTM), used in this study to value ecosystem services, has limitations. Yet, these limitations should not detract from the core finding that ecosystems produce significant economic value for society. Some limitations include:

- Every ecosystem is unique; per-acre values derived from another location may be of limited relevance to the ecosystems under analysis.

- Even within a single ecosystem, the value per acre depends on the size of the ecosystem; in most cases, as the size decreases, the per-acre value is expected to increase, and vice versa. (In technical terms, the marginal cost per acre is generally expected to increase as the quantity supplied decreases; a single average value is not the same as a range of marginal values).

- Gathering all the information needed to estimate the specific value for every ecosystem within the study area is not currently feasible. Therefore, the full value of all of the shrubland, grassland, et cetera in a large geographic area cannot yet be ascertained. In technical terms, far too few data points are available to construct a realistic demand curve or estimate a demand function.

- The prior studies upon which calculations are based encompass a wide variety of time periods, geographic areas, investigators, and analytic methods. Many of them provide a range of estimated values rather than single-point estimates. The present study preserves this variance; no studies were removed from the database because their estimated values were deemed too high or too low. In addition, only limited sensitivity analyses were performed. This approach is similar to determining an asking price for a piece of land based on the prices of comparable parcels ("comps"): Even though the property being sold is unique, realtors and lenders feel justified in following this procedure to the extent of publicizing a single asking price rather than a price range.

- In response to the study by Costanza et al. (1997) of the value of all of the world's ecosystems, critics objected to the absence of imaginary exchange transactions. However, including exchange transactions is not necessary if one recognizes the purpose of valuation at this scale—a purpose that is more analogous to national income accounting than to estimating exchange values.[16]

This report displays study results in a way that allows one to appreciate the range of values and their distribution. It is clear from viewing the tables that the final estimates are not precise. However, they are much better estimates than the alternative of assuming that ecosystem services have zero value, or, alternatively, of assuming they have infinite value. Pragmatically, in estimating the value of ecosystem services, it is better to be approximately right than precisely wrong.

Appendix D. Land Cover Maps

Figure 4. Land Cover at Meadowdale Beach Park (Scenario 1.0 - MBPERP)

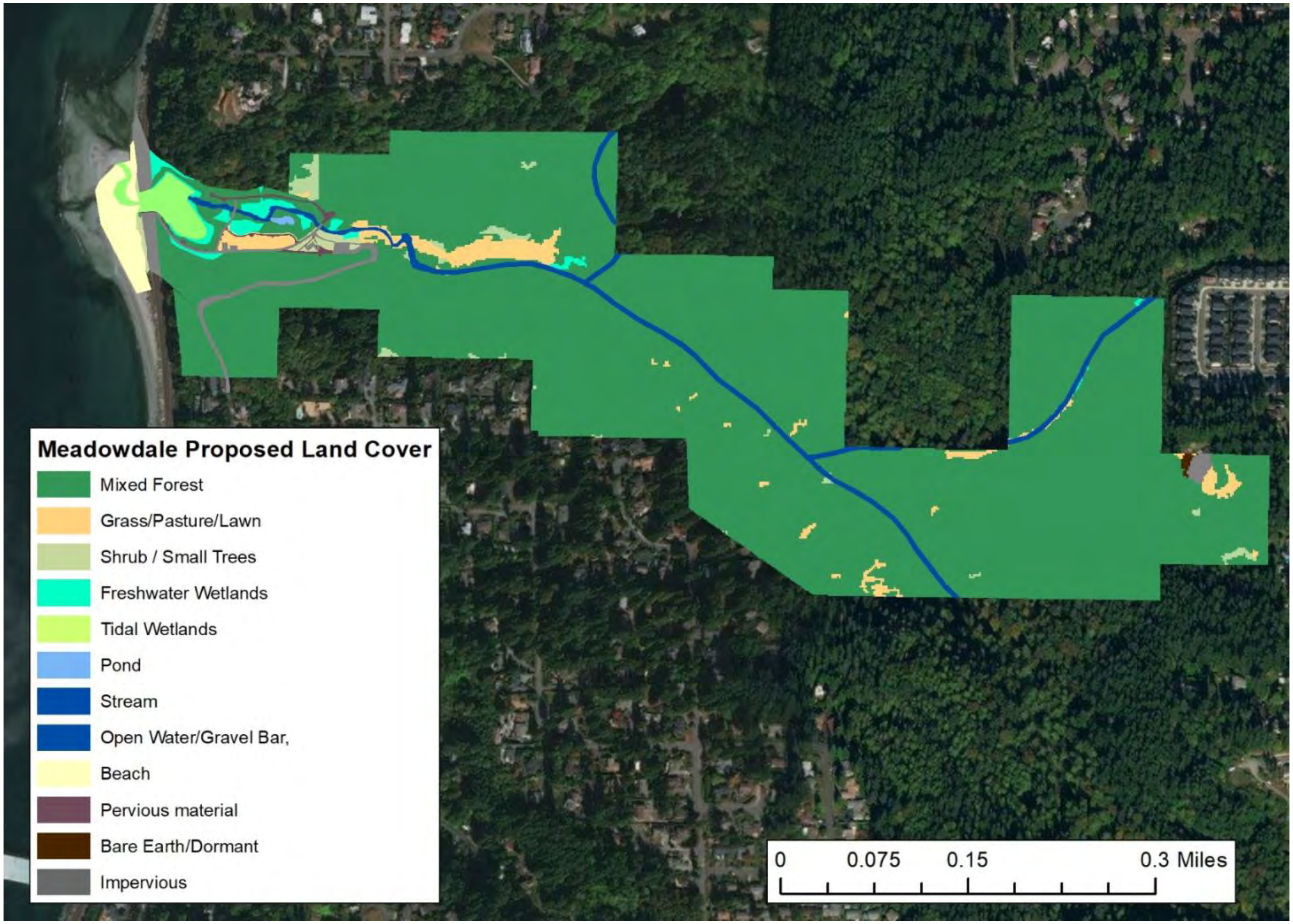
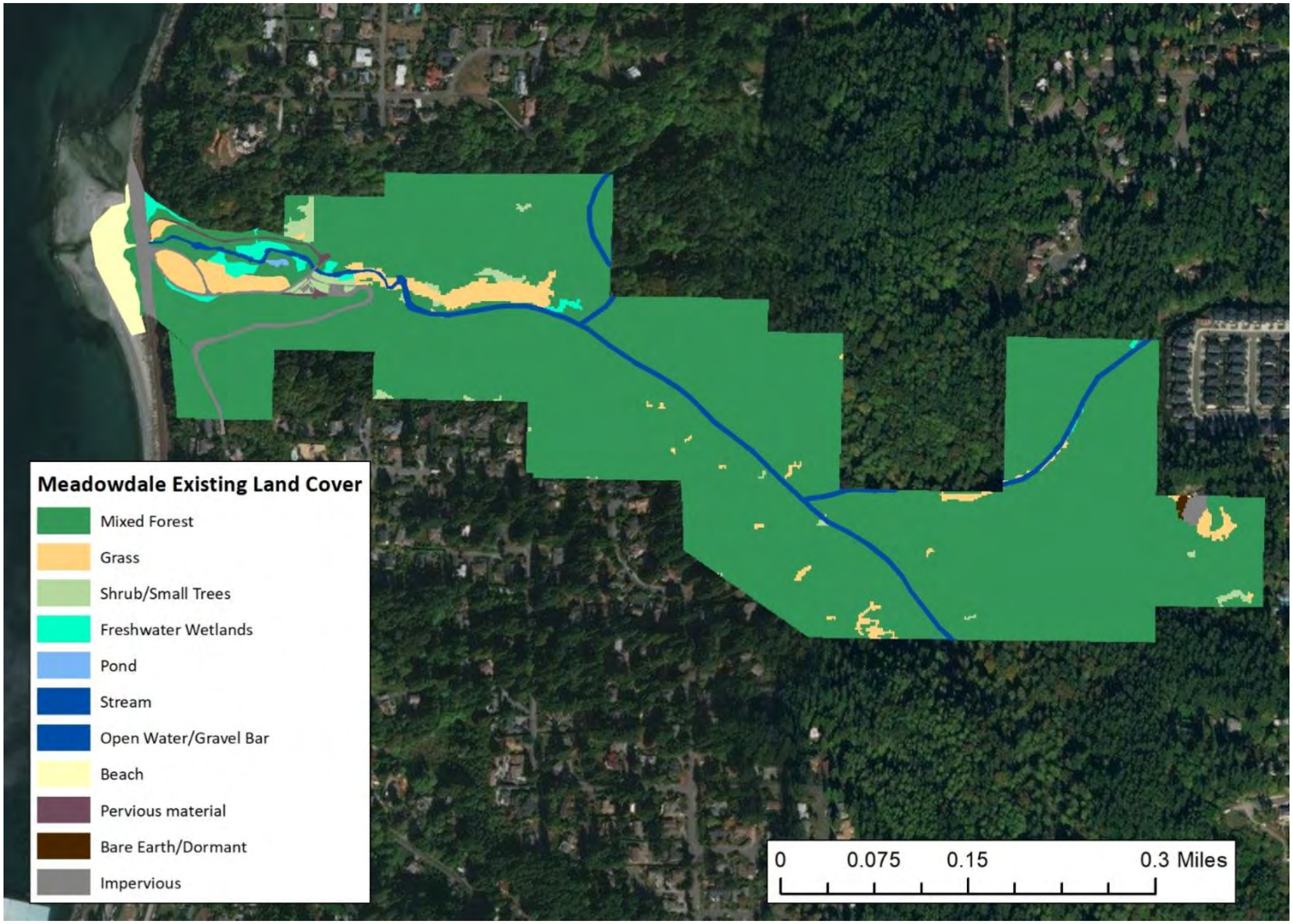


Figure 5. Land Cover at Meadowdale Beach Park (Scenario 2.0 - No Action)



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Appendix F. Estimation of Eelgrass Changes

CONFLUENCE
ENVIRONMENTAL COMPANY

To: Peter Hummel, Anchor QEA

From: Paul Schlenger and Grant Novak

Date: October 17, 2017

Re: Estimation of Eelgrass Changes Associated with Proposed Restoration

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As requested, this memo provides an estimate of the change in eelgrass area that could result from the proposed Meadowdale Beach Park estuary restoration project. This information will be used in a benefit:cost analysis of the proposed project.

We are not aware of studies from previous restoration projects to serve as a relevant reference for estimating such a change. As a result, the best estimate we can provide is highly uncertain.

To support the economic benefits analysis, we based our estimation of potential eelgrass change on ecological principles guided by the following conceptual considerations of how the proposed project may affect growing conditions for eelgrass:

- Following restoration, it is anticipated that some low intertidal and subtidal sand habitat will provide additional suitable growing conditions to support an expansion of eelgrass.
- It is anticipated that the creek channel across the lower estuary (i.e., waterward of the railroad embankment) will have more meanders and the stream will more often flow toward the north than in current conditions. This is because the high velocity flows at the culvert outlet (i.e., "firehouse effect") will be removed (due to removal of culvert and bridge construction) allowing the northerly longshore drift to have a greater impact on channel alignment than it does currently.
- In the existing condition, the eelgrass directly in front of the creek mouth (i.e., due west of creek) is patchier than in adjacent areas that support a continuous bed. This is an indication of the instability of growing conditions resulting from the creek flows and sediment delivery. Due to the creek being more often turned to the north, the shoreline area directly in front of the creek mouth (i.e., due west of creek) will have the creek channel directed at it less often. This is expected to provide more stable growing conditions for eelgrass immediately west of the current culvert outlet.

Since quantifying the potential change in eelgrass coverage is acknowledged to be highly uncertain, we decided to base our estimate on the acreages documented in the existing conditions survey and make a simple estimate of expansion over the first 50 years postconstruction. Currently, 2.8 acres of eelgrass were documented in front of the creek delta[1], of which 2.3 acres is continuous and 0.5 acres is patchy. For the purposes of the benefit:cost analysis, we recommend assuming that the eelgrass expansion in the first 25 years will approximately be equivalent to the area currently delineated as patchy. This increase equates to approximately a 20% increase in eelgrass coverage in the first 25 years. Assuming some continued expansion as sediment is continually delivered to the nearshore over time, an additional increase of 5% is estimated in years 25 to 50 post-restoration.

[1] This area is based on the three most northerly polygons shown in Figure 2 of the 2017 eelgrass survey.

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