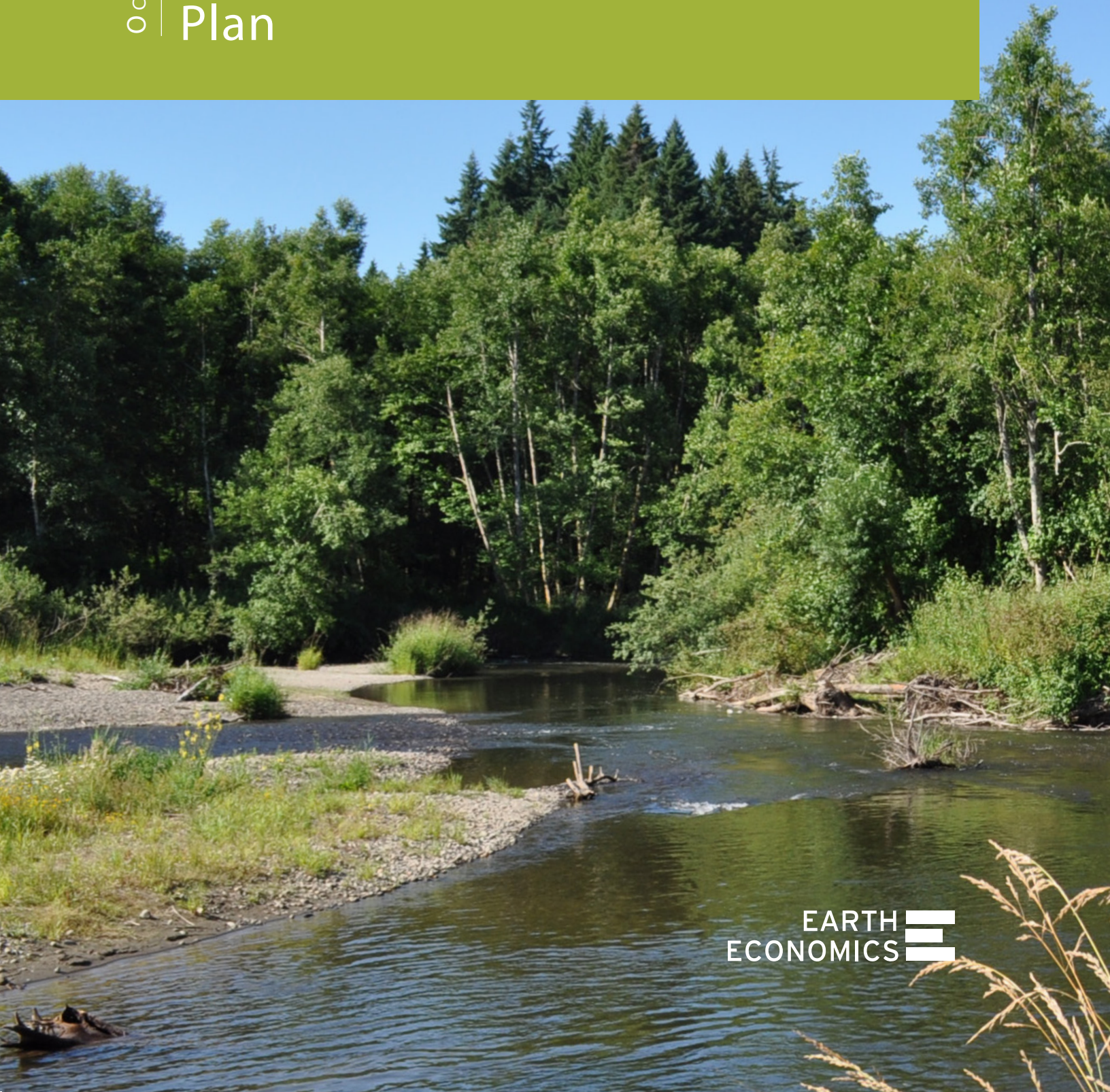


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Benefit-Cost Analysis of Selected Actions from the Thurston Climate Adaptation Plan



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Earth Economics

<http://www.eartheconomics.org/>
info@eartheconomics.org

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Primary Authors:

Corrine Armistead, GIS Analyst, Earth Economics
Peter Casey, Research Lead, Earth Economics
Maya Kocian, Senior Program Director, Earth Economics
Lola Flores, Project Director, Earth Economics

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Executive Summary

The *Thurston Climate Adaptation Plan* is an important step toward ensuring community resilience and economic sustainability. As part of this plan, the Thurston Regional Planning Council is considering several actions to prepare for climate change impacts.

This report provides a holistic benefit-cost analysis (BCA) for two climate adaptation actions identified in the *Thurston Climate Adaptation Plan*, going beyond traditional economic measures (e.g., capital costs, acquisition costs) to take nature's services into account. Action F-01 evaluates and secures sustained funding to restore and protect riparian vegetation along freshwater and marine shorelines. Action G-12 aims to increase incentives for targeted urban development, ensure that redevelopment projects are financially viable. The benefit-cost ratio (BCR) is the dollar value of benefits produced by each dollar of related costs; in other words, the return on investment for every \$1 in expenditures or forfeited revenue. Our BCA results show that both of these adaptation actions will provide significantly greater ecosystem service benefits that should be taken into account when considering whether to take other actions. Highlights include:

- The BCR for Action F-01 ranges from 1.73 (based on low estimates of the value of ecosystem services) to 9.34 (based on high estimates).
- The BCR for Action G-12 ranges from 14.78 (low estimates) to 18.15 (high estimates).
- Ecosystem services in restored riparian areas will produce between \$2,644 and \$8,311 per acre, every year.

Additional community benefits, such as expanded employment opportunities and associated income have not been included in this analysis. Even without these benefits, investing in climate adaptation in Thurston County offers exceptionally good returns.

Introduction

Watersheds within the Thurston Region and around the Puget Sound face a range of threats from natural hazards, including droughts, floods, and fires. In the coming years, climate change will intensify these natural hazards and, subsequently, their effects on underprepared populations. With funding from the National Estuary Program (NEP), the Thurston Regional Planning Council (TRPC) is working to better prepare communities for future threats through regional planning efforts.

TRPC is developing “a watershed-based climate adaptation plan with actions the Thurston County region could take to prepare for and adjust to climate change impacts in the decades ahead.”ⁱ This plan includes 90 actions, split into six broad categories that include drought and water quality; flood and erosion; and, transportation and energy.ⁱⁱ An additional component of plan development is the use of benefit-cost analysis (BCA) to evaluate possible actions. In this report, Earth Economics presents a more holistic assessment of the benefits and costs of two proposed climate adaptation actions to Thurston County, including the benefits provided by ecosystem services, as well as more conventional metrics of benefits and costs.

BCA is a proven economic tool for developing environmental, health, and safety regulations.ⁱⁱⁱ Traditional BCAs include economic benefits and costs occurring within the market, like acquisition and maintenance costs. A holistic BCA includes these traditional market measures, but also incorporates non-market benefits and costs, such as ecosystem services and social impacts. Environmental and social benefits are often just as tangible as economic benefits. For example, families displaced by flooding experience a social cost. Incorporating economic, environmental, and social benefits and costs into policy analysis provides a more holistic perspective of what people value, whether or not a market transaction occurs. Ecosystems are vital to economies, providing essential goods and services that enable cities, communities, households, and their residents to thrive. However, society has largely undervalued the importance of functioning ecosystems, leading to the degradation or destruction of natural assets. This loss of natural assets translates to tangible economic costs. For example, the loss of free flood protection provided by natural wetlands necessitates replacements. The ecosystem function that generates flood risk reduction must be replaced with costly levees, and flooded houses must be fixed.

To avoid ecosystem losses, it is important to include ecosystem service benefits in decision making. Economic value can be assigned by employing ecosystem services valuation, a method that economists use to ascribe monetary value to ecosystem services. For example, in 2012, Earth Economics assessed Thurston County’s ecosystems, finding that they provide at least \$608 million in economic benefits to the regional economy *every year*.^{xii} These economic benefits come from ecosystem services such as flood reduction, habitat, and water supply.

Use of Ecosystem Services in BCAs

While far from fully recognized, ecosystem service values have been included in local and federal policy discussions in recent decades. This section highlights environmental and public health policy decisions that incorporated non-market benefits, including ecosystem services.

In 1995, Meyer et al. conducted a BCA that relied heavily on people's willingness to pay for preservation and use of the Elwha River.^{iv} This study found that non-market benefits exceeded market benefits by a factor of over 100. The results of this analysis influenced the decision to restore the Elwha River by removing two dams.

On a broader scale, the U.S. Forest Service incorporated non-market benefits into forest management decisions in 1996. One USFS report found that accounting for the non-market benefits of federal land aligned with the economic objectives of federal land management, which require that lands are managed to "maximize net public benefits".^v Non-market methods used by environmental economists can be adapted by economists working in other policy contexts. For example, revealed and stated preference valuations are used to estimate the benefits of health hazard reduction, such as willingness to pay for fire alarms, automobile safety, or an improvement in quality of life.^{vi} Given the efficacy of non-market benefit estimation in a variety of policy contexts, policy decisions with a significant impact on natural capital or ecosystem services-producing land should incorporate non-market benefits into policy analysis.

Prior use of Ecosystem Services by Earth Economics

In Seattle, the \$6.4 million Thornton Creek Confluence Project, an urban stream daylighting and floodplain expansion project, relied on a holistic BCA for approval. During the planning phase, Seattle Public Utilities produced a BCA that included not only flood risk reduction and infrastructure operations and maintenance cost reduction outcomes, but also habitat improvement benefits.^{vii} These economic benefits, calculated by Earth Economics, helped demonstrate that the project would have a positive net return. The project was subsequently approved by the Asset Management Committee, Seattle Public Utilities' decision-making body.

Mojica et al. conducted a BCA of four dams on the Lower Snake River, correcting an earlier cost benefit analysis that didn't account for non-market benefits. When lost recreation benefits were incorporated into a BCA of the dams, the benefit-cost ratio of the dams sank to 0.15, indicating that every dollar spent provided a benefit of 15 cents.^{viii}

Earth Economics specializes in the valuation of non-market benefits provided by natural landscapes. Recently, Earth Economics and Royal Engineering conducted an ecosystem services valuation of Louisiana's coastal wetlands, projecting future land cover types.^{ix} These projections were based upon changes in hydrology resulting from installation of sediment diversions near the mouth of the Mississippi River. The change in ecosystem services value between different scenarios was viewed as the benefit in a BCA of sediment diversion installation.

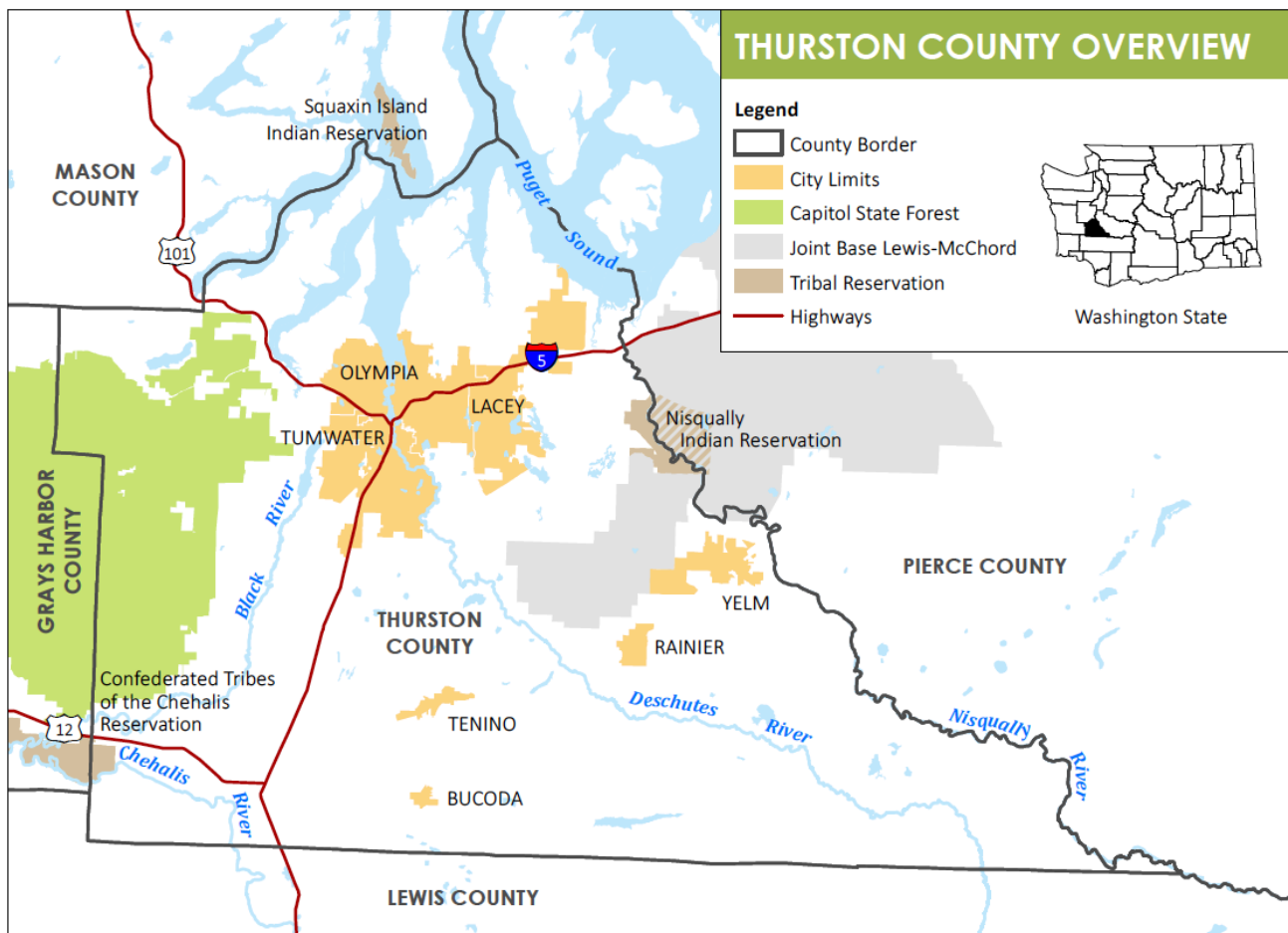
The Federal Emergency Management Agency (FEMA) requires all applicants to its hazard mitigation grant programs to demonstrate a benefit-to-cost ratio greater than one to qualify. In 2013, FEMA

became the first federal agency to adopt ecosystem services valuation in formal policy. The policy was approved using values and concepts provided by Earth Economics. Faced with rising natural disaster costs and climate uncertainty, FEMA approved Mitigation Policy FP-108-024-01, which allows the inclusion of ecosystem services in BCA for flood-related acquisition projects. In 2016, FEMA adopted additional values provided by Earth Economics that added ecosystem services values for drought and wildfire mitigation. Today, leaders are able to make more informed decisions, leading to stronger, more cost-effective projects that take nature into account and save taxpayer dollars.

Study Overview

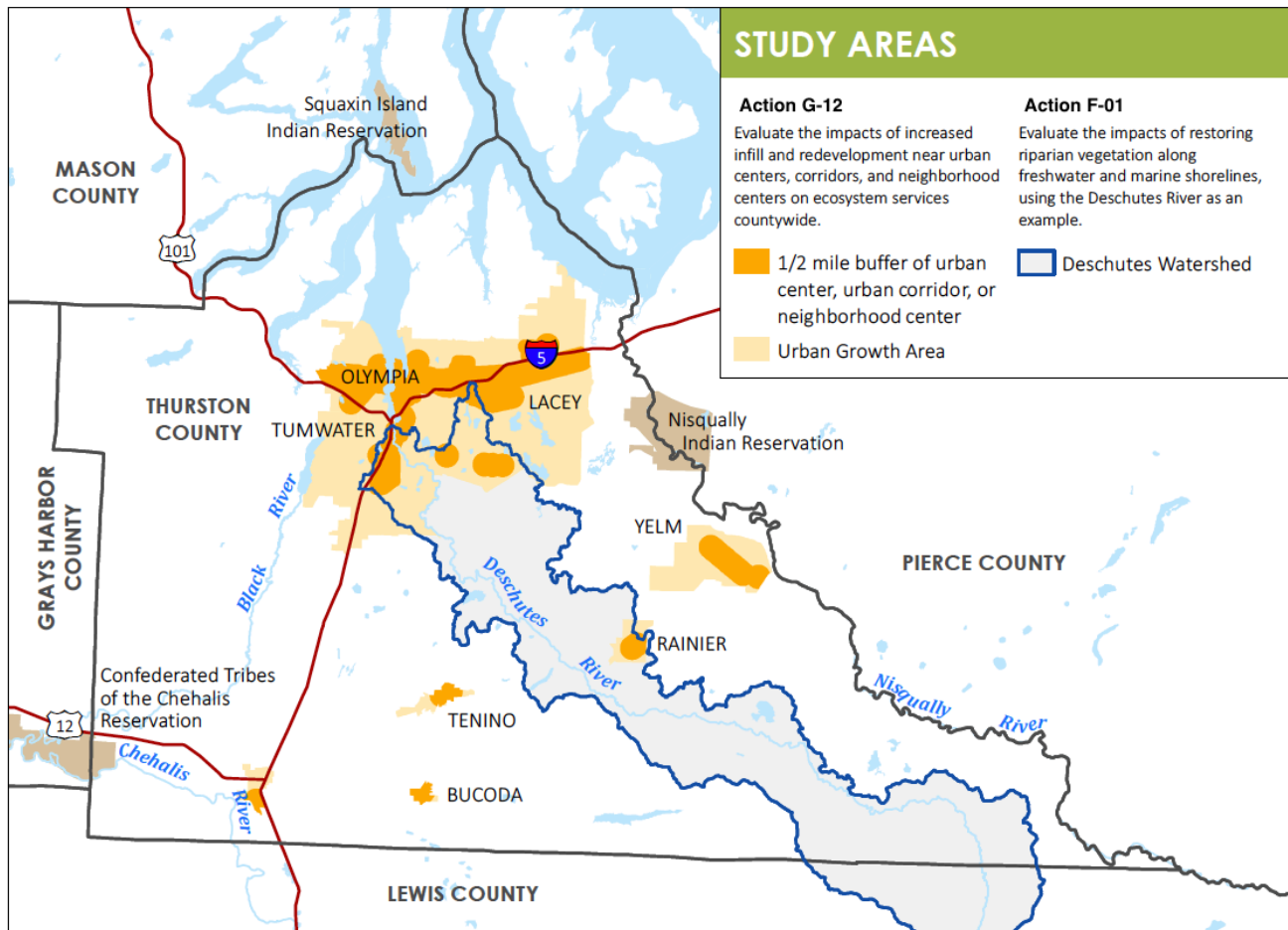
This analysis develops BCAs for two proposed climate adaptation actions within TRPC’s climate adaptation plan to serve as examples of how to conduct a holistic BCA. The plan targets actions to implement in the Thurston County portion of three watersheds (the Nisqually, Deschutes, and Kennedy/Goldsborough (WRIA 11, 13, and 14)). Situated directly along Southern Puget Sound, this region offers a diverse landscape of coastal lowlands, prairie flatlands and foothills of the Cascade mountain range. The population centers of Olympia, Lacey, and Tumwater, with a combined 100,000+ residents, also fall within the planning area (see Figure 1).

Figure 1. Climate Adaptation Planning Region



As determined in agreement with TRPC and the stakeholder group, Action F-01 and Action G-12 were selected for sample BCAs.ⁱⁱ To illustrate benefits and costs, specific planning scenarios are associated with each action. As depicted in Figure 2, the planning scenario for each action in this analysis focuses on only a portion of the larger study region. These sample planning scenarios provide quantitative inputs for a holistic BCA that can be adjusted or replicated as other implementation scenarios or actions are considered. The two BCAs developed in this analysis provide a model for the inclusion of ecosystem services and additional non-market benefits into assessments of climate adaptation actions. Details of Action F-01 and Action G-12 are provided below.

Figure 2. Actions F-01 and G-12 Scenario Geographies

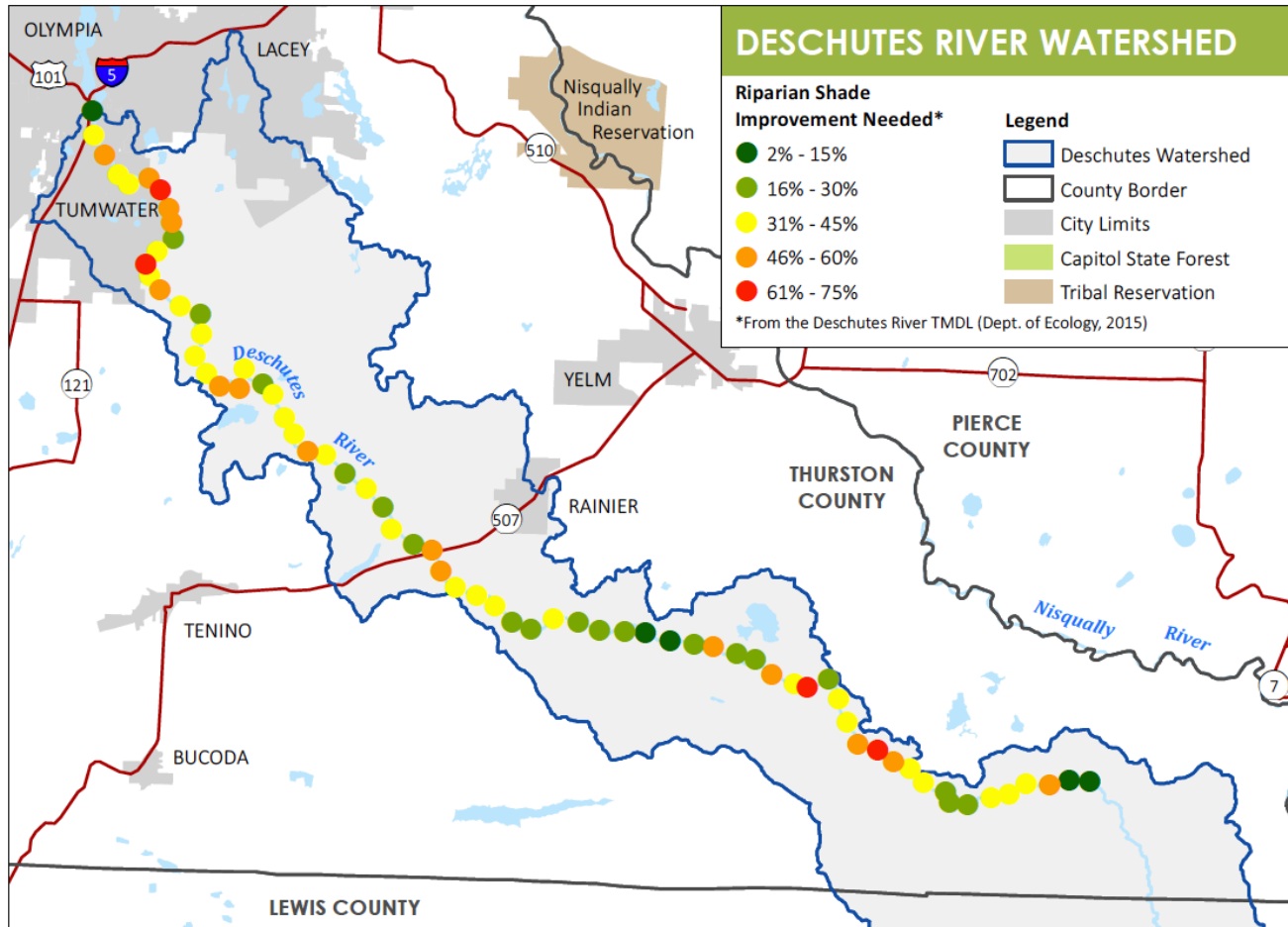


Action F-01

Action F-01 proposes to evaluate and secure sustained funding to restore and protect riparian vegetation along freshwater and marine shorelines. Restoration along the Deschutes River is the planning scenario utilized to demonstrate the benefits and costs of Action F-01. Extensive planning has been completed in this watershed, related to multiple Total Maximum Daily Load (TMDL) studies and other impairments. TRPC used the shade allocation targets identified in the Deschutes River TMDL to estimate the change in land cover under a restoration and conservation scenario.

Similar scenario development in other watersheds could be used in additional Action F-01 BCAs. The degree of riparian restoration needed along stretches of the Deschutes River is highlighted in Figure 3.

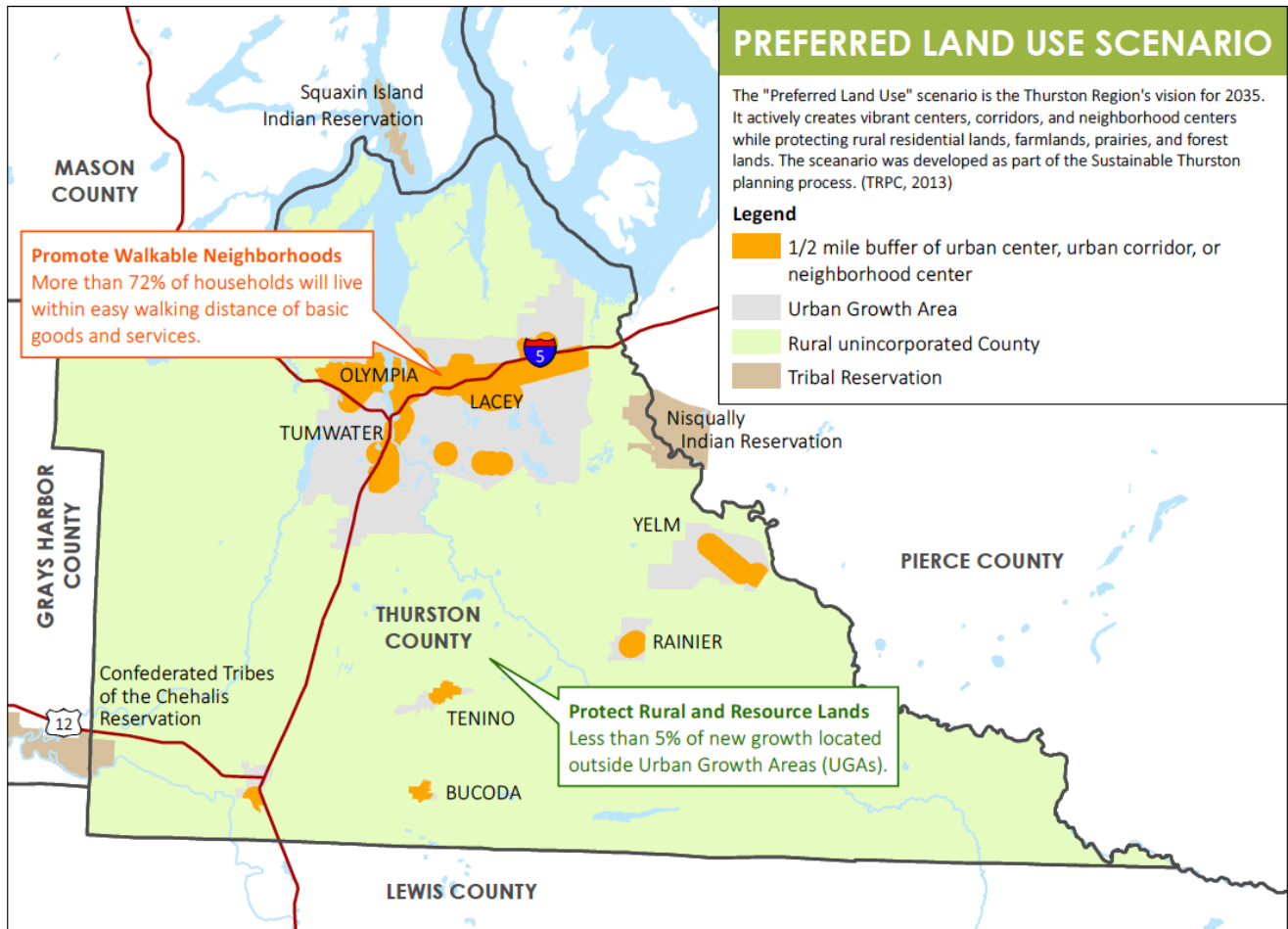
Figure 3. Deschutes Watershed with Proposed Restoration Sites under Action F-01



Action G-12

Action G-12 proposes to increase incentives to improve the financial viability of targeted urban development and redevelopment projects in designated centers, corridors, and neighborhood centers. This action can both preserve rural natural assets by avoiding development and enhance residents’ resilience by shortening their distance to services. The implementation scenario of Action G-12 used in this analysis is region-wide, and was developed as the Preferred Land Use scenario of the Sustainable Thurston project, a region-wide visioning project completed in 2013. The Preferred Land Use scenario represented a “compact” growth scenario compared to the Baseline scenario – or adopted land use plans projection. The targets from the Preferred Land Use Scenario^{xi} are shown in Figure 4.

Figure 4. Zones of Future Development within Thurston Region



Holistic BCA Methods

Ecosystem Services Valuation

Ecosystem service benefits are included in the BCA for both actions. The derivation of ecosystem service values follows the methodology presented in Earth Economics' 2012 report, *The Natural Value of Thurston County, A Rapid Ecosystem Service Valuation*.^{xii} Updates were made to 2012 values based on improved valuation literature. The per-acre ecosystem service values used in the following BCAs are presented in Appendix B.

Action F-01 Benefit and Cost Methods

This particular action requires restoration of riparian lands, converting currently developed, agricultural, or non-optimal vegetated lands to forests. The benefit from Action F-01 is expressed as the difference between ecosystem services values of current baseline land cover and projected land cover under successful implementation. TRPC provided data on project costs, including restoration and the acquisition of easements on private land, based on 40 Thurston County riparian restoration

projects listed in the Washington State Recreation and Conservation Office’s PRISM database.^{xiii} Projects were funded between 1999 and 2016.

Please note that not all expected costs and benefits were included in this analysis (e.g., benefits of improved or restored salmon runs due to riparian restoration).

Action G-12 Benefit and Cost Methods

The evaluation of this action is based upon the expected benefits and costs associated with incentivizing downtown development and redevelopment, as an alternative to continuing current suburban expansion rates. The benefits of Action G-12 are based upon the difference in ecosystem services provided by the Baseline (i.e., adopted land use plans) and Preferred Land Use scenarios. Additional benefits are experienced by county, city, and town governments in the form of avoided service provisioning costs. The costs of Action G-12 include foregone government revenues from impact fee decreases and tax exemptions. Details on the methods used to evaluate Action G-12 are provided in Appendices D and E.

Holistic BCA Results

Action F-01 Results

Action F-01 provides a benefit-cost ratio ranging from 1.73 to 9.34, based on the low and high ecosystem services estimates, respectively. Appendix B (Table 4) details the per land cover ecosystem service values utilized to represent benefits. The total and per-acre costs of restoration on both public and private land are displayed in Table 1. The net present costs and benefits of restoration and the associated benefit-cost ratios are shown in Table 2.

Table 1. Action F-01: Per-Acre and Total Costs

	Program Costs	
	Private Land	Public Land
Acreage of Converted Land	510	35
Avg. Restoration Cost (\$/acre)	\$13,866	\$13,866
Avg. Easement Cost (\$/acre)	\$9,457	\$0
Total Cost (\$/acre)	\$23,323	\$13,866
Costs (2016\$)	\$11,894,730	\$485,310
Public + Private (2016\$)	\$12,380,040	

Table 2. Action F-01: Fifty Year Net Present Value and Benefit-Cost Ratios

	Net Present Value	
	Low	High
2.875% Discount Rate	\$21,382,000	\$115,633,000
Benefit-Cost Ratio	1.73	9.34

Action G-12 Results

Action G-12 provides a BCR ranging from 14.78 to 18.15 when ecosystem service benefits are included, based on the low and high estimates of the value of these nonmarket benefits, relative to a baseline of continued suburban growth. In other words, Thurston County can expect between \$14.78 and \$18.15 in benefits for every dollar it invests in targeted urban development and redevelopment. The Preferred Land Use scenario preserves 6,175 acres of rural land, ensuring the yearly production of \$12-\$17 million in ecosystem services over the baseline (2016\$).

The net present value over a 50-year period (2.875% discount rate) for all ecosystem service benefits (see Appendix B) and avoided public service provisioning costs (see Appendix D) is between \$1.05 billion and \$1.29 billion.

Reducing impact development fees for multifamily projects in urban areas, such as downtown Olympia, Lacey’s Woodland District, and Tumwater’s Town Center, Capitol Corridor, and Brewery District, results in a one-time loss of \$260,000. Additional tax incentives for urban development under the Preferred Land Use scenario would reduce city, county, and state revenue by a total of \$71 million (see Appendix E for further details). Net present costs, benefits, and BCRs associated with Action G-12 are presented in Table 3. The land cover changes on which these net present values are based are shown in Appendix B in Table 5.

Table 3. Action G-12: 50-Year Net Present Values and Benefit-Cost Ratios

	Low	High
NPV of Ecosystem Services*	\$343,260,000	\$582,072,000
Avoided Public Service Costs*	\$703,498,000	
Total Benefits	\$1,046,758,000	\$1,285,570,000
Costs		
Foregone Impact Fees	\$260,000	
Tax Exemptions	\$70,581,000	
Total Costs (2016\$)	\$70,841,000	
Benefit-Cost Ratios	14.78	18.15

* 2.875 discount rate, over 50 years.

Conclusions and Recommendations

This report provides a benefit-cost analysis of two actions from the *Thurston Climate Adaptation Plan* and highlights the importance of including ecosystem services and social impacts in the region's decision-making process. Earth Economics' earlier work revealed that Thurston County provide goods and services are valued at least \$608 million every year. Any decision with the potential to affect the value of the goods and services provided by ecosystems must consider the entire range of benefits and costs to ensure that a course of action will maximize net public benefits.

Understanding the immense value of ecosystem services, which ultimately shape the regional economy, is a critical first step in developing policies, investing public dollars, and making decisions regarding natural resource management and flood mitigation.

Earth Economics recommends the following next steps:

- **Include Ecosystem Services and Social Benefits in Future Benefit-Cost Analyses.** As local governments consider courses of action to address floodplain management and climate adaptation needs in the region, officials should consider the costs and benefits of their actions with regard to ecosystem services. BCAs that incorporate ESV can provide governments, organizations, and private landowners a way to calculate the true rate of return on conservation and restoration investments. Including ecosystem services values also allows for the full consideration of green and grey alternatives to infrastructure projects. A handful of state and federal agencies, including FEMA, already include ESV in their formal BCAs (Mitigation Policy FP-108-024-01, 2013). Thurston County jurisdictions should join the ranks of these leading agencies and include ESV in future BCAs.
- **Engage Stakeholders to Expand Benefits and Costs Under Action Scenarios.** Ultimately, a holistic BCA for all action items in the *Thurston Climate Adaptation Plan*, that involves land use changes, would support jurisdictions' decision-making processes and base decisions on what people value, as opposed to solely the market transactions that take place.
- **Protect and Restore Natural Capital.** Farmland preservation, salmon habitat restoration, and flood damage mitigation are priorities for the Thurston Region. TRPC partners can help accelerate this work by advocating for the acceptance and application of ecosystem service valuation, and a holistic approach to benefit-cost analysis, in the jurisdictions' planning processes. Taking this approach will lead to additional conservation efforts throughout the Thurston Region, and support long-term economic growth.

Glossary of Terms

Benefit-cost analysis: A common tool that compares the present-day cost of a project with its long-term benefits, often used by decision makers to determine whether or not a project will be funded.

Benefit-cost ratio: The dollar value of benefit per dollar of associated cost. If a ratio number is higher than 1, then the project is typically funded. A project with a benefit-cost ratio greater than 1 indicates that the project benefits outweigh the costs. A project with a benefit-cost ratio less than 1 indicates that the project's costs outweigh the benefits.

Discount rate: The rate at which people value current consumption or income, compared with later consumption or income. It determines the present value of future cash, due to uncertainty, productivity, or time preference for the present.

Ecosystem goods and services: Benefits obtained from ecosystems. Goods are tangible, and often traded in markets (e.g., potable water, fish, timber). Services provide less tangible, often non-market benefits (e.g., flood protection, water quality, climate stability).

Market-based valuation: Value estimates based on observed willingness-to-pay for a given good or service (i.e., market pricing).

Natural capital: Earth's stock of organic and inorganic materials and energies (renewable and nonrenewable) and living biological systems (ecosystems) which constitute the biophysical context for the human economy and human wellbeing.

Net present benefits: The measure of the total benefits in today's dollars, including future benefits which have been annually discounted over a pre-determined period of time (e.g., project period).

Net present cost: The costs expressed in discounted present values. Future costs which have been annually discounted over a pre-determined period of time (e.g., project period).

Net present value: The measure of the total value in today's dollars, including future contributions which have been annually discounted over a pre-determined period of time (e.g., project period).

Non-market value: A value recognized by people but not usually expressed in prices because the valuable thing either is not currently, or cannot conceivably, be traded in markets.

Riparian areas: Habitat which is immediately adjacent to freshwater areas (e.g. marshes, forests, etc.).

Appendix A – BCA Limitations

BCA Limitations

The BCAs conducted for this report do not provide a complete estimation of all potential benefits arising from these actions. For example, the riparian restoration in Action F-01 may be associated with increased levels of recreation, which improves the health of the local population. This increase in health is not accounted for within the analysis. Similarly, Vehicle Miles Traveled (VMT) in Action G-12 are excluded, which could be expected to reduce local air pollution, greenhouse gas emissions and total commuting time. The change in ecosystem services brought about by Actions F-01 and G-12 may result in a change in consumer behavior. The increased density of downtown and urban centers will increase the number of businesses that can be supported within the areas and may encourage employers to move in and take advantage of an expanded market. These unquantified benefits were outside the scope of the report and would require a great deal more data and time to incorporate into the analysis in a quantitative manner.

Appendix B – Ecosystem Service Tables

Land cover acreages for each scenario were developed by Thurston Regional Planning Council. Methodology is described in Appendix F.

Table 4. Action F-01 Acreage and Value Change

Land Cover	Acres			Annual Value			
	Baseline Scenario	Restoration Scenario	Change	Low \$/acre	High \$/acre	Change (Low)	Change (High)
Developed							
Barren Land	2.2	0	-2.2	\$0	\$0	0	0
Developed, High Intensity	1.4	0.02	-1.3	\$0	\$0	0	0
Developed, Medium Intensity	11.0	0.06	-11	\$0	\$0	0	0
Developed, Low Intensity	78.2	0.2	-78	\$0	\$0	0	0
Developed, Open Space	45.2	2.0	-43	\$0	\$0	0	0
Shoreline	11.6	0	-12	\$0	\$0	0	0
Cultivated							
Field Crops	9.3	0	-9.3	\$719	\$1,959	(\$6,683)	(\$18,196)
Pastures	82	0	-82.1	\$2,334	\$2,345	(\$191,636)	(\$192,532)
Forest							
Deciduous	115	229	114.5	\$2,787	\$8,311	\$318,961	\$951,213
Evergreen	298	596	298.5	\$2,644	\$8,235	\$789,166	\$2,458,032
Mixed	132	264	132	\$2,648	\$8,172	\$349,676	\$1,079,263
Grasslands	84	0.10	-84	\$4,972	\$5,430	(\$418,848)	(\$457,461)
Shrublands	223	0.7	-222.1	\$606	\$1,153	(\$134,512)	(\$256,163)
Wetlands							
Forested/Woody	395	395	-0.05	\$16,006	\$19,847	(\$815)	(\$1,011)
Totals						\$705,308	\$3,563,145

Note: This analysis includes the value of both carbon storage and carbon sequestration (i.e., the additional carbon stored each year). Only the latter are reflected in Table 4. The change in carbon stock value from baseline to restoration ranges from a low of \$2,261,000 to a high of \$19,039,000.

Table 5. Action G-12 Acreage and Value Change

Land Cover	Acres			Annual Value			
	Baseline Scenario	Preferred Land Use Scenario	Change	Low \$/acre	High \$/acre	Change (Low)	Change (High)
Cultivated							
Field Crops	5,910	6,052	142	719	1,959	\$101,944	\$277,579
Pastures	34,272	35,517	1,245	2,334	2,345	\$2,905,868	\$2,919,454
Forest							
Deciduous	26,108	26,843	735	2,563	4,057	\$1,883,871	\$2,981,950
Evergreen	135,334	136,847	1,513	2,420	3,981	\$3,662,480	\$6,024,718
Mixed	46,553	47,518	965	2,424	3,918	\$2,339,311	\$3,781,395
Grasslands	35,946	36,519	574	1,052	1,454	\$603,669	\$834,505
Shrublands	67,190	68,191	1,001	543	551	\$543,638	\$551,596
Wetlands							
Forested/Woody	26,645	26,645	0	15,587	19,709	\$0	\$0
Grass/herbaceous	289	289	0	9,201	10,056	\$0	\$0
Totals	378,247	384,422	6,175			\$12,040,782	\$17,371,197

Note: This analysis includes the value of both carbon storage and carbon sequestration (i.e., the additional carbon stored each year). Only the latter are reflected in Table 5. The change in carbon stock value from baseline to restoration ranges from a low of \$16,842,000 to a high of \$111,149,000.

Appendix C – Ecosystem Services Benefit Transfer References

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Appendix D – Action G-12 Benefit, Avoided Cost of Service Provision

Shifting patterns of urban and suburban development affect regional resiliency in multiple ways, but perhaps the most immediately evident are changes to cost of providing public services to residents. This analysis looks specifically at these changes to county, town, and city government expenditures in Thurston County.

This analysis considers development expected to occur from 2017 to 2040, under two Sustainable Thurston project scenarios, the Baseline of “business as usual,” and another known as Preferred Land Use, which seeks to incentivize targeted urban development and redevelopment. The associated service provisioning costs have been projected through 2065, for consistency with our earlier assessment of net present values over a 50 year planning horizon.

Different patterns of development (e.g., urban vs. rural) and dwelling types (e.g., single-family vs. multifamily), lead to varying costs for the provision of public services. For instance, the per-household cost to extend power lines to homes in urban areas is far less than for rural or suburban homes. To estimate these cost differences, this analysis draws from a report of development patterns in Halifax, Nova Scotia,^{xv} using their estimates of the differential costs of providing public services to various dwelling types to estimate similar Thurston County, city, and town government expenditures.

Using the per-household cost of service for varying development patterns and rates of development, this analysis compares the baseline scenario to the preferred land use scenario. Calculations and sources are detailed below.

Dwelling types

After adapting the classification of dwelling types in the Halifax study to those in the Sustainable Thurston project, the following development patterns were provided by TRPC for the baseline year, 2016, as well as the two development scenarios.

Distribution of dwelling types, provided by TRPC (aggregated multiple categories from Sustainable Thurston Plan)

Dwelling Types	2016 Units	2040 Baseline Units	2040 Preferred Land Use Units
Pattern B	34,652	42,045	36,858
Pattern D	43,134	72,942	69,203
Pattern E	12,557	13,550	13,849
Pattern F	18,676	32,451	31,858
Pattern G	6,219	9,486	14,226
Total	115,238	170,475	165,994

Thurston County 2016 Cost of Service by Dwelling Type

2016 Thurston County/Town/City Public Service Expenditures^{xvi} = \$538,749,979

b = Cost of service provision per household, pattern B

Solve for b , then adjust other development patterns (D,E,F,G) according to Halifax Percent of Pattern B service cost

Cost = (b x number of B units)

+ ((b x (Halifax cost per unit Pattern D / Halifax cost per unit Pattern B)) x (number of D units))

+ ((b x (Halifax cost per unit Pattern E / Halifax cost per unit Pattern B)) x (number of E units))

+ ((b x (Halifax cost per unit Pattern F / Halifax cost per unit Pattern B)) x (number of F units))

+ ((b x (Halifax cost per unit Pattern G / Halifax cost per unit Pattern B)) x (number of G units))

$\$538,749,979 = 34,652b + (b \times (\$3,088/\$4,112) \times 43,134) + (b \times (\$1,914/\$4,112) \times 12,557) + \text{etc.}$

$\$538,749,979 = 34,652b + 32350.5b + 5901.8b + \text{etc.}$

$\$538,749,979 = 84,917.03b$

$b = \$6,344.43$

Table 6. Projected Service Provision Costs per Household

Dwelling Types	Cost/Household (CAN 2004)	Percentage of Pattern B Service Cost	Thurston County Units 2016	Projected Thurston County Cost/Household (2016\$)
Pattern B	\$4,112.00		34,652	\$6,344.43
Pattern D	\$3,088.00	75%	43,134	\$4,758.32
Pattern E	\$1,914.00	47%	12,557	\$2,981.88
Pattern F	\$2,172.00	53%	18,676	\$3,362.55
Pattern G	\$1,413.00	34%	6,219	\$2,157.11

Rate of Development

To calculate total service costs associated with development, the rate of development was assumed constant over the analysis period, 2017 to 2040. Year 2016 is excluded, assuming that the first additional units will be completed in 2017 and final units finished in 2040. This enables the calculating of annual costs of service provision, accounting for the increase in units over time.

Dwelling Types	Change in units 2040 Baseline	Change in units 2040 Preferred	Rate of Development Baseline (2017-2040) (Units/year)	Rate of Development Preferred (2017-2040) (Units/year)
Pattern B	7,393	2,206	308.04	91.92
Pattern D	29,808	26,069	1,242.00	1,086.21
Pattern E	993	1,292	41.38	53.83
Pattern F	13,775	13,182	573.96	549.25
Pattern G	3,267	8,007	136.13	333.63

Annual Service Provision Costs

Annual increase in cost of services is calculated based on the number of dwellings completed from the 2016 baseline. Additional dwellings of each type are multiplied by the respective annual service costs. From 2041 to 2065, no additional development is assumed, but annual service costs of dwellings built from 2017 to 2040 are continued through 2065. This allows for a 50-year net present value calculation for total service provision costs under each scenario. The difference in service provision cost, represents the savings by the county.

$$\begin{aligned}
 & \textit{Thurston County Savings} \\
 & = \textit{Total Baseline Service Provision Costs} \\
 & - \textit{Total Preferred Land Use Service Provision Costs} = \$703,497,600
 \end{aligned}$$

Appendix E – Action G-12 Cost, Impact Fees and Tax Exemption

Impact Fees

Subsidizing development and redevelopment in urban centers, urban corridors, and other residential centers results in a loss to city, county, and state revenue, through lowered fees and revenues. The dollar values in this analysis (2016\$), were derived from a comparison of impacts fees for two Olympia development projects, one within the subsidized downtown zone, and one outside.

Transportation Impact Fee Per Unit, Non Subsidized = \$2,293

Parks Impact Fee Per Unit, Non Subsidized = \$3,196

Transportation Impact Fee Per Unit, Subsidized = \$0

Park Impact Fee Per Unit, Subsidized = \$2,614

Baseline Scenario

Number of New Multifamily Units in Targeted Development Zone = 3,267 units

Number of New Multifamily Units Outside of Targeted Development Zone = 13,775 units

Baseline Revenue Per Unit

= Transportation Impact Fee, non subsidized

+ Park Impact Fee, non subsidized = (\$2,293 + \$3,196) = \$5,489 per unit

*Total Baseline Revenue = \$5,489 per unit * 17,042 units = \$93,543,538*

Future Development Scenario

Number of New Multifamily Units in Targeted Development Zone = 8,007 units

Number of New Multifamily Units Outside of Targeted Development Zone = 13,182 units

Future Development Revenue Per Unit in Targeted Development Zone

= Transportation Impact Fee, subsidized + Park Impact Fee, subsidized

= (\$0 + \$2,614) = \$2,641 per unit

Future Development Revenue Per Unit Outside of Targeted Development Zone

= Transportation Impact Fee, non subsidized

+ Park Impact Fee, non subsidized = (\$2,293 + \$3,196) = \$5,489 per unit

Total Future Development Revenue

*= (\$2,614 per unit * 8,007 units) + (\$5,489 per unit * 13,182 units)*

= \$93,286,296

Difference Between Scenarios

$$\text{Reduced Impact Fee Revenue} = \$93,543,538 - \$93,286,296 = \$257,242$$

Tax Exemption

Tax exemptions for development and redevelopment projects in urban centers, corridors, and residential centers can be significant incentives for developers. This scenario applies the average annual tax exemptions from a downtown Lacey project completed in 2008,^{xvii} and assumes a constant rate of development from 2017 to 2040. Tax holidays were applied to new multifamily dwellings in the urban corridor starting the year of the expected building completion and assumed to continue for 12 years. In other words, units completed in 2040 would be tax exempt until 2051.

$$\text{Multifamily Tax Exemption Per Unit Per Year} = \$1,161 \text{ per unit per year}$$

$$\text{Number of New Multifamily Units in Targeted Development Zone} = 8,007 \text{ units}$$

$$\begin{aligned} \text{Number of New Multifamily Units Constructed Annually in Targeted Development Zone} \\ = 334 \end{aligned}$$

$$\begin{aligned} \text{Total Annual Tax Exemption} &= (\$1,161 \text{ per unit per year}) * (334 \text{ units}) \\ &= \$387,415.36 \text{ per year} \end{aligned}$$

$$\text{Total Tax Exemption (2.875\% Discount Rate over 35 year period)} = \$70,583,995.42$$

Appendix F – Land Cover Estimates

Action F-01 (Restoration)

2011 NOAA C-CAP land cover within a 100-foot buffer of the Deschutes River was used for the Baseline Scenario under Action F-01.

Change in land cover was estimated using the riparian shade improvement targets identified in the Deschutes River TMDL.^{xvii} Shade improvement targets represent the increase in percent canopy cover needed at each river kilometer to meet water quality standards. “Total Acres to Restore” was equal to the sum of the shade improvement times the area (including the 100-foot buffer) of each kilometer segment.

Acreage in ten “unrestored” land cover classes was reduced proportionally by “Total Acres to Restore”. Land cover in three forest land cover classes was increased proportionally by the same amount. Land cover classes are listed in Table 7.

Table 7. Land Cover Classes Adjusted in Action F-01 Restoration Scenario

Land Cover Classes <u>Decreased</u> by Total Acres to Restore	Land Cover Classes <u>Increased</u> by Total Acres to Restore
<ul style="list-style-type: none"> • Barren Land • Cultivated (Crops) • Developed, High Intensity • Developed, Medium Intensity • Developed, Low Intensity • Developed, Open Space • Grassland/Herbaceous • Pasture/Hay • Scrub/Shrub • Shoreline 	<ul style="list-style-type: none"> • Deciduous Forest • Evergreen Forest • Mixed Forest

Action G-12 (Infill)

Using TRPC’s parcel-level population estimates for 2011 and 2011 NOAA C-CAP land cover, average land cover across ten residential density categories was calculated (Table 8).

Table 8. Percent Land Cover for Residential Density Groups

Dwelling Units / Acre	High Intensity Developed	Med. Intensity Developed	Low Intensity Developed	Developed Open space	All Other Land Covers
0 to 0.1	0%	1%	3%	4%	92%
0.1 to 0.2	0%	0%	5%	7%	88%
0.2 to 0.5	0%	1%	10%	11%	78%
0.5 to 1.0	1%	2%	23%	15%	59%
1 to 2	0%	5%	35%	15%	45%
2 to 5	0%	14%	55%	8%	22%
5 to 10	2%	39%	43%	6%	10%
10 to 20	5%	45%	36%	5%	9%
20 or More	12%	47%	27%	7%	7%

For the Baseline and Preferred Land Use scenarios, percent land cover in the four developed land cover classes was calculated by demining the maximum residential density of each parcel (based on zoning, critical areas, and existing uses) and multiplying the parcel area by the respective land cover percent in Table 8. The calculated developed land cover area was added to the 2011 land cover; non-developed covers were decreased proportionately.

In situations where there was already developed land covers on the parcel, it was assumed that developed land covers would not be converted to less intensive categories.

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