ECONOMIC IMPACTS OF USING WORKING LANDS AND PRAIRIE PRESERVES FOR HABITAT PROTECTION, THURSTON COUNTY, WASHINGTON

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ABOUT

This economic analysis was a completed as part of a three-year research project titled "Ecological and Economic Benefit-Cost Comparison of Grazed and Ungrazed Prairie Land for Critical Species Protection in Western Washington." Funding was provided by the U.S. Dept. o Agriculture *Western Sustainable Research and Education* program, project # SW18-103 (see: Bramwell et al. 2021(a) and https://projects.sare.org/sare_project/sw18-103/).

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SUMMARY

This study quantified the economic impacts of five scenarios (Table 2) that represent varying utilization of working lands (as either cow-calf or grass-finished beef operations) for species protection in the Thurston County Habitat Conservation Plan (HCP).

- Sales from the livestock sectors introduced 'new' dollars into the region through the sale of product outside of the region or substitution of locally produced product (like beef) for imported product.
- New Reserve (NR) sectors in the baseline model run did not introduce new dollars into the region because all funding for these sectors (new prairie preserves established on abandoned range, and abandoned cropland, or Scotch broom) were projected by Thurston County to be funded locally from mitigation fees (on developers) and other sources (i.e. Conservation Futures taxes)
- Total economic impacts increased when more working lands were recruited into the program ($0 with no working lands in Scenario 1 to $2.09 million with 400 ac working lands in Scenario 2, and $7.83 million with 1,500 ac of working lands in Scenario 4).
- Assuming 25% of NR funding could somehow be sourced externally increased total economic impacts ($688 thousand in Scenario 1, $3.60 million in Scenario 2, and $11.65 million in Scenario 4).
- Generally, total economic impacts uniformly increased, and costs decreased, in scenarios where greater proportions of working lands easements (WLE) were engaged.
- Restoration costs uniformly decreased in scenarios where greater proportions of WLE were engaged ($1.43 million in Scenario 1 with no working lands; $812 thousand in Scenario 4 with 1,500 acres WLE)
- While WLE acquisition and restoration costs were lower than for NR acres, habitat value between WLE and NR are not equivalent (Bramwell et al. 2021b). Higher NR acquisition and restoration costs may be justified in the Thurston County HCP by higher habitat values designed for and needed from NR acres. This economic data is intended only to help optimize the balance of WLE and NR acreage used in the HCP by weighing *economic costs and benefits* of utilizing each land type with respective *habitat value costs and benefits*.
- Private tax revenue generated by working lands retained on the tax base while participating in the County HCP increased when more working lands acreage was recruited ($0 in Scenario 1 and $390 thousand in Scenario 4).
- Economic multipliers for cow-calf (2.05) and grass-finished beef sectors (2.51) were higher than economic multipliers for New Reserves established on Scotch broom (1.80), abandoned range (1.92), or abandoned cropland (1.90) due to higher rates of local re-spending in the livestock sectors.
- Scenarios overall exerted minimal impact on job creation due to the efficiency of managing large acreages, whether as New Reserves or Working Lands.
- Total program costs were optimized as greater acreages of working lands were utilized in the program ($99.68 million in Scenario 1 with no working lands; $92.18 million in Scenario 2 with 400 ac working lands; $71.58 million in Scenario 4 with 1,500 ac working lands).
- Generally, acquisition and restoration cost savings are possible by recruiting WLE acres, to the extent that the use of WLE still allows Thurston County to meet habitat protection requirements.

INTRODUCTION

Prairie ecosystems of south Puget Sound are a home for rare species, a beautiful landscape of unusual landforms, and a productive grazing resource for many farm and ranch families. Balancing the needs of private farm businesses and rare species conservation is a challenge in this region, but it is a challenge that communities face worldwide: balancing the need for food and livelihoods with the need for species protection and the maintenance of ecosystem functions.

In 2014, six species of threatened or endangered species resident on south Puget Sound prairies in Thurston County were listed through the Endangered Species Act. In Response, Thurston County began development of a Habitat Conservation Plan (HCP; https://www.thurstoncountywa.gov/planning/HCP), which is a tool for long-term land-use planning to offset the impacts of development or other negative impacts on listed species.

Due to the costly and long-term nature of the HCP, cost optimization and potential positive local economic impacts of the program were of interest to decision-makers, planners, the public, and farmers. The intention of this impact analysis was to provide information on the potential economic impacts and costs of different combinations of New Reserves (NR) and Working Lands Easements (WLE) in the Thurston County HCP. The total economic impacts of five different combinations (scenarios) of NR and WLE are presented in the body of this report. For comparison, a summary of program costs calculated by scenario, and based on costs presented in the County HCP, are presented in Appendix I.

IMPACT ANALYSIS STUDY ASSUMPTIONS

Development of model scenarios to estimate economic impacts of different combinations of Native Reserves (NR) and Working Lands Easements (WLE)

The Thurston County HCP identifies strategies to procure or otherwise protect land sufficient to protect the habitat of native prairie species listed as threatened or endangered in the Endangered Species Act. As the county notes, "protection, enhancement, and management of habitat supporting the Covered Species is paramount to achieving the Biological Goal of the HCP." Covered species residing in grasslands or prairies in the county include the Taylor's Checkerspot Butterfly, Oregon Vesper Sparrow, and three subspecies of the Mazama Pocket Gopher (Olympia Pocket Gopher, Tenino Pocket Gopher, and Yelm Pocket Gopher).

The county plan proposes three primary strategies to secure habitat for covered species, including New Reserves (NR), Working Lands Easements (WLE), and enhanced existing preserves. In Table 7.7 of the HCP, the County identifies acreage targets for each habitat protection strategy (Table 1).

Table 1. Projected Conservation Lands* Engaged in the Thurston County HCP Broken Down by Covered Species

	Projected Conservation Lands Engaged (Acres)								
	YPG N	YPG E	YPG S	OPG	TPG	TCB (in YPG S)	OVS (in YPG E)	OSF	Total
New Reserves	744	400	516	346	73	0	0	618	**2,698**
Working Lands Easements	0	163	210	0	28	0	31	0	**433**
Enhanced Existing Preserves	0	130	168	0	0	40	0	0	**339**
TOTAL	**744**	**693**	**895**	**346**	**101**	**40**	**31**	**618**	**3,469**

**Acreage totals are those that correspond to the HCP submitted to US Fish and Wildlife, and correspond to Appendix I.*
YPG N: Yelm pocket gopher north; YPG E: Yelm pocket gopher east; YPG S: Yelm pocket gopher south; OPG: Olympia pocket gopher; TPG: Tenino pocket gopher; OVS: Oregon vesper sparrow; OSF: Oregon spotted frog.

In order to support County decision-making regarding the economic impacts of different 'mixes' of acreage between, namely, NR and WLE, the research team collaborated with county planning staff to develop five scenarios to bracket the potential acreage extents and combinations of NR and WLE (Table 2).

For the purposes of this study, NR were projected to be established on land in one of three initial conditions, including abandoned range, abandoned cropland, or Scotch broom. Abandoned may otherwise be considered to mean 'previously managed as', or 'derelict'. An equal distribution across these three initial conditions for NR was assumed. WLE were projected to be managed either as a cow-calf operations or grass finished (pasture based) cattle operations. Cow-calf refers to raising a calf from birth to approximately 8 months of age and selling the calf to be grown out to butcher weight. Grass finished refers to raising calves from the primary herd of cows from birth through to butcher weight all while grazing pasture. The latter typically requires 24 to 28 months. It was assumed that 80% of WLE acreage were cow-calf operations and 20% were grass finished beef operations.

Table 2. Model Scenarios Identifying Acreage Mixes of New Reserves and Working Lands Easements to Protect, Enhance and Manage Habitat for the Covered Species

Model Scenarios	New Reserves[1] (ac)				Working Lands Easements [2,3] (ac)			Total (ac)
Total acreage: 3,469	Total Reserve	Abn-Crp	Abn-Rgn	Sct-Brm	Total Working	Cow-calf	Grass-finish	
	100%	33%	33%	33%	100%	80%	20%	
Draft HCP	2,689	896	896	896	400	320	80	3,089
Scenario 1	3,469	1,156	1,156	1,156	0	0	0	3,469
Scenario 2	3,069	1,023	1,023	1,023	400	320	80	3,469
Scenario 3	2,469	823	823	823	1,000	800	200	3,469
Scenario 4	1,969	656	656	656	1,500	1,200	300	3,469

[1]New reserves starting point split evenly as "abandoned cropland (Abn-Crp), Abandoned rangeland (Abn-Rgn), and and Scotch broom (Sct-Brm)
[2]Working lands split 80:20 cow-calf and grass finished steer
[3]Easements set up using grazing budget

In the model scenarios, the total projected acreage required to protect covered species in the HCP was divided between NR and WLE. In the Draft HCP, which is the only scenario summing to a different total (3,089 ac) than the other four scenarios, the total was divided between 2,689 acres in NR and 400 acres of WLE. In scenarios one through four, WLE ranged from 0 to 1,500 acres while NR ranged from 1,969 acres to 3,469 acres, all summing to 3,469 acres. These scenarios were not intended to provide a "preferred combination", but rather to offer benchmark economic impacts at different levels of collaboration with working lands owners, namely:

1. Utilizing no working lands easement acres in the HCP
2. Meeting minimal participation among private landowners by enrolling 400 working lands acres
3. Reaching a somewhat mid-range enrollment of 1,000 working lands acres, and
4. Enrolling what may be considered a high-end enrollment of 1,500 working lands acres.

Data Source

Data for the impact assessment derived from five different enterprise budgets developed specifically for this project (Painter and Bramwell 2021). These included three restoration budgets and two grazing budgets. The enterprise budgets were developed with the participation of two expert panels consisting of four restoration land managers and five cattle producers. Meetings with these panels were held for the purpose of conducting what is known as a Delphi Method (DM) survey of costs of, on the one hand habitat restoration, and on the other hand, cattle production in Thurston County. The DM is a formalized approach to assembling a group of experts and soliciting information in their area of expertise (Linstone and Turoff, 1975; Hsu 2007; Weblar et al. 1991), in this case, regarding the costs and earnings associated with various habitat restoration practices or cattle grazing practices.

Regarding cattle operations, enterprise budgets were created that compare costs and earnings from traditional cow-calf production systems and grass-finished livestock enterprises that market directly to consumers. Regarding habitat restoration work, enterprise budgets were created that compare the costs from work to restore prairie on land that had been previously managed for either crop production, range/grazing, or had become overgrown with Scotch broom. These are referred to as abandoned cropland, abandoned range, and Scotch broom. The latter budgets average costs across long restoration timeframes ranging from nine to 14 years.

Costs in enterprise budgets were generated on a per acre basis for NR budgets, and on a per head basis for WLE budgets. Per head costs were converted to per acres costs assuming a stocking rate of 2 acres per head for livestock operations.

The Use of Partial Budgets for Grazing Operations

In addition to basic grazing enterprise budgets, land enrolled for WLE required development of a 'partial budget' (a budget outlining limited additional costs that are overlaid on the cow-calf and grass finished enterprise budgets) to account for costs associated with several conservation practices potentially required for working lands easement acreages to provide habitat value. Such practices include infrastructure for rotational (or "planned grazing"), seeding of native prairie species, and spring grazing deferment when cattle are removed from the grazing site to allow native plants to flower and set seed.

Methods for Generating Economic Impacts

Economic contribution analysis is generally regarded as referring to the effects on economic activity in a region as a result of the exogenous[1] sales of a given sector in a previous time period. In this manner, contribution analysis retrospectively evaluates the effects of a policy or change or sale that was made in the past. Conversely, economic impact analysis represents a projection of an anticipated change in economic activity within a region's economy due to a change in the exogenous sales of a given sector. An impact analysis, therefore, evaluates the likely future economic impact of a policy or change or sale, should that change be implemented. More discussion of impacts and benefits is presented in Watson et al. (2007). Because we looked at the expected changes in economic activity associated with NR and WLE conservation programs, we use the term "impact analysis" for this study.

Model Expenditures and Sales for Industry Sector or Program

The first step in estimating economic impacts is to use enterprise budgets to build a model of the

[1] Exogenous refers to sales to a purchaser outside the region, or otherwise substituting a local for a non-local purchase

expenditures (inputs) and sales (outputs) associated with the respective conservation programs. Given the enterprise budgets, the economic model is calculated by first converting the expenditure functions from the enterprise budget data into percentages of the total expenditure that is made in each individual type of expenditure. These percentages represent the share of each dollar of output that goes to each type of expenditure. The expenditure categories from the enterprise budget data were bridged to the closest 3-digit NAICS sector using descriptions of the sectors provided by the U.S. Bureau of Economic Analysis (BEA).

Additionally, because some of the expenses included in the enterprise budget data were retail purchases, we needed to apply margins to select sectors. Specifically, the "Other variable expenses", "Fertilizer expense", and "Fuel and oil expense" were assumed to be retail expenditures. To account for this we applied a 25% retail and 25% transportation margin to the expenditure (Steinback and Thunberg, 2006; Leonard and Watson, 2011). The components of the production function are presented in Table 3.

Table 3. Sector Expenditures per acre and the Associated NAICS Code

NAICS Code	Cow Calf	Grass finished livestock	Conservation Partial	Scotch Broom	Abandoned Range	Abandoned Cropland
111	$644.00	$616.00	$273.98	$193.33	$120.84	$124.29
112	$352.80	$350.00				
115	$150.00	$250.00	$81.26	$135.05	$98.87	$92.00
230	$301.48	$83.34	$23.53	$17.84	$17.84	$17.84
311		$788.00				
325	$14.00	$10.42	$20.38	$15.83	$8.17	$6.65
441	$154.72			$2.77	$1.69	$0.00
484	$19.60	$36.00				
522	$166.40	$57.50		$2.01	$1.01	$3.55
524				$0.66	$0.34	$0.00
531				$50.00	$50.00	$50.00
541	$34.56	$67.08				
561	$10.00	$20.84				
811	$238.00	$158.32		$9.29	$17.61	$13.66
Purchase of Cow/ Calf		$2,264.92				
Total	$2,085.56	$4,702.42	$399.15	$426.78	$316.37	$307.99

Determination of Proportion of Each Dollar of Output Going into Purchasing Inputs from other Local Sectors in the Economy

The shares of the expenditure data from the enterprise budgets represent the gross absorption coefficients (GAC), which are defined as "value of the commodity purchased as inputs by regional industries expressed as a proportion of total dollar outlays for the particular industry" (Holland & Beleiciks, 2006.) However, before they can be incorporated into a standard input-output model, these gross absorption coefficients need to be purged of imports to represent regional absorption coefficients (RAC). To obtain the RACs, the GACs are multiplied by the regional purchase coefficient (RPC) for each respective input (Table 4). RPCs are defined as the proportion of commodity demand

from within a region that is met by supply from that same region. The RPCs used in this study were obtained from the Commodity Balance Sheet from IMPLAN; since RPCs are region-specific values, assumptions were made to identify representative counties from the national IMPLAN data for the appropriate geographies.

To illustrate the computation of the RACs, a scenario using the state of California as an example can be considered. Across all marketing channels in California, the expenses and shares from the enterprise budget data and RPCs from IMPLAN are presented in table 4. The RAC presented in Table 3 is obtained by multiplying the GAC times the RPC.

Table 4. NAICS code sectors and their corresponding RPCs used in this model

NAICS Code	Sector	RPC
111	Cropland Farming	0.110490737
112	Livestock	0.223042153
115	Agricultural Services	0.882150856
230	Construction	0.946383303
311	Food Products	0.038637013
325	Chemical Manufacturing	0.021816769
441	Retail Trade	0.993361867
484	Truck Transportation	0.609398828
522	Credit and Finance	0.266862801
524	Insurance	0.464566763
531	Real Estate	0.90478012
541	Professional and Scientific Services	0.376495013
561	Administrative Support Services	0.772453562
811	Repair and Maintenance	0.922674415
NA	Purchase of Cow/Calf	1.0

To obtain the RACs, the respective expenditure shares presented in Table 3 are multiplied by the RPCs presented in Table 4. Once the RACs for the respective local food enterprise were obtained, each set of coefficients were inserted into a matrix of RACs for all other sectors in the respective region's economy. This matrix is collectively referred to as the "A matrix" and it represents the matrix of technical coefficients, or how much of each dollar of output goes into purchasing inputs from other local sectors in the economy. The default A matrix from Thurston County were then taken from 2016 IMPLAN data.

Calculate New Dollars Generated by Each Industry Sector or Program

For the sectors that were generated for this study as presented in Table 3, it was assumed based on the Thurston County HCP that all of the revenue for the NR sectors (abandoned range, and abandoned cropland, Scotch broom,) came from local sources (mitigation fees and property taxes for a land protection program known as Conservation Futures). This assumption implies that these sectors do not bring in new dollars to the region's economy. However, it is assumed that the meat and livestock from the cow/calf and the grass-finished beef sectors (WLE) either sell their output outside of the county or sales within the county substitute for livestock/beef purchases that would otherwise consist of product imported from outside the county. Therefore, the sales of the livestock sectors are modeled as comprising new dollars in the regional economy (Cooke and Watson 2011). Incorporating these assumptions, the impacts of all the sectors presented in table 3 are then estimated using an input/output model.

Using the A matrix described above, the input/output model of an economy can be expressed in equation 1.

1) $X = AX + Y,$

where X represents a vector or industry outputs, A is the matrix of technical coefficients, and Y is a vector of exogenous final demands (i.e. new dollars into the region's economy). These input output matrices can always be thought of as both where a sector sells its output (that is the interpretation across the row) or where a sector buys its inputs (that is the interpretation down the columns). Since local sector A's sales to local sector B can also be

thought of as sector B's purchases from sector A, the inputs and outputs are the same in total. Interpreting equation one by moving across a given row in A, the term AX represents the total amount of output a given sector sells locally. Another way to think about equation 1 is that all output of a given sector must either be sold locally or exported out of the region. In this way, equation one represents an accounting identity that says: for any given sector's output (X), they sell some percentage of its output locally (A) and the remaining output is sold outside the region (Y).

Calculating Local Multipliers for Each New Dollar

In order to calculate regional economic impacts, we must derive the equation that translates changes in exogenous output into changes in economic activity. To accomplish this, we will first rearrange equation 1 to gather like terms together yields equation 2.

2) $(I - A)X = Y$

where I is an identity matrix of ones along the diagonal and zeros in the off diagonal cells. Finally, when we solve for X, we are left with equation 3, the fundamental equation of input/output analysis.

3) $X = (I - A)^{-1}Y$

This equation illustrates how output (X) is related to exogenous final demand (Y) through the multiplier ($(I-A)^{-1}$). The column sum of the $(I-A)^{-1}$ matrix through the producing sectors is the output multiplier for each respective sector. The multipliers are the column sums for each sector in the region's economy.

DEFINITIONS

To help clarify the model and interpret the results, we present the following definitions:

- Basic Industry - Those industries that produce goods and services ultimately sold to consumers outside the region (exogenous). These sectors bring new dollars into the economy which then create non-basic economic activity through the multiplier effect.
- Import substitution – The act of substituting a locally sourced good for a previously imported good. If a region can develop local production to meet a demand previously satisfied by imports, it follows that this "import substitution" has precisely the same impact on the regional economy as an equivalent increase in exports. In either case, there is an increase in sales by producers within the region (Cooke and Watson 2011).
- Multiplier – The total economic activity that gets generated in a regional economy when a respective sector brings in a new dollar into the region. This is calculated in the (I-A)-1 matrix and can also be defined as the ratio of total economic activity to basic economic activity.

- New Reserves – land acquired by the County for the purpose of securing native prairie and high-quality native prairie to generate mitigation credits.
- Working Lands Easements – easements voluntarily established on working lands that ensure permanent land protection and stipulate practices to co-manage for farming and habitat protection, with the aim of generating mitigation credits.

RESULTS

Total Economic Impact

The economic impacts of the proposed scenarios depended on fundamental assumptions related to the analysis. In the baseline model run, we assumed that all sales from the cow-calf and grass finished sectors enrolled in the WLE program are either sold outside the region or, if they are sold locally, that they are displacing sales that would otherwise be imported from outside the region. In this way, all the sales of livestock sectors were modeled as exogenous increases in sales and that they represent 'new dollars' into the region (Cooke and Watson 2011).

By contrast, in the baseline model run we assumed that all of the funding for the NR sectors (conservation partial, abandoned range, and abandoned cropland, and Scotch broom) derive locally from mitigation fees and other sources (such as property taxes for the County Conservation Futures program). Under this assumption, those sectors are not expected to bring in any new dollars and each dollar spent on those programs displaces a dollar that households would have spent in the local economy. While this assumption was likely overly cautious and conservative, it provided a bookend of the lowest possible economic impact that NR would make to the local economy. However, this assumption was adopted because the Thurston County Habitat Conservation Plan identified only local funding sources to cover costs associated with 1) NR and 2) the costs of conservation actions added above and beyond basic operating costs on WLE (Conservation partial costs as applied to cow-calf and grass finished sectors).

The results of this baseline model run are presented in Table 5. The greater proportion of 'new dollars' and overall larger multipliers associated with WLE as compared to NR sectors resulted in increasing total impact from Scenario 1 to Scenario 4.

Table 5. Economic Impacts‡ of the Respective Scenarios with Baseline Assumptions

Scenario	Abandon Cropland	Abandon Range	Scotch Broom	Conservation Partial	Cow calf operation	Grass finished livestock	Total Impact
Draft HCP	0	0	0	0	$1,095	$993	$2,088
Scenario 1	0	0	0	0	0	0	0
Scenario 2	0	0	0	0	$1,095	$993	$2,088
Scenario 3	0	0	0	0	$2,738	$2,483	$5,221
Scenario 4	0	0	0	0	$4,107	$3,724	$7,831

‡Figures reported in 1,000s

While the base scenario assumed no external dollars for NR sectors, it is not certain that 100% of the funding for the conservation partial, abandoned cropland, abandoned range, and Scotch broom sectors will come from local dollars that will completely displace other local spending. Therefore, to account for those possibilities, two additional model runs were performed assuming that 15% and then 25% of the funding for these programs derives from outside sources. These results are presented in tables 6 and 7 respectively.

Table 6. Economic impacts‡ of the respective scenarios with the 15% exogenous restoration funding assumptions

Scenario	Abandon Crop	Abandon Range	Scotch Broom	Conservation Partial	Cow calf operation	Grass finished livestock	Total Impact
Draft HCP	$94	$98	$119	$30	$1,095	$993	$2,429
Scenario 1	$121	$126	$153	$0	$0	$0	$401
Scenario 2	$107	$112	$136	$30	$1,095	$993	$2,473
Scenario 3	$86	$90	$109	$75	$2,738	$2,483	$5,581
Scenario 4	$69	$72	$87	$112	$4,107	$3,724	$8,171

‡Figures reported in 1,000s

Table 7. Economic impacts‡ of the respective scenarios with the 25% exogenous restoration funding assumptions

Scenario	Abandon Crop	Abandon Range	Scotch Broom	Conservation Partial	Cow calf operation	Grass finished livestock	Total Impact
Draft HCP	$157	$163	$198	$917	$1,095	$993	$3,523
Scenario 1	$202	$210	$256	$0	$0	$0	$668
Scenario 2	$179	$186	$226	$917	$1,095	$993	$3,597
Scenario 3	$144	$150	$182	$2,293	$2,738	$2,483	$7,989
Scenario 4	$115	$119	$145	$3,439	$4,107	$3,724	$11,649

‡Figures reported in 1,000s

Restoration Costs, Livestock Production Costs, and Tax Impacts

The overall economic impact of model scenarios (Tables 5, 6, and 7), can be further understood by looking at some additional economic implications of the different scenarios. Table 8 illustrates the restoration costs, livestock production costs, and private tax revenue generated under each scenario. Restoration costs are a direct model output and summarize just the cost of restoration by scenario (not land acquisition or easement acquisition). The value is obtained by summing the total funds associated with the restoration of scotch broom, abandoned pasture, and abandoned cropland acres for each respective scenario. Those figures trace back directly to the enterprise budgets used to build the contributions model.

Restoration costs decreased from Scenario 1 to Scenario 4 because of decreasing NR acres, which are more expensive to restore than WLE acres. Like restoration costs, livestock production costs trace back directly to the livestock enterprise budgets used to build the contributions model.

These private costs of livestock production represent two things. First, they represent economic activity stemming from livestock operations, which drive overall economic contributions as reported in Tables 5, 6, and 7. The costs were calculated by summing the total cost of production of the livestock and conservation partial sectors for each respective scenario. These operation cost results tell us that an increase in livestock production costs mirrors the overall increasing economic impact from Scenario 1 to Scenario 4. This is due both to more 'new dollars' and higher multipliers among WLE as compared to NR sectors.

Second, livestock production costs represent land management expenses borne exclusively by the private sector, but with benefits to both the private and public sectors. Private operators benefit from their expenditures most obviously through potential business profits; the public benefits through the maintenance of open space, weed management, water infiltration and storage, and aesthetic and cultural assets, among others. These costs are embedded in the livestock operations that would theoretically participate in the HCP. Overall, they increased from Scenario 1 to Scenario 4, representing increasing contributions of the private livestock sector to conservation land management, and a benefit to the public.

Tax revenue generated by each model scenario was calculated with data from the Thurston County Assessor regarding land capability classification (and corresponding property tax valuation) of land that would be utilized for WLEs. The tax rate associated with land capability classes eligible to sell working lands easements through participation in the HCP is $260/ac. This value was multiplied by the number of working land acres associated with each scenario to get the tax revenue from each respective scenario.

No tax revenue was projected to be collected on NR acreage in the County HCP. As a result, total tax revenue increased from Scenario 1 to scenario 4, reflecting the increased proportion of working lands easements across these scenarios. This reflects a basic logic that greater utilization of private working lands results in more retained taxable acreage in the county when proceeding from Scenario 1 to Scenario 4.

Table 8. Other Economic Implications of Different Model Scenarios

	Restoration Costs ($)	Livestock Production Costs ($)	Tax Revenue from Livestock Production ($)
Draft HCP	1,109,000	1,199,000	104,000
Scenario 1	1,430,000	0	0
Scenario 2	1,266,000	1,199,000	104,000
Scenario 3	1,018,000	2,997,000	260,000
Scenario 4	812,000	4,496,000	390,000

Economic Output and Employment Multipliers

The economic output and employment multipliers are presented in Tables 9 and 10 so that the economic impacts of additional or alternative assumptions can be readily estimated. The economic output impact of any scenario can be estimated by multiplying the new dollars associated with the scenario into the region's economy by the multiplier provided in table 9. For example, if the grass finished livestock sector generated $100 new dollars, then $250.60 ($100 x 2.506) of new economic activity would be generated in the local economy.

Table 9. Total Economic Output Multipliers† Corresponding to the Different Industry Sectors.

Working Lands Easements Multipliers			New Reserves Multipliers		
Cow-calf	Grass fed livestock	Conservation partial	Scotch broom	Abandoned range	Abandoned cropland
2.050	2.507	2.293	1.799	1.925	1.903

†The multiplier can be understood in the following terms: For every new dollar brought in by the sector, X dollars are generated across the region

Table 10. Total Economic Employment Multipliers† Corresponding to the Different Industry Sectors

Working Lands Easements Multipliers			New Reserves Multipliers		
Cow-calf	Grass fed livestock	Conservation partial	Scotch broom	Abandoned range	Abandoned cropland
1.593	1.556	1.125	1.406	1.352	1.333

†The multipliers can be understood in the following terms: for every new job in the sector, X number of jobs are created across the region

Economic Employment Impact

Like overall economic impact, the impact in terms of jobs can be estimated by multiplying the new jobs associated with a sector by the jobs multiplier presented in Table 10. For example, if the grass finished beef sector generated 100 new jobs, the resulting local economic jobs impact would be an additional 156 jobs (100 x 1.556).

In the baseline model run in which no new dollars were generated from NR sectors, no new jobs were generated (i.e. zero multiplied by any of the NR sector jobs multipliers). The total number of new jobs estimated to be added due to cow-calf and grass finished livestock operations per 100 acres was 0.35 FTE and 0.12 FTE, respectively. While agricultural jobs rarely track standard employment conventions, we assumed a "job" to be equivalent to a 2080 hours per year to quantify FTE for reporting purposes. Due to the relatively limited acreage (from only 400 to 1,500 WLE acres) of agricultural land in any scenario, job creation even in these sectors was limited, ranging from 0 (Scenario 1) to 4 (Scenario 4). For comparison, a

livestock cow-calf enterprise requires 730 hours per 50-head. For the NR sectors, only about 2-4 new jobs were created even if 100% of costs were assumed to be covered by 'new dollars' (much beyond the 15% and 25% exogenous dollars in the second two model runs as reported in Tables 6 and 7). This too reflects the limited acreage involved (1,979 to 3,469 acres) and the ability to manage it with a focused workforce.

Output Multipliers

The total economic impact multipliers provided in Table 9 are calculated as the sum of more specific industry sectors (i.e. construction, food products, fabrication, machinery) through which a new dollar 'bounces' as it moves through the local economy. These detailed output multipliers are presented in Table 12, and they provide further detail on the specific sectors of the local economy that are expected to be impacted by new dollars brought into the local economy by these sectors. Notice that the total reported in the bottom line of Table 12 is equal to the numbers reported in Table 9.

Table 12. Detailed Economic Output Multipliers Corresponding to the Different Industry Sectors

Sector	Cow Calf	Grass finished	Conservation Partial	Scotch Broom	Abandon Range	Abandon Cropland
111 Cropland Farming	0.03282	0.03041	0.13991	0.04392	0.03582	0.03781
112 Livestock	0.16286	0.15301	0.00149	0.00076	0.00081	0.00079
1121 Cow-Calf	1.00000	0.45734	0.00000	0.00000	0.00000	0.00000
1122 Steer Finishing	0.00000	1.00000	0.00000	0.00000	0.00000	0.00000
1123 Conservation Partial	0.00000	0.00000	1.00000	0.00000	0.00000	0.00000
1124 Scotch Broom	0.00000	0.00000	0.00001	1.00000	0.00001	0.00001
1125 Abandoned Range	0.00000	0.00000	0.00001	0.00000	1.00000	0.00000
1126 Abandoned Cropland	0.00000	0.00000	0.00001	0.00000	0.00000	1.00000
113 Forestry & Logging	0.00007	0.00012	0.00015	0.00008	0.00009	0.00009
114 Fishing- Hunting & Trapping	0.00003	0.00016	0.00006	0.00003	0.00004	0.00004
115 Ag & Forestry Svcs	0.07465	0.08824	0.38232	0.23673	0.26425	0.25274
211 Oil & gas extraction	0.00038	0.00035	0.00051	0.00024	0.00025	0.00025
212 Mining	0.00030	0.00026	0.00042	0.00019	0.00020	0.00020
213 Mining services	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001
221 Utilities	0.00528	0.00564	0.00869	0.00519	0.00594	0.00583
230 Construction	0.13906	0.08266	0.11292	0.04482	0.05753	0.05884
311 Food products	0.00210	0.16250	0.00134	0.00074	0.00085	0.00083
312 Beverage & Tobacco	0.00069	0.00070	0.00116	0.00064	0.00074	0.00073
313 Textile Mills	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
314 Textile Products	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001
315 Apparel	0.00001	0.00001	0.00001	0.00001	0.00001	0.00001
316 Leather & Allied	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
321 Wood Products	0.00100	0.00069	0.00098	0.00058	0.00072	0.00073
322 Paper Manufacturing	0.00017	0.00049	0.00031	0.00015	0.00016	0.00016
323 Printing & Related	0.00018	0.00016	0.00021	0.00013	0.00015	0.00015
324 Petroleum & coal prod	0.00924	0.00838	0.01066	0.00501	0.00552	0.00544
325 Chemical Manufacturing	0.00069	0.00068	0.09558	0.03324	0.02269	0.01908
326 Plastics & rubber prod	0.00040	0.00046	0.00048	0.00025	0.00029	0.00028
327 Nonmetal mineral prod	0.00110	0.00074	0.00101	0.00048	0.00059	0.00060
331 Primary metal mfg	0.00001	0.00000	0.00001	0.00000	0.00000	0.00000
332 Fabricated metal prod	0.00048	0.00042	0.00040	0.00020	0.00025	0.00024
333 Machinery Mfg	0.00005	0.00004	0.00004	0.00002	0.00003	0.00003

334 Computer & oth electron	0.00002	0.00002	0.00002	0.00001	0.00002	0.00002
335 Electrical eqpt & appliances	0.00001	0.00001	0.00001	0.00000	0.00000	0.00000
336 Transportation eqpmt	0.00133	0.00119	0.00152	0.00089	0.00111	0.00106
337 Furniture & related prod	0.00019	0.00016	0.00026	0.00015	0.00018	0.00018
339 Miscellaneous mfg	0.00007	0.00006	0.00010	0.00006	0.00007	0.00007
42 Wholesale Trade	0.02405	0.02855	0.03179	0.01655	0.01866	0.01813
441 Motor veh & parts dealers	0.07524	0.03715	0.00889	0.01055	0.01042	0.00579
442 Furniture & home furnishings	0.00165	0.00139	0.00244	0.00130	0.00153	0.00151
443 Electronics & appliances stores	0.00125	0.00096	0.00157	0.00081	0.00098	0.00097
444 Bldg materials & garden dealers	0.00505	0.00422	0.00732	0.00387	0.00459	0.00452
445 food & beverage stores	0.00473	0.00444	0.00837	0.00456	0.00533	0.00522
446 Health & personal care stores	0.00332	0.00275	0.00477	0.00253	0.00300	0.00295
447 Gasoline stations	0.00167	0.00141	0.00247	0.00131	0.00156	0.00153
448 Clothing & accessories stores	0.00290	0.00247	0.00436	0.00233	0.00275	0.00271
451 Sports- hobby- book & music stores	0.00152	0.00128	0.00222	0.00118	0.00140	0.00137
452 General merch stores	0.00698	0.00651	0.01205	0.00658	0.00771	0.00755
453 Misc retailers	0.00249	0.00207	0.00358	0.00190	0.00226	0.00222
454 Non-store retailers	0.00343	0.00308	0.00565	0.00304	0.00358	0.00351
481 Air transportation	0.00021	0.00021	0.00031	0.00017	0.00020	0.00020
482 Rail Transportation	0.00123	0.00208	0.00175	0.00083	0.00085	0.00081
483 Water transportation	0.00020	0.00030	0.00022	0.00011	0.00013	0.00012
484 Truck transportation	0.01231	0.01651	0.00733	0.00382	0.00435	0.00423
485 Transit & ground passengers	0.00107	0.00099	0.00154	0.00087	0.00102	0.00101
486 Pipeline transportation	0.00001	0.00001	0.00002	0.00001	0.00001	0.00001
487 Sightseeing transportation	0.00125	0.00132	0.00136	0.00076	0.00088	0.00085
49A Postal service, couriers & messengers	0.00292	0.00302	0.00278	0.00157	0.00182	0.00176
493 Warehousing & storage	0.00269	0.00243	0.00280	0.00147	0.00164	0.00156
511 Publishing industries	0.00044	0.00041	0.00067	0.00038	0.00044	0.00043
512 Motion picture & sound recording	0.00034	0.00031	0.00055	0.00030	0.00035	0.00035
515 Broadcasting	0.00023	0.00021	0.00029	0.00017	0.00020	0.00020
517 Telecommunications	0.00489	0.00444	0.00703	0.00399	0.00468	0.00461
518 Internet & data process svcs	0.00034	0.00034	0.00035	0.00021	0.00024	0.00024
519 Other information services	0.00049	0.00045	0.00063	0.00037	0.00043	0.00042
521 Monetary authorities	0.01079	0.00941	0.01303	0.00879	0.01036	0.01045

522 Credit intermediation & related	0.07028	0.03588	0.00180	0.00548	0.00432	0.01134
523 Securities & other financial	0.00490	0.00416	0.00617	0.00358	0.00416	0.00419
524 Insurance carriers & related	0.01469	0.01209	0.01682	0.01197	0.01305	0.01216
525 Funds- trusts & other finan	0.00345	0.00323	0.00604	0.00331	0.00386	0.00378
531 Real estate	0.08212	0.07508	0.12588	0.16593	0.20719	0.20877
532 Rental & leasing svcs	0.00316	0.00291	0.00474	0.00243	0.00280	0.00275
533 Lessor of nonfinance intang assets	0.00079	0.00089	0.00120	0.00061	0.00064	0.00063
541 Professional- scientific & tech svcs	0.03048	0.03435	0.01738	0.01066	0.01240	0.01223
551 Management of companies	0.00174	0.00225	0.00325	0.00151	0.00149	0.00143
561 Admin support svcs	0.01818	0.01901	0.01623	0.01314	0.01589	0.01584
562 Waste mgmt & remediation svcs	0.00169	0.00184	0.00257	0.00170	0.00198	0.00194
611 Educational svcs	0.00373	0.00353	0.00681	0.00369	0.00430	0.00422
621 Ambulatory health care	0.02760	0.02604	0.04940	0.02688	0.03139	0.03074
622 Hospitals	0.02043	0.01924	0.03630	0.01982	0.02313	0.02264
623 Nursing & residential care	0.00358	0.00337	0.00637	0.00348	0.00406	0.00398
624 Social assistance	0.00532	0.00503	0.00959	0.00521	0.00608	0.00596
711 Performing arts & spectator sports	0.00144	0.00135	0.00223	0.00124	0.00145	0.00142
712 Museums & similar	0.00017	0.00016	0.00030	0.00017	0.00019	0.00019
713 Amusement- gambling & recreation	0.00205	0.00193	0.00356	0.00194	0.00227	0.00223
721 Accommodations	0.00018	0.00016	0.00027	0.00016	0.00019	0.00018
722 Food svcs & drinking places	0.02199	0.02063	0.03632	0.02006	0.02343	0.02304
811 Repair & maintenance	0.10634	0.08212	0.01223	0.02426	0.05102	0.04209
812 Personal & laundry svcs	0.00347	0.00325	0.00597	0.00329	0.00386	0.00377
813 Religious- grantmaking- & similar orgs	0.00538	0.00497	0.00880	0.00481	0.00560	0.00551
814 Private households	0.00022	0.00020	0.00039	0.00021	0.00025	0.00024
92 Government	0.00980	0.00942	0.01537	0.00873	0.01013	0.00997
93 Non NAICs	0.00000	0.00000	0.00000	0.00000	0.00000	0.00000
Total Multiplier	2.05010	2.50673	2.29279	1.79917	1.92485	1.90269

APPENDIX I. PROGRAM COSTS

The impact analysis above reports the potential economic impact of different combinations of NR and WLE in Thurston County's HCP. These impacts can be compared to the costs of implementing the HCP. Appendix I provides program cost information drawn from the County HCP published on the County webpage but adapted to present the information in the scenario format used in this study report.

Cost estimates to implement the HCP were developed by Thurston County to cover program administration, conservation lands acquisition, conservation lands habitat restoration and enhancement, and conservation lands management and maintenance.

Cost estimations in the county HCP, as submitted for review with US Fish and Wildlife, did not include the model scenarios as used in this study to evaluate varying levels of NR and WLE. As a result, program cost estimates between the two analyses are similar but not comparable in an exact sense. Cost estimates developed by the county were based on set total acreages of NR and WLE, yet in this analysis these acreages change across the scenarios.

In order to make cost estimations as comparable as possible, the scenario cost estimates reported here were based on the distribution of acreage by gopher subspecies as reported in HCP Table 8.2. This is because land acquisition costs are reported to be different based on the gopher subspecies in question. Once established, the proportion of acreage by sub-species was held constant in this analysis (Table A.1.1).

Table A.1.1. Calculated Percentage of Total Acreage in Each Scenario Allocated for Each Mazama Pocket Gopher Subspecies

	YPG N	YPG E	YPG S	OPG	TPG	TCB	OVS	OSF
Subspecies distribution (Table 8.2)	774	400	516	346	73	0	0	618
Calculated proportion by subspecies	28.4%	14.7%	18.9%	12.7%	2.7%	0.0%	0.0%	22.7%

Once the proportion of total acreage in each scenario could be assigned by gopher sub-species, cost estimations for each scenario were calculated by assigning the total acreage in NR across sub-species to arrive at acreage required for each subspecies, and then multiplying those acreages by the cost per acre (Thurston County HCP Table 8.2) projected for each subspecies.

Acquisition costs for WLE were estimated at $10,000 based on USDA Natural Resource Conservation Service easement costs. Total costs by scenario were calculated by multiple Working Lands Easement acreage by the cost per acre. Total estimated acquisition costs are summarized in Table A.1.2.

While WLE acquisition costs were lower, habitat value between WLE and NR are not equivalent (Bramwell et al. 2021b), and therefore higher acquisition costs may be justified by higher habitat values designed for and required from NR acres. The right balance of NR and WLE is likely needed.

Table A.1.2. Total Estimated Acquisition Costs for NR and WLE

	New Reserve	WLE	Total
Submitted HCP*	$ 78,361,021	$ 4,330,000	$ 82,691,021
Draft HCP	$ 77,269,082	$ 4,000,000	$ 81,269,082
Scenario 1	$ 99,682,575	$ -	$ 99,682,575
Scenario 2	$ 88,188,476	$ 4,000,000	$ 92,188,476
Scenario 3	$ 70,947,327	$ 10,000,000	$ 80,947,327
Scenario 4	$ 56,579,703	$ 15,000,000	$ 71,579,703

**Figures here were from the HCP report submitted to US Fish and Wildlife in summer 2021*

The figures above for "submitted HCP" differ from the total estimated acquisition cost as calculated by Thurston County, which is reported in the HCP as $70,521,181. Given that figures for this analysis have been parsed into different scenarios, the distribution of actual MPG sub-species and respective acquisition costs, varied from how the county assigned and calculated subspecies acreage and costs.

Useful in this analysis is the estimated relative differences in acquisition costs among the scenarios, indicating opportunity to optimize total costs through different combinations of NR and WLE acreage.

Habitat Restoration Costs Based on Thurston County HCP and Model Scenarios

Annual restoration costs in the Thurston County HCP for the first nine years are estimated at $435/ac for NR, and $200 for WLE. For the purposes of this analysis, a separate "Partial Budget" (explained above) was developed to estimate the total annual costs in additional feed or forage acreage, infrastructure, native seed, machinery, herbicide, planning and other costs that may be required to enhance habitat on WLE. That analysis identified the initial restoration costs on WLE at $158/ac.

Long-term annual maintenance costs in the Thurston County HCP are estimated at $400 for NR, and $200 for WLE. The partial budget analysis for Working Lands Easement maintenance estimated long-term maintenance costs of $241/ac.
Total restoration and maintenance costs for NR and WLE, is reported in Table A.1.3. Restoration and maintenance costs may be lower on some Working Lands Acreage because a substantial proportion of the habitat acreage needs in the Thurston County HCP are for the MPG, and native prairie plant enhancement (the second largest restoration cost in the partial budget) is not essential for MPG habitat (Bramwell et al. 2021b). However, augmenting the native prairie plant diversity on some (potentially large) portion of grazed WLE may certainly be desirable or even required for overall prairie habitat enhancement.

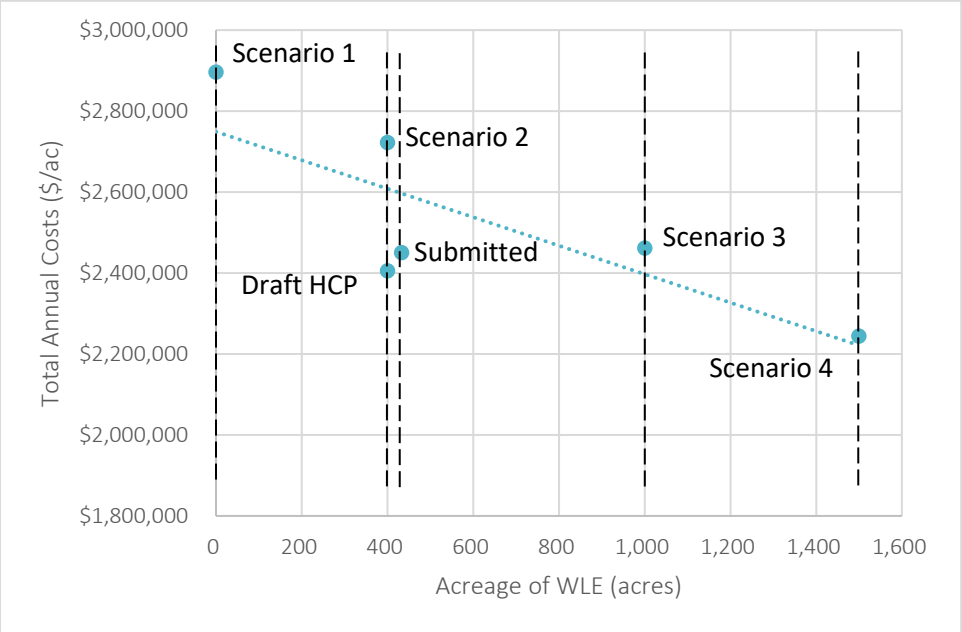
Table A.1.3. Total Restoration and Maintenance Costs for NR and WLE Combined

	New Reserve	WLE	Total
Submitted HCP	$ 2,277,045	$ 173,200	$ 2,450,245
Draft HCP	$ 2,245,315	$ 160,000	$ 2,405,315
Alt scenario 1	$ 2,562,615	$ 160,000	$ 2,722,615
Alt scenario 2	$ 2,896,615	$ -	$ 2,896,615
Alt scenario 3	$ 2,061,615	$ 400,000	$ 2,461,615
Alt scenario 4	$ 1,644,115	$ 600,000	$ 2,244,115

Restoration and maintenance costs (Table A.1.3 and Figure A.1.1) decreased as the proportion of WLE Acreage increased. Restoration and maintenance costs of NR as drawn from the HCP were assumed to be $435 and $400/ac respectively. Restoration and maintenance costs of WLE were assumed to be $200 and $200 respectively. A separate partial budget analysis for this study estimated restoration and maintenance costs to be $158 and $241, respectively, with effectively no-difference in long-term restoration and maintenance costs than those originally projected in the County HCP.

While WLE restoration and maintenance costs were lower than for NR acres, habitat value between WLE and NR are not equivalent (Bramwell et al. 2021b). Higher NR restoration and maintenance costs may be justified in the Thurston County HCP by higher habitat values designed for and required from NR acres. To the extent that the achievable habitat value on WLE acres satisfies specific needs within the HCP, WLE acres can be integrated. Likewise, to the extent that higher achievable habitat value on NR are needed in the HCP, NR must be integrated. This economic data provides information for Thurston County to balance economic costs and benefits of recruiting WLE and NR acres with habitat value costs and benefits.

Figure A.1.1. Effect of Acreage of WLE Enrolled in the Thurston County HCP on Total Annual Habitat Restoration + Maintenance* Costs, as Depicted by Model Scenario**



**Costs are those estimated during the first nine years of the HCP and include both initial restoration and maintenance costs for NR and WLE combined*

***Dash lines indicate scenarios as increasing acreages of Working Lands Easement (from zero to 1,500 acres across five scenarios)*

Restoration and maintenance costs were lower for scenarios using higher proportions of working lands because some restoration and maintenance actions are achieved merely in the course of ranch operations managing the land base as part of private enterprise. The increase in livestock production costs from Scenario 1 to Scenario 4 reported in Table 9 reenforce this point that partnership with private landowners embeds some basic costs of working lands conservation (such as weed management) in livestock operations.

APPENDIX II. SOURCE OF FUNDING

Source of funding is instrumental in an impact analysis because dollars sourced locally (endogenous) for a program detract from expenditures that may have reasonably applied to another purchase within the study geography. By comparison, dollars sourced non-locally or outside the study geography (exogenous) add to expenditures due to either sale of a commodity outside the study area, or substitution of a non-local purchase with a local purchase.

Funding for the Thurston County HCP utilizes a combination of non-local (exogenous) and local (endogenous) dollars. Positive economic impacts accrue due to the program 1) to the extent that exogenous dollars are sourced to cover program costs, and 2) local downstream transactions (transactions within the local economy) multiple those "new dollars". Based on the Thurston County HCP, most program costs for land acquisition or easements, restoration, and maintenance derive from endogenous mitigation fees and other local sources (Conservation Futures, for example), as defined below in the Thurston County HCP.

- Mitigation Fees. These include Certificate of Inclusion Applicant's Mitigation Fees and the costs paid by Thurston County to purchase credits to mitigate debits from its own Covered Activities (e.g., transportation projects).
- Other Local Funding. These include contributions from Conservation Futures (funded from property tax). Other possible local sources of local funding could be identified during the Permit Term.

Exogenous sources to cover program costs in this analysis were identified as sales of local product (calves or beef) that substitute for (and thereby decrease) consumer purchasing (dollars flowing out of the study geography) of non-local product. In this way "new dollars" are generated by preventing dollars from flowing out of the study geography.

Another potential source of exogenous funding would be funding flowing into the county to cover the costs of land acquisition, easements, restoration, or maintenance such as grant dollars. In the baseline model run, it was assumed that federal funds could not co-mingle with funds for mitigation needs, and therefore the predominance of funding was projected to derive either from local tax fees collected through Conservation Futures or mitigation fees collected at time of permitting.

Specific Assumptions Regarding the Source of Funds

In the baseline model run in this study, the entirety of operational expenses for grazing operations were assumed to be covered by exogenous sources of revenue (either selling a product out of the study area to bring in new dollars or substituting a non-local purchase for a local one). Restoration and maintenance costs were assumed to derive from local funding. Generally, the entirety of funding for NR was assumed to derive from local funding as noted in the Thurston County HCP (Section 8.4). However, the potential for external grant or other funding was of interest to project partners, and likely, and so two additional model runs were conducted to project economic impacts of externally sourced funding for NR restoration and maintenance. For these analyses it was assumed that 15% and 25% of funds for NR were exogenous.

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