SB 5506 Budget Note Report

Third-party assessment of the operations, sustainability, and climate vulnerability of state-owned fish hatcheries

Prepared for the Joint Committee on Ways and Means
by the Oregon Department of Fish and Wildlife

March 2025

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Key Assessment Findings

- ODFW operates 14 state-owned hatcheries (State hatcheries) with an annualized budget of $12.5 million for the 2023-25 biennium, not including capital contributions. Operating costs for these hatcheries are rising and spending has not kept pace with inflation.

- The Regional Economic Impact (REI) of State hatcheries from fisheries, visitors, and hatchery operations is $55.5 million, which is equivalent to 1,100 jobs in the state level economy. Trout fisheries account for nearly half of the total REI.

- A benefit-cost analysis (BCA) based on fisheries and hatchery visitors concluded that benefits exceed costs at all State hatcheries. Fishery benefits exceeded costs for all fish species except summer steelhead, which did not have positive net benefits. Trout had the highest net benefits.

- Some State hatchery facilities are expected to be resilient to climate change, while other facilities are already being impacted by high water temperatures, low summer flows, and other environmental hazards that are projected to worsen in a changing climate.

- Costs to address hatchery infrastructure needs at State hatcheries, including deferred maintenance and climate resilience upgrades, ranged from less than $2 million at Fall River Hatchery to over $40 million at Rock Creek Hatchery. The estimated total cost to address infrastructure needs at all 14 State hatchery facilities is approximately $180 million. This is a conservative estimate and ODFW expects that actual construction costs will be higher in most cases due to rising costs and complexity of engineering for some projects.

- Infrastructure alternatives that consolidate State hatchery production in fewer facilities could result in long-term infrastructure cost savings of $4–14 million while maintaining current system capacity. This savings is less than 10% of total cost to address infrastructure needs and reducing the number of facilities would have benefits and risks for hatchery resilience.

- Climate vulnerability varies among hatchery stocks depending on species, run type, and geographic location in the state. Spring Chinook salmon and summer steelhead programs generally appear to be more vulnerable, while trout programs are highly resilient and adaptable.

- Both hatchery fish and naturally produced fish have important contributions to fisheries in Oregon. In some areas, naturally produced fish are doing well and are expected to continue supporting sustainable angling and harvest opportunities. In other areas, naturally produced fish populations and habitat quality are not robust enough to support harvest fisheries. Habitat restoration may improve naturally produced fish status in some areas and, conversely, development and the impacts of a changing climate may lead to a decrease in naturally produced fish status. Given this, and the expectation of ongoing angler demand there will continue to be a need for a combination of mitigation, harvest augmentation, and conservation hatchery programs in Oregon.

- Through planning and policies, ODFW has established a comprehensive approach to achieving hatchery program objectives while minimizing impacts on native fish populations, including those listed under the Endangered Species Act.

INTRODUCTION

Oregon's rivers, streams and lakes are home to naturally produced (wild) populations of salmon, steelhead, and trout. In many river basins, naturally produced fish are healthy and abundant and support vibrant fisheries. For example, >75% of fall chinook harvested on Oregon's coast each fall are of naturally produced origin.

In some locations, the abundance of naturally produced fish populations has declined as a result of a range of factors. In these locations, naturally produced fish may not be sufficiently abundant to meet the fishery demand and/or the population may have declined to a level that requires intervention to prevent extirpation while habitat issues are addressed. Hatcheries are an important tool in these instances for providing fishery opportunity and conservation benefits. The need for, type, and characteristics of a hatchery program ultimately link to the health of the naturally produced population.

ODFW operates 33 fish hatchery facilities, 14 of which are state owned (**Figure 1**). Collectively, these hatcheries produce over 40 million fish annually for release in Oregon rivers and lakes. Hatcheries operated by the Oregon Department of Fish and Wildlife (ODFW) provide social, economic, and cultural benefits to Oregonians by sustaining sport, commercial, and tribal fishing opportunities.

The ability of ODFW to continue operating these facilities and maintain current production levels of fish is challenged by rising costs, significant deferred maintenance needs, and the impacts of climate change—including wildfire, increasing stream temperatures and disease incidence, decreasing stream flow, and reduced ocean survival of fish. ODFW is proactively meeting these challenges by assessing the hatchery system and examining how to adapt and invest for the future. ODFW initiated a formal assessment of the climate vulnerability of several hatchery facilities in 2020 and has since expanded that analysis. For federally owned facilities operated by ODFW, deferred maintenance needs have been catalogued as part of large-scale efforts to address federal hatchery infrastructure needs. For some of these facilities, federal agencies are planning to conduct climate vulnerability assessments, as well.

To advance ODFW's review of the hatchery system, the legislatively adopted budget for the 2023-25 biennium included a budget note directing ODFW to procure a third-party assessment of the operations, sustainability, and climate vulnerability of state-owned fish hatcheries. ODFW was further directed to present a thorough and detailed report to the legislature during the 2025 session that includes, at a minimum, the following:

- Funding models and financial sustainability of state-owned hatchery operations, including consideration of facility maintenance costs.
- An economic cost-benefit analysis that includes:

    - The total agency costs associated with producing hatchery fish at each facility.
    - The estimated economic benefits associated with production of hatchery fish.
- A summary of how the ecological impacts and benefits of hatchery programs on naturally produced fish are incorporated into federal and state planning and policy making.
- Climate vulnerability for a sample set of state-owned hatcheries. This assessment should include:
    - The projected impact of climate change on the ability of each hatchery to rear and release fish.
    - The likely impact of climate change on the viability of, and need (augmentation and conservation) for hatchery programs.
    - Recommendations to mitigate these impacts through hatchery program changes, such as the species of fish released, and other measures.

During the 2023-25 biennium, ODFW procured a third-party assessment consistent with the budget note directive. Due to the range of expertise needed to rigorously address the assessment components identified in the budget note, ODFW issued seven separate contracts that comprise the third-party assessment. This summary report synthesizes the key findings from the third-party assessment. Final reports submitted by contractors for each of the seven contracts are provided as appendices to this report.

To expand the assessment to include a broader range of considerations and perspectives on Oregon's hatchery system, ODFW also reached out to the nine federally recognized tribes in Oregon and contracted with Willamette Partnership to conduct an extensive public engagement process (including multiple public forums, public webinars, a rigorous small-group process, and a public survey). Details of the public engagement process and a report of outcomes are available at https://www.dfw.state.or.us/fish/hatchery/resilience.asp. ODFW will utilize the input received from tribes and the public to inform decisions and recommendations related to investing in a sustainable hatchery system.

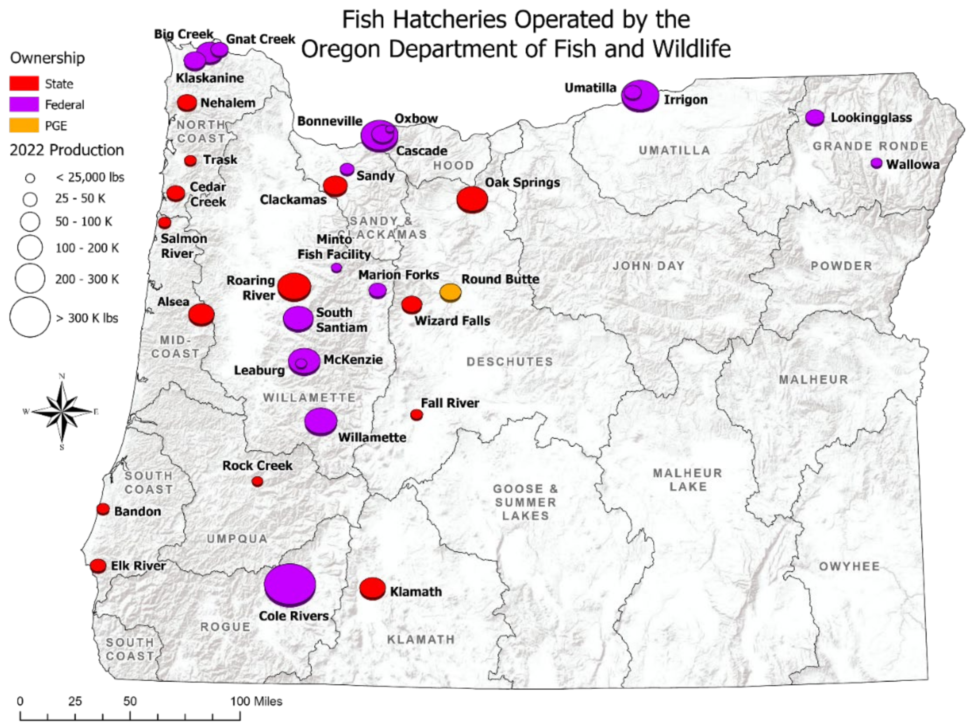


Figure 1. Map showing locations, ownership, and fish production levels of the 33 fish hatcheries operated by ODFW (PGE = Portland General Electric). Fish production levels are expressed in thousands of pounds and include salmon, steelhead, and resident trout production.

STATE HATCHERY ECONOMICS

The Research Group, LLC conducted an economic analysis of the 14 state-owned hatcheries operated by ODFW (Appendix A). The State hatchery financial portrayal in the economic analysis is a one-year model for 2023 revenues and costs. In 2023, State hatcheries released 8.4 million salmon and steelhead and 3.8 million trout and kokanee. The one-year model used annual hatchery costs taken from fiscal year 2023-2025 budgets modified to some extent by actual expenditures. Modeled hatchery fishery benefits were calculated based on recent average rates at which released hatchery fish are harvested as adults. In reality, there is wide variation in hatchery costs and production, anadromous and resident fish survival, and hatchery visitors. There are also changes to fisheries management, environmental conditions, hatchery site circumstances, and the general economy. Thus, the one-year portrayal is a stylized but reasonable representation of hatchery production and economic use activity in any given recent year. Due to interconnectedness in operations and budget tracking, Wizard Falls Hatchery and Fall River Hatchery were combined in the economic analysis. Rock Creek Hatchery, which was extensively damaged by a wildfire in 2020 and has not operated since then, was represented in the economic analysis based on hatchery operations and objectives prior to the wildfire damage.

Costs and Funding

The annualized budget for the 14 state-owned hatcheries operated by ODFW, excluding annual capital contributions, was $12.5 million during the most recent biennium. When capital contributions based on long-term replacement costs are included, the annual budgets sum to $16.4 million. About 22 percent of the supporting revenues are from the State general fund, 51 percent are from license fees, 25 percent are from federal programs such as the Sport Fishing Restoration (SFR), and 2 percent are from other external sources such as PGE (**Figure 2**).

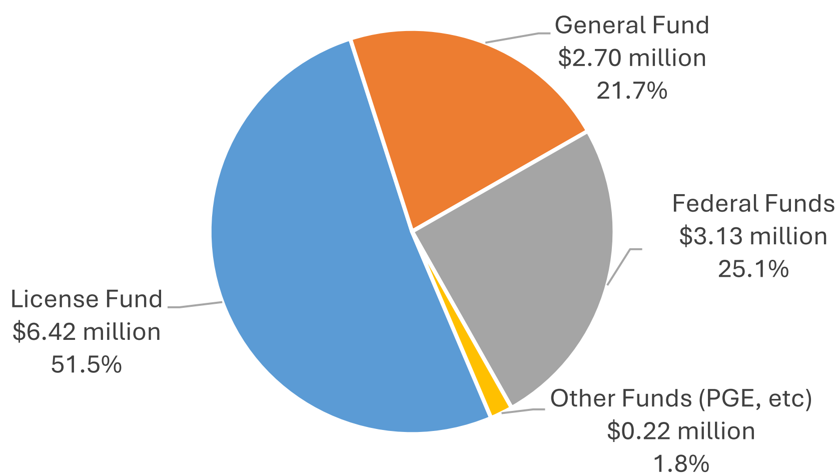


Figure 2. State hatchery budget revenue sources.

For the economic analysis, State hatchery costs were divided into two categories: variable costs (57 percent of total costs) and fixed costs (43 percent of total costs). Variable costs include hatchery operational expenses and support services such as fish health, marking, and liberation (**Table 1**). Fixed costs include headquarter administration, field management, heavy maintenance, bond expenses, wildfire payments, and annual capital contributions (**Table 1**). The bond expenses are from each hatchery's contribution to a $10 million deferred maintenance/catastrophe bond fund. The $10 million bond fund was a one-time allotment, and funds were used for hatchery improvements over a five-year period. Wildfire payments are insurance premium payments required at Klamath and Rock Creek hatcheries due to an insurance company settlement for wildfire damage. Capital contributions represent annualized replacement costs based on a straight-line method, 70-year useful life, and 25 percent salvage value. Existing facilities are generally considered fully depreciated.

Table 1. Annual State hatchery costs by category in 2023 dollars.

Cost Category		Amount	Share
Variable			
Operation (personal services, feed, utilities, etc.)		$8,199,700	50%
Support (fish health, marking, and liberation)		$1,147,800	7%
	Subtotal	$9,347,500	57%
Fixed			
Headquarter Administration		$254,400	2%
Field Management		$219,000	1%
Heavy Maintenance (capital/fixed)		$1,048,400	6%
Bond Expenses		$440,000	3%
Wildfire Payments		$1,160,000	7%
Annual Capital Contribution		$3,880,400	24%
	Subtotal	$7,002,200	43%
Total		**$16,349,700**	

State hatchery cost trends over the last three biennia were examined based on hatchery operation personal services (PS) and supplies and services (SS). Fish production pounds have been relatively stable over this period. Spending for PS and SS increased over the three biennia, but spending has not kept up with inflation. Fish feed prices, which have risen substantially in both nominal and inflation-adjusted terms, are just one of the drivers of rising hatchery costs. Revenue trends indicate that license and fee per capita revenue is decreasing in recent years. Given rising costs, the assessment found that the ongoing financial sustainability of the system will be dependent on some combination of increased revenue and/or decreased costs. The assessment highlighted some options, which could include an increase from existing revenue sources (e.g., through greater general fund appropriations or higher license and fee prices); establishment of new revenue sources; lowering costs through increased efficiency or reduced production; and shifting production responsibilities to other entities. Decision-making about these funding sources would require a more detailed hatchery financing planning study that includes a social and economic impact analysis.

Cost Effectiveness

Cost effectiveness analysis (CEA) can be a useful economic description tool. CEA relates costs to an analytical objective to determine the least costly way to achieve the objective. Objectives in this hatchery economic analysis included fish production pounds and number of harvested adult fish. **Table 2** shows cost per harvested adult by species and run type across all State hatcheries. Trout had a substantially lower cost per harvested adult than anadromous fish (salmon and steelhead) due to lower production cost and a much higher catch rate. Summer steelhead had the highest cost per harvested adult among anadromous fish species. **Figure 3** shows cost per fish production pound at each hatchery.

Hatcheries that primarily raise trout (e.g., Roaring Springs, Oak Springs, and Klamath) had the lowest cost per production pound while facilities that primarily raise salmon and steelhead generally had higher costs per pound. Furthermore, there are efficiency gains with larger production facilities having lower cost per pound and smaller facilities having higher cost per pound (**Figure 4**).

Table 2. Cost per harvested adult by species for all State hatcheries combined (costs for individual hatcheries may be higher or lower than those shown here) based on harvest in ocean and freshwater fisheries in Oregon. Total cost includes variable and fixed costs, including annualized capital contributions.

Species	Variable Cost	Total Cost
Trout	$3.51	$6.21
Anadromous Species		
Fall Chinook Salmon	$105	$161
Spring/Summer Chinook Salmon	$121	$241
Coho Salmon	$42	$73
Winter Steelhead	$76	$132
Summer Steelhead	$252	$438

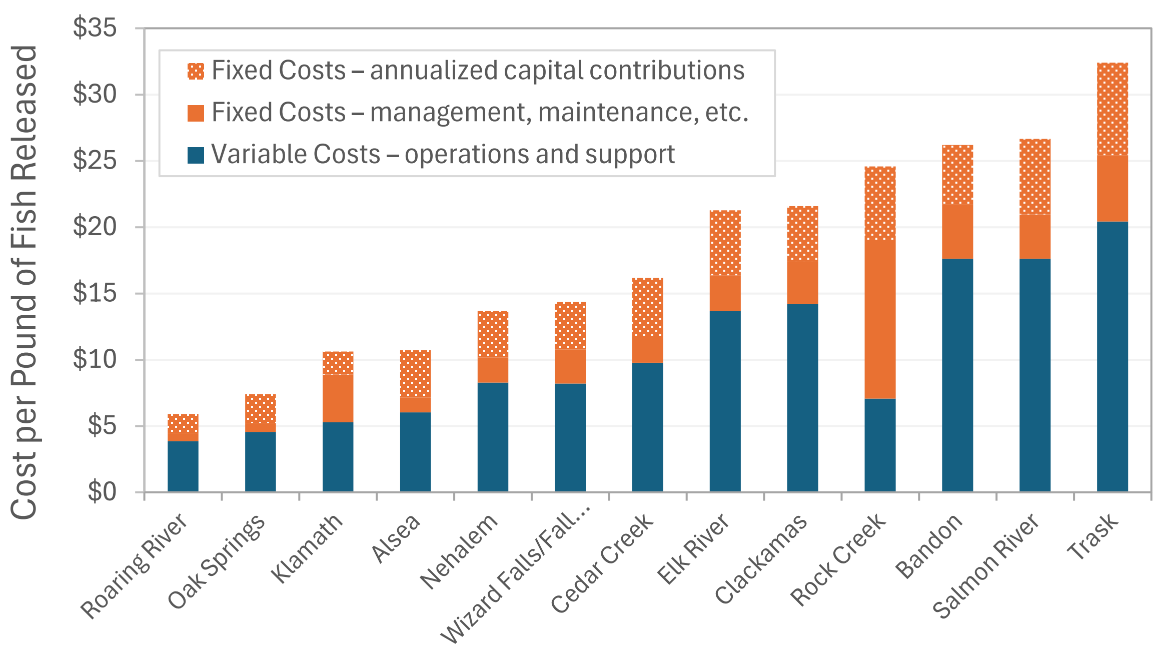


Figure 3. Cost per pound of fish released at State hatcheries including variable costs and fixed costs. Annualized capital contributions are separated out from other fixed costs to show how each contributes to total cost.

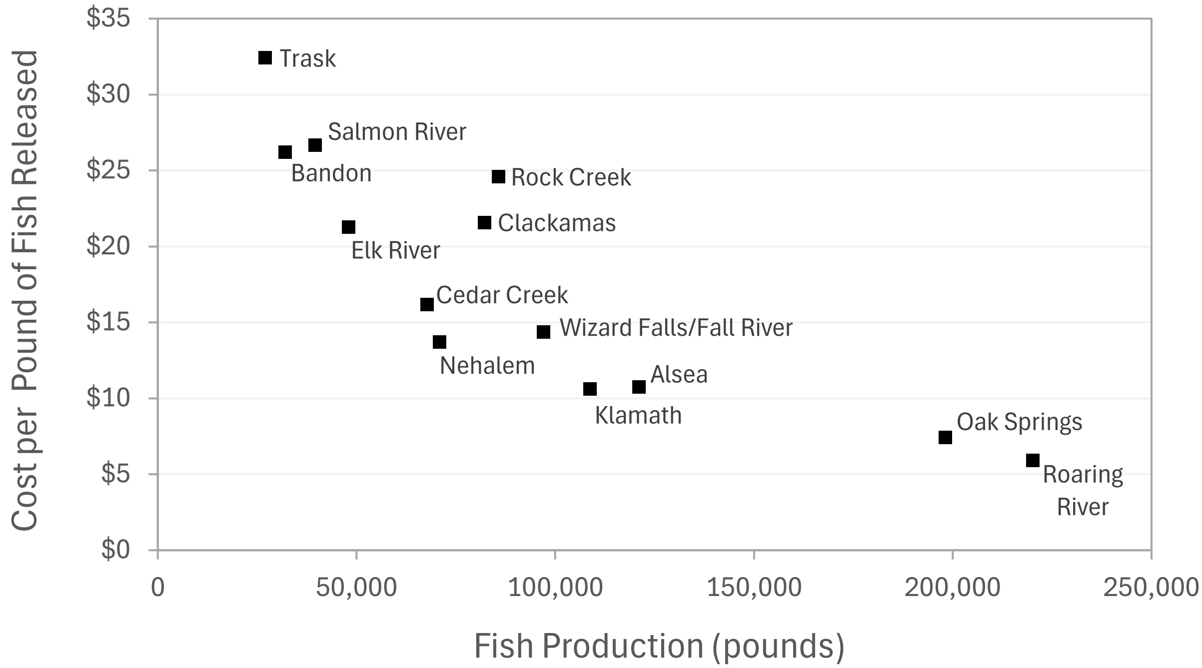


Figure 4. Fish production pounds and cost per pound released at State hatcheries.

Regional Economic Impact

Regional Economic Impact (REI) is a way to show how a direct change in expenditures is multiplied throughout the regional and statewide economies. The measurement units for REI with most bearing in this analysis are labor income, job equivalents, and state/local taxes generated. The REI analysis considered active-use economic activity from commercial harvesting, recreational fishing, hatchery visits, and hatchery operations. There are other production-related direct and indirect financial values not included such as egg and carcass sales, food bank donations, and supplying fish to tribes for ceremonial and subsistence purposes.

The State hatchery summed direct values (DV) were $0.4 million commercial harvest value, $62.3 million recreation spending, and $6.5 million visitor spending. These DV represented 166,000 pounds of anadromous species harvest in commercial fisheries, 659,000 recreational fishing angler days, and 169,000 hatchery visitor days.

Total REI attributed benefits for State hatcheries was $55.5 million labor income, which is equivalent to 1,100 jobs in the state level economy. State/local tax associated with this economic activity is $6.0 million. Federal taxes would be in addition to this amount. Trout fisheries contributed nearly half of the

REI, followed by anadromous species fisheries, hatchery operations, and hatchery visitors (**Table 3**). Commercial fisheries and ocean recreational fisheries accounted for a small proportion of total REI compared to freshwater fisheries for anadromous species. Winter steelhead accounted for nearly half of the REI from anadromous freshwater fisheries.

Table 3. State hatchery regional economic impact (REI) from ocean and freshwater fisheries, hatchery visitors and hatchery operations, expressed in labor income.

	REI	
Category	Amount	Share
Trout Fisheries	$25,576,000	46.1%
Anadromous Fisheries		
Commercial (Ocean and Columbia River)	$692,000	1.2%
Recreational (Ocean)	$224,000	0.4%
Recreational (Freshwater)	$12,811,000	23.1%
Hatchery Visitors	$4,909,000	8.8%
Hatchery Operations	$11,273,000	20.3%
Total	**$55,484,000**	

Benefit-Cost Analysis

In addition to regional economic impacts, the economic analysis provided information about hatchery program net benefits. The net benefits are a calculation for net economic value (NEV) held by users of hatchery production minus hatchery production costs. The value to consumers (for example, a recreational angler) can be measured in terms of their willingness-to-pay (WTP), whereas value to producers (for example a commercial fisheries harvester) can be approximated by the change in net income or profits. The net benefits are expressed as an absolute measure—the difference between NEV and costs— and as a ratio of NEV divided by costs. A ratio of NEV to costs greater than or equal to one is synonymous with a result that net benefits are positive.

The net benefit calculation is more widely referred to as benefit-cost analysis (BCA). BCA is an economic analysis tool that can incorporate different complexity levels in its application, including consideration of different time horizons and opportunity costs. In this assessment, resources allowed for a limited BCA application where current year costs were utilized in the calculation, and not all benefits (such as passive use values) or costs (such as adverse impacts to naturally produced stocks) were considered. While it is a limited approach, it still provides valuable information about the provision of a public service.

Passive use values, like the existence value associated with the simple presence of a fish population, are complex and difficult to measure. Nevertheless, they are important for bringing into perspective the total value of fish resources. Likewise, fish resources can be related to a society's importance beyond its economic value. This is a cultural perspective that recognizes the shared ways in which fish and fisheries are important to human communities and does not view values as something inherent to the environment or to individuals. This perspective is not always incorporated into fish resource decision making. Of special consideration is the cultural value tribal communities have for fish resources, which are interconnected with tribal culture and have been since time immemorial. Although these passive use and cultural values could not be incorporated in the BCA, they are discussed in the economic analysis report, along with several environmental justice considerations associated with hatchery fish production.

Results of the limited BCA by species are shown in **Table 4**. Trout fisheries have the highest benefit-cost ratio, and ratios were positive for all species except summer steelhead. Net benefits from fisheries and visitors for individual State hatcheries are shown in **Figure 5**. All hatcheries had a ratio of NEV to costs greater than one, indicating positive net benefits. Benefit-cost ratios were lowest at Elk River (1.21) and Salmon River (1.22) and highest at Roaring River (10.61). In general, hatcheries with a higher proportion of trout production had higher benefit-cost ratios. Also, there is a strong relationship between net benefits and cost per pound at these facilities, with larger facilities having lower cost per pound.

Table 4. State hatchery costs, NEV, and benefit-cost ratio by species (2023 dollars).

Species	Cost Base	Total NEV	Net Benefits	Benefit-Cost Ratio
Trout	$6,559,000	$41,531,000	$34,973,000	6.33
Fall Chinook Salmon	$1,549,000	$3,205,000	$1,656,000	2.07
Spring Chinook Salmon	$1,688,000	$4,768,000	$3,080,000	2.82
Coho Salmon	$1,918,000	$2,062,000	$144,000	1.08
Winter steelhead	$3,336,000	$9,480,000	$6,144,000	2.84
Summer steelhead	$1,300,000	$1,083,000	($217,000)	0.83
Visitors		$4,214,000	$4,214,000	
Total	**$16,350,000**	**$66,344,000**	**$49,994,000**	**4.06**

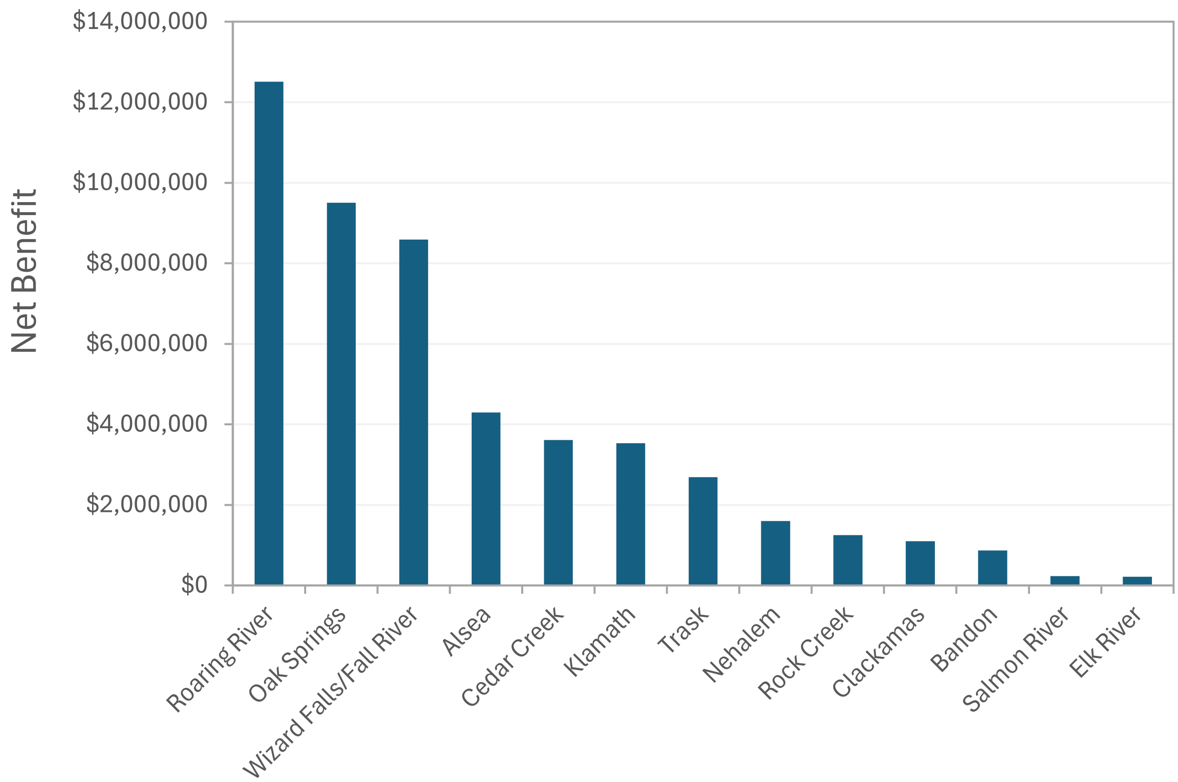


Figure 5. State hatchery net benefits from fisheries and visitors (2023 dollars).

Climate Vulnerability Assessment

Oregon is experiencing climate and ocean changes that are consistent with changes observed and projected globally, such as increased average air and water temperatures, disrupted precipitation patterns, and increased ocean acidification and hypoxia. These changes are expected to continue in the future, resulting in cascading impacts that, in general, include: 1) changing precipitation patterns, including a decreasing trend for snowpack volume, resulting in changes in streamflow characterized by increased frequency and severity of flooding, increased flows in winter, and decreased flows in late summer and fall; 2) an increasing trend in freshwater and marine water temperatures; 3) a change in wildfire patterns, including an increase in the frequency and magnitude of intense wildfires; 4) Changing ocean currents and stratification, including changes in the frequency and magnitude of coastal upwelling; and 5) rising average ocean levels. To chart a sustainable future for Oregon's hatchery system, it is crucial to understand how these impacts could affect hatchery facilities and the fish they produce. Therefore, third-party contractors conducted assessments focused on hatchery facilities and infrastructure, as well as the hatchery programs at those facilities.

Hatchery Facilities

ODFW operates a network of fish hatcheries critical to supporting the state's fisheries by producing and releasing both anadromous and resident fish species like salmon, steelhead, and trout. These hatcheries play a vital role in conservation, habitat mitigation, and sustaining recreational and commercial fishing, which contributes significantly to the local and state economy. However, many hatcheries face challenges such as aging infrastructure, deferred maintenance, increasing operational costs, and the worsening impacts of climate change on water availability and quality.

To identify sustainable strategies for maintaining fish production across the system, Lynker Technologies, LLC conducted a comprehensive assessment of the 14 State hatcheries using a Multi-Criteria Decision Analysis (MCDA) framework (Appendix B). The assessment included three additional federally owned hatcheries operated by ODFW that currently, or could potentially, provide rearing capacity for state-funded hatchery programs. The MCDA framework used quantitative and qualitative criteria in four categories: Climate Resilience and Hazards; Fish Production and Hatchery Importance/Connectivity; Infrastructure Costs; and Economic Analysis. This approach provided a holistic view of each hatchery’s strengths, vulnerabilities, and potential for future improvements.

Overall climate resilience scores for the 17 study hatcheries are shown in **Figure 6**. The highest scoring facilities (e.g., South Santiam, Wizard Falls, Fall River, and Klamath Falls) are expected to have sufficiently good water quality and availability into the future. In contrast, the lowest scoring facilities (e.g., Alsea, Salmon River, and Rock Creek) had low water quality scores and either limited water availability and/or relatively high risk from other hazards like flooding and sea level rise. Fish Production and Hatchery Importance/Connectivity scores are shown in **Figure 7**. Hatcheries with higher scores indicate greater relative importance of the hatchery based on production size or other factors (e.g., unique broodstocks or mitigation obligations), connectivity of the hatchery within the system, and excess capacity for future growth.

Cost estimates for addressing infrastructure needs at each hatchery are shown in **Figure 8**. Infrastructure costs are categorized as (1) deferred maintenance; (2) project modifications—unique infrastructure projects required to maintain or increase hatchery capacity at select facilities; or (3) climate, technology, and infrastructure upgrades to improve hatchery resilience. Although categorizing projects this way provides useful information, it is important to note that there is overlap between the categories. For example, climate resilience and adaptation needs are considered when addressing deferred maintenance. Cost estimates were informed by a hatchery cooling technology evaluation by Solarc Engineering, LLC (Appendix C), a deferred hatchery maintenance evaluation by QRS Consulting, LCC (Appendix D), and expert opinion from ODFW fish propagation and engineering staff. Infrastructure cost estimates to maintain existing production capacity at each facility ranged from less than $2 million dollars at Fall River to over $40 million at Rock Creek[1]. The estimated cost of addressing infrastructure needs across the 17 study hatcheries summed to nearly $250 million. Infrastructure needs at the 14 State hatcheries account for nearly $180 million dollars of this total. The remaining $70 million cost applies to the three federal hatcheries and will require federal funding sources. These costs are based on a high level assessment completed in 2024. In the majority of instances, the actual costs at the time of construction will likely be higher given recent increasing trends in construction costs and the complexity of engineering at these sites.

Figure 6 shows aggregated MCDA scores across all four categories for the 14 State hatcheries. Facilities on the left side of the figure (e.g., Wizard Falls, Clackamas, Oak Springs) have the highest aggregated scores, indicating they are most resilient. Conversely, facilities on the right side of the figure (e.g., Rock Creek, Bandon, Salmon River, Alsea) have the lowest combined scores, suggesting they face more risks or costs. These facilities are of particular concern. Several of these hatcheries were also considered when evaluating alternative hatchery operations models.

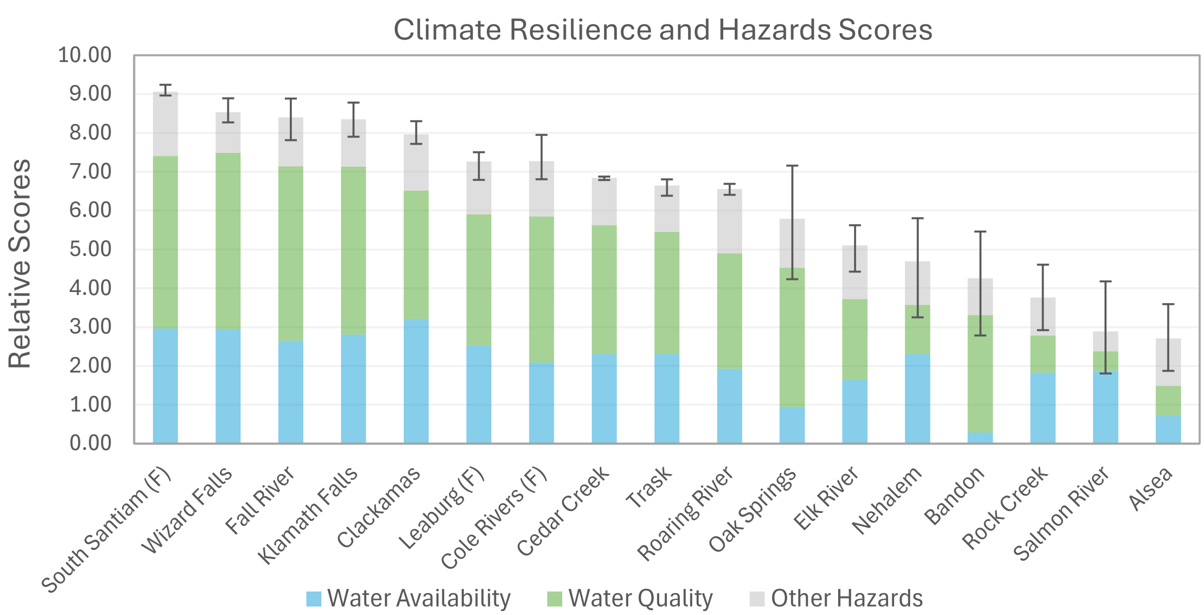


Figure 6. Climate Resilience and Hazards category scores for 14 State hatcheries and three federally-owned hatcheries (F) operated by ODFW. Higher relative scores indicate higher climate resilience; error bars are based on scoring across three scenarios: (1) equal weighting of metrics, (2) drought resilience weighting, and (3) water quality weighting.

[1] The infrastructure cost estimate for Rock Creek Hatchery was reflective of maintaining coho, winter steelhead, and fall Chinook and approximately 40% of the spring Chinook program onsite. Infrastructure to maintain the full spring Chinook program onsite was cost prohibitive.

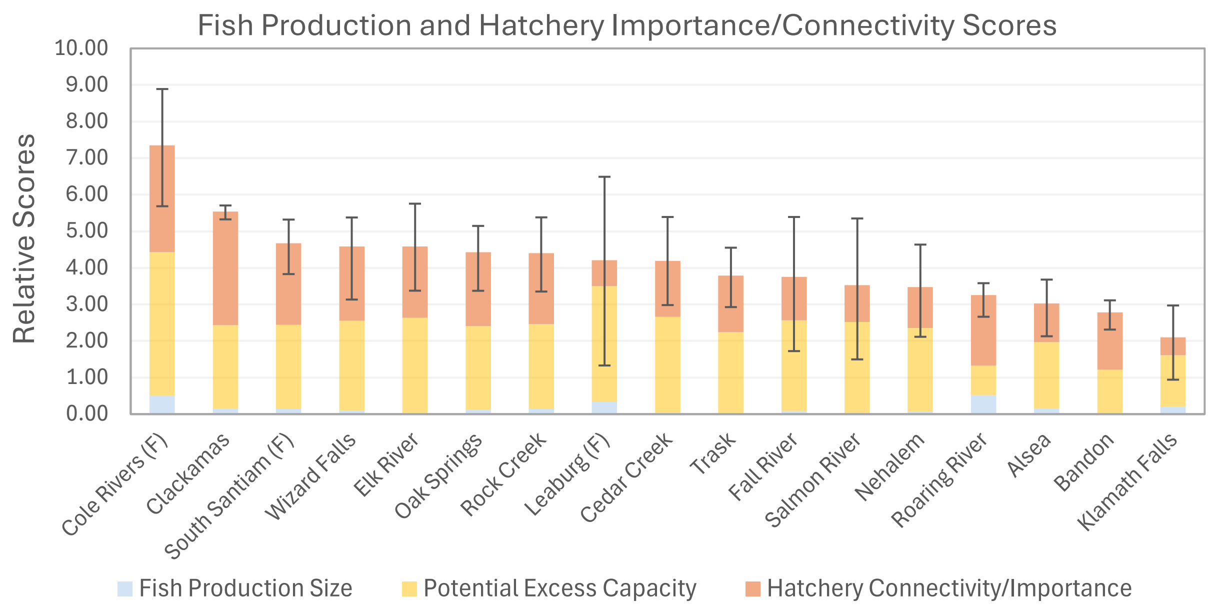


Figure 7. Fish Production and Hatchery Importance/Connectivity scores for 14 State hatcheries and three federally-owned hatcheries (F) operated by ODFW. Bar heights represent scenario-averaged scores; error bars show high and low scores across three weighting scenarios: (1) equal weighting of metrics, (2) excess capacity weighting, and (3) program importance weighting.

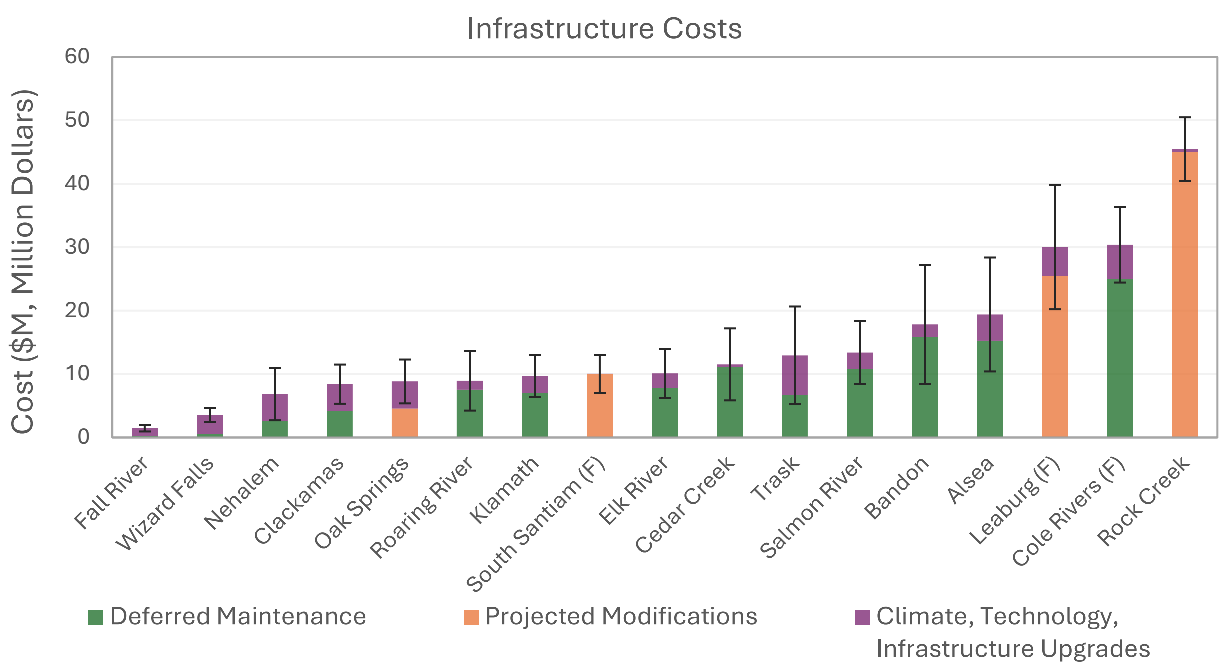


Figure 8. Total infrastructure costs (2024 estimates) in millions of dollars (state and federal), which combines costs from deferred maintenance, projected modifications, and climate, technology, and infrastructure upgrades.

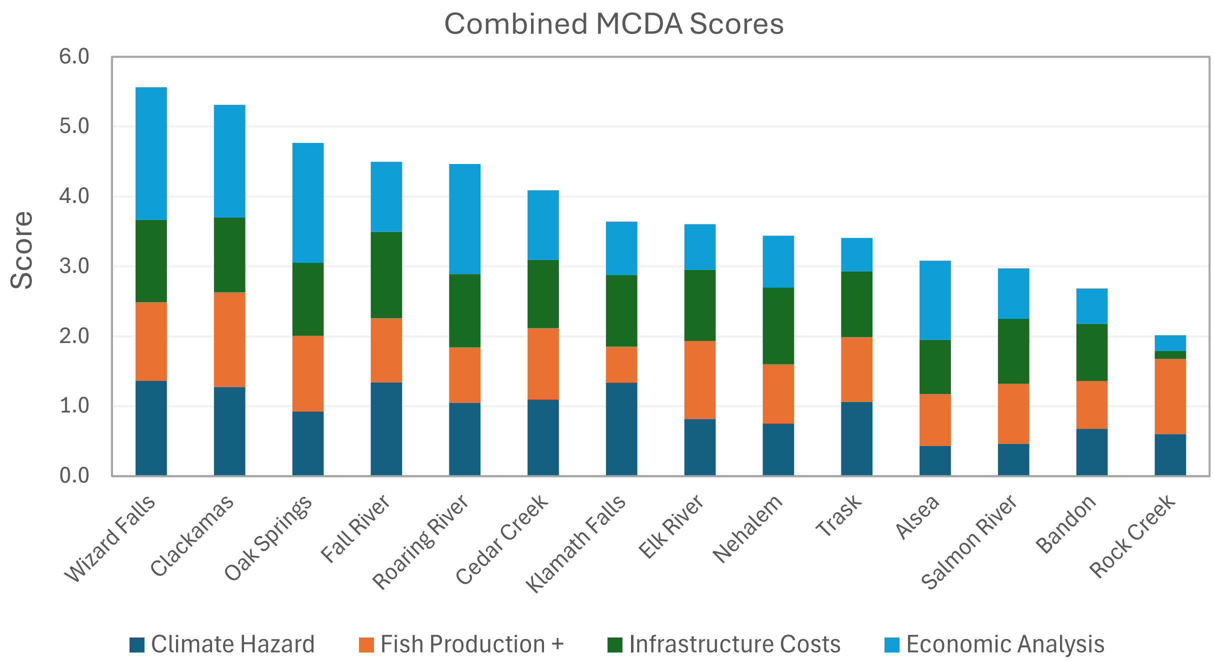


Figure 9. Combined Multi-Criteria Decision Analysis (MCDA) scores for the 14 State hatcheries. Higher scores indicate higher resilience, greater fish production and importance/connectivity, lower infrastructure costs, and more positive economic indicators.

To explore costs and benefits of hatchery consolidation, two major alternative operating plans (Alternative 1 and Alternative 2) were analyzed as a part of the hatchery assessment. Alternative 1 would maintain current production at all hatcheries and rebuild Rock Creek Hatchery to restore most of the pre-fire production capacity. This alternative can be described as a return to the operational status quo for ODFW. In comparison, Alternative 2 represents consolidated operations that would maintain the same production capacity across fewer ODFW hatcheries. Three different consolidation scenarios for Alternative 2 were evaluated (**Table 5**). In all three scenarios, ODFW would make investments to maintain very similar hatchery production capacity for salmon, steelhead, and trout.

Table 5. Summary of the alternative operational scenarios evaluated in the assessment.

Alternative 1 (Status Quo)	Upgrades to all existing facilities
Alternative 2a (Consolidation)	*Northwest:* • Expand Cedar Creek, Oak Springs, and Fall River • Shift Nehalem production to Cedar Creek, Trask, Salmon River, and Clackamas • Shift trout production to Oak Springs and Fall River *Southwest:* • Expand Bandon and Elk River • Build capacity for South Umpqua programs • Shift Rock Creek production to Cole Rivers, South Umpqua, and Elk River
Alternative 2b (Consolidation)	*Northwest:* • Expand Cedar Creek, Oak Springs, and Fall River • Shift Salmon River production to Cedar Creek, Roaring River, and Clackamas • Shift trout production to Nehalem, Oak Springs, and Fall River *Southwest:* • Same as Alternative 2a
Alternative 2c (Consolidation)	*Northwest:* • Expand Cedar Creek, Nehalem, Oak Springs, and Fall River • Shift Alsea production to Cedar Creek, Salmon River, and Clackamas • Shift trout production to Nehalem, Oak Springs, and Fall River *Southwest:* • Same as Alternative 2a

The alternatives analysis found that consolidating operations (Alternatives 2a-c) does not offer significant infrastructure cost savings over the status quo (Alternative 1), and potential savings are well within the range of uncertainty for cost estimates (**Figure 10**). The cost savings for Alternatives 2a, 2b, and 2c are estimated to be $4 million, $6 million, and $14 million, respectively, compared to Alternative 1 representing the status quo. The consolidation alternatives generally focused on decommissioning hatcheries with higher risks and costs to prioritize investment in other hatcheries with lower risk. Consolidation may be a helpful tool for divesting from the most vulnerable facilities and minimizing future disruptions. However, hatchery consolidation may have other risks and benefits that were not evaluated in the assessment. For instance, it's possible that a consolidated hatchery system could become more vulnerable due to having fewer facilities that can absorb operational changes in response to extreme events (e.g., wildfire). Hatchery consolidation could also potentially reduce operational costs, but most production costs are expected to be associated with the fish and be allocated to whichever hatchery assumes its production. A more detailed study would be required to quantify how the proposed alternatives would impact operating costs, staffing levels, and fish production.

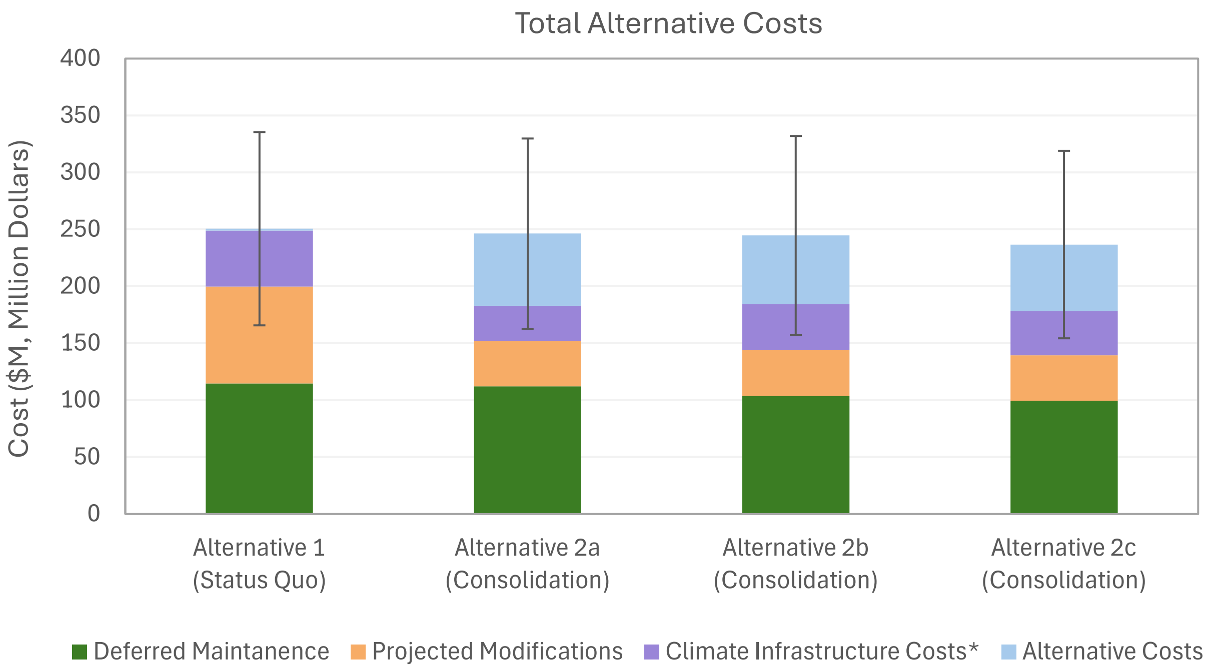


Figure 10. Total costs (deferred maintenance, climate infrastructure/new technology, projected modifications, and additional costs for alternative scenario) across the alternative operational scenarios; error bars show high and low estimates. Some climate costs were duplicative in the alternative scenario, so those costs were removed in the total climate infrastructure cost sum.

Hatchery Programs

In addition to effects on hatchery facilities, climate change is expected to affect the performance and sustainability of hatchery programs, as well as the future need for programs. The assessment examined each of these topics in depth.

Researchers affiliated with Oregon State University and the U.S. Geological Survey assessed the climate vulnerability of hatchery programs using both quantitative and qualitative approaches (Appendix E). The quantitative assessment focused on a set of hatchery programs representing the five primary anadromous species and run types—coho salmon, fall Chinook salmon, spring Chinook salmon, summer steelhead, and winter steelhead—reared in Oregon hatcheries. Programs were selected based on the quality of monitoring data available and with the goal of representing different regions of the state (e.g., Oregon Coast, Lower Columbia River, Lower Snake River). The quantitative analysis examined long-term trends in hatchery fish survival and investigated relationships between survival and environmental indicators like river flow and sea surface temperature. A complementary qualitative assessment evaluated climate vulnerability of hatchery fish based on several exposure and sensitivity metrics across their life cycle. A separate qualitative approach was used to evaluate the vulnerability of ODFW's resident trout stocking programs. Together, these analyses provide a picture of which hatchery programs are likely to be most resilient and which programs could be at higher risk.

The trend analysis found that smolt-to-adult returns (SARs) have declined, on average, for many hatchery programs; however, some programs (e.g., Elk River fall Chinook) showed positive trends. Cyclical patterns of survival were evident in many of the programs, so trend analysis results were sensitive to the time frame examined, which ended during the recent period of marine ecosystem disturbance and lower survival for most stocks. Negative long-term SAR trends were observed for nearly all spring Chinook and summer steelhead programs, including several that were also found to have high climate vulnerability in the qualitative assessment. Coho salmon programs were generally found to have moderate climate vulnerability in the qualitative assessment and negative long-term SAR trends in the quantitative analysis. Long-term SAR trend results were mixed for fall Chinook salmon and winter steelhead programs, and these run types were generally found to have lower climate vulnerability.

Due to natural variability across populations, relationships between environmental indicators (predictors) and hatchery fish survival (SARs) differed among stocks. In some cases, predictors that influenced survival were related to hatchery management practices (e.g., average size at release, total number of fish released). However, for many populations, marine conditions emerged as the most significant predictors of survival. To understand the long-term effects of a changing climate on survival, it would be helpful to forecast predictor variables into the future. Unfortunately, long-term projections do not exist for the majority of the metrics that this analysis identified as important drivers. In general, climate projections forecast rising temperatures and increased variability in marine ecosystems from the west coast of the USA to the Bering Sea in Alaska. These changes are expected to affect marine conditions by disrupting food availability, altering migration patterns, and increasing the frequency of extreme weather events—all of which could impact fish survival.

ODFW's resident trout stocking programs face some of the same environmental challenges as salmon and steelhead programs. However, trout stocking programs are expected to be resilient due to several factors, including: 1) trout broodstocks are generally maintained at facilities with cold, stable water sources; 2) trout can be shifted among facilities seasonally to take advantage of rearing space when temperature and flow are not limiting; 3) trout stocking locations and timing are highly adaptable; and 4) there are possibilities for shifting to more climate-resilient trout stocks. With these diverse options for maintaining production and adapting to climate change, ODFW's trout stocking programs are expected to remain resilient and viable into the foreseeable future.

ODFW's hatchery programs generally fall into one of three categories: 1) mitigation programs operated pursuant to an agreement to provide fishing and harvest opportunities lost as a result of habitat deterioration, destruction, or migration blockage; 2) harvest augmentation programs used to increase fishing and harvest opportunities where there is no mitigation program in place; and 3) conservation programs operated to conserve or restore naturally produced fish populations. These categories are not mutually exclusive and some programs may have a conservation purpose in addition to mitigation or harvest augmentation objectives. Whether a hatchery program is needed and the type of program implemented is based on the status of naturally produced fish and/or impacts to habitat in a river basin. Because of changes in naturally produced fish status (positive and negative), the need for the three different types of hatchery programs has changed over time in Oregon and will continue to change in the future—an important consideration when planning investments in the hatchery system. Therefore, the third-party assessment included an evaluation of the likely future need for different types of hatchery programs across different species and regions of the state. Four Peaks Environmental conducted the evaluation (Appendix F), which considered several factors that could influence the need for hatchery programs in the future. These factors included the status of salmon and steelhead stocks and their climate change vulnerability; existing mitigation, harvest augmentation, and conservation hatchery programs; contribution of hatchery fish to overall angler harvest; and trends in angling license and harvest tag sales.

The evaluation of future hatchery need was conducted at a regional scale (**Table 7**) that generally aligns with the boundaries of federally designated Evolutionarily Significant Units (ESUs) and state designated Species Management Units (SMUs). ESUs (or Distinct Population Segments, DPS) are the units used in federal status assessments and Endangered Species Act (ESA) listing decisions. SMUs are the scale at which ODFW conducts conservation planning under Oregon's Native Fish Conservation Policy. SMUs are similar to ESUs, but are divided into specific run types (e.g., separate spring Chinook and fall Chinook salmon SMUs may be designated in a single Chinook salmon ESU). An ESU/SMU/DPS may contain multiple hatchery programs of different types depending on obligations to mitigate for passage barriers or other habitat impacts, the capacity of naturally produced fish to meet harvest demand, and the status of individual populations.

The assessment found that most salmon and steelhead ESU/SMU/DPSs in the state are currently at a moderate or higher biological risk. Fourteen ESU/SMU/DPSs are listed as threatened under the federal ESA, one is listed as endangered under the state ESA, and 19 are state-listed as either sensitive or sensitive-critical. The majority of ESU/SMU/DPSs examined are also at substantial risk due to climate change. The review of hatchery programs in Oregon found that most have mitigation or harvest augmentation as their primary purpose. Mitigation programs make up the majority of hatchery programs in all regions except the Oregon Coast, where nearly all programs are classified as harvest augmentation. Conservation hatchery programs are concentrated in the Columbia River Basin. Recent data indicates that hatchery-origin fish account for 70% of salmon and steelhead harvest in the state overall. Hatchery contribution to total harvest is highest for steelhead, followed by coho salmon and Chinook salmon. For fall Chinook salmon, naturally produced fish account for most of the harvest in some regions, including the Oregon Coast.

The assessment substantiated a future need for a combination of mitigation, harvest augmentation, and conservation hatchery programs for a variety of different species in multiple regions (**Table 6**). Mitigation programs are generally associated with dams and as long as those dams continue to exist, there will be a need to mitigate for their impacts on fish habitat. Harvest augmentation needs are directly linked to future fishery demand and naturally produced fish status. Angling license sales declined in the 1990s, but have been relatively stable since then. In contrast, salmon and steelhead tag sales have seen more consistent declines over time, which may due to shifting preferences or perceived declines in opportunity. If these sales trends continue and are representative of angler interest, fishery demand could change in the future. Last, naturally produced fish status may increase as a result of work to protect and restore habitat or decrease as a result of habitat degradation and changes in the environment. Given this range of possibilities, harvest augmentation needs are likely to continue at some level. Finally, based on the current status and climate vulnerability of some ESU/SMU/DPSs, an ongoing or increasing need for conservation hatchery programs is expected.

Table 6. Summary of likely future need for mitigation, harvest augmentation and conservation hatchery programs, and overall future hatchery need, by geographic area and species.

ESU/SMU/DPS	Species	Future Mitigation Need	Future Harvest Augmentation Need	Future Conservation Hatchery Need	Future Hatchery Need
Snake River	Fall Chinook	Yes	--	Increasing	Yes, Increasing
	Spring/Summer Chinook	Yes	--	Yes	Yes
	Steelhead	Yes	--	Yes	Yes
Middle Columbia	Coho	Yes	--	*Insufficient Data*	Yes
	Fall Chinook	Yes	--	*Insufficient Data*	Yes
	Spring Chinook	Yes	--	Yes	Yes
	Steelhead	Yes	--	Yes	Yes
Lower Columbia	Coho	Yes	Yes	Increasing	Yes, Increasing
	Fall Chinook	Yes	Yes	Increasing	Yes, Increasing
	Spring Chinook	Yes	Yes	Yes	Yes
	Chum	No	NA	Yes	Yes
	Winter Steelhead	Yes	Yes	Increasing	Yes, Increasing
	Summer Steelhead	No	Yes	Increasing	Increasing
Upper Willamette	Spring Chinook	Yes	--	Increasing	Yes, Increasing
	Steelhead	Yes	--	Increasing	Yes, Increasing
Rogue–South Coast	Coho	Yes	--	Increasing	Yes, Increasing
	Fall Chinook	No	Yes	*Insufficient Data*	Yes
	Spring Chinook	Yes	--	*Insufficient Data*	Yes
	Winter Steelhead	Yes	Yes	No	Yes
	Summer Steelhead	Yes	--	No	Yes
Oregon Coast	Coho	Yes	Yes	Increasing	Yes, Increasing
	Fall Chinook	No	Yes	Yes	Yes
	Spring Chinook	No	Yes	Increasing	Yes, Increasing
	Chum	No	NA	*Insufficient Data*	No
	Winter Steelhead	No	Yes	No	Yes
	Summer Steelhead	No	Yes	Increasing	Yes, Increasing

PLANNING AND POLICY MAKING

ODFW operates 33 fish hatcheries and several additional rearing ponds, acclimation sites, and trapping facilities. These facilities support hatchery programs that collectively release over 40 million fish annually in Oregon rivers and lakes. Although hatchery programs are operated with the goals of providing harvest or conservation benefits, all hatchery programs potentially impose risks on naturally produced populations. The type and level of risk can vary with the type of program and the status of the naturally produced population(s) it interacts with. Risks related to the operation of hatcheries fall into four broad categories: genetic, ecological, fish health, and environmental.

A review of regulatory approval processes and management requirements for hatchery programs in Oregon by Four Peaks Environment (Appendix G) found that ODFW has established a comprehensive approach to minimize risks from hatchery programs while still achieving programmatic goals. ODFW policy documents and management plans address hatchery program operation, management practices to minimize impacts of hatchery programs on native fish populations, management practices for fish health in the fish hatcheries, and hatchery operational practices to avoid environmental impacts (**Figure 11**). These documents include the Native Fish Conservation Policy (NFCP), the Fish Hatchery Management Policy, the Fish Health Management Policy, Hatchery Genetic and Management Plans (HGMPs), Conservation and Recovery Plans, and National Pollutant Discharge Elimination System (NPDES) permits. Hatcheries are managed under these policies, plans, and permits to ensure risk to naturally produced fish is within acceptable and clearly defined limits.

Many of the hatchery programs operated by ODFW may directly or indirectly interact with federally listed threatened or endangered fish species, necessitating consultation under the federal ESA. The consultation process to obtain authorization under the ESA for a hatchery program typically entails development of an HGMP, initiation of consultation with the listing federal agency, and working with federal agency through each step of the consultation process. HGMPs are comprehensive plans used in federal ESA consultation for hatcheries and are submitted to obtain authorization to operate hatchery programs under the ESA. ODFW has developed HGMPs which contain the specific program objectives and provide detailed information on the operational guidelines and management strategies for each program to achieve the objectives and maintain the genetic integrity of the naturally produced populations and hatchery programs. ESA authorizations typically contain reasonable and prudent measures and terms and conditions to minimize the risk of take of listed species.

Figure 11. Conceptual model of harvest hatchery program management strategies implemented by ODFW to limit impacts to naturally produced fish and achieve program goals; not all strategies or planning and policy documents apply to all programs.

ODFW SUMMARY

Fisheries in Oregon are supported by both naturally produced and hatchery fish. ODFW utilizes hatchery fish in areas where naturally produced fish populations are not able to sustainably meet the harvest demand, where access to habitat has been restricted because of dams, or as a tool to recover imperiled or extirpated naturally produced populations.

The assessment found that the State hatchery system provides significant economic benefit to Oregon but faces considerable challenges from rising costs, deferred maintenance, and a changing environment. Some State-owned facilities are expected to be resilient to climate change, while other facilities are already being impacted by high water temperatures, low summer flows, and other environmental hazards that are projected to worsen in a changing climate

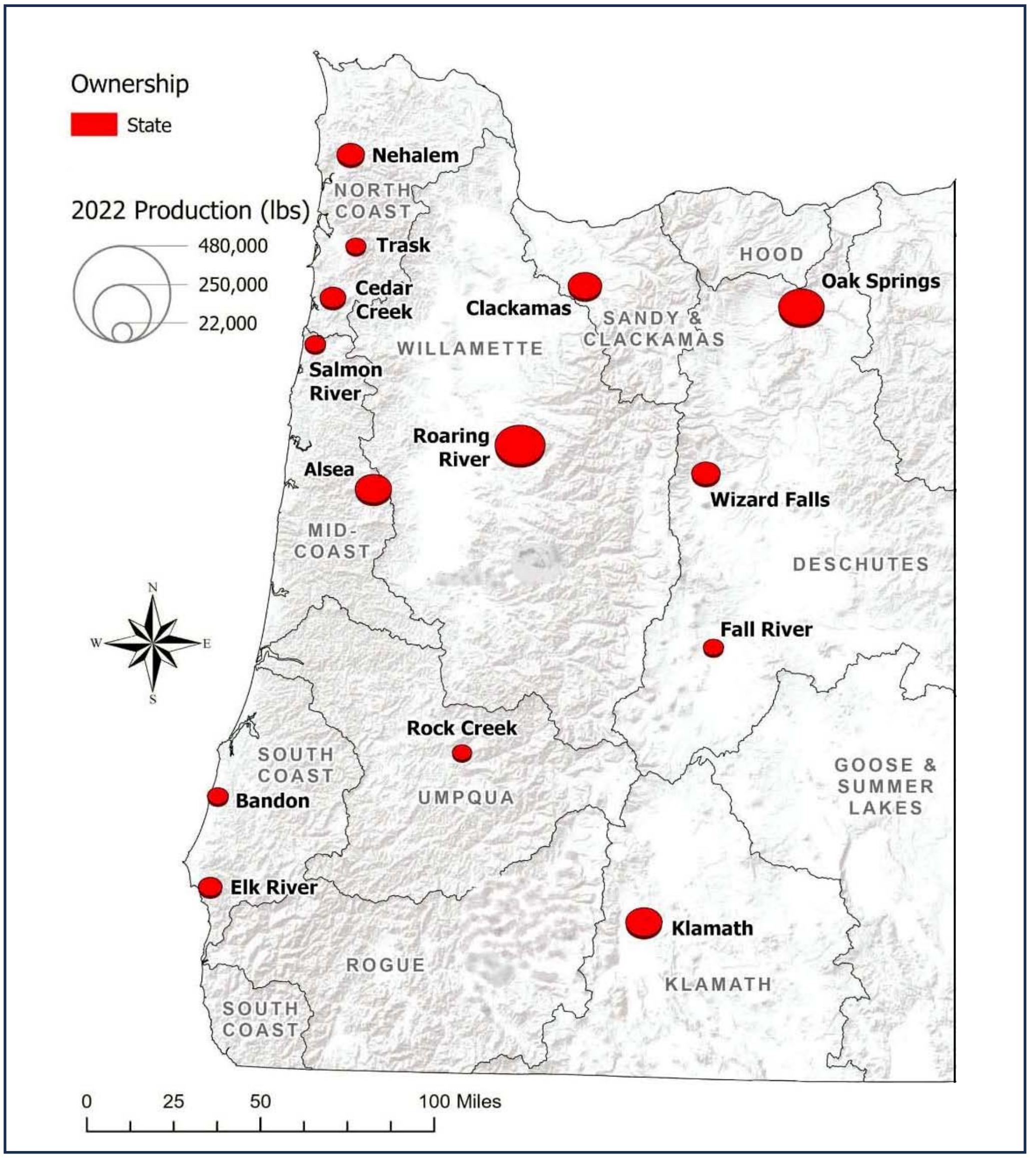
Given the ongoing need for hatcheries to mitigate impacts from dams, provide for fishing opportunities, support local businesses and economies, and recover depressed naturally produced populations it will be important to strategically address infrastructure needs in a way that continues and adds resiliency to the system.

The data from this assessment gives decision makers at all levels information to anticipate the impact of a changing climate our hatchery system. It will inform strategic decision making in the coming decade. As ODFW makes decisions and recommendations about the hatchery system, we will use the results of this assessment, in combination with feedback received from Tribes and the public and information regarding hatchery performance, wild fish, community values, environmental conditions, and costs.

APPENDIX A: STATE OWNED HATCHERY ECONOMIC ANALYSIS TECHNICAL REPORT

Prepared by The Research Group, LLC

State Owned Hatchery Economic Analysis
Technical Report



Oregon Department of Fish and Wildlife

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State Owned Hatchery Economic Analysis
Technical Report

for the

LOOKING AHEAD: Charting a Sustainable Future for Oregon's Hatchery System Project

Prepared for

Oregon Department of Fish and Wildlife

Prepared by

The Research Group, LLC
Corvallis, Oregon

November 6, 2024

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Preface and Acknowledgements

This study report was prepared for the Oregon Department of Fish and Wildlife (ODFW) by The Research Group, LLC (TRG), Corvallis, Oregon. The primary author at TRG was Shannon Davis who was greatly assisted by Kari Olsen. While this report had a primary author, there were other contributors providing guidance on the economic analysis underpinnings. Hans Radtke, Ph.D. Natural Resource Consultant provided valuable assistance for understanding the economics of hatchery operations and sustainable funding mechanisms. Chris Carter, Ph.D., retired ODFW staff economist was the principal investigator for the original Oregon coastal hatchery economic model that was subsequently updated and used twice more in the last 20 years to evaluate hatcheries net economic benefits. The present study mimics methods used by Dr. Carter. Gil Sylvia, Ph.D. retired executive director Coastal Marine Experiment Station reviewed report drafts and gave thoughtful and invaluable advice on report content.

The report was prepared to inform decision making about the future of Oregon's hatchery system. It is a companion report to other publications provided by third-party contractors also retained to review the hatchery system. The study design draws substantially on economic modeling methods, data, and results described in previous TRG hatchery economic analysis studies. Recounting and paraphrasing those study publications are used in this report sometimes without attribution.

The ODFW study leaders were Shaun Clements, Deputy Director for Fish and Wildlife Programs; Scott Patterson, Fish Propagation Program Manager; and, Chris Lorion, Native Fish Conservation Coordinator. Scott was instrumental in providing hatchery budget and capital improvement information. Chris with assistance from Micki Varney, Stock Assessment Biologist was helpful in gathering data for hatchery production and adult survival-to-fisheries rates. Brandy Nichols, Budget and Economics Program Manager and her team (Camilla Kennedy and Seth Urbanski) provided timely information about Department revenue streams. John Seabourne, Fish Division Operations Manager provided detailed hatchery budget data and interpretations. Site visits were made by TRG to about half of the State hatcheries. ODFW hatchery coordinators and individual hatchery managers were generous in their time and need to be complimented for their helpful spirit in providing information about production processes. Finance directors in surrounding states provided their state budget profiles and hatchery production numbers. Finally, because authorization was not sought to mention names, there were many other TRG colleagues and ODFW staff that need to be thanked anonymously for their advice.

Numerous coordination meetings were held with ODFW study leaders during the development of this report. The meetings had thoughtful and informative conversations regarding data availability and hatchery financing. Meeting results helped define study direction and depth. ODFW staff provided early draft report reviews. Relevant review comments from ODFW study leaders and other peers were carefully considered and addressed in preparation of this study's final report. The review feedback helped make the study findings as sound as possible and ensures the report meets standards for objectivity, evidence, and responsiveness to the study

charges. Although reviewers provided many useful comments and suggestions, they were not asked to endorse study results. The authors are solely responsible for content.

The report contains methodologies recommended with the understanding that technically sound and defensible approaches would be used. Where judgment became necessary, conservative interpretation was to be employed. Because this philosophy was strictly adhered to in all aspects of the report, the materials developed are deemed useful descriptions of economic implications and contain reasonable estimates of current hatchery system economic effects.

The report is prepared to assist in decision making. The author's interpretations and recommendations should prove valuable for that purpose, but no assurance can be given that decisions based on this plan will fulfill expectations of market demands nor achieve financial projections. Government legislation and policies, market circumstances and other situations can affect the basis of assumptions in unpredictable ways and lead to changes in study conclusions. Neither the study sponsor, nor author, nor any person acting on their behalf makes any warranty of representation, expressed or implied, with respect to the accuracy, completeness or usefulness of the information contained in this document, or that the use of any information, apparatus, method, or process disclosed in this document may not infringe on privately owned rights.

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Maps, Tables, and Figures

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List of Acronyms

BCA	benefit-cost analysis
C&S	ceremonial and subsistence
CDFW	California Department of Fish and Wildlife
CPUE	catch per unit effort
CEA	cost effectiveness analysis
DV	direct value
FY	fiscal year
GDPIPD	Gross Domestic Product Implicit Price Deflator
HPMP	Hatchery Program Management Plan
IDFG	Idaho Department of Fish and Game
MA	Mitchell Act
NEV	net economic value
ODFW	Oregon Department of Fish and Wildlife
OHRC	Oregon Hatchery Research Center
PS	personal services
REI	regional economic impacts
SAR	smolt to Oregon fisheries catch rate
STEP	salmon trout enhancement program
SS	supplies and services
TRG	The Research Group, LLC
USFWS	U.S. Fish and Wildlife Service
WDFW	Washington Department of Fish and Wildlife
WTP	willingness to pay

State Owned Hatchery Economic Analysis
LOOKING AHEAD: Charting a Sustainable Future for Oregon's Hatchery System Project

Executive Summary

Introduction

The 2023 Oregon Legislature instructed the Oregon Department of Fish and Wildlife to review the State owned hatchery system. This economic analysis study report will be synthesized and combined with other reports from third-party contractors retained to participate in the review. The synthesized report is due for Legislature presentation in the Spring 2025.

ODFW operates 33 fish hatcheries statewide. Of those, 14 are considered State owned hatcheries. The others are 18 federal owned hatcheries and one Portland General Electric owned hatchery. All hatcheries total releases in 2023 were 44.1 million of which 5.3 million are resident species such as trout and kokanee. State hatcheries releases in 2023 were 8.4 million anadromous and 3.8 million resident species. State hatchery objectives are for fisheries enhancement with a few instances of programs for mitigation and stock recovery. The other hatcheries that ODFW operates include multiple objectives for fishery augmentation, dam mitigation for the loss of fish habitat, and stock conservation (supplementation and restoration).

The economic analysis is to provide information for informed decision making concerning the future management of State owned hatcheries. The scope of the analysis was restricted to addressing the direct use economic net benefits from hatchery production and cost of operations. This restriction omits the effects that science continues to show concerning potential adverse impacts to wild fish stocks. There may as well also be positive conservation effects depending on hatchery production objectives such as restoring the productivity of natural populations, nutrient cycling, and reducing the demographic risk of expiration in severely depleted stocks. Regardless, it is recognized enhancement hatcheries have social and economic benefits from preserving fishable stocks, community economic development from hatchery spending, contributions to tribal interests, and the provision of education opportunities. Other ecological economic research is necessary to develop more in-depth economic and environmental review encompassing an ecosystem and biodiversity frame of reference.

Methods were used to allocate accounting cost centers to fish species production to better understand the State hatcheries benefits. Allocation methods were necessary because hatchery accounting does not always track internal operation costs at the species level. The modeling was done at the individual hatchery level to learn about operation cost effectiveness.

Modeled economic measurements are for a number of quantifications. Direct value (DV) was estimated for commercial harvest revenue and spending from recreational angling and hatchery visitor trips. Cost effectiveness analysis (CEA) calculations are cost per release, cost per production pound and cost per harvested adult. Economic benefit estimates for active uses of fish production are provided with measurements for regional economic impacts (REI) and net economic value (NEV). REI considers the economic contributions from fishing, visitor trips, and hatchery operation. REI is expressed as labor income including the multiplier effect, job equivalents, and State/local taxes generated. NEV is used in a limited benefit-cost analysis (BCA). Passive use and cultural values are discussed in a qualitative manner. A separate report section has descriptions about how hatchery production can affect environmental justice.

The economic analysis was performed under a tight schedule that precluded undertaking benefiter (fisheries participants and hatchery visitors) surveys. Therefore, literature derived economic ratio estimators were used to translate hatchery production to economic measurements. There are qualifying assumptions that accompany such a benefit transfer approach.

The fisheries economic benefit measures were only for Oregon fisheries since future management decisions will be driven by those effects. This omits the economic effects accruing to economies in Alaska, British Columbia and Washington from large fisheries harvests of anadromous species with Oregon hatchery origin. For example, north Oregon Coast fall Chinook stocks total catch is 55 percent in non-Oregon fisheries. If a future study was inclusive of benefits to external economies, it would be of interest to show impacts to Oregon's economy from non-Oregon origin stocks.

Economic value calculations are reduced to per fish units and then associated with harvested adults. The harvested adults are "attributed" meaning they are a share of the total harvests credited to the rearing (partial or entire) hatchery. The share factor is the participating hatchery rearing time divided by the total rearing time at release. It is typical that fish at various growth stages are transferred to other hatcheries and to remote acclimation facilities. The share factor purpose is to not inflate benefits accruing to State hatcheries when partial rearing is occurring. Another perspective is that the fish would not have been produced without at least partial involvement of a hatchery. Therefore, using attributed harvests results in conservative estimates of economic value.

The analysis did not investigate alternative production scenarios other than status quo operations. This is despite acknowledgment that tradeoff analysis for attaining hatchery fisheries enhancement objectives in other manners (such as through habitat improvements, different fishery management regimes, etc.) is of interest. There would have to be an extension to this study's modeling to assess the economic value changes to wild stocks and other influences on hatchery fish release survival (such as climate driven environmental conditions).

The focused approach to the analysis left out some hatchery economic effects that deserved attention. These include fish provided to food banks, hatchery operation volunteers, salmon trout enhancement program (STEP), harvests from hatchery participation in conservation programs (for example stock supplementation, species restoration and stream enrichment using surplus carcasses), and increased fishing opportunities from recycling spring Chinook and steelhead. Although there is significant offsetting economic value in these examples and other related activities, the study workscope did not include examining their economic benefits and costs.

A review of hatchery budget revenue sources and cost trends raised questions about State hatchery operation financial stability. This led to discussions about Oregon funding and how financial support can be more closely linked to hatchery benefiters. A cursory review of example financing techniques was provided.

There are model design and study report organization details that need noting. State hatchery financial portrayal is a one-year model for 2023 revenues and costs. The one-year model is a stylized but reasonable representation of current hatchery production and economic activity. There is added information about real production cost and revenue indicator trends. When individual hatcheries are identified in the report narrative and displays, the list number will be less. The Wizard and Falls Creek hatcheries are separate facilities but are managed as one hence the hatchery list number being 13. The Rock Creek Hatchery was extensively damaged by a wildfire in 2020 and has not operated since then. It is included as a studied hatchery using projected budgets and production levels based on previous hatchery operations and objectives.

<u>Hatchery Costs</u>

The State hatcheries annualized budget (excluding annual capital contributions) during the biennium was $12.5 million. When capital contributions are included, the annual budgets sum to $16.4 million. About 22 percent of the supporting revenues are from the State general fund, 51 percent from license fees, 25 percent from federal programs such as the Sport Fishing Restoration Fund and two percent are from other external sources.

State hatchery cost categories are for variable (about 57 percent of total costs) and fixed costs (43 percent). The variable costs for operations (50 percent) include personal services, feed, utilities, travel, and other. The variable costs for support services (seven percent) includes fish health, CWT/marking, and fish liberation. The fixed costs include headquarter administration (two percent), field management (one percent), heavy maintenance (six percent) and bond expenses (three percent). The bond expenses are from each hatchery's contribution to a $10 million deferred maintenance/catastrophe bond fund. The $10 million bond fund was a one-time allotment. Funds were used for hatchery improvements over a five-year period. Wildfire payments (seven percent) are insurance premium payments required at Klamath ($260,000) and Rock Creek ($900,000) hatcheries. The insurance premiums are due to insurance company settlement for paying wildfire damages at the two hatcheries. Capital costs (24 percent) are expressed as existing facilities annual depreciation and for annualized replacement costs. Existing facilities are generally considered fully depreciated. Annual replacement costs are based on a straight-line method, 70-year useful life, and 25 percent salvage value.

Cost trends over the last three biennia shows nominal increases in spending, but it appears the spending has not kept up with increasing production costs. At static or decreased budget revenues combined with constant production schedules, a financing collision occurs. It will be necessary to increase revenues, adjust production levels, accomplish efficiencies, or a combination. Other State hatchery review contractors are addressing efficiencies. Shifting revenue sources and amounts are discussed in this report as part of the sustainable funding topic.

Cost Effectiveness Analysis

Hatchery production CEA indicators by species are shown on Table ES.1. Rearing costs are highly dependent on time spent at hatcheries. Steelhead cost per release can be three times salmon releases due to the rearing time differential. Cost per facility pound reflects the size of fish at the time of transfer out of State hatchery rearing and/or size at release. Cost per harvested adult is a translation of releases times a smolt to Oregon fisheries catch rate. Hatchery production fisheries effective SAR by species are shown in Table ES.2. (The effective rate will be less than actual SAR because its calculation is based on attributed catch.) The SARs brood years and later catch years use multiple periods depending on data availability. There is high variability for SARs across the selected brood and catch years.

The cost per harvested adult has a net benefit perspective. The net benefit statistic can be a comparative efficiency indicator for other means to increase fishing opportunities (spawning habitat improvements, predation removal programs, resolving migration route impediments, etc.). Using statistics for comparative purposes will often have time horizon complexities where the other means will take several fish generations to reach capacity production levels. The net benefit statistic used for that type of evaluation was not addressed in this economic analysis study.

Regional Economic Impacts

The study's REI model translates benefiter and hatchery operation spending into measurements of economic effects within study adopted economies. Using existing secondary industry input-output relationship models, the initial spending is tracked for respending until the money leaks out from the study economies. The measurements for the economic effects from the initial spending and respending are provided in several metrics including labor income, equivalent jobs and state/local taxes generated.

The model inputs for initial spending are characterized by benefiter direct values and the previously described hatchery costs. The State hatchery summed direct values for fisheries are $0.4 million commercial harvest value, $62.3 million recreation spending, and $6.5 million visitor spending. These direct values represent commercial fisheries 166 thousand pounds anadromous species catch, 659 thousand recreational fishing angler days, and 169 thousand visitor days.

Selective spending categories for hatchery costs are used in the REI calculations. For example, the local economy REI does not include headquarter costs. The local and statewide REI does not include capital contribution estimates. Annual capital contributions would be properly included when construction spending actually occurs.

The REI model results are shown on Table ES.3 and Figure ES.1. Total REI for State hatchery economic effects are $55.5 million labor income which is equivalent to 1,100 jobs in the state level economy. State/local taxes associated with this economic activity are $6.0 million. Federal taxes would be in addition to this amount. Trout fisheries contribute about 46 percent of the REI, followed by anadromous species fisheries (25 percent), hatchery operations (20 percent) and hatchery visitors (nine percent). State hatcheries anadromous commercial fisheries REI is a small contributor to Oregon total ocean and freshwater fisheries. Oregon commercial salmon troll and net fisheries REI in 2021 is $11.6 million labor income (2023 dollars). Study results show modeled REI from Oregon hatcheries contributions from commercial fisheries in 2023 are $0.7 million income or a six percent share. The two years are incongruous, but the comparison give a picture of the relative share that State hatchery production contributes to the State's commercial salmon fishing industry.

Net Benefits

The REI measures the value of hatchery production through the financial activity that is associated with active benefiters and hatchery operations spending. A second way to measure hatchery production economic value is to account for extra value people and business are willing to pay (WTP) for the fish. The extra value is what people expect that a product or activity they spend money on will be worth at least as much, and probably more to them, than what they spend to procure it. NEV is the difference between WTP and what would be actually spent. WTP for recreational fisheries has to come from survey information. The WTP from commercial fisheries can be the profit from the connected businesses in harvesting, primary processing, guiding, and other businesses. Those estimates can be made without surveying if enough is known about those businesses finances. For this economic analysis study, NEV on a per unit basis (days for recreational anglers and harvest pounds for commercial businesses) was taken from literature.

The calculation of net benefits from hatchery production is the result from a limited BCA. The calculation for this study is simply NEV minus hatchery costs. It is expressed in absolute values and as ratio of NEV to hatchery costs. A positive absolute value and a ratio greater than one will mean the NEV is more than the costs. Using a BCA approach has many advantages for dealing with the time dimension for providing hatchery services and even accounting for other ecosystem values and opportunity costs. However, assigned study scope precluded the additional complexity.

Hatchery net benefits from fisheries and visitors are shown on Table ES.4. The benefit-cost ratio is positive for all species except summer steelhead at 0.83. Trout fisheries have the highest ratio at 6.33. Table ES.5 shows the ratio for individual hatcheries. All hatcheries are positive and range from the lowest Elk River (1.21) closely followed by Salmon River at 1.22 to highest Roaring River (10.61). In general, the hatcheries with the higher proportion of trout production had higher benefit-cost ratios. There is also a strong relationship between net benefits and cost per pound at these facilities, with larger facilities having lower costs per pound and smaller facilities having higher cost per pound.

Study results show the net benefit sensitivity to SARs. For the example summer steelhead, it would be necessary for the SAR to increase about 20.0 percent to make net benefits zero.

Passive Use and Cultural Value

Passive uses pertains to the existence of the fish resource including provisions for the option to use the resource (option value), maintaining the resource for future generations (bequest value), and believing fish should be abundant so that others can benefit (altruistic value). Measuring these values is complex and their abstract nature makes them difficult to understand, thus it is more troublesome to incorporate them into policy making decisions.

Economists have defined and occasionally measured existence values associated with the simple presence of a fish population. The value is reckoned as the amount that people would be willing to pay (WTP) to assure the existence of a fish stock, or to pay for a specified increase in the fish stock. One study in 1999 found that the typical Washington household WTP $203 (2023 dollars) for a 50 percent increase in migratory fish populations. This represents the value held by households that do not fish and households that do fish. With a total of two million households holding such values at the time of the survey, the overall value per fish is a remarkable $458 (2023 dollars). This estimate pertains to a rather broad class of fish including all hatchery and wild origin stocks in the Columbia Basin.

The passive use values, no matter how tenuous the value determinations, are important for bringing into perspective the total value of fish resources. The passive use value measurement usually always dwarfs active use values. It is incumbent on the presenter of the measurement to explain the measurement's applicability, including it not being additive with other measures. Policy discussions about continuing or just refining hatchery practices whose purpose is to support fisheries need to consider society's comparative importance on the continued existence of those fish resources.

Many tribes live and fish in Oregon. Anadromous fish species and resident fish are interconnected with tribal culture and have been since time immemorial. Some of the federally recognized tribes in the analysis area are party to treaties with the US that reserve tribes fishing rights. The US has Indian trust responsibility for all tribes whether or not there are treaties. Trust responsibilities are fiduciary obligations to protect tribal lands, assets, and resources. Several tribes have recently signed memorandums of agreement to advance the government-to-government relationships between those tribes and the State of Oregon and enhance tribal sovereignty. In regards to tribal impacts, the provision of hatchery fish can be a welcome substitute for degraded wild stocks but continued adverse impacts to wild stock recovery is a tribal concern.

Distribution of fish from hatchery programs with tribal involvement is directly affected by levels of hatchery production. Changes to hatchery production as well as changes in environmental conditions could possibly reduce the number of hatchery-origin salmon and steelhead available for tribal benefits.

All tribes in the analysis area could be impacted by changes in hatchery production. However, assessing these impacts from an environmental justice perspective would require input and information from those tribes and investigating is beyond the scope of this analysis.

This study is an economic analysis about status quo conditions, but if there was change in hatchery practices then environmental justice impacts would be a consideration. As such, an analysis area was chosen and relevant socio-economic characteristics were compiled. The chosen analysis area was the counties where State hatcheries are located. Discussions are provided about how hatchery practices might have harm and benefits in the identified communities. The impact categories discussed are how hatcheries contribute to employment, food subsistence and fish as a traditional cultural resource.

Discussions are provided using related socioeconomic measures. Example measures are whether any of the hatcheries are located in counties determined to be minority (Native American or Hispanic) or low-income (families below poverty level) using data for percent minority, poverty rate, or income compared to the State reference area. All of the hatchery located counties meet the test except Clackamas (Clackamas Hatchery) and Deschutes (Fall River Hatchery). Jefferson County where Wizard Falls Hatchery is located has the highest percentage of Native American and Hispanic population, highest rural population and highest incidence of family poverty rate.

It can be assumed some fishing industry participant households are in the lower income levels. Any lessened commercial catch due to lessened hatchery production has the potential to affect those households. The counties where hatcheries are located are rural with per capita income generally lower than statewide. While the jobs at the hatchery are skilled occupations with competitive wage levels, the multiplier effect of these jobs will mean occupations with lower wage levels can be affected. Recreational fishing trips motivated by hatchery fish abundance (expectation of satisfying catch rates) occur in the hatchery located counties. Recreational fishing economic impacts affect jobs in the visitor industry. Those jobs are tiered with lower wage and salary level categories. Lessened hatchery protection will lower angler spending due to less trips. The lowered spending will potentially affect income being received by households of concern.

Hatchery programs distribute some collected fish to food banks or food share organizations. And if requested, will supply fish to tribes for ceremonial and subsistence purposes. The counties of concern benefit from these program distributions and lessened hatchery production will potentially lower the donations.

In addition to employment and benefiter distributional impacts, there are other hatchery physical issues to consider (water quantity and quality, power use, etc.). Hatchery size and remote location make those attributes of less environmental justice concern if operations stay within hatchery water diversion and discharge state and local permit standards.

<u>Sustainable Funding</u>

The primary purpose of the economic analysis was to show the economic value from enhanced fishing opportunities afforded by State owned hatchery production. A review of hatchery budget revenue sources and cost trends finds a pending financing crunch from decreasing revenues from license and fees and increasing production costs all the while trying to keep constant production levels. A cursory review of example financing techniques is provided. There is a deeper dive into raising revenues through increasing fisheries direct user fees. The financing discussions are brief and are presented without prescriptive actions. It is recommended an all-hatchery financing planning study be undertaken to distinguish alternatives with accompanying social and economic impact analysis to assist decision making about future hatchery management.

Moving towards sustainable hatchery funding will mean not only fiscal adaptation to better balance benefiter funding, but also can mean emphasis that hatchery operation services are being delivered with highest efficiency given trending environmental conditions. Climate change causing new environmental conditions will require planning for changes at facilities and operations. The ODFW will also need to lead in associated government services that affect hatchery objectives like fishery management, habitat protection and helping the State of Oregon attain climate change goals.

Other State hatchery review contractors are addressing facility and operations actions needed for climate change challenges and taking care of deferred maintenance items. This report discusses fiscal adaptation possibilities for hatchery sustainable funding. Discussions include reviewing surrounding states hatchery financing to discern if there is a better financing template. Flows from general fund support is the central issue because of the tradeoff use of those funds for other State government services. Better aligning benefiter support requires looking at mechanisms to better extract equitable payments to financially support hatcheries.

The general fund revenue support for all ODFW managed hatcheries is eight percent and 22 percent for the State owned hatcheries. License and fees revenue support are 13 percent and 52 percent, respectively. The balance of revenue support is federal and other external programs. While use of general funds is justified because fish being produced are a public resource, the direct active use benefiters are mostly an isolated society segment. There is the view that benefiters should have a higher stake in the funding from which their proportion of benefits is being derived. If the payment vehicle is an increase in license and fees used for State hatchery funding to eliminate the general fund revenue, the total increase for the model year is $2.7 million assuming all other funding source amounts are constant.

State owned hatcheries primary purpose currently is to enhance Oregon fishing opportunities. To that end, funding should reflect support from those that benefit. Benefiters would include in no particular order: (1) commercial and recreational fishing participants, (2) tribes using fish for C&S, (3) local entities and organizations appreciating the education opportunities and economic development aspects from local hatchery operations, and (4) the public concerned about fish species conservation. Assigning benefiter funding responsibilities would be consistent with the well-established utility principle of cost recovery. This thinking suggests an apportionment of hatchery costs would correspond with benefits received. This would spread support liabilities among direct users (e.g. through licenses and fees) and the public (e.g. through general fund revenue sources). The links to public benefits from enhancement hatchery production is through user caused downstream economic effects (i.e. multiplier effects) and conservation values balanced against adverse impacts to wild stocks. Finding and proposing alternative public share burdens was not tasked for this study and is left for future research.

Tabulation shows how fisheries direct user benefiter liability would be proportioned based on benefits received or associated fisheries production costs. The proportion of benefits received is the before mentioned NEV estimate and the associated production cost is the cost per harvested adult times catch.

	Associated Funding Liability	
Fisheries	Proportion of Benefits Received	Production Costs
Commercial		
Anadromous	0.1%	0.1%
Recreation		
Anadromous	33.1%	59.7%
Trout	66.8%	40.1%

The proportion shows the high recreation fisheries participants liability singular responsibilities. An issue is the overlapping participation in the two fisheries.

Trout fishing is pervasive across the state. The most obvious mechanism would be a surcharge on an angling license although other possibilities exist such as a new harvest tag. The additional cost design would have to consider price elasticity. Angling per capita participation has been on a downward trend in recent years and increased access costs could exacerbate the lessened demand.

Anadromous fisheries are more specialized in gear and fishing modes and more expensive to pursue in trip costs. There are revenue generation mechanisms that could target the fishery such as harvest tag possession requirements to avoid penalizing non-anadromous participants.

Report discussion for sustainable funding does not address an equitable assignment of total hatchery costs among all benefiters. The discussion only addresses how fisheries benefiter revenue generation mechanisms might compensate for decreased general fund revenue dependency. Different mechanisms to secure the increased funds from commercial and recreational participants would need to be investigated and vetted by stakeholder groups. Ultimately the mechanism would need Oregon Fish and Wildlife Commission approval and legislative action.

Previously discussed findings show high WTP values per fish and in aggregate. The political will to shift funding burden could rely on those findings, but there will still be stakeholder resistance to raising fees. Benefiters are habituated to comparatively low-cost access to fish resources. There will be arguments promulgated that anglers pay in other ways that make their existing share equitable (for example State income taxes, gas taxes, excise taxes on fishing gear and boats, etc.). In the end, there is a significant imbalance between the hatchery production cost per harvested fish and any direct and indirect layered access fee accounting. Taking steps to resolve the imbalance through benefiter fee increases will further progress for enhancement hatchery sustainable funding.

It was suggested a hatchery financing planning study be undertaken that offers a range of feasible alternatives that are accompanied with social and economic impact analysis. A financing options evaluation matrix was provided with only brief discussion about methods and results. Offering the matrix highlights considerations for implementing the options, but is not a substitute for necessary detailed analysis and impact explanations. More decision making information about option packaging is necessary.

Table ES.1
Hatchery Production Cost Indicators by Species

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Cost per release	1.31	1.59	1.17	0.82	0.86	0.70	2.35	3.25
Cost per facility pound	13.64	9.04	20.71	24.44	18.67	21.81	20.95	18.08
Cost per harvested adult	14.50	6.21	137	161	241	73	132	438

Notes: 1. Cost per harvested adult are for attributed catch in Oregon fisheries.

Table ES.2
Hatchery Fisheries Effective Smolt to Oregon Fisheries Catch Rates by Species

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Harvested adults (thous. fish)	1,127.4	1,056.2	71.2	9.6	7.0	26.3	25.3	3.0
Target releases (thous. fish)	12,514.5	4,132.0	8,382.6	1,883.1	1,958.7	2,723.8	1,417.4	399.5
Effective SAR		25.56%	0.85%	0.51%	0.36%	0.97%	1.78%	0.74%

Notes: 1. Harvested adults are attributed catch in Oregon fisheries. The effective SAR calculation for this table is based on the lesser attributed catch, which will be less than actual SAR data that is based on all-hatchery fisheries harvests.
2. SARs mean brood years and later catch years use multiple periods depending on data availability. There is high variability for SARs across the brood and catch years.

Table ES.3
Regional Economic Impact from Fisheries, Hatchery Visitors, and Hatchery Operations

	REI		State/Local
	Labor Income ($000's)	FTE Jobs	Taxes ($000's)
Fisheries	39,303	779	4,277
Hatchery visitors	4,909	97	534
Hatchery operations	11,273	223	1,227
Total	55,484	1,100	6,037

Notes: 1. REI measurement for labor income at the statewide economy level in thousands of 2023 dollars. REI includes the multiplier effect.
2. Jobs are full and part-time equivalent (FTE). The calculation of FTE is assumed to be average annual earnings for Oregon.
3. REI from fisheries are for attributed harvests. Attributed harvests are the portion of catch based on the share of rearing time spent at that hatchery and total rearing time at release. Fisheries are Oregon only.

Table ES.4
Hatchery Net Benefits from Fisheries by Species and Visitors

Species	Cost Base	NEV Attributed Benefits	Net Benefits Cost Base	Benefit-cost Ratio
Trout	6,559	41,531	34,973	6.33
Fall Chinook	1,549	3,205	1,656	2.07
Spring/sum Chinook	1,688	4,768	3,080	2.82
Coho	1,918	2,062	144	1.08
Winter steelhead	3,336	9,480	6,144	2.84
Summer steelhead	1,300	1,083	(217)	0.83
Visitors		4,214	4,214	
Total	16,350	66,344	49,994	4.06

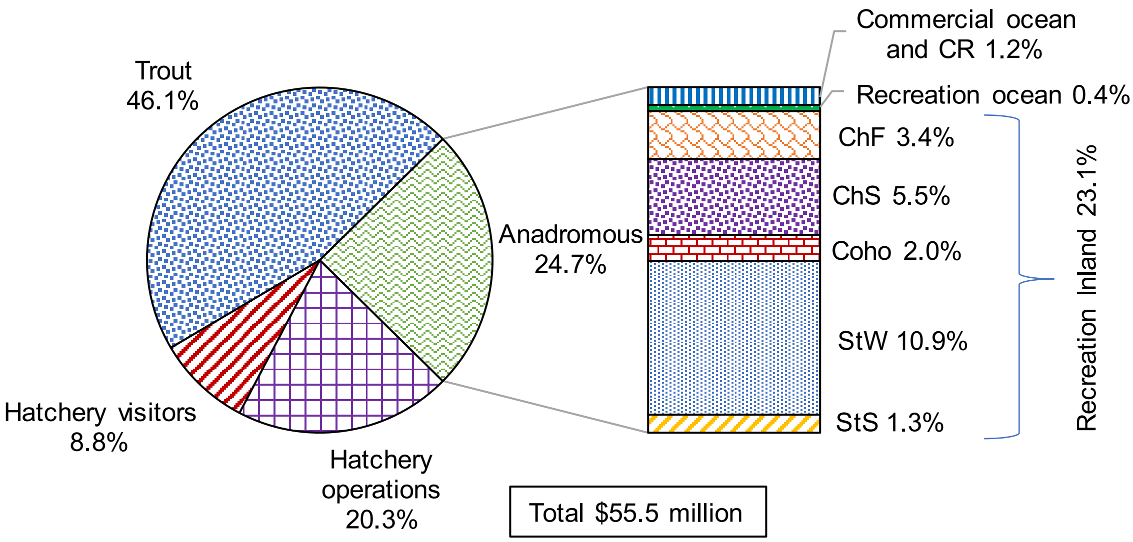
Notes: 1. Cost, NEV, and net benefits are in thousands.
2. Total net benefits are summed fisheries NEV and visitors NEV minus species allocated hatchery costs. Benefits do not include passive use values.
3. Hatchery cost base includes variable and fixed costs. Fixed costs include annualized capital contributions.

Table ES.5
Individual Hatchery Production, Economic Value, and Net Benefits

Hatchery	Pounds	Releases	Total Cost	Total REI	Total NEV	Net Benefits	Benefit-cost Ratio
Alsea	121,027	437,789	1,297	4,384	5,594	4,297	4.31
Bandon	32,058	979,559	840	1,851	1,705	866	2.03
Cedar Creek	67,678	824,444	1,094	3,812	4,703	3,609	4.30
Clackamas	82,280	3,272,801	1,776	3,884	2,871	1,095	1.62
Elk River	48,079	891,964	1,023	1,659	1,241	218	1.21
Klamath	108,757	396,734	1,154	3,742	4,689	3,535	4.06
Nehalem	70,931	371,012	971	2,416	2,568	1,597	2.64
Oak Springs	198,103	1,112,919	1,465	7,985	10,969	9,504	7.49
Roaring River	220,065	906,823	1,301	9,842	13,808	12,507	10.61
Salmon River	39,550	482,331	1,055	1,713	1,289	234	1.22
Trask	26,968	640,614	874	3,066	3,565	2,691	4.08
Wizard/Falls River	97,034	1,570,956	1,393	8,332	9,986	8,593	7.17
Rock Creek	85,717	626,589	2,107	2,800	3,355	1,248	1.59
Total	1,198,247	12,514,538	16,350	55,484	66,344	49,994	4.06

Notes: 1. Cost, REI, NEV, and net benefits are in thousands of 2023 dollars.
2. Total REI includes fisheries, hatchery visitor, and hatchery operations. The REI measurement is labor income at the statewide economy level.
3. NEV includes values for active uses (fisheries and visitors). It does not include passive use values.
4. Rock Creek Hatchery visitor count is based on activity prior to wildfire damage closure.

Figure ES.1
Regional Economic Impact from Ocean and Freshwater
Fisheries, Hatchery Visitors, and Hatchery Operations



Notes: 1. REI measurement for labor income at the statewide economy level in millions of 2023 dollars.
2. Acronyms are ChF - fall Chinook, ChS - spring Chinook, StW - winter steelhead, and StS - summer steelhead.

I. Introduction

The Oregon Legislature directed the Oregon Department of Fish and Wildlife (ODFW) to provide a third-party assessment of the operations, sustainability, and climate vulnerability of State owned hatcheries.[1] The ODFW operates 33 fish hatcheries statewide. Of those, 14 are considered State owned hatcheries.[2] (See Map I.1 for their location and relative production size.) The others are 18 federal owned hatcheries and one Portland General Electric owned hatchery. This report provides investigative results for one of the legislative directions topics to complete a State hatcheries economic analysis.[3]

State hatchery objectives are for fisheries enhancement with a few instances of programs for mitigation and species restoration. The other hatcheries that ODFW operates include multiple objectives for fishery augmentation, dam mitigation for the loss of fish habitat and conservation (supplementation and species restoration).[4]

All-hatcheries total releases in 2023 were 44.1 million of which 5.3 million are resident fish such as rainbow trout and kokanee (ODFW May 2024). State hatcheries releases in 2023 were 8.4 million anadromous and 3.8 million resident species.[5] A broadbrush estimate of regional economic impact shows Oregon all hatchery fisheries contribute $350 million labor income (2023 dollars) to the State economy.[6] There are many caveats to this broadbrush estimate, but clearly shows that ODFW managed hatchery production is an important contributor to the State economy.

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[1] The directions are contained in Senate Bill 5506 passed in the Oregon 2023 Legislative Session as a budget note within ODFW 2023-2025 biennium budget.

[2] Wizard Falls Hatchery and Fall River Hatchery were combined in the economic analysis and are referred to as Wizard/Falls River in tables and figures.

[3] The Rock Creek Hatchery was extensively damaged by a wildfire in 2020 and has not operated since then. It is included as a studied hatchery using projected budgets based on previous hatchery operations and objectives.

[4] Even with State hatcheries primary objective being fisheries enhancement, there are biological benefits from artificial production for reducing the demographic risk of extirpation in severely depleted stocks. A concern in addition to hatchery origin fish density effects (food competition, disease, etc.) is genomic alteration of hatchery fish for introgression (loss of fitness) and integrity (spawning reproduction). Anderson et al. (January 2020) recounts mixed results in literature about multi-generational hatchery effects. Dayan et al. (2024) presents experimental evidence fitness characteristics are not lost in one example hatchery origin fish.

[5] The releases are actual releases as reported in ODFW (May 2024) which can differ from planned target production. This study 2023 model uses target releases for each State hatchery.

[6] Oregon sportfishing freshwater trips for trout and anadromous species compared to trips for any species was about 90 percent in 2008 (Runyan 2009). Saltwater trips for anadromous species were about one-third. An estimate of sportfishing regional economic impacts in Oregon is $415 million labor income ($498 million 2023 dollars) for freshwater and $99 million labor income ($119 2023 dollars) for saltwater in 2018 (ASA 2020). Summing over trout and anadromous species, regional economic impacts would be $487 million labor income (2023 dollars). The TRG (June 2024) estimates commercial (net and troll) salmon economic impacts in Oregon fisheries to be $12 million in 2021 ($13 million 2023 dollars). Four Peaks (August 2024) estimated anadromous species catch was 70 percent hatchery origin. If it is assumed the share is uniform across all anadromous and resident fish fisheries (which it is probably not) and fish numbers are a predictor of the spending that generates the economic impacts (which they are probably not), then using the disparate study result would imply Oregon hatchery origin fish generate $350 million income (includes multiplier effect).

Elk River Hatchery raceway.

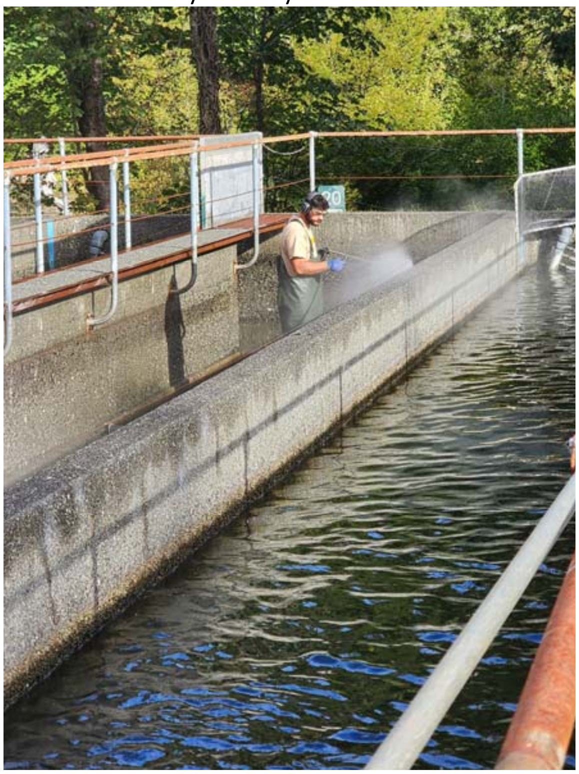

Photo credit Oregon Department of Fish and Wildlife.

The purpose for the economic analysis is to provide information for informed decision making concerning the future management of the State hatchery system. The scope of the analysis was restricted to addressing the positive economic benefits from hatchery production and operations. This restriction omits the minuses that science continues to show concerning adverse impacts on wild fish stocks. Regardless, it is recognized enhancement hatcheries have social and economic benefits from preserving fishable stocks, community economic development from hatchery spending, contributions to tribal interests, and the provision of education opportunities. Other ecological economic research is necessary to develop more in-depth economic and environmental review encompassing an ecosystem and biodiversity frame of reference.

Methods were used to allocate accounting cost centers to fish species production to better understand the State hatcheries benefits. The modeling was done at the individual hatchery level to learn about operation cost effectiveness. Allocation methods were necessary because hatchery accounting does not always track internal operation costs at the species and efficiency indicator level.

Modeled economic measurements are offered for a number of quantifications. Direct value (DV) was estimated for commercial harvest value, recreational angling trip expenditures, and visitor trip spending. Cost effectiveness analysis (CEA) calculations were cost per release, cost per production pound, and cost per Oregon fisheries harvested adult. Economic benefit estimates for active uses of fish production are provided with measurements for regional economic impacts (REI) and net economic value (NEV). REI considers the economic contributions from fishing, visitor trips, and hatchery operation expenditures. REI is expressed as labor income including the multiplier effect and job equivalents. State/local taxes generated are estimated. NEV is used in a limited benefit-cost analysis (BCA). The economic benefit measures were only for Oregon fisheries since future management decisions will be driven by those effects.[1]

[1] Anadromous fish ocean migration patterns expose State hatcheries production to non-Oregon based fisheries. Columbia River and northern Oregon Coast anadromous stocks have high capture rates in coastal waters in southeast Alaska, British Columbia and Washington. For example, Oregon Coast northern fall Chinook stocks capture (adjusted to account for several rivers differential harvest rates) in southeast Alaska and British Columbia fisheries is about 55 percent of total catch for 2019 through 2021 (PSC 2023).

State hatchery financial portrayal is a one-year model for 2023 revenues and costs. There is added information about real cost indicator trends, and when combined with information about what is necessary for attaining efficiencies and anticipating climate changes, will assist the State hatchery review project. The one-year model uses annual hatchery costs taken from fiscal year (FY) 2023-2025 budgets somewhat modified by actual expenditures that have occurred during the FY. The modeled benefits are calculated seemingly from one brood cycle associated with hatchery planned production. In reality, there is wide variation in hatchery costs and production, anadromous fish smolt and trout survival and hatchery visitor attendance. There are changes to fisheries management, environmental conditions, hatchery site circumstances, and the general economy. In that sense, the one-year portrayal is a stylization to represent the reasonable representation of hatchery production and economic use activity in any given recent year.[1]

The measure for harvested adults is attributed harvests. The measure is the portion of catch based on the share of rearing time spent at that hatchery and total rearing time at release. This accounting is to properly credit the hatcheries with the share of fish production they provide. A different perspective on this assumption would be the fish would not be produced at all if a State hatchery did not provide partial rearing. For that reasoning, harvest estimates would be considered conservative in this report.

A sensitivity assessment was performed for the key variable release-to-harvested adult rate based on accrued net benefits. A more thorough uncertainty analysis approach would have been able to offer probability statistics looking at all model inputs.

The descriptions of all Oregon commercial and recreational salmon and steelhead fisheries refer to data Year 2021. Although Year 2023 catch and harvest value data is available, it was decided the fishing conditions were not representative of recent years (TRG June 2024). The ocean troll salmon fishery off the central and southern Oregon Coast was closed in 2023 except for a late September and October season. Landings from north of Cape Falcon catch areas were allowed but constrained.

The focused approach to the analysis left out some hatchery economic effects that deserved attention.

- Surplus fish are provided to food banks and to tribes for ceremonial and subsistence purposes.

- Hatcheries rely on volunteer help and donations for carrying out propagation work.

[1] Shown tables and figure titles without dates are annual for the model year 2023. Table and figure titles that simply show the word "hatchery" are referencing only State hatcheries. Tables and figures that itemize trout production would include minor production of other resident species such as kokanee.

- A very active salmon trout enhancement program (STEP) manned by volunteers using donated land and facilities.

- There are the conservation related benefits (for example species restoration and stream enrichment using surplus carcasses) from State hatchery operations. While the hatchery costs are included in the economic analysis, any increased wild adult returns contributing to harvests were not included in the model.

- There are few cases where steelhead and spring Chinook have been recycled to enhance fisheries at locations near the returning hatcheries. Although recycling is not treated explicitly in the models presented, it shows promise as a way to increase recreational benefits from hatchery production. The risk of increasing interactions between hatchery and wild fish should also be considered when evaluating recycling as a management tool.

Although there is significant offsetting economic value in these examples and other related activities, the study workscope did not include examining their economic benefits and costs.

Anadromous and resident fish have non-market economic value (sometimes called passive use value) and cultural/spiritual value. Surveys have shown people hold these values knowing that native fish exist and will exist in the future. State hatcheries are related to that value because some hatchery programs include species restoration and hatchery fish can provide substitute fisheries to allow native fish escapement to natural habitat.

Tribes have a special relationship linked to fish resources. The cultures, inter-tribal economic interactions, and religions of tribes are all impacted and influenced by fish. State hatcheries provide tribal harvesting opportunities and ensure species survival. Changes in hatchery production have the potential to affect the extent of harvests available for tribes and minority and low-income populations. Environmental justice objectives are to minimize disproportionate impacts to communities traditionally underrepresented in public processes. Qualitative discussions of passive use values, tribal values, and environmental justice are offered.

Discussions are also provided for current funding for the State hatcheries. Review of hatchery funding models in neighboring states is provided as background information. Discussions are offered for different approaches to fund operations and capital improvements. The approaches more closely link hatchery benefiters to funding sources.

The economic analysis was performed under a tight schedule that precluded undertaking benefiter (fisheries participants and hatchery visitors) surveys. Therefore, literature derived economic ratio estimators were used to translate hatchery production to economic measurements. Literature does not always separate catch rates and economic value per fish in hatchery and non-selective fisheries. It is assumed the provided rates apply equally to both fish origins. The challenges for applying borrowed estimators in a different time and space is discussed by Ready and Navrud (2005) and Newbold et al. (March 2018).

Provenance for the economic analysis model borrowed estimators and data inputs are shown in Table I.1. Appendix A contains the model inputs per unit values.

Economic analysis results and interpretations put into context a "with" and "without" scenario for hatchery production effects. However, a more realistic public policy scenario would not be as simple as what might occur if hatcheries production was abandoned. Hatchery production is politically viewed as a viable replacement for lost natural production; scenarios for modifying production levels and practices would be more likely. The study results could be used to characterize the modifications based on incremental findings, such as a particular stock's average regional economic impacts per release, when the weakness of that characterization is admitted.[1]

Additional investigations on tradeoffs and covariate examinations could be done using economics to determine the extent of impacts and benefiter winners and losers. For example, (1) effects from hatchery practices and production levels that might be changed to reduce impacts to natural production (Flagg 2015, McMillan et al. October 2023), (2) changing harvest management to compensate for lost hatchery production, and (3) prediction of climate effects. Such economic investigations requiring an extension of this report's modeling is left to future research.

The contents of this report's *Chapter II* address facilities and operations. Cost effectiveness indicators are provided in *Chapter III. Chapter IV* presents the regional economic impact modeling results in local and statewide economies. Benefit-cost analysis applied to species and individual hatcheries are explained in *Chapter V. Chapter VI* provides a review of passive use, cultural use values, and environmental justice effects. *Chapter VII* has explanations for hatchery sustainable funding techniques.

There are three appendices. *Appendix A* contains tables showing the economic analysis model inputs. It also has a table showing the social indicators for all Oregon counties that were used in the environmental justice review. *Appendix B* has information about the hatchery target release numbers and rearing practices, details about hatchery budgets, and treatment of hatchery capital costs. *Appendix C* contains surrounding states hatchery location maps and budgets.

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[1] Model results are averages for status quo conditions rather than marginal results. The latter should be used in impact analysis. (Impact analysis, for example, would determine economic effects from changed hatchery practices.) Impact inferences can be made for incremental changes using per unit averages, but they will be biased and not necessarily represent the economic effects. There is large variability in model inputs such as the adopted average smolt to Oregon fisheries catch rates (SARs). Relying on statistical averages masks the descriptive ranges that may occur in actual production and realized benefits. The methods scale large economic activities, such as overall commercial and recreational fisheries, to a small subset of the activities. The scaling may or may not reflect true representation of the subject subset.

Map I.1
State Owned Hatcheries Operated by the Oregon Department of Fish and Wildlife

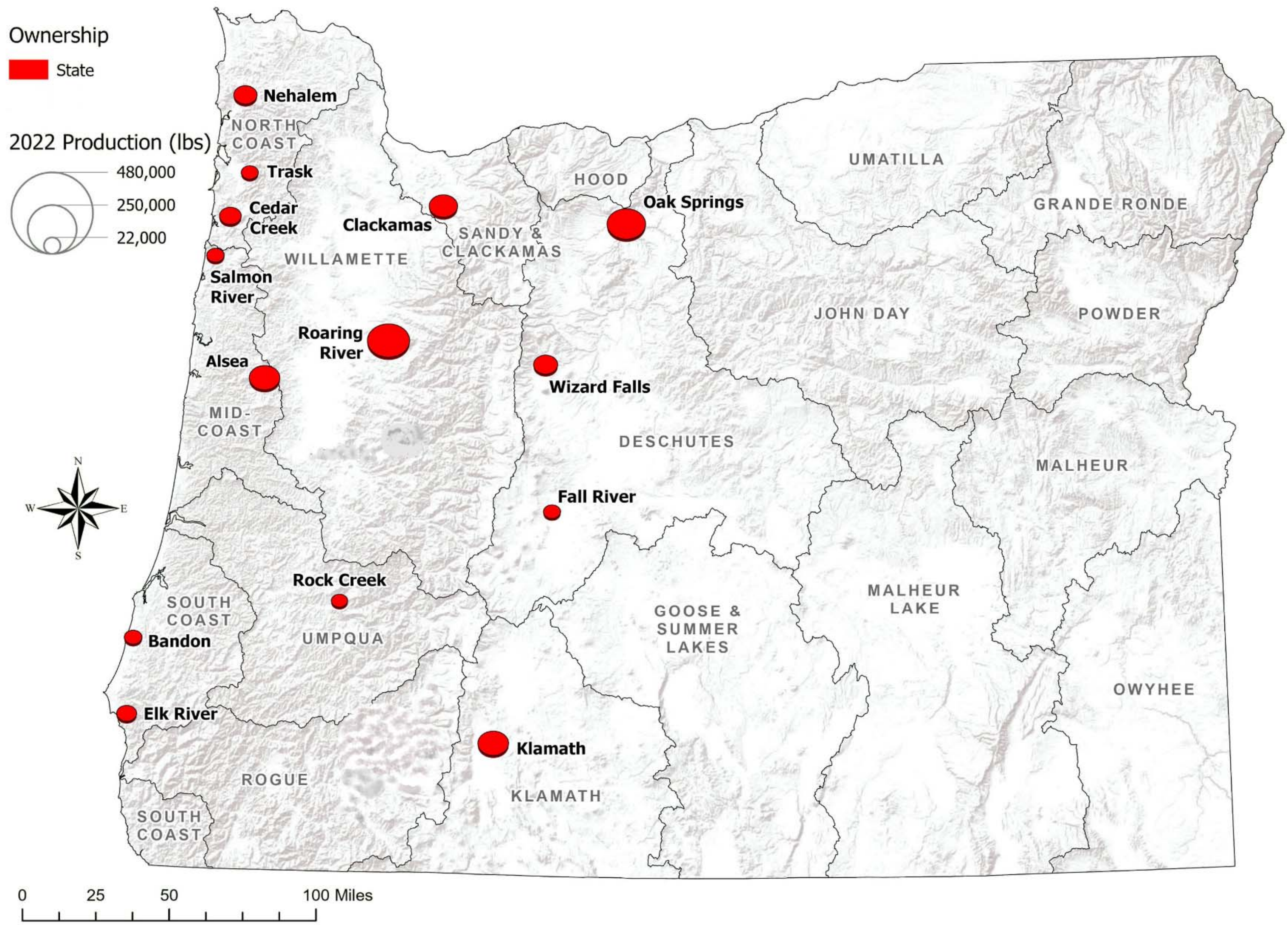

Table I.1
Provenance for Data and Economic Use Values

Annualized Costs

[1] Replacement: Scott Patterson, ODFW (August 2024)
[2] Operation: Scott Patterson, ODFW (July 2024)

Production

[3] Facility releases: HPMP's (2024), audited by Chris Lorion (August 2024)
[4] Facility pounds: Garza and Kent, ODFW (May 2024)

Catch Per Unit Effort (CPUE) and Smolt to Oregon Fisheries Catch Rate (SAR)

[5] Trout CPUE: Upton (January 2006)
[6] Anadromous ocean CPUE: PFMC (February 2024)
[7] Anadromous inland CPUE: TRG (June 2024)
[8] Anadromous Columbia River CPUE: TRG (November 2014)
[9] SARs: Chris Lorion (May, July, and August 2024)

Translations

[10] Anadromous ocean harvested fish per pound: PFMC (February 2024)
[11] Anadromous Columbia River harvested fish per pound: TRG (November 2014)
[12] Rearing time fish life stage and growth size: Chris Lorion and Scott Patterson (June 2024)
[13] Real dollar year: Gross Domestic Product Implicit Price Deflator (GDPIPD) developed by U.S. BEA
[14] State-to-local coastwide adjustment factor: BEA Rims II data year 2021 local and Oregon models
[15] Oregon and coastwide net earnings per job in 2021, and population trends: BEA (January 2024)
[16] Tax generation: Oregon Legislative Revenue Office (February 2023)

Regional Economic Impact (REI)

[17] Recreational ocean REI per day: PFMC (February 2024)
[18] Commercial troll REI per pound: TRG (June 2024)
[19] Commercial Columbia River price per pound: TRG (June 2024)
[20] Commercial and recreational Columbia River REI per fish: TRG (November 2014)
[21] Recreational salmon/steelhead inland REI per day: TRG (June 2024)
[22] Trout REI per day: Upton (January 2006); $34.56 in 2001 dollars
[23] Visitor REI per day: Mojica et al. (January 2021); $49.54 in 2019 dollars
[24] Operations spending: BEA Rims II data year 2021 local and Oregon models
[25] Commercial troll multipliers: IO-PAC economy response coefficients from NWFSC

Net Economic Value (NEV)

[26] Commercial harvesting and primary processing profitability: TRG (June 2024), Kitts et al. (May 2022), FEAM budgets
[27] Recreational salmon/steelhead fishing: Rosenberger (November 2018); $81.37 NEV per day in 2018 dollars
[28] Recreational trout fishing: USFWS (January 2016); $69 NEV per day in 2011
[29] Visitor: Rosenberger (November 2018); $41.83 NEV per day in 2018 dollars

Passive Use Values and Environmental Justice

[30] Layton et al. (1999)
[31] Social and demographic: Census Bureau American Community Survey (ACS) 5-Year Estimates
[32] Rural population: The Ford Family Foundation and OSU Extension Service (August 2023)
[33] Commercial salmon landings: TRG (June 2024)
[34] Recreational ocean salmon trips: PFMC (February 2024)
[35] Recreational fishing expenditures: Dean Runyan Associates (May 2009)

Direct Values (DV)

[36] Recreational fisheries expenditures to REI ratio, anadromous: Lovell et al. (2020)
[37] Recreational fisheries expenditures to REI ratio, trout: TRG (1991)
[38] Commercial fisheries ex-vessel value to REI ratio, ocean: TRG (June 2024)
[39] Commercial fisheries ex-vessel value to REI ratio, Columbia River: TRG (November 2014)
[40] Visitor expenditures to REI ratio: Mojica et al. (January 2021)

Surrounding States Financing

[41] WDFW, CDFW, and IDFG personal communication (September 2024)

II. Facilities and Operations

State hatcheries are characterized by their recent operation and capital costs, planned releases (numbers and pounds), and predicted harvests resulting from the releases for the model year. Operation cost (nominal and real dollars) trend indicators are provided and interpreted. Hatchery physical descriptions and operation details can be found in ODFW HPMP (various dates 2024) and the project's other hatchery review contractor reports.

A. Production Costs

An annualized budget for all 33 ODFW operated hatcheries during the FY 2023-2025 biennium was $44.2 million (see Table II.1 for sources of funds).[1] Hatcheries represent close to one-third of ODFW total budget (ODFW October 2023a). The 14 State hatcheries annualized budget (excluding depreciation and capital contributions) during the biennium was $12.5 million (see Table II.2 for sources of funds). When capital contribution costs are included, the annual budgets sum to $16.3 million. About 22 percent of the supporting revenues are from the general fund, 52 percent from other funds including licenses and fees, 25 percent federal fund including the Sport Fishing Restoration Fund and 2 percent are from external sources.

State hatchery cost categories shown on Table II.4 are for variable (about 57 percent of total costs) and fixed (43 percent) costs. The variable costs for operations (50 percent) include personal services, feed, utilities, travel, and other. The variable costs for support services (seven percent) include fish health, CWT/marking, and fish liberation. Liberation costs include hauling truck costs. Labor costs for liberation is included in operations. The fixed costs categories are headquarter administration (two percent), field management (one percent), heavy maintenance (six percent), and bond expenses (three percent). Headquarter administration includes policy making, report preparation, financial/budgeting accounting, monitoring, permitting, and other duties. Field management includes hatchery coordination. Maintenance (heavy) includes

Oak Springs Hatchery site.

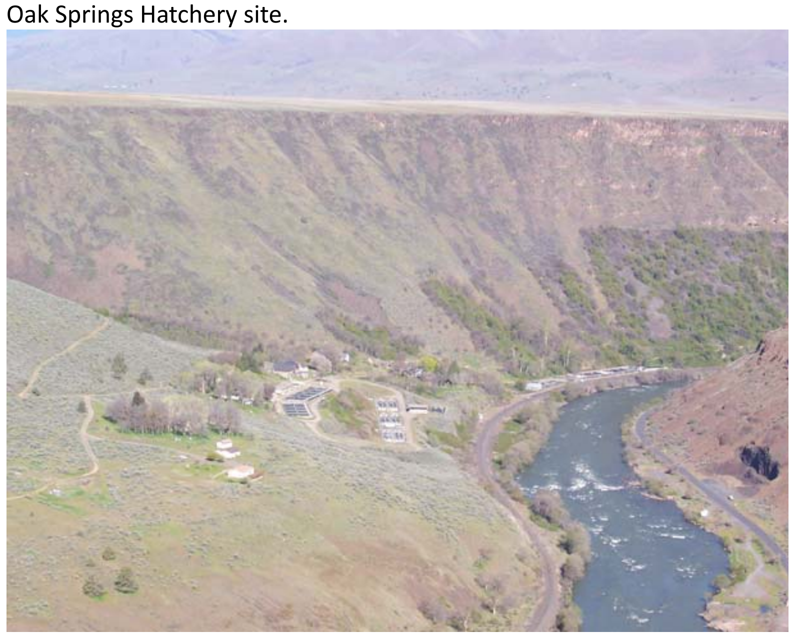

Photo credit Oregon Department of Fish and Wildlife.

[1] The shown budgets in this report will slightly deviate from the Departments Legislatively Approved Budget because the numbers will reflect actual revenues and expenditures that have happened during the biennium.

housing costs, spending from emergency contingency and R&E funds for improvements and upkeep. Bond expenses are from each hatchery's contribution to maintaining a $10 million deferred maintenance/catastrophe bond fund. Wildfire payments (seven percent) are insurance premiums required at the Klamath ($260,000) and Rock Creek ($900,000) hatcheries. The insurance premiums are due to insurance company settlement for paying wildfire damages.

Hatchery cost accounting should reflect the long-term nature of the facility investments. It is necessarily a judgment whether light or heavy maintenance are investment costs. For this study it was assumed any light or heavy maintenance or improvements are expensed in the chosen study year. Many of the hatcheries were built many years ago at relatively low cost compared to what it would take to replace the facilities with more modern structures/equipment and permitting requirements. It is assumed existing facilities are generally fully depreciated. Hatchery replacement cost estimates were available and were included as an annual capital contribution based on a straight-line method, 70-year useful life, and 25 percent salvage value. Individual State hatchery replacement cost estimates and annual capital contributions are shown on Table II.3. The annualized capital cost contributions are 24 percent of total costs in Table II.4.

State hatchery annual costs allocated by trout and anadromous species is shown on Table II.4. The allocation is based on species rearing time (months) spent at the State hatchery in relation to a hatchery's total rearing time spent on all species. An alternate allocation could have been production pounds in relation to a hatchery's total production pounds. The rearing time modeling assumption should not be a substitute for more detailed species itemized cost accounting. It can be considered a reasonable estimate useful for the economic modeling and efficiency evaluations used in this report.[1]

An attributed factor is calculated to determine the harvest that should be associated with a State hatchery. The factor is the share of rearing time (months) that a fish spends at a State hatchery prior to release. For example, if operations are to raise and release a stock from the same hatchery, then that stock's Oregon fisheries catch is 100 percent attributed to the raising hatchery. If the stock is transferred outside of the State hatchery system at a time measured 50 percent growth stage, then 50 percent of the Oregon fisheries benefits are attributed to the early rearing hatchery. The factor should be considered an index of planned production benefits rather than a measure of actual production or capacity benefits.

State individual hatchery production pounds are shown on Table II.5. All of the hatcheries are actual three-year annual average 2021-2023 with two exceptions. Clackamas uses a two-year average 2021-2022 and Rock Creek uses the attributed pound definition. The Rock Creek hatchery estimate would apply if the hatchery is rebuilt and becomes operational. The information summarizes the production pound detail by species shown in Table B.3.

[1] It is suggested that a cost accounting procedure design be completed that would give species level production cost information. The design could be carried out in a pilot hatchery setting, then when perfected, added to manager responsibilities at all hatcheries.

State hatchery production pound trends by species for the recent seven years are shown on Figure II.2. The trend has been mostly stable at 1.1 to 1.2 million pounds during the years from 2017 to 2023. The shown production is actual as hatchery operators struggle with challenges in costs, water supplies, disease outbreaks, weather conditions, wildfire damage, etc. when trying to satisfy production goals. The stable trend implies production target goals are fixed. Year-to-year variability would be in response to incidents (disease outbreak, wildfires, weather events, practices accidents, etc.).

Oregon fisheries harvests resulting from State hatchery production are calculated using target releases, SARs, and the attributed factor. Table II.6 shows species summarized State hatcheries attributed harvests, target releases, and effective SARs. Effective SARs are less than model input SAR data because it's based on attributed catch rather than total Oregon fisheries catch. SAR brood years and later catch years are averages over multiple periods depending on data availability. There is high variability for SAR across the brood and catch years. The high variability for trout SAR is whether the release was for put-and-grow management or put-and-take management.[1] Table II.7 shows individual hatchery target releases and attributed catch for anadromous and trout species. Figure II.1 depicts individual hatchery variable, fixed, and capital contribution costs. Table II.6 and Table II.7 information is a tabulation from the details shown on Table B.1.

B. Hatchery Cost Trends

Trend descriptions are provided for State hatchery operation personal services (PS) and supplies and services (SS). A broader look at cost trends would include reviewing the hatchery programs headquarter (coordination, evaluation, etc.) and services (liberation, marking, etc.) costs that are incurred in support of all ODFW operated hatcheries. A hatchery funding indicator trend statistic for angling license and fee revenue generation is included in Chapter VII. The revenue trend shows license and fee per capita revenue is decreasing in recent years.

PS and recurring/special SS costs are shown in Table II.8 and as an index to the 2017-2019 biennium on Figure II.3. PS, recurring SS, and special SS nominal costs increased 9.7 percent, 2.7 percent, and 22.5 percent respectively between 2017-2019 and 2021-2023 biennia. Real costs decreased 6.7 percent, decreased 12.6 percent, and increased 4.2 percent respectively over the same period. Special SS costs for housing maintenance and taking care of other deferred maintenance items as a share of total PS and SS have slightly increased. The nominal and real percent shares for the three biennia chronologically are 5.5, 5.8, and 6.2. Production efficiency

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[1] Put-and-grow management is a technique used in waters where reproduction capability is limited but habitat conditions support good growth and survival of juveniles and adults. Releases are usually smaller (e.g. fingerlings) than legal size. Put-and-take management is a technique used in waters that are easily accessible to the general public, where angling demand is high, and where habitat conditions are not necessarily suitable to support a satisfactory fishery. Releases are usually legal and trophy size. Oregon Trout Management Policy Guidelines state stocking should be in situations where 40 percent of yearling rainbow plants are caught (OAR 635-500-0105(4)(b)).

indicator (total PS/SS cost per production pound) trend nominal is increasing (efficiency loss), but real is decreasing (efficiency gain).

The index is shown for nominal and real 2023 dollar costs. The dollar adjustment can show whether spending has kept up with price inflation if purchased units (labor, utilities, commodities, etc.) are constant. Production pound trends shown in Figure II.2 are relatively stable over the last three biennia. Given the downward trend of the PS and recurring SS shown in Figure II.3, it appears that while nominal spending has increased, the spending has not kept up with price inflation.

Overall State hatchery expenditures are irregular as the Department compromises operation and maintenance requirements given static funding in order to meet hatchery production goals.[1] The cost trends over the three biennia will change in the 2023-2025 biennium. There will be high wildfire damage related repair and insurance premium costs in future biennia that will be added pressure on hatchery budgeting for same production levels.

Figure II.4 shows fish feed price and purchase trends for State hatcheries. The change in nominal dollars in 2023 compared to the five-year average 2017-2021 is 22.1 percent. The change in real dollars over the same period is 8.7 percent. There has been increasing global aquaculture production in net pen and land based RAS salmon facilities. Supplies for preferred feed mix have lagged meeting the increased demand. Competitive purchasing has raised prices.

The cost trends show hatchery accounting is about managing a financing collision. The collision occurs because of the dynamic nature of spending requirements and the static provision of budget revenues. Aquaculture manufacturing is capital intensive (equipment and buildings are subject to breakdowns) with undependable inputs (feed costs, water quality, utility interruptions, etc.) Budgeted general funds can be firm but license and fees outlook is decreasing and even federal sources can have last minute changes. Production is difficult to throttle short-term to save money in response to the budget vagrancies. Production adaptation and prioritization are necessary at all levels of hatchery administration and management in such financial situations.

[1] There are several accountancy maneuvers available when beginning budget revenues do not materialize or costs exceed budget expectations. For example, the Department can hold hatchery staff vacancies open in order to use PS to cover some of the shortfalls. Another example is using funds in non-hatchery program budgets to make hatchery equipment purchases or facility improvements. Feed is purchased in large lots and sometimes budget SS expenditures do not reflect changes in end-of-year inventories.

Table II.1
Hatchery (All) Funding Sources

Source	FY 2023-25	Annual	Share
General fund /3	6,975	3,488	7.9%
Other Fund License and Fee:	11,735	5,868	13.3%
Other Fund Obligated /4	9,130	4,565	10.3%
Other Fund Dedicated /5	1,088	544	1.2%
BPA	8,422	4,211	9.5%
USCOE	23,960	11,980	27.1%
LSRCP	8,180	4,090	9.3%
MA	12,485	6,242	14.1%
SFR	4,321	2,161	4.9%
PSC, PSMFC, PST, NOAA	2,131	1,065	2.4%
Total	88,428	44,214	100.0%

Notes:
1. Funding amounts thousands 2023 dollars.
2. Acronyms:
   SAFE - Select Area Fisheries Enhancement Program (Lower Columbia River net pen project)
   PGE - Portland General Electric
   PSMFC - Pacific States Marine Fisheries Commission
   PST - Pacific Salmon Treaty
   NOAA - National Oceanic and Atmospheric Administration Fisheries
   MA – Mitchell Act
   BPA - Bonneville Power Administration
   LSRCP – Lower Snake River Compensation Plan
   USCOE – U.S. Army Corps of Engineers
   COP – City of Portland
   SFR – Sports Fishing Restoration (manufacturers federal excise taxes on sport fishing equipment, import duties on fishing tackle and pleasure boats, and the portion of the gasoline fuel tax attributable to small engines and motorboats)
3. Includes $1.0 million for hatchery independent resiliency assessments.
4. PGE, Idaho Power, COP, Pacific Corps, Douglas County, Burns Paiute, egg and carcass sales, Wasco Electric-hydro, Cow Creek.
5. SAFE.

Table II.2
Hatchery (State) Budget Revenue Source and Use

Source	Operations	Support/ Maintenance	Total	Share
GF	1,426	1,273	2,700	21.7%
OF	3,564	2,856	6,420	51.5%
FF	2,987	141	3,127	25.1%
Other	222		222	1.8%
Total	8,200	4,270	12,469	100.0%

Notes: 1. Amounts thousands 2023 dollars.
2. GF General fund
OF Licenses and fees
FF Federal fund including Mitchell Act, US Army Corps of Engineers and Sport Fishing Restoration
Other PGE, Douglas County, hydroelectric sales
3. See Table B.5 for individual hatchery revenue source and use.

Table II.3
Individual Hatchery Facility Replacement Cost Estimate and Annual Capital Contribution

Hatchery	Replacement Cost	Depreciation	Annual Capital Contribution
Alsea	40,500	--	434
Bandon	13,350	--	143
Cedar Creek	28,040	--	300
Clackamas	32,150	--	344
Elk River	22,020	--	236
Klamath	17,600	--	189
Nehalem	23,330	--	250
Oak Springs	40,000	--	429
Roaring River	29,760	--	319
Salmon River	21,070	--	226
Trask	17,570	--	188
Wizard/Falls River	32,400	--	347
Rock Creek	44,380	--	476
Total	362,170	--	3,880

Notes: 1. Amounts are thousands 2023 dollars.
2. Existing investments are assumed to be fully depreciated. Annual capital contributions for each hatchery are calculated using straight-line method, 70-year life, and 25 percent salvage value.

Table II.4
Hatchery Costs by Species

	Cost Category		Species				
	Amount	Share	Trout		Anadromous		Share
Variable	9,347.5	57%	3,707.5	40%	5,640.0	60%	100%
Operation	8,199.7	50%	3,510.4	43%	4,689.3	57%	100%
Support	1,147.8	7%	197.1	17%	950.7	83%	100%
Fixed	7,002.2	43%	2,851.4	41%	4,150.8	59%	100%
Headquarter	254.4	2%	97.3	38%	157.1	62%	100%
Field management	219.0	1%	90.0	41%	129.0	59%	100%
Maintenance heavy (capital/fixed)	1,048.4	6%	454.8	43%	593.6	57%	100%
Bond expenses	440.0	3%	144.1	33%	295.9	67%	100%
Wildfire payments	1,160.0	7%	410.0	35%	750.0	65%	100%
Annual capital contribution	3,880.4	24%	1,655.2	43%	2,225.2	57%	100%
Total Costs	16,349.7	100%	6,558.9	40%	9,790.8	60%	100%

Notes: 1. Costs are thousands 2023 dollars.
2. Costs are allocated to species based on individual hatchery rearing time. The allocated costs are then summed over all State hatcheries.

Table II.5
Individual Hatchery Release Pounds

	Fish Pounds			
Hatchery	2021	2022	2023	Average
Alsea	127,996	122,474	112,612	121,027
Bandon	31,242	30,793	34,138	32,058
Cedar Creek	70,343	60,066	72,624	67,678
Clackamas	58,714	105,846	38,511	82,280
Elk River	54,653	47,355	42,228	48,079
Klamath	124,377	94,032	107,863	108,757
Nehalem	74,799	69,932	68,062	70,931
Oak Springs	202,223	177,393	214,693	198,103
Roaring River	235,511	203,615	221,069	220,065
Salmon River	43,443	30,249	44,958	39,550
Trask	31,019	26,576	23,309	26,968
Wizard/Falls River	89,906	103,249	97,947	97,034
Rock Creek				85,717
Total	1,144,226	1,071,580	1,078,014	1,198,247

Notes: 1. Clackamas fish pounds average is two-year 2021 and 2022. Rock Creek uses attributed pounds.

Table II.6
Hatchery Fisheries Effective Smolt to Oregon Fisheries Catch Rate by Species

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Harvested adults (thous. fish)	1,127.4	1,056.2	71.2	9.6	7.0	26.3	25.3	3.0
Freshwater	1,123.6	1,056.2	67.4	8.5	6.1	24.6	25.3	3.0
Commercial (Col. R.)	19.7	--	19.7	--	0.1	19.7	--	--
Recreational	1,103.9	1,056.2	47.7	8.5	6.0	4.9	25.3	3.0
Ocean	3.8	--	3.8	1.1	0.9	1.8	--	--
Commercial	1.6	--	1.6	0.7	0.8	0.1	--	--
Recreational	2.3	--	2.3	0.5	0.1	1.7	--	--
Total	1,127.4	1,056.2	71.2	9.6	7.0	26.3	25.3	3.0
Commercial	21.3	--	21.3	0.7	0.9	19.7	--	--
Recreational	1,106.1	1,056.2	49.9	8.9	6.1	6.6	25.3	3.0
Target releases (thous. fish)	12,514.5	4,132.0	8,382.6	1,883.1	1,958.7	2,723.8	1,417.4	399.5
Effective SAR		25.56%	0.85%	0.51%	0.36%	0.97%	1.78%	0.74%
Commercial		--	0.25%	0.04%	0.04%	0.72%	--	--
Recreational		25.56%	0.60%	0.48%	0.31%	0.24%	1.78%	0.74%

Notes:
1. See Table B.1 for hatchery and stock specific SAR.
2. Harvested adults are attributed catch in Oregon fisheries. Effective SAR is less than model input SAR data because its based on attributed catch rather than total Oregon fisheries catch.
3. Columbia River categorized hatcheries include Clackamas, Oak Springs, Roaring River, and Wizard/Falls River.
4. Elk River Hatchery fall Chinook releases into Garrison Lake are counted as trout and are caught as smolt size with an assumed trout SAR. Oak Springs summer steelhead is released to Haystack Reservoir that has no migration, therefore assumed to have trout SAR.
5. STEP egg-to-fry program contributions are not tracked for fisheries harvests. Other STEP program releases are tracked for fisheries harvests.

Table II.7
Individual Hatchery Releases and Attributed Catch

	Target Releases				Attributed Catch			
	Anadromous		Trout		Anadromous		Trout	
Hatchery	Amount	Percent	Amount	Percent	Amount	Percent	Amount	Percent
Alsea	281,600	3.4%	156,189	3.8%	5,050	7.1%	89,114	8.4%
Bandon	978,500	11.7%	1,059	0.0%	4,379	6.1%	413	0.0%
Cedar Creek	824,444	9.8%	0	0.0%	8,983	12.6%	0	0.0%
Clackamas	3,272,801	39.0%	0	0.0%	23,611	33.2%	0	0.0%
Elk River	634,727	7.6%	257,237	6.2%	3,250	4.6%	5,075	0.5%
Klamath	0	0.0%	396,734	9.6%	0	0.0%	114,172	10.8%
Nehalem	300,202	3.6%	70,810	1.7%	3,411	4.8%	30,350	2.9%
Oak Springs	153,182	1.8%	959,738	23.2%	1,835	2.6%	264,034	25.0%
Roaring River	150,833	1.8%	755,990	18.3%	1,680	2.4%	326,476	30.9%
Salmon River	463,056	5.5%	19,275	0.5%	4,385	6.2%	8,681	0.8%
Trask	640,614	7.6%	0	0.0%	8,042	11.3%	0	0.0%
Wizard/Falls River	88,889	1.1%	1,482,067	35.9%	0	0.0%	203,083	19.2%
Rock Creek	593,711	7.1%	32,878	0.8%	6,593	9.3%	14,808	1.4%
Total	8,382,560	100.0%	4,131,977	100.0%	71,220	100.0%	1,056,205	100.0%

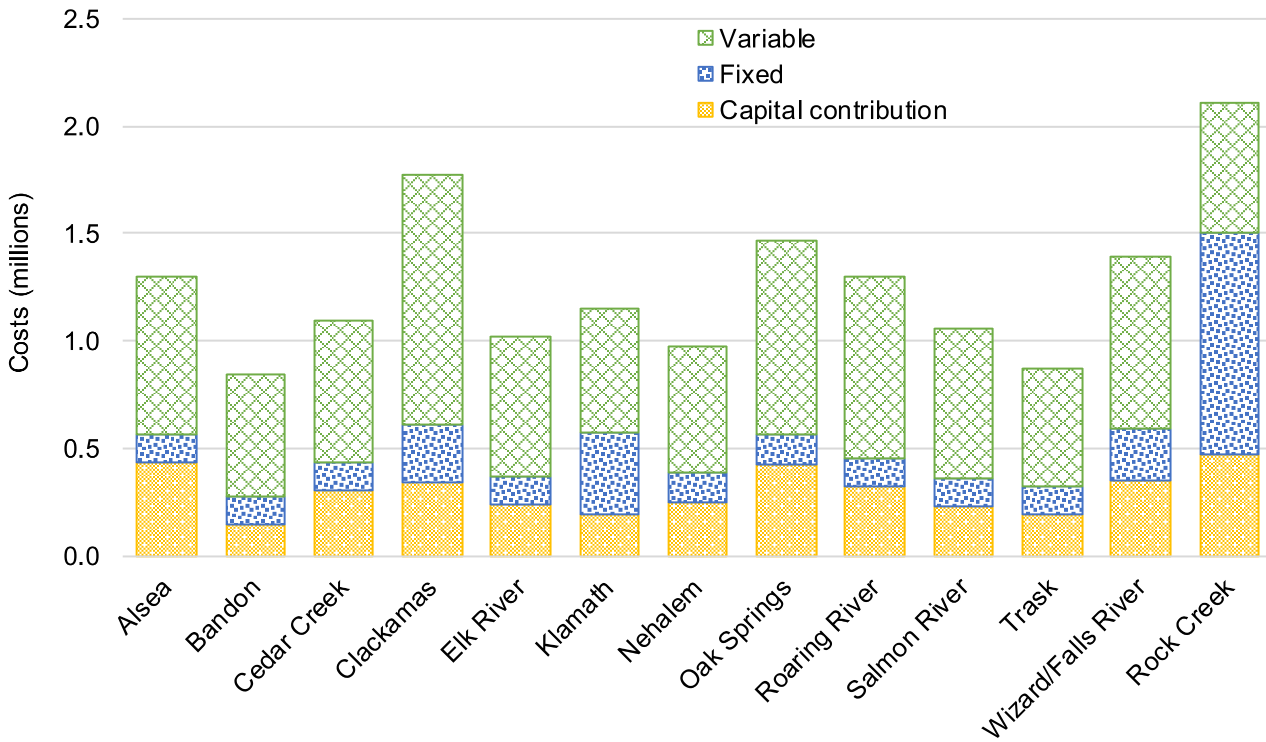
Notes: 1. See Table B.1 for detailed stock releases and SAR.
2. Catch is attributed harvested adults for Oregon fisheries.

Table II.8
Hatchery Personal Services and Supplies and Services Itemization and Production Measure in 2017-2019 to 2021-2023 Biennia

	2017-2019		2019-2021		2021-2023		% Change 2017-2019 to 2021-2023
	Amount	Share	Amount	Share	Amount	Share	
Nominal dollars							
PS	9,952	67.3%	10,281	68.4%	10,920	68.0%	9.7%
Recurring SS	4,021	27.2%	3,881	25.8%	4,132	25.7%	2.7%
Special SS	815	5.5%	868	5.8%	998	6.2%	22.5%
Total	14,788	100.0%	15,031	100.0%	16,050	100.0%	8.5%
Real 2023 dollars							
PS	11,701		11,407		10,920		-6.7%
Recurring SS	4,728		4,306		4,132		-12.6%
Special SS	958		963		998		4.2%
Total	17,386		16,676		16,050		-7.7%
Production measure							
Total PS/SS cost per pound							
Nominal	6.63		6.27		6.79		2.3%
Real	7.80		6.96		6.79		-13.0%

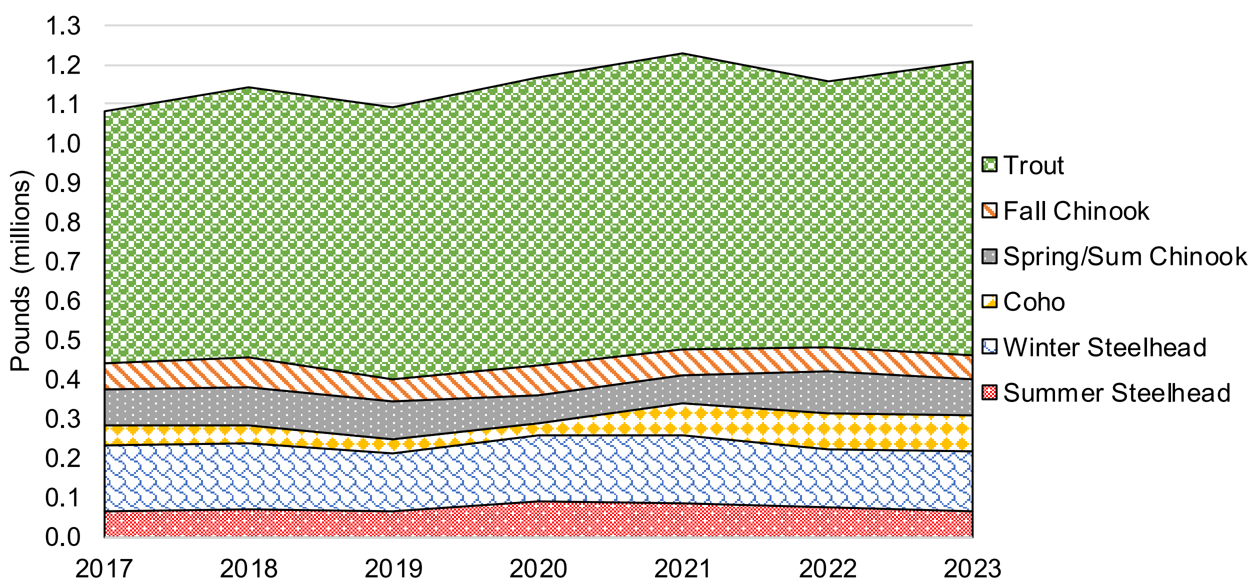
Notes:
1. Costs are in thousands of nominal dollars or real adjusted to 2023 dollars.
2. PS is personal services including all overhead. Recurring SS costs are supplies and services that include travel, telecom, uniform, fish feed, chemicals for fish feed, fuels, utilities, office supplies, light repairs, and miscellaneous program supplies. Special SS costs are for housing and other heavy maintenance.
3. Costs are for bienniums and do not include all cost categories as shown on Table II.2. They are sufficiently broad for showing cost trends.
4. Cost per pound includes all species in calendar years of the last two years of the biennium.

Figure II.1
Individual Hatchery Variable, Fixed, and Capital Contribution



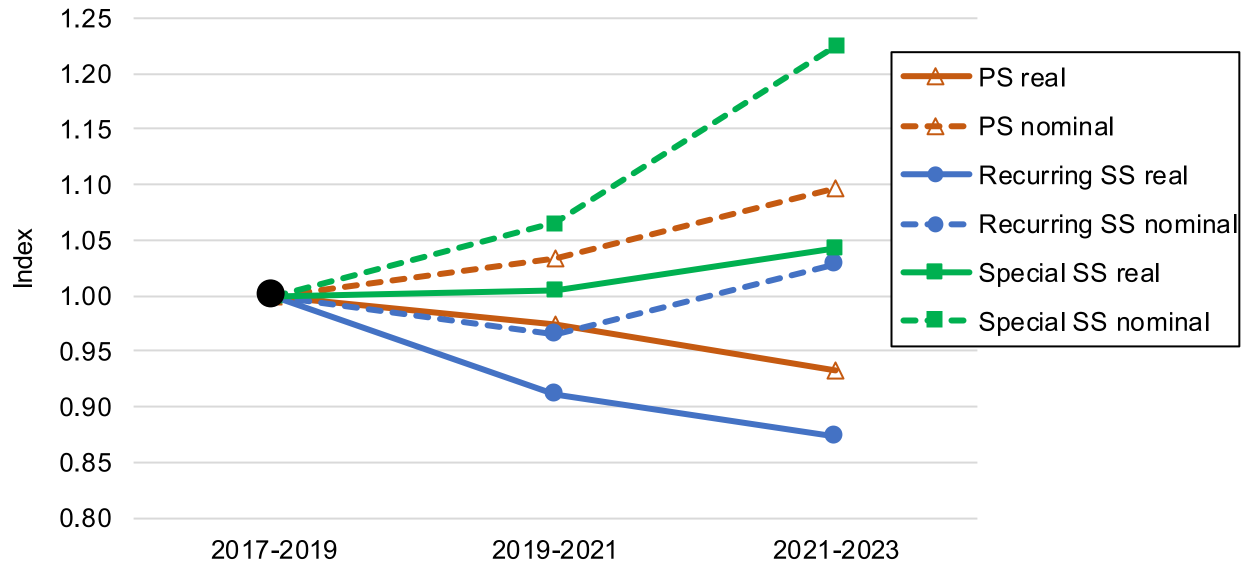
Notes: Capital contributions are annualized replacement costs. Existing facility investments are assumed to be fully depreciated.

Figure II.2
Hatchery Production Pound Trends in 2017 to 2023



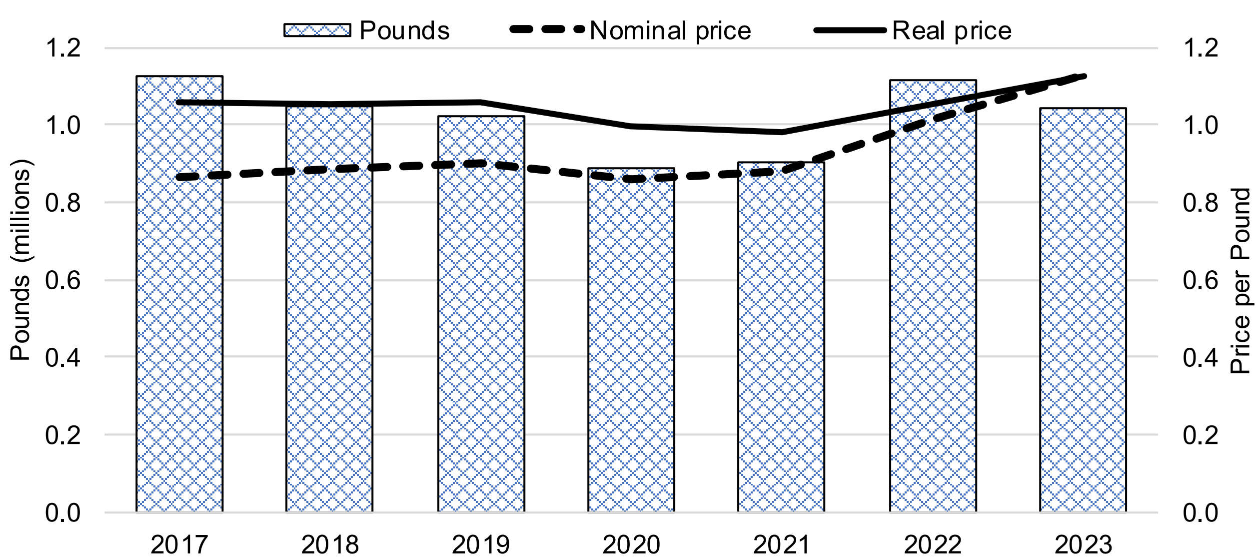
Notes: Production pounds for Clackamas Hatchery in 2023 is a two-year average for 2021 and 2022. Production pounds for Rock Creek Hatchery since 2020 is attributed pounds using the study model for 2023.

Figure II.3
Hatchery Personal Services and Supplies and Services
Cost Index Trends for 2017-2019 to 2021-2023 Biennia



Notes: 1. Real costs adjusted to 2023 dollars.
2. PS is personal services including all overhead. Recurring SS costs are supplies and services that include travel, telecom, uniform, fish feed, chemicals for fish feed, fuels, utilities, office supplies, light repairs, and miscellaneous program supplies. Special SS costs are for housing and other heavy maintenance.

Figure II.4
Hatchery Fish Feed Price and Pounds in 2017 to 2023



Notes: 1. Price is nominal and real 2023 dollars for fish feed purchased for State hatcheries.
2. Purchases are not differentiated for high protein mix or brands.

III. Cost Effectiveness

Cost effectiveness analysis (CEA) can be a useful economic description tool when economic active use benefits and other non-use values are difficult to measure. It simply relates costs to an analytical objective to determine the least cost way to achieve the objective. Costs can be direct costs and objectives can be whatever the purpose or purposes of the proposed action. For example, an objective can be fishery augmentation. In this case the measure is production cost divided by the fishery harvest contribution number. Another objective might be to operate hatcheries in a way that does not impair natural stocks. The measure might be cost per stray, cost per eggs produced with natural brood stock, or other measure of impacted native salmon and steelhead populations of concern. Tradeoff analysis becomes straightforward with the CEA where hatchery costs can be related to costs for other methods providing same objectives. Example other methods might be resolving migration barriers or making habitat improvements.

Oak Springs Hatchery hatch house.

Photo credit Oregon Department of Fish and Wildlife.

The key assumption used in this CEA is that all State hatcheries have the same production objectives. This allows for comparing the hatchery costs and effects measures across hatcheries.

The provided CEA references operation costs (variable and fixed) explained in Chapter II. Facility capital costs and production pounds for individual hatcheries are shown in Table B.3. Table III.1 shows individual State hatcheries annualized operation and capital costs per actual production pound and facility replacement cost per actual production pound. Table III.2 summarizes the cost per attributed release and actual production pound ratios by species. The cost per harvested adult by species is shown in Table III.3. Table III.4 shows individual hatchery efficiency measures by species. There are efficiency gains with larger production facilities having lower cost per pound and smaller facilities having higher cost per pound as shown on Figure III.1.

Rearing costs reflected in these indicators are highly dependent on time spent at hatcheries. Steelhead cost per release can be three times salmon releases due to the rearing time differential. The cost per harvested adult is discussed in Chapter VII with a net benefit perspective.

Although not addressed in this report, the net benefit statistic described in Chapter VII can also be a comparative efficiency indicator for other means to increase fishing opportunities (spawning habitat improvements, predation removal programs, resolving migration route impediments, etc.). Using the net benefit statistic for comparative purposes will often have time horizon complexities where the other means will take several fish generations to reach capacity production levels.

Table III.1
Individual Hatchery Operation and Annual Capital Contributions Per Facility Production Pound

		Total Cost		Replacement
Hatchery	Variable	w/o Cap.	w/ Cap.	Cost
Alsea	6.04	7.13	10.72	335
Bandon	17.63	21.73	26.20	416
Cedar Creek	9.78	11.72	16.16	414
Clackamas	14.20	17.39	21.58	391
Elk River	13.67	16.37	21.28	458
Klamath	5.29	8.88	10.61	162
Nehalem	8.28	10.17	13.69	329
Oak Springs	4.56	5.23	7.40	202
Roaring River	3.85	4.46	5.91	135
Salmon River	17.62	20.96	26.67	533
Trask	20.43	25.42	32.40	652
Wizard/Falls River	8.20	10.78	14.35	334
Rock Creek	7.08	19.04	24.58	518
Total	7.80	10.41	13.64	302

Notes: 1. Total annual cost includes variable and fixed costs. Fixed costs are itemized for with and without annual capital contribution.

Table III.2
Hatchery Cost Per Release and Per Facility Production Pound by Species

	Total	Trout	Anadromous Species: Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Releases (thousands fish)	12,514.5	4,132.0	8,382.6	1,883.1	1,958.7	2,723.8	1,417.4	399.5
Cost per release								
Variable	0.75	0.90	0.67	0.54	0.43	0.40	1.36	1.87
Total	1.31	1.59	1.17	0.82	0.86	0.70	2.35	3.25
Facility pounds (thousands)	1,198.2	725.4	472.9	63.4	90.4	87.9	159.2	71.9
Cost per facility pound								
Variable	7.80	5.11	11.93	15.93	9.39	12.52	12.13	10.41
Total	13.64	9.04	20.71	24.44	18.67	21.81	20.95	18.08

Notes: 1. Total annual cost includes variable and fixed costs. Fixed costs include annual capital contribution.

Table III.3
Hatchery Cost Per Harvested Adult by Species

	Total	Trout	Anadromous Species: Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Cost per harvested adult freshwater and ocean								
Variable cost	8.29	3.51	79	105	121	42	76	252
Total cost	14.50	6.21	137	161	241	73	132	438

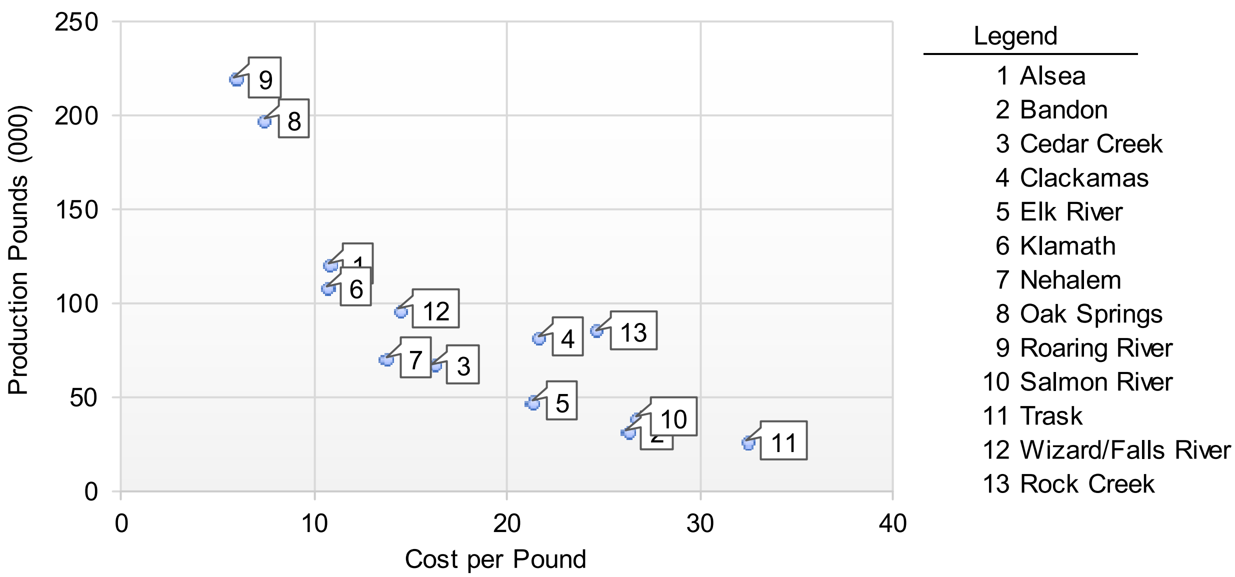
Notes: 1. Steelhead and trout fisheries are freshwater only.
2. Harvested adults are attributed catch in Oregon fisheries.

Table III.4
Individual Hatchery Efficiency Measures by Species

	Cost per Facility Pound						Cost per Harvested Adult					
Hatchery	Trout	Fall Chinook	Spr/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead	Trout	Fall Chinook	Spr/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Alsea	6.97	--	--	--	21.35	--	7.00	--	--	--	133	--
Bandon	19.25	44.54	--	--	21.00	--	198.29	229	--	--	146	--
Cedar Creek	0.00	285.12	14.13	--	15.44	15.56	--	104	99	--	111	214
Clackamas	0.00	--	31.40	14.43	84.41	173.83	--	--	525	43	182	399
Elk River	11.20	18.00	--	--	59.98	--	15.85	311	--	--	253	--
Klamath	10.67	--	0.00	--	--	--	10.11	--	--	--	--	--
Nehalem	8.63	28.88	--	21.49	18.22	--	11.07	1,689	--	203	162	--
Oak Springs	7.01	--	--	--	7.75	78.49	4.86	--	--	--	59	--
Roaring River	5.82	--	--	--	9.69	4.67	3.23	--	--	--	127	175
Salmon River	19.63	20.16	--	28.50	--	--	40.64	124	--	126	--	698
Trask	0.00	27.72	34.42	206.22	28.65	--	--	61	293	221	84	--
Wizard/Falls River	16.56	--	0.00	--	--	8.68	6.10	--	--	--	--	--
Rock Creek	22.50	--	15.81	89.73	19.20	54.80	23.80	--	440	242	136	1,090
All	9.04	24.44	18.67	21.81	20.95	18.08	6.21	161	241	73	132	438

Notes: 1. Harvested adults are attributed catch in Oregon fisheries.

Figure III.1
Individual Hatchery Production Pounds and Cost Per Pound



IV. Regional Economic Impact

A. Model Methods

The public and decision makers sometimes just want to know what level of economic activity is being stirred-up within a specified geographic region stemming from a decision making action. This type of analysis providing the economic activity statistic is called Regional Economic Impact (REI). It is a way to show how direct change in expenditures is multiplied throughout the regional and statewide economies. The measurement unit for REI with most bearing is labor income, job equivalents, and state/local taxes generated. There are other equivalent measures such as business output and value added. The measures for income changes and jobs have some comparative usefulness for showing distributional effects across economies. The measures for business output and value added are less tangible when trying to relate what might happen in an economy from a public decision regarding hatcheries.

Oak Springs Hatchery intake.

Photo credit Oregon Department of Fish and Wildlife.

REI measurements are provided despite the limitation for only having meaning in the immediate sense. It is realized that any changes made in an economy are going to have offsetting adjustments that may be unpredictable in the long term. The REI analysis considers active use economic activity from commercial harvesting, recreational fishing, hatchery visits, and hatchery operations.

Key assumptions used in the REI analysis are:

- The period of analysis is indeterminate, with quantitative changes in resource costs and benefits and regional economic activity being near-term. Hatchery budget information is assembled to apply to Year 2023. It can be assumed the annual REI is for the same year. For benefits from actions to conserve depressed species, long-term effects from the recovery species would be made.

- Local level impacts are calculated for hatchery operations. Total impacts are at the state level economy. State level measurements over estimate impacts at the local level because of interactions (leakages) with state level economies.

- Recreational fisheries and visitor impacts are calculated using trip spending. Expenditures for fishing related durable items can be considerable but associating economic impacts to those expenditures is problematic. The use of purchases can be spread over many other recreational activities.

- Expenditures per day translated to REI per fish assume all trip expenditures are associated with overall trip purpose being for fishing.

- Visitor impacts are only shown for the state level economy despite spending occurs at trip origin, en-route, and destination. If known, the location spending could be included in impact calculations at the local level.

- No differentiation is made between anglers that are residents and nonresidents. This is important to point out because non-resident spending in regional economies generates new income through their trip expenditures. Local resident fishing trip spending may or may not have been spent anyway in the regional economy.

- Commercial fishing economic benefits include effects from harvesting and primary processing.

- Hatchery operations light and heavy maintenance is included as a fully expensed annual expenditure, but effects from any major one-time improvement construction is not included.

- No substitution is assumed. If fishing opportunities provided by State hatcheries are reduced, are there alternative fishing opportunities available? Will there be same spending for non-fishing activities? Will changes to hatchery objectives have alternative REI effects?

- The ocean and freshwater fall salmon fisheries are mixed stocks (coho and fall Chinook) and the proportion of species catch during a trip is not always reported. An assumed fishery's target species is used to determine total trip days and economic benefits. It was assumed coho was the target species in the ocean fishery and Chinook was the target species in the freshwater fishery. The proportion of species economic benefits is based on catch.

- Economic model inputs assume existing environmental, fisheries, markets, and hatchery production conditions:
  - Protected habitat conditions (inland and estuarine) as they influence wild fish survival/recovery.
  - Stable ocean and freshwater conditions as they influence SAR for anadromous and trout species. This assumption includes unchanged predation and other fish passage mortality rates.
  - Continued management regimes in ocean mixed stock fisheries based on assumptions about hooking and handling mortality rates, wild fish encounter rates, bycatch levels and commercial/sport catch allocation schedules.
  - Attainable harvest rates on hatchery fish in inland fisheries for anadromous and trout species.
  - Continuation of current commercial fish prices.
  - Same processing product forms, yields, labor requirements, investment returns, locations, and market prices.
  - Unaltered hatchery production objectives with same costs (variable, fixed and capital contributions) and release locations.
  - Unchanged headquarter services and costs.
  - Same repair and heavy maintenance levels and access to capital improvement programs such as R&E.

The REI calculation equations using algebraic notation are as follows. The input data numbered sources showing in brackets refer to Table I.1.

Equation IV.1

$$RPFT = RPDT \cdot (1 / CPUET)$$

where: RPFT = regional economic impacts per fish for trout
RPDT = regional economic impacts per day for trout [22]
CPUET = catch per unit effort for trout fisheries [5]

Equation IV.2

$$RPFR_f = RPDR \cdot SCR_f \cdot PR_f$$

where: RPFR = regional economic impacts per fish for recreational anadromous fisheries
RPDR = regional economic impacts per day for target species recreational anadromous fisheries [17]
SCR = success rate for anadromous fisheries [6], [7], [8]
PR = proportion of catch
f = recreational anadromous fisheries

Equation IV.3

$$RPFC_l = RPP_l \cdot PPF_l$$

where: RPFC = regional economic impacts per fish for commercial fisheries
RPP = regional economic impacts per pound by commercial fisheries [18]
PPF = pounds per fish caught in ocean and Columbia River by fisheries [10], [11]
l = commercial fisheries

Equation IV.4

$$ATT_{m,k} = REL_{m,k} \cdot SAR_{m,k} \cdot MO_{m,k}$$

where: ATT = attributed adult harvests by fishery and hatchery
REL = releases by fishery and hatchery [3]
SAR = smolt-to-adult rate for Oregon fisheries [9]
MO = hatchery share rearing months of total months at release [12]
m = recreational or commercial or trout fisheries
k = hatcheries

Equation IV.5

$$REI_{m,k} = RPF_{m,k} \cdot ATT_{m,k}$$

where: REI = regional economic impact for fisheries at hatchery k
RPF = regional economic impact per fish for Oregon recreational and commercial fisheries

Equation IV.6

$$REIV_{k} = MPF \cdot CNT_{k} \cdot RPV$$

where: REIV = regional economic impact from hatchery visitor trip spending
MPF = assumed multipurpose trip factor
CNT = hatchery visitor counts
RPV = regional economic impacts per trip [23]

Equation IV.7

$$DVC_{m,k} = PPF_{m,k} \cdot ATT_{m,k} \cdot PRC_{m}$$

where: DVC = direct value for commercial fisheries
PRC = harvest price for fisheries [19]

Equation IV.8

$$DVR_{f} = RTR_{f} \cdot REI_{m}$$

where: DVR = direct value for recreational fisheries trip spending
RTR = ratio of expenditures to regional economic impacts from fisheries trips [36], [37]

Equation IV.9

$$DVV_{k} = RTV \cdot REIV_{k}$$

where: DVV = direct value from visitor trip spending
RTV = ratio of expenditures for regional economic impacts from visitor trip spending [40]

The study's REI model translates benefiter and hatchery operation spending into measurements of economic effects within study adopted economies. Using existing secondary industry input-output relationship models, the initial spending is tracked for respending until the money leaks out from the study economies. The model inputs for initial spending are characterized by benefiter direct values (DV) and the previously described hatchery costs.

B. Direct Values

The State hatchery summed DV are \$0.4 million commercial harvest value, \$62.3 million recreation spending and \$6.5 million visitor spending (Table IV.1). These DV represent commercial fisheries 166 thousand pounds anadromous species catch, 659 thousand recreational fishing angler days and 169 thousand visitor days. There are other production related direct and indirect financial values not included such as egg/carcass sales, surplus fish sales, food bank donations, and supplying fish to tribes for ceremonial and subsistence purposes.

The DV calculations for commercial fisheries revenue and recreational fisheries first round spending may give some information about revenue flows, but do not reflect total impacts on an economy nor do they reflect a dollar value that can be used to compare and contrast fish resource benefits. Harvest value does reflect market forces that define the revenue a harvester receives from an initial buyer. However, the revenue alone is not a predictor of NEV without knowing harvester and processor profitability (TRG 2009b). While recreational expenditures provide prima facie backing there is value, they are not a measure of that value (Huppert 1983). They do not account for the regard an angler holds for the quality of the fishery. Expenditures are a cost whose change may conflict with a fishery value shift. When costs go down, the angler may decide whether the fishery value increases.

Economic and social values are better reflected in REI and NEV measurements. But even with their better meaning, they are only the value of fishing and not the value of fish resources. That value is much more complex and is addressed in Chapter VI where passive use and cultural values are discussed.

C. Results Discussion

Results for total fisheries related REI labor income is shown in Table IV.2. The total REI from fisheries is $39.3 million labor income of which $25.6 million is from trout fisheries and $13.7 million is anadromous fisheries. Anadromous commercial fisheries REI is a small contributor to Oregon total salmon fisheries REI (TRG June 2024). Oregon commercial salmon troll and net fisheries REI in 2021 is $13.0 million labor income (2023 dollars). Study results show modeled REI from Oregon State hatcheries contributions from anadromous fisheries in 2023 are $0.7 million labor income or a six percent share. The two base years are incongruous, but the comparison gives a picture of the relative share that State hatchery production contributes to the State's commercial salmon fishing industry.

Fisheries REI per harvested adult by Oregon harvesting location and species is shown on Table A.5. For example, one adult harvested spring Chinook averaged across all fisheries generates $466 labor income and one harvested trout generates $24 labor income.

Selective spending categories for hatchery costs are used in hatchery operation REI calculations. For example, the local economy REI does not include headquarter costs. The local and statewide REI does not include capital contribution cost estimates. Capital costs would be properly included when construction spending actually occurs. Table B.2b shows the calculations for individual hatcheries operations REI at the local and statewide economy level. The summed hatchery operations REI at the local economy level is $8.2 million labor income and $11.3 million labor income at the state economy level. Table IV.3 shows individual hatchery REI from visitors, attributed fisheries and hatchery operations.

Total REI attributed benefits from fisheries, visitor spending and hatchery operations for State hatcheries is $55.5 million labor income which is equivalent to 1,100 jobs in the state level economy (Table ES.3).[1,2] State/local tax associated with this economic activity is $6.0 million. Federal taxes would be in addition to this amount. Trout fisheries contribute about 46 percent of the REI, followed by anadromous species fisheries (25 percent), hatchery operations (20 percent) and hatchery visitors (nine percent) (Figure ES.1).

Table IV.1
Hatchery Fisheries by Species and Visitor Direct Values

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Fisheries (thousands)								
Commercial harvest value								
Columbia River	209.8	--	209.8	--	9.1	200.7	--	--
Ocean	174.2	--	174.2	78.3	94.3	1.6	--	--
Recreational trip expenditures								
Coast	30,345.6	9,482.5	20,863.1	3,892.6	4,796.4	1,171.6	10,000.0	1,002.5
Columbia River	31,479.3	25,961.0	5,518.2	--	1,451.9	1,074.9	2,505.2	486.3
Ocean	461.0	--	461.0	79.5	93.0	288.5	--	--
Visitor trip expenditures (thousands)								
	6,538.3							
Commercial pounds	166,257	--	166,257	8,084	10,855	147,318	--	--
Columbia River	148,049	--	148,049	--	1,125	146,924	--	--
Ocean	18,208	--	18,208	8,084	9,730	394	--	--
Recreational angler days	658,787	450,217	208,569	32,874	48,916	18,186	97,456	11,138
Coast	293,363	120,451	172,912	32,262	39,753	9,710	82,880	8,308
Columbia River	361,875	329,767	32,108	--	8,448	6,254	14,577	2,829
Ocean	3,549	--	3,549	612	716	2,221	--	--
Visitor days	168,550							

[1] Local and State economy level REI impacts (labor income and equivalent jobs) for hatchery operations by individual hatcheries are shown on Table B.2b.
[2] Attributed fisheries REI is about two-thirds of the fisheries REI when all release benefits are credited to a rearing (partial or entire) hatchery.

Table IV.2
Hatchery Fisheries Regional Economic Impact by Species

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
REI total (thousands)	39,303.2	25,576.0	13,727.2	2,071.6	3,266.3	1,593.7	6,072.6	722.9
Freshwater	38,761.8	25,576.0	13,185.8	1,890.3	3,049.3	1,450.8	6,072.6	722.9
Coast hatcheries	16,973.8	6,842.6	10,131.2	1,890.3	2,329.2	568.9	4,856.0	486.8
Col. R. hatcheries	21,788.1	18,733.5	3,054.6	--	720.1	881.8	1,216.5	236.1
Commercial	374.9	--	374.9	--	15.1	359.8	--	--
Recreational	21,413.1	18,733.5	2,679.7	--	705.0	522.0	1,216.5	236.1
Ocean	541.4	--	541.4	181.4	217.0	143.0	--	--
Commercial	317.5	--	317.5	142.8	171.9	2.9	--	--
Recreational	223.9	--	223.9	38.6	45.1	140.1	--	--

Notes: 1. REI expressed in thousands labor income in Year 2023 dollars.
2. Columbia River categorized hatcheries include Clackamas, Oak Springs, Roaring River, and Wizard/Falls River.

Table IV.3
Individual Hatchery Visitor Counts and Visitor/Fisheries/Operations Regional Economic Impacts

Hatchery	Visitor Counts	Visitor REI Statewide	Attributed Fisheries REI	Operations REI Local	Operations REI Statewide	Statewide Total REI
Alsea	5,000	146	3,341	652	897	4,384
Bandon	3,000	87	1,016	553	748	1,851
Cedar Creek	4,000	116	2,835	640	861	3,812
Clackamas	20,000	582	2,142	847	1,160	3,884
Elk River	2,500	73	794	583	791	1,659
Klamath	8,000	233	2,765	539	744	3,742
Nehalem	5,500	160	1,483	566	773	2,416
Oak Springs	750	22	6,881	788	1,082	7,985
Roaring River	18,000	524	8,352	693	965	9,842
Salmon River	2,800	82	785	624	846	1,713
Trask	12,000	349	1,989	532	728	3,066
Wizard/Falls River	80,000	2,330	4,918	767	1,085	8,332
Rock Creek	7,000	204	2,002	414	594	2,800
Total	168,550	4,909	39,303	8,197	11,273	55,484

Notes:
1. REI expressed in thousands labor income in Year 2023 dollars.
2. REI local effects from hatchery operations and support spending. See Table B.2 for REI local effects measured by jobs.
3. REI statewide hatchery operations effects include local effects at the statewide economy level plus feed, headquarter, administration, field management, and heavy maintenance spending. Bond expenses, wildfire payments, and annual capital cost contributions are not included in the REI calculations.
4. Klamath Hatchery is temporarily closed to visitors due to access road damage so estimates are based on visitor counts prior to closure. Rock Creek Hatchery visitor count is based on activity prior to wildfire damage closure.

V. Net Benefits

This chapter provides information about hatchery program net benefits. The net benefits are a calculation for net economic value (NEV) held by users of hatchery production minus hatchery production costs. The calculation can result in a negative number unlike the calculation of regional economic impacts (REI) shown in the previous chapter which is always positive. REI calculations utilize the user spending and the hatchery production costs to show how much money is stirred up in an economy as expressed in a variety of measurements. The net benefits are expressed as an absolute measure (i.e. the difference) and as a ratio of NEV divided by costs. A ratio greater than or equal to one is synonymous to a calculation result that net benefits are positive. The net benefit results are not so much about the veracity of the number, but providing information about social welfare and production efficiencies.[1] In addition to providing net benefit numbers, this chapter contains interpretive discussions about benefiter social impacts.

The net benefit calculation is more widely referred to as benefit-cost analysis (BCA). It is an economic analysis tool with different complexity levels in its application. A tool advantage is being able to incorporate a time dimension to the NEV and costs. For example, major improvements may be necessary in the future to keep a hatchery in operation. Or there might be planned operation production changes in the future that will influence NEV. There are techniques to account for the future benefits and costs to relate result information to valuations today. A result when there are time dimensions is net present value (NPV). The NPV metric reduces discounted monetary values from timing of future costs to an equivalent value in a current year. There are additional complexities with accounting for indirect effects such as benefiter opportunity costs (for example lost wages from time spent recreational fishing) and lost production in wild stocks.[2] Study resources allowed for a limited BCA application where direct NEV and current year costs are utilized in the calculation. While it is a limited approach, it still provides rich understandings about the provision of a public service.

The public pays for manufacturing a product and it is given away as an opportunity for recreational anglers to enjoy a fishing experience, commercial fishing interests to generate a profit, tribes to use fish for ceremonial and subsistence (C&S) purposes, etc. A measurement for this type of effect is to find the change in social welfare or the value to consumers and producers of this manufactured product.

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[1] CEA discussed in Chapter III, which uses harvest numbers and the cost side of production, can similarly be useful for showing operation efficiencies.

[2] Potential benefits foregone by the choice to use a resource in one way rather than another is referred to as opportunity costs. Sometimes it is difficult to determine on which side of the equation an opportunity cost is placed, let alone determining its size. For example, a fish not harvested has minus benefits from a fishing activity and may have positive benefits from its non-use. However, in the case of hatchery production for sustaining fisheries, that fish may return to the hatchery and not be needed for even broodstock to maintain future populations. Those fish might be donated to food banks, which have value determined by the cost it would take to substitute food. Generally, opportunity costs are on a tier not included in quantitative analysis because they are indefinable and they will cancel their influence on an equation's results.

Trask Hatchery hatch house.

Photo credit Oregon Department of Fish and Wildlife.

The value to consumers (for example a recreational angler) can be measured in terms of their willingness-to-pay (WTP), whereas value to producers (for example a commercial fisheries harvester) can be approximated by the change in net income or profits. For recreational fishing benefits, consumer surplus is the difference in WTP for a heightened experience minus the cost for the existing level of enjoyment. The dollar value information is usually gathered in an angler survey. Questions are asked about additional costs that would be acceptable to catch additional fish. For commercial and recreational fishing, the producer surpluses are the profits realized by businesses. This would include commercial fishing harvesters and processors, recreational angling guide services, lodging businesses, etc.[1]

Other values that could be included in a BCA are associated with non-consumptive uses and non-uses of the resource. An example of a non-consumptive use of the resource is viewing migrating salmon at fish ladder interpretative centers. An example of a non-use is the value people derive from certain resources without ever directly or indirectly using them. These existence values are additive over and above the use values. Only the active use values from recreational and commercial harvesting activities are included in this study's model. The passive use values (i.e. resource non-use) are discussed qualitatively in Chapter VI.

The BCA for this study is referenced as a limited analysis. Not all benefits (such as passive use values) or costs (such as adverse impacts to wild stocks) are considered. Important components of the equation do not have readily available input values nor are they necessarily warranted for inclusion. First, for those effects that can be quantified, the level of uncertainty associated with the estimates is believed to be relatively large. Second, there is incomplete scientific basis for being able to predict biological and economic effects in a short or long term. Because the analysis adopts a single-time approach of potential effects that are near term in nature, study modeling does not take into account adjustments that would be made over time. Despite the limitations, offered BCA should be considered a comparative tool that can provide insight into

[1] For commercial fishing benefits, there is also consumer surplus (difference in WTP for seafood minus what is actually being paid). Economic theory says that prices will rise if the resource supply is constrained, and therefore consumer surplus would decrease as long as WTP stays the same. It is suggested that there are many salmon substitutes, and depending on how discriminating the consumer might be towards the resource, the number of harvested fish being changed will probably not change the price.

the relative magnitude and direction of economic changes associated with hatchery production practices.

Key assumptions used in the BCA are as follows.[1]

- Producer (commercial harvester and processor, and charter boat operator) opportunity costs are undefinable;
- Producer surplus recreational uses, such as from charter boats, guide services, marinas, lodges, and other recreational related businesses, is comparatively small;
- Consumer WTP and existing seafood prices would be unaffected;
- Hatchery labor is comprised of skilled occupations and those occupations are in a ready demand status, therefore, hatchery labor benefits equal labor costs;
- The effects from other user groups and changes to harvest management regimes such as ocean fisheries bycatch, C&S harvests, research, etc. are not applicable;
- Non-consumptive use and non-use values are inconsequential to the quantitative analysis; and,
- Interactions with other fisheries are not economically significant.

The BCA analysis does not attempt to measure State hatcheries program total benefits over time in relation to its costs. It only provides simple one-time estimates of benefits from commercial and recreational harvests and visitors.

The equations to calculate NEV are interchangeable with REI equations described in Chapter IV and are not repeated. NEV borrowed data sources are shown in Table I.1. For recreational fisheries NEV, the studies generating values generally are for surveys that determine WTP for a fishing experience per day.[2] It was necessary to convert fish to days which can suspect value meaning. A fishery with a low catch rate would inconsistently have an average value per fish greater than a fishery with a high catch rate. It could be there are high quality fisheries having a high WTP with low catch. An example (not substantiated with a literature reference) might be the trout fisheries for legal (high catch rate) versus trophy size (low catch rate).

A modeling issue when converting fish to days is that the ocean and freshwater fall salmon fishery is mixed stock coho and fall Chinook, yet survey results identify CPUE singularly for the combined species trip. To determine the conversion, it was necessary to assume a target species for a trip. The target species was coho for the ocean fishery and Chinook for freshwater fishery. The proportion of species NEV is based on the fishery's coho and Chinook catch.

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[1] The assumptions list was prepared by the TRG for the economic analysis of Mitchell Act (MA) hatcheries. TRG used the same BCA methods for that project. The economic analysis report is Appendix I in NMFS (2010).

[2] A recent study of Oregon and Washington ocean recreation fishery was to determine WTP results per salmon catch (Anderson and Lee 2013). Modeled results show WTP for hatchery and wild salmon separately across species, size, and whether or not the fish may be legally retained. For example, WTP values for hatchery Chinook that can be kept are higher than the corresponding values for wild origin. Some anglers indicated that they release wild salmon they could legally keep due to a conservation motive. The differences results were not universally applicable to all the fisheries analyzed in this hatchery economic analysis study.

Fisheries NEV by species is shown in Table V.1. NEV per harvested adult is shown in Table A.6. Fisheries with high NEV per harvested adult include the angler prized Columbia River spring/summer Chinook. The fishery has high demand and low CPUE (Table A.1). The adopted spring/summer Chinook fishery CPUE (11.45 angler days per fish) is from [6]. The adopted coastal coho fishery CPUE (15.00 angler days per fish) is averaged over hatchery and wild origin stocks and has high (41 percent) non-retained catch rate [7].

Net benefits by species is shown in Table V.2. The fisheries benefit cost ratio is positive for all species except summer steelhead at 0.83. Trout fisheries have the highest ratio at 6.33.

Individual hatchery net benefits from fisheries and visitors are shown on Table V.3. All-hatcheries ratios are positive and range from lowest Elk River (1.21) closely followed by Salmon River (1.22) to highest Roaring River (10.61). In general, the hatcheries with the higher proportion of trout production had higher benefit-cost ratios. Also, there is a strong relationship between net benefits and cost per pound at these facilities, with larger facilities having lower cost per pound and smaller facilities having higher cost per pound.

The key variable in calculating net benefits for fisheries is SAR. Figure V.1 shows fisheries net benefit sensitivity to SAR uncertainty. The percent change in SAR for net benefits to be zero are annotated on each species figure. The only species requiring positive movement is summer steelhead. That species SAR would have to be 20.0 percent greater for net benefits to be zero. A more comprehensive approach to net benefit sensitivities would include showing simultaneous NEV variability.

Table V.1
Hatchery Fisheries Net Economic Value by Species

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
NEV fisheries (thousands)	62,129.4	41,531.5	20,597.9	3,204.6	4,767.6	2,062.2	9,480.0	1,083.4
Freshwater	61,768.8	41,531.5	20,237.3	3,138.2	4,689.7	1,846.0	9,480.0	1,083.4
Coast hatcheries	27,931.2	11,111.3	16,819.9	3,138.2	3,866.9	944.5	8,062.0	808.2
Col. R. hatcheries	33,837.6	30,420.2	3,417.4	--	822.8	901.5	1,417.9	275.2
Commercial	35.9	--	35.9	--	1.0	34.9	--	--
Recreational	33,801.7	30,420.2	3,381.5	--	821.8	866.6	1,417.9	275.2
Ocean	360.6	--	360.6	66.4	77.9	216.2	--	--
Commercial	15.4	--	15.4	6.9	8.3	0.2	--	--
Recreational	345.2	--	345.2	59.5	69.6	216.0	--	--

Notes: 1. NEV expressed in thousands of Year 2023 dollars.
2. Columbia River categorized hatcheries include Clackamas, Oak Springs, Roaring River, and Wizard/Falls River.

Table V.2
Hatchery Net Benefits from Fisheries by Species and Visitors

Species	Cost Base Variable	Cost Base Total	Attributed Benefits NEV Commercial	Attributed Benefits NEV Recreational	Attributed Benefits NEV Total	Net Benefits Cost Base Variable	Net Benefits Cost Base Total	Benefit-cost Ratio
Trout	3,707	6,559	-	41,531	41,531	37,824	34,973	6.33
Fall Chinook	1,009	1,549	60	3,145	3,205	2,195	1,656	2.07
Spring/sum Chinook	849	1,688	71	4,697	4,768	3,918	3,080	2.82
Coho	1,101	1,918	251	1,811	2,062	961	144	1.08
Winter steelhead	1,932	3,336	-	9,480	9,480	7,548	6,144	2.84
Summer steelhead	749	1,300	-	1,083	1,083	335	(217)	0.83
Visitors					4,214	4,214	4,214	
Total	9,347	16,350	381	61,748	66,344	56,996	49,994	4.06

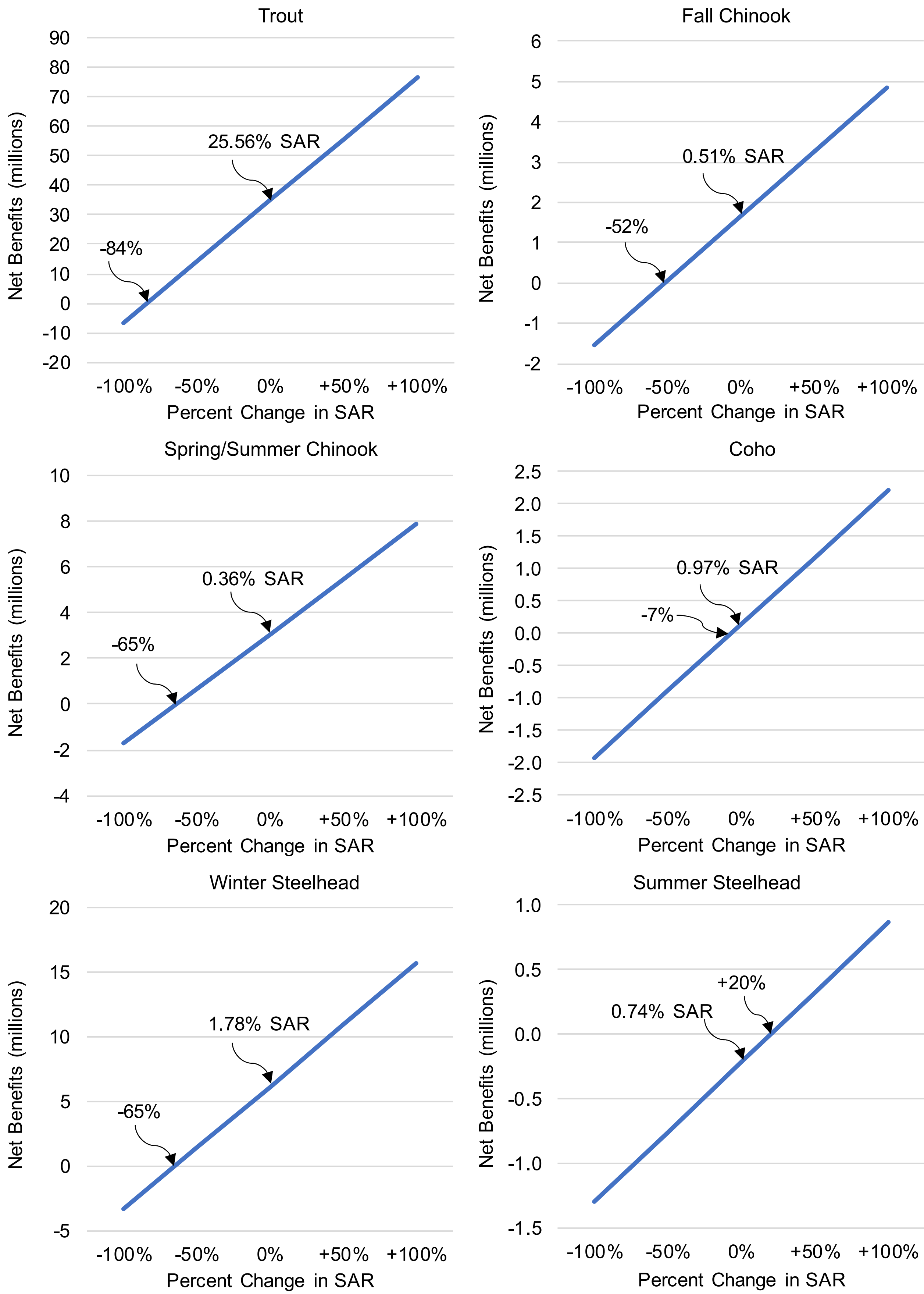
Notes: 1. Cost and NEV expressed in thousands of Year 2023 dollars.
2. Total net benefits are summed fisheries NEV and visitors NEV minus hatchery costs expressed in thousands of Year 2023 dollars.
3. Cost base total includes variable and fixed costs. Fixed costs include annual capital cost contributions.

Table V.3
Individual Hatchery Net Benefits from Fisheries and Visitors

Hatchery	Cost Base Variable	Cost Base Total	Attributed Fisheries Benefit NEV	Visitor NEV	Total NEV	Net Benefits Cost Base Variable	Net Benefits Cost Base Total	Benefit-cost Ratio
Alsea	731	1,297	5,469	125	5,594	4,864	4,297	4.31
Bandon	565	840	1,630	75	1,705	1,140	866	2.03
Cedar Creek	662	1,094	4,603	100	4,703	4,042	3,609	4.30
Clackamas	1,168	1,776	2,371	500	2,871	1,703	1,095	1.62
Elk River	657	1,023	1,178	63	1,241	583	218	1.21
Klamath	576	1,154	4,489	200	4,689	4,114	3,535	4.06
Nehalem	587	971	2,430	138	2,568	1,981	1,597	2.64
Oak Springs	904	1,465	10,951	19	10,969	10,066	9,504	7.49
Roaring River	848	1,301	13,358	450	13,808	12,961	12,507	10.61
Salmon River	697	1,055	1,219	70	1,289	592	234	1.22
Trask	551	874	3,265	300	3,565	3,014	2,691	4.08
Wizard/Falls River	796	1,393	7,986	2,000	9,986	9,190	8,593	7.17
Rock Creek	607	2,107	3,180	175	3,355	2,748	1,248	1.59
Total	9,347	16,350	62,129	4,214	66,344	56,996	49,994	4.06

Notes: 1. Cost, NEV, and net benefits expressed in thousands of Year 2023 dollars.

Figure V.1
Hatchery Net Benefits from Fisheries Sensitivity to SAR Uncertainty



Notes: 1. Annotated SAR is an effective rate used in model for calculating attributed net benefits. Annotated percent change in SAR shows variation necessary for net benefits to be zero.

VI. Passive Use and Cultural Value

A. Passive Use Value

This section will provide a discussion of passive use values.[1] Passive uses pertains to the existence of the fish resource including derivatives for providing an option to use the resource (option value), maintaining the resource for future generations (bequest value), and believing fish should be abundant so that others can benefit (altruistic value). Measuring these values is more complex and their abstract nature makes them difficult to understand, thus it is more troublesome to incorporate them into policy making decisions (Arror 1993).

Economists have defined and occasionally measured values associated with the simple presence of a fish population.[2] The value is reckoned as the amount that people would be willing to pay to assure the existence of a fish stock, or to pay for a specified increase in the fish stock. Unless explicitly specified in the survey questions, study results will not separately account for differences between hatchery and wild origin fish. This is confounded by some hatchery objectives are to restore fish stocks and science findings that hatchery production can adversely impact wild stocks. Policy maker reference to passive use values need to be aware of the dichotomy that may exist in the fish origin valuations.

A survey premise or separate question should also specify the extent of ecological value a responder considers. Anadromous fish play a role in ecosystem predator and prey relationships and ocean/freshwater nutrient transport (Holtgrieve and Schindler 2011). Cederholm et al. (2000) states, "As a seasonal resource, salmon directly affect the ecology of many aquatic and terrestrial consumers, and indirectly affect the entire food web." Without the premise or question, it would be unclear if the determined passive use value includes anadromous fish role in supporting overall ecosystem health or just the consumptive use of fish.

The Bell et al. (2003) study has particular applicability in locality and pertains to enhancing fish runs. The study used a contingent value method to survey three Oregon Coast communities regarding their willingness to pay for local coho salmon enhancement programs. Findings indicate that households were willing to pay $40 to $193 per year (2023 dollars) to prevent the species from going extinct to $35 to $202 per year (2023 dollars) to have high catch rates

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[1] See TRG (2006) for a more full discussion for considering passive use value for hatchery management policy making.

[2] Economic values can be nonmarket (no market information exists), as well as financial (prices exist from markets where traded goods are for well-defined property rights that are exclusive, transferable, and enforceable [Panayotou 1992]). For example, some people (termed non-users) who do not actually fish may still place a value on the existence of the resource. Deriving this value must rely on expressed preference information (either real or hypothetical) gathered through surveys that address the particular setting and policy issues needing decisions. Such values can play a significant role in determining future programs related to the management of a natural resource and should be a criterion in any policymaking. However, they should be used carefully in the decision making because of the difficulties in measuring such values.

depending on the household income (low or high) and the location (Tillamook Bay, Yaquina Bay or Coos Bay).

Layton et al. (1999) created an individual value function for a variety of fish categories (including Columbia basin migratory fish) among Washington residents. Completed for the Washington Department of Ecology, that study developed a means of estimating WTP for any given increase in fish population from an assumed current level, and for two different "without program" fish population projections. For example, for a current fish population of two million and a projected stable future population of two million in the Columbia Basin, Layton et al. (1999) finds that the typical Washington household would be WTP $203 per year (2023 dollars) for a 50 percent increase in the migratory fish population. This value does not distinguish the difference in values between households who fish versus do not fish. With a total of two million households holding such values, the overall average value per fish is $458 (2023 dollars). This particular study's estimate pertains to a rather broad class of fish, including all hatchery and wild origin stocks in the Columbia Basin.

Loomis (1999) developed a marginal (e.g. the value of the next additional fish) WTP benefit function based on increases to salmon populations on the lower Snake River. The study argues the benefit function is representative of the entire Pacific Northwest salmon population. The value that society places on the marginal fish returning to spawn in any one Northwest river is a function of the aggregate count of all salmon returning to spawn in all Northwest rivers. Also, the results indicate that the marginal value goes down as the total population of salmon goes up. EcoNorthwest (January 2009) used the Loomis (1999) study to estimate the passive use value for Pacific Northwest salmon to be annual marginal $1,427 and the average $2,583 (2023 dollars) when assessing Rogue River salmon.

Other passive use value research concerning saving or increasing salmon abundance include Olsen et al. (1990). The study offered different values for salmon and steelhead in different locations (Washington, Oregon, Columbia River Basin). Households were itemized for those that fish and those that do not fish. Households that do not fish had an average WTP of $58 per year to double salmon populations while households that do fish had an average WTP of $158 (real 2023 dollars) to double salmon populations.

The passive use values, no matter how remarkable high and tenuous in their derivation, are important for bringing into perspective active use values. Any passive use value measurement associated with policy decisions affecting fish resources will usually dwarf active use values. A relatively small proportion of West Coast residents participate in fishing while surveys show many households hold value for fish resource existence even though they likely will never participate in salmon fishing or even view a wild salmon (Loomis 1999). It is incumbent on the presenter of the measurement to explain the measurement's applicability, including it not being additive with other measures.

From previous chapter discussions about fish resource active use values and this chapter definition of passive use values, there is a decision necessary on which value to focus on for the fish resource question being addressed. For example, if a particular fish resource is not depleted or threatened with extinction and the action being considered will not adversely impact the fish resource, there is less need to consider the existence value of that resource. Since society would not be deciding whether to allocate scarce resources to restore or save fish, the existence value is less relevant. If the policy decision under consideration is whether to invest resources to increase the fish populations, then the values which are measured will correspond to only the increase in fish numbers. In other words, passive use value would be a less appropriate value to compare with the value of the resources necessary to increase the population by some incremental amount. Given the interconnectedness of fish resource impacts that may occur from decisions about hatchery management, as well as the fact that the existence of some fish populations may be in question, measurements of both active and passive use values can be important to decision makers.[1]

B. Cultural Value

Fish resources can be related to a society's importance beyond its economic value (Ignatius et al. 2019). This is a cultural perspective that recognizes the shared ways in which fish and the fisheries are important to human communities, and does not view values as something inherent to the environment or to individuals. This perspective is not always incorporated into fish resource decision making. Of special consideration is the cultural value tribal communities have for fish resources.

Many tribes live and fish in Oregon. Anadromous fish species and resident fish are interconnected with tribal culture and have been since time immemorial (Sutton 2017). There are nine federally recognized tribes in Oregon and additional tribes that had traditional and customary boundaries in parts of the state of Oregon or had ceded or reserved lands within the state of Oregon; many of which utilize fish occasionally including special occasions (ceremonies, celebrations, funerals, etc.) and for cultural identity (Wilkinson 2000, Quaempts et al. 2018, Earth Economics 2021). Several tribes in the analysis area are party to treaties with the US that reserve tribes fishing rights. These tribal treaty-reserved rights have been held by the courts to include the right to half of the harvestable salmon returning to these waters every year. The U.S. has Indian trust responsibility for all tribes whether or not there are treaties. Trust responsibilities are fiduciary obligations to protect tribal lands, assets, and resources. Several tribes have recently signed memorandums of agreement with ODFW to advance the government-to-government relationships between those tribes and the State of Oregon and enhance tribal sovereignty.[2]

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[1] Naish et al. (2008) discussed hatchery production in context with the political response to societal demands for salmon and steelhead harvest and conservation. They found that economic analysis rarely plays a role in decision making for that response. They conclude that knowledge gaps may have prevented that information from being generated in the past, but suggest that future political responses need not be made in ignorance of significant economic implications.
[2] The ODFW website provides information about tribal relationships and interrelated natural resource policies https://www.dfw.state.or.us/tribal_relations/

State hatchery anadromous fish releases are for returning stocks not generally harvested in Columbia River zones where commercial treaty fisheries occur. However, increases and decreases in hatchery production could have direct or at least indirect impacts to all tribes from necessary fisheries management addressing allocation of changed abundance.

Three examples are offered for State hatchery programs with direct tribal involvement.

- The Yakama Nation, Confederated Tribes of Warm Springs, Confederated Tribes of the Umatilla, and the Nez Perce Tribe hold treaty-reserved access to harvest along the Willamette River. The Willamette Falls area is the ancestral homelands of the Confederated Tribes of Grand Ronde. The treaty fishery tribes in some years will harvest salmon at Willamette Falls to fulfill C&S fisheries needs. Adult returns from Roaring River and Clackamas Hatchery spring Chinook and steelhead releases contribute to the Willamette River fishery.[1]

- The Confederated Tribe of Siletz Indians operates the Lhuuke Illahee Fish Hatchery near Logsden, Oregon. Tribe members volunteer for the maintenance, feeding, rearing, and adult recovery at the hatchery. This offers an opportunity for education and work experience. Tribal members become involved in indigenous cultural practices. Winter steelhead adult returns contribute to the Siletz River recreational fishery. The program provides up to 5,000 smolts from Siletz River wild winter steelhead broodstock spawned and reared at the Alsea Hatchery.

- The Coquille Indian Tribe members participate in Coos River fall Chinook broodstock capture. The Bandon Hatchery rears up to 100,000 fall Chinook fish to pre-smolt size for transfer to Coquille Tribe facilities for acclimation and release into Fourth Creek. The Bandon Hatchery also raises smolts to a larger size for release in other locations in the Coos River basin. ODFW provided approximately 70 adult (1,050 pounds) spring Chinook to the Tribe from Cole Rivers Hatchery for tribal subsistence and ceremonial use. Approximately 500 additional pounds of fall Chinook was provided from Bandon Hatchery for tribal subsistence and ceremonial uses.

Distribution of fish from hatchery programs with tribal involvement is directly affected by levels of hatchery production. Changes to hatchery production as well as changes in environmental conditions could reduce the number of salmon and steelhead available for tribal use.

C. Environmental Justice

This study is an economic analysis about status quo conditions, but if there was change in hatchery practices then environmental justice impacts would be a consideration. It would be

[1] The Clackamas River is a tributary to the Willamette River several hundred yards below Willamette Falls.

necessary to identify an analysis area and its characteristics.[1] Then connect the action being analyzed to how potential harm and benefits will impact the identified communities.[2] There are relevant impact categories that can be discussed for imaginary production actions: how hatcheries contribute to employment, food subsistence, and fish as a traditional cultural resources. Other impact categories that are indirectly related to environmental justice considerations are from hatchery operations requiring extensive electric power purchases, fresh water use, fish feed consumption, and are a pollution source (such as requiring holding pond discharge treatment). These other categories deserve mention but are not explored in this report.

Given the wide dispersal of State hatcheries and where fishing opportunities from releases occur, the analysis area adopted are county boundaries within the State. County boundaries should have sufficient granularity so as not to dilute or inflate discussed impacts. Special mention of tribal impacts (ecological, cultural, human health, economics) should be added to the more general population impact categories. Several relevant social and demographic characteristics for all 36 counties are shown on Table A.7 and for counties where State hatcheries are located on Table VI.1. For example, there would be concern if any of the hatchery located counties are determined to be minority (Native American or Hispanic) or low-income (families below poverty level) using criteria for percent minority, poverty rate, or income compared to the State reference area. All of the hatchery located counties meet the test except Clackamas (Clackamas Hatchery) and Deschutes (Fall River Hatchery). Jefferson County where Wizard Falls Hatchery is located has the highest percentage of Native American and Hispanic population, highest rural population and highest incidence of family poverty rate.

Hatchery intensity indexes are shown on Table VI.1. The salmon commercial pounds index is ranking of landings at ports summed to be within counties. Clatsop had the highest landings and Tillamook had the lowest of all counties that had landings in Oregon. The recreational fishing expenditures (travel and day trips in Runyan 2023) index are rankings (using five categories) of reported expenditures divided by county population. An index of 5 means the highest per capita expenditures and 1 means the lowest per capita expenditures. Many of the hatchery located counties had high index scores for recreational fishing.

In Oregon, the major landing harbors are located in Clatsop, Tillamook, Lincoln, Coos, and Curry counties. In recent years Newport and Coos Bay have had the highest salmon landings (PFMC

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[1] Environmental justice State definition (ORS 182.535 Section 3) means the equal protection from environmental and health risks, fair treatment and meaningful involvement in decision making of all people regardless of race, color, national origin, immigration status, income or other identities with respect to the development, implementation and enforcement of environmental laws, regulations and policies that affect the environment in which people live, work, learn and practice spirituality and culture. There is a similar definition in federal laws: Executive Order 12898 and Title VI of the Civil Rights Act of 1964.

[2] “Environmental justice community” includes communities of color, communities experiencing lower incomes, communities experiencing health inequities, tribal communities, rural communities, remote communities, coastal communities, communities with limited infrastructure and other communities traditionally underrepresented in public processes and adversely harmed by environmental and health hazards, including seniors, youth and persons with disabilities (ORS 182.535 Section 4).

2023). The communities where these harbors are located are in lower than average income level counties. In 2021, per capital average personal income for the State was $61,596. All of the affected coastal counties have average income levels less than $55,000, with the exception of Coos County which was less than $60,000. Jobs in the counties include employment in fishing industry occupations at harvesting and processing business. Many of the jobs are part-time and remuneration levels have a wide range. Remunerations are connected to catch levels since pay is a share of harvest value. Processing work occurs when processors receive fish deliveries. It can be assumed some fishing industry participant households are in the lower income levels. Any lessened commercial catch due to lessened hatchery production has the potential to affect those households.

The counties where hatcheries are located are rural with average income generally lower than statewide. While the jobs at the hatchery are skilled occupations with competitive wage levels, the multiplier effect of these jobs will mean occupations with lower wage levels can be affected. Recreational fishing trips motivated by hatchery fish abundance (expectation of satisfying catch rates) occur in the hatchery located counties. Recreational fishing economic impacts affect jobs in the visitor industry. Those jobs will be tiered with lower wage and salary level categories. Lessened hatchery production will lower angler spending due to lowered motivation to make trips. The lowered spending will potentially affect income being received by households of concern.

Hatchery programs distribute some collected fish to food banks or food share organizations. And if requested, will supply fish to tribes for ceremonial and subsistence purposes. The counties of concern benefit from the distribution and any lessened hatchery production will have adverse impacts.

All tribes in the analysis area could be impacted by changes in hatchery production. However, assessing these impacts from an environmental justice perspective would require input and information from those tribes and that investigation is beyond the scope of this analysis. The impacts to tribes from a cultural value perspective is addressed in this chapter's Section B.

Table VI.1
Hatchery Located Counties Social and Demographic Characteristics in 2021

				Population Percent									Recreation
				Minority					Individuals	Percent		Salmon	Fishing
			Per	Non-Hispanic					Below	Housing With	Percent	Commercial	Expenditures
			Capita		Native		Hispanic	Rural	Poverty	Inadequate	Families	Pounds	Total Per
County	State Hatcheries	Population	Income	White	American	Other	(all races)	Population	Level	Plumbing	in Poverty	Index	Capita Index
Clackamas	Clackamas	418,577	45,140	79.9%	0.4%	10.6%	9.1%	17.1%	7.5%	0.4%	5.0%	--	1
Coos	Bandon	64,619	31,824	84.1%	1.9%	7.0%	6.9%	38.1%	16.3%	0.5%	11.7%	3	4
Curry	Elk River	23,234	34,302	84.9%	1.3%	6.2%	7.7%	51.8%	13.2%	0.5%	7.9%	2	4
Deschutes	Fall River	194,964	40,778	86.0%	0.5%	5.1%	8.3%	29.2%	9.4%	0.4%	6.0%	--	3
Douglas	Rock Creek	110,680	28,293	86.3%	0.9%	6.6%	6.2%	40.4%	13.8%	0.8%	9.1%	--	3
Jefferson	Wizard Falls	24,232	28,140	57.1%	13.0%	9.3%	20.6%	67.0%	14.9%	1.2%	13.7%	--	3
Klamath	Klamath	68,899	27,701	76.0%	3.1%	6.9%	13.9%	37.8%	19.1%	0.7%	13.0%	--	3
Lincoln	Alsea, Salmon River	49,866	32,776	80.8%	2.0%	7.5%	9.7%	38.0%	13.8%	0.5%	8.4%	4	5
Linn	Roaring River	127,200	29,598	83.7%	0.6%	6.1%	9.7%	34.2%	11.8%	0.4%	7.2%	--	2
Tillamook	Cedar Creek, Nehalem, Trask	27,129	31,501	83.3%	0.8%	5.3%	10.6%	60.7%	13.6%	0.3%	9.2%	1	5
Wasco	Oak Springs	26,603	33,982	73.2%	2.4%	5.0%	19.4%	34.8%	9.7%	0.3%	5.4%	--	5
State		4,207,177	37,816	74.1%	0.8%	11.6%	13.6%	19.5%	12.1%	0.5%	7.5%	0	2

Notes: 1. Salmon commercial pounds index is ranking of landings at ports summed to be within counties. Clatsop had the highest landings and Tillamook had the lowest of all counties that had landings in Oregon.

2. Recreational fishing expenditures (travel and day trips) index are rankings (using five categories) of reported expenditures divided by county population. An index of 5 means the highest per capita expenditures and 1 means the lowest per capita expenditures.

VII. Sustainable Funding

A. Financing Options

The primary purpose of the economic analysis was to show the economic value from enhanced fishing opportunities due to State owned hatchery production. Values include economic effects from hatchery visitation and hatchery operations. A review of hatchery budget revenue sources and cost trends raised questions about State hatchery operation's financial stability. Chapter II discusses the pending financing crunch from decreasing revenues from license and fee sales and increasing costs of production all the while trying to satisfy objectives for constant production. This chapter provides an identification of possible financing techniques to deal with the crunch. Discussions delve a little deeper into price increase for fisheries access fees. The discussions are brief and are presented without recommended prescriptive actions.

It is suggested that a hatchery financing planning study be undertaken that will offer a range of feasible alternatives accompanied with social and economic impact analysis. The options identification and brief discussions in this report is not sufficient review for financing plan decision making. The alternatives would include a variety of methods other than just traditional sources of income secured through biennium legislature approved budgets. The methods could address: (1) increasing revenues from existing sources (e.g. through greater general fund appropriations or higher license and fee prices); (2) establishing increasing revenues from new sources (e.g. special mitigation or land/water development assessments); (3) increasing efficiencies or lowering production levels to lower costs; and/or (4) shifting production responsibilities to other levels of government, public-private ventures, or other entities (e.g. tribes, STEP organizations, etc.).

As the ODFW mission evolves to reflect the public's growing concern regarding natural resource protection (ODFW and OCRF 2023), existing hatchery objectives and programs should be reviewed for better alignment with fund source purpose. For hatchery production consumptive uses, there may be a need to place more emphasis on local fishing opportunities. In such case, there may be avenues for increased funding for hatchery based programs through license and fee increases such as spatial-based harvest cards. General revenue funds may be the more relevant funding source when raising priority for hatchery conservation programs aimed at sustaining species.[1] General fund justification is also from the other non-consumptive hatchery benefits such as the economic benefit to rural underserved communities and providing education opportunities.

When it can be shown hatchery public benefits (such as from rearing fish for conservation purposes) compared to fisheries direct use benefits are high, then there can be more acceptance for general fund and even innovative financing techniques. An example innovative

[1] The ODFW Hatchery Management Policy (OAR 635-007-0542) provides general fish culture and facility guidelines. The policy describes best management practices that are intended to help ensure the conservation of both naturally produced native fish and hatchery produced fish.

financing technique might be securing dedicated funding from sumptuary taxes or lottery fund distribution. Both examples have voter-approved beneficiary distributions and a legal interpretation would be necessary to show hatchery funding qualifies within an existing distribution category. Using findings in this report shows hatchery operations have major REI therefore hatchery support might satisfy qualifying criteria for lottery fund economic development distribution. Another example innovative technique is related to mitigation. Where future water and land development actions (such as energy generation or major industry siting) have a purported connection to fish resource recovery or fisheries interruption, siting approval mitigation agreements for hatchery funding might be justified. Whether or not there is fish recovery hindrance or fisheries impacts, development sponsors may appreciate the positive public relations benefits from the extra taxation.

The suggested financing planning study would use analytical procedures to identify opportunities, constraints and payoffs from applying innovative techniques in specific situations.[1] The new study scope would include descriptions of the advantages and disadvantages of each financing approach. The planning study would review optimizing assets in concert with recommended facility efficiency improvements. For example, increasing operation scales through centralization may show fish transfer costs can be decreased.

To help envision a financing planning study scope, an evaluation matrix is provided for example techniques that fall within the above mentioned four methods (Table VII.1). The listing of example financing sources is grouped to hatchery objectives (conservation, fisheries enhancement, mitigation), benefaction and hatchery management (such as public-private cooperative agreements).[2] Evaluation results for implementation promise are shown using criteria for financing capacity, institutional feasibility and probable private/public acceptance. Each technique's potentiality assessment is provided using circled filled icons. Readers' own scoring is encouraged to add critical thinking about how the pending financing crunch can be overcome with more sustainable funding. Offering this evaluation matrix only highlights considerations for applying the techniques and does not supplant the necessity for detailed analysis and impact explanations.

Not all of the identified techniques are necessarily used in Oregon nor at other states for hatchery operation and capital improvement financing. While all seem workable, the selected options to pursue need additional review for legality and whether there is upfront political support. Most will need to be elevated to legislative statutory review for implementation. Using the shown evaluation criteria, the most promising is increasing license and fee prices. Even for that option, the financing technique should have additional review for increased price market

[1] Investigating innovative financing techniques should include identifying “free riders.” Is there a sector or group benefiting from hatchery production but not providing an equitable share of support? A free rider example is the discounted license and fee schedule based on age. The discounts are legislative decisions and the subsidy is borne by other hatchery revenue sources such as licenses and fees paid by fisheries direct users.

[2] OAR 635-009-0410 recognizes there may be a Cooperative Salmon Hatchery Program approach to hatchery production in order to provide harvest opportunities for Oregon’s citizens. The approach may be a way to develop new sources of revenue or support for hatchery production.

tolerance. Following sections in this report discuss the license and fee price increase option in more detail.

Discussions about funding techniques in this chapter do not have an all-hatchery system wide perspective. It is a myopic look at sourcing funds more aligned with State hatchery benefiters. There could be consequences from changing license and fee price structures even with mechanisms designed to target fisheries direct users. The suggested financing planning study would more appropriately have the system wide scope. At that level, there could be better accounting for how centralized services (headquarter administration, coordination and support) are shared among all hatcheries.

B. Current Funding Issues

State owned hatcheries primary purpose is to enhance Oregon fishing opportunities. To that end, it is expected funding should reflect support from those that benefit (Trushenski June 2018).[1] Benefiters would include in no particular order: (1) commercial and recreational fishing participants, (2) tribes using fish for C&S, (3) local entities and organizations appreciating the education opportunities and economic development aspects from local hatchery operations, and (4) the public concerned about fish species conservation. Moving towards sustainable hatchery funding can mean not only fiscal adaptation to better balance benefiter funding, but also will mean emphasis that hatchery operation services are being delivered with highest efficiency given trending environmental conditions. Climate change causing new environmental conditions will require planning and provision for new facilities and operations.

Other State hatchery review contractors are addressing facility and operations actions needed for making efficiency gains, taking care of deferred maintenance items, and addressing climate change challenges. This chapter discusses fiscal adaptation possibilities for hatchery sustainable funding. Flows from general fund support is a central issue because of the tradeoff use of those funds for other State government services. Better aligning benefiter support requires looking at mechanisms to better extract equitable payments to financially support enhancement hatcheries. A review of other surrounding states hatchery financing is included to discern if there is a better financing template.

The general fund revenue support for all ODFW managed hatcheries is eight percent (Table II.1) and 22 percent for the 14 State owned hatcheries (Table II.2). License and fees revenue support are 13 percent and 52 percent, respectively. The balance of revenue support is federal and other external programs. While use of general funds is justified because fish being produced is a public resource, the fisheries direct active use benefiters are mostly an isolated society segment. There is the view that benefiters should have a higher stake in the funding from which

[1] The concept of a "user-pays, public-benefits" program in which those who consumptively use the resource pay for the privilege is the funding approach promulgated by The American System of Conservation Funding. Additional information about the program is at: https://www.fishwildlife.org/afwa-informs/resources/american-system-conservation-funding.

their proportion of benefits is being derived. If State hatcheries general fund support is eliminated, the deficit for the model year is $2.7 million assuming all other funding source amounts are constant.

C. Surrounding States' Hatchery Funding

Surrounding state hatchery funding is not unlike Oregon's approach with a mix of state derived revenue combined with federal and external sources. (See Appendix C for surrounding state hatchery locations and budgets.) Each state uses a hatchery cost center to track revenue distribution and operating expenditures. The following summaries are states' hatchery budget amounts and production levels. The budgets do not include depreciation or annual capital contributions. The descriptions are not inclusive of federal (not operated by states) nor tribal hatcheries. The summaries include descriptions for major capital improvement funding approaches. Example recreational license and harvest card current price are provided. Like Oregon, there are other endorsement and fisheries access fees at the other states.

- Washington Department of Fish and Wildlife (WDFW) operates 80 hatcheries including ancillary facilities with total FY 2024 budget $69 million. Revenues are State general fund 36 percent, local government and utility districts 23 percent, federal 26 percent and other 15 percent. (Washington State statewide and local government general fund is primarily from sales and use taxes.) When fisheries related license and fee revenues are itemized, the revenues are 11 percent of total hatchery production costs. The majority of local funding contracts are mitigation based, but there are some driven by conservation and tribal co-management responsibilities. These non-mitigation contracts are for specific propagation programs and services such as marking and tagging. Another example of non-mitigation local funding contract is a cooperative agreement with a non-profit entity for a trout hatchery. Total anadromous and resident fish target releases were 187 million and 16 million respectively in 2023. The current angling resident license and salmon/steelhead harvest card fees are $69.55 and $12.60.

  Hatchery heavy maintenance and facility improvement funding is usually through legislature appropriations for individual projects using the State's bonding capacity. Federal sources are exploited when available. For example, the current budget includes a large Inflation Reduction Act (IRA) grant for two major improvements at Mitchell Act funded hatcheries.

- Idaho Department of Fish and Game (IDFG) operates 19 hatcheries that had a FY 2024 budget of $18 million. There was no State general fund support. Licenses and fee revenues are 32 percent and the balance is federal. Hatchery target releases in 2023 were 30 million anadromous and trout species. The current angling resident license and salmon/steelhead harvest card fees are $30.50 and $15.25.

  Funding for hatchery improvements varies on whether it is an anadromous or resident fish hatchery. Improvements to resident fish hatcheries are primarily funded with IDFG license funds. Five dollars from each fishing license sold is earmarked for construction, repair, or rehabilitation of state fish hatcheries, fishing lakes or reservoirs, or for fishing access. There is a base (recurring annual) appropriation to spend license dollars on deferred maintenance at hatcheries. Improvements to anadromous fish hatcheries are funded from a couple of sources in addition to license funds. Federal funded hatcheries include support from such programs as BPA, SRA, and LSRCP. There are other anadromous non-federal funded hatcheries such as those supported by the Idaho Power Company (IPC). IDFG works with the federal and non-federal entities to implement hatchery improvements when needed. Major improvements to anadromous fish hatcheries may require a request for legislative appropriation to spend the federal or non-federal funds.

- California Department of Fish and Wildlife (CDFW) operates 22 hatcheries. Their FY 2024 budget is $52 million. State general fund support is about 12 percent and fishing license fee support (California Hatchery and Inland Fisheries Fund) is 50 percent. Hatchery target releases for 2024 are 48 million total (38 million anadromous and 10 million trout). Statutes require one-third of all sport fishing license fees collected to be used for hatchery operations. The current angling resident license and salmon/steelhead harvest card fees are $61.82 and $18.36.

  Major hatchery improvements are funded through a variety of sources. There have been significant one-time general fund appropriations in the last few years. There also has been a variety of bond funding for hatchery upgrades/construction in the past. CDFW also utilizes Fish and Game Preservation Fund, Hatchery and Inland Fisheries Fund, and Federal Funds to make hatchery improvements. Any type of alternative funding typically still requires legislative action/approval for CDFW to receive the required appropriation authority to bring in the funds and/or expend them.

Each surrounding state's hatchery objectives have overlays for mitigation, fisheries augmentation, and stock conservation. Hatchery size and species production varies widely. WDFW production alone is more than ODFW, IDFG and CDFW combined. WDFW has the most diverse funding sources compared to the other surrounding states. Funding does have comparatively high support from general funds and mitigation. There is a WDFW example for non-profit entity funding support. IDFG emphasizes no general funds are used for hatchery operations (personal communication August 2024). CDFW treats general fund revenue with flexibility. In some years, the line item has been negative when other line items have unexpected higher amounts than budgeted. The three surrounding states financing templates are specific to a state's taxation policies, mitigation driven responsibilities and/or are similar to ODFW budgeting. While specific, the financing structures can be illuminating for showing a modified ODFW approach to State hatchery funding requirements.

D. Financing Option for Increasing Fisheries Direct User Payments

This section's discussion for sustainable funding does not address an assignment of hatchery costs among all benefiters. The discussion only addresses how fisheries direct user benefiter revenue generation mechanisms might be relied upon for increased revenue. It is noted license and fee revenue reliability is a concern since angling per capita participation has been on a downward trend and increased license costs could exacerbate the reduced demand (ODFW October 2023(b), Four Peaks August 2024).

Assigning fisheries direct user or other benefiters funding responsibilities would be consistent with the well-established utility principle of cost recovery. This thinking suggests an apportionment of hatchery costs would correspond with benefits received. This would spread support liabilities among fisheries direct users (e.g. through licenses and fees), special interest groups (e.g. non-profit entities, tribes, etc.), and the public (e.g. through the general fund revenue source). The links to public benefits from enhancement hatchery production is through fisheries direct user downstream positive economic effects (i.e. multiplier effects) and conservation values balanced against adverse impacts to wild stocks.[1]

The spread of fisheries direct user funding responsibilities is shown in the following table (based on numbers from Table VII.2). Commercial and recreational sector funding liabilities are proportioned to benefits received (NEV) or associated with fisheries production cost (cost per harvested adult times catch).

	Associated Funding Liability	
Fisheries	Proportion of Benefits Received	Production Costs
Commercial		
Anadromous	0.1%	0.1%
Recreation		
Anadromous	33.1%	59.7%
Trout	66.8%	40.1%

The association shows the high recreation fisheries participants singular liability responsibilities. A funding issue is the overlapping responsibility when anglers participate in both anadromous and trout fisheries. Anadromous fisheries are more specialized in gear and fishing modes and more expensive to pursue (trip costs). There are revenue generation mechanisms that could target the fishery such as through prices and features on harvest cards to avoid penalizing the non-anadromous fishery participants.

[1] Without in-depth research, it would be conjecture on the sign (positive or negative) and magnitude of enhancement hatchery public benefits when adverse impacts to wild stocks balanced with conservation benefits from supplementation and restoration are considered. Regardless, it is recognized enhancement hatcheries have social and economic benefits from preserving fishable stocks, community economic development from angler and hatchery spending, contributions to tribal interests, and the provision of education opportunities.

The current example angling license price and sales activity in 2023 is resident $44 with 201,775 sold. There are many other nonresident, age, hunting combination, and term angling license types. Figure VII.1 shows real dollar angling license and fees revenue generation trends from 2014 to 2023.[1] The figure shows the price increases that have occurred during that period. Angling license and fee per capita sales have been decreasing in recent years except for a COVID related bump-up in years 2020 and 2021. Increased fishing activity during COVID years was associated with stress relief and driven by the perceived safety of social fish distancing (Midway et al. 2021). State population increases have helped maintain absolute revenue trends.

There was a surcharge imposed on angling license fees in 1989 by the legislature to fund the restoration and enhancement (R&E) Program. The R&E Program provides benefits to all of Oregon's fish species, both freshwater and marine, that provide recreation and commercial fishing opportunities (ODFW 2023c). The angling license surcharge ranges from $1 to $10 depending on residency of other license types. There is also a commercial gillnetting and troll fishing permits fee ($74 and $65, respectively) and landing fee ($0.04 per pound) dedicated to R&E Program (see below commercial fishing taxation discussion). The fees have raised on the order of $2.2 million annually depending on license sales and anadromous fish commercial landings. The Oregon hatchery system has been a major recipient of the R&E Program funds. (See Table B.4 for a recent list of State hatchery improvement projects funded by the R&E Program.)

Trout fishing is pervasive across the state. The most obvious mechanism to increase revenue would be a surcharge on an angling license although other possibilities exist such as a new harvest card.

For recreation anadromous fisheries, Oregon has a combined (salmon/steelhead, sturgeon, halibut) angling tag with the following example price and sale activity in 2023: $46 resident and 106,651 sold. The tag authorizes wild/hatchery harvest of 20 salmon or steelhead per year. There is also a salmon/steelhead hatchery harvest tag with 2023 sale activity: $33 resident and 6,547 sold. The tag is to be used for hatchery harvests greater than 20 fish per year. The harvest tag sales from all harvest tag types excluding SportsPac sales was $5.7 million in 2023. An increased revenue financing mechanism could be changing the cost on one or each of the tags. For an example when not considering price elasticity, a 20 percent increase on all tags would raise an additional $1.1 million in 2023. If purchase of the hatchery tag was mandatory for resident and non-resident combination tag holders at same price with inelastic demand, the amount raised would be an additional $3.6 million in 2023.

There is very little revenue generation liability that is associated with commercial fisheries. The State hatchery commercial fisheries harvest sector DV is $384 thousand which was five percent

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[1] National and state level trends in fishing license holders and sales is at a U.S. Fish and Wildlife Service (USFWS) maintained website. An interactive dashboard provides options for showing trends nationally and for each state. Use Internet search keywords "USFWS Dashboard License and Apportionment Data" without quotes to find the website.

of total salmon fisheries harvest value in 2021 (2023 dollars). The commercial salmon fisheries have an ad valorem fee (3.15 percent). The fisheries also have salmon and steelhead poundage fees for R&E five cents per round pound and an Oregon Hatchery Research Center (OHRC) four cents per round pound. The revenue raised from all commercial salmon and steelhead landings in Year 2021 (expressed in 2023 dollars) for the ad valorem, R&E, and OHRC was $228 thousand, $90 thousand, and $72 thousand respectively. The State hatcheries associated liability would be $12 thousand, $5 thousand, and $4 thousand respectively. It would only be necessary to redirect all salmon and steelhead ad valorem fee a minimal amount to satisfy the commercial fisheries liability.

Targeting fisheries direct users to raise funds dedicated to hatcheries will be controversial. There will be duplicity criticism because angling license and fees have already been surcharged to be used partially for hatchery improvements. Market sensitivity for price increases will be tested. Existing license and fee prices are comparable in Washington and California which may signal maximum price acceptance. A roll-out of price increases would be better received if connected to commensurate costs being incurred and/or shown to have demonstrated loss of other revenue sources. It will help if there is additional information about the increased responsibilities for how ODFW is embracing stewardship and innovation to address operation challenges, hatchery reform, and climate change.

Previously discussed findings show high WTP values per fish and in aggregate (Table V.3). The political will to shift funding burden could rely on those findings, but there will still be stakeholder resistance to raising fees. Fisheries direct users are habituated to comparatively low cost access to fish resources. There will be arguments promulgated that users pay in other ways that make their existing share equitable (for example State income taxes, gas taxes, excise taxes on fishing gear and boats, etc.). There is a significant imbalance between the hatchery production cost per harvested fish and any direct and indirect layered fisheries access fee accounting (Table III.3). Taking steps to resolve the imbalance through benefiter fee increases will make further progress for enhancement hatchery sustainable funding.

The license and fee financing examination assumes State hatcheries will continue to be primarily for fisheries enhancement. Given research findings about the impact of mixing hatchery and wild stocks, it could be there will be policy questioning about State hatchery objectives. If wild populations continue to decline and stressed under climate change, using hatchery production effectively to sustain natural salmon production, provide fishing opportunities, and meet public values will become increasingly important (Terui et al. 2023).

License and fee revenue is distributed across many programs to carry out ODFW missions. It could be marketing studies would show that fisheries participant extracted revenue has maximized (due to price elasticity). In this case, it will be necessary to pursue other hatchery financing options as well as exploring reprioritization for how license and fee revenue is shared across programs.

E. Funding Discussion

A broad range of financing options have been identified. Pursuing any of the techniques will need to be intensively investigated and vetted by stakeholder groups. Ultimately the changed financing approach will need Oregon Fish and Wildlife Commission approval and legislative action. Any increased fisheries access fees would need to be reviewed for distributional impacts and environmental justice. A concern is that it will be regressive taxation harming proportionally more low-income households.

The review of existing license and fee schedules shows the modest changes that would be needed for general fund replacement funding. The example is for status quo State hatchery financing and does not take into consideration other methods to preserve fisheries opportunities. The other methods could be through a combination of fisheries management changes, making habitat improvements, and continued hatchery reform leading to increased wild fish production. Only reviewing the status quo does not include what might be savings from individual hatchery closings nor throttling hatchery production.

The realities of the fiscal situation is falling revenues from the license and fee revenue source, increasing hatchery operation costs, and facilities reaching their life cycle end. The hatchery financing crunch is giving urgency to making system strategic planning decisions. Finding a combination of methods to increase revenue will not be straightforward. Estimating the amount of increased funding is complicated by any other funding sources having variability. Federal funds can change depending on national spending policies. While general funds are accompanied with scrutiny, they are a dependable source subject to continued biennium legislature approved budgets.

It was suggested a hatchery financing planning study be undertaken that offers a range of feasible alternatives that are accompanied with social and economic impact analysis. A financing options evaluation matrix was provided with only brief discussion about methods and results. Offering the matrix highlights considerations for implementing the options, but is not a substitute for necessary detailed analysis and impact explanations. More decision making information about option packaging is necessary.

Table VII.1
Sustainable Funding Option Considerations

Financing Options, Grouped	Consideration	Evaluation Criteria: Financing Capacity	Evaluation Criteria: Institutional Feasibility	Evaluation Criteria: Private/public Acceptance
Conservation				
General fund	Investments should be tied to conservation objectives; abstract value measurements for getting public support	●	●	◔
Lottery fund	Requires resetting allocations if dedicated for hatchery O&M; competitive with other allocation recipients; already used for ODFW non-hatchery services (management, monitoring, permitting, coordination, etc.)	◕	○	◕
Sumptuary taxes	Misdirected environmental taxation; concern regressive tax that discriminates against lower class	◕	◒	○
Enhancement				
License/harvest card	Priority for other ODFW functions; price elasticity concerns if price increased; already surcharged for hatchery capital improvements	◕	●	◕
Community (funding)	Unprecedented for other than mitigation; justified for hatchery local education opportunity and economic development benefits	◔	◔	◕
Tribes	Co-management and cooperative agreements for operations possible; facilities typically tribal ownership	●	◕	◕
Mitigation				
Habitat degradation	May require revisiting past arrangements for land developments and water withdrawals; potential for one-time development fees	◔	○	◔
Fisheries interruption	Example new energy generation and transmission facilities; requires burden of proof for impacts	◕	○	◔
Benefaction				
Perpetual	Endowments can legally restrict donated funds for certain uses	○	◔	◕
One-off	Not appropriate for ongoing O&M, more relatable to capital improvements.	○	◔	◕
Management				
Public-private venture	Cost effectiveness questions	◔	◔	◕
Other entity operate	Requires training and monitoring	◕	○	◕

Evaluation Criteria

Financing capacity - dependable amounts for ongoing O&M costs.
Institutional feasibility - successful statutory review, passes legal interpretations, has precedence
Private/public acceptance - probable positive feedback from industry and fisheries representatives

Legend for Potential

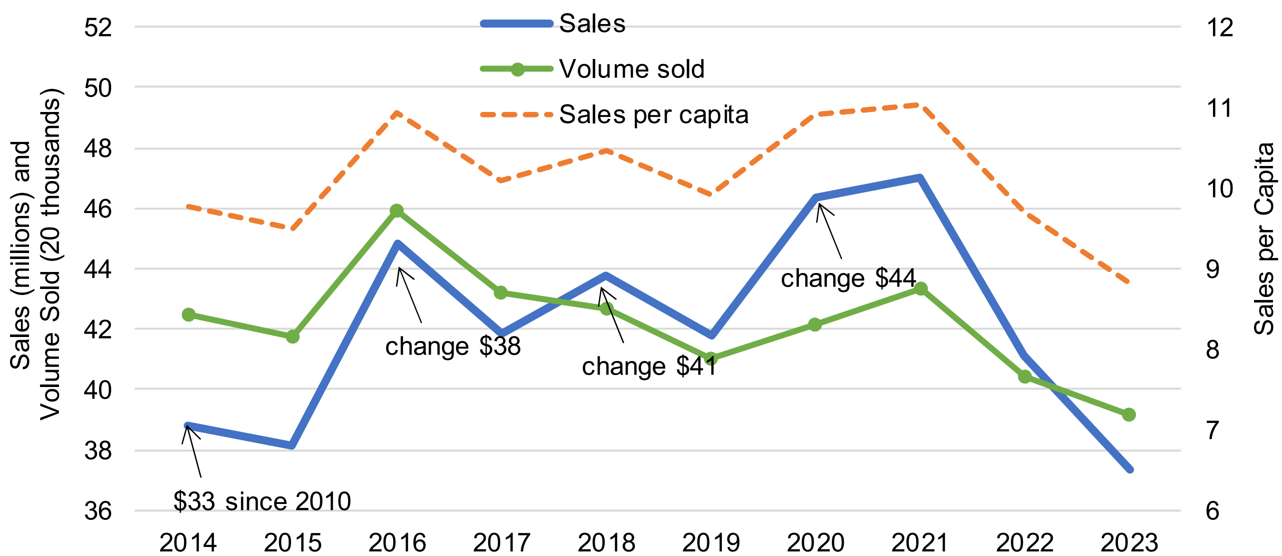
- ● High
- ◕ Moderate
- ◒ Perhaps
- ◔ Unlikely
- ○ Low

Table VII.2
Hatchery Fisheries Benefiter Funding Liability Associated with
Proportion of Benefits Received and Production Costs

Benefiter	Anadromous NEV		Anadromous Costs		Trout NEV		Trout Costs		Total NEV	Total Costs
Commercial	51.3	0.1%	24.4	0.1%	-	-	-	-	51.3	24.4
Recreation	20,546.6	33.1%	9,766.4	59.7%	41,531.5	66.8%	6,558.9	40.1%	62,078.1	16,325.3
Total welfare	20,597.9				41,531.5				62,129.4	
Total costs			9,790.8				6,558.9			16,349.7

Notes: 1. NEV and production costs are thousands 2023 dollars.
2. NEV from Table V.1 and costs are from Table II.4.

Figure VII.1
Angling License and Tag Sales with Price Changes in 2014 to 2023



Notes: 1. Absolute and per capita sales are real 2023 dollars.
2. Shown sales revenue includes all resident and non-resident licenses for basic angling licenses, youth and senior licenses, resident and non-resident uniformed services licenses, all daily and multiple day licenses, all harvest and hatchery harvest tags, two-rod endorsement, and all SportsPac and combination (license/tag) licenses. There are other required endorsement and access fee revenue not included.
3. Annotated license price change years are for basic resident angling license. Other license and tag prices generally changed on those dates.

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Appendix A
Economic Analysis Model Inputs

Table A.1
Fisheries Recreational Success Rates

	Anadromous Species				
	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Success rates					
Coast inland	6.00	7.50	15.00	4.00	4.00
Columbia River	3.19	11.45	3.19	3.19	3.19
Ocean	7.47	7.47	1.67	--	--

Success rates for trout by hatchery

Hatchery		2005
Cedar Creek	legals	0.42
Nehalem	legals	0.42
	trophy	1.05
Alsea	legals	0.42
	trophy	1.05
Bandon	trophy	1.05
Elk River	legals	0.32
	trophy	1.05
Salmon River	legals	0.42
Rock Creek	legals	0.32
	trophy	1.05

Notes: 1. Success rates are expressed as number of days per fish retained.
2. Trout CPUE is a function of site release quantity in days per fish.

Sources: TRG (June 2024) for coast inland [7]; TRG (November 2014) for Columbia River [8]; PFMC (February 2024) for ocean Chinook and coho (weighted average 2013-2022) [6]. ODFW (2014) for trout [5].

Table A.2
Hatchery Rearing Life Cycle Duration and Growth Size

Species	Life Cycle	Release Size (fpp)	Transfer/Release Duration (months)
Trout	Eyed-eggs		3
	Fingerlings	200	10
	Legal	2-3	22
	Trophy	0.5	34
Steelhead summer	Eyed-eggs		3
	Fingerlings	200	6
	Smolt	4-6	18
Steelhead winter	Eyed-eggs		3
	Fingerlings	200	5
	Smolt	4-6	16
Fall Chinook (pre-smolts)	Green eggs		2
	Eyed-eggs		3
	Fingerlings	200	6
	Pre-smolt	75	8
Fall Chinook (smolts)	Green eggs		2
	Eyed-eggs		3
	Fingerlings	200	6
	Smolt	12-18	11
Spring Chinook (sub-yearling)	Green eggs		2
	Eyed-eggs		3
	Fingerlings	200	8
	Smolt	12	13
Spring Chinook (yearling)	Eyed-eggs		3
	Fingerlings	200	8
	Smolt	10	20
Coho	Smolt	10-15	18

Notes: 1. Timing is months in an artificial propagation environment to reach shown sizes. (The months are not additive for a species.)
2. Growth times size are highly dependent on water temperature and other environmental conditions so a range would be a better characterization.

Source: ODFW personal communication May 2024 [12].

Table A.3
Recreational Regional Economic Impact Per Angler Day

	Trout	Anadromous Species
Economic contributions per angler day		
Coast inland	56.81	58.59
Columbia River		83.46
Ocean		63.08

Notes: 1. Economic contributions are expressed as income adjusted to Year 2023 dollars using the GDPIPD.
Sources: TRG (May 2014) for anadromous coast inland [21]; ODFW (2014) for trout coast inland [22]; TRG (November 2014) for Columbia River [20]; PFMC (February 2024) for ocean [17].

Table A.4
Commercial Ocean Regional Economic Impact Per Pound and Columbia River Prices

	Anadromous Species				
	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Ocean (Oregon landings)					
Pounds per fish	11.91	11.91	5.73	--	--

Notes: 1. Pounds are average dressed weight for 2013-2022 seasons.
Source: PFMC (February 2024) [10].

Ocean (Oregon landings)

Economic impacts per pound in 2021:	Volume	Value	Per Dollar Multiplier	Impacts	2021$ Impacts Per Pound	2023$ Impacts Per Pound
Salmon, fixed gear	266,808	2,254,148	1.82	4,108,687	15.40	17.08
Troll coho	14,760	52,883	1.82	96,391	6.53	7.25
Troll Chinook	252,026	2,201,219	1.82	4,012,212	15.92	17.66

Notes: 1. Economic contributions are expressed as personal income adjusted to Year 2023 dollars using the GDPIPD.
Source: TRG (June 2024) [18].

	Anadromous Species				
	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Columbia River, Oregon side					
Price (2023$)	2.38	8.09	1.37	1.66	1.66

Sources: TRG (November 2014) for Columbia River REI per fish, updated to 2023 prices from TRG (June 2024) [19].

	Anadromous Species				
	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
Ocean (Oregon landings)					
Pounds per fish for NEV	11.40	11.40	6.50	--	--

Notes: 1. Pounds are average dressed weight for 2023 season.
Source: PFMC (February 2024) [10].

Columbia River	18.36	18.36	7.47	--	--
Pounds per fish for NEV					

Source: TRG (November 2014) [11].

Table A.5
Hatchery Fisheries Regional Economic Impact Per Harvested Adult by Species

			Anadromous Species					
	Total	Trout	Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
REI per fish average								
Freshwater								
Recreational, coast inland		24		223	439	223	234	234
Recreational, Columbia R.		24		223	955	223	266	266
Commercial, Columbia R.		--		80	246	18	161	161
Ocean								
Commercial		--		210	210	42	--	--
Recreational		--		83	471	83	0	0
All fisheries freshwater and ocean	35	24	193	215	466	61	240	244

Notes: 1. REI expressed as labor income in 2023 dollars.
2. Harvested adults are attributed catch in Oregon fisheries.
3. Recreational ocean and freshwater coho and fall Chinook are coincident fisheries. The literature provided REI is per experience (angler day) without regard to different effort or expenditures necessary for singularly pursued species.

Source: Recreational ocean REI per day: PFMC (February 2024) [17]; recreational salmon/steelhead inland REI per day: TRG (June 2024) [21]; trout REI per day: Upton (January 2006) [22]; trout CPUE: Upton (January 2006) [5]; anadromous ocean CPUE: PFMC (February 2024) [6]; anadromous inland CPUE: TRG (June 2024) [7]; anadromous Columbia River CPUE: TRG (November 2014) [8]; and attributed harvest from study.

Table A.6
Hatchery Fisheries Net Economic Value Per Harvested Adult by Species

	Total	Trout	Anadromous Species: Subtotal	Fall Chinook	Spring/Sum Chinook	Coho	Winter Steelhead	Summer Steelhead
NEV per fish average								
Freshwater								
Recreational, coast inland		39		370	730	370	389	389
Recreational, Columbia R.		39		370	1,114	370	310	310
Commercial, Columbia R.		--		6	17	2	0	0
Ocean								
Recreational		--		128	727	128	--	--
Commercial		--		10	10	3	--	--
NEV per harvested adult freshwater and ocean	55	39	289	333	680	78	375	365

Notes: 1. NEV is recreational angler WTP and commercial salmon fishery profits (including harvest and processing sectors).
2. Harvested adults are attributed catch in Oregon fisheries.
3. Recreational ocean and freshwater coho and fall Chinook are coincident fisheries. The literature provided NEV is per experience (angler day) without regard to different WTP for singularly pursued species.

Source: Recreational salmon/steelhead fishing NEV per day: Rosenberger (November 2018) [27]; recreational trout fishing NEV per day: USFWS (January 2016) [28]; trout CPUE: Upton (January 2006) [5]; anadromous ocean CPUE: PFMC (February 2024) [6]; anadromous inland CPUE: TRG (June 2024) [7]; anadromous Columbia River CPUE: TRG (November 2014) [8]; and attributed harvest from study.

Table A.7
Counties (All) Social and Demographic Characteristics in 2021

				Population Percent									Recreation
				Minority					Individuals	Percent		Salmon	Fishing
			Per	Non-Hispanic					Below	Housing With	Percent	Commercial	Expenditures
	State		Capita		Native		Hispanic	Rural	Poverty	Inadequate	Families	Pounds	Total Per
County	Hatcheries	Population	Income	White	American	Other	(all races)	Population	Level	Plumbing	in Poverty	Index	Capita Index
Baker		16,539	29,463	89.6%	1.4%	4.2%	4.8%	41.4%	14.1%	1.0%	10.0%	--	4
Benton		94,667	37,287	79.2%	0.4%	12.5%	7.9%	19.4%	18.3%	0.1%	7.5%	--	1
Clackamas	*	418,577	45,140	79.9%	0.4%	10.6%	9.1%	17.1%	7.5%	0.4%	5.0%	--	1
Clatsop		40,720	34,387	82.9%	0.6%	7.6%	8.9%	39.1%	9.9%	0.2%	4.5%	5	4
Columbia		52,381	34,347	86.4%	0.8%	7.0%	5.7%	41.2%	10.1%	0.5%	6.2%	--	1
Coos	*	64,619	31,824	84.1%	1.9%	7.0%	6.9%	38.1%	16.3%	0.5%	11.7%	3	4
Crook		24,300	33,431	87.3%	1.3%	3.5%	7.9%	49.8%	9.6%	0.4%	6.0%	--	3
Curry	*	23,234	34,302	84.9%	1.3%	6.2%	7.7%	51.8%	13.2%	0.5%	7.9%	2	4
Deschutes	*	194,964	40,778	86.0%	0.5%	5.1%	8.3%	29.2%	9.4%	0.4%	6.0%	--	3
Douglas	*	110,680	28,293	86.3%	0.9%	6.6%	6.2%	40.4%	13.8%	0.8%	9.1%	--	3
Gilliam		1,954	30,182	87.4%	2.1%	5.5%	5.0%	100.0%	11.8%	0.2%	1.5%	--	--
Grant		7,225	30,352	90.0%	1.0%	4.7%	4.3%	100.0%	15.4%	0.8%	7.7%	--	5
Harney		7,454	24,599	86.1%	1.1%	7.3%	5.5%	44.4%	11.7%	0.1%	3.4%	--	4
Hood River		23,915	39,176	61.9%	0.3%	6.0%	31.8%	51.8%	6.3%	0.5%	3.4%	--	4
Jackson		221,662	33,346	79.2%	0.7%	6.4%	13.7%	20.6%	13.5%	0.3%	8.4%	--	2
Jefferson	*	24,232	28,140	57.1%	13.0%	9.3%	20.6%	67.0%	14.9%	1.2%	13.7%	--	3
Josephine		87,686	29,260	85.2%	0.6%	6.3%	7.9%	43.1%	16.1%	0.9%	11.9%	--	2
Klamath	*	68,899	27,701	76.0%	3.1%	6.9%	13.9%	37.8%	19.1%	0.7%	13.0%	--	3
Lake		8,119	27,093	82.4%	2.2%	6.2%	9.2%	100.0%	19.1%	1.7%	13.4%	--	4
Lane		380,532	33,517	80.7%	0.6%	9.3%	9.4%	18.0%	16.5%	0.4%	8.9%	--	2
Lincoln	* *	49,866	32,776	80.8%	2.0%	7.5%	9.7%	38.0%	13.8%	0.5%	8.4%	4	5
Linn	*	127,200	29,598	83.7%	0.6%	6.1%	9.7%	34.2%	11.8%	0.4%	7.2%	--	2
Malheur		31,313	20,436	60.0%	0.9%	4.3%	34.7%	58.9%	19.4%	0.3%	14.6%	--	3
Marion		344,037	30,591	63.4%	0.5%	8.6%	27.5%	15.4%	13.4%	0.5%	9.4%	--	1
Morrow		11,964	28,223	57.7%	0.3%	4.2%	37.8%	100.0%	14.8%	0.2%	11.5%	--	3
Multnomah		810,011	44,675	68.1%	0.6%	19.2%	12.1%	1.3%	12.7%	0.6%	7.5%	--	1
Polk		86,347	34,858	76.6%	1.5%	7.2%	14.7%	20.4%	12.0%	0.3%	8.4%	--	1
Sherman		1,784	30,502	86.9%	0.5%	6.7%	5.9%	100.0%	12.1%	0.8%	9.3%	--	5
Tillamook	* * *	27,129	31,501	83.3%	0.8%	5.3%	10.6%	60.7%	13.6%	0.3%	9.2%	1	5
Umatilla		79,509	27,140	64.0%	2.6%	5.6%	27.8%	31.7%	12.8%	0.3%	9.5%	--	2
Union		26,255	28,596	88.0%	0.8%	6.1%	5.1%	42.9%	14.2%	1.4%	7.6%	--	2
Wallowa		7,330	35,367	91.4%	0.6%	4.3%	3.7%	100.0%	9.0%	0.3%	3.6%	--	5
Wasco	*	26,603	33,982	73.2%	2.4%	5.0%	19.4%	34.8%	9.7%	0.3%	5.4%	--	5
Washington		596,969	44,362	63.7%	0.3%	18.9%	17.1%	5.5%	8.0%	0.6%	5.2%	--	1
Wheeler		1,477	24,298	82.3%	0.1%	7.7%	9.9%	100.0%	14.0%	0.8%	7.7%	--	5
Yamhill		107,024	34,765	75.8%	0.8%	7.1%	16.3%	26.5%	11.5%	0.6%	8.0%	--	1
State		4,207,177	37,816	74.1%	0.8%	11.6%	13.6%	19.5%	12.1%	0.5%	7.5%		2

Notes:
1. State hatcheries show asterisks indicating the number of State hatcheries in the county.
2. Salmon commercial landings and recreational trips in Lane and Douglas counties are included in Coos County totals for index.
3. Columbia River Lower River commercial net fisheries are included in Clatsop County. Columbia River Upper River tribal fisheries are not included for index.
4. Recreational fishing expenditures for index are in 2008 dollars (thousands). Recreational fishing expenditures include saltwater and freshwater anadromous and resident fisheries.
5. Salmon commercial pounds index is ranking of landings at ports summed to be within counties. Clatsop had the highest landings and Tillamook had the lowest of all counties that had landings in Oregon.
6. Recreational fishing expenditures (travel and day trips) index are rankings (using five categories) of reported expenditures divided by county population. An index of 5 means the highest per capita expenditures and 1 means the lowest per capita expenditures.

Sources:
1. Census Bureau American Community Survey (ACS) 5-Year Estimates [31].
2. Rural population from The Ford Family Foundation and OSU Extension Service (August 2023) [32].

Appendix B
Hatchery Program Characterizations

Table B.1
Hatchery Rearing, Transfer, Release, and Fisheries Characterizations

Hatch-ery	Species	Stock Name	Stock Number	Annualized Budgets Fish No.	Annualized Budgets Months	Target Releases Local	Target Releases Transfers State	Target Releases Transfers Outside	Target Releases Total	State Share	Hatchery Months	Life Cycle Months	Hatchery Rearing Share	SAR Ocean Comm.	SAR Ocean Rec.	SAR Ocean Total	SAR Freshwater	Release Size (fpp)	Facilities Transferred
Alsea																			
	trout	Trout (eggs/fry)	72T	156,136	12	--			--		--	--	--	--	--	--	--	--	
		Trout (legals)		151,939	12	151,836			151,836	100%	22	22	100%	--	--	--	57.06%	3.0	
		Trout (trophy)		4,200	6	4,353			4,353	100%	34	34	100%	--	--	--	57.06%	0.5	
	StW	StW Siletz (smolt)	33F	50,000	13	50,000			50,000	100%	16	16	100%	--	--	--	3.14%	6.0	
		StW Siletz (smolt)						8,000	8,000	0%	3	5	60%	--	--	--	--		8,000 to STEP egg-to-fry releases
		StW Siuslaw (smolt)	38F	85,000	5	0	85,000		85,000	100%	16	16	100%	--	--	--	1.40%	6.0	to Roaring River
		StW Alsea (trap/spawn/smc	43H, 43F	140,000	20	140,000			140,000	100%	16	16	100%	--	--	--	1.64%	6.0	
		StW Alsea (trap/spawn/smolt)						3,000	3,000	0%	3	5	60%	--	--	--	--		3,000 to STEP egg-to-fry releases
Bandon																			
	trout	Trout (trophy)	72T	3,200	8	3,000			3,000	100%	12	34	35%	--	--	--	38.96%	0.5	from Klamath 1 fpp, released trophy size local
	StW	StW Coos	37H	125,000	2	0		125,000	125,000	0%	2	16	13%	--	--	--	1.47%	6.0	to outside hatcheries
		StW Coquille	44H	45,000	16	45,000			45,000	100%	14	16	90%	--	--	--	2.34%	6.0	
		StW (Tenmile-eggs)	88H	30,000	3	0	25,000		25,000	100%	2	2	100%	--	--	--	1.17%	6.0	to Elk River
		StW (SF Coquille)	144	70,000	15	70,000			70,000	100%	14	16	90%	--	--	--	2.34%	6.0	
	ChF	ChF Coos, eggs	37H	2,092,500	6			1,887,500	1,887,500	0%	2	8	25%	0.01%	0.00%	0.01%	0.11%	75.0	eggs to STEP and outside hatcheries
		ChF Coos, pre-smolts				205,000			205,000	100%	8	8	100%	0.01%	0.00%	0.01%	0.11%	75.0	
		ChF Coquille-eggs	44H	145,000	10	0		175,000	175,000	0%	10	11	90%	0.06%	0.01%	0.07%	0.34%	13.0	to outside hatcheries
Cedar Creek																			
	StW	StW (Nestucca)	47F	140,000	17	140,000			140,000	100%	16	16	100%	--	--	--	1.75%	6.0	
	StS	StS (Nestucca)	47H	100,000	17	100,000			100,000	100%	17	18	94%	--	--	--	1.05%	6.0	remainder to outside
		StS (Siletz-eggs)	33H	50,000	3	0	50,000		50,000	100%	2	2	100%	--	--	--	0.95%	6.0	to Salmon River
	ChF	ChF Nestucca	47H	100,000	8	0		100,000	100,000	0%	11	11	100%	0.00%	0.00%	0.00%	1.11%	18.0	to STEP
	ChS	ChS Trask	34H	215,000	9	210,000			210,000	100%	20	20	100%	0.07%	0.01%	0.07%	0.82%	10.0	eyed eggs from Trask
		ChS Nestucca	47H	230,000	11	230,000			230,000	100%	20	20	100%	0.07%	0.01%	0.07%	0.82%	10.0	
Clackamas																			
	ChS	ChS Clackamas, eggs	19H	1,050,000	12			1,230,000	1,230,000	0%	2	8	25%	--	--	--	--		1.3 million green eggs transferred out; 1.0 million transferred back for final rearing, with 70,000 released as fingerlings
		ChS Clackamas, smolts				1,000,000			1,000,000	100%	8	13	62%	0.02%	0.00%	0.02%	0.13%	12.0	
	Coho	Coho Big Creek	13H	2,430,000	17	0		2,430,000	2,430,000	0%	16	18	90%	0.00%	0.04%	0.04%	0.91%	15.0	unfed fry from Cascade, to outside hatcheries
	StS	StS (So. Santiam)	24H	150,000	2	150,000			150,000	100%	2	18	11%	--	--	--	1.19%	6.0	smolts from Bonneville released local
	StW	StW Clackamas	122H	160,000	9	210,000		50,000	260,000	81%	9	16	56%	--	--	--	1.20%	6.0	eyed eggs to Oak Springs, some smolts back for local release
Elk River																			
	ChF	ChF-Elk River	35H	275,000	18	275,000			275,000	100%	11	11	100%	0.08%	0.09%	0.18%	0.28%	18.0	
	(trout)	ChF-Elk River/Garrison		250,000	5	250,000			250,000	100%	11	11	100%	--	--	--	0.10%	900.0	released fry closed system
	ChF	ChF-Chetco	96H	200,000	12	200,000			200,000	100%	10	11	90%	0.05%	0.05%	0.10%	0.13%	18.0	
		ChF-Chetco						200	200	0%	3	5	60%	--	--	--	--		200 to STEP egg-to-fry releases
		ChF-Umpqua/Smith	151H	70,000	12	70,000			70,000	100%	10	11	90%	0.07%	0.08%	0.15%	0.23%	18.0	
		ChF-Coquille	44H	50,000	10	50,000			50,000	100%	10	11	91%	0.07%	0.08%	0.15%	0.23%	18.0	
	StW	StW-Tenmile	88H	25,000	13	25,000			25,000	100%	13	16	81%	--	--	--	1.66%	6.0	
		StW-Chetco	96H	50,000	17	50,000			50,000	100%	16	16	100%	--	--	--	1.66%	6.0	
		StW-Chetco						1,400	1,400	0%	3	5	60%	--	--	--	--		1,400 to STEP egg-to-fry releases
	trout	Trout	72T or 053T	9,000	9	13,267			13,267	100%	12	22	55%	--	--	--	66.67%	3.0	fingerlings from Klamath released as legals/trophy
Klamath																			
	trout	Brown Trout-CAT	71T	46,000	18	58,500			58,500	100%	22	22	100%	--	--	--	33.71%	3.0	eyed eggs from Shasta Hatchery
		Rainbow Trout	53H	482,000	8	482,050			482,050	100%	8	22	36%	--	--	--	33.71%	3.0	fingerlings from Oak Springs
		Rainbow Trout	53T	46,000	4	46,000			46,000	100%	4	22	18%	--	--	--	33.71%	3.0	fingerlings from Wizard Falls
		Rainbow Trout fingerlings	72T	201,020	12	55,000	0		55,000	100%	10	10	100%	--	--	--	16.00%	50.0	eyed eggs from Roaring River, to Rock Creek, Bandon, Fall River, Elk River
		Rainbow Trout legals		92,720	12	48,120	52,600		100,720	100%	12	22	55%	--	--	--	33.71%	3.0	
		Rainbow Trout legals				0	3,000		3,000	100%	22	34	65%	--	--	--	33.71%	3.0	transfer to Bandon as legal
		Rainbow Trout trophy		13,350	10	14,400	14,500		28,900	100%	10	34	29%	--	--	--	33.71%	0.5	
		Rainbow mt. lakes	127T	25,000	6	25,000			25,000	100%	6	10	60%	--	--	--	5.00%	200.0	fry from Wizard Falls
		Brook Trout	74T	32,000	6	32,000			32,000	100%	6	10	60%	--	--	--	5.00%	200.0	fry from Fall River
Nehalem																			
	ChF	ChF-Trask (Necanicum)	34H	25,000	4	25,000			25,000	100%	4	11	36%	0.01%	0.01%	0.01%	0.20%	18.0	smolts from Trask
	Coho	Coho-NF Nehalem	32F	100,000	17	100,000			100,000	100%	17	18	94%	0.01%	0.09%	0.10%	0.74%	15.0	
		Coho-Trask	34F	100,000	12	0	100,000		100,000	100%	12	18	67%	0.03%	0.20%	0.23%	0.51%	15.0	smolts from Trask, to Trask
	trout	Rainbow fingerlings	72T	73,100	12	5,000		500	5,500	91%	7	10	70%	--	--	--	5.00%	200.0	eyed eggs from Roaring River, some to STEP
		Rainbow legals		68,100	12	66,550			66,550	100%	22	22	100%	--	--	--	45.04%	3.0	
		Rainbow trophy		1,550	9	1,550			1,550	100%	9	34	26%	--	--	--	45.04%	0.5	
	StW	StW-NF Nehalem	32F	105,000	17	90,000			90,000	100%	16	16	100%	--	--	--	1.85%	6.0	
		StW Necanicum	32H	25,000	17	40,000			40,000	100%	16	16	100%	--	--	--	1.08%	6.0	

Table B.1 (cont.)

Hatch-ery	Species	Stock Name	Stock Number	Annualized Budgets Fish No.	Annualized Budgets Months	Target Releases Local	Target Releases Transfers State	Target Releases Transfers Outside	Target Releases Total	State Share	Hatchery Months	Life Cycle Months	Hatchery Rearing Share	SAR Ocean Comm.	SAR Ocean Rec.	SAR Ocean Total	SAR Freshwater	Release Size (fpp)	Facilities Transferred
Oak Springs																			
	trout	Rainbow - eggs	53H	2,200,000	--	--	--	--	--	--	--	--	--	--	--	--	--	--	
		Eggs transferred outside						37,200	37,200	0%	3	22	14%	--	--	--	45.87%	3.0	reared and released legal by High Desert STEP and Lower Willamette STEF
		Fingerlings transferred state		917,625	12		480,000		480,000	100%	10	22	45%	--	--	--	16.00%	21.5	transferred to Klamath for their release legal
		Fingerlings released local		165,225	12	284,500			284,500	100%	10	10	100%	--	--	--	16.00%	21.5	
		Legals released local				140,800			140,800	100%	22	22	100%			--	45.04%	2.0	
		Trophy released local		43,825	8	13,105			13,105	100%	34	34	100%	--	--	--	45.04%	0.5	
		Rainbow - eggs	53T	2,500,000	--	--	--	--	--	--	--	--	--		--		--	--	
		Eggs transferred													--				
		Released as fingerlings state					550,000		550,000	100%	3	22	14%		--	--	16.00%	200.0	transferred to Wizard/Fall Creek released legal
		Released as fingerlings outside						13,000	13,000	0%	3	22	14%		--		16.00%	200.0	transferred to High Desert STEP released legal
		Fingerlings													--				
		Released as legals outside						234,000	234,000	0%	10	34	29%		--		45.04%	3.0	transferred to Irrigon and Wallowa released legal/trophies
		Sub-legals													--				
		Released as legals state					8,000		8,000	100%	20	22	91%		--	--	45.04%	3.0	transferred to Rock Creek released legal
		Released as legals outside						100,000	100,000	0%	20	22	91%		--		45.04%	3.0	transferred to Leaburg released legal
		Legals													--				
		Released local				22,000			22,000	100%	22	22	100%		--	--	45.04%	3.0	
		Trophy													--				
		Released outside		5,000	7	5,000			5,000	100%	34	34	100%	--	--	--	45.04%	0.5	transferred to Bonneville released legal
	StS	StS – eyed eggs	66H				11,000	--	11,000	100%	--	--	--		--		--	--	transferred to Round Butte Hatchery released legal
	(trout)	Released as smolt local, no migration		9,000	13	9,000			9,000	100%	18	18	100%	--	--	--	45.04%	6.0	released fry closed system, therefore trout SAR
	StW	StW - eyed eggs	122H	265,000	11	--	265,000	--	265,000	100%	--	--	--	--	--	--	--	--	from Clackamas
		Transferred as fingerlings																	
		Released as fingerlings state					100,000		100,000	100%	5	11	45%	--	--	--	1.20%	200.0	
		Released as smolts state					60,000		60,000	100%	11	11	100%	--	--	--	1.20%	6.0	
		Released as smolts outside						105,000	105,000	0%	5	11	45%	--	--	--	1.20%	6.0	
	trout	WV Rainbow legals	133 (H&T)	20,300	36	18,300			18,300	100%	34	34	100%	--	--	--	45.04%	3.0	remainder brood stock
Roaring River																			
	trout	Rainbow - eggs	72T	1,000,000	36	0	--	--	--	--	--	--	--	--	--	--	--	--	to Alsea, Klamath, Salmon River, Nehalem, STEP, research, outside hatche
		Rainbow - eggs		6,000,000	36	0	--	--	--	--	--	--	--	--	--	--	--	--	
		Eggs transferred																	
		Released as legals state					890,000		890,000	100%	3	22	14%	--	--	--	57.06%	3.0	transferred to Alsea, Klamath, Nehalem released legal
		Released as legals outside						1,419,000	1,419,000	0%	3	22	14%	--	--	--	57.06%	3.0	transferred to STEP (High Desert, Mid/Lwr -Willamette, Gardiner) and hatcheries (Cole Rivers, Willamette) released legal
		Fingerlings																	
		Released local		422,581	12	255,400			255,400	100%	10	10	100%	--	--	--	16.00%	50.0	natural production legal
		Released as legals state					43,000		43,000	100%	10	22	45%	--	--	--	57.06%	3.0	Salmon River released legal and trophy
		Legals																	
		Released local		167,181	12	119,548			119,548	100%	22	22	100%	--	--	--	57.06%	3.0	
		Transferred state					600		600	100%	22	22	100%	--	--	--	57.06%	3.0	Cedar Creek released legal
		Trophy		46,033	8	46,033			46,033	100%	34	34	100%	--	--	--	57.06%	0.5	
	StS	Smolts	24H	96,000	14	96,000			96,000	100%	15	18	83%	--	--	--	0.86%	6.0	received eyed eggs from South Santiam
	StW	Smolts	38H	85,000	15	85,000			85,000	100%	15	18	83%	--	--	--	1.40%	6.0	received eyed eggs from Alsea Hatchery
Salmon River																			
	ChF	ChF (trap-release)	36H	200,000	13	200,000			200,000	100%	11	11	100%	0.03%	0.00%	0.04%	0.91%	18.0	
	Coho	Coho Big Creek (Klaskanine	13H	385,000	11	0		385,000	385,000	0%	11	18	61%	0.00%	0.04%	0.04%	0.91%	15.0	to Klaskanine
	trout	Rainbow	72T	30,000	12	30,000			30,000	100%	12	22	55%	--	--	--	45.04%	3.0	from Roaring River @ 75 fpp
		Rainbow		15,700	12	4,500			4,500	100%	22	34	65%	--	--	--	45.04%	3.0	from Roaring River 75 fpp, released trophy local
	StS	StS Siletz	33H	50,000	10	50,000			50,000	100%	10	18	56%	--	--	--	0.95%	6.0	
Trask																			
	ChF	ChF (trap-release) smolts	34H	175,000	11	150,000	25,000		175,000	100%	11	11	100%	0.03%	0.00%	0.04%	1.72%	18.0	to Nehalem
		unfed fry						1,700	1,700	0%	3	5	60%	--	--	--	--		to STEP egg-to-fry releases
	ChS	ChS eggs	34H	340,000	14		205,000	190,000	395,000	52%	3	20	15%	--	--	--	--		to Cedar Creek+outside, back to Trask; 395,000 are transferred as green eg
		ChS smolts				70,000			70,000	100%	13	13	100%	0.02%	0.00%	0.02%	0.44%	12.0	
		ChS smolts out and back				285,000			285,000	100%	8	20	40%	0.02%	0.00%	0.02%	0.44%	10.0	
		ChS smolts					65,000	35,000	100,000	65%	2	20	10%	0.02%	0.00%	0.02%	0.44%	10.0	Cedar Cr (65,000) plus Whiskey Cr (35,000)
		unfed fry						1,000	1,000	0%	3	5	60%	--	--	--	--		to STEP egg-to-fry releases
	Coho	Coho (trap-release)	34W	100,000	8	100,000			100,000	100%	14	18	78%	0.01%	0.22%	0.23%	0.51%	15.0	to Nehalem then back to Trask
		Coho (trap-release)						16,000	16,000	0%	3	18	17%	0.01%	0.22%	0.23%	0.51%	15.0	to STEP released as fingerlings in a reservoir, but fall over dam to ocean
	StW	StW-Wilson	121W	157,000	16	110,000			110,000	100%	16	16	100%	--	--	--	2.67%	6.0	to Tuffy Creek
		StW-Wilson						40,000	40,000	0%	8	16	50%	-- --		--	2.67%	6.0	
		unfed fry						500	500	0%	3	5	60%	--	--	--	--		to STEP egg-to-fry releases

Table B.1 (cont.)

Hatch-ery	Species	Stock Name	Stock Number	Annualized Budgets Fish No.	Annualized Budgets Months	Target Releases Local	Target Releases Transfers State	Target Releases Transfers Outside	Target Releases Total	State Share	Hatchery Months	Life Cycle Months	Hatchery Rearing Share	SAR Ocean Comm.	SAR Ocean Rec.	SAR Ocean Total	SAR Freshwater	Release Size (fpp)	Facilities Transferred
Wizard/Falls River (75:25)																			
	trout	Rainbow -eggs	127H	350,000	36	0	--	--	--	--	--	--	--	--	--	--	--	--	to Fall River, Klamath, and other
		Rainbow -eggs	127T	1,200,000	36	0		197,600	197,600	0%	3	22	14%	--	--	--	45.04%	3.0	
		Rainbow fingerling	127H	50,000	12	48,925			48,925	100%	10	10	100%	--	--	--	16.00%	15.0	
		Rainbow trophy	127H	1,075	6	1,075			1,075	100%	34	34	100%	--	--	--	45.04%	0.4	
		Rainbow fingerling (odd year	127T	284,000	12	99,200	133,000	9,600	241,800	96%	10	10	100%	--	--	--	2.50%	200.0	to Klamath and outside
		Rainbow fingerling	127T			241,800			241,800	100%	10	10	100%	--	--	--	16.00%	155.0	
		Rainbow legals	127T	18,125	8	51,525	46,000		97,525	100%	22	22	100%	--	--	--	45.04%	3.0	
		Rainbow trophy	127T			8,380			8,380	100%	34	34	100%	--	--	--	45.04%	1.0	
		Brook Trout -air fingerlings	74T	37,400	6	202,750	80,000	4,200	286,950	99%	7	10	70%	--	--	--	2.50%	200.0	eyed eggs from outside
		Rainbow Trout Legals	72T			41,196		450	41,646	99%	22	22	100%	--	--	--	45.04%	3.0	
		Brook Trout YY fingerlings	129H	35,000	9	35,000			35,000	100%	7	10	70%	--	--	--	1.00%	55.0	eyed eggs from outside
		Kokanee fingerlings	67H	170,000	12	200,000		25,000	225,000	89%	10	10	100%	--	--	--	16.00%	46.0	
		Rainbow fingerlings	53T	431,125	8	356,125		75,000	431,125	83%	7	10	70%	--	--	--	10.00%	80.0	eyed eggs from Oak Springs, transfers to Klamath
	StS	StS	66H	100,000	16	100,000			100,000	100%	16	18	89%	--	--	--	--	6.0	reintroduction species, unknown SAR
	trout	Tiger Trout	74T	40,000	12	40,000			40,000	100%	12	22	55%	--	--	--	0.00%	20.0	Tiger trout cannot be harvested in the two lakes where they are stocked
Rock Creek																			
	ChS	ChS (trap-release)	55H	342,000	10	342,000			342,000	100%	20	20	100%	0.11%	0.01%	0.12%	0.24%	10.0	
	Coho	Coho	18H	60,000	10	60,000			60,000	100%	18	18	100%	0.03%	0.60%	0.63%	1.84%	15.0	
	trout	Rainbow legals	72T	76,000	8	55,100			55,100	100%	12	22	55%	--	--	--	45.04%	3.0	from Klamath as fingerlings, released legal local
		Rainbow trophy	53T			8,000			8,000	100%	12	34	35%	--	--	--	45.04%	0.5	from Oak Springs as legals, released trophy local
	StS	StS Umpqua	55H	75,000	10	74,000			74,000	100%	10	18	56%	--	--	--	0.84%	6.0	
		StS Umpqua						1,000	1,000	0%	3	5	60%	--	--	--	--		1,000 STEP egg-to-fry release
	StW	StW 18		150,000	10	150,000			150,000	100%	16	16	100%	--	--	--	2.36%	6.0	

Notes:
1. Smolt to fisheries catch rates (SARs) are catch in Oregon commercial and recreational fisheries. Columbia River releases for ocean commercial catch include troll fishery landings at Oregon ports. Columbia River freshwater includes commercial gillnet fisheries with landings in Oregon and recreational catch from trips originating at Oregon side of Columbia River.
2. Chinook average SARs based on CWT recoveries for brood years 2010-2017 and freshwater catch 2014-2021. Coho average SARs based on CWT recoveries for brood years 2000-2006 and freshwater catch 2013-2023. Steelhead average SARs based on harvest card (2013-2018) or ODFW Electronic Licensing System (2018-2022) expansions.
3. StS 66H stock at Oak Springs and Fall River is a reintroduction species. The Oak Springs releases are in a closed system so the assigned SAR are if they are trout. The Fall River releases have an unknown SAR.
4. ChF 35H stock at Elk River over production is release into Garrison Lake. It is a closed system with no migration so a trout SAR is assigned.
5. The columns "annualized budgets" are assumptions from ODFW used to determine prorated costs by species programs. Annualized budget fish numbers are adjusted to be release equivalent. This means natural mortality between life cycle stages is incorporated into the fish numbers.
6. The column "hatchery rearing share" is used to credit economic value to an individual hatchery based on rearing months spent at that hatchery compared to total rearing and acclimation months at time of release.
7. Transfers to STEP egg-to-fry releases have insignificant SARs therefore no contribution to fisheries benefits are assumed.
8. For Clackamas and Salmon River coho, the percent of SAR that is Oregon is estimated to be 2.85% ocean sport, 59.86% freshwater commercial, and 7.13% freshwater sport. For Clackamas spring Chinook, 0.99% ocean sport, 3.85% ocean commercial, 2.11% freshwater commercial, and 25.45% freshwater sport.

Source: Annualized budget information and SARs from ODFW personal communication. Hatchery operation characteristics from individual ODFW HPMP and hatchery manager interviews.

Table B.2a
Hatchery Production Regional Economic Impact Effects

			Local REI Effects						Statewide REI Effects									
Hatchery	REI Factors		PS	Utilities	Travel	Other	Support	Subtotal	Feed	Hdqr Admin	Field Mgmt	Mtnc Heavy	Subtotal	Total	Bond	Wildfire	Capital	Total
Alsea	Operating Share		66.2%	1.2%	0.8%	12.1%			19.6%									
	Amount	686,282	454,213	8,560	5,788	83,224	44,252	596,037	134,496	16,071	17,495	75,601	243,663	839,701	23,810	-	433,929	1,297,439
	Statewide REI		670,373	2,802	3,077	60,662	39,721	776,635	47,666	8,298	9,033	55,105	120,101	896,736				
	Local REI		566,540	2,096	2,115	50,309	30,685	651,745						651,745				
Bandon	Operating Share		83.3%	1.5%	1.1%	7.7%			6.3%									
	Amount	401,181	334,335	6,096	4,384	30,967	163,989	539,771	25,399	16,071	17,495	74,197	133,162	672,932	23,810	-	143,036	839,778
	Statewide REI		493,445	1,995	2,331	22,572	147,197	667,539	9,001	8,298	9,033	54,082	80,414	747,953				
	Local REI		417,016	1,493	1,602	18,719	113,710	552,540						552,540				
Cedar Creek	Operating Share		74.6%	2.1%	1.4%	10.5%			11.5%									
	Amount	583,938	435,397	12,157	8,008	61,446	77,683	594,692	66,928	16,071	17,495	74,488	174,982	769,675	23,810	-	300,429	1,093,913
	Statewide REI		642,603	3,979	4,258	44,788	69,728	765,357	23,719	8,298	9,033	54,294	95,344	860,700				
	Local REI		543,071	2,977	2,927	37,144	53,865	639,985						639,985				
Clackamas	Operating Share		42.0%	16.3%	0.7%	28.0%			13.1%									
	Amount	898,878	377,100	146,333	6,263	251,686	269,356	1,050,737	117,689	45,476	9,095	77,793	250,053	1,300,790	130,476	-	344,464	1,775,730
	Statewide REI		556,562	47,895	3,330	183,454	241,773	1,033,014	41,709	23,479	4,696	56,703	126,587	1,159,601				
	Local REI		470,357	35,837	2,289	152,144	186,771	847,398						847,398				
Elk River	Operating Share		66.9%	13.2%	1.3%	9.0%			9.7%									
	Amount	548,716	366,958	72,161	6,999	49,525	108,445	604,088	53,072	16,071	17,495	72,644	159,282	763,370	23,810	-	235,929	1,023,109
	Statewide REI		541,594	23,618	3,721	36,099	97,340	702,372	18,809	8,298	9,033	52,950	89,089	791,462				
	Local REI		457,707	17,672	2,558	29,938	75,196	583,071						583,071				
Klamath	Operating Share		71.6%	0.6%	3.2%	8.6%			16.0%									
	Amount	528,251	378,360	3,085	16,818	45,430	47,337	491,030	84,705	16,071	17,495	72,490	190,761	681,790	23,810	260,000	188,571	1,154,171
	Statewide REI		558,422	1,010	8,942	33,114	42,490	643,977	30,019	8,298	9,033	52,838	100,187	744,164				
	Local REI		471,928	756	6,147	27,462	32,823	539,117						539,117				
Nehalem	Operating Share		76.7%	7.8%	1.4%	1.6%			12.5%									
	Amount	533,682	409,149	41,773	7,561	8,647	53,664	520,795	66,551	16,071	17,495	76,497	176,614	697,409	23,810	-	249,964	971,183
	Statewide REI		603,863	13,672	4,020	6,303	48,169	676,028	23,586	8,298	9,033	55,758	96,674	772,702				
	Local REI		510,332	10,230	2,764	5,227	37,211	565,763						565,763				
Oak Springs	Operating Share		66.8%	1.0%	2.5%	6.6%			23.1%									
	Amount	844,314	563,903	8,108	20,916	55,725	59,441	708,093	195,447	16,071	17,495	75,512	304,525	1,012,618	23,810	-	428,571	1,464,999
	Statewide REI		832,264	2,654	11,121	40,618	53,355	940,012	69,266	8,298	9,033	55,040	141,637	1,081,649				
	Local REI		703,356	1,986	7,645	33,686	41,217	787,889						787,889				
Roaring Rive	Operating Share		57.1%	1.0%	2.6%	16.6%			22.6%									
	Amount	798,137	455,815	8,108	20,916	132,491	49,393	666,723	180,705	16,071	17,495	77,285	291,556	958,278	23,810	-	318,857	1,300,945
	Statewide REI		672,737	2,654	11,121	96,573	44,335	827,420	64,042	8,298	9,033	56,333	137,705	965,124				
	Local REI		568,538	1,986	7,645	80,091	34,249	692,508						692,508				
Salmon Rive	Operating Share		65.2%	6.7%	2.1%	14.8%			11.2%									
	Amount	605,850	394,931	40,866	12,634	89,495	91,052	628,978	67,924	16,071	17,495	74,596	176,086	805,064	23,810	-	225,750	1,054,623
	Statewide REI		582,879	13,375	6,718	65,233	81,728	749,933	24,072	8,298	9,033	54,373	95,775	845,708				
	Local REI		492,598	10,008	4,618	54,100	63,135	624,459						624,459				

Table B.2a (cont.)

			Local REI Effects						Statewide REI Effects									
Hatchery	REI Factors		PS	Utilities	Travel	Other	Support	Subtotal	Feed	Hdqr Admin	Field Mgmt	Mtnc Heavy	Subtotal	Total	Bond	Wildfire	Capital	Total
Trask	Operating Share		75.8%	4.7%	2.2%	7.3%			10.0%									
	Amount	473,858	358,952	22,238	10,387	34,801	77,214	503,592	47,480	16,071	17,495	77,132	158,178	661,770	23,810	-	188,250	873,829
	Statewide REI		529,777	7,279	5,523	25,366	69,307	637,252	16,827	8,298	9,033	56,221	90,378	727,630				
	Local REI		447,721	5,446	3,796	21,037	53,540	531,540						531,540				
Wizard/Falls	Operating Share		72.7%	3.1%	5.2%	6.7%			12.3%									
	Amount	765,391	556,369	23,726	40,105	51,281	30,630	702,111	93,776	32,143	17,495	152,294	295,708	997,819	47,619	-	347,143	1,392,581
	Statewide REI		821,145	7,766	21,324	37,379	27,493	915,107	33,234	16,595	9,033	111,007	169,869	1,084,976				
	Local REI		693,959	5,810	14,658	30,999	21,239	766,666						766,666				
Rock Creek	Operating Share		27.8%	3.7%	2.1%	52.5%			13.9%									
	Amount	531,181	147,661	19,846	10,905	278,932	75,364	532,708	73,837	16,071	17,495	67,857	175,260	707,968	23,810	900,000	475,500	2,107,277
	Statewide REI		217,933	6,496	5,798	203,314	67,647	501,187	26,168	8,298	9,033	49,461	92,959	594,146				
	Local REI		184,177	4,860	3,986	168,614	52,257	413,895						413,895				
All	Operating Share		63.8%	5.0%	2.1%	14.3%			14.7%									
	Amount	8,199,658	5,233,144	413,058	171,684	1,173,650	1,147,820	8,139,355	1,208,010	254,405	219,031	1,048,383	2,729,829	10,869,184	440,000	1,160,000	3,880,393	16,349,577
	Statewide REI		7,723,597	135,194	91,284	855,473	1,030,283	9,835,831	428,119	131,349	113,086	764,166	1,436,720	11,272,552				
	Local REI		6,527,300	101,158	62,750	709,471	795,898	8,196,578						8,196,578				

Notes: 1. Bond expenses, insurance payments, and capital contribution costs are not included in REI.

2. RIMS II response coefficient industry codes for hatchery expenditure items in local economy model are PS (115000), Utilities (221300), Travel (721000), Other (811300), Support (115000). Industry codes in statewide economy model are PS (115000), Utilities (221300), Travel (721000), Other (811300), Support (115000), Feed (311700), Hdqr Admin (S00A00), Field Mgmt (S00A00), Mtnc Heavy (811300).

3. Support includes fish health, marking, and liberation. Hdqr Admin is admin headquarters. Field Mgmt is admin field (excluding insurance). Mtnc Heavy is housing, emergency, and R&E.

Sources: Operating shares and amounts from ODFW. Economy response coefficients from RIMS II for data year 2021. Local response coefficient from five coastal counties model.

Table B.2b

Individual Hatchery Operations Local and Statewide Regional Economic Impact and Jobs

Hatchery	County	Local REI	Local FTE Jobs	State REI	State FTE Jobs
Alsea	Lincoln	651,745	14	896,736	18
Bandon	Coos	552,540	11	747,953	15
Cedar Creek	Tillamook	639,985	13	860,700	17
Clackamas	Clackamas	847,398	18	1,159,601	23
Elk River	Curry	583,071	12	791,462	16
Klamath	Klamath	539,117	11	744,164	15
Nehalem	Tillamook	565,763	12	772,702	15
Oak Springs	Wasco	787,889	16	1,081,649	21
Roaring River	Linn	692,508	14	965,124	19
Salmon River	Lincoln	624,459	13	845,708	17
Trask	Tillamook	531,540	11	727,630	14
Wizard/Falls River	Jefferson/Deschutes	766,666	16	1,084,976	22
Rock Creek	Douglas	413,895	9	594,146	12
Total		8,196,578	171	11,272,552	223

Notes: 1. Jobs are full and part-time equivalent (FTE). The calculation of FTE is assumed to be average annual earnings for Oregon statewide or coastwide economies.

Sources: Average income per job from BEA (January 2024).

Table B.3
Individual Hatchery Facility Depreciation and Annual Capital Contributions

Alsea Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
trout	Trout (eggs/fry)	72T		93,011	89,264	86,148	89,474
	Trout (legals)						
	Trout (trophy)						
StW	StW Siletz (smolt)	33F		34,985	33,210	26,464	31,553
	StW Siletz (smolt)						
	StW Siuslaw (smolt)	38F					
	StW Alsea (trap/spawn/smolt)	43H, 43F					
	StW Alsea (trap/spawn/smolt)						
	Total		$ 40,500,000	127,996	122,474	112,612	121,027
	Cost per facility pound		$ 335				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 40,500,000
Salvage value (25 percent replacement estimate)	$ 10,125,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 433,929
Interest expense	$ -

Replacement Cost Item	Year	Per Unit	Units	Amount
House		$ 750,000	4	$ 3,000,000
Shop				$ 200,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	9.4	$ 18,800,000
Pumps		$ 50,000	-	$ -
Piping		$ 400	5,200	$ 2,080,000
Valves		$ 10,000	57	$ 570,000
Abatement				$ 400,000
Discharge				$ 200,000
Raceways		$ 250,000	33	$ 8,250,000
Adult holding and ladder		$ 250,000	2	$ 500,000
Adult trap and ladder		$ 3,000,000	1	$ 3,000,000
Year last major constructed	1936			
*Projected from major construction	2022	$ 1,923,596		
Total (est 2022)				$ 40,500,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Bandon Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
trout	Trout (trophy)	72T		4,042	4,576	4,128	4,249
StW	StW Coos	37H		20,176	20,875	20,209	20,420
	StW Coquille	44H					
	StW (Tenmile-eggs)	88H					
	StW (SF Coquille)	144					
ChF	ChF Coos, eggs	37H		7,024	5,342	9,801	7,389
	ChF Coos, pre-smolts						
	ChF Coquille-eggs	44H					
	Total		$ 13,350,000	31,242	30,793	34,138	32,058
	Cost per facility pound		$ 416				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 13,350,000
Salvage value (25 percent replacement estimate)	$ 3,337,500
Useful life (years)	70
Annual capital contribution (straight-line)	$ 143,036
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	3	$ 2,250,000
Shop				$ 200,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	1.2	$ 2,400,000
Pumps		$ 50,000	-	$ -
Piping		$ 400	2,000	$ 800,000
Valves		$ 10,000	20	$ 200,000
Abatement				$ -
Discharge				$ -
Raceways		$ 250,000	7	$ 1,750,000
Adult holding and ladder		$ 250,000	1	$ 250,000
Adult trap and ladder		$ 2,000,000	1	$ 2,000,000
Year last major constructed	1925			
*Projected from major construction	2022	$ 798,295		
Total (est 2022)				$ 13,350,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Cedar Creek Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
StW	StW (Nestucca)	47F		21,185	12,529	19,395	17,703
StS	StS (Nestucca)	47H		20,497	19,819	20,262	20,193
	StS (Siletz-eggs)	33H					
ChF	ChF Nestucca	47H		401	412	407	407
ChS	ChS Trask	34H		26,318	25,387	31,251	27,652
	ChS Nestucca	47H					
trout				1,942	1,919	1,309	1,723
Coho							
	Total		$ 28,040,000	70,343	60,066	72,624	67,678
	Cost per facility pound		$ 414				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 28,040,000
Salvage value (25 percent replacement estimate)	$ 7,010,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 300,429
Interest expense	$ -

Replacement Cost Item	Year	Per Unit	Units	Amount
House		$ 750,000	3	$ 2,250,000
Shop				$ 1,500,000
Hatch house				$ 3,500,000
Office				$ 500,000
Intakes(s)		$ 2,000,000	4.45	$ 8,900,000
Pumps		$ 50,000	2	$ 100,000
Piping		$ 400	4,000	$ 1,600,000
Valves		$ 10,000	34	$ 340,000
Abatement				$ 400,000
Discharge				$ 200,000
Raceways		$ 250,000	21	$ 5,250,000
Adult holding and ladder		$ 250,000	2	$ 500,000
Adult trap and ladder		$ 3,000,000	1	$ 3,000,000
Year last major constructed	1925			
*Projected from major construction	2022	$ 1,640,840		
Total (est 2022)				$ 28,040,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Clackamas Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
ChS	ChS Clackamas, eggs	19H		2,681	28,758	-24,289	15,720
	ChS Clackamas, smolts						
Coho	Coho Big Creek	13H		54,565	67,868	66,630	61,217
StS	StS (So. Santiam)	24H		1,654	-745	-934	455
StW	StW Clackamas	122H		-2,400	9,965	-2,896	3,783
trout				2,214			1,107
	Total		$ 32,150,000	58,714	105,846	38,511	82,280
	Cost per facility pound		$ 391				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 32,150,000
Salvage value (25 percent replacement estimate)	$ 8,037,500
Useful life (years)	70
Annual capital contribution (straight-line)	$ 344,464
Interest expense	$ -

Replacement Cost Item	Year	Per Unit	Units	Amount
House		$ 750,000	4	$ 3,000,000
Shop				$ 200,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	8.00	$ 16,000,000
Pumps		$ 50,000	5	$ 250,000
Piping		$ 400	4,000	$ 1,600,000
Valves		$ 10,000	20	$ 200,000
Abatement				$ 400,000
Discharge				$ -
Raceways		$ 250,000	13	$ 3,250,000
Adult holding and ladder		$ 250,000	3	$ 750,000
Adult trap and ladder		$ 3,000,000	1	$ 3,000,000
Year last major constructed	1979			
*Projected from major construction	2022	$ 7,913,550		
Total (est 2022)				$ 32,150,000

Comment: Cost includes upgrade structures; doesn't include hydro install $3 million

Table B.3 (cont.)

Elk River Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
ChF	ChF-Elk River	35H		38,767	38,386	30,779	35,977
(trout)	ChF-Elk River/Garrison						
ChF	ChF-Chetco	96H					
	ChF-Chetco						
	ChF-Umpqua/Smith	151H					
	ChF-Coquille	44H					
StW	StW-Tenmile	88H		8,170	1,123	5,468	4,920
	StW-Chetco	96H					
	StW-Chetco						
trout	Trout	72T or 053T		7,716	7,846	5,981	7,181
	Total		$ 22,020,000	54,653	47,355	42,228	48,079
	Cost per facility pound		$ 458				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 22,020,000
Salvage value (25 percent replacement estimate)	$ 5,505,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 235,929
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	3	$ 2,250,000
Shop				$ 200,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	3.56	$ 7,120,000
Pumps		$ 50,000	4	$ 200,000
Piping		$ 400	3,000	$ 1,200,000
Valves		$ 10,000	30	$ 300,000
Abatement				$ -
Discharge				$ -
Raceways		$ 250,000	24	$ 6,000,000
Adult holding and ladder		$ 250,000	1	$ 250,000
Adult trap and ladder		$ 1,000,000	1	$ 1,000,000
Year last major constructed	1968			
*Projected from major construction	2022	$ 2,594,646		
Total (est 2022)				$ 22,020,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Klamath Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
trout	Brown Trout-CAT	71T			3,735	6,730	3,488
	Rainbow Trout	53H		124,354	89,467	100,028	104,616
	Rainbow Trout	53T					
	Rainbow Trout fingerlings	72T					
	Rainbow Trout legals						
	Rainbow Trout legals						
	Rainbow Trout trophy						
	Rainbow mt. lakes	127T					
	Brook Trout	74T		23		-1	7
ChS					830	1,106	645
	Total		$ 17,600,000	124,377	94,032	107,863	108,757
	Cost per facility pound		$ 162				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 17,600,000
Salvage value (25 percent replacement estimate)	$ 4,400,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 188,571
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	4	$ 3,000,000
Shop				$ 7,000,000
Hatch house				$ -
Office				$ -
Intakes(s)		$ -		$ 1,000,000
Pumps		$ 50,000	-	$ -
Piping		$ 400	3,000	$ 1,200,000
Valves		$ 10,000	30	$ 300,000
Abatement				$ -
Discharge				$ 100,000
Raceways		$ 250,000	20	$ 5,000,000
Adult holding and ladder		$ 250,000	-	$ -
Adult trap and ladder		$ -	1	$ -
Year last major constructed	1929			
*Projected from major construction	2022	$ 1,028,378		
Total (est 2022)				$ 17,600,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Nehalem Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
ChF	ChF-Trask (Necanicum)	34H		1,184	1,118	1,113	1,138
Coho	Coho-NF Nehalem	32F		12,442	11,236	12,886	12,188
	Coho-Trask	34F					
trout	Rainbow fingerlings	72T		42,904	40,664	33,227	38,932
	Rainbow legals						
	Rainbow trophy						
StW	StW-NF Nehalem	32F		18,269	16,914	20,836	18,673
	StW Necanicum	32H					
	Total		$ 23,330,000	74,799	69,932	68,062	70,931
	Cost per facility pound		$ 329				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 23,330,000
Salvage value (25 percent replacement estimate)	$ 5,832,500
Useful life (years)	70
Annual capital contribution (straight-line)	$ 249,964
Interest expense	$ -

Replacement Cost Item	Year	Per Unit	Units	Amount
House		$ 750,000	4	$ 3,000,000
Shop				$ 200,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	3.56	$ 7,120,000
Pumps		$ 50,000	4	$ 200,000
Piping		$ 400	3,000	$ 1,200,000
Valves		$ 10,000	36	$ 360,000
Abatement				$ 400,000
Discharge				$ 100,000
Raceways		$ 250,000	24	$ 6,000,000
Adult holding and ladder		$ 250,000	1	$ 250,000
Adult trap and ladder		$ 1,000,000	1	$ 1,000,000
Year last major constructed	1966			
*Projected from major construction	2022	$ 2,560,735		
Total (est 2022)				$ 23,330,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Oak Springs Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
trout	Rainbow - eggs	53H		173,911	167,634	203,720	181,755
	Eggs transferred outside			3,440			1,147
	Fingerlings transferred state						
	Fingerlings released local						
	Legals released local						
	Trophy released local						
	Rainbow - eggs	53T					
	Eggs transferred						
	Released as fingerlings state						
	Released as fingerlings outside						
	Fingerlings						
	Released as legals outside						
	Sub-legals						
	Released as legals state						
	Released as legals outside						
	Legals						
	Released local						
	Trophy						
	Released outside						
StS	StS – eyed eggs	66H		2,800			933
(trout)	Released as smolt local, no migration						
StW	StW - eyed eggs	122H		22,071	9,256	10,950	14,092
	Transferred as fingerlings						
	Released as fingerlings state						
	Released as smolts state						
	Released as smolts outside						
trout	WV Rainbow legals	133 (H&T)		1	503	23	176
	Total		$ 40,000,000	202,223	177,393	214,693	198,103
	Cost per facility pound		$ 202				

Non-operating expenses

Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 40,000,000
Salvage value (25 percent replacement estimate)	$ 10,000,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 428,571
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	5	$ 3,750,000
Shop				$ 200,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ -		$ 1,000,000
Pumps		$ 50,000	-	$ -
Piping		$ 400	52,000	$ 20,800,000
Valves		$ 10,000	50	$ 500,000
Abatement				$ 400,000
Discharge				$ 100,000
Raceways		$ 250,000	35	$ 8,750,000
Adult holding and ladder		$ 250,000	2	$ 500,000
Adult trap and ladder		$ 500,000	1	$ 500,000
Year last major constructed	1996			
*Projected from major construction	2022	$ 21,445,046		
Total (est 2022)				$ 40,000,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Roaring River Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
trout	Rainbow - eggs	72T					
	Rainbow - eggs						
	Eggs transferred						
	Released as legals state			190,928	163,755	189,199	181,294
	Released as legals outside						
	Fingerlings						
	Released local						
	Released as legals state						
	Legals						
	Released local						
	Transferred state						
	Trophy						
StS	Smolts	24H		30,310	26,884	20,306	25,833
StW	Smolts	38H		14,273	12,976	11,564	12,938
	Total		$ 29,760,000	235,511	203,615	221,069	220,065
	Cost per facility pound		$ 135				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 29,760,000
Salvage value (25 percent replacement estimate)	$ 7,440,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 318,857
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	4	$ 3,000,000
Shop				$ 500,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	5.00	$ 10,000,000
Pumps		$ 50,000	-	$ -
Piping		$ 400	3,000	$ 1,200,000
Valves		$ 10,000	36	$ 360,000
Abatement				$ 1,000,000
Discharge				$ 200,000
Raceways		$ 250,000	36	$ 9,000,000
Adult holding and ladder		$ 250,000	2	$ 500,000
Adult trap and ladder		$ 500,000	1	$ 500,000
Year last major constructed	1996			
*Projected from major construction	2022	$ 15,955,114		
Total (est 2022)				$ 29,760,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Salmon River Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
ChF	ChF (trap-release)	36H		11,518	11,891	11,627	11,679
Coho	Coho Big Creek (Klaskanine)	13H		10,458	6,040	13,189	9,896
trout	Rainbow	72T		21,467	12,318	20,142	17,976
	Rainbow						
StS	StS Siletz	33H					
	Total		$ 21,070,000	43,443	30,249	44,958	39,550
	Cost per facility pound		$ 533				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 21,070,000
Salvage value (25 percent replacement estimate)	$ 5,267,500
Useful life (years)	70
Annual capital contribution (straight-line)	$ 225,750
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	3	$ 2,250,000
Shop				$ 250,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	2.66	$ 5,320,000
Pumps		$ 50,000	4	$ 200,000
Piping		$ 400	2,500	$ 1,000,000
Valves		$ 10,000	20	$ 200,000
Abatement				$ 1,500,000
Discharge				$ 100,000
Raceways		$ 250,000	13	$ 3,250,000
Adult holding and ladder		$ 250,000	2	$ 500,000
Adult trap and ladder		$ 3,000,000	1	$ 3,000,000
Year last major constructed	1975			
*Projected from major construction	2022	$ 3,836,620		
Total (est 2022)				$ 21,070,000

Comment: Cost includes upgrade structures; doesn't include obmeyer weir $18 million

Table B.3 (cont.)

Trask Hatchery

	Stock Production	ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
ChF	ChF (trap-release) smolts	34H		8,287	6,718	5,344	6,783
	unfed fry						
ChS	ChS eggs	34H		7,631	7,999	7,307	7,646
	ChS smolts						
	ChS smolts out and back						
	ChS smolts						
	unfed fry						
Coho	Coho (trap-release)	34W		845	590	480	638
	Coho (trap-release)						
StW	StW-Wilson	121W		12,213	9,820	8,428	10,154
	StW-Wilson						
	unfed fry						
trout				2,043	1,449	1,750	1,747
	Total		$ 17,570,000	31,019	26,576	23,309	26,968
	Cost per facility pound		$ 652				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 17,570,000
Salvage value (25 percent replacement estimate)	$ 4,392,500
Useful life (years)	70
Annual capital contribution (straight-line)	$ 188,250
Interest expense	$ -

Replacement Cost

Item	Year	Per Unit	Units	Amount
House		$ 750,000	3	$ 2,250,000
Shop				$ 250,000
Hatch house				$ 3,500,000
Office				$ -
Intakes(s)		$ 2,000,000	2.66	$ 5,320,000
Pumps		$ 50,000	1	$ 50,000
Piping		$ 400	3,500	$ 1,400,000
Valves		$ 10,000	20	$ 200,000
Abatement				$ 500,000
Discharge				$ 100,000
Raceways		$ 250,000	10	$ 2,500,000
Adult holding and ladder		$ 250,000	2	$ 500,000
Adult trap and ladder		$ 1,000,000	1	$ 1,000,000
Year last major constructed	1916			
*Projected from major construction	2022	$ 652,536		
Total (est 2022)				$ 17,570,000

Comments: Cost includes upgrade structures

Table B.3 (cont.)

Wizard/Falls River Hatchery

	Stock Production	ID	Capital Cost	2021	2022	2023	Average
				Pounds of Fish Reared by Facility			
trout	Rainbow -eggs	127H		59,167	69,638	68,796	65,867
	Rainbow -eggs	127T		-26	277	74	108
	Rainbow fingerling	127H					
	Rainbow trophy	127H					
	Rainbow fingerling (odd years)	127T					
	Rainbow fingerling	127T					
	Rainbow legals	127T					
	Rainbow trophy	127T					
	Brook Trout -air fingerlings	74T		3318	557	3178	2,351
	Rainbow Trout Legals	72T					
	Brook Trout YY fingerlings	129H					
	Kokanee fingerlings	67H		4,763	5,071	5,056	4,963
	Rainbow fingerlings	53T					
StS	StS	66H		19,588	18,773	14,505	17,622
trout	Tiger Trout	74T		1,607	1,225	1,876	1,569
ChS				1,489	7,708	4,462	4,553
	Total		$ 32,400,000	89,906	103,249	97,947	97,034
	Cost per facility pound		$ 334				

Replacement Cost				
Item	Year	Per Unit	Units	Amount
House		$ 750,000	7	$ 5,250,000
Shop				$ 500,000
Hatch house				$ 7,000,000
Office				$ -
Intakes(s)		$ -		$ 2,000,000
Pumps		$ 50,000	1	$ 50,000
Piping		$ 400	5,000	$ 2,000,000
Valves		$ 10,000	65	$ 650,000
Abatement				$ 2,000,000
Discharge				$ 200,000
Raceways		$ 250,000	51	$ 12,750,000
Adult holding and ladder		$ 250,000	-	$ -
Adult trap and ladder		$ -	1	$ -
Year last major constructed	1947, 1952			
*Projected from major construction	2022	$ 2,633,934		
Total (est 2022)				$ 32,400,000

Comments: Cost includes upgrade structures

Non-operating expenses

Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 32,400,000
Salvage value (25 percent replacement estimate)	$ 8,100,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 347,143
Interest expense	$ -

Table B.3 (cont.)

Rock Creek Hatchery

Stock Production		ID	Capital Cost	Pounds of Fish Reared by Facility 2021	2022	2023	Average
ChS	ChS (trap-release)	55H		4,441	7,217	-10,249	470
Coho	Coho	18H					
trout	Rainbow legals	72T		-4,125	11,716	24,776	10,789
	Rainbow trophy	53T					
StS	StS Umpqua	55H			2,578	-1,745	278
	StS Umpqua						
StW	StW 18						
ChF							
	Total		$ 44,380,000	316	21,511	12,782	11,536
	Cost per facility pound		$ 518				

Non-operating expenses	
Depreciation (existing assets fully depreciated)	$ -
Facility replacement estimate	$ 44,380,000
Salvage value (25 percent replacement estimate)	$ 11,095,000
Useful life (years)	70
Annual capital contribution (straight-line)	$ 475,500
Interest expense	$ -

Replacement Cost Item	Year	Per Unit	Units	Amount
House		$ 750,000	5	$ 3,750,000
Shop				$ 7,000,000
Hatch house				$ -
Office				$ -
Intakes(s)		$ 2,000,000	12.00	$ 24,000,000
Pumps		$ 50,000	4	$ 200,000
Piping		$ 400	5,200	$ 2,080,000
Valves		$ 10,000	25	$ 250,000
Abatement				$ 1,500,000
Discharge				$ 100,000
Raceways		$ 250,000	17	$ 4,250,000
Adult holding and ladder		$ 250,000	1	$ 250,000
Adult trap and ladder		$ 1,000,000	1	$ 1,000,000
Year last major constructed	1979			
*Projected from major construction	2022	$ 10,959,895		
Total (est 2022)				$ 44,380,000

Comments: Cost includes upgrade structures

Notes: 1. Cost per facility pound is based on hatchery total cost and three-year facility production average (except Clackamas Hatchery is two-year and Rock Creek is attributed pounds). Production pounds reported in ODFW (May 2024).

2. Interest expense would be included as a non-operating expense if facility construction was funded by a loan.

Table B.4
Hatchery Engineering and Maintenance Projects in the Last 10 Years

Hatchery	Year	Project	Funding	Amount
Alsea	2018	Alsea Hatchery Valve Replacement		$ 5,107
Bandon	2022	Bandon Hatchery Septic Replacement		$ 25,000
	2023	Bandon Hatchery Septic Replacement		$ 25,000
Cedar Creek	2015	Cedar Creek Storage Tank Removal		$ 24,754
		Cedar Creek Residence lead Abatement		$ 3,450
	2016	Cedar Creek Hatchery Pond Improvement	ODOT/R&E	$ 1,680,630
		Cedar Creek Hatchery Pump Improvement	R&E	$ 89,927
	2021	Cedar Creek Hatchery – Three Rivers Fish Trap Replacement	Bond	$ 2,500,000
		Cedar Creek Hatchery – Sand Trap Building Roof Replacement	Bond	$ 145,000
	2022	Cedar Creek Hatchery Office Roof Replacement	Bond	$ 88,000
		Cedar Creek Shop Roof Replacement	Bond	$ 101,032
	2023	Cedar Creek Hatchery Office Roof Replacement	Bond	$ 88,000
		Cedar Creek Shop Roof Replacement	Bond	$ 101,032
Clackamas				
Elk River	2017	Elk River VFD Pump Station Improvement		$ 51,604
		Elk River Waterline Improvement	R&E	$ 30,800
	2021	Elk River Hatchery – Domestic Pipeline Replacement	Bond	$ 165,000
Klamath	2019	Klamath Hatchery Wall Repair	Bond	$ 81,997
Nehalem	2014	Nehalem Lighting Upgrade		$ 11,783
Oak Springs	2014	Oak Springs Pipeline Repair		$ 2,450
	2015	Oak Springs Hatchery HVAC Replacement		$ 1,700
	2018	Oak Springs Hatchery Alarm Repair		$ 495
Roaring River	2018	Roaring River Hatchery Pond Replacement		$ 931,195
	2020	Roaring River Paving	R&E	$ 73,850
	2022	Roaring River Septic Repair	SFR	$ 26,500
		Roaring River Roof Replacement		$ 26,250
	2023	Roaring River Septic Repair	SFR	$ 26,500
		Roaring River Roof Replacement		$ 26,250
Rock Creek	2014	Rock Creek Jib Crane Install		$ 8,573
		Rock Creek Valve Repair		$ 13,481
	2015	Rock Creek Pond Replacement		$ 588,674
		Rock Creek Residence Roof Replacement		$ 52,237
	2017	Rock Creek Hatchery Raw Water Filter Improvement	R&E	$ 75,699
	2018	Rock Creek Hatchery Pumping Station Repair		$ 59,406
Salmon River	2015	Salmon River Waste Drain Repair		$ 11,815
	2020	Salmon River VFD Pump Control Install	Bond	$ 40,040
	2022	Salmon River Hatchery Pipeline Replacement	Bond	$ 368,065
		Salmon River Electrical Protection System	Bond	$ 18,250
		Salmon River Main Valve Replacement	Bond	$ 198,449
		Salmon River Pump Replacement	Bond	$ 307,260
		Salmon Hatchery Intake Replacement	Bond	$ 895,539
		Salmon River Holding Pond Replacement	Bond	$ 189,329
	2023	Salmon River Hatchery Pipeline Replacement	Bond	$ 368,065
		Salmon River Electrical Protection System	Bond	$ 18,250
		Salmon River Main Valve Replacement	Bond	$ 198,449
		Salmon River Pump Replacement	Bond	$ 307,260
		Salmon Hatchery Intake Replacement	Bond	$ 895,539
		Salmon River Holding Pond Replacement	Bond	$ 189,329
Trask				
Wizard/Falls River	2014	Wizard Falls New Electric Service		$ 28,005
	2015	Wizard Falls Backup Generator - Phase 1		$ 33,480
	2016	Wizard Falls Hatchery Pond Improvement	R&E	$ 144,922
	2016	Wizard Falls Hatchery Electrical Improvement	R&E	$ 94,000
	2019	Fall River Fishway & Intake Screen Improvement	Bond	$ 256,621
			Total	$ 11,694,043

Notes: 1. Funding program was not provided for all projects in the information source.
Source: ODFW propagation reports (various years) Table 27.

Table B.5
Individual Hatchery Budget Source and Use

	Operations									Operations Breakdown					
Hatchery	GF%	GF	OF%	OF	FF%	FF	Other%	Other	Total	PS	Feed	Utilities	Travel	Other	Total
Alsea	0.0%	-	100.0%	686	0.0%	-	0.0%	-	686	66.2%	19.6%	1.2%	0.8%	12.1%	100.0%
Bandon	0.0%	-	100.0%	401	0.0%	-	0.0%	-	401	83.3%	6.3%	1.5%	1.1%	7.7%	100.0%
Cedar Creek	1.8%	11	98.2%	573	0.0%	-	0.0%	-	584	74.6%	11.5%	2.1%	1.4%	10.5%	100.0%
Clackamas	0.0%	-	0.0%	-	81.8%	735	18.2%	164	899	42.0%	13.1%	16.3%	0.7%	28.0%	100.0%
Elk River	76.6%	420	23.4%	128	0.0%	-	0.0%	-	549	66.9%	9.7%	13.2%	1.3%	9.0%	100.0%
Klamath	0.0%	-	25.0%	132	75.0%	396	0.0%	-	528	71.6%	16.0%	0.6%	3.2%	8.6%	100.0%
Nehalem	25.7%	137	74.3%	397	0.0%	-	0.0%	-	534	76.7%	12.5%	7.8%	1.4%	1.6%	100.0%
Oak Springs	0.0%	-	22.3%	188	74.4%	628	3.3%	28	844	66.8%	23.1%	1.0%	2.5%	6.6%	100.0%
Roaring River	0.0%	-	18.2%	145	81.8%	653	0.0%	-	798	57.1%	22.6%	1.0%	2.6%	16.6%	100.0%
Salmon River	42.0%	254	58.0%	351	0.0%	-	0.0%	-	606	65.2%	11.2%	6.7%	2.1%	14.8%	100.0%
Trask	88.1%	417	11.9%	56	0.0%	-	0.0%	-	474	75.8%	10.0%	4.7%	2.2%	7.3%	100.0%
Wizard/Falls River	0.0%	-	25.0%	191	75.0%	574	0.0%	-	765	72.7%	12.3%	3.1%	5.2%	6.7%	100.0%
Rock Creek	35.1%	186	59.1%	314	0.0%	-	5.8%	31	531	27.8%	13.9%	3.7%	2.1%	52.5%	100.0%
Total		1,426		3,564		2,987		222	8,200						

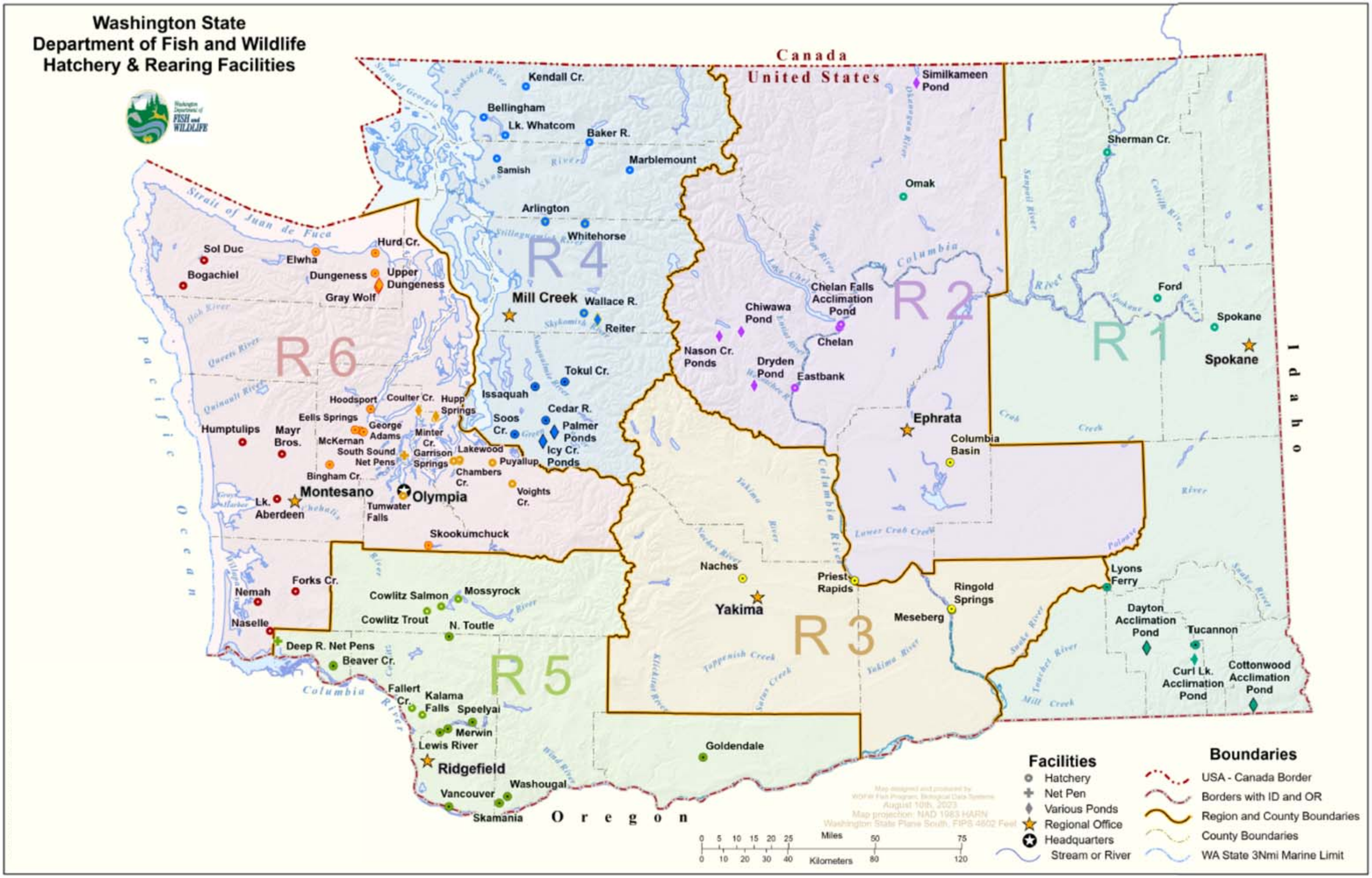
	Support													
	Admin	Marking	Liberation							Health				
Hatchery	100% OF	100% GF	GF%	GF	OF%	OF	FF%	FF	Total	GF%	GF	OF%	OF	Total
Alsea	34	14	62.5%	7	37.5%	4	0.0%	-	12	42.3%	8	57.7%	11	19
Bandon	34	133	62.5%	7	37.5%	4	0.0%	-	12	42.3%	8	57.7%	11	19
Cedar Creek	34	50	62.5%	7	37.5%	4	0.0%	-	12	42.3%	7	57.7%	9	16
Clackamas	55	208	0.0%	-	0.0%	-	100.0%	42	42	42.3%	8	57.7%	11	19
Elk River	34	75	62.5%	7	37.5%	4	0.0%	-	12	42.3%	9	57.7%	12	21
Klamath	34	-	0.0%	-	22.0%	9	78.0%	32	40	42.3%	3	57.7%	4	7
Nehalem	34	23	62.5%	7	37.5%	4	0.0%	-	12	42.3%	8	57.7%	11	19
Oak Springs	34	19	0.0%	-	22.0%	7	78.0%	26	33	42.3%	3	57.7%	4	7
Roaring River	34	9	0.0%	-	22.0%	7	78.0%	26	33	42.3%	3	57.7%	4	7
Salmon River	34	67	62.5%	3	37.5%	2	0.0%	-	5	42.3%	8	57.7%	11	19
Trask	34	47	62.5%	7	37.5%	4	0.0%	-	12	42.3%	8	57.7%	11	19
Wizard/Falls River	50	5	0.0%	-	22.0%	4	78.0%	15	19	42.3%	3	57.7%	4	7
Rock Creek	34	45	62.5%	7	37.5%	4	0.0%	-	12	42.3%	8	57.7%	11	19
Total	473	696		55		60		141	256		83		113	196

	Maintenance					Total Operations,
	Housing	Emergency	R&E	Bond	Wildfire	Support, and
Hatchery	100% OF	100% OF	100% OF	100% GF	100% OF	Maintenance
Alsea	8	4	64	24		864
Bandon	6	4	64	24		697
Cedar Creek	7	4	64	24		793
Clackamas	10	4	64	130		1,431
Elk River	5	4	64	24		787
Klamath	5	4	64	24	260	965
Nehalem	9	4	64	24		721
Oak Springs	8	4	64	24		1,037
Roaring River	9	4	64	24		982
Salmon River	7	4	64	24		829
Trask	9	4	64	24		686
Wizard/Falls River	17	7	129	48		1,046
Rock Creek	-	4	64	24	900	1,632
Total	98	50	900	440	1,160	12,469

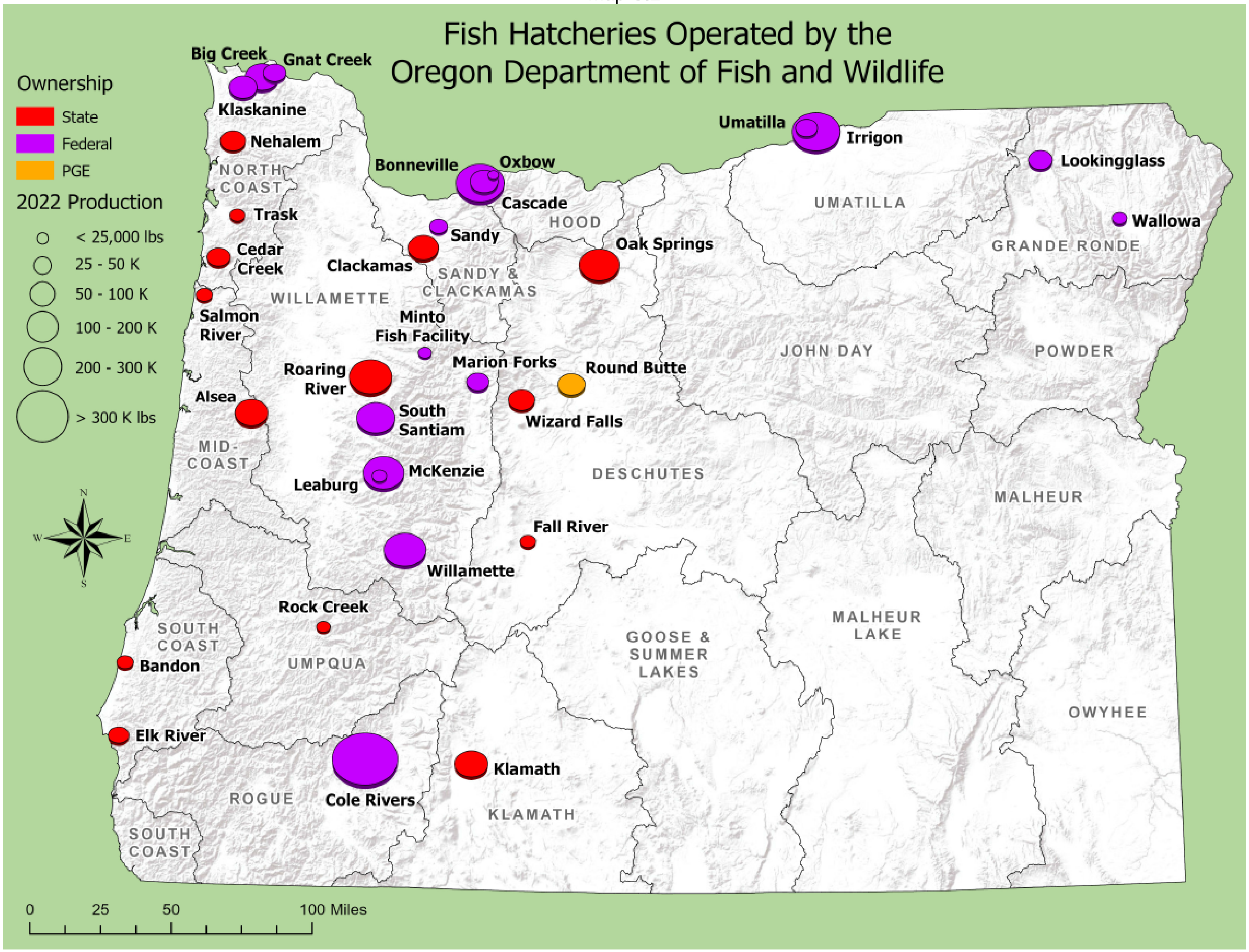
Notes: 1. Amounts in thousands.
2. GF General fund
OF Licenses and fees
FF Federal fund including Mitchell Act, US Army Corps of Engineers and Sport Fishing Restoration
Other PGE, Douglas County, hydroelectric sales

Appendix C
Hatchery Location Maps

Map C.1
Washington Department of Fish and Wildlife Hatchery and Rearing Facilities



Map C.2



Fish Hatcheries Operated by the
Oregon Department of Fish and Wildlife
Ownership
State
Federal
PGE
2022 Production
< 25,000 lbs
25 - 50 K
50 - 100 K
100 - 200 K
200 - 300 K
> 300 K lbs
Big Creek
Gnat Creek
Klaskanine
Nehalem
NORTH COAST
Trask
Cedar Creek
Salmon River
Alsea
MID-COAST
Bonneville
Oxbow
Cascade
HOOD
Sandy
Clackamas
SANDY & CLACKAMAS
WILLAMETTE
Minto Fish Facility
Marion Forks
Roaring River
South Santiam
Leaburg
McKenzie
Willamette
Oak Springs
Round Butte
Wizard Falls
Fall River
DESCHUTES
Umatilla
Irrigon
UMATILLA
Lookingglass
Wallowa
GRANDE RONDE
JOHN DAY
POWDER
MALHEUR
Rock Creek
UMPQUA
SOUTH COAST
Bandon
Elk River
Cole Rivers
ROGUE
SOUTH COAST
Klamath
KLAMATH
GOOSE & SUMMER LAKES
MALHEUR LAKE
OWYHEE
N
W
E
S
0
25
50
100 Miles

Map C.3
California Department of Fish and Wildlife Fish Hatchery Locations

California Department of Fish and Wildlife

Fish Hatchery and Stocking Program

Hatchery Locations

Map C.4
Idaho Department of Fish and Game Hatcheries

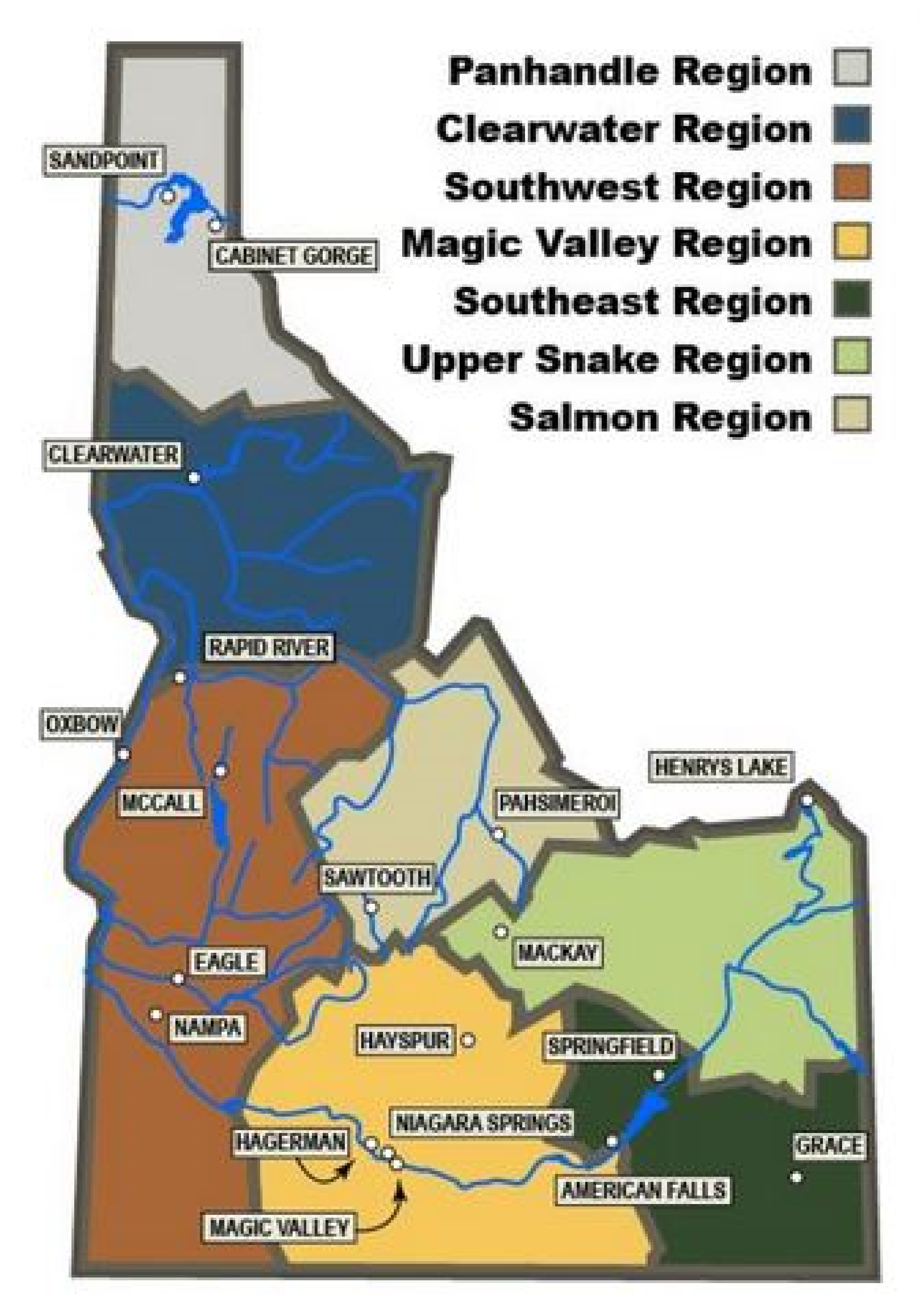


Table C.1
Surrounding States Annual Hatchery Revenue Budgets

Washington Department of Fish and Wildlife

FY24	Amount	Share
Flexible Funding		
General Fund - State	24,926,968	36.3%
Fish, Wildlife, and Conservation Acct	4,300,581	6.3%
Aquatic Lands Enhancements Acct (ALEA)	1,318,510	1.9%
Dedicated/Restricted Funding		
Regional Fisheries Enhancement Group (PSRFE)	1,189,755	1.7%
Warm Water Game Fish Account	110,685	0.2%
Limited Fish and Wildlife Account - Two-Pole Fund	2,024,719	3.0%
Model Toxics Control Operating Account (MTCA)	138,625	0.2%
Climate Commitment Account	125,000	0.2%
Contract Funding - Total Dollars		
RCO	815,365	1.2%
Local		
Chelan County PUD	3,987,388	5.8%
City of Tacoma	5,512,788	8.0%
Grant County PUD	982,819	1.4%
PacifiCorp	2,904,085	4.2%
Seattle Public Utilities	775,272	1.1%
Other GF - Local	1,816,486	2.6%
Federal		
ACOE	1,896,025	2.8%
BPA	779,530	1.1%
BPA - SAFE	402,799	0.6%
NOAA Mitchell Act	5,315,309	7.7%
NOAA - PST	4,514,967	6.6%
USFWS - DJ	1,791,414	2.6%
USFWS - LSRCP & Lyons Complex	2,987,854	4.4%
Total	68,616,944	100.0%

Notes: Acronyms:
RCO - Washington State Recreation and Conservation Office
ACOE – US Army Corps of Engineers
LSRCP – Lower Snake River Compensation Plan

Oregon Department of Fish and Wildlife

FY 2023-25 (annual)	Amount	Share
General fund	3,487,678	7.9%
Other Fund License /3	5,867,645	13.3%
Other Fund Obligated /4	4,565,060	10.3%
Other Fund Dedicated /5	544,120	1.2%
BPA	4,210,999	9.5%
USCOE	11,979,834	27.1%
LSRCP	4,090,181	9.3%
MA	6,242,415	14.1%
SFR	2,160,542	4.9%
PSC, PSMFC, PST, NOAA	1,065,393	2.4%
Total	44,213,866	100.0%

Notes:
1. Acronyms:
   SAFE - Select Area Fisheries Enhancement Program (Lower Columbia River net pen project)
   PGE - Portland General Electric
   PSMFC - Pacific States Marine Fisheries Commission
   PST - Pacific Salmon Treaty
   NOAA - National Oceanic and Atmospheric Administration Fisheries
   MA – Mitchell Act
   BPA - Bonneville Power Administration
   LSRCP – Lower Snake River Compensation Plan
   USCOE – U.S. Army Corps of Engineers
   COP – City of Portland
   SFR – Sports Fishing Restoration (manufacturers federal excise taxes on sport fishing equipment, import duties on fishing tackle and pleasure boats, and the portion of the gasoline fuel tax attributable to small engines and motorboats)
2. Includes $1.0 million for hatchery independent resiliency assessments.
3. PGE, Idaho Power, COP, Pacific Corps, Douglas County, Burns Paiute, egg and carcass sales, Wasco Electric-hydro, Cow Creek.
4. SAFE.

California Department of Fish and Wildlife

FY 2023-24	Amount	Share
General Fund	6,332,000	12.1%
California Environmental License Plate Fund	1,000	0.0%
Fish and Game Preservation Fund	3,875,000	7.4%
Federal Trust Fund	5,468,000	10.5%
Reimbursements	8,650,000	16.5%
Hatchery and Inland Fisheries Fund	26,037,000	49.8%
California Emergency Relief Fund	1,912,000	3.7%
Total	52,275,000	100.0%

Notes:
1. Federal Trust Fund includes SFR, USCOE, NOAA Fisheries, Bureau of Reclamation and other federal sources.
2. Reimbursements are non-federal fund sources. Examples are:
   a. Pacific Gas & Electric Company. Agreements for trout stocking mitigation included in FERC license agreements.
   b. Siskiyou Power Authority. Agreement for anadromous fish and trout stocking included in FERC license agreement.
   c. Negotiated agreement between CDFW and San Francisco Public Utilities Commission for a temporary water treatment system during repairs to the Hetch Hetchy tunnels.
   d. California Department of Water Resources. Mitigation agreement to operate Feather River Hatchery to produce Chinook salmon and steelhead. Also to conduct genetic identification of juvenile salmon at various locations in the valley to help inform to help inform California State Water Project operations.

Idaho Department of Fish and Game

FY24	Amount	Share
License	5,739,350	32.4%
BPA	1,048,496	5.9%
DJ	1,253,791	7.1%
LSRCP	6,599,345	37.2%
IPC	3,022,990	17.0%
PSMFC	69,249	0.4%
State	-	
Total	17,733,221	100.0%

Notes: Acronyms:
License - Dedicated funds from IDFG
BPA - Bonneville Power Administration
DJ - Dingell-Johnson Act, otherwise known as Sport Fish Restoration Act
LSRCP - Lower Snake River Compensation Plan
IPC - Idaho Power Company
PSMFC - Pacific States Marine Fisheries Commission
State - State General Fund (IDFG receives no general fund tax revenue)

APPENDIX B: ASSESSMENT OF ODFW STATE HATCHERY INFRASTRUCTURE ALTERNATIVES

Prepared by Lynker Technologies, LLC

Assessment of ODFW State Hatchery Infrastructure Alternatives

Oregon Department of Fish and Wildlife

March 5, 2025

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Boulder, Colorado **DC—Metro** **Pacific—Oahu**

Executive Summary

The Oregon Department of Fish and Wildlife (ODFW) operates a network of fish hatcheries critical to supporting the state's fisheries by producing and releasing both anadromous and resident fish species like salmon, steelhead, and trout. These hatcheries play a vital role in conservation, habitat mitigation, and sustaining recreational and commercial fishing, which contributes significantly to the local and state economy. However, many hatcheries face challenges such as aging infrastructure, deferred maintenance, increasing operational costs, and the worsening impacts of climate change on water availability and quality. Recognizing these challenges, ODFW has been assessing the current state of its hatcheries to identify sustainable strategies for maintaining fish production across the system.

ODFW contracted Lynker to conduct a comprehensive assessment of 17 hatcheries (14 state and three federal), using a Multi-Criteria Decision Analysis (MCDA) framework. The assessment focused on factors such as infrastructure conditions, climate vulnerabilities, economic impacts, and program importance. The findings aim to guide ODFW's decisions on future investments, ensuring that its hatchery network continues to meet conservation and production goals.

Lynker's MCDA framework used quantitative and qualitative criteria in four categories: Climate Resilience and Hazards, Fish Production and Hatchery Importance/Connectivity, Operations and Infrastructure Costs, and Economic Impact Analysis. This approach provided a holistic view of each hatchery's strengths, vulnerabilities, and potential for future improvements. These categories were aggregated into a final combined score and ranking, which was then used to develop alternative operational models for status quo and consolidated operational scenarios.

Key Results from MCDA

1. Climate Resilience and Hazards

Methods: This category evaluated hatcheries based on water availability, water quality, and vulnerability to climate risks like drought, rising stream temperatures, and other climate hazards. Criteria included greenhouse gas (GHG) emissions and projected future water temperatures.

Results: Hatcheries like South Santiam, Wizard Falls, and Fall River ranked highest due to favorable water conditions and lower susceptibility to climate change. In contrast, hatcheries like Rock Creek, Alsea, and Salmon River were more vulnerable, especially regarding critical water temperature thresholds under current and projected future conditions. Alsea and Bandon also have challenges related to water availability.

2. Fish Production and Hatchery Importance/Connectivity

Methods: This category assessed fish production volume, potential for expanded production, and the biological uniqueness of the species reared. Connectivity within the ODFW network and obligations under conservation and treaty programs were also considered.

Results: Cole Rivers, Clackamas, and South Santiam ranked highest due to their large production volumes and importance in fulfilling mitigation obligations. These hatcheries play critical roles within the broader system. Conversely, Klamath Falls and Nehalem showed limited production capacity and connectivity, making them less essential to the overall hatchery network.

3. Operations and Infrastructure Costs

Methods: This category analyzed annual operating costs, deferred maintenance, infrastructure to improve climate resilience, and projected modifications. The goal was to identify current financial burdens and estimate future costs for necessary upgrades.

Results: Rock Creek emerged as the costliest due to the need for significant rebuilding after fire damage in 2020. Other high-cost hatcheries included Alsea and Bandon when considering state-only infrastructure costs, or Cole Rivers and Leaburg when considering state and federal infrastructure costs. Fall River and Wizard Falls had minimal infrastructure needs, while the federal hatcheries Leaburg and South Santiam do not have state infrastructure costs, only federal.

4. Economic Impact Analysis

Methods: This category assessed the economic contributions of each hatchery at the local, state, and regional levels, including visitor spending, employment, and the value of fish production for commercial and recreational purposes. This assessment was based on an independent economic study by The Research Group, LLC.

Results: Hatcheries like Clackamas and Wizard Falls contributed significantly to local economies due to high visitor numbers and recreational fishing impact. Smaller hatcheries like Bandon and Nehalem had lower economic contributions due to their smaller production and fewer visitors.

5. Combined Categorical Results

The scores from the four MCDA categories (climate hazard; fish production, connectivity, and excess capacity scores; infrastructure costs; and economic impact) were combined to evaluate relative hatchery scoring within the 17 hatcheries evaluated for this study. Wizard Falls, Clackamas, Cole Rivers (F), and South Santiam (F) scored in the highest 75th percentile representing facilities indicating lower overall risk, higher fish production and program importance, lower costs, and higher economic impact. Rock Creek, Bandon, Alsea, and Salmon River scored in the lowest 25th percentile representing facilities that have the lowest ranked scores.

Alternative Operational Models

To investigate potential costs and benefits of different operational models, four alternatives were developed by ODFW and analyzed for this study:

Alternative 1: Status Quo with Minor Adjustments
This model represents maintaining current operations while addressing deferred maintenance and rebuilding Rock Creek Hatchery to restore most of its pre-fire capacity. This approach preserves the existing hatchery network with minor upgrades to ensure continued fish production.

Alternative 2: Consolidation of Operations
This set of alternatives proposes consolidating operations by shifting production out of selected hatcheries with higher risks and costs (i.e., Rock Creek and one hatchery in the Northwest Region), while expanding production at other facilities to maintain the same overall system production capacity. Under these scenarios, the goal is to optimize production, reduce overall costs, and mitigate risks related to aging infrastructure and climate change. In all scenarios, Oak Springs and Fall River Hatcheries would be expanded so that trout production could be shifted from coastal facilities, leaving more capacity for anadromous production. Three sub-scenarios were developed under Alternative 2:

- **Alternative 2a:** Shift production at Nehalem and Rock Creek Hatcheries to other facilities. This reduces infrastructure costs associated with two facilities while reallocating production to more resilient hatcheries.
- **Alternative 2b**: Shift production at Salmon River and Rock Creek Hatcheries to other facilities. Salmon River faces significant climate and operational challenges, particularly related to current and projected stream temperatures.

- **Alternative 2c:** Shift production at Alsea and Rock Creek Hatcheries to other facilities and convert Alsea into a Salmon Trout Enhancement Program (STEP) facility. This conversion allows Alsea to continue contributing to fishery enhancement, while production shifts to more resilient hatcheries.

The analysis found that consolidating operations (Alternatives 2a-c) does not offer significant infrastructure cost savings over the status quo (Alternative 1), and any cost savings are well within the range of uncertainty of cost estimates. The cost savings for Alternatives 2a, 2b, and 2c are estimated to be $4M, $6M, and$14M, respectively with the greatest savings under Alternative 2c, compared to Alternative 1 representing the status quo.

The consolidation alternatives generally focused on shifting production out of hatcheries with higher risks and costs (e.g., Rock Creek), to prioritize investment in other hatcheries with lower risk. Consolidation may be a helpful tool in eliminating the highest risk facilities to invest in lower risk facilities. However, consolidation schemes may have other risks and benefits that are not considered in this assessment. For instance, it's possible that a consolidated hatchery system could become more vulnerable due to having fewer facilities that can absorb operational changes in response to extreme events (e.g., wildfire).

Conclusion

The MCDA framework provided a comprehensive evaluation of 17 hatcheries across the four categories: climate resilience, fish production, infrastructure costs, and economic impact. Hatcheries like Wizard Falls, Clackamas, Cole Rivers, and South Santiam ranked highest overall, indicating their strong roles in fish production and resilience to future challenges. In contrast, hatcheries like Rock Creek, Bandon, Salmon River, and Alsea ranked lowest, highlighting the need for significant investment or further consideration by ODFW for consolidation of operations. As the State of Oregon looks forward to the future of hatchery programs across the state, these results can help guide ODFW in making informed decisions about how to optimally manage and invest in its hatchery network, ensuring the long-term sustainability of ODFW's fish rearing programs amid changing environmental and economic conditions.

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1. Introduction

Fish hatcheries operated by the Oregon Department of Fish and Wildlife (ODFW) are facing increasing challenges that threaten their ability to maintain current production and continue operations into the future. These challenges include both intrinsic factors, such as the aging infrastructure necessary for the successful rearing of fish, and extrinsic, climate-driven factors that push environmental conditions outside of the critical thresholds required for fish rearing. To effectively address the diverse and complex challenges facing these hatcheries, and assess possible alternative hatchery operations models or scenarios, ODFW contracted with Lynker to conduct a comprehensive and independent Multi-Criteria Decision Analysis (MCDA) of a subset of the ODFW hatcheries, the results of which are outlined in this report.

MCDA is a decision-making tool that allows for the evaluation of diverse criteria by systematically analyzing and comparing various factors to arrive at the most informed and balanced decision. In the context of hatchery management, MCDA offers a structured framework to assess the performance, resilience, and future viability of hatcheries based on a broad range of criteria, including infrastructure conditions, climate resilience, economic impacts, and program importance.

Through the MCDA process, this analysis evaluates the status and conditions of ODFW's 14 state-owned hatcheries, as well as three federally owned hatcheries operated by ODFW that currently, or could potentially, support state hatchery production. The MCDA framework has been applied to develop and propose alternative operational models based on this assessment, incorporating projected climate change impacts, operating costs, infrastructure needs, economic considerations, and the importance of each hatchery and its programs within the broader system. The use of the MCDA ensures that the recommendations provided in this report are not only data-driven but also balanced across multiple dimensions of hatchery management, facilitating informed decision-making for the future of the ODFW hatchery network.

Included in this analysis are the projected potential impacts of climate change at each facility, an evaluation of the overall resilience of the hatcheries to these projected changes, an assessment of hatchery importance and contributions to the system, and an analysis of deferred maintenance and infrastructure needs as described by ODFW. Additionally, the results from an independent economic impact analysis of the ODFW hatchery system have been summarized to provide a comprehensive view of the costs and benefits of ODFW hatchery operations. Finally, we use these findings to present several alternative operational models that present possible future paths forward for the ODFW hatchery system.

Overview of Report Objectives

- Assessment of climate vulnerability and resilience of hatcheries, including:
    - Projected impact of climate change on the ability of each hatchery to rear and release fish, and the overall viability of the hatchery programs
    - Recommendations to mitigate these impacts through hatchery program changes and other measures
- Assessment of current operating costs, deferred maintenance, and infrastructure upgrades
- Development of alternative operational models for a consolidated ODFW hatchery network
- Demonstrating different approaches to possibly mitigate the stated challenges, while maintaining or minimally reducing current production levels

- Costs and benefits of different hatchery approaches to maintaining the current level of production of anadromous and resident salmonids at state-owned hatcheries

Section 2 of the report introduces the methods implemented to construct the MCDA and select the criteria for the analysis. Section 3 provides the results of the MCDA framework by the four combined categories: (1) Climate Resilience and Hazards, (2) Fish Production and Hatchery Importance/Connectivity, (3) Operations and Infrastructure Costs, and (4) Economic Impact Analysis. Section 4 compares the costs and fish production across the two main alternatives, and Section 5 summarizes the findings in a brief conclusion. Finally, the detailed hatchery results can be found in the appendix in Section 7.

2. Methods: MCDA Framework Development

Each fish hatchery within the ODFW system has distinct operational requirements, contributions to the system, exposure and responses to climate stresses, deferred maintenance backlogs, and economic impacts on the State of Oregon. Assessing the ODFW hatchery system — and exploring potential future operational scenarios — therefore necessitates a holistic evaluation of all aspects of each fish hatchery. Given the complexity inherent in this decision-making process, this study employs a Multi-Criteria Decision Analysis (MCDA) to integrate both qualitative and quantitative metrics into a weighted-sum model framework. This approach enables the development of categorical and total scoring metrics for ranking the 14 state hatcheries and 3 federal hatcheries evaluated within this study. Based on these scoring metrics, we also develop and present several alternative operational models.

The framework developed by Lynker consists of four main organizing categories that together encompass a range of variables influencing, modifying, or guiding hatchery operations. These categories are: (1) Climate Resilience and Hazards, (2) Fish Production and Hatchery Importance/Connectivity, (3) Operations and Infrastructure Costs, and (4) Economic Impact Analysis. The first three categories represent Lynker-led analyses, while the fourth summarizes an independent economic analysis conducted by an ODFW contractor. Within each category, criteria groupings are measured by one or more criteria, identified as key metrics for assessing ODFW hatcheries and informing alternative operational models. These criteria are then organized into three hierarchical levels: final combined scores, categories, and weighting scenarios (Figure 2-1).

To assess the sensitivity of categorical scoring to various criteria weighting strategies, different thematic weighting scenarios were developed within each of the categories. These scenarios either applied equal weights across all criteria within a category or employed heavier weights on specific criteria more aligned with ODFW-defined objectives, e.g., identifying hatcheries with good water quality within the Climate Resilience and Hazards category. In the weighting scenarios, the weights may vary across criteria but do not vary between hatcheries; each hatchery is subjected to the same weight for any given criterion, thereby optimizing the framework for comparative analysis across hatcheries. "Equal weights" scenarios provide a baseline understanding of how scoring outcomes are influenced by the selected criteria within a given category. In categories where multiple weighting scenarios were developed, the resulting spread of category scores illustrates the sensitivity of the scoring to weighting choices. This approach allows for the condensation of a broad (though not exhaustive) list of decision-making criteria into the most essential considerations, making clear the trade-offs required for assessing alternative operational models within the ODFW hatchery system.

The following sections provide a detailed summary of these categories, their respective criteria, and any weight scenarios applied within. Each section also describes the location of supplemental information within the appendix, including supporting figures, details on the raw data sources, pre/post-processing methodologies applied, and any other pertinent background information.

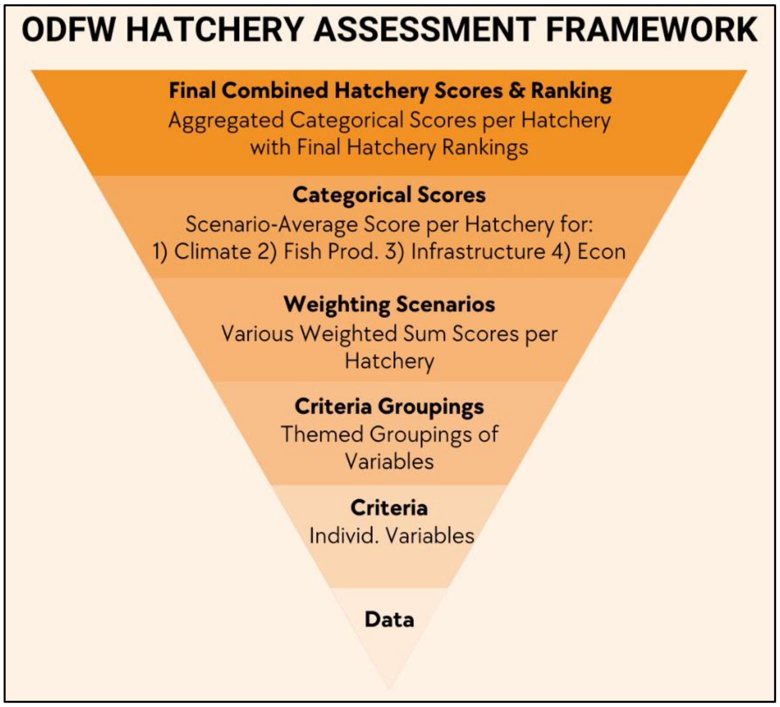

Figure 2-1: Overview of the Multi-Criteria Decision Analysis (MCDA) framework methodology used within the hatchery assessment. Progressing from the raw data (bottom) to the final combined hatchery scores and rankings (top).

2.1. Climate Resilience and Hazards

This section outlines the variables analyzed as part of the hatchery Climate Resilience and Hazards category. This includes natural hazards (e.g., water temperature, water supply, sea level rise), other physical hazards (e.g., power supply), and additional climate-relevant indicators, such as greenhouse gas emissions (GHG) associated with hatchery operations.

Climate and hazards represent some of the most significant challenges to the ongoing production and operations of ODFW hatcheries, given the close relationship between hatcheries and the hydrologic and climatic conditions of the watersheds that support fish populations. Within this category, several key variables act as single determinants — indicators that can independently undermine the viability of a hatchery unless significant and costly mitigation strategies are implemented (e.g., the use of chillers for cooling intake water). To reflect the critical importance of these factors, these individual criteria are weighted heavily across all weighting scenarios.

The Climate Resilience and Hazards category is primarily based on the prior Climate Change Risk Assessment (Lynker, 2023), with additional key variables supplementing the analysis. This study provides a standardized methodology for scoring the seventeen hatcheries. The original report included scores for six hatcheries, and the remaining eleven hatchery scores were calculated by ODFW using the same methods. The following describes the methodology for each indicator below. Weighting scenarios for this category include: (1) equal weights, (2) drought resilience, and (3) water quality.

The Climate and Hazards category is divided into three criteria groupings: (1) Water Availability, (2) Water Quality, and (3) Other Hazards, as further described in Section 2.1 of the Methods. These criteria groupings are comprised of individual criteria as described in Table 2-1.

Table 2-1: Climate and Hazards criteria and grouping, and the corresponding appendices containing supplemental information.

Criteria Grouping	Units	Criteria	Appendix Section
Water Availability	min-max norm, inverted	Water Rights Potential Impact	Section 7.1.2
	min-max norm, inverted	Low Flow Potential Impact	Section 7.1.2
	min-max norm, inverted	Drought Potential Impact	Section 7.1.2
Water Quality	min-max norm, inverted	Observed Maximum Stream Temperature	Section 7.1.3
	binary (0, 10)	Water Temperature Criticality (Observed Max Stream Temp. < 68F)	Section 7.1.3
	min-max norm, inverted	VELMA Projected Change in Annual Max Temp	Section 7.1.3
	min-max norm, inverted	Pathogens Potential Impact	Section 7.1.2
	min-max norm, inverted	Flooding Potential Impact	Section 7.1.2
	min-max norm, inverted	Watershed Condition Potential Impact	Section 7.1.2
Other Hazards	min-max norm, inverted	GHG Emissions - Power & Fish Production (per pound of fish)	Section 7.1.1
	min-max norm, inverted	Wildfire Potential Impact	Section 7.1.2
	min-max norm, inverted	Sea Level Rise Potential Impact	Section 7.1.2

2.1.1. Water Availability

Water supply represents one of the most critical challenges for ODFW in sustaining hatchery operations under a changing climate. The first metric in this category is *Water Rights Potential Impact.* This metric describes the seniority of the water rights for each hatchery and any additional water rights available to it. *Low Flow Potential Impact* uses mid-century climate projections based on a worst-case model scenario (RCP8.5). The complete methods for calculating this metric are found in the Final Combined Risk Assessment, Section 2.1.11. *Drought Potential Impact* is based on a retrospective 22-year timeseries for the county that the hatchery is in, using data from the UNL Drought Monitor (National Drought Mitigation Center 2022). The scoring is based on the percentage of county area in drought categories D0 (abnormally dry) and D1 (moderate drought).

2.1.2. Water Quality

Water temperature is included in the framework as (1) *Observed Maximum Stream Temperature,* (2) *Water Temperature Criticality,* and (3) *VELMA Projected Change in Annual Max Temp.* The first metric is based on data from a single year, 2016, due to temperature data being unavailable for other years across all hatcheries. The second temperature metric, *Water Temperature Criticality* is a simple binary indicator of temperatures that exceed a 68° F temperature. The next metric is *VELMA Projected Change in Annual Max Temp*. The model component, Visualizing Ecosystem Land Management Assessments (VELMA) is a “spatially explicit ecohydrological watershed model” designed to aid in water quality predictions driven by contamination, soil properties, and climatic change. The model, developed by the

US Environmental Protection Agency (EPA) and implemented by ODFW, predicts the change in annual maximum temperature for hatcheries that rely on surface water flows. Hatcheries with groundwater resources, or hatcheries that were otherwise omitted from the VELMA modeling, have been assigned a score of 10/10, e.g., Cole Rivers and Klamath Falls. *Pathogens Potential Impact* is highly correlated to water temperature and uses the same scoring methodology as *Water Temperature Potential Impact*.

2.1.3. Other Climate and Hazards Indicators

This category includes Greenhouse gas (GHG) emissions, wildfire, and sea level rise potential impacts.

GHG Emissions

ODFW plans to be carbon neutral by mid-century and one of their goals to achieve this plan is to reduce its electricity consumption. We assessed the carbon footprint of each of the 17 ODFW hatcheries by determining the total greenhouse gas (GHG) emissions as metric tons of equivalent carbon dioxide (CO_{2e}) per year based on energy consumption (kWh) and emissions from fish production. Additionally, we quantified the nitrous oxide (N_2O) GHG emissions from fish production processes. N_2O is released during microbial nitrification and denitrification of fish waste during fish production.

Wildfire Potential Impact

Wildfire Potential Impact is calculated using burn probability data from US Forest Service and Oregon Department of Forestry (2018), using a 5-mile buffer to determine the exposure of each hatchery.

Sea level Rise Potential Impact

This metric determines the risk of inundation for coastal hatcheries. This score includes two determinants, the first being a binary variable for hatcheries where the footprint intersects with projected sea level increases. The second determinant is a score, based on the degree to which saltwater intrusion is already occurring. This information was sourced from interviews with hatchery staff.

2.2. Fish Production and Hatchery Importance/Connectivity

The Fish Production and Hatchery Importance/Connectivity includes metrics related to total fish biomass, excess production capacity, and the connectivity of each hatchery to other facilities, including the export of fish or eggs and involvement in the STEP program. These metrics are essential for understanding the operational capabilities and potential of each hatchery within the broader ODFW system.

The Fish Production and Hatchery Connectivity category is divided into three criteria groupings: (1) Fish Production, (2) Potential Excess Capacity, and (3) Connectivity & Importance, as further described in Section 2.2 of the Methods. These criteria groupings are comprised of individual criteria as described in Table 2-2.

Table 2-2: Fish Production and Hatchery Connectivity criteria and grouping, and the corresponding appendices containing supplemental information.

Criteria Grouping	Units	Criteria	Appendix Section
Fish Production	min-max normalized	Average Monthly Biomass - All Species	Section 7.2; 7.2.1
Potential Excess Capacity	min-max normalized	Hatchery Rearing Volume	Section 7.2
	min-max normalized	Potential Excess Water Capacity (Annual)	Section 7.2
	min-max normalized	Potential Excess Water Capacity (6-month, May-Oct)	Section 7.2
	min-max normalized	Number of Months with Water Shortage	Section 7.2; 7.1.4
	min-max normalized	Number of Months with Projected Water Shortage	Section 7.2; 7.1.4
	min-max norm, inverted	Density Index (Annual Avg)	Section 7.2
	min-max norm, inverted	Density Index (Annual Max)	Section 7.2
	binary min-max (0/10)	Are there undeveloped spaces OR facilities that can be repurposed?	Section 7.2
Connectivity & Importance	min-max normalized	Population Served (Annual Number of Visitors)	Section 7.2; Section 7.2.2
	scaled (CDC index * 10)	Social Vulnerability Index (County)	Section 7.2; Section 7.2.2
	min-max normalized	Connectivity - Exports to hatcheries (count)	Section 7.2; Section 7.2.2
	min-max normalized	Connectivity - Exports to acclimation facilities (Count)	Section 7.2; Section 7.2.2
	binary min-max (0/10)	Connectivity - Exports to STEP (Yes/No)	Section 7.2; Section 7.2.2
	binary min-max (0/10)	Production for mitigation obligations	Section 7.2; Section 7.2.2
	binary min-max (0/10)	Production for obligations under Pacific Salmon Treaty	Section 7.2; Section 7.2.2
	binary min-max (0/10)	Production for obligations under US v Oregon Management Agreement	Section 7.2; Section 7.2.2
	min-max normalized	Biological Uniqueness - Number of Unique Adult Broodstock Programs	Section 7.2; Section 7.2.2

2.2.1. Fish Production

The fish biomass criteria within the Fish Production criteria grouping is calculated from 2022 data, providing a point-in-time "snapshot" that quantifies current hatchery production levels. This metric is crucial for guiding the development of alternative operational models, as it reflects the hatchery's current output. In this analysis, production levels serve a dual role: they are both a component of the decision-making framework and an outcome to be optimized in the proposed operational models. For example, scenarios that involve the consolidation of operations might prioritize the concentration of production levels at specific facilities, or ensuring production remains constant across an ODFW region or watershed. Therefore, production data is only included in the scoring (i.e., weighted greater than zero) for scenarios where increased production is advantageous for a hatchery. This approach ensures that the scoring system remains relevant and avoids introducing inputs that could have an inverse relationship with desired outcomes, depending on the scenario or criteria context.

2.2.2. Potential Excess Capacity

Potential excess capacity quantifies the ability of a hatchery to absorb productions from others. This category incorporates hatchery rearing volume, potential excess water capacity, months of water shortage, density index, and a binary available-space variable.

Hatchery Rearing Volume includes hatchery space that supports fish development in various life stages such as raceways and ponds. Infrastructure for water supply and staff areas are excluded. The *potential excess water capacity* metric indicates water availability beyond the minimum demand required by the hatchery. This metric is determined by the water usage exceeding the minimum demand for the years 2021 and 2022. Usage is considered analogous to the total water availability, due to the tendency for hatchery water rights to be out of priority during critical dry periods. Similarly, *6-month water capacity* limits the aggregation to the months between May and October, when dry conditions are most prevalent. The number of months with water shortage is split into a current and projected metric, with the predicted shortage being a function of estimates for decreased flows of 0-15% and increased stream temperatures of 0-3°C, depending on the hatchery and month of the year. Density index is a function of the fish biomass (in pounds) and the hatchery rearing volume in cubic-feet, and represents an approximate range for rearing capacity, based on the current facilities. Differences between individual hatchery facilities and the species being reared may dictate that the true maximum density may be lower or higher for a given site. To account for seasonal variation, a mean annual density index is derived across each month. The last metric is a binary variable indicating if the hatchery has either undeveloped space or additional facilities that could be repurposed to facilitate increased production.

2.2.3. Connectivity and Importance

Included in the production analysis is a measure of the connectivity of the hatchery, representing the complexity or logistical challenge of fish exports for a given hatchery. This metric is represented by variables of (1) exports to other hatcheries, (2) exports to acclimation facilities, and (3) exports to Salmon and Trout Enhancement Programs (STEP). From a planning perspective, high levels of existing exports generally indicate that the hatchery has the infrastructure and facilities to adapt to increasing or diversified exports. The last metric, export to STEP programs, is a binary predictor, due to uncertainty in the number of STEP locations associated with each hatchery.

The goals and objectives of each hatchery are defined within the Hatchery Program Management Plan (HPMP), and include the practices adopted by each hatchery to achieve the stated objectives. Within the framework, this section is expanded to encompass additional criteria relating to the social value provided by hatchery visitation. This metric is composed of two indicators, which represent (1) the number of visitors received by the hatchery and (2) the social vulnerability of residents within the county. The first indicator, number of visitors, is included within the HPMP and provided as an approximate count. The second indicator is the Social Vulnerability Index (SVI). This index is a quantitative measure of socioeconomic and demographic factors that individually and cumulatively adversely impact the community, measured by the US Census, at the census tract level. Larger SVI values indicate higher vulnerability. Within the framework, the index is averaged to the county level.

Production obligations are also included in this category, which can take the form of an international agreement in the case of the Pacific Salmon Treaty, or other legally binding obligations, such as the US v. Oregon Management Agreement.

2.3. Operations and Infrastructure Costs

This section provides in detail the sources and metrics used to calculate total operations and infrastructure cost for each hatchery. The category consists of four metrics: Operating costs, deferred maintenance, new infrastructure, and projected modifications. Funding responsibility between the State and Federal varies across metric and hatchery, the percentage splits are summarized in Table 7-4. The operations and infrastructure costs are composed of four categories of costs: 1) annual operating costs, 2) deferred maintenance, 3) projected modifications, and 4) climate and infrastructure upgrades.

The annual operating costs are the annualized budget for each hatchery. The deferred maintenance costs include items that are overdue for repair or replacement to maintain or make more efficient the existing operation of the facilities. The projected modifications upgrades that address unique infrastructure needs at particular hatcheries and have been separated from the other climate and infrastructure upgrades category. This metric includes the cost to rebuild Rock Creek Hatchery. Finally, the climate and infrastructure upgrades are the estimated costs associated with upgrading the hatchery's existing facilities to address current and projected climate hazards (e.g., the cost of recirculation systems). Since facilities would be upgraded with improved technology as deferred maintenance is conducted, there is some overlap between the types of improvements included in deferred maintenance versus those included in the climate and infrastructure category.

Table 2-3. Infrastructure cost criteria and grouping, and the corresponding appendices containing supplemental information.

Criteria Grouping	Units	Criteria	Appendix Section
Cost share between State and Federal/Other	Percentage	–	Table 7-4
Operating Costs	Cost (million dollars)	Annual average cost	Section 7.3.1
Deferred Maintenance	Cost (million dollars)	Combined across projects, total averaged cost with low and high ranges	Section 7.3.2
New Infrastructure (Climate & Tech)	Cost (million dollars)	Combined across projects, total averaged cost with low and high ranges	Section 7.3.3
Projected Modifications	Cost (million dollars)	Combined across projects, total averaged cost with low and high ranges	Section 7.3.4

2.3.1. Operating Costs

Operating costs refer to the annual or biennial budget allocated to upkeep hatchery operations. This cost is mandatory for each hatchery to remain open. These data are the annualized outputs from the *Economic Analysis of Oregon Hatcheries* report using data from fiscal year 2023-2025 as prepared by ODFW and The Research Group, LLC. The operating costs are further split into three general categories, budget, support costs and maintenance. The budget is allocated according to the fish programs supported at the hatchery. The support costs consist of fish program expenses, which includes administrative management overhead, fish health, marking, and fish lib. Maintenance encompasses housing maintenance, emergency, R&E (Research and Experimental), and 30-year amortized bond expenditures, all of which support the hatchery management.

2.3.2. Deferred Maintenance

Deferred maintenance refers to the costs required to update or make more efficient existing infrastructure to continue operations. The list of considerations and budget are documented from two sources, namely a deferred maintenance report that reviewed Alsea, Bandon, Elk River, Salmon River, Cedar Creek, Trask, Nehalem and Roaring River hatcheries (QRS Consulting, LLC, 2024) and a comprehensive infrastructure list developed by ODFW staff.

Such examples of deferred maintenance items are updates to hatch houses, pipeline replacements, improvements to the abatement ponds, repaving the facility, among other items. While these items are intended to maintain operations, they are also recommended with climate resiliency in mind by making more efficient the water supply and energy use. Some of these updates also may increase capacity in the hatchery, allowing for increased fish production or assuming the production from other hatcheries that have limited capacity.

2.3.3. Investment in New Infrastructure

To increase climate resiliency across the hatcheries, projects have been identified that include improvements and upgrades, and new infrastructure and technologies. New infrastructure costs were organized into three broad categories – those that focus on water quality (e.g., chillers, shade cover), adding renewable energy sources, and other costs, such as improving intakes, ponds and raceways, and hatchery buildings.

The initial list of new infrastructure projects was gathered from Climate Change Risk Assessment for Select Oregon Salmon Hatcheries (Lynker, 2023). Section 4 of the report provided recommendations for Rock Creek, Alsea, Bandon, Cole Rivers, Leaburg, and Oak Springs hatcheries. Recommendations focused on addressing climate risks with new technology, improvements, or new infrastructure. Individual assessment reports for each hatchery provide cost estimates for the recommendations.

Many of the new infrastructure projects were identified by ODFW staff as priorities to include with cost estimates. Where appropriate, estimates were added to the analysis using costs from prior Lynker assessments (Lynker, 2023). Other costs were estimated based on similar projects and costs listed for other hatcheries. ODFW provided spreadsheets and documentation with remaining cost estimates to include in the analysis.

Table 2-4. Additional information for deferred maintenance and new technology cost estimates developed by other reports.

Resource/Report	Author	Details
Preliminary Hatching Systems Cooling Evaluation	Solarc Engineering (December 2023)	New infrastructure estimates for Rock Creek. Due to climate change and wildfire which removed natural shade trees, new infrastructure is needed to cool the water to maintain adequate conditions for reproduction. The report outlines conceptual design, existing resources, and new construction and equipment. It also provides an "order of magnitude" cost estimate for constructing the cooling system.
Cost estimates for adding hydropower to Clackamas	NLine Energy (April 2024)	The costs associated with construction can be reduced with tax credits and grants. Additionally, there is a calculated net economic benefit over the next 30 years.
Technical Memorandum – Deferred Hatchery Maintenance	QRS Consulting, LLC (July 2024)	The QRS deferred maintenance report details some items that may be considered for new infrastructure. For example, the cost estimate for extending pond walls at Salmon River is described in the report and has been added to new infrastructure costs. The QRS report reviews deferred maintenance items for Alsea, Bandon, Elk River, Salmon River, Cedar Creek, Trask, Nehalem, Roaring River hatcheries.

2.3.4. Projected Modifications

Projected modifications are identified hatchery-specific needs, which makes this metric different from deferred maintenance and new infrastructure projects. They include projects that fulfill infrastructure needs or build system capacity that are not related to deferred maintenance or building climate resilience. These projects are for Leaburg, Oak Springs, Rock Creek, and South Santiam hatcheries and the data were provided by ODFW staff. Such projects under this metric include the rebuilding of Rock Creek, modifying infrastructure for water and fish handling, and improvements to buildings.

2.3.5. Cost Variability

The cost of infrastructure upgrades is ultimately unique to each site, dependent on hatchery size and layout, available space to name a few. In most cases, the costs are generic for the upgrade type (e.g., new building, new raceway, new solar panels, UV treatment system), with underlying basis informed by previous Lynker reports and cost estimates provided by ODFW staff. However, in a few instances site-specific costs were provided accounting for a more complete integration of the new technology into the hatchery system.

The Solarc report provided a detailed cost assessment for the installation of chillers at Rock Creek Hatchery. This comprehensive 'Cooling System' estimate included costs for not just chillers, but supporting infrastructure like new buildings, water storage facilities, piping, and electrical systems. These ancillary engineering costs were not considered in the Lynker reports. Thus, the true cost of the technology is both site-dependent and likely 2 to 4 times the cost estimate in the Lynker report. RAS/Chillers capital and operations and maintenance (O&M) costs from the Lynker report range on average from $3.1 million ($3.1M) to $9.28M depending on the hatchery's need and capacity. As part of Rock Creek's rebuild estimate, the RAS/Chillers installation (full construction cost) ranges from $12M (ODFW) to $20M (Solarc).

The estimated cost for the design and build of raceways is based on a number of factors specific to the site including the number of raceways needed, the size of footprint, and the alignment. In this analysis, the estimated cost for the design and build of raceways is $0.5-1M for two to four raceways. In the alternative scenarios, a range of $1.5-2M was used (e.g., Oak Springs, ODFW). Both cost estimates are lower than the site-specific costs presented in the QRS report. The QRS report has larger ranges because the proposed projects have itemized ancillary expenses need to connect the raceway to the hatchery system. For example, 'Rearing Pond Alignment' ($5 to $15.1M) for Alsea encompass demolishing large amounts of existing infrastructure, configuring piping, and installing eight raceways.

The variability in cost for similar infrastructure demonstrates the importance of hatchery-specific needs. Providing a detailed infrastructure analysis for each facility is not in the scope of this project, therefore, it is important to emphasize that the cost estimates used in this report capture the general scope of infrastructure costs. Note that the cost estimates were developed in 2023-2024 and may increase in the future due to inflation and other factors.

2.4. Economic Analysis

An economic analysis was performed by The Research Group, LLC, on behalf of ODFW. This report quantifies and describes the economic value created by each hatchery, using methods to allocate costs at the species level in order to produce cost-effectiveness estimates. Economic variables estimated by this study include direct value, cost effectiveness analysis, regional economic impact, net economic impact, and net economic value. The study also includes economic factors that are qualitative in nature, such as environmental justice and cultural values. The study methods are described in detail in the report (TRG, 2024). It's important to note that the economic analysis was only conducted on state-owned fish hatcheries, therefore data is unavailable for federal hatcheries (Cole Rivers, Leaburg, and South Santiam). Additionally, Fall River Hatchery is treated as a satellite facility to Wizard Falls, and all economic data has been applied to Wizard Falls. Therefore, the average economic scores were applied to the four hatcheries with missing data. The economic analysis criteria incorporated into this report are summarized in Table 2-5.

Like other categories, the economic outputs are normalized to be used comparatively within the framework. The economic analysis scoring is conducted with a single category containing nine indicators. The metrics adapted for use in the framework are described below, organized by table names from the economic analysis.

Annual Costs per Facility Production Pound (Table III.1):

The table presents individual hatchery operation and capital costs per facility production pound. From this table, *Variable Costs* and *Total Costs (With Cap)* are used. *Total Costs (With Cap)* includes operations and capital costs with replacement costs.

Hatchery Visitor Accounts and Regional Economic Impacts (Table IV.3):

This table includes individual hatchery visitor counts and regional economic impacts for visitors, fisheries, and operations, which are all included as metrics. These values are outputs from the REI model, which uses "existing secondary industry input- output relationship models".

Individual Hatchery Net Benefits From Fisheries and Visitors (Table V.3):

This table describes individual hatchery net benefits from fisheries and visitors, and *Benefit-Cost Ratio* is a primary outcome of the economic study, reporting the overall relationship between costs and benefits for each hatchery. *Total Net Economic Value* is also included in this framework, describing both fisheries and visitor value.

Hatchery Production Regional Economic Impact Effects (Table B.2)

This table describes hatchery production regional economic impact effects. The metrics used are statewide and local regional economic impact (REI), which includes the economic contributions derived from fishing, visitation, and hatchery operations.

Table 2-5. Economic Analysis Criteria. Criteria are named according to their corresponding data source in the economic analysis.

Criteria Grouping	Units	Criteria	Appendix Section
Economic Analysis	min-max normalized - Inverted	Individual Hatchery Contributions and Annual Capital Contributions per Facility Pound Production: Variable Costs (Table III.1)	See Economic Analysis
	min-max normalized - Inverted	Individual Hatchery Contributions and Annual Capital Contributions per Facility Pound Production: Total Cost with Capital Contribution (Table III.1)	
	min-max normalized	Hatchery Visitor Counts and Regional Economic Impacts (REI): Visitor REI Statewide (Table IV.3)	
	min-max normalized	Hatchery Visitor Counts and Regional Economic Impacts (REI): Operations REI Local (Table IV.3)	
	min-max normalized	Hatchery Visitor Counts and Regional Economic Impacts (REI): Operations REI Statewide (Table IV.3)	
	min-max norm, inverted	Hatchery Net Benefits From Fisheries and Visitors: Total Net Economic Value (NEV) (Table V.3)	
	min-max norm	Hatchery Net Benefits From Fisheries and Visitors: Benefit-Cost Ratio (Table V.3)	
	min-max norm	Hatchery Production Regional Economic Impact Effects: REI Local Effects (Table B.2a)	
	Min-max norm	Hatchery Production Regional Economic Impact Effects: REI Statewide Effects (Table B.2a)	

3. MCDA Framework Results and Discussion

In this section, we present the average hatchery scoring results across each of the four Multi-Criteria Decision Analysis (MCDA) categories: Climate Resilience and Hazards (Section 3.1), Fish Production and Hatchery Importance/Connectivity (Section 3.2), Operations and Infrastructure Costs (Section 3.3), and Economic Impact Analysis (Section 3.4). Section 3.5 presents the aggregated results of the four categorical scores using a linear (i.e., even) weighting.

As discussed in the framework methods (Section 2), the categorical scores for each individual hatchery represent the average of scores from one to three weighting scenarios, which are unique to each category, as outlined below. By developing different weighting scenarios, we can evaluate the sensitivity of the categorical scores to the relative importance placed on certain criteria or criteria groupings. The normalized criteria weights within each scenario were developed with input from ODFW, reflecting specific concerns related to sustaining current and future hatchery production.

3.1. Climate Resilience and Hazards Scoring

The Climate Resilience and Hazard category of the MCDA framework includes twelve criteria across the water availability, water quality, and other hazards criteria groupings, which were weighted according to three weighting scenarios (Table 3-1). These criteria were identified and selected to best describe changing hydroclimatic conditions within the ODFW hatchery system and the resilience of hatcheries and their watersheds to these changes. All hatcheries were scored for each individual criteria (see the Appendix, Table 7-1). Criteria included previously calculated Potential Impacts (e.g., Drought Potential Impact; Lynker, 2022), as well as variables describing the current and projected future hydroclimatic conditions as it relates to fish viability (e.g., Water Temperature Criticality). Any criteria that were calculated as a function of ODFW fish production or water rights (such as Excess Water Capacity), are categorized under the Fish Production MCDA category (Section 3.2) even if they are related to climate impacts by nature. The one exception to this is the Greenhouse Gas (GHG) Emissions criteria, which is normalized by hatchery fish biomass, but critically linked to climate resilience more broadly and thus included here.

3.1.1. Weights and Weighting Scenarios

The three weighting schemes applied to the Climate Resilience and Hazards scoring are equal weights (Scenario 1; blue), drought resilience (Scenario 2; orange), and water quality (Scenario 3; green) (Table 3-1). In the first scenario, an equal weighting scheme applies the same 8.3% weights to all criteria, such that no single variable is weighted more than another. In contrast, the Drought Resilience scenario more heavily weights the Drought Potential Impact, Water Rights Potential Impact, and Low Flow Potential Impact criteria to calculate a climate resilience score that best captures the ability of a hatchery to withstand low flows and drought conditions. In the third and final scenario, Water Quality, higher scores are given to Water Temperature Criticality, VELMA Projected Change in Annual Maximum Temperature, Pathogens Potential Impact, and Observed Maximum Stream Temperature criteria to calculate a climate resilience score that best captures the ability of a hatchery to withstand current and projected future changes in temperature and associated changes to water quality.

Table 3-1: Climate Resilience and Hazards Scoring criteria, criteria groupings, and weighting scenarios.

CLIMATE RESILIENCE SCORING		Equal Weights		Drought Resilience		Water Quality	
		Scenario 1		Scenario 2		Scenario 3	
Criteria Grouping	Criteria	Weights	Weights Normalized	Weights	Weights Normalized	Weights	Weights Normalized
Water Availability	Water Rights Potential Impact	10	8.3%	20	20.0%	5	5.0%
	Low Flow Potential Impact	10	8.3%	15	15.0%	5	5.0%
	Drought Potential Impact	10	8.3%	30	30.0%	5	5.0%
Water Quality	Observed Maximum Stream Temperature	10	8.3%	5	5.0%	10	10.0%
	Water Temperature Criticality (Observed Max T < 68F)	10	8.3%	5	5.0%	25	25.0%
	VELMA Projected Change in Annual Max Temp	10	8.3%	5	5.0%	20	20.0%
	Pathogens Potential Impact	10	8.3%	5	5.0%	10	10.0%
	Flooding Potential Impact	10	8.3%	0	0.0%	5	5.0%
	Watershed Condition Potential Impact	10	8.3%	0	0.0%	5	5.0%
Other Hazards	GHG Emissions - Power & Fish Production (per lbs fish)	10	8.3%	5	5.0%	0	0.0%
	Wildfire Potential Impact	10	8.3%	5	5.0%	5	5.0%
	Sea Level Rise Potential Impact	10	8.3%	5	5.0%	5	5.0%
		120.00	100%	100.00	100%	100.00	100%

3.1.2. Categorical Scores

The results of the scenario-averaged Climate Resilience and Hazards scores (i.e., the "climate resilience score") are shown in the stacked bar plot (Figure 3-1) and in the pie chart map (Figure 3-2), where the range of the error bars in the bar plot denote the minimum and maximum scores across the three weighting scenarios. Hatcheries with greater spread in the error bars were more sensitive (i.e., showed greater differences across the three scenario scores) to the different weighting schemes. This contrasts with hatcheries with smaller spread in the error bars, which were less sensitive to different weighting schemes, placing greater confidence on the hatchery categorical score. Hatcheries with higher scores indicate greater resilience to climate change and hazards while hatcheries with lower scores indicate higher risk or vulnerability to climate change and hazards. The hatchery scores have all been normalized, so the final scores have no units and are only meaningful when compared in the context of the 17 hatcheries analyzed in this study.

Summary:

Highest scores: The hatcheries with the highest scenario-averaged climate resilience scores are South Santiam (9.06), Wizard Falls (8.53), Fall River (8.4), and Klamath Falls (8.36).

- All four hatcheries have observed maximum stream temperatures below 68 Fahrenheit (F), thereby scoring 10 out of a possible 10 for "Water Temperature Criticality" (see Figure 7-5 in the Appendix for more information). This stream temperature criticality threshold was set in consultation with ODFW staff biologists.
- Because of low stream temperatures, all four hatcheries scored 10/10 for "Pathogens Potential Impact".
- In addition to having ideal water quality characteristics, these climate resilient hatcheries also have good access to water (10/10 "Water Rights Potential Impact"). They also all scored a 6.0 or above for "Drought Potential Impact".

Lowest Scores: In contrast, Alsea (2.71), Salmon River (2.89), Rock Creek (3.76), and Bandon (4.26) ranked the lowest, indicating the least resilience, or having the most risk, to the climate and hazard variables included in Table 3-1.

- Alsea, Salmon River, and Rock Creek all scored 0/10 for "Water Temperature Criticality", due to observed maximum stream temperatures above 68F. The criteria scoring for "Observed Maximum Stream Temperature" for these three hatcheries was a 1.7 or less; Bandon was only marginally better, scoring a 4.0/10. This includes Rock Creek's access to water from the North Umpqua River, which is colder but still above key maximum stream temperature thresholds (Figure 7-5).
- Scores for VELMA-projected changes in maximum stream temperature were also low, ranging from 0 (Salmon River) to 5.2 (Rock Creek). Section 7.1.3 of the Appendix further discusses ODFW's methods for VELMA modeling of projected end of century stream temperatures.
- Water availability was more varied across these sites, with Rock Creek and Salmon River having higher "Water Rights Potential Impact" score (10.0 and 6.7, respectively), while Alsea and Bandon both scored 0.
- The variability in categorical scores across the weighting scenarios (as shown by the error bars) demonstrates that the lowest scoring hatcheries are sensitive to the weighting methodology, while the best scoring hatcheries are less sensitive to these framework decisions.

Scenario 2 (Drought Resilience)

Scenario 2 (orange column in Table 3-1) has the highest weighting for *Drought Potential Impact* (30/100) and *Water Rights Potential Impact* (20/100), thereby ranking each site primarily by projected future water availability. Within Scenario 2, South Santiam has the highest overall score at 8.96. In this scenario, South Santiam has a *Drought Potential Impact* of 10, showing the lowest projected risk of drought impacts across the hatcheries.

The lowest scoring hatcheries in the drought resilience scenario were Alsea (2.66), Bandon (2.79), and Salmon River (4.18). Alsea scored 4.0 and 0.0 for *Drought Potential Impact* and *Water Rights Potential Impacts*, while Bandon scored 0.0 and 2.0. Salmon River scored slightly better with 6.0 and 6.7 across these two variables.

Scenario 3 (Water Quality)

Scenario 3 (green column in Table 3-1) more strongly weights *Water Temperature Criticality* (25/100), and *VELMA Projected Change in Annual Max T* (20/100). In this scenario, the highest scoring hatcheries are South Santiam (9.24), Wizard Falls (8.89), and Fall River (8.88). The lowest scoring hatcheries for Scenario 3 are Salmon River (1.81), Alsea (1.87), and Rock Creek (2.92).

This category has several hatcheries that show high sensitivity to the weighting scenario, such as Bandon, Nehalem, and Oak Springs. For these locations, there is a large scenario-dependent spread in the scoring, divergent results for the water quality and drought resilience weighting scenarios. Oak Springs scores 7.16 for the water quality scenario, but only 4.23 for the water supply scenario, with a combined scenario-averaged score of 5.79 (including Scenario 1, equal weights, blue column in Table 3-1).

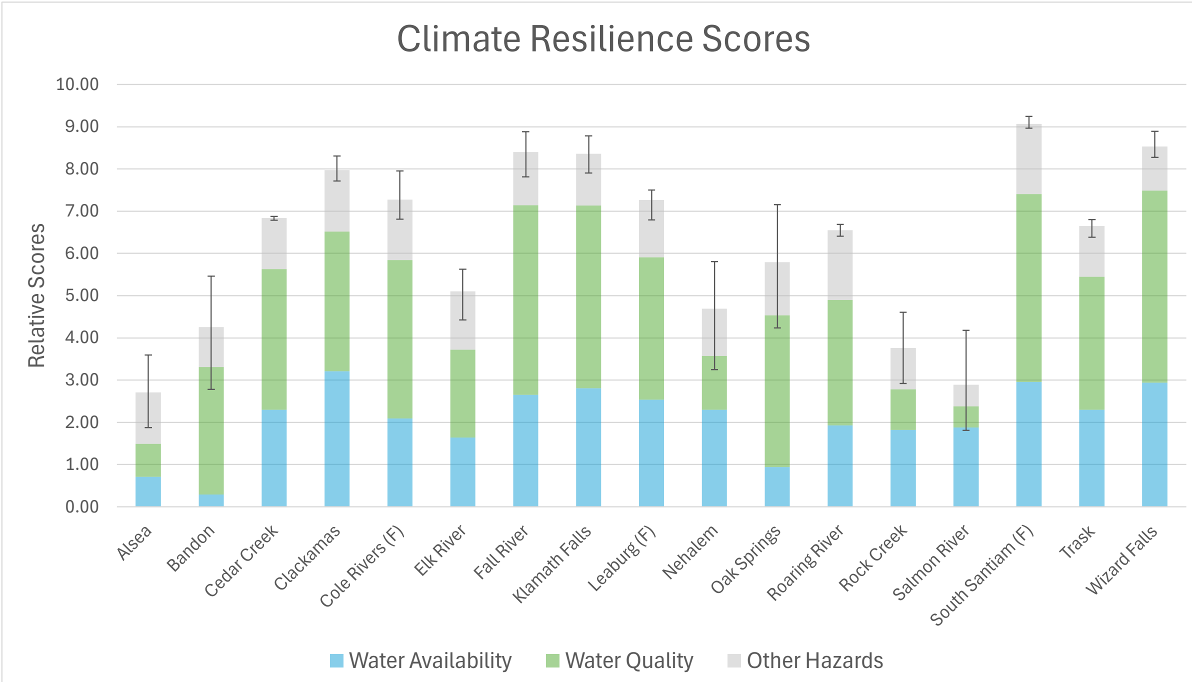

Figure 3-1: Climate Resilience and Hazards category scores for 17 ODFW study hatcheries. Bar heights represent the scenario-averaged scores, while the error bars show high and low scores across the three weighting scenarios.

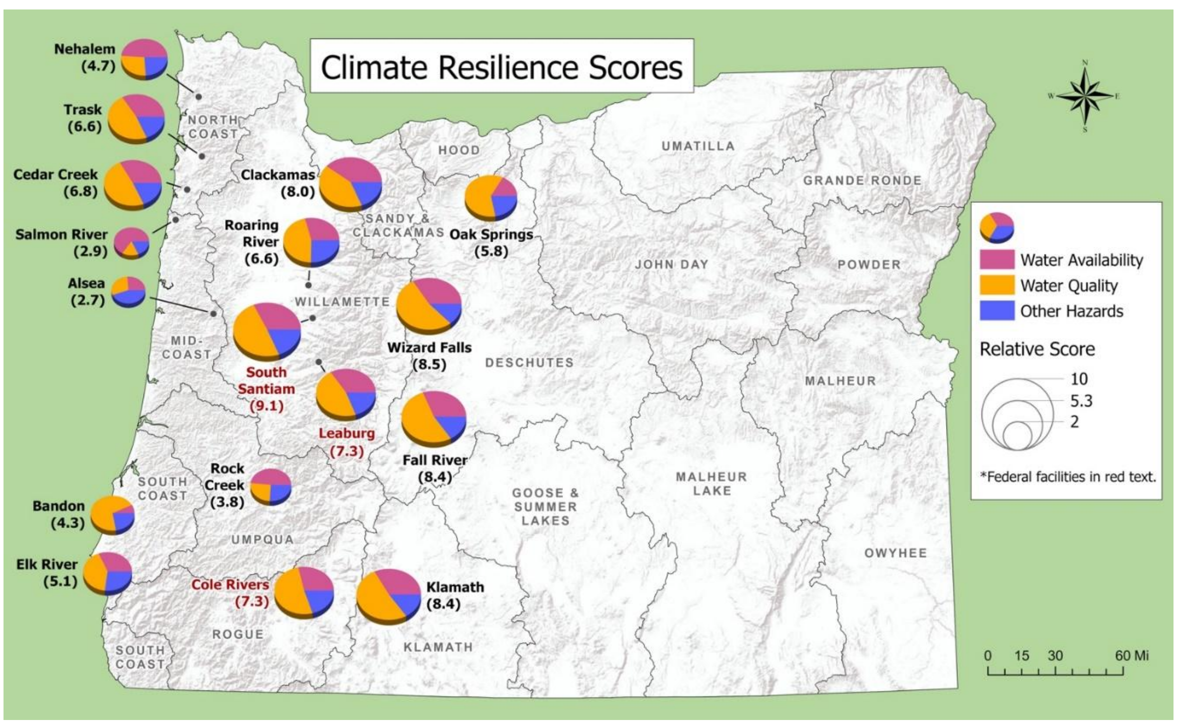

Figure 3-2: Average Climate Resilience and Hazards category scores across three weighting scenarios for 17 ODFW study hatcheries. Larger pie charts indicated higher relative scores. Criteria groupings are Water Availability (red), Water Quality (orange), and Other Hazards (purple).

3.2. Fish Production and Hatchery Importance/Connectivity

The Fish Production and Hatchery Importance/Connectivity category of the MCDA framework includes eighteen criteria across the fish production, potential excess capacity, and connectivity/importance criteria groupings, which were weighted according to three weighting scenarios (Table 3-2). All hatcheries were scored for each individual criteria (see the Appendix, Table 7-3). These criteria were identified and selected to best describe current fish production levels (as measured by average monthly biomass), the potential excess capacity in hatcheries to absorb additional production under alternative operational scenarios, and the biological uniqueness and relative importance of a hatchery's contributions to the ODFW system. Fish production and excess capacity criteria were calculated from current 2022-2023 fish production and water usage levels. Other information used to develop the connectivity and importance criteria included the ODFW Hatchery Management Plans (HMPs), Hatchery Genetic Management Plans (HGMPs), and qualitative surveys of ODFW fish hatchery managers across the system. Additional factors considered included legal obligations for fish deliveries under treaties and agreements and production for other mitigation obligations.

3.2.1. Weights and Weighting Scenarios

The three weighting schemes applied to Fish Production and Importance/Connectivity scoring are equal weights (Scenario 1; blue), potential excess capacity (Scenario 2; orange), and program importance (Scenario 3; purple) (Table 3-2). In the first scenario, an equal weighting scheme applies the same 5.6% weights to all criteria, such that no single variable is weighted more than another. In contrast, the Excess Capacity scenario more heavily weights the Hatchery Rearing Volume, Potential Excess Water Capacity, Number of Months with Water Shortage, Density Index, and Undeveloped/Unused Spaces criteria to calculate a score that best captures the ability of a hatchery to absorb additional production under alternative operational scenarios. In the third and final scenario, Program Importance, higher scores are given to Biological Uniqueness, Production Obligations, and Connectivity criteria to calculate a score that best captures the intrinsic value of the hatchery to the ODFW fish hatchery system.

Table 3-2: Fish Production, Importance, and Capacity Scoring criteria, criteria groupings, and weighting scenarios.

FISH PRODUCTION, IMPORTANCE, & CAPACITY		Equal Weights Scenario 1		Excess Capacity Scenario 2		Program Importance Scenario 3	
Category	Variable	Weights	Weights Normalized	Weights	Weights Normalized	Weights	Weights Normalized
Fish Production	Avg Monthly Biomass - All Species	10	5.6%	5	5.0%	5	5.0%
Potential Excess Capacity	Hatchery Rearing Volume	10	5.6%	10	10.0%	0	0.0%
	Potential Excess Water Capacity (annual)	10	5.6%	5	5.0%	0	0.0%
	Potential Excess Water Capacity (6-month, May-Oct)	10	5.6%	10	10.0%	0	0.0%
	Number of Months with Water Shortage	10	5.6%	15	15.0%	0	0.0%
	Number of Months with Projected Water Shortage	10	5.6%	10	10.0%	0	0.0%
	Density Index (Annual Avg)	10	5.6%	5	5.0%	0	0.0%
	Density Index (Annual Max)	10	5.6%	10	10.0%	0	0.0%
	Are there undeveloped spaces OR facilities that can be repurposed?	10	5.6%	10	10.0%	0	0.0%
Connectivity/Importance	Population Served (Visitors/year)	10	5.6%	0	0.0%	2.5	2.5%
	Social Vulnerability Index (county)	10	5.6%	0	0.0%	2.5	2.5%
	Connectivity - Exports to hatcheries (count)	10	5.6%	0	0.0%	10	10.0%
	Connectivity - Exports to acclimation facilites (count)	10	5.6%	0	0.0%	10	10.0%
	Connectivity - Exports to STEP (yes/no)	10	5.6%	0	0.0%	10	10.0%
	Production for mitigation obligations	10	5.6%	5	5.0%	5	5.0%
	Production for obligations under Pacific Salmon Treaty	10	5.6%	5	5.0%	10	10.0%
	Production for obligations under US v Oregon Management Agreement	10	5.6%	5	5.0%	20	20.0%
	Biological Uniqueness - Number of Unique Adult Broodstock Programs	10	5.6%	5	5.0%	25	25.0%
		180	100.00%	100	100.00%	100	100.00%

3.2.2. Categorical Scores

The Fish Production and Hatchery Importance/Connectivity scores (i.e., the “hatchery importance scores”) are shown in the stacked bar plot (Figure 3-3) and spatially in the pie chart map (Figure 3-4). The fish production category contains three categories, representing the overall ability of each hatchery to facilitate expanded production based on (1) the current production, (2) estimated capacity to increase production, and (3) a general category for connectivity to other facilities, importance, and non-production based social benefits. Hatcheries with higher scores indicate greater relative importance of the hatchery based on fish production, connectivity of the hatchery within the system, and excess capacity for future growth, while hatcheries with lower scores indicate lower relative importance of the hatchery. The hatchery scores have all been normalized, so the final scores have no units and are only meaningful when compared in the context of the 17 hatcheries analyzed in this study.

Summary:

<u>Highest scores:</u> The hatcheries with the highest scenario-averaged fish production scores are Cole Rivers (7.35), Clackamas (5.54), South Santiam (4.67), and Wizard Falls (4.59).

- All four of these hatcheries scored highly for connectivity/importance criteria, including Exports to STEP (10) and production for mitigation obligations (10). Clackamas also has production obligations under US v. Oregon Management Agreement, while South Santiam and Wizard Falls score highly for Exports to Other Hatcheries (10.0 and 8.6, respectively).
- The fish production at all hatcheries, as measured by average monthly biomass, is not particularly high (with the exception of Cole Rivers, 9.7/10), though this criterion is weighted low (5-10%) across all three scenarios.

- All four hatcheries also demonstrated high potential excess capacity. For example, all hatcheries score an 8.6 or greater for Number of Months with Water Shortage (the number of months where the calculated minimum water demand, per Piper's Flow Index as calculated by ODFW, is greater than the actual water usage), and the Number of Months with Projected Water Shortage, which estimates minimum water demands under decreased flows and increased stream temperatures.

Lowest Scores: In contrast, Klamath Falls (2.10), Bandon (2.78), Alsea (3.03), and Roaring River (3.25) ranked the lowest, indicating the least importance, connectivity, and excess capacity.

- These four hatcheries have low scores for Biological Uniqueness – Number of Unique Adult Broodstock Programs (2.5/10 or below) and do not have any Production Obligations under the Pacific Salmon Treaty or US v Oregon Management Agreement. Only Roaring River has any Production for Mitigation Obligations.
- While Alsea, Bandon, and Roaring River do have undeveloped spaces or facilities that could be repurposed, the overall excess capacity of these low-scoring hatcheries is limited. For example, the Potential Excess Water Capacity (the difference between actual water usage and the calculated minimum water demand, a theorical capacity) is below 1.0 for all hatcheries, with some hatcheries already exhibiting water shortages.

Scenario 2 – Excess Capacity

Scenario 2 "Excess Capacity" (orange column in Table 3-2) focuses on the suitability of each hatchery to become a hub of expanded production. This scenario includes 13 weighted variables, reflecting a broad range of criteria, including rearing volume, water availability, hatchery density and facilities. Relative to the climate and hazards scoring, the weights for this group are more evenly distributed, with the highest weight for Number of Months with Water Shortage at 15%. Cole Rivers leads this scenario category, due to high scoring across all excess capacity metrics. These include available rearing volume (low density), potential excess water capacity, and low risk of water shortages.

The lowest scores in this scenario were found at Bandon (2.31), Roaring River (2.66), Klamath Falls (2.97), and Alsea (3.68). Bandon demonstrates significant concern over water availability, scoring 0/10 for water capacity and shortage metrics, as well as rearing volume (0.1/10). Roaring River shows similar concerns with water usage-based variables. Klamath Falls scores generally low across weighted variables in the Scenario 2, with the exception of the two water shortage variables, *Number of Months with Water Shortage* (current and projected).

Scenario 3 – Program Importance

The third scenario, "Program Importance" (pink column in Table 3-2) weights the total species production variable as well as the nine connectivity and importance variables, for a total of ten weighted variables. This weighting methodology favors the hatchery connectivity, production obligations, biological uniqueness, and social value variables. Within this category biological uniqueness has the highest weight, 25%, followed by a binary variable, representing production obligations under the US v. Oregon management agreement, with 20%. This weighting scenario gives Cole Rivers a top score of 5.68, followed by Clackamas at 5.58, and South Santiam at 3.83.

Hatcheries with the lowest scores in this scenario were Klamath Falls (0.94), Leaburg (1.33), Salmon River (1.50), and Fall River (1.72). The overall lower scoring in this category is due to the number of binary ("yes"/"no") variables. Commonalities across these lower scoring hatcheries include no production obligations (with the exception of Salmon River, which has obligations under the Pacific Salmon Treaty), and low biological uniqueness (i.e. fewer broodstock programs).

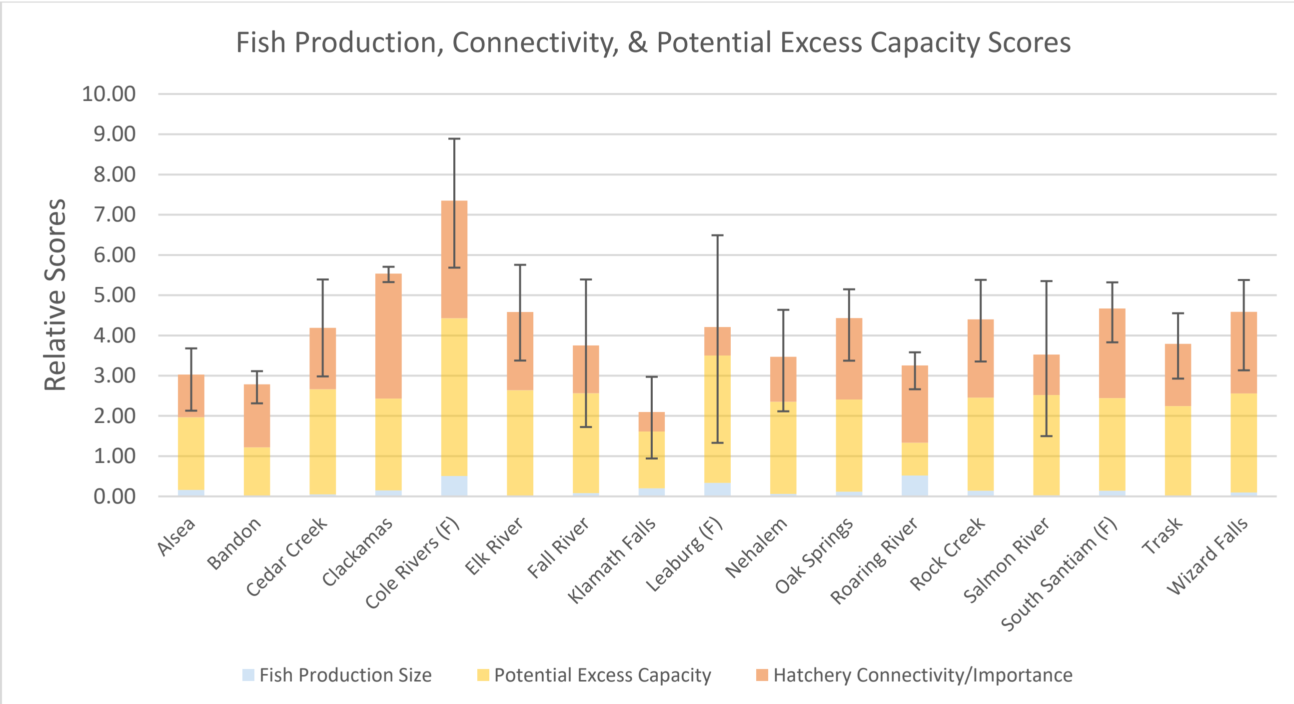

Figure 3-3: Fish Production, Connectivity, and Potential Excess Capacity category scores for 17 ODFW study hatcheries. Bar heights represent the scenario-averaged scores, while the error bars show high and low scores across the three weighting scenarios.

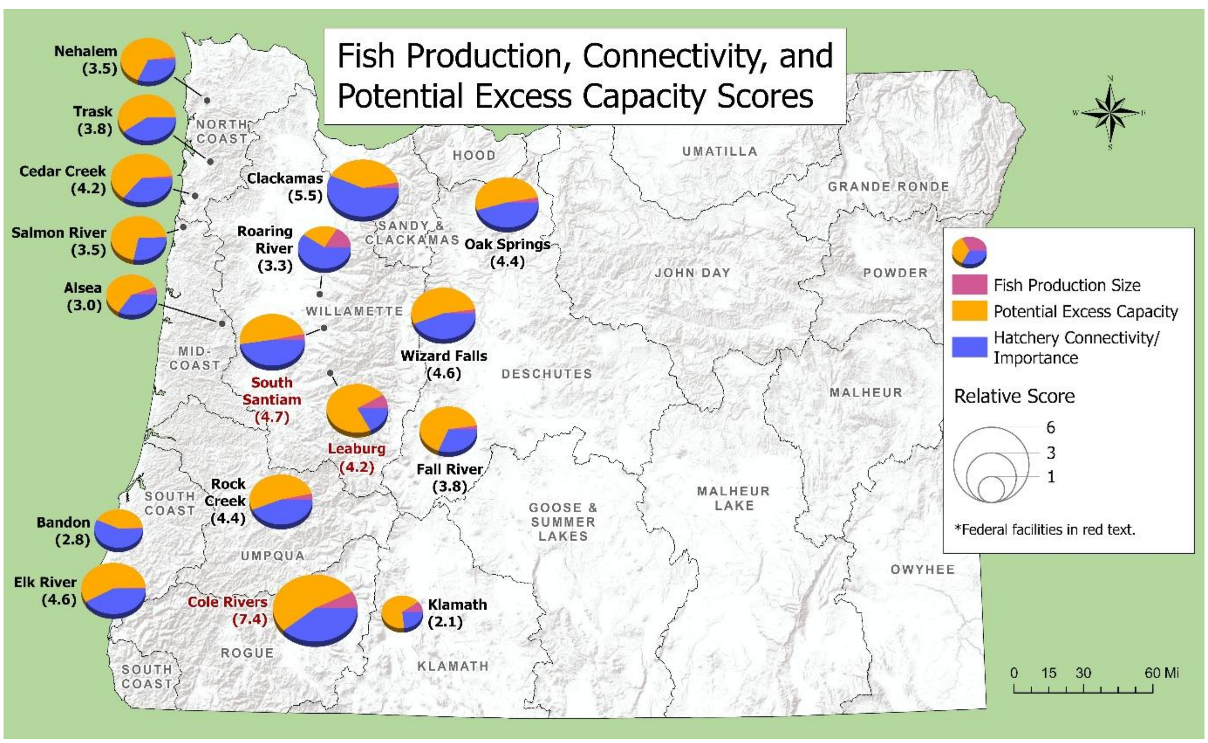

Figure 3-4: Average Fish Production, Connectivity, and Potential Excess Capacity category scores across three weighting scenarios for 17 ODFW study hatcheries. Larger pie charts indicated higher relative scores. Criteria groupings are Fish Production Size (red), Potential Excess Capacity (orange), and Hatchery Connectivity/Importance (purple).

3.3. Operations and Infrastructure Costs

Operations and infrastructure costs section of the MCDA framework includes costs associated with four criteria groups: 1) annual operations, 2) deferred maintenance, 3) new infrastructure, and 4) projected modifications. These criteria groups are the annual operating budget of the hatcheries, the backlog of maintenance for each hatchery, improvements to existing infrastructure needed to improve hatchery resilience, and additional project costs. The individual projects could include items such as new raceways, new hatchery buildings, recirculation and cooling systems, and new intake structures for the hatchery. The groups were developed in coordination with ODFW staff, and the individual projects were identified from previous Lynker reports and recommendations from ODFW staff.

Table 3-3: Operation and infrastructure costs associated with deferred maintenance, new infrastructure, and projected modifications.

OPERATION AND INFRASTRUCTURE COSTS	Category method
Cost Type	No Weights
Operational Costs	Total
Deferred Maintenance	subtotal
Climate and New Tech	subtotal
Projected Modifications	subtotal
	Sum Total

3.3.1. Weights and Weighting Scenarios

In the preceding two sections, climate resilience and hatchery importance, we evaluated scores using several different weighting schemes, where multiple criteria were scored using different weights as part of a sensitivity analysis. Although we evaluated infrastructure costs using a similar approach, the results were most meaningful using the raw costs in millions of dollars summed across deferred maintenance, climate and new technology, and projected modifications. Therefore, total infrastructure costs represent the total without any weighting applied. The scoring sensitivity in this case is represented by the range of costs as they occur for each indicator (e.g., a new raceway is $0.5-2 million). Although this represents a departure in methods from the other categories, it provides results that are more representative of the true costs, and the range of each cost estimate provides an adequate representation of the uncertainty of the scores. Additional information about each criteria group can be found in the appendix.

Operating costs were not included in the infrastructure costs since they represent annual costs, not one-time capital costs needed to improve or add hatchery infrastructure. Therefore, annual operational costs are considered separately from the other costs and may be evaluated against economic benefit for each hatchery (e.g., a large hatchery may have higher operating costs but will also have a higher economic benefit).

3.3.2. Categorical Scores

The Infrastructure Cost scores (i.e., the "hatchery cost scores") are shown as total costs in the stacked bar plots (Figure 3-5 for total costs and Figure 3-6 for state only costs) and spatially in the pie chart map (Figure 3-7). Total infrastructure costs represent subtotal costs from deferred maintenance (green columns), projected modifications (orange columns), and new climate and technology upgrades (purple columns). The range of error bars added to Figure 3-5, Figure 2-1, and Figure 3-6 represent the magnitude of the difference between the high range and low range of costs.

Summary

- Rock Creek, Cole Rivers (F), Leaburg (F), and Alsea Hatcheries have the highest total infrastructure costs across all hatcheries.
- Fall River (a subsidiary of Wizard Falls), Wizard Falls, Nehalem, and Clackamas have the lowest total infrastructure costs, much of the cost comes from climate upgrades like building a new bridge at Wizard Falls or pond and raceway upgrades.

The summarized results show that Rock Creek, Cole Rivers, and Leaburg Hatcheries are projected to have the highest costs for current and future operations. In the case of Cole Rivers, these costs stem from deferred maintenance costs associated with hatchery building upgrades and improvements. For Leaburg and Rock Creek, the costs are associated with projected modifications. Leaburg needs upgrades to the intake and pipeline and the adult ladder, trap, and holding facilities. Rock Creek burned down in the 2020 Archie Creek Fire, and the $40-50 million costs are associated with a complete rebuild of the fish hatchery. Since Cole Rivers, Leaburg, and South Santiam are federal hatcheries, some or all of these costs may be associated with federal spending instead of state spending.

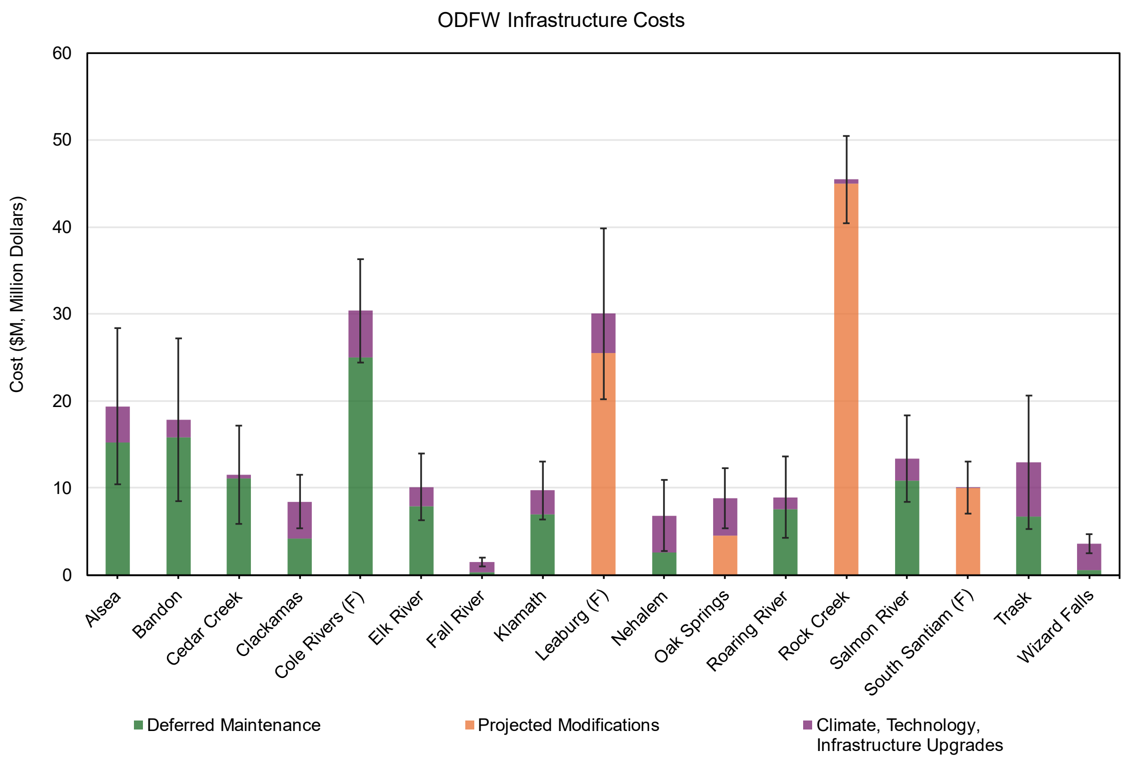

Figure 3-5: Total infrastructure costs in million dollars (state and federal), which combines costs from deferred maintenance, projected modifications, and climate, technology, and infrastructure upgrades.

Total costs are further separated into State and Federal/Other spending, delineating who has the funding responsibility for each metric (for more detailed information, see Appendix Section 7.3). Most costs for federal hatcheries are of federal responsibility, except for a few metrics that have cost sharing as noted in Table 7-4 in the appendix. The state-only costs are presented in Figure 3-6. When analyzed according to the state-only costs, Rock Creek, Alsea, Bandon, and Salmon River have the highest costs. Fall River, Wizard Falls, and Nehalem have the lowest costs of the state-owned hatcheries.

In Figure 3-7, the spatial representation of infrastructure costs for each hatchery are displayed on a map of Oregon. Results of this map show that the largest contributing costs for Rock Creek, Leaburg, and South Santiam are projected modifications. For most other hatcheries, the largest costs are attributed to deferred maintenance items.

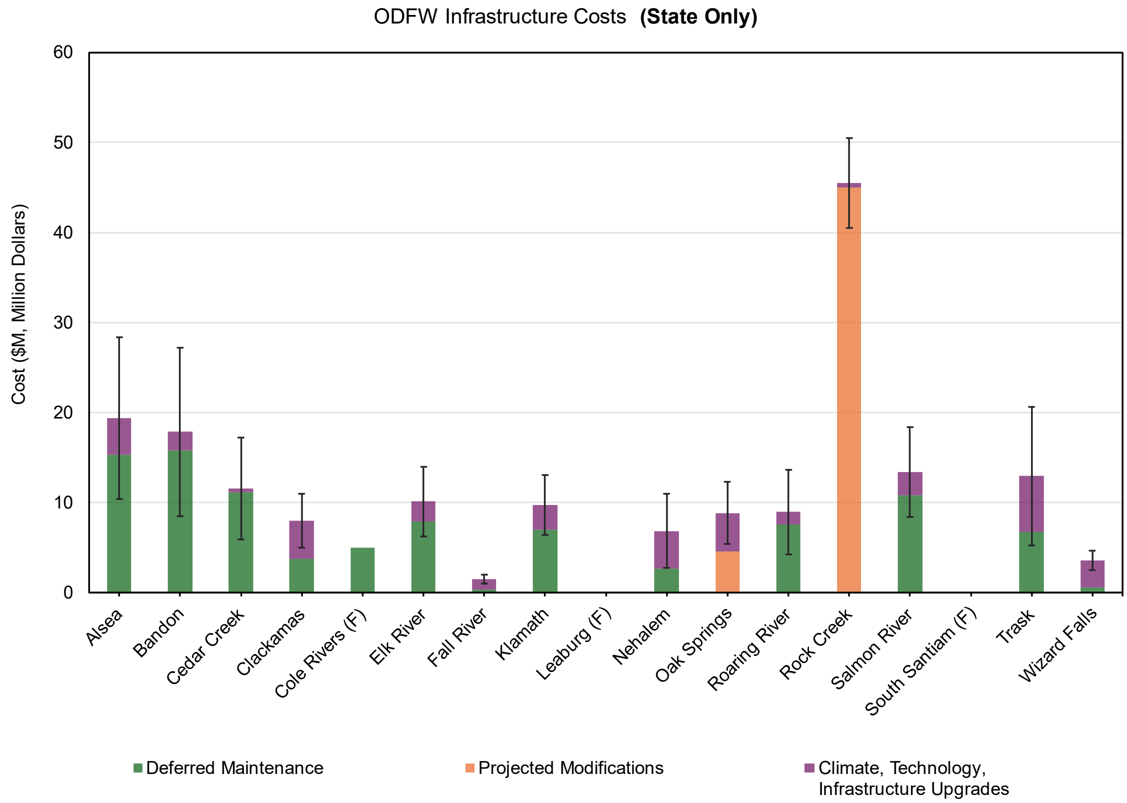

Figure 3-6: State-only total infrastructure costs of ODFW study hatcheries in million dollars.

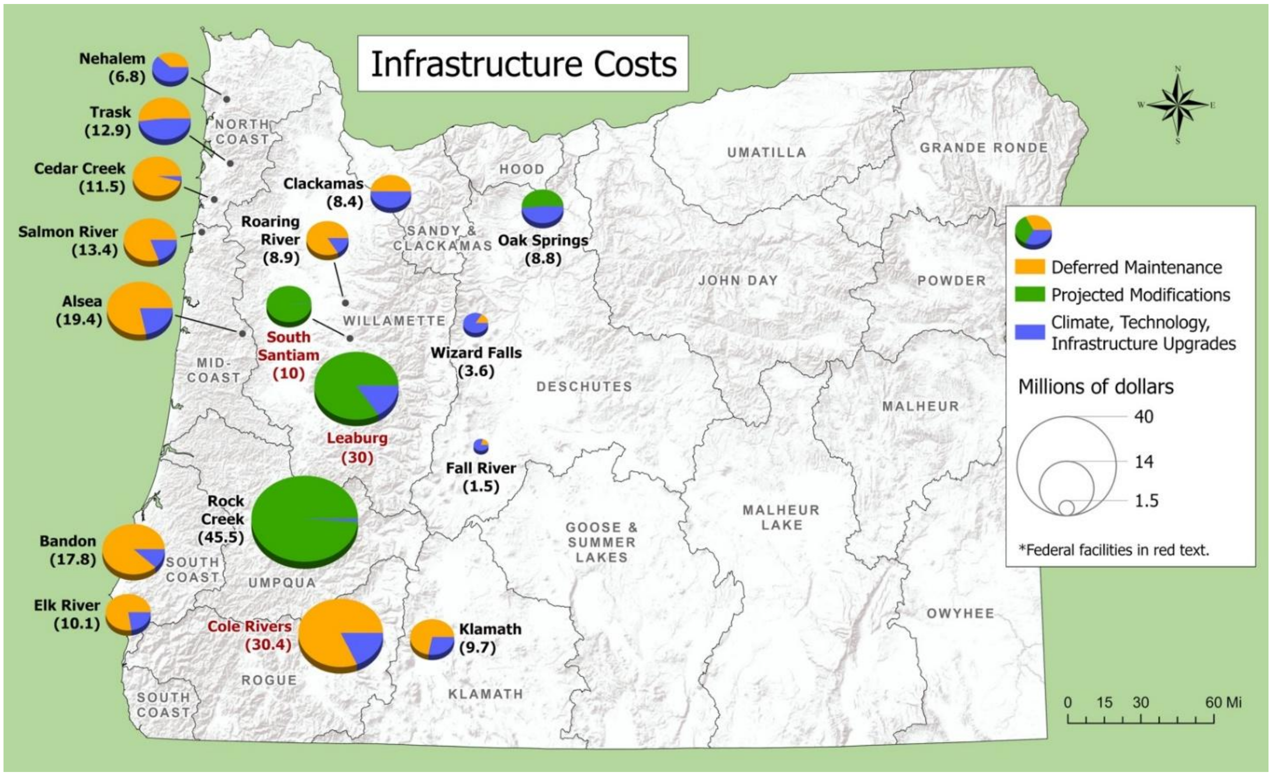

Figure 3-7: Infrastructure Costs for the 17 ODFW study hatcheries. Subtotal costs are for Deferred Maintenance (yellow), Project Modifications (green), and Climate/Technology/Infrastructure Upgrades (blue) and are separated out by relative contribution to the total costs. The size of the pie charts represents the magnitude of the total costs – bigger (smaller) pie charts represent more (less) total costs.

The state's average annual operating costs for each hatchery are shown in Figure 3-8. Hatcheries are ordered from highest to lowest operational costs to easily identify the full range of operational costs across the ODFW hatcheries. Most hatcheries cost less than $1M to operate annually. The highest operational cost for state-owned hatcheries are Clackamas, Rock Creek, Alsea, and Cedar Creek. The lowest operational cost for state-owned hatcheries are Klamath ($0.17M), Wizard Falls ($0.23M), Roaring River ($0.24M), and Oak Springs ($0.26M). South Santiam and Cole Rivers have low state operating costs, but have large annual operating costs when considering state and federal budgets. A more detailed breakdown of operating costs (including state vs. federal costs) can be found in Appendix 7.3.1 and Figure 7-27.

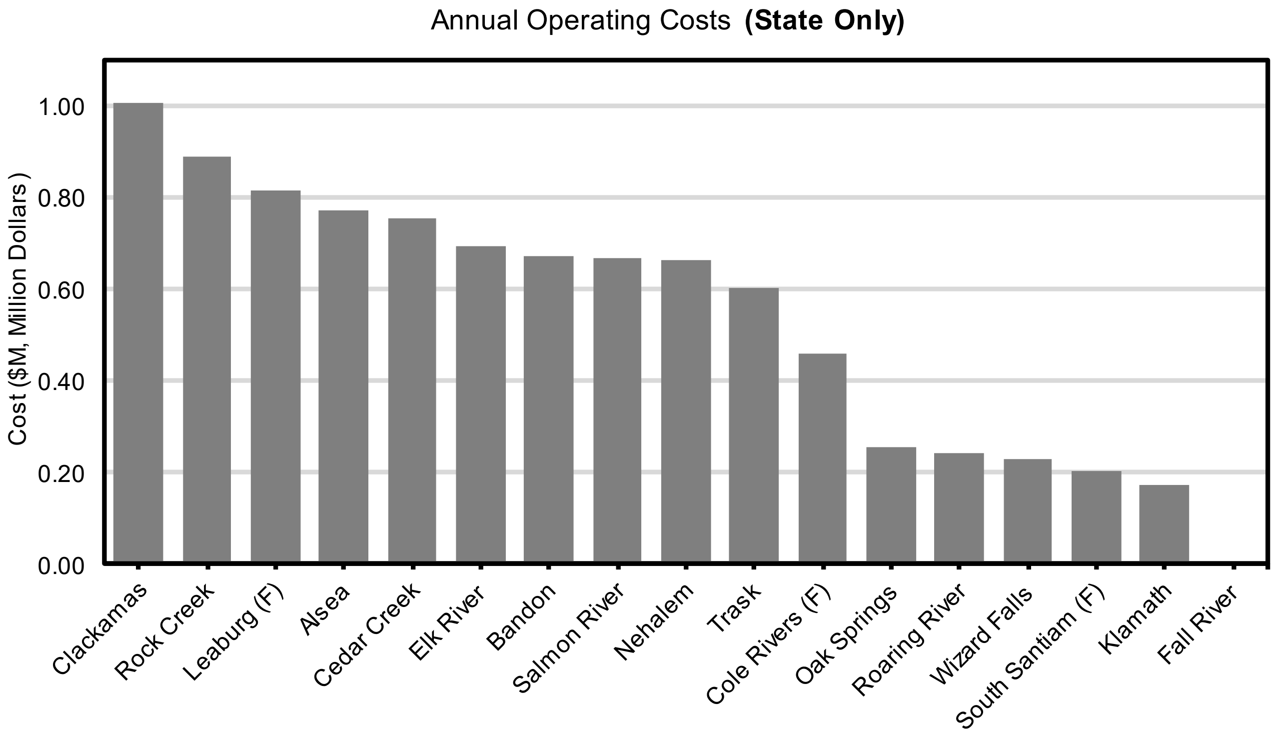

Figure 3-8: Average annual operating costs (in millions of dollars) for the hatcheries, ordered from highest cost to lowest cost. These costs only include the state portion of annual operating costs. Fall River operating costs are included in the total for Wizard Falls.

3.4. Economic Impact Analysis

The economic impact analysis conducted by The Research Group, LLC, was incorporated into the MCDA framework by min-max normalizing nine variables: annual production variable costs, annual production total costs (with capital contributions), visitor regional economic impacts (REI) – statewide, hatchery operations REI – local, hatchery operations REI – statewide, total net economic value (NEV), hatchery benefit-cost ratio, hatchery REI local effects, and hatchery REI statewide effects.

3.4.1. Weights and Weighting Scenarios

Three weighting schemes were developed for the economic section: (1) an equal weighting scheme, (2) local impacts, and (3) statewide impact. The equal weighting use the same weight (11.1%) for each of the nine variables. The local impacts weighting uses results from Tables IV.3 and B2 in the economic report to bias the scoring towards economic impact effects local to the hatcheries (i.e. county level). Similarly, the statewide weighting considers the impacts on a broader statewide basis. Variables without a geographic distinction are held constant or reduced uniformly for the two region-based weighting scenarios.

Table 3-4. Economic scoring criteria and weights.

ECONOMIC SCORING SHEET			Equal Weights Scenario 1		Local Impacts Scenario 2		Statewide Impacts Scenario 4	
Category	Units (positively oriented)	Variable	Weights	Weights Normalized	Weights	Weights Normalized	Weights	Weights Normalized
Economic Analysis	MinMax Norm - Inverted	Individual Hatchery Contributions and Annual Capital Contributions per Facility Pound Production: Variable Costs (Table III.1)	10	11.1%	5	4.3%	5	4.2%
	MinMax Norm - Inverted	Individual Hatchery Contributions and Annual Capital Contributions per Facility Pound Production: Total Cost with Capital Contribution (Table III.1)	10	11.1%	5	4.3%	5	4.2%
	MinMax Norm	Hatchery Visitor Counts and Regional Economic Impacts (REI): Visitor REI Statewide (Table IV.3)	10	11.1%	5	4.3%	30	25.0%
	MinMax Norm	Hatchery Visitor Counts and Regional Economic Impacts (REI): Operations REI Local (Table IV.3)	10	11.1%	40	34.8%	5	4.2%
	MinMax Norm	Hatchery Visitor Counts and Regional Economic Impacts (REI): Operations REI Statewide (Table IV.3)	10	11.1%	5	4.3%	30	25.0%
	MinMax Norm	Hatchery Net Benefits From Fisheries and Visitors: Total Net Economic Value (NEV) (Table V.3)	10	11.1%	5	4.3%	5	4.2%
	MinMax Norm	Hatchery Net Benefits From Fisheries and Visitors: Benefit-Cost Ratio (Table V.3)	10	11.1%	5	4.3%	5	4.2%
	MinMax Norm	Hatchery Production Regional Economic Impact Effects: REI Local Effects (Table B.2a)	10	11.1%	40	34.8%	5	4.2%
	MinMax Norm	Hatchery Production Regional Economic Impact Effects: REI Statewide Effects (Table B.2a)	10	11.1%	5	4.3%	30	25.0%

3.4.2. Categorical Scores

In the economic impact scoring, four hatcheries stand out with the highest overall scores: Clackamas, Oak Springs, Roaring River, and Wizard Falls. These hatcheries scored between 6.82 and 8.20. The next highest scoring was 4.89, at Alsea. The scoring was generally consistent across the three weighting scenarios, indicating that the results are insensitive to being weighted for positive economic impacts in either a local or statewide context. More broadly, this points to the subset of economic variables pulled from the economic analysis having a general positive correlation, with the regional context not exerting a strong control on the overall hatchery scoring. The three federal hatcheries were not included in the economic analysis and are included only as a mean value. Similarly, Fall River Hatchery was analyzed as a part of Wizard Falls Hatchery, and the results are reported for Wizard Falls only. Average economic scores are used for Fall River Hatchery (Figure 3-9).

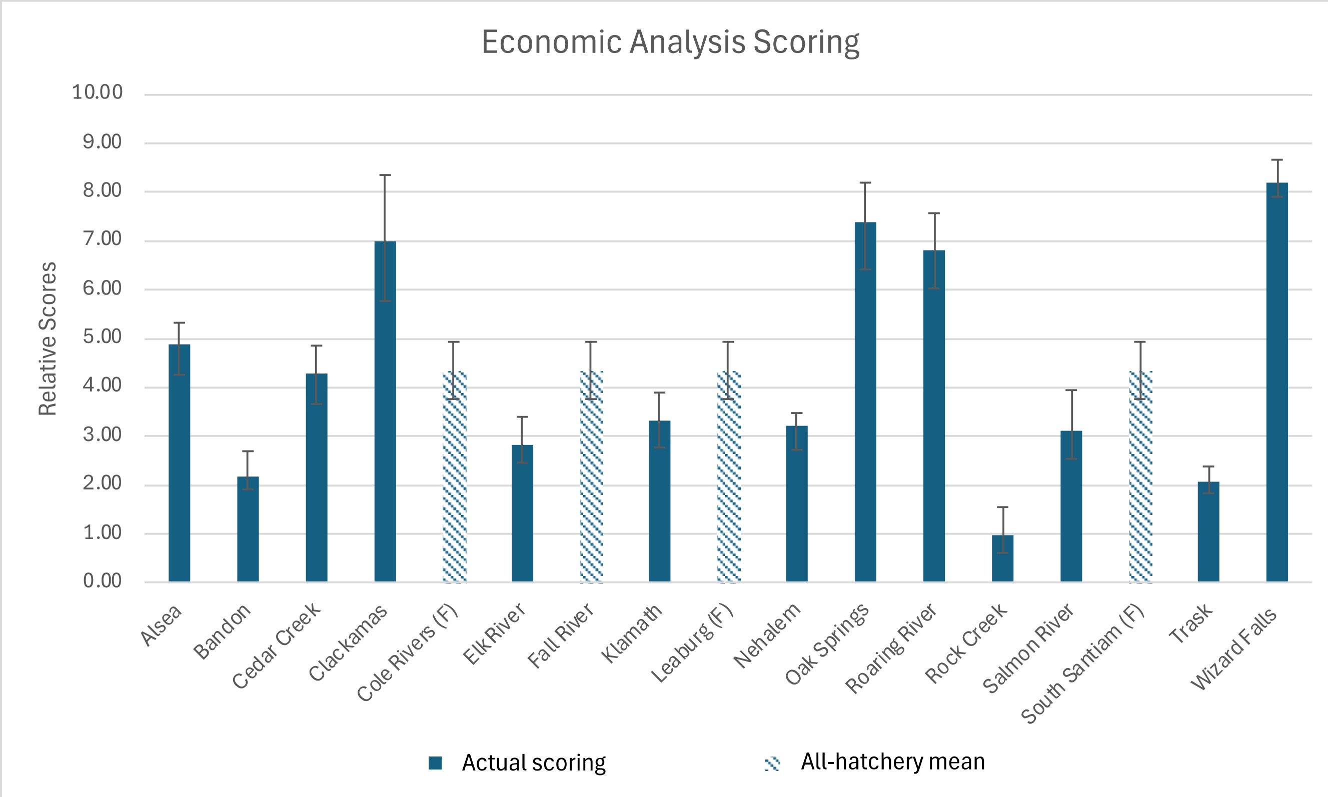

Figure 3-9. Economic Analysis Scoring for each hatchery. Hatched columns indicate no data and are assigned a mean value.

3.5. Combined Categorical Results

The scores from the four categories previously presented in Section 3.1 through 3.4 were combined to evaluate relative total scores across the 17 hatcheries evaluated for this study. The facility scores were based on the four categories of the MCDA: climate hazard scores; fish production, connectivity, and excess capacity scores; infrastructure costs; and economic impact. For this analysis, the state-only portion of the infrastructure costs were used, excluding the federal portions of the costs. An analysis using the state and federal costs is presented in Section 3.5.1.

The scores from these categories are combined in Table 3-5 to provide a final total score for each facility, with higher scores indicating better hatchery results (i.e., lower vulnerability to climate change, more fish production and hatchery importance, and lower infrastructure costs) and lower scores indicating worse hatchery results (i.e., higher vulnerability to climate change, less fish production and hatchery importance, and higher infrastructure costs). Although the sum of the categorical scores offers a first level overview of hatchery results, the different magnitudes of the raw normalized scores may add an unintended bias or skewness. To address this, the raw normalized scores were renormalized using three different methods: min-max normalization, standardization using the mean, and standardization using the standard deviation. Each method was used to evaluate the hatcheries in the highest 75th percentile representing the best scoring hatcheries and the those in the lowest 25th percentile, representing the worst scoring hatcheries. We found that the same hatcheries were scored in the 75th and 25th percentiles regardless of the normalization method, indicating the results are largely insensitive to different categorical weightings.

Table 3-5: MCDA categorical scores and total scores by ODFW study hatchery, ranked from highest to lowest total score. Federal hatcheries in the ODFW system are marked with an (F).

Hatchery	Climate Resilience & Hazards Score	Fish Production & Importance / Connectivity Score	Infrastructure Costs Score*	Economic Impact Score	Total Raw Score
Wizard Falls	8.53	4.59	1.02	8.20	22.35
Clackamas	7.97	5.54	0.92	6.99	21.42
Cole Rivers (F)	7.27	7.35	0.99	4.33	19.94
South Santiam (F)	9.06	4.67	1.10	4.33	19.16
Oak Springs	5.79	4.43	0.91	7.39	18.52
Fall River	8.40	3.75	1.07	4.33	17.54
Roaring River	6.55	3.25	0.90	6.82	17.53
Leaburg (F)	7.27	4.21	1.10	4.33	16.90
Cedar Creek	6.84	4.19	0.85	4.28	16.16
Klamath Falls	8.36	2.10	0.89	3.32	14.66
Elk River	5.11	4.58	0.88	2.81	13.38
Trask	6.65	3.79	0.82	2.05	13.31
Nehalem	4.70	3.47	0.95	3.21	12.33
Alsea	2.71	3.03	0.67	4.89	11.30
Salmon River	2.89	3.52	0.81	3.11	10.33
Bandon	4.26	2.78	0.71	2.18	9.93
Rock Creek	3.76	4.40	0.10	0.96	9.22

*An offset of 0.1 units were applied to Infrastructure Cost Scores to ensure non-zero score values.

The standardized results are presented in Figure 3-10 using a stacked bar chart, with the hatcheries arranged alphabetically. The stacked bar chart shows the individual contribution of each of the four categories ("Climate Hazard," "Fish Production", "Infrastructure Costs", and “Economic Impact”) to the total hatchery score. Figure 3-11 shows the total standardized score, with hatcheries arranged by descending score.

Facilities in the highest 75th percentile (Wizard Falls, Clackamas, Cole Rivers (F), and South Santiam (F)) represent facilities that have the best overall scores, indicating lower risks, higher fish production and importance, lower costs, and higher economic impact in comparison to others. Conversely, the bottom 25th percentile (Rock Creek, Bandon, Salmon River, and Alsea) represents facilities that have the lowest ranked scores indicating the highest climate risk, lowest fish production and importance, the highest costs, and the lowest economic impact. These facilities may need the most investment to achieve resilience or should be considered for operational alternatives. While the top four and bottom four scoring hatcheries were stable, the ordering of Clackamas and Cole Rivers in the 75th percentile and Alsea and Salmon River in the 25th percentile varied depending on the normalization method. This is true for the hatcheries with scores between the 25th and 75th percentiles as well, where the ranking of several individual hatcheries would change based on normalization method. Figures showing raw normalized scores, min-max normalization, standardization using the mean, and standardization using the standard deviation are presented in the Appendix in Section 7.7.1.

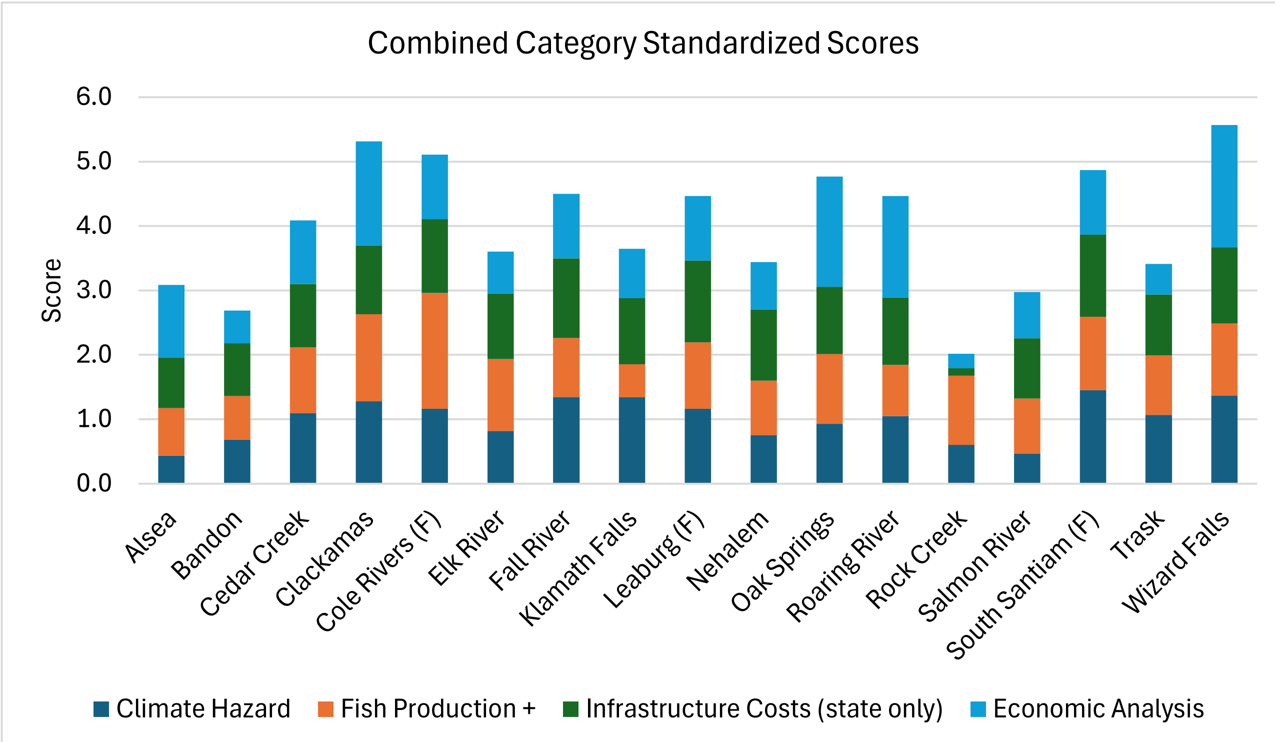

Figure 3-10: Stacked bar plot showing standardized scores for the aggregate hatchery analysis.

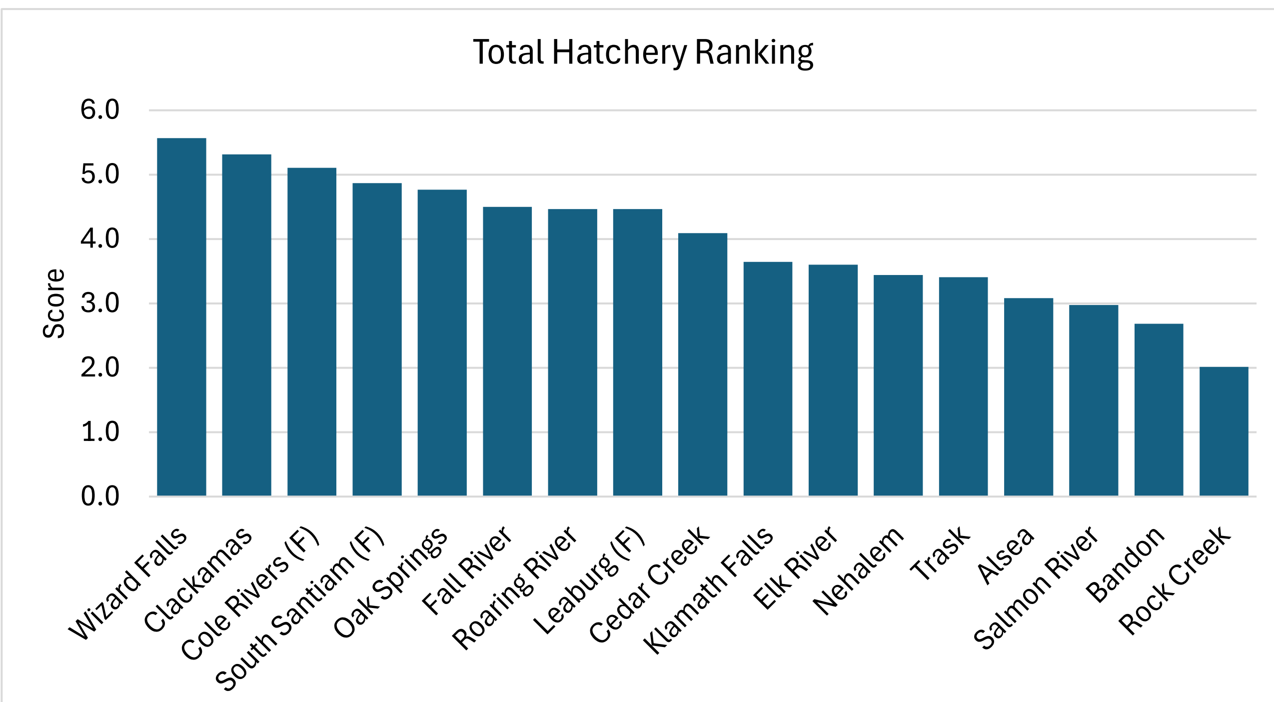

Figure 3-11: Final aggregated total hatchery rankings, based on scores Figure 3-10, from highest ranking (best) on the left to lowest on the right.

Since the economic data were not available at all hatcheries (i.e., federal hatcheries and Fall River) the combined categorical results were reviewed using three categories (Climate Hazard," "Fish Production", and "Infrastructure Costs"), excluding “Economic Impact” to understand the sensitivity of the results with the addition of economic scores. The hatcheries in the highest 75th percentile remained unchanged, but the ordering differed: Cole Rivers (F), South Santiam (F), Clackamas, and Wizard Falls. The order of Wizard Falls and Clackamas varied by normalization method. The hatcheries in the lowest 25th percentile also remained unchanged, but the ordering differed: Rock Creek, Alsea, Bandon, and Salmon River.

3.5.1. State and Federal Infrastructure Costs

This section briefly describes how the hatchery rankings would change with the inclusion of federal infrastructure costs associated with the federal hatcheries in addition to the state costs already presented in Section 3.5. The standardized scores are presented, with hatcheries sorted by descending score.

Figure 3-12 presents the standardized scores, which were ranked to classify the facilities based on their relative scores. The highest 75th percentile hatcheries (Wizard Falls, Clackamas, Oak Springs, and South Santiam (F)) represent facilities that have the best overall scores. Conversely, the bottom 25th percentile (Rock Creek, Bandon, Salmon River, and Alsea) represents facilities that have the lowest ranked scores indicating the highest climate risk, lowest fish production and importance, and the highest costs. For this analysis, the hatcheries included in the 75th percentile did change based on the normalization technique used where in one method Fall River Hatchery was included instead of Oak Springs Hatchery. The hatcheries included in the bottom 25th percentile did not change based on normalization method. The change in the rankings for the highest 75th percentile hatcheries reflects the additional federal costs associated with upgrades to hatchery infrastructure. Figures showing raw normalized scores, min-max normalization, standardization using the mean, and standardization using the standard deviation are presented in the Appendix, in Section 7.7.2.

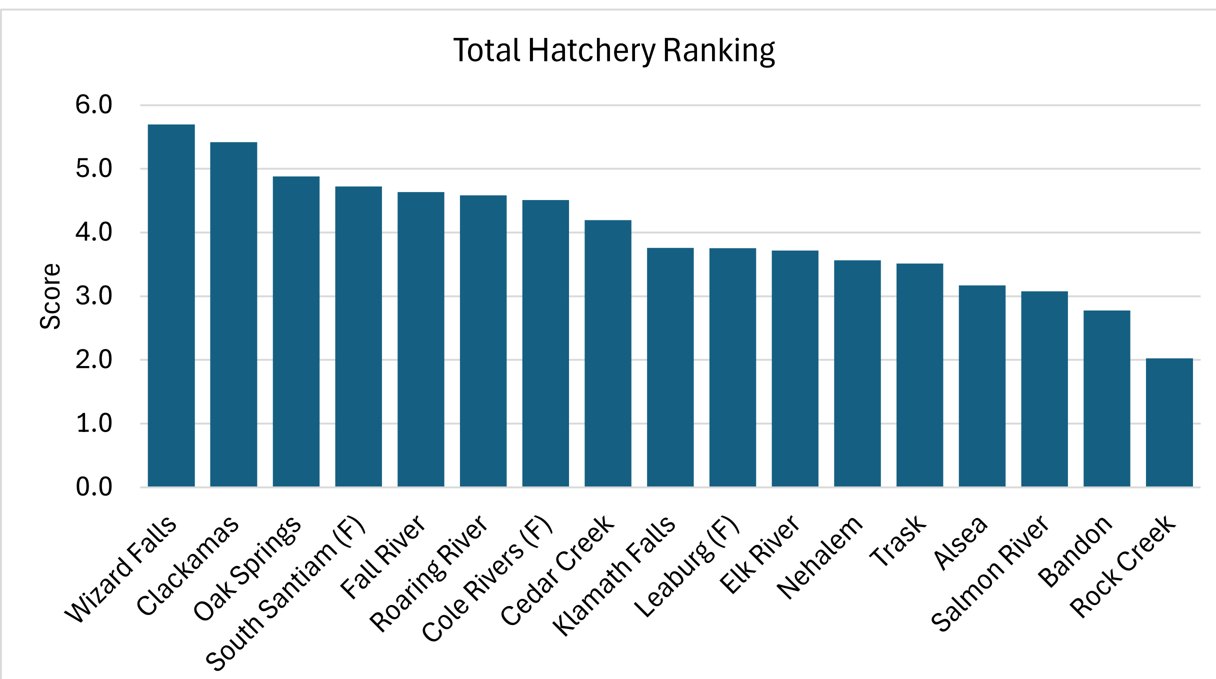

Figure 3-12: Final aggregated total hatchery rankings with state and federal infrastructure costs, arranged from highest ranking (best) on the left to lowest on the right.

4. Alternative Operational Scenario Analysis

This section provides an overview of potential ODFW hatchery alternative operational models, using the categorical and combined scoring results from Section 3. The following subsections are organized as follows: Section 4.1 introduces the alternative scenarios, Section 4.2 analyzes the alternatives according to their combined categorical scores, Section 4.3 presents the costs of each alternative, and Section 4.4 summarizes the estimated changes in fish production under each alternative.

4.1. Summary of Alternative Scenarios

Two major alternative operating plans (Alternative 1 and Alternative 2) were developed by ODFW and analyzed as a part of this hatchery assessment, as outlined in Table 4-1. Alternative 1 maintains current production at all hatcheries and rebuilds Rock Creek Hatchery to restore most of the pre-fire production capacity. This alternative can be described as a return to the operational status quo for ODFW. In comparison, Alternative 2 represents consolidated operations that would maintain the same production capacity across fewer ODFW hatcheries. Three different consolidation scenarios for Alternative 2 were evaluated: Alternative 2a, 2b, and 2c. All three Alternative 2 scenarios propose to 1) expand Oak Springs and Fall River Hatcheries; 2) shift production that previously occurred at Rock Creek Hatchery to other facilities and decommission the Rock Creek Hatchery site; and 3) shift production from one of three facilities in the Northwest region to several other facilities and decommission the originating facility. Consolidation details for the Northwest region differ among the three scenarios (Table 4.1). In all three scenarios, ODFW would make investments in remaining facilities to maintain very similar hatchery production capacity for salmon, steelhead, and trout. Investment is designated as funding deferred maintenance and climate resilience projects at hatcheries while expansion indicates expanding hatchery facilities to accommodate additional fish production.

Alternative 1 represents a baseline scenario focused on rebuilding Rock Creek Hatchery and conducting deferred maintenance and minor upgrades to the Elk River Hatchery, which are also included in Alternatives 2a-c. In Alternative 2a, the approach for the Southwest region involves expanding Bandon and Elk River Hatcheries and building new capacity in the South Umpqua to accommodate production shifts from Rock Creek Hatchery, which would not be utilized. In the northwest region, Cedar Creek Hatchery would be expanded to accommodate shifting production out of Nehalem Hatchery. Additionally, the Oak Springs and Fall River facilities in the Deschutes region would be upgraded, facilitating a shift in trout production to create more space for anadromous production at coastal facilities in the Northwest region. Alternative 2b closely resembles 2a, with the same actions in the Southwest and Deschutes regions; however, in the Northwest region, ODFW would expand facilities at Cedar Creek Hatchery and Nehalem Hatchery to accommodate shifting production out of Salmon River Hatchery. Finally, Alternative 2c maintains the same southwest and Deschutes strategies as Alternative 2a and 2b, but in the Northwest region would expand Cedar Creek and Nehalem hatcheries to accommodate shifting production out of Alsea Hatchery, which would be converted to a STEP collection and acclimation facility. Investment in deferred maintenance and climate resilience projects would be completed at all hatcheries not designated for decommissioning for alternatives 1, 2a, 2b, and 2c. Each alternative represents a unique combination of actions aimed at optimizing resources and facilities across these regions. The alternatives are summarized in Table 4-1.

Table 4-1: Description of the alternative operational scenarios for ODFW hatcheries evaluated within this study.

Scenario Name	Description
Alternative 1 (Status Quo)	**Southwest:** Expand Elk River; Rebuild Rock Creek **All Hatcheries:** Address deferred maintenance and invest in climate upgrades
Alternative 2a (Consolidation)	**Southwest:** Expand Bandon and Elk River; build capacity for South Umpqua programs; shift production from Rock Creek to Cole Rivers, Elk River, and South Umpqua **Northwest:** Expand Cedar Creek; Shift production from Nehalem to Cedar Creek, Salmon River and Clackamas **Deschutes:** Expand Oak Springs and Fall River; shift trout production from coastal facilities **All Hatcheries:** Address deferred maintenance and invest in climate upgrades
Alternative 2b (Consolidation)	**Southwest:** Expand Bandon and Elk River; build capacity for South Umpqua programs; shift production from Rock Creek to Cole Rivers, Elk River, and South Umpqua **Northwest:** Expand Cedar Creek and Nehalem; shift production from Salmon River to Cedar Creek, Roaring River, and Clackamas **Deschutes:** Expand Oak Springs and Fall River; shift trout production from coastal facilities **All Hatcheries:** Address deferred maintenance and invest in climate upgrades
Alternative 2c (Consolidation)	**Southwest:** Expand Bandon and Elk River; build capacity for South Umpqua programs; shift production from Rock Creek to Cole Rivers, Elk River, and South Umpqua **Northwest:** Expand Cedar Creek and Nehalem; convert Alsea to a collection and acclimation facility and shift production to Cedar Creek, Salmon River, and Clackamas **Deschutes:** Expand Oak Springs and Fall River; shift trout production from coastal facilities **All Hatcheries:** Address deferred maintenance and invest in climate upgrades

4.2. Analysis of Alternatives by Category

The alternatives were analyzed by their categorical scores for Climate Resilience and Hazards, Fish Production & Connectivity/Importance, Operating and Infrastructure Costs, and the Economic Analysis (Section 3) to understand the consolidation scenarios in the context of the larger hatchery assessment under the MCDA framework. Categorical hatchery rankings are from 1 to 17 such that lower ranks (i.e., closer to 17) indicate worse hatchery scoring (higher vulnerability and infrastructure costs, etc.) and higher ranks (i.e., closer to 1) indicate better hatchery scoring (lower vulnerability and infrastructure costs, etc.). The results presented in Table 4-2 show the ranks organized by category (in columns) and by alternative and type of change in the alternative (in rows). For instance, within each alternative a hatchery may see an expansion ("expand") of its facilities to meet additional production, have investment ("invest") to meet existing facility needs (e.g., deferred maintenance), or experience a shift or reduction ("shift") in fish production to other hatcheries. Changes that are universal across all alternatives are presented in the top of the table, while changes that are unique to each alternative are presented at the bottom of the table.

Assessing the alternatives in this way shows that most of the hatcheries considered for decommissioning and production shifts in the consolidation scenarios (Rock Creek, Nehalem, Salmon River, and/or Alsea) tend to score more poorly across most categories, though this is not the case universally. Rock Creek, Alsea, and Salmon River were the three lowest ranking hatcheries for Climate Resilience and Hazards, and Nehalem was ranked 13 out of 17. Alsea, Salmon River, and Nehalem also ranked in the bottom half for Fish Production and Connectivity/Importance, while Rock Creek ranked higher at 7 out of 17. Rock Creek and Alsea were the two lowest ranking hatcheries for Operating and Infrastructure Costs, and Salmon River also ranked low at 14 out of 17. Nehalem had lower costs, ranking 6 of 17 for Operating and Infrastructure Costs. Differences among Alsea, Salmon River, and Nehalem in this category explain the differences in total infrastructure costs among the three consolidation scenarios discussed in the section below. In the Economic Analysis category, Rock Creek was the lowest ranking hatchery and Nehalem and Salmon River ranked 12 and 13, respectively. Of the four, only Alsea ranked in the upper half of hatcheries at 5 out 17.

Given the generally low ranks for hatcheries that would be decommissioned and have their production shifted elsewhere, consolidation would generally increase median rankings of the remaining hatcheries across categories. However, we also find that under some alternative operational scenarios, hatcheries with low rankings are scheduled for investment (e.g., expansion in Bandon for Alternatives 2a-c). In these instances, it may be the case that greater investment is needed to overcome challenges related to climate vulnerabilities, or that there is more deferred maintenance for ODFW to address to resume full production capacity. Often, a hatchery's geographic location or program importance may outweigh lower scoring in the Climate and Hazards and the Operations and Infrastructure Costs categories and justify these investments, but with potential tradeoffs to other hatchery operations or programs.

Table 4-2: Summary of categorical hatchery scores by alternative scenarios and types of change (i.e., expansion, investment, or shift in production). Categorical rankings are relative to the ODFW study hatcheries and are provided out of 17, as noted in the parentheses.

Alternative	Type of Change	Climate Resilience and Hazards (Rank)	Fish Production & Connectivity / Importance (Rank)	Infrastructure Costs & Deferred Maintenance (Rank) [1]	Economic Analysis (Rank)
Universal Changes					
All Alternatives	Expand	Bandon (14th) Cedar Creek (8th) Elk River (12th) Fall River (3rd) Oak Springs (11th)	Bandon (16th) Cedar Creek (9th) Elk River (5th) Fall River (11th) Oak Springs (6th)	Bandon (15th) Cedar Creek (12th) Elk River (11th) Fall River (3rd) Oak Springs (8th)	Bandon (15th) Cedar Creek (10th) Elk River (14th) Fall River (8th) Oak Springs (2nd)
	Invest	Clackamas (5th) Cole Rivers (6th) Klamath Falls (4th) Leaburg (7th) Roaring River (10th) South Santiam (1st) Trask (9th) Wizard Falls (2nd)	Clackamas (2nd) Cole Rivers (1st) Klamath Falls (17th) Leaburg (8th) Roaring River (14th) South Santiam (3rd) Trask (10th) Wizard Falls (4th)	Clackamas (7th) Cole Rivers (5th) Klamath Falls (10th) Leaburg (2nd) Roaring River (9th) South Santiam (1st) Trask (13th) Wizard Falls (13th)	Clackamas (3rd) Cole Rivers (6th) Klamath Falls (11th) Leaburg (9th) Roaring River (4th) South Santiam (7th) Trask (16th) Wizard Falls (1st)
	Shift	Rock Creek (15th)	Rock Creek (7th)	Rock Creek (17th)	Rock Creek (17th)
Alternative-Specific Changes					
Alt. 2a	Expand	None (see expanded facilities for all alternatives)	None (see expanded facilities for all alternatives)	None (see expanded facilities for all alternatives)	None (see expanded facilities for all alternatives)
	Invest	Alsea (17th) Salmon River (16th)	Alsea (15th) Salmon River (12th)	Alsea (16th) Salmon River (14th)	Alsea (5th) Salmon River (13th)
	Shift	Nehalem (13th)	Nehalem (13th)	Nehalem (6th)	Nehalem (12th)
Alt. 2b	Expand	Nehalem (13th)	Nehalem (13th)	Nehalem (6th)	Nehalem (12th)
	Invest	Alsea (17th)	Alsea (15th)	Alsea (16th)	Alsea (5th)
	Shift	Salmon River (16th)	Salmon River (12th)	Salmon River (14th)	Salmon River (13th)
Alt. 2c	Expand	Nehalem (13th)	Nehalem (13th)	Nehalem (6th)	Nehalem (12th)
	Invest	Salmon River (16th)	Salmon River (12th)	Salmon River (14th)	Salmon River (13th)
	Shift	Alsea (17th)	Alsea (15th)	Alsea (16th)	Alsea (5th)

1) State-only infrastructure costs.

4.3. Alternative Cost Results

Each alternative scenario has associated costs for addressing deferred maintenance backlogs and implementing upgrades to absorb the fish production from other hatcheries across the ODFW system facing decommissioning (Figure 4-1). The total hatchery costs for each alternative scenario were calculated as the sum of the deferred maintenance, new technology costs, projected modification costs, and any additional costs for each alternative. If a hatchery is closing in an alternative, only the costs associated with decommissioning the hatchery are applied in the "Alternative Cost" category (Figure 4-1; light blue), all other costs for that hatchery were zero. For example, the total average cost for Rock Creek Hatchery in Alternative 1 is estimated to be $46 million, which includes the costs to rebuild the hatchery, install new technologies, and the annual operating costs. In comparison, under Alternatives 2a-c, the cost to decommission Rock Creek Hatchery is estimated at $20 million which includes both the decommissioning cost and costs to build new facilities in the South Umpqua River ($2.7-7.5 million), but deferred maintenance, projected modifications, climate infrastructure costs are set to zero.

Lynker met with ODFW to identify the costs associated with changes in hatchery operations (i.e., staff and operating budgets) proposed in the alternative, but it was determined that any assumptions would be speculative. There are potential savings with the consolidation of a hatchery, but most production costs are expected to be associated with the fish and be allocated to whichever hatchery resumes its production. The exact cost savings for a hatchery consolidation are beyond the scope of this analysis and therefore, operating costs were not included in this analysis. A more detailed study would be required to quantify how the proposed alternatives would impact operating costs, staffing levels, and fish production.

As discussed in Section 4.1 and summarized in Table 4-1, Alternative 1 maintains the status quo with two exceptions: it assumes Rock Creek Hatchery is rebuilt and includes investment at Elk River Hatchery for four new raceways. In Alternatives 2a-c, one hatchery in the Northwest region is decommissioned (out of Nehalem, Salmon River, or Alsea) along with Rock Creek Hatchery in the Southwest region. The costs for each of these scenarios is shown in Figure 4-1: Alternative 1, representing a return to the ODFW status quo, has an estimated total cost of $251 million. Alternatives 2a, 2b, and 2c have estimated totals costs of $246 million, $245 million, and $237 million, respectively. In all scenarios, high and low cost estimates are marked by the error bars. Note that the cost estimates were developed in 2023-2024 and may increase in the future due to inflation and other factors.

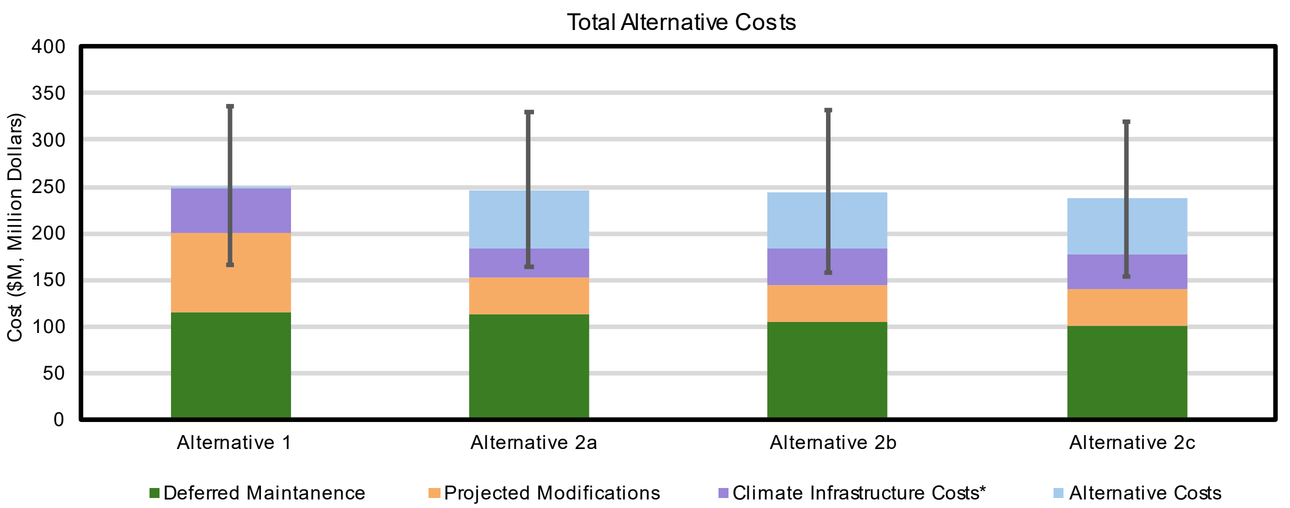

Figure 4-1: Total costs (deferred maintenance, climate infrastructure/new technology, projected modifications, and additional costs for alternative scenario) across the four alternative scenarios, where the error bars show high and low estimates based on ODFW provided information. * indicates that some climate costs were duplicative in the alternative scenario, so those costs were not double counted but rather removed in the total climate infrastructure cost sum.

Though significant uncertainty in the cost estimates exists, it is apparent that there are not significant costs savings in Alternatives 2a-c over Alternative 1, despite the decommissioning of two ODFW hatcheries under the each of the three scenarios in Alternative 2. There are several reasons for this. Alternative 1 includes the additional cost of reconstructing the presently non-operational Rock Creek Hatchery ($40-50 million in projected modification costs), higher climate infrastructure costs associated with upgrading more ODFW hatcheries, and slightly higher deferred maintenance costs to address maintenance backlogs. However, this is offset by investment and expansion in the alternative operations to maintain the current level of fish production. Alternatives 2a-c have much lower estimates for projected modification costs than Alternative 1 (since Rock Creek Hatchery is not built), but this is largely offset by the cost of new hatchery investments (see 'Alternative Costs' in Figure 4-1), which range from $59 to $63 million, depending on the specifics of the alternative, and the decommissioning costs at Rock Creek Hatchery ($10-20 million). Because of these factors, Alternatives 2a-c do not offer significant cost savings over Alternative 1, and any cost savings are well within the range of uncertainty of cost estimates provided by ODFW. The cost savings associated with shifting production from hatcheries and the decision to not rebuild Rock Creek Hatchery in Alternatives 2a, 2b, and 2c are estimated to be $4M, $6M, and $14M, respectively with the greatest savings under Alternative 2c (Figure 4-2).

The consolidation alternatives outlined in this report generally focused on shifting production out of hatcheries with higher risks and costs (e.g., Rock Creek) to prioritize investment in other hatcheries with lower risks. Consolidation may be a helpful tool in eliminating the highest risk facilities to invest in lower risk facilities. However, consolidation schemes may have other risks and benefits that are not considered in this assessment. For instance, it is also possible that consolidating ODFW's hatchery system could increase vulnerability due to there being fewer facilities available to absorb operations and fish production under a future hatchery closure scenario, e.g., from wildfire.

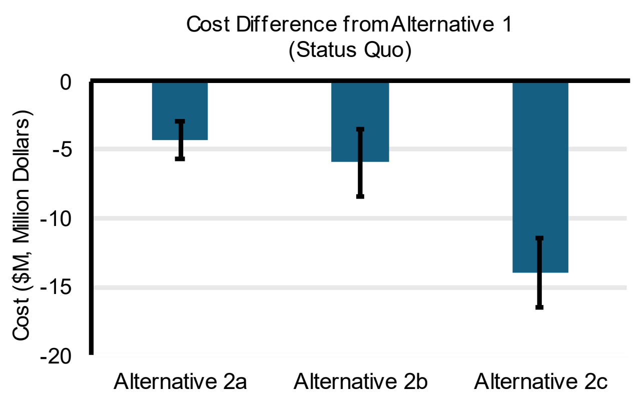

Figure 4-2: Total Cost Savings of Alternatives 2a, 2b, and 2c compared to Alternative 1.

4.4. Fish Production Results

A key element of these alternatives (Alternatives 2a-c) is that they aim to maintain system-wide production numbers at or near historical levels. The estimated total annual production in all four alternative scenarios is 2,150,289 pounds (lbs). Table 4-3 lists the estimated total annual production for all fish species under all alternative operational models by hatchery. The Rock Creek Hatchery summer steelhead program (Stock 55H) was not included in this analysis as this program was eliminated by the Oregon Fish and Wildlife Commission in April 2022.

Table 4-3: Total annual fish production by hatcheries for the four alternative scenarios.

Hatchery	Alternative 1 (lbs)	Alternative 2a (lbs)	Alternative 2b (lbs)	Alternative 2c (lbs)
Alsea	111,436	111,436	55,595	0
Bandon	37,097	85,887	85,887	85,887
Cedar Creek	81,084	102,783	93,584	89,507
Clackamas	240,192	251,684	251,684	251,684
Cole Rivers (F)	444,057	444,676	444,676	444,676
Elk River	45,714	52,714	52,714	52,714
Fall River	61,259	71,658	69,592	69,236
Klamath Falls	176,149	176,149	176,149	176,149
Leaburg (F)	266,334	266,334	266,334	266,334
Nehalem	72,447	0	128,288	128,288
Oak Springs	128,425	149,225	149,949	144,380
Roaring River	112,053	112,053	112,053	112,053
Rock Creek	56,408	0	0	0
Salmon River	53,850	60,239	0	65,597
S. Santiam (F)	144,583	144,583	144,583	144,583
Trask	43,993	45,660	43,993	43,993
Wizard Falls	75,208	75,208	75,208	75,208
Total	**2,150,289**	**2,150,289**	**2,150,289**	**2,150,289**

Figure 4-3 illustrates how production could be redistributed through the system, considering hatchery fish programs, available rearing capacity, climate resilience, infrastructure upgrades, and other factors. The annual production numbers are based on 2022 data provided by ODFW, with Rock Creek data for Alternative 1 sourced from 2019 production figures. The figure offers further details on how production may be adjusted within the system under Alternative 2 operational models as facilities are consolidated compared to the status quo under Alternative 1.

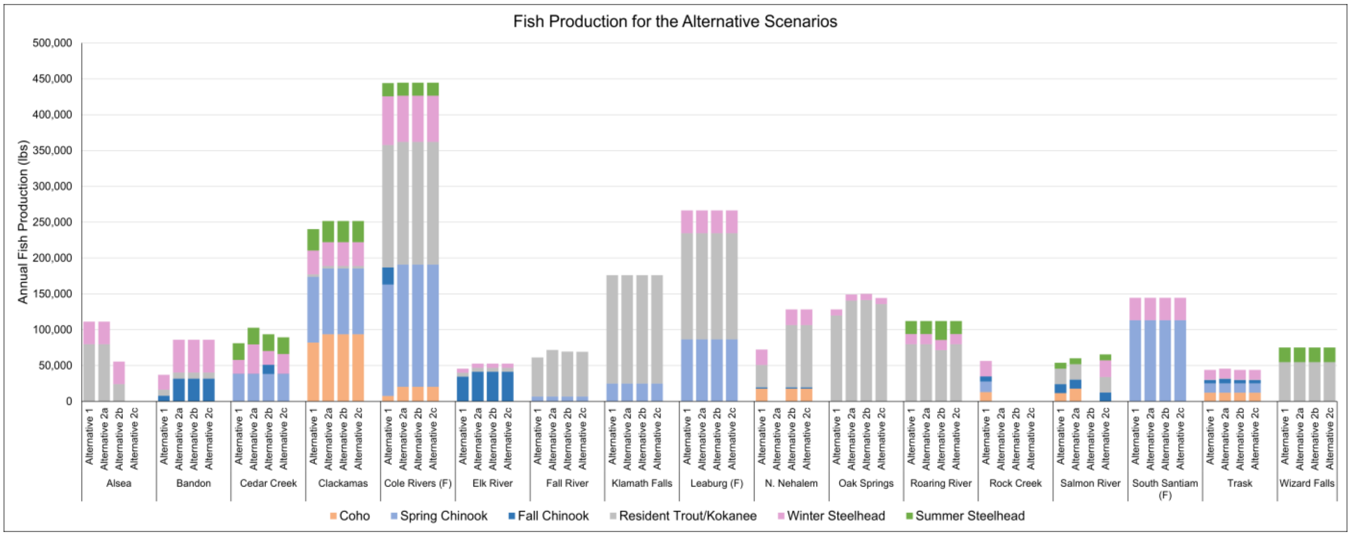

Figure 4-3: Fish species reared for each alternative operational model.

Additionally, the fish production under the status quo (Alternative 1) and the alternatives (Alternatives 2a and 2c) are compared visually and spatially in Figure 4-4, Figure 4-5, Figure 4-6, and Figure 4-7. In these figures, the fish production is depicted by hatchery at the location of the hatchery, with the size of the pie charge based on the total fish production (in pounds) at the hatchery. The fish species (Coho, Spring Chinook, Fall Chinook, Resident Trout and Kokanee, Winter Steelhead, or Summer Steelhead) are depicted as portions of the pie chart, with larger portions indicating more production of a given fish species.

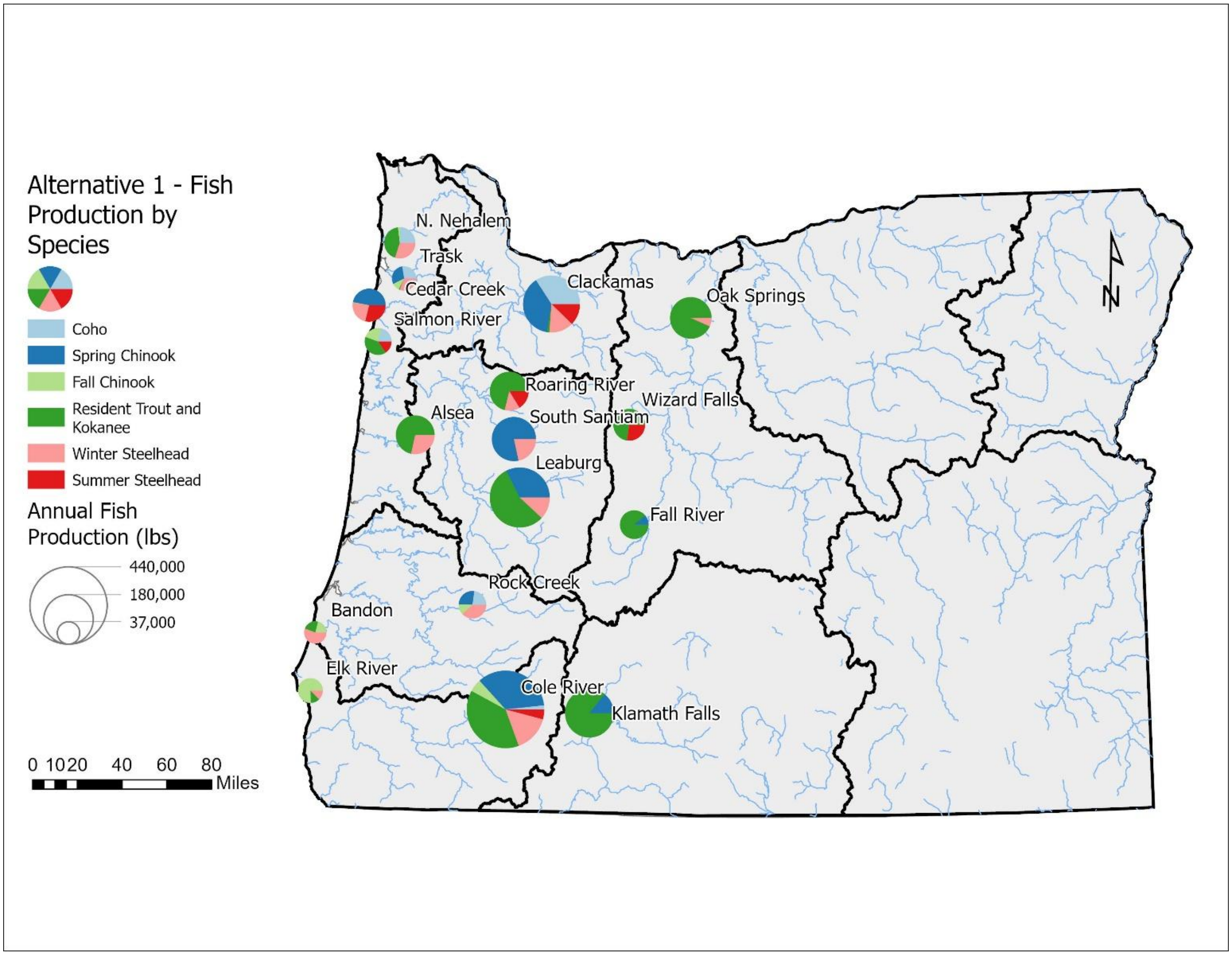

Figure 4-4: Alternative 1, fish production by hatchery and species.

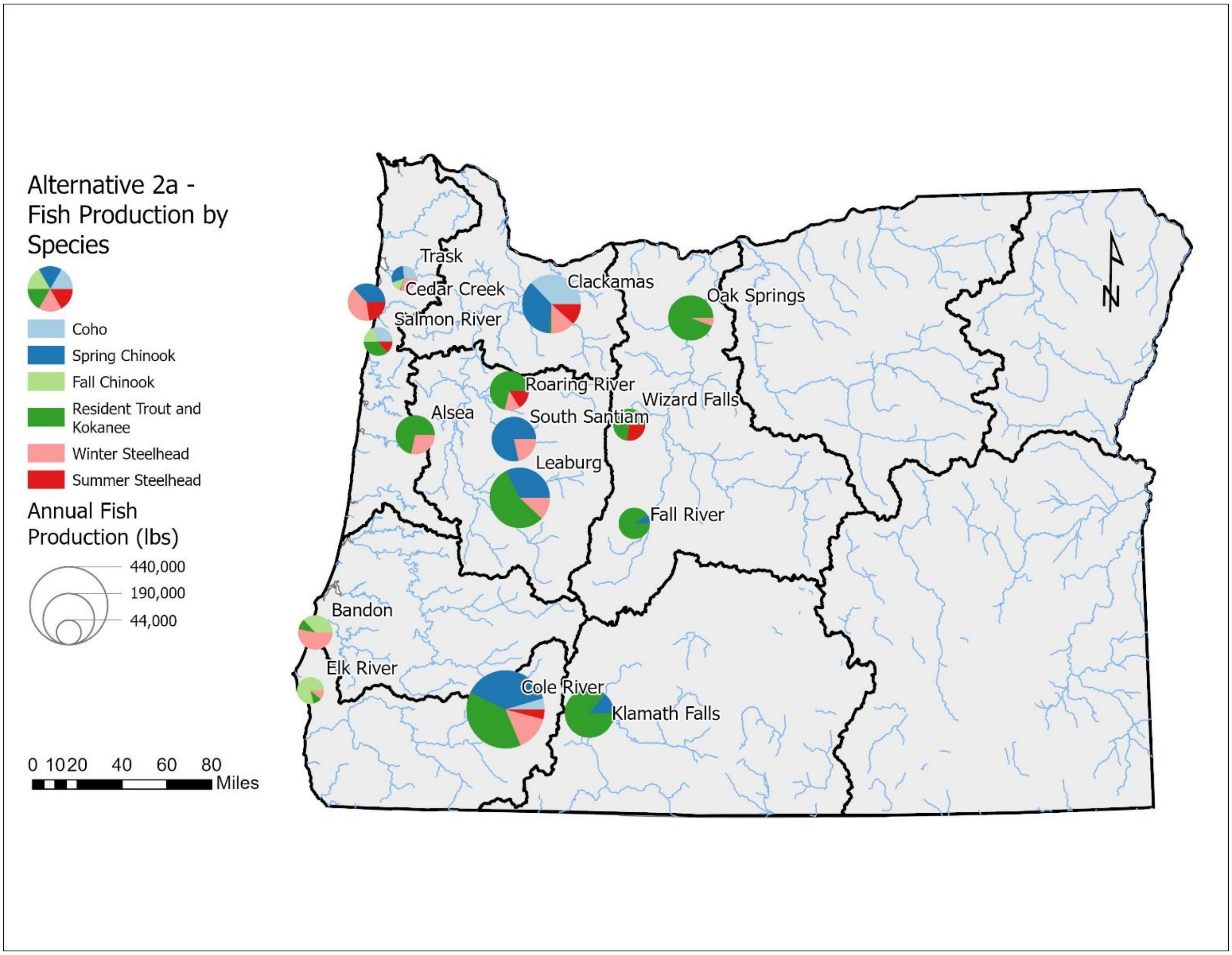

Figure 4-5: Alternative 2a, fish production by hatchery and species.

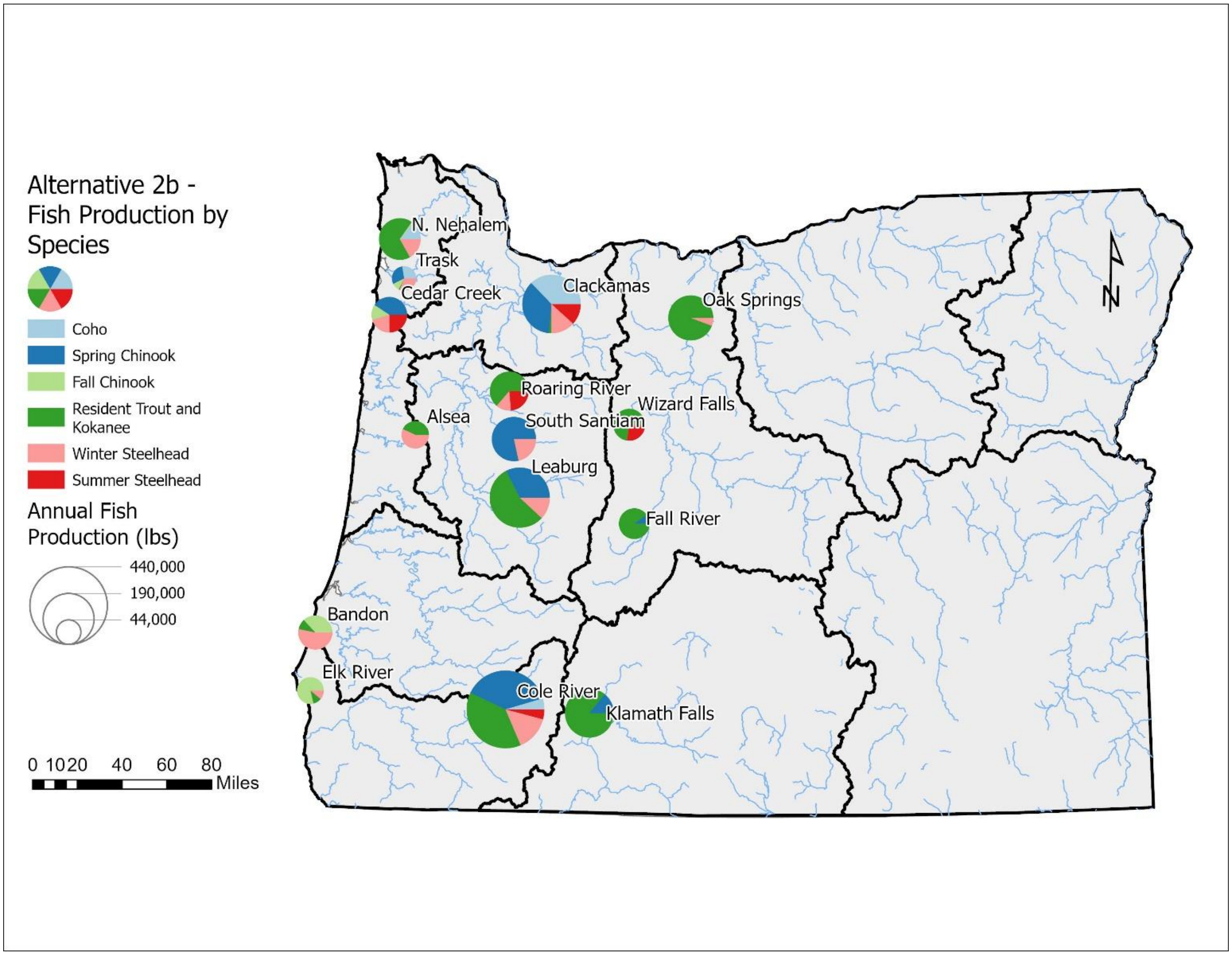

Figure 4-6: Alternative 2b, fish production by hatchery and species.

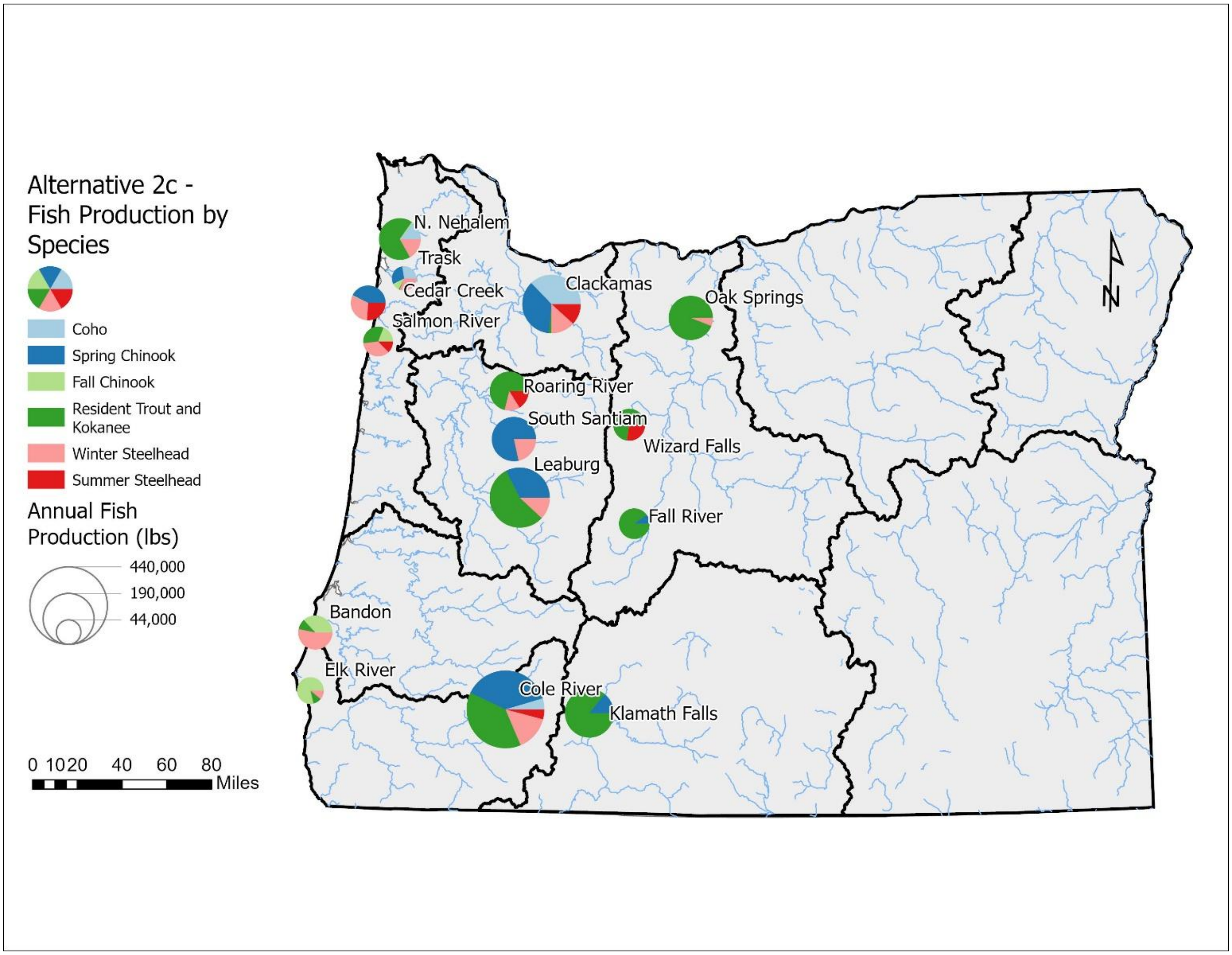

Figure 4-7: Alternative 2c, fish production by hatchery and species.

5. Conclusion

Lynker completed a fish hatchery assessment on 14 state-owned hatcheries and three federal hatcheries for a total of 17 hatcheries: Alsea, Bandon, Cedar Creek, Clackamas, Cole Rivers (F), Elk River, Fall River, Klamath, Leaburg (F), Nehalem, Oak Springs, Roaring River, Rock Creek, Salmon River, South Santiam (F), Trask, and Wizard Falls.

The project began with the collection and assessment of relevant hatchery data including but not limited to fish production, infrastructure costs, and climate hazards. This data was used to inform a multi-criteria decision analysis (MCDA), a framework which identified the criteria and weightings used to evaluate and score the fish hatcheries. The indicator criteria were separated into 4 categories: 1) climate hazards, 2) fish production, excess capacity, and connectivity, 3) infrastructure costs, and 4) economic analysis. The categorical results were then combined using equal weighting to determine the overall highest scoring hatcheries (i.e., higher resilience to climate hazards, higher importance in the ODFW hatchery system, lower infrastructure costs, and higher economic benefit) and the lowest scoring hatcheries (i.e., lower resilient to climate hazards, lower importance in the ODFW hatchery system, higher infrastructure costs, and lower economic benefit). The results show that Wizard Falls, Clackamas, Cole Rivers (F), and South Santiam (F) are the highest scoring hatcheries, followed by Oak Springs and Fall River. Rock Creek, Bandon, Salmon River, and Alsea are the hatcheries with the lowest scores, followed by Trask and Nehalem.

The framework is designed to be as comprehensive as feasible, considering current hatchery conditions (e.g., current production, water supply, water quality issues), future hatchery conditions (e.g., potential excess capacity, climate-impacted water temperature), but also social vulnerability considerations, broodstock considerations, and related hatchery facilities and programs (e.g., STEP, acclimation facilities). However, there are additional criteria that are harder to objectively quantify and therefore are not included in this quantitative framework, or are only included using simple (e.g., binary) classifications with lower weighting schemes. These may include, local and regional dependencies or importance, tribal needs, historical and cultural importance, fish program importance, geographic location, and relation to federal hatchery programs.

This hatchery assessment framework provides a quantitative analysis of 17 fish hatcheries selected by ODFW. The results can be used to help guide decision making by ODFW and their stakeholders as the department continues to work toward long-term sustainability.

6. References

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7. Appendix

7.1. Climate Resilience and Hazards

Table 7-1: Individual hatchery criteria scores for the Climate and Hazards category. Scores are normalized between hatcheries so that the minimum raw score is a 0 and the maximum raw score is a 10, where higher scores are more favorable.

Criteria Grouping	Units (positively oriented)	Individual Criteria	Alsea	Bandon	Cedar Creek	Clackamas	Cole Rivers	Elk River	Fall River	Klamath Falls	Leaburg	Nehalem	Oak Springs	Roaring River	Rock Creek	Salmon River	South Santian	Trask	Wizard Falls
Water Availability	*min-max norm, inverted*	**Water Rights Potential Impact**	0.0	0.0	6.7	10.0	10.0	8.3	10.0	10.0	10.0	6.7	0.0	8.3	10.0	6.7	10.0	6.7	10.0
	min-max norm, inverted	**Low Flow Potential Impact**	1.4	0.0	4.3	10.0	4.3	1.4	7.1	5.7	2.9	4.3	10.0	1.4	1.4	2.9	4.3	4.3	7.1
	min-max norm, inverted	**Drought Potential Impact**	4.0	2.0	8.0	8.0	4.0	4.0	6.0	8.0	8.0	8.0	0.0	6.0	4.0	6.0	10.0	8.0	8.0
Water Quality	*min-max norm, inverted*	**Observed Maximum Stream Temperature**	1.2	4.0	4.6	2.7	5.5	1.9	5.6	10.0	4.5	0.0	5.3	5.7	1.7	0.0	6.7	4.2	6.3
	binary 0, 10	**Water Temperature Criticality (Observed Max T < 68F)**	0.0	10.0	10.0	10.0	10.0	0.0	10.0	10.0	10.0	0.0	10.0	10.0	0.0	0.0	10.0	10.0	10.0
	min-max norm, inverted	**VELMA Projected Change in Annual Max Temp**	1.1	3.9	4.5	8.9	10.0	6.4	10.0	10.0	10.0	3.5	10.0	3.0	5.2	0.0	10.0	7.1	10.0
	min-max norm, inverted	**Pathogens Potential Impact**	0.0	8.0	8.0	0.0	8.0	10.0	10.0	10.0	4.0	4.0	6.0	6.0	0.0	4.0	10.0	4.0	10.0
	min-max norm, inverted	**Flooding Potential Impact**	7.1	2.9	7.1	10.0	1.4	2.9	10.0	4.3	0.0	5.7	7.1	4.3	5.7	0.0	7.1	4.3	10.0
	min-max norm, inverted	**Watershed Condition Potential Impact**	5.7	5.7	5.7	8.6	5.7	7.1	10.0	4.3	7.1	7.1	0.0	5.7	0.0	4.3	10.0	5.7	10.0
Other Hazards	*min-max norm, inverted*	**GHG Emissions - Power & Fish Production (per lbs fish)**	10.0	8.8	10.0	9.8	9.2	10.0	9.9	9.2	10.0	9.8	10.0	9.8	3.7	0.0	9.7	10.0	9.7
	min-max norm, inverted	**Wildfire Potential Impact**	8.3	3.3	8.3	6.7	6.7	8.3	3.3	3.3	5.0	8.3	3.3	10.0	3.3	8.3	10.0	6.7	0.0
	min-max norm, inverted	**Sea Level Rise Potential Impact**	4.3	5.7	4.3	10.0	10.0	7.1	10.0	10.0	10.0	2.9	10.0	10.0	10.0	0.0	10.0	5.7	10.0

7.1.1. Greenhouse Gas (GHG) Emissions & Electricity Providers

We determined the greenhouse gas emissions associated with each hatchery based on power generation and fish production (Figure 7-1). We calculated the GHG emissions from power (electricity and natural gas/propane consumption) using the following method:

$$GHG\ emissions\ from\ power\ =\ [activity\ data] * [emissions\ rate\ by\ utility\ provider]$$

We used the energy consumption (kWh) (e.g., electricity and natural gas/propane) estimated by hatchery in the ODFW's Base Year Greenhouse Gas Inventory Report (ODFW GHG Report) and the 2022 emissions rate by utility provider per kilowatt ($kgCO_{2e}$/kWh) from the State of Oregon Department of Environmental Quality: Greenhouse Gas Emissions from Electricity Use 2010-2022 Report. The estimated energy consumption in the ODFW GHG Report was not differentiated between natural gas or propane. Therefore, we assumed all was from propane as a conservative assumption.

The electricity generated by each utility serving the ODFW hatcheries comes from various fuel sources. These fuel sources have different contributions to GHG emissions with coal, natural gas, and petroleum being the largest contributors. Therefore, we have determined the percentage of the fuel mix based on the total GHG emissions from power generation by each hatchery facility (Figure 7-2).

We estimated the greenhouse gas emissions from fish production as follows:

$$GHG\ emissions\ from\ fish\ production\ =\ [annual\ fish\ prod] * [emission\ factor] * [GWP]$$

The annual fish production numbers were provided by ODFW hatchery managers in kg. We used an emission factor of 0.791 kg CO_{2e} / kg production annually (MJ MacLeod et al. 2020. Quantifying greenhouse gas emissions from global aquaculture. Nature Scientific Reports, 10: 11679) and a 100-year time horizon global warming potential (GWP) relative to CO_2 of 265 for nitrous oxide (N_2O) (IPCC Fifth Assessment Report, 2014 (AR5)).

Table 7-2: Electrical Provider by Hatchery

Hatchery	Electricity Provider
Alsea	Consumers Power
Bandon	Pacific Power
Cedar Creek	Tillamook PUD
Clackamas	Portland General Electric (PGE)
Cole Rivers (F)	Pacific Power
Elk River	Coos-Curry Electric Cooperative
Fall River	Midstate Electric Cooperative
Klamath	Pacific Power
Leaburg (F)	EWEB (Eugene Water and Electric Board)
Nehalem	Tillamook PUD
Oak Springs	Wasco Electric Cooperative (WEC)
Roaring River	Portland General Electric (PGE)
Rock Creek	Pacific Power
Salmon River	Pacific Power
South Santiam (F)	Pacific Power
Trask	Tillamook PUD
Wizard Falls	Central Electric Cooperative

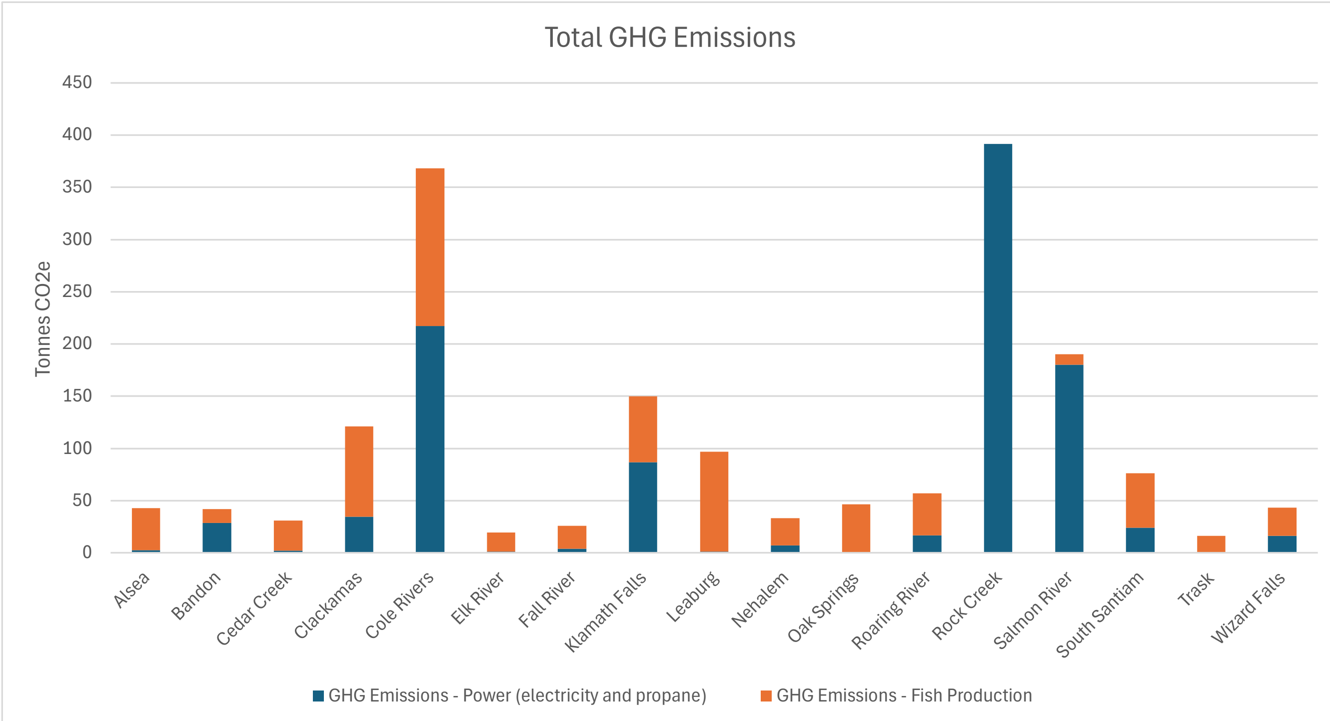

Figure 7-1: Greenhouse gas (GHG) emissions by hatchery from power generation (blue) and fish production (orange).

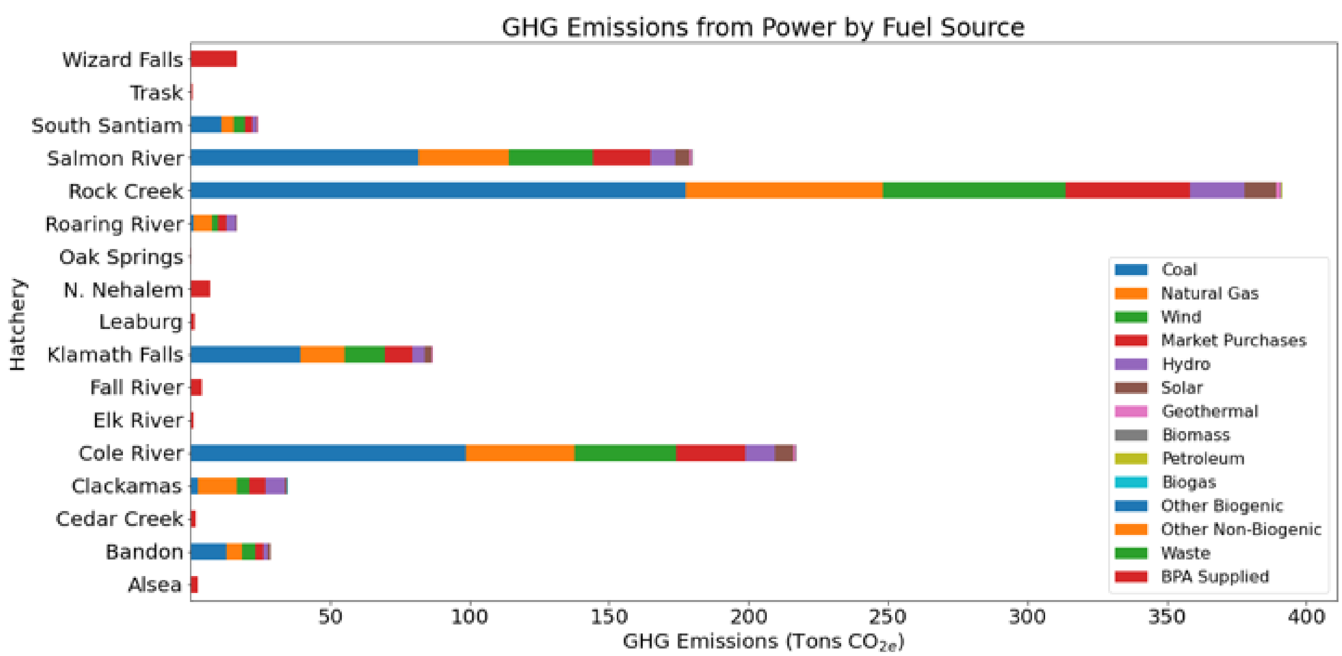

Figure 7-2. Greenhouse gas (GHG) emissions by hatchery from power by fuel source (Source: https://www.oregon.gov/energy/energy-oregon/pages/electricity-mix-in-oregon.aspx).

7.1.2. Climate Potential Impacts

Climate Potential Impacts are defined by the *Climate Risk Assessment* conducted by Lynker in 2023. This report defines a methodology for determining hazards, followed by an analysis for six ODFW hatcheries. The assessment included current and potential risks associated with climate change. Assessment for the remaining hatcheries included in this report was conducted by ODFW, using the same methodology. Of the 15 scoring categories in the original assessment, only the potential impact categories are included in this framework (Figure 7-3). The scoring components for the final score at each hatchery are shown in Figure 7-4.

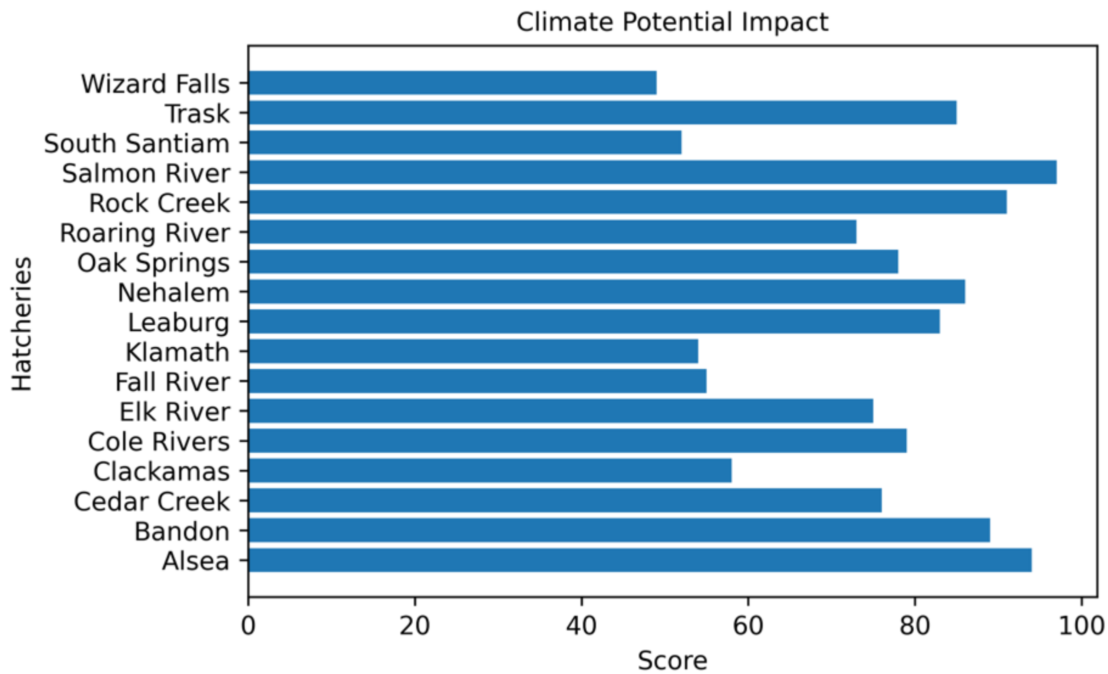

Figure 7-3: Climate hazard potential impact scores. Higher scores indicate greater potential impacts, high climate vulnerability, and lower climate resilience.

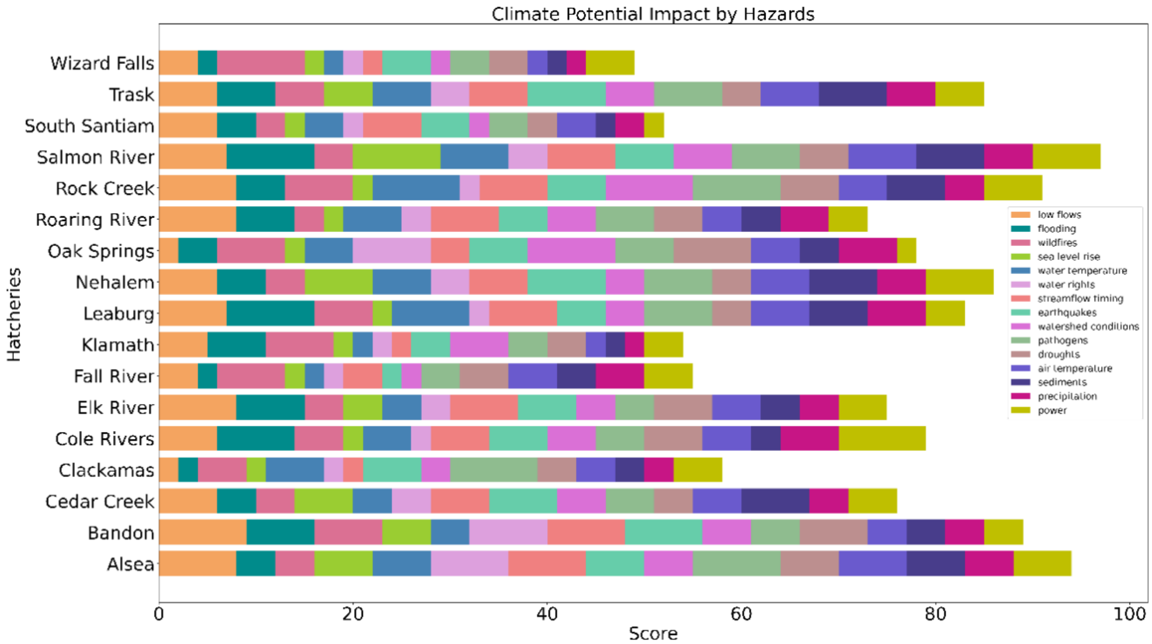

Figure 7-4. Total climate potential impact scores disaggregated by individual climate hazards. Higher scores indicate greater potential climate risk.

7.1.3. Stream Temperature

Observed stream temperature data were collected for all hatcheries through at least 2016, with subsequent years included as available. When available, more recent 2022-2023 stream temperature data were used. The future projected stream temperatures in Figure 7-5 are calculated by adding ODFW's VELMA-based projected change in temperature to the observations to estimate a late-century maximum stream temperature under a high emissions (RCP 8.5) emissions scenario. VELMA estimated changes in temperature are an average of the low and high-end General Circulation Model (GCM) members.

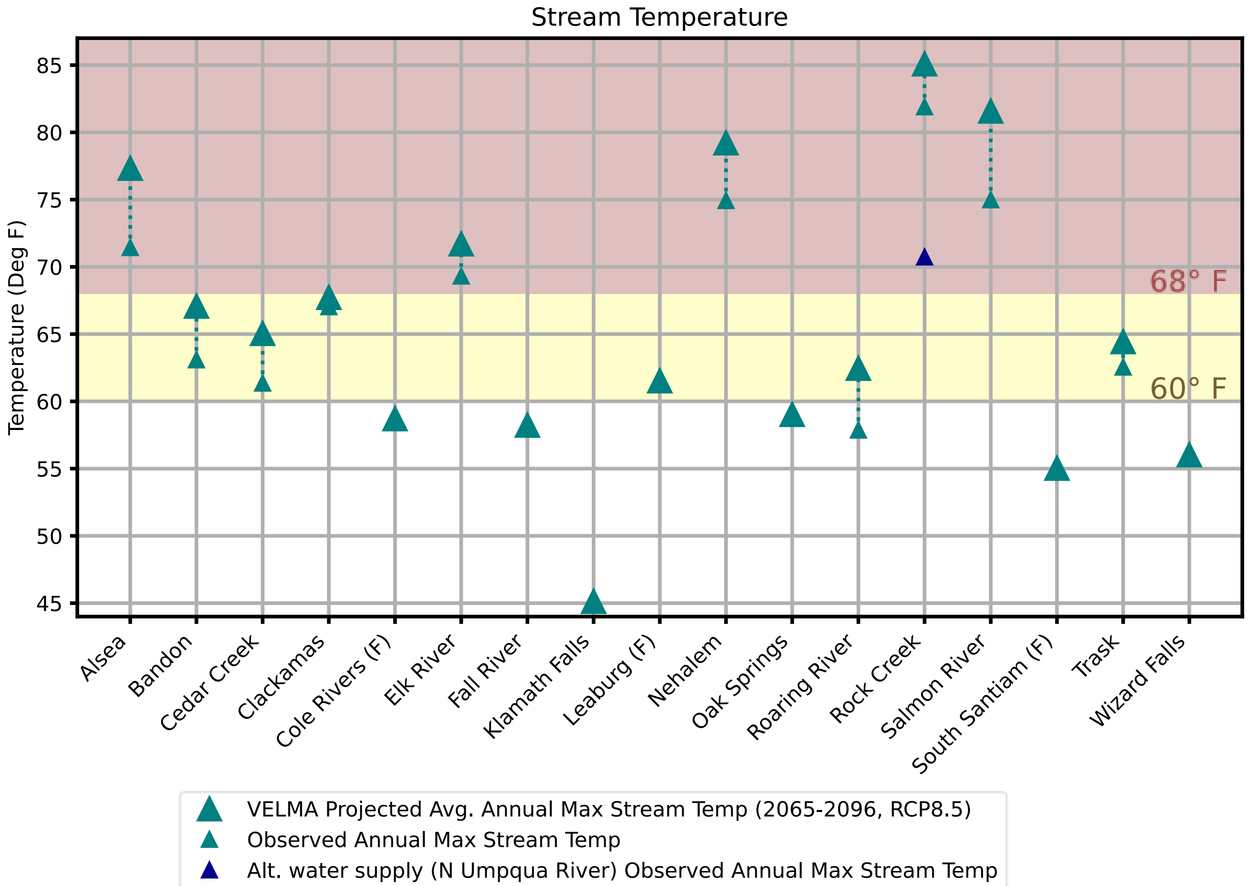

Figure 7-5: Observed (small triangle) and VELMA-projected maximum stream temperatures (large top triangle) for an end-of-century high emissions (RCP 8.5) scenario from ODFW internal modeling efforts. VELMA projections are an average of the low and high GCM end-members.

7.1.4. Water Use and Minimum Water Demand

The below figures show reported 2022-2023 water usage (grey line), as compared to the ODFW-calculated minimum water demand (blue line), based on Piper's Flow Index for historical water temperatures and fish density. Water shortages (grey shaded regions) are estimated as months when minimum water demands, for given fish densities and water temperatures, are greater than the reported water usage. Conversely, potential excess water (yellow shaded regions) are estimated as months when the reported water usage is greater than the minimum water demand. Mid-century climate projections for minimum water demand are ODFW calculated estimates using Piper's Flow Index with decreases in flows of 0-15% and increases in stream temperatures of 0-3C during the spring through fall months.

7.1.4.1. Alsea

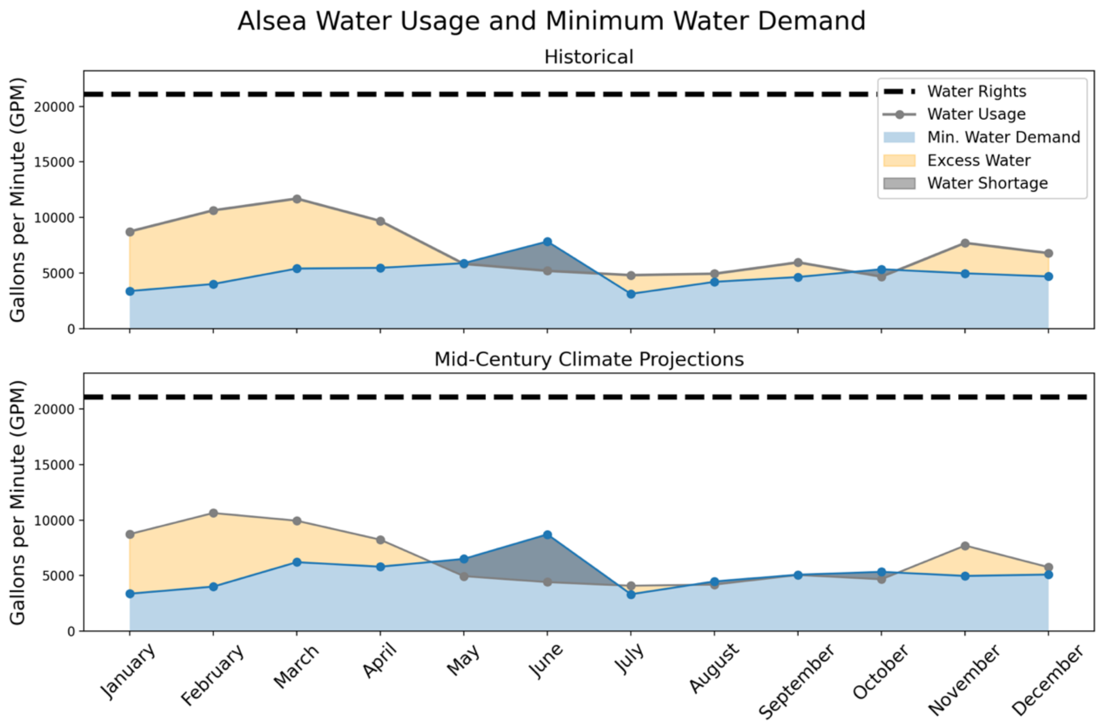

Figure 7-6: Alsea water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.2. Bandon

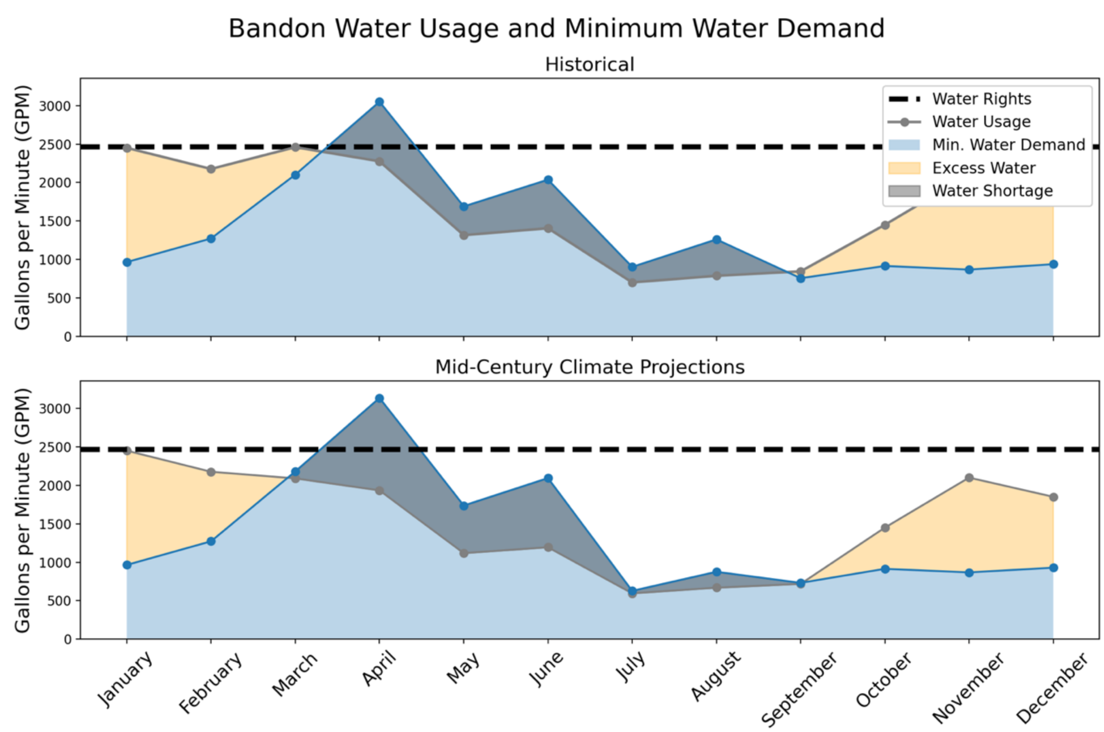

Figure 7-7: Bandon water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.3. Cedar Creek

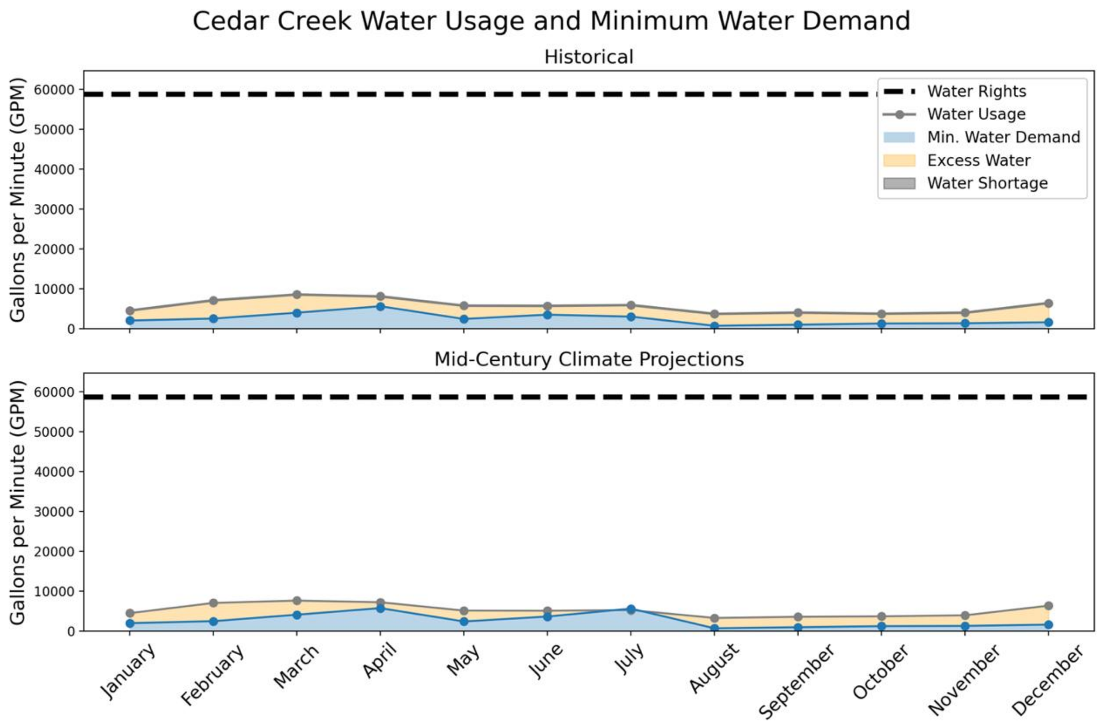

Figure 7-8: Cedar Creek water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.4. Clackamas

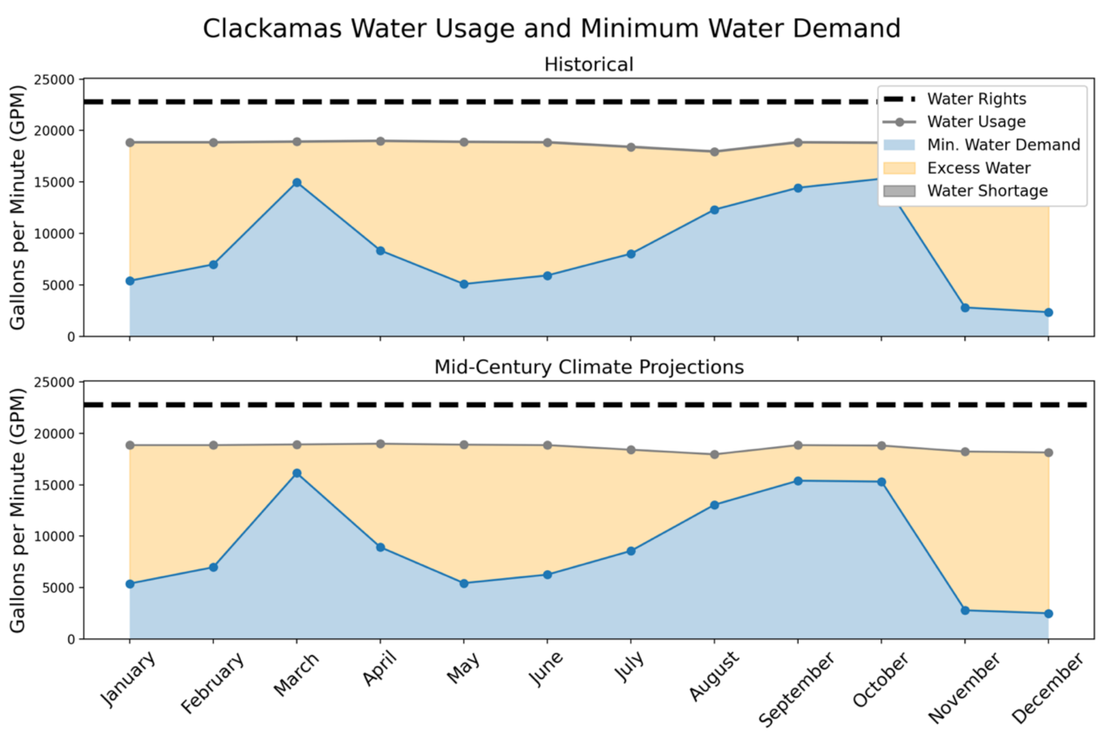

Figure 7-9: Clackamas water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.5. Cole Rivers

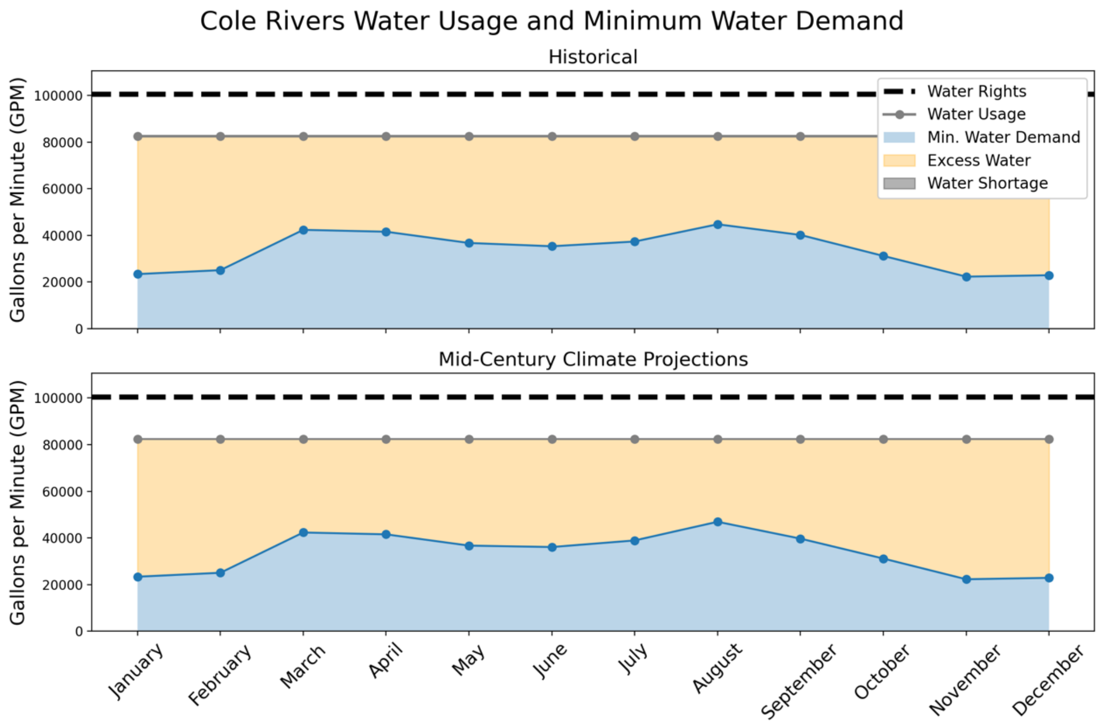

Figure 7-10: Cole Rivers water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.6. Elk River

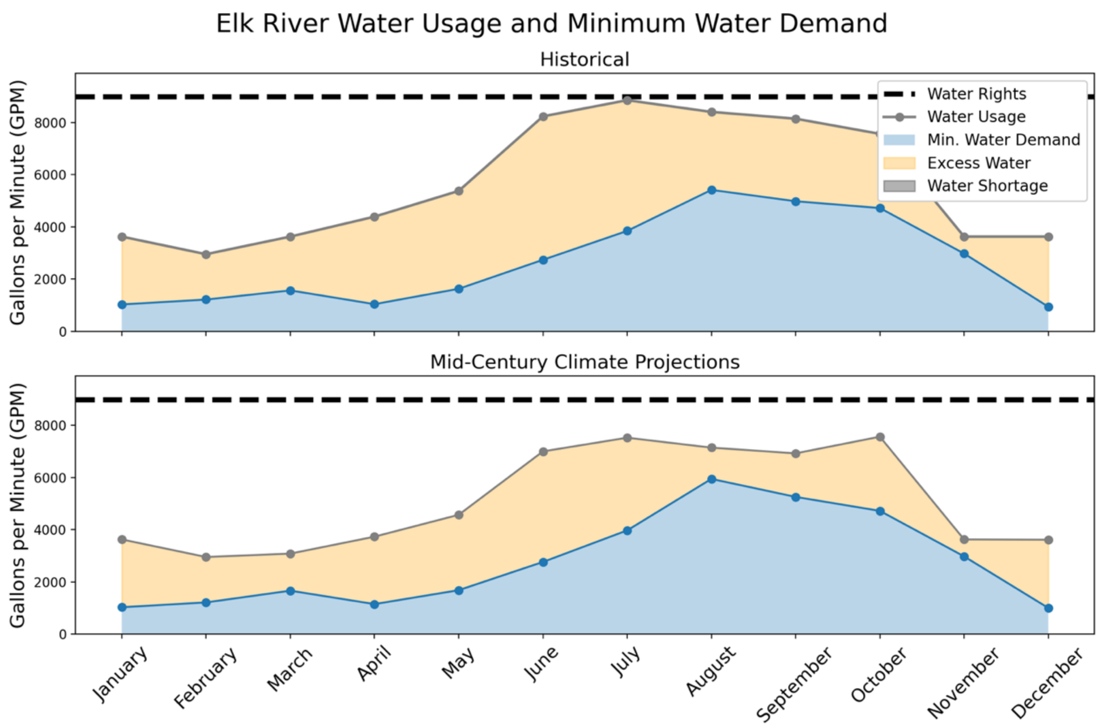

Figure 7-11: Elk River water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.7. Fall River

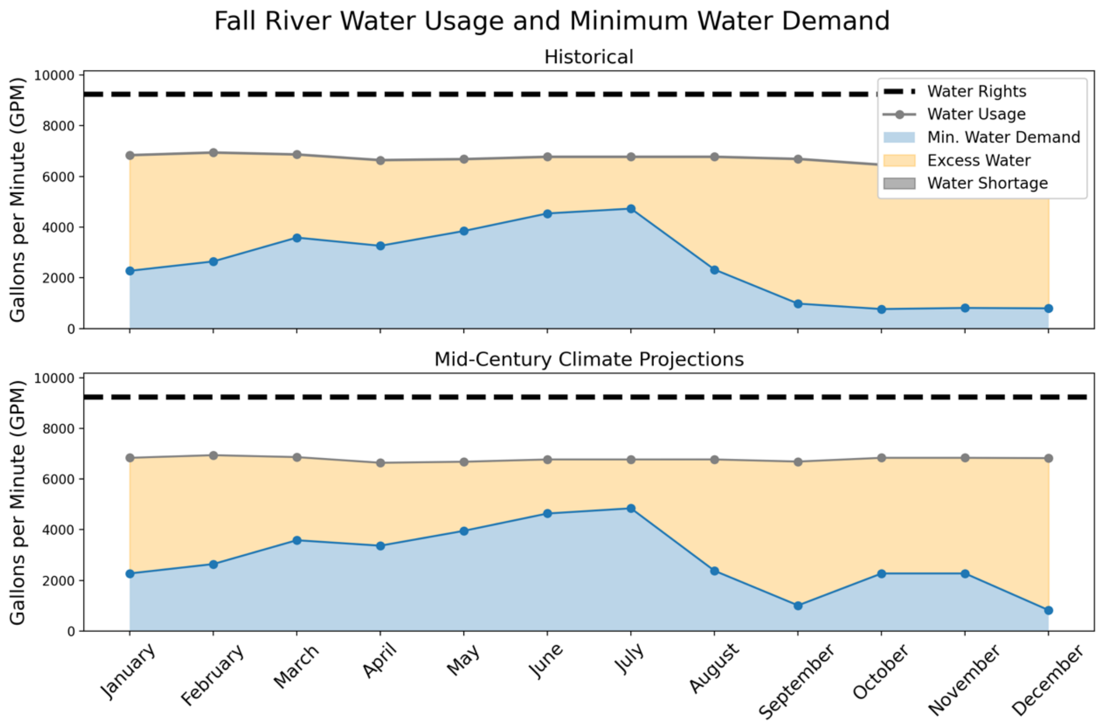

Figure 7-12: Fall River water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.8. Klamath Falls

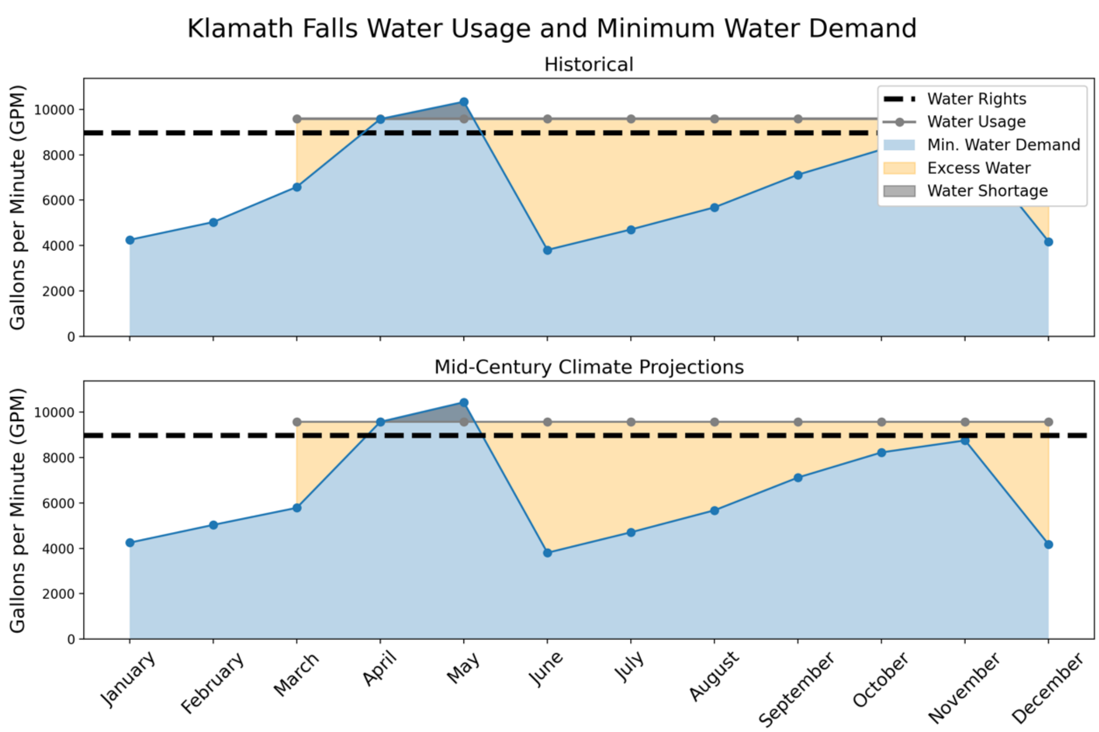

Figure 7-13: Klamath Falls water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.9. Leaburg

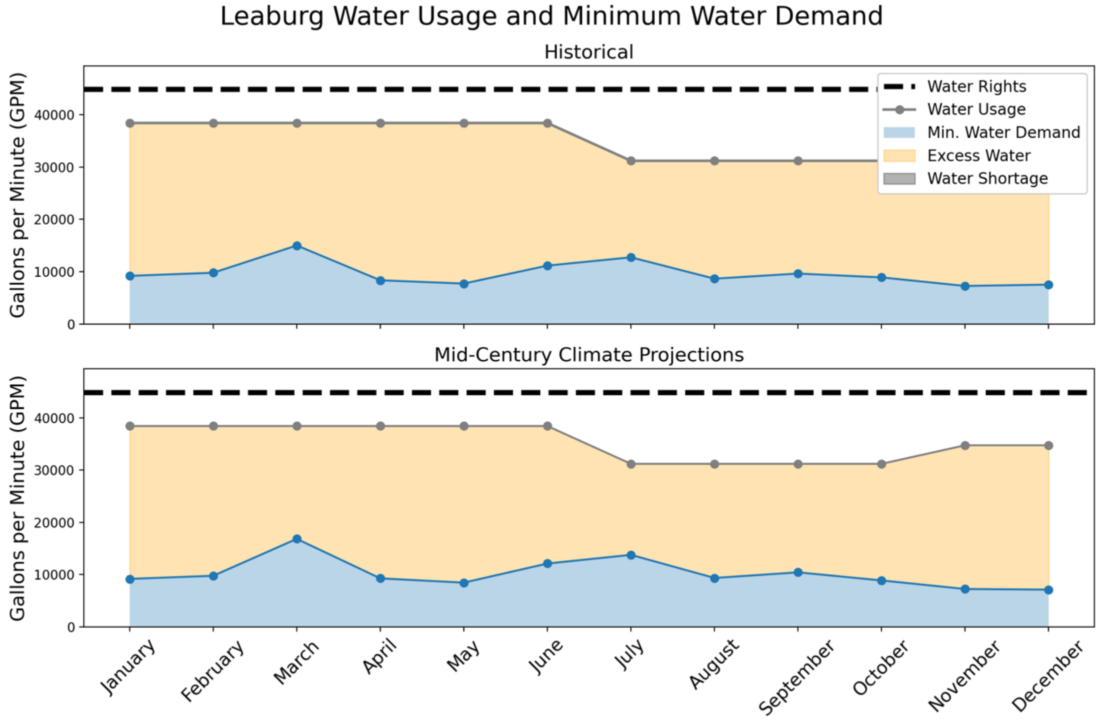

Figure 7-14: Leaburg water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.10. Nehalem

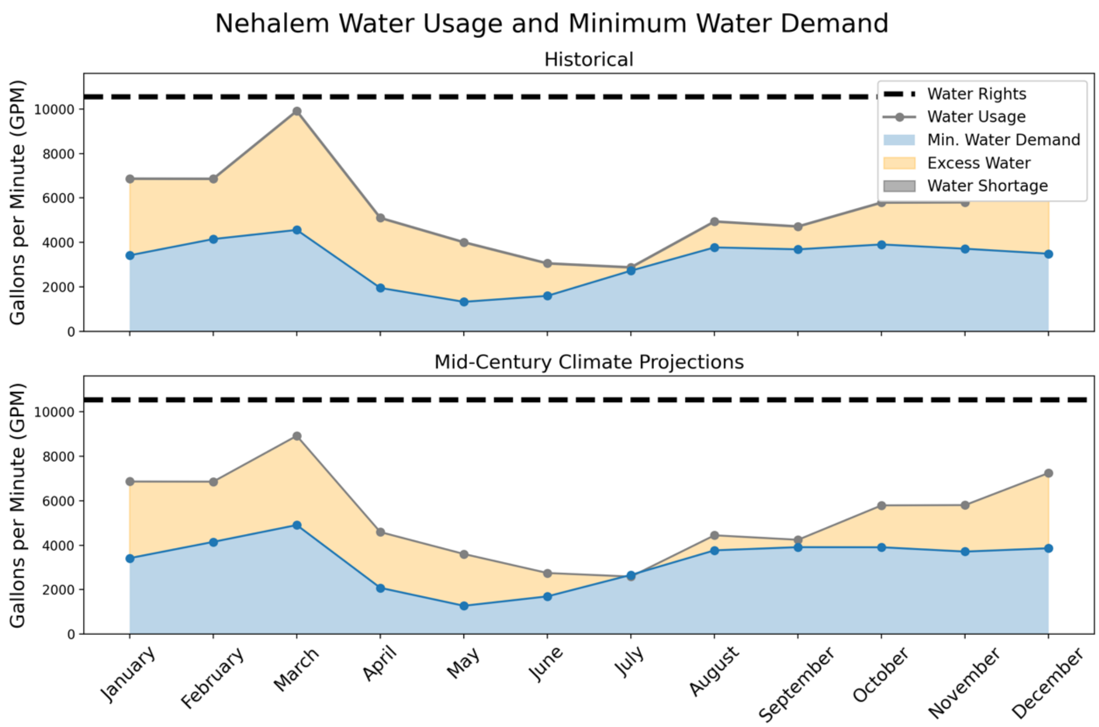

Figure 7-15: Nehalem water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.11. Oak Springs

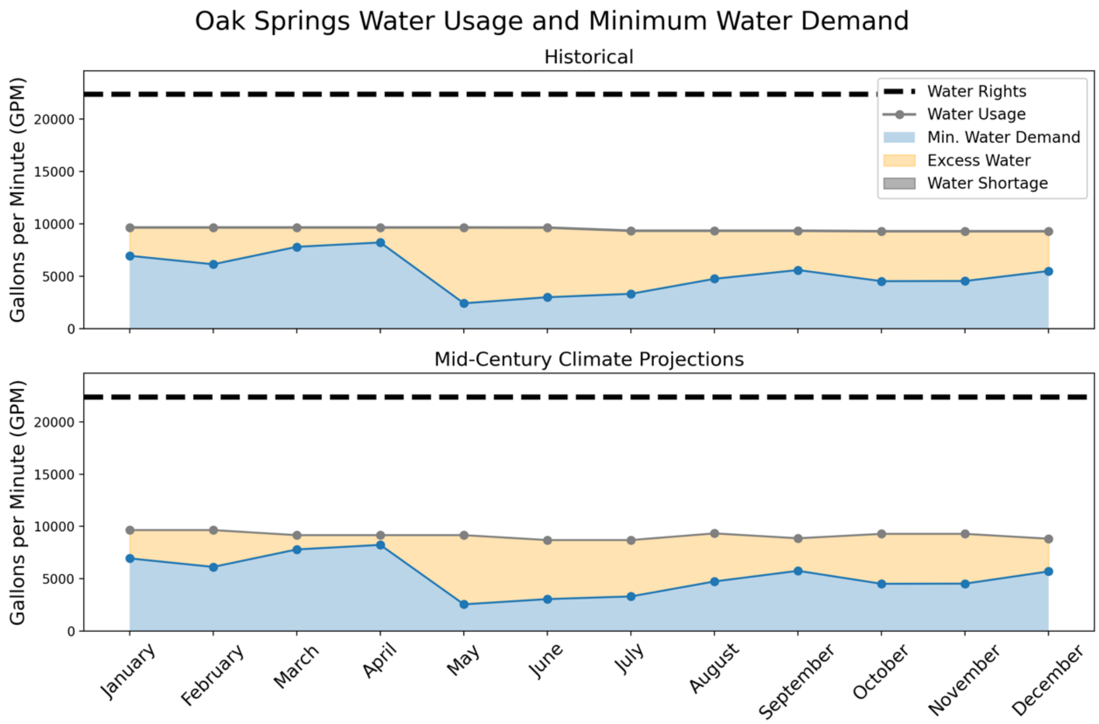

Figure 7-16: Oak Springs water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.12. Roaring River

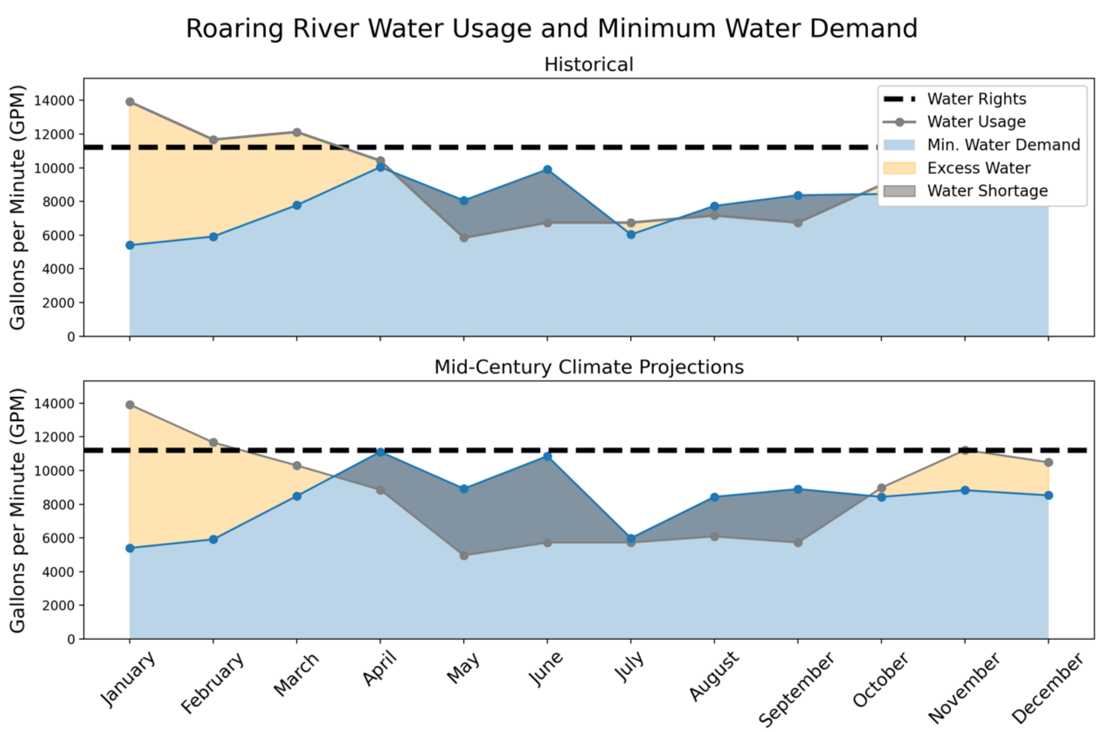

Figure 7-17: Roaring River water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.13. Rock Creek

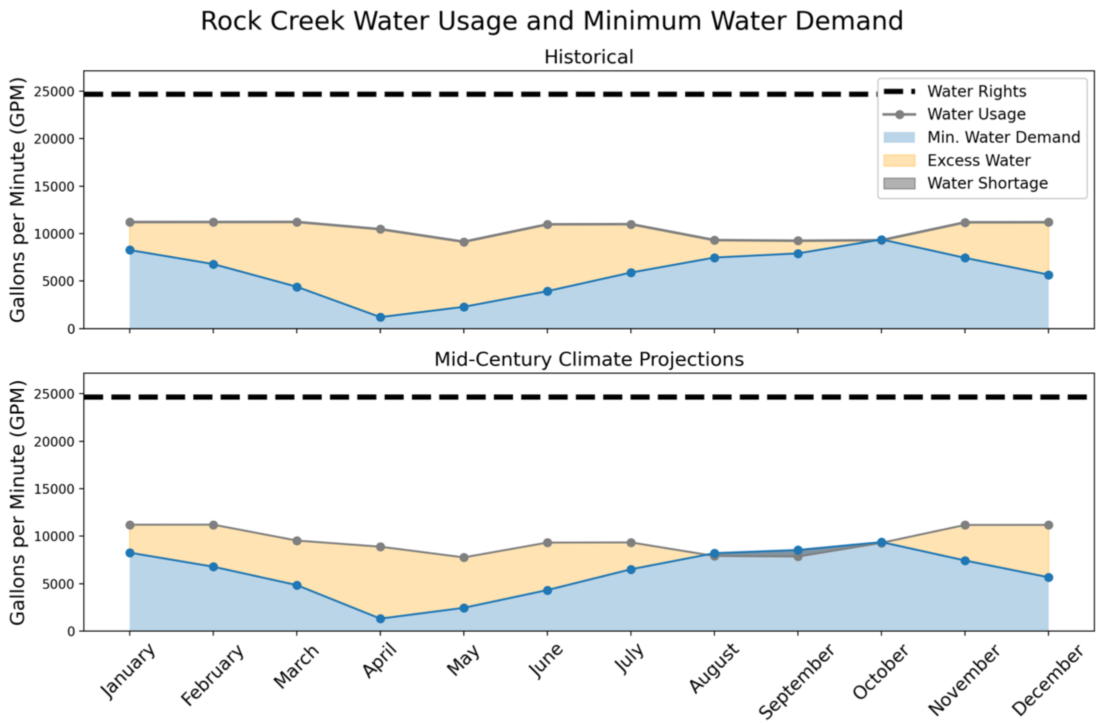

Figure 7-18: Rock Creek water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.14. Salmon River

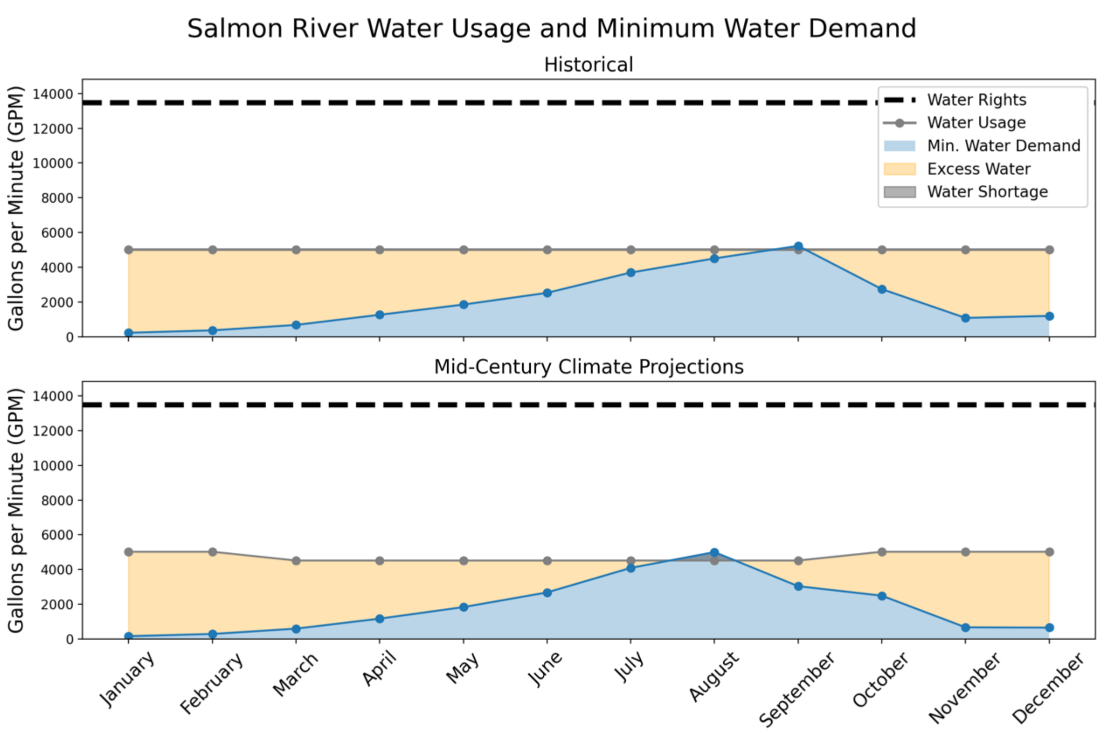

Figure 7-19: Salmon River water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.15. South Santiam

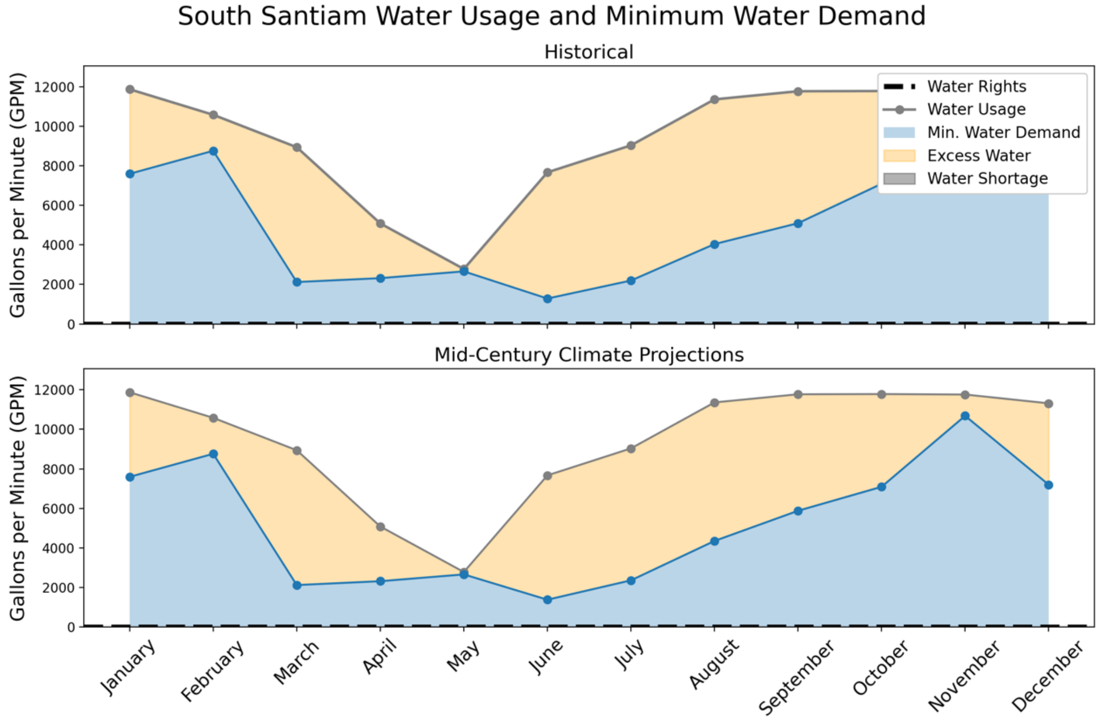

Figure 7-20: South Santiam water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.16. Trask

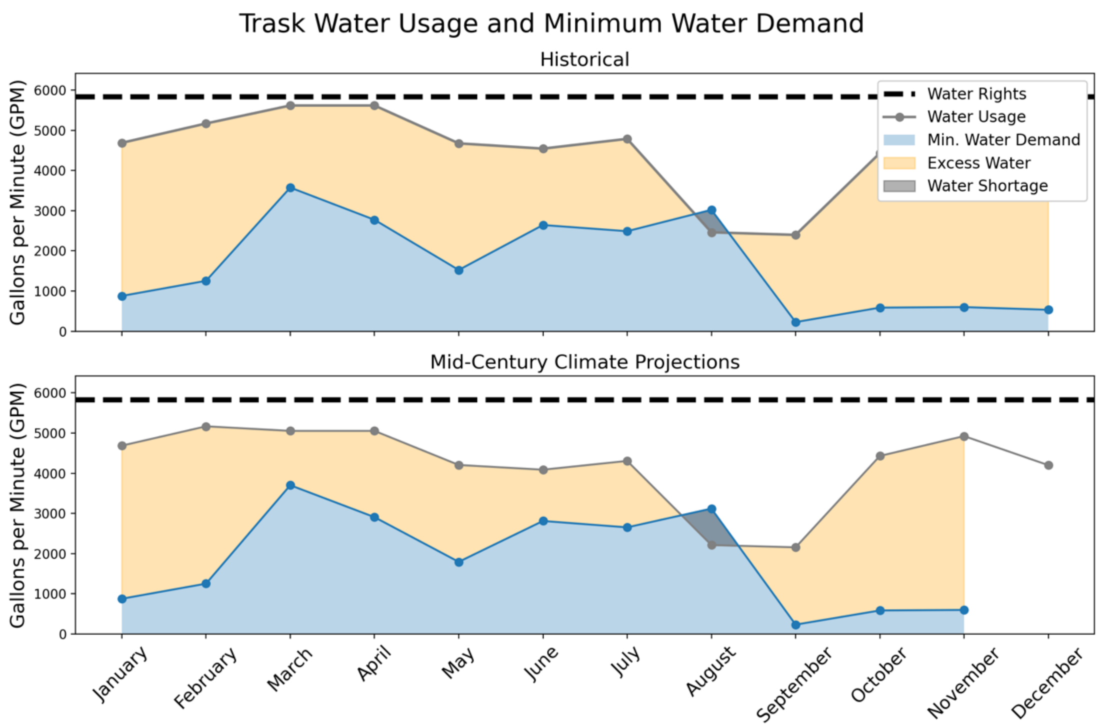

Figure 7-21: Trask water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.1.4.17. Wizard Falls

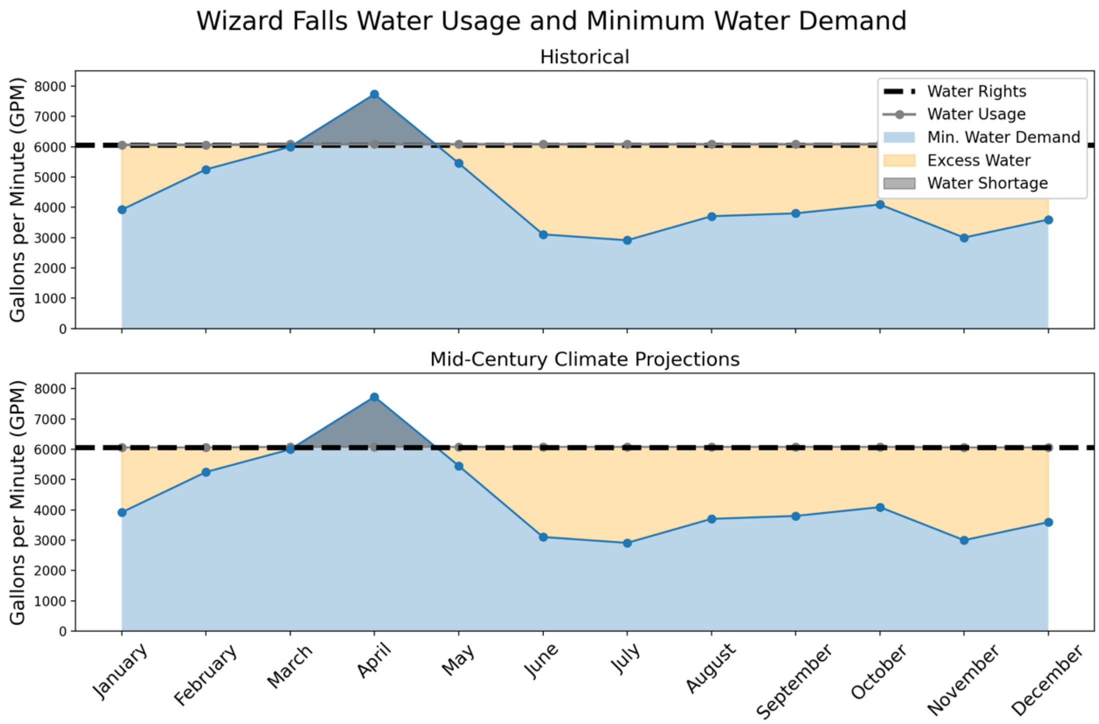

Figure 7-22: Wizard Falls water usage and minimum water demand for historical (top) and mid-century (bottom) periods.

7.2. Fish Production and Hatchery Importance/Connectivity

The full scoring criteria and categorical groupings are shown in Table 7-3. Figure 7-23 compares hatchery production and total annual biomass, where biomass indicates rearing activity at the time of sampling and differs from annual production due to fish movement between hatcheries and associated activities. Figure 7-24 lists the subcategories that make up the overall Social Vulnerability Index (SVI) score used within the hatchery connectivity and importance category. SVI is a derived from 16 U.S. Census variables included in the five-year American Community Survey. In this MCDA, a multiplier of 10 is used to standardize SVI to the existing scoring. Figure 7-25 shows the individual SVI for each hatchery in the original index range (0.0 - 1.0).

Table 7-3: Individual hatchery criteria scores for the Fish Production and Hatchery Importance/Connectivity category. Scores are normalized between hatcheries so that the minimum raw score is a 0 and the maximum raw score is a 10, where higher scores are more favorable.

Criteria Grouping	Units (positively oriented)	Individual Criteria	Alsea	Bandon	Cedar Creek	Clackamas	Cole Rivers	Elk River	Fall River	Klamath Falls	Leaburg	Nehalem	Oak Springs	Roaring River	Rock Creek	Salmon River	South Santiam	Trask	Wizard Falls
Fish Production	*min-max norm*	Avg Monthly Biomass - All Species	3.1	0.2	0.9	2.8	9.7	0.4	1.6	3.8	6.5	1.2	2.3	10.0	2.7	0.5	2.7	0.0	1.8
	min-max norm	Avg Monthly Biomass - Coho	0.0	0.0	0.0	10.0	1.2	0.0	0.0	0.0	0.0	3.2	0.0	0.0	1.2	1.5	0.0	0.4	0.0
	min-max norm	Avg Monthly Biomass - Chinook	0.0	0.4	2.2	3.8	8.6	2.5	1.0	3.6	10.0	0.1	0.0	0.0	3.9	0.7	9.9	1.2	0.0
	min-max norm	Avg Monthly Biomass - Summer Steelhead	0.0	0.0	3.0	2.6	10.0	0.0	0.0	0.0	4.7	0.0	0.0	6.5	4.9	1.0	8.3	0.0	3.8
	min-max norm	Avg Monthly Biomass - Winter Steelhead	3.2	2.9	2.2	3.1	10.0	0.8	0.0	0.0	0.0	2.5	0.7	1.0	3.8	0.0	0.0	1.3	0.0
	min-max norm	Avg Monthly Biomass - Resident Trout and Kokanee	3.2	0.2	0.3	0.0	5.2	0.3	2.1	3.8	4.4	0.8	2.9	10.0	0.9	0.6	0.0	0.0	2.0
Potential Excess Capacity	*min-max norm*	Hatchery Rearing Volume	2.2	0.1	1.7	3.4	10.0	0.7	0.7	0.9	5.0	0.5	3.3	1.5	2.5	1.4	0.8	0.0	2.1
	min-max norm	Potential Excess Water Capacity (annual)	0.4	0.0	0.6	2.0	10.0	0.6	0.8	0.2	5.2	0.4	0.8	0.2	0.9	0.5	0.8	0.5	0.3
	min-max norm	Potential Excess Water Capacity (6-month, May-Oct)	0.0	0.0	0.6	1.9	10.0	0.9	0.9	0.7	5.3	0.3	1.2	0.0	0.8	0.4	1.2	0.5	0.5
	min-max norm	Number of Months with Water Shortage	4.0	0.0	10.0	10.0	10.0	10.0	10.0	8.0	10.0	10.0	10.0	2.0	8.0	8.0	10.0	8.0	8.0
	min-max norm	Number of Months with Projected Water Shortage	2.9	0.0	8.6	10.0	10.0	10.0	10.0	8.6	10.0	8.6	10.0	1.4	5.7	8.6	10.0	8.6	8.6
	min-max norm, inverted	Density Index (Annual Avg)	8.3	8.3	9.8	9.3	9.1	9.5	7.5	4.6	8.5	7.7	9.6	0.0	8.9	10.0	6.0	8.9	9.2
	min-max norm, inverted	Density Index (Annual Max)	8.6	7.5	9.2	7.8	9.5	8.9	7.4	3.3	8.3	6.1	9.3	0.0	8.4	10.0	4.5	7.3	9.3
	binary min-max (0/10)	Are there undeveloped spaces OR facilities that can be repurposed?	10	10	10	0	10	10	10	0	10	10	0	10	10	10	10	10	10
Connectivity/Importance	*min-max norm*	Population Served (Visitors/year)	0.6	0.3	0.5	2.8	0.6	0.3	2.8	1.0	10.0	0.7	0.0	2.5	0.9	0.3	1.0	1.2	8.6
	*scaled (index * 10)*	Social Vulnerability Index (county)	4.0	5.6	5.1	3.6	5.2	5.6	3.0	6.1	5.3	5.1	7.4	5.6	5.3	6.1	5.6	5.1	6.3
	min-max norm	Connectivity - Exports to hatcheries (count)	1.4	1.4	1.4	5.7	1.4	0.0	0.0	5.7	0.0	2.9	8.6	10.0	0.0	0.0	10.0	4.3	8.6
	min-max norm	Connectivity - Exports to acclimation facilites (count)	0.9	10.0	0.9	2.7	9.1	2.7	0.0	0.0	0.0	0.0	0.9	0.0	0.0	0.0	0.9	0.9	0.0
	binary min-max (0/10)	Connectivity - Exports to STEP (yes/no)	10.0	10.0	10.0	10.0	10.0	10.0	10.0	0.0	0.0	10.0	10.0	10.0	10.0	0.0	10.0	10.0	10.0
	binary min-max (0/10)	Production for mitigation obligations	0.0	0.0	0.0	10.0	10.0	0.0	10.0	0.0	0.0	0.0	10.0	10.0	10.0	0.0	10.0	0.0	10.0
	binary min-max (0/10)	Production for obligations under Pacific Salmon Treaty	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.0	0.0	0.0	0.0
	binary min-max (0/10)	Production for obligations under US v Oregon Management Agreement	0.0	0.0	0.0	10.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0
	min-max norm	Biological Uniqueness - Number of Unique Adult Broodstock Programs	2.5	2.5	6.3	3.8	10.0	3.8	0.0	0.0	2.5	2.5	2.5	1.3	6.3	1.3	3.8	5.0	1.3

7.2.1. Fish Production and Monthly Average Biomass

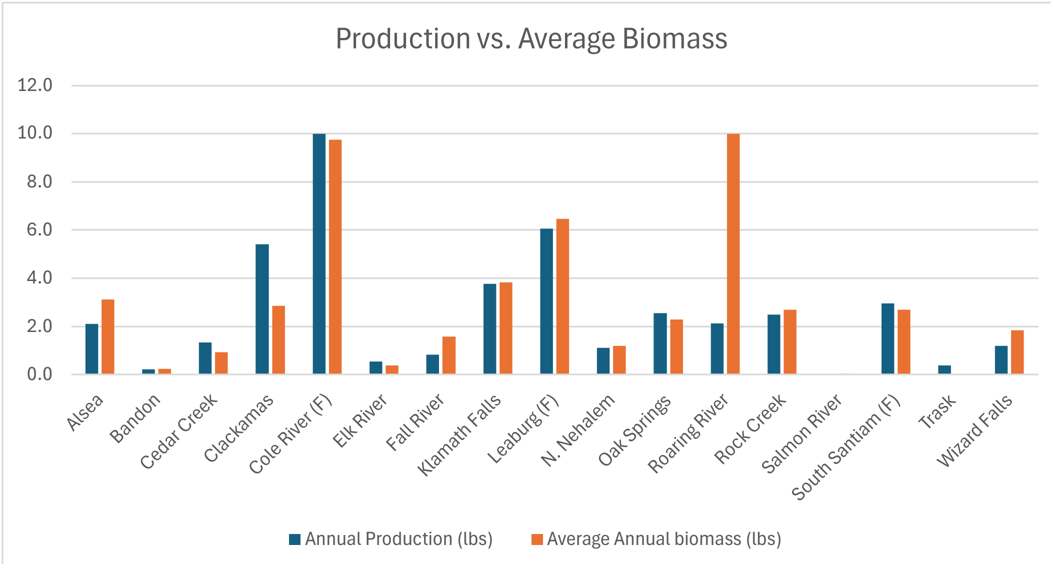

Figure 7-23: Estimates of annual hatchery production (blue), calculated as the sum of the negative change in monthly biomass, as compared to the average annual biomass (orange) for each of the 17 ODFW study hatcheries.

7.2.2. Hatchery Connectivity/Importance

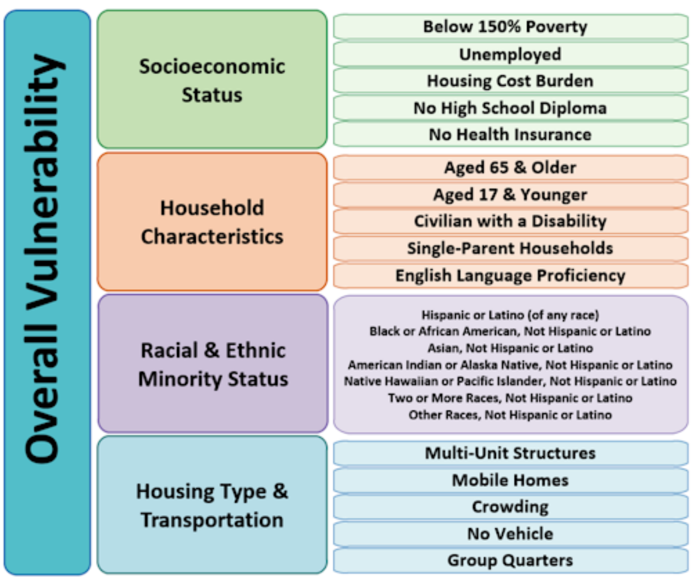

Figure 7-24: Social Vulnerability Index (SVI) indicators from the Center for Disease Control (CDC).

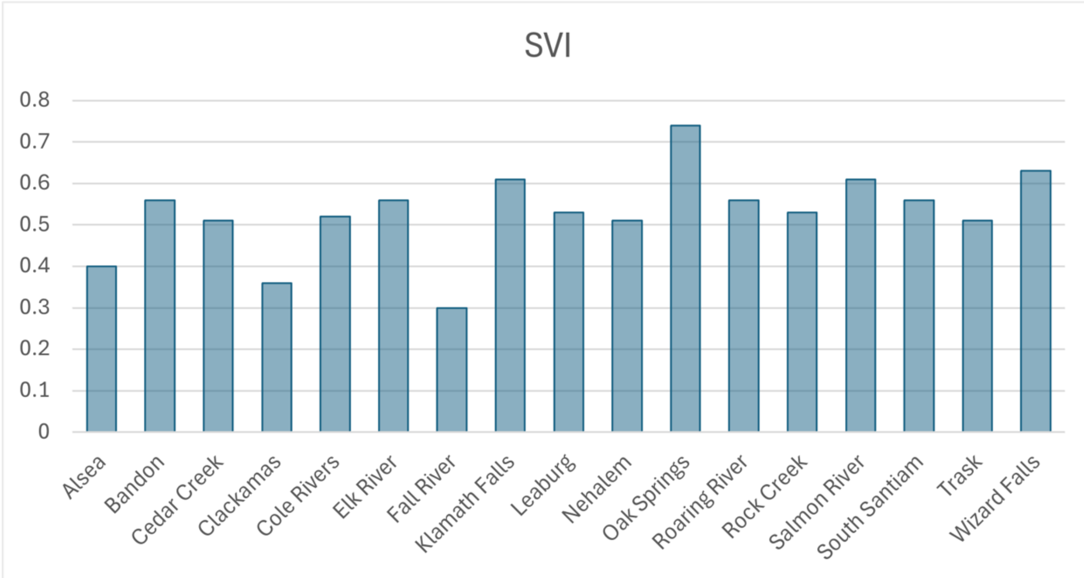

Figure 7-25: Social Vulnerability Index (SVI) for each hatchery as reported by the CDC for the county surrounding each hatchery.

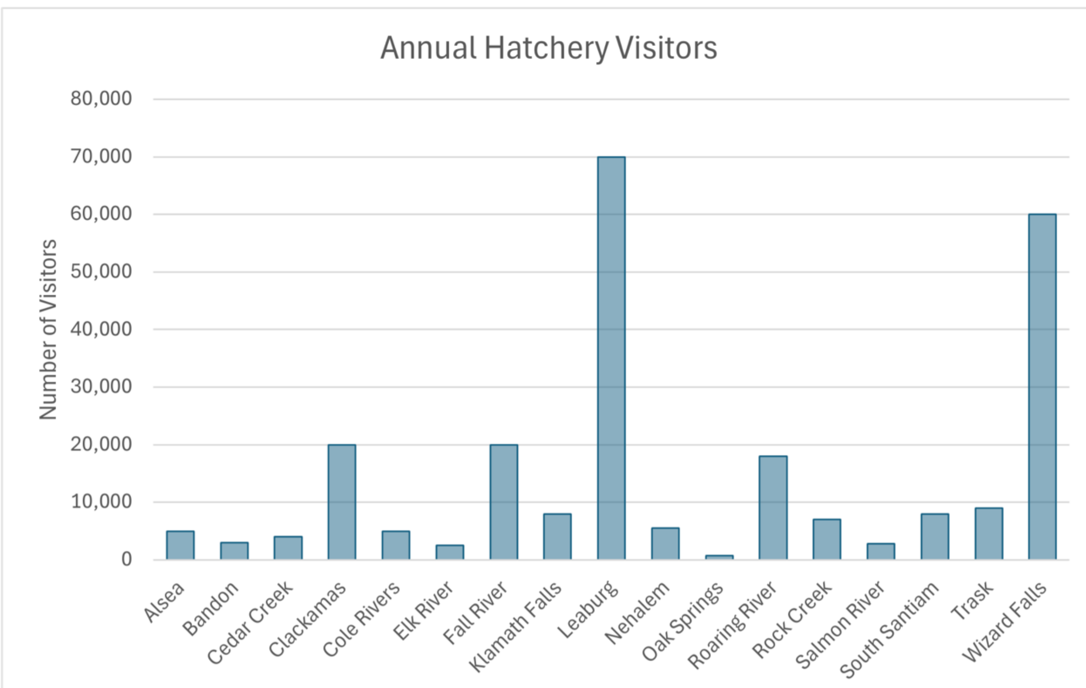

Figure 7-26: Annual number of hatchery visitors, as reported in ODFW's Hatchery Management Plans (HMPs).

7.3. Operations and Infrastructure Costs

The following section provides finer information on the compilation of the operations and infrastructure cost metric. It is important to note that operation costs are not included in the total infrastructure cost summation, as the annual operating costs are spent differently than capital costs (i.e., infrastructure estimates).

Operations and infrastructure costs are shared for some hatcheries between the State and Federal/other agencies; the cost share data were sourced from ODFW staff and supporting ODFW economic analyses.

Table 7-4. Operations and infrastructure cost share, percentage of responsibility between State and Federal/Other.

Hatchery	State/Federal Cost Share (%)			
	Operating Costs	Deferred Maintenance	New Infrastructure	Projected Modifications
Alsea	100/0	100/0	100/0	-
Bandon	100/0	100/0	100/0	-
Cedar Creek	100/0	100/0	100/0	-
Clackamas	79/21	86/14	100/0	-
Cole Rivers (F)	20/80	20/80	0/100	-
Elk River	100/0	100/0	100/0	-
Fall River	-	100/0	100/0	-
Klamath	25/75	100/0	100/0	-
Leaburg (F)	85/15	-	0/100	0/100
Nehalem	100/0	100/0	100/0	-
Oak Springs	25/75	-	100/0	100/0
Roaring River	25/75	-	100/0	-
Rock Creek	100/0	100/0	100/0	100/0
Salmon River	100/0	100/0	100/0	-
South Santiam (F)	15/85	-	0/100	0/100
Trask	100/0	100/0	100/0	-
Wizard Falls	25/75	100/0	100/0	-

7.3.1. Operating Costs

The annual operating costs for each state and federal hatchery are provided in Figure 7-27. The dark purple color shows the state portion of the annual operating costs, and the light pink color shows the federal or other (e.g., municipal) portion of the costs. Fall River's operating costs are zero, because they are included with Wizard Falls as it is operated as a satellite facility to Wizard Falls.

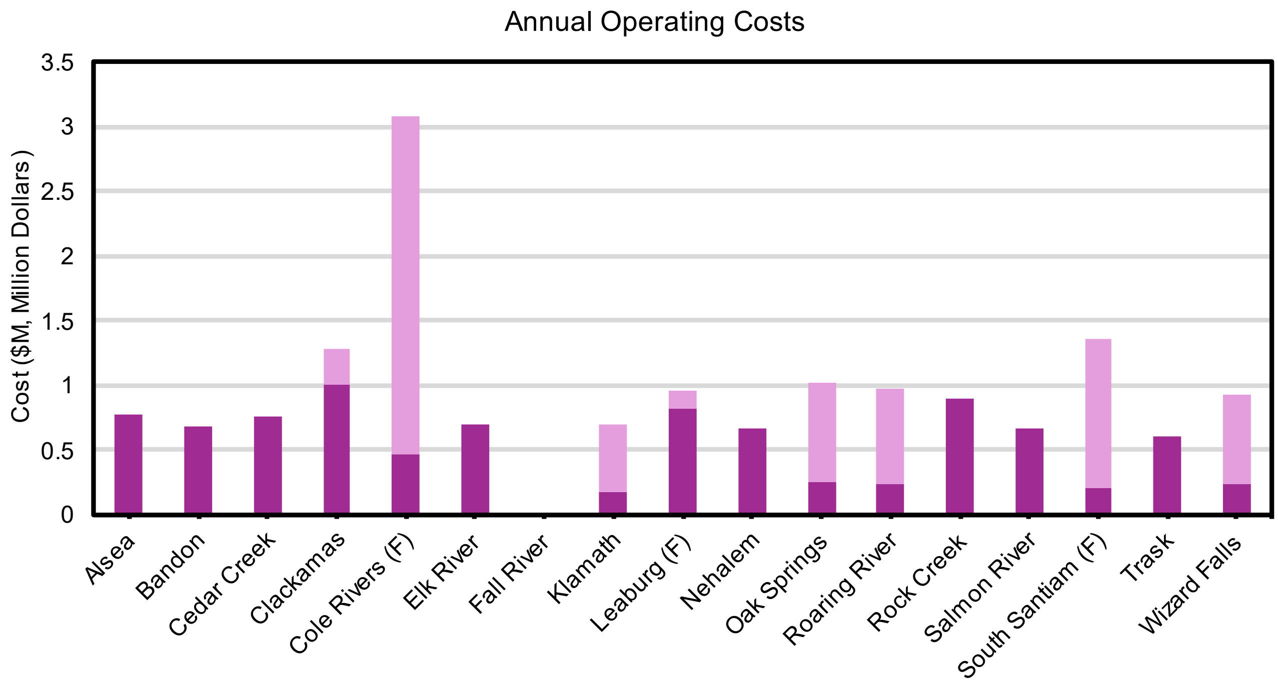

Figure 7-27. Annual operating costs across hatcheries, cost in millions of dollars.

7.3.2. Deferred Maintenance

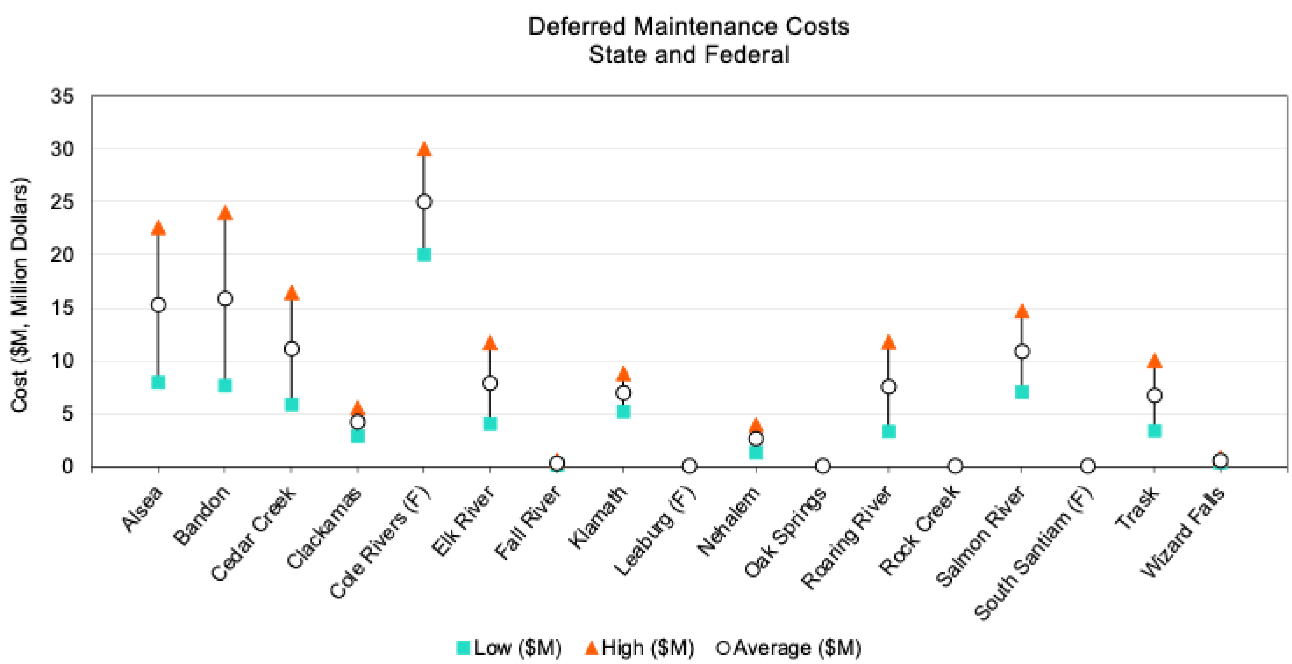

Figure 7-28. Deferred maintenance cost estimates across hatcheries, cost in million dollars.

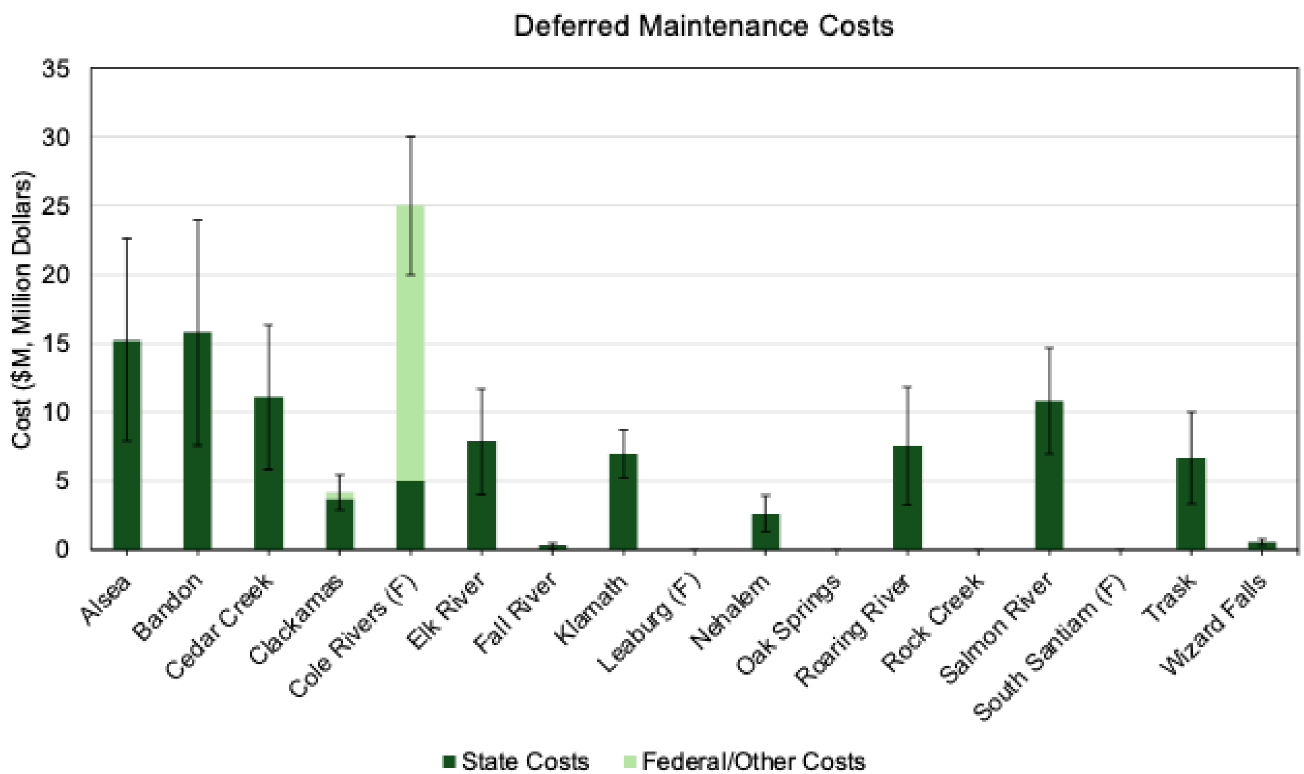

Figure 7-29. Deferred maintenance estimates delineated by state and federal funding across hatcheries, cost in million dollars.

7.3.3. New Infrastructure (Climate Resilience & Technology Upgrades)

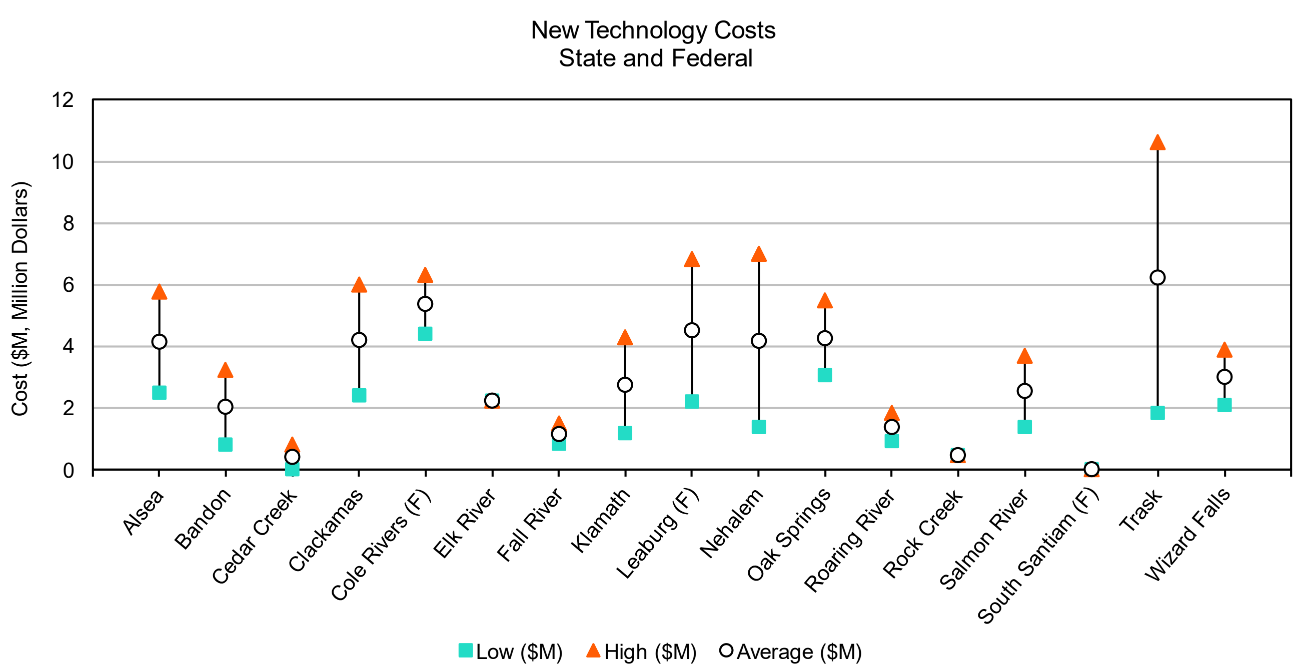

Figure 7-30. New technology / climate infrastructure cost estimates across hatcheries, cost in million dollars.

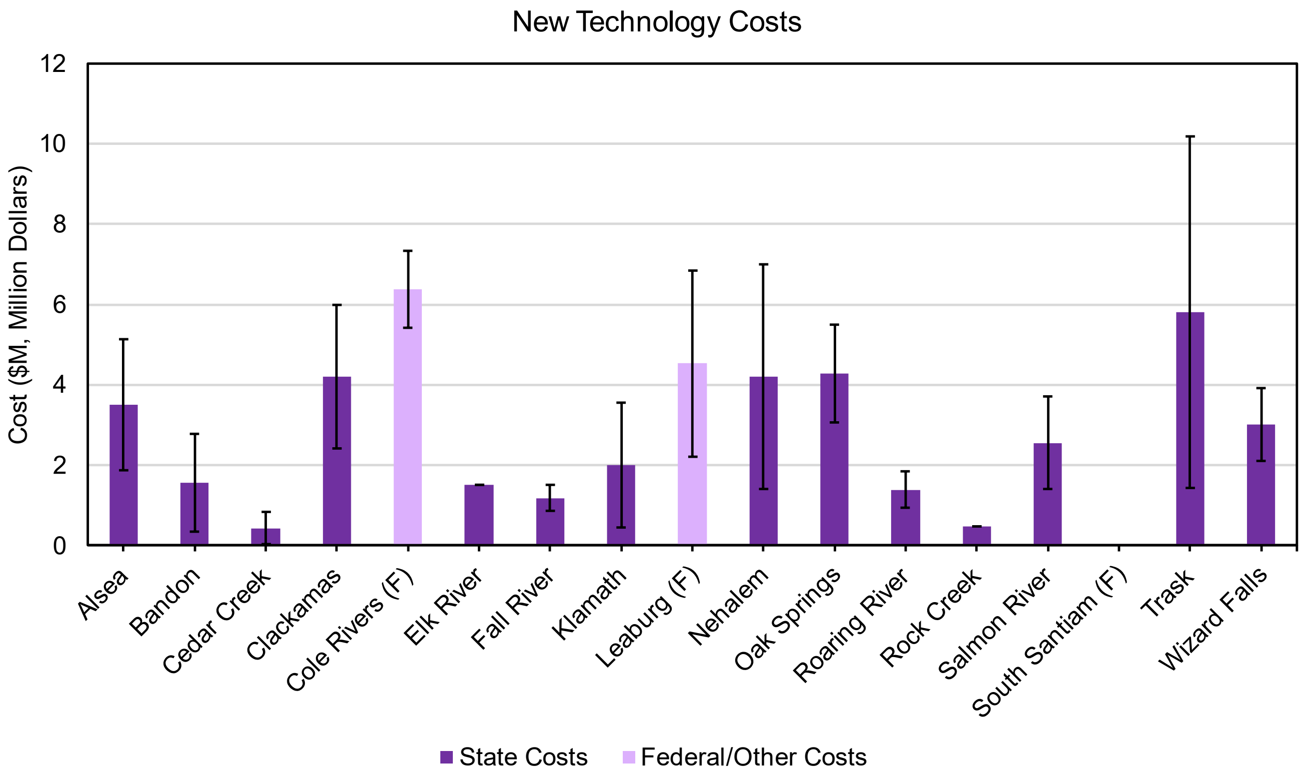

Figure 7-31. New technology / climate infrastructure estimates delineated by state and federal funding across hatcheries, cost in million dollars.

7.3.4. Projected Modification Costs

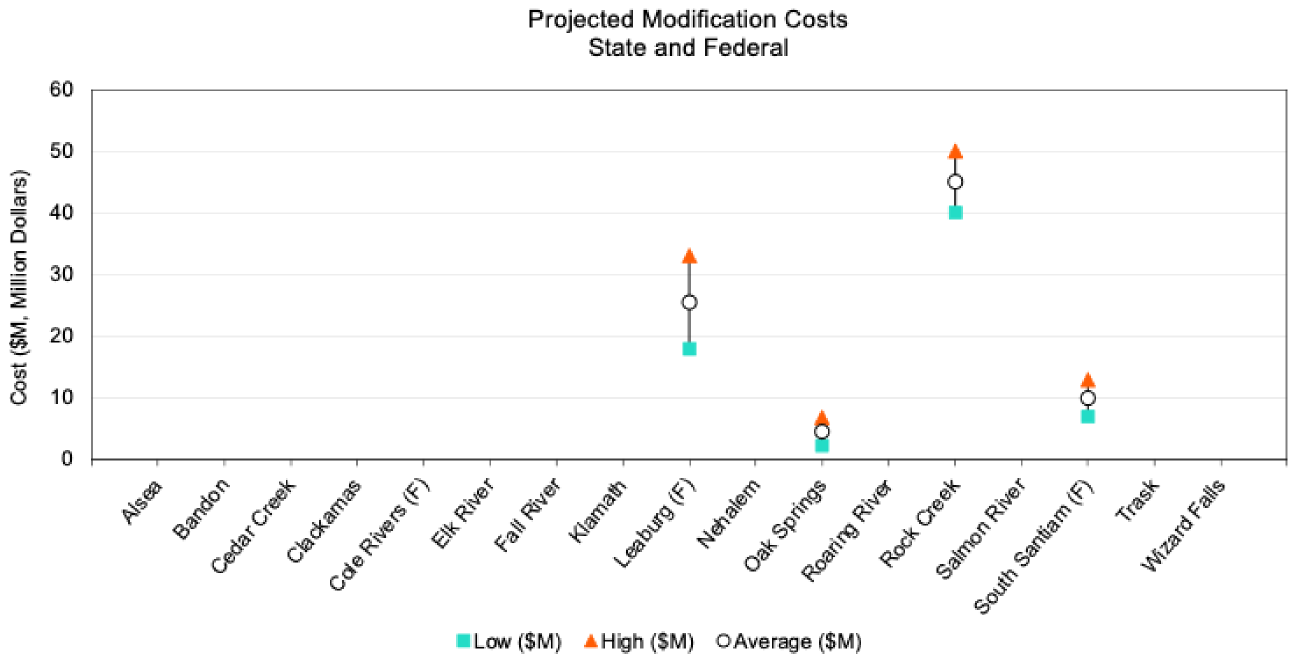

Figure 7-32. Projected modification costs for select hatcheries, cost in million dollars.

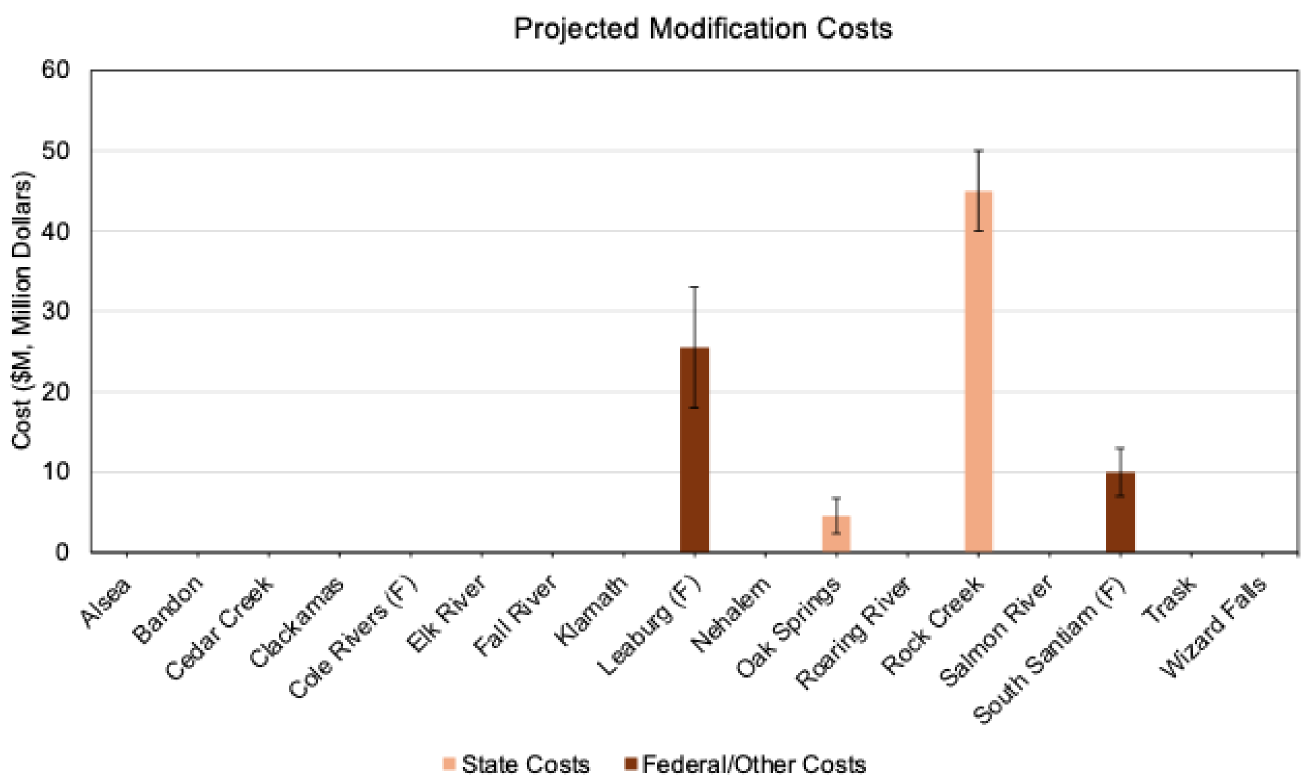

Figure 7-33. Projected modification costs for select hatcheries delineated by state and federal funding, cost in million dollars.

7.3.5. Itemized Costs

Infrastructure costs are estimates based on information from ODFW staff and previously completed reports on behalf of ODFW (as detailed in Section 2.3). The costs for similar infrastructure upgrades across hatcheries vary based on the hatchery's current operation and capacity, geographic location, and other environmental variables. Additionally, ancillary costs can vary based on the specifics of the hatchery upgrade–some upgrades would influence O&M and other operating costs.

7.3.5.1. Alsea

Table 7-5. Alsea itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Intake replacement	$1.8 to $5.5	RAS + Chillers*	$1.57 to $3.43	N/A	
Hatchery building improvements	$1 to $1.5	Full UV & ozone system*	$0.34		
Rearing pond alignment	$5 to $15.1	Shade cover	$0.03 to $0.83		
Abatement pond replacement	$0.1 to $0.5	Settling tank	$0.02		
		Fire suppression system	$0.03 to $0.06		
		Biodigesters*	$0.11		
		Solar power	$0.08 to $0.60		
		Hydropower	$0.35 to $0.40		
Total	**$7.9 to $22.6**	**Total**	**$2.51 to $5.78**	**Total**	**–**
		** includes both capital and O&M costs, low costs (RAS+Chillers) and high costs (Chillers only)*			

7.3.5.2. Bandon

Table 7-6. Bandon itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Intake replacement	$1.3 to $7.1	RAS + Chillers*	$0.46 to $1.53	N/A	
Intake area improvements	$0.2 to $0.4	Full UV & ozone system*	$0.24		
Hatchery building improvements	$1.0 to $2.0	Shade cover	$0.03 to $0.83		
Geiger creek dam relocation	$2.2 to $6.5	Fire suppression system	$0.03 to $0.06		
Ferry creek dam replacement	$2.1 to $6.4	Solar power	$0.08 to $0.60		
Reservoir improvement	$0.25 to $0.5				
Rearing pond repare/replace	$0.5 to $1.0				
Raceways reseal	$0.07				
Total	**$7.62 to $23.97**	**Total**	**$0.83 to $3.26**	**Total**	**–**
		** includes both capital and O&M costs*			

7.3.5.3. Cedar Creek

Table 7-7. Cedar Creek itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Hatchery building improvements	$1.0 to $2.0	Shade cover	$0.03 to $0.83	N/A	
Replace asphalt pond with raceways	$2.3 to $6.8				
Steelhead raceway replacement	$2.2 to $6.7				
Reline or reseal pond	$0.2 to $0.5				
Drum filter cover	$0.13 to $0.38				
Total	**$5.83 to $16.38**	**Total**	**$0.03 to $0.83**	**Total**	**–**

7.3.5.4. Clackamas

Table 7-8. Clackamas itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Pipeline and valve replacement	$0.4 to $0.5	Chillers only	$1.00	N/A	
Adult trap expansion	$2.5 to $5.0	Shade cover	$1.00 to $4.00		
		Solar power	$0.08 to $0.60		
		Hydropower	$0.35 to $0.40		
Total	**$2.9 to $5.5**	**Total**	**$2.43 to $6.00**	**Total**	**–**

7.3.5.5. Cole Rivers (F)

Table 7-9. Cole Rivers (F) itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Hatchery building rebuild	$20 to $30	RAS only*	$2.06	N/A	
		Full UV & ozone system*	$0.34		
		Shade cover	$0.03 to $0.83		
		Fire suppression system	$0.03 to $0.06		
		Biodigesters*	$0.11		
		Solar power	$0.08 to $0.60		
		Hydropower	$0.35 to $0.40		
		Additional raceways	$1.50 to $2.00		
		Reseal raceways	$0.87		
		Reline ponds	$0.07		
Total	**$20 to $30**	**Total**	**$5.43 to $7.33**	**Total**	**–**
		** includes both capital and O&M costs*			

7.3.5.6. Elk River

Table 7-10. Elk River itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Intake replacement	$2.4 to $7.1	Additional residence	$2.25	N/A	
Adult holding pond redesign	$0.1 to $0.2				
Main water delivery system replace	$1.3 to $3.9				
Supply line to raceways replace	$0.2 to $0.5				
Total	**$4.0 to $11.7**	**Total**	**$2.25**	**Total**	**–**

7.3.5.7. Fall River

Table 7-11. Fall River itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Build offline settling pond	$0.1 to $0.5	Additional raceways	$0.75 to $1.00	N/A	
		Abatement pond	$0.10 to $0.50		
Total	**$0.1 to $0.5**	**Total**	**$0.85 to $1.50**	**Total**	**–**

7.3.5.8. Klamath Falls

Table 7-12. Klamath Falls itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Hatchery building rebuild	$5.0 to $8.0	RAS only	$0.20 to $2.30	N/A	
Adult holding pond redesign	$0.1 to $0.5	Solar power	$0.25 to $0.50		
Cover open spring	$0.1 to $0.2	Intake improvements	$0.25 to $0.50		
Snail removal	$0.01 to $0.03	Additional raceways	$0.50 to $1.00		
Total	**$5.21 to $8.73**	**Total**	**$1.20 to $4.30**	**Total**	**–**

7.3.5.9. Leaburg

Table 7-13. Leaburg itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
N/A		RAS + Chillers*	$1.55 to $4.82	Intake, pipeline	$8 to $15
		Shade cover	$0.02 to $0.83	Adult ladder, trap, holding	$10 to $18
		Settling tank	$0.06		
		Fire suppression system	$0.03 to $0.06		
		Biodigesters*	$0.11		
		Hydropower	$0.35 to $0.4		
		Solar	$0.075 to $0.6		
Total	–	**Total**	**$2.21 to $6.85**	**Total**	**$18 to $33**
		* includes both capital and O&M averaged costs, for low costs (RAS+Chillers) and high costs (Chillers)			

7.3.5.10. Nehalem

Table 7-14. Nehalem itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Intake replacement	$1.3 to $3.9	Shade cover	$0.5 to $2	N/A	
Al abatement / HH well	$0.01 to $0.03	Pond redesign and replacement	$0.9 to $5		
Total	**$1.31 to $3.93**	**Total**	**$1.4 to $7**	**Total**	–

7.3.5.11. Oak Springs

Table 7-15. Oak Springs itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
N/A		RAS only*	$1.50	Holding ponds and rearing raceways	$2.3 to $6.8
		Full UV & Ozone system*	$0.34		
		Shade cover	$0.02 to $0.83		
		Fire suppression system	$0.03 to $0.06		
		Biodigesters*	$0.11		
		Hydropower	$0.30		
		Full UV & Ozone system*	$0.34		
		Additional water rights	$0.19		
		Troughs	$0.005 to $0.05		
		Snail mitigation	$0.01 to $0.03		
		Additional raceways	$0.5 to $1		
		Spawning building	$0.05 to $0.5		
Total	–	**Total**	**$3.08 to $5.49**	**Total**	**$2.3 to $6.8**
		* includes both capital and O&M averaged costs			

7.3.5.12. Roaring River

Table 7-16. Roaring River itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Intake, ladder, recirculation	$2.3 to $6.8	Full UV & Ozone system*	$0.34	N/A	
Brood ponds	$0.5 to $2.5	Solar	$0.1 to $0.5		
Steelhead ponds	$0.5 to $2.5	Serial reuse treatment	$0.5 to $1		
Total	**$3.3 to $11.8**	**Total**	**$0.94 to $1.84**	**Total**	–
		* includes both capital and O&M averaged costs			

7.3.5.13. Rock Creek

Table 7-17. Rock Creek itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
N/A		Biodigesters	$0.08	Rebuild	$40 to $50
		Hydropower	$0.40		
Total		**Total**	**$0.48**	**Total**	**$40 to $50**

7.3.5.14. Salmon River

Table 7-18. Salmon River itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Intake	$5.5 to $11	Extend pond walls	$0.9 to $2.7	N/A	
Repave facility	$0.5 to 0.75	Raise height of electrical room	$0.5 to $1		
Supply line to raceways	$1 to $2.90				
Total	**$7 to $14.65**	**Total**	**$1.4 to $3.7**	**Total**	–

7.3.5.15. South Santiam (F)

Table 7-19. South Santiam (F) itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
N/A		Shade cover	$0.02	Expanded early rearing	$5 to $8
				Modifications to adult holding containers	$2 to $5
Total		**Total**	**$0.02**	**Total**	**$7 to $13**

7.3.5.16. Trask

Table 7-20. Trask itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
New intake	$1.1 to $3.2	RAS + Chillers*	$1.61 to $10.13	N/A	
Hatchery building	$0.35 to $1	Solar	$0.25 to $0.5		
Shop building	$0.35 to $1				
Replace upper adult HP*	$0.5 to $1.5				
Expand lower adult HP*	$0.28 to $0.83				
Abatement pond	$0.8 to $2.5				
Total	**$3.38 to $10.03**	**Total**	**$1.86 to $10.63**	**Total**	–
** HP = Holding pond*		** includes both capital and O&M averaged costs, for low costs (RAS+Chillers) and high costs (Chillers)*			

7.3.5.17. Wizard Falls

Table 7-21. Wizard Falls itemized infrastructure cost summary for each category: deferred maintenance (DM), new technology, and projected modifications (PM).

DM Category	Cost ($M)	New Tech Category	Cost ($M)	PM Category	Cost ($M)
Additional feed	$0.1 to $0.25	Shade cover	$0.025 to $0.83	N/A	
		Settling tank	$0.08		
Additional storage	$0.25 to $0.50	New bridge	$1		
		Upgrade information/visitor center	$1 to $2		
Total	**$0.35 to $0.75**	**Total**	**$2.11 to $3.91**	**Total**	–

7.4. Economic Impact Analysis

The methodology for the economic analysis conducted by TRG, can be found in the full report, which is available online via the ODFW website: https://www.dfw.state.or.us/fish/hatchery/resilience.asp.

7.5. Alternative Operational Scenarios

Table 7-22: Changes in fish production for the alternative 2 operational models

Hatchery	Alternative 2a	Alternative 2b	Alternative 2c
Alsea	No changes	Absorb 70% of trout to Nehalem	Shift. STEP collection/ acclimation facility.
Bandon	Absorb the following from Cole Rivers: 125k Winter Steelhead Coos River Stock 37H, 25k Winter Steelhead Tenmile Lakes Stock 18H, Fall Chinook Coos River Stock 37H, and Fall Chinook Coquille River Stock 44H	Absorb the following from Cole Rivers: 125k Winter Steelhead Coos River Stock 37H, 25k Winter Steelhead Tenmile Lakes Stock 18H, Fall Chinook Coos River Stock 37H, and Fall Chinook Coquille River Stock 44H	Absorb the following from Cole Rivers: 125k Winter Steelhead Coos River Stock 37H, 25k Winter Steelhead Tenmile Lakes Stock 18H, Fall Chinook Coos River Stock 37H, and Fall Chinook Coquille River Stock 44H
Cedar Creek	Absorb 100k Winter Steelhead from Nehalem	Absorb 200k Fall Chinook from Salmon River	Absorb 50K Winter Steelhead from Alsea
Clackamas	Absorb Coho from Salmon River	Absorb Coho from Salmon River	Absorb Coho from Salmon River
Cole Rivers (F)	Cover 60k Coho and 150k Winter Steelhead fry from Rock Creek for rearing, 342k Spring Chinook adults from Rock Creek for spawning and rearing	Cover 60k Coho and 150k Winter Steelhead fry from Rock Creek for rearing, 342k Spring Chinook adults from Rock Creek for spawning and rearing	Cover 60k Coho and 150k Winter Steelhead fry from Rock Creek for rearing, 342k Spring Chinook adults from Rock Creek for spawning and rearing
Elk River	Absorb 70k Fall Chinook from Rock Creek	Absorb 70k Fall Chinook from Rock Creek	Absorb 70k Fall Chinook from Rock Creek
Fall River	Absorb 1/3 of Nehalem trout	Cover shifted Roaring River trout production	Absorb 10% of Alsea trout production
Klamath Falls	Absorb 68k trout from Rock Creek (currently there)	Absorb 68k trout from Rock Creek (currently there)	Absorb 68k trout from Rock Creek (currently there)
Leaburg (F)	No changes	No changes	No changes
Nehalem	Shift	Absorb 70% of Alsea trout	Absorb 70% of Alsea trout
Oak Springs	Absorb 2/3 of Nehalem trout	Cover Salmon River trout production	Cover 20% of Alsea trout production
Roaring River	No changes	Absorb 50k Summer Steelhead Siletz production from Salmon River. Move trout to Fall River	No changes
Rock Creek	Decommissioned	Decommissioned	Decommissioned
Salmon River	Absorb 200k Coho from Nehalem; move Coho to Clackamas	Shift	Move coho production to Clackamas, absorb 140k Alsea steelhead production.
South Santiam (F)	No changes	No changes	No changes
Trask	Absorb 25k Fall Chinook (Necanicum) from Nehalem	No changes	No changes
Wizard Falls	No changes	No changes	No changes

The potential increased fish rearing capacity based on new or upgraded rearing units for the alternative scenarios is shown in Table 7-23 to Table 7-25. The potential increased rearing capacity (in pounds) is a function of the density index, and an increased rearing volume calculated based on the volume added by installing new raceways, containers or circular rearing units. The density index used in these calculations was obtained by dividing the total pounds of fish currently produced at each hatchery (2022-2023 production numbers) by the total current rearing volume. We assumed that the rearing volumes for newly built raceways at a specific hatchery are the same as the volume of existing raceways at the facility. These raceway volumes were obtained from ODFW's Hatchery Management Plans (HMPs).

A comparison between the potential increased rearing capacity and the changes in production for the alternatives 2a-2c from the alternative 1 (status quo) is also presented in Table 7-23 to Table 7-25. In general, the changes in production for the alternatives 2a-2c from alternative 1 align well with the potential increased rearing capacity based on new rearing units. There are some cases where the changes in production for the alternatives are higher than the potential increased rearing capacity. In those cases, we examined the annual average density index for that specific hatchery, which was calculated as outlined in Section 2.2.2, and determined if there is capacity based on current rearing volumes to absorb this additional production.

Table 7-23: Potential increased capacity for Alternative 2a based on upgrades to rearing units and changes in fish reared from Alternative 1

Hatchery	Alternative 2a		
	Potential Increased Capacity Based on New or Upgraded Rearing Units (lbs)	Changes in Fish Reared from Alt 1 (lbs)	Notes
Alsea	0	0	-
Bandon	51,233	48,790	-
Cedar Creek	15,000	21,699	Small difference in production. Average density index = 0.2 so there is capacity based on current rearing volumes. 4 raceways will be returned to serial use.
Clackamas	0	11,492	Coho moved here from Salmon River. Average density index = 0.2 so there is capacity based on current rearing volumes
Cole Rivers (F)	0	619	-
Elk River	10,664	7,000	-
Fall River	11,666	10,399	-
Klamath Falls	0	0	-
Leaburg (F)	0	0	-
Nehalem	0	-72,447	Shift
Oak Springs	20,800	20,800	-
Roaring River	0	0	-
Rock Creek	0	-56,408	Decommissioned
Salmon River	0	6,389	Small increase in production. Average density index = 0.1 so there is capacity based on current rearing volumes
South Santiam (F)	0	0	-
Trask	0	1,667	Small increase in production. Average density index = 0.3 so there is capacity based on current rearing volumes
Wizard Falls	0	0	-

Table 7-24: Potential increased capacity for Alternative 2b based on upgrades to rearing units and changes in fish reared from Alternative 1

Hatchery	Alternative 2b		
	Potential Increased Capacity Based on New or Upgraded Rearing Units (lbs)	Changes in Fish Reared from Alt 1 (lbs)	Notes
Alsea	0	-55,841	-
Bandon	51,233	48,790	-
Cedar Creek	15,000	12,500	-
Clackamas	0	11,492	Coho moved here from Salmon River. Average density index = 0.2 so there is capacity based on current rearing volumes
Cole Rivers (F)	0	619	-
Elk River	10,664	7,000	-
Fall River	11,666	8,333	-
Klamath Falls	0	0	-
Leaburg (F)	0	0	-
Nehalem	36,224	55,841	Raceways realignments are increasing capacity by 50%. Average density index = 0.5 so there is capacity based on current rearing volumes
Oak Springs	21,524	21,524	-
Roaring River	0	0	-
Rock Creek	0	-56,408	Decommissioned
Salmon River	0	-53,850	Shift
South Santiam (F)	0	0	-
Trask	0	0	-
Wizard Falls	0	0	-

Table 7-25: Potential increased capacity for Alternative 2c based on upgrades to rearing units and changes in fish reared from Alternative 1

Hatchery	Alternative 2c		
	Potential Increased Capacity Based on New or Upgraded Rearing Units (lbs)	Changes in Fish Reared from Status Quo (lbs)	Notes
Alsea	0	-111,436	Shift
Bandon	51,233	48,790	-
Cedar Creek	15,000	8,423	-
Clackamas	0	11,492	Coho moved here from Salmon River. Average density index = 0.2 so there is capacity based on current rearing volumes
Cole Rivers (F)	0	619	-
Elk River	10,664	7,000	-
Fall River	11,666	7,977	-
Klamath Falls	0	0	-
Leaburg (F)	0	0	-
Nehalem	36,224	55,841	Raceways realignments are increasing capacity by 50%. Average density index = 0.5 so there is capacity based on current rearing volumes
Oak Springs	15,955	15,955	-
Roaring River	0	0	-
Rock Creek	0	--56,408	Decommissioned
Salmon River	0	11,747	Small increase in production. Average density index = 0.1 so there is capacity based on current rearing volumes
South Santiam (F)	0	0	-
Trask	0	0	-
Wizard Falls	0	0	-

7.6. Alternative Cost Scenarios

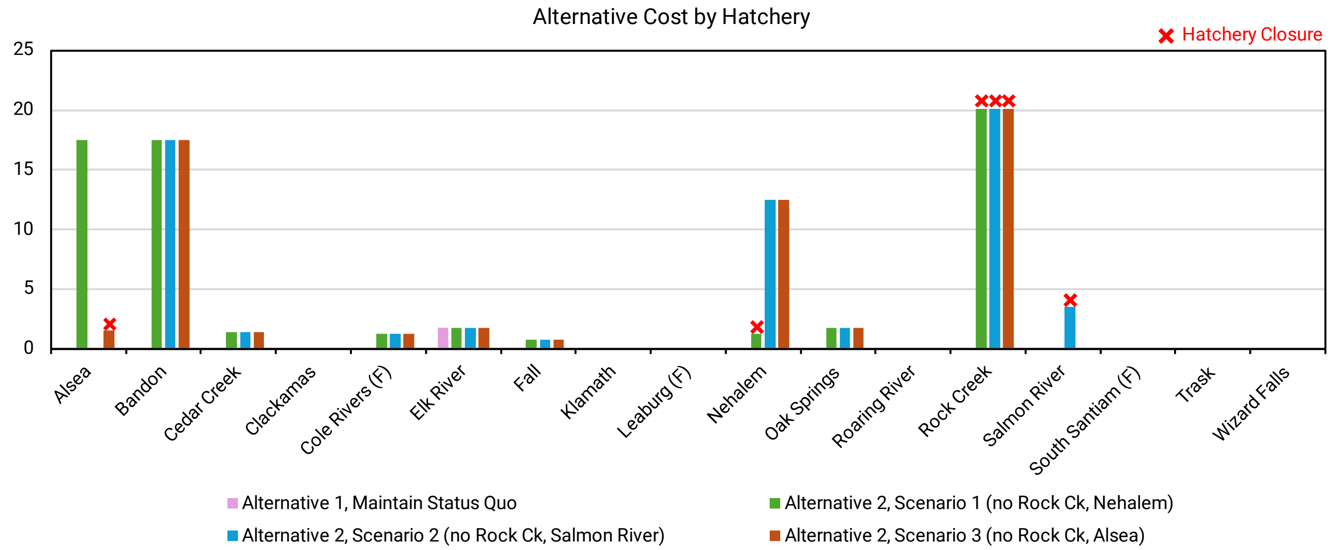

Figure 7-34. Alternative scenario costs for each hatchery, in millions of dollars. Red 'X' indicates hatchery shift.

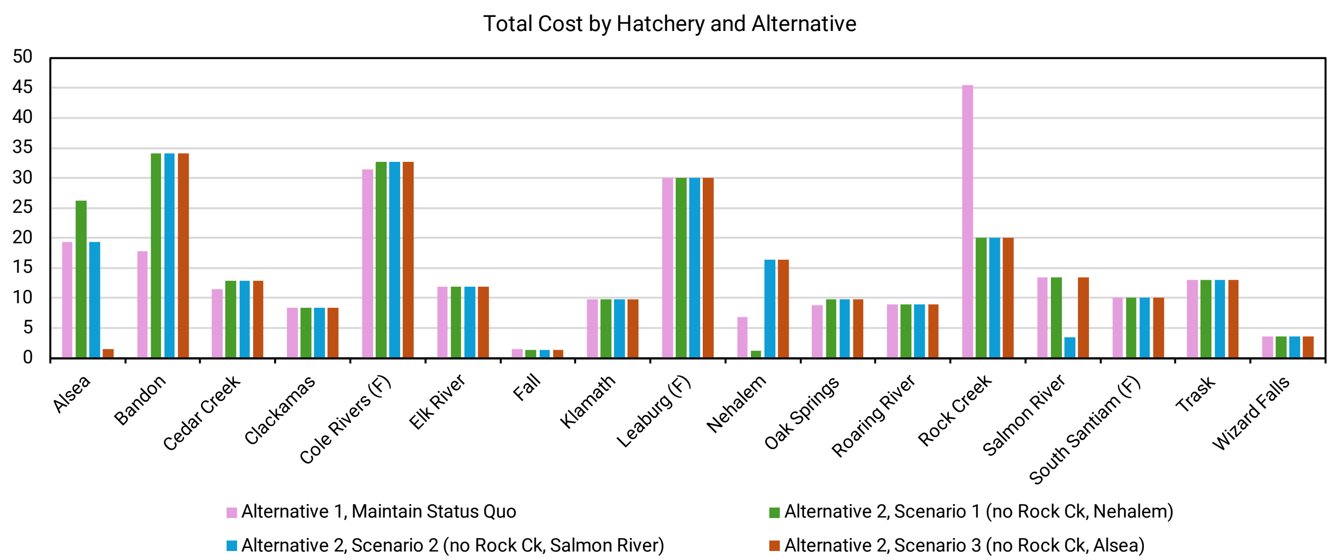

Figure 7-35. Total State and Federal costs (deferred maintenance, climate infrastructure/new technology minus duplicative costs proposed by the alternative scenario, projected modifications, and additional costs for alternative scenario) for each hatchery across alternative scenarios.

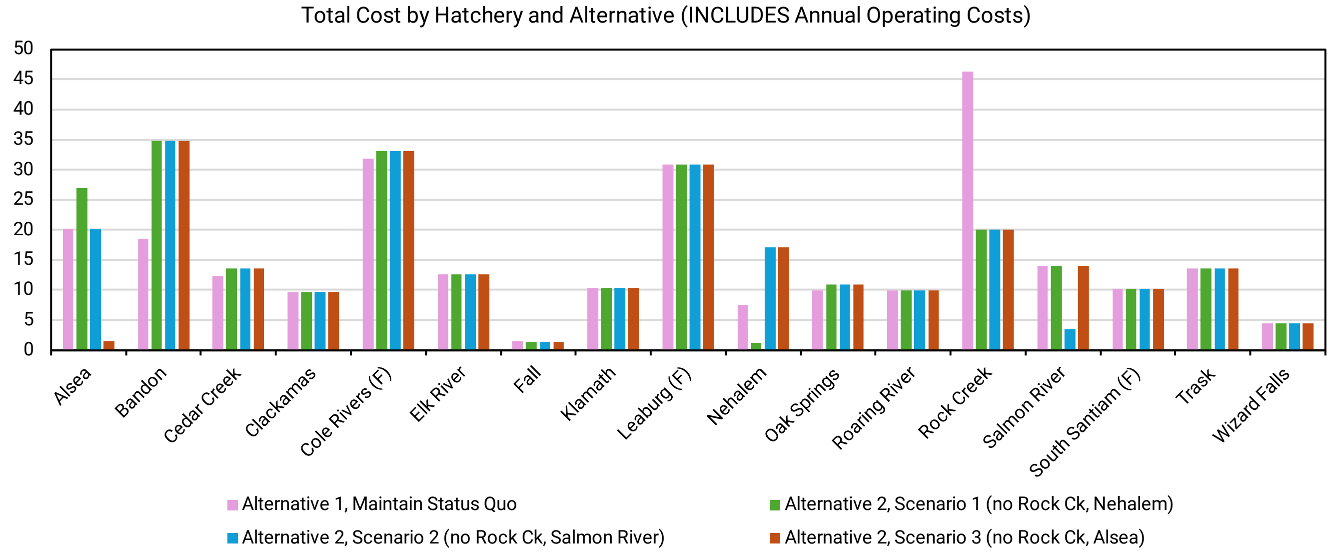

Figure 7-36. Total State and Federal costs (deferred maintenance, climate infrastructure/new technology minus duplicative costs proposed by the alternative scenario, projected modifications, and additional costs for alternative scenario) INCLUDING annual operating costs for each hatchery across alternative scenarios.

Table 7-26. Average total State AND Federal costs and costs per category, in million dollars. Total costs were calculated as AOC (annual operating costs) + DM (deferred maintenance) + PM (projected maintenance) + Climate (climate infrastructure) + Alt (alternative costs) – Dupe (duplicative costs from climate infrastructure and alternative upgrades).

Hatchery	Alsea	Bandon	Cedar Creek	Clackamas	Cole Rivers (F)	Elk River	Fall	Klamath	Leaburg (F)	Nehalem	Oak Springs	Roaring River	Rock Creek	Salmon River	South Santiam (F)	Trask	Wizard Falls
Alt 1	20.17	18.51	12.28	9.69	31.84	12.55	1.48	10.41	30.85	7.48	9.85	9.91	46.37	14.05	10.22	13.55	4.48
AOC	0.78	0.67	0.76	1.28	0.46	0.70	0.00	0.69	0.82	0.66	1.02	0.97	0.89	0.67	0.20	0.60	0.92
DM	15.25	15.80	11.10	4.20	25.00	7.85	0.30	6.97	0.00	2.62	0.00	7.55	0.00	10.83	0.00	6.71	0.55
PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.50	0.00	4.55	0.00	45.00	0.00	10.00	0.00	0.00
Climate	4.15	2.04	0.43	4.21	6.38	2.25	1.18	2.75	4.53	4.20	4.28	1.39	0.48	2.55	0.02	6.24	3.01
Alt	0.00	0.00	0.00	0.00	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alt 2a	26.99	34.83	13.63	9.69	33.09	12.55	1.35	10.41	30.85	1.25	10.85	9.91	20.10	14.05	10.22	13.55	4.48
AOC	0.78	0.67	0.76	1.28	0.46	0.70	0.00	0.69	0.82		1.02	0.97		0.67	0.20	0.60	0.92
DM	15.25	15.80	11.10	4.20	25.00	7.85	0.30	6.97	0.00		0.00	7.55		10.83	0.00	6.71	0.55
PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.50		4.55	0.00		0.00	10.00	0.00	0.00
Climate	4.15	2.04	0.43	4.21	6.38	2.25	1.18	2.75	4.53		4.28	1.39		2.55	0.02	6.24	3.01
Alt	17.50	17.50	1.35	0.00	1.25	1.75	0.75	0.00	0.00	1.25	1.75	0.00	20.10	0.00	0.00	0.00	0.00
Dupe	10.68	1.18	0.00	0.00	0.00	0.00	0.88	0.00	0.00		0.75	0.00			0.00	0.00	0.00
Alt 2b	20.17	34.83	13.63	9.69	33.09	12.55	1.35	10.41	30.85	17.03	10.85	9.91	20.10	3.50	10.22	13.55	4.48
AOC	0.78	0.67	0.76	1.28	0.46	0.70	0.00	0.69	0.82	0.66	1.02	0.97			0.20	0.60	0.92
DM	15.25	15.80	11.10	4.20	25.00	7.85	0.30	6.97	0.00	2.62	0.00	7.55			0.00	6.71	0.55
PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.50	0.00	4.55	0.00			10.00	0.00	0.00
Climate	4.15	2.04	0.43	4.21	6.38	2.25	1.18	2.75	4.53	4.20	4.28	1.39			0.02	6.24	3.01
Alt	0.00	17.50	1.35	0.00	1.25	1.75	0.75	0.00	0.00	12.50	1.75	0.00	20.10	3.50	0.00	0.00	0.00
Dupe	0.00	1.18	0.00	0.00	0.00	0.00	0.88	0.00	0.00	2.95	0.75	0.00			0.00	0.00	0.00
Alt 2c	1.50	34.83	13.63	9.69	33.09	12.55	1.35	10.41	30.85	17.03	10.85	9.91	20.10	14.05	10.22	13.55	4.48
AOC		0.67	0.76	1.28	0.46	0.70	0.00	0.69	0.82	0.66	1.02	0.97		0.67	0.20	0.60	0.92
DM		15.80	11.10	4.20	25.00	7.85	0.30	6.97	0.00	2.62	0.00	7.55		10.83	0.00	6.71	0.55
PM		0.00	0.00	0.00	0.00	0.00	0.00	0.00	25.50	0.00	4.55	0.00		0.00	10.00	0.00	0.00
Climate		2.04	0.43	4.21	6.38	2.25	1.18	2.75	4.53	4.20	4.28	1.39		2.55	0.02	6.24	3.01
Alt	1.50	17.50	1.35	0.00	1.25	1.75	0.75	0.00	0.00	12.50	1.75	0.00	20.10	0.00	0.00	0.00	0.00
Dupe		1.18	0.00	0.00	0.00	0.00	0.88	0.00	0.00	2.95	0.75	0.00					0.00

Table 7-27. Itemized alternative costs by hatchery. Only listing hatcheries with alternative costs, otherwise, defaulted to infrastructure costs. If a hatchery is planned for decommissioning, then only those costs to close are considered in the total cost. Items in bold indicate hatcheries that are closing/mothballing.

Alternative	Hatchery	Alternative only items	Alt Cost ($M)
Alt 1	Elk River	Build raceways	$1.5 to $2
Alt 2a	Alsea	Serial raceways, shade, chilling	$15 to $20
	Bandon	Increase capacity	$15 to $20
	Cedar Creek	Build raceways, return existing raceways to serial use	$1.1 to $1.6
	Cole Rivers (F)	Additional housing for ODFW staff	$1.5
	Elk River	Build raceways	$1.5 to $2
	Fall River	Build raceways	$0.5 to $1
	Nehalem	**Mothball hatchery**	**$1 to $1.5**
	Oak Springs	Increase capacity	$1.5 to $2
	Rock Creek	**Decommission and upgrade/build facilities on the S. Umpqua**	**$12.7 to $27.5**
Alt 2b	Bandon	Increase capacity	$15 to $20
	Cedar Creek	Build raceways, return existing raceways to serial use	$1.1 to $1.6
	Cole Rivers (F)	Additional housing for ODFW staff	$1.5
	Elk River	Build raceways	$1.5 to $2
	Fall River	Build raceways	$0.5 to $1
	Nehalem	Raceway realignment	$10 to $15
	Oak Springs	Increase capacity	$1.5 to $2
	Rock Creek	**Decommission and upgrade/build facilities on the S. Umpqua**	**$12.7 to $27.5**
	Salmon River	**Decommission hatchery**	**$2 to $5**
Alt 2c	Alsea	Mothball hatchery	$1 to $2
	Bandon	Increase capacity	$15 to $20
	Cedar Creek	Build raceways, return existing raceways to serial use	$1.1 to $1.6
	Cole Rivers (F)	Additional housing for ODFW staff	$1.5
	Elk River	Build raceways	$1.5 to $2
	Fall River	Build raceways	$0.5 to $1
	Nehalem	Raceway realignment	$10 to $15
	Oak Springs	Increase capacity	$1.5 to $2
	Rock Creek	**Decommission and upgrade/build facilities on the S. Umpqua**	**$12.7 to $27.5**

Table 7-28. Average total STATE ONLY costs and costs per category, in million dollars. State costs were calculated as AOC (annual operating costs) + DM (deferred maintenance) + PM (projected maintenance) + Climate (climate infrastructure) + Alt (alternative costs) – Dupe (duplicative costs from climate infrastructure and alternative upgrades).

Hatchery	Alsea	Bandon	Cedar Creek	Clackamas	Cole Rivers (F)	Elk River	Fall	Klamath	Leaburg (F)	Nehalem	Oak Springs	Roaring River	Rock Creek	Salmon River	South Santiam (F)	Trask	Wizard Falls
Alt 1	20.17	18.51	12.28	8.97	5.46	12.55	1.48	9.89	0.82	7.48	9.09	9.18	46.37	14.05	0.20	13.55	3.79
AOC	0.78	0.67	0.76	1.01	0.46	0.70	0.00	0.17	0.82	0.66	0.26	0.24	0.89	0.67	0.20	0.60	0.23
DM	15.25	15.80	11.10	3.75	5.00	7.85	0.30	6.97	0.00	2.62	0.00	7.55	0.00	10.83	0.00	6.71	0.55
PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00	45.00	0.00	0.00	0.00	0.00
Climate	4.15	2.04	0.43	4.21	0.00	2.25	1.18	2.75	0.00	4.20	4.28	1.39	0.48	2.55	0.00	6.24	3.01
Alt	0.00	0.00	0.00	0.00	0.00	1.75	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Dupe	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Alt 2a	26.99	34.83	13.63	8.97	6.71	12.55	1.35	9.89	0.82	1.25	10.09	9.18	20.10	14.05	0.20	13.55	3.79
AOC	0.78	0.67	0.76	1.01	0.46	0.70	0.00	0.17	0.82		0.26	0.24		0.67	0.20	0.60	0.23
DM	15.25	15.80	11.10	3.75	5.00	7.85	0.30	6.97	0.00		0.00	7.55		10.83	0.00	6.71	0.55
PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00		4.55	0.00		0.00	0.00	0.00	0.00
Climate	4.15	2.04	0.43	4.21	0.00	2.25	1.18	2.75	0.00		4.28	1.39		2.55	0.00	6.24	3.01
Alt	17.50	17.50	1.35	0.00	1.25	1.75	0.75	0.00	0.00	1.25	1.75	0.00	20.10	0.00	0.00	0.00	0.00
Dupe	10.68	1.18	0.00	0.00	0.00	0.00	0.88	0.00	0.00		0.75	0.00			0.00	0.00	0.00
Alt 2b	20.17	34.83	13.63	8.97	6.71	12.55	1.35	9.89	0.82	17.03	10.09	9.18	20.10	3.50	0.20	13.55	3.79
AOC	0.78	0.67	0.76	1.01	0.46	0.70	0.00	0.17	0.82	0.66	0.26	0.24			0.20	0.60	0.23
DM	15.25	15.80	11.10	3.75	5.00	7.85	0.30	6.97	0.00	2.62	0.00	7.55			0.00	6.71	0.55
PM	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00			0.00	0.00	0.00
Climate	4.15	2.04	0.43	4.21	0.00	2.25	1.18	2.75	0.00	4.20	4.28	1.39			0.00	6.24	3.01
Alt	0.00	17.50	1.35	0.00	1.25	1.75	0.75	0.00	0.00	12.50	1.75	0.00	20.10	3.50	0.00	0.00	0.00
Dupe	0.00	1.18	0.00	0.00	0.00	0.00	0.88	0.00	0.00	2.95	0.75	0.00			0.00	0.00	0.00
Alt 2c	1.50	34.83	13.63	8.97	6.71	12.55	1.35	9.89	0.82	17.03	10.09	9.18	20.10	14.05	0.20	13.55	3.79
AOC		0.67	0.76	1.01	0.46	0.70	0.00	0.17	0.82	0.66	0.26	0.24		0.67	0.20	0.60	0.23
DM		15.80	11.10	3.75	5.00	7.85	0.30	6.97	0.00	2.62	0.00	7.55		10.83	0.00	6.71	0.55
PM		0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00	4.55	0.00		0.00	0.00	0.00	0.00
Climate		2.04	0.43	4.21	0.00	2.25	1.18	2.75	0.00	4.20	4.28	1.39		2.55	0.00	6.24	3.01
Alt	1.50	17.50	1.35	0.00	1.25	1.75	0.75	0.00	0.00	12.50	1.75	0.00	20.10	0.00	0.00	0.00	0.00
Dupe		1.18	0.00	0.00	0.00	0.00	0.88	0.00	0.00	2.95	0.75	0.00			0.00	0.00	0.00

7.7. Combined Categorical Results

7.7.1. State-Only Costs

The methods of considering the four categorical scores are provided in the figures below, using state-only infrastructure costs.

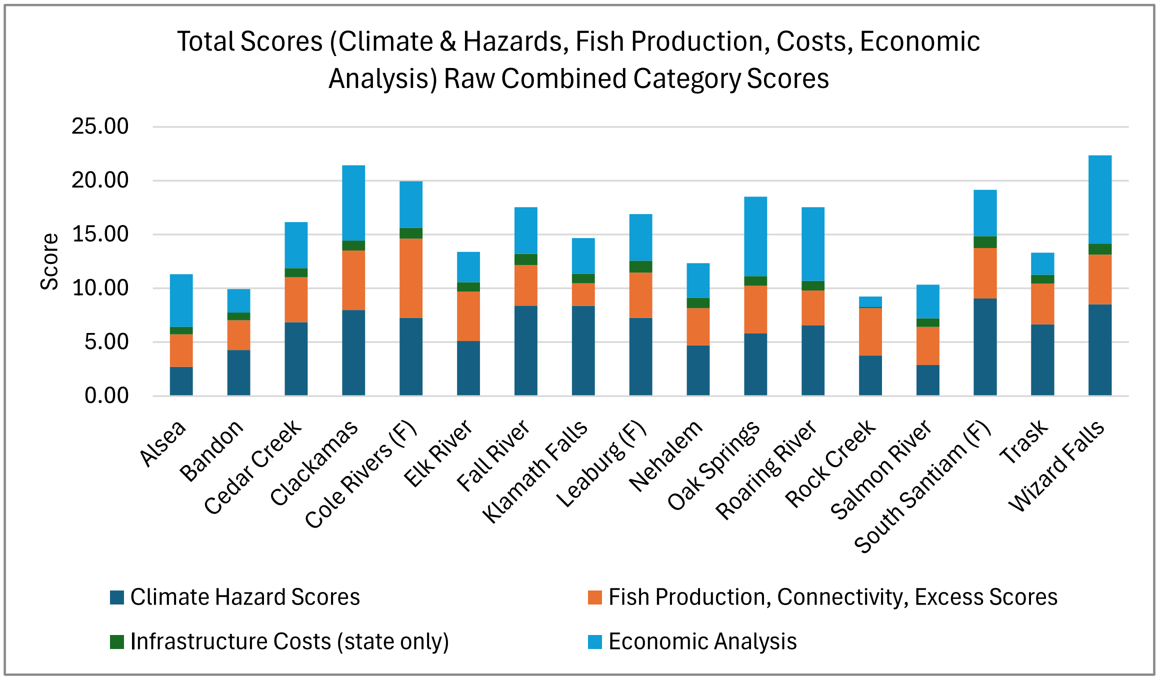

Figure 7-37: Sum of Normalized Scores.

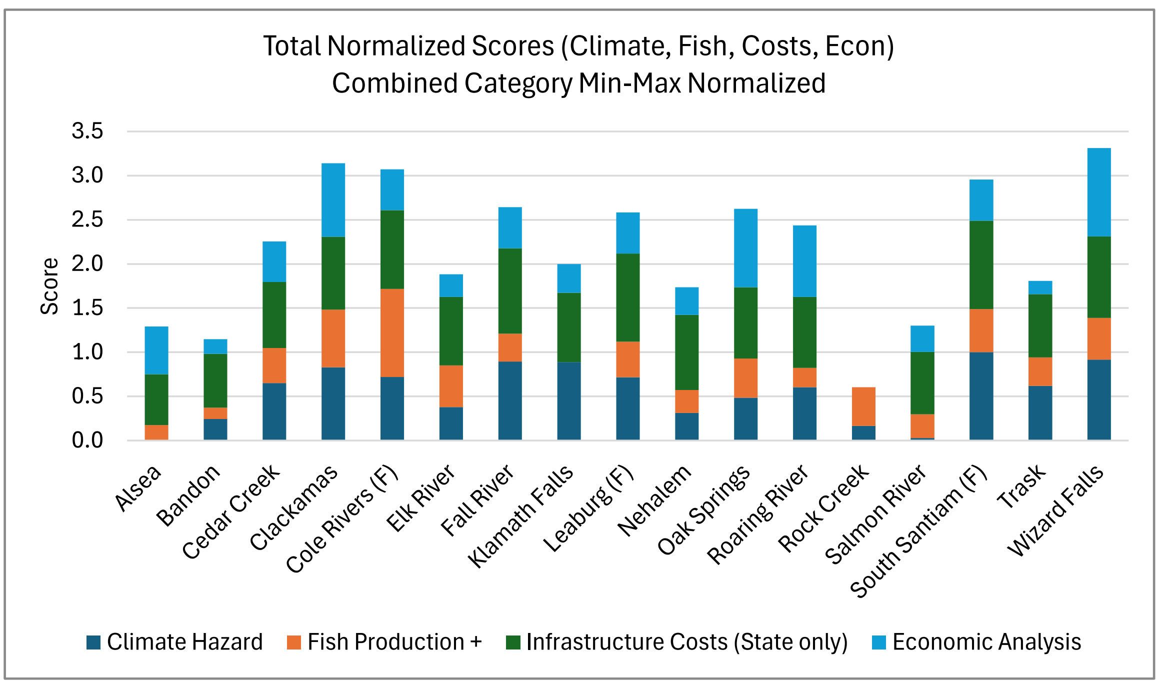

Figure 7-38: Min-max normalized scores.

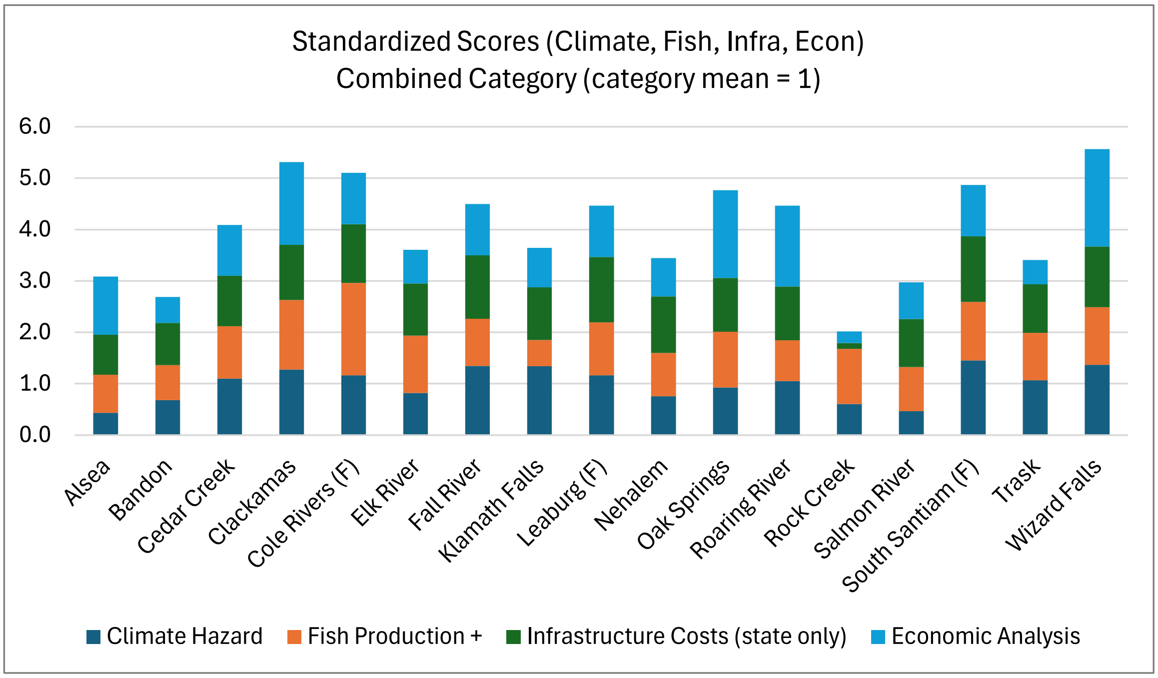

Figure 7-39: Standardized scores (category mean=1).

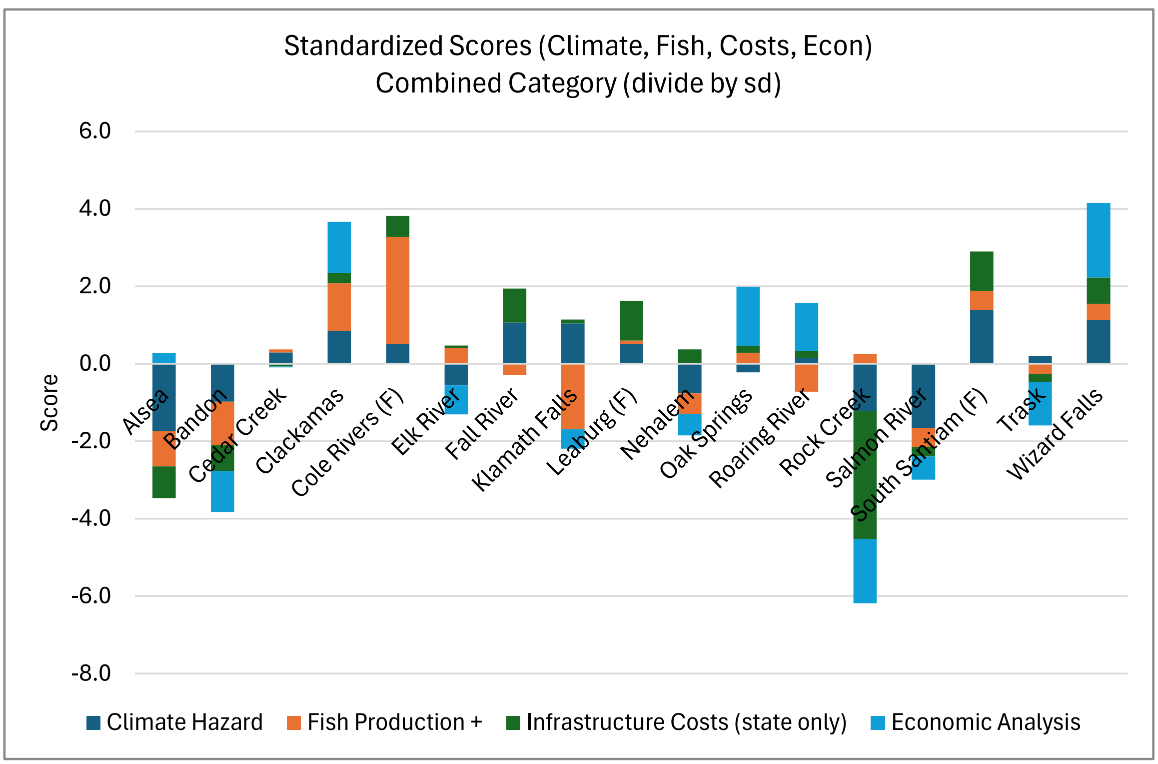

Figure 7-40:Standardized Scores using standard deviation.

7.7.2. State and Federal Costs

The methods of considering the four categorical scores are provided in the figures below, using state and federal infrastructure costs.

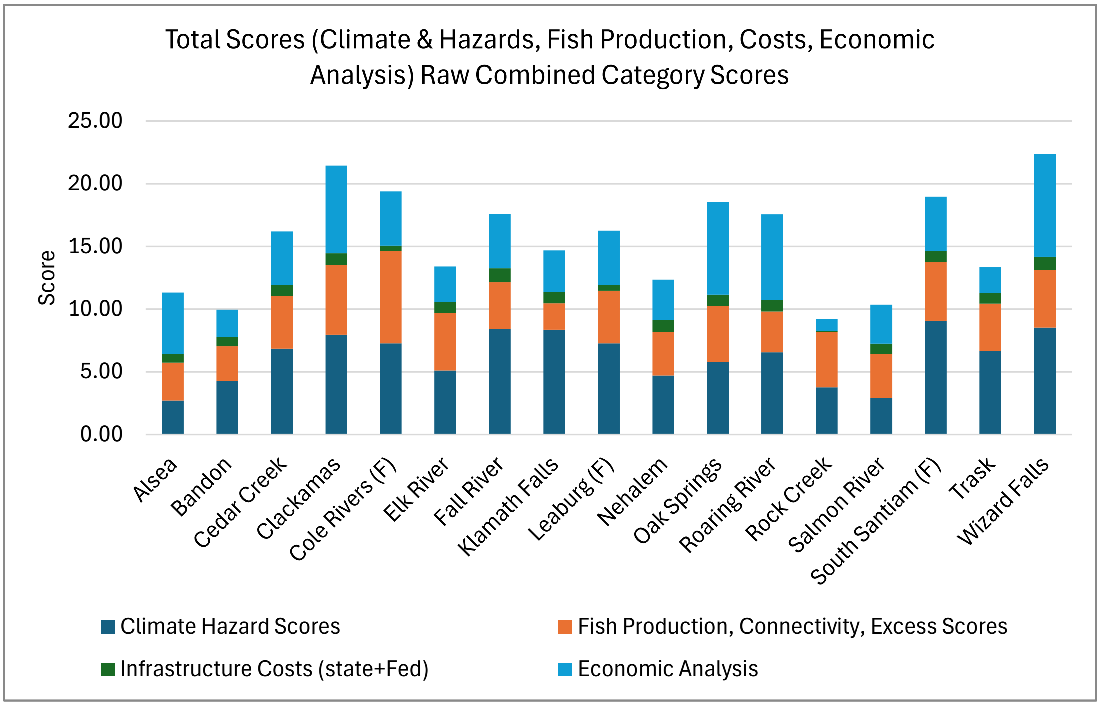

Figure 7-41: Sum of normalized scores (state and federal costs).

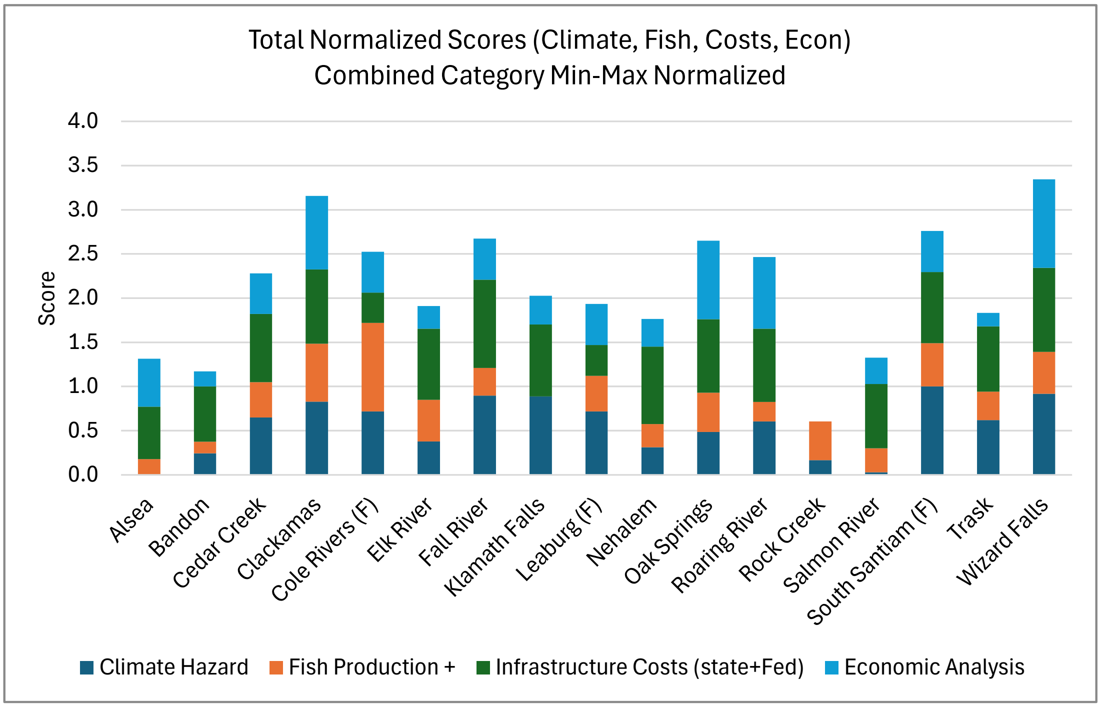

Figure 7-42: Min-max normalized scores (state and federal costs).

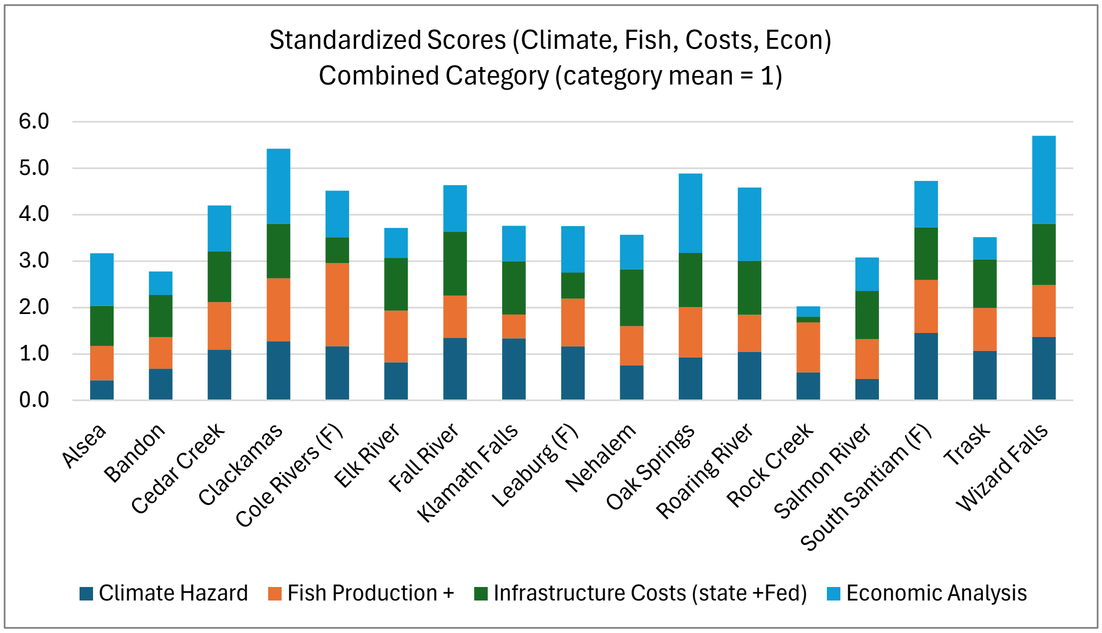

Figure 7-43: Standardized scores (category mean=1).

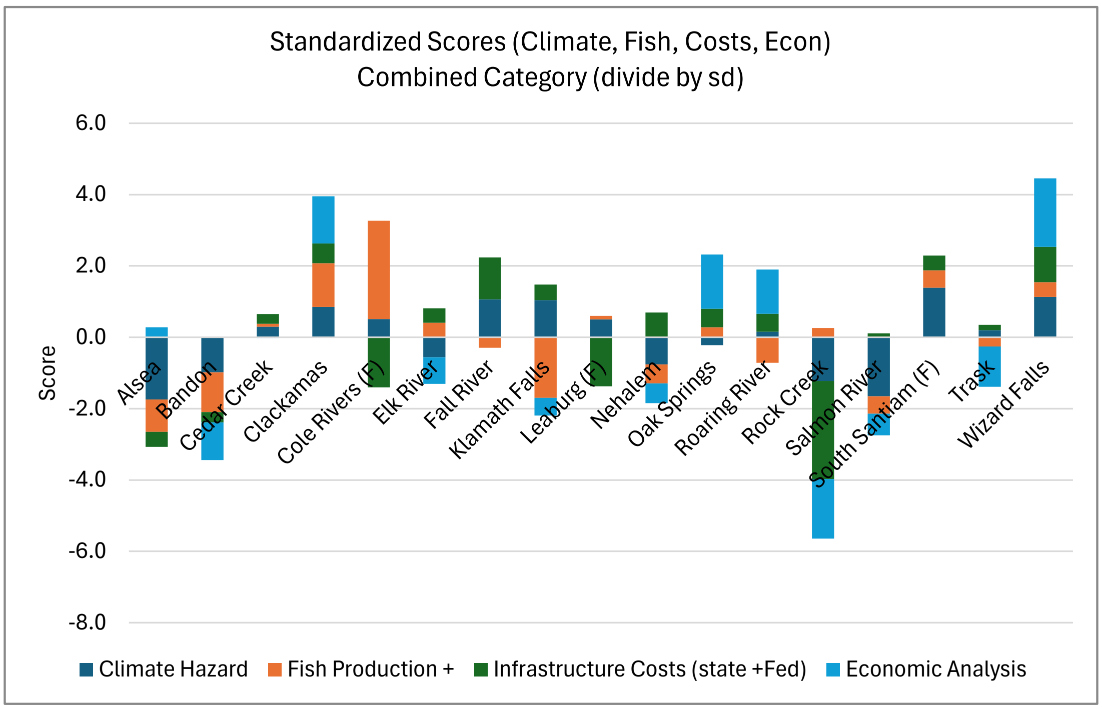

Figure 7-44: Standardized scores using standard deviation.